RFP No. **DACW09-03-R-0010**

U.S. ARMY CORPS
OF ENGINEERS
LOS ANGELES DISTRICT

WASTE WATER TREATMENT PLANT UPGRADE,

FORT IRWIN, CALIFORNIA

Construction Solicitation and Specifications

8(a) Competitive

August 2003

This page was intentionally left blank for duplex printing.

PROJECT TABLE OF CONTENTS

RFP No. DACW09-03-R-0010
WASTE WATER TREATMENT PLANT UPGRADE,
FORT IRWIN, CALIFORNIA

DIVISION 0 - BIDDING REQUIREMENTS, CONTRACT FORMS,
AND CONDITIONS OF THE CONTRACT

00SF1442 Solictation, Offer And Award(SF-1442)
00CorpPr CERTIFICATE OF CORPORAL PRINCIPAL
00010 PRICING SCHEDULE
00100 Bidding Schedule/Instructions to Bidders
00110 PROPOSAL SUBMISSION REQUIREMENTS AND INSTRUCTIONS
00120 PROPOSAL EVALUATION AND CONTRACT AWARD
00600 Representations And Certifications
00700 Contract Clauses
00800 Special Contract Requirements
00850 Rates of Wages

DIVISION 1 - GENERAL REQUIREMENTS

01010 SUMMARY OF WORK
01070 ABBREVIATIONS OF INSTITUTIONS
01090 REFERENCE STANDARDS
01300 CONTRACTOR SUBMITTALS
01301 SCHEDULE OF VALUES
01311 CPM CONSTRUCTION SCHEDULE
01313 CONSTRUCTION AND SCHEDULE CONSTRAINTS
01400 QUALITY CONTROL
01410 ENVIRONMENT PROTECTION
01505 MOBILIZATION
01510 TEMPORARY UTILITIES
01530 PROTECTION AND RESTORATION OF EXISTING FACILITIES
01550 SITE ACCESS AND STORAGE
01560 TEMPORARY ENVIRONMENTAL CONTROLS
01600 PRODUCTS, MATERIALS, EQUIPMENT AND SUBSTITUTIONS
01650 TESTING OF CONCRETE AND STEEL HYDRAULIC STRUCTURES
01655 GRAVITY PIPELINE TESTING
01656 PRESSURE PIPE TESTING AND DISINFECTION
01660 EQUIPMENT TESTING AND PLANT STARTUP
01700 PROJECT CLOSEOUT

DIVISION 2 - SITE WORK

02100 SITE PREPARATION
22000 EARTHWORK
02210 CONTROLLED LOW STRENGTH MATERIAL
02490 PRECAST CONCRETE MANHOLES AND VAULTS
02565 DUCTILE IRON PIPE (AWWA C151, MODIFIED)
02572 STEEL PIPE FABRICATED SPECIALS (AWWA C200, MODIFIED)
02574 STEEL YARD PIPING
02595 SMALL PVC NONPRESSURE PIPE, RUBBER JOINTS (ASTM D 3034, MODIFIED)
02597 PVC PRESSURE PIPE, RUBBER JOINTS (AWWA C900, MODIFIED)
02776 POND LINER
02831 CHAIN LINK FENCING AND GATES

DIVISION 3 – CONCRETE

03100 CONCRETE FORMWORK
03200 REINFORCEMENT STEEL
03290 JOINTS IN CONCRETE
03300 CAST-IN-PLACE CONCRETE
03315 GROUT

DIVISION 4 - MASONRY

04232 REINFORCED CONCRETE BLOCK MASONRY

DIVISION 5 – METALS

05100 STRUCTURAL STEEL FRAMING
05500 MISCELLANEOUS METALWORK

DIVISION 7 - THERMAL AND MOISTURE PROTECTION

07410 Metal Roofing
07920 Sealants and Caulking

DIVISION 9 - FINISHES

09800 PROTECTIVE COATING
09813 POLYURETHANE COATING ON PIPE

DIVISION 10 – SPECIALTIES

10520 FIRE PROTECTION SPECIALTIES

DIVISION 11 – EQUIPMENT

11000 EQUIPMENT GENERAL PROVISIONS
11036 DC-SCR DRIVES
11052 AUTOMATIC, REFRIGERATED SAMPLERS
11100 PUMPS, GENERAL
11103 VERTICAL TURBINE PUMPS
11110 HORIZONTAL CLOSE-COUPLED END SUCTION PUMPS
11148 SUBMERSIBLE NON-CLOG PUMPS
11200 MIXERS AND FLOCCULATORS, GENERAL
11210 VERTICAL-SHAFT FLOCCULATOR UNITS
11214 SUBMERSIBLE SAMPLING PUMPS
11237 ROTATING PIPE SKIMMERS
11258 CHEMICAL FEEDING EQUIPMENT, GENERAL
11259 METERING PUMPS
11364 FLOCCULATION SYSTEM
11365 FILTRATION SYSTEM
11500 BLOWERS, COMPRESSORS, AND VACUUM PUMPS, GENERAL
11511 COMPRESSORS, TANK-MOUNTED, RECIPROCATING
11522 REFRIGERATED AIR DRYER AND COALESCING FILTER
11602 VACUUM INDUCTION MIXER

DIVISION 13 - SPECIAL CONSTRUCTION

13122 PRE-ENGINEERED METAL BUILDING
13675 POLYETHYLENE TANKS

DIVISION 15 - MECHANICAL

15000 PIPING, GENERAL
15005 PIPING IDENTIFICATION
15006 PIPE SUPPORTS
15025 STEEL PIPE (ASTM A 53 / A 106, MODIFIED)
15030 STAINLESS STEEL PIPE (ASTM A 312, MODIFIED)
15037 COPPER WATER TUBE (ASTM B 88, MODIFIED)
15045 CAST IRON SOIL PIPE (ASTM A 74, MODIFIED)
15060 PVC PRESSURE PIPE (ASTM D 1785, MODIFIED)
15065 CPVC PRESSURE PIPE (ASTM F 441, MODIFIED)
15075 METERS, GENERAL
15081 MAGNET1IC FLOW METERS15145 - PIPE AND EQUIPMENT INSULATION
15145 PIPE AND EQUIPMENT INSULATION
15180 STRAINERS
15200 VALVES, GENERAL
15201 VALVE AND GATE ACTUATORS
15202 BUTTERFLY VALVES
15203 CHECK VALVES
15204 BALL VALVES
15205 DIAPHRAGM VALVES
15206 GATE VALVES
15207 PLUG VALVES
15215 PRESSURE REDUCING VALVES
15218 PRESSURE RELIEF VALVES
15230 MISCELLANEOUS VALVES
15235 FIRE HYDRANTS
15250 HYDRAULIC GATES, GENERAL
15254 SLIDE/STOP GATES
15256 SLUICE AND SHEAR GATES
15430 PLUMBING PIPING AND SPECIALTIES
15440 PLUMBING FIXTURES
15500 HEATING, VENTILATING, AND AIR CONDITIONING

DIVISION 16 - ELECTRICAL

16050 ELECTRICAL WORK, GENERAL
16110 ELECTRICAL RACEWAY SYSTEMS
16111 UNDERGROUND RACEWAY SYSTEMS
16120 WIRES AND CABLES
16140 WIRING DEVICES
16425 480V MAIN SWITCHGEAR
16431 PROTECTIVE DEVICE STUDIES
16450 GROUNDING
16455 VARIABLE FREQUENCY DRIVE UNITS
16460 ELECTRIC MOTORS
16470 PANELBOARDS AND GENERAL PURPOSE DRY TYPE TRANSFORMERS
16480 LOW VOLTAGE MOTOR CONTROL CENTERS
16485 LOCAL CONTROL STATIONS AND MISCELLANEOUS ELECTRICAL DEVICES
16500 LIGHTING
16950 ELECTRICAL TESTS

DIVISION 17 - INSTRUMENTATION|DIV_17.pdf

17100 PROCESS CONTROL AND INSTRUMENTATION SYSTEMS
17100a APPENDIX A

17100b APPENDIX B
17101 OPEN CHANNEL FLOW MEASURING SYSTEMS
17103 LIQUID FLOW DETECTION DEVICES
17106 LEVEL MEASURING SYSTEMS
17107 LEVEL DETECTION SWITCHES
17108 PRESSURE MEASURING SYSTEMS
17109 PRESSURE DETECTION SWITCHES
17112 PROCESS ANALYZER MEASURING SYSTEMS
17200 CONTROL PANELS
17201 CONTROL PANEL INSTRUMENTATION
17300 CONTROL STRATEGIES
17510 PLC-BASED CONTROL SYSTEMS HARDWARE
17520 PLC/COMPUTER SOFTWARE

SOLICITATION, OFFER, AND AWARD *(Construction, Alteration, or Repair)*	1. SOLICITATION NO.	2. TYPE OF SOLICITATION	3. DATE ISSUED	PAGE OF PAGES
	DACA09-03-R-0010	☐ SEALED BID *(IFB)* ☒ NEGOTIATED *(RFP)*	05 Aug 03	

IMPORTANT - The "offer" section on the reverse must be fully completed by offeror.

4. CONTRACT NO.	5. REQUISITION/PURCHASE REQUEST NO.	6. PROJECT NO.

7. ISSUED BY CODE	8. ADDRESS OFFER TO
Contracting Division West Region Branch P. O. Box 532711 Los Angeles, California 90053-2325	See Item No. 7

9. FOR INFORMATION CALL:	A. NAME	B. TELEPHONE NO. *(Include area code) (NO COLLECT CALLS)*
▶	Julie Ayala	213.452.3241

SOLICITATION

NOTE: In sealed bid solicitations "offer" and "offeror" mean "bid" and "bidder".

10. THE GOVERNMENT REQUIRES PERFORMANCE OF THE WORK DESCRIBED IN THESE DOCUMENTS *(Title, identifying no., date):*
WASTE WATER TREATMENT PLANT UPGRADE (TERTIARY PROJECT) FORT IRWIN, CALIFORNIA

The work consists of upgrading the existing Fort Irwin Waste Water Treatment Plant (WWTP) from secondary to tertiary treatment and providing a recycled waste distribution system. The tertiary effluent will meet the State's Title 22 requirements for unrestricted access use, which will result in greater effluent reclamation potential. The increased reclamation will reduce the demand for groundwater pumping and effluent percolation. The tertiary effluent will be primarily used for landscape irrigation in the cantonment area.

For this procurement, the Small Business Administration (SBA) has determined that competition will be restricted to eligible 8(a) firms certified for participation in the 8(a) program with Headquarters or approved satellite offices within region (of the Small Business Administration and which have a NAICS Code of 237110 among their approved NAICS Codes.

Please Note: This procurement may be delayed, cancelled, revised at any time during the solicitation, evaluation, and/or final award process.

11. The Contractor shall begin performance within * calendar days and complete it within * calendar days after receiving ☐ award, ☒ notice to proceed. This performance period is ☒ mandatory, ☐ negotiable. *(See* * Section 00800 .*)*

12A. THE CONTRACTOR MUST FURNISH ANY REQUIRED PERFORMANCE AND PAYMENT BONDS? *(If "YES," indicate within how may calendar days after award in Item 12B.)*	12B. CALENDAR DAYS
☒ YES ☐ NO	10

13. ADDITIONAL SOLICITATION REQUIREMENTS:

A. Sealed offers in original and 4 copies to perform the work required are due at the place specified in Item 8 by _____ *(hour)* local time _____ *(date)*. If this is a sealed bid solicitation, offers will be publicly opened at that time. Sealed envelopes containing offers shall be marked to show the offeror's name and address, the solicitation number, and the date and time offers are due.

B. An offer guarantee ☒ is, ☐ is not required.

C. All offers are subject to the (1) work requirements, and (2) other provisions and clauses incorporated in the solicitation in full text or by reference.

D. Offers providing less than 90 calendar days for Government acceptance after the date offers are due will not be considered and will be rejected.

OFFER *(Must be fully completed by offeror)*

14. NAME AND ADDRESS OF OFFEROR *(Include ZIP Code)*	15. TELEPHONE NO. *(Include area code)*
	16. REMITTANCE ADDRESS *(Include only if different than Item 14)*
CODE FACILITY CODE	

17. The offeror agrees to perform the work required at the prices specified below in strict accordance with the terms of this solicitation, if this offer is accepted by the Government in writing within _____ calendar days after the date offers are due. *(Insert any number equal to or greater than the minimum requirement stated in Item 13D. Failure to insert any number means the offeror accepts the minimum in Item 13D.*

AMOUNTS ▶	Refer to Price Schedule

18. The offeror agrees to furnish any required performance and payment bonds.

19. ACKNOWLEDGMENT OF AMENDMENTS
(The offeror acknowledges receipt of amendments to the solicitation - give number and date of each)

AMENDMENT NO.										
DATE										

20A. NAME AND TITLE OF PERSON AUTHORIZED TO SIGN OFFER *(Type or print)*	20B. SIGNATURE	20C. OFFER DATE

AWARD *(To be completed by Government)*

21. ITEMS ACCEPTED:

22. AMOUNT	23. ACCOUNTING AND APPROPRIATION DATA
24. SUBMIT INVOICES TO ADDRESS SHOWN IN ▶ *(4 Copies unless otherwise specified)* ITEM	25. OTHER THAN FULL AND OPEN COMPETITION PURSUANT TO ☐ 10 U.S.C 2304(c) ( ) ☐ 41 U.S.C 253(c) ( )
26. ADMINISTERED BY CODE	27. PAYMENT WILL BE MADE BY

CONTRACTING OFFICER WILL COMPLETE ITEM 28 OR 29 AS APPLICABLE

☐ 28. NEGOTIATED AGREEMENT *Contractor is required to sign this document and return _____ copies to issuing office.)* Contractor agrees to furnish and deliver all items or perform all work requirements identified on this form and any continuation sheets for the consideration stated in this contract. The rights and obligations of the parties to this contract shall be governed by (a) this contract award, (b) the solicitation, and (c) the clauses, representations, certifications, and specifications incorporated by reference in or attached to this contract.

☐ 29. AWARD *(Contractor is not required to sign this document.)* Your offer on this solicitation is hereby accepted as to the items listed. This award consummates the contract, which consists of (a) the Government solicitation and your offer, and (b) this contract award. No further contractual document is necessary.

30A. NAME AND TITLE OF CONTRACTOR OR PERSON AUTHORIZED TO SIGN *(Type or print)*		31A. NAME OF CONTRACTING OFFICER *(Type or print)*	
30B. SIGNATURE	30C. DATE	31B. UNITED STATES OF AMERICA BY	31C. AWARD DATE

CERTIFICATE OF CORPORATE PRINCIPAL

1) IF THE OFFEROR IS A JOINT VENTURE, COMPLETE THE FOLLOWING:

(Company Name)	(Signature)	(Title)
(Company Name)	(Signature)	(Title)
(Company Name)	(Signature)	(Title)

2) IF THE OFFEROR IS PARTNERSHIP, LIST FULL NAME OF ALL PARTNERS:

(Company Name)	(Signature)	(Title)
(Company Name)	(Signature)	(Title)
(Company Name)	(Signature)	(Title)

3) IF THE OFFEROR IS A CORPORATION, THE FOLLOWING CERTIFICATION SHOULD BE COMPLETED:

CERTIFICATION AS TO CORPORATE PRINCIPAL

I, _____ , certify that I am the Secretary of the corporation named as principal in the

within contract; that _____ , who signed the said contract on behalf of the principal, was the

_____ of the corporation; that I know his signature and that his signature is genuine; and that said contract was duly signed, sealed and attested for in behalf of said corporation by authority of its governing body.

_____
CORPORATE PRINCIPAL

CORPORATE SEAL

_____
SECRETARY

This page was intentionally left blank for duplex printing.

PRICING SCHEDULE

THE CONTRACTOR SHALL FURNIAH ALL PLANT, LABOR, MATERIAL, EQUIPMENT, ETC., NECESSARY TO PERFORM ALL WORK IN STRICT ACCORDANCE WITH THE TERMS AND CONDITIONS SET FORTH IN THE CONTRACT TO INCLUDE ALL ATTTACHMENTS THERETO.

BASE BID ITEMS:

Line item #	Description	Estimated Quantity	Unit of Measure	Unit Price	Total Price
0001	Construct Flow Equalization Basins and Junction Box	2	LS	Lump Sum	$_____
0002	Construct a Filter Influent Pump Station	1	LS	Lump Sum	$_____
0003	Construct a Flash Mix Pump Station	1	LS	Lump Sum	$_____
0004	Construct a Filtration System	1	LS	Lump Sum	$_____
0005	Construct a Chlorine Contact Tank	1	LS	Lump Sum	$_____
0006	Construct a Recycled Water Pump Station	1	LS	Lump Sum	$_____
0007	Construct an Electrical Building	1	LS	Lump Sum	$_____
0008	Construct a Reject Water Pump Station	1	LS	Lump Sum	$_____

Line item #	Description	Estimated Quantity	Unit of Measure	Unit Price	Total Price

0009

In addition, the base contract shall include modification to the existing chlorine contact tank, existing sodium hypochlorite facility and all site modifications. This also includes grading, piping addition and modification, electrical and instrumentation work specified and shown completed, tested and ready for operation. Major piping includes, but is not limited to, interconnecting piping between treatment processes listed above and chemical piping.

LS Lump Sum $_____

TOTAL AMOUNT BASE BID: $_____

OPTION ITEMS:

0010

Construction of the Recycled Water Pipeline from the intersection of South Loop Road and Inner Loop Road (STA 79+41.14) to the intersection of Inner Loop Road and Barstow Road (STA 108+68.18), as shown on drawings CS-5 through CS-6, and construction of the following two pipeline segments **(Option No. 1):**

Segment 1 – Barstow Road East (STA 0+00.00 to STA 9+40.00) as shown on drawing CS-8.
Segment 2 – Barstow Road West (STA 0+00.00 to STA 10+00.00) as shown on drawing CS-9.

LS Lump Sum $_____

0011

Construction of the Recycled Water Pipeline from the intersection of South Loop Road and Inner Loop Road (STA 79+41.14) to the intersection of Inner Loop Road and Barstow Road (STA 108+68.18), as shown on drawings CS-5 through CS-6, and construction of the following two pipeline segments **(Option 2):**

Segment 1 – Barstow Road East (STA 0+00.00 to STA 9+40.00) as shown on drawing CS-8.
Segment 2 – Barstow Road West (STA 0+00.00 to STA 10+00.00) as shown on drawing CS-9.

LS Lump Sum $_____

0012

Construction of the Recycled Water Pipeline from the intersection of Inner Loop Road and Barstow Road (STA 108+68.18) to the intersection of Inner Loop Road and Langford Lake Road (STA 133+00.00), as shown on drawings CS-6 through CS-7, and construction of the following pipeline segment **(Option 3):**

Segment 3 – Normandy Road (STA 0+00.00 to STA 6+00.00) as shown on drawing CS-10.

LS Lump Sum $_____

TOTAL AMOUNT OPTION ITEMS: $_____

TOTAL AMOUNT BASE BID & OPTION ITEMS: $_____

1. The successful bidder/offeror grants the option items listed in the Pricing Schedule to the Government. The Option Items may be exercised any time up to 120 calendar days after receipt of Notice to Proceed. Exercise of the options occurs upon mailing of written notice to the Contractor. Exercise will be made by the Contracting Officer. The price for exercise of the options includes all work and effort associated with the scope of the item. For Determination of lowest bid/offer, refer to paragraph title EVALUATION OF OPTIONS in Section 00100 of this solicitation. No additional time for contract completion will be allowed when an option is exercised. The given contract completion time was formulated to include time necessary to perform all option work.

2. Prices must be submitted on all individual items of this Pricing Schedule. Failure to do so may be cause for rejection of bids.

3. If a modification to a price is submitted which provides for a lump sum adjustment to the total price, the application of the lump sum adjustment to each item in the Pricing Schedule must be stated. If it is not stated, the bidder/offeror agrees that the lump sum adjustment shall be applied on a pro rata basis to every item in the Pricing Schedule.

4. The bidder/offeror shall distribute his indirect costs (overhead, profit, bond, etc.) over all items in the Pricing Schedule. The Government will review all submitted Pricing Schedules for any unbalancing of the items. Any submitted Pricing Schedule determined to be unbalanced may be considered nonresponsive and cause the bidder/offeror to be ineligible for award.

5. EFARS 52.214-500 APPARENT CLERICAL MISTAKES-ARITHMETIC DISCRPANCIES

   (a) For the purpose of initial evaluation of bids/offers, the following will be utilized in resolving arithmetic discrepancies found on the face of the Pricing Schedule as submitted by the bidders/offerors:
      (1) Obviously misplaced decimal points will be corrected;
      (2) Discrepancy between unit price and extended price, the unit price will govern;
      (3) Apparent errors in extensions of unit prices will be corrected;
      (4) Apparent errors in addition of lump sum and extended prices will be corrected.
   (b) For the purpose of bid/offer evaluation, the Government will proceed on the assumption that the bidder/offeror intends the bid/offer to be evaluated on the basis of unit prices, the total arrived at by resolution of arithmetic discrepancies as provided above and the bid/offer will be so reflected on the abstract of bids/offers.
   (c) These correction procedures shall not be used to resolve any ambiguity concerning which bid is low.

This page was intentionally left blank for duplex printing.

52.0000-4010 INQUIRIES 2
52.0000-4023 SAFETY REQUIREMENTS 2
52.209-4501 CONTRACTOR REPONSIBILITY, PRE-AWARD SURVEY 2
52.211-1 AVAILABILITY OF SPECIFICATIONS LISTED IN THE GSA INDEX OF FEDERAL SPECIFICATIONS, STANDARDS AND COMMERCIAL ITEM DESCRIPTIONS, FPMR PART 101-29 (AUG 1998) 2
52.211-2 AVAILABILITY OF SPECIFICATIONS LISTED IN THE DOD INDEX OF SPECIFICATIONS AND STANDARDS (DODISS) AND DESCRIPTIONS LISTED IN THE ACQUISITION MANAGEMENT SYSTEMS AND DATA REQUIREMENTS CONTROL LIST, DOD 5010.12-L (DEC 1999) 3
52.211-6 BRAND NAME OR EQUAL (AUG 1999) 3
52.211-14 NOTICE OF PRIORITY RATING FOR NATIONAL DEFENSE USE (SEP 1990) 3
52.211-15 DEFENSE PRIORITY AND ALLOCATION REQUIREMENTS (SEP 1990) 4
52.214-34 SUBMISSION OF OFFERS IN THE ENGLISH LANGUAGE (APR 1991) 4
52.214-35 SUBMISSION OF OFFERS IN U.S. CURRENCY (APR 1991) 4
52.0214-4583 TELEGRAPHIC BIDS/OFFERS ARE NOT ACCEPTABLE 4
52.0214-4584 FACSIMILE BIDS/OFFERS 4
52.215-1 INSTRUCTIONS TO OFFERORS--COMPETITIVE ACQUISITION (MAY 2001) 4
52.215-4009 SUBMISSION OF PROPOSALS (APR 2002) 7
52.215-4009 SPECIAL INSTRUCTIONS PERTAINING TO HAND-CARRIED OFFERS: 8
52.217-5 EVALUATION OF OPTIONS (JUL 1990) 10
52.219-18 NOTIFICATION OF COMPETITION LIMITED TO ELIGIBLE 8(A) CONCERNS (JUN 1999) 10
52.222-23 NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION TO ENSURE EQUAL EMPLOYMENT OPPORTUNITY FOR CONSTRUCTION (FEB 1999) 11
52.225-12 NOTICE OF BUY AMERICAN ACT REQUIREMENT-- CONSTRUCTION MATERIALS UNDER TRADE AGREEMENTS (MAY 2002) 11
52.228-1 BID GUARANTEE (SEP 1996) 12
52.228-4507 BID GUARANTEE FORM AND AMOUNT 13
52.232-38 SUBMISSION OF ELECTRONIC FUNDS TRANSFER INFORMATION WITH OFFER (MAY 1999) 13
52.233-2 SERVICE OF PROTEST (AUG 1996) 13
52.236-27 SITE VISIT (CONSTRUCTION) (FEB 1995) 14
52.236-28 PREPARATION OF PROPOSALS--CONSTRUCTION (OCT 1997) 14
PAST PERFORMANCE QUESTIONNAIRE FOR 15
RFP NO. DACA09-03-R-0010 15

Section 00100 - Bidding Schedule/Instructions to Bidders

CLAUSES INCORPORATED BY FULL TEXT

52.0000-4010 INQUIRIES

Perspective bidders/offerors should submit inquiries related to this solicitation by writing or calling the following (collect calls will not be accepted:

(1) For inquiries of a contractual nature (solicitation requirements, interpretation of contractual language) call:
Julie Ayala, 213.452.3241; Lucia A. Carvajal 213.452.3240

(2) For inquiries of a technical nature (specification or drawings) call:
Randi Elder, 760.380.4387

(3) Please include the solicitation number, project title and location of project with your questions. Written inquiries must be received by this office not later than 7-calendar days prior to bid opening date/date set for receipt of offers.

52.0000-4023 SAFETY REQUIREMENTS

The bidder's attention is directed to the latest version of U.S Army Corps of Engineers Safety and Health Manual, EM 385-1-1, which will be strictly enforced. This publication may be obtained from the US Army Engineer District, Los Angeles, ATTN: Safety Office, P.O. Box 532711, Los Angeles, California 90053-2325.

52.209-4501 CONTRACTOR REPONSIBILITY, PRE-AWARD SURVEY

In order to determine a contractor's responsibility for purposes of contract award in accordance with FAR Part 9, a statement regarding previous experience in performing comparable work, and/or plant to be used in performing the work is required. After the bid opening, the Government will request this information and set a due date for its submission.

52.211-1 AVAILABILITY OF SPECIFICATIONS LISTED IN THE GSA INDEX OF FEDERAL SPECIFICATIONS, STANDARDS AND COMMERCIAL ITEM DESCRIPTIONS, FPMR PART 101-29 (AUG 1998)

(a) The GSA Index of Federal Specifications, Standards and Commercial Item Descriptions, FPMR Part 101-29, and copies of specifications, standards, and commercial item descriptions cited in this solicitation may be obtained for a fee by submitting a request to--GSA Federal Supply Service, Specifications Section, Suite 8100, 470 East L'Enfant Plaza, SW, Washington, DC 20407, Telephone (202) 619-8925, Facsimile (202) 619-8978.

(b) If the General Services Administration, Department of Agriculture, or Department of Veterans Affairs issued this solicitation, a single copy of specifications, standards, and commercial item descriptions cited in this solicitation may be obtained free of charge by submitting a request to the addressee in paragraph (a) of this provision. Additional copies will be issued for a fee.

52.211-2 AVAILABILITY OF SPECIFICATIONS LISTED IN THE DOD INDEX OF SPECIFICATIONS AND STANDARDS (DODISS) AND DESCRIPTIONS LISTED IN THE ACQUISITION MANAGEMENT SYSTEMS AND DATA REQUIREMENTS CONTROL LIST, DOD 5010.12-L (DEC 1999)

Copies of specifications, standards, and data item descriptions cited in this solicitation may be obtained--

(a) From the ASSIST database via the Internet at http://assist.daps.mil; or

(b) By submitting a request to the--Department of Defense Single Stock Point (DoDSSP), Building 4, Section D, 700 Robbins Avenue, Philadelphia, PA 19111-5094, Telephone (215) 697-2667/2179, Facsimile (215) 697-1462.

(End of provision)

52.211-6 BRAND NAME OR EQUAL (AUG 1999)

(a) If an item in this solicitation is identified as “brand name or equal,” the purchase description reflects the characteristics and level of quality that will satisfy the Government's needs. The salient physical, functional, or performance characteristics that “equal” products must meet are specified in the solicitation.

(b) To be considered for award, offers of “equal” products, including “equal” products of the brand name manufacturer, must--

(1) Meet the salient physical, functional, or performance characteristic specified in this solicitation;

(2) Clearly identify the item by--

(i) Brand name, if any; and

(ii) Make or model number;
(3) Include descriptive literature such as illustrations, drawings, or a clear reference to previously furnished descriptive data or information available to the Contracting Officer; and

(4) Clearly describe any modifications the offeror plans to make in a product to make it conform to the solicitation requirements. Mark any descriptive material to clearly show the modifications.

(c) The Contracting Officer will evaluate “equal” products on the basis of information furnished by the offeror or identified in the offer and reasonably available to the Contracting Officer. The Contracting Officer is not responsible for locating or obtaining any information not identified in the offer.

(d) Unless the offeror clearly indicates in its offer that the product being offered is an “equal” product, the offeror shall provide the brand name product referenced in the solicitation.

(End of provision)

52.211-14 NOTICE OF PRIORITY RATING FOR NATIONAL DEFENSE USE (SEP 1990)

Any contract awarded as a result of this solicitation will be DX rated order; X DO rated order certified for national defense use under the Defense Priorities and Allocations System (DPAS) (15 CFR 700), and the Contractor will be required to follow all of the requirements of this regulation. [Contracting Officer check appropriate box.]

(End of provision)

52.211-15 DEFENSE PRIORITY AND ALLOCATION REQUIREMENTS (SEP 1990)

This is a rated order certified for national defense use, and the Contractor shall follow all the requirements of the Defense Priorities and Allocations System regulation (15 CFR 700).

(End of clause)

52.214-34 SUBMISSION OF OFFERS IN THE ENGLISH LANGUAGE (APR 1991)

Offers submitted in response to this solicitation shall be in the English language. Offers received in other than English shall be rejected.

(End of provision)

52.214-35 SUBMISSION OF OFFERS IN U.S. CURRENCY (APR 1991)

Offers submitted in response to this solicitation shall be in terms of U.S. dollars. Offers received in other than U.S. dollars shall be rejected.

(End of provision)

52.0214-4583 TELEGRAPHIC BIDS/OFFERS ARE NOT ACCEPTABLE

Any telegram to modify or withdraw a bid/offer sent to this office must be physically delivered to the office designated for receipt of bid/offer by the date and time set for bid opening/receipt of proposals.
No one from this office will be dispatched to the local telegraph office to pick up any telegram for any reason.

52.0214-4584 FACSIMILE BIDS/OFFERS

Facsimile bids/offers, modifications thereto, or cancellations of bids/offers will not be accepted.

52.215-1 INSTRUCTIONS TO OFFERORS--COMPETITIVE ACQUISITION (MAY 2001)

(a) Definitions. As used in this provision--

“Discussions” are negotiations that occur after establishment of the competitive range that may, at the Contracting Officer's discretion, result in the offeror being allowed to revise its proposal.

“In writing or written” means any worded or numbered expression which can be read, reproduced, and later communicated, and includes electronically transmitted and stored information.

“Proposal modification” is a change made to a proposal before the solicitation's closing date and time, or made in response to an amendment, or made to correct a mistake at any time before award.

“Proposal revision” is a change to a proposal made after the solicitation closing date, at the request of or as allowed by a Contracting Officer as the result of negotiations.

“Time”, if stated as a number of days, is calculated using calendar days, unless otherwise specified, and will include Saturdays, Sundays, and legal holidays. However, if the last day falls on a Saturday, Sunday, or legal holiday, then the period shall include the next working day.

(b) Amendments to solicitations. If this solicitation is amended, all terms and conditions that are not amended remain unchanged. Offerors shall acknowledge receipt of any amendment to this solicitation by the date and time specified in the amendment(s).

(c) Submission, modification, revision, and withdrawal of proposals. (1) Unless other methods (e.g., electronic commerce or facsimile) are permitted in the solicitation, proposals and modifications to proposals shall be submitted in paper media in sealed envelopes or packages (i) addressed to the office specified in the solicitation, and (ii) showing the time and date specified for receipt, the solicitation number, and the name and address of the offeror. Offerors using commercial carriers should ensure that the proposal is marked on the outermost wrapper with the information in paragraphs (c)(1)(i) and (c)(1)(ii) of this provision.

(2) The first page of the proposal must show--

(i) The solicitation number;

(ii) The name, address, and telephone and facsimile numbers of the offeror (and electronic address if available);

(iii) A statement specifying the extent of agreement with all terms, conditions, and provisions included in the solicitation and agreement to furnish any or all items upon which prices are offered at the price set opposite each item;

(iv) Names, titles, and telephone and facsimile numbers (and electronic addresses if available) of persons authorized to negotiate on the offeror's behalf with the Government in connection with this solicitation; and

(v) Name, title, and signature of person authorized to sign the proposal. Proposals signed by an agent shall be accompanied by evidence of that agent's authority, unless that evidence has been previously furnished to the issuing office.

(3) Submission, modification, or revision, of proposals.

(i) Offerors are responsible for submitting proposals, and any modifications, or revisions, so as to reach the Government office designated in the solicitation by the time specified in the solicitation. If no time is specified in the solicitation, the time for receipt is 4:30 p.m., local time, for the designated Government office on the date that proposal or revision is due.

(ii)(A) Any proposal, modification, or revision received at the Government office designated in the solicitation after the exact time specified for receipt of offers is “late” and will not be considered unless it is received before award is made, the Contracting Officer determines that accepting the late offer would not unduly delay the acquisition; and--

(1) If it was transmitted through an electronic commerce method authorized by the solicitation, it was received at the initial point of entry to the Government infrastructure not later than 5:00 p.m. one working day prior to the date specified for receipt of proposals; or

(2) There is acceptable evidence to establish that it was received at the Government installation designated for receipt of offers and was under the Government's control prior to the time set for receipt of offers; or

(3) It is the only proposal received.

(B) However, a late modification of an otherwise successful proposal that makes its terms more favorable to the Government, will be considered at any time it is received and may be accepted.

(iii) Acceptable evidence to establish the time of receipt at the Government installation includes the time/date stamp of that installation on the proposal wrapper, other documentary evidence of receipt maintained by the installation, or oral testimony or statements of Government personnel.

(iv) If an emergency or unanticipated event interrupts normal Government processes so that proposals cannot be received at the office designated for receipt of proposals by the exact time specified in the solicitation, and urgent Government requirements preclude amendment of the solicitation, the time specified for receipt of proposals will be deemed to be extended to the same time of day specified in the solicitation on the first work day on which normal Government processes resume.

(v) Proposals may be withdrawn by written notice received at any time before award. Oral proposals in response to oral solicitations may be withdrawn orally. If the solicitation authorizes facsimile proposals, proposals may be withdrawn via facsimile received at any time before award, subject to the conditions specified in the provision at 52.215-5, Facsimile Proposals. Proposals may be withdrawn in person by an offeror or an authorized representative, if the identity of the person requesting withdrawal is established and the person signs a receipt for the proposal before award.

(4) Unless otherwise specified in the solicitation, the offeror may propose to provide any item or combination of items.

(5) Offerors shall submit proposals in response to this solicitation in English, unless otherwise permitted by the solicitation, and in U.S. dollars, unless the provision at FAR 52.225-17, Evaluation of Foreign Currency Offers, is included in the solicitation.

(6) Offerors may submit modifications to their proposals at any time before the solicitation closing date and time, and may submit modifications in response to an amendment, or to correct a mistake at any time before award.

(7) Offerors may submit revised proposals only if requested or allowed by the Contracting Officer.

(8) Proposals may be withdrawn at any time before award. Withdrawals are effective upon receipt of notice by the Contracting Officer.

(d) Offer expiration date. Proposals in response to this solicitation will be valid for the number of days specified on the solicitation cover sheet (unless a different period is proposed by the offeror).

(e) Restriction on disclosure and use of data. Offerors that include in their proposals data that they do not want disclosed to the public for any purpose, or used by the Government except for evaluation purposes, shall--

(1) Mark the title page with the following legend: This proposal includes data that shall not be disclosed outside the Government and shall not be duplicated, used, or disclosed--in whole or in part--for any purpose other than to evaluate this proposal. If, however, a contract is awarded to this offeror as a result of--or in connection with-- the submission of this data, the Government shall have the right to duplicate, use, or disclose the data to the extent provided in the resulting contract. This restriction does not limit the Government's right to use information contained in this data if it is obtained from another source without restriction. The data subject to this restriction are contained in sheets [insert numbers or other identification of sheets]; and

(2) Mark each sheet of data it wishes to restrict with the following legend: Use or disclosure of data contained on this sheet is subject to the restriction on the title page of this proposal.

(f) Contract award. (1) The Government intends to award a contract or contracts resulting from this solicitation to the responsible offeror(s) whose proposal(s) represents the best value after evaluation in accordance with the factors and subfactors in the solicitation.

(2) The Government may reject any or all proposals if such action is in the Government's interest.

(3) The Government may waive informalities and minor irregularities in proposals received.

(4) The Government intends to evaluate proposals and award a contract without discussions with offerors (except clarifications as described in FAR 15.306(a)). Therefore, the offeror's initial proposal should

contain the offeror's best terms from a cost or price and technical standpoint. The Government reserves the right to conduct discussions if the Contracting Officer later determines them to be necessary. If the Contracting Officer determines that the number of proposals that would otherwise be in the competitive range exceeds the number at which an efficient competition can be conducted, the Contracting Officer may limit the number of proposals in the competitive range to the greatest number that will permit an efficient competition among the most highly rated proposals.

(5) The Government reserves the right to make an award on any item for a quantity less than the quantity offered, at the unit cost or prices offered, unless the offeror specifies otherwise in the proposal.

(6) The Government reserves the right to make multiple awards if, after considering the additional administrative costs, it is in the Government's best interest to do so.

(7) Exchanges with offerors after receipt of a proposal do not constitute a rejection or counteroffer by the Government.

(8) The Government may determine that a proposal is unacceptable if the prices proposed are materially unbalanced between line items or subline items. Unbalanced pricing exists when, despite an acceptable total evaluated price, the price of one or more contract line items is significantly overstated or understated as indicated by the application of cost or price analysis techniques. A proposal may be rejected if the Contracting Officer determines that the lack of balance poses an unacceptable risk to the Government.

(9) If a cost realism analysis is performed, cost realism may be considered by the source selection authority in evaluating performance or schedule risk.

(10) A written award or acceptance of proposal mailed or otherwise furnished to the successful offeror within the time specified in the proposal shall result in a binding contract without further action by either party.

(11) The Government may disclose the following information in postaward debriefings to other offerors:

(i) The overall evaluated cost or price and technical rating of the successful offeror;

(ii) The overall ranking of all offerors, when any ranking was developed by the agency during source selection;

(iii) A summary of the rationale for award; and

(iv) For acquisitions of commercial items, the make and model of the item to be delivered by the successful offeror.

(End of provision)

52.215-4009 SUBMISSION OF PROPOSALS (APR 2002)

(a) Envelopes containing offers, cost and technical, etc., must be sealed, marked and addressed follows:

MARK ENVELOPES:

RFP No. DACA09-03-0010
Proposal Due Date: 5 September 2003
Proposal Due Time: 2:00 PM

ADDRESS ENVELOPES TO:

Department of the Army
U. S. Army Engineer District, Los Angeles
ATTN: Contracting Division
C/O: JULIE AYALA OR LUCIA CARVAJAL
P. O. Box 532711
Los Angeles, CA 90053-2325

(b) Hand carried proposals may be deposited prior to the time and date set for receipt of proposals as follows:

US Army Engineer District, Los Angeles
911 Wilshire Blvd, Suite 980
Los Angeles, California 90017

52.215-4009 SPECIAL INSTRUCTIONS PERTAINING TO HAND-CARRIED OFFERS:

Due to security precautions, all Corps of Engineers visitors/couriers are now required to check in at the Public Affairs Office (PAO), Suite 980, Wilshire Blvd, Los Angeles, CA. Offerors are no longer permitted to hand-carry their offers directly to Contacting Division without an authorized escort. **Offers may NOT be left unattended at the Public Affairs Office (PAO), Suite 980.**

Offerors who desire to hand-deliver their offers prior to the scheduled time/date set for receipt of offerors must notify the Contracting Division to arrange for receipt of their offer by Contracting Division personnel. Normally the contact will be the Contract Specialist designated above. In the event the Contract Specialist cannot be reached, please call the main Contracting Division telephone number, 213-452-3231 or the following alternative telephone numbers -3233, -3245, -3234, or -3235, in order to request assistance.

30 minutes prior to the scheduled receipt of offer time/date, the Contract Specialist will be in the Public Affairs Office (PAO) Suite 980, to accept offers. After visitor in-processing, any offeror will subsequently be escorted to the Contracting Division, if necessary.

In order to expedite visitor processing, offerors are encouraged to complete the information requested on the Notice of Visitor(s) Form (attached). The completed form can be faxed to the Contract Specialist at 213.452.4187 prior to the date for receipt of offers. In addition, no more than 2 visitors per firm will be permitted within the building. No exceptions will be made. The offeror is responsible for compliance with the security requirements and shall ensure that any company representative, courier or delivery personnel are aware of these special procedures pertaining to hand carried offers.

NOTICE OF VISITOR(S)

1. Date(s) of Visit *(Inclusive)*	**2. Arrival Time**	
3. Name of Visitor(s) *(Last, First)*	**4. Agency/Company of Visitor**	
5. Name of Person Being Visited *(Include Div, Br, Sec)* **CYNTHIA MYRTETUS** **LUCIA A. CARVAJAL** **CONTRACTING DIVISION**	**6. Suite Number** **1040**	**7. Telephone Number** **213.452.3247** **213.452.3240**
8. Contact Person *(if other than Person Being Visited)* **LUCIA A. CARVAJAL**		**9. Telephone Number** **213.452.3240**
10. Other Comments or Instructions		

- All visitors must report to the Public Affairs Office, Suite 980
- Visitors must use the Visitor Tag provided.
- Visitors must be escorted to Corps of Engineers floors
- Parking validation is only available for Engineering Division, Construction-Operations, and Information Management field personnel.
- Delivery personnel will be validated for 30 minutes only.

52.216-1 TYPE OF CONTRACT (APR 1984)

The Government contemplates award of a firm fixed price contract resulting from this solicitation.

(End of clause)

52.217-5 EVALUATION OF OPTIONS (JUL 1990)

(a) Except when it is determined in accordance with FAR 17.206(b) not to be in the Government's best interests, the Government will evaluate offers for award purposes by adding the total price for all options to the total price for the basic requirement. Evaluation of options will not obligate the Government to exercise the option(s).

(b) The Government may reject an offer as nonresponsive if it is materially unbalanced as to prices for the basic requirement and the option quantities. An offer is unbalanced when it is based on prices significantly less than cost for some work and prices which are significantly overstated for other work.

(End of provision)

52.219-18 NOTIFICATION OF COMPETITION LIMITED TO ELIGIBLE 8(A) CONCERNS (JUN 1999)

(a) Offers are solicited only from small business concerns expressly certified by the Small Business Administration (SBA) for participation in the SBA's 8(a) Program and which meet the following criteria at the time of submission of offer—**COMPETITON IS LIMITED TO FIRMS IN THE SBA'S REGION IX. (CALIFORNIA, ARIZONA, NEVADA AND HAWAII).**

(1) The Offeror is in conformance with the 8(a) support limitation set forth in its approved business plan; and

(2) The Offeror is in conformance with the Business Activity Targets set forth in its approved business plan or any remedial action directed by the SBA.

(b) By submission of its offer, the Offeror represents that it meets all of the criteria set forth in paragraph (a) of this clause.

(c) Any award resulting from this solicitation will be made to the Small Business Administration, which will subcontract performance to the successful 8(a) offeror selected through the evaluation criteria set forth in this solicitation.

(d)(1) Agreement. A small business concern submitting an offer in its own name agrees to furnish, in performing the contract, only end items manufactured or produced by small business concerns in the United States. The term "United States" includes its territories and possessions, the Commonwealth of Puerto Rico, the Trust Territory of the Pacific Islands, and the District of Columbia. If this procurement is processed under simplified acquisition procedures and the total amount of this contract does not exceed $25,000, a small business concern may furnish the product of any domestic firm. This paragraph does not apply in connection with construction or service contracts.

(2) The Contractor will notify the U. S. Army Corps of Engineers Contracting Officer in writing immediately upon entering an agreement (either oral or written) to transfer all or part of its stock or other ownership interest to any other party.

(End of clause)

52.222-23 NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION TO ENSURE EQUAL EMPLOYMENT OPPORTUNITY FOR CONSTRUCTION (FEB 1999)

(a) The offeror's attention is called to the Equal Opportunity clause and the Affirmative Action Compliance Requirements for Construction clause of this solicitation.

(b) The goals for minority and female participation, expressed in percentage terms for the Contractor's aggregate workforce in each trade on all construction work in the covered area, are as follows:

Goals for minority participation for each trade	Goals for female participation for each trade
19.7%	6.9%

These goals are applicable to all the Contractor's construction work performed in the covered area. If the Contractor performs construction work in a geographical area located outside of the covered area, the Contractor shall apply the goals established for the geographical area where the work is actually performed. Goals are published periodically in the Federal Register in notice form, and these notices may be obtained from any Office of Federal Contract Compliance Programs office.

(c) The Contractor's compliance with Executive Order 11246, as amended, and the regulations in 41 CFR 60-4 shall be based on (1) its implementation of the Equal Opportunity clause, (2) specific affirmative action obligations required by the clause entitled "Affirmative Action Compliance Requirements for Construction," and (3) its efforts to meet the goals. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade. The Contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from Contractor to Contractor, or from project to project, for the sole purpose of meeting the Contractor's goals shall be a violation of the contract, Executive Order 11246, as amended, and the regulations in 41 CFR 60-4. Compliance with the goals will be measured against the total work hours performed.

(d) The Contractor shall provide written notification to the Deputy Assistant Secretary for Federal Contract Compliance, U.S. Department of Labor, within 10 working days following award of any construction subcontract in excess of $10,000 at any tier for construction work under the contract resulting from this solicitation. The notification shall list the --

(1) Name, address, and telephone number of the subcontractor;

(2) Employer's identification number of the subcontractor;

(3) Estimated dollar amount of the subcontract;

(4) Estimated starting and completion dates of the subcontract; and

(5) Geographical area in which the subcontract is to be performed.

(e) As used in this Notice, and in any contract resulting from this solicitation, the "covered area" is Fort Irwin, CA
(End of provision)

52.225-12 NOTICE OF BUY AMERICAN ACT REQUIREMENT-- CONSTRUCTION MATERIALS UNDER TRADE AGREEMENTS (MAY 2002)

(a) Definitions. Construction material, designated country construction material, domestic construction material, foreign construction material, and NAFTA country construction material, as used in this

provision, are defined in the clause of this solicitation entitled “Buy American Act--Construction Materials under Trade Agreements” (Federal Acquisition Regulation (FAR) clause 52.225-11).

(b) Requests for determination of inapplicability. An offeror requesting a determination regarding the inapplicability of the Buy American Act should submit the request to the Contracting Officer in time to allow a determination before submission of offers. The offeror shall include the information and applicable supporting data required by paragraphs (c) and (d) of FAR clause 52.225-11 in the request. If an offeror has not requested a determination regarding the inapplicability of the Buy American Act or Balance of Payments Program before submitting its offer, or has not received a response to a previous request, the offeror shall include the information and supporting data in the offer.

(c) Evaluation of offers. (1) The Government will evaluate an offer requesting exception to the requirements of the Buy American Act, based on claimed unreasonable cost of domestic construction materials, by adding to the offered price the appropriate percentage of the cost of such foreign construction material, as specified in paragraph (b)(4)(i) of FAR clause 52.225-11.

(2) If evaluation results in a tie between an offeror that requested the substitution of foreign construction material based on unreasonable cost and an offeror that did not request an exception, the Contracting Officer will award to the offeror that did not request an exception based on unreasonable cost.

(d) Alternate offers. (1) When an offer includes foreign construction material, other than designated country or NAFTA country construction material, that is not listed by the Government in this solicitation in paragraph (b)(3) of FAR clause 52.225-11, the offeror also may submit an alternate offer based on use of equivalent domestic, designated country, or NAFTA country construction material.

(2) If an alternate offer is submitted, the offeror shall submit a separate Standard Form 1442 for the alternate offer, and a separate price comparison table prepared in accordance with paragraphs (c) and (d) of FAR clause 52.225-11 for the offer that is based on the use of any foreign construction material for which the Government has not yet determined an exception applies.

(3) If the Government determines that a particular exception requested in accordance with paragraph (c) of FAR clause 52.225-11 does not apply, the Government will evaluate only those offers based on use of the equivalent domestic, designated country, or NAFTA country construction material, and the offeror shall be required to furnish such domestic, designated country, or NAFTA country construction material. An offer based on use of the foreign construction material for which an exception was requested--

(i) Will be rejected as nonresponsive if this acquisition is conducted by sealed bidding; or

(ii) May be accepted if revised during negotiations.

(End of provision)

52.228-1 BID GUARANTEE (SEP 1996)

(a) Failure to furnish a bid guarantee in the proper form and amount, by the time set for opening of bids, may be cause for rejection of the bid.

(b) The bidder shall furnish a bid guarantee in the form of a firm commitment, e.g., bid bond supported by good and sufficient surety or sureties acceptable to the Government, postal money order, certified check, cashier's check, irrevocable letter of credit, or, under Treasury Department regulations, certain bonds or notes of the United States. The Contracting Officer will return bid guarantees, other than bid bonds, (1) to unsuccessful bidders as soon as practicable after the opening of bids, and (2) to the successful bidder upon execution of contractual documents and bonds (including any necessary coinsurance or reinsurance agreements), as required by the bid as accepted.-

(c) The amount of the bid guarantee shall be 20% percent of the bid price or $3,000,000.00, whichever is less.-

(d) If the successful bidder, upon acceptance of its bid by the Government within the period specified for acceptance, fails to execute all contractual documents or furnish executed bond(s) within 10 days after receipt of the forms by the bidder, the Contracting Officer may terminate the contract for default.-

(e) In the event the contract is terminated for default, the bidder is liable for any cost of acquiring the work that exceeds the amount of its bid, and the bid guarantee is available to offset the difference.

(End of clause)

52.228-4507 BID GUARANTEE FORM AND AMOUNT

When bids/proposals exceed $100,000, the offeror shall furnish a separated bid guarantee in accordance with the solicitation provision titled "Bid Guarantee", FAR 52.228-1. In accordance with FAR 28.101-2 the bid guarantee amount shall be a least 20 percent of the "bid price" but shall not exceed $3 million. When the penal sum is expressed as a percentage, a maximum dollar limitation may be stated. If there are option line items on the Pricing Schedule (Schedule B), the term "bid price" is hereby defined as the total bid not to include any amount for line items designated as "options". In bids/proposals that contain "additives", the "bid price" is defined as the total of all bid items including additive line items. FAR 28.106-1 states that a Standard Form (SF) 24 shall be used for the bid bond. In accordance with FAR 28.202(a)(1), corporate sureties utilized must appear on the list contained in the Department of Treasury Circular 570 titled "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and Acceptable Reinsuring Companies."

52.232-38 SUBMISSION OF ELECTRONIC FUNDS TRANSFER INFORMATION WITH OFFER (MAY 1999)

The offeror shall provide, with its offer, the following information that is required to make payment by electronic funds transfer (EFT) under any contract that results from this solicitation. This submission satisfies the requirement to provide EFT information under paragraphs (b)(1) and (j) of the clause at 52.232-34, Payment by Electronic Funds Transfer--Other than Central Contractor Registration.

(1) The solicitation number (or other procurement identification number).

(2) The offeror's name and remittance address, as stated in the offer.

(3) The signature (manual or electronic, as appropriate), title, and telephone number of the offeror's official authorized to provide this information.

(4) The name, address, and 9-digit Routing Transit Number of the offeror's financial agent.

(5) The offeror's account number and the type of account (checking, savings, or lockbox).

(6) If applicable, the Fedwire Transfer System telegraphic abbreviation of the offeror's financial agent.

(7) If applicable, the offeror shall also provide the name, address, telegraphic abbreviation, and 9-digit Routing Transit Number of the correspondent financial institution receiving the wire transfer payment if the offeror's financial agent is not directly on-line to the Fedwire and, therefore, not the receiver of the wire transfer payment.

(End of provision)

52.233-2 SERVICE OF PROTEST (AUG 1996)

(a) Protests, as defined in section 33.101 of the Federal Acquisition Regulation, that are filed directly with an agency, and copies of any protests that are filed with the General Accounting Office (GAO), shall be served on the Contracting Officer (addressed as follows) by obtaining written and dated acknowledgment of receipt from DANIEL CARRASCO,
C/O JULIE AYALA,

U.S. Army Corps of Engineers
Los Angeles District
P. O. Box 532711
ATTN: CT-W
Los Angeles, CA 90053-2325

911 Wilshire Blvd., Suite 1040
Los Angeles, CA 90017

(b) The copy of any protest shall be received in the office designated above within one day of filing a protest with the GAO.

(End of provision)

52.236-27 SITE VISIT (CONSTRUCTION) (FEB 1995)

(a) The clauses at 52.236-2, Differing Site Conditions, and 52.236-3, Site Investigations and Conditions Affecting the Work, will be included in any contract awarded as a result of this solicitation. Accordingly, offerors or quoters are urged and expected to inspect the site where the work will be performed.

(b) Site visits may be arranged during normal duty hours by contacting:
Name: RANDI ELDER
Address: FORT IRWIN RESIDENT OFFICE, 5th ST & AVE F, FT IRWIN, CA 92310-0048
Telephone: 760.380.4387

(End of provision)

52.236-28 PREPARATION OF PROPOSALS--CONSTRUCTION (OCT 1997)

(a) Proposals must be (1) submitted on the forms furnished by the Government or on copies of those forms, and (2) manually signed. The person signing a proposal must initial each erasure or change appearing on any proposal form.

(b) The proposal form may require offerors to submit proposed prices for one or more items on various bases, including--

(1) Lump sum price;

(2) Alternate prices;

(3) Units of construction; or

(4) Any combination of paragraphs (b)(1) through (b)(3) of this provision.

(c) If the solicitation requires submission of a proposal on all items, failure to do so may result in the proposal being rejected without further consideration. If a proposal on all items is not required, offerors should insert the words “no proposal” in the space provided for any item on which no price is submitted.

(d) Alternate proposals will not be considered unless this solicitation authorizes their submission.
(End of provision)

PAST PERFORMANCE QUESTIONNAIRE FOR
RFP NO. DACA09-03-R-0010

(TO BE SUBMITTED BY OFFEROR'S CURRENT/FORMER CLIENT/CUSTOMER)

The contractor listed below is being considered in a Source Selection by U.S. Army Corps of Engineers, Los Angeles District, Los Angeles, CA. It would be appreciated if you would provide us with comments regarding the contractor's past performance. Your comments are considered Source Selection Sensitive, therefore, you are advised that the Federal Acquisition Regulation (3.104-5) prohibits the release of the names of individuals providing reference information about an offeror's past performance. In order to maintain the integrity of the source selection process, respectfully request that you do not divulge the name of the contractor nor discuss your comments on this questionnaire with any other individuals. TO MEET THE ARMY'S NEED, THE REQUESTED INFORMATION MUST BE RECEIVED **NO LATER THAN 2:00 P.M., 5 SEP 2003.** PLEASE SUBMIT YOUR RESPONSE VIA FACSIMILE OR MAIL TO: U.S. ARMY CORPS OF ENGINEERS, LOS ANGELES DISTRICT, CONTRACTING DIVISION, **ATTN: JULIE AYALA/LUCIA CARVAJAL,** P.O. BOX 532711, LOS ANGELES, CA 90053-2325, FAX: (213) 452-4187.

Handwritten completion of this questionnaire in ink is acceptable, if legible.

Please include evaluation of contractor's performance based solely on the performance for which the contractor was/is liable. Please do not let factors beyond the control of the contractor that have resulted in performance delays or other problems bias the evaluation of the contractor's performance.

Past Project Information:

Contractor (Prime/A-E):
Project Title/Contract Number:

Evaluator: (the following information will assist in the analysis of the data. Information will be kept confidential)

Name:	Date:
Phone No.:	Fax No.:
Address:	
Position held or function in relation to project:	

The following is a definition of the rating system used:

Exceptional: Performance meets contractual requirements and exceeds many to the Government's benefit. The contractual performance of the element or sub-element being assessed was accomplished with few minor problems for which corrective actions taken by the contractor were highly effective.

Very Good: Performance meets contractual requirements and exceeds some to the Government's benefit. The contractual performance of the element or sub-element being assessed was accomplished with some minor problems for which corrective actions taken by the contractor were effective.

Satisfactory: Performance meets contractual requirements. The contractual performance of the element or sub-element contains some minor problems for which corrective actions taken by the contractor appear or were satisfactory.

Marginal: Performance does not meet some contractual requirements. The contractual performance of the element or sub-element being assessed reflects a serious problem for which the contractor has not yet identified corrective actions. The contractor's proposed actions appear only marginally effective or were not fully implemented.

Unsatisfactory: Performance does not meet most contractual requirements and recovery is not likely in a timely manner. The contractual performance of the element or sub-element contains serious problem(s) for which the contractor's corrective actions appear or were ineffective.

Ratings: In completing this questionnaire please circle a letter corresponding to your rating, or NA if you are unable to provide an evaluation for any area:

E=Exceptional, VG=Very Good, S=Satisfactory, M=Marginal, U=Unsatisfactory

Please provide clear and concise narrative explanations (both positive and negative) for your answers. This is especially important for any rating above or below satisfactory.

Please rate and provide any supporting information for the following: (Use additional sheets as needed)

1. The contractor's overall corporate management, integrity, reasonableness and cooperative conduct.
Rating: E VG S M U N/A
Comments:

2. The relationship between the contractor and owner's contract team.
Rating: E VG S M U N/A
Comments:

3. The contractor's on-site management and coordination of subcontractors.
Rating: E VG S M U N/A
Comments:

4. The contractor's performance on delivery of quality work.
Rating: E VG S M U N/A
Comments:

5. The contractor's quality control (CQC) system.
Rating: E VG S M U N/A
Comments:

6. The contractor's ability to meet the performance schedule.
Rating: E VG S M U N/A
Comments:

7. What did the contractor do to improve schedule problems, if any?
Rating: E VG S M U N/A
Comments:

8. The contractor's ability to provide the required work at a reasonable total price.
Rating: E VG S M U N/A
Comments:

9. The contractor's compliance with labor standards, if applicable.
Rating: E VG S M U N/A
Comments:

10. The contractor's compliance with safety standards and/or number of incidents.
Rating: E VG S M U N/A
Comments:

11. Has the contractor been given any of the following: Cure notice, show cause, letters of reprimand, suspension of payments, termination? If yes, please explain.
12. Would you award another contract to this contractor? If no, please state reasons for not recommending this contractor additional work.
13. Was the customer satisfied with the end product?
14. Has the contractor been provided an opportunity to discuss any negative performance ratings? If so, what were the results?
15. OVERALL RATING_____
Please provide any additional comments (use additional sheets if necessary):

(End of section)

SECTION 00110
PROPOSAL SUBMISSION REQUIREMENTS AND INSTRUCTIONS

1. REQUIREMENT FOR SEPARATE PRICE AND TECHNICAL PROPOSALS

a. Each offeror must submit **both** a Price Proposal and a Technical Proposal. The Price Proposal and the Technical Proposal must be submitted as separate (i.e., physically distinct) volumes. Both the Price Proposal and the Technical Proposal must be received by the closing date and time set for receipt of proposals.

b. **The Price Proposal (Volume 1)** must include the signed Standard Form 1442, "Solicitation, Offer and Award," acknowledgement of all amendments, the completed Pricing Schedule, the Offeror's completed Representations and Certification, Bid Bond, and any other requirements described below.

c. **The Technical Proposal (Volume 2)** consists of all information and material submitted or provided for evaluation in response to the technical (non-cost) evaluation factors and any significant sub factors specified in Section 00120. The purpose of the technical evaluation is to assess the quality of each offer (i.e., the quality of the proposed product or service), to determine the capability of each offeror, and to determine the ability of each offeror to perform the perspective contract successfully. This is accomplished though the evaluation of technical proposals. This process will assess their relative qualities solely on factors and sub factors specified in the Solicitation. The relative strengths, deficiencies, significant weaknesses, and risks supporting the proposal evaluation will be documented fully and completely in the contract file. No dollar amounts from the Price Proposal are to be included in the Technical Proposal.

2. GENERAL INSTRUCTIONS

a. Submit only typed/printed hard-copy paper documents unless specifically authorized elsewhere in this section.

b. Use only 8 ½ by 11 inch paper unless another size paper. Do not use "fold-outs." Do not use a font smaller that 10, an unusual font such as script, or condensed print for any narrative submission. Smaller font sizes may be used for non-narrative submissions (e.g., charts, graphs, etc.,) as long as the text is clearly legible. All page margins must be at least 1-inch wide. Do not justify the right margin.

c. Three-ring binders are preferred. Use of pressboard or other report covers with compressions or other type fasteners are acceptable. Do not use spring clamps or exceed the recommended capacity of the fasteners or binds. Do not use plastic multi-hole/spiral binding systems, heat-binding systems, or other systems that do not facilitate the ready insertion of additional pages.

d. Please ensure that the outside of each separate volume is clearly marked to indicate its contents and the identity of the offeror. Additionally, the original cost/price proposal and original technical proposal should be clearly indicated on the outside cover.

e. "Confidential" projects cannot be submitted to demonstrate capability unless all of the information required for evaluation purposes as specified herein can nonetheless be provided to the Government as part of the offeror's technical proposal. Offerors that include in their proposals information that they do not want to disclose to the public for any purpose, or used by the Government except for evaluation purposes, must be clearly marked in accordance with the instructions at FAR 52.215-1, "Instructions to Offeror-Competitive Acquisition," paragraph (3), "Restrictions on disclosure and use of data."

3. SPECIFIC INSTRUCTIONS FOR THE PRICE PROPOSAL, VOLUME 1

a. <u>Number of Sets of the Price Proposal</u>

Submit the **Original and two (2) additional sets** of the written Price Proposal (i.e., the Original and two (2) copies of all of the information required below, with each set separately packaged).

b. Format and Contents of the Price Proposal/List of Tabs

The Original and all copies of the price proposal shall be appropriately labeled as such, shall be organized as indicated below, and shall be comprised of the following:

TAB	CONTENTS OF THE PRICE PROPOSAL
#1	**The SF 1442** completed by the offeror and duly executed with an original signature by an official authorized to bind the company in accordance with the instructions at FAR 4.102. **Acknowledgement of any and all amendments** to the solicitation in accordance with the instructions on Standard Form 30 Amendment.
#2	**The completed Pricing Schedule** with the Offeror's proposed contract line item prices inserted in the appropriate spaces. Prices must be proposed for all contract line
#3	**"Representations and Certifications, and Other Statements of Bidders/Offerors" Section 00600, must be completed by offeror.**
#4	**An Offer Guarantee, Standard Form 24, "Bid Bond."**

4. SPECIFIC INSTRUCTIONS FOR THE TECHNICAL PROPOSAL, VOLUME 2

a. Number of Sets of the Technical Proposal

Submit the **Original and four (4) additional sets** of the written Technical Proposal (i.e., the Original and **four (4)** copies of all of the information required below, with each set separately packaged).

b. Format and Contents of the Technical Proposal/List of Tabs

The original and all copies of the technical proposal shall be appropriately labeled as such, shall be organized as indicated below, and shall be comprised of the following:

TAB	CONTENTS OF THE TECHNICAL PROPOSAL
#1	**The Proposal Cover Sheet** as required by FAR 52.215-1(c)(i)(v). This provision, titled "Instructions to Offerors-Competitive Acquisition," is provided in full text in Section 00100.
#2	**Past Performance, refer to Section 00120**
#3	**Management Approach, refer to Section 00120**
#4	**Customer Satisfaction, refer to Section 00120**
#5	**Understanding of Requirements, refer to Section 00120**
#6	**Scheduling, refer to Section 00120**

5. PROPOSAL EXPENSE AND PREAWARD COSTS.

This solicitation does not commit the Government to pay any costs incurred in the preparation and submission of the initial and any subsequent proposals or for any cost.

This page was intentionally left blank for duplex printing.

SECTION 00120
PROPOSAL EVALUATION AND CONTRACT AWARD

1. ELIGIBILITY FOR CONTRACT AWARD

In accordance with FAR 1.602-1(b), no contract shall be entered into unless the contracting officer ensures that all requirements of law, executive orders, regulations, and all other applicable procedures, including clearances and approvals, have been met. This includes the requirement at FAR 9.103 that no award shall be made unless the contracting officer makes an affirmative determination of responsibility. To be determined responsible, a prospective contractor must meet the general standards in FAR 9.104-1 and any special standards set forth in the solicitation in accordance with FAR 9.104-2.

2. SOURCE SELECTION USING THE TRADE-OFF PROCESS

The Government will select the offer that represents the best value to the Government by using the trade-off process described in FAR Part 15. This process permits tradeoffs between price and technical (non-cost) factors and allows the Government to accept other than the lowest priced offer. The award decision will be based on a comparative assessment of proposals against the source selection criteria in the solicitation.

3. RELATIVE IMPORTANCE OF PRICE TO THE TECHNICAL EVALUATION FACTORS

The Government intends to make award to the responsible offeror whose proposal is the most advantageous to the Government in accordance with the following relationship between cost/price and technical merit:

All evaluation factors other than cost or price, when combined, are approximately equal to cost or price. The Government is concerned with striking the most advantageous balance between technical merit ("quality") and cost to the Government (i.e., the price). The degree of importance of price could become greater depending upon the equality of the technical proposals. If competing technical proposals are determined to be essentially equal, price could become the controlling factor.

4. EVALUATION OF THE PRICE PROPOSAL

Price or cost to the Government will be evaluated and considered but will not be scored or combined with other aspects of the proposal evaluation. The proposed price will be analyzed for reasonableness. It may also be analyzed to determine whether it is realistic for the work to be performed; reflects a clear understanding of the requirements; and is consistent with the Offeror's Technical Proposal. Additionally, all offers with separately priced line items will be analyzed for unbalanced pricing.

5. THE TECHNICAL EVALUATION FACTORS AND SUBFACTORS:

The Technical Proposal will be evaluated based on the following technical evaluation factors and sub factors:

FACTOR 1: Past Performance

Sub factor 1a, Construction Experience

Sub factor 1b, Quality of Service or Product and Past Performance Appraisals

Sub factor 1c, Ability to Solve Complex Problems

Sub factor 1d, Subcontract Management

FACTOR 2: Management Approach

Sub factor 2a, Staff Resumes and Chain of Command

Sub factor 2b, Project Site Supervision

FACTOR 3: Customer Satisfaction

FACTOR 4: Understanding of Requirements

FACTOR 5; Scheduling

IMPORTANT CLARIFICATION:

The Government is interested in "how well you did it" under the Past Performance Factor.

6. RELATIVE WEIGHTING OF THE TECHNICAL EVALUATION FACTORS AND SUBFACTORS:

All evaluation factors and sub factors are of equal importance.

7. GENERAL TECHNICAL EVALUATION CRITERIA

a. The offeror's conformance with the specified format and submission requirements will be considered during the technical evaluation. Failure to comply with the format and/or submission requirements may be seen as indicative of the type of problems that could be expected to arise during contract performance. Lack of conformance could therefore result in a higher risk assessment, in addition, to any other impacts on the evaluation. Material omission may cause the technical proposal to be rejected as unacceptable.

SPECIAL NOTE: Inaccurate or incomplete past performance data from the Offeror may result in a less than satisfactory past performance/risk assessment rating. Substantial failures and/or material omissions under any factor or sub factor may cause the technical proposal to be rejected as unacceptable as the Government cannot make award based on a proposal that contains deficiencies.

b. Technical Proposals which do not provide the specified information in the specified location in accordance with the submission instructions in Section 00110 may be downgraded.

c. Proposals which are generic, vague, or lacking in detail may be downgraded.

d. Any prescribed page and formatting limitations will be strictly adhered to and enforced by he Government. The Government will not evaluate any excess information resulting from the Offeror's failure to comply with the submission instructions. Examples: If an offeror were to submit three pages in response to an item with a two-page limitation, the information on the first two pages would be evaluated but the information on the third page would not be evaluated. If an offeror were to submit a flood-out sheet (11x 17) in response to a one page limitation where fold-out sheets were not specifically authorized, only the information that could reasonably have been submitted on one 8 ½ x 11 inch sheet would have been evaluated. The maximum number of pages allowed for Volume 2, Tabs 2-7 shall not **exceed 10**. The offeror may distribute the use of pages in each Tab (2-7), but the total number of pages for all Tabs shall not **exceed 50**.

e. The degree of risk to the Government inherent in the offeror's technical proposal will be a consideration under every evaluation factor/sub factor.

The two types of risks evaluated as part of this source selection process are performance risk and proposal risk.

Performance risks are those associated with an offeror's likelihood of success in performing the solicitation's requirements as indicated by the offeror's record of past performance. Performance risk is assessed separately from the other technical merit evaluation factors under the Past Performance Evaluation Factor.

Proposal risks are those associated with the offeror's proposed approach in meeting the requirements of the solicitation. It is an assessment that is integral to the evaluation of technical merit for each factor, except for past performance, as indicated above.

8. SPECIFIC TECHNICAL EVALUATION CRITERIA

FACTOR 1: PAST PERFORMANCE (Volume 2, Tab #2)

The offeror shall provide information and identify references on (3) completed contracts similar in nature to this solicitation's work requirements. Specifically, knowledge and experience of Waste Water Treatment Plant (WWTP) Tertiary and recycled water distribution systems as effected by California State Title 22 requirements for unrestricted access use. The Government may contact selected references submitted by the offeror; the Government may also check past performance information obtained from sources other than those identified by the offeror, **including automated databases and questionnaires** In the case of an offeror without a record of recent, relevant past performance (and for which there is also no recent, relevant past performance information for its predecessor companies, key subcontractors, and key personnel), or for whom information on past performance is not available or cannot be verified, the offeror will **not** be evaluated favorably or unfavorably on past performance. All relevant facts and circumstances gathered from the offeror's listed references and other sources of the information available to the Government will be used to evaluate the offeror's overall past performance. Confidential customers/clients will not be accepted as references. At no time will the names of the individuals providing reference information on the offeror's past performance be revealed to the offeror or to any other party. The Government will evaluate past performance information to assess the risks associated with each offeror's likelihood of success in performing the requirements stated in the solicitation. The Government will focus on information that demonstrates quality of performance on recent, relevant, contracts. The result of the evaluation will be a performance risk rating based on each offeror's record of past performance.

To assist the Government in properly evaluating this Factor, the offeror shall address the following four (4) sub factors, using the above general criteria. All four sub factors are of equal importance.

Sub factor 1a. CONSTRUCTION EXPERIENCE: List all completed contracts, under each, the offeror shall indicate the firm's role in each contract, and the percentage of work for which the firm was responsible, whether the offeror was the prime, in a joint venture or subcontractor. All completed projects submitted shall contain the name and address of the customer; whether the customer was a federal, state or local government agency or private enterprise; name and current telephone numbers of persons in the customer's office who are familiar with the contract and the offeror's performance; two points of contact (1) one technical and (1) one contractual, including name, current phone and facsimile numbers for each; the contract number, if applicable, or other types of identification; contract award price; the final contract price; number and dollar amount of modifications initiated by the customer and the number and dollar amount of modifications initiated by the contractor; type of contract or subcontract (fixed-price, cost reimbursement or T&M); description of work (of the whole or the portion performed by the offeror if it was less than the entire contract); contract performance period with beginning and completion dates; and percentage of work that was subcontracted out be the offeror.

Sub factor 1b. QUALITY OF SERVICE OR PRODUCT AND PAST PERFORMANCE APPRAISALS. For the listed contracts, provide documentation that attests to the offeror's quality of performance. Include copies of formal past performance appraisals or letters from customers or contracting

agencies. The information should address both technical and administrative aspects of the contracts, when available. Information should also be provided on the performance of key personnel responsible for quality control and enforcement of health and safety standards. If the government elects to enter into discussions with those offerors whose technical
Proposals are determined to be in the competitive range, but who have negative or unsatisfactory past performance evaluations without being given an opportunity to rebut them, then the offeror will be requested to explain the circumstances of these evaluations. If this offeror has not yet had a chance to comment or rebut the negative or unsatisfactory past performance evaluations by others (which will be ascertained by the Government during reference checks), the information will be treated as unconfirmed. The Government will consider the number and severity of an offeror's problems on past contracts. Sheer numbers of confirmed negative comments may result in the offeror being given an overall rating of less than "Satisfactory." Negative comments in areas that are not of vital importance to the successful completion of this contract may not result in a rating of less than "Satisfactory." Conversely, one or only a few negative confirmed comments in areas of vital importance to successful performance of this contract may render an overall past performance risk rating of less than "Satisfactory."

Sub factor 1c. ABILITY TO SOLVE COMPLEX CONTRACT PROBLEMS.
For each listed contract, provide a narrative that addresses any unusual or challenging problems that occurred before, during or after construction. The offeror should identify the problems, the sequence of events that led to the problem and the corrective actions taken by the offeror to resolve the issues and move on with construction. The offeror should describe the risk taken to ensure the successful completion of the contracts and why the risks were taken in light of the potential failures that could occur. The offeror should describe the actions of other parties who were involved in problem resolution and how the offeror interacted with those parties and ensured that resolution would be achieved. The discussion should describe the roles of both field personnel and the home office of the offeror and the level of authority granted to the field to make decisions for resolving problems of monetary value and technical difficulty.

Sub factor 1d. SUBCONTRACT MANAGEMENT. Provide a narrative that describes how subcontracts were managed for the listed contracts. For each contract, list the name of the principle subcontractors whose contract value exceeded 5% of the offeror's contract or subcontract price and what principle item of work was performed. Describe the techniques used by the offeror to ensure that the subcontractor performed in accordance with the contract plans and specifications. Include topics such as: adherence to schedule; enforcement of health and safety standards; conformance to DOL Wage Determinations for federal work; steps taken to repair or replace non-conforming work; policies on withholding retainage; and policies on making payments to subcontractors to ensure conformance with the Prompt Payment Act. For any situation that involved the removal of a subcontractor for noncompliance with the contract terms, describe conditions leading to the removal and steps taken to replace the subcontractor promptly so as not to affect the contract completion of work or quality.

For this sub factor, the following will also be taken into consideration: the age and relevance of past performance information; the offeror's overall work record; and for an problems identified, the number, type and severity of the problems and the effectiveness of corrective actions taken on the part of the offeror.

FACTOR 2: MANAGEMENT APPROACH (Volume 2, Tab #3)

The offeror shall provide information and describe how the firm deals with personnel; develops, coordinates and implements subcontracts; and provides day-to-day supervision of projects. To assist the Government in evaluating this Factor, the offeror shall address the following two (2) sub factors: Both sub factors are of equal importance.

Sub factor 2a. STAFF RESUMES AND CHAIN OF COMMAND

Provide current resumes of management and technical staff, include their positions, authorities, and experience and their projected level of involvement with the work required in this solicitation. Include an organizational chart that demonstrates how the field technical and supervisory staff interacts with home office personnel and include a chain of command that would be used for resolving problems. If major

subcontractors will be used on a regular basis, provide resumes of key personnel and describe how they will interact with your firm in managing the work for which they will be responsible.

The offeror shall provide information and describe how the company deals with personnel; develops, coordinates and implements subcontracts; and provides day-to-day supervision of projects.

Sub factor 2b. PROJECT SITE SUPERVISION

Describe procedures and policies used to select and hire key personnel, such as superintendents and CQC system managers. Discuss how selection is made in light of the contract or task order requirements and how offeror ensures that the individual selected will meet these requirements (e.g., Section 01451, Contractor Quality Control). To augment the information provided in Sub factor 2a above, describe how much authority would be given to the superintendent to act in behalf of the company, including but not limited to, signing modifications to task orders, making decisions that affect cost or schedule, arranging for use of equipment, and ordering delivery of materials. For the CQC manager, describe this person's authorities and relationships to the home office or site manager, if another person. Discuss the latitude that the CQC manager has in performing his/her duties, such as directing the removal of nonconforming work (this could include rejecting asphalt or concrete loads), approving critical submittals and developing final and final punch lists for incomplete or noncompliant work.

FACTOR 3. CUSTOMER SATISFACTION (Volume 2, Tab #4)

Provide written support as to the level of satisfaction obtained from the offeror's customers for similar work performed. Provide letters of recommendation/appreciation or certificates of appreciation/recommendation from the offeror's customers or contracting agencies for contracts addressed in this Factor. For contracts that may not be addressed in Factors 1 and 2 (Past Performance & Management Approach), provide copies of final past performance appraisals, if available. Government personnel may contact the references listed in this section to obtain or verify the information. **The offeror shall address the following topics,** at a minimum:

KNOWLEDGE OF CUSTOMER REQUIREMENTS: Describe the offeror's relationships with customers, both government and commercial, in terms of obtaining a complete understanding of the customer's requirements and expectations. Discuss how this understanding is translated into ensuring that the project is completed to meet these requirements, including adherence to the specifications and maintenance of standards of good workmanship. Discuss your policy of improving company processes that result in product quality improvement for meeting customer expectations. Provide specific examples with discussion of company process improvements.

SCHEDULE ADHERENCE: Describe the offeror's management methodology and process to assure schedule adherence, timely contract data requirement delivery, responsiveness to contract changes, customer communications and requests, and contract completion (from both production and administrative perspectives). Describe data collection techniques for use in the identification of improvements in schedule adherence. Provide examples with discussion of instances where company has made process improvements.

REASONABLE AND COOPERATIVE BEHAVIOR: describe the offeror's mechanisms for handling customer complaints, coming to resolution and utilizing this information to develop and implement quality improvement. Describe the offeror's mechanisms for problem solving and cooperative resolution of unforeseeable impediments or obstacles (such as change in customer's requirements) to performance of work requirements after award of the task order. Describe policies used to assure that the offeror's task order change cost estimates are reasonable as submitted for negotiation. Provide examples identifying instance of successful problem resolution and reasonableness of pricing.

FACTOR 4. UNDERSTANDING OF REQUIREMENTS (Volume 2, Tab #5)

Demonstrate offeror's understanding of all technical and administrative aspects of the work required in this solicitation. A statement simply attesting to this understanding will receive a rating of "Unsatisfactory," for this Factor. Offeror shall respond to this Factor by preparing a narrative describing their understanding of the contract requirements, which shall address, at a minimum, the most significant work items in the Pricing Schedule, Section 00100; any administrative requirements found in Section 00800; and the Technical Specifications, including General Requirements. For Example, as part of the narrative , the offeror could address all preparatory and procedural requirements necessary to assure the successful layout of asphalt and/or concrete is in conformance with Section 02741; offerors should also ensure that they address the relevant aspects of airfield repairs as shown in the Pricing Schedule and Technical Specifications.

FACTOR 5. SCHEDULING (Volume 2, Tab #6)

Demonstrate the ability to schedule work based on a periodic or multiple issuance of Task Orders. Offerors shall respond to this Factor by preparing a narrative, bar chart or combination thereof that portrays all salient critical work elements that would affect the performance schedule in a task Order. The narrative should address the administrative (e.g., submittals, clearances, public notifications, etc., as well as the constructive aspects of the Task Order.

9. CONTRACT AWARD

a. Selection and Award Without Discussion. It is the intent of the Government to make award based on initial offers, without further discussion or additional information. Therefore, proposals should be submitted initially on the most favorable terms from a price and technical standpoint. If award is not made on initial offers, discussions will be conducted as described below.

b. Competitive Range. After initial evaluation of proposals and it is determined that discussions are to be conducted, the Contracting Officer will establish a competitive range comprised of the most highly rated proposals, unless the range is further reduced for purposes of efficiency (e.g., it may be determined that the number of most highly rated proposals that might otherwise be included in the competitive range exceeds the number at which an efficient competition can be conducted). Discussions may be held with firms in the competitive range.

c. Discussions. The Government may conduct written or oral (telephonic) discussions with all offerors in the competitive range. As a result of discussions, offerors may make revisions to their initial offers. If an offeror's proposal is eliminated or otherwise removed from the competitive range during discussions, no further revisions to that offeror's proposal will be accepted or considered. Discussions will result in a request for final proposal Revisions, the date and time of which will be common to all offerors.

d. Selection and Award. The Government intends to make award based on initial offers. If discussions are conducted, then after receipt of Final Proposal Revisions, the Government will evaluate supplemental information provided by the offerors. Selection will be made on the basis of the responsible offeror, whose proposal represents the "Best Value" to the Government using the trade-off process described in FAR Part 15.

Section 00600
Representations & Certifications

52.203-2 CERTIFICATE OF INDEPENDENT PRICE DETERMINATION (APR 1985) 2
52.203-11 CERTIFICATION AND DISCLOSURE REGARDING PAYMENTS TO INFLUENCE CERTAIN FEDERAL TRANSACTIONS (APR 1991) 2
52.204-3 TAXPAYER IDENTIFICATION (OCT 1998) 3
52.204-6 DATA UNIVERSAL NUMBERING SYSTEM (DUNS) NUMBER (JUN 99) 4
52.209-5 CERTIFICATION REGARDING DEBARMENT, SUSPENSION, PROPOSED DEBARMENT, AND OTHER RESPONSIBILITY MATTERS (DEC 2001)..... 5
52.219-1 SMALL BUSINESS PROGRAM REPRESENTATIONS (APR 2002) - ALTERNATE I (APR 2002)..... 6
52.219-2 EQUAL LOW BIDS. (OCT 1995)..... 8
52.219-19 SMALL BUSINESS CONCERN REPRESENTATION FOR THE SMALL BUSINESS COMPETITIVENESS DEMONSTRATION PROGRAM (OCT 2000) 9
52.222-21 PROHIBITION OF SEGREGATED FACILITIES (FEB 1999) 9
52.222-22 PREVIOUS CONTRACTS AND COMPLIANCE REPORTS (FEB 1999) 10
52.222-25 AFFIRMATIVE ACTION COMPLIANCE (APR 1984)..... 10
52.222-38 COMPLIANCE WITH VETERANS' EMPLOYMENT REPORTING REQUIREMENTS (DEC 2001) 10
52.223-13 CERTIFICATION OF TOXIC CHEMICAL RELEASE REPORTING (OCT 2000)..... 10
252.204-7001 COMMERCIAL AND GOVERNMENT ENTITY (CAGE) CODE REPORTING (AUG 1999)..... 11
252.204-7004 REQUIRED CENTRAL CONTRACTOR REGISTRATION (NOV 2001) 11
252.209-7001 DISCLOSURE OF OWNERSHIP OR CONTROL BY THE GOVERNMENT OF A TERRORIST COUNTRY (MAR 1998) 12
252.247-7022 REPRESENTATION OF EXTENT OF TRANSPORTATION BY SEA (AUG 1992)... 13

CLAUSES INCORPORATED BY FULL TEXT

52.203-2 CERTIFICATE OF INDEPENDENT PRICE DETERMINATION (APR 1985)

(a) The offeror certifies that --

(1) The prices in this offer have been arrived at independently, without, for the purpose of restricting competition, any consultation, communication, or agreement with any other offeror or competitor relating to –

(i) Those prices,

(ii) The intention to submit an offer, or

(iii) The methods of factors used to calculate the prices offered:

(2) The prices in this offer have not been and will not be knowingly disclosed by the offeror, directly or indirectly, to any other offeror or competitor before bid opening (in the case of a sealed bid solicitation) or contract award (in the case of a negotiated solicitation) unless otherwise required by law; and

(3) No attempt has been made or will be made by the offeror to induce any other concern to submit or not to submit an offer for the purpose of restricting competition.

(b) Each signature on the offer is considered to be a certification by the signatory that the signatory --

(1) Is the person in the offeror's organization responsible for determining the prices offered in this bid or proposal, and that the signatory has not participated and will not participate in any action contrary to subparagraphs (a)(1) through (a)(3) of this provision; or

(2) (i) Has been authorized, in writing, to act as agent for the following principals in certifying that those principals have not participated, and will not participate in any action contrary to subparagraphs (a)(1) through (a)(3) of this provison _____ (insert full name of person(s) in the offeror's organization responsible for determining the prices offered in this bid or proposal, and the title of his or her position in the offeror's organization);

(ii) As an authorized agent, does certify that the principals named in subdivision (b)(2)(i) above have not participated, and will not participate, in any action contrary to subparagraphs (a)(1) through (a)(3) above; and

(iii) As an agent, has not personally participated, and will not participate, in any action contrary to subparagraphs (a)(1) through (a)(3) of this provision.

(c) If the offeror deletes or modifies subparagraph (a)(2) of this provision, the offeror must furnish with its offer a signed statement setting forth in detail the circumstances of the disclosure.

(End of clause)

52.203-11 CERTIFICATION AND DISCLOSURE REGARDING PAYMENTS TO INFLUENCE CERTAIN FEDERAL TRANSACTIONS (APR 1991)

(a) The definitions and prohibitions contained in the clause, at FAR 52.203-12, Limitation on Payments to Influence Certain Federal Transactions, included in this solicitation, are hereby incorporated by reference in paragraph (b) of this Certification.

(b) The offeror, by signing its offer, hereby certifies to the best of his or her knowledge and belief that on or after December 23, 1989,--

(1) No Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress on his or her behalf in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment or modification of any Federal contract, grant, loan, or cooperative agreement;

(2) If any funds other than Federal appropriated funds (including profit or fee received under a covered Federal transaction) have been paid, or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress or an employee of a Member of Congress on his or her behalf in connection with this solicitation, the offeror shall complete and submit, with its offer, OMB standard form LLL, Disclosure of Lobbying Activities, to the Contracting Officer; and

(3) He or she will include the language of this certification in all subcontract awards at any tier and require that all recipients of subcontract awards in excess of $100,000 shall certify and disclose accordingly.

(c) Submission of this certification and disclosure is a prerequisite for making or entering into this contract imposed by section 1352, title 31, United States Code. Any person who makes an expenditure prohibited under this provision, shall be subject to a civil penalty of not less than $10,000, and not more than $100,000, for each such failure.

(End of provision)

52.204-3 TAXPAYER IDENTIFICATION (OCT 1998)

(a) Definitions.

“Common parent,” as used in this provision, means that corporate entity that owns or controls an affiliated group of corporations that files its Federal income tax returns on a consolidated basis, and of which the offeror is a member.

“Taxpayer Identification Number (TIN),” as used in this provision, means the number required by the Internal Revenue Service (IRS) to be used by the offeror in reporting income tax and other returns. The TIN may be either a Social Security Number or an Employer Identification Number.

(b) All offerors must submit the information required in paragraphs (d) through (f) of this provision to comply with debt collection requirements of 31 U.S.C. 7701(c) and 3325(d), reporting requirements of 26 U.S.C. 6041, 6041A, and 6050M, and implementing regulations issued by the IRS. If the resulting contract is subject to the payment reporting requirements described in Federal Acquisition Regulation (FAR) 4.904, the failure or refusal by the offeror to furnish the information may result in a 31 percent reduction of payments otherwise due under the contract.

(c) The TIN may be used by the Government to collect and report on any delinquent amounts arising out of the offeror's relationship with the Government (31 U.S.C. 7701(c)(3)). If the resulting contract is subject to the payment reporting requirements described in FAR 4.904, the TIN provided hereunder may be matched with IRS records to verify the accuracy of the offeror's TIN.

(d) Taxpayer Identification Number (TIN).

___ TIN:._____

___ TIN has been applied for.

___ TIN is not required because:

___ Offeror is a nonresident alien, foreign corporation, or foreign partnership that does not have income effectively connected with the conduct of a trade or business in the United States and does not have an office or place of business or a fiscal paying agent in the United States;

___ Offeror is an agency or instrumentality of a foreign government;

___ Offeror is an agency or instrumentality of the Federal Government.

(e) Type of organization.

___ Sole proprietorship;

___ Partnership;

___ Corporate entity (not tax-exempt);

___ Corporate entity (tax-exempt);

___ Government entity (Federal, State, or local);

___ Foreign government;

___ International organization per 26 CFR 1.6049-4;

___ Other _____

(f) Common parent.

___ Offeror is not owned or controlled by a common parent as defined in paragraph (a) of this provision.

___ Name and TIN of common parent:

Name _____

TIN _____

(End of provision)

52.204-6 DATA UNIVERSAL NUMBERING SYSTEM (DUNS) NUMBER (JUN 99)

(a) The offeror shall enter, in the block with its name and address on the cover page of its offer, the annotation "DUNS" followed by the DUNS number that identifies the offeror's name and address exactly as stated in the offer.

(b) If the offeror does not have a DUNS number, it should contact Dun and Bradstreet directly to obtain one. A DUNS number will be provided immediately by telephone at no charge to the offeror. For information on obtaining a DUNS number, the offeror, if located within the United States, should call Dun and Bradstreet at 1-800-333-0505. The offeror should be prepared to provide the following information:

(1) Company name.

(2) Company address.

(3) Company telephone number.

(4) Line of business.

(5) Chief executive officer/key manager.

(6) Date the company was started.

(7) Number of people employed by the company.

(8) Company affiliation.

(c) Offerors located outside the United States may obtain the location and phone number of the local Dun and Bradstreet Information Services office from the Internet Home Page at http://www.customerservice@dnb.com. If an offeror is unable to locate a local service center, it may send an e-mail to Dun and Bradstreet at globalinfo@mail.dnb.com.

(End of provision)

52.209-5 CERTIFICATION REGARDING DEBARMENT, SUSPENSION, PROPOSED DEBARMENT, AND OTHER RESPONSIBILITY MATTERS (DEC 2001)

(a)(1) The Offeror certifies, to the best of its knowledge and belief, that--

(i) The Offeror and/or any of its Principals--

(A) Are ( ) are not ( ) presently debarred, suspended, proposed for debarment, or declared ineligible for the award of contracts by any Federal agency;

(B) Have ( ) have not ( ), within a three-year period preceding this offer, been convicted of or had a civil judgment rendered against them for: commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, state, or local) contract or subcontract; violation of Federal or state antitrust statutes relating to the submission of offers; or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, tax evasion, or receiving stolen property; and

(C) Are ( ) are not ( ) presently indicted for, or otherwise criminally or civilly charged by a governmental entity with, commission of any of the offenses enumerated in subdivision (a)(1)(i)(B) of this provision.

(ii) The Offeror has ( ) has not ( ), within a three-year period preceding this offer, had one or more contracts terminated for default by any Federal agency.

(2) "Principals," for the purposes of this certification, means officers; directors; owners; partners; and, persons having primary management or supervisory responsibilities within a business entity (e.g., general manager; plant manager; head of a subsidiary, division, or business segment, and similar positions).

THIS CERTIFICATION CONCERNS A MATTER WITHIN THE JURISDICTION OF AN AGENCY OF THE UNITED STATES AND THE MAKING OF A FALSE, FICTITIOUS, OR FRAUDULENT CERTIFICATION MAY RENDER THE MAKER SUBJECT TO PROSECUTION UNDER SECTION 1001, TITLE 18, UNITED STATES CODE.

(b) The Offeror shall provide immediate written notice to the Contracting Officer if, at any time prior to contract award, the Offeror learns that its certification was erroneous when submitted or has become erroneous by reason of changed circumstances.

(c) A certification that any of the items in paragraph (a) of this provision exists will not necessarily result in withholding of an award under this solicitation. However, the certification will be considered in connection with a determination of the Offeror's responsibility. Failure of the Offeror to furnish a certification or provide such additional information as requested by the Contracting Officer may render the Offeror nonresponsible.

(d) Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render, in good faith, the certification required by paragraph (a) of this provision. The knowledge and information of an Offeror is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

(e) The certification in paragraph (a) of this provision is a material representation of fact upon which reliance was placed when making award. If it is later determined that the Offeror knowingly rendered an erroneous certification, in addition to other remedies available to the Government, the Contracting Officer may terminate the contract resulting from this solicitation for default.

(End of provision)

52.219-1 SMALL BUSINESS PROGRAM REPRESENTATIONS (APR 2002) - ALTERNATE I (APR 2002)

(a)(1) The North American Industry Classification System (NAICS) code for this acquisition is (237110).

(2) The small business size standard is $28,500,000.

(3) The small business size standard for a concern which submits an offer in its own name, other than on a construction or service contract, but which proposes to furnish a product which it did not itself manufacture, is 500 employees.

(b) Representations. (1) The offeror represents as part of its offer that it ( ) is, ( ) is not a small business concern.

(2) (Complete only if the offeror represented itself as a small business concern in paragraph (b)(1) of this provision.) The offeror represents, for general statistical purposes, that it ( ) is, ( ) is not a small disadvantaged business concern as defined in 13 CFR 124.1002.

(3) (Complete only if the offeror represented itself as a small business concern in paragraph (b)(1) of this provision.) The offeror represents as part of its offer that it ( ) is, ( ) is not a women-owned small business concern.

(4) (Complete only if the offeror represented itself as a small business concern in paragraph (b)(1) of this provision.) The offeror represents as part of its offer that it ( ) is, ( ) is not a veteran-owned small business concern.

(5) (Complete only if the offeror represented itself as a veteran-owned small business concern in paragraph (b)(4) of this provision.) The offeror represents as part of its offer that it ( ) is, ( ) is not a service-disabled veteran-owned small business concern.

(6) [Complete only if the offeror represented itself as a small business concern in paragraph (b)(1) of this provision.] The offeror represents, as part of its offer, that--

(i) It ( ) is, ( ) is not a HUBZone small business concern listed, on the date of this representation, on the List of Qualified HUBZone Small Business Concerns maintained by the Small Business Administration, and no material change in ownership and control, principal office, or HUBZone employee percentage has occurred since it was certified by the Small Business Administration in accordance with 13 CFR part 126; and

(ii) It ( ) is, ( ) is not a joint venture that complies with the requirements of 13 CFR part 126, and the representation in paragraph (b)(6)(i) of this provision is accurate for the HUBZone small business concern or concerns that are participating in the joint venture. (The offeror shall enter the name or names of the HUBZone small business concern or concerns that are participating in the joint venture:_____.) Each HUBZone small business concern participating in the joint venture shall submit a separate signed copy of the HUBZone representation.

(7) (Complete if offeror represented itself as disadvantaged in paragraph (b)(2) of this provision.) The offeror shall check the category in which its ownership falls:

____ Black American.

____ Hispanic American.

____ Native American (American Indians, Eskimos, Aleuts, or Native Hawaiians).

____ Asian-Pacific American (persons with origins from Burma, Thailand, Malaysia, Indonesia, Singapore, Brunei, Japan, China, Taiwan, Laos, Cambodia (Kampuchea), Vietnam, Korea, The Philippines, U.S. Trust Territory of the Pacific Islands (Republic of Palau), Republic of the Marshall Islands, Federated States of Micronesia, the Commonwealth of the Northern Mariana Islands, Guam, Samoa, Macao, Hong Kong, Fiji, Tonga, Kiribati, Tuvalu, or Nauru).

____ Subcontinent Asian (Asian-Indian) American (persons with origins from India, Pakistan, Bangladesh, Sri Lanka, Bhutan, the Maldives Islands, or Nepal).

____ Individual/concern, other than one of the preceding.

(c) Definitions. As used in this provision--

Service-disabled veteran-owned small business concern--

(1) Means a small business concern--

(i) Not less than 51 percent of which is owned by one or more service-disabled veterans or, in the case of any publicly owned business, not less than 51 percent of the stock of which is owned by one or more service-disabled veterans; and

(ii) The management and daily business operations of which are controlled by one or more service-disabled veterans or, in the case of a veteran with permanent and severe disability, the spouse or permanent caregiver of such veteran.

(2) Service-disabled veteran means a veteran, as defined in 38 U.S.C. 101(2), with a disability that is service-connected, as defined in 38 U.S.C. 101(16).

"Small business concern," means a concern, including its affiliates, that is independently owned and operated, not dominant in the field of operation in which it is bidding on Government contracts, and qualified as a small business under the criteria in 13 CFR Part 121 and the size standard in paragraph (a) of this provision.

Veteran-owned small business concern means a small business concern--

(1) Not less than 51 percent of which is owned by one or more veterans (as defined at 38 U.S.C. 101(2)) or, in the case of any publicly owned business, not less than 51 percent of the stock of which is owned by one or more veterans; and

(2) The management and daily business operations of which are controlled by one or more veterans.

"Women-owned small business concern," means a small business concern --

(1) That is at least 51 percent owned by one or more women or, in the case of any publicly owned business, at least 51 percent of the stock of which is owned by one or more women; or

(2) Whose management and daily business operations are controlled by one or more women.

(d) Notice.

(1) If this solicitation is for supplies and has been set aside, in whole or in part, for small business concerns, then the clause in this solicitation providing notice of the set-aside contains restrictions on the source of the end items to be furnished.

(2) Under 15 U.S.C. 645(d), any person who misrepresents a firm's status as a small, HUBZone small, small disadvantaged, or women-owned small business concern in order to obtain a contract to be awarded under the preference programs established pursuant to section 8(a), 8(d), 9, or 15 of the Small Business Act or any other provision of Federal law that specifically references section 8(d) for a definition of program eligibility, shall--

(i) Be punished by imposition of fine, imprisonment, or both;

(ii) Be subject to administrative remedies, including suspension and debarment; and

(iii) Be ineligible for participation in programs conducted under the authority of the Act.

(End of provision)

52.219-2 EQUAL LOW BIDS. (OCT 1995)

(a) This provision applies to small business concerns only.

(b) The bidder's status as a labor surplus area (LSA) concern may affect entitlement to award in case of tie bids. If the bidder wishes to be considered for this priority, the bidder must identify, in the following space, the LSA in which the costs to be incurred on account of manufacturing or production (by the bidder or the first-tier subcontractors) amount to more than 50 percent of the contract price.

_____

_

_____

_

(c) Failure to identify the labor surplus area as specified in paragraph (b) of this provision will preclude the bidder from receiving priority consideration. If the bidder is awarded a contract as a result of receiving priority consideration under this provision and would not have otherwise received award, the bidder shall perform the contract or cause the contract to be performed in accordance with the obligations of an LSA concern.

52.219-19 SMALL BUSINESS CONCERN REPRESENTATION FOR THE SMALL BUSINESS COMPETITIVENESS DEMONSTRATION PROGRAM (OCT 2000)

(a) Definition.

"Emerging small business" as used in this solicitation, means a small business concern whose size is no greater than 50 percent of the numerical size standard applicable to the North American Industry Classification System (NAICS) code assigned to a contracting opportunity.

(b) [Complete only if the Offeror has represented itself under the provision at 52.219-1 as a small business concern under the size standards of this solicitation.] The Offeror [ ] is, [ ] is not an emerging small business.

(c) (Complete only if the Offeror is a small business or an emerging small business, indicating its size range.)

Offeror's number of employees for the past 12 months (check this column if size standard stated in solicitation is expressed in terms of number of employees) or Offeror's average annual gross revenue for the last 3 fiscal years (check this column if size standard stated in solicitation is expressed in terms of annual receipts). (Check one of the following.)

No. of Employees	Avg. Annual Gross Revenues
____ 50 or fewer	____ $1 million or less
____ 51 - 100	____ $1,000,001 - $2 million
____ 101 - 250	____ $2,000,001 - $3.5 million
____ 251 - 500	____ $3,500,001 - $5 million
____ 501 - 750	____ $5,000,001 - $10 million
____ 751 - 1,000	____ $10,000,001 - $17 million
____ Over 1,000	____ Over $17 million

(End of provision)

52.222-21 PROHIBITION OF SEGREGATED FACILITIES (FEB 1999)

(a) Segregated facilities, as used in this clause, means any waiting rooms, work areas, rest rooms and wash rooms, restaurants and other eating areas, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees, that are segregated by explicit directive or are in fact segregated on the basis of race, color, religion, sex, or national origin because of written or oral policies or employee custom. The term does not include separate or single-user rest rooms or necessary dressing or sleeping areas provided to assure privacy between the sexes.

(b) The Contractor agrees that it does not and will not maintain or provide for its employees any segregated facilities at any of its establishments, and that it does not and will not permit its employees to perform their services at any location under its control where segregated facilities are maintained. The Contractor agrees that a breach of this clause is a violation of the Equal Opportunity clause in this contract.

(c) The Contractor shall include this clause in every subcontract and purchase order that is subject to the Equal Opportunity clause of this contract.

(End of clause)

52.222-22 PREVIOUS CONTRACTS AND COMPLIANCE REPORTS (FEB 1999)

The offeror represents that --

(a) ( ) It has, ( ) has not participated in a previous contract or subcontract subject to the Equal Opportunity clause of this solicitation;

(b) ( ) It has, ( ) has not, filed all required compliance reports; and

(c) Representations indicating submission of required compliance reports, signed by proposed subcontractors, will be obtained before subcontract awards.

(End of provision)

52.222-25 AFFIRMATIVE ACTION COMPLIANCE (APR 1984)

The offeror represents that

(a) [ ] it has developed and has on file, [ ] has not developed and does not have on file, at each establishment, affirmative action programs required by the rules and regulations of the Secretary of Labor (41 CFR 60-1 and 60-2), or

(b) [ ] has not previously had contracts subject to the written affirmative action programs requirement of the rules and regulations of the Secretary of Labor.

(End of provision)

52.222-38 COMPLIANCE WITH VETERANS' EMPLOYMENT REPORTING REQUIREMENTS (DEC 2001)

By submission of its offer, the offeror represents that, if it is subject to the reporting requirements of 38 U.S.C. 4212(d) (i.e., if it has any contract containing Federal Acquisition Regulation clause 52.222-37, Employment Reports on Special Disabled Veterans, Veterans of the Vietnam Era, and Other Eligible Veterans), it has submitted the most recent VETS-100 Report required by that clause.

(End of provision)

52.223-13 CERTIFICATION OF TOXIC CHEMICAL RELEASE REPORTING (OCT 2000)

(a) Submission of this certification is a prerequisite for making or entering into this contract imposed by Executive Order 12969, August 8, 1995.

(b) By signing this offer, the offeror certifies that--

(1) As the owner or operator of facilities that will be used in the performance of this contract that are subject to the filing and reporting requirements described in section 313 of the Emergency Planning and

Community Right-to-Know Act of 1986 (EPCRA) (42 U.S.C. 11023) and section 6607 of the Pollution Prevention Act of 1990 (PPA) (42 U.S.C. 13106), the offeror will file and continue to file for such facilities for the life of the contract the Toxic Chemical Release Inventory Form (Form R) as described in sections 313(a) and (g) of EPCRA and section 6607 of PPA; or

(2) None of its owned or operated facilities to be used in the performance of this contract is subject to the Form R filing and reporting requirements because each such facility is exempt for at least one of the following reasons: (Check each block that is applicable.)

( ) (i) The facility does not manufacture, process or otherwise use any toxic chemicals listed under section 313(c) of EPCRA, 42 U.S.C. 11023(c);

( ) (ii) The facility does not have 10 or more full-time employees as specified in section 313.(b)(1)(A) of EPCRA 42 U.S.C. 11023(b)(1)(A);

( ) (iii) The facility does not meet the reporting thresholds of toxic chemicals established under section 313(f) of EPCRA, 42 U.S.C. 11023(f) (including the alternate thresholds at 40 CFR 372.27, provided an appropriate certification form has been filed with EPA);

( ) (iv) The facility does not fall within Standard Industrial Classification Code (SIC) major groups 20 through 39 or their corresponding North American Industry Classification System (NAICS) sectors 31 through 33; or

( ) (v) The facility is not located within any State of the United States, the District of Columbia, the Commonwealth of Puerto Rico, Guam, American Samoa, the United States Virgin Islands, the Northern Mariana Islands, or any other territory or possession over which the United States has jurisdiction.

(End of clause)

252.204-7001 COMMERCIAL AND GOVERNMENT ENTITY (CAGE) CODE REPORTING (AUG 1999)

(a) The offeror is requested to enter its CAGE code on its offer in the block with its name and address. The CAGE code entered must be for that name and address. Enter “CAGE” before the number.

(b) If the offeror does not have a CAGE code, it may ask the Contracting Officer to request one from the Defense Logistics Information Service (DLIS). The Contracting Officer will--

(1) Ask the Contractor to complete section B of a DD Form 2051, Request for Assignment of a Commercial and Government Entity (CAGE) Code;

(2) Complete section A and forward the form to DLIS; and

(3) Notify the Contractor of its assigned CAGE code.

(c) Do not delay submission of the offer pending receipt of a CAGE code.

(End of provision)

252.204-7004 REQUIRED CENTRAL CONTRACTOR REGISTRATION (NOV 2001)

(a) Definitions.

As used in this clause--

(1) Central Contractor Registration (CCR) database means the primary DoD repository for contractor information required for the conduct of business with DoD.

(2) Data Universal Numbering System (DUNS) number means the 9-digit number assigned by Dun and Bradstreet Information Services to identify unique business entities.

(3) Data Universal Numbering System +4 (DUNS+4) number means the DUNS number assigned by Dun and Bradstreet plus a 4-digit suffix that may be assigned by a parent (controlling) business concern. This 4-digit suffix may be assigned at the discretion of the parent business concern for such purposes as identifying subunits or affiliates of the parent business concern.

(4) Registered in the CCR database means that all mandatory information, including the DUNS number or the DUNS+4 number, if applicable, and the corresponding Commercial and Government Entity (CAGE) code, is in the CCR database; the DUNS number and the CAGE code have been validated; and all edits have been successfully completed.

(b)(1) By submission of an offer, the offeror acknowledges the requirement that a prospective awardee must be registered in the CCR database prior to award, during performance, and through final payment of any contract resulting from this solicitation, except for awards to foreign vendors for work to be performed outside the United States.

(2) The offeror shall provide its DUNS or, if applicable, its DUNS+4 number with its offer, which will be used by the Contracting Officer to verify that the offeror is registered in the CCR database.

(3) Lack of registration in the CCR database will make an offeror ineligible for award.

(4) DoD has established a goal of registering an applicant in the CCR database within 48 hours after receipt of a complete and accurate application via the Internet. However, registration of an applicant submitting an application through a method other than the Internet may take up to 30 days. Therefore, offerors that are not registered should consider applying for registration immediately upon receipt of this solicitation.

(c) The Contractor is responsible for the accuracy and completeness of the data within the CCR, and for any liability resulting from the Government's reliance on inaccurate or incomplete data. To remain registered in the CCR database after the initial registration, the Contractor is required to confirm on an annual basis that its information in the CCR database is accurate and complete.

(d) Offerors and contractors may obtain information on registration and annual confirmation requirements by calling 1-888-227-2423, or via the Internet at http://www.ccr.gov.

(End of clause)

252.209-7001 DISCLOSURE OF OWNERSHIP OR CONTROL BY THE GOVERNMENT OF A TERRORIST COUNTRY (MAR 1998)

(a) "Definitions."

As used in this provision --

(a) "Government of a terrorist country" includes the state and the government of a terrorist country, as well as any political subdivision, agency, or instrumentality thereof.

(2) "Terrorist country" means a country determined by the Secretary of State, under section 6(j)(1)(A) of the Export Administration Act of 1979 (50 U.S.C. App. 2405(j)(i)(A)), to be a country the government of

which has repeatedly provided support for such acts of international terrorism. As of the date of this provision, terrorist countries include: Cuba, Iran, Iraq, Libya, North Korea, Sudan, and Syria.

(3) "Significant interest" means --

(i) Ownership of or beneficial interest in 5 percent or more of the firm's or subsidiary's securities. Beneficial interest includes holding 5 percent or more of any class of the firm's securities in "nominee shares," "street names," or some other method of holding securities that does not disclose the beneficial owner;

(ii) Holding a management position in the firm, such as a director or officer;

(iii) Ability to control or influence the election, appointment, or tenure of directors or officers in the firm;

(iv) Ownership of 10 percent or more of the assets of a firm such as equipment, buildings, real estate, or other tangible assets of the firm; or

(v) Holding 50 percent or more of the indebtness of a firm.

(b) "Prohibition on award."

In accordance with 10 U.S.C. 2327, no contract may be awarded to a firm or a subsidiary of a firm if the government of a terrorist country has a significant interest in the firm or subsidiary or, in the case of a subsidiary, the firm that owns the subsidiary, unless a waiver is granted by the Secretary of Defense.

(c) "Disclosure."

If the government of a terrorist country has a significant interest in the Offeror or a subsidiary of the Offeror, the Offeror shall disclosure such interest in an attachment to its offer. If the Offeror is a subsidiary, it shall also disclose any significant interest the government of a terrorist country has in any firm that owns or controls the subsidiary. The disclosure shall include --

(1) Identification of each government holding a significant interest; and

(2) A description of the significant interest held by each government.

(End of provision)

252.247-7022 REPRESENTATION OF EXTENT OF TRANSPORTATION BY SEA (AUG 1992)

(a) The Offeror shall indicate by checking the appropriate blank in paragraph (b) of this provision whether transportation of supplies by sea is anticipated under the resultant contract. The term supplies is defined in the Transportation of Supplies by Sea clause of this solicitation.

(b) Representation. The Offeror represents that it:

____ (1) Does anticipate that supplies will be transported by sea in the performance of any contract or subcontract resulting from this solicitation.

____ (2) Does not anticipate that supplies will be transported by sea in the performance of any contract or subcontract resulting from this solicitation.

(c) Any contract resulting from this solicitation will include the Transportation of Supplies by Sea clause. If the Offeror represents that it will not use ocean transportation, the resulting contract will also include the Defense FAR Supplement clause at 252.247-7024, Notification of Transportation of Supplies by Sea.

(End of provision)

Section 00700
Contract Clauses

52.202-1 DEFINITIONS (MAY 2001) --ALTERNATE I (MAR 2001) 4
52.203-3 GRATUITIES (APR 1984) 4
52.203-5 COVENANT AGAINST CONTINGENT FEES (APR 1984) 5
52.203-6 RESTRICTIONS ON SUBCONTRACTOR SALES TO THE GOVERNMENT (JUL 1995) .. 5
52.203-7 ANTI-KICKBACK PROCEDURES. (JUL 1995) 6
52.203-8 CANCELLATION, RESCISSION, AND RECOVERY OF FUNDS FOR ILLEGAL OR IMPROPER ACTIVITY (JAN 1997) 7
52.203-10 PRICE OR FEE ADJUSTMENT FOR ILLEGAL OR IMPROPER ACTIVITY (JAN 1997) 7
52.203-12 LIMITATION ON PAYMENTS TO INFLUENCE CERTAIN FEDERAL TRANSACTIONS (JUN 1997) 8
52.204-4 PRINTED OR COPIED DOUBLE-SIDED ON RECYCLED PAPER (AUG 2000) 12
52.209-6 Protecting the Government's Interest When Subcontracting With Contractors Debarred, Suspended, or Proposed for Debarment (JUL 1995) 13
52.211-6 BRAND NAME OR EQUAL (AUG 1999) 14
52.215-2 AUDIT AND RECORDS--NEGOTIATION (JUN 1999) 14
52.215-11 PRICE REDUCTION FOR DEFECTIVE COST OR PRICING DATA--MODIFICATIONS (OCT 1997) 16
52.215-13 SUBCONTRACTOR COST OR PRICING DATA--MODIFICATIONS (OCT 1997) 17
52.219-8 UTILIZATION OF SMALL BUSINESS CONCERNS (OCT 2000) 17
52.219-14 LIMITATIONS ON SUBCONTRACTING (DEC 1996) 19
52.222-3 Convict Labor (Aug 1996) 19
52.222-4 Contract Work Hours and Safety Standards Act - Overtime Compensation. (SEP 2000) 20
52.222-6 DAVIS-BACON ACT (FEB 1995) 21
52.222-7 WITHHOLDING OF FUNDS (FEB 1988) 22
52.222-8 PAYROLLS AND BASIC RECORDS (FEB 1988) 22
52.222-9 APPRENTICES AND TRAINEES (FEB 1988) 23
52.222-10 COMPLIANCE WITH COPELAND ACT REQUIREMENTS (FEB 1988) 24
52.222-11 SUBCONTRACTS (LABOR STANDARDS (FEB 1988) 25
52.222-12 CONTRACT TERMINATION--DEBARMENT (FEB 1988) 25
52.222-13 COMPLIANCE WITH DAVIS-BACON AND RELATED ACT REGULATIONS (FEB 1988) 25
52.222-14 DISPUTES CONCERNING LABOR STANDARDS (FEB 1988) 25
52.222-15 CERTIFICATION OF ELIGIBILITY (FEB 1988) 25
52.222-26 EQUAL OPPORTUNITY (APR 2002) 26
52.222-27 AFFIRMATIVE ACTION COMPLIANCE REQUIREMENTS FOR CONSTRUCTION (FEB 1999) 27
52.222-35 AFFIRMATIVE ACTION FOR DISABLED VETERANS AND VETERANS OF THE VIETNAM ERA (APR 1998) 31
52.222-36 AFFIRMATIVE ACTION FOR WORKERS WITH DISABILITIES (JUN 1998) 33
52.222-37 EMPLOYMENT REPORTS ON DISABLED VETERANS AND VETERANS OF THE VIETNAM ERA (JAN 1999) 34
52.223-3 HAZARDOUS MATERIAL IDENTIFICATION AND MATERIAL SAFETY DATA (JAN 1997) 35
52.223-5 POLLUTION PREVENTION AND RIGHT-TO-KNOW INFORMATION (APR 1998) 36
52.223-6 DRUG-FREE WORKPLACE (MAY 2001) 36
52.223-7 NOTICE OF RADIOACTIVE MATERIALS (JAN 1997) 38
52.223-10 WASTE REDUCTION PROGRAM (AUG 2000) 39
52.223-14 TOXIC CHEMICAL RELEASE REPORTING (OCT 2000) 39
52.225-11 BUY AMERICAN ACT--CONSTRUCTION MATERIALS UNDER TRADE AGREEMENTS (JUL 2002) 40
52.225-13 RESTRICTIONS ON CERTAIN FOREIGN PURCHASES (JUL 2000) 43
52.227-1 AUTHORIZATION AND CONSENT (JUL 1995) 43

52.227-2 NOTICE AND ASSISTANCE REGARDING PATENT AND COPYRIGHT INFRINGEMENT (AUG 1996) 44
52.227-4 PATENT INDEMNITY--CONSTRUCTION CONTRACTS (APR 1984) 44
52.228-2 ADDITIONAL BOND SECURITY (OCT 1997) 44
52.228-5 INSURANCE--WORK ON A GOVERNMENT INSTALLATION (JAN 1997) 45
52.228-11 PLEDGES OF ASSETS (FEB 1992) 45
52.229-3 FEDERAL, STATE, AND LOCAL TAXES (JAN 1991) 46
52.232-5 PAYMENTS UNDER FIXED-PRICE CONSTRUCTION CONTRACTS (MAY 1997) 46
52.232-8 DISCOUNTS FOR PROMPT PAYMENT (FEB 2002) 49
52.232-9 LIMITATION ON WITHHOLDING OF PAYMENTS (APR 1984) 49
52.232-17 INTEREST (JUNE 1996) 50
52.232-23 ASSIGNMENT OF CLAIMS (JAN 1986) 50
52.232-25 PROMPT PAYMENT (FEB 2002) 50
52.232-27 PROMPT PAYMENT FOR CONSTRUCTION CONTRACTS (FEB 2002) 54
52.232-33 PAYMENT BY ELECTRONIC FUNDS TRANSFER—CENTRAL CONTRACTOR REGISTRATION (MAY 1999) 60
52.233-1 Disputes. (JUL 2002) 61
52.233-2 SERVICE OF PROTEST (AUG 1996) 63
52.233-3 PROTEST AFTER AWARD (AUG. 1996) 63
52.236-2 DIFFERING SITE CONDITIONS (APR 1984) 64
52.236-3 SITE INVESTIGATION AND CONDITIONS AFFECTING THE WORK (APR 1984) 65
52.236-5 MATERIAL AND WORKMANSHIP (APR 1984) 65
52.236-6 SUPERINTENDENCE BY THE CONTRACTOR (APR 1984) 66
52.236-7 PERMITS AND RESPONSIBILITIES (NOV 1991) 66
52.236-8 OTHER CONTRACTS (APR 1984) 66
52.236-9 PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS (APR 1984) 66
52.236-10 OPERATIONS AND STORAGE AREAS (APR 1984) 67
52.236-11 USE AND POSSESSION PRIOR TO COMPLETION (APR 1984) 67
52.236-12 CLEANING UP (APR 1984) 67
52.236-13 ACCIDENT PREVENTION (NOV 1991) – ALTERNATE I (NOV 1991) 68
52.236-14 AVAILABILITY AND USE OF UTILITY SERVICES (APR 1984) 69
52.236-15 SCHEDULES FOR CONSTRUCTION CONTRACTS (APR 1984) 69
52.236-17 LAYOUT OF WORK (APR 1984) 69
52.236-26 PRECONSTRUCTION CONFERENCE (FEB 1995) 70
52.242-3 Penalties for Unallowable Costs. (MAY 2001) 70
52.242-13 BANKRUPTCY (JUL 1995) 71
52.242-14 SUSPENSION OF WORK (APR 1984) 71
52.243-4 CHANGES (AUG 1987) 72
52.245-2 GOVERNMENT PROPERTY (FIXED-PRICE CONTRACTS) (DEC 1989) 72
52.246-12 INSPECTION OF CONSTRUCTION (AUG 1996) 75
52.246-21 WARRANTY OF CONSTRUCTION (MAR 1994) 76
52.248-3 VALUE ENGINEERING--CONSTRUCTION (FEB 2000) - ALTERNATE I (APR 1984) 77
52.249-2 TERMINATION FOR CONVENIENCE OF THE GOVERNMENT (FIXED-PRICE) (SEP 1996) - ALTERNATE I (SEP 1996) 80
52.249-10 DEFAULT (FIXED-PRICE CONSTRUCTION) (APR 1984) 83
52.252-4 ALTERATIONS IN CONTRACT (APR 1984) 84
52.253-1 COMPUTER GENERATED FORMS (JAN 1991) 84
252.201-7000 CONTRACTING OFFICER'S REPRESENTATIVE (DEC 1991) 84
252.203-7001 PROHIBITION ON PERSONS CONVICTED OF FRAUD OR OTHER DEFENSE-CONTRACT-RELATED FELONIES (MAR 1999) 84
252.203-7002 DISPLAY OF DOD HOTLINE POSTER (DEC 1991) 86
252.204-7000 DISCLOSURE OF INFORMATION (DEC 1991) 86
252.204-7003 CONTROL OF GOVERNMENT PERSONNEL WORK PRODUCT (APR 1992) 86
252.205-7000 PROVISION OF INFORMATION TO COOPERATIVE AGREEMENT HOLDERS (DEC 1991) 87

252.209-7000 ACQUISITION FROM SUBCONTRACTORS SUBJECT TO ONSITE INSPECTION UNDER THE INTERMEDIATE-RANGE NUCLEAR FORCES (INF) TREATY (NOV 1995) 87
252.219-7003 SMALL, SMALL DISADVANTAGED AND WOMEN-OWNED SMALL BUSINESS SUBCONTRACTING PLAN (DOD CONTRACTS) (APR. 1996) 87
252.219-7009 SECTION 8(A) DIRECT AWARD (MAR 2002) 88
252.223-7004 DRUG-FREE WORK FORCE (SEP 1988) 89
252.223-7006 PROHIBITION ON STORAGE AND DISPOSAL OF TOXIC AND HAZARDOUS MATERIALS (APR 1993) 90
252.225-7012 Preference for Certain Domestic Commodities (APR 2002) 90
252.225-7031 SECONDARY ARAB BOYCOTT OF ISRAEL (JUN 1992) 92
252.227-7000 Non-estoppel. (OCT 1966) 92
252.227-7022 GOVERNMENT RIGHTS (UNLIMITED) (MAR 1979) 92
252.227-7023 DRAWINGS AND OTHER DATA TO BECOME PROPERTY OF GOVERNMENT. (MAR 1979) 93
252.227-7033 RIGHTS IN SHOP DRAWINGS (APR 1966) 93
252.231-7000 SUPPLEMENTAL COST PRINCIPLES (DEC 1991) 93
252.236-7000 MODIFICATION PROPOSALS - PRICE BREAKDOWN. (DEC 1991) 93
252.242-7000 POSTAWARD CONFERENCE (DEC 1991) 94
252.243-7001 PRICING OF CONTRACT MODIFICATIONS (DEC 1991) 94
252.243-7002 REQUESTS FOR EQUITABLE ADJUSTMENT (MAR 1998) 94
252.247-7024 Notification of Transportation of Supplies by Sea (MAR 2000) 95

CLAUSES INCORPORATED BY FULL TEXT

52.202-1 DEFINITIONS (MAY 2001) --ALTERNATE I (MAR 2001)

(a) Agency head or head of the agency means the Secretary (Attorney General, Administrator, Governor, Chairperson, or other chief official, as appropriate) of the agency, unless otherwise indicated, including any deputy or assistant chief official of the executive agency.

(b) Commercial component means any component that is a commercial item.

(c) Component means any item supplied to the Government as part of an end item or of another component, except that for use in 52.225-9, and 52.225-11 see the definitions in 52.225-9(a) and 52.225-11(a).

(d) Contracting Officer means a person with the authority to enter into, administer, and/or terminate contracts and make related determinations and findings. The term includes certain authorized representatives of the Contracting Officer acting within the limits of their authority as delegated by the Contracting Officer.

(e) Nondevelopmental item means--

(1) Any previously developed item of supply used exclusively for governmental purposes by a Federal agency, a State or local government, or a foreign government with which the United States has a mutual defense cooperation agreement;

(2) Any item described in paragraph (f)(1) of this definition that requires only minor modification or modifications of a type customarily available in the commercial marketplace in order to meet the requirements of the procuring department or agency; or

(3) Any item of supply being produced that does not meet the requirements of paragraph (f)(1) or (f)(2) solely because the item is not yet in use.

(f) "Contracting Officer" means a person with the authority to enter into, administer, and/or terminate contracts and make related determinations and findings. The term includes certain authorized representatives of the Contracting Officer acting within the limits of their authority as delegated by the Contracting Officer.

(g) Except as otherwise provided in this contract, the term "subcontracts" includes, but is not limited to, purchase orders and changes and modifications to purchase orders under this contract.

(End of clause)

52.203-3 GRATUITIES (APR 1984)

(a) The right of the Contractor to proceed may be terminated by written notice if, after notice and hearing, the agency head or a designee determines that the Contractor, its agent, or another representative--

(1) Offered or gave a gratuity (e.g., an entertainment or gift) to an officer, official, or employee of the Government; and

(2) Intended, by the gratuity, to obtain a contract or favorable treatment under a contract.

(b) The facts supporting this determination may be reviewed by any court having lawful jurisdiction.

(c) If this contract is terminated under paragraph (a) of this clause, the Government is entitled--

(1) To pursue the same remedies as in a breach of the contract; and

(2) In addition to any other damages provided by law, to exemplary damages of not less than 3 nor more than 10 times the cost incurred by the Contractor in giving gratuities to the person concerned, as determined by the agency head or a designee. (This subparagraph (c)(2) is applicable only if this contract uses money appropriated to the Department of Defense.)

(d) The rights and remedies of the Government provided in this clause shall not be exclusive and are in addition to any other rights and remedies provided by law or under this contract.

(End of clause)

52.203-5 COVENANT AGAINST CONTINGENT FEES (APR 1984)

(a) The Contractor warrants that no person or agency has been employed or retained to solicit or obtain this contract upon an agreement or understanding for a contingent fee, except a bona fide employee or agency. For breach or violation of this warranty, the Government shall have the right to annul this contract without liability or, in its discretion, to deduct from the contract price or consideration, or otherwise recover, the full amount of the contingent fee.

(b) "Bona fide agency," as used in this clause, means an established commercial or selling agency, maintained by a contractor for the purpose of securing business, that neither exerts nor proposes to exert improper influence to solicit or obtain Government contracts nor holds itself out as being able to obtain any Government contract or contracts through improper influence.

"Bona fide employee," as used in this clause, means a person, employed by a contractor and subject to the contractor's supervision and control as to time, place, and manner of performance, who neither exerts nor proposes to exert improper influence to solicit or obtain Government contracts nor holds out as being able to obtain any Government contract or contracts through improper influence.

"Contingent fee," as used in this clause, means any commission, percentage, brokerage, or other fee that is contingent upon the success that a person or concern has in securing a Government contract.

"Improper influence," as used in this clause, means any influence that induces or tends to induce a Government employee or officer to give consideration or to act regarding a Government contract on any basis other than the merits of the matter.

(End of clause)

52.203-6 RESTRICTIONS ON SUBCONTRACTOR SALES TO THE GOVERNMENT (JUL 1995)

(a) Except as provided in (b) of this clause, the Contractor shall not enter into any agreement with an actual or prospective subcontractor, nor otherwise act in any manner, which has or may have the effect of restricting sales by such subcontractors directly to the Government of any item or process (including computer software) made or furnished by the subcontractor under this contract or under any follow-on production contract.

(b) The prohibition in (a) of this clause does not preclude the Contractor from asserting rights that are otherwise authorized by law or regulation.

(c) The Contractor agrees to incorporate the substance of this clause, including this paragraph (c), in all subcontracts under this contract which exceed $100,000.

52.203-7 ANTI-KICKBACK PROCEDURES. (JUL 1995)

(a) Definitions.

"Kickback," as used in this clause, means any money, fee, commission, credit, gift, gratuity, thing of value, or compensation of any kind which is provided, directly or indirectly, to any prime Contractor, prime Contractor employee, subcontractor, or subcontractor employee for the purpose of improperly obtaining or rewarding favorable treatment in connection with a prime contract or in connection with a subcontract relating to a prime contract.

"Person," as used in this clause, means a corporation, partnership, business association of any kind, trust, joint-stock company, or individual.

"Prime contract," as used in this clause, means a contract or contractual action entered into by the United States for the purpose of obtaining supplies, materials, equipment, or services of any kind.

"Prime Contractor," as used in this clause, means a person who has entered into a prime contract with the United States.

"Prime Contractor employee," as used in this clause, means any officer, partner, employee, or agent of a prime Contractor.

"Subcontract," as used in this clause, means a contract or contractual action entered into by a prime Contractor or subcontractor for the purpose of obtaining supplies, materials, equipment, or services of any kind under a prime contract.

"Subcontractor," as used in this clause, (1) means any person, other than the prime Contractor, who offers to furnish or furnishes any supplies, materials, equipment, or services of any kind under a prime contract or a subcontract entered into in connection with such prime contract, and (2) includes any person who offers to furnish or furnishes general supplies to the prime Contractor or a higher tier subcontractor.

"Subcontractor employee," as used in this clause, means any officer, partner, employee, or agent of a subcontractor.

(b) The Anti-Kickback Act of 1986 (41 U.S.C. 51-58) (the Act), prohibits any person from -

(1) Providing or attempting to provide or offering to provide any kickback;

(2) Soliciting, accepting, or attempting to accept any kickback; or

(3) Including, directly or indirectly, the amount of any kickback in the contract price charged by a prime Contractor to the United States or in the contract price charged by a subcontractor to a prime Contractor or higher tier subcontractor.

(c)(1) The Contractor shall have in place and follow reasonable procedures designed to prevent and detect possible violations described in paragraph (b) of this clause in its own operations and direct business relationships.

(2) When the Contractor has reasonable grounds to believe that a violation described in paragraph (b) of this clause may have occurred, the Contractor shall promptly report in writing the possible violation. Such reports shall be made to the inspector general of the contracting agency, the head of the contracting agency if the agency does not have an inspector general, or the Department of Justice.

(3) The Contractor shall cooperate fully with any Federal agency investigating a possible violation

described in paragraph (b) of this clause.

(4) The Contracting Officer may (i) offset the amount of the kickback against any monies owed by the United States under the prime contract and/or (ii) direct that the Prime Contractor withhold, from sums owed a subcontractor under the prime contract, the amount of any kickback. The Contracting Officer may order the monies withheld under subdivision (c)(4)(ii) of this clause be paid over to the Government unless the Government has already offset those monies under subdivision (c)(4)(i) of this clause. In either case, the Prime Contractor shall notify the Contracting Officer when the monies are withheld.

(5) The Contractor agrees to incorporate the substance of this clause, including this subparagraph (c)(5) but excepting subparagraph (c)(1), in all subcontracts under this contract which exceed $100,000.

52.203-8 CANCELLATION, RESCISSION, AND RECOVERY OF FUNDS FOR ILLEGAL OR IMPROPER ACTIVITY (JAN 1997)

(a) If the Government receives information that a contractor or a person has engaged in conduct constituting a violation of subsection (a), (b), (c), or (d) of Section 27 of the Office of Federal Procurement Policy Act (41 U.S.C. 423) (the Act), as amended by section 4304 of the 1996 National Defense Authorization Act for Fiscal Year 1996 (Pub. L. 104-106), the Government may--

(1) Cancel the solicitation, if the contract has not yet been awarded or issued; or

(2) Rescind the contract with respect to which--

(i) The Contractor or someone acting for the Contractor has been convicted for an offense where the conduct constitutes a violation of subsection 27(a) or (b) of the Act for the purpose of either--

(A) Exchanging the information covered by such subsections for anything of value; or

(B) Obtaining or giving anyone a competitive advantage in the award of a Federal agency procurement contract; or

(ii) The head of the contracting activity has determined, based upon a preponderance of the evidence, that the Contractor or someone acting for the Contractor has engaged in conduct constituting an offense punishable under subsections 27(e)(1) of the Act.

(b) If the Government rescinds the contract under paragraph (a) of this clause, the Government is entitled to recover, in addition to any penalty prescribed by law, the amount expended under the contract.

(c) The rights and remedies of the Government specified herein are not exclusive, and are in addition to any other rights and remedies provided by law, regulation, or under this contract.

(End of clause)

52.203-10 PRICE OR FEE ADJUSTMENT FOR ILLEGAL OR IMPROPER ACTIVITY (JAN 1997)

(a) The Government, at its election, may reduce the price of a fixed-price type contract and the total cost and fee under a cost-type contract by the amount of profit or fee determined as set forth in paragraph (b) of this clause if the head of the contracting activity or designee determines that there was a violation of subsection 27 (a), (b), or (c) of the Office of Federal Procurement Policy Act, as amended (41 U.S.C. 423), as implemented in section 3.104 of the Federal Acquisition Regulation.

(b) The price or fee reduction referred to in paragraph (a) of this clause shall be--

(1) For cost-plus-fixed-fee contracts, the amount of the fee specified in the contract at the time of award;

(2) For cost-plus-incentive-fee contracts, the target fee specified in the contract at the time of award, notwithstanding any minimum fee or "fee floor" specified in the contract;

(3) For cost-plus-award-fee contracts--

(i) The base fee established in the contract at the time of contract award;

(ii) If no base fee is specified in the contract, 30 percent of the amount of each award fee otherwise payable to the Contractor for each award fee evaluation period or at each award fee determination point.

(4) For fixed-price-incentive contracts, the Government may--

(i) Reduce the contract target price and contract target profit both by an amount equal to the initial target profit specified in the contract at the time of contract award; or

(ii) If an immediate adjustment to the contract target price and contract target profit would have a significant adverse impact on the incentive price revision relationship under the contract, or adversely affect the contract financing provisions, the Contracting Officer may defer such adjustment until establishment of the total final price of the contract. The total final price established in accordance with the incentive price revision provisions of the contract shall be reduced by an amount equal to the initial target profit specified in the contract at the time of contract award and such reduced price shall be the total final contract price.

(5) For firm-fixed-price contracts, by 10 percent of the initial contract price or a profit amount determined by the Contracting Officer from records or documents in existence prior to the date of the contract award.

(c) The Government may, at its election, reduce a prime contractor's price or fee in accordance with the procedures of paragraph (b) of this clause for violations of the Act by its subcontractors by an amount not to exceed the amount of profit or fee reflected in the subcontract at the time the subcontract was first definitively priced.

(d) In addition to the remedies in paragraphs (a) and (c) of this clause, the Government may terminate this contract for default. The rights and remedies of the Government specified herein are not exclusive, and are in addition to any other rights and remedies provided by law or under this contract.

(End of clause)

52.203-12 LIMITATION ON PAYMENTS TO INFLUENCE CERTAIN FEDERAL TRANSACTIONS (JUN 1997)

(a) Definitions.

"Agency," as used in this clause, means executive agency as defined in 2.101.

"Covered Federal action," as used in this clause, means any of the following Federal actions:

(1) The awarding of any Federal contract.

(2) The making of any Federal grant.

(3) The making of any Federal loan.

(4) The entering into of any cooperative agreement.

(5) The extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

"Indian tribe" and "tribal organization," as used in this clause, have the meaning provided in section 4 of the Indian Self-Determination and Education Assistance Act (25 U.S.C. 450B) and include Alaskan Natives.

"Influencing or attempting to influence," as used in this clause, means making, with the intent to influence, any communication to or appearance before an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with any covered Federal action.

"Local government," as used in this clause, means a unit of government in a State and, if chartered, established, or otherwise recognized by a State for the performance of a governmental duty, including a local public authority, a special district, an intrastate district, a council of governments, a sponsor group representative organization, and any other instrumentality of a local government.

"Officer or employee of an agency," as used in this clause, includes the following individuals who are employed by an agency:

(1) An individual who is appointed to a position in the Government under Title 5, United States Code, including a position under a temporary appointment.

(2) A member of the uniformed services, as defined in subsection 101(3),Title 37, United States Code.

(3) A special Government employee, as defined in section 202, Title 18, United States Code.

(4) An individual who is a member of a Federal advisory committee, as defined by the Federal Advisory Committee Act, Title 5, United States Code, appendix 2.

"Person," as used in this clause, means an individual, corporation, company, association, authority, firm, partnership, society, State, and local government, regardless of whether such entity is operated for profit, or not for profit. This term excludes an Indian tribe, tribal organization, or any other Indian organization with respect to expenditures specifically permitted by other Federal law.

"Reasonable compensation," as used in this clause, means, with respect to a regularly employed officer or employee of any person, compensation that is consistent with the normal compensation for such officer or employee for work that is not furnished to, not funded by, or not furnished in cooperation with the Federal Government.

"Reasonable payment," as used in this clause, means, with respect to professional and other technical services, a payment in an amount that is consistent with the amount normally paid for such services in the private sector.

"Recipient," as used in this clause, includes the Contractor and all subcontractors. This term excludes an Indian tribe, tribal organization, or any other Indian organization with respect to expenditures specifically permitted by other Federal law.

"Regularly employed," as used in this clause, means, with respect to an officer or employee of a person requesting or receiving a Federal contract, an officer or employee who is employed by such person for at least 130 working days within 1 year immediately preceding the date of the submission that initiates agency consideration of such person for receipt of such contract. An officer or employee who is employed by such person for less than 130 working days within 1 year immediately preceding the date of the submission that initiates agency consideration of such person shall be considered to be regularly employed as soon as he or she is employed by such person for 130 working days.

"State," as used in this clause, means a State of the United States, the District of Columbia, the Commonwealth of Puerto Rico, a territory or possession of the United States, an agency or instrumentality of a State, and multi-State, regional, or interstate entity having governmental duties and powers.

(b) Prohibitions.

(1) Section 1352 of Title 31, United States Code, among other things, prohibits a recipient of a Federal contract, grant, loan, or cooperative agreement from using appropriated funds to pay any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with any of the following covered Federal actions: the awarding of any Federal contract; the making of any Federal grant; the making of any Federal loan; the entering into of any cooperative agreement; or the modification of any Federal contract, grant, loan, or cooperative agreement.

(2) The Act also requires Contractors to furnish a disclosure if any funds other than Federal appropriated funds (including profit or fee received under a covered Federal transaction) have been paid, or will be paid, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with a Federal contract, grant, loan, or cooperative agreement.

(3) The prohibitions of the Act do not apply under the following conditions:

(i) Agency and legislative liaison by own employees.

(A) The prohibition on the use of appropriated funds, in subparagraph (b)(1) of this clause, does not apply in the case of a payment of reasonable compensation made to an officer or employee of a person requesting or receiving a covered Federal action if the payment is for agency and legislative liaison activities not directly related to a covered Federal action.

(B) For purposes of subdivision (b)(3)(i)(A) of this clause, providing any information specifically requested by an agency or Congress is permitted at any time.

(C) The following agency and legislative liaison activities are permitted at any time where they are not related to a specific solicitation for any covered Federal action:

(1) Discussing with an agency the qualities and characteristics (including individual demonstrations) of the person's products or services, conditions or terms of sale, and service capabilities.

(2) Technical discussions and other activities regarding the application or adaptation of the person's products or services for an agency's use.

(D) The following agency and legislative liaison activities are permitted where they are prior to formal solicitation of any covered Federal action--

(1) Providing any information not specifically requested but necessary for an agency to make an informed decision about initiation of a covered Federal action;

(2) Technical discussions regarding the preparation of an unsolicited proposal prior to its official submission; and

(3) Capability presentations by persons seeking awards from an agency pursuant to the provisions of the Small Business Act, as amended by Pub. L. 95-507, and subsequent amendments.

(E) Only those services expressly authorized by subdivision (b)(3)(i)(A) of this clause are permitted under this clause.

(ii) Professional and technical services.

(A) The prohibition on the use of appropriated funds, in subparagraph (b)(1) of this clause, does not apply in the case of--

(1) A payment of reasonable compensation made to an officer or employee of a person requesting or receiving a covered Federal action or an extension, continuation, renewal, amendment, or modification of a covered Federal action, if payment is for professional or technical services rendered directly in the preparation, submission, or negotiation of any bid, proposal, or application for that Federal action or for meeting requirements imposed by or pursuant to law as a condition for receiving that Federal action.

(2) Any reasonable payment to a person, other than an officer or employee of a person requesting or receiving a covered Federal action or an extension, continuation, renewal, amendment, or modification of a covered Federal action if the payment is for professional or technical services rendered directly in the preparation, submission, or negotiation of any bid, proposal, or application for that Federal action or for meeting requirements imposed by or pursuant to law as a condition for receiving that Federal action. Persons other than officers or employees of a person requesting or receiving a covered Federal action include consultants and trade associations.

(B) For purposes of subdivision (b)(3)(ii)(A) of this clause, "professional and technical services" shall be limited to advice and analysis directly applying any professional or technical discipline. For example, drafting of a legal document accompanying a bid or proposal by a lawyer is allowable. Similarly, technical advice provided by an engineer on the performance or operational capability of a piece of equipment rendered directly in the negotiation of a contract is allowable. However, communications with the intent to influence made by a professional (such as a licensed lawyer) or a technical person (such as a licensed accountant) are not allowable under this section unless they provide advice and analysis directly applying their professional or technical expertise and unless the advice or analysis is rendered directly and solely in the preparation, submission or negotiation of a covered Federal action. Thus, for example, communications with the intent to influence made by a lawyer that do not provide legal advice or analysis directly and solely related to the legal aspects of his or her client's proposal, but generally advocate one proposal over another are not allowable under this section because the lawyer is not providing professional legal services. Similarly, communications with the intent to influence made by an engineer providing an engineering analysis prior to the preparation or submission of a bid or proposal are not allowable under this section since the engineer is providing technical services but not directly in the preparation, submission or negotiation of a covered Federal action.

(C) Requirements imposed by or pursuant to law as a condition for receiving a covered Federal award include those required by law or regulation and any other requirements in the actual award documents.

(D) Only those services expressly authorized by subdivisions (b)(3)(ii)(A)(1) and (2) of this clause are permitted under this clause.

(E) The reporting requirements of FAR 3.803(a) shall not apply with respect to payments of reasonable compensation made to regularly employed officers or employees of a person.

(c) Disclosure.

(1) The Contractor who requests or receives from an agency a Federal contract shall file with that agency a disclosure form, OMB standard form LLL, Disclosure of Lobbying Activities, if such person has made or has agreed to make any payment using nonappropriated funds (to include profits from any covered Federal action), which would be prohibited under subparagraph (b)(1) of this clause, if paid for with appropriated funds.

(2) The Contractor shall file a disclosure form at the end of each calendar quarter in which there occurs any event that materially affects the accuracy of the information contained in any disclosure form previously

filed by such person under subparagraph (c)(1) of this clause. An event that materially affects the accuracy of the information reported includes--

(i) A cumulative increase of $25,000 or more in the amount paid or expected to be paid for influencing or attempting to influence a covered Federal action; or

(ii) A change in the person(s) or individual(s) influencing or attempting to influence a covered Federal action; or

(iii) A change in the officer(s), employee(s), or Member(s) contacted to influence or attempt to influence a covered Federal action.

(3) The Contractor shall require the submittal of a certification, and if required, a disclosure form by any person who requests or receives any subcontract exceeding $100,000 under the Federal contract.

(4) All subcontractor disclosure forms (but not certifications) shall be forwarded from tier to tier until received by the prime Contractor. The prime Contractor shall submit all disclosures to the Contracting Officer at the end of the calendar quarter in which the disclosure form is submitted by the subcontractor. Each subcontractor certification shall be retained in the subcontract file of the awarding Contractor.

(d) Agreement. The Contractor agrees not to make any payment prohibited by this clause.

(e) Penalties.

(1) Any person who makes an expenditure prohibited under paragraph (a) of this clause or who fails to file or amend the disclosure form to be filed or amended by paragraph (b) of this clause shall be subject to civil penalties as provided for by 31 U.S.C. 1352. An imposition of a civil penalty does not prevent the Government from seeking any other remedy that may be applicable.

(2) Contractors may rely without liability on the representation made by their subcontractors in the certification and disclosure form.

(f) Cost allowability. Nothing in this clause makes allowable or reasonable any costs which would otherwise be unallowable or unreasonable. Conversely, costs made specifically unallowable by the requirements in this clause will not be made allowable under any other provision.

(End of clause)

52.204-4 PRINTED OR COPIED DOUBLE-SIDED ON RECYCLED PAPER (AUG 2000)

(a) Definitions. As used in this clause--

“Postconsumer material” means a material or finished product that has served its intended use and has been discarded for disposal or recovery, having completed its life as a consumer item. Postconsumer material is a part of the broader category of “recovered material.” For paper and paper products, postconsumer material means “postconsumer fiber” defined by the U.S. Environmental Protection Agency (EPA) as--

(1) Paper, paperboard, and fibrous materials from retail stores, office buildings, homes, and so forth, after they have passed through their end-usage as a consumer item, including: used corrugated boxes; old newspapers; old magazines; mixed waste paper; tabulating cards; and used cordage; or

(2) All paper, paperboard, and fibrous materials that enter and are collected from municipal solid waste; but not

(3) Fiber derived from printers' over-runs, converters' scrap, and over-issue publications.

“Printed or copied double-sided” means printing or reproducing a document so that information is on both sides of a sheet of paper.

“Recovered material,” for paper and paper products, is defined by EPA in its Comprehensive Procurement Guideline as “recovered fiber” and means the following materials:

(1) Postconsumer fiber; and

(2) Manufacturing wastes such as--

(i) Dry paper and paperboard waste generated after completion of the papermaking process (that is, those manufacturing operations up to and including the cutting and trimming of the paper machine reel into smaller rolls or rough sheets) including: envelope cuttings, bindery trimmings, and other paper and paperboard waste resulting from printing, cutting, forming, and other converting operations; bag, box, and carton manufacturing wastes; and butt rolls, mill wrappers, and rejected unused stock; and

(ii) Repulped finished paper and paperboard from obsolete inventories of paper and paperboard manufacturers, merchants, wholesalers, dealers, printers, converters, or others.

(b) In accordance with Section 101 of Executive Order 13101 of September 14, 1998, Greening the Government through Waste Prevention, Recycling, and Federal Acquisition, the Contractor is encouraged to submit paper documents, such as offers, letters, or reports, that are printed or copied double-sided on recycled paper that meet minimum content standards specified in Section 505 of Executive Order 13101, when not using electronic commerce methods to submit information or data to the Government.

(c) If the Contractor cannot purchase high-speed copier paper, offset paper, forms bond, computer printout paper, carbonless paper, file folders, white wove envelopes, writing and office paper, book paper, cotton fiber paper, and cover stock meeting the 30 percent postconsumer material standard for use in submitting paper documents to the Government, it should use paper containing no less than 20 percent postconsumer material. This lesser standard should be used only when paper meeting the 30 percent postconsumer material standard is not obtainable at a reasonable price or does not meet reasonable performance standards.

(End of clause)

52.209-6 Protecting the Government's Interest When Subcontracting With Contractors Debarred, Suspended, or Proposed for Debarment (JUL 1995)

(a) The Government suspends or debars Contractors to protect the Government's interests. The Contractor shall not enter into any subcontract in excess of the $25,000 with a Contractor that is debarred, suspended, or proposed for debarment unless there is a compelling reason to do so.

(b) The Contractor shall require each proposed first-tier subcontractor, whose subcontract will exceed $25,000, to disclose to the Contractor, in writing, whether as of the time of award of the subcontract, the subcontractor, or its principles, is or is not debarred, suspended, or proposed for debarment by the Federal Government.

(c) A corporate officer or a designee of the Contractor shall notify the Contracting Officer, in writing, before entering into a subcontract with a party that is debarred, suspended, or proposed for debarment (see FAR 9.404 for information on the List of Parties Excluded from Federal Procurement and Nonprocurement Programs). The notice must include the following:

(1) The name of the subcontractor.

(2) The Contractor's knowledge of the reasons for the subcontractor being on the List of Parties Excluded from Federal Procurement and Nonprocurement Programs.

(3) The compelling reason(s) for doing business with the subcontractor notwithstanding its inclusion on the List of Parties Excluded from Federal Procurement and Nonprocurement Programs.

(4) The systems and procedures the Contractor has established to ensure that it is fully protecting the Government's interests when dealing with such subcontractor in view of the specific basis for the party's debarment, suspension, or proposed debarment.

(End of clause)

52.211-6 BRAND NAME OR EQUAL (AUG 1999)

(a) If an item in this solicitation is identified as “brand name or equal,” the purchase description reflects the characteristics and level of quality that will satisfy the Government's needs. The salient physical, functional, or performance characteristics that “equal” products must meet are specified in the solicitation.

(b) To be considered for award, offers of “equal” products, including “equal” products of the brand name manufacturer, must--

(1) Meet the salient physical, functional, or performance characteristic specified in this solicitation;

(2) Clearly identify the item by--

(i) Brand name, if any; and

(ii) Make or model number;
(3) Include descriptive literature such as illustrations, drawings, or a clear reference to previously furnished descriptive data or information available to the Contracting Officer; and

(4) Clearly describe any modifications the offeror plans to make in a product to make it conform to the solicitation requirements. Mark any descriptive material to clearly show the modifications.

(c) The Contracting Officer will evaluate “equal” products on the basis of information furnished by the offeror or identified in the offer and reasonably available to the Contracting Officer. The Contracting Officer is not responsible for locating or obtaining any information not identified in the offer.

(d) Unless the offeror clearly indicates in its offer that the product being offered is an “equal” product, the offeror shall provide the brand name product referenced in the solicitation.

(End of provision)

52.215-2 AUDIT AND RECORDS--NEGOTIATION (JUN 1999)

(a) As used in this clause, "records" includes books, documents, accounting procedures and practices, and other data, regardless of type and regardless of whether such items are in written form, in the form of computer data, or in any other form.

(b) Examination of costs. If this is a cost-reimbursement, incentive, time-and-materials, labor-hour, or price redeterminable contract, or any combination of these, the Contractor shall maintain and the Contracting Officer, or an authorized representative of the Contracting Officer, shall have the right to examine and audit all records and other evidence sufficient to reflect properly all costs claimed to have been incurred or anticipated to be incurred directly or indirectly in performance of this contract. This right of examination

shall include inspection at all reasonable times of the Contractor's plants, or parts of them, engaged in performing the contract.

(c) Cost or pricing data. If the Contractor has been required to submit cost or pricing data in connection with any pricing action relating to this contract, the Contracting Officer, or an authorized representative of the Contracting Officer, in order to evaluate the accuracy, completeness, and currency of the cost or pricing data, shall have the right to examine and audit all of the Contractor's records, including computations and projections, related to--

(1) The proposal for the contract, subcontract, or modification;

(2) The discussions conducted on the proposal(s), including those related to negotiating;

(3) Pricing of the contract, subcontract, or modification; or

(4) Performance of the contract, subcontract or modification.

(d) Comptroller General--(1) The Comptroller General of the United States, or an authorized representative, shall have access to and the right to examine any of the Contractor's directly pertinent records involving transactions related to this contract or a subcontract hereunder.

(2) This paragraph may not be construed to require the Contractor or subcontractor to create or maintain any record that the Contractor or subcontractor does not maintain in the ordinary course of business or pursuant to a provision of law.

(e) Reports. If the Contractor is required to furnish cost, funding, or performance reports, the Contracting Officer or an authorized representative of the Contracting Officer shall have the right to examine and audit the supporting records and materials, for the purpose of evaluating (1) the effectiveness of the Contractor's policies and procedures to produce data compatible with the objectives of these reports and (2) the data reported.

(f) Availability. The Contractor shall make available at its office at all reasonable times the records, materials, and other evidence described in paragraphs (a), (b), (c), (d), and (e) of this clause, for examination, audit, or reproduction, until 3 years after final payment under this contract or for any shorter period specified in Subpart 4.7, Contractor Records Retention, of the Federal Acquisition Regulation (FAR), or for any longer period required by statute or by other clauses of this contract. In addition--

(1) If this contract is completely or partially terminated, the Contractor shall make available the records relating to the work terminated until 3 years after any resulting final termination settlement; and

(2) The Contractor shall make available records relating to appeals under the Disputes clause or to litigation or the settlement of claims arising under or relating to this contract until such appeals, litigation, or claims are finally resolved.

(g) The Contractor shall insert a clause containing all the terms of this clause, including this paragraph (g), in all subcontracts under this contract that exceed the simplified acquisition threshold, and--

(1) That are cost-reimbursement, incentive, time-and-materials, labor-hour, or price-redeterminable type or any combination of these;

(2) For which cost or pricing data are required; or

(3) That require the subcontractor to furnish reports as discussed in paragraph (e) of this clause.

The clause may be altered only as necessary to identify properly the contracting parties and the Contracting Officer under the Government prime contract.

(End of clause)

52.215-11 PRICE REDUCTION FOR DEFECTIVE COST OR PRICING DATA--MODIFICATIONS (OCT 1997)

(a) This clause shall become operative only for any modification to this contract involving a pricing adjustment expected to exceed the threshold for submission of cost or pricing data at FAR 15.403-4, except that this clause does not apply to any modification if an exception under FAR 15.403-1 applies.

(b) If any price, including profit or fee, negotiated in connection with any modification under this clause, or any cost reimbursable under this contract, was increased by any significant amount because (1) the Contractor or a subcontractor furnished cost or pricing data that were not complete, accurate, and current as certified in its Certificate of Current Cost or Pricing Data, (2) a subcontractor or prospective subcontractor furnished the Contractor cost or pricing data that were not complete, accurate, and current as certified in the Contractor's Certificate of Current Cost or Pricing Data, or (3) any of these parties furnished data of any description that were not accurate, the price or cost shall be reduced accordingly and the contract shall be modified to reflect the reduction. This right to a price reduction is limited to that resulting from defects in data relating to modifications for which this clause becomes operative under paragraph (a) of this clause.

(c) Any reduction in the contract price under paragraph (b) of this clause due to defective data from a prospective subcontractor that was not subsequently awarded the subcontract shall be limited to the amount, plus applicable overhead and profit markup, by which--

(1) The actual subcontract; or

(2) The actual cost to the Contractor, if there was no subcontract, was less than the prospective subcontract cost estimate submitted by the Contractor; provided, that the actual subcontract price was not itself affected by defective cost or pricing data.

(d)(1) If the Contracting Officer determines under paragraph (b) of this clause that a price or cost reduction should be made, the Contractor agrees not to raise the following matters as a defense:

(i) The Contractor or subcontractor was a sole source supplier or otherwise was in a superior bargaining position and thus the price of the contract would not have been modified even if accurate, complete, and current cost or pricing data had been submitted.

(ii) The Contracting Officer should have known that the cost or pricing data in issue were defective even though the Contractor or subcontractor took no affirmative action to bring the character of the data to the attention of the Contracting Officer.

(iii) The contract was based on an agreement about the total cost of the contract and there was no agreement about the cost of each item procured under the contract.

(iv) The Contractor or subcontractor did not submit a Certificate of Current Cost or Pricing Data.

(2)(i) Except as prohibited by subdivision (d)(2)(ii) of this clause, an offset in an amount determined appropriate by the Contracting Officer based upon the facts shall be allowed against the amount of a contract price reduction if--

(A) The Contractor certifies to the Contracting Officer that, to the best of the Contractor's knowledge and belief, the Contractor is entitled to the offset in the amount requested; and

(B) The Contractor proves that the cost or pricing data were available before the “as of” date specified on its Certificate of Current Cost or Pricing Data, and that the data were not submitted before such date.

(ii) An offset shall not be allowed if--

(A) The understated data were known by the Contractor to be understated before the "as of" date specified on its Certificate of Current Cost or Pricing Data; or

(B) The Government proves that the facts demonstrate that the contract price would not have increased in the amount to be offset even if the available data had been submitted before the "as of" date specified on its Certificate of Current Cost or Pricing Data.

(e) If any reduction in the contract price under this clause reduces the price of items for which payment was made prior to the date of the modification reflecting the price reduction, the Contractor shall be liable to and shall pay the United States at the time such overpayment is repaid--

(1) Simple interest on the amount of such overpayment to be computed from the date(s) of overpayment to the Contractor to the date the Government is repaid by the Contractor at the applicable underpayment rate effective for each quarter prescribed by the Secretary of the Treasury under 26 U.S.C. 6621(a)(2); and

A penalty equal to the amount of the overpayment, if the Contractor or subcontractor knowingly submitted cost or pricing data that were incomplete, inaccurate, or noncurrent.

(End of clause)

52.215-13 SUBCONTRACTOR COST OR PRICING DATA--MODIFICATIONS (OCT 1997)

(a) The requirements of paragraphs (b) and (c) of this clause shall--

(1) Become operative only for any modification to this contract involving a pricing adjustment expected to exceed the threshold for submission of cost or pricing data at FAR 15.403-4; and

(2) Be limited to such modifications.

(b) Before awarding any subcontract expected to exceed the threshold for submission of cost or pricing data at FAR 15.403-4, on the date of agreement on price or the date of award, whichever is later; or before pricing any subcontract modification involving a pricing adjustment expected to exceed the threshold for submission of cost or pricing data at FAR 15.403-4, the Contractor shall require the subcontractor to submit cost or pricing data (actually or by specific identification in writing), unless an exception under FAR 15.403-1 applies.

(c) The Contractor shall require the subcontractor to certify in substantially the form prescribed in FAR 15.406-2 that, to the best of its knowledge and belief, the data submitted under paragraph (b) of this clause were accurate, complete, and current as of the date of agreement on the negotiated price of the subcontract or subcontract modification.

The Contractor shall insert the substance of this clause, including this paragraph (d), in each subcontract that exceeds the threshold for submission of cost or pricing data at FAR 15.403-4 on the date of agreement on price or the date of award, whichever is later.

(End of clause)

52.219-8 UTILIZATION OF SMALL BUSINESS CONCERNS (OCT 2000)

(a) It is the policy of the United States that small business concerns, veteran-owned small business concerns, service-disabled veteran-owned small business concerns, HUBZone small business concerns,

small disadvantaged business concerns, and women-owned small business concerns shall have the maximum practicable opportunity to participate in performing contracts let by any Federal agency, including contracts and subcontracts for subsystems, assemblies, components, and related services for major systems. It is further the policy of the United States that its prime contractors establish procedures to ensure the timely payment of amounts due pursuant to the terms of their subcontracts with small business concerns, veteran-owned small business concerns, service-disabled veteran-owned small business concerns, HUBZone small business concerns, small disadvantaged business concerns, and women-owned small business concerns.

(b) The Contractor hereby agrees to carry out this policy in the awarding of subcontracts to the fullest extent consistent with efficient contract performance. The Contractor further agrees to cooperate in any studies or surveys as may be conducted by the United States Small Business Administration or the awarding agency of the United States as may be necessary to determine the extent of the Contractor's compliance with this clause.

Definitions. As used in this contract--

HUBZone small business concern means a small business concern that appears on the List of Qualified HUBZone Small Business Concerns maintained by the Small Business Administration.

Service-disabled veteran-owned small business concern--

(1) Means a small business concern--

(i) Not less than 51 percent of which is owned by one or more service-disabled veterans or, in the case of any publicly owned business, not less than 51 percent of the stock of which is owned by one or more service-disabled veterans; and

(ii) The management and daily business operations of which are controlled by one or more service-disabled veterans or, in the case of a veteran with permanent and severe disability, the spouse or permanent caregiver of such veteran.

(2) Service-disabled veteran means a veteran, as defined in 38 U.S.C. 101(2), with a disability that is service-connected, as defined in 38 U.S.C. 101(16).

Small business concern means a small business as defined pursuant to Section 3 of the Small Business Act and relevant regulations promulgated pursuant thereto.

Small disadvantaged business concern means a small business concern that represents, as part of its offer that--

(1) It has received certification as a small disadvantaged business concern consistent with 13 CFR part 124, subpart B;

(2) No material change in disadvantaged ownership and control has occurred since its certification;

(3) Where the concern is owned by one or more individuals, the net worth of each individual upon whom the certification is based does not exceed $750,000 after taking into account the applicable exclusions set forth at 13 CFR 124.104(c)(2); and

(4) It is identified, on the date of its representation, as a certified small disadvantaged business in the database maintained by the Small Business Administration (PRO-Net).

Veteran-owned small business concern means a small business concern--

(1) Not less than 51 percent of which is owned by one or more veterans (as defined at 38 U.S.C. 101(2)) or, in the case of any publicly owned business, not less than 51 percent of the stock of which is owned by one or more veterans; and

(2) The management and daily business operations of which are controlled by one or more veterans.

Women-owned small business concern means a small business concern--

(1) That is at least 51 percent owned by one or more women, or, in the case of any publicly owned business, at least 51 percent of the stock of which is owned by one or more women; and

(2) Whose management and daily business operations are controlled by one or more women.

(d) Contractors acting in good faith may rely on written representations by their subcontractors regarding their status as a small business concern, a veteran-owned small business concern, a service-disabled veteran-owned small business concern, a HUBZone small business concern, a small disadvantaged business concern, or a women-owned small business concern.

(End of clause)

52.219-14 LIMITATIONS ON SUBCONTRACTING (DEC 1996)

(a) This clause does not apply to the unrestricted portion of a partial set-aside.

(b) By submission of an offer and execution of a contract, the Offeror/Contractor agrees that in performance of the contract in the case of a contract for--
(1) Services (except construction). At least 50 percent of the cost of contract performance incurred for personnel shall be expended for employees of the concern.

(2) Supplies (other than procurement from a nonmanufacturer of such supplies). The concern shall perform work for at least 50 percent of the cost of manufacturing the supplies, not including the cost of materials.

(3) General construction. The concern will perform at least 15 percent of the cost of the contract, not including the cost of materials, with its own employees.

(4) Construction by special trade contractors. The concern will perform at least 25 percent of the cost of the contract, not including the cost of materials, with its own employees.

(End of clause)

52.222-3 Convict Labor (Aug 1996)

The Contractor agrees not to employ in the performance of this contract any person undergoing a sentence of imprisonment which has been imposed by any court of a State, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American Samoa, the Commonwealth of the Northern Mariana Islands, or the Trust Territory of the Pacific Islands. This limitation, however, shall not prohibit the employment by the Contractor in the performance of this contract of persons on parole or probation to work at paid employment during the term of their sentence or persons who have been pardoned or who have served their terms. Nor shall it prohibit the employment by the Contractor in the performance of this contract of persons confined for violation of the laws of any of the States, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American Samoa, the Commonwealth of the Northern Mariana Islands, or the Trust Territory of the Pacific Islands who are authorized to work at paid employment in the community under the laws of such jurisdiction, if--

(a)(1) The worker is paid or is in an approved work training program on a voluntary basis;

(2) Representatives of local union central bodies or similar labor union organizations have been consulted;

(3) Such paid employment will not result in the displacement of employed workers, or be applied in skills, crafts, or trades in which there is a surplus of available gainful labor in the locality, or impair existing contracts for services; and

(4) The rates of pay and other conditions of employment will not be less than those paid or provided for work of a similar nature in the locality in which the work is being performed; and

(b) The Attorney General of the United States has certified that the work-release laws or regulations of the jurisdiction involved are in conformity with the requirements of Executive Order 11755, as amended by Executive Orders 12608 and 12943.

(End of clause)

52.222-4 Contract Work Hours and Safety Standards Act - Overtime Compensation. (SEP 2000)

(a) Overtime requirements. No Contractor or subcontractor employing laborers or mechanics (see Federal Acquisition Regulation 22.300) shall require or permit them to work over 40 hours in any workweek unless they are paid at least 1 and 1/2 times the basic rate of pay for each hour worked over 40 hours.

(b) Violation; liability for unpaid wages; liquidated damages. The responsible Contractor and subcontractor are liable for unpaid wages if they violate the terms in paragraph (a) of this clause. In addition, the Contractor and subcontractor are liable for liquidated damages payable to the Government. The Contracting Officer will assess liquidated damages at the rate of $10 per affected employee for each calendar day on which the employer required or permitted the employee to work in excess of the standard workweek of 40 hours without paying overtime wages required by the Contract Work Hours and Safety Standards Act.

(c) Withholding for unpaid wages and liquidated damages. The Contracting Officer will withhold from payments due under the contract sufficient funds required to satisfy any Contractor or subcontractor liabilities for unpaid wages and liquidated damages. If amounts withheld under the contract are insufficient to satisfy Contractor or subcontractor liabilities, the Contracting Officer will withhold payments from other Federal or Federally assisted contracts held by the same Contractor that are subject to the Contract Work Hours and Safety Standards Act.

(d) Payrolls and basic records.

(1) The Contractor and its subcontractors shall maintain payrolls and basic payroll records for all laborers and mechanics working on the contract during the contract and shall make them available to the Government until 3 years after contract completion. The records shall contain the name and address of each employee, social security number, labor classifications, hourly rates of wages paid, daily and weekly number of hours worked, deductions made, and actual wages paid. The records need not duplicate those required for construction work by Department of Labor regulations at 29 CFR 5.5(a)(3) implementing the Davis-Bacon Act.

(2) The Contractor and its subcontractors shall allow authorized representatives of the Contracting Officer or the Department of Labor to inspect, copy, or transcribe records maintained under paragraph (d)(1) of this clause. The Contractor or subcontractor also shall allow authorized representatives of the Contracting Officer or Department of Labor to interview employees in the workplace during working hours.

(e) Subcontracts. The Contractor shall insert the provisions set forth in paragraphs (a) through (d) of this clause in subcontracts exceeding $100,000 and require subcontractors to include these provisions in any lower tier subcontracts. The Contractor shall be responsible for compliance by any subcontractor or lower-tier subcontractor with the provisions set forth in paragraphs (a) through (d) of this clause.

(End of clause)

52.222-6 DAVIS-BACON ACT (FEB 1995)

(a) All laborers and mechanics employed or working upon the site of the work will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR Part 3), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the Contractor and such laborers and mechanics. Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph (d) of this clause; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such period. Such laborers and mechanics shall be paid not less than the appropriate wage rate and fringe benefits in the wage determination for the classification of work actually performed, without regard to skill, except as provided in the clause entitled Apprentices and Trainees. Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein; provided, That the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classifications and wage rates conformed under paragraph (b) of this clause) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the Contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

(b)(1) The Contracting Officer shall require that any class of laborers or mechanics which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The Contracting Officer shall approve an additional classification and wage rate and fringe benefits therefor only when all the following criteria have been met:

(i) The work to be performed by the classification requested is not performed by a classification in the wage determination.

(ii) The classification is utilized in the area by the construction industry.

(iii) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(2) If the Contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the Contracting Officer agree on the classification and wage rate (including the amount designated for fringe benefits, where appropriate), a report of the action taken shall be sent by the Contracting Officer to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210. The Administrator or an authorized representative will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the Contracting Officer or will notify the Contracting Officer within the 30-day period that additional time is necessary.

(3) In the event the Contractor, the laborers or mechanics to be employed in the classification, or their representatives, and the Contracting Officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the Contracting Officer shall refer the questions, including the views of all interested parties and the recommendation of the Contracting Officer, to the Administrator of the Wage and Hour Division for determination. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the Contracting

Officer or will notify the Contracting Officer within the 30-day period that additional time is necessary.

(4) The wage rate (including fringe benefits, where appropriate) determined pursuant to subparagraphs (b)(2) and (b)(3) of this clause shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

(c) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the Contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(c) If the Contractor does not make payments to a trustee or other third person, the Contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program; provided, That the Secretary of Labor has found, upon the written request of the Contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the Contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

(End of clause)

52.222-7 WITHHOLDING OF FUNDS (FEB 1988)

The Contracting Officer shall, upon his or her own action or upon written request of an authorized representative of the Department of Labor, withhold or cause to be withheld from the Contractor under this contract or any other Federal contract with the same Prime Contractor, or any other Federally assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same Prime Contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the Contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work, all or part of the wages required by the contract, the Contracting Officer may, after written notice to the Contractor, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

(End of clause)

52.222-8 PAYROLLS AND BASIC RECORDS (FEB 1988)

(a) Payrolls and basic records relating thereto shall be maintained by the Contractor during the course of the work and preserved for a period of 3 years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made, and actual wages paid. Whenever the Secretary of Labor has found, under paragraph (d) of the clause entitled Davis-Bacon Act, that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the Contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

(b)(1) The Contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to the Contracting Officer. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under paragraph (a) of this clause. This information may be submitted in any form desired. Optional Form WH-347 (Federal Stock Number 029-005-00014-1) is available for this purpose and may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. The Prime Contractor is responsible for the submission of copies of payrolls by all subcontractors.

(2) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the Contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify--

(i) That the payroll for the payroll period contains the information required to be maintained under paragraph (a) of this clause and that such information is correct and complete;

(ii) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in the Regulations, 29 CFR Part 3; and

(iii) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(3) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by subparagraph (b)(2) of this clause.

(4) The falsification of any of the certifications in this clause may subject the Contractor or subcontractor to civil or criminal prosecution under Section 1001 of Title 18 and Section 3729 of Title 31 of the United States Code.

(c) The Contractor or subcontractor shall make the records required under paragraph (a) of this clause available for inspection, copying, or transcription by the Contracting Officer or authorized representatives of the Contracting Officer or the Department of Labor. The Contractor or subcontractor shall permit the Contracting Officer or representatives of the Contracting Officer or the Department of Labor to interview employees during working hours on the job. If the Contractor or subcontractor fails to submit required records or to make them available, the Contracting Officer may, after written notice to the Contractor, take such action as may be necessary to cause the suspension of any further payment. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

(End of clause)

52.222-9 APPRENTICES AND TRAINEES (FEB 1988)

(a) Apprentices. Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Bureau of Apprenticeship and Training, or with a State Apprenticeship Agency recognized by the Bureau, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Bureau of Apprenticeship and Training or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of

apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the Contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated in this paragraph, shall be paid not less than the applicable wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the Contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Bureau of Apprenticeship and Training, or a State Apprenticeship Agency recognized by the Bureau, withdraws approval of an apprenticeship program, the Contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(b) Trainees. Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed in the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate in the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate in the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate in the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the Contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(c) Equal employment opportunity. The utilization of apprentices, trainees, and journeymen under this clause shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR Part 30.

(End of clause)

52.222-10 COMPLIANCE WITH COPELAND ACT REQUIREMENTS (FEB 1988)

The Contractor shall comply with the requirements of 29 CFR Part 3, which are hereby incorporated by reference in this contract.

(End of clause)

52.222-11 SUBCONTRACTS (LABOR STANDARDS (FEB 1988)

(a) The Contractor or subcontractor shall insert in any subcontracts the clauses entitled Davis-Bacon Act, Contract Work Hours and Safety Standards Act-Overtime Compensation, Apprentices and Trainees, Payrolls and Basic Records, Compliance with Copeland Act Requirements, Withholding of Funds, Subcontracts (Labor Standards), Contract Termination-Debarment, Disputes Concerning Labor Standards, Compliance with Davis-Bacon and Related Act Regulations, and Certification of Eligibility, and such other clauses as the Contracting Officer may, by appropriate instructions, require, and also a clause requiring subcontractors to include these clauses in any lower tier subcontracts. The Prime Contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with all the contract clauses cited in this paragraph.

(b)(1) Within 14 days after award of the contract, the Contractor shall deliver to the Contracting Officer a completed Statement and Acknowledgment Form (SF 1413) for each subcontract, including the subcontractor's signed and dated acknowledgment that the clauses set forth in paragraph (a) of this clause have been included in the subcontract.

(2) Within 14 days after the award of any subsequently awarded subcontract the Contractor shall deliver to the Contracting Officer an updated completed SF 1413 for such additional subcontract.

(End of clause)

52.222-12 CONTRACT TERMINATION--DEBARMENT (FEB 1988)

A breach of the contract clauses entitled Davis-Bacon Act, Contract Work Hours and Safety Standards Act--Overtime Compensation, Apprentices and Trainees, Payrolls and Basic Records, Compliance with Copeland Act Requirements, Subcontracts (Labor Standards), Compliance with Davis-Bacon and Related Act Regulations, or Certification of Eligibility may be grounds for termination of the contract, and for debarment as a Contractor and subcontractor as provided in 29 CFR 5.12.

(End of clause)

52.222-13 COMPLIANCE WITH DAVIS-BACON AND RELATED ACT REGULATIONS (FEB 1988)

All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR Parts 1, 3, and 5 are hereby incorporated by reference in this contract.

(End of clause)

52.222-14 DISPUTES CONCERNING LABOR STANDARDS (FEB 1988)

The United States Department of Labor has set forth in 29 CFR Parts 5, 6, and 7 procedures for resolving disputes concerning labor standards requirements. Such disputes shall be resolved in accordance with those procedures and not the Disputes clause of this contract. Disputes within the meaning of this clause include disputes between the Contractor (or any of its subcontractors) and the contracting agency, the U.S. Department of Labor, or the employees or their representatives.

(End of clause)

52.222-15 CERTIFICATION OF ELIGIBILITY (FEB 1988)

(a) By entering into this contract, the Contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the Contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(b) No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(c) The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

(End of clause)

52.222-26 EQUAL OPPORTUNITY (APR 2002)

(a) Definition. United States, as used in this clause, means the 50 States, the District of Columbia, Puerto Rico, the Northern Mariana Islands, American Samoa, Guam, the U.S. Virgin Islands, and Wake Island.

(b) If, during any 12-month period (including the 12 months preceding the award of this contract), the Contractor has been or is awarded nonexempt Federal contracts and/or subcontracts that have an aggregate value in excess of $10,000, the Contractor shall comply with paragraphs (b)(1) through (b)(11) of this clause, except for work performed outside the United States by employees who were not recruited within the United States. Upon request, the Contractor shall provide information necessary to determine the applicability of this clause.

(1) The Contractor shall not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. However, it shall not be a violation of this clause for the Contractor to extend a publicly announced preference in employment to Indians living on or near an Indian reservation, in connection with employment opportunities on or near an Indian reservation, as permitted by 41 CFR 60-1.5.

(2) The Contractor shall take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, sex, or national origin. This shall include, but not be limited to, (i) employment, (ii) upgrading, (iii) demotion, (iv) transfer, (v) recruitment or recruitment advertising, (vi) layoff or termination, (vii) rates of pay or other forms of compensation, and (viii) selection for training, including apprenticeship.

(3) The Contractor shall post in conspicuous places available to employees and applicants for employment the notices to be provided by the Contracting Officer that explain this clause.

(4) The Contractor shall, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, or national origin.

(5) The Contractor shall send, to each labor union or representative of workers with which it has a collective bargaining agreement or other contract or understanding, the notice to be provided by the Contracting Officer advising the labor union or workers' representative of the Contractor's commitments under this clause, and post copies of the notice in conspicuous places available to employees and applicants for employment.

(6) The Contractor shall comply with Executive Order 11246, as amended, and the rules, regulations, and orders of the Secretary of Labor.

(7) The Contractor shall furnish to the contracting agency all information required by Executive Order 11246, as amended, and by the rules, regulations, and orders of the Secretary of Labor. The Contractor shall also file Standard Form 100 (EEO-1), or any successor form, as prescribed in 41 CFR part 60-1.

Unless the Contractor has filed within the 12 months preceding the date of contract award, the Contractor shall, within 30 days after contract award, apply to either the regional Office of Federal Contract Compliance Programs (OFCCP) or the local office of the Equal Employment Opportunity Commission for the necessary forms.

(8) The Contractor shall permit access to its premises, during normal business hours, by the contracting agency or the OFCCP for the purpose of conducting on-site compliance evaluations and complaint investigations. The Contractor shall permit the Government to inspect and copy any books, accounts, records (including computerized records), and other material that may be relevant to the matter under investigation and pertinent to compliance with Executive Order 11246, as amended, and rules and regulations that implement the Executive Order.

(9) If the OFCCP determines that the Contractor is not in compliance with this clause or any rule, regulation, or order of the Secretary of Labor, this contract may be canceled, terminated, or suspended in whole or in part and the Contractor may be declared ineligible for further Government contracts, under the procedures authorized in Executive Order 11246, as amended. In addition, sanctions may be imposed and remedies invoked against the Contractor as provided in Executive Order 11246, as amended; in the rules, regulations, and orders of the Secretary of Labor; or as otherwise provided by law.

(10) The Contractor shall include the terms and conditions of subparagraphs (b)(1) through (11) of this clause in every subcontract or purchase order that is not exempted by the rules, regulations, or orders of the Secretary of Labor issued under Executive Order 11246, as amended, so that these terms and conditions will be binding upon each subcontractor or vendor.

(11) The Contractor shall take such action with respect to any subcontract or purchase order as the contracting officer may direct as a means of enforcing these terms and conditions, including sanctions for noncompliance; provided, that if the Contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of any direction, the Contractor may request the United States to enter into the litigation to protect the interests of the United States.

(c) Notwithstanding any other clause in this contract, disputes relative to this clause will be governed by the procedures in 41 CFR 60-1.1.

(End of clause)

52.222-27 AFFIRMATIVE ACTION COMPLIANCE REQUIREMENTS FOR CONSTRUCTION (FEB 1999)

(a) Definitions. "Covered area," as used in this clause, means the geographical area described in the solicitation for this contract.

"Deputy Assistant Secretary," as used in this clause, means Deputy Assistant Secretary for Federal Contract Compliance, U.S. Department of Labor, or a designee.

"Employer's identification number," as used in this clause, means the Federal Social Security number used on the employer's quarterly federal tax return, U.S. Treasury Department Form 941.

"Minority," as used in this clause, means--

(1) American Indian or Alaskan Native (all persons having origins in any of the original peoples of North America and maintaining identifiable tribal affiliations through membership and participation or community identification).

(2) Asian and Pacific Islander (all persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands);

(3) Black (all persons having origins in any of the black African racial groups not of Hispanic origin); and

(4) Hispanic (all persons of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin, regardless of race).

(b) If the Contractor, or a subcontractor at any tier, subcontracts a portion of the work involving any construction trade, each such subcontract in excess of $10,000 shall include this clause and the Notice containing the goals for minority and female participation stated in the solicitation for this contract.

(c) If the Contractor is participating in a Hometown Plan (41 CFR 60-4) approved by the U.S. Department of Labor in a covered area, either individually or through an association, its affirmative action obligations on all work in the plan area (including goals) shall comply with the plan for those trades that have unions participating in the plan. Contractors must be able to demonstrate participation in, and compliance with, the provisions of the plan. Each Contractor or subcontractor participating in an approved plan is also required to comply with its obligations under the Equal Opportunity clause, and to make a good faith effort to achieve each goal under the plan in each trade in which it has employees. The overall good-faith performance by other Contractors or subcontractors toward a goal in an approved plan does not excuse any Contractor's or subcontractor's failure to make good-faith efforts to achieve the plan's goals.

(d) The Contractor shall implement the affirmative action procedures in subparagraphs (g)(1) through (16) of this clause. The goals stated in the solicitation for this contract are expressed as percentages of the total hours of employment and training of minority and female utilization that the Contractor should reasonably be able to achieve in each construction trade in which it has employees in the covered area. If the Contractor performs construction work in a geographical area located outside of the covered area, it shall apply the goals established for the geographical area where that work is actually performed. The Contractor is expected to make substantially uniform progress toward its goals in each craft.

(e) Neither the terms and conditions of any collective bargaining agreement, nor the failure by a union with which the Contractor has a collective bargaining agreement, to refer minorities or women shall excuse the Contractor's obligations under this clause, Executive Order 11246, as amended, or the regulations thereunder.

(f) In order for the nonworking training hours of apprentices and trainees to be counted in meeting the goals, apprentices and trainees must be employed by the Contractor during the training period, and the Contractor must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U.S. Department of Labor.

(g) The Contractor shall take affirmative action to ensure equal employment opportunity. The evaluation of the Contractor's compliance with this clause shall be based upon its effort to achieve maximum results from its actions. The Contractor shall document these efforts fully and implement affirmative action steps at least as extensive as the following:

(1) Ensure a working environment free of harassment, intimidation, and coercion at all sites and in all facilities where the Contractor's employees are assigned to work. The Contractor, if possible, will assign two or more women to each construction project. The Contractor shall ensure that foremen, superintendents, and other onsite supervisory personnel are aware of and carry out the Contractor's obligation to maintain such a working environment, with specific attention to minority or female individuals working at these sites or facilities.

(2) Establish and maintain a current list of sources for minority and female recruitment. Provide written notification to minority and female recruitment sources and community organizations when the Contractor or its unions have employment opportunities available, and maintain a record of the organizations' responses.

(3) Establish and maintain a current file of the names, addresses, and telephone numbers of each minority and female off-the-street applicant, referrals of minorities or females from unions, recruitment sources, or community organizations, and the action taken with respect to each individual. If an individual was sent to the union hiring hall for referral and not referred back to the Contractor by the union or, if referred back, not employed by the
Contractor, this shall be documented in the file, along with whatever additional actions the Contractor may have taken.

(4) Immediately notify the Deputy Assistant Secretary when the union or unions with which the Contractor has a collective bargaining agreement has not referred back to the Contractor a minority or woman sent by the Contractor, or when the Contractor has other information that the union referral process has impeded the Contractor's efforts to meet its obligations.

(5) Develop on-the-job training opportunities and/or participate in training programs for the area that expressly include minorities and women, including upgrading programs and apprenticeship and trainee programs relevant to the Contractor's employment needs, especially those programs funded or approved by the Department of Labor. The Contractor shall provide notice of these programs to the sources compiled under subparagraph (g)(2) of this clause.

(6) Disseminate the Contractor's equal employment policy by--

(i) Providing notice of the policy to unions and to training, recruitment, and outreach programs, and requesting their cooperation in assisting the Contractor in meeting its contract obligations;

(ii) Including the policy in any policy manual and in collective bargaining agreements;

(iii) Publicizing the policy in the company newspaper, annual report, etc.;

(iv) Reviewing the policy with all management personnel and with all minority and female employees at least once a year; and

(v) Posting the policy on bulletin boards accessible to employees at each location where construction work is performed.

(7) Review, at least annually, the Contractor's equal employment policy and affirmative action obligations with all employees having responsibility for hiring, assignment, layoff, termination, or other employment decisions. Conduct review of this policy with all on-site supervisory personnel before initiating construction work at a job site. A written record shall be made and maintained identifying the time and place of these meetings, persons attending, subject matter discussed, and disposition of the subject matter.

(8) Disseminate the Contractor's equal employment policy externally by including it in any advertising in the news media, specifically including minority and female news media. Provide written notification to, and discuss this policy with, other Contractors and subcontractors with which the Contractor does or anticipates doing business.

(9) Direct recruitment efforts, both oral and written, to minority, female, and community organizations, to schools with minority and female students, and to minority and female recruitment and training organizations serving the Contractor's recruitment area and employment needs. Not later than 1 month before the date for acceptance of applications for apprenticeship or training by any recruitment source, send written notification to organizations such as the above, describing the openings, screening procedures, and tests to be used in the selection process.

(10) Encourage present minority and female employees to recruit minority persons and women. Where reasonable, provide after-school, summer, and vacation employment to minority and female youth both on the site and in other areas of the Contractor's workforce.

(11) Validate all tests and other selection requirements where required under 41 CFR 60-3.

(12) Conduct, at least annually, an inventory and evaluation at least of all minority and female personnel for promotional opportunities. Encourage these employees to seek or to prepare for, through appropriate training, etc., opportunities for promotion.

(13) Ensure that seniority practices, job classifications, work assignments, and other personnel practices do not have a discriminatory effect by continually monitoring all personnel and employment-related activities to ensure that the Contractor's obligations under this contract are being carried out.

(14) Ensure that all facilities and company activities are nonsegregated except that separate or single-user rest rooms and necessary dressing or sleeping areas shall be provided to assure privacy between the sexes.

(15) Maintain a record of solicitations for subcontracts for minority and female construction contractors and suppliers, including circulation of solicitations to minority and female contractor associations and other business associations.

(16) Conduct a review, at least annually, of all supervisors' adherence to and performance under the Contractor's equal employment policy and affirmative action obligations.

(h) The Contractor is encouraged to participate in voluntary associations that may assist in fulfilling one or more of the affirmative action obligations contained in subparagraphs (g)(1) through (16) of this clause. The efforts of a contractor association, joint contractor-union, contractor-community, or similar group of which the contractor is a member and participant may be asserted as fulfilling one or more of its obligations under subparagraphs (g)(1) through (16) of this clause, provided the Contractor--

(1) Actively participates in the group;

(2) Makes every effort to ensure that the group has a positive impact on the employment of minorities and women in the industry;

(3) Ensures that concrete benefits of the program are reflected in the Contractor's minority and female workforce participation;

(4) Makes a good-faith effort to meet its individual goals and timetables; and

(5) Can provide access to documentation that demonstrates the effectiveness of actions taken on behalf of the Contractor. The obligation to comply is the Contractor's, and failure of such a group to fulfill an obligation shall not be a defense for the Contractor's noncompliance.

(i) A single goal for minorities and a separate single goal for women shall be established. The Contractor is required to provide equal employment opportunity and to take affirmative action for all minority groups, both male and female, and all women, both minority and nonminority. Consequently, the Contractor may be in violation of Executive Order 11246, as amended, if a particular group is employed in a substantially disparate manner.

(j) The Contractor shall not use goals or affirmative action standards to discriminate against any person because of race, color, religion, sex, or national origin.

(k) The Contractor shall not enter into any subcontract with any person or firm debarred from Government contracts under Executive Order 11246, as amended.

(l) The Contractor shall carry out such sanctions and penalties for violation of this clause and of the Equal Opportunity clause, including suspension, termination, and cancellation of existing subcontracts, as may be imposed or ordered under Executive Order 11246, as amended, and its implementing regulations, by the OFCCP. Any failure to carry out these sanctions and penalties as ordered shall be a violation of this clause

and Executive Order 11246, as amended.

(m) The Contractor in fulfilling its obligations under this clause shall implement affirmative action procedures at least as extensive as those prescribed in paragraph (g) of this clause, so as to achieve maximum results from its efforts to ensure equal employment opportunity. If the Contractor fails to comply with the requirements of Executive Order 11246, as amended, the implementing regulations, or this clause, the Deputy Assistant Secretary shall take action as prescribed in 41 CFR 60-4.8.

(n) The Contractor shall designate a responsible official to--

(1) Monitor all employment-related activity to ensure that the Contractor's equal employment policy is being carried out;

(2) Submit reports as may be required by the Government; and

(3) Keep records that shall at least include for each employee the name, address, telephone number, construction trade, union affiliation (if any), employee identification number, social security number, race, sex, status (e.g., mechanic, apprentice, trainee, helper, or laborer), dates of changes in status, hours worked per week in the indicated trade, rate of pay, and locations at which the work was performed. Records shall be maintained in an easily understandable and retrievable form; however, to the degree that existing records satisfy this requirement, separate records are not required to be maintained.

Nothing contained herein shall be construed as a limitation upon the application of other laws that establish different standards of compliance or upon the requirements for the hiring of local or other area residents (e.g., those under the Public Works Employment Act of 1977 and the Community Development Block Grant Program).

(End of clause)

52.222-35 AFFIRMATIVE ACTION FOR DISABLED VETERANS AND VETERANS OF THE VIETNAM ERA (APR 1998)

(a)) Definitions. As used in this clause--

All employment openings includes all positions except executive and top management, those positions that will be filled from within the contractor's organization, and positions lasting 3 days or less. This term includes full-time employment, temporary employment of more than 3 days' duration, and part-time employment.

Appropriate office of the State employment service system means the local office of the Federal-State national system of public employment offices with assigned responsibility to serve the area where the employment opening is to be filled, including the District of Columbia, Guam, the Commonwealth of Puerto Rico, and the Virgin Islands.

Positions that will be filled from within the Contractor's organization means employment openings for which no consideration will be given to persons outside the Contractor's organization (including any affiliates, subsidiaries, and parent companies) and includes any openings that the Contractor proposes to fill from regularly established “recall” lists. The exception does not apply to a particular opening once an employer decides to consider applicants outside of its organization.

Veteran of the Vietnam era means a person who--

(1) Served on active duty for a period of more than 180 days, any part of which occurred between August 5, 1964, and May 7, 1975, and was discharged or released therefrom with other than a dishonorable discharge; or

(2) Was discharged or released from active duty for a service-connected disability if any part of such active duty was performed between August 5, 1964, and May 7, 1975.

(b) General. (1) Regarding any position for which the employee or applicant for employment is qualified, the Contractor shall not discriminate against the individual because the individual is a disabled veteran or a veteran of the Vietnam era. The Contractor agrees to take affirmative action to employ, advance in employment, and otherwise treat qualified disabled veterans and veterans of the Vietnam era without discrimination based upon their disability or veterans' status in all employment practices such as--

(i) Employment;

(ii) Upgrading;

(iii) Demotion or transfer;

(iv) Recruitment;

(v) Advertising;

(vi) Layoff or termination;

(vii) Rates of pay or other forms of compensation; and

(viii) Selection for training, including apprenticeship.

(2) The Contractor agrees to comply with the rules, regulations, and relevant orders of the Secretary of Labor (Secretary) issued under the Vietnam Era Veterans' Readjustment Assistance Act of 1972 (the Act), as amended.

(c) Listing openings. (1) The Contractor agrees to list all employment openings existing at contract award or occurring during contract performance, at an appropriate office of the State employment service system in the locality where the opening occurs. These openings include those occurring at any Contractor facility, including one not connected with performing this contract. An independent corporate affiliate is exempt from this requirement.

(2) State and local government agencies holding Federal contracts of $10,000 or more shall also list all their employment openings with the appropriate office of the State employment service.

(3) The listing of employment openings with the State employment service system is required at least concurrently with using any other recruitment source or effort and involves the obligations of placing a bona fide job order, including accepting referrals of veterans and nonveterans. This listing does not require hiring any particular job applicant or hiring from any particular group of job applicants and is not intended to relieve the Contractor from any requirements of Executive orders or regulations concerning nondiscrimination in employment.

(4) Whenever the Contractor becomes contractually bound to the listing terms of this clause, it shall advise the State employment service system, in each State where it has establishments, of the name and location of each hiring location in the State. As long as the Contractor is contractually bound to these terms and has so advised the State system, it need not advise the State system of subsequent contracts. The Contractor may advise the State system when it is no longer bound by this contract clause.

(d) Applicability. This clause does not apply to the listing of employment openings that occur and are filled outside the 50 States, the District of Columbia, the Commonwealth of Puerto Rico, Guam, and the Virgin Islands.

(e) Postings. (1) The Contractor agrees to post employment notices stating (i) the Contractor's obligation under the law to take affirmative action to employ and advance in employment qualified disabled veterans and veterans of the Vietnam era, and (ii) the rights of applicants and employees.

(2) These notices shall be posted in conspicuous places that are available to employees and applicants for employment. They shall be in a form prescribed by the Deputy Assistant Secretary for Federal Contract Compliance Programs, Department of Labor (Deputy Assistant Secretary), and provided by or through the Contracting Officer.

(3) The Contractor shall notify each labor union or representative of workers with which it has a collective bargaining agreement or other contract understanding, that the Contractor is bound by the terms of the Act, and is committed to take affirmative action to employ, and advance in employment, qualified disabled veterans and veterans of the Vietnam Era.

(f) Noncompliance. If the Contractor does not comply with the requirements of this clause, appropriate actions may be taken under the rules, regulations, and relevant orders of the Secretary issued pursuant to the Act.

(g) Subcontracts. The Contractor shall include the terms of this clause in every subcontract or purchase order of $10,000 or more unless exempted by rules, regulations, or orders of the Secretary. The Contractor shall act as specified by the Deputy Assistant Secretary to enforce the terms, including action for noncompliance.

(End of clause)

52.222-36 AFFIRMATIVE ACTION FOR WORKERS WITH DISABILITIES (JUN 1998)

(a) General. (1) Regarding any position for which the employee or applicant for employment is qualified, the Contractor shall not discriminate against any employee or applicant because of physical or mental disability. The Contractor agrees to take affirmative action to employ, advance in employment, and otherwise treat qualified individuals with disabilities without discrimination based upon their physical or mental disability in all employment practices such as--

(i) Recruitment, advertising, and job application procedures;

(ii) Hiring, upgrading, promotion, award of tenure, demotion, transfer, layoff, termination, right of return from layoff, and rehiring;

(iii) Rates of pay or any other form of compensation and changes in compensation;

(iv) Job assignments, job classifications, organizational structures, position descriptions, lines of progression, and seniority lists;

(v) Leaves of absence, sick leave, or any other leave;

(vi) Fringe benefits available by virtue of employment, whether or not administered by the Contractor;

(vii) Selection and financial support for training, including apprenticeships, professional meetings, conferences, and other related activities, and selection for leaves of absence to pursue training;

(viii) Activities sponsored by the Contractor, including social or recreational programs; and

(ix) Any other term, condition, or privilege of employment.

(2) The Contractor agrees to comply with the rules, regulations, and relevant orders of the Secretary of Labor (Secretary) issued under the Rehabilitation Act of 1973 (29 U.S.C. 793) (the Act), as amended.

(b) Postings. (1) The Contractor agrees to post employment notices stating--

(i) The Contractor's obligation under the law to take affirmative action to employ and advance in employment qualified individuals with disabilities; and

(ii) The rights of applicants and employees.

(2) These notices shall be posted in conspicuous places that are available to employees and applicants for employment. The Contractor shall ensure that applicants and employees with disabilities are informed of the contents of the notice (e.g., the Contractor may have the notice read to a visually disabled individual, or may lower the posted notice so that it might be read by a person in a wheelchair). The notices shall be in a form prescribed by the Deputy Assistant Secretary for Federal Contract Compliance of the U.S. Department of Labor (Deputy Assistant Secretary) and shall be provided by or through the Contracting Officer.

(3) The Contractor shall notify each labor union or representative of workers with which it has a collective bargaining agreement or other contract understanding, that the Contractor is bound by the terms of Section 503 of the Act and is committed to take affirmative action to employ, and advance in employment, qualified individuals with physical or mental disabilities.

(c) Noncompliance. If the Contractor does not comply with the requirements of this clause, appropriate actions may be taken under the rules, regulations, and relevant orders of the Secretary issued pursuant to the Act.

(d) Subcontracts. The Contractor shall include the terms of this clause in every subcontract or purchase order in excess of $10,000 unless exempted by rules, regulations, or orders of the Secretary. The Contractor shall act as specified by the Deputy Assistant Secretary to enforce the terms, including action for noncompliance.

(End of clause)

52.222-37 EMPLOYMENT REPORTS ON DISABLED VETERANS AND VETERANS OF THE VIETNAM ERA (JAN 1999)

(a) Unless the Contractor is a State or local government agency, the Contractor shall report at least annually, as required by the Secretary of Labor, on--

(1) The number of disabled veterans and the number of veterans of the Vietnam era in the workforce of the contractor by job category and hiring location; and

(2) The total number of new employees hired during the period covered by the report, and of that total, the number of disabled veterans, and the number of veterans of the Vietnam era.

(b) The above items shall be reported by completing the form entitled "Federal Contractor Veterans' Employment Report VETS-100."

(c) Reports shall be submitted no later than September 30 of each year beginning September 30, 1988.

(d) The employment activity report required by paragraph (a)(2) of this clause shall reflect total hires during the most recent 12-month period as of the ending date selected for the employment profile report required by paragraph (a)(1) of this clause. Contractors may select an ending date: (1) As of the end of any pay period during the period January through March 1st of the year the report is due, or (2) as of December

31, if the contractor has previous written approval from the Equal Employment Opportunity Commission to do so for purposes of submitting the Employer Information Report EEO-1 (Standard Form 100).

(e) The count of veterans reported according to paragraph (a) of this clause shall be based on voluntary disclosure. Each Contractor subject to the reporting requirements at 38 U.S.C. 4212 shall invite all disabled veterans and veterans of the Vietnam era who wish to benefit under the affirmative action program at 38 U.S.C. 4212 to identify themselves to the Contractor. The invitation shall state that the information is voluntarily provided; that the information will be kept confidential; that disclosure or refusal to provide the information will not subject the applicant or employee to any adverse treatment; and that the information will be used only in accordance with the regulations promulgated under 38 U.S.C. 4212.

(f) Subcontracts. The Contractor shall include the terms of this clause in every subcontract or purchase order of $10,000 or more unless exempted by rules, regulations, or orders of the Secretary.

(End of clause)

52.223-3 HAZARDOUS MATERIAL IDENTIFICATION AND MATERIAL SAFETY DATA (JAN 1997)

(a) "Hazardous material", as used in this clause, includes any material defined as hazardous under the latest version of Federal Standard No. 313 (including revisions adopted during the term of the contract).

(b) The offeror must list any hazardous material, as defined in paragraph (a) of this clause, to be delivered under this contract. The hazardous material shall be properly identified and include any applicable identification number, such as National Stock Number or Special Item Number. This information shall also be included on the Material Safety Data Sheet submitted under this contract.

Material (If none, insert "None")	Identification No.
_____	_____
_____	_____
_____	_____

(c) This list must be updated during performance of the contract whenever the Contractor determines that any other material to be delivered under this contract is hazardous.

(d) The apparently successful offeror agrees to submit, for each item as required prior to award, a Material Safety Data Sheet, meeting the requirements of 29 CFR 1910.1200(g) and the latest version of Federal Standard No. 313, for all hazardous material identified in paragraph (b) of this clause. Data shall be submitted in accordance with Federal Standard No. 313, whether or not the apparently successful offeror is the actual manufacturer of these items. Failure to submit the Material Safety Data Sheet prior to award may result in the apparently successful offeror being considered nonresponsible and ineligible for award.

(e) If, after award, there is a change in the composition of the item(s) or a revision to Federal Standard No. 313, which renders incomplete or inaccurate the data submitted under paragraph (d) of this clause, the Contractor shall promptly notify the Contracting Officer and resubmit the data.

(f) Neither the requirements of this clause nor any act or failure to act by the Government shall relieve the Contractor of any responsibility or liability for the safety of Government, Contractor, or subcontractor personnel or property.

(g) Nothing contained in this clause shall relieve the Contractor from complying with applicable Federal, State, and local laws, codes, ordinances, and regulations (including the obtaining of licenses and permits) in connection with hazardous material.

(h) The Government's rights in data furnished under this contract with respect to hazardous material are as follows:

(1) To use, duplicate and disclose any data to which this clause is applicable. The purposes of this right are to--

(i) Apprise personnel of the hazards to which they may be exposed in using, handling, packaging, transporting, or disposing of hazardous materials;

(ii) Obtain medical treatment for those affected by the material; and

(iii) Have others use, duplicate, and disclose the data for the Government for these purposes.

(2) To use, duplicate, and disclose data furnished under this clause, in accordance with subparagraph (h)(1) of this clause, in precedence over any other clause of this contract providing for rights in data.

(3) The Government is not precluded from using similar or identical data acquired from other sources.

(End of clause)

52.223-5 POLLUTION PREVENTION AND RIGHT-TO-KNOW INFORMATION (APR 1998)

(a) Executive Order 12856 of August 3, 1993, requires Federal facilities to comply with the provisions of the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA)(42 U.S.C. 11001-11050) and the Pollution Prevention Act of 1990 (PPA)(42 U.S.C. 13101-13109).

(b) The Contractor shall provide all information needed by the Federal facility to comply with the emergency planning reporting requirements of Section 302 of EPCRA; the emergency notice requirements of Section 304 of EPCRA; the list of Material Safety Data Sheets required by Section 311 of EPCRA; the emergency and hazardous chemical inventory forms of Section 312 of EPCRA; the toxic chemical release inventory of Section 313 of EPCRA, which includes the reduction and recycling information required by Section 6607 of PPA; and the toxic chemical reduction goals requirements of Section 3-302 of Executive Order 12856.

(End of clause)

52.223-6 DRUG-FREE WORKPLACE (MAY 2001)

(a) Definitions. As used in this clause --

"Controlled substance" means a controlled substance in schedules I through V of section 202 of the Controlled Substances Act (21 U.S.C. 812) and as further defined in regulation at 21 CFR 1308.11 - 1308.15.

"Conviction" means a finding of guilt (including a plea of nolo contendere) or imposition of sentence, or both, by any judicial body charged with the responsibility to deter- mine violations of the Federal or State criminal drug statutes.

"Criminal drug statute" means a Federal or non-Federal criminal statute involving the manufacture, distribution, dispensing, possession, or use of any controlled substance.

"Drug-free workplace" means the site(s) for the performance of work done by the Contractor in connection with a specific contract at which employees of the Contractor are prohibited from engaging in the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance.

"Employee" means an employee of a Contractor directly engaged in the performance of work under a Government contract. "Directly engaged" is defined to include all direct cost employees and any other Contractor employee who has other than a minimal impact or involvement in contract performance.

"Individual" means an offeror/contractor that has no more than one employee including the offeror/contractor.

(b) The Contractor, if other than an individual, shall-- within 30 days after award (unless a longer period is agreed to in writing for contracts of 30 days or more performance duration), or as soon as possible for contracts of less than 30 days performance duration--

(1) Publish a statement notifying its employees that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the Contractor's workplace and specifying the actions that will be taken against employees for violations of such prohibition;

(2) Establish an ongoing drug-free awareness program to inform such employees about--

(i) The dangers of drug abuse in the workplace;

(ii) The Contractor's policy of maintaining a drug-free workplace;

(iii) Any available drug counseling, rehabilitation, and employee assistance programs; and

(iv) The penalties that may be imposed upon employees for drug abuse violations occurring in the workplace;

(3) Provide all employees engaged in performance of the contract with a copy of the statement required by subparagraph (b)(1) of this clause;

(4) Notify such employees in writing in the statement required by subparagraph (b)(1) of this clause that, as a condition of continued employment on this contract, the employee will--

(i) Abide by the terms of the statement; and

(ii) Notify the employer in writing of the employee's conviction under a criminal drug statute for a violation occurring in the workplace no later than 5 days after such conviction.

(5) Notify the Contracting Officer in writing within 10 days after receiving notice under subdivision (b)(4)(ii) of this clause, from an employee or otherwise receiving actual notice of such conviction. The notice shall include the position title of the employee;

(6) Within 30 days after receiving notice under subdivision (b)(4)(ii) of this clause of a conviction, take one of the following actions with respect to any employee who is convicted of a drug abuse violation occurring in the workplace:

(i) Taking appropriate personnel action against such employee, up to and including termination; or

(ii) Require such employee to satisfactorily participate in a drug abuse assistance or rehabilitation program approved for such purposes by a Federal, State, or local health, law enforcement, or other appropriate agency; and

(7) Make a good faith effort to maintain a drug-free workplace through implementation of subparagraphs (b)(1) though (b)(6) of this clause.

(c) The Contractor, if an individual, agrees by award of the contract or acceptance of a purchase order, not to engage in the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance while performing this contract.

(d) In addition to other remedies available to the Government, the Contractor's failure to comply with the requirements of paragraph (b) or (c) of this clause may, pursuant to FAR 23.506, render the Contractor subject to suspension of contract payments, termination of the contract for default, and suspension or debarment.

(End of clause)

52.223-7 NOTICE OF RADIOACTIVE MATERIALS (JAN 1997)

(a) The Contractor shall notify the Contracting Officer or designee, in writing, * days prior to the delivery of, or prior to completion of any servicing required by this contract of, items containing either (1) radioactive material requiring specific licensing under the regulations issued pursuant to the Atomic Energy Act of 1954, as amended, as set forth in Title 10 of the Code of Federal Regulations, in effect on the date of this contract, or (2) other radioactive material not requiring specific licensing in which the specific activity is greater than 0.002 microcuries per gram or the activity per item equals or exceeds 0.01 microcuries. Such notice shall specify the part or parts of the items which contain radioactive materials, a description of the materials, the name and activity of the isotope, the manufacturer of the materials, and any other information known to the Contractor which will put users of the items on notice as to the hazards involved (OMB No. 9000-0107).

* The Contracting Officer shall insert the number of days required in advance of delivery of the item or completion of the servicing to assure that required licenses are obtained and appropriate personnel are notified to institute any necessary safety and health precautions. See FAR 23.601(d).

(b) If there has been no change affecting the quantity of activity, or the characteristics and composition of the radioactive material from deliveries under this contract or prior contracts, the Contractor may request that the Contracting Officer or designee waive the notice requirement in paragraph (a) of this clause. Any such request shall-

(1) Be submitted in writing;

(2) State that the quantity of activity, characteristics, and composition of the radioactive material have not changed; and

(3) Cite the contract number on which the prior notification was submitted and the contracting office to which it was submitted.

(c) All items, parts, or subassemblies which contain radioactive materials in which the specific activity is greater than 0.002 microcuries per gram or activity per item equals or exceeds 0.01 microcuries, and all containers in which such items, parts or subassemblies are delivered to the Government shall be clearly marked and labeled as required by the latest revision of MIL-STD 129 in effect on the date of the contract.

(d) This clause, including this paragraph (d), shall be inserted in all subcontracts for radioactive materials meeting the criteria in paragraph (a) of this clause.

(End of clause)

52.223-10 WASTE REDUCTION PROGRAM (AUG 2000)

(a) Definitions. As used in this clause--

Recycling means the series of activities, including collection, separation, and processing, by which products or other materials are recovered from the solid waste stream for use in the form of raw materials in the manufacture of products other than fuel for producing heat or power by combustion.

Waste prevention means any change in the design, manufacturing, purchase, or use of materials or products (including packaging) to reduce their amount or toxicity before they are discarded. Waste prevention also refers to the reuse of products or materials.

Waste reduction means preventing or decreasing the amount of waste being generated through waste prevention, recycling, or purchasing recycled and environmentally preferable products.

(b) Consistent with the requirements of Section 701 of Executive Order 13101, the Contractor shall establish a program to promote cost-effective waste reduction in all operations and facilities covered by this contract. The Contractor's programs shall comply with applicable Federal, State, and local requirements, specifically including Section 6002 of the Resource Conservation and Recovery Act (42 .S.C. 6962, et seq.) and implementing regulations (40 CFR part 247).

(End of clause)

52.223-14 TOXIC CHEMICAL RELEASE REPORTING (OCT 2000)

(a) Unless otherwise exempt, the Contractor, as owner or operator of a facility used in the performance of this contract, shall file by July 1 for the prior calendar year an annual Toxic Chemical Release Inventory Form (Form R) as described in sections 313(a) and (g) of the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) (42 U.S.C. 11023(a) and (g)), and section 6607 of the Pollution Prevention Act of 1990 (PPA) (42 U.S.C. 13106). The Contractor shall file, for each facility subject to the Form R filing and reporting requirements, the annual Form R throughout the life of the contract.

(b) A Contractor owned or operated facility used in the performance of this contract is exempt from the requirement to file an annual Form R if--

(1) The facility does not manufacture, process, or otherwise use any toxic chemicals listed under section 313(c) of EPCRA, 42 U.S.C. 11023(c);

(2) The facility does not have 10 or more full-time employees as specified in section 313(b)(1)(A) of EPCRA, 42 U.S.C. 11023(b)(1)(A);

(3) The facility does not meet the reporting thresholds of toxic chemicals established under of EPCRA, 42 U.S.C. 11023(f) (including the alternate thresholds at 40 CFR 372.27, provided an appropriate certification form has been filed with EPA);

(4) The facility does not fall within Standard Industrial Classification Code (SIC) major groups 20 through 39 or their corresponding North American Industry Classification System (NAICS) sectors 31 through 33; or

(5) The facility is not located within any State of the United States, the District of Columbia, the Commonwealth of Puerto Rico, Guam, American Samoa, the United States Virgin Islands, the Northern Mariana Islands, or any other territory or possession over which the United States has jurisdiction.
(c) If the Contractor has certified to an exemption in accordance with one or more of the criteria in paragraph (b) of this clause, and after award of the contract circumstances change so that any of its owned or operated facilities used in the performance of this contract is no longer exempt--

(1) The Contractor shall notify the Contracting Officer; and

(2) The Contractor, as owner or operator of a facility used in the performance of this contract that is no longer exempt, shall (i) submit a Toxic Chemical Release Inventory Form (Form R) on or before July 1 for the prior calendar year during which the facility becomes eligible; and (ii) continue to file the annual Form R for the life of the contract for such facility.

(d) The Contracting Officer may terminate this contract or take other action as appropriate, if the Contractor fails to comply accurately and fully with the EPCRA and PPA toxic chemical release filing and reporting requirements.

(e) Except for acquisitions of commercial items, as defined in FAR Part 2, the Contractor shall--

(1) For competitive subcontracts expected to exceed $100,000 (including all options), include a solicitation provision substantially the same as the provision at FAR 52.223-13, Certification of Toxic Chemical Release Reporting; and

(2) Include in any resultant subcontract exceeding $100,000 (including all options), the substance of this clause, except this paragraph (e).

(End of clause)

52.225-11 BUY AMERICAN ACT--CONSTRUCTION MATERIALS UNDER TRADE AGREEMENTS (JUL 2002)

(a) Definitions. As used in this clause--

Component means an article, material, or supply incorporated directly into a construction material.

Construction material means an article, material, or supply brought to the construction site by the Contractor or subcontractor for incorporation into the building or work. The term also includes an item brought to the site preassembled from articles, materials, or supplies. However, emergency life safety systems, such as emergency lighting, fire alarm, and audio evacuation systems, that are discrete systems incorporated into a public building or work and that are produced as complete systems, are evaluated as a single and distinct construction material regardless of when or how the individual parts or components of those systems are delivered to the construction site. Materials purchased directly by the Government are supplies, not construction material.

Cost of components means--

(1) For components purchased by the Contractor, the acquisition cost, including transportation costs to the place of incorporation into the construction material (whether or not such costs are paid to a domestic firm), and any applicable duty (whether or not a duty-free entry certificate is issued); or

(2) For components manufactured by the Contractor, all costs associated with the manufacture of the component, including transportation costs as described in paragraph (1) of this definition, plus allocable overhead costs, but excluding profit. Cost of components does not include any costs associated with the manufacture of the end product.

Designated country means any of the following countries: Aruba, Austria, Bangladesh, Belgium, Benin, Bhutan, Botswana, Burkina Faso, Burundi, Canada, Cape Verde, Central African Republic, Chad, Comoros, Denmark.

Djibouti, Equatorial Guinea, Finland, France, Gambia, Germany, Greece, Guinea, Guinea-Bissau, Haiti, Hong Kong, Ireland, Israel, Italy, Japan.

Kiribati, Korea, Republic of, Lesotho, Liechtenstein, Luxembourg, Malawi, Maldives, Mali, Mozambique, Nepal, Netherlands, Niger, Norway, Portugal, Rwanda.

Sao Tome and Principe, Sierra Leone, Singapore, Somalia, Spain, Sweden, Switzerland, Tanzania U.R., Togo, Tuvalu, Uganda, United Kingdom, Vanuatu, Western Samoa, Yemen.

Designated country construction material means a construction material that--

(1) Is wholly the growth, product, or manufacture of a designated country; or

(2) In the case of a construction material that consists in whole or in part of materials from another country, has been substantially transformed in a designated country into a new and different construction material distinct from the materials from which it was transformed.

Domestic construction material means--

(1) An unmanufactured construction material mined or produced in the United States; or

(2) A construction material manufactured in the United States, if the cost of its components mined, produced, or manufactured in the United States exceeds 50 percent of the cost of all its components. Components of foreign origin of the same class or kind for which nonavailability determinations have been made are treated as domestic.

Foreign construction material means a construction material other than a domestic construction material.

North American Free Trade Agreement country means Canada or Mexico.

North American Free Trade Agreement country construction material means a construction material that--

(1) Is wholly the growth, product, or manufacture of a North American Free Trade Agreement (NAFTA) country; or

(2) In the case of a construction material that consists in whole or in part of materials from another country, has been substantially transformed in a NAFTA country into a new and different construction material distinct from the materials from which it was transformed.

United States means the 50 States and the District of Columbia, U.S. territories and possessions, Puerto Rico, the Northern Mariana Islands, and any other place subject to U.S. jurisdiction, but does not include leased bases.

(b) Construction materials. (1) This clause implements the Buy American Act (41 U.S.C. 10a-10d) and the Balance of Payments Program by providing a preference for domestic construction material. In addition, the Contracting Officer has determined that the Trade Agreements Act and the North American Free Trade Agreement (NAFTA) apply to this acquisition. Therefore, the Buy American Act restrictions are waived for designated country and NAFTA country construction materials.

(2) The Contractor shall use only domestic, designated country, or NAFTA country construction material in performing this contract, except as provided in paragraphs (b)(3) and (b)(4) of this clause.

(3) The requirement in paragraph (b)(2) of this clause does not apply to the construction materials or components listed by the Government as follows: (Contracting Officer to list applicable excepted materials or indicate “none”)

(4) The Contracting Officer may add other foreign construction material to the list in paragraph (b)(3) of this clause if the Government determines that--

(i) The cost of domestic construction material would be unreasonable. The cost of a particular domestic construction material subject to the restrictions of the Buy American Act is unreasonable when the cost of such material exceeds the cost of foreign material by more than 6 percent;

(ii) The application of the restriction of the Buy American Act to a particular construction material would be impracticable or inconsistent with the public interest; or

(iii) The construction material is not mined, produced, or manufactured in the United States in sufficient and reasonably available commercial quantities of a satisfactory quality.

(c) Request for determination of inapplicability of the Buy American Act.

(1)(i) Any Contractor request to use foreign construction material in accordance with paragraph (b)(4) of this clause shall include adequate information for Government evaluation of the request, including--

(A) A description of the foreign and domestic construction materials;

(B) Unit of measure;

(C) Quantity;

(D) Price;

(E) Time of delivery or availability;

(F) Location of the construction project;

(G) Name and address of the proposed supplier; and

(H) A detailed justification of the reason for use of foreign construction materials cited in accordance with paragraph (b)(3) of this clause.

(ii) A request based on unreasonable cost shall include a reasonable survey of the market and a completed price comparison table in the format in paragraph (d) of this clause.

(iii) The price of construction material shall include all delivery costs to the construction site and any applicable duty (whether or not a duty-free certificate may be issued).

(iv) Any Contractor request for a determination submitted after contract award shall explain why the Contractor could not reasonably foresee the need for such determination and could not have requested the determination before contract award. If the Contractor does not submit a satisfactory explanation, the Contracting Officer need not make a determination.

(2) If the Government determines after contract award that an exception to the Buy American Act applies and the Contracting Officer and the Contractor negotiate adequate consideration, the Contracting Officer will modify the contract to allow use of the foreign construction material. However, when the basis for the exception is the unreasonable price of a domestic construction material, adequate consideration is not less than the differential established in paragraph (b)(4)(i) of this clause.

(3) Unless the Government determines that an exception to the Buy American Act applies, use of foreign construction material is noncompliant with the Buy American Act.

(d) Data. To permit evaluation of requests under paragraph (c) of this clause based on unreasonable cost, the Contractor shall include the following information and any applicable supporting data based on the survey of suppliers:

Foreign and Domestic Construction Materials Price Comparison

Construction material description	Unit of measure	Quantity	Price (dollars) \1\
Item 1:			
Foreign construction material....	.....	.....	.....
Domestic construction material...	.....	.....	.....
Item 2:			
Foreign construction material....	.....	.....	.....
Domestic construction material...	.....	.....	.....

\1\ Include all delivery costs to the construction site and any applicable duty (whether or not a duty-free entry certificate is issued).

List name, address, telephone number, and contact for suppliers surveyed. Attach copy of response; if oral, attach summary.

Include other applicable supporting information.

(End of clause)

52.225-13 RESTRICTIONS ON CERTAIN FOREIGN PURCHASES (JUL 2000)

(a) The Contractor shall not acquire, for use in the performance of this contract, any supplies or services originating from sources within, or that were located in or transported from or through, countries whose products are banned from importation into the United States under regulations of the Office of Foreign Assets Control, Department of the Treasury. Those countries are Cuba, Iran, Iraq, Libya, North Korea, Sudan, the territory of Afghanistan controlled by the Taliban, and Serbia (excluding the territory of Kosovo).

(b) The Contractor shall not acquire for use in the performance of this contract any supplies or services from entities controlled by the government of Iraq.

(c) The Contractor shall insert this clause, including this paragraph (c), in all subcontracts.

(End of clause)

52.227-1 AUTHORIZATION AND CONSENT (JUL 1995)

(a) The Government authorizes and consents to all use and manufacture, in performing this contract or any subcontract at any tier, of any invention described in and covered by a United States patent (1) embodied in the structure or composition of any article the delivery of which is accepted by the Government under this contract or (2) used in machinery, tools, or methods whose use necessarily results from compliance by the Contractor or a subcontractor with (i) specifications or written provisions forming a part of this contract or (ii) specific written instructions given by the Contracting Officer directing the manner of performance. The entire liability to the Government for infringement of a patent of the United States shall be determined solely by the provisions of the indemnity clause, if any, included in this contract or any subcontract hereunder (including any lower-tier subcontract), and the Government assumes liability for all other infringement to the extent of the authorization and consent hereinabove granted.

(b) The Contractor agrees to include, and require inclusion of, this clause, suitably modified to identify the parties, in all subcontracts at any tier for supplies or services (including construction, architect-engineer

services, and materials, supplies, models, samples, and design or testing services expected to exceed the simplified acquisition threshold (however, omission of this clause from any subcontract, including those at or below the simplified acquisition threshold, does not affect this authorization and consent.)

(End of clause)

52.227-2 NOTICE AND ASSISTANCE REGARDING PATENT AND COPYRIGHT INFRINGEMENT (AUG 1996)

(a) The Contractor shall report to the Contracting Officer, promptly and in reasonable written detail, each notice or claim of patent or copyright infringement based on the performance of this contract of which the Contractor has knowledge.

(b) In the event of any claim or suit against the Government on account of any alleged patent or copyright infringement arising out of the performance of this contract or out of the use of any supplies furnished or work or services performed under this contract, the Contractor shall furnish to the Government, when requested by the Contracting Officer, all evidence and information in possession of the Contractor pertaining to such suit or claim. Such evidence and information shall be furnished at the expense of the Government except where the Contractor has agreed to indemnify the Government.

(d) The Contractor agrees to include, and require inclusion of, this clause in all subcontracts at any tier for supplies or services (including construction and architect-engineer subcontracts and those for material, supplies, models, samples, or design or testing services) expected to exceed the simplified acquisition threshold at (FAR) 2.101.to exceed the dollar amount set forth in 13.000 of the Federal Acquisition Regulation (FAR).

(End of clause)

52.227-4 PATENT INDEMNITY--CONSTRUCTION CONTRACTS (APR 1984)

Except as otherwise provided, the Contractor agrees to indemnify the Government and its officers, agents, and employees against liability, including costs and expenses, for infringement upon any United States patent (except a patent issued upon an application that is now or may hereafter be withheld from issue pursuant to a Secrecy Order under 35 U.S.C. 181) arising out of performing this contract or out of the use or disposal by or for the account of the Government of supplies furnished or work performed under this contract.

(End of clause)

52.228-2 ADDITIONAL BOND SECURITY (OCT 1997)

The Contractor shall promptly furnish additional security required to protect the Government and persons supplying labor or materials under this contract if--

(a) Any surety upon any bond, or issuing financial institution for other security, furnished with this contract becomes unacceptable to the Government.

(b) Any surety fails to furnish reports on its financial condition as required by the Government;

(c) The contract price is increased so that the penal sum of any bond becomes inadequate in the opinion of the Contracting Officer; or

(d) An irrevocable letter of credit (ILC) used as security will expire before the end of the period of required

security. If the Contractor does not furnish an acceptable extension or replacement ILC, or other acceptable substitute, at least 30 days before an ILC's scheduled expiration, the Contracting officer has the right to immediately draw on the ILC.

(End of clause)

52.228-5 INSURANCE--WORK ON A GOVERNMENT INSTALLATION (JAN 1997)

(a) The Contractor shall, at its own expense, provide and maintain during the entire performance of this contract, at least the kinds and minimum amounts of insurance required in the Schedule or elsewhere in the contract.

(b) Before commencing work under this contract, the Contractor shall notify the Contracting Officer in writing that the required insurance has been obtained. The policies evidencing required insurance shall contain an endorsement to the effect that any cancellation or any material change adversely affecting the Government's interest shall not be effective (1) for such period as the laws of the State in which this contract is to be performed prescribe, or (2) until 30 days after the insurer or the Contractor gives written notice to the Contracting Officer, whichever period is longer.

(c) The Contractor shall insert the substance of this clause, including this paragraph (c), in subcontracts under this contract that require work on a Government installation and shall require subcontractors to provide and maintain the insurance required in the Schedule or elsewhere in the contract. The Contractor shall maintain a copy of all subcontractors' proofs of required insurance, and shall make copies available to the Contracting Officer upon request.

(End of clause)

52.228-11 PLEDGES OF ASSETS (FEB 1992)

(a) Offerors shall obtain from each person acting as an individual surety on a bid guarantee, a performance bond, or a payment bond--

(1) Pledge of assets; and

(2) Standard Form 28, Affidavit of Individual Surety.

(b) Pledges of assets from each person acting as an individual surety shall be in the form of--

(1) Evidence of an escrow account containing cash, certificates of deposit, commercial or Government securities, or other assets described in FAR 28.203-2 (except see 28.203-2(b)(2) with respect to Government securities held in book entry form) and/or;

(2) A recorded lien on real estate. The offeror will be required to provide--

(i) Evidence of title in the form of a certificate of title prepared by a title insurance company approved by the United States Department of Justice. This title evidence must show fee simple title vested in the surety along with any concurrent owners; whether any real estate taxes are due and payable; and any recorded encumbrances against the property, including the lien filed in favor of the Government as required by FAR 28.203-3(d);

(ii) Evidence of the amount due under any encumbrance shown in the evidence of title;

(iii) A copy of the current real estate tax assessment of the property or a current appraisal dated no earlier than 6 months prior to the date of the bond, prepared by a professional appraiser who certifies that the

appraisal has been conducted in accordance with the generally accepted appraisal standards as reflected in the Uniform Standards of Professional Appraisal Practice, as promulgated by the Appraisal Foundation.

(End of clause)

52.229-3 FEDERAL, STATE, AND LOCAL TAXES (JAN 1991)

(a) "Contract date," as used in this clause, means the date set for bid opening or, if this is a negotiated contract or a modification, the effective date of this contract or modification.

"All applicable Federal, State, and local taxes and duties," as used in this clause, means all taxes and duties, in effect on the contract date, that the taxing authority is imposing and collecting on the transactions or property covered by this contract.

"After-imposed Federal tax," as used in this clause, means any new or increased Federal excise tax or duty, or tax that was exempted or excluded on the contract date but whose exemption was later revoked or reduced during the contract period, on the transactions or property covered by this contract that the Contractor is required to pay or bear as the result of legislative, judicial, or administrative action taking effect after the contract date. It does not include social security tax or other employment taxes.
"After-relieved Federal tax," as used in this clause, means any amount of Federal excise tax or duty, except social security or other employment taxes, that would otherwise have been payable on the transactions or property covered by this contract, but which the Contractor is not required to pay or bear, or for which the Contractor obtains a refund or drawback, as the result of legislative, judicial, or administrative action taking effect after the contract date.

(b) The contract price includes all applicable Federal, State, and local taxes and duties.

(c) The contract price shall be increased by the amount of any after-imposed Federal tax, provided the Contractor warrants in writing that no amount for such newly imposed Federal excise tax or duty or rate increase was included in the contract price, as a contingency reserve or otherwise.

(d) The contract price shall be decreased by the amount of any after-relieved Federal tax.

(e) The contract price shall be decreased by the amount of any Federal excise tax or duty, except social security or other employment taxes, that the Contractor is required to pay or bear, or does not obtain a refund of, through the Contractor's fault, negligence, or failure to follow instructions of the Contracting Officer.

(f) No adjustment shall be made in the contract price under this clause unless the amount of the adjustment exceeds $250.

(g) The Contractor shall promptly notify the Contracting Officer of all matters relating to any Federal excise tax or duty that reasonably may be expected to result in either an increase or decrease in the contract price and shall take appropriate action as the Contracting Officer directs.

(h) The Government shall, without liability, furnish evidence appropriate to establish exemption from any Federal, State, or local tax when the Contractor requests such evidence and a reasonable basis exists to sustain the exemption.

(End of clause)

52.232-5 PAYMENTS UNDER FIXED-PRICE CONSTRUCTION CONTRACTS (MAY 1997)

(a) Payment of price. The Government shall pay the Contractor the contract price as provided in this

contract.

(b) Progress payments. The Government shall make progress payments monthly as the work proceeds, or at more frequent intervals as determined by the Contracting Officer, on estimates of work accomplished which meets the standards of quality established under the contract, as approved by the Contracting Officer.

(1) The Contractor's request for progress payments shall include the following substantiation:

(i) An itemization of the amounts requested, related to the various elements of work required by the contract covered by the payment requested.

(ii) A listing of the amount included for work performed by each subcontractor under the contract.

(iii) A listing of the total amount of each subcontract under the contract.

(iv) A listing of the amounts previously paid to each such subcontractor under the contract.

(v) Additional supporting data in a form and detail required by the Contracting Officer.

(2) In the preparation of estimates, the Contracting Officer may authorize material delivered on the site and preparatory work done to be taken into consideration. Material delivered to the Contractor at locations other than the site also may be taken into consideration if--

(i) Consideration is specifically authorized by this contract; and

(ii) The Contractor furnishes satisfactory evidence that it has acquired title to such material and that the material will be used to perform this contract.

(c) Contractor certification. Along with each request for progress payments, the Contractor shall furnish the following certification, or payment shall not be made: (However, if the Contractor elects to delete paragraph (c)(4) from the certification, the certification is still acceptable.)

I hereby certify, to the best of my knowledge and belief, that--

(1) The amounts requested are only for performance in accordance with the specifications, terms, and conditions of the contract;

(2) Payments to subcontractors and suppliers have been made from previous payments received under the contract, and timely payments will be made from the proceeds of the payment covered by this certification, in accordance with subcontract agreements and the requirements of chapter 39 of Title 31, United States Code;

(3) This request for progress payments does not include any amounts which the prime contractor intends to withhold or retain from a subcontractor or supplier in accordance with the terms and conditions of the subcontract; and

(4) This certification is not to be construed as final acceptance of a subcontractor's performance.

_____

(Name)

_____

(Title)

_____

(Date)

(d) Refund of unearned amounts. If the Contractor, after making a certified request for progress payments, discovers that a portion or all of such request constitutes a payment for performance by the Contractor that fails to conform to the specifications, terms, and conditions of this contract (hereinafter referred to as the "unearned amount"), the Contractor shall--

(1) Notify the Contracting Officer of such performance deficiency; and

(2) Be obligated to pay the Government an amount (computed by the Contracting Officer in the manner provided in paragraph (j) of this clause) equal to interest on the unearned amount from the 8th day after the date of receipt of the unearned amount until--

(i) The date the Contractor notifies the Contracting Officer that the performance deficiency has been corrected; or

(ii) The date the Contractor reduces the amount of any subsequent certified request for progress payments by an amount equal to the unearned amount.

(e) Retainage. If the Contracting Officer finds that satisfactory progress was achieved during any period for which a progress payment is to be made, the Contracting Officer shall authorize payment to be made in full. However, if satisfactory progress has not been made, the Contracting Officer may retain a maximum of 10 percent of the amount of the payment until satisfactory progress is achieved. When the work is substantially complete, the Contracting Officer may retain from previously withheld funds and future progress payments that amount the Contracting Officer considers adequate for protection of the Government and shall release to the Contractor all the remaining withheld funds. Also, on completion and acceptance of each separate building, public work, or other division of the contract, for which the price is stated separately in the contract, payment shall be made for the completed work without retention of a percentage.

(f) Title, liability, and reservation of rights. All material and work covered by progress payments made shall, at the time of payment, become the sole property of the Government, but this shall not be construed as--

(1) Relieving the Contractor from the sole responsibility for all material and work upon which payments have been made or the restoration of any damaged work; or

(2) Waiving the right of the Government to require the fulfillment of all of the terms of the contract.

(g) Reimbursement for bond premiums. In making these progress payments, the Government shall, upon request, reimburse the Contractor for the amount of premiums paid for performance and payment bonds (including coinsurance and reinsurance agreements, when applicable) after the Contractor has furnished evidence of full payment to the surety. The retainage provisions in paragraph (e) of this clause shall not apply to that portion of progress payments attributable to bond premiums.

(h) Final payment. The Government shall pay the amount due the Contractor under this contract after--

(1) Completion and acceptance of all work;

(2) Presentation of a properly executed voucher; and

(3) Presentation of release of all claims against
the Government arising by virtue of this contract, other than claims, in stated amounts, that the Contractor has specifically excepted from the operation of the release. A release may also be required of the assignee if

the Contractor's claim to amounts payable under this contract has been assigned under the Assignment of Claims Act of 1940 (31 U.S.C. 3727 and 41 U.S.C. 15).

(i) Limitation because of undefinitized work. Notwithstanding any provision of this contract, progress payments shall not exceed 80 percent on work accomplished on undefinitized contract actions. A "contract action" is any action resulting in a contract, as defined in FAR Subpart 2.1, including contract modifications for additional supplies or services, but not including contract modifications that are within the scope and under the terms of the contract, such as contract modifications issued pursuant to the Changes clause, or funding and other administrative changes.

(j) Interest computation on unearned amounts. In accordance with 31 U.S.C. 3903(c)(1), the amount payable under subparagraph (d)(2) of this clause shall be--

(1) Computed at the rate of average bond equivalent rates of 91-day Treasury bills auctioned at the most recent auction of such bills prior to the date the Contractor receives the unearned amount; and

(2) Deducted from the next available payment to the Contractor.

(End of clause)

52.232-8 DISCOUNTS FOR PROMPT PAYMENT (FEB 2002)

(a) Discounts for prompt payment will not be considered in the evaluation of offers. However, any offered discount will form a part of the award, and will be taken if payment is made within the discount period indicated in the offer by the offeror. As an alternative to offering a discount for prompt payment in conjunction with the offer, offerors awarded contracts may include discounts for prompt payment on individual invoices.

(b) In connection with any discount offered for prompt payment, time shall be computed from the date of the invoice. If the Contractor has not placed a date on the invoice, the due date shall be calculated from the date the designated billing office receives a proper invoice, provided the agency annotates such invoice with the date of receipt at the time of receipt. For the purpose of computing the discount earned, payment shall be considered to have been made on the date that appears on the payment check or, for an electronic funds transfer, the specified payment date. When the discount date falls on a Saturday, Sunday, or legal holiday when Federal Government offices are closed and Government business is not expected to be conducted, payment may be made on the following business day.

(End of clause)

52.232-9 LIMITATION ON WITHHOLDING OF PAYMENTS (APR 1984)

If more than one clause or Schedule term of this contract authorizes the temporary withholding of amounts otherwise payable to the Contractor for supplies delivered or services performed, the total of the amounts withheld at any one time shall not exceed the greatest amount that may be withheld under any one clause or Schedule term at that time; provided, that this limitation shall not apply to--

(a) Withholdings pursuant to any clause relating to wages or hours of employees;

(b) Withholdings not specifically provided for by this contract;

(c) The recovery of overpayments; and

(d) Any other withholding for which the Contracting Officer determines that this limitation is inappropriate.

(End of clause)

52.232-17 INTEREST (JUNE 1996)

(a) Except as otherwise provided in this contract under a Price Reduction for Defective Cost or Pricing Data clause or a Cost Accounting Standards clause, all amounts that become payable by the Contractor to the Government under this contract (net of any applicable tax credit under the Internal Revenue Code (26 U.S.C. 1481)) shall bear simple interest from the date due until paid unless paid within 30 days of becoming due. The interest rate shall be the interest rate established by the Secretary of the Treasury as provided in Section 12 of the Contract Disputes Act of 1978 (Public Law 95-563), which is applicable to the period in which the amount becomes due, as provided in paragraph (b) of this clause, and then at the rate applicable for each six-month period as fixed by the Secretary until the amount is paid. reproduce, prepare derivative works, distribute copies to the public, and (b) Amounts shall be due at the earliest of the following dates:

(1) The date fixed under this contract.

(2) The date of the first written demand for payment consistent with this contract, including any demand resulting from a default termination.

(3) The date the Government transmits to the Contractor a proposed supplemental agreement to confirm completed negotiations establishing the amount of debt.

(4) If this contract provides for revision of prices, the date of written notice to the Contractor stating the amount of refund payable in connection with a pricing proposal or a negotiated pricing agreement not confirmed by contract modification.

(c) The interest charge made under this clause may be reduced under the procedures prescribed in 32.614-2 of the Federal Acquisition Regulation in effect on the date of this contract.

(End of clause)

52.232-23 ASSIGNMENT OF CLAIMS (JAN 1986)

(a) The Contractor, under the Assignment of Claims Act, as amended, 31 U.S.C. 3727, 41 U.S.C. 15 (hereafter referred to as "the Act"), may assign its rights to be paid amounts due or to become due as a result of the performance of this contract to a bank, trust company, or other financing institution, including any Federal lending agency. The assignee under such an assignment may thereafter further assign or reassign its right under the original assignment to any type of financing institution described in the preceding sentence.

(b) Any assignment or reassignment authorized under the Act and this clause shall cover all unpaid amounts payable under this contract, and shall not be made to more than one party, except that an assignment or reassignment may be made to one party as agent or trustee for two or more parties participating in the financing of this contract.

(c) The Contractor shall not furnish or disclose to any assignee under this contract any classified document (including this contract) or information related to work under this contract until the Contracting Officer authorizes such action in writing.

(End of clause)

52.232-25 PROMPT PAYMENT (FEB 2002)

Notwithstanding any other payment clause in this contract, the Government will make invoice payments under the terms and conditions specified in this clause. The Government considers payment as being made on the day a check is dated or the date of an electronic funds transfer (EFT). Definitions of pertinent terms are set forth in sections 2.101, 32.001, and 32.902 of the Federal Acquisition Regulation. All days referred to in this clause are calendar days, unless otherwise specified. (However, see paragraph (a)(4) of this clause concerning payments due on Saturdays, Sundays, and legal holidays.)

(a) Invoice payments--(1) Due date. (i) Except as indicated in paragraphs (a)(2) and (c) of this clause, the due date for making invoice payments by the designated payment office is the later of the following two events:

(A) The 30th day after the designated billing office receives a proper invoice from the Contractor (except as provided in paragraph (a)(1)(ii) of this clause).

(B) The 30th day after Government acceptance of supplies delivered or services performed. For a final invoice, when the payment amount is subject to contract settlement actions, acceptance is deemed to occur on the effective date of the contract settlement.

(ii) If the designated billing office fails to annotate the invoice with the actual date of receipt at the time of receipt, the invoice payment due date is the 30th day after the date of the Contractor's invoice, provided the designated billing office receives a proper invoice and there is no disagreement over quantity, quality, or Contractor compliance with contract requirements.

(2) Certain food products and other payments. (i) Due dates on Contractor invoices for meat, meat food products, or fish; perishable agricultural commodities; and dairy products, edible fats or oils, and food products prepared from edible fats or oils are--

(A) For meat or meat food products, as defined in section 2(a)(3) of the Packers and Stockyard Act of 1921 (7 U.S.C. 182(3)), and as further defined in Pub. L. 98-181, including any edible fresh or frozen poultry meat, any perishable poultry meat food product, fresh eggs, and any perishable egg product, as close as possible to, but not later than, the 7th day after product delivery.

(B) For fresh or frozen fish, as defined in section 204(3) of the Fish and Seafood Promotion Act of 1986 (16 U.S.C. 4003(3)), as close as possible to, but not later than, the 7th day after product delivery.

C) For perishable agricultural commodities, as defined in section 1(4) of the Perishable Agricultural Commodities Act of 1930 (7 U.S.C. 499a(4)), as close as possible to, but not later than, the 10th day after product delivery, unless another date is specified in the contract.

(D) For dairy products, as defined in section 111(e) of the Dairy Production Stabilization Act of 1983 (7 U.S.C. 4502(e)), edible fats or oils, and food products prepared from edible fats or oils, as close as possible to, but not later than, the 10th day after the date on which a proper invoice has been received. Liquid milk, cheese, certain processed cheese products, butter, yogurt, ice cream, mayonnaise, salad dressings, and other similar products, fall within this classification. Nothing in the Act limits this classification to refrigerated products. When questions arise regarding the proper classification of a specific product, prevailing industry practices will be followed in specifying a contract payment due date. The burden of proof that a classification of a specific product is, in fact, prevailing industry practice is upon the Contractor making the representation.

(ii) If the contract does not require submission of an invoice for payment (e.g., periodic lease payments), the due date will be as specified in the contract.

(3) Contractor's invoice. The Contractor shall prepare and submit invoices to the designated billing office specified in the contract. A proper invoice must include the items listed in paragraphs (a)(3)(i) through (a)(3)(x) of this clause. If the invoice does not comply with these requirements, the designated billing office

will return it within 7 days after receipt (3 days for meat, meat food products, or fish; 5 days for perishable agricultural commodities, dairy products, edible fats or oils, and food products prepared from edible fats or oils), with the reasons why it is not a proper invoice. The Government will take into account untimely notification when computing any interest penalty owed the Contractor.

(i) Name and address of the Contractor.

(ii) Invoice date and invoice number. (The Contractor should date invoices as close as possible to the date of the mailing or transmission.)

(iii) Contract number or other authorization for supplies delivered or services performed (including order number and contract line item number).

(iv) Description, quantity, unit of measure, unit price, and extended price of supplies delivered or services performed.

(v) Shipping and payment terms (e.g., shipment number and date of shipment, discount for prompt payment terms). Bill of lading number and weight of shipment will be shown for shipments on Government bills of lading.

(vi) Name and address of Contractor official to whom payment is to be sent (must be the same as that in the contract or in a proper notice of assignment).

(vii) Name (where practicable), title, phone number, and mailing address of person to notify in the event of a defective invoice.

(viii) Taxpayer Identification Number (TIN). The Contractor shall include its TIN on the invoice only if required elsewhere in this contract.

(ix) Electronic funds transfer (EFT) banking information.

(A) The Contractor shall include EFT banking information on the invoice only if required elsewhere in this contract.

(B) If EFT banking information is not required to be on the invoice, in order for the invoice to be a proper invoice, the Contractor shall have submitted correct EFT banking information in accordance with the applicable solicitation provision (e.g., 52.232-38, Submission of Electronic Funds Transfer Information with Offer), contract clause (e.g., 52.232-33, Payment by Electronic Funds Transfer--Central Contractor Registration, or 52.232-34, Payment by Electronic Funds Transfer--Other Than Central Contractor Registration), or applicable agency procedures.

(C) EFT banking information is not required if the Government waived the requirement to pay by EFT.

(x) Any other information or documentation required by the contract (e.g., evidence of shipment).

(4) Interest penalty. The designated payment office will pay an interest penalty automatically, without request from the Contractor, if payment is not made by the due date and the conditions listed in paragraphs (a)(4)(i) through (a)(4)(iii) of this clause are met, if applicable. However, when the due date falls on a Saturday, Sunday, or legal holiday, the designated payment office may make payment on the following working day without incurring a late payment interest penalty.

(i) The designated billing office received a proper invoice.

(ii) The Government processed a receiving report or other Government documentation authorizing payment, and there was no disagreement over quantity, quality, or Contractor compliance with any contract term or condition.

(iii) In the case of a final invoice for any balance of funds due the Contractor for supplies delivered or services performed, the amount was not subject to further contract settlement actions between the Government and the Contractor.

(5) Computing penalty amount. The Government will compute the interest penalty in accordance with the Office of Management and Budget prompt payment regulations at 5 CFR part 1315.

(i) For the sole purpose of computing an interest penalty that might be due the Contractor, Government acceptance is deemed to occur constructively on the 7th day (unless otherwise specified in this contract) after the Contractor delivers the supplies or performs the services in accordance with the terms and conditions of the contract, unless there is a disagreement over quantity, quality, or Contractor compliance with a contract provision. If actual acceptance occurs within the constructive acceptance period, the Government will base the determination of an interest penalty on the actual date of acceptance. The constructive acceptance requirement does not, however, compel Government officials to accept supplies or services, perform contract administration functions, or make payment prior to fulfilling their responsibilities.

(ii) The prompt payment regulations at 5 CFR 1315.10(c) do not require the Government to pay interest penalties if payment delays are due to disagreement between the Government and the Contractor over the payment amount or other issues involving contract compliance, or on amounts temporarily withheld or retained in accordance with the terms of the contract. The Government and the Contractor shall resolve claims involving disputes and any interest that may be payable in accordance with the clause at FAR 52.233-1, Disputes.

(6) Discounts for prompt payment. The designated payment office will pay an interest penalty automatically, without request from the Contractor, if the Government takes a discount for prompt payment improperly. The Government will calculate the interest penalty in accordance with the prompt payment regulations at 5 CFR part 1315.

(7) Additional interest penalty. (i) The designated payment office will pay a penalty amount, calculated in accordance with the prompt payment regulations at 5 CFR part 1315 in addition to the interest penalty amount only if--

(A) The Government owes an interest penalty of $1 or more;

(B) The designated payment office does not pay the interest penalty within 10 days after the date the invoice amount is paid; and

(C) The Contractor makes a written demand to the designated payment office for additional penalty payment, in accordance with paragraph (a)(7)(ii) of this clause, postmarked not later than 40 days after the invoice amount is paid.

(ii)(A) The Contractor shall support written demands for additional penalty payments with the following data. The Government will not request any additional data. The Contractor shall--

(1) Specifically assert that late payment interest is due under a specific invoice, and request payment of all overdue late payment interest penalty and such additional penalty as may be required;

(2) Attach a copy of the invoice on which the unpaid late payment interest is due; and

(3) State that payment of the principal has been received, including the date of receipt.

(B) If there is no postmark or the postmark is illegible--

(1) The designated payment office that receives the demand will annotate it with the date of receipt, provided the demand is received on or before the 40th day after payment was made; or

(2) If the designated payment office fails to make the required annotation, the Government will determine the demand's validity based on the date the Contractor has placed on the demand, provided such date is no later than the 40th day after payment was made.

(iii) The additional penalty does not apply to payments regulated by other Government regulations (e.g., payments under utility contracts subject to tariffs and regulation).

(b) Contract financing payment. If this contract provides for contract financing, the Government will make contract financing payments in accordance with the applicable contract financing clause.

(c) Fast payment procedure due dates. If this contract contains the clause at 52.213-1, Fast Payment Procedure, payments will be made within 15 days after the date of receipt of the invoice.

(d) Overpayments. If the Contractor becomes aware of a duplicate payment or that the Government has otherwise overpaid on an invoice payment, the Contractor shall immediately notify the Contracting Officer and request instructions for disposition of the overpayment.

(End of clause)

52.232-27 PROMPT PAYMENT FOR CONSTRUCTION CONTRACTS (FEB 2002)

Notwithstanding any other payment terms in this contract, the Government will make invoice payments under the terms and conditions specified in this clause. The Government considers payment as being made on the day a check is dated or the date of an electronic funds transfer. Definitions of pertinent terms are set forth in sections 2.101, 32.001, and 32.902 of the Federal Acquisition Regulation. All days referred to in this clause are calendar days, unless otherwise specified. (However, see paragraph (a)(3) concerning payments due on Saturdays, Sundays, and legal holidays.)

(a) Invoice payments--(1) Types of invoice payments. For purposes of this clause, there are several types of invoice payments that may occur under this contract, as follows:

(i) Progress payments, if provided for elsewhere in this contract, based on Contracting Officer approval of the estimated amount and value of work or services performed, including payments for reaching milestones in any project.

(A) The due date for making such payments is 14 days after the designated billing office receives a proper payment request. If the designated billing office fails to annotate the payment request with the actual date of receipt at the time of receipt, the payment due date is the 14th day after the date of the Contractor's payment request, provided the designated billing office receives a proper payment request and there is no disagreement over quantity, quality, or Contractor compliance with contract requirements.

(B) The due date for payment of any amounts retained by the Contracting Officer in accordance with the clause at 52.232-5, Payments Under Fixed-Price Construction Contracts, is as specified in the contract or, if not specified, 30 days after approval by the Contracting Officer for release to the Contractor.

(ii) Final payments based on completion and acceptance of all work and presentation of release of all claims against the Government arising by virtue of the contract, and payments for partial deliveries that have been accepted by the Government (e.g., each separate building, public work, or other division of the contract for which the price is stated separately in the contract).

(A) The due date for making such payments is the later of the following two events:

(1) The 30th day after the designated billing office receives a proper invoice from the Contractor.

(2) The 30th day after Government acceptance of the work or services completed by the Contractor. For a final invoice when the payment amount is subject to contract settlement actions (e.g., release of claims), acceptance is deemed to occur on the effective date of the contract settlement.

(B) If the designated billing office fails to annotate the invoice with the date of actual receipt at the time of receipt, the invoice payment due date is the 30th day after the date of the Contractor's invoice, provided the designated billing office receives a proper invoice and there is no disagreement over quantity, quality, or Contractor compliance with contract requirements.

(2) Contractor's invoice. The Contractor shall prepare and submit invoices to the designated billing office specified in the contract. A proper invoice must include the items listed in paragraphs (a)(2)(i) through (a)(2)(xi) of this clause. If the invoice does not comply with these requirements, the designated billing office must return it within 7 days after receipt, with the reasons why it is not a proper invoice. When computing any interest penalty owed the Contractor, the Government will take into account if the Government notifies the Contractor of an improper invoice in an untimely manner.

(i) Name and address of the Contractor.

(ii) Invoice date and invoice number. (The Contractor should date invoices as close as possible to the date of mailing or transmission.)

(iii) Contract number or other authorization for work or services performed (including order number and contract line item number).

(iv) Description of work or services performed.

(v) Delivery and payment terms (e.g., discount for prompt payment terms).

(vi) Name and address of Contractor official to whom payment is to be sent (must be the same as that in the contract or in a proper notice of assignment).

(vii) Name (where practicable), title, phone number, and mailing address of person to notify in the event of a defective invoice.

(viii) For payments described in paragraph (a)(1)(i) of this clause, substantiation of the amounts requested and certification in accordance with the requirements of the clause at 52.232-5, Payments Under Fixed-Price Construction Contracts.

(ix) Taxpayer Identification Number (TIN). The Contractor shall include its TIN on the invoice only if required elsewhere in this contract.

(x) Electronic funds transfer (EFT) banking information.

(A) The Contractor shall include EFT banking information on the invoice only if required elsewhere in this contract.

(B) If EFT banking information is not required to be on the invoice, in order for the invoice to be a proper invoice, the Contractor shall have submitted correct EFT banking information in accordance with the applicable solicitation provision (e.g., 52.232-38, Submission of Electronic Funds Transfer Information with Offer), contract clause (e.g., 52.232-33, Payment by Electronic Funds Transfer--Central Contractor Registration, or 52.232-34, Payment by Electronic Funds Transfer--Other Than Central Contractor Registration), or applicable agency procedures.

(C) EFT banking information is not required if the Government waived the requirement to pay by EFT.

(xi) Any other information or documentation required by the contract.

(3) Interest penalty. The designated payment office will pay an interest penalty automatically, without request from the Contractor, if payment is not made by the due date and the conditions listed in paragraphs (a)(3)(i) through (a)(3)(iii) of this clause are met, if applicable. However, when the due date falls on a Saturday, Sunday, or legal holiday, the designated payment office may make payment on the following working day without incurring a late payment interest penalty.

(i) The designated billing office received a proper invoice.

(ii) The Government processed a receiving report or other Government documentation authorizing payment and there was no disagreement over quantity, quality, Contractor compliance with any contract term or condition, or requested progress payment amount.

(iii) In the case of a final invoice for any balance of funds due the Contractor for work or services performed, the amount was not subject to further contract settlement actions between the Government and the Contractor.

(4) Computing penalty amount. The Government will compute the interest penalty in accordance with the Office of Management and Budget prompt payment regulations at 5 CFR part 1315.

(i) For the sole purpose of computing an interest penalty that might be due the Contractor for payments described in paragraph (a)(1)(ii) of this clause, Government acceptance or approval is deemed to occur constructively on the 7th day after the Contractor has completed the work or services in accordance with the terms and conditions of the contract. If actual acceptance or approval occurs within the constructive acceptance or approval period, the Government will base the determination of an interest penalty on the actual date of acceptance or approval. Constructive acceptance or constructive approval requirements do not apply if there is a disagreement over quantity, quality, or Contractor compliance with a contract provision. These requirements also do not compel Government officials to accept work or services, approve Contractor estimates, perform contract administration functions, or make payment prior to fulfilling their responsibilities.

(ii) The prompt payment regulations at 5 CFR 1315.10(c) do not require the Government to pay interest penalties if payment delays are due to disagreement between the Government and the Contractor over the payment amount or other issues involving contract compliance, or on amounts temporarily withheld or retained in accordance with the terms of the contract. The Government and the Contractor shall resolve claims involving disputes, and any interest that may be payable in accordance with the clause at FAR 52.233-1, Disputes.

(5) Discounts for prompt payment. The designated payment office will pay an interest penalty automatically, without request from the Contractor, if the Government takes a discount for prompt payment improperly. The Government will calculate the interest penalty in accordance with the prompt payment regulations at 5 CFR part 1315.

(6) Additional interest penalty. (i) The designated payment office will pay a penalty amount, calculated in accordance with the prompt payment regulations at 5 CFR part 1315 in addition to the interest penalty amount only if--

(A) The Government owes an interest penalty of $1 or more;

(B) The designated payment office does not pay the interest penalty within 10 days after the date the invoice amount is paid; and

(C) The Contractor makes a written demand to the designated payment office for additional penalty payment, in accordance with paragraph (a)(6)(ii) of this clause, postmarked not later than 40 days after the date the invoice amount is paid.

(ii)(A) The Contractor shall support written demands for additional penalty payments with the following data. The Government will not request any additional data. The Contractor shall--

(1) Specifically assert that late payment interest is due under a specific invoice, and request payment of all overdue late payment interest penalty and such additional penalty as may be required;

(2) Attach a copy of the invoice on which the unpaid late payment interest was due; and

(3) State that payment of the principal has been received, including the date of receipt.

(B) If there is no postmark or the postmark is illegible--

(1) The designated payment office that receives the demand will annotate it with the date of receipt provided the demand is received on or before the 40th day after payment was made; or

(2) If the designated payment office fails to make the required annotation, the Government will determine the demand's validity based on the date the Contractor has placed on the demand, provided such date is no later than the 40th day after payment was made.

(b) Contract financing payments. If this contract provides for contract financing, the Government will make contract financing payments in accordance with the applicable contract financing clause.

(c) Subcontract clause requirements. The Contractor shall include in each subcontract for property or services (including a material supplier) for the purpose of performing this contract the following:

(1) Prompt payment for subcontractors. A payment clause that obligates the Contractor to pay the subcontractor for satisfactory performance under its subcontract not later than 7 days from receipt of payment out of such amounts as are paid to the Contractor under this contract.

(2) Interest for subcontractors. An interest penalty clause that obligates the Contractor to pay to the subcontractor an interest penalty for each payment not made in accordance with the payment clause--

(i) For the period beginning on the day after the required payment date and ending on the date on which payment of the amount due is made; and

(ii) Computed at the rate of interest established by the Secretary of the Treasury, and published in the Federal Register, for interest payments under section 12 of the Contract Disputes Act of 1978 (41 U.S.C. 611) in effect at the time the Contractor accrues the obligation to pay an interest penalty.

(3) Subcontractor clause flowdown. A clause requiring each subcontractor to use:

(i) Include a payment clause and an interest penalty clause conforming to the standards set forth in paragraphs (c)(1) and (c)(2) of this clause in each of its subcontracts; and

(ii) Require each of its subcontractors to include such clauses in their subcontracts with each lower-tier subcontractor or supplier.

(d) Subcontract clause interpretation. The clauses required by paragraph (c) of this clause shall not be construed to impair the right of the Contractor or a subcontractor at any tier to negotiate, and to include in their subcontract, provisions that--

(1) Retainage permitted. Permit the Contractor or a subcontractor to retain (without cause) a specified percentage of each progress payment otherwise due to a subcontractor for satisfactory performance under the subcontract without incurring any obligation to pay a late payment interest penalty, in accordance with terms and conditions agreed to by the parties to the subcontract, giving such recognition as the parties deem appropriate to the ability of a subcontractor to furnish a performance bond and a payment bond;

(2) Withholding permitted. Permit the Contractor or subcontractor to make a determination that part or all of the subcontractor's request for payment may be withheld in accordance with the subcontract agreement; and

(3) Withholding requirements. Permit such withholding without incurring any obligation to pay a late payment penalty if--

(i) A notice conforming to the standards of paragraph (g) of this clause previously has been furnished to the subcontractor; and

(ii) The Contractor furnishes to the Contracting Officer a copy of any notice issued by a Contractor pursuant to paragraph (d)(3)(i) of this clause.

(e) Subcontractor withholding procedures. If a Contractor, after making a request for payment to the Government but before making a payment to a subcontractor for the subcontractor's performance covered by the payment request, discovers that all or a portion of the payment otherwise due such subcontractor is subject to withholding from the subcontractor in accordance with the subcontract agreement, then the Contractor shall--

(1) Subcontractor notice. Furnish to the subcontractor a notice conforming to the standards of paragraph (g) of this clause as soon as practicable upon ascertaining the cause giving rise to a withholding, but prior to the due date for subcontractor payment;

(2) Contracting Officer notice. Furnish to the Contracting Officer, as soon as practicable, a copy of the notice furnished to the subcontractor pursuant to paragraph (e)(1) of this clause;

(3) Subcontractor progress payment reduction. Reduce the subcontractor's progress payment by an amount not to exceed the amount specified in the notice of withholding furnished under paragraph (e)(1) of this clause;

(4) Subsequent subcontractor payment. Pay the subcontractor as soon as practicable after the correction of the identified subcontract performance deficiency, and--

(i) Make such payment within--

(A) Seven days after correction of the identified subcontract performance deficiency (unless the funds therefor must be recovered from the Government because of a reduction under paragraph (e)(5)(i)) of this clause; or

(B) Seven days after the Contractor recovers such funds from the Government; or

(ii) Incur an obligation to pay a late payment interest penalty computed at the rate of interest established by the Secretary of the Treasury, and published in the Federal Register, for interest payments under section 12 of the Contracts Disputes Act of 1978 (41 U.S.C. 611) in effect at the time the Contractor accrues the obligation to pay an interest penalty;

(5) Notice to Contracting Officer. Notify the Contracting Officer upon--

(i) Reduction of the amount of any subsequent certified application for payment; or

(ii) Payment to the subcontractor of any withheld amounts of a progress payment, specifying--

(A) The amounts withheld under paragraph (e)(1) of this clause; and

(B) The dates that such withholding began and ended; and

(6) Interest to Government. Be obligated to pay to the Government an amount equal to interest on the withheld payments (computed in the manner provided in 31 U.S.C. 3903(c)(1)), from the 8th day after receipt of the withheld amounts from the Government until--

(i) The day the identified subcontractor performance deficiency is corrected; or

(ii) The date that any subsequent payment is reduced under paragraph (e)(5)(i) of this clause.

(f) Third-party deficiency reports--(1) Withholding from subcontractor. If a Contractor, after making payment to a first-tier subcontractor, receives from a supplier or subcontractor of the first-tier subcontractor (hereafter referred to as a "second-tier subcontractor") a written notice in accordance with section 2 of the Act of August 24, 1935 (40 U.S.C. 270b, Miller Act), asserting a deficiency in such first-tier subcontractor's performance under the contract for which the Contractor may be ultimately liable, and the Contractor determines that all or a portion of future payments otherwise due such first-tier subcontractor is subject to withholding in accordance with the subcontract agreement, the Contractor may, without incurring an obligation to pay an interest penalty under paragraph (e)(6) of this clause--

(i) Furnish to the first-tier subcontractor a notice conforming to the standards of paragraph (g) of this clause as soon as practicable upon making such determination; and

(ii) Withhold from the first-tier subcontractor's next available progress payment or payments an amount not to exceed the amount specified in the notice of withholding furnished under paragraph (f)(1)(i) of this clause.

(2) Subsequent payment or interest charge. As soon as practicable, but not later than 7 days after receipt of satisfactory written notification that the identified subcontract performance deficiency has been corrected, the Contractor shall--

(i) Pay the amount withheld under paragraph (f)(1)(ii) of this clause to such first-tier subcontractor; or

(ii) Incur an obligation to pay a late payment interest penalty to such first-tier subcontractor computed at the rate of interest established by the Secretary of the Treasury, and published in the Federal Register, for interest payments under section 12 of the Contracts DisputesAct of 1978 (41 U.S.C. 611) in effect at the time the Contractor accrues the obligation to pay an interest penalty.

(g) Written notice of subcontractor withholding. The Contractor shall issue a written notice of any withholding to a subcontractor (with a copy furnished to the Contracting Officer), specifying--

(1) The amount to be withheld;

(2) The specific causes for the withholding under the terms of the subcontract; and

(3) The remedial actions to be taken by the subcontractor in order to receive payment of the amounts withheld.

(h) Subcontractor payment entitlement. The Contractor may not request payment from the Government of any amount withheld or retained in accordance with paragraph (d) of this clause until such time as the Contractor has determined and certified to the Contracting Officer that the subcontractor is entitled to the payment of such amount.

(i) Prime-subcontractor disputes. A dispute between the Contractor and subcontractor relating to the amount or entitlement of a subcontractor to a payment or a late payment interest penalty under a clause included in the subcontract pursuant to paragraph (c) of this clause does not constitute a dispute to which the Government is a party. The Government may not be interpleaded in any judicial or administrative proceeding involving such a dispute.

(j) Preservation of prime-subcontractor rights. Except as provided in paragraph (i) of this clause, this clause shall not limit or impair any contractual, administrative, or judicial remedies otherwise available to the Contractor or a subcontractor in the event of a dispute involving late payment or nonpayment by the Contractor or deficient subcontract performance or nonperformance by a subcontractor.

(k) Non-recourse for prime contractor interest penalty. The Contractor's obligation to pay an interest penalty to a subcontractor pursuant to the clauses included in a subcontract under paragraph (c) of this clause shall not be construed to be an obligation of the Government for such interest penalty. A cost-reimbursement claim may not include any amount for reimbursement of such interest penalty.

(l) Overpayments. If the Contractor becomes aware of a duplicate payment or that the Government has otherwise overpaid on an invoice payment, the Contractor shall immediately notify the Contracting Officer and request instructions for disposition of the overpayment.

(End of clause)

52.232-33 PAYMENT BY ELECTRONIC FUNDS TRANSFER—CENTRAL CONTRACTOR REGISTRATION (MAY 1999)

(a) Method of payment. (1) All payments by the Government under this contract shall be made by electronic funds transfer (EFT), except as provided in paragraph (a)(2) of this clause. As used in this clause, the term “EFT” refers to the funds transfer and may also include the payment information transfer.

(2) In the event the Government is unable to release one or more payments by EFT, the Contractor agrees to either--

(i) Accept payment by check or some other mutually agreeable method of payment; or

(ii) Request the Government to extend the payment due date until such time as the Government can make payment by EFT (but see paragraph (d) of this clause).

(b) Contractor's EFT information. The Government shall make payment to the Contractor using the EFT information contained in the Central Contractor Registration (CCR) database. In the event that the EFT information changes, the Contractor shall be responsible for providing the updated information to the CCR database.

(c) Mechanisms for EFT payment. The Government may make payment by EFT through either the Automated Clearing House (ACH) network, subject to the rules of the National Automated Clearing House Association, or the Fedwire Transfer System. The rules governing Federal payments through the ACH are contained in 31 CFR part 210.

(d) Suspension of payment. If the Contractor's EFT information in the CCR database is incorrect, then the Government need not make payment to the Contractor under this contract until correct EFT information is entered into the CCR database; and any invoice or contract financing request shall be deemed not to be a proper invoice for the purpose of prompt payment under this contract. The prompt payment terms of the contract regarding notice of an improper invoice and delays in accrual of interest penalties apply.

(e) Contractor EFT arrangements. If the Contractor has identified multiple payment receiving points (i.e., more than one remittance address and/or EFT information set) in the CCR database, and the Contractor has

not notified the Government of the payment receiving point applicable to this contract, the Government shall make payment to the first payment receiving point (EFT information set or remittance address as applicable) listed in the CCR database.

(f) Liability for uncompleted or erroneous transfers. (1) If an uncompleted or erroneous transfer occurs because the Government used the Contractor's EFT information incorrectly, the Government remains responsible for--

(i) Making a correct payment;

(ii) Paying any prompt payment penalty due; and

(iii) Recovering any erroneously directed funds.

(2) If an uncompleted or erroneous transfer occurs because the Contractor's EFT information was incorrect, or was revised within 30 days of Government release of the EFT payment transaction instruction to the Federal Reserve System, and--

(i) If the funds are no longer under the control of the payment office, the Government is deemed to have made payment and the Contractor is responsible for recovery of any erroneously directed funds; or

(ii) If the funds remain under the control of the payment office, the Government shall not make payment, and the provisions of paragraph (d) of this clause shall apply.

(g) EFT and prompt payment. A payment shall be deemed to have been made in a timely manner in accordance with the prompt payment terms of this contract if, in the EFT payment transaction instruction released to the Federal Reserve System, the date specified for settlement of the payment is on or before the prompt payment due date, provided the specified payment date is a valid date under the rules of the Federal Reserve System.

(h) EFT and assignment of claims. If the Contractor assigns the proceeds of this contract as provided for in the assignment of claims terms of this contract, the Contractor shall require as a condition of any such assignment, that the assignee shall register in the CCR database and shall be paid by EFT in accordance with the terms of this clause. In all respects, the requirements of this clause shall apply to the assignee as if it were the Contractor. EFT information that shows the ultimate recipient of the transfer to be other than the Contractor, in the absence of a proper assignment of claims acceptable to the Government, is incorrect EFT information within the meaning of paragraph (d) of this clause.

(i) Liability for change of EFT information by financial agent. The Government is not liable for errors resulting from changes to EFT information made by the Contractor's financial agent.

(j) Payment information. The payment or disbursing office shall forward to the Contractor available payment information that is suitable for transmission as of the date of release of the EFT instruction to the Federal Reserve System. The Government may request the Contractor to designate a desired format and method(s) for delivery of payment information from a list of formats and methods the payment office is capable of executing. However, the Government does not guarantee that any particular format or method of delivery is available at any particular payment office and retains the latitude to use the format and delivery method most convenient to the Government. If the Government makes payment by check in accordance with paragraph (a) of this clause, the Government shall mail the payment information to the remittance address contained in the CCR database.

(End of Clause)

52.233-1 Disputes. (JUL 2002)

(a) This contract is subject to the Contract Disputes Act of 1978, as amended (41 U.S.C. 601-613).

(b) Except as provided in the Act, all disputes arising under or relating to this contract shall be resolved under this clause.

(c) Claim, as used in this clause, means a written demand or written assertion by one of the contracting parties seeking, as a matter of right, the payment of money in a sum certain, the adjustment or interpretation of contract terms, or other relief arising under or relating to this contract. However, a written demand or written assertion by the Contractor seeking the payment of money exceeding $100,000 is not a claim under the Act until certified. A voucher, invoice, or other routine request for payment that is not in dispute when submitted is not a claim under the Act. The submission may be converted to a claim under the Act, by complying with the submission and certification requirements of this clause, if it is disputed either as to liability or amount or is not acted upon in a reasonable time.

(d)(1) A claim by the Contractor shall be made in writing and, unless otherwise stated in this contract, submitted within 6 years after accrual of the claim to the Contracting Officer for a written decision. A claim by the Government against the Contractor shall be subject to a written decision by the Contracting Officer.

(2)(i) The contractors shall provide the certification specified in subparagraph (d)(2)(iii) of this clause when submitting any claim -

(A) Exceeding $100,000; or

(B) Regardless of the amount claimed, when using -

(1) Arbitration conducted pursuant to 5 U.S.C. 575-580; or

(2) Any other alternative means of dispute resolution (ADR) technique that the agency elects to handle in accordance with the Administrative Dispute Resolution Act (ADRA).

(ii) The certification requirement does not apply to issues in controversy that have not been submitted as all or part of a claim.

(iii) The certification shall state as follows: "I certify that the claim is made in good faith; that the supporting data are accurate and complete to the best of my knowledge and belief; that the amount requested accurately reflects the contract adjustment for which the Contractor believes the Government is liable; and that I am duly authorized to certify the claim on behalf of the Contractor.

(3) The certification may be executed by any person duly authorized to bind the Contractor with respect to the claim.

(e) For Contractor claims of $100,000 or less, the Contracting Officer must, if requested in writing by the Contractor, render a decision within 60 days of the request. For Contractor-certified claims over $100,000, the Contracting Officer must, within 60 days, decide the claim or notify the Contractor of the date by which the decision will be made.

(f) The Contracting Officer's decision shall be final unless the Contractor appeals or files a suit as provided in the Act.

(g) If the claim by the Contractor is submitted to the Contracting Officer or a claim by the Government is presented to the Contractor, the parties, by mutual consent, may agree to use alternative disput resolution (ADR). If the Contractor refuses an offer for ADR, the Contractor shall inform the Contracting Officer, in writing, of the Contractor's specific reasons for rejecting the request.

(h) The Government shall pay interest on the amount found due and unpaid from (1) the date the

Contracting Officer receives the claim (certified, if required); or (2) the date that payment otherwise would be due, if that date is later, until the date of payment. With regard to claims having defective certifications, as defined in (FAR) 48 CFR 33.201, interest shall be paid from the date that the Contracting Officer initially receives the claim. Simple interest on claims shall be paid at the rate, fixed by the Secretary of the Treasury as provided in the Act, which is applicable to the period during which the Contracting Officer receives the claim and then at the rate applicable for each 6-month period as fixed by the Treasury Secretary during the pendency of the claim.

(i) The Contractor shall proceed diligently with performance of this contract, pending final resolution of any request for relief, claim, appeal, or action arising under the contract, and comply with any decision of the Contracting Officer.

(End of clause)

52.233-2 SERVICE OF PROTEST (AUG 1996)

(a) Protests, as defined in section 33.101 of the Federal Acquisition Regulation, that are filed directly with an agency, and copies of any protests that are filed with the General Accounting Office (GAO), shall be served on the Contracting Officer (addressed as follows) by obtaining written and dated acknowledgment of receipt from _____. (Contracting Officer designate the official or location where a protest may be served on the Contracting Officer.)

(b) The copy of any protest shall be received in the office designated above within one day of filing a protest with the GAO.

(End of provision)

52.233-3 PROTEST AFTER AWARD (AUG. 1996)

(a) Upon receipt of a notice of protest (as defined in FAR 33.101) or a determination that a protest is likely (see FAR 33.102(d)), the Contracting Officer may, by written order to the Contractor, direct the Contractor to stop performance of the work called for by this contract. The order shall be specifically identified as a stop-work order issued under this clause. Upon receipt of the order, the Contractor shall immediately comply with its terms and take all reasonable steps to minimize the incurrence of costs allocable to the work covered by the order during the period of work stoppage. Upon receipt of the final decision in the protest, the Contracting Officer shall either--

(1) Cancel the stop-work order; or

(2) Terminate the work covered by the order as provided in the Default, or the Termination for Convenience of the Government, clause of this contract.

(b) If a stop-work order issued under this clause is canceled either before or after a final decision in the protest, the Contractor shall resume work. The Contracting Officer shall make an equitable adjustment in the delivery schedule or contract price, or both, and the contract shall be modified, in writing, accordingly, if--

(1) The stop-work order results in an increase in the time required for, or in the Contractor's cost properly allocable to, the performance of any part of this contract; and

(2) The Contractor asserts its right to an adjustment within 30 days after the end of the period of work stoppage; provided, that if the Contracting Officer decides the facts justify the action, the Contracting Officer may receive and act upon a proposal at any time before final payment under this contract.

(c) If a stop-work order is not canceled and the work covered by the order is terminated for the convenience of the Government, the Contracting Officer shall allow reasonable costs resulting from the stop-work order in arriving at the termination settlement.

(d) If a stop-work order is not canceled and the work covered by the order is terminated for default, the Contracting Officer shall allow, by equitable adjustment or otherwise, reasonable costs resulting from the stop-work order.

(e) The Government's rights to terminate this contract at any time are not affected by action taken under this clause.

(f) If, as the result of the Contractor's intentional or negligent misstatement, misrepresentation, or miscertification, a protest related to this contract is sustained, and the Government pays costs, as provided in FAR 33.102(b)(2) or 33.104(h)(1), the Government may require the Contractor to reimburse the Government the amount of such costs. In addition to any other remedy available, and pursuant to the requirements of Subpart 32.6, the Government may collect this debt by offsetting the amount against any payment due the Contractor under any contract between the Contractor and the Government.

(End of clause)

52.236-2 DIFFERING SITE CONDITIONS (APR 1984)

As prescribed in 36.502, insert the following clause in solicitations and contracts when a fixed-price construction contract or a fixed-price dismantling, demolition, or removal of improvements contract is contemplated and the contract amount is expected to exceed the small purchase limitation. The Contracting Officer may insert the clause in solicitations and contracts when a fixed-price construction or a fixed-price contract for dismantling, demolition, or removal of improvements is contemplated and the contract amount is expected to be within the small purchase limitation.

(a) The Contractor shall promptly, and before the conditions are disturbed, give a written notice to the Contracting Officer of

(1) subsurface or latent physical conditions at the site which differ materially from those indicated in this contract, or

(2) unknown physical conditions at the site, of an unusual nature, which differ materially from those ordinarily encountered and generally recognized as inhering in work of the character provided for in the contract.

(b) The Contracting Officer shall investigate the site conditions promptly after receiving the notice. If the conditions do materially so differ and cause an increase or decrease in the Contractor's cost of, or the time required for, performing any part of the work under this contract, whether or not changed as a result of the conditions, an equitable adjustment shall be made under this clause and the contract modified in writing accordingly.

(c) No request by the Contractor for an equitable adjustment to the contract under this clause shall be allowed, unless the Contractor has given the written notice required; provided, that the time prescribed in (a) above for giving written notice may be extended by the Contracting Officer.

(d) No request by the Contractor for an equitable adjustment to the contract for differing site conditions shall be allowed if made after final payment under this contract.

(End of clause)

52.236-3 SITE INVESTIGATION AND CONDITIONS AFFECTING THE WORK (APR 1984)

(a) The Contractor acknowledges that it has taken steps reasonably necessary to ascertain the nature and location of the work, and that it has investigated and satisfied itself as to the general and local conditions which can affect the work or its cost, including but not limited to

(1) conditions bearing upon transportation, disposal, handling, and storage of materials;

(2) the availability of labor, water, electric power, and roads;

(3) uncertainties of weather, river stages, tides, or similar physical conditions at the site;

(4) the conformation and conditions of the ground; and (5) the character of equipment and facilities needed preliminary to and during work performance. The Contractor also acknowledges that it has satisfied itself as to the character, quality, and quantity of surface and subsurface materials or obstacles to be encountered insofar as this information is reasonably ascertainable from an inspection of the site, including all exploratory work done by the Government, as well as from the drawings and specifications made a part of this contract. Any failure of the Contractor to take the actions described and acknowledged in this paragraph will not relieve the Contractor from responsibility for estimating properly the difficulty and cost of successfully performing the work, or for proceeding to successfully perform the work without additional expense to the Government.

(b) The Government assumes no responsibility for any conclusions or interpretations made by the Contractor based on the information made available by the Government. Nor does the Government assume responsibility for any understanding reached or representation made concerning conditions which can affect the work by any of its officers or agents before the execution of this contract, unless that understanding or representation is expressly stated in this contract.

(End of clause)

52.236-5 MATERIAL AND WORKMANSHIP (APR 1984)

(a) All equipment, material, and articles incorporated into the work covered by this contract shall be new and of the most suitable grade for the purpose intended, unless otherwise specifically provided in this contract. References in the specifications to equipment, material, articles, or patented processes by trade name, make, or catalog number, shall be regarded as establishing a standard of quality and shall not be construed as limiting competition. The Contractor may, at its option, use any equipment, material, article, or process that, in the judgment of the Contracting Officer, is equal to that named in the specifications, unless otherwise specifically provided in this contract.

(b) The Contractor shall obtain the Contracting Officer's approval of the machinery and mechanical and other equipment to be incorporated into the work. When requesting approval, the Contractor shall furnish to the Contracting Officer the name of the manufacturer, the model number, and other information concerning the performance, capacity, nature, and rating of the machinery and mechanical and other equipment. When required by this contract or by the Contracting Officer, the Contractor shall also obtain the Contracting Officer's approval of the material or articles which the Contractor contemplates incorporating into the work. When requesting approval, the Contractor shall provide full information concerning the material or articles. When directed to do so, the Contractor shall submit samples for approval at the Contractor's expense, with all shipping charges prepaid. Machinery, equipment, material, and articles that do not have the required approval shall be installed or used at the risk of subsequent rejection.

(c) All work under this contract shall be performed in a skillful and workmanlike manner. The Contracting Officer may require, in writing, that the Contractor remove from the work any employee the Contracting Officer deems incompetent, careless, or otherwise objectionable.

(End of clause)

52.236-6 SUPERINTENDENCE BY THE CONTRACTOR (APR 1984)

At all times during performance of this contract and until the work is completed and accepted, the Contractor shall directly superintend the work or assign and have on the worksite a competent superintendent who is satisfactory to the Contracting Officer and has authority to act for the Contractor.

(End of clause)

52.236-7 PERMITS AND RESPONSIBILITIES (NOV 1991)

The Contractor shall, without additional expense to the Government, be responsible for obtaining any necessary licenses and permits, and for complying with any Federal, State, and municipal laws, codes, and regulations applicable to the performance of the work. The Contractor shall also be responsible for all damages to persons or property that occur as a result of the Contractor's fault or negligence. The Contractor shall also be responsible for all materials delivered and work performed until completion and acceptance of the entire work, except for any completed unit of work which may have been accepted under the contract.

(End of clause)

52.236-8 OTHER CONTRACTS (APR 1984)

The Government may undertake or award other contracts for additional work at or near the site of the work under this contract. The Contractor shall fully cooperate with the other contractors and with Government employees and shall carefully adapt scheduling and performing the work under this contract to accommodate the additional work, heeding any direction that may be provided by the Contracting Officer. The Contractor shall not commit or permit any act that will interfere with the performance of work by any other contractor or by Government employees.

(End of clause)

52.236-9 PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS (APR 1984)

(a) The Contractor shall preserve and protect all structures, equipment, and vegetation (such as trees, shrubs, and grass) on or adjacent to the work site, which are not to be removed and which do not unreasonably interfere with the work required under this contract. The Contractor shall only remove trees when specifically authorized to do so, and shall avoid damaging vegetation that will remain in place. If any limbs or branches of trees are broken during contract performance, or by the careless operation of equipment, or by workmen, the Contractor shall trim those limbs or branches with a clean cut and paint the cut with a tree-pruning compound as directed by the Contracting Officer.

(b) The Contractor shall protect from damage all existing improvements and utilities

(1) at or near the work site, and

(2) on adjacent property of a third party, the locations of which are made known to or should be known by the Contractor. The Contractor shall repair any damage to those facilities, including those that are the property of a third party, resulting from failure to comply with the requirements of this contract or failure to exercise reasonable care in performing the work. If the Contractor fails or refuses to repair the damage

promptly, the Contracting Officer may have the necessary work performed and charge the cost to the Contractor.

(End of clause)

52.236-10 OPERATIONS AND STORAGE AREAS (APR 1984)

(a) The Contractor shall confine all operations (including storage of materials) on Government premises to areas authorized or approved by the Contracting Officer. The Contractor shall hold and save the Government, its officers and agents, free and harmless from liability of any nature occasioned by the Contractor's performance.

(b) Temporary buildings (e.g., storage sheds, shops, offices) and utilities may be erected by the Contractor only with the approval of the Contracting Officer and shall be built with labor and materials furnished by the Contractor without expense to the Government. The temporary buildings and utilities shall remain the property of the Contractor and shall be removed by the Contractor at its expense upon completion of the work. With the written consent of the Contracting Officer, the buildings and utilities may be abandoned and need not be removed.

(c) The Contractor shall, under regulations prescribed by the Contracting Officer, use only established roadways, or use temporary roadways constructed by the Contractor when and as authorized by the Contracting Officer. When materials are transported in prosecuting the work, vehicles shall not be loaded beyond the loading capacity recommended by the manufacturer of the vehicle or prescribed by any Federal, State, or local law or regulation. When it is necessary to cross curbs or sidewalks, the Contractor shall protect them from damage. The Contractor shall repair or pay for the repair of any damaged curbs, sidewalks, or roads.

(End of clause)

52.236-11 USE AND POSSESSION PRIOR TO COMPLETION (APR 1984)

(a) The Government shall have the right to take possession of or use any completed or partially completed part of the work. Before taking possession of or using any work, the Contracting Officer shall furnish the Contractor a list of items of work remaining to be performed or corrected on those portions of the work that the Government intends to take possession of or use. However, failure of the Contracting Officer to list any item of work shall not relieve the Contractor of responsibility for complying with the terms of the contract. The Government's possession or use shall not be deemed an acceptance of any work under the contract.

(b) While the Government has such possession or use, the Contractor shall be relieved of the responsibility for the loss of or damage to the work resulting from the Government's possession or use, notwithstanding the terms of the clause in this contract entitled "Permits and Responsibilities." If prior possession or use by the Government delays the progress of the work or causes additional expense to the Contractor, an equitable adjustment shall be made in the contract price or the time of completion, and the contract shall be modified in writing accordingly.

(End of clause)

52.236-12 CLEANING UP (APR 1984)

The Contractor shall at all times keep the work area, including storage areas, free from accumulations of waste materials. Before completing the work, the Contractor shall remove from the work and premises any rubbish, tools, scaffolding, equipment, and materials that are not the property of the Government. Upon

completing the work, the Contractor shall leave the work area in a clean, neat, and orderly condition satisfactory to the Contracting Officer.

(End of clause)

52.236-13 ACCIDENT PREVENTION (NOV 1991) – ALTERNATE I (NOV 1991)

(a) The Contractor shall provide and maintain work environments and procedures which will

(1) safeguard the public and Government personnel, property, materials, supplies, and equipment exposed to Contractor operations and activities;

(2) avoid interruptions of Government operations and delays in project completion dates; and

(3) control costs in the performance of this contract.

(b) For these purposes on contracts for construction or dismantling, demolition, or removal of improvements, the Contractor shall-

(1) Provide appropriate safety barricades, signs, and signal lights;

(2) Comply with the standards issued by the Secretary of Labor at 29 CFR Part 1926 and 29 CFR Part 1910; and

(3) Ensure that any additional measures the Contracting Officer determines to be reasonably necessary for the purposes are taken.

(e) If this contract is for construction or dismantling, demolition or removal of improvements with any Department of Defense agency or component, the Contractor shall comply with all pertinent provisions of the latest version of U.S. Army Corps of Engineers Safety and Health Requirements Manual, EM 385-1-1, in effect on the date of the solicitation.

(c) Whenever the Contracting Officer becomes aware of any noncompliance with these requirements or any condition which poses a serious or imminent danger to the health or safety of the public or Government personnel, the Contracting Officer shall notify the Contractor orally, with written confirmation, and request immediate initiation of corrective action. This notice, when delivered to the Contractor or the Contractor's representative at the work site, shall be deemed sufficient notice of the noncompliance and that corrective action is required. After receiving the notice, the Contractor shall immediately take corrective action. If the Contractor fails or refuses to promptly take corrective action, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. The Contractor shall not be entitled to any equitable adjustment of the contract price or extension of the performance schedule on any stop work order issued under this clause.

(e) The Contractor shall insert this clause, including this paragraph (e), with appropriate changes in the designation of the parties, in subcontracts.

(f) Before commencing the work, the Contractor shall-

(1) Submit a written proposed plan for implementing this clause. The plan shall include an analysis of the significant hazards to life, limb, and property inherent in contract work performance and a plan for controlling these hazards; and

(2) Meet with representatives of the Contracting Officer to discuss and develop a mutual understanding relative to administration of the overall safety program.

(End of clause)

52.236-14 AVAILABILITY AND USE OF UTILITY SERVICES (APR 1984)

(a) The Government shall make all reasonably required amounts of utilities available to the Contractor from existing outlets and supplies, as specified in the contract. Unless otherwise provided in the contract, the amount of each utility service consumed shall be charged to or paid for by the Contractor at prevailing rates charged to the Government or, where the utility is produced by the Government, at reasonable rates determined by the Contracting Officer. The Contractor shall carefully conserve any utilities furnished without charge.

(b) The Contractor, at its expense and in a workmanlike manner satisfactory to the Contracting Officer, shall install and maintain all necessary temporary connections and distribution lines, and all meters required to measure the amount of each utility used for the purpose of determining charges. Before final acceptance of the work by the Government, the Contractor shall remove all the temporary connections, distribution lines, meters, and associated paraphernalia.

(End of clause)

52.236-15 SCHEDULES FOR CONSTRUCTION CONTRACTS (APR 1984)

(a) The Contractor shall, within five days after the work commences on the contract or another period of time determined by the Contracting Officer, prepare and submit to the Contracting Officer for approval three copies of a practicable schedule showing the order in which the Contractor proposes to perform the work, and the dates on which the Contractor contemplates starting and completing the several salient features of the work (including acquiring materials, plant, and equipment). The schedule shall be in the form of a progress chart of suitable scale to indicate appropriately the percentage of work scheduled for completion by any given date during the period. If the Contractor fails to submit a schedule within the time prescribed, the Contracting Officer may withhold approval of progress payments until the Contractor submits the required schedule.

(b) The Contractor shall enter the actual progress on the chart as directed by the Contracting Officer, and upon doing so shall immediately deliver three copies of the annotated schedule to the Contracting Officer. If, in the opinion of the Contracting Officer, the Contractor falls behind the approved schedule, the Contractor shall take steps necessary to improve its progress, including those that may be required by the Contracting Officer, without additional cost to the Government. In this circumstance, the Contracting Officer may require the Contractor to increase the number of shifts, overtime operations, days of work, and/or the amount of construction plant, and to submit for approval any supplementary schedule or schedules in chart form as the Contracting Officer deems necessary to demonstrate how the approved rate of progress will be regained.

(c) Failure of the Contractor to comply with the requirements of the Contracting Officer under this clause shall be grounds for a determination by the Contracting Officer that the Contractor is not prosecuting the work with sufficient diligence to ensure completion within the time specified in the contract. Upon making this determination, the Contracting Officer may terminate the Contractor's right to proceed with the work, or any separable part of it, in accordance with the default terms of this contract.

(End of clause)

52.236-17 LAYOUT OF WORK (APR 1984)

The Contractor shall lay out its work from Government established base lines and bench marks indicated

on the drawings, and shall be responsible for all measurements in connection with the layout. The Contractor shall furnish, at its own expense, all stakes, templates, platforms, equipment, tools, materials, and labor required to lay out any part of the work. The Contractor shall be responsible for executing the work to the lines and grades that may be established or indicated by the Contracting Officer. The Contractor shall also be responsible for maintaining and preserving all stakes and other marks established by the Contracting Officer until authorized to remove them. If such marks are destroyed by the Contractor or through its negligence before their removal is authorized, the Contracting Officer may replace them and deduct the expense of the replacement from any amounts due or to become due to the Contractor.

(End of clause)

52.236-26 PRECONSTRUCTION CONFERENCE (FEB 1995)

If the Contracting Officer decides to conduct a preconstruction conference, the successful offeror will be notified and will be required to attend. The Contracting Officer's notification will include specific details regarding the date, time, and location of the conference, any need for attendance by subcontractors, and information regarding the items to be discussed.

(End of clause)

52.242-3 Penalties for Unallowable Costs. (MAY 2001)

(a) Definition. Proposal, as used in this clause, means either--

(1) A final indirect cost rate proposal submitted by the Contractor after the expiration of its fiscal year which--

(i) Relates to any payment made on the basis of billing rates; or

(ii) Will be used in negotiating the final contract price; or

(2) The final statement of costs incurred and estimated to be incurred under the Incentive Price Revision clause (if applicable), which is used to establish the final contract price.

(b) Contractors which include unallowable indirect costs in a proposal may be subject to penalties. The penalties are prescribed in 10 U.S.C. 2324 or 41 U.S.C. 256, as applicable, which is implemented in Section 42.709 of the Federal Acquisition Regulation (FAR).

(c) The Contractor shall not include in any proposal any cost that is unallowable, as defined in Subpart 2.1 of the FAR, or an executive agency supplement to the FAR.

(d) If the Contracting Officer determines that a cost submitted by the Contractor in its proposal is expressly unallowable under a cost principle in the FAR, or an executive agency supplement to the FAR, that defines the allowability of specific selected costs, the Contractor shall be assessed a penalty equal to--

(1) The amount of the disallowed cost allocated to this contract; plus

2) Simple interest, to be computed--

(i) On the amount the Contractor was paid (whether as a progress or billing payment) in excess of the amount to which the Contractor was entitled; and

(ii) Using the applicable rate effective for each six-month interval prescribed by the Secretary of the

Treasury pursuant to Pub. L. 92-41 (85 Stat. 97).

(e) If the Contracting Officer determines that a cost submitted by the Contractor in its proposal includes a cost previously determined to be unallowable for that Contractor, then the Contractor will be assessed a penalty in an amount equal to two times the amount of the disallowed cost allocated to this contract.

(f) Determinations under paragraphs (d) and (e) of this clause are final decisions within the meaning of the Contract Disputes Act of 1978 (41 U.S.C. 601, et seq.).

(g) Pursuant to the criteria in FAR 42.709-5, the Contracting Officer may waive the penalties in paragraph (d) or (e) of this clause.

(h) Payment by the Contractor of any penalty assessed under this clause does not constitute repayment to the Government of any unallowable cost which has been paid by the Government to the Contractor.

(End of clause)

52.242-13 BANKRUPTCY (JUL 1995)

In the event the Contractor enters into proceedings relating to bankruptcy, whether voluntary or involuntary, the Contractor agrees to furnish, by certified mail or electronic commerce method authorized by the contract, written notification of the bankruptcy to the Contracting Officer responsible for administering the contract. This notification shall be furnished within five days of the initiation of the proceedings relating to bankruptcy filing. This notification shall include the date on which the bankruptcy petition was filed, the identity of the court in which the bankruptcy petition was filed, and a listing of Government contract numbers and contracting offices for all Government contracts against which final payment has not been made. This obligation remains in effect until final payment under this contract.

(End of clause)

52.242-14 SUSPENSION OF WORK (APR 1984)

(a) The Contracting Officer may order the Contractor, in writing, to suspend, delay, or interrupt all or any part of the work of this contract for the period of time that the Contracting Officer determines appropriate for the convenience of the Government.

(b) If the performance of all or any part of the work is, for an unreasonable period of time, suspended, delayed, or interrupted (1) by an act of the Contracting Officer in the administration of this contract, or (2) by the Contracting Officer's failure to act within the time specified in this contract (or within a reasonable time if not specified), an adjustment shall be made for any increase in the cost of performance of this contract (excluding profit) necessarily caused by the unreasonable suspension, delay, or interruption, and the contract modified in writing accordingly. However, no adjustment shall be made under this clause for any suspension, delay, or interruption to the extent that performance would have been so suspended, delayed, or interrupted by any other cause, including the fault or negligence of the Contractor, or for which an equitable adjustment is provided for or excluded under any other term or condition of this contract. (c) A claim under this clause shall not be allowed (1) for any costs incurred more than 20 days before the Contractor shall have notified the Contracting Officer in writing of the act or failure to act involved (but this requirement shall not apply as to a claim resulting from a suspension order), and (2) unless the claim, in an amount stated, is asserted in writing as soon as practicable after the termination of the suspension, delay, or interruption, but not later than the date of final payment under the contract.

(End of clause)

52.243-4 CHANGES (AUG 1987)

(a) The Contracting Officer may, at any time, without notice to the sureties, if any, by written order designated or indicated to be a change order, make changes in the work within the general scope of the contract, including changes--

(1) In the specifications (including drawings and designs);

(2) In the method or manner of performance of the work;

(3) In the Government-furnished facilities, equipment, materials, services, or site; or

(4) Directing acceleration in the performance of the work.

(b) Any other written or oral order (which, as used in this paragraph (b), includes direction, instruction, interpretation, or determination) from the Contracting Officer that causes a change shall be treated as a change order under this clause; provided, that the Contractor gives the Contracting Officer written notice stating

(1) the date, circumstances, and source of the order and

(2) that the Contractor regards the order as a change order.

(c) Except as provided in this clause, no order, statement, or conduct of the Contracting Officer shall be treated as a change under this clause or entitle the Contractor to an equitable adjustment.

(d) If any change under this clause causes an increase or decrease in the Contractor's cost of, or the time required for, the performance of any part of the work under this contract, whether or not changed by any such order, the Contracting Officer shall make an equitable adjustment and modify the contract in writing. However, except for an adjustment based on defective specifications, no adjustment for any change under paragraph (b) of this clause shall be made for any costs incurred more than 20 days before the Contractor gives written notice as required. In the case of defective specifications for which the Government is responsible, the equitable adjustment shall include any increased cost reasonably incurred by the Contractor in attempting to comply with the defective specifications.

(e) The Contractor must assert its right to an adjustment under this clause within 30 days after

(1) receipt of a written change order under paragraph (a) of this clause or (2) the furnishing of a written notice under paragraph (b) of this clause, by submitting to the Contracting Officer a written statement describing the general nature and amount of the proposal, unless this period is extended by the Government. The statement of proposal for adjustment may be included in the notice under paragraph (b) above.

(f) No proposal by the Contractor for an equitable adjustment shall be allowed if asserted after final payment under this contract.

(End of clause)

52.245-2 GOVERNMENT PROPERTY (FIXED-PRICE CONTRACTS) (DEC 1989)

(a) Government-furnished property. (1) The Government shall deliver to the Contractor, for use in connection with and under the terms of this contract, the Government-furnished property described in the Schedule or specifications together with any related data and information that the Contractor may request and is reasonably required for the intended use of the property (hereinafter referred to as "Government-furnished property").

(2) The delivery or performance dates for this contract are based upon the expectation that Government-furnished property suitable for use (except for property furnished "as is") will be delivered to the Contractor at the times stated in the Schedule or, if not so stated, in sufficient time to enable the Contractor to meet the contract's delivery or performance dates.

(3) If Government-furnished property is received by the Contractor in a condition not suitable for the intended use, the Contractor shall, upon receipt of it, notify the Contracting Officer, detailing the facts, and, as directed by the Contracting Officer and at Government expense, either repair, modify, return, or otherwise dispose of the property. After completing the directed action and upon written request of the Contractor, the Contracting Officer shall make an equitable adjustment as provided in paragraph (h) of this clause.

(4) If Government-furnished property is not delivered to the Contractor by the required time, the Contracting Officer shall, upon the Contractor's timely written request, make a determination of the delay, if any, caused the Contractor and shall make an equitable adjustment in accordance with paragraph (h) of this clause.

(b) Changes in Government-furnished property. (1) The Contracting Officer may, by written notice, (i) decrease the Government-furnished property provided or to be provided under this contract, or (ii) substitute other Government-furnished property for the property to be provided by the Government, or to be acquired by the Contractor for the Government, under this contract. The Contractor shall promptly take such action as the Contracting Officer may direct regarding the removal, shipment, or disposal of the property covered by such notice.

(2) Upon the Contractor's written request, the Contracting Officer shall make an equitable adjustment to the contract in accordance with paragraph (h) of this clause, if the Government has agreed in the Schedule to make the property available for performing this contract and there is any--

(i) Decrease or substitution in this property pursuant to subparagraph (b)(1) of this clause; or

(ii) Withdrawal of authority to use this property, if provided under any other contract or lease.

(c) Title in Government property. (1) The Government shall retain title to all Government-furnished property.

(2) All Government-furnished property and all property acquired by the Contractor, title to which vests in the Government under this paragraph (collectively referred to as "Government property"), are subject to the provisions of this clause. However, special tooling accountable to this contract is subject to the provisions of the Special Tooling clause and is not subject to the provisions of this clause. Title to Government property shall not be affected by its incorporation into or attachment to any property not owned by the Government, nor shall Government property become a fixture or lose its identity as personal property by being attached to any real property.

(3) Title to each item of facilities and special test equipment acquired by the Contractor for the Government under this contract shall pass to and vest in the Government when its use in performing this contract commences or when the Government has paid for it, whichever is earlier, whether or not title previously vested in the Government.

(4) If this contract contains a provision directing the Contractor to purchase material for which the Government will reimburse the Contractor as a direct item of cost under this contract--

(i) Title to material purchased from a vendor shall pass to and vest in the Government upon the vendor's delivery of such material; and

(ii) Title to all other material shall pass to and vest in the Government upon--

(A) Issuance of the material for use in contract performance;

(B) Commencement of processing of the material or its use in contract performance; or

(C) Reimbursement of the cost of the material by the Government, whichever occurs first.

(d) Use of Government property. The Government property shall be used only for performing this contract, unless otherwise provided in this contract or approved by the Contracting Officer.

(e) Property administration. (1) The Contractor shall be responsible and accountable for all Government property provided under this contract and shall comply with Federal Acquisition Regulation (FAR) Subpart 45.5, as in effect on the date of this contract.

(2) The Contractor shall establish and maintain a program for the use, maintenance, repair, protection, and preservation of Government property in accordance with sound industrial practice and the applicable provisions of Subpart 45.5 of the FAR.

(3) If damage occurs to Government property, the risk of which has been assumed by the Government under this contract, the Government shall replace the items or the Contractor shall make such repairs as the Government directs. However, if the Contractor cannot effect such repairs within the time required, the Contractor shall dispose of the property as directed by the Contracting Officer. When any property for which the Government is responsible is replaced or repaired, the Contracting Officer shall make an equitable adjustment in accordance with paragraph (h) of this clause.

(4) The Contractor represents that the contract price does not include any amount for repairs or replacement for which the Government is responsible. Repair or replacement of property for which the Contractor is responsible shall be accomplished by the Contractor at its own expense.

(f) Access. The Government and all its designees shall have access at all reasonable times to the premises in which any Government property is located for the purpose of inspecting the Government property.

(g) Risk of loss. Unless otherwise provided in this contract, the Contractor assumes the risk of, and shall be responsible for, any loss or destruction of, or damage to, Government property upon its delivery to the Contractor or upon passage of title to the Government under paragraph (c) of this clause. However, the Contractor is not responsible for reasonable wear and tear to Government property or for Government property properly consumed in performing this contract.

(h) Equitable adjustment. When this clause specifies an equitable adjustment, it shall be made to any affected contract provision in accordance with the procedures of the Changes clause. When appropriate, the Contracting Officer may initiate an equitable adjustment in favor of the Government. The right to an equitable adjustment shall be the Contractor's exclusive remedy. The Government shall not be liable to suit for breach of contract for--

(1) Any delay in delivery of Government-furnished property;

(2) Delivery of Government-furnished property in a condition not suitable for its intended use;

(3) A decrease in or substitution of Government-furnished property; or

(4) Failure to repair or replace Government property for which the Government is responsible.

(i) Final accounting and disposition of Government property. Upon completing this contract, or at such earlier dates as may be fixed by the Contracting Officer, the Contractor shall submit, in a form acceptable to the Contracting Officer, inventory schedules covering all items of Government property (including any resulting scrap) not consumed in performing this contract or delivered to the Government. The Contractor

shall prepare for shipment, deliver f.o.b. origin, or dispose of the Government property as may be directed or authorized by the Contracting Officer. The net proceeds of any such disposal shall be credited to the contract price or shall be paid to the Government as the Contracting Officer directs.

(j) Abandonment and restoration of Contractor's premises. Unless otherwise provided herein, the Government--

(1) May abandon any Government property in place, at which time all obligations of the Government regarding such abandoned property shall cease; and

(2) Has no obligation to restore or rehabilitate the Contractor's premises under any circumstances (e.g., abandonment, disposition upon completion of need, or upon contract completion). However, if the Government-furnished property (listed in the Schedule or specifications) is withdrawn or is unsuitable for the intended use, or if other Government property is substituted, then the equitable adjustment under paragraph (h) of this clause may properly include restoration or rehabilitation costs.

(k) Communications. All communications under this clause shall be in writing.

(l) Overseas contracts. If this contract is to be performed outside of the United States of America, its territories, or possessions, the words "Government" and "Government-furnished" (wherever they appear in this clause) shall be construed as "United States Government" and "United States Government-furnished," respectively.

(End of clause)

52.246-12 INSPECTION OF CONSTRUCTION (AUG 1996)

(a) Definition. "Work" includes, but is not limited to, materials, workmanship, and manufacture and fabrication of components.

(b) The Contractor shall maintain an adequate inspection system and perform such inspections as will ensure that the work performed under the contract conforms to contract requirements. The Contractor shall maintain complete inspection records and make them available to the Government. All work shall be conducted under the general direction of the Contracting Officer and is subject to Government inspection and test at all places and at all reasonable times before acceptance to ensure strict compliance with the terms of the contract.

(c) Government inspections and tests are for the sole benefit of the Government and do not--

(1) Relieve the Contractor of responsibility for providing adequate quality control measures;

(2) Relieve the Contractor of responsibility for damage to or loss of the material before acceptance;

(3) Constitute or imply acceptance; or

(4) Affect the continuing rights of the Government after acceptance of the completed work under paragraph (i) of this section.

(d) The presence or absence of a Government inspector does not relieve the Contractor from any contract requirement, nor is the inspector authorized to change any term or condition of the specification without the Contracting Officer's written authorization.

(e) The Contractor shall promptly furnish, at no increase in contract price, all facilities, labor, and material reasonably needed for performing such safe and convenient inspections and tests as may be required by the Contracting Officer. The Government may charge to the Contractor any additional cost of inspection or test

when work is not ready at the time specified by the Contractor for inspection or test, or when prior rejection makes reinspection or retest necessary. The Government shall perform all inspections and tests in a manner that will not unnecessarily delay the work. Special, full size, and performance tests shall be performed as described in the contract.

(f) The Contractor shall, without charge, replace or correct work found by the Government not to conform to contract requirements, unless in the public interest the Government consents to accept the work with an appropriate adjustment in contract price. The Contractor shall promptly segregate and remove rejected material from the premises.

(g) If the Contractor does not promptly replace or correct rejected work, the Government may (1) by contract or otherwise, replace or correct the work and charge the cost to the Contractor or (2) terminate for default the Contractor's right to proceed.

(h) If, before acceptance of the entire work, the Government decides to examine already completed work by removing it or tearing it out, the Contractor, on request, shall promptly furnish all necessary facilities, labor, and material. If the work is found to be defective or nonconforming in any material respect due to the fault of the Contractor or its subcontractors, the Contractor shall defray the expenses of the examination and of satisfactory reconstruction. However, if the work is found to meet contract requirements, the Contracting Officer shall make an equitable adjustment for the additional services involved in the examination and reconstruction, including, if completion of the work was thereby delayed, an extension of time.

(i) Unless otherwise specified in the contract, the Government shall accept, as promptly as practicable after completion and inspection, all work required by the contract or that portion of the work the Contracting Officer determines can be accepted separately. Acceptance shall be final and conclusive except for latent defects, fraud, gross mistakes amounting to fraud, or the Government's rights under any warranty or guarantee.

(End of clause)

52.246-21 WARRANTY OF CONSTRUCTION (MAR 1994)

(a) In addition to any other warranties in this contract, the Contractor warrants, except as provided in paragraph (i) of this clause, that work performed under this contract conforms to the contract requirements and is free of any defect in equipment, material, or design furnished, or workmanship performed by the Contractor or any subcontractor or supplier at any tier.

(b) This warranty shall continue for a period of 1 year from the date of final acceptance of the work. If the Government takes possession of any part of the work before final acceptance, this warranty shall continue for a period of 1 year from the date the Government takes possession.

(c) The Contractor shall remedy at the Contractor's expense any failure to conform, or any defect. In addition, the Contractor shall remedy at the Contractor's expense any damage to Government-owned or controlled real or personal property, when that damage is the result of--

(1) The Contractor's failure to conform to contract requirements; or

(2) Any defect of equipment, material, workmanship, or design furnished.

(d) The Contractor shall restore any work damaged in fulfilling the terms and conditions of this clause. The Contractor's warranty with respect to work repaired or replaced will run for 1 year from the date of repair or replacement.

(e) The Contracting Officer shall notify the Contractor, in writing, within a reasonable time after the discovery of any failure, defect, or damage.

(f) If the Contractor fails to remedy any failure, defect, or damage within a reasonable time after receipt of notice, the Government shall have the right to replace, repair, or otherwise remedy the failure, defect, or damage at the Contractor's expense.
(g) With respect to all warranties, express or implied, from subcontractors, manufacturers, or suppliers for work performed and materials furnished under this contract, the Contractor shall--

(1) Obtain all warranties that would be given in normal commercial practice;

(2) Require all warranties to be executed, in writing, for the benefit of the Government, if directed by the Contracting Officer; and

(3) Enforce all warranties for the benefit of the Government, if directed by the Contracting Officer.

(h) In the event the Contractor's warranty under paragraph (b) of this clause has expired, the Government may bring suit at its expense to enforce a subcontractor's, manufacturer's, or supplier's warranty.

(i) Unless a defect is caused by the negligence of the Contractor or subcontractor or supplier at any tier, the Contractor shall not be liable for the repair of any defects of material or design furnished by the Government nor for the repair of any damage that results from any defect in Government-furnished material or design.

(j) This warranty shall not limit the Government's rights under the Inspection and Acceptance clause of this contract with respect to latent defects, gross mistakes, or fraud.

(End of clause)

52.248-3 VALUE ENGINEERING--CONSTRUCTION (FEB 2000) - ALTERNATE I (APR 1984)

(a) General. The Contractor is encouraged to develop, prepare, and submit value engineering change proposals (VECP's) voluntarily. The Contractor shall share in any instant contract savings realized from accepted VECP's, in accordance with paragraph (f) below.

(b) Definitions. "Collateral costs," as used in this clause, means agency costs of operation, maintenance, logistic support, or Government-furnished property.

"Collateral savings," as used in this clause, means those measurable net reductions resulting from a VECP in the agency's overall projected collateral costs, exclusive of acquisition savings, whether or not the acquisition cost changes.

"Contractor's development and implementation costs," as used in this clause, means those costs the Contractor incurs on a VECP specifically in developing, testing, preparing, and submitting the VECP, as well as those costs the Contractor incurs to make the contractual changes required by Government acceptance of a VECP.

"Government costs," as used in this clause, means those agency costs that result directly from developing and implementing the VECP, such as any net increases in the cost of testing, operations, maintenance, and logistic support. The term does not include the normal administrative costs of processing the VECP.

"Instant contract savings," as used in this clause, means the estimated reduction in Contractor cost of performance resulting from acceptance of the VECP, minus allowable Contractor's development and implementation costs, including subcontractors' development and implementation costs (see paragraph (h) below).

"Value engineering change proposal (VECP)" means a proposal that--

(1) Requires a change to this, the instant contract, to implement; and

(2) Results in reducing the contract price or estimated cost without impairing essential functions or characteristics; provided, that it does not involve a change--

(i) In deliverable end item quantities only; or

(ii) To the contract type only.

(c) VECP preparation. As a minimum, the Contractor shall include in each VECP the information described in subparagraphs (1) through (7) below. If the proposed change is affected by contractually required configuration management or similar procedures, the instructions in those procedures relating to format, identification, and priority assignment shall govern VECP preparation. The VECP shall include the following:

(1) A description of the difference between the existing contract requirement and that proposed, the comparative advantages and disadvantages of each, a justification when an item's function or characteristics are being altered, and the effect of the change on the end item's performance.

(2) A list and analysis of the contract requirements that must be changed if the VECP is accepted, including any suggested specification revisions.

(3) A separate, detailed cost estimate for (i) the affected portions of the existing contract requirement and (ii) the VECP. The cost reduction associated with the VECP shall take into account the Contractor's allowable development and implementation costs, including any amount attributable to subcontracts under paragraph (h) below.

(4) A description and estimate of costs the Government may incur in implementing the VECP, such as test and evaluation and operating and support costs.

(5) A prediction of any effects the proposed change would have on collateral costs to the agency.

(6) A statement of the time by which a contract modification accepting the VECP must be issued in order to achieve the maximum cost reduction, noting any effect on the contract completion time or delivery schedule.

(7) Identification of any previous submissions of the VECP, including the dates submitted, the agencies and contract numbers involved, and previous Government actions, if known.

(d) Submission. The Contractor shall submit VECP's to the Resident Engineer at the worksite, with a copy to the Contracting Officer.

(e) Government action. (1) The Contracting Officer shall notify the Contractor of the status of the VECP within 45 calendar days after the contracting office receives it. If additional time is required, the Contracting Officer shall notify the Contractor within the 45-day period and provide the reason for the delay and the expected date of the decision. The Government will process VECP's expeditiously; however, it shall not be liable for any delay in acting upon a VECP.

(2) If the VECP is not accepted, the Contracting Officer shall notify the Contractor in writing, explaining the reasons for rejection. The Contractor may withdraw any VECP, in whole or in part, at any time before it is accepted by the Government. The Contracting Officer may require that the Contractor provide written notification before undertaking significant expenditures for VECP effort.

(3) Any VECP may be accepted, in whole or in part, by the Contracting Officer's award of a modification to this contract citing this clause. The Contracting Officer may accept the VECP, even though an agreement on price reduction has not been reached, by issuing the Contractor a notice to proceed with the change. Until a notice to proceed is issued or a contract modification applies a VECP to this contract, the Contractor shall perform in accordance with the existing contract. The decision to accept or reject all or part of any VECP is a unilateral decision made solely at the discretion of the Contracting Officer.

(f) Sharing.

(1) Rates. The Government's share of savings is determined by subtracting Government costs from instant contract savings and multiplying the result by (i) 45 percent for fixed-price contracts or (ii) 75 percent for cost-reimbursement contracts.

(2) Payment. Payment of any share due the Contractor for use of a VECP on this contract shall be authorized by a modification to this contract to--

(i) Accept the VECP;

(ii) Reduce the contract price or estimated cost by the amount of instant contract savings; and

(iii) Provide the Contractor's share of savings by adding the amount calculated to the contract price or fee.

(g) Subcontracts. The Contractor shall include an appropriate value engineering clause in any subcontract of $50,000 or more and may include one in subcontracts of lesser value. In computing any adjustment in this contract's price under paragraph (f) above, the Contractor's allowable development and implementation costs shall include any subcontractor's allowable development and implementation costs clearly resulting from a VECP accepted by the Government under this contract, but shall exclude any value engineering incentive payments to a subcontractor. The Contractor may choose any arrangement for subcontractor value engineering incentive payments; provided, that these payments shall not reduce the Government's share of the savings resulting from the VECP.

(h) Data. The Contractor may restrict the Government's right to use any part of a VECP or the supporting data by marking the following legend on the affected parts:

"These data, furnished under the Value Engineering--Construction clause of contract . . . . . , shall not be disclosed outside the Government or duplicated, used, or disclosed, in whole or in part, for any purpose other than to evaluate a value engineering change proposal submitted under the clause. This restriction does not limit the Government's right to use information contained in these data if it has been obtained or is otherwise available from the Contractor or from another source without limitations."

If a VECP is accepted, the Contractor hereby grants the Government unlimited rights in the VECP and supporting data, except that, with respect to data qualifying and submitted as limited rights technical data, the Government shall have the rights specified in the contract modification implementing the VECP and shall appropriately mark the data. (The terms "unlimited rights" and "limited rights" are defined in Part 27 of the Federal Acquisition Regulation.)

(j) Collateral savings. If a VECP is accepted, the Contracting Officer will increase the instant contract amount by 20 percent of any projected collateral savings determined to be realized in a typical year of use after subtracting any Government costs not previously offset. However, the Contractor's share of collateral savings will not exceed the contract's firm-fixed-price or estimated cost, at the time the VECP is accepted,

or $100,000, whichever is greater. The Contracting Officer will be the sole determiner of the amount of collateral savings.

(End of clause)

52.249-2 TERMINATION FOR CONVENIENCE OF THE GOVERNMENT (FIXED-PRICE) (SEP 1996) - ALTERNATE I (SEP 1996)

(a) The Government may terminate performance of work under this contract in whole or, from time to time, in part if the Contracting Officer determines that a termination is in the Government's interest. The Contracting Officer shall terminate by delivering to the Contractor a Notice of Termination specifying the extent of termination and the effective date.

(b) After receipt of a Notice of Termination, and except as directed by the Contracting Officer, the Contractor shall immediately proceed with the following obligations, regardless of any delay in determining or adjusting any amounts due under this clause:

(1) Stop work as specified in the notice.

(2) Place no further subcontracts or orders (referred to as subcontracts in this clause) for materials, services, or facilities, except as necessary to complete the continued portion of the contract.

(3) Terminate all subcontracts to the extent they relate to the work terminated.

(4) Assign to the Government, as directed by the Contracting Officer, all right, title, and interest of the Contractor under the subcontracts terminated, in which case the Government shall have the right to settle or to pay any termination settlement proposal arising out of those terminations.

(5) With approval or ratification to the extent required by the Contracting Officer, settle all outstanding liabilities and termination settlement proposals arising from the termination of subcontracts; the approval or ratification will be final for purposes of this clause.

(6) As directed by the Contracting Officer, transfer title and deliver to the Government (i) the fabricated or unfabricated parts, work in process, completed work, supplies, and other material produced or acquired for the work terminated, and (ii) the completed or partially completed plans, drawings, information, and other property that, if the contract had been completed, would be required to be furnished to the Government.

(7) Complete performance of the work not terminated.

(8) Take any action that may be necessary, or that the Contracting Officer may direct, for the protection and preservation of the property related to this contract that is in the possession of the Contractor and in which the Government has or may acquire an interest.

(9) Use its best efforts to sell, as directed or authorized by the Contracting Officer, any property of the types referred to in subparagraph (b)(6) of this clause; provided, however, that the Contractor (i) is not required to extend credit to any purchaser and (ii) may acquire the property under the conditions prescribed by, and at prices approved by, the Contracting Officer. The proceeds of any transfer or disposition will be applied to reduce any payments to be made by the Government under this contract, credited to the price or cost of the work, or paid in any other manner directed by the Contracting Officer.

(c) The Contractor shall submit complete termination inventory schedules no later than 120 days from the effective date of termination, unless extended in writing by the Contracting Officer upon written request of the Contractor within this 120-day period.

(d) After expiration of the plant clearance period as defined in Subpart 45.6 of the Federal Acquisition Regulation, the Contractor may submit to the Contracting Officer a list, certified as to quantity and quality, of termination inventory not previously disposed of, excluding items authorized for disposition by the Contracting Officer. The Contractor may request the Government to remove those items or enter into an agreement for their storage. Within 15 days, the Government will accept title to those items and remove them or enter into a storage agreement. The Contracting Officer may verify the list upon removal of the items, or if stored, within 45 days from submission of the list, and shall correct the list, as necessary, before final settlement.

(e) After termination, the Contractor shall submit a final termination settlement proposal to the Contracting Officer in the form and with the certification prescribed by the Contracting Officer. The Contractor shall submit the proposal promptly, but no later than 1 year from the effective date of termination, unless extended in writing by the Contracting Officer upon written request of the Contractor within this 1-year period. However, if the Contracting Officer determines that the facts justify it, a termination settlement proposal may be received and acted on after 1 year or any extension. If the Contractor fails to submit the proposal within the time allowed, the Contracting Officer may determine, on the basis of information available, the amount, if any, due the Contractor because of the termination and shall pay the amount determined.

(f) Subject to paragraph (e) of this clause, the Contractor and the Contracting Officer may agree upon the whole or any part of the amount to be paid or remaining to be paid because of the termination. The amount may include a reasonable allowance for profit on work done. However, the agreed amount, whether under this paragraph (g) or paragraph (g) of this clause, exclusive of costs shown in subparagraph (g)(3) of this clause, may not exceed the total contract price as reduced by (1) the amount of payments previously made and (2) the contract price of work not terminated. The contract shall be modified, and the Contractor paid the agreed amount. Paragraph (g) of this clause shall not limit, restrict, or affect the amount that may be agreed upon to be paid under this paragraph.

(g) If the Contractor and Contracting Officer fail to agree on the whole amount to be paid the Contractor because of the termination of work, the Contracting Officer shall pay the Contractor the amounts determined as follows, but without duplication of any amounts agreed upon under paragraph (f) of this clause:

(1) For contract work performed before the effective date of termination, the total (without duplication of any items) of--

(i) The cost of this work;

(ii) The cost of settling and paying termination settlement proposals under terminated subcontracts that are properly chargeable to the terminated portion of the contract if not included in subdivision (g)(1)(i) of this clause; and

(iii) A sum, as profit on subdivision (g)(1)(i) of this clause, determined by the Contracting Officer under 49.202 of the Federal Acquisition Regulation, in effect on the date of this contract, to be fair and reasonable; however, if it appears that the Contractor would have sustained a loss on the entire contract had it been completed, the Contracting Officer shall allow no profit under this subdivision (iii) and shall reduce the settlement to reflect the indicated rate of loss.

(2) The reasonable costs of settlement of the work terminated, including--

(i) Accounting, legal, clerical, and other expenses reasonably necessary for the preparation of termination settlement proposals and supporting data;

(ii) The termination and settlement of subcontracts (excluding the amounts of such settlements); and

(iii) Storage, transportation, and other costs incurred, reasonably necessary for the preservation, protection, or disposition of the termination inventory.

(h) Except for normal spoilage, and except to the extent that the Government expressly assumed the risk of loss, the Contracting Officer shall exclude from the amounts payable to the Contractor under paragraph (g) of this clause, the fair value, as determined by the Contracting Officer, of property that is destroyed, lost, stolen, or damaged so as to become undeliverable to the Government or to a buyer.

(i) The cost principles and procedures of Part 31 of the Federal Acquisition Regulation, in effect on the date of this contract, shall govern all costs claimed, agreed to, or determined under this clause.

(j) The Contractor shall have the right of appeal, under the Disputes clause, from any determination made by the Contracting Officer under paragraph (e), (g), or (l) of this clause, except that if the Contractor failed to submit the termination settlement proposal or request for equitable adjustment within the time provided in paragraph (e) or (l), respectively, and failed to request a time extension, there is no right of appeal.

(k) In arriving at the amount due the Contractor under this clause, there shall be deducted--

(1) All unliquidated advance or other payments to the Contractor under the terminated portion of this contract;

(2) Any claim which the Government has against the Contractor under this contract; and

(3) The agreed price for, or the proceeds of sale of, materials, supplies, or other things acquired by the Contractor or sold under the provisions of this clause and not recovered by or credited to the Government.

(l) If the termination is partial, the Contractor may file a proposal with the Contracting Officer for an equitable adjustment of the price(s) of the continued portion of the contract. The Contracting Officer shall make any equitable adjustment agreed upon. Any proposal by the Contractor for an equitable adjustment under this clause shall be requested within 90 days from the effective date of termination unless extended in writing by the Contracting Officer.

(m)(1) The Government may, under the terms and conditions it prescribes, make partial payments and payments against costs incurred by the Contractor for the terminated portion of the contract, if the Contracting Officer believes the total of these payments will not exceed the amount to which the Contractor will be entitled.

(2) If the total payments exceed the amount finally determined to be due, the Contractor shall repay the excess to the Government upon demand, together with interest computed at the rate established by the Secretary of the Treasury under 50 U.S.C. App. 1215(b)(2). Interest shall be computed for the period from the date the excess payment is received by the Contractor to the date the excess is repaid. Interest shall not be charged on any excess payment due to a reduction in the Contractor's termination settlement proposal because of retention or other disposition of termination inventory until 10 days after the date of the retention or disposition, or a later date determined by the Contracting Officer because of the circumstances.

(n) Unless otherwise provided in this contract or by statute, the Contractor shall maintain all records and documents relating to the terminated portion of this contract for 3 years after final settlement. This includes all books and other evidence bearing on the Contractor's costs and expenses under this contract. The Contractor shall make these records and documents available to the Government, at the Contractor's office, at all reasonable times, without any direct charge. If approved by the Contracting Officer, photographs, microphotographs, or other authentic reproductions may be maintained instead of original records and documents.

(End of clause)

52.249-10 DEFAULT (FIXED-PRICE CONSTRUCTION) (APR 1984)

(a) If the Contractor refuses or fails to prosecute the work or any separable part, with the diligence that will insure its completion within the time specified in this contract including any extension, or fails to complete the work within this time, the Government may, by written notice to the Contractor, terminate the right to proceed with the work (or the separable part of the work) that has been delayed. In this event, the Government may take over the work and complete it by contract or otherwise, and may take possession of and use any materials, appliances, and plant on the work site necessary for completing the work. The Contractor and its sureties shall be liable for any damage to the Government resulting from the Contractor's refusal or failure to complete the work within the specified time, whether or not the Contractor's right to proceed with the work is terminated. This liability includes any increased costs incurred by the Government in completing the work.

(b) The Contractor's right to proceed shall not be terminated nor the Contractor charged with damages under this clause, if--

(1) The delay in completing the work arises from unforeseeable causes beyond the control and without the fault or negligence of the Contractor. Examples of such causes include

(i) acts of God or of the public enemy,

(ii) acts of the Government in either its sovereign or contractual capacity,

(iii) acts of another Contractor in the performance of a contract with the Government,

(iv) fires,

(v) floods,

(vi) epidemics,

(vii) quarantine restrictions,

(viii) strikes,

(ix) freight embargoes,

(x) unusually severe weather, or delays of subcontractors or suppliers at any tier arising from unforeseeable causes beyond the control and without the fault or negligence of both the Contractor and the subcontractors or suppliers; and

(2) The Contractor, within 10 days from the beginning of any delay (unless extended by the Contracting Officer), notifies the Contracting Officer in writing of the causes of delay. The Contracting Officer shall ascertain the facts and the extent of delay. If, in the judgment of the Contracting Officer, the findings of fact warrant such action, the time for completing the work shall be extended. The findings of the Contracting Officer shall be final and conclusive on the parties, but subject to appeal under the Disputes clause.

(c) If, after termination of the Contractor's right to proceed, it is determined that the Contractor was not in default, or that the delay was excusable, the rights and obligations of the parties will be the same as if the termination had been issued for the convenience of the Government.

The rights and remedies of the Government in this clause are in addition to any other rights and remedies provided by law or under this contract.

(End of clause)

52.252-4 ALTERATIONS IN CONTRACT (APR 1984)

Portions of this contract are altered as follows:

(End of clause)

52.253-1 COMPUTER GENERATED FORMS (JAN 1991)

(a) Any data required to be submitted on a Standard or Optional Form prescribed by the Federal Acquisition Regulation (FAR) may be submitted on a computer generated version of the form, provided there is no change to the name, content, or sequence of the data elements on the form, and provided the form carries the Standard or Optional Form number and edition date.

(b) Unless prohibited by agency regulations, any data required to be submitted on an agency unique form prescribed by an agency supplement to the FAR may be submitted on a computer generated version of the form provided there is no change to the name, content, or sequence of the data elements on the form and provided the form carries the agency form number and edition date.

(f) If the Contractor submits a computer generated version of a form that is different than the required form, then the rights and obligations of the parties will be determined based on the content of the required form.

(End of clause)

252.201-7000 CONTRACTING OFFICER'S REPRESENTATIVE (DEC 1991)

(a) "Definition. Contracting officer's representative" means an individual designated in accordance with subsection 201.602-2 of the Defense Federal Acquisition Regulation Supplement and authorized in writing by the contracting officer to perform specific technical or administrative functions.

(b) If the Contracting Officer designates a contracting officer's representative (COR), the Contractor will receive a copy of the written designation. It will specify the extent of the COR's authority to act on behalf of the contracting officer. The COR is not authorized to make any commitments or changes that will affect price, quality, quantity, delivery, or any other term or condition of the contract.

(End of clause)

252.203-7001 PROHIBITION ON PERSONS CONVICTED OF FRAUD OR OTHER DEFENSE-CONTRACT-RELATED FELONIES (MAR 1999)

(a) Definitions. As used in this clause—

(1) “Arising out of a contract with the DoD” means any act in connection with—

(i) Attempting to obtain;

(ii) Obtaining, or

(iii) Performing a contract or first-tier subcontract of any agency, department, or component of the Department of Defense (DoD).

(2) "Conviction of fraud or any other felony" means any conviction for fraud or a felony in violation of state or Federal criminal statutes, whether entered on a verdict or plea, including a plea of *nolo contendere*, for which sentence has been imposed.

(3) "Date of conviction" means the date judgment was entered against the individual.

(b) Any individual who is convicted after September 29, 1988, of fraud or any other felony arising out of a contract with the DoD is prohibited from serving--

(1) In a management or supervisory capacity on any DoD contract or first-tier subcontract;

(2) On the board of directors of any DoD contractor or first-tier subcontractor;

(3) As a consultant, agent, or representative for any DoD contractor or first-tier subcontractor; or

(4) In any other capacity with the authority to influence, advise, or control the decisions of any DoD contractor or subcontractor with regard to any DoD contract or first-tier subcontract.

(c) Unless waived, the prohibition in paragraph (b) of this clause applies for not less than 5 years from the date of conviction.

(d) 10 U.S.C. 2408 provides that a defense contractor or first-tier subcontractor shall be subject to a criminal penalty of not more than $500,000 if convicted of knowingly—

(1) Employing a person under a prohibition specified in paragraph (b) of this clause; or

(2) Allowing such a person to serve on the board of directors of the contractor or first-tier subcontractor.

(e) In addition to the criminal penalties contained in 10 U.S.C. 2408, the Government may consider other available remedies, such as—

(1) Suspension or debarment;

(2) Cancellation of the contract at no cost to the Government; or

(3) Termination of the contract for default.

(f) The Contractor may submit written requests for waiver of the prohibition in paragraph (b) of this clause to the Contracting Officer. Requests shall clearly identify—

(1) The person involved;

(2) The nature of the conviction and resultant sentence or punishment imposed;

(3) The reasons for the requested waiver; and

(4) An explanation of why a waiver is in the interest of national security.

(g) The Contractor agrees to include the substance of this clause, appropriately modified to reflect the identity and relationship of the parties, in all first-tier subcontracts exceeding the simplified acquisition

threshold in Part 2 of the Federal Acquisition Regulation, except those for commercial items or components.

(h) Pursuant to 10 U.S.C. 2408(c), defense contractors and subcontractors may obtain information as to whether a particular person has been convicted of fraud or any other felony arising out of a contract with the DoD by contacting The Office of Justice Programs, The Denial of Federal Benefits Office, U.S. Department of Justice, telephone (202) 616-3507.

(End of clause)

252.203-7002 DISPLAY OF DOD HOTLINE POSTER (DEC 1991)

(a) The Contractor shall display prominently in common work areas within business segments performing work under Department of Defense (DoD) contracts, DoD Hotline Posters prepared by the DoD Office of the Inspector General.

(b) DoD Hotline Posters may be obtained from the DoD Inspector General, ATTN: Defense Hotline, 400 Army Navy Drive, Washington, DC 22202-2884.

(g) The Contractor need not comply with paragraph (a) of this clause if it has established a mechanism, such as a hotline, by which employees may report suspected instances of improper conduct, and instructions that encourage employees to make such reports.

(End of clause)

252.204-7000 DISCLOSURE OF INFORMATION (DEC 1991)

(a) The Contractor shall not release to anyone outside the Contractor's organization any unclassified information, regardless of medium (e.g., film, tape, document), pertaining to any part of this contract or any program related to this contract, unless--

(1) The Contracting Officer has given prior written approval; or

(2) The information is otherwise in the public domain before the date of release.

(b) Requests for approval shall identify the specific information to be released, the medium to be used, and the purpose for the release. The Contractor shall submit its request to the Contracting Officer at least 45 days before the proposed date for release.

(c) The Contractor agrees to include a similar requirement in each subcontract under this contract. Subcontractors shall submit requests for authorization to release through the prime contractor to the Contracting Officer.

(End of clause)

252.204-7003 CONTROL OF GOVERNMENT PERSONNEL WORK PRODUCT (APR 1992)

The Contractor's procedures for protecting against unauthorized disclosure of information shall not require Department of Defense employees or members of the Armed Forces to relinquish control of their work products, whether classified or not, to the contractor.

(End of clause)

252.205-7000 PROVISION OF INFORMATION TO COOPERATIVE AGREEMENT HOLDERS (DEC 1991)

(a) Definition.

"Cooperative agreement holder" means a State or local government; a private, nonprofit organization; a tribal organization (as defined in section 4(c) of the Indian Self-Determination and Education Assistance Act (Pub. L. 93-268; 25 U.S.C. 450 (c))); or an economic enterprise (as defined in section 3(e) of the Indian Financing Act of 1974 (Pub. L. 93-362; 25 U.S.C. 1452(e))) whether such economic enterprise is organized for profit or nonprofit purposes; which has an agreement with the Defense Logistics Agency to furnish procurement technical assistance to business entities.

(b) The Contractor shall provide cooperative agreement holders, upon their request, with a list of those appropriate employees or offices responsible for entering into subcontracts under defense contracts. The list shall include the business address, telephone number, and area of responsibility of each employee or office.

(c) The Contractor need not provide the listing to a particular cooperative agreement holder more frequently than once a year.

(End of clause)

252.209-7000 ACQUISITION FROM SUBCONTRACTORS SUBJECT TO ONSITE INSPECTION UNDER THE INTERMEDIATE-RANGE NUCLEAR FORCES (INF) TREATY (NOV 1995)

(a) The Contractor shall not deny consideration for a subcontract award under this contract to a potential subcontractor subject to on-site inspection under the INF Treaty, or a similar treaty, solely or in part because of the actual or potential presence of Soviet inspectors at the subcontractor's facility, unless the decision is approved by the Contracting Officer.

(b) The Contractor shall incorporate this clause, including this paragraph (b), in all solicitations and contracts exceeding the simplified acquisition threshold in part 13 of the Federal Acquisition Regulation, except those for commercial items.

(End of clause)

252.219-7003 SMALL, SMALL DISADVANTAGED AND WOMEN-OWNED SMALL BUSINESS SUBCONTRACTING PLAN (DOD CONTRACTS) (APR. 1996)

This clause supplements the Federal Acquisition Regulation 52.219-9, Small, Small Disadvantaged and Women-Owned Small Business Subcontracting Plan, clause of this contract.

(a) *Definitions. Historically black colleges and universities,* as used in this clause, means institutions determined by the Secretary of Education to meet the requirements of 34 CFR 608.2. The term also means any nonprofit research institution that was an integral part of such a college or university before November 14, 1986.

Minority institutions, as used in this clause, means institutions meeting the requirements of section 1046(3) of the Higher Education Act of 1965 (20 U.S.C. 1135d-5(3)). The term also includes Hispanic-serving institutions as defined in section 316(b)(1) of such Act (20 U.S.C. 1059c(b)(1)).

(b) Except for company or division-wide commercial items subcontracting plans, the term *small disadvantaged business,* when used in the FAR 52.219-9 clause, includes historically black colleges and universities and minority institutions, in addition to small disadvantaged business concerns.

(c) Work under the contract or its subcontracts shall be credited toward meeting the small disadvantaged business concern goal required by paragraph (d) of the FAR 52.219-9 clause when:

(1) It is performed on Indian lands or in joint venture with an Indian tribe or a tribally-owned corporation, and

(2) It meets the requirements of 10 U.S.C. 2323a.

(d) Subcontracts awarded to workshops approved by the Committee for Purchase from People Who are Blind or Severely Disabled (41 U.S.C. 46-48), may be counted toward the Contractor's small business subcontracting goal.

(e) A mentor firm, under the Pilot Mentor-Protege Program established under Section 831 of Pub. L. 101-510, as amended, may count toward its small disadvantaged business goal, subcontracts awarded--

(f) The master plan approval referred to in paragraph (f) of the FAR 52.219-9 clause is approval by the Contractor's cognizant contract administration activity.

(g) In those subcontracting plans which specifically identify small, small disadvantaged, and women-owned small businesses, the Contractor shall notify the Administrative Contracting Officer of any substitutions of firms that are not small, small disadvantaged, or women-owned small businesses for the firms listed in the subcontracting plan. Notifications shall be in writing and shall occur within a reasonable period of time after award of the subcontract. Contractor-specified formats shall be acceptable.

(End of clause)

252.219-7009 SECTION 8(A) DIRECT AWARD (MAR 2002)

(a) This contract is issued as a direct award between the contracting office and the 8(a) Contractor pursuant to the Partnership Agreement dated February 1, 2002, between the Small Business Administration (SBA) and the Department of Defense. Accordingly, the SBA, even if not identified in Section A of this contract, is the prime contractor and retains responsibility for 8(a) certification, for 8(a) eligibility determinations and related issues, and for providing counseling and assistance to the 8(a) Contractor under the 8(a) Program. The cognizant SBA district office is:

(To be completed by the Contracting Officer at the time of award)

(b) The contracting office is responsible for administering the contract and for taking any action on behalf of the Government under the terms and conditions of the contract; provided that the contracting office shall give advance notice to the SBA before it issues a final notice terminating performance, either in whole or in part, under the contract. The contracting office also shall coordinate with the SBA prior to processing any novation agreement. The contracting office may assign contract administration functions to a contract administration office.

(c) The Contractor agrees that--

(1) It will notify the Contracting Officer, simultaneous with its notification to the SBA (as required by SBA's 8(a) regulations at 13 CFR 124.308), when the owner or owners upon whom 8(a) eligibility is based plan to relinquish ownership or control of the concern. Consistent with Section 407 of Pub. L. 100-656,

transfer of ownership or control shall result in termination of the contract for convenience, unless the SBA waives the requirement for termination prior to the actual relinquishing of ownership and control; and

(2) It will not subcontract the performance of any of the requirements of this contract without the prior written approval of the SBA and the Contracting Officer.

(End of Clause)

252.223-7004 DRUG-FREE WORK FORCE (SEP 1988)

(a) Definitions.

(1) "Employee in a sensitive position," as used in this clause, means an employee who has been granted access to classified information; or employees in other positions that the Contractor determines involve national security; health or safety, or functions other than the foregoing requiring a high degree of trust and confidence.

(2) "Illegal drugs," as used in this clause, means controlled substances included in Schedules I and II, as defined by section 802(6) of title 21 of the United States Code, the possession of which is unlawful under chapter 13 of that Title. The term "illegal drugs" does not mean the use of a controlled substance pursuant to a valid prescription or other uses authorized by law.

(b) The Contractor agrees to institute and maintain a program for achieving the objective of a drug-free work force. While this clause defines criteria for such a program, contractors are encouraged to implement alternative approaches comparable to the criteria in paragraph (c) that are designed to achieve the objectives of this clause.

(c) Contractor programs shall include the following, or appropriate alternatives:

(1) Employee assistance programs emphasizing high level direction, education, counseling, rehabilitation, and coordination with available community resources;

(2) Supervisory training to assist in identifying and addressing illegal drug use by Contractor employees;

(3) Provision for self-referrals as well as supervisory referrals to treatment with maximum respect for individual confidentiality consistent with safety and security issues;

(4) Provision for identifying illegal drug users, including testing on a controlled and carefully monitored basis. Employee drug testing programs shall be established taking account of the following:

(i) The Contractor shall establish a program that provides for testing for the use of illegal drugs by employees in sensitive positions. The extent of and criteria for such testing shall be determined by the Contractor based on considerations that include the nature of the work being performed under the contract, the employee's duties, and efficient use of Contractor resources, and the risks to health, safety, or national security that could result from the failure of an employee adequately to discharge his or her position.

(ii) In addition, the Contractor may establish a program for employee drug testing--

(A) When there is a reasonable suspicion that an employee uses illegal drugs; or

(B) When an employees has been involved in an accident or unsafe practice;

(C) As part of or as a follow-up to counseling or rehabilitation for illegal drug use;

(D) As part of a voluntary employee drug testing program.

(iii) The Contractor may establish a program to test applicants for employment for illegal drug use.

(iv) For the purpose of administering this clause, testing for illegal drugs may be limited to those substances for which testing is prescribed by section 2..1 of subpart B of the "Mandatory Guidelines for Federal Workplace Drug Testing Programs" (53 FR 11980 (April 11, 1988), issued by the Department of Health and Human Services.

(d) Contractors shall adopt appropriate personnel procedures to deal with employees who are found to be using drugs illegally. Contractors shall not allow any employee to remain on duty or perform in a sensitive position who is found to use illegal drugs until such times as the Contractor, in accordance with procedures established by the Contractor, determines that the employee may perform in such a position.

(e) The provisions of this clause pertaining to drug testing program shall not apply to the extent that are inconsistent with state or local law, or with an existing collective bargaining agreement; provided that with respect to the latter, the Contractor agrees those issues that are in conflict will be a subject of negotiation at the next collective bargaining session.

(End of clause)

252.223-7006 PROHIBITION ON STORAGE AND DISPOSAL OF TOXIC AND HAZARDOUS MATERIALS (APR 1993)

(a) "Definitions".

As used in this clause --

(1) "Storage" means a non-transitory, semi-permanent or permanent holding, placement, or leaving of material. It does not include a temporary accumulation of a limited quantity of a material used in or a waste generated or resulting from authorized activities, such as servicing, maintenance, or repair of Department of Defense (DoD) items, equipment, or facilities.

(2) "Toxic or hazardous materials" means:

(i) Materials referred to in section 101(14) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 (42 U.S.C. 9601(14)) and materials designated under section 102 of CERCLA (42 U.S.C. 9602) (40 CFR part 302);

(ii) Materials that are of an explosive, flammable, or pyrotechnic nature; or

(iii) Materials otherwise identified by the Secretary of Defense as specified in DoD regulations.

(b) In accordance with 10 U.S.C. 2692, the Contractor is prohibited from storing or disposing of non-DoD-owned toxic or hazardous materials on a DoD installation, except to the extent authorized by a statutory exception to 10 U.S.C. 2692 or as authorized by the Secretary of Defense or his designee.

(End of clause)

252.225-7012 Preference for Certain Domestic Commodities (APR 2002)

(a) Definitions. As used in this clause--

(1) Component means any item supplied to the Government as part of an end product or of another component.

(2) End product means supplies delivered under a line item of this contract.

(b) The Contractor shall deliver under this contract only such of the following items, either as end products or components, that have been grown, reprocessed, reused, or produced in the United States, its possessions, or Puerto Rico:

(1) Food.

(2) Clothing.

(3) Tents, tarpaulins, or covers.

(4) Cotton and other natural fiber products.

(5) Woven silk or woven silk blends.

(6) Spun silk yarn for cartridge cloth.

(7) Synthetic fabric, and coated synthetic fabric, including all textile fibers and yarns that are for use in such fabrics.

(8) Canvas products.

(9) Wool (whether in the form of fiber or yarn or contained in fabrics, materials, or manufactured articles).

(10) Any item of individual equipment (Federal Supply Class 8465) manufactured from or containing fibers, yarns, fabrics, or materials listed in this paragraph (b).

(c) This clause does not apply--

(1) To items listed in section 25.104(a) of the Federal Acquisition Regulation (FAR), or other items for which the Government has determined that a satisfactory quality and sufficient quantity cannot be acquired as and when needed at U.S. market prices;

(2) To end products incidentally incorporating cotton, other natural fibers, or wool, for which the estimated value of the cotton, other natural fibers, or wool--

(i) Is not more than 10 percent of the total price of the end product; and (ii) Does not exceed the simplified acquisition threshold in FAR part 2;

(3) To foods that have been manufactured or processed in the United States, its possessions, or Puerto Rico, regardless of where the foods (and any component if applicable) were grown or produced;

(4) To chemical warfare protective clothing produced in the countries listed in subsection 225.872-1 of the Defense FAR Supplement; or

(5) To fibers and yarns that are for use in synthetic fabric or coated synthetic fabric (but does apply to the synthetic or coated synthetic fabric itself), if--

(i) The fabric is to be used as a component of an end product that is not a textile product. Examples of textile products, made in whole or in part of fabric, include--

(A) Draperies, floor coverings, furnishings, and bedding (Federal Supply Group 72, Household and Commercial Furnishings and Appliances);

(B) Items made in whole or in part of fabric in Federal Supply Group 83, Textile/leather/furs/apparel/findings/ tents/flags, or Federal Supply Group 84, Clothing, Individual Equipment and Insignia;

(C) Upholstered seats (whether for household, office, or other use); and

(D) Parachutes (Federal Supply Class 1670); or

(ii) The fibers and yarns are para-aramid fibers and yarns manufactured in the Netherlands.

(End of clause)

252.225-7031 SECONDARY ARAB BOYCOTT OF ISRAEL (JUN 1992)

(a) Definitions. As used in this clause--

(1) "Foreign person" means any person other than a United States person as defined in Section 16(2) of the Export Administration Act of 1979 (50 U.S.C. App. Sec 2415).

(2) "United States person" is defined in Section 16(2) of the Export Administration Act of 1979 and means any United States resident or national (other than an individual resident outside the United States and employed by other than a United States person), any domestic concern (including any permanent domestic establishment of any foreign concern), and any foreign subsidiary or affiliate (including any permanent foreign establishment) of any domestic concern which is controlled in fact by such domestic concerns, as determined under regulations of the President.

(b) Certification. By submitting this offer, the Offeror, if a foreign person, company or entity, certifies that it--

(1) Does not comply with the Secondary Arab Boycott of Israel; and

(2) Is not taking or knowingly agreeing to take any action, with respect to the Secondary Boycott of Israel by Arab countries, which 50 U.S.C. App. Sec 2407(a) prohibits a United States person from taking.

(End of clause)

252.227-7000 Non-estoppel. (OCT 1966)

The Government reserves the right at any time to contest the enforceability, validity, scope of, or the title to any patent or patent application herein licensed without waiving or forfeiting any right under this contract.

(End of clause)

252.227-7022 GOVERNMENT RIGHTS (UNLIMITED) (MAR 1979)

The Government shall have unlimited rights, in all drawings, designs, specifications, notes and other works developed in the performance of this contract, including the right to use same on any other Government design or construction without additional compensation to the Contractor. The Contractor hereby grants to the Government a paid-up license throughout the world to all such works to which he may assert or establish any claim under design patent or copyright laws. The Contractor for a period of three (3) years after completion of the project agrees to furnish the original or copies of all such works on the request of the Contracting Officer.

(End of clause)

252.227-7023 DRAWINGS AND OTHER DATA TO BECOME PROPERTY OF GOVERNMENT. (MAR 1979)

All designs, drawings, specifications, notes and other works developed in the performance of this contract shall become the sole property of the Government and may be used on any other design or construction without additional compensation to the Contractor. The Government shall be considered the "person for whom the work was prepared" for the purpose of authorship in any copyrightable work under 17 U.S.C. 201(b). With respect thereto, the Contractor agrees not to assert or authorize others to assert any rights nor establish any claim under the design patent or copyright laws. The Contractor for a period of three (3) years after completion of the project agrees to furnish all retained works on the request of the Contracting Officer. Unless otherwise provided in this contract, the Contractor shall have the right to retain copies of all works beyond such period.

(End of clause)

252.227-7033 RIGHTS IN SHOP DRAWINGS (APR 1966)

(a) Shop drawings for construction means drawings, submitted to the Government by the Construction Contractor, subcontractor or any lower-tier subcontractor pursuant to a construction contract, showing in detail (i) the proposed fabrication and assembly of structural elements and (ii) the installation (i.e., form, fit, and attachment details) of materials or equipment. The Government may duplicate, use, and disclose in any manner and for any purpose shop drawings delivered under this contract.

(b) This clause, including this paragraph (b), shall be included in all subcontracts hereunder at any tier.

252.231-7000 SUPPLEMENTAL COST PRINCIPLES (DEC 1991)

When the allowability of costs under this contract is determined in accordance with part 31 of the Federal Acquisition Regulation (FAR), allowability shall also be determined in accordance with part 231 of the Defense FAR Supplement, in effect on the date of this contract.

(End of clause)

252.236-7000 MODIFICATION PROPOSALS - PRICE BREAKDOWN. (DEC 1991)

(a) The Contractor shall furnish a price breakdown, itemized as required and within the time specified by the Contracting Officer, with any proposal for a contract modification.

(b) The price breakdown --

(1) Must include sufficient detail to permit an analysis of profit, and of all costs for --

(i) Material;

(ii) Labor;

(iii) Equipment;

(iv) Subcontracts; and

(v) Overhead; and

(2) Must cover all work involved in the modification, whether the work was deleted, added, or changed.

(c) The Contractor shall provide similar price breakdowns to support any amounts claimed for subcontracts.

(d) The Contractor's proposal shall include a justification for any time extension proposed.

252.242-7000 POSTAWARD CONFERENCE (DEC 1991)

The Contractor agrees to attend any postaward conference convened by the contracting activity or contract administration office in accordance with Federal Acquisition Regulation subpart 42.5.

(End of clause)

252.243-7001 PRICING OF CONTRACT MODIFICATIONS (DEC 1991)

When costs are a factor in any price adjustment under this contract, the contract cost principles and procedures in FAR part 31 and DFARS part 231, in effect on the date of this contract, apply.

252.243-7002 REQUESTS FOR EQUITABLE ADJUSTMENT (MAR 1998)

(a) The amount of any request for equitable adjustment to contract terms shall accurately reflect the contract adjustment for which the Contractor believes the Government is liable. The request shall include only costs for performing the change, and shall not include any costs that already have been reimbursed or that have been separately claimed. All indirect costs included in the request shall be properly allocable to the change in accordance with applicable acquisition regulations.

(b) In accordance with 10 U.S.C. 2410(a), any request for equitable adjustment to contract terms that exceeds the simplified acquisition threshold shall bear, at the time of submission, the following certificate executed by an individual authorized to certify the request on behalf of the Contractor:

I certify that the request is made in good faith, and that the supporting data are accurate and complete to the best of my knowledge and belief.

(Official's Name)

(Title)

(c) The certification in paragraph (b) of this clause requires full disclosure of all relevant facts, including--

(1) Cost or pricing data if required in accordance with subsection 15.403-4 of the Federal Acquisition Regulation (FAR); and

(2) Information other than cost or pricing data, in accordance with subsection 15.403-3 of the FAR, including actual cost data and data to support any estimated costs, even if cost or pricing data are not required.

(d) The certification requirement in paragraph (b) of this clause does not apply to----

(1) Requests for routine contract payments; for example, requests for payment for accepted supplies and services, routine vouchers under a cost-reimbursement type contract, or progress payment invoices; or

(2) Final adjustment under an incentive provision of the contract.

252.247-7024 Notification of Transportation of Supplies by Sea (MAR 2000)

(a) The Contractor has indicated by the response to the solicitation provision, Representation of Extent of Transportation by Sea, that it did not anticipate transporting by sea any supplies. If, however, after the award of this contract, the Contractor learns that supplies, as defined in the Transportation of Supplies by Sea clause of this contract, will be transported by sea, the Contractor --

(1) Shall notify the Contracting Officer of that fact; and

(2) Hereby agrees to comply with all the terms and conditions of the Transportation of Supplies by Sea clause of this contract.

(b) The Contractor shall include this clause; including this paragraph (b), revised as necessary to reflect the relationship of the contracting parties--

(1) In all subcontracts under this contract, if this contract is a construction contract; or

(2) If this contract is not a construction contract, in all subcontracts under this contract that are for--

(i) Noncommercial items; or

(ii) Commercial items that--

(A) The Contractor is reselling or distributing to the Government without adding value (generally, the Contractor does not add value to items that it subcontracts for f.o.b. destination shipment);

(B) Are shipped in direct support of U.S. military contingency operations, exercises, or forces deployed in humanitarian or peacekeeping operations; or

(C) Are commissary or exchange cargoes transported outside of the Defense Transportation System in accordance with 10 U.S.C. 2643.

(End of clause)

This page was intentionally left blank for duplex printing.

Section 00800
Special Contract Requirements

Special Contract Requirements....1
52.0001-4001 CONTRACT ADMINISTRATION DATA....2
52.0028-4001 REQUIRED INSURANCE....2
52.211-10 COMMENCEMENT, PROSECUTION, AND COMPLETION OF WORK (APR 1984)....3
52.211-12 LIQUIDATED DAMAGES--CONSTRUCTION (SEP 2000)....3
52.228-12 Prospective Subcontractor Requests for Bonds. (OCT 1995)....3
52.228-14 IRREVOCABLE LETTER OF CREDIT (DEC 1999)....3
52.228-15 Performance and Payment Bonds--Construction (JUL 2000)-....7
52.231-5000 EQUIPMENT OWNERSHIP AND OPERATING EXPENSE SCHEDULE....7
MAR 1995)—EFARS....7
52.232-33 PAYMENT BY ELECTRONIC FUNDS TRANSFER—CENTRAL CONTRACTOR REGISTRATION (MAY 1999)....8
52.236-4 PHYSICAL DATA (APR 1984)....9
52.236-16 QUANTITY SURVEYS (APR 1984)....10
52.236-21 SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION (FEB 1997) - ALTERNATE I (APR 1984....10
52.249-5000 BASIS FOR SETTLEMENT OF PROPOSALS....11
252.236-7001 CONTRACT DRAWINGS, MAPS, AND SPECIFICATIONS (AUG 2000)....11
PIL 2003-06, 19 Feb 03 Security Contract Language for all Corps of Engineers' Unclassified Contracts....14
52.211.4853 WORK DAYS AND HOURS (APR 1992)....15
52.215-4101 ALTERNATE STRUCTURED APPROACH TO WEIGHTED GUIDELINE METHOD FOR CONSTRUCTION CONTRACTS (EFARS 15.973-100) (MAY 1995)....15
52.0223-4803 HAZARDOUS MATERIALS DELIVERED UNDER THIS CONTRACT (MAY 1993)....16
52.0232-4501 INVOICES (AUG 1991)....16
52.236-4001 AS-BUILT DRAWINGS (PROGRESS PAYMENT) (OCT 1998)....16
52.236-4581 AVAILABILITY OF UTILITIES SERVICES (APR 1992)....17
ER 415-1-15 TIME EXTENSIONS FOR UNUSUALLY SEVERE WEATHER (31 OCT 89)....17

CLAUSES INCORPORATED BY FULL TEXT

52.0001-4001 CONTRACT ADMINISTRATION DATA

The Contract Administration Office for this contract subsequent to award is:

Department of the Army
Los Angeles District, Corps of Engineers
P.O. Box 532711
Los Angeles, California 90053-2325

ATTN: JULIE AYALA/LUCIA CARVAJAL

Telephone No: 213.452.3241 or 213.452.3240

Payment will be made by:

USACE Finance Center
ATTN: CEFC-AO-P
5270 Integrity Drive
Millington, TN 38054-5005

Submit Invoices to:

REFER TO SF 1442, BLOCK 26, "SOLICITATION, OFFER AND AWARD" WHICH WILL BE COMPLETED AT TIME OF CONTRACT AWARD

52.0028-4001 REQUIRED INSURANCE

Include this clause in all solicitations and contracts.

Insurance is required as follows:

a. Either Workman's Compensation or Employer's Liability Insurance with a minimum limit of $100,000.00.

b. General Liability. The Contracting Officer shall require bodily injury liability insurance coverage written on the comprehensive form or policy of at least $500,000.00 per occurrence.

c. Automobile Liability Insurance for Bodily Injury and Property Damage with minimum limits of $200,000.00 for injury or death of any one person; $500,000.00 for each accident or occurrence of bodily injury liability; and $20,000.00 for each accident or occurrence for property liability.

d. In every case the insurance coverage shall amount to at least the limits stated above. However, where the Financial Responsibility Compulsory Insurance Law of the State in which the installation is located requires higher limits, the Automobile Liability Insurance Policy should provide coverage of at least those limits.

Prior to the commencement of work hereunder, the Contractor shall furnish to the Contracting Office a certificate or written statement of the above required insurance. The policies evidencing required insurance shall contain an endorsement to the effect that cancellation or any material change in the policies adversely affecting the interests of the Government in such insurance shall not be effective until 10 days after written notice thereof to the Contracting Officer.

The Contractor agrees to insert the substance of this clause, including this paragraph, in all subcontracts hereunder.

52.211-10 COMMENCEMENT, PROSECUTION, AND COMPLETION OF WORK (APR 1984)

The Contractor shall be required to (a) commence work under this contract within 10 calendar days after the date the Contractor receives the notice to proceed, (b) prosecute the work diligently, and (c) complete the entire work ready for use not later than 420 calendar days after the contractor receives the Notice to Proceed. No additional time for contract completion will be allowed when an option is exercised. The given contract completion time was formulated to include time necessary to perform all option work. The time stated for completion shall include final cleanup of the premises.

(End of clause)

52.211-12 LIQUIDATED DAMAGES--CONSTRUCTION (SEP 2000)

(a) If the Contractor fails to complete the work within the time specified in the contract, the Contractor shall pay liquidated damages to the Government in the amount of $ 907.00 for each calendar day of delay until the work is completed or accepted.

(b) If the Government terminates the Contractor's right to proceed, liquidated damages will continue to accrue until the work is completed. These liquidated damages are in addition to excess costs of repurchase under the Termination clause.

(End of clause)

52.228-12 Prospective Subcontractor Requests for Bonds. (OCT 1995)

In accordance with Section 806(a)(3) of Pub. L. 102-190, as amended by Sections 2091 and 8105 of Pub. L. 103-355, upon the request of a prospective subcontractor or supplier offering to furnish labor or material for the performance of this contract for which a payment bond has been furnished to the Government pursuant to the Miller Act, the Contractor shall promptly provide a copy of such payment bond to the requester.

(End of clause)

52.228-14 IRREVOCABLE LETTER OF CREDIT (DEC 1999)

(a) “Irrevocable letter of credit” (ILC), as used in this clause, means a written commitment by a federally insured financial institution to pay all or part of a stated amount of money, until the expiration date of the letter, upon presentation by the Government (the beneficiary) of a written demand therefor. Neither the financial institution nor the offeror/Contractor can revoke or condition the letter of credit.

(b) If the offeror intends to use an ILC in lieu of a bid bond, or to secure other types of bonds such as performance and payment bonds, the letter of credit and letter of confirmation formats in paragraphs (e) and (f) of this clause shall be used.

(c) The letter of credit shall be irrevocable, shall require presentation of no document other than a written demand and the ILC (including confirming letter, if any), shall be issued/confirmed by an acceptable federally insured financial institution as provided in paragraph (d) of this clause, and--

(1) If used as a bid guarantee, the ILC shall expire no earlier than 60 days after the close of the bid acceptance period;

(2) If used as an alternative to corporate or individual sureties as security for a performance or payment bond, the offeror/Contractor may submit an ILC with an initial expiration date estimated to cover the entire period for which financial security is required or may submit an ILC with an initial expiration date that is a minimum period of one year from the date of issuance. The ILC shall provide that, unless the issuer provides the beneficiary written notice of non-renewal at least 60 days in advance of the current expiration date, the ILC is automatically extended without amendment for one year from the expiration date, or any future expiration date, until the period of required coverage is completed and the Contracting Officer provides the financial institution with a written statement waiving the right to payment. The period of required coverage shall be:

(i) For contracts subject to the Miller Act, the later of--

(A) One year following the expected date of final payment;

(B) For performance bonds only, until completion of any warranty period; or

(C) For payment bonds only, until resolution of all claims filed against the payment bond during the one-year period following final payment.

(ii) For contracts not subject to the Miller Act, the later of--

(A) 90 days following final payment; or

(B) For performance bonds only, until completion of any warranty period.

(d) Only federally insured financial institutions rated investment grade or higher shall issue or confirm the ILC. The offeror/Contractor shall provide the Contracting Officer a credit rating that indicates the financial institution has the required rating(s) as of the date of issuance of the ILC. Unless the financial institution issuing the ILC had letter of credit business of less than $25 million in the past year, ILCs over $5 million must be confirmed by another acceptable financial institution that had letter of credit business of less than $25 million in the past year.

(e) The following format shall be used by the issuing financial institution to create an ILC:

_____

[Issuing Financial Institution's Letterhead or Name and Address]

Issue Date _____

IRREVOCABLE LETTER OF CREDIT NO. _____

Account party's name _____

Account party's address _____

For Solicitation No. _____(for reference only)

TO: [U.S. Government agency]

[U.S. Government agency's address]

1. We hereby establish this irrevocable and transferable Letter of Credit in your favor for one or more drawings up to United States $_____. This Letter of Credit is payable at [issuing financial institution's and, if any, confirming

financial institution's] office at [issuing financial institution's address and, if any, confirming financial institution's address] and expires with our close of business on _____, or any automatically extended expiration date.
2. We hereby undertake to honor your or the transferee's sight draft(s) drawn on the issuing or, if any, the confirming financial institution, for all or any part of this credit if presented with this Letter of Credit and confirmation, if any, at the office specified in paragraph 1 of this Letter of Credit on or before the expiration date or any automatically extended expiration date.

3. [This paragraph is omitted if used as a bid guarantee, and subsequent paragraphs are renumbered.] It is a condition of this Letter of Credit that it is deemed to be automatically extended without amendment for one year from the expiration date hereof, or any future expiration date, unless at least 60 days prior to any expiration date, we notify you or the transferee by registered mail, or other receipted means of delivery, that we elect not to consider this Letter of Credit renewed for any such additional period. At the time we notify you, we also agree to notify the account party (and confirming financial institution, if any) by the same means of delivery.

4. This Letter of Credit is transferable. Transfers and assignments of proceeds are to be effected without charge to either the beneficiary or the transferee/assignee of proceeds. Such transfer or assignment shall be only at the written direction of the Government (the beneficiary) in a form satisfactory to the issuing financial institution and the confirming financial institution, if any.

5. This Letter of Credit is subject to the Uniform Customs and Practice (UCP) for Documentary Credits, 1993 Revision, International Chamber of Commerce Publication No. 500, and to the extent not inconsistent therewith, to the laws of _____ [state of confirming financial institution, if any, otherwise state of issuing financial institution].

6. If this credit expires during an interruption of business of this financial institution as described in Article 17 of the UCP, the financial institution specifically agrees to effect payment if this credit is drawn against within 30 days after the resumption of our business.

Sincerely,

_____

[Issuing financial institution]

(f) The following format shall be used by the financial institution to confirm an ILC:

_____
[Confirming Financial Institution's Letterhead or Name and Address]

(Date) _____

Our Letter of Credit Advice Number _____

Beneficiary: _____ [U.S. Government agency]

Issuing Financial Institution: _____

Issuing Financial Institution's LC No.: _____

Gentlemen:

1. We hereby confirm the above indicated Letter of Credit, the original of which is attached, issued by _____ [name of issuing financial institution] for drawings of up to United States dollars _____/U.S. $_____ and expiring with our close of business on _____ [the expiration date], or any automatically extended expiration date.

2. Draft(s) drawn under the Letter of Credit and this Confirmation are payable at our office located at _____.

3. We hereby undertake to honor sight draft(s) drawn under and presented with the Letter of Credit and this Confirmation at our offices as specified herein.

4. [This paragraph is omitted if used as a bid guarantee, and subsequent paragraphs are renumbered.] It is a condition of this confirmation that it be deemed automatically extended without amendment for one year from the expiration date hereof, or any automatically extended expiration date, unless:

(a) At least 60 days prior to any such expiration date, we shall notify the Contracting Officer, or the transferee and the issuing financial institution, by registered mail or other receipted means of delivery, that we elect not to consider this confirmation extended for any such additional period; or

(b) The issuing financial institution shall have exercised its right to notify you or the transferee, the account party, and ourselves, of its election not to extend the expiration date of the Letter of Credit.

5. This confirmation is subject to the Uniform Customs and Practice (UCP) for Documentary Credits, 1993 Revision, International Chamber of Commerce Publication No. 500, and to the extent not inconsistent therewith, to the laws of _____ [state of confirming financial institution].
6. If this confirmation expires during an interruption of business of this financial institution as described in Article 17 of the UCP, we specifically agree to effect payment if this credit is drawn against within 30 days after the resumption of our business.

Sincerely,

_____

[Confirming financial institution]

(g) The following format shall be used by the Contracting Officer for a sight draft to draw on the Letter of Credit:

SIGHT DRAFT

_____

[City, State]

(Date) _____

[Name and address of financial institution]

Pay to the order of _____ [Beneficiary Agency] _____ the sum of United States $_____.
This draft is drawn under Irrevocable Letter of Credit No. _____.

_____

[Beneficiary Agency]

By: _____

(End of clause)

52.228-15 Performance and Payment Bonds--Construction (JUL 2000)-

(a) Definitions. As used in this clause--

Original contract price means the award price of the contract; or, for requirements contracts, the price payable for the estimated total quantity; or, for indefinite-quantity contracts, the price payable for the specified minimum quantity. Original contract price does not include the price of any options, except those options exercised at the time of contract award.

(b) Amount of required bonds. Unless the resulting contract price is $100,000 or less, the successful offeror shall furnish performance and payment bonds to the Contracting Officer as follows:

(1) Performance bonds (Standard Form 25). The penal amount of performance bonds at the time of contract award shall be 100 percent of the original contract price.

(2) Payment Bonds (Standard Form 25-A). The penal amount of payment bonds at the time of contract award shall be 100 percent of the original contract price.

(3) Additional bond protection. (i) The Government may require additional performance and payment bond protection if the contract price is increased. The increase in protection generally will equal 100 percent of the increase in contract price.

(ii) The Government may secure the additional protection by directing the Contractor to increase the penal amount of the existing bond or to obtain an additional bond.

(c) Furnishing executed bonds. The Contractor shall furnish all executed bonds, including any necessary reinsurance agreements, to the Contracting Officer, within the time period specified in the Bid Guarantee provision of the solicitation, or otherwise specified by the Contracting Officer, but in any event, before starting work.

(d) Surety or other security for bonds. The bonds shall be in the form of firm commitment, supported by corporate sureties whose names appear on the list contained in Treasury Department Circular 570, individual sureties, or by other acceptable security such as postal money order, certified check, cashier's check, irrevocable letter of credit, or, in accordance with Treasury Department regulations, certain bonds or notes of the United States. Treasury Circular 570 is published in the Federal Register or may be obtained from the U.S. Department of Treasury, Financial Management Service, Surety Bond Branch, 401 14th Street, NW, 2nd Floor, West Wing, Washington, DC 20227.

(e) Notice of subcontractor waiver of protection (40 U.S.C. 270b(c). Any waiver of the right to sue on the payment bond is void unless it is in writing, signed by the person whose right is waived, and executed after such person has first furnished labor or material for use in the performance of the contract.

(End of clause)

52.231-5000 EQUIPMENT OWNERSHIP AND OPERATING EXPENSE SCHEDULE
MAR 1995)—EFARS

(a) This clause does not apply to terminations. See 52.249-5000, Basis for Settlement of Proposals and FAR Part 49.

(b) Allowable cost for construction and marine plant and equipment in sound workable condition owned or controlled and furnished by a contractor or subcontractor at any tier shall be based on actual cost data for each piece of equipment or groups of similar serial and series for which the Government can determine both ownership and operating costs from the contractor's accounting records. When both ownership and operating costs cannot be determined for any piece of equipment or groups of similar serial or series equipment from the contractor's accounting records, costs for that equipment shall be based upon the applicable provisions of EP 1110-1-8, Construction Equipment Ownership and Operating Expense Schedule, Region ____. Working conditions shall be

considered to be average for determining equipment rates using the schedule unless specified otherwise by the contracting officer. For equipment not included in the schedule, rates for comparable pieces of equipment may be used or a rate may be developed using the formula provided in the schedule. For forward pricing, the schedule in effect at the time of negotiations shall apply. For retroactive pricing, the schedule in effect at the time the work was performed shall apply.

(c) Equipment rental costs are allowable, subject to the provisions of FAR 31.105(d)(ii) and FAR 31.205-36. Rates for equipment rented from an organization under common control, lease-purchase arrangements, and sale-leaseback arrangements, will be determined using the schedule, except that actual rates will be used for equipment leased from an organization under common control that has an established practice of leasing the same or similar equipment to unaffiliated lessees.

(d) When actual equipment costs are proposed and the total amount of the pricing action exceeds the small purchase threshold, the contracting officer shall request the contractor to submit either certified cost or pricing data, or partial/limited data, as appropriate. The data shall be submitted on Standard Form 1411, Contract Pricing Proposal Cover Sheet.

(End of clause)

52.232-33 PAYMENT BY ELECTRONIC FUNDS TRANSFER—CENTRAL CONTRACTOR REGISTRATION (MAY 1999)

(a) Method of payment. (1) All payments by the Government under this contract shall be made by electronic funds transfer (EFT), except as provided in paragraph (a)(2) of this clause. As used in this clause, the term “EFT” refers to the funds transfer and may also include the payment information transfer.

(2) In the event the Government is unable to release one or more payments by EFT, the Contractor agrees to either--

(i) Accept payment by check or some other mutually agreeable method of payment; or

(ii) Request the Government to extend the payment due date until such time as the Government can make payment by EFT (but see paragraph (d) of this clause).

(b) Contractor's EFT information. The Government shall make payment to the Contractor using the EFT information contained in the Central Contractor Registration (CCR) database. In the event that the EFT information changes, the Contractor shall be responsible for providing the updated information to the CCR database.

(c) Mechanisms for EFT payment. The Government may make payment by EFT through either the Automated Clearing House (ACH) network, subject to the rules of the National Automated Clearing House Association, or the Fedwire Transfer System. The rules governing Federal payments through the ACH are contained in 31 CFR part 210.

(d) Suspension of payment. If the Contractor's EFT information in the CCR database is incorrect, then the Government need not make payment to the Contractor under this contract until correct EFT information is entered into the CCR database; and any invoice or contract financing request shall be deemed not to be a proper invoice for the purpose of prompt payment under this contract. The prompt payment terms of the contract regarding notice of an improper invoice and delays in accrual of interest penalties apply.

(e) Contractor EFT arrangements. If the Contractor has identified multiple payment receiving points (i.e., more than one remittance address and/or EFT information set) in the CCR database, and the Contractor has not notified the Government of the payment receiving point applicable to this contract, the Government shall make payment to the first payment receiving point (EFT information set or remittance address as applicable) listed in the CCR database.

(f) Liability for uncompleted or erroneous transfers. (1) If an uncompleted or erroneous transfer occurs because the Government used the Contractor's EFT information incorrectly, the Government remains responsible for--

(i) Making a correct payment;

(ii) Paying any prompt payment penalty due; and
(iii) Recovering any erroneously directed funds.

(2) If an uncompleted or erroneous transfer occurs because the Contractor's EFT information was incorrect, or was revised within 30 days of Government release of the EFT payment transaction instruction to the Federal Reserve System, and--

(i) If the funds are no longer under the control of the payment office, the Government is deemed to have made payment and the Contractor is responsible for recovery of any erroneously directed funds; or

(ii) If the funds remain under the control of the payment office, the Government shall not make payment, and the provisions of paragraph (d) of this clause shall apply.

(g) EFT and prompt payment. A payment shall be deemed to have been made in a timely manner in accordance with the prompt payment terms of this contract if, in the EFT payment transaction instruction released to the Federal Reserve System, the date specified for settlement of the payment is on or before the prompt payment due date, provided the specified payment date is a valid date under the rules of the Federal Reserve System.

(h) EFT and assignment of claims. If the Contractor assigns the proceeds of this contract as provided for in the assignment of claims terms of this contract, the Contractor shall require as a condition of any such assignment, that the assignee shall register in the CCR database and shall be paid by EFT in accordance with the terms of this clause. In all respects, the requirements of this clause shall apply to the assignee as if it were the Contractor. EFT information that shows the ultimate recipient of the transfer to be other than the Contractor, in the absence of a proper assignment of claims acceptable to the Government, is incorrect EFT information within the meaning of paragraph (d) of this clause.

(i) Liability for change of EFT information by financial agent. The Government is not liable for errors resulting from changes to EFT information made by the Contractor's financial agent.

(j) Payment information. The payment or disbursing office shall forward to the Contractor available payment information that is suitable for transmission as of the date of release of the EFT instruction to the Federal Reserve System. The Government may request the Contractor to designate a desired format and method(s) for delivery of payment information from a list of formats and methods the payment office is capable of executing. However, the Government does not guarantee that any particular format or method of delivery is available at any particular payment office and retains the latitude to use the format and delivery method most convenient to the Government. If the Government makes payment by check in accordance with paragraph (a) of this clause, the Government shall mail the payment information to the remittance address contained in the CCR database.

(End of Clause)

52.236-4 PHYSICAL DATA (APR 1984)

Data and information furnished or referred to below is for the Contractor's information. The Government shall not be responsible for any interpretation of or conclusion drawn from the data or information by the Contractor.

(a) The indications of physical conditions on the drawings and in the specifications are the result of site investigations.

(b) Weather conditions the contractor shall satisfy himself as to the hazards likely to arise from whether conditions.

(c) Transportation facilities the contractor shall make his/her own investigation of the conditions of existing public and private roads and clearances, restrictions, bridge load limits and other limitations affecting transportation and ingress and egress at the job site. The unavailability of transportation facilities or limitations there of shall not

become a basis for claims against the Government or extensions of time for completion of the work.

(d) N/A.

(End of clause)

52.236-16 QUANTITY SURVEYS (APR 1984)

(a) Quantity surveys shall be conducted, and the data derived from these surveys shall be used in computing the quantities of work performed and the actual construction completed and in place.

(b) The Government shall conduct the original and final surveys and make the computations based on them. The Contractor shall conduct the surveys for any periods for which progress payments are requested and shall make the computations based on these surveys. All surveys conducted by the Contractor shall be conducted under the direction of a representative of the Contracting Officer, unless the Contracting Officer waives this requirement in a specific instance.

(c) Promptly upon completing a survey, the Contractor shall furnish the originals of all field notes and all other records relating to the survey or to the layout of the work to the Contracting Officer, who shall use them as necessary to determine the amount of progress payments. The Contractor shall retain copies of all such material furnished to the Contracting Officer.

(End of clause)

52.236-21 SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION (FEB 1997) - ALTERNATE I (APR 1984

(a) The Contractor shall keep on the work site a copy of the drawings and specifications and shall at all times give the Contracting Officer access thereto. Anything mentioned in the specifications and not shown on the drawings, or shown on the drawings and not mentioned in the specifications, shall be of like effect as if shown or mentioned in both. In case of difference between drawings and specifications, the specifications shall govern. In case of discrepancy in the figures, in the drawings, or in the specifications, the matter shall be promptly submitted to the Contracting Officer, who shall promptly make a determination in writing. Any adjustment by the Contractor without such a determination shall be at its own risk and expense. The Contracting Officer shall furnish from time to time such detailed drawings and other information as considered necessary, unless otherwise provided.

(b) Wherever in the specifications or upon the drawings the words "directed", "required", "ordered", "designated", "prescribed", or words of like import are used, it shall be understood that the "direction", "requirement", "order", "designation", or "prescription", of the Contracting Officer is intended and similarly the words "approved", "acceptable", "satisfactory", or words of like import shall mean "approved by," or "acceptable to", or "satisfactory to" the Contracting Officer, unless otherwise expressly stated.

(c) Where "as shown," as indicated", "as detailed", or words of similar import are used, it shall be understood that the reference is made to the drawings accompanying this contract unless stated otherwise. The word "provided" as used herein shall be understood to mean "provide complete in place," that is "furnished and installed".

(d) Shop drawings means drawings, submitted to the Government by the Contractor, subcontractor, or any lower tier subcontractor pursuant to a construction contract, showing in detail (1) the proposed fabrication and assembly of structural elements, and (2) the installation (i.e., fit, and attachment details) of materials or equipment. It includes drawings, diagrams, layouts, schematics, descriptive literature, illustrations, schedules, performance and test data, and similar materials furnished by the contractor to explain in detail specific portions of the work required by the contract. The Government may duplicate, use, and disclose in any manner and for any purpose shop drawings delivered under this contract.

(e) If this contract requires shop drawings, the Contractor shall coordinate all such drawings, and review them for accuracy, completeness, and compliance with contract requirements and shall indicate its approval thereon as evidence of such coordination and review. Shop drawings submitted to the Contracting Officer without evidence of the Contractor's approval may be returned for resubmission. The Contracting Officer will indicate an approval or disapproval of the shop drawings and if not approved as submitted shall indicate the Government's reasons therefor. Any work done before such approval shall be at the Contractor's risk. Approval by the Contracting Officer shall not relieve the Contractor from responsibility for any errors or omissions in such drawings, nor from responsibility for complying with the requirements of this contract, except with respect to variations described and approved in accordance with (f) below.

(f) If shop drawings show variations from the contract requirements, the Contractor shall describe such variations in writing, separate from the drawings, at the time of submission. If the Contracting Officer approves any such variation, the Contracting Officer shall issue an appropriate contract modification, except that, if the variation is minor or does not involve a change in price or in time of performance, a modification need not be issued.

(g) The Contractor shall submit to the Contracting Officer for approval four copies (unless otherwise indicated) of all shop drawings as called for under the various headings of these specifications. Three sets (unless otherwise indicated) of all shop drawings, will be retained by the Contracting Officer and one set will be returned to the Contractor. Upon completing the work under this contract, the Contractor shall furnish a complete set of all shop drawings as finally approved. These drawings shall show all changes and revisions made up to the time the equipment is completed and accepted.

(End of clause)

52.249-5000 BASIS FOR SETTLEMENT OF PROPOSALS

Actual costs will be used to determine equipment costs for a settlement proposal submitted on the total cost basis under FAR 49.206-2(b). In evaluating a terminations settlement proposal using the total cost basis, the following principles will be applied to determine allowable equipment costs:

(1) Actual costs for each piece of equipment, or groups of similar serial or series equipment, need not be available in the contractor's accounting records to determine total actual equipment costs.

(2) If equipment costs have been allocated to a contract using predetermined rates , those charges will be adjusted to actual costs.

(3) Recorded job costs adjusted for unallowable expenses will be used to determine equipment operating expenses.

(4) Ownership costs (depreciation) will be determined using the contractor's depreciation schedule (subject to the provisions of FAR 31.205-11).

(5) License, taxes, storage and insurance costs are normally recovered as an indirect expense and unless the contractor charges these costs directly to contracts, they will be recovered through the indirect expense rate.

(End of Clause)

252.236-7001 CONTRACT DRAWINGS, MAPS, AND SPECIFICATIONS (AUG 2000)

(a) The Government will provide to the Contractor, without charge, one set of contract drawings and specifications, except publications incorporated into the technical provisions by reference, in electronic or paper media as chosen by the Contracting Officer.

(b) The Contractor shall--

(1) Check all drawings furnished immediately upon receipt;

(2) Compare all drawings and verify the figures before laying out the work;

(3) Promptly notify the Contracting Officer of any discrepancies;

(4) Be responsible for any errors that might have been avoided by complying with this paragraph (b); and

(5) Reproduce and print contract drawings and specifications as needed.

(c) In general--

(1) Large-scale drawings shall govern small-scale drawings; and

(2) The Contractor shall follow figures marked on drawings in preference to scale measurements.

(d) Omissions from the drawings or specifications or the misdescription of details of work that are manifestly necessary to carry out the intent of the drawings and specifications, or that are customarily performed, shall not relieve the Contractor from performing such omitted or misdescribed details of the work. The Contractor shall perform such details as if fully and correctly set forth and described in the drawings and specifications.

(e) The work shall conform to the specifications and the contract drawings identified on the following index of drawings:

Title	Drawing No.
General	
Cover	G-0
Vicinty and Location map and List of drawings	G-1
Symbols	G-2
Abbreviations	G-3
Hydraulic Profile and design Criteria	G-4
Process Flow Schematic	G-5
Civil Genearal Notes and Symbols	GC-1
Standard Details 1	GC-2
Standard Details 2	GC-3
Standard Details 3	GC-4
Standard Details 4	GC-5
Civil Details	GC-6
Civil	
Tertiary Upgrade Key Plan	C-1
Horizontal Control and Paving Plan - Area 1	C-2
Horizontal Control and Paving Plan - Area 2	C-3
Grading and Drainage Plan - Area 1	C-4
Grading and Drainage Plan - Area 2	C-5
Yard Piping Plan - Area 1	C-6
Yard Piping Plan - Area 2	C-7
Recycled Water Piping Key Plan	CS-1
Recycled Water Piping Plan STA 0+07 to 25+00	CS-2
Recycled Water Piping Plan STA 25+00 to 51+00	CS-3

Recycled Water Piping Plan STA 51+00 to 78+00	CS-4
Recycled Water Piping Plan STA 78+00 to 105+00	CS-5
Recycled Water Piping Plan STA 105+00 to 130+00	CS-6
Recycled Water Piping Plan STA 130+00 to 133+00	CS-7
Recycled Water Piping Plan STA 0+00 to 9+40	CS-8
Recycled Water Piping Plan STA 0+00 to 10+00	CS-9
Recycled Water Piping Plan STA 0+00 to 6+00	CS-10
Recycled Water Piping Station 48+78.77	CS-11

Architectural

Electrical Building - Plans and Elevations	10A-1

Mechanical

Piping Schedule	GM-1
Equipment Schedules	GM-2
Mecahnical Standard Details - 1	GM-3
Mecahnical Standard Details - 2	GM-4
Mecahnical Standard Details - 3	GM-5
Flow Equalization Basins - Junction Box	5M-1
Filter Influent Pump Station - Plan and Section	5M-2
Flash Mix Ps - Plan and Section	6M-1
Flocculation Tank - Plan	7M-1
Flocculation Tank - Section	7M-2
Tertiary Filters - Plan	8M-1
Tertiary Filters - Section	8M-2
Reject Water Pump Station - Plan and Section	8M-3
Chlorine Contact Tank - Plan	9M-1
Chlorine Contact Tank - Section	9M-2
Recycled Water Pump Station -Plan	9M-3
Electrical Building	10M-1
Existing Chemical Area	11M-1

Structural

Standard Details	GS-1
Standard Details	GS-2
Standard Details	GS-3
Standard Details	GS-4
Standard Details	GS-5
Flow Equalization Basins - Junction Box	5S-1
Flash Mix Pump Station Plan and Section	6S-1
Flocculation Tank Plan and Section	7S-1
Tertiary Filters - Foundation Plan	8S-1
Chlorine Contact and RW PS - FDN Plan	9S-1
Chlorine Contact and RW PS - TOP Plan	9S-2
Chlorine Contact and RW PS - Sections 1	9S-3
Recycled Water PS	9S-4
Electrical Building - FDN Plan	10S-1

Electrical	
Electrical Symbols -1	GE-1
Electrical Symbols -2	GE-2
Elcetrical Abbreviations and General Notes	GE-3
Electrical Standard Details -1	GE-4
Electrical Standard Details -2	GE-5
Electrical Site Plan	E-1
Electrical Single Line Diagrams	E-2
Electrical Equipment Elevation Diagrams	E-3
Schematic Diagrams - 1	E-4
Schematic Diagrams - 2	E-5
Cable and Conduit Schedule	E-6
Lighting Fixture and Panel Schedules	E-7
Filter Influent Pumping Station - Electrical Plan	5E-1
Flash Mix PS/Flocculation Tank - Electrical Plan	6E-1
Tretiary Filters - Electrical Plan	8E-1
Waste Washwater PS Electrical Plan	8E-2
Chlorine Contact Tank - Electrical Plan	9E-1
Recycling Water PS - Electrical Plan	9E-2
Electrical Building - Power Plan	10E-1
Electrical Building - Lighting Plan	10E-2
Hypo Feed	11E-1

Instrumentation	
Symbols and Abbreviations	GI-1
Symbols and Abbreviations	GI-2
System Block Diagram	GI-3
P&ID Filter Influent PS	5I-1
P&ID Flash Mix PS/Flocculation Tank	6I-1
P&ID Filters/Air Compressor	8I-1
P&ID Reject Water PS	8I-2
P&ID Chlorine Contact Tank	9I-1
P&ID Recycled Water PS	9I-2
PEC/CA	10I-1
Hypro I	11I-1
Hypro Feed II	11I-2

(End of clause)

All Contractor employees (U.S. citizens and Non- U.S. citizens) working under this contract *(to include grants, cooperative agreements and task orders)* who require access to Automated Information Systems (AIS), (stand alone computers, network computers/systems, e-mail) shall, at a minimum, be designated into an ADP-III position (non-sensitive) in accordance with DoD 5220-22-R, Industrial Security Regulation. The investigative requirements for an ADP-III position are a favorable National Agency Check (NAC), SF-85P, Public Trust Position. The contractor shall have each applicable employee complete a SF-85P and submit to the Los Angeles District, ATTN: CESPL-P.O Box 532711, Los Angeles, California 90053 Security Officer within three (3) working days after award of any contract or task order, and shall be submitted prior to the individual being permitted access to an AIS. Contractors that have a commercial or government entity (CAGE) Code and Facility Security Clearance through the Defense Security Service shall process the NACs and forward visit requests/results of NAC to the (insert the name and address of the Division/ District) Security Officer. For those contractors that do not have a CAGE Code or Facility Security Clearance, the (insert the name and address of the Division/ District) Security Office will process the investigation in coordination with the Contractor and contract employees.

In accordance with Engineering Regulation, ER 380-1-18, Section 4, foreign nationals who work on Corps of Engineers' contracts or task orders shall be approved by the HQUSACE Foreign Disclosure Officer or higher before beginning work on the contract/task order. This regulation includes subcontractor employees. (NOTE: exceptions to the above requirement include foreign nationals who perform janitorial and/or ground maintenance services.) The contractor shall submit to the Division/District Contract Office, the names of all foreign nationals proposed for performance under this contract/task order, along with documentation to verify that he/she was legally admitted into the United States and has authority to work and/or go to school in the US. Such documentation may include a US passport, Certificate of US citizenship (INS Form N-560 or N-561), Certificate of Naturalization (INS Form N-550 or N-570), foreign passport with I-551 stamp or attached INS Form I-94 indicating employment authorization, Alien Registration Receipt Card with photograph (INS Form I-151 or I-551), Temporary Resident Card (INS Form I-688), Employment Authorization Card (INS Form I-688A), Reentry Permit (INS Form I-327), Refugee Travel Document (INS Form I-571), Employment Authorization Document issued by the INS which contains a photograph (INS Form I-688B).

Classified contracts require the issuance of a DD Form 254 (Department of Defense Contract Security Classification Specification).
(End of Clause)

52.211.4853 WORK DAYS AND HOURS (APR 1992)

The normal work days and hours for this project will be Monday through Friday, excluding federal holidays, from 7:00 a.m. to 4:30 p.m. Access to the work site may be restricted to these hours and days. Work during other than normal hours and days must be coordinated in advance with the Administrative Contracting Officer.

52.215-4101 ALTERNATE STRUCTURED APPROACH TO WEIGHTED GUIDELINE METHOD FOR CONSTRUCTION CONTRACTS (EFARS 15.973-100) (MAY 1995)

The following alternate structured approach shall be used for all fixed-price construction contract actions.

Factor	Rate	Weight	Value
Degree of risk	20		
Relative difficulty of work	15		
Size of job	15		
Period of performance	15		
Contractor's investment	5		
Assistance by Government	5		
Subcontracting	25		

Total 100%

Based on the circumstances of the procurement action, each of the above factors shall be weighted from .03 to .12 as indicated below. "Value shall be obtained by multiplying the rate by the weight. The Value column when totaled indicates the fair and reasonable profit percentage under the circumstances of the particular procurement. The profit percentage should be multiplied by the total contract costs, including general and administrative costs.

(1) Degree of risk. Where the work involves no risk or the degree of risk is very small, the weighting should be .03; as the degree of risk increases, the weighting should be increased up to a maximum of .12. Lump sum items shall generally have a higher weight than unit price items; other things to consider include the nature of the work and where it is to be performed. Consider the portion of the work to be done by subcontractors, amount and type of labor included in costs, whether the negotiation is before or after performance of the work, etc. Modifications settled before the fact have much greater risk than those settled after the fact. A weight of .03 is appropriate for after the fact equitable adjustments and/or settlements.

(2) Relative Difficulty of Work: If the work is difficult and complex, the weight should be .12 and should be proportionately reduced to .03 on the simplest of jobs. This factor is tied in to some extent with the degree of risk. Some other things to consider are the nature of the work, by whom it is to be done (i.e., subcontractors, consultants), what is the time schedule.

(3) Size of Job. Work of $100,000 or less shall be weighted at .12. Work estimated between $100,000 and $5,000,000 shall be proportionately weighted from .12 to .05. Work from $5,000,000 to $10,000,000 shall be weighted at .04. Work in excess of $10,000,000 shall be weighted at .03. It should be noted that control of fixed expenses generally improves with increased job magnitude.

(4) Period of Performance. Work not to exceed one month is to be proportionately weighted at .03. Work in excess of 24 months is to be weighted at .12. Durations between one month and 24 months are to be proportionately weighted between .03 and .12.

(5) Contractor's Investment. To be weighted from .03 to .12 on the basis of below average, average and above average. Things to consider include amount of subcontracting, Government-furnished property or data such as surveys, soil tests, method of making progress payments, and any mobilization payment items.

(6) Assistance by Government. To be weighted from .12 to .03 on the basis of average to above average. Consider use of Government-owned property, equipment and facilities, and expediting assistance.

(7) Subcontracting. To be weighted inversely proportional to the amount of subcontracting. Where 80% or more of the work is to be subcontracted use .03. The weighting should be increased proportionately to .12 where all the work is performed by the contractor's own forces.

52.0223-4803 HAZARDOUS MATERIALS DELIVERED UNDER THIS CONTRACT (MAY 1993)

(a) If any hazardous materials will be delivered under this contract (see Section 00600, FAR 52.223-3, and DFARS 252.223-7001), the Material Safety Data Sheets (MSDS) for locally purchased, nonstandard stock hazardous material will be submitted to the Corps of Engineers Contracting Officer or Contracting Officer's Representative. For all other materials, the MSDS will also be submitted to U.S. Army Environmental Hygiene Agency, ATTN: HSE-OI, Aberdeen Proving Grounds MD 21010.

(b) Hazardous material is defined in Federal Standard No. 313, sold by the General Services Administration Specifications Unit (3FBP-W), 7th & D Streets, SW, Washington DC 20407.

52.0232-4501 INVOICES (AUG 1991)

The Government shall pay the Contractor upon submission of proper invoices for supplies delivered and accepted or services rendered and accepted for the portion of work actually performed under this contract. Invoices will be submitted in quadruplicate to the address in Block 26, SF1442, which will be completed at time of award. Invoices shall be submitted on ENG Form 93 which will be provided to the Contractor by the Government

52.236-4001 AS-BUILT DRAWINGS (PROGRESS PAYMENT) (OCT 1998)

One-half of one percent of construction award money shall be withheld until the final as-built drawings and CADD files are accepted by the Government

52.236-4581 AVAILABILITY OF UTILITIES SERVICES (APR 1992)

All reasonably required amounts of water, electricity, and other utilities essential to contract performance will be made available to the contractor at no cost to the contractor from existing systems, outlets and supplies. All temporary connections, outlets and distribution lines, as may be required, shall be installed, maintained and removed by the Contractor at Contractor's expense; removal shall be before final acceptance of the work by the Government. The Contractor shall carefully conserve any utilities furnished without charge.

ER 415-1-15 TIME EXTENSIONS FOR UNUSUALLY SEVERE WEATHER (31 OCT 89)

This provision specifies the procedure for the determination of time extensions for unusually severe weather in accordance with the contract clause entitled "Default: Fixed Price Construction)". In order for the Contracting Officer to award a time extension under this clause, the following conditions must be satisfied:

The weather experienced at the project site during the contract period must be found to be unusually severe, that is, more severe than the adverse weather anticipated for the project location during any given month.

The unusually severe weather must actually cause a delay to the completion of the project. The delay must be beyond the control and without the fault or negligence of the Contractor.

The following schedule of monthly anticipated adverse weather delays is based on National Oceanic and Atmospheric Administration (NOAA) or similar data for the project location and will constitute the base line for monthly weather time evaluations. The Contractor's progress schedule must reflect these anticipated adverse weather delays in all weather dependent activities.

MONTHLY ANTICIPATED ADVERSE WEATHER DELAY
WORK DAYS BASED ON (5) DAY WORK WEEK

PRECIPITATION OVER 0.10 INCHES

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2	1	1	0	0	0	0	0	1	0	1	1

TEMPERATURE BELOW 32 DEG F.

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
18	9	4	0	0	0	0	0	0	0	6	20

SURFACE WINDS OVER 20MPH

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2	3	5	5	4	2	1	1	1	2	2	3

Upon acknowledgement of the Notice to Proceed (NTP) and continuing throughout the contract, the Contractor will record on the daily CQC report, the occurrence of adverse weather and resultant impact to normally scheduled work. Actual adverse weather delay days must prevent work on critical activities for 50 percent or more of the Contractor's schedule workday. The number of actual adverse weather delay days shall include days impacted by actual adverse weather (even if adverse weather occurred in previous month), be calculated chronologically from the first to the last day of each month, and be recorded as full days. If the number of actual adverse weather delay days exceeds the number of days anticipated listed above, the Contracting Officer will convert any qualifying delays to calendar days, giving full consideration for equivalent fair weather work days, and issue a modification in accordance with the contract clause entitled "Default (Fixed Price Construction)".

BRS Document Viewer
General Decision Number CA030037

General Decision Number CA030037
Superseded General Decision No. CA020037
State: California Construction Type:
BUILDING DREDGING
HEAVY
HIGHWAY
County(ies):
SAN BERNARDINO BUILDING CONSTRUCTION PROJECTS; DREDGING PROJECTS (does not include hopper dredge work); HEAVY CONSTRUCTION PROJECTS (does not include water well drilling); HIGHWAY CONSTRUCTION PROJECTS
Modification Number Publication Date
0 06/13/2003

COUNTY(ies):
SAN BERNARDINO ASBE0005B 08/05/2002

	Rates	Fringes
ASBESTOS WORKER/INSULATOR Includes the application of all insulating materials, protective coverings, coatings, & finishes to all types of mechanical systems	33.06	8.11

ASBE0005Z 01/01/2003

	Rates	Fringes
Includes preparation, wetting, stripping, removal, scrapping, vacuuming, bagging and disposing oa all insuling materials from mechanical systems, whether they contain asbestos or not		
HAZADOUS MATERIAL HANDLER	15.75	2.55

BOIL0092F 10/01/2002

	Rates	Fringes
BOILERMAKER	31.96	13.30

BRCA0004U 05/01/2003

	Rates	Fringes
BRICKLAYER; MARBLE MASON	29.42	6.20

BRCA0018G 06/01/2002

	Rates	Fringes
TILE LAYERS	26.50	7.45
TILE FINISHERS	16.65	2.91
MARBLE FINISHER	19.90	3.56

BRCA0018K 12/01/2000

	Rates	Fringes
TERRAZZO WORKER	26.78	5.34
TERRAZZO FINISHER	20.53	5.34

CARP0002B 07/01/2001

	Rates	Fringes
DIVERS:		
Diver, wet	486.08 per day	5.61
Diver, stand-by	243.04 per day	5.61
Diver tender	235.04 per day	5.61

CARP0002Q 07/01/2002

	Rates	Fringes
Work on wood framed construction of single family residences, apartments or condominiums under 4 stories		
DRYWALL INSTALLERS	19.00	5.18
DRYWALL STOCKER/SCRAPPER	10.00	4.68
All other work		
DRYWALL INSTALLERS	29.00	6.68
DRYWALL STOCKER/SCRAPPER	10.00	4.68

CARP0003E 07/01/2002

	Rates	Fringes
Work on wood frame, tilt up or concrete block construction including but not limited to: shopping centers, stores, office buildings, fast food establishments, also including curb, gutter and sidewalks where the total cost of the project does not exceed seven and one-half million ($7,500,000.00) dollars.		
CARPENTERS:		
Carpenter, cabinet installer, insulation installer, floor worker and acoustical installer	22.75	6.28
Shingler	22.88	6.28
Roof loader of shingles	15.42	6.28
Saw filer	22.83	6.28
Table power saw operator	22.85	6.28
Pneumatic nailer or power stapler	23.00	6.28
Fence builder	20.30	6.28
Millwright	23.25	6.28
Pile driver; Derrick barge; Bridge or dock carpenter; Cable splicer; Heavy framer; Rockslinger	22.88	6.28
Head rockslinger	22.98	6.28
Rock barge or scow	22.78	6.28
Scaffold builder	17.00	6.28
All other work:		
Carpenter, cabinet installer, insulation installer, floor worker and acoustical installer	29.00	6.68
Shingler	29.13	6.68
Roof loader of shingles	20.77	6.68
Saw filer	29.08	6.68
Table power saw operator	29.10	6.68
Pneumatic nailer or power stapler	29.25	6.68
Fence builder	24.79	6.68
Millwright	29.50	6.68
Pile driver; Derrick barge; Bridge or dock carpenter; Cable splicer; Heavy framer; Rockslinger	29.13	6.68
Rockslinger	29.13	6.68
Rock barge or scow	29.03	6.68
Scaffold builder	23.20	6.68

FOOTNOTE:
Work of forming in the construction of open cut sewers or storm drains, on operations in which horizontal lagging is used in conjunction with steel H-Beams driven or placed in pre-drilled holes, for that portion of a lagged trench against which concrete is poured, namely, as a substitute for back forms (which work is performed by piledrivers): $0.13 per hour additional.

CARP0003H 08/01/2002

	Rates	Fringes
MODULAR FURNITURE INSTALLER	14.00	5.16
FULL WALL TECHNICIAN	20.14	5.16
MOBILE FILING SYSTEM INSTALLERS	13.10	4.66

ELEC0011C 12/01/2001

	Rates	Fringes
COMMUNICATIONS AND SYSTEMS WORK:		
Installer	22.13	3% + 4.40
Technician	23.93	3% + 4.40

SCOPE OF WORK:
Installation, testing, service and maintenance of systems utilizing the transmission and/or transference of voice, sound, vision and digital for commercial, educational, security and entertainment purposes for the following: TV monitoring and surveillance, background-foreground music, intercom and telephone interconnect, inventory control systems, microwave transmission, multi-media, multiplex, nurse call systems, radio page, school intercom and sound, burglar alarms, fire alarm (see last paragraph below) and low voltage master clock systems in commercial buildings.
Communication Systems that transmit or receive information and/or control systems that are intrinsic to the above listed systems; inclusion or exclusion of terminations and testings of conductors determined by their function; excluding all other data systems or multiple systems which include control function or power supply; excluding installation of raceway systems, conduit systems, line voltage work, and energy management systems.
Does not cover work performed at China Lake Naval Ordnance Test Station.
Fire alarm work shall be performed at the current inside wireman total cost package.

ELEC0477B 06/04/2002

	Rates	Fringes
Electrician	28.25	3%+10.75
Cable splicer	27.75	3%+10.75
Electrician, tunnel work	33.37	3%+10.75

ZONE PAY:
Zone A - 80 road miles from Post Office, 455 Orange Show Lane, San Bernardino, will be a free zone for all contractors
Zone B - Any work performed outside Zone A's 80 road miles, shall add $8.00 per hour to the current wage scale.

ELEC1245A 06/01/2002

	Rates	Fringes
LINE CONSTRUCTION		
Lineman; Cable splicer	33.16	4.5%+7.08
Equipment specialist (operates crawler tractors, commercial motor vehicles, backhoes, trenchers, cranes (50 tons and		

below), and overhead and underground distribution line equipment)	28.19	4.5%+6.80
Groundman	21.56	4.5%+6.80
Powderman	31.51	4.5%+6.84

ELEV0018A 09/15/2001

	Rates	Fringes
ELEVATOR MECHANIC	33.695	7.455

FOOTNOTE:
Vacation Pay: 8% with 5 or more years of service, 6% for 6 months to 5 years service. Paid Holidays: New Years Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day and Friday after, and Christmas Day.

ENGI0012C 07/01/2002

	Rates	Fringes
POWER EQUIPMENT OPERATORS:		
GROUP 1	27.85	11.85
GROUP 2	28.63	11.85
GROUP 3	28.92	11.85
GROUP 4	30.21	11.85
GROUP 5	30.43	11.85
GROUP 6	30.54	11.85
GROUP 7	30.66	11.85
GROUP 8	30.83	11.85
GROUP 9	30.93	11.85
GROUP 10	30.96	11.85
GROUP 11	31.04	11.85
GROUP 12	31.16	11.85
GROUP 13	31.33	11.85
GROUP 14	31.43	11.85
GROUP 15	31.54	11.85
GROUP 16	31.66	11.85
GROUP 17	31.83	11.85
GROUP 18	31.93	11.85
GROUP 19	32.04	11.85
GROUP 20	32.16	11.85
GROUP 21	32.33	11.85
CRANES, PILEDRIVING & HOISTING EQUIPMENT:		
GROUP 1	29.00	11.85
GROUP 2	29.78	11.85
GROUP 3	30.07	11.85
GROUP 4	30.21	11.85
GROUP 5	30.43	11.35
GROUP 6	30.54	11.85
GROUP 7	30.66	11.35
GROUP 8	30.83	11.85
GROUP 9	31.00	11.85
GROUP 10	32.00	11.85
GROUP 11	33.00	11.85
GROUP 12	34.00	11.85
GROUP 13	35.00	11.80
TUNNEL WORK:		
GROUP 1	30.28	11.85
GROUP 2	30.57	11.85
GROUP 3	30.71	11.85
GROUP 4	30.93	11.85
GROUP 5	31.04	11.85
GROUP 6	31.16	11.85
GROUP 7	31.46	11.85

FOOTNOTES: Workers required to suit up and work in a hazardous material environment: $1.00 per hour additional.

Combination mixer and compressor operator on gunite work shall be classified as a concrete mobile mixer operator.

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1: Bargeman; Brakeman; Compressor operator; Ditch Witch, with seat or similar type equipment; Elevator operator-inside; Engineer Oiler; Forklift operator (includes loed, lull or similar types under 5 tons; Generator operator; Generator, pump or compressor plant operator; Pump operator; Signalman; Switchman

GROUP 2: Asphalt-rubber plant operator (nurse tank operator); Concrete mixer operator-skip type; Conveyor operator; Fireman; Forklift operator (includes loed, lull or similar types over 5 tons; Hydrostatic pump operator; oiler crusher (asphalt or concrete plant); Petromat laydown machine; PJU side dum jack; Screening and conveyor machine oeprator (or similar types); Skiploader (wheel type up to 3/4 yd. without attachment); Tar pot fireman; Temporary heating plant operator; Trenching machine oiler

GROUP 3: Asphalt-rubber blend operator; Bobcat or similar type (side steer); Equipment greaser (rack); Ford Ferguson (with dragtype attachments); Helicopter radioman (ground); Stationary pipe wrapping and cleaning machine operator

GROUP 4: Asphalt plant fireman; Backhoe operator (mini-max or similar type); Boring machine operator; Boxman or mixerman (asphalt or concrete); Chip spreading machine operator; Concrete cleaning decontamination machine operator; Concrete Pump Operator (small portable); Drilling machine operator, small auger types (Texoma super economatic or similar types - Hughes 100 or 200 or similar types - drilling depth of 30' maximum); Equipment greaser (grease truck); Guard rail post driver operator; Highline cableway signalman; Horizontal Directional Drilling Machine; Hydra-hammer-aero stomper; Micro Tunneling (above ground tunnel); Power concrete curing machine operator; Power concrete saw operator; Power-driven jumbo form setter operator; Power sweeper operator; Roller operator (compacting); Screed operator (asphalt or concrete); Trenching machine operator (up to 6 ft.); Vacuum or much truck

GROUP 5: Articulating material hauler; Asphalt plant engineer; Batch plant operator; Bit sharpener; Concrete joint machine operator (canal and similar type); Concrete planer operator; Dandy digger; Deck engine operator; Derrickman (oilfield type); Drilling machine operator, bucket or auger types (Calweld 100 bucket or similar types - Watson 1000 auger or similar types - Texoma 330, 500 or 600 auger or similar types - drilling depth of 45' maximum); Drilling machine operator (including water wells); Hydrographic seeder machine operator (straw, pulp or seed), Jackson track maintainer, or similar type; Kalamazoo Switch tamper, or similar type; Machine tool operator; Maginnis internal full slab vibrator, Mechanical berm, curb or gutter(concrete or asphalt); Mechanical finisher operator (concrete, Clary-Johnson-Bidwell or similar); Micro tunnel system (below ground); Pavement breaker operator (truck mounted); Road oil mixing machine operator; Roller operator (asphalt or finish), rubber-tired earth moving equipment (single engine, up to and including 25 yds. struck); Self-propelled tar pipelining machine operator; Skiploader operator (crawler and wheel type, over 3/4 yd. and up to and including 1-1/2 yds.); Slip form pump operator (power driven hydraulic lifting device for concrete forms); Tractor operator-bulldozer, tamper-scraper (single engine, up to 100 h.p. flywheel and similar types, up to and including D-5 and similar types); Tugger hoist operator (1 drum); Ultra high pressure waterjet cutting tool system operator; Vacuum blasting machine operator

GROUP 6: Asphalt or concrete spreading operator (tamping or

finishing); Asphalt paving machine operator (Barber Greene or similar type); Asphalt-rubber distribution operator; Backhoe operator (up to and including 3/4 yd.), small ford, Case or similar; Cast-in-place pipe laying machine operator; Combination mixer and compressor operator (gunite work); Compactor operator (self-propelled); Concrete mixer operator (paving); Crushing plant operator; Drill Doctor; Drilling machine operator, Bucket or auger types (Calweld 150 bucket or similar types - Watson 1500, 2000 2500 auger or similar types - Texoma 700, 800 auger or similar types - drilling depth of 60' maximum); Elevating grader operator; Grade checker; Gradall operator; Grouting machine operator; Heavy-duty repairman; Heavy equipment robotics operator; Kalamazoo balliste regulator or similar type; Kolman belt loader and similar type; Le Tourneau blob compactor or similar type; Loader operator (Athey, Euclid, Sierra and similar types); Ozzie padder or similar types; P.C. slot saw; Pneumatic concrete placing machine operator (Hackley-Presswell or similar type); Pumpcrete gun operator; Rotary drill operator (excluding caisson type); Rubber-tired earth-moving equipment operator (single engine, caterpillar, Euclid, Athey Wagon and similar types with any and all attachments over 25 yds. up to and including 50 cu. yds. struck); Rubber-tired earth-moving equipment operator (multiple engine up to and including 25 yds. struck); Rubber-tired scraper operator (self-loading paddle wheel type-John Deere, 1040 and similar single unit); Self-propelled curb and gutter machine operator; Shuttle buggy; Skiploader operator (crawler and wheel type over 1-1/2 yds. up to and including 6-1/2 yds.); Soil remediation plant operator; Surface heaters and planer operator; Tractor compressor drill combination operator; Tractor operator (any type larger than D-5 - 100 flywheel h.p. and over, or similar-bulldozer, tamper, scraper and push tractor single engine); Tractor operator (boom attachments), Traveling pipe wrapping, cleaning and bendng machine operator; Trenching machine operator (over 6 ft. depth capacity, manufacturer's rating); Ultra high pressure waterjet cutting tool system mechanic; Water pull (compaction) operator

GROUP 7: Drilling machine operator, Bucket or auger types (Calweld 200 B bucket or similar types-Watson 3000 or 5000 auger or similar types-Texoma 900 auger or similar types-drilling depth of 105' maximum); Dual drum mixer, dynamic compactor LDC350 (or similar types); Monorail locomotive operator (diesel, gas or electric); Motor patrol-blade operator (single engine); Multiple engine tractor operator (Euclid and similar type-except Quad 9 cat.); Rubber-tired earth-moving equipment operator (single engine, over 50 yds. struck); Pneumatic pipe ramming tool and similar types; Prestressed wrapping machine operator; Rubber-tired earth-moving equipment operator (single engine, over 50 yds. struck); Rubber tired earth moving equipment operator (multiple engine, Euclid, caterpillar and similar over 25 yds. and up to 50 yds. struck), Tower crane repairman; Tractor loader operator (crawler and wheel type over 6-1/2 yds.); Woods mixer operator (and similar Pugmill equipment)

GROUP 8: Auto grader operator; Automatic slip form operator; Drilling machine operator, bucket or auger types (Calweld, auger 200 CA or similar types - Watson, auger 6000 or similar types - Hughes Super Duty, auger 200 or similar types - drilling depth of 175' maximum); Hoe ram or similar with compressor; Mass excavator operator less tha 750 cu. yards; Mechanical finishing machine operator; Mobile form traveler operator; Motor patrol operator (multi-engine); Pipe mobile machine operator; Rubber-tired earth-moving equipment operator (multiple engine, Euclid, Caterpillar and similar type, over 50 cu. yds. struck); Rubber-tired self-

loading scraper operator (paddle-wheel-auger type self-loading - two (2) or more units)
GROUP 9: Rubber-tired earth-moving equipment operator operating equipment with push-pull system (single engine, up to and including 25 yds. struck)
GROUP 10: Canal liner operator; Canal trimmer operator; Remote-control earth-moving equipment operator (operating a second piece of equipment: $1.00 per hour additional); Wheel excavator operator (over 750 cu. yds.)
GROUP 11: Rubber-tired earth-moving equipment operator, operating equipment with push-pull system (single engine, Caterpillar, Euclid, Athey Wagon and similar types with any and all attachments over 25 yds. and up to and including 50 yds. struck); Rubber-tired earth-moving equipment operator, operating equipment with push-pull system (multiple engine-up to and including 25 yds. struck)
GROUP 12: Rubber-tired earth-moving equipment operator, operating equipment with push-pull system (single engine, over 50 yds. struck); Rubber-tired earth-moving equipment operator, operating equipment with push-pull system (multiple engine, Euclid, Caterpillar and similar, over 25 yds. and up to 50 yds. struck)
GROUP 13: Rubber-tired earth-moving equipment operator, operating equipment with push-pull system (multiple engine, Euclid, Caterpillar and similar, over 50 cu. yds. struck); Tandem tractor operator (operating crawler type tractors in tandem - Quad 9 and similar type)
GROUP 14: Rubber-tired earth-moving equipment operator, operating in tandem (scrapers, belly dumps and similar types in any combination, excluding compaction units - single engine, up to and including 25 yds. struck)
GROUP 15: Rotex concrete belt operator (or similar types); Rubber-tired earth-moving equipment operator, operating in tandem (scrapers, belly dumps and similar types in any combination, excluding compaction units - single engine, Caterpillar, Euclid, Athey Wagon and similar types with any and all attachments over 25 yds.and up to and including 50 cu. yds. struck); Rubber-tired earth-moving equipment operator, operating in tandem (scrapers, belly dumps and similar types in any combination, excluding compaction units - multiple engine, up to and including 25 yds. struck)
GROUP 16: Rubber-tired earth-moving equipment operator, operating in tandem (scrapers, belly dumps and similar types in any combination, excluding compaction units - single engine, over 50 yds. struck); Rubber-tired earth-moving equipment operator, operating in tandem (scrapers, belly dumps, and similar types in any combination, excluding compaction units - multiple engine, Euclid, Caterpillar and similar, over 25 yds. and up to 50 yds. struck)
GROUP 17: Rubber-tired earth-moving equipment operator, operating in tandem (scrapers, belly dumps and similar types in any combination, excluding compaction units - multiple engine, Euclid, Caterpillar and similar type, over 50 cu. yds. struck)
GROUP 18: Rubber-tired earth-moving equipment operator, operating equipment with the tandem push-pull system (single engine, up to and including 25 yds. struck)
GROUP 19: Rubber-tired earth-moving equipment operator, operating equipment with the tandem push-pull system (single engine, Caterpillar, Euclid, Athey Wagon and similar types with any and all attachments over 25 yds. and up to and including 50 yds. struck); Rubber-tired earth-moving equipment operator, operating with the tandem push-pull system (multiple engine, up to and including 25 yds. struck)

GROUP 20: Rubber-tired earth-moving equipment operator, operating equipment with the tandem push-pull system (single engine, over 50 yds. struck); Rubber-tired earth-moving equipment operator, operating equipment with the tandem push-pull system (multiple engine, Euclid, Caterpillar and similar, over 25 yds. and up to 50 yds. struck)
GROUP 21: Concrete pump operator-truck mounted; Rubber-tired earth-moving equipment operator, operating equipment with the tandem push-pull system (multiple engine, Euclid, Caterpillar and similar type, over 50 cu. yds. struck)
CRANES, PILEDRIVING AND HOISTING EQUIPMENT CLASSIFICATIONS
GROUP 1: Engineer oiler; Fork lift operator (includes loed, lull or similar types)
GROUP 2: Truck crane oiler
GROUP 3: A-frame or winch truck operator; Ross carrier operator (jobsite)
GROUP 4: Bridge-type unloader and turntable operator; Helicopter hoist operator
GROUP 5: Hydraulic boom truck; Stinger crane (Austin-Western or similar type); Tugger hoist operator (1 drum)
GROUP 6: Bridge crane operator; Cretor crane operator; Hoist operator (Chicago boom and similar type); Lift mobile operator; Lift slab machine operator (Vagtborg and similar types); Material hoist and/or manlift operator; Polar gantry crane operator; Self Climbing scaffold (or similar type); Shovel, backhoe, dragline, clamshell operator (over 3/4 yd. and up to 5 cu. yds. mrc); Tugger hoist operator
GROUP 7: Pedestal crane operator; Shovel, backhoe, dragline, clamshell operator (over 5 cu. yds. mrc); Tower crane repair; Tugger hoist operator (3 drum)
GROUP 8: Crane operator (up to and including 25 ton capacity); Crawler transporter operator; Derrick barge operator (up to and including 25 ton capacity); Hoist operator, stiff legs, Guy derrick or similar type (up to and including 25 ton capacity); Shovel, backhoe, dragline, clamshell operator (over 7 cu. yds., M.R.C.)
GROUP 9: Crane operator (over 25 tons and up to and including 50 tons mrc); Derrick barge operator (over 25 tons up to and including 50 tons mrc); Highline cableway operator; Hoist operator, stiff legs, Guy derrick or similar type (over 25 tons up to and including 50 tons mrc); K-crane operator; Polar crane operator; Self erecting tower crane operator maximum lifting capacity ten tons
GROUP 10: Crane operator (over 50 tons and up to and including 100 tons mrc); Derrick barge operator (over 50 tons up to and including 100 tons mrc); Hoist operator, stiff legs, Guy derrick or similar type (over 50 tons up to and including 100 tons mrc), Mobile tower crane operator (over 50 tons, up to and including 100 tons M.R.C.); Tower crane operator and tower gantry
GROUP 11: Crane operator (over 100 tons and up to and including 200 tons mrc); Derrick barge operator (over 100 tons up to and including 200 tons mrc); Hoist operator, stiff legs, Guy derrick or similar type (over 100 tons up to and including 200 tons mrc); Mobile tower crane operator (over 100 tons up to and including 200 tons mrc)
GROUP 12: Crane operator (over 200 tons up to and including 300 tons mrc); Derrick barge operator (over 200 tons up to and including 300 tons mrc); Hoist operator, stiff legs, Guy derrick or similar type (over 200 tons, up to and including 300 tons mrc); Mobile tower crane operator (over 200 tons, up to and including 300 tons mrc)
GROUP 13: Crane operator (over 300 tons); Derrick barge operator (over 300 tons); Helicopter pilot; Hoist operator, stiff

legs, Guy derrick or similar type (over 300 tons); Mobile tower crane operator (over 300 tons)

TUNNEL CLASSIFICATIONS

GROUP 1: Skiploader (wheel type up to 3/4 yd. without attachment)
GROUP 2: Power-driven jumbo form setter operator
GROUP 3: Dinkey locomotive or motorperson (up to and including 10 tons)
GROUP 4: Bit sharpener; Equipment greaser (grease truck); Slip form pump operator (power-driven hydraulic lifting device for concrete forms); Tugger hoist operator (1 drum); Tunnel locomotive operator (over 10 and up to and including 30 tons)
GROUP 5: Backhoe operator (up to and including 3/4 yd.); Small Ford, Case or similar; Drill doctor; Grouting machine operator; Heading shield operator; Heavy-duty repairperson; Loader operator (Athey, Euclid, Sierra and similar types); Mucking machine operator (1/4 yd., rubber-tired, rail or track type); Pneumatic concrete placing machine operator (Hackley-Presswell or similar type); Pneumatic heading shield (tunnel); Pumpcrete gun operator; Tractor compressor drill combination operator; Tugger hoist operator (2 drum); Tunnel locomotive operator (over 30 tons)
GROUP 6: Heavy Duty Repairman
GROUP 7: Tunnel mole boring machine operator

ENGI0012D 08/01/2002

	Rates	Fringes
POWER EQUIPMENT OPERATORS:		
DREDGING:		
Leverman	34.65	11.85
Dredge dozer	31.18	11.85
Deckmate	31.07	11.85
Winch operator (stern winch on dredge)	30.52	11.85
Fireman; deckhand and bargeman	29.98	11.85
Barge mate	30.59	11.85

IRON0001R 07/01/2002

	Rates	Fringes
IRONWORKERS:		
Fence erector	25.97	15.29
Ornamental, reinforcing and structural	26.86	15.29

FOOTNOTE: Work at China Lake Naval Test Station, Edwards Air Force Base, Fort Irwin Military Station, Fort Irwin Training Center-Goldstone, 29 Palms-Marine Corps, U.S. Marine Base-Barstow additional $3.00 per hour.

Work at Yermo Marine Corps Logistic Center additional $2.00 per hour.

LABO0001B 07/01/2002

	Rates	Fringes
BRICK TENDER	21.10	9.57

LABO0002H 07/01/2002

	Rates	Fringes
LABORERS:		
GROUP 1	20.10	9.98
GROUP 2	20.65	9.98
GROUP 3	21.20	9.98
GROUP 4	22.75	9.98
GROUP 5	23.10	9.98
TUNNEL LABORERS:		
GROUP 1	23.01	9.98

GROUP 2	23.33	9.98
GROUP 3	23.79	9.98
GROUP 4	24.48	9.98
GUNITE LABORERS:		
GROUP 1	22.84	12.73
GROUP 2	21.89	12.73
GROUP 3	18.35	12.73

FOOTNOTE: GUNITE PREMIUM PAY:
Workers working from a Bosn'n's Chair or suspended from a rope or cable shall receive 40 cents per hour above the foregoing applicable classification rates.
Workers doing gunite and/or shotcrete work in a tunnel shall receive 35 cents per hour above the foregoing applicable classification rates, paid on a portal-to-portal basis.
Any work performed on, in or above any smoke stack, silo, storage elevator or similar type of structure, when such structure is in excess of 75'-0" above base level and which work must be performed in whole or in part more than 75'-0" above base level, that work performed above the 75'-0" level shall be compensated for at 35 cents per hour above the applicable classification wage rate.

LABORER CLASSIFICATIONS

GROUP 1: Cleaning and handling of panel forms; Concrete screeding for rough strike-off; Concrete, water curing; Demolition laborer, the cleaning of brick if performed by a worker performing any other phase of demolition work, and the cleaning of lumber; Fire watcher, limber, brush loader, piler and debris handler; Flag person; Gas, oil and/or water pipeline laborer; Laborer, asphalt-rubber material loader; Laborer, general or construction; Laborer, general clean-up; Laborer, landscaping; Laborer, jetting; Laborer, temporary water and air lines; Material hose operator (walls, slabs, floors and decks); Plugging, filling of shee bolt holes; Dry packing of concrete; Railroad maintenance, repair track person and road beds; Streetcar and railroad construction track laborers; Rigging and signaling; Scaler; Slip form raiser; Tar and mortar; Tool crib or tool house laborer; Traffic control by any method; Window cleaner; Wire mesh pulling - all concrete pouring operations

GROUP 2: Asphalt shoveler; Cement dumper (on 1 yd. or larger mixer and handling bulk cement); Cesspool digger and installer; Chucktender; Chute handler, pouring concrete, the handling of the chute from readymix trucks, such as walls, slabs, decks, floors, foundation, footings, curbs, gutters and sidewalks; Concrete curer, impervious membrane and form oiler; Cutting torch operator (demolition); Fine grader, highways and street paving, airport, runways and similar type heavy construction; Gas, oil and/or water pipeline wrapper - pot tender and form person; Guinea chaser; Headerboard person - asphalt; Laborer, packing rod steel and pans; Membrane vapor barrier installer; Power broom sweeper (small); Riprap stonepaver, placing stone or wet sacked concrete; Roto scraper and tiller; Sandblaster (pot tender); Septic tank digger and installer(lead); Tank scaler and cleaner; Tree climber, faller, chain saw operator, Pittsburgh chipper and similar type brush shredder; Underground laborer, including caisson bellower

GROUP 3: Buggymobile person; Concrete cutting torch; Concrete pile cutter; Driller, jackhammer, 2-1/2 ft. drill steel or longer; Dri-pak-it machine; Gas, oil and/or water pipeline wrapper, 6-in. pipe and over, by any method, inside and out; High scaler (including drilling of same); Hydro seeder and similar type; Impact wrench multi-plate; Kettle person, pot person and workers applying asphalt, lay-kold, creosote, lime caustic and similar type materials ("applying" means applying, dipping,

brushing or handling of such materials for pipe wrapping and waterproofing); Operator of pneumatic, gas, electric tools, vibrating machine, pavement breaker, air blasting, come-alongs, and similar mechanical tools not separately classified herein; Pipelayer's backup person, coating, grouting, making of joints, sealing, caulking, diapering and including rubber gasket joints, pointing and any and all other services; Rock slinger; Rotary scarifier or multiple head concrete chipping scarifier; Steel headerboard and guideline setter; Tamper, Barko, Wacker and similar type; Trenching machine, hand-propelled
GROUP 4: Asphalt raker, lute person, ironer, asphalt dump person, and asphalt spreader boxes (all types); Concrete core cutter (walls, floors or ceilings), grinder or sander; Concrete saw person, cutting walls or flat work, scoring old or new concrete; Cribber, shorer, lagging, sheeting and trench bracing, hand-guided lagging hammer; Head rock slinger; Laborer, asphalt-rubber distributor boot person; Laser beam in connection with laborers' work; Oversize concrete vibrator operator, 70 lbs. and over; Pipelayer performing all services in the laying and installation of pipe from the point of receiving pipe in the ditch until completion of operation, including any and all forms of tubular material, whether pipe, metallic or non-metallic, conduit and any other stationary type of tubular device used for the conveying of any substance or element, whether water, sewage, solid gas, air, or other product whatsoever and without regard to the nature of material from which the tubular material is fabricated; No-joint pipe and stripping of same; Prefabricated manhole installer; Sandblaster (nozzle person), water blasting, Porta Shot-Blast
GROUP 5: Blaster powder, all work of loading holes, placing and blasting of all powder and explosives of whatever type, regardless of method used for such loading and placing; Driller: All power drills, excluding jackhammer, whether core, diamond, wagon, track, multiple unit, and any and all other types of mechanical drills without regard to the form of motive power; Toxic waste removal

TUNNEL LABORER CLASSIFICATIONS

GROUP 1: Batch plant laborer; Bull gang mucker, track person; Changehouse person; Concrete crew, including rodder and spreader; Dump person; Dump person (outside); Swamper (brake person and switch person on tunnel work); Tunnel materials handling person
GROUP 2: Chucktender, cabletender; Loading and unloading agitator cars; Nipper; Pot tender, using mastic or other materials (for example, but not by way of limitation, shotcrete, etc.); Vibrator person, jack hammer, pneumatic tools (except driller)
GROUP 3: Blaster, driller, powder person; Chemical grout jet person; Cherry picker person; Grout gun person; Grout mixer person; Grout pump person; Jackleg miner; Jumbo person; Kemper and other pneumatic concrete placer operator; Miner, tunnel (hand or machine); Nozzle person; Operating of troweling and/or grouting machines; Powder person (primer house); Primer person; Sandblaster; Shotcrete person; Steel form raiser and setter; Timber person, retimber person, wood or steel; Tunnel Concrete finisher
GROUP 4: Diamond driller; Sandblaster; Shaft and raise work

GUNITE LABORER CLASSIFICATIONS

GROUP 1: Nozzle person and rod person
GROUP 2: Gun person
GROUP 3: Rebound person

Fort Irwin, George Air Force Base,
Marine Corps Air Station 29 Palms,
Marine Corps Logistics Supply Base:

PLASTERER TENDER	26.00	10.17
PLASTER CLEANUP LABORER	23.45	10.17

Remainder of San Bernardino County:

PLASTERER TENDER	23.00	10.17
PLASTER CLEANUP LABORER	20.45	10.17

LABO0882B 01/01/2002

	Rates	Fringes
ASBESTOS REMOVAL LABORER	20.97	7.65

SCOPE OF WORK: Includes site mobilization, initial site cleanup, site preparation, removal of asbestos-containing material and toxic waste, encapsulation, enclosure and disposal of asbestos-containing materials and toxic waste by hand or with equipment or machinery; scaffolding, fabrication of temporary wooden barriers and assembly of decontamination stations.

LABO1184A 07/01/2002

	Rates	Fringes
LABORERS - STRIPING:		
GROUP 1	20.65	8.42
GROUP 2	21.50	8.42
GROUP 3	23.82	8.42
GROUP 4	26.02	8.42

LABORERS - STRIPING CLASSIFICATIONS

GROUP 1: Protective coating, pavement sealing, including repair and filling of cracks by any method on any surface in parking lots, game courts and playgrounds; carstops; operation of all related machinery and equipment; equipment repair technician

GROUP 2: Traffic surface abrasive blaster; pot tender - removal of all traffic lines and markings by any method (sandblasting, waterblasting, grinding, etc.) and preparation of surface for coatings. Traffic control person: controlling and directing traffic through both conventional and moving lane closures; operation of all related machinery and equipment

GROUP 3: Traffic delineating device applicator: Layout and application of pavement markers, delineating signs, rumble and traffic bars, adhesives, guide markers, other traffic delineating devices including traffic control. This category includes all traffic related surface preparation (sandblasting, waterblasting, grinding) as part of the application process. Traffic protective delineating system installer: removes, relocates, installs, permanently affixed roadside and parking delineation barricades, fencing, cable anchor, guard rail, reference signs, monument markers; operation of all related machinery and equipment; power broom sweeper

GROUP 4: Striper: layout and application of traffic stripes and markings; hot thermo plastic; tape traffic stripes and markings, including traffic control; operation of all related machinery and equipment

---

LABO1184E 07/01/2002

	Rates	Fringes
SLURRY SEAL WORK		
LABORERS:		
Group 1	21.66	8.42
Group 2	22.86	8.42
Group 3	24.72	8.42
Group 4	26.32	8.42

GROUP 1 - Traffic Control Person & Serviceman; including work of installing and protecting utility covers, traffic

delineating devices, posting of no parking and notifications for public convenience, surface cleaning by any method, repair and filing of cracks by any means, and other work not directly connected with the application of slurry seal.
GROUP 2 - Squeegeeman (finish); Traffic control person.
GROUP 3 - Applicator operator (line driver); Power broom sweeper operator; Operation of all related machinery and equipment; Shuttleman
GROUP 4 - Mix operator

PAIN0036A 07/01/2002

	Rates	Fringes
Work on service stations and and car washes; Small new commercial work (defined as construction up to and including 3 stories in height, such as small shopping centers, small stores, small office buildings and small food establishments); Small new industrial work (defined as light metal buildings, small warehouses, small storage facilities and tilt-up buildings); Repaint work (defined as repaint of breweries, commercial recreational facilities, hotels which operate commercial establishments as part of hotel service, and sports facilities); Tenant improvement work (defined as tenant improvement work not included in conjunction with the construction of the building, and all repainting of tenant improvement projects		
PAINTER (including lead abatement)	21.75	5.89
All other work:		
PAINTER	25.02	5.89

PAIN0036H 10/01/2002

	Rates	Fringes
DRYWALL FINISHERS	26.33	8.48

PAIN0036R 06/01/2002

	Rates	Fringes
GLAZIERS	29.20	8.45

FOOTNOTE: Additional $1.25 per hour for work in a condo, from the third (3rd) floor and up
Additional $1.25 per hour for work on the outside of the building from a swing state or any suspended contrivance, from the ground up

---

PAIN1247B 01/01/2003

	Rates	Fringes
SOFT FLOOR LAYER	26.70	6.25

PLAS0200H 08/07/2002

	Rates	Fringes
FORT IRWIN; GEORGE AIR FORCE BASE; MAARINE CORPS AIR STATION 29 PALM,; AND MARINE CORPS LOGISTICS SUPPLY BASE:		
PLASTERERS	29.77	6.76
REMAINDER OF COUNTY:		
PLASTERERS	26.77	6.76

PLAS0500B 07/01/2002

	Rates	Fringes
CEMENT MASON	23.05	11.56

PLUM0016B 07/01/2002

	Rates	Fringes
PLUMBER; STEAMFITTER:		
Work on strip malls, light commercial, tenant improvement and remodel work	23.03	8.24
Work on new additions and remodeling of bars, restaurants, stores and commercial buildings, not to exceed 5,000 sq. ft. of floor space	28.92	9.44
All other work:		
Fort Irwin Army Base, Marine Corps Logistic Base at Nebo, Marine Corps Logistic Base at Yermo and Twenty-Nine Palms Marine Base	33.31	10.01
George Air Force Base	32.06	10.01
Remainder of County	29.81	10.01
SEWER AND STORM DRAIN WORK	20.25	9.75

PLUM0345A 07/01/2002

	Rates	Fringes
LANDSCAPE & IRRIGATION FITTER	23.27	9.56

ROOF0036B 09/01/2001

	Rates	Fringes
ROOFER	24.77	5.40
Duties limited to the following: Roof removal of any type of roofing or roofing material; or spudding, or sweeping; and/or clean-up; and/or preload in, or in preparing the roof for application of roofing, damp and/or waterproofing materials		
PREPARER	16.24	1.00

FOOTNOTE: Pitch premium: Work on which employees are exposed to pitch fumes or required to handle pitch, pitch base or pitch impregnated products, or any material containing coal tar pitch, the entire roofing crew shall receive $1.75 per hour "pitch premium" pay.

SFCA0669I 01/01/2003

	Rates	Fringes
DOES NOT INCLUDE THE NORTHERN PART OF THE CITY OF CHINO, OR THE CITIES OF MONTCLAIR OR ONTARIO:		
SPRINKLER FITTER (FIRE)	26.75	9.60

SFCA0709D 09/01/2002

	Rates	Fringes
THE NORTHERN PART OF THE CITY OF CHINO, AND THE CITIES OF MONTCLAIR AND ONTARIO:		
SPRINKLER FITTER (FIRE)	36.18	11.50

SHEE0102G 07/01/2002

	Rates	Fringes
INDUSTRIAL		
Work on all air pollution control systems, noise abatement panels, blow pipe, air-veyor systems, dust collecting, baghouses, heating, air conditioning, and ventilating (other than creature comfort) and all other industrial work, including metal insulated ceilings		
SHEETMETAL WORKER	26.07	15.00

SHEE0102H 01/01/2003

	Rates	Fringes
COMMERCIAL:		
Work on all commercial HVAC for creature comfort and computer clean rooms, architectural metals, metal roofing and lagging, over insulation		
SHEET METAL WORKER	29.41	11.97

TEAM0011I 07/01/2002

	Rates	Fringes
EDWARDS AFB, FORT IRWIN, GEORGE AFB, MARINE CORPS LOGISTIC BASE AT NEBO & YERMO, TWENTY-NINE PALMS BASE		
TRUCK DRIVERS:		
GROUP 1	24.84	12.84
GROUP 2	24.99	12.84
GROUP 3	25.12	12.84
GROUP 4	25.31	12.84
GROUP 5	25.25	12.84
GROUP 6	25.37	12.84
GROUP 7	25.62	12.84
GROUP 8	25.87	12.84
GROUP 9	26.02	12.84
GROUP 10	26.37	12.84
GROUP 11	26.87	12.84
REMAINDER OF COUNTY:		
GROUP 1	21.84	12.84
GROUP 2	21.99	12.84
GROUP 3	22.12	12.84
GROUP 4	22.31	12.84
GROUP 5	22.25	12.84
GROUP 6	22.37	12.84
GROUP 7	22.62	12.84
GROUP 8	22.87	12.84
GROUP 9	23.02	12.84
GROUP 10	23.37	12.84
GROUP 11	23.87	12.84

TRUCK DRIVER CLASSIFICATIONS

GROUP 1: Truck driver

GROUP 2: Driver of vehicle or combination of vehicles - 2 axles; Traffic control pilot car excluding moving heavy

equipment permit load; Truck-mounted broom
GROUP 3: Driver of vehicle or combination of vehicles - 3 axles; Boot person; Cement mason distribution truck; Fuel truck driver; Water truck - 2 axle; Dump truck, less than 16 yds. water level; Erosion control driver
GROUP 4: Driver of transit mix truck, under 3 yds.; Dumpcrete truck, less than 6-1/2 yds. water level
GROUP 5: Water truck, 3 or more axles; Truck greaser and tire person ($0.50 additional for tire person); Pipeline and utility working truck driver, including winch truck and plastic fusion, limited to pipeline and utility work; Slurry truck driver
GROUP 6: Transit mix truck, 3 yds. or more; Dumpcrete truck, 6-1/2 yds. water level and over; Vehicle or combination of vahicles - 4 or more axle; Oil spreader truck; Dump truck, 16 yds. to 25 yds. water level
GROUP 7: A Frame, Swedish crane or similar; Forklift driver; Ross carrier driver
GROUP 8: Dump truck, 25 yds. or more water level; Truck repair person; Water pull - single engine; Welder
GROUP 9: Truck repair person/welder; Low bed driver, 9 axles or over
GROUP 10: Dump truck - 50 yds. or more water level; Water pull - single engine with attachment
GROUP 11: Water pull - twin engine; Water pull - twin engine with attachments; Winch truck driver - $1.25 additional when operating winch or similar special attachments
---
WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.
===
Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29 CFR 5.5(a)(1)(ii)).

In the listing above, the "SU" designation means that rates listed under that identifier do not reflect collectively bargained wage and fringe benefit rates. Other designations indicate unions whose rates have been determined to be prevailing.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U. S. Department of Labor
200 Constitution Avenue, N. W.

Washington, D. C. 20210
2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N. W.
Washington, D. C. 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.
3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U. S. Department of Labor
200 Constitution Avenue, N. W.
Washington, D. C. 20210

4.) All decisions by the Administrative Review Board are final.

END OF GENERAL DECISION

This page was intentionally left blank for duplex printing.

SECTION 01010 - SUMMARY OF WORK

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The WORK to be performed under this Contract shall consist of furnishing plant, tools, equipment, materials, supplies, and manufactured articles, and furnishing all labor, transportation, and services, including fuel, power, water, and essential communications, and performing all work or other operations required for the fulfillment of the Contract in strict accordance with the Contract Documents. The WORK shall be complete, and all work, materials, and services not expressly indicated or called for in the Contract Documents which may be necessary for the complete and proper construction of the WORK in good faith shall be provided by the CONTRACTOR as though originally so indicated, at no increase in cost to the GOVERNMENT.

B. The WORK shall be completed in 420 calendar days.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

A. The WORK of this Contract comprises the construction required to upgrade the existing wastewater treatment plant. The work includes the following:

Base Contract:

Construction of the following processes:

- Flow Equalization Basins (2) and Junction Box
- Filter Influent Pump Station
- Flash Mix Pump Station
- Flocculation Tank
- Filters
- Chlorine Contact Tank
- Recycled Water Pump Station
- Electrical Building
- Reject Water Pump Station

In addition, the base contract shall include modification to the existing chlorine contact tank, existing sodium hypochlorite facility, and all site modifications, including grading, piping addition and modification, electrical and instrumentation work specified and shown, completed, tested and ready for operation. Major piping includes, but is not limited to, interconnecting piping between treatment processes listed above and chemical piping.

Additional Item 1:
Construction of the Recycled Water Pipeline from the Recycled Water Pump Station (STA 0+00.00) to the intersection of South Loop Road and Inner Loop Road (STA 79+41.14), as shown on drawings CS-2 through CS-5, and the pipeline segment from STA 0+95.17 to connection with the golf driving range irrigation forcemain at N638639, E2399816.

Additional Item 2:
Construction of the Recycled Water Pipeline from the intersection of South Loop Road and Inner Loop Road (STA 79+41.14) to the intersection of Inner Loop Road and Barstow Road (STA 108+68.18), as shown on drawings CS-5 through CS-6, and construction of the following two pipeline segments:
Segment 1 – Barstow Road East (STA 0+00.00 to STA 9+40.00) as shown on drawing CS-8.
Segment 2 – Barstow Road West (STA 0+00.00 to STA 10+00.00) as shown on drawing CS-9.

Additional Item 3:
Construction of the Recycled Water Pipeline from the intersection of Inner Loop Road and Barstow Road (STA 108+68.18) to the intersection of Inner Loop Road and Langford Lake Road (STA 133+00.00), as shown on drawings CS-6 through CS-7, and construction of the following pipeline segment:
Segment 3 – Normandy Road (STA 0+00.00 to STA 6+00.00) as shown on drawing CS-10.

B. The WORK is located at the Wastewater Treatment Plant, U.S. Army National Training Center, Fort Irwin, California.

1.3 CONTRACT METHOD

A. The WORK hereunder will be constructed under a single contract comprising several lump sum price items.

1.4 WORK BY OTHERS

A. If two or more contracts are being performed at one time on the same Site or adjacent land in such manner that work under one contract may interfere with work under another, the GOVERNMENT will determine the sequence and order of the Work in either or both contracts. When the Site of one contract is the necessary or convenient means of access for performance of work under another, the GOVERNMENT may grant privilege of access or other reasonable privilege to the contractor so desiring, to the extent, amount , and in manner and at time that the GOVERNMENT may determine. No GOVERNMENT determination of method or time or sequence or order of the work or access privilege shall be the basis for a claim for delay or damage. The CONTRACTOR shall conduct its operations so as to cause a minimum of interference with the work of such other contractors, and shall cooperate fully with such contractors to allow continued safe access to their respective portions of the Site, as required to perform work under their respective contracts.

B. **Interference With Work On Utilities:** The CONTRACTOR shall cooperate fully with all utility forces of the GOVERNMENT or forces of other public or private agencies engaged in the relocation, altering, or otherwise rearranging of any facilities which interfere with the progress of the WORK, and shall schedule the WORK so as to minimize interference with said relocation, altering, or other rearranging of facilities.

1.5 WORK SEQUENCE

A. The CONTRACTOR's attention is directed to the fact that during the period of construction, no interruption in the flow and temporary treatment process can be accommodated, and the CONTRACTOR shall so schedule its construction operations that no interference with the operation of the plant system will occur during this critical period.

B. Access to the site is limited to the hours of 6:00 A.M. to 4:30 P.M. during Monday through Friday, unless approved by the CONTRACTING OFFICER.

1.6 CONTRACTOR USE OF SITE

A. The CONTRACTOR's use of the Site shall be limited to its construction operations, including on-Site storage of materials, on-Site fabrication facilities, and field offices.

1.7 OUTAGE PLAN AND REQUESTS

A. Unless the Contract Documents indicate otherwise, the CONTRACTOR shall not remove from service, de-energize, or modify settings for any existing operating tank, pipeline, valve, channel, equipment, structure, road, or any other facility without permission from the CONTRACTING OFFICER.

B. Where the WORK requires modifications to existing facilities or construction of new facilities and connection of new facilities to existing facilities, the CONTRACTOR shall submit a detailed outage plan and schedule for the CONTRACTING OFFICER'S approval a minimum of 2 weeks in advance of the time that such outage is planned.

C. A completed System Outage Request form (blank furnished by the CONTRACTING OFFICER) shall accompany each outage plan. The outage plans shall be coordinated with the construction schedule and shall meet the restrictions and conditions of the Contract Documents. The outage plan shall describe the CONTRACTOR's method for preventing bypassing of other treatment units; the length of time required to complete said operation; any necessary temporary power, controls, instrumentation or alarms required to maintain control, monitoring, and alarms for the treatment plant processes; and the manpower, plant, and equipment which the CONTRACTOR will furnish for proper operation of associated treatment units. All costs for preparing and implementing the outage plans shall be at no increase in cost to the GOVERNMENT.

D. The CONTRACTING OFFICER shall be notified in writing at least one week in advance of the required outage if the schedule for performing the work has changed or if revisions to the outage plan are required.

E. The CONTRACTOR shall provide written confirmation of the shutdown date and time two working days prior to the actual shutdown.

1.8 GOVERNMENT USE OF THE SITE

A. The GOVERNMENT may utilize all or part of the existing Site and existing facilities during the entire period of construction for the conduct of the normal operations. The CONTRACTOR shall cooperate and coordinate with the CONTRACTING OFFICER to facilitate the GOVERNMENT'S operations and to minimize interference with the CONTRACTOR's operations at the same time. In any event, the GOVERNMENT shall be allowed access to the Site during the period of construction.

1.9 PROJECT MEETINGS

A. **Preconstruction Conference:**

1. Prior to the commencement of WORK at the Site, a preconstruction conference will be held at a mutually agreed time and place. The conference shall be attended by

the CONTRACTOR'S Project Manager, its superintendent, and its Subcontractors as the CONTRACTOR deems appropriate. Other attendees will be:

a. CONTRACTING OFFICER and the Resident Project Representative.

b. Directorate of Public Works (DPW) Representatives.

c. Plant Operations Staff.

d. Others as requested by CONTRACTOR or CONTRACTING OFFICER.

2. The CONTRACTOR shall bring the preconstruction conference submittals in accordance with Section 01300 - Contractor Submittals.

3. The purpose of the conference is to designate responsible personnel and establish a working relationship. Matters requiring coordination will be discussed and procedures for handling such matters established. The complete agenda will be furnished to the CONTRACTOR on the date of the meeting. However, the CONTRACTOR should be prepared to discuss all of the items listed below.

a. Status of CONTRACTOR's insurance and bonds.

b. CONTRACTOR's tentative schedules.

c. Transmittal, review, and distribution of CONTRACTOR's submittals.

d. Processing applications for payment.

e. Maintaining record documents.

f. Critical work sequencing.

g. Field decisions and Change Orders.

h. Use of Site, office and storage areas, security, housekeeping, and GOVERNMENT'S needs.

i. Major equipment deliveries and priorities.

j. CONTRACTOR's assignments for safety and first aid.

k. Daily Report Form which the CONTRACTING OFFICER will furnish.

l. Submittal Transmittal Form which the CONTRACTING OFFICER will furnish.

4. The CONTRACTING OFFICER's Representative will preside at the preconstruction conference and will arrange for keeping and distributing the minutes to all persons in attendance.

5. The CONTRACTOR and its Subcontractors should plan on the conference taking no less than one full working day including travel.

B. **Progress Meetings:**

1. The CONTRACTOR shall schedule and hold regular on-Site progress meetings at least weekly and at other times as requested by CONTRACTING OFFICER or as required by progress of the WORK. The CONTRACTOR, CONTRACTING OFFICER's Representative, and all Subcontractors active on the Site shall attend each meeting. CONTRACTOR may at its discretion request attendance by representatives of its Suppliers, manufacturers, and other Subcontractors.

2. The CONTRACTING OFFICER's Representative will preside at the progress meetings and will arrange for keeping and distributing the minutes. The purpose of the meetings is to review the progress of the WORK, maintain coordination of efforts, discuss changes in scheduling, and resolve other problems which may develop. During each meeting, the CONTRACTOR shall present any issues which may impact its progress with a view to resolve these issues expeditiously.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

- END OF SECTION -

This page was intentionally left blank for duplex printing.

SECTION 01070 - ABBREVIATIONS OF INSTITUTIONS

PART 1 -- GENERAL

1.1 GENERAL

A. Wherever in these Specifications references are made to the standards, specifications, or other published data of the various international, national, regional, or local organizations, such organizations may be referred to by their acronym or abbreviation only. As a guide to the user of these Specifications, the following acronyms or abbreviations which may appear in these Specifications shall have the meanings indicated herein.

1.2 ABBREVIATIONS

AA	Aluminum Association
AAMA	Architectural Aluminum Manufacturer's Association
AAR	Association of American Railroads
AASHTO	American Association of State Highway and Transportation Officials
AATCC	American Association of Textile Chemists and Colorists
ACI	American Concrete Institute
AFBMA	Anti-Friction Bearing Manufacturer's Association, Inc.
AFPA	American Forest Products Association
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AHA	American Hardboard Association
AHAM	Association of Home Appliance Manufacturers
AI	The Asphalt Institute
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMCA	Air Moving and Conditioning Association
ANS	American Nuclear Society
ANSI	American National Standards Institute, Inc.
APA	American Plywood Association or American Parquet Association, Inc.
API	American Petroleum Institute
APWA	American Public Works Association
ARI	Air-Conditioning and Refrigeration Institute
ASA	Acoustical Society of America
ASAE	American Society of Agricultural Engineers
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
ASLE	American Society of Lubricating Engineers
ASME	American Society of Mechanical Engineers
ASNT	American Society of Nondestructive Testing
ASQC	American Society for Quality Control
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AWCI	American Wire Cloth Institute
AWPA	American Wood Preservers Association
AWPI	American Wood Preservers Institute
AWS	American Welding Society
AWWA	American Water Works Association
BBC	Basic Building Code, Building Officials and Code Administrators International

BHMA	Builders Hardware Manufacturer's Association
CABO	Council of American Building Officials
CBM	Certified Ballast Manufacturers
CDA	Copper Development Association
CEMA	Conveyors Equipment Manufacturer's Association
CGA	Compressed Gas Association
CLPCA	California Lathing and Plastering Contractors Association
CLFMI	Chain Link Fence Manufacturer's Institute
CMA	Concrete Masonry Association
CRSI	Concrete Reinforcing Steel Institute
DCDMA	Diamond Core Drill Manufacturer's Association
DHI	Door and Hardware Institute
DIPRA	Ductile Iron Pipe Research Association
EIA	Electronic Industries Association
ETL	Electrical Test Laboratories
EPA	Environmental Protection Agency
FCC	Federal Communications Commission
FCI	Fluid Controls Institute
FM	Factory Mutual System
FPL	Forest Products Laboratory
HI	Hydronics Institute, Hydraulic Institute
HPMA	Hardwood Plywood Manufacturers Association
IAPMO	International Association of Plumbing and Mechanical Officials
ICBO	International Conference of Building Officials
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
IME	Institute of Makers of Explosives
IP	Institute of Petroleum (London)
IPC	Institute of Printed Circuits
IPCEA	Insulated Power Cable Engineers Association
ISDSI	Insulated Steel Door Systems Institute
ISA	Instrument Society of America
ISEA	Industrial Safety Equipment Association
ISO	International Organization for Standardization
ITE	Institute of Traffic Engineers
MBMA	Metal Building Manufacturer's Association
MIL	Military Standards (DoD)
MPTA	Mechanical Power Transmission Association
MSS	Manufacturers Standardization Society
MTI	Marine Testing Institute
NAAMM	National Association of Architectural Metal Manufacturer's
NACE	National Association of Corrosion Engineers
NAGDM	National Association of Garage Door Manufacturers
NB	National Board of Boiler and Pressure Vessel Inspectors (alternate NBBPVI)
NBS	National Bureau of Standards (Now NIST)
NCCLS	National Committee for Clinical Laboratory Standards
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NETA	International Electrical Testing Association
NFPA	National Fire Protection Association or National Fluid Power Association or National Forest Products Association
NISO	National Information Standards Organization
NLGI	National Lubricating Grease Institute
NMA	National Microfilm Association

NRCA	National Roofing Contractors Association
NSF	National Sanitation Foundation
NWMA	National Woodwork Manufacturers Association
NWWDA	National Wood Window and Door Association
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PPI	Plastics Pipe Institute
RCRA	Resource Conservation and Recovery Act
RIS	Redwood Inspection Service
RMA	Rubber Manufacturers Association
RVIA	Recreational Vehicle Industry Association
RWMA	Resistance Welder Manufacturer's Association
SAE	Society of Automotive Engineers
SAMA	Scientific Apparatus Makers Association
SDI	Steel Door Institute, Steel Deck Institute
SMA	Screen Manufacturers Association
SMACCNA	Sheet Metal and Air Conditioning Contractors National Association
SPI	Society of the Plastics Industry, Inc.
SPIB	Southern Pine Inspection Bureau
SPR	Simplified Practice Recommendation
SSA	Swedish Standards Association
SSBC	Southern Standard Building Code, Southern Building Code Congress
SSPC	Society for Protective Coating
SSPWC	Standard Specifications for Public Works Construction
TAPPI	Technical Association of the Pulp and Paper Industry
TFI	The Fertilizer Institute
TIA	Telecommunications Industries Association
TPI	Truss Plate Institute
UBC	Uniform Building Code
UL	Underwriters Laboratories, Inc.
WCLIB	West Coast Lumber Inspection Bureau
WCRSI	Western Concrete Reinforcing Steel Institute
WEF	Water Environment Federation
WIC	Woodwork Institute of California
WRI	Wire Reinforcement Institute, Inc.
WWPA	Western Wood Products Association

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION -

This page was intentionally left blank for duplex printing.

SECTION 01090 - REFERENCE STANDARDS

PART 1 -- GENERAL

1.1 GENERAL

A. **Titles of Sections and Paragraphs:** Titles and subtitles accompanying specification sections and paragraphs are for convenience and reference only, and do not form a part of the Specifications.

B. **Applicable Publications:** Whenever in these Specifications references are made to published specifications, codes, standards, or other requirements, it shall be understood that wherever no date is specified, only the latest specifications, standards, or requirements of the respective issuing agencies which have been published as of the date that the Contract is advertised for bids shall apply; except to the extent that said standards or requirements may be in conflict with applicable laws, ordinances, or governing codes. No requirements set forth in the Specifications or shown on the Drawings will be waived because of any provision of, or omission from, said standards or requirements.

C. **Specialists, Assignments:** In certain instances, specification text requires (or implies) that specific work is to be assigned to specialists or expert entities, who must be engaged for the performance of that work. Such assignments shall be recognized as special requirements over which the CONTRACTOR has no choice or option. These requirements shall not be interpreted so as to conflict with the enforcement of building codes and similar regulations governing the WORK; also they are not intended to interfere with local union jurisdiction settlements and similar conventions. Such assignments are intended to establish which party or entity involved in a specific unit of work is recognized as "expert" for the indicated construction processes or operations. Nevertheless, the final responsibility for fulfillment of the entire set of contract requirements remains with the CONTRACTOR.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. The CONTRACTOR shall construct the WORK in accordance with the Contract Documents and the referenced portions of those referenced codes, standards, and specifications.

B. References herein to "Building Code" or "Uniform Building Code" shall mean Uniform Building Code of the International Conference of Building Officials (ICBO). References to “Building Code” or “Standard Building Code” shall mean the Standard Building Code of the Southern Building Code Congress International. References to “Building Code” or “National Building Code” shall mean the National Building Code of Building Officials and Code Administrators International (BOCA). Similarly, references to "Mechanical Code" or "Uniform Mechanical Code," "Plumbing Code" or "Uniform Plumbing Code," "Fire Code" or "Uniform Fire Code," shall mean Uniform Mechanical Code, Uniform Plumbing Code and Uniform Fire Code of the International Conference of the Building Officials (ICBO). "Electric Code" or "National Electric Code (NEC)" shall mean the National Electric Code of the National Fire Protection Association (NFPA). The latest edition of the codes as approved by the Municipal Code and used by the local agency as of the date that the WORK is advertised for bids, as adopted by the agency having jurisdiction, shall apply to the WORK herein, including all addenda, modifications, amendments, or other lawful changes thereto.

C. In case of conflict between codes, reference standards, drawings, and the other Contract Documents, the most stringent requirements shall govern. All conflicts shall be brought to the attention of the CONTRACTING OFFICER for clarification and directions prior to ordering or providing any materials or furnishing labor. The CONTRACTOR shall bid for the most stringent requirements.

D. References herein to "OSHA Regulations for Construction" shall mean **Title 29, Part 1926, Construction Safety and Health Regulations,** Code of Federal Regulations (OSHA), including all changes and amendments thereto.

E. References herein to "OSHA Standards" shall mean **Title 29, Part 1910, Occupational Safety and Health Standards,** Code of Federal Regulations (OSHA), including all changes and amendments thereto.

F. **Applicable Standard Specifications**: References in the Contract Documents to "Standard Specifications" or SSPWC shall mean the Standard Specifications for Public Works Construction, 1997 Edition.

G. **Applicable Safety Standards:** References herein to "Cal-OSHA" shall mean **State of California, Department of Industrial Relations, Construction Safety Orders,** as amended to date, and all changes and amendments thereto.

1.3 REGULATIONS RELATED TO HAZARDOUS MATERIALS

A. The CONTRACTOR shall be responsible that all work included in the Contract Documents, regardless if shown or not, shall comply with all EPA, OSHA, RCRA, NFPA, and any other Federal, State, and Local Regulations governing the storage and conveyance of hazardous materials, including petroleum products.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

- END OF SECTION -

SECTION 01300 SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SUBMITTAL IDENTIFICATION

SD-01 Data
SD-04 Drawings
SD-06 Instructions
SD-07 Schedules
SD-08 Statements
SD-09 Reports
SD-13 Certificates
SD-14 Samples
SD-18 Records
SD-19 Operation and Maintenance Manuals

1.2 SUBMITTAL CLASSIFICATION

Submittals are classified as follows:

A. Government Approved
Governmental approval is required for extensions of design, critical materials, deviations, equipment whose compatibility with the entire system must be checked, and other items as designated by the Contracting Officer. Within the terms of the Contract Clause entitled "Specifications and Drawings for Construction," they are considered to be "shop drawings."

B Information Only All submittals not requiring Government approval will be for information only. They are not considered to be "shop drawings" within the terms of the Contract Clause referred to above.

1.3 SUBMITTAL REVIEW AND APPROVAL

Before submission, Contractor shall review all submittals prepared by subcontractors, suppliers, and himself, for completeness, accuracy, and compliance with plans and specifications. Contractor shall not use red markings on submittals. Red markings are reserved for use by the Contracting Officer. Approval by Contractor shall be indicated on each drawing by an "Approved" stamp with Contractor's name, signature, and date. The Contractor shall have independent agents not associated with his organization to do the review. The review shall be done by a licensed architect or registered engineers in the appropriate disciplines of architectural, civil, structural, mechanical and electrical, as appropriate. The reviews shall be thorough and complete and authenticated by registered engineer's or architect's stamp. This administration of submittal review must be integrated into the Contractor's Quality Control Plan. The plan must delineate in precise detail how the Contractor intends to satisfy this requirement. This should include names of organizations, qualifications and names of individuals who will be doing the work with their qualifications/resumes. Supplier's or subcontractors certifications are not acceptable as meeting this requirement of independent review. Submittals not conforming to the requirements of this section will be returned to the Contractor for correction and resubmittal.

1.4 APPROVED SUBMITTALS

The Contracting Officer's approval of submittals shall not be construed as a complete check, but will indicate only that the general method of construction, materials, detailing and other information are satisfactory. Approval will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor under the Contractor Quality Control (CQC) requirements of this contract is responsible for dimensions, the design of adequate connections and details, and the satisfactory construction of all work. After submittals have been approved by the Contracting Officer, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

1.5 DISAPPROVED SUBMITTALS

The Contractor shall make all corrections required by the Contracting Officer and promptly furnish a corrected submittal in the form and number of copies specified for the initial submittal. If the Contractor considers any correction indicated on the submittals to constitute a change to the contract, a notice in accordance with the Contract Clause "Changes" shall be given promptly to the Contracting Officer.

1.6 PAYMENT FOR ITEMS FOR WHICH A SUBMITTAL AND APPROVAL IS REQUIRED

In accordance with FAR 52.232-5, "Payments Under Fixed-Price Construction Contracts", the Government shall make progress payments to the Contractor monthly based on estimates of work accomplished which meets the standards of quality established under the contract. On items for which submittals must be approved by the Contracting Officer, payment cannot be made for the item until the Government establishes that the item "meets the standards of quality" required by the contract. The Contractor shall not invoice for, nor shall the Government make payment for any item, for which submittal and approval is required, until the item has been submitted and approved as described herein.

1.7 ADDITIONAL GOVERNMENT APPROVED SUBMITTALS

In addition to those specified in paragraph 1.2 SUBMITTAL CLASSIFICATION, the following classifications of submittals also require Government Approval. Mechanical and Electrical Systems, and Fire Protection and Fire Detection Submittals.

A. Special Reviews Mechanical and Electrical Systems: The Contractor shall furnish one reproducible, unfolded copy of all wiring and control diagrams and approved system layout drawings with the operating instructions called for under the various headings of these specifications for mechanical and electrical systems.

1.8 CERTIFICATES OF COMPLIANCE

Any certificates required for demonstrating proof of compliance of materials with specification requirements shall be executed in the number of copies required by the above paragraph 3.5.1 “Procedures”. Each certificate shall be signed by an official authorized to certify in behalf of the manufacturing company and shall contain the name

and address of the Contractor, the project name and location, and the quantity and date or dates of shipment or delivery to which the certificates apply. Copies of laboratory test reports submitted with certificates shall contain the name and address of the testing laboratory and the date or dates of the tests to which the report applies. Certification shall not be construed as relieving the Contractor from furnishing satisfactory material, if, after tests are performed on selected samples, the material is found not to meet the specific requirements.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 GENERAL

The Contractor shall make submittals as required by the specifications. The Contracting Officer may request submittals in addition to those specified when deemed necessary to adequately describe the work covered in the respective sections. Units of weights and measures used on all submittals shall be the same as those used in the contract drawings. Each submittal shall be complete and in sufficient detail to allow ready determination of compliance with contract requirements. Prior to submittal, all items shall be checked and approved by the Contractor's Quality Control (CQC) System Manager and each item shall be stamped, signed, and dated by the CQC System Manager indicating action taken. Proposed deviations from the contract requirements shall be clearly identified. Submittals shall include items such as: Contractor's, manufacturer's, or fabricator's drawings; descriptive literature including (but not limited to) catalog cuts, diagrams, operating charts or curves; test reports; test cylinders; samples; O&M manuals (including parts list); certifications; warranties; and other such required submittals. Submittals requiring Government approval shall be scheduled and made prior to the acquisition of the material or equipment covered thereby. Samples remaining upon completion of the work shall be picked up and disposed of in accordance with manufacturer's Material Safety Data Sheets (MSDS) and in compliance with existing laws and regulations.

3.2 SUBMITTAL REGISTER (ENG FORM 4288)

At the end of this section is one set of ENG Form 4288 listing items of equipment and materials for which submittals are required by the specifications; this list may not be all inclusive and additional submittals may be required. The Contractor will also be given the submittal register files, containing the computerized ENG Form 4288 and instructions on the use of the files. These submittal register files will be furnished a separate diskette. Columns "d" through "r" have been completed by the Government; the Contractor shall complete columns "a" and "s" through "u" and submit the forms (hard copy plus associated electronic file) to the Contracting Officer for approval within thirty (30) calendar days after Notice to Proceed. The Contractor shall keep this diskette up-to-date and shall submit it to the Government together with the monthly payment request. The approved submittal register will become the scheduling document and will be used to control submittals throughout the life of the contract. The submittal register and the progress schedules shall be coordinated.

3.3 SCHEDULING

Submittals covering component items forming a system or items that are interrelated shall be scheduled to be coordinated and submitted concurrently. Certifications to be submitted with the pertinent drawings shall be so scheduled. Adequate time (a minimum of 35 calendar days exclusive of mailing time) shall be allowed and shown on the register for review and approval. No delay damages or time extensions will be allowed for time lost in late submittals.

3.4 TRANSMITTAL FORM (ENG Form 4025)

The Contractor shall complete ENG Form 4025, "Transmittal of Shop Drawings, Equipment Data, Material Samples, or Manufacturer's Certificates of Compliance" and forward four (4) copies of same with each set of shop drawings, certificates of compliance, materials, fixtures and equipment lists submitted for approval. Three (3) copies of the ENG Form 4025 shall be submitted for information only data. No translucent or coated reproduced copies will be accepted. Each item submitted shall be listed separately on the ENG Form 4025. For new submittals or resubmittals mark the appropriate box; or resubmittals also insert previous transmittal number. Blank ENG Forms 4025 will be furnished by the Contracting Officer on request. Shop drawings shall be either blue line or black line prints on a white background. Blueprints are not acceptable. Each submittal shall be identified with the Contractor's name, Contract Number, Transmittal Number, and Item Number to correspond with Item Number listed on ENG Form 4288. The following identification shall be marked on submittals as applicable:
Contract Number
Project Title and Location
Subcontractor's Name
Supplier's Name or Manufacturer's Name
Specification Section and Paragraph Number
Contract Drawing File Number

3.5 SUBMITTAL PROCEDURE

Submittals shall be made as follows:

A. Procedures

Submittals required by the CONTRACT CLAUSES and other non-technical parts of the contract are not included in this section. The Contractor shall submit to the Contracting Officer: four (4) copies for approval, and three (3) copies for information only, of all shop drawings, certificates of compliance, materials, fixtures and equipment lists called for under the various headings of these specifications. These drawings, certificates and lists shall be complete and detailed and, prior to submission, must be reviewed and certified correct by the Contractor as required by the Quality Control System paragraph of the Construction Quality Control Section. If approved by the Contracting Officer, three (3) sets of all submittals will be retained by the Contracting Officer and one (1) set will be returned to the Contractor. Submittals for information only usually will not be returned. The Contractor is encouraged to submit paper documents that are printed/copied double-sided on recycled paper that has at least 20% postconsumer material.

(a) Resubmittals:

(1) If a submittal is returned for correction or is not satisfactory and is disapproved by the Contracting Officer, the Contractor shall resubmit the corrected material in the same quantity, including reproducibles as specified for the original submittal for approval within 14 days after receipt by him of the disapproved material.

B. Deviations

For submittals which include proposed deviations requested by the Contractor, the column "variation" of ENG Form 4025 shall be checked. The Contractor shall set forth in writing the reason for any deviations and annotate such deviations on the submittal. The Government reserves the right to rescind inadvertent approval of submittals containing unnoted deviations.

3.6 NOT APPLICABLE

3.7 SPARE PARTS LIST AND MAINTENANCE OPERATIONS MANUALS

Within 30 calendar days after approval of shop drawings and equipment lists, the Contractor shall submit, to the Contracting Officer, 3 copies of spare parts lists and operating and maintenance manuals as required under the various headings of these specifications. One reproducible, unfolded copy shall be provided of all operating instructions, control diagrams, etc., that are larger than 8-1/2-inches by 11-inches; this does not apply to standard manufacturer's data.

(A) Spare parts lists shall contain the following listed information:

(1) Quantity of parts required for 120 days and one year of operation.

(2) Description of each spare part.

(3) Drawing number and shop drawing reference.

(4) Part equipment code number.

(5) Unit price of each item.

(6) Total price of all items.

(7) Procurement lead time with particular attention to long lead times.

(8) Name and address of nearest supplier.

(9) Such remarks and data as the manufacturer may consider pertinent.

(10) Complete parts list of all replaceable items.

(B) Operation, Maintenance, and Repair Manuals and Instructions:

(1) The requirements for furnishing operating, maintenance, and repair data/manuals and field instructions under this contract are specified in the Technical Specifications. The Contractor shall submit to the Contracting Officer, not later than 60 calendar days after the Notice to Proceed, an outline showing the proposed submittal date(s) of operation and maintenance manuals to be furnished the Government and the scheduled date(s) of all required field instructions to be provided by Contractor furnished personnel or manufacturer's representatives. All operation and maintenance manuals must be furnished to the Contracting Officer not later than 60 calendar days prior to turnover of the facility to the Government.

(2) Failure on the part of the Contractor to comply with requirements of this clause will result in no further payment until all required O&M data/manuals are submitted and accepted.

(3) All O&M data/manuals submittal data shall be entered in a separate section of the master submittal register.

(4) Six O & M Manuals are required. The Contractor shall provide a lockable cabinet located in the Mechanical Room. One master O&M Manual shall be placed in this cabinet. The other 5 O&M Manuals shall be provided to the Contracting Officer. Location of the cabinet shall be shown on the mechanical room layout drawing.

3.8 NOT APPLICABLE

3.9 AS-BUILT DRAWINGS

(Internet Address: http://www.cbbs.spk.usace.army.mil/html/aeguide.html.)

(A) Working As-Built Drawings. The Contractor shall maintain a current record of the work as actually constructed in the form of working as-built drawings. These will typically be red-line mark-ups of the construction plans. The quantity of sets to be red-lined can be found under the paragraph below, Submittal Requirements for Review and Approval. It is the Contractor=s responsibility to ensure the use of the most current drawings. Subject to the approval of the Contracting Officer, a member of the Contractor=s Quality Control Organization will be assigned the sole responsibility for the maintenance and currency of the as-built drawings. Any reassignment of duties concerning the maintenance of the as-built drawings will be promptly reported to the Contracting Officer. Guidelines and drafting standards for preparing working and final as-built drawings can be found on the Internet. These instructions include submittal requirements for shop drawings.

(B) Final As-Built Drawings. The Contractor shall prepare final, record copy drawings which depict the actual conditions upon completion of construction. The deliverable required shall be in both hard copy and electronic format.

Submittal Requirements for Review and Approval.

Working as-built drawings.(GA)

Three sets of red-line markups shall be submitted after the completion of each major phase of work (or bid items, if appropriate), in conjunction with approval of progress payments.

Final as-built drawings.(GA)

All three sets of red-line markups and one new set (hard copy bond or blue-line) of completed final as-built drawings shall be submitted for review within 10 working days prior to the pre-final inspection. If upon review, the drawings are found to contain errors and/or omissions, they shall be returned to the Contractor for corrections. Within 15 calendar days after the final project inspection, the Contractor shall submit for approval the one copy of updated red-line mark-up CADD files depicting final as-built conditions. If upon review by the Sacramento District, the drawings are found to contain errors and/or omissions, they shall be returned to the Contractor for corrections. Within 45 calendar days after the final inspection, the Contractor shall transfer the final as-built drawings to the Government according to paragraph, End-User (Customer Requirements).

The Contractor will be required to convert the drawings from whatever format they receive from the government to AutoCAD Release 14.

(C) End-User (Customer) Requirements

1. CADD Format.
AutoCAD Release 14 for use on NT 4.0 Operating System (No conversion of format will be allowed.)

2. Hard Copy Media and Quantities. **One full size 559mm x 391mm on vellum and two (2) half-size 11"x17" on bond.**

(D) Delivering electronic files. Specific instructions for labeling disks or CD-ROMs, directory structure, indexing and additional documentation requirements are listed on the Internet.

3.10 GEOTECHNICAL AND CONCRETE MATERIALS REPORT

Contractor shall prepare an as constructed geotechnical and concrete materials report for project. For additional information see (Internet Address: http://www.cbbs.usace.army.mil/net/usace-docs/eng-regs/er1110-1-1901/toc.htm

3.11 CONTROL OF SUBMITTALS

The Contractor shall carefully control his procurement operations to ensure that each individual submittal is made on or before the Contractor scheduled submittal date shown on the approved "Submittal Register."

3.12 GOVERNMENT APPROVED SUBMITTALS

Upon completion of review of submittals requiring Government approval, the submittals will be identified as having received approval by being so stamped and dated. Three (3)

copies of the submittal will be retained by the Contracting Officer and one (1) copies of the submittal will be returned to the Contractor.

3.13 INFORMATION ONLY SUBMITTALS

Normally submittals for information only will not be returned. Approval of the Contracting Officer is not required on information only submittals. The Government reserves the right to require the Contractor to resubmit any item found not to comply with the contract. This does not relieve the Contractor from the obligation to furnish material conforming to the plans and specifications; will not prevent the Contracting Officer from requiring removal and replacement of nonconforming material incorporated in the work; and does not relieve the Contractor of the requirement to furnish samples for testing by the Government laboratory or for check testing by the Government in those instances where the technical specifications so prescribe.

3.15 STAMPS

Stamps used by the Contractor on the submittal data to certify that the submittal meets contract requirements shall be similar to the following:

```
_____|
CONTRACTOR || |
| (Firm Name) |
| |
| |
| |
| _____ Approved |
| |
| |
| _____ Approved with corrections as noted on submittal data and/or |
| attached sheets(s). |
| |
| |
| |
| SIGNATURE:_____|
| TITLE: _____|
| DATE: _____|
|_____|
```

-- End of Section --

SECTION 01301 - SCHEDULE OF VALUES

PART 1 -- GENERAL

1.1 GENERAL

A. This Section defines the process whereby the Schedule of Values (lump sum price breakdown) shall be developed and incorporated into the cost loading function of the CPM Schedule as specified in Section 01311 - Scheduling and Reporting. Monthly progress payment amounts shall be determined from the monthly progress updates of the CPM Schedule activities.

B. The Schedule of Values shall be developed independent but simultaneous with the development of the CPM Schedule activities and logic.

1.2 PRELIMINARY SCHEDULE OF VALUES

A. The CONTRACTOR shall submit a preliminary Schedule of Values for the major components of the WORK at the Preconstruction Conference in accordance with Section 01010 - Summary or Work. The listing shall include, at a minimum, the proposed value for the following major WORK components:

1. Mobilization: 2 percent of Contract Price.

2. The total value of electrical WORK.

3. The total value of Instrumentation and Control WORK.

4. The total value of Protective Coatings WORK.

5. The total value of yard mechanical WORK inclusive of excavation, pipe installation, testing and backfill of pipe, and all incidental WORK associated with underground pipe installations.

6. The total value of all mechanical WORK, exclusive of yard mechanical WORK included in Item 5 above. This includes all piping, valves, equipment, tanks, and appurtenances at new and existing structures. Additionally, this total value shall be broken down into separate values for each new and existing structure constructed or modified as a part of the WORK.

7. The total value of structural reinforced concrete WORK inclusive of all excavation, dewatering, subgrade preparation, backfill and incidental WORK for all new structures. Additionally, this total value shall be broken down into separate values for each new structure constructed as a part of the WORK. Miscellaneous and minor concrete WORK may be listed as one item in this breakdown.

8. The total value of site civil WORK inclusive of clearing and grubbing, paving, grading and drainage WORK.

9. The total value of all other WORK not specifically included in the above items.

B. The CONTRACTOR and CONTRACTING OFFICER shall meet and jointly review the preliminary Schedule of Values and make any adjustments in value allocations if, in the opinion of the CONTRACTING OFFICER, these are necessary to establish fair and reasonable allocation of values for the major WORK components. Front end loading will not be permitted. The CONTRACTING OFFICER may require reallocation of major WORK components from items in the above listing if in the opinion of the CONTRACTING OFFICER such reallocation is necessary. This review and any necessary revisions shall be completed within 15 days from the date of Notice to Proceed.

1.3 DETAILED SCHEDULE OF VALUES

A. The CONTRACTOR shall prepare and submit a detailed Schedule of Values to the CONTRACTING OFFICER within 30 days from the date of Notice to Proceed. The detailed Schedule of Values shall be based on the accepted preliminary Schedule of Values for major WORK components. Because the ultimate requirement is to develop a detailed Schedule of Values sufficient to determine appropriate monthly progress payment amounts through cost loading of the CPM Schedule activities, sufficient detailed breakdown shall be provided to meet this requirement. The CONTRACTING OFFICER shall be the sole judge of acceptable numbers, details and description of values established. If, in the opinion of the CONTRACTING OFFICER, a greater number of Schedule of Values items than proposed by the CONTRACTOR is necessary, the CONTRACTOR shall add the additional items so identified by the CONTRACTING OFFICER.

1. The minimum detail of breakdown of the major WORK components is indicated below. Greater detail shall be provided as directed by the CONTRACTING OFFICER.

a. Mobilization - no breakdown required.

b. Section 01311, broken down by submittal.

c. The electrical WORK shall be broken down by structure and yard facilities. Structures electrical WORK shall be broken down into conduit and raceway installation, cable and wire installation, electrical equipment installation, terminations and lighting. Yard facilities shall be broken down by duct bank designation and substations.

d. Instrumentation and Control WORK shall be broken down by structure.

e. Protective Coating WORK shall be broken down by structure and yard area. Where specific coating WORK at structures or yard areas may be critical to performing the WORK to meet milestone and Contract dates, such WORK shall be included as individual pay and Schedule activity items.

f. Yard piping WORK shall be broken down into individual pipelines running from and to Contract termination points. Each pipeline shall be an individual pay item unless otherwise allowed by the CONTRACTING OFFICER.

g. Mechanical WORK shall be broken down within each structure to identify individual piping systems, equipment installation by equipment name and number, and equipment testing and checkout.

h. Concrete structures shall be broken down into excavation, subgrade preparation, and appurtenant prefoundation WORK, concrete foundation construction, slabs on grade, walls/columns, suspended slabs, stairs, etc. (sufficient breakdown shall be provided to accommodate necessary Schedule detail), hydrostatic structure testing where required and backfill.

i. Civil site WORK shall be broken down into individual drainage piping, drainage structures, site concrete, paving, excavation cut and fill, removal of existing pipe, clearing and grubbing and any other items determined to be necessary for the establishment of Pay and Schedule Activity items.

j. Equipment testing and plant startup broken down for completion milestones for each.

k. All other WORK not specifically included in the above items shall be broken down as necessary for establishment of pay and Schedule activity items.

2. The CONTRACTOR and CONTRACTING OFFICER shall meet and jointly review the detailed Schedule of Values within 35 days from the date of Notice to Proceed. The value allocations and extent of detail shall be reviewed to determine any necessary adjustments to the values and to determine if sufficient detail has been proposed to allow acceptable cost loading of the CPM Schedule activities. Any adjustments deemed necessary to the value allocation or level of detail shall be made by the CONTRACTOR and a revised detailed Schedule of Values shall be submitted within 40 days from the date of Notice to Proceed.

3. Following acceptance of the detailed Schedule of Values, the CONTRACTOR shall incorporate the values into the cost loading portion of the CPM Schedule. The CPM activities and logic shall have been developed concurrent with development of the detailed Schedule of Values; however, it shall be necessary to adjust the detailed Schedule of Values to correlate to individual Schedule activities. It is anticipated that instances will occur, due to the independent but simultaneous development of the Schedule of Values and the CPM Schedule activities, where interfacing these two documents will require changes to each document. Schedule activities may need to be added to accommodate the detail of the Schedule of Values. Schedule of Value items may need to be added to accommodate the detail of the CPM Schedule activities. Where such instances arise, the CONTRACTOR shall propose changes to the Schedule of Values and to the CPM Schedule activities to satisfy the CPM Schedule cost loading requirements.

1.4 CROSS REFERENCE LISTING

A. To assist in the correlation of the Schedule of Values and the CPM Schedule, the CONTRACTOR shall provide a Cross Reference Listing which shall be furnished in two parts. The first part shall list each Scheduled Activity with the breakdown of the respective valued items making up the total cost of the activity. The second part shall list the valued item with the respective Scheduled Activity or Activities that make up the total cost indicated. In the case where a number of schedule items make up the total cost for a valued item (shown in the Schedule of Values) the total cost for each scheduled item should be indicated.

B. These listings shall be updated and submitted in conjunction with the CPM monthly submittals as stated in Specification Section 01311.

C. Approved change orders reflected in the CPM Schedule shall be incorporated into the Schedule of Values as a single unit identified by the change order number.

1.5 CHANGES TO SCHEDULE OF VALUES

A. Changes to the CPM Schedule which add activities not included in the original schedule but included in the original WORK (schedule omissions) shall have values assigned as approved by the CONTRACTING OFFICER. Other activity values shall be reduced to provide equal value adjustment increases for added activities as approved by the CONTRACTING OFFICER.

B. In the event that the CONTRACTOR and CONTRACTING OFFICER agree to make adjustments to the original Schedule of Values because of inequities discovered in the original accepted detailed Schedule of Values, increases and equal decreases to values for activities may be made.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

- END OF SECTION -

SECTION 01311 - CPM CONSTRUCTION SCHEDULE

PART 1 -- GENERAL

1.1 GENERAL

A. Scheduling of the WORK shall be performed by the CONTRACTOR in accordance with the requirements of this Section.

B. Development of the schedule, the cost loading of the schedule, monthly payment requisitions and project status reporting requirements of the Contract shall employ computerized Critical Path Method (CPM) scheduling. The CPM Schedule shall be cost loaded based on the schedule of values as approved by the CONTRACTING OFFICER in accordance with the requirements of Section 01301 - Schedule of Values. The CPM schedule and all reports should be prepared with the current version of Primavera Project Planner (P3) software. Where submittals are required hereunder, the CONTRACTOR shall submit four copies of each submittal item.

1.2 QUALIFICATIONS

A. The CONTRACTOR certify that either the CONTRACTOR has in-house capability qualified to use CPM technique and the Primavera P3 software or that the CONTRACTOR will arrange for the services of a CPM consultant so qualified. In either event the statement shall identify the individual who will perform the CPM scheduling. Capability shall be verified by description of construction projects on which the individual has successfully applied computerized CPM and shall include at least two projects of similar nature, scope and value not less than one-half the Total Bid Price of this project. The statement shall also identify the contact persons for the referenced projects with current telephone and address information.

1.3 INITIAL SCHEDULE SUBMITTALS

A. The CONTRACTOR shall submit two short term schedule documents at the Preconstruction Conference which shall serve as the CONTRACTOR'S Plan of Operation for the initial 60 day period of the Contract Time and to identify the manner in which the CONTRACTOR intends to complete all WORK within the Contract Time.

1. 60 Day Plan of Operation: During the initial 60 days of the Contract Time, the CONTRACTOR shall conduct operations in accordance with a 60 day bar chart type of plan of operation. The bar chart so prepared shall show the accomplishment of the CONTRACTOR'S early activities (mobilization, permits, submittals necessary for early material and equipment procurement, submittals necessary for long lead equipment procurement, CPM submittals, initial Site work and other submittals and activities required in the first 60 days).

2. Project Overview Bar Chart: The overview bar chart shall indicate the major components of the WORK and the sequence relations between major components and subdivisions of major components. The overview bar chart shall indicate the relationships and time frames in which the various components of the WORK will be made substantially complete and placed into service in order to meet the project milestones. Sufficient detail shall be included for the identification of subdivisions of major components into such activities as (1) excavation, (2) foundation subgrade

preparation, (3) foundation concrete, (4) completion of all structural concrete, (5) major mechanical work, (6) major electrical work, (7) instrumentation and control work, and (8) other important work for each major facility within the overall project scope. Planned durations and start dates shall be indicated for each work item subdivision. Each major component and subdivision component shall be accurately plotted on time scale sheets not to exceed 36-inch by 60-inch in size. Not more than four sheets shall be employed to represent this overview information.

B. The CONTRACTING OFFICER and the CONTRACTOR shall meet to review and discuss the 60-day plan of operation and project overview bar chart within 5 days after submittal to the CONTRACTING OFFICER. The CONTRACTING OFFICER'S review and comment on the schedules will be limited to conformance with the sequencing and milestone requirements in the Contract Documents. The CONTRACTOR shall make corrections to the schedules necessary to comply with the requirements and shall adjust the schedules to incorporate any missing information requested by the CONTRACTING OFFICER.

1.4 CPM SCHEDULE SUBMITTALS

A. **Original CPM Schedule Submittal**: With 45 days after the commencement date stated in the Notice to Proceed, the CONTRACTOR shall submit for review by the CONTRACTING OFFICER a hard copy of the CPM Schedule and the Computerized Schedule Report tabulations. The CONTRACTOR shall also submit a 3-1/2-inch high density floppy disk or CD which contains all of the schedule submittal information. The disk shall contain data compatible with Primavera P3 to generate network diagrams and schedule reports identical to the hard copies submitted. This submittal shall have already been reviewed and approved by the CONTRACTOR'S Project Manager, prior to submission. The CPM Schedule shall be a time-scaled network diagram of the "i-j" activity-on-arrow or precedence type. The Network Diagram shall describe the activities to be accomplished and their logical relationships and show the critical path. The CONTRACTOR'S attention is directed to the requirement that the schedule shall contain sufficient detail and information to cost load the CPM schedule in accordance with the approved schedule of values under Section 01301. Each installation and Site work activity shall be cost loaded as indicated.

B. All float in the schedule shall belong to the project. The Computerized Schedule Report tabulations shall include the following:

1. Report of activities sorted by activity number. Activity numbers, where practical, shall correlate to the area numbers designated in the Contract Drawings and further defined in Section 01010 - Summary of Work.

2. Report of activities sorted by early start date.

3. Report of activities sorted by total float.

4. Report of activities sorted by responsibility code. Responsibility codes shall be established for the CONTRACTOR, GOVERNMENT, subcontractors, suppliers, etc. These codes shall be identified in the Network Diagram.

5. A successor-predecessor report which shall identify the successor and predecessor activities for each activity and ties between schedule activities.

C. **Revisions to the Original CPM Schedule**: Within 65 days after the commencement date stated in the Notice to Proceed, the CONTRACTOR shall have revised the original CPM schedule submittal to address all review comments and resubmit the network diagrams and reports for the CONTRACTING OFFICER'S review. The CONTRACTING OFFICER, within 14 days from the date that the CONTRACTOR submitted the revised schedule will either (1) accept the schedule and cost loaded activities as submitted, or (2) advise the CONTRACTOR in writing to review any part or parts of the schedule which either do not meet the Contract requirements or are unsatisfactory for the CONTRACTING OFFICER to monitor the project's progress and status or evaluate monthly payment requests by the CONTRACTOR. The CONTRACTING OFFICER may accept the schedule with conditions that the first monthly CPM schedule update be revised to correct deficiencies identified. When the schedule is accepted, it shall be considered as the "Original CPM Construction Schedule" until an updated schedule has been submitted. The GOVERNMENT reserves the right to require that the CONTRACTOR adjust, add to, or clarify any portion of the schedule which may later be discovered to be insufficient for the monitoring of the WORK or approval of partial payment requests. No additional compensation will be provided for such adjustments, additions, or clarifications.

D. Acceptance

1. Acceptance of the CONTRACTOR'S schedule by the CONTRACTING OFFICER will be based solely upon compliance with the requirements. By way of the CONTRACTOR assigning activity durations and proposing the sequence of the WORK, the CONTRACTOR agrees to utilize sufficient and necessary management and other resources to perform the work in accordance with the schedule. Upon submittal of a schedule update, the updated schedule shall be considered the "current" project schedule.

2. Submission of the CONTRACTOR'S progress schedule to the CONTRACTING OFFICER shall not relieve the CONTRACTOR of total responsibility for scheduling, sequencing, and pursuing the WORK to comply with the requirements of the Contract Documents, including adverse effects such as delays resulting from ill-timed WORK.

E. Monthly Updates and Periodic CPM Schedule Submittals

1. Following the acceptance of the CONTRACTOR'S original CPM Schedule, the CONTRACTOR shall monitor the progress of the WORK and adjust the schedule each month to reflect actual progress and any changes in planned future activities. Each schedule update submitted shall be complete including all information requested in the original schedule submittal and be in the schedule report format indicated below. Each update shall continue to show all work activities including those already completed. Completed activities shall accurately reflect "as built" information by indicating when the work was actually started and completed.

2. Neither the submission nor the updating of the CONTRACTOR'S original schedule submittal nor the submission, updating, change, or revision of any other report, curve, schedule, or narrative submitted to the CONTRACTING OFFICER by the CONTRACTOR under this Contract, nor the CONTRACTING OFFICER'S review or acceptance of any such report, curve, schedule, or narrative shall have the effect of amending or modifying, in any way, the Contract Times or milestone dates or of modifying or limiting, in any way, the CONTRACTOR'S obligations under this

Contract. Only a signed, fully executed Change Order can modify contractual obligations.

3. The monthly schedule update submittal will be reviewed with the CONTRACTOR during a monthly construction progress. The goal of these meetings is to enable the CONTRACTOR and the CONTRACTING OFFICER to initiate appropriate remedial action to minimize any known or foreseen delay in completion of the WORK and to determine the amount of WORK completed since the last month's schedule update. The status of the WORK will be determined by the percent complete of each activity in the updated CPM Schedule. These meetings are considered a critical component of the overall monthly schedule update submittal, and the CONTRACTOR shall have appropriate personnel attend. As a minimum, these meetings shall be attended by the CONTRACTOR'S Project Manager. The CONTRACTOR shall plan on the meeting taking no less than 6 hours. Within 7 working days after the monthly progress meeting, the CONTRACTOR shall submit the revised CPM Schedule, the revised CPM computerized tabulations as noted in this Section, the revised successor/predecessor report, the Project Status Reports as defined below and the CONTRACTOR'S Application for Payment. Within 5 working days of receipt of the revised submittals, the CONTRACTING OFFICER will either accept or reject the monthly schedule update submittal. If accepted, the percent complete in the monthly update shall be the basis for the Application for Payment to be submitted by the CONTRACTOR. If rejected, the update shall be corrected and resubmitted by the CONTRACTOR before the Application for Payment for the update period will be processed.

F. **Schedule Revisions**: The CONTRACTOR shall highlight or otherwise identify all changes to the schedule logic or activity durations made from the previous schedule. The CONTRACTOR shall modify any portions of the CPM schedule which become infeasible because of activities behind schedule or for any other valid reason.

1.5 CHANGE ORDERS

A. Upon approval of a Change Order, or upon receipt by the CONTRACTOR of authorization to proceed with additional work, the change shall be reflected in the next submittal of the CPM Schedule. The CONTRACTOR shall utilize a sub-network in the schedule depicting the changed work and its effect on other activities. This sub-network shall be tied to the main network with appropriate logic so that a true analysis of the critical path can be made.

1.6 CPM STANDARDS

A. **Definitions**: CPM, as required by this Section, shall be interpreted to be generally as outlined in the Association of General Contractors (AGC) publication, "The Use of CPM in Construction." except that either "i-j" arrow diagrams or precedence diagramming format may be utilized. In the case of conflicts between this specification and the AGC document, this specification shall govern.

B. **Construction Schedules**: Construction schedules shall include a graphic network diagram and computerized construction schedule reports as required below for status reporting.

C. **Networks**: The CPM network shall be in a form of a time scaled "i-j" activity-on-arrow or precedence type diagram and may be divided into a number of separate sheets with suitable match lines relating the interface points among the sheets. Individual sheets shall not exceed 36 inches by 60 inches.

D. Construction and procurement activities shall be presented in a time-scaled format with a calendar time line along the entire sheet length. Each activity arrow or node shall be plotted so that the beginning and completion dates of each activity are accurately represented along the calendar time line. All activities shall use symbols that clearly distinguish between critical path activities, non-critical activities, and free float for each non-critical activity. All activity items shall be identified by their respective activity number, responsibility code, work duration, and their dollar value. All non-critical path activities shall show total float time in scale form by utilizing a dotted line or some other graphical means.

E. **Duration Estimates**: The duration estimate for each activity shall be computed in working days and shall represent the single best estimate considering the scope of the work and resources planned for the activity. Except for certain non-labor activities, such as curing of concrete or delivery of materials, activity duration shall not exceed 10 working days nor be less than one working day unless otherwise accepted by the CONTRACTING OFFICER.

F. Float Time

1. Definition: Unless otherwise provided herein, float is synonymous with total float. Total float is the period of time measured by the number of working days each non-critical path activity may be delayed before it and its succeeding activities become part of the critical path. If a non-critical path activity is delayed beyond its float period, then that activity becomes part of the critical path and controls the end date of the work. Thus, delay of a non-critical path activity beyond its float period will cause delay to the project itself.

2. Float Ownership: Neither the GOVERNMENT nor the CONTRACTOR owns the float time. The project owns the float time. As such, liability for delay of the project completion date rests with the party actually causing delay to the project completion date. For example, if Party A uses some, but not all of the float time and Party B later uses the remainder of the float time as well as additional time beyond the float time, Party B shall be liable for the costs associated with the time that represents a delay to the project's completion date. Party A would not be responsible for any costs since it did not consume all of the float time and additional float time remained, therefore, the project's completion date was unaffected.

1.7 SCHEDULE REPORT FORMAT

A. **Schedule Reports**: Schedule Reports shall be prepared based on the CPM Schedule, and shall include the following minimum data for each activity:

1. Activity numbers and responsibility codes.

2. Work Order No.

3. CIP No.

4. Estimated activity duration.

5. Activity description.

6. Activity's percent completion.

7. Early start date (calendar dated).

8. Early finish date (calendar dated).

9. Late start date (calendar dated).

10. Late finish date (calendar dated).

11. Status (whether critical).

12. Total float for each activity.

13. Free float for each activity.

14. Cost value for each activity.

B. **Project Information**: Each Schedule Report shall be prefaced with the following summary data:

1. Project name.

2. Contractor.

3. Type of tabulation.

4. Project duration.

5. Contract Times (revised to reflect time extensions by Change Order).

6. The commencement date stated in the Notice to Proceed.

7. The data date and plot date of the CPM Schedule.

8. If an update, cite the new schedule completion date.

1.8 PROJECT STATUS REPORTING

A. The CONTRACTOR shall furnish monthly project status reports (Overview Bar Chart and a written narrative report) in conjunction with the revised CPM Schedules as indicated above. Status reporting shall be in the form below.

B. The CONTRACTOR shall prepare and submit monthly an Overview Bar Chart schedule of the major project components. The overview bar chart schedule shall be a summary of the current CPM Schedule (original and as updated and adjusted throughout the entire construction period). It shall be limited to not more than four sheets which shall not exceed 36 inches by 60 inches. The major project components shall be represented as time bars which shall be subdivided into various types of work including demolition,

excavation and earthwork, yard piping, concrete construction, mechanical, electrical and instrumentation installations. Major components shall include each new structure by area designation, sitework, modifications to existing structures, tie-ins to existing facilities, and plant startups.

C. Each major component and subdivision shall be accurately plotted consistent with the project overview bar chart above. It shall represent the same status indicated by early start and finish activity information contained in the latest update of the CPM Schedule. In addition, a percent completion shall be indicated for each major component and subdivision. The initial submittal of the overview bar chart schedule shall be made at the time that the revised original CPM Schedule is submitted to the CONTRACTING OFFICER (65 days from the commencement date stated in the Notice to Proceed). The CONTRACTOR shall amend the overview schedule to include any additional detail required by the CONTRACTING OFFICER. The CONTRACTOR shall include any additional information requested by the CONTRACTING OFFICER at any time during the construction of the WORK.

D. The CONTRACTOR shall prepare monthly written narrative reports of the status of the project for submission to the CONTRACTING OFFICER. Written status reports shall include:

1. The status of major project components (percent complete, amount of time ahead or behind schedule) and an explanation of how the project will be brought back on schedule if delays have occurred.

2. The progress made on critical activities indicated on the CPM Schedule.

3. Explanations for any lack of work on critical path activities planned to be performed during the last month.

4. Explanations for any schedule changes, including changes to the logic or to activity durations.

5. A list of the critical activities scheduled to be performed in the next two month period.

6. The status of major material and equipment procurement.

7. The value of materials and equipment properly stored at the Site but not yet incorporated into the WORK.

8. Any delays encountered during the reporting period.

9. An assessment of inclement weather delays and impacts to the progress of the WORK.

E. The CONTRACTOR may include any other information pertinent to the status of the project. The CONTRACTOR shall include additional status information requested by the CONTRACTING OFFICER.

1.9 INCLEMENT WEATHER PROVISIONS OF THE SCHEDULE

A. The CONTRACTOR'S construction schedule shall include at least 5 working days of delay due to unusually severe weather.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

- END OF SECTION -

SECTION 01313 - CONSTRUCTION AND SCHEDULE CONSTRAINTS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. WORK shall be scheduled, sequenced, and performed in a manner which minimizes disruption to the operation and maintenance of existing facilities.

B. The CONTRACTOR shall incorporate the construction and schedule constraints of this Section in preparing the construction schedules required under Section 01311 – CPM Construction Schedule.

1.2 EXISTING PLANT

A. The WORK shall be executed while the existing wastewater treatment plant is in operation. Operation of the existing plant shall not be jeopardized as a result of the execution of the WORK.

B. Unless indicated otherwise, temporary pumping, piping, power, lighting, controls, instrumentation, alarms, security devices, and safety devices shall be provided by the CONTRACTOR whenever its work or interruption due to its work affects the existing facility.

C. The construction constraints in this Section do not include all items affecting the completion of the WORK, but are intended to describe the sequence of critical events necessary to minimize disruption to the ongoing treatment plant processes and to ensure compliance with NPDES Permit requirements. It shall be understood and agreed by the CONTRACTOR that the critical events described are not all inclusive and that additional items of work not included may be required to minimize disruption and ensure compliance. Deviation from or modification of these suggested sequences is permitted if techniques and methods known to the CONTRACTOR will result in reducing disruption to the facility operation and maintaining treatment efficiency, and if deviation is approved in advance by the CONTRACTING OFFICER.

1.3 OPERATION OF PLANT EQUIPMENT

A. Operational functions or shutdown of the existing plant required to facilitate CONTRACTOR's operation will be done by the GOVERNMENT's personnel only.

B. The plant operation and maintenance personnel will cooperate in every way that is practical in order to facilitate CONTRACTOR's operation. However, certain shutdown and connections may only be permissible at times other than normal working hours such as nights or weekends. No additional payment will be made to the CONTRACTOR for any night, weekend, or holiday premium or overtime payments.

C. If it becomes necessary for the proper operation or maintenance of portions of the plant, the GOVERNMENT may require the CONTRACTOR to reschedule an approved shutdown. The CONTRACTOR shall then reschedule its operations so there shall be no conflict with necessary operations or maintenance of the plant. The CONTRACTOR shall, within 2 working days, furnish the CONTRACTING OFFICER a revised outage request and a plan for rescheduling the shutdown in accordance with the requirements of the construction schedule.

1.4 BYPASSING

A. Bypassing of untreated or partially treated sewage to surface waters or drainage courses is prohibited during construction. In the event accidental bypassing is caused by the CONTRACTOR's operations, the GOVERNMENT shall immediately be entitled to employ others to stop the bypassing and costs incurred therefore will be deducted from the CONTRACTOR's construction progress payments.

1.5 COMPLIANCE WITH WASTE DISCHARGE PERMIT

A. In scheduling and performing the WORK, the CONTRACTOR shall not, directly or indirectly, prevent the plant from achieving the discharge requirements. Penalties imposed on the GOVERNMENT as a result of any discharge violation caused by the actions of the CONTRACTOR or its employees, or subcontractors shall be borne in full by the CONTRACTOR, including fines, legal fees, and other expenses to the GOVERNMENT resulting directly or indirectly from such discharge violations. The GOVERNMENT may recover such sums by deductions from the construction progress payments.

B. The CONTRACTOR shall take all necessary precautions to ensure that no damage occurs to the plant facilities, including piping, utilities, roads, and structures, that are to remain in operation and are not to be modified or replaced, in accordance with Section 01530 - Protection and Restoration of Existing Facilities.

1.6 OUTAGE REQUESTS

A. Modifications to existing facilities, the construction of new facilities, and the connection of new to existing facilities may require the temporary outage or bypass of existing treatment processes or facilities. In such cases, the CONTRACTOR shall coordinate WORK with the CONTRACTING OFFICER as described below. The CONTRACTOR shall submit a detailed outage plan and time schedule for all construction activities which will make it necessary to remove a tank, pipeline, channel, electrical circuit, equipment, structure, road, or other facilities from service.

B. The outage plans shall be submitted to the CONTRACTING OFFICER for acceptance a minimum of 2 weeks in advance of the time that such outages are required. The outage plans shall be coordinated with the construction schedule and shall meet the restrictions and conditions of this Section. The outage plan shall describe the CONTRACTOR's method for preventing bypassing of other treatment units; the length of time required to complete the operation; any necessary temporary power, controls, instrumentation, or alarms required to maintain control, monitoring, and alarms for the treatment plant processes; and the manpower, plant, and equipment which the CONTRACTOR shall provide in order to ensure proper operation of associated treatment units. All costs for preparing and implementing the outage plans shall be the responsibility of the CONTRACTOR as part of the WORK.

C. The CONTRACTOR shall not begin an alteration affecting existing facilities until specific written approval has been granted by the CONTRACTING OFFICER in each case.

D. The CONTRACTING OFFICER will coordinate the CONTRACTOR's planned procedure with the treatment facility personnel. The CONTRACTING OFFICER has the authority to modify any proposed shutdown procedures if such procedures would adversely impact the plant operations.

E. The CONTRACTING OFFICER shall be notified in writing at least one week in advance of the required outage if the schedule for performing the work has changed or if revisions to the outage plan are required. The CONTRACTOR shall provide written confirmation of the shutdown date and time 2 working days prior to the actual shutdown.

1.7 TEMPORARY CONNECTIONS

A. The making of connections to existing facilities or other operations that interfere with the operation of the existing equipment shall be thoroughly planned in advance, and all required equipment, materials, and labor shall be on hand at the time of undertaking the connections. Work shall be completed as quickly as possible and with as little delay as possible, and shall proceed continuously (24 hours a day and seven days a week) if necessary to complete modifications and/or connections in the minimum time.

B. The cost of any temporary facilities and night, weekend, or holiday work and overtime payments required during process interruptions shall be included in the price of the WORK.

C. Temporary facilities and piping shall be located to minimize interference with CONTRACTOR's construction facilities and GOVERNMENT's operation and maintenance of the wastewater treatment plant. Unless otherwise indicated, each temporary pipeline shall be of the same size as its connection to the existing or permanent facility at the downstream end of the pipeline. Piping materials shall be suitable for the material being conveyed and be as required in the Contract Specifications.

D. When temporary electrical power, controls, instrumentation, or alarms are required for routine continuous operations of existing or new equipment, the CONTRACTOR shall provide the necessary equipment and appurtenances. Prior to installing said equipment and appurtenances, CONTRACTOR shall furnish a submittal on the proposed components and installation for CONTRACTING OFFICER's review and approval.

E. A plan showing the size and location of the temporary facilities and piping shall be submitted to the CONTRACTING OFFICER at the same time as the outage plan required under this Section. All costs for design, provision, operation, and removal of temporary facilities and piping shall be the responsibility of the CONTRACTOR.

1.8 CONSTRUCTION SEQUENCING

A. All construction activities shall be scheduled and sequenced to ensure continuous operation of the existing treatment facilities. The CONTRACTOR's scheduling shall develop all construction sequencing so that the work will not adversely impact treatment. The CONTRACTOR shall be responsible for development of the construction sequencing. In implementing the construction sequencing, the CONTRACTOR shall maintain the existing facilities in service until new facilities are constructed and are operational to supplement the existing capacity.

1. During all rehabilitation, modification, and demolition work, safe working conditions for personnel shall be maintained at all times. The foregoing includes at least proper trench excavation, the provision of temporary equipment guards, supports, warning signs, walkways, covers over openings, handrailing, and protection of electrical equipment and power supply.

2. All temporary facilities shall be constructed in accordance with applicable codes and regulations to operate safely and properly.

3. Valves to be temporarily shut off during the work shall be tagged as such and shall be wired shut with a crimped lead seal and padlocked.

4. Electrical and mechanical equipment shall be similarly shut down.

1.9 PERMITS

A. The CONTRACTOR shall abide by the conditions of all permits and shall obtain proof of satisfaction of conditions from issuers of permits prior to acceptance of the WORK by the GOVERNMENT.

1.10 SCHEDULE CONSTRAINTS

A. **General:** It is the CONTRACTOR'S responsibility to coordinate and plan the construction activities to integrate each schedule constraint into performance of the overall work.

B. The following constraints affect the construction schedule.

1. The upgrades to the wastewater treatment plant will require five tie-ins to the existing plant. The first connection is the tertiary plant tie-in at the existing 24-inch steel pipe, as shown on Detail B on sheet GC-6. The second plant tie-in is the Flocculation Tank overflow, as shown in Detail C on sheet GC-6. The third and fourth plant tie-ins are at the Recycled Water Storage Tank, as shown on sheet C-7 (connection #60 and plugging the existing inlet). The fifth connection is with the existing sodium hypochlorite facility, as shown on sheet 11M-1.

a. The flow in the existing 24-inch pipe from the secondary clarifiers may be diverted for up to 8-hours over a single 48-hour time period for the work to be completed on the tertiary plant tie-in, as shown in Detail B on sheet GC-6. During the outage, the CONTRACTOR shall route the flow from the secondary clarifiers to the lagoon adjacent to the secondary clarifiers. Upon completion of the work, the CONTRACTOR shall pump all flow diverted to the lagoon back to the oxidation ditch using its own pumping equipment.

b. The flow in the existing 24-inch pipe from the secondary clarifiers may be diverted for up to 8-hours over a single 48-hour time period for the work to be completed on the Flocculation Tank overflow tie-in, as shown in Detail C on sheet GC-6. During the outage, the CONTRACTOR shall route the flow from the secondary clarifiers to the lagoon adjacent to the secondary clarifiers. Upon completion of the work, the CONTRACTOR shall pump all flow diverted to the lagoon back to the oxidation ditch using its own pumping equipment.

c. The tie-in at the Recycled Water Storage Tank (connection #60 on sheet C-7) shall be completed after the tertiary plant tie-in, as described in paragraph 1.10.B.1.a above, has been completed. The Recycled Water Storage Tank tie-in shall be completed with the Recycled Water Storage Tank in service (note: this tank serves as the chlorine contact tank for the existing secondary treatment plant). Cofferdams shall be used in such a manner that the tank retains a 30-minute detention time when being used for secondary effluent disinfection.

d. Plugging the existing inlet to the Recycled Water Storage Tank, as shown on sheet C-7, shall be completed after all other work on the plant for the Tertiary Upgrade has been completed. The plug shall be completed with the Recycled Water Storage Tank in service.

e. Provisions shall be made such that the tie-ins to the existing sodium hypochlorite facility will not interrupt flow of sodium hypochlorite to the plant. Temporary sodium hypochlorite feeders, totes and piping shall be used as necessary.

2. The Recycled Water Pipeline will have one tie-in to an existing pipeline, as shown in Detail E on sheet GC-6. A 24-hour outage to the existing irrigation forcemain will be allowed for this connection.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION -

This page was intentionally left blank for duplex printing.

SECTION 01400 CONTRACTOR QUALITY CONTROL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 1077 (1996) Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation

ASTM D 3666 (1996) Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Bituminous Paving Materials

ASTM D 3740 (1996) Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction

ASTM E 329 (1995b) Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

The Contractor is responsible for quality control and shall establish and maintain an effective quality control system in compliance with the Contract Clause titled "Inspection of Construction." The quality control system shall consist of plans, procedures, and organization necessary to produce an end product which complies with the contract requirements. The system shall cover all construction operations, both onsite and offsite, and shall be keyed to the proposed construction sequence. The project superintendent will be held responsible for the quality of work on the job and is subject to removal by the Contracting Officer for non-compliance with quality requirements specified in the contract. The project superintendent in this context shall mean the individual with the responsibility for the overall management of the project including quality and production.

3.2 QUALITY CONTROL PLAN

A. General

The Contractor shall furnish for review by the Government, not later than 15 days after receipt of notice to proceed, the Contractor Quality Control (CQC) Plan proposed to implement the requirements of the Contract Clause titled "Inspection of Construction." The plan shall identify personnel, procedures, control, instructions, tests, records, and forms to be used. The Government will consider an interim plan for the first 60 days of operation. Construction will be permitted to begin only after acceptance of the CQC Plan

or acceptance of an interim plan applicable to the particular feature of work to be started. Work outside of the features of work included in an accepted interim plan will not be permitted to begin until acceptance of a CQC Plan or another interim plan containing the additional features of work to be started.

B. Content of the CQC Plan

The CQC Plan shall include, as a minimum, the following to cover all construction operations, both onsite and offsite, including work by subcontractors, fabricators, suppliers, and purchasing agents:

1. A description of the quality control organization, including a chart showing lines of authority and acknowledgment that the CQC staff shall implement the three phase control system for all aspects of the work specified. The staff shall include a CQC System Manager who shall report to the project superintendent.

2. The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a CQC function.

3. A copy of the letter to the CQC System Manager signed by an authorized official of the firm which describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop work which is not in compliance with the contract. The CQC System Manager shall issue letters of direction to all other various quality control representatives outlining duties, authorities, and responsibilities. Copies of these letters shall also be furnished to the Government.

4. Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, offsite fabricators, suppliers, and purchasing agents. These procedures shall be in accordance with Section 01330 SUBMITTAL PROCEDURES.

5. Control, verification, and acceptance testing procedures for each specific test to include the test name, specification paragraph requiring test, feature of work to be tested, test frequency, and person responsible for each test. (Laboratory facilities will be approved by the Contracting Officer.)

6. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests including documentation.

7. Procedures for tracking construction deficiencies from identification through acceptable corrective action. These procedures shall establish verification that identified deficiencies have been corrected.

8. Reporting procedures, including proposed reporting formats.

9. A list of the definable features of work. A definable feature of work is a task which is separate and distinct from other tasks, has separate control requirements, and may be identified by different trades or disciplines, or it may be work by the same trade in a different environment. Although each section of the specifications may generally be considered as a definable feature of work, there are frequently more than one definable

features under a particular section. This list will be agreed upon during the coordination meeting.

C. Acceptance of Plan

Acceptance of the Contractor's plan is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. The Government reserves the right to require the Contractor to make changes in his CQC Plan and operations including removal of personnel, as necessary, to obtain the quality specified.

D. Notification of Changes

After acceptance of the CQC Plan, the Contractor shall notify the Contracting Officer in writing of any proposed change. Proposed changes are subject to acceptance by the Contracting Officer.

3.3 COORDINATION MEETING

After the Preconstruction Conference, before start of construction, and prior to acceptance by the Government of the CQC Plan, the Contractor shall meet with the Contracting Officer or Authorized Representative and discuss the Contractor's quality control system. The CQC Plan shall be submitted for review a minimum of 14 calendar days prior to the Coordination Meeting. During the meeting, a mutual understanding of the system details shall be developed, including the forms for recording the CQC operations, control activities, testing, administration of the system for both onsite and offsite work, and the interrelationship of Contractor's Management and control with the Government's Quality Assurance. Minutes of the meeting shall be prepared by the Government and signed by both the Contractor and the Contracting Officer. The minutes shall become a part of the contract file. There may be occasions when subsequent conferences will be called by either party to reconfirm mutual understandings and/or address deficiencies in the CQC system or procedures which may require corrective action by the Contractor.

3.4 QUALITY CONTROL ORGANIZATION

A. Personnel Requirements

The requirements for the CQC organization are a CQC System Manager and sufficient number of additional qualified personnel to ensure contract compliance. The Contractor shall provide a CQC organization which shall be at the site at all times during progress of the work and with complete authority to take any action necessary to ensure compliance with the contract. All CQC staff members shall be subject to acceptance by the Contracting Officer.

B. CQC System Manager

The Contractor shall identify as CQC System Manager an individual within his organization at the site of the work who shall be responsible for overall management of CQC and have the authority to act in all CQC matters for the Contractor. The CQC System Manager shall be a graduate engineer, or a graduate of construction

management with a minimum of 5 years in related work. This CQC System Manager shall be on the site at all times during construction and will be employed by the prime Contractor. The CQC System Manager can also serve as the site safety engineer. An alternate for the CQC System Manager will be identified in the plan to serve in the event of the System Manager's absence. The requirements for the alternate will be the same as for the designated CQC System Manager.

C. Additional Requirement

In addition to the above experience and or education requirements the CQC System Manager shall have completed the course entitled "Construction Quality Management For Contractors". This course is offered quarterly by the Los Angeles District, contact the Contracting Officer for more information.

D. Organizational Changes

The Contractor shall maintain the CQC staff at full strength at all times. Specialized personnel, as defined in Paragraph 3.4.3 above, must be reasonably available if not physically present. When it is necessary to make changes to the CQC staff, the Contractor shall revise the CQC Plan to reflect the changes and submit the changes to the Contracting Officer for acceptance.

3.5 SUBMITTALS AND DELIVERABLES

Submittals, if needed, shall be made as specified in Section 01300 SUBMITTAL PROCEDURES. The CQC organization shall be responsible for certifying that all submittals and deliverables are in compliance with the contract requirements.

3.6 CONTROL

Contractor Quality Control is the means by which the Contractor ensures that the construction, to include that of subcontractors and suppliers, complies with the requirements of the contract. At least three phases of control shall be conducted by the CQC System Manager for each definable feature of work as follows:

A. Preparatory Phase

This phase shall be performed prior to beginning work on each definable feature of work, after all required plans/documents/materials are approved/accepted, and after copies are at the work site. This phase shall include:

1. A review of each paragraph of applicable specifications, reference codes, and standards. A copy of those sections of referenced codes and standards applicable to that portion of the work to be accomplished in the field shall be made available by the Contractor at the preparatory inspection. These copies shall be maintained in the field and available for use by Government personnel until final acceptance of the work.
2. A review of the contract drawings.
3. A check to assure that all materials and/or equipment have been tested, submitted, and approved.
4. Review of provisions that have been made to provide required control inspection and testing.

5. Examination of the work area to assure that all required preliminary work has been completed and is in compliance with the contract.

6. A physical examination of required materials, equipment, and sample work to assure that they are on hand, conform to approved shop drawings or submitted data, and are properly stored.

7. A review of the appropriate activity hazard analysis to assure safety requirements are met.

8. Discussion of procedures for controlling quality of the work including repetitive deficiencies. Document construction tolerances and workmanship standards for that feature of work.

9. A check to ensure that the portion of the plan for the work to be performed has been accepted by the Contracting Officer.

10. Discussion of the initial control phase.

11. The Government shall be notified at least 48 hours in advance of beginning the preparatory control phase. This phase shall include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. The results of the preparatory phase actions shall be documented by separate minutes prepared by the CQC System Manager and attached to the daily CQC report. The Contractor shall instruct applicable workers as to the acceptable level of workmanship required in order to meet contract specifications.

B. Initial Phase

This phase shall be accomplished at the beginning of a definable feature of work. The following shall be accomplished:

1. A check of work to ensure that it is in full compliance with contract requirements. Review minutes of the preparatory meeting.

2. Verify adequacy of controls to ensure full contract compliance. Verify required control inspection and testing.

3. Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Compare with required sample panels as appropriate.

4. Resolve all differences.

5. Check safety to include compliance with and upgrading of the safety plan and activity hazard analysis. Review the activity analysis with each worker.

6. The Government shall be notified at least 48 hours in advance of beginning the initial phase. Separate minutes of this phase shall be prepared by the CQC System Manager and attached to the daily CQC report. Exact location of initial phase shall be indicated for future reference and comparison with follow-up phases.

7. The initial phase should be repeated for each new crew to work onsite, or any time acceptable specified quality standards are not being met.

C. Follow-up Phase

Daily checks shall be performed to assure control activities, including control testing, are providing continued compliance with contract requirements, until completion of the particular feature of work. The checks shall be made a matter of record in the CQC documentation. Final follow-up checks shall be conducted and all deficiencies corrected prior to the start of additional features of work which may be affected by the deficient work. The Contractor shall not build upon nor conceal non-conforming work.

D. Additional Preparatory and Initial Phases

Additional preparatory and initial phases shall be conducted on the same definable features of work if: the quality of on-going work is unacceptable; if there are changes in the applicable CQC staff, onsite production supervision or work crew; if work on a definable feature is resumed after a substantial period of inactivity; or if other problems develop.

3.7 TESTS

A. Testing Procedure

The Contractor shall perform specified or required tests to verify that control measures are adequate to provide a product which conforms to contract requirements. Upon request, the Contractor shall furnish to the Government duplicate samples of test specimens for possible testing by the Government. Testing includes operation and/or acceptance tests when specified. ***The Contractor shall procure the services of an independent commercial laboratory that has been approved by the Resident Engineer***. In addition, the laboratory shall be submitted as part of the Contractor=s Quality Control Plan and approved by the Contracting Officer. The Contractor shall perform the following activities and record and provide the following data:

1. Verify that testing procedures comply with contract requirements.
2. Verify that facilities and testing equipment are available and comply with testing standards.
3. Check test instrument calibration data against certified standards.
4. Verify that recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.
5. Results of all tests taken, both passing and failing tests, shall be recorded on the CQC report for the date taken. Specification paragraph reference, location where tests were taken, and the sequential control number identifying the test shall be given. If approved by the Contracting Officer, actual test reports may be submitted later with a reference to the test number and date taken. An information copy of tests performed by an offsite or commercial test facility shall be provided directly to the Contracting Officer. Failure to submit timely test reports as stated may result in nonpayment for related work performed and disapproval of the test facility for this contract.

B. Testing Laboratories

1. Capability Check

The Contractor shall use an independent commercial laboratory that has been inspected by the AASHTO Materials Reference Laboratory (AMRL) or the Cement and Concrete Reference Laboratory (CCRL), as applicable, for the required test methods. The inspection report(s) and the written response(s) to any noted deficiencies shall be included with the Contractor Quality Control Plan and will be subject to approval by the Resident Engineer. Laboratories utilized for testing soils, concrete, asphalt, or steel shall meet the applicable requirements of ASTM D 3740, C 1077, D3666 and E 329.

2. Quality Assurance Check

The Government reserves the right to perform a quality assurance check of the laboratory equipment and procedures.

3. Onsite Laboratory

The Government reserves the right to utilize the Contractor's control testing laboratory and equipment to make assurance tests, and to check the Contractor's testing procedures, techniques, and test results at no additional cost to the Government.

4. Furnishing or Transportation of Samples for Testing

Costs incidental to the transportation of samples or materials will be borne by the Contractor. Samples of materials for test verification and acceptance testing by the Government shall be delivered to the QA laboratory designated by the Contracting Officer. Coordination for each specific test, exact delivery location and dates will be made through the Area Office.

3.8 COMPLETION INSPECTION

A. Punch-Out Inspection

Near the end of the work, or any increment of the work established by a time stated in the Special Clause, "Commencement, Prosecution, and Completion of Work", or by the specifications, the CQC Manager shall conduct an inspection of the work. A punch list of items which do not conform to the approved drawings and specifications shall be prepared and included in the CQC documentation, as required by paragraph DOCUMENTATION. The list of deficiencies shall include the estimated date by which the deficiencies will be corrected. The CQC System Manager or staff shall make a second inspection to ascertain that all deficiencies have been corrected. Once this is accomplished, the Contractor shall notify the Government that the facility is ready for the Government Pre-Final inspection.

B. Pre-Final Inspection

The Government will perform the pre-final inspection to verify that the facility is complete and ready to be occupied. A Government Pre-Final Punch List may be developed as a result of this inspection. The Contractor's CQC System Manager shall ensure that all items on this list have been corrected before notifying the Government, so that a Final inspection with the customer can be scheduled. Any items noted on the Pre-Final inspection shall be corrected in a timely manner. These inspections and any deficiency corrections required by this paragraph shall be accomplished within the time slated for completion of the entire work or any particular increment of the work if the project is divided into increments by separate completion dates.

C. Final Acceptance Inspection

The Contractor's Quality Control Inspection personnel, plus the superintendent or other primary management person, and the Contracting Officer's Representative shall be in attendance at the final acceptance inspection. Additional Government personnel including, but not limited to, those from U.S. Border Patrol user groups, and major commands may also be in attendance. The final acceptance inspection will be formally scheduled by the Contracting Officer based upon results of the Pre-Final inspection. Notice shall be given to the Contracting Officer at least 14 days prior to the final acceptance inspection and shall include the Contractor's assurance that all specific items previously identified to the Contractor as being unacceptable, along with all remaining work performed under the contract, will be complete and acceptable by the date scheduled for the final acceptance inspection. Failure of the Contractor to have all

contract work acceptably complete for this inspection will be cause for the Contracting Officer to bill the Contractor for the Government's additional inspection cost in accordance with the contract clause titled "Inspection of Construction".

3.9 DOCUMENTATION

The Contractor shall maintain current records providing factual evidence that required quality control activities and/or tests have been performed. These records shall include the work of subcontractors and suppliers and shall be on an acceptable form that includes, as a minimum, the following information:

1. Contractor/subcontractor and their area of responsibility.
2. Operating plant/equipment with hours worked, idle, or down for repair.
3. Work performed each day, giving location, description, and by whom. When Network Analysis (NAS) is used, identify each phase of work performed each day by NAS activity number.
4. Test and/or control activities performed with results and references to specifications/drawings requirements. The control phase shall be identified (Preparatory, Initial, Follow-up). List deficiencies noted, along with corrective action.
5. Quantity of materials received at the site with statement as to acceptability, storage, and reference to specifications/drawings requirements.
6. Submittals and deliverables reviewed, with contract reference, by whom, and action taken.
7. Off-site surveillance activities, including actions taken.
8. Job safety evaluations stating what was checked, results, and instructions or corrective actions.
9. Instructions given/received and conflicts in plans and/or specifications.
10. Contractor's verification statement. These records shall indicate a description of trades working on the project; the number of personnel working; weather conditions encountered; and any delays encountered. These records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in the work and workmanship comply with the contract. The original and one copy of these records in report form shall be furnished to the Government daily within 24 hours after the date covered by the report, except that reports need not be submitted for days on which no work is performed. As a minimum, one report shall be prepared and submitted for every 7 days of no work and on the last day of a no work period. All calendar days shall be accounted for throughout the life of the contract. The first report following a day of no work shall be for that day only. Reports shall be signed and dated by the CQC System Manager. The report from the CQC System Manager shall include copies of test reports and copies of reports prepared by all subordinate quality control personnel.

3.10 IMPLEMENTATION OF GOVERNMENT RESIDENT MANAGEMENT SYSTEM FOR CONTRACTOR QUALITY CONTROL OF CONTRACT

The Contractor shall utilize a Government furnished CQC Programming Module (A computerized executable file which is WINDOWS based and operates on an IBM-compatible PC with 200 Mhz Pentium or higher processor, 32+ MB of RAM, 4 GB hard drive disk space for sole use by the RMS system, 3 ½ inch high-density floppy drive, Compact disk reader, color monitor, Laser printer compatible with Hp LaserJet III or better, with a minimum 4 MB installed memory and connection to the internet, minimum 28 BPS.

The software shall contain MS Windows 95 or newer version operating system (MS Windows NT 4.0 or newer is recommended, Word Processing software compatible with MS Word 97 or newer, internet Browser, The Contractor's computer system shall be protected by virus protection software that is regularly upgraded with all issued manufacturer's updates throughout the life of the contract and Electronic mail (E-mail) compatible with MS Outlook.

The Module includes a Daily CQC Reporting System form which must also be used. This form may be in addition to other Contractor desired reporting forms. However, all other such reporting forms shall be consolidated into this one Government specified Daily CQC Report Form. The Contractor will also be required to complete Government-Furnished Module elements which includes, but is not limited to, Prime Contractor staffing; letter codes; planned cumulative progress earnings; subcontractor information showing trade, name, address, point-of-contact, and insurance expiration dates; definable features of work; pay activity and activity information; required Quality Control tests tied to individual activities; planned User Schooling tied to specific specification paragraphs and contractor activities; Installed Property Listing, Transfer Property Listing and submittal information relating to specification section, description, activity number, review period and expected procurement period. The sum of all activity values shall equal the contract amount, and all Bid Items, Options and Additives shall be separately identified, in accordance with the "Pricing Schedule". Bid Items may include multiple Activities, but Activities may only be assigned to one such Bid Item. This Module shall be completed to the satisfaction of the Contracting Officer prior to any contract payment (except for Bonds, Insurance and/or Mobilization, as approved by the Contracting Officer) and shall be updated as required.

(a) During the course of the contract, the Contractor will receive various Quality Assurance comments from the Government that will reflect corrections needed to Contractor activities or reflect outstanding or future items needing the attention of the Contractor. The Contractor will acknowledge receipt of these comments by specific number reference on his Daily CQC Report, and will also reflect on his Daily CQC Report when these items are specifically completed or corrected to permit Government verification.

(b) The Contractor's schedule system shall include, as specific and separate activities, all Preparatory Phase Meetings (inspections); all O&M Manuals; and all Test Plans of Electrical and Mechanical Equipment or Systems that require validation testing or instructions to Government representatives.

3.11 CONSTRUCTION CONTROL MANUAL

In addition to the requirements specified in the various Technical Specifications hereinafter, test procedures and minimum number of tests will be performed in accordance with SPK PAM 415-1-2, "Construction Control Manual". Neither the specified minimum number of tests nor the lack of them shall in any way limit or relieve the Contractor of his responsibility to perform adequate tests to assure compliance with the quality requirements of these specifications. The referenced standards listed in this Construction Control Manual shall be of the latest issue unless otherwise specified. 1093 The "Construction Control Manual" may be examined in the following office locations, and will be furnished to the Contractor:

Corps of Engineers Corps of Engineers
Los Angeles District Fort Irwin Resident Office
Construction Management Section Corner of 5th Street and F Avenue
Fort Irwin, California

911 Wilshire Blvd Los Angeles, California

3.12 JOINT INSPECTION DURING WARRANTY PERIOD

The Government will perform this inspection at the 4th and 9th month after project acceptance by the customer. The Contractor's CQC System Manager and/or primary management person, the Contracting Officer's Representative, and the Building Manager (customer) shall be in attendance at this inspection. Additional Government personnel, including but not limited to those from the post Directorate of Public Works user groups and Major Commands, may also be in attendance. This joint inspection will be formally scheduled by the Contracting Officer. For additional warranty requirements, see FAR 52.246-21,Warranty of Construction (Mar 1994).

-- End of Section --

SECTION 01410 ENVIRONMENT PROTECTION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

The Contractor shall perform the work minimizing environmental pollution and damage as the result of construction operations. Environmental pollution and damage is the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade the utility of the environment for aesthetic, cultural and/or historical purposes. The control of environmental pollution and damage requires consideration of land, water, and air, and includes management of visual aesthetics, noise, solid, chemical, gaseous, and liquid waste, radiant energy and radioactive materials, as well as other pollutants. The environmental resources within the project boundaries and those affected outside the limits of permanent work shall be protected during the entire duration of this contract.

A. Subcontractors

The Contractor shall ensure compliance with this section by subcontractors.

B. Environmental Protection Plan

The Contractor shall submit an environmental protection plan within 15 days after receipt of the notice to proceed. Approval of the Contractor's plan will not relieve the Contractor of responsibility for adequate and continuing control of pollutants and other environmental protection measures. The environmental protection plan shall include, but shall not be limited to, the following:

a. A list of Federal, State, and local laws, regulations, and permits concerning environmental protection, pollution control and abatement that are applicable to the Contractor's proposed operations and the requirements imposed by those laws, regulations, and permits.

b. Methods for protection of features to be preserved within authorized work areas like trees, shrubs, vines, grasses and ground cover, landscape features, air and water quality, fish and wildlife, soil, historical, archaeological, and cultural resources.

C. Permits

The Contractor shall obtain all needed permits or licenses. The Government will not obtain any permits for this project; see Contract Clause PERMITS AND RESPONSIBILITIES. The State department of natural resources, through the national pollutant discharge elimination system (NPDES), requires general permits, a notice of intent, and a notice of discontinuation. The Contractor shall be responsible for implementing the terms and requirements of the appropriate permits as needed and for payment of all fees. Prior to commencement of the work the Contractor will:

1. Apply for all permits required for this project.

2. Submit a copy of each permit application to the Contracting Officer.

D. Preconstruction Survey

Prior to starting any onsite construction activities, the Contractor and the Contracting Officer shall make a joint condition survey after which the Contractor shall prepare a brief report indicating on a layout plan the condition of trees, shrubs and grassed areas immediately adjacent to work sites and adjacent to the assigned storage area and access routes as applicable. This report will be signed by both the Contracting Officer and the Contractor upon mutual agreement as to its accuracy and completeness.

E. Meetings

The Contractor shall meet with representatives of the Contracting Officer to alter the environmental protection plan as needed for compliance with the environmental pollution control program.

F. Notification

The Contracting Officer will notify the Contractor in writing of any observed noncompliance with the previously mentioned Federal, State or local laws or regulations, permits, and other elements of the Contractor's environmental protection plan. The Contractor shall, after receipt of such notice, inform the Contracting Officer of proposed corrective action and take such action when approved. If the Contractor fails to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No time extensions shall be granted or costs or damages allowed to the Contractor for any such suspensions.

G. Litigation

If work is suspended, delayed, or interrupted due to a court order of competent jurisdiction, the Contracting Officer will determine whether the order is due in any part to the acts or omissions of the Contractor, or subcontractors at any tier, not required by the terms of the contract. If it is determined that the order is not due to Contractor's failing, such suspension, delay, or interruption shall be considered as ordered by the Contracting Officer in the administration of the contract under the contract clause SUSPENSION OF WORK.

H. Previously Used Equipment

The Contractor shall thoroughly clean all construction equipment previously used at other sites before it is brought into the work areas, ensuring that soil residuals are removed and that egg deposits from plant pests are not present; the Contractor shall consult with the USDA jurisdictional office for additional cleaning requirements.

I. Payment

No separate payment will be made for work covered under this section; all costs associated with this section shall be included in the contract unit and/or lump sum prices in the Bidding Schedule.

1.2 LAND RESOURCES

The Contractor shall confine all activities to areas defined by the drawings and specifications. Prior to the beginning of any construction, the Contractor shall identify the land resources to be preserved within the work area. Except in areas indicated on the drawings or specified to be cleared, the Contractor shall not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, topsoil, and land forms without permission. No ropes, cables, or guys shall be fastened to or attached to any trees for anchorage unless specifically authorized. Where such emergency use is permitted, the Contractor shall provide effective protection for land and vegetation resources at all times as defined in the following subparagraphs. Stone, earth or other material displaced into uncleared areas shall be removed.

A. Work Area Limits

Prior to any construction, the Contractor shall mark the areas that need not be disturbed under this contract. Isolated areas within the general work area which are to be saved and protected shall also be marked or fenced. Monuments and markers shall be protected before construction operations commence. Where construction operations are to be conducted during darkness, the markers shall be visible. The Contractor's personnel shall be knowledgeable of the purpose for marking and/or protecting particular objects.

B. Landscape

Trees, shrubs, vines, grasses, land forms and other landscape features indicated and defined on the drawings to be preserved shall be clearly identified by marking, fencing, or wrapping with boards, or any other approved techniques.

C. Unprotected Erodible Soils

Earthwork brought to final grade shall be finished as indicated. Side slopes and back slopes shall be protected as soon as practicable upon completion of rough grading. All earthwork shall be planned and conducted to minimize the duration of exposure of unprotected soils. Except in cases where the constructed feature obscures borrow areas, quarries, and waste material areas, these areas shall not initially be totally cleared. Clearing of such areas shall progress in reasonably sized increments as needed to use the developed areas as approved by the Contracting Officer.

D. Disturbed Areas

The Contractor shall effectively prevent erosion and control sedimentation through approved methods including, but not limited to, the following:

1. Retardation and control of runoff. Runoff from the construction site or from storms shall be controlled, retarded, and diverted to protected drainage courses by means of diversion ditches, benches, berms, and by any measures required by area wide plans under the Clean Water Act.
2. Erosion and sedimentation control devices. The Contractor shall construct or install temporary and permanent erosion and sedimentation control features as indicated on the drawings. Berms, dikes, drains, sedimentation basins, grassing, and mulching

shall be maintained until permanent drainage and erosion control facilities are completed and operative.

3. Sediment basins. Sediment from construction areas shall be trapped in temporary or permanent sediment basins in accordance with the drawings. The basins shall accommodate the runoff of a local 5 year storm. After each storm, the basins shall be pumped dry and accumulated sediment shall be removed to maintain basin effectiveness. Overflow shall be controlled by paved weirs or by vertical overflow pipes. The collected topsoil sediment shall be reused for fill on the construction site, and/or stockpiled for use at another site. The Contractor shall institute effluent quality monitoring programs as required by State and local environmental agencies.

E. Contractor Facilities and Work Areas

The Contractor's field offices, staging areas, stockpile storage, and temporary buildings shall be placed in areas designated on the drawings or as directed by the Contracting Officer. Temporary movement or relocation of Contractor facilities shall be made only when approved. Borrow areas shall be managed to minimize erosion and to prevent sediment from entering nearby waters. Spoil areas shall be managed and controlled to limit spoil intrusion into areas designated on the drawings and to prevent erosion of soil or sediment from entering nearby waters. Spoil areas shall be developed in accordance with the grading plan indicated on the drawings. Temporary excavation and embankments for plant and/or work areas shall be controlled to protect adjacent areas from despoilment.

1.3 WATER RESOURCES

The Contractor shall keep construction activities under surveillance, management, and control to avoid pollution of surface and ground waters. Toxic or hazardous chemicals shall not be applied to soil or vegetation when such application may cause contamination of the fresh water reserve. Monitoring of water areas affected by construction shall be the Contractor's responsibility. The Contractor shall monitor all water areas affected by construction activities.

A. Washing and Curing Water

Waste waters directly derived from construction activities shall not be allowed to enter water areas. Waste waters shall be collected and placed in retention ponds where suspended material can be settled out or the water evaporates to separate pollutants from the water. Analysis shall be performed and results reviewed and approved before water in retention ponds is discharged.

1. Wild Life Encounters During Construction: It is not anticipated that there will be an abundance of wild life encounters at the project site. However, should the Contractor discover animals living within the construction boundaries, operation shall be suspended at the site of discovery and continued in other areas. The Contractor shall notify the Contracting Officer and Biological Monitor immediately of the finding. Included with the notification shall be a brief statement to the Contracting Officer and Biological Monitor of the location and the findings. How to identify sensitive animals that may be discovered will be provided at the Preconstruction Conference.

2. Desert Tortoise:

Contractor employees shall not touch, harm, harass, or kill desert tortoises. The Biological Monitor shall be notified immediately of all desert tortoise sightings. The Biological Monitor will be responsible for removing desert tortoises out of immediate dangers. Should construction activities threaten the survival of any desert tortoises, those activities will immediately cease until the Biological Monitor safely removes the tortoise(s). The Biological Monitor shall perform clearance surveys in all areas of planned disturbance. The Biological Monitor will be available to accompany construction crews during period of tortoise activity to provide protection of these animals and their burrows.

(a) The Contractor shall implement an employees environmental awareness program which will be provided to construction and operation employees with information to encourage awareness and preservation of the desert ecosystem and the resources found in the Western Mojave Desert. This information shall be distributed to and discussed with all employees during employee orientation sessions. This information shall also be provided to all visitors and subcontractors that will be on-site. The Contractor shall have all persons participating in the environmental awareness program sign and affidavit declaring that the individual understands and will adhere to the guidelines set forth in the program material.

(b) The Contractor shall develop a strict trash and litter control program. A litter control program shall consist of supplying an adequate number of covered trash and litter receptacles in all appropriate locations.

3. Protection of Endangered Trees:

(a) Endangered Trees within Project Site: Due to the limited vegetation in the area, removal or relocation of plants shall be minimized. The Contractor shall obtain approval from the Contracting Officer before removing or relocating any endangered plants within the construction boundaries. One such plant is the Joshua Tree, which is an endangered species. How to identify this tree and procedures for relocating those within the project site, are described as follows:

(1) Joshua Trees: Only trees under 5 feet tall shall be moved using hand tools. Mark North side of the tree and plant in same orientation. Using shovel, dig down to get main root mass (generally within 2 feet of surface). Try to get tap root and a fibrous water storage structure that it leads to. Take some of the soil to put in new hole. Roots should be dusted with sulfur to prevent rot. A small amount of manure can be mixed in with soil when replanting. Soil should be tamped down and a small berm placed around plant 5-foot diameter. Water with several gallons. Stake in 2 directions to prevent wind from knocking down. If not transplanted right away, "heel in" the plant (lay them on their side and cover roots with soil). Very large Joshua Trees (10-20 feet tall) shall not be moved but be detoured around by the utilities. If plants need relocation areas, they can be used in landscaping around the base.

1.4 AIR RESOURCES

Equipment operation and activities or processes performed by the Contractor in accomplishing the specified construction shall be in accordance with the State's rules and all Federal emission and performance laws and standards. Ambient Air Quality Standards set by the Environmental Protection Agency shall be maintained. Monitoring of air quality shall be the Contractor's responsibility. The Contractor shall monitor all air areas affected by the construction activities. Monitoring results will be periodically reviewed by the Government to ensure compliance.

A. Particulates

Dust particles; aerosols and gaseous by-products from construction activities; and processing and preparation of materials, such as from asphalt batch plants; shall be controlled at all times, including weekends, holidays and hours when work is not in progress. The Contractor shall maintain excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, spoil areas, borrow areas, and other work areas within or outside the project boundaries free from particulates which would cause the air pollution standards to be exceeded or which would cause a hazard or a nuisance. Sprinkling, chemical treatment of an approved type, light bituminous treatment, baghouse, scrubbers, electrostatic precipitators or other methods will be permitted to control particulates in the work area. Sprinkling, to be efficient, must be repeated to keep the disturbed area damp at all times. The Contractor must have sufficient, competent equipment available to accomplish these tasks. Particulate control shall be performed as the work proceeds and whenever a particulate nuisance or hazard occurs.

1.5 WASTE DISPOSAL

Disposal of wastes shall be as specified below.

A. Solid Wastes

Solid wastes (excluding clearing debris) shall be placed in containers, which are emptied on a regular schedule. Handling and disposal shall be conducted to prevent contamination. Segregation measures shall be employed so that no hazardous or toxic waste will become co-mingled with solid waste. The Contractor shall transport solid waste off Government property and dispose of it in compliance with Federal, State, and local requirements for solid waste disposal. Waste materials shall also be transported off Government property for disposal. The Contractor shall comply with Federal, State, and local laws and regulations pertaining to the use of landfill areas.

B. Chemical Wastes

Chemicals shall be dispensed ensuring no spillage to ground or water. Periodic inspections of dispensing areas to identify leakage and initiate corrective action shall be performed and documented. The Government will periodically review this documentation. Chemical waste shall be collected in corrosion resistant, compatible containers. Collection drums shall be monitored and removed to a staging or storage area when contents are within 150 mm (6 inches) of the top. Wastes shall be disposed of in accordance with Federal and local laws and regulations.

C. Hazardous Wastes

The Contractor shall take sufficient measures to prevent spillage of hazardous and toxic materials during dispensing and shall collect waste in suitable containers observing compatibility. The Contractor shall transport hazardous waste off Government property and dispose of it in compliance with Federal and local laws and regulations. Spills of hazardous or toxic materials shall be immediately reported to the Contracting Officer. Cleanup and cleanup costs due to spills shall be the Contractor's responsibility.

D. Burning Rubbish and Debris:

Open burning of rubbish, debris and other combustibles will not be permitted on the Fort.

E. HISTORICAL, ARCHAEOLOGICAL, AND CULTURAL RESOURCES

Existing historical, archaeological, and cultural resources within the Contractor's work area will be so designated by the Contracting Officer if any has been identified. The Contractor shall take precautions to preserve all such resources, as they existed at the time they were first pointed out. The Contractor shall provide and install protection for these resources and be responsible for their preservation during the life of the contract. If during excavation or other construction activities any previously unidentified or unanticipated resources are discovered or found, all activities that may damage or alter such resources shall be temporarily suspended. Resources covered by this paragraph include but are not limited to: any human skeletal remains or burials; artifacts; shell, midden, bone, charcoal, or other deposits; rocks or coral alignments, pavings, wall, or other constructed features; and any indication of agricultural or other human activities. Upon such discovery or find, the Contractor shall immediately notify the Contracting Officer. While waiting for instructions the Contractor shall record, report, and preserve the finds.

1.7 POST CONSTRUCTION CLEANUP

The Contractor shall clean up all areas used for construction.

1.8 RESTORATION OF LANDSCAPE DAMAGE

The Contractor shall restore landscape features damaged or destroyed during construction operations outside the limits of the approved work areas.

1.9 MAINTENANCE OF POLLUTION FACILITIES

The Contractor shall maintain permanent and temporary pollution control facilities and devices for the duration of the contract or for that length of time construction activities create the particular pollutant. 1093

1.10 TRAINING OF CONTRACTOR PERSONNEL

The Contractor's personnel shall be trained in all phases of environmental protection. The training shall include methods of detecting and avoiding pollution, familiarization with pollution standards, both statutory and contractual, and installation and care of

devices, vegetative covers, and instruments required for monitoring purposes to ensure adequate and continuous environmental pollution control.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

SECTION 01505 GENERAL REQUIREMENTS

PART 1 GENERAL

1.1 SCRAP MATERIAL

Materials specified to be removed and become the property of the Contractor are designated as scrap, and the Contractor, by signing this contract, hereby acknowledges that he has made due allowance for value, if any, of such scrap in the contract price. All scrap, solid waste, or hazardous materials (to be reused by the contractors) shall be disposed of and removed, off Fort Irwin property in accordance with applicable laws and regulations at Contractor's expense, unless otherwise specified in the contract. Hazardous waste generated by contractors on Fort Irwin shall be disposed of in accordance with Depot Policy. Contact the Environmental Office (760) 380-3410 for proper instructions. Government receptacles or containers shall not be used for disposal.

1.2 WRITTEN GUARANTEES AND GUARANTOR'S LOCAL REPRESENTATIVE

Prior to completion of the contract, the Contractor shall obtain and furnish to the Contracting Officer's representative written guarantees for all the equipment and/or appliances furnished under the contract. The Contractor shall furnish with each guarantee: The name, address, and telephone number of the guarantor's representative nearest to the location where the equipment and/or appliances are installed, who, upon request of the Using Service's representative, will honor the guarantee during the guaranty period and will provide the services prescribed by the terms of the guarantee.

1.3 PRICING OF CONTRACTOR-FURNISHED PROPERTY

The Contractor shall promptly furnish and shall cause any sub-contractor or supplier to furnish, in like manner, unit prices and descriptive data required by the Government for Property Record purposes of fixtures and equipment furnished and/or installed by the Contractor or sub-contractor, except prices do not need to be provided for Government-Furnished Property. This information shall be listed on RMS CQC Module furnished by the Government. See example forms at the end of this section.

1.4 TEMPORARY ELECTRIC WIRING

A. Temporary Power and Lighting

The Contractor shall provide construction power facilities in accordance with the safety requirements of the National Electrical Code NFPA No. 70 and the SAFETY AND HEALTH REQUIREMENTS MANUAL EM 385-1-1. The Contractor, or his delegated subcontractor, shall enforce all the safety requirements of electrical extensions for the work of all subcontractors. All work shall be accomplished by skilled electrical tradesmen in a workmanlike manner, as approved by the Contracting Officer.

B. Construction Equipment

In addition to the requirements of EM 385-1-1, SAFETY AND HEALTH REQUIREMENTS MANUAL, all temporary wiring conductors installed for operation of

construction tools and equipment shall be either Type TW or THW contained in metal raceways, or may be multiconductor cord. Temporary wiring shall be secured above the ground or floor in a workmanlike manner and shall not present an obstacle to persons or equipment. Open wiring may only be used outside of buildings, and then only in strict accordance with the provisions of the National Electrical Code.

B. Circuit Protection

In addition to the present requirements in EM 385-1-1 and the National Electrical Code, all 15 and 20-ampere receptacle outlets used for obtaining power during construction shall have ground fault circuit interrupters (GFCI) for personnel protection. Block and brick saws shall also be equipped with GFCI. The Contracting Officer may allow an exception to this requirement for circuits for concrete vibrators or circuits operating at other than 60 Hertz normal (in both cases an assured grounding program as described in the National Electrical Code, except utilizing the daily inspection frequency of the grounding means of such equipment, may be permitted). The assured grounding program will not be permitted as a substitute for usage of GFCI'S except as described above. All generator powered 15- and 20-ampere, 60 Hertz receptacle outlets shall have GFCI'S, and shall be properly grounded. A testing means shall be provided which will impose a measured fault of 5 milliamperes, plus or minus 1 milliamperes, and result in tripping the GFCI unit.

1.5 UTILITIES

If the Contractor encounters, within the construction limits of the entire project, utilities not shown on the plans and not visible as to the date of this contract and such utilities will interfere with construction operations, he shall immediately notify the Contracting Officer in writing to enable a determination by the Contracting Officer as to the necessity for removal or relocation.

1.6 GENERAL SAFETY REQUIREMENTS

A. General

The Corps of Engineers Safety and Health Requirements Manual, EM 385-1-1, (see Contract Clauses, Section 00700, ACCIDENT PREVENTION) and the Occupational Safety and Health Act (OSHA) Standards for Construction (Title 29, Code of Federal Regulations Part 1926 as revised from time to time); General Industry Standards (Title 29, Code of Federal Regulations Part 1910 as revised from time to time); and the National Fire Protection Association Codes are applicable to this contract. In case of conflict the most stringent requirement of the standards is applicable.
(2) The Army Safety Program, AR 385-10; U.S. Army Explosive Safety Program (DRAFT), AR 385-64; U.S. Army Ammunition and Explosives Safety Standards, (DRAFT) DA PAM 385-64; Fort Irwin Safety Manual, SIAD Reg 385-1; Corps of Engineers Safety and Health Requirements Manual, EM 385-1-1, (see Contract Clauses, Section 00700, ACCIDENT PREVENTION) and the Occupational Safety and Health Act (OSHA) Standards for Construction are applicable to this contract. In case of conflict the most stringent requirement of all standards is applicable.

B. The Prime Contractor's Superintendent

The Prime Contractor's superintendent shall take an active role in enforcing the safety requirements by participation in safety conferences, hazard analysis (see below), tool box meetings, walk-through inspections, correction of violations, etc., and including that of the subcontractor's work.

C. Job Hazard Analysis

each major phase of work prior to entering that phase of activity. The analysis shall include major or high risk hazards, as well as commonly recurring deficiencies that might possibly be encountered for that operation, and shall identify proposed methods and techniques of accomplishing each phase in a safe manner. The Prime Contractor's superintendent shall take active participation in the Job Hazard Analysis, including the subcontractors' work. Prior to start of actual work a meeting shall be held with Prime Contractor, Government, and affected subcontractor to review the Job Hazard Analysis. In addition, job site meetings shall be held to indoctrinate foreman and workers on details of this analysis.

Explosive Ordnance: The project site has been cleared of explosive ordnance by the Army E.O.D. In the event that the Contractor encounters any explosive devices or objects of a suspicious nature, he shall immediately clear the site of all employees and notify the Contracting Officer's Representative. All employees are to be trained in familiarizing themselves with explosive ordnance and safety procedures. This training will be conducted by the Government. The job hazard analysis shall address this in specific detail.

D. Violations

If recurring violations and/or gross violation indicate that the safety performance is unsatisfactory, corrective action shall be taken as directed, and at the discretion of the Contracting Officer the retention or some part thereof will be withheld from the progress payment until corrective action has been completed.

E. Elevated Work Areas

Workers in elevated work areas in excess of 6 feet above an adjoining surface require special safety attention. In addition to the provisions of EM 385-1-1, the following safety measures are required to be submitted to the Contracting Officer's Representative. Prior to commencement of work in elevated work areas, the Contractor shall submit drawings depicting all provisions of his positive protection system including, but not limited to, all details of guardrails.

F. Protection

Joists shall be provided by safety nets, tie-off's, hydraulic man lifts, scaffolds, or other required means. Decking crews must be tied-off or work over nets or platforms not over 6 feet below the work area. Walking on beams and/or girders and the climbing of columns is prohibited without positive protection.

G. Guard Rails

Perimeter guardrails shall be installed at floor, roof, or wall openings more than 6 feet above an adjoining surface and on roof perimeters. Rails shall be designed to protect all phases of elevated work including, but not limited to, roofing operations and installation of gutters and flashing. Rails around roofs may not be removed until all work on the roof is complete and all traffic on or across the roof ceases. Rails shall be designed by a licensed engineer to provide adequate stability under any anticipated impact loading. As a minimum, the rails shall consist of a top rail at a height of 42 inches, a mid rail and a toe board. Use of tie-offs, hydraulic man lifts, scaffolds, or other means of roof edge protection methods may be utilized on small structures such as family housing, prefabricated metal buildings, etc.

H. Fire Prevention

Twenty-four hours notice shall be given to the Contracting Officer for coordination with the Facility Fire Department prior to conducting any fire hazardous operation. Cutting or welding will be permitted only in areas that are or have been made fire safe where possible, all combustibles shall be located at least 35 feet horizontally from the work site. Where such location is impracticable, combustibles shall be protected with fire blankets and/or protective welding screens to prevent slag from running out of the work area. Edges of covers at the floor shall be tight to prevent sparks from going under them. This precaution is also important at overlaps where several covers are used to protect a large pile. The Contractor shall not allow any welding/cutting or open flame operations in facilities that are protected by a wet pipe fire sprinkler or an automatic detection system, if the system is out of service. First priority of work will be to return the suppression/detection system to operational condition. Return the fire detection and/or suppression system back to an operational status (if possible) during periods that the facility is unoccupied, and at the end of the workday. The Contractor shall post a fire guard for a 24 hour period (or certify to the Fire Department that the facility is safe) after welding, cutting, and open flame operations in a facility when: (a) fire detection and suppression system can not be returned to service; (b) fire detection or suppression systems do not exist. Other fire prevention precautions shall be in accordance with the latest National Fire Codes.

I. Record keeping/Reporting Requirements

On all contract operations, the Prime Contractor shall be responsible for recording and reporting all accident exposure and experience incident work. (This includes exposure and experience of the prime contractor and his/her sub-contractor(s)). As a minimum these records shall include exposure workhours and a log of occupational injuries and illnesses. (OSHA Form 200 or state equivalent as prescribed by 29 CFR 1904.5) Reference EM 385-1-1, 01.D.04.

J. Accident Reporting

In addition to the requirements for reporting accidents in accordance with EM 385-1-1, Section 1, the Prime Contractor will submit at the 50% point and 100% of project completion, a written summary of worker's compensation claims filed by workers on the project. The report will include all subcontractors. The main report covering the Prime Contractor claims will be certified as "correct and true" by the Contractor's compensation insurance carrier. The same certification will be required for subcontractor reports.

1.7 PLANNED UTILITY OUTAGES AND STREET CLOSURES

All utility outages and street closures shall be of as short a duration as possible and shall be scheduled as far in advance as possible with the Directorate of Public Works (DPW), Building 385, in no case less than 14 days before the outage or closure. The Contractor shall obtain in writing from the DPW a statement or schedule giving the permissible times of outages or closures for particular installations and the maximum time allowed for each. The Contractor shall strictly observe such schedules and will be held responsible for any violations. A copy of the schedule, provided by the DPW, will be provided to the Resident Engineer, prior to the outage.

1.8 EXCAVATION PERMITS

All excavation permits will be issued directly to the Contractor from the Directorate of Public Works (DPW). The appropriate form, for this request, may be obtained from the DPW of the Resident Office. Processing time required by the DPW is 14 calendar days. Questions concerning the excavation permit should be directed to the Directorate of Public Works located in Building No. 385.

1.9 TIME EXTENSIONS FOR UNUSUALLY SEVERE WEATHER

(A) This provision specifies the procedure for the determination of time extensions for unusually severe weather in accordance with the CONTRACT CLAUSE, Section 00700, entitled "DEFAULT (FIXED-PRICE CONSTRUCTION)". In order for the Contracting Officer to award a time extension under this clause, the following conditions must be satisfied:
(1) The weather experienced at the project site during the contract period must be found to be unusually severe, that is, more severe than the adverse weather anticipated for the project location during any given month.
(2) The unusually severe weather must actually cause a delay to the completion of the project. The delay must be beyond the control and without the fault or negligence of the Contractor.
(B) The following schedule of monthly anticipated adverse weather delays is based on National Oceanic and Atmospheric Administration (NOAA) or similar data for the project location and will constitute the base line for monthly weather time evaluations. The Contractor's progress schedule must reflect these anticipated adverse weather delays in all weather dependent activities.

MONTHLY ANTICIPATED ADVERSE WEATHER DELAY WORK DAYS BASED ON (5) DAY WORK WEEK

ELEMENT	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Precipitation over 0.10"	2	1	1	0	0	0	0	1	0	1	1	
Temperature below 32 degrees F	18	9	4	0	0	0	0	0	0	6	20	
Surface Wind over 17 Knots (20MPH)	2	3	5	5	4	2	1	1	1	2	2	3

(C) Upon acknowledgement of the Notice to Proceed (NTP) and continuing throughout the contract, the Contractor will record on the daily CQC report, the occurrence of adverse weather and resultant impact to normally scheduled work. Actual adverse weather delay days must prevent work on critical activities for 50 percent or more of the Contractor's scheduled work day. (ER 415-1-15, 31 OCT 89)

1.10 SPECIAL CONSTRUCTION PROCEDURES

(A) Temporary Fence: The Contractor shall erect and maintain a temporary site fence. The fence shall be at least a 6'-0" high chain link fence installed on metal posts. A vision inhibitor consisting of slats or other approved means, shall be installed. The fence shall be capable of withstanding wind loads of 60 m.p.h. without damage. All materials and installation are subject to approval of the Contracting Officer's Representative. The fence shall encompass the entire project site. The fence location and design shall be submitted for approval. The submittal shall provide detailed drawings and computations signed by a registered engineer. The layout will include the proposed location of access gates. Gates are to be locked at all times when the Contractor is not on site. For purposes of safety, the Contractor shall provide tagged keys to the Fort Irwin Resident Engineer's Office and the Fort Irwin Fire Department. The Contractor shall clean daily the fence perimeter, both within the fence and outside of the fence to prevent any accumulation of trash and debris adjacent to the fence. The fence will be removed upon a written notice by the Contracting Officer's Representative.

(B) Digging permits require 10 working days notification.

(C) Work hours are 7:30 a.m. to 4:00 p.m., Monday through Friday or as directed.

(D) All reclaimed water shall be used for construction purposes if available.

1.11 MANDATORY WORK STOPPAGES

(A) A mandatory work stoppage occurs whenever the Contractor is restricted from working a full workday and is unable to reallocate work forces to other locations. All costs associated with five mandatory work stoppages must be included in the bid price. No additional compensation or extension to the Contract performance period will be given as a result of five mandatory work stoppages.

(1) In the event that the Contractor's work force is required to evacuate any part of the working area during working hours established by the Contractor for this contract, the Government will then make an adjustment under the clause entitled, FAR 52.212-12 SUSPENSION OF WORK, see Section 00700. The Government's liability will be considered to be limited to reimbursement for loss of time of Contractor's employees and equipment which otherwise would have been employed on the job. The completion time for any part of the work will not be extended if the total number of working hours of work stoppage does not exceed 0.8 times the number of calendar days in the period between the date of notice to proceed and the specified completion date. In the event the Contractor is required to evacuate the area in excess of the time specified above, the completion times will be adjusted.

(B) The Contractor may be required, without advance notice, to move work to a different location. The Contractor shall be prepared to increase or decrease his work forces with appropriate trades to perform work in the relocated work areas at no additional cost to the Government.

(C) The Contractor shall notify the Contracting Officer when a mandatory work stoppage occurs for recording purposes. Otherwise, the work stoppage will not be credited to the Contractor.

1.12 DISPOSAL OF REMOVED MATERIALS

(A) The Government inspector will examine all materials removed from the project not indicated for reuse, and will tag or otherwise designate those materials which are serviceable or salvable.

(B) Serviceable or salvageable items, except for locks, latches, and cylinders, shall be turned in, by appointment, to the base Defense Reutilization and Marketing Office (DRMO) or Base Supply by the Contractor. All locks, latches, and cylinders shall be turned in to the Base Lockshop. The Contractor shall schedule DRMO appointments far enough in advance to allow efficient processing of turn-ins. Scrap metal shall be segregated into ferrous and nonferrous metals, and shall be cut, dismantled, palletized, or prepared as required by the DRMO office for acceptance. Dismantling of equipment or material into separate components may be required. The Contractor shall protect materials from damage or theft during the interval between removal and disposal. Any serviceable or salvageable items not accepted by DRMO or Base Supply, for whatever reason, will become the property of the Contractor and will be properly handled, transported, and be disposed of off-base by the Contractor in conformance with all federal, state, and local regulations.

(C) Unusable items (with no salvage value) shall be transported off the installation or as directed by the Contracting Officer. The Contractor shall dispose of refuse off base at no additional cost to the Government.

1.13 CONTRACTOR SAFETY PERSONNEL REQUIREMENTS (1985 JAN HQ USACE)

(A) The contractor shall at his discretion, employ a full-time, on-site, safety person to manage the Contractor's safety program or the project superintendent will be allowed to serve as the safety manager, provided the safety program is not compromised. The Contracting Officer will, at his discretion, require a full time Safety Manger should the duties of the Project Superintendent exceed his capacity to satisfactorily perform both positions.

(B) The following conditions shall be met:
(1) The safety manger shall have the authority to take immediate steps to correct unsafe or unhealthful conditions. The employment of a safety and health person(s) shall not abrogate the safety and health responsibilities of other personnel.
(2) Qualifications for Safety and Health Person(s).
- (a) Safety and Health Person(s) shall have a degree in engineering or safety in at least a four year program from an accredited school and shall have been engaged in safety and occupational health for at least one (1) year of experience (no time being credited to this one (1) year unless at least fifty (50) percent of the time was devoted to safety and occupational health) and shall have at least one (1) year experience in construction, or—
- (b) Safety and Health Person(s) shall have legal registration as a Professional Engineer or a Certified Safety Professional and shall have been engaged in

safety and occupational health for at least one (1) year of experience (no time being credited to this one (1) year unless at least fifty (50) percent of the time was devoted to safety and occupational health) and shall have at least one (1) year experience in construction, or-

(c) Safety and Health Person(s) shall have a degree other than that specified in paragraph, Qualifications for Safety and Health Person(s) above, and shall have been engaged in safety and occupational health for at least three (3) years of experience (no time being credited to these three (3) years unless at least fifty (50) percent of the time each year was devoted to safety and occupational health) and shall have at least two (2) years experience in construction, or—

(d) In lieu of a degree, Safety and Health person(s) shall have been engaged in safety and occupational health for at least five (5) years of experience (no time being credited to these five (5) years unless at least fifty (50) percent of the time each year was devoted to safety and occupational health) and shall have at least two (2) years experience in construction.

(e) First aid work is not a creditable experience.

(3) The name and qualifications of the nominated safety and health person(s) shall be furnished to the Contracting Officer for acceptability and a functional description of duties shall be provided prior to the prework conference.

NOTE: The Contractor shall have one or more Safety and Health Persons, each of whom meets the qualifications of (B)(2) Qualifications for Safety and Health Person(s), physically present on the actual site of the work whenever work of any sort is being performed by a Contractor, subcontractor, or supplier personnel on the work site. The foregoing clause language shall not be interpreted to contravene this note.

1.14 MONTHLY SAFETY INSPECTION

A monthly on-site inspection will be made by the insurance carriers of the prime and subcontractors. The Contractor's safety program will be reviewed and a meeting will be held with the Contracting Officer's Representative to discuss the job-site safety. A written report will be made by the Contractor stating the results of the inspection and the action taken.

1.15 WARRANTY PROBLEM PROCEDURE

Upon receipt of the written notice from the Contracting Officer as stated in paragraph WARRANTY OF CONSTRUCTION, subparagraph 5, the Contractor shall report to Building Number 384, BSI Work Order Branch, to pick up a copy of the work order describing the warranty problem. After the warranty item has been corrected the Contractor shall return the completed work order to Building Number 384 and indicate the corrective action taken.

1.16 COLOR SCHEME FOR CONTRACTOR FACILITIES

(A) All Contractor storage and operational facilities including temporary structures, signs and fencing, that remain at the site shall be compatible with the color scheme used on the project signs as directed by the Contracting Officer.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

This page was intentionally left blank for duplex printing.

SECTION 01510 - TEMPORARY UTILITIES

PART 1 -- GENERAL

1.1 GENERAL REQUIREMENTS

A. **Types**: The types of utility services required for general temporary use at the Site include the following:

Water service (potable for certain uses)
Sanitary sewer
Electric power service
Telephone service

1.2 JOB CONDITIONS

A. **Scheduled Uses**: The CONTRACTOR shall, in conjunction with establishment of job progress schedule, establish a schedule for implementation and termination of service for each temporary utility at the earliest feasible time, and when acceptable to CONTRACTING OFFICER, change over from use of temporary utility service to permanent service.

B. Telephone and water connections will be available near the Operations Building and the existing Chlorine Contact Tank.

PART 2 -- PRODUCTS

2.1 MATERIALS

A. The CONTRACTOR shall provide either new or used materials and equipment, which are in substantially undamaged condition and without significant deterioration and which are recognized in the construction industry, by compliance with appropriate standards, as being suitable for intended use in each case.

PART 3 -- EXECUTION

3.1 INSTALLATION OF TEMPORARY UTILITY SERVICES

A. **General**: Wherever feasible, the CONTRACTOR shall engage the utility company to install temporary service to project, or as a minimum, to make connection to existing utility service; locate services where they will not interfere with total project construction WORK, including installation of permanent utility services; and maintain temporary services as installed for required period of use; and relocate, modify or extend as necessary from time to time during that period as required to accommodate total project construction WORK.

B. **Approval of Electrical Connections:** Temporary connections for electricity shall be subject to approval of the CONTRACTING OFFICER and the power company representative, and shall be removed in like manner at the CONTRACTOR's expense prior to final acceptance of the WORK.

C. **Separation of Circuits:** Unless otherwise permitted by the CONTRACTING OFFICER, circuits used for power purposes shall be separate from lighting circuits.

D. **Construction Wiring:** Wiring for temporary electric light and power shall be properly installed and maintained and shall be securely fastened in place. Electrical facilities shall conform to the requirements of Title 8, Industrial Relations, Subchapter 5, Electrical Safety Orders, California Administrative Code; and Subpart K of the OSHA Safety and Health Standards for Construction.

3.2 INSTALLATION OF POWER DISTRIBUTION SYSTEM

A. **Power:** The CONTRACTOR shall provide power required for its operations under the Contract, and shall provide and maintain all temporary power lines required to perform the WORK in a safe and satisfactory manner.

B. **Temporary Power Distribution**: The CONTRACTOR shall provide a weatherproof, grounded, temporary power distribution system sufficient for performance of entire WORK of project, including temporary electrical heating where indicated, operation of test equipment and test operation of building equipment and systems which cannot be delayed until permanent power connections are operable, temporary operation of other temporary facilities, including permanent equipment and systems which must be placed in operation prior to use of permanent power connections (pumps, HVAC equipment, elevators, and similar equipment), and power for temporary operation of existing facilities (if any) at the Site during change-over to new permanent power system. Provide circuits of adequate size and proper power characteristics for each use; run circuit wiring generally overhead, and rise vertically in locations where it will be least exposed to possible damage from construction operations and will result in minimal interference with performance of the WORK; provide rigid steel conduit or equivalent raceways for wiring which must be exposed on grade, floors, decks, or other exposures to damage or abuse.

3.3 INSTALLATION OF LIGHTING

A. **Construction Lighting:** WORK conducted at night or under conditions of deficient daylight shall be suitably lighted to insure proper WORK and to afford adequate facilities for inspection and safe working conditions.

B. **Temporary Lighting**: The CONTRACTOR shall provide a general, weatherproof, grounded temporary lighting system in every area of construction work, as soon as overhead floor/roof deck structure has been installed to provide sufficient illumination for safe work and traffic conditions. Run circuit wiring generally overhead, and rise vertically in locations where it will be least exposed to possible damage from construction operations on grade, floors, decks, or other areas of possible damage or abuse.

3.4 WATER SUPPLY

A. **General:** The GOVERNMENT will furnish, without charge, up to 2,000,000-gallons of water over the course of the project from a designated source located at the plant site, if required by the CONTRACTOR in performance of the WORK under the Contract; however, the CONTRACTOR shall provide all facilities necessary to convey the water from the GOVERNMENT-designated source to the points of use in accordance with the requirements of the Contract Documents. These facilities shall include a back flow preventer installed at the hydrant by the CONTRACTOR. All potable drinking water for the CONTRACTOR's forces however shall be supplied by the CONTRACTOR as indicated in Paragraph 3.4C below.

B. The CONTRACTOR shall provide and operate all pumping facilities, pipelines, valves, hydrants, storage tanks, and all other equipment necessary for the adequate development and operation of the water supply system. Water used for domestic purposes shall be free of contamination and shall conform to the requirements of the State and local authorities for potable water. The CONTRACTOR shall be solely responsible for the adequate functioning of its water supply system and shall be solely liable for any claims arising from the use of same, including discharge or waste of water therefrom.

C. **Potable Water:** All drinking water on the site during construction shall be furnished by the CONTRACTOR and shall be bottled water or water furnished in approved dispensers. Notices shall be posted conspicuously throughout the site warning the CONTRACTOR's personnel that piped water may be contaminated.

D. **Water Connections**: The CONTRACTOR shall not make connection to or draw water from any fire hydrant or pipeline without first obtaining permission from the CONTRACTING OFFICER. For each such connection made, the CONTRACTOR shall first attach to the fire hydrant or pipeline a valve and a meter.

3.5 INSTALLATION OF SANITARY FACILITIES

A. **Toilet Facilities:** Fixed or portable chemical toilets shall be provided wherever needed for the use of CONTRACTOR's employees. Toilets at construction job sites shall conform to the requirements of Subpart D, Section 1926.51 of the OSHA Standards for Construction.

B. **Sanitary and Other Organic Wastes**: The CONTRACTOR shall establish a regular daily collection of all sanitary and organic wastes. All wastes and refuse from sanitary facilities provided by the CONTRACTOR or organic material wastes from any other source related to the CONTRACTOR's operations shall be disposed of away from the Site in a manner satisfactory to the CONTRACTING OFFICER and in accordance with all laws and regulations pertaining thereto.

3.6 INSTALLATION OF FIRE PROTECTION

A. **Fire Protection:** The construction plant and all other parts of the WORK shall be connected with the CONTRACTOR's temporary water supply system and shall be adequately protected against damage by fire. Hose connections and hose, water casks, chemical equipment, or other sufficient means shall be provided for fighting fires in the temporary structures and other portions of the WORK, and responsible persons shall be designated and instructed in the operation of such fire apparatus so as to prevent or minimize the hazard of fire. The CONTRACTOR's fire protection program shall conform to the requirements of Article 34, Section 1805, b of Cal-OSHA, and Subpart F of the OSHA Standards for Construction.

3.7 INSTALLATION OF COMMUNICATIONS

A. **Telephone Services:** The CONTRACTOR shall provide and maintain at all times during the progress of the WORK not less than one telephone in good working order at its own field construction office at or near the Site. Each such telephone shall be connected to an established exchange for toll service and with all other telephones utilized by the CONTRACTOR.

3.8 OPERATIONS AND TERMINATIONS

A. **Inspections**: Prior to placing temporary utility services into use, the CONTRACTOR shall inspect and test each service and arrange for governing authorities' required inspection and tests, and obtain required certifications and permits for use thereof.

B. **Protection**: The CONTRACTOR shall maintain distinct markers for underground lines, and protect from damage during excavating operations.

C. **Termination and Removal**: When need for a temporary utility service or a substantial portion thereof has ended, or when its service has been replaced by use of permanent services, or not later than time of substantial completion, the CONTRACTOR shall promptly remove installation unless requested by CONTRACTING OFFICER to retain it for a longer period. The CONTRACTOR shall complete and restore WORK which may have been delayed or affected by installation and use of temporary utility, including repairs to construction and grades and restoration and cleaning of exposed surfaces.

D. **Removal of Water Connections:** Before final acceptance of the WORK on the project, all temporary connections and piping installed by the CONTRACTOR shall be entirely removed, and all affected improvements shall be restored to original condition or better, to the satisfaction of the CONTRACTING OFFICER and to the agency owning the affected utility.

- END OF SECTION -

SECTION 01530 - PROTECTION AND RESTORATION OF EXISTING FACILITIES

PART 1 -- GENERAL

1.1 GENERAL

A. The CONTRACTOR shall protect all existing utilities and improvements not designated for removal and shall restore damaged or temporarily relocated utilities and improvements to a condition equal to or better than prior to such damage or temporary relocation, all in accordance with the Contract Documents.

1.2 RIGHTS-OF-WAY

A. The CONTRACTOR shall not do any WORK that would affect any oil, gas, sewer, or water pipeline; any telephone, telegraph, or electric transmission line; any fence; or any other structure, nor shall the CONTRACTOR enter upon the rights-of-way involved until notified that the GOVERNMENT has secured authority therefor from the proper party.

B. After authority has been obtained, the CONTRACTOR shall give said party due notice of its intention to begin work, if required by said party, and shall remove, shore, support, or otherwise protect such pipeline, transmission line, ditch, fence, or structure, or replace the same.

1.3 PROTECTION OF STREET OR ROADWAY MARKERS

A. The CONTRACTOR shall not destroy, remove, or otherwise disturb any existing survey markers or other existing street or roadway markers without proper authorization. No pavement breaking or excavation shall be started until all survey or other permanent marker points that will be disturbed by the construction operations have been properly referenced. Survey markers or points disturbed by the CONTRACTOR shall be accurately restored after street or roadway resurfacing has been completed.

1.4 RESTORATION OF PAVEMENT

A. **General:** All paved areas including asphaltic concrete berms cut or damaged during construction shall be replaced with similar materials of equal thickness to match the existing adjacent undisturbed areas, except where specific resurfacing requirements have been called for in the Contract Documents or in the requirements of the agency issuing the permit. The pavement restoration requirement to match existing sections shall apply to all components of existing sections, including sub-base, base, and pavement. Temporary and permanent pavement shall conform to the requirements of the affected pavement owner. Pavements which are subject to partial removal shall be neatly saw cut in straight lines.

1.5 EXISTING UTILITIES AND IMPROVEMENTS

A. **General:** The CONTRACTOR shall protect underground Utilities and other improvements which may be impaired during construction operations, regardless of whether or not the Utilities are indicated on the Drawings. The CONTRACTOR shall take all possible precautions for the protection of unforeseen Utility lines to provide for uninterrupted service and to provide such special protection as may be necessary.

B. Except where the Drawings indicate Utilities have been field located during design or certain Utility locations shall be exposed as part of the WORK, the CONTRACTOR shall be responsible for exploratory excavations as it deems necessary to determine the exact locations and depths of Utilities which may interfere with its work. All such exploratory excavations shall be performed as soon as practicable after Notice to Proceed and, in any event, a sufficient time in advance of construction to avoid possible delays to the CONTRACTOR's progress. When such exploratory excavations show the Utility location as shown on the Drawings to be in error, the CONTRACTOR shall so notify the CONTRACTING OFFICER.

C. The number of exploratory excavations required shall be that number which is sufficient to determine the alignment and grade of the Utility.

D. **Utilities to be Moved:** When utility lines that are to be removed are encountered within the area of operations, the CONTRACTOR shall notify the CONTRACTING OFFICER a sufficient time in advance for the necessary measures to be taken to prevent interruption of service.

E. **Utilities to be Removed:** Where the proper completion of the WORK requires the temporary or permanent removal and/or relocation of an existing Utility or other improvement which is indicated, the CONTRACTOR shall remove and, without unnecessary delay, temporarily replace or relocate such Utility or improvement in a manner satisfactory to the CONTRACTING OFFICER. In all cases of such temporary removal or relocation, restoration to the former location shall be accomplished by the CONTRACTOR in a manner that will restore or replace the Utility or improvement as nearly as possible to its former locations and to as good or better condition than found prior to removal.

F. **GOVERNMENT's Right of Access:** The right is reserved to the GOVERNMENT to enter at any time upon any public street, alley, right-of-way, or easement for the purpose of making changes in their property made necessary by the WORK of this Contract.

G. **Underground Utilities Indicated:** Existing Utility lines that are indicated or the locations of which are made known to the CONTRACTOR prior to excavation and that are to be retained, and all Utility lines that are constructed during excavation operations shall be protected from damage during excavation and backfilling and, if damaged, shall be immediately repaired or replaced by the CONTRACTOR.

H. **Underground Utilities Not Indicated:** In the event that the CONTRACTOR damages existing Utility lines that are not indicated or the locations of which are not made known to the CONTRACTOR prior to excavation, a verbal report of such damage shall be made immediately to the CONTRACTING OFFICER and a written report thereof shall be made promptly thereafter.

I. **Approval of Repairs:** All repairs to a damaged Utility or improvement are subject to inspection and approval by the CONTRACTING OFFICER before being concealed by backfill or other work.

J. **Maintaining in Service:** Unless indicated otherwise, oil and gasoline pipelines, power, and telephone or the communication cable ducts, gas and water mains, irrigation lines, sewer lines, storm drain lines, poles, and overhead power and communication wires and cables encountered along the line of the WORK shall remain continuously in service

during all the operations under the Contract, unless other arrangements satisfactory to the CONTRACTING OFFICER are made with the owner of said pipelines, duct, main, irrigation line, sewer, storm drain, pole, or wire or cable. The CONTRACTOR shall be responsible for and shall repair all damage due to its operations, and the provisions of this Section shall not be abated even in the event such damage occurs after backfilling or is not discovered until after completion of the backfilling.

1.6 TREES OR SHRUBS WITHIN STREET RIGHTS-OF-WAY AND PROJECT LIMITS

A. **General:** Except where trees or shrubs are indicated to be removed, the CONTRACTOR shall exercise all necessary precautions so as not to damage or destroy any trees or shrubs, including those lying within street rights-of-way and project limits, and shall not trim or remove any trees unless such trees have been approved for trimming or removal by the jurisdictional agency or GOVERNMENT. Existing trees and shrubs which are damaged during construction shall be trimmed or replaced by the CONTRACTOR or a certified tree company under permit from the jurisdictional agency and/or the GOVERNMENT. Tree trimming and replacement shall be accomplished in accordance with the following paragraphs.

1.7 LAWN AREAS

A. Lawn or landscaped areas damaged during construction shall be repaired to match the pre-construction condition to the satisfaction of the CONTRACTING OFFICER.

1.8 NOTIFICATION BY THE CONTRACTOR

A. Prior to any excavation in the vicinity of any existing underground facilities, including all water, sewer, storm drain, gas, petroleum products, or other pipelines; all buried electric power, and communications, the CONTRACTOR shall notify the CONTRACTING OFFICER not less than 3 days nor more than 7 days prior to excavation so that a representative of said owners can be present during such work if they so desire. The CONTRACTOR shall also notify the regional notification center at 1-800-422-4133 at least 2 days, but no more than 14 days, prior to such excavation.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

- END OF SECTION -

This page was intentionally left blank for duplex printing.

SECTION 01550 - SITE ACCESS AND STORAGE

PART 1 -- GENERAL

1.1 TEMPORARY CROSSINGS

A. **Street Use:** Nothing herein shall be construed to entitle the CONTRACTOR to the exclusive use of any public street, alleyway, or parking area during the performance of the WORK hereunder, and it shall so conduct its operations as not to interfere unnecessarily with the authorized work of other parties in such streets, alleyways, or parking areas. No street shall be closed to the public without first obtaining permission of the CONTRACTING OFFICER.

1.2 CONTRACTOR'S WORK AND STORAGE AREA

A. The GOVERNMENT will designate and arrange for the CONTRACTOR's use, a portion of the property adjacent to the WORK for its exclusive use during the term of the Contract as a storage and shop area for its construction operations relative to this Contract. At completion of WORK, the CONTRACTOR shall return this area to its original condition, including grading and landscaping.

B. The CONTRACTOR shall make its own arrangements for any necessary off-Site storage or shop areas necessary for the proper execution of the WORK.

C. Lands to be furnished by the GOVERNMENT for construction operation will be located at the Fort Irwin WWTP. Should the CONTRACTOR find it necessary to use any additional land for other purposes during the construction of the WORK, the CONTRACTING OFFICER may consider additional land at a different location.

D. The CONTRACTOR shall construct and use a separate storage area for hazardous materials used in constructing the WORK.

1. For the purpose of this paragraph, hazardous materials to be stored in the separate area are all products labeled with any of the following terms: Warning, Caution, Poisonous, Toxic, Flammable, Corrosive, Reactive, or Explosive. In addition, whether or not so labeled, the following materials shall be stored in the separate area: diesel fuel, gasoline, new and used motor oil, hydraulic fluid, cement, paints and paint thinners, two-part epoxy coatings, sealants, asphaltic products, glues, solvents, wood preservatives, sand blast materials, and spill absorbent.

2. Hazardous materials shall be stored in groupings according to the Material Safety Data Sheets.

3. The CONTRACTOR shall develop and submit to the CONTRACTING OFFICER a plan for storing and disposing of the materials above.

4. The CONTRACTOR shall obtain and submit to the CONTRACTING OFFICER a single EPA number for wastes generated at the Site.

5. The separate storage area shall meet all the requirements of all authorities having jurisdiction over the storage of hazardous materials. Such authorities are: Cal-OSHA, Cal-EPA, Mojave Desert AQMD, Regional Water Quality Control Board, and U.S. Army Corps of Engineers – Fort Irwin National Training Center.

6. The separate storage area shall be inspected by the U.S. Army Corps of Engineers prior to construction of the area, upon completion of construction of the area, and upon cleanup and removal of the area.

7. All hazardous materials which are delivered in containers shall be stored in the original containers until use. Hazardous materials which are delivered in bulk shall be stored in containers which meet the requirements of authorities having jurisdiction.

1.1 PARKING

A. The CONTRACTOR shall maintain traffic and parking areas in a sound condition, free of excavated material, construction equipment, mud, and construction materials. The CONTRACTOR shall repair breaks, potholes, low areas which collect standing water, and other deficiencies.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

- END OF SECTION -

SECTION 01560 - TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 -- GENERAL

1.1 EXPLOSIVES AND BLASTING

A. The use of explosives on the WORK will not be permitted.

1.2 DUST ABATEMENT

A. The CONTRACTOR shall prevent its operation from producing dust in amounts damaging to property, cultivated vegetation, or domestic animals, or causing a nuisance to persons living in or occupying buildings in the vicinity. The CONTRACTOR shall be responsible for any damage resulting from dust originating from its operations. The dust abatement measures shall be continued until the CONTRACTOR is relieved of further responsibility by the CONTRACTING OFFICER.

1.3 RUBBISH CONTROL

A. During the progress of the WORK, the CONTRACTOR shall keep the Site and other areas used by it in a neat and clean condition, and free from any accumulation of rubbish. The CONTRACTOR shall dispose of all rubbish and waste materials of any nature occurring at the Site, and shall establish regular intervals of collection and disposal of such materials and waste. The CONTRACTOR shall also keep its haul roads free from dirt, rubbish, and unnecessary obstructions resulting from its operations. Disposal of all rubbish and surplus materials shall be off the Site in accordance with local codes and ordinances governing locations and methods of disposal, and in conformance with all applicable safety laws, and to the particular requirements of Part 1926 of the OSHA Safety and Health Standards for Construction.

1.4 SANITATION

A. **Toilet Facilities:** Fixed or portable chemical toilets shall be provided wherever needed for the use of employees. Toilets at construction job sites shall conform to the requirements of Part 1926 of the OSHA Standards for Construction.

B. **Sanitary and Other Organic Wastes:** The CONTRACTOR shall establish a regular daily collection of all sanitary and organic wastes. All wastes and refuse from sanitary facilities provided by the CONTRACTOR or organic material wastes from any other source related to the CONTRACTOR's operations shall be disposed of away from the Site in a manner satisfactory to the CONTRACTING OFFICER and in accordance with all laws and regulations pertaining thereto.

1.5 CHEMICALS

A. All chemicals used during project construction or furnished for project operation, whether defoliant, soil sterilant, herbicide, pesticide, disinfectant, polymer, reactant or of other classification, shall show approval of either the U.S. Environmental Protection Agency or the U.S. Department of Agriculture. Use of all such chemicals and disposal of residues shall be in strict accordance with the printed instructions of the manufacturer.

1.6 CULTURAL RESOURCES

A. The CONTRACTOR's attention is directed to the National Historic Preservation Act of 1966 (16 U.S.C. 470) and 36 CFR 800 which provides for the preservation of potential historical architectural, archaeological, or cultural resources (hereinafter called "cultural resources").

B. The CONTRACTOR shall conform to the applicable requirements of the National Historic Preservation Act of 1966 as it relates to the preservation of cultural resources.

C. In the event potential cultural resources are discovered during subsurface excavations at the site of construction, the following procedures shall be instituted:

1. The CONTRACTING OFFICER will issue a Field Order directing the CONTRACTOR to cease all construction operations at the location of such potential cultural resources find.

2. Such Field Order shall be effective until such time as a qualified archaeologist can be called to assess the value of these potential cultural resources and make recommendations.

D. If the archaeologist determines that the potential find is a bona fide cultural resource, at the direction of the CONTRACTING OFFICER the CONTRACTOR shall suspend work at the location of the find.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

- END OF SECTION -

SECTION 01600 - PRODUCTS, MATERIALS, EQUIPMENT AND SUBSTITUTIONS

PART 1 -- GENERAL

1.1 DEFINITIONS

A. The word "Products," as used in the Contract Documents, is defined to include purchased items for incorporation into the WORK, regardless of whether specifically purchased for the project or taken from CONTRACTOR's stock of previously purchased products. The word "Materials," is defined as products which must be substantially cut, shaped, worked, mixed, finished, refined, or otherwise fabricated, processed, installed, or applied to form WORK. The word "Equipment" is defined as products with operational parts, regardless of whether motorized or manually operated, and particularly including products with service connections (wiring, piping, and other like items). Definitions in this paragraph are not intended to negate the meaning of other terms used in the Contract Documents, including "specialties," "systems," "structure," "finishes," "accessories," "furnishings," special construction," and similar terms, which are self-explanatory and have recognized meanings in the construction industry.

B. Neither "Products" nor "Materials" nor "Equipment" includes machinery and equipment used for preparation, fabrication, conveying, and erection of the WORK.

1.2 QUALITY ASSURANCE

A. **Source Limitations:** To the greatest extent possible for each unit of WORK, the CONTRACTOR shall provide products, materials, and equipment of a singular generic kind from a single source.

B. **Compatibility of Options:** Where more than one choice is available as options for CONTRACTOR's selection of a product, material, or equipment, the CONTRACTOR shall select an option which is compatible with other products, materials, or equipment. Compatibility is a basic general requirement of product, material and equipment selections.

1.3 PRODUCT DELIVERY AND STORAGE

A. The CONTRACTOR shall deliver and store the WORK in accordance with manufacturer's written recommendations and by methods and means which will prevent damage, deterioration, and loss including theft. Delivery schedules shall be controlled to minimize long-term storage of products at the Site and overcrowding of construction spaces. In particular, the CONTRACTOR shall ensure coordination to ensure minimum holding or storage times for flammable, hazardous, easily damaged, or sensitive materials to deterioration, theft, and other sources of loss.

1.4 TRANSPORTATION AND HANDLING

A. Products shall be transported by methods to avoid damage and shall be delivered in undamaged condition in manufacturer's unopened containers and packaging.

B. The CONTRACTOR shall provide equipment and personnel to handle products, materials, and equipment by methods to prevent soiling and damage.

C. The CONTRACTOR shall provide additional protection during handling to prevent marring and otherwise damaging products, packaging, and surrounding surfaces.

1.5 STORAGE AND PROTECTION

A. Products shall be stored in accordance with manufacturer's written instructions and with seals and labels intact and legible. Sensitive products shall be stored in weather-tight climate controlled enclosures and temperature and humidity ranges shall be maintained within tolerances required by manufacturer's recommendations.

B. For exterior storage of fabricated products, products shall be placed on sloped supports above ground. Products subject to deterioration shall be covered with impervious sheet covering and ventilation shall be provided to avoid condensation.

C. Loose granular materials shall be stored on solid flat surfaces in a well-drained area and shall be prevented from mixing with foreign matter.

D. Storage shall be arranged to provide access for inspection. The CONTRACTOR shall periodically inspect to assure products are undamaged and are maintained under required conditions.

E. Storage shall be arranged in a manner to provide access for maintenance of stored items and for inspection.

1.6 MAINTENANCE OF PRODUCTS IN STORAGE

A. Stored products shall be periodically inspected on a scheduled basis. The CONTRACTOR shall maintain a log of inspections and shall make the log available on request.

B. The CONTRACTOR shall comply with manufacturer's product storage requirements and recommendations.

C. The CONTRACTOR shall maintain manufacturer-required environmental conditions continuously.

D. The CONTRACTOR shall ensure that surfaces of products exposed to the elements are not adversely affected and that weathering of finishes does not occur.

E. For mechanical and electrical equipment, the CONTRACTOR shall provide a copy of the manufacturer's service instructions with each item and the exterior of the package shall contain notice that instructions are included.

F. Products shall be serviced on a regularly scheduled basis, and a log of services shall be maintained and submitted as a record document prior to final acceptance by the GOVERNMENT in accordance with the Contract Documents.

1.7 PROPOSED SUBSTITUTIONS OR "OR-EQUAL" ITEM

A. Whenever materials or equipment are indicated in the Contract Documents by using the name of a proprietary item or the name of a particular manufacturer, the naming of the item is intended to establish the type, function, and quality required. If the name is followed by the words "or equal" indicating that a substitution is permitted, materials or equipment of other manufacturers may be accepted if sufficient information is submitted by the CONTRACTOR to allow the CONTRACTING OFFICER to determine that the material or equipment proposed is equivalent or equal to that named, subject to the following requirements:

1. The burden of proof as to the type, function, and quality of any such substitution product, material or equipment shall be upon the CONTRACTOR.

2. The CONTRACTING OFFICER will be the sole judge as to the type, function, and quality of any such substitution and the CONTRACTING OFFICER'S decision shall be final.

3. The CONTRACTING OFFICER may require the CONTRACTOR to furnish additional data about the proposed substitution.

4. The GOVERNMENT may require the CONTRACTOR to furnish a special performance guarantee or other surety with respect to any substitution.

5. Acceptance by the CONTRACTING OFFICER of a substitution item proposed by the CONTRACTOR shall not relieve the CONTRACTOR of the responsibility for full compliance with the Contract Documents and for adequacy of the substitution.

6. The CONTRACTOR shall pay all costs of implementing accepted substitutions, including redesign and changes to WORK necessary to accommodate the substitution.

B. The procedure for review by the CONTRACTING OFFICER will include the following:

1. If the CONTRACTOR wishes to provide a substitution item, the CONTRACTOR shall make written application to the CONTRACTING OFFICER on the "Substitution Request Form."

2. Unless otherwise provided by law or authorized in writing by the CONTRACTING OFFICER, the "Substitution Request Form(s)" shall be submitted within the 35-day period after award of the Contract.

3. Wherever a proposed substitution item has not been submitted within said 35-day period, or wherever the submission of a proposed substitution material or equipment has been judged to be unacceptable by the CONTRACTING OFFICER, the CONTRACTOR shall provide the material or equipment indicated in the Contract Documents.

4. The CONTRACTOR shall certify by signing the form that the list of paragraphs on the form are correct for the proposed substitution.

5. The CONTRACTING OFFICER will evaluate each proposed substitution within a reasonable period of time.

6. As applicable, no shop drawing submittals shall be made for a substitution item nor shall any substitution item be ordered, installed, or utilized without the CONTRACTING OFFICER'S prior written acceptance of the CONTRACTOR'S "Substitution Request Form."

7. The CONTRACTING OFFICER will record the time required by the CONTRACTING OFFICER in evaluating substitutions proposed by the CONTRACTOR and in making changes by the CONTRACTOR in the Contract Documents occasioned thereby.

C. The CONTRACTOR's application shall address the following factors which will be considered by the CONTRACTING OFFICER in evaluating the proposed substitution:

1. Whether the evaluation and acceptance of the proposed substitution will prejudice the CONTRACTOR's achievement of Substantial Completion on time.

2. Whether acceptance of the substitution for use in the WORK will require a change in any of the Contract Documents to adapt the design to the proposed substitution.

3. Whether incorporation or use of the substitution in connection with the WORK is subject to payment of any license fee or royalty.

4. Whether all variations of the proposed substitution from the items originally specified are identified.

5. Whether available maintenance, repair, and replacement service are indicated. The manufacturer shall have a local service agency (within 50 miles of the site) which maintains properly trained personnel and adequate spare parts and is able to respond and complete repairs within 24 hours.

6. Whether an itemized estimate is included of all costs that will result directly or indirectly from acceptance of such substitution, including cost of redesign and claims of other contractors affected by the resulting change.

7. Whether the proposed substitute item meets or exceeds the experience and/or equivalency requirements listed in the appropriate technical specifications.

D. Without any increase in cost to the GOVERNMENT, the CONTRACTOR shall be responsible for and pay all costs in connection with proposed substitutions and of inspections and testing of equipment or materials submitted for review prior to the CONTRACTOR'S purchase thereof for incorporation in the WORK, whether or not the CONTRACTING OFFICER accepts the proposed substitution or proposed equipment or material. The CONTRACTOR shall reimburse the GOVERNMENT for the charges of the CONTRACTING OFFICER for evaluating each proposed substitution.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

- END OF SECTION -

This page was intentionally left blank for duplex printing.

SECTION 01650 - TESTING OF CONCRETE AND STEEL HYDRAULIC STRUCTURES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall test concrete and steel hydraulic structures in accordance with the Contract Documents.

B. The CONTRACTOR shall be responsible for obtaining permits for discharging excess testing water and dechlorination of such water if required to satisfy permit limits.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01300 – Contractor Submittals.

B. Submittals shall include:

1. A testing plan and schedule, including methods for water conveyance, control, and disposal shall be submitted in writing for approval.

2. Resume of experienced technician, if liquid chlorine is proposed.

PART 2 -- PRODUCTS

2.1 EQUIPMENT AND MATERIALS

A. Temporary valves, bulkheads, and other water control equipment shall be as determined by the CONTRACTOR. No materials shall be used which would be injurious to the WORK.

PART 3 -- EXECUTION

3.1 GENERAL

A. Water for testing will be furnished by the GOVERNMENT; however, the CONTRACTOR shall convey the water from the GOVERNMENT-designated source to the points of use.

B. All hydraulic structures and appurtenant pressure piping shall be tested. All testing operations shall be performed in the presence of the CONTRACTING OFFICER.

C. Protective coating on the interior of steel reservoirs shall be applied before the testing operations.

D. Membrane liner on interior vertical walls of concrete structures shall be installed prior to testing, but membrane liner on the floor shall be installed only after the structure has successfully passed the hydraulic tests.

E. Release of water from structures after testing has been completed shall comply with federal, state, and local regulations.

3.2 PRELIMINARY CLEANING AND FLUSHING

A. Prior to testing, hydraulic structures shall be cleaned by thoroughly hosing down all surfaces with a high-pressure hose and nozzle of sufficient size to deliver a minimum flow of 50 gpm. Water, dirt, and foreign material accumulated in this cleaning operation shall be discharged from the structure or otherwise removed.

3.3 TESTING OF STEEL STRUCTURES

A. **General:** The test shall consist of filling the structure with water to the maximum operating water surface elevation and observing for visible leakage over a period of time.

B. **Evaluation and Repairs:** After the tank has been filled for 7 days, outside surfaces shall be inspected for visible leakage. Leakage, as evidenced by liquid droplets, flowing water, or rusty stains, shall be repaired. The tank will not be accepted if any leakage as defined above is visible. Repaired tanks shall be re-tested.

3.4 TESTING OF CONCRETE STRUCTURES

A. **General:** Testing shall be performed prior to backfilling. Testing shall not be performed sooner than 14 days after all portions of structure walls and associated roof systems have been completed.

B. **Leakage Test and Repairs:** After the structure has been filled, the leakage test shall be performed as follows:

1. The structure shall be filled to the maximum operating water level indicated on the Drawings, or if not indicated or if the level will be controlled by a weir, fill the structure to the weir level or to the overflow elevation, whichever is higher. The rate of filling shall not exceed 24 inches of depth per day.

2. Inspect the structure for visible leakage. Locations with any visible leakage, as evidenced by liquid droplets, flowing water, or moist areas on the outside surface which only could have originated from inside the structure, will be considered defective and shall be repaired before testing proceeds.

3. Measure and record initial water level readings at two locations that are approximately 180 degrees apart if the structure is circular or at opposite ends of the structure if the structure is rectangular.

4. Construct evaporation/precipitation devices as follows. A clear plastic calibrated open top container greater than 18-inches in diameter and in depth shall be partly filled with water, floated in the structure, and held in position at each measurement location but away from structure walls and items passing overhead such as beams or pipes. Measure the depth of water in the device.

5. Record the structure water levels and depths of water in the evaporation/precipitation devices at 24-hour intervals for a 7-day test period.

6. Each daily change in water surface elevation at each measurement point shall be adjusted by subtracting the change in water depth in the corresponding evaporation/precipitation device.

7. Acceptance Criteria: Both criteria apply.

    a. Allowable leakage

        1) Unlined concrete structures will pass the test if the water loss at the end of 7-days, as determined by averaging adjusted results at the two measurement locations, is equal to or less than 0.20 percent of the structure volume. Structures with multiple cells shall have the cells tested and evaluated individually.

        2) Lined concrete structures will pass the test if the water loss/gain at the end of 7-days equals that lost/gained due to evaporation/precipitation.

    b. No visible leakage appears during the 7-day test.

8. If intermediate readings or observed leakage indicate that the allowable leakage will be exceeded, the test may be terminated before the end of the 7-day period and appropriate action taken to correct the problem before starting a new 7-day test period.

9. If the structure fails the test, the CONTRACTOR may at its option repeat the test or empty the structure as acceptable to the CONTRACTING OFFICER and examine the interior for evidence of any cracking or other conditions that might be responsible for the leakage. Cracks shall be "vee'd" and sealed with polyurethane sealant in accordance with Section 03300 – Cast-In-Place Concrete. Each source of leakage shall be repaired on the water-holding side.

10. Following these operations, the CONTRACTOR shall again test the structure. The structure will not be accepted until the water loss leakage test is passed and all visible leakage repaired. In the case of a reservoir, the retesting shall again be exclusive of the spraying operation.

3.5 TESTING OF APPURTENANT PIPING

A. Piping appurtenant to hydraulic structures shall be tested in accordance with Section 01656 -Pressure Pipe Testing and Disinfection.

3.6 CONNECTIONS TO EXISTING SYSTEM

A. Where connections are to be made to an existing potable water system, the interior surfaces of all pipe and fittings used in making the connections shall be swabbed or sprayed with a one percent hypochlorite solution before installation. Thorough flushing shall be started as soon as the connection is completed and shall be continued until all discolored water is eliminated.

- END OF SECTION -

This page was intentionally left blank for duplex printing.

SECTION 01655 - GRAVITY PIPELINE TESTING

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall test sanitary system pipelines in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01300 – Contractor Submittals.

B. Furnish:

1. A testing plan and schedule including methods for water conveyance, control, leak testing, and water disposal shall be submitted in writing for approval.

2. Where deflection testing of flexible pipe is required, submit a method for mandrel testing or other measurement, as applicable to pipe size.

PART 2 -- PRODUCTS

2.1 DEFLECTION MANDREL

A. **Mandrel Design:** The CONTRACTOR shall construct a mandrel of steel or rigid plastic that can withstand a force of 200 psi without deforming. The mandrel shall have 9 or more "runners" or legs, as long as the number is an odd number. The mandrel barrel length shall be at least 75 percent of the pipe inside diameter.

B. **Mandrel Diameter:** The outside diameter shall taper out to 95 percent of the inside diameter of the pipe. For the purpose of determining the mandrel diameter, the inside diameter of the pipe shall be the average outside diameter of the pipe minus 2 minimum wall thicknesses for OD controlled pipe and shall be the average inside diameter for ID controlled pipe, all dimensions in accordance with the respective pipe standards. Statistical or "tolerance packages" shall not be considered in mandrel sizing. The mandrel shall be stamped or engraved at a location other than a runner with the pipe size and material it is intended to test.

C. **Proving Ring:** Fabricate a 1/2-inch thick, 3-inch wide steel bar bent to a circle 0.02 inches larger than the mandrel diameter calculated above. Furnish the proving ring to the CONTRACTING OFFICER before any pipe is backfilled. The CONTRACTOR shall pass the mandrel through the proving ring at times determined by the CONTRACTING OFFICER.

PART 3 -- EXECUTION

3.1 GENERAL

A. Gravity sewer pipes and service laterals shall be tested for exfiltration or infiltration and deflection as indicated. Manholes shall be tested for leakage prior to backfill placement, whereas pipes shall be backfilled prior to testing. The maximum length of pipe tested shall be the four reaches between 5 manholes. Leakage tests shall be completed and

approved prior to placing of permanent resurfacing of pavement. When leakage or infiltration exceeds the allowed amount, the CONTRACTOR shall locate the leaks and make the necessary repairs or replacements to reduce the leakage or infiltration to the allowable limits. Individually detectable leaks shall be repaired, regardless of whether the test results are acceptable or not.

B. Unless otherwise indicated, water for testing will be furnished by the GOVERNMENT; however, the CONTRACTOR shall convey the water from the GOVERNMENT-designated source to the points of use.

C. No materials shall be used which would be injurious to pipeline structure and future function. Air test gauges shall be laboratory-calibrated test gauges, and if required by the CONTRACTING OFFICER, shall be recalibrated by a certified laboratory prior to the leakage test. Air test gauges shall have a size and pressure range appropriate for the pipe being tested.

D. Testing operations shall be performed in the presence of the CONTRACTING OFFICER.

3.2 TESTING SCHEDULE

A. Leakage Tests

1. Perform the type of leakage tests determined from the table below, based on pipe size, slope between manholes (Criterion 1), and difference in water levels (Criterion 2).

	Criterion 1		**Criterion 2**	
Nominal Pipe Size	**Manhole Delta H, feet**		**Test Water vs. Ground Water Delta H, feet**	
	Less than or equal to10 ft	greater than 10 ft	greater than or equal to 4 ft	less than 4 ft
less than or equal to 24 inches	See Criterion 2	Infiltration or Air See Note 1	Exfiltration	Infiltration or Air
greater than 24 inches	See Criterion 2	See Criterion 2	Exfiltration	Infiltration

Note 1. If ground water is present, perform an infiltration test or air test at the option of the CONTRACTOR; if no ground water is present, perform an air test.

2. Definitions

a. Delta H is the difference between 2 elevations, expressed in feet.

b. Manhole Delta H is the invert elevation difference in 2 adjacent manholes.

c. Test Water vs. Ground Water Delta H is the required elevation of water surface for testing minus the average elevation of ground water adjacent to the pipe to be tested.

3. For pressure sewers and force mains, conduct water pressure tests as required by Section 01656 - Pressure Pipe Testing and Disinfection.

B. **Deflection Tests**: Flexible pipes 30 inches and smaller shall be tested for deflection by the mandrel test. Larger flexible pipe shall be tested by a method approved by the CONTRACTING OFFICER. Excessively deflected pipe shall be removed and replaced.

3.3 WATER EXFILTRATION TEST

A. Each section of sewer shall be tested between successive manholes by closing the lower end and the inlet sewers of the upper manhole with stoppers or inflatable plugs. The pipe and manhole shall be filled with water to a point 4 feet above the centerline of the sewer at the center of the upper manhole; or if ground water is present, 4 feet above the average adjacent ground water level, whichever is higher.

B. Water shall remain in the pipe for at least one hour or until the water level stabilizes, whichever is longer, before the test begins. The minimum test duration shall be 4 hours.

C. Unless indicated otherwise, the CONTRACTOR shall measure exfiltration. Measure the amount of water added to the upstream manhole to maintain the water level at the elevation set above. Compare the amount added to the allowable leakage calculated below, and if the amount added is equal to or less than the allowable amount, the tested section of the pipe has passed.

D. There shall be no leakage allowed for PVC lined manholes. Non-PVC lined manhole may have an allowable leakage computed by the formula:

$$E = 0.000012\ LD\ (H)^{1/2}$$

Where:

E = Allowable leakage in gallons per minute of sewer tested.

L = Length of sewer and house connections tested, in feet.

D = Internal diameter of the pipe in inches.

H = Difference in elevation between the water surface in the upper manhole and the centerline of the pipe at the lower manhole; or if ground water is present above the centerline of the pipe in the lower manhole, the difference in elevation between the water surface in the upper manhole and the ground water at the lower manhole.

3.4 WATER INFILTRATION TEST

A. The end of the sewer at the upper structure shall be closed to prevent the entrance of water, and pumping of ground water shall be discontinued for at least 3 days, after which the section shall be tested for infiltration.

B. The infiltration into each individual reach of sewer between adjoining manholes shall not exceed that allowed by the formula above, where H is the difference in the elevation between the ground water surface and the invert of the sewer at the downstream manhole.

C. Unless otherwise indicated, infiltration shall be measured by the CONTRACTOR.

3.5 AIR PRESSURE TEST

A. The CONTRACTOR shall furnish all materials, equipment, and labor for making an air test. The CONTRACTING OFFICER shall approve air test equipment.

B. The CONTRACTOR may conduct an initial air test of the sewer main line after densification of the backfill but prior to installation of the service laterals. Such tests will be considered to be for the CONTRACTOR's convenience and need not be performed in the presence of the CONTRACTING OFFICER.

C. Each section of sewer shall be tested between successive manholes by plugging and bracing all openings in the pipe and the upper ends of all service laterals. Prior to insertion in the sewer, each plug shall be checked with a soap solution to detect any air leakage. If any leaks are found, the air pressure shall be released and the leaks eliminated or the plug replaced.

D. The test of the pipe and service laterals shall be conducted in the presence of the CONTRACTING OFFICER. Testing of pipe, regardless of the pipe material, shall be performed in accordance with ASTM F 1417 - Standard Test Method for Installation of Plastic Gravity Sewer Line Using Low Pressure Air.

E. Air pressure in the sewer line shall be increased to 4.0 psi above groundwater pressure (1.0 psi for each 2.3 feet of water elevation above the highest point of the pipe). Do not allow the pressure at any point in the pipe to reach 9 psi under any circumstances. Allow the pressure to stabilize for 5 minutes, then reduce the pressure to 3.5 psi above groundwater pressure and start the test. Stop the air release and record the decrease in pressure over time.

F. **Pass/Fail Criterion:** The time taken for the pressure to decrease from 3.5 to 2.5 psi above groundwater pressure shall be equal to or greater than the time below

Nominal Pipe Diameter, inches	Minimum Time, min:sec	Length for Minimum Time, ft	Increased Time for Longer Lengths, seconds per foot
4	3:46	597	.0380
6	5:40	398	0.854
8	7:34	298	1.520
10	9:26	239	2.374
12	11:20	199	3.418
18	17:00	133	7.692
24	22:40	99	13.674
30	28:20	80	21.366
36	34:00	66	30.768

G. Testing criteria of pipe 12-inches and larger may be adjusted if the CONTRACTING OFFICER approves. The air pressure decrease may be 0.5 psi instead of 1.0 psi, and the corresponding minimum times will be one-half of the tablulated times.

H. For pipe larger than 24 inches, air pressure tests may be performed on each joint. The time for the pressure to fall from 3.5 to 2.5 psi, both above groundwater pressure, shall not be less than 10 seconds regardless of pipe diameter.

I. If the time is less than the allowable time, the pipe will be considered defective and shall be repaired and retested.

3.6 DEFLECTION TEST

A. Mandrel Test

1. The CONTRACTING OFFICER shall be allowed to test the mandrel with the proving ring at any time. The mandrel shall pass through the proving ring with no greater than 0.02 inch clearance, and if it does not, the mandrel will be considered defective and shall be replaced.

2. The CONTRACTOR shall test all flexible pipe 30 inches and smaller for deflection, joint displacement, and other obstructions by passing the mandrel through the pipe not less than 30 days after completion of the trench backfill.

3. Pipe with diameter less than the mandrel will be considered defective, and the CONTRACTOR shall replace it.

B. Flexible pipe in sizes larger than 30 inches shall have deflections measured by a rigid metal bar, a rigid frame, or other method approved by the CONTRACTING OFFICER.

1. The average inside diameter shall be measured before the pipe is installed and backfilled.

2. Deflection is defined as the difference between vertical inside diameter in the pipe before and after installation and backfilling.

3.7 MANHOLE TEST

A. Sewer manholes shall be hydrostatically tested (vacuum testing is not allowed) for leakage prior to backfilling. Prior to testing, manholes shall be visually inspected for obvious defects. Leaks or cracks shall be repaired to the satisfaction of the CONTRACTING OFFICER.

B. **Hydrostatic Testing**: All pipes entering the manhole shall be sealed at a point outside the manhole walls to include testing of the pipe to manhole joints. The manhole shall be filled with water to a level 2 inches below the top of the frame. Safety lines shall be secured to all plugs utilized. After a period of at least one hour to allow the water level to stabilize, the manhole shall be refilled and the water level shall be marked. The water level shall again be checked after 4 hours. If the water level falls more than 1-inch, the leakage shall be considered excessive, and the CONTRACTOR shall make repairs and retest the manhole. The exterior of the manhole shall be inspected during this period for visible evidence of leakage. Visible moisture, sweating, or beads of water on the exterior of the manhole shall not be considered leakage, but any water running across the surface will be considered leakage and shall be repaired to the satisfaction of the CONTRACTING OFFICER regardless of the volume of water lost.

- END OF SECTION -

This page was intentionally left blank for duplex printing.

SECTION 01656 - PRESSURE PIPE TESTING AND DISINFECTION

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall test and disinfect potable water pipelines and appurtenant piping, in accordance with the Contract Documents.

B. The CONTRACTOR shall be responsible for obtaining permits for discharging excess testing and disinfection water and dechlorination of such water if required to satisfy permit limits.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01300 – Contractor Submittals.

B. Furnish:

1. A testing plan and schedule, including method for water conveyance, control, disposal, and disinfection shall be submitted in writing for approval.

2. Name of certified bacteriological testing laboratory.

3. Resume of experienced technician, if liquid chlorine is proposed.

PART 2 -- PRODUCTS

2.1 MATERIAL REQUIREMENTS

A. All test equipment, chemicals for chlorination, temporary valves, bulkheads, and other water control equipment, and choice of disinfectant shall be as determined by the CONTRACTOR. No materials shall be used which would be injurious to the WORK.

B. Chlorine for disinfection may be in the form of liquid chlorine, sodium hypochlorite solution, or calcium hypochlorite granules or tablets.

1. Liquid chlorine shall be in accordance with the requirements of ANSI/AWWA B301 - Liquid Chlorine, and shall be used only when each of the following conditions are satisfied:

a. With appropriate gas flow chlorinators and ejectors.

b. Under the direct supervision of an experienced technician.

c. When appropriate safety practices are observed.

2. Sodium and calcium hypochlorite shall be in accordance with ANSI/AWWA B300 - Hypochlorites.

C. Dechlorination agents may be sodium bisulfate, sodium sulfite, or sodium thiosulfate.

PART 3 -- EXECUTION

3.1 GENERAL

A. Water for testing and disinfecting water pipelines will be furnished by the GOVERNMENT; however, the CONTRACTOR shall convey the water from the GOVERNMENT-designated source to the points of use.

B. All pressure pipelines shall be tested; those for potable water shall be disinfected. All chlorinating and testing operations shall be performed in the presence of the CONTRACTING OFFICER.

C. Disposal of flushing water and water containing chlorine shall be by methods acceptable to the CONTRACTING OFFICER.

D. Disinfection operations shall be scheduled as late as possible during the Contract Time to maximize the degree of sterility of the facilities at the time the WORK is accepted by the GOVERNMENT. Bacteriological testing shall be performed by a certified testing laboratory accepted by the GOVERNMENT. Results of the bacteriological testing shall be satisfactory with the State Department of Health or other appropriate regulatory agency.

3.2 HYDROSTATIC TESTING OF PIPELINES

A. Pipeline 30-inches diameter and larger shall be visually inspected that all debris has been removed prior to flushing.

B. Prior to hydrostatic testing, pipelines shall be flushed or blown out as appropriate. The CONTRACTOR shall test pipelines either in sections or as a unit. No section of the pipeline shall be tested until all field-placed concrete or mortar has attained an age of 14 days. The test shall be made by closing valves when available or by placing temporary bulkheads in the pipe and filling the line slowly with water. The CONTRACTOR shall be responsible for ascertaining that all test bulkheads are suitably restrained to resist the thrust of the test pressure without damage to or movement of the adjacent pipe. Unharnessed sleeve-type couplings, expansion joints, or other sliding joints shall be restrained or suitably anchored prior to the test to avoid movement and damage to piping and equipment. Remove or protect any pipeline-mounted devices that may be damaged by the test pressure. The CONTRACTOR shall provide sufficient temporary tappings in the pipelines to allow for all entrapped air to exit. After completion of the tests, such taps shall be permanently plugged. Care shall be taken that all air relief valves are open during filling.

C. The pipeline shall be filled at a rate which will not cause any surges or exceed the rate at which the air can be released through the release valves at a reasonable velocity. All the air within the pipeline shall be allowed to escape. The differential pressure across the orifices in the air release valves shall not be allowed to exceed 5 psi at any time during filling. After the pipeline or section thereof has been filled, it shall be allowed to stand under a slight pressure for at least 24 hours to allow the concrete or mortar lining, as applicable, to absorb water and to allow the escape of air from air pockets. During this period, bulkheads, valves, and connections shall be examined for leaks. If leaks are found, corrective measures satisfactory to the CONTRACTING OFFICER shall be taken.

D. The hydrostatic test shall consist of holding the test pressure on the pipeline for a period of 4 hours. The test pressure for pipelines shall be as indicated. The test pressure for yard piping shall be as indicated on the Piping Schedule measured at the lowest point of the pipeline section being tested. No pressure test will be required for a reservoir

overflow line. All visible leaks shall be repaired in a manner acceptable to the CONTRACTING OFFICER. Add water to restore the test pressure if the pressure decreases 5 psi below test pressure during the test period.

E. The maximum allowable leakage for distribution and transmission pipelines shall be 0 U.S. gallons per inch of diameter per mile of pipe per 24 hours for pipe with 40-ft or greater lengths between joints and with rubber-gasketed joints and 0 U.S. gallons per inch of diameter per mile of pipe per 24 hours for pipe with 20-ft or less lengths between joints and with rubber-gasketed joints. The maximum leakage for yard piping shall be as indicated on the Piping Schedule. Pipe with welded joints shall have no leakage. Exposed piping shall show no visible leaks and no pressure loss during the test. In the case of pipelines that fail to pass the leakage test, the CONTRACTOR shall determine the cause of the leakage, shall take corrective measures necessary to repair the leaks, and shall again test the pipelines.

3.3 DISINFECTING PIPELINES

A. **General:** All potable water pipelines except those appurtenant to hydraulic structures shall be disinfected in accordance with the requirements of ANSI/AWWA C651 - Disinfecting Water Mains, using the Continuous-Feed Method as modified herein.

B. **Chlorination:** A chlorine-water mixture shall be uniformly introduced into the pipeline by means of a solution-feed chlorinating device. The chlorine solution shall be introduced at one end of the pipeline through a tap in such a manner that as the pipeline is filled with water, the dosage applied to the water entering the pipe shall be approximately 50 mg/l. Care shall be taken to prevent the strong chlorine solution in the line being disinfected from flowing back into the line supplying the water.

C. **Retention Period:** Chlorinated water shall be retained in the pipeline for at least 24 hours. After the chlorine-treated water has been retained for the required time, the free chlorine residual at the pipeline extremities and at other representative points shall be at least 25 mg/l. If testing does not demonstrate a residual of 25 mg/l or greater, the disinfection procedure above shall be repeated.

D. **Chlorinating Valves:** During the process of chlorinating the pipelines, valves and other appurtenances shall be operated from closed to full open to closed while the pipeline is filled with the heavily-chlorinated water.

E. **Sampling Ports:** The CONTRACTOR shall provide sampling ports along the pipeline as defined on AWWA C651. Taps may be made at manways and air valves to help facilitate the spacing requirement.

F. **Final Flushing:** After the applicable retention period, the heavily chlorinated water shall be flushed from the pipeline until chlorine measurements show that the concentration in the water leaving the pipeline is no higher than that generally prevailing in the system or is acceptable for domestic use. Any release of chlorinated water shall comply with federal, state, and local regulation and the permits for the project. Chlorine in excessive amounts shall be treated before discharge.

G. **Bacteriological Testing:** After final flushing and before the pipeline is placed in service, a sample, or samples shall be collected from the end of the line, and shall be tested for bacteriological quality in accordance with the requirements of the State Department of Health or other appropriate regulatory agency. For this purpose the pipe shall be re-filled with fresh potable water and left for a period of 24 hours before any

sample is collected. If testing does not demonstrate a free chlorine residual after the 24-hour period, the disinfection procedure above shall be repeated. If the initial disinfection treatment fails to produce satisfactory bacteriological test results, the disinfection procedure shall be repeated until acceptable results are obtained.

3.4 CONNECTIONS TO EXISTING SYSTEM

A. Where connections are to be made to an existing potable water system, the interior surfaces of all pipe and fittings used in making the connections shall be swabbed or sprayed with a one percent hypochlorite solution before installation. Thorough flushing shall be started as soon as the connection is completed and shall be continued until discolored water is eliminated.

- END OF SECTION -

SECTION 01660 – EQUIPMENT TESTING AND PLANT STARTUP

PART 1 -- GENERAL

1.1 GENERAL

A. Equipment testing and plant startup are prerequisites to satisfactory completion of the contract requirements and shall be completed within the Contract Times.

B. The startup of a treatment plant is a highly complex operation requiring the combined expertise of the CONTRACTOR, manufacturers' representatives, subcontractors, and the GOVERNMENT. The CONTRACTOR shall be responsible for coordinating all parties for a successful startup: GOVERNMENT'S representative will be available for technical and operational advice prior to and during startup.

C. Testing and startup activities shall be scheduled according to Section 01311 - CPM Construction Schedule. The 7-day test and the 8-day test shall start prior to midday on a Monday, Tuesday, or Wednesday. Testing periods shall not include holidays, based on the GOVERNMENT'S calendar.

D. During system testing and startup, product water shall be discharged to the plant sewer.

1.2 SUBMITTALS

A. **Schedule:** The schedule for testing and startup shall be submitted under Section 01311.

B. **Testing and Startup Plan:** Not less than 30-days prior to startup, submit for review a detailed Testing and Startup Plan. The Plan shall include schedules for submitting final Owner's Manuals, schedule for training the GOVERNMENT personnel, list of GOVERNMENT and CONTRACTOR-furnished supplies, electrical testing, and detailed schedule of operations to achieve successful system testing, startup, and performance and acceptance testing. The Plan shall include test checklists and data forms for each item of equipment and shall address coordination with the GOVERNMENT'S staff. The CONTRACTOR shall revise the Plan as necessary based on review comments.

C. **System Outage Requests:** Request for shutdown of existing systems as necessary to test or start up new facilities.

D. **Records and Documentation:**

1. Equipment Installation Certification: Where required by the specifications, submit documentation from manufacturer's representative that the equipment has been properly installed and lubricated, is in accurate alignment, is free from undue stresses from connecting piping and anchoring, and has operated satisfactorily under full load conditions.

2. Records of testing and startup as indicated below.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION

3.1 EXECUTION

A. **Prerequisites:** The following shall be completed before testing and startup begins.

1. Furnish all Owner's Manual information required by the Contract Documents.

2. Provide all safety equipment, emergency shower and eyewash units, fire extinguishers, gas detectors, protective guards and shields, emergency repair kits, safety chains, handrails, gratings, safety signs, and valve and piping identification required by the Contract Documents. Devices and equipment shall be fully functional, adjusted, and tested.

3. Manufacturer's certifications of proper installation have been accepted.

4. Leakage tests, electrical tests, and adjustments have been completed.

5. The CONTRACTING OFFICER has approved the CONTRACTOR's Testing and Startup Plan.

6. Functional verification of the individual instrumentation loops (analog, status, alarm, and control).

7. Adjustment of the pressure switches, flow switches, timing relays, level switches, vibration switches, temperature switches, RTD monitors, pressure regulating valves, and all other control devices to the settings determined by the CONTRACTING OFFICER or the equipment manufacturer.

8. Functional verification of the individual interlocks between the field-mounted control devices and the motor control circuits, control circuits of variable-speed controllers, and packaged system controls.

B. **Supplies:**

1. The CONTRACTOR shall furnish all necessary materials not listed for the GOVERNMENT to furnish.

2. The GOVERNMENT will furnish water and power.

C. **Records of Testing and Startup:** The CONTRACTOR shall maintain the following during testing and startup and submit originals to CONTRACTING OFFICER prior to acceptance:

1. Lubrication and service records for each mechanical and electrical equipment item

2. Hours of daily operation for each mechanical and electrical equipment item

3. Equipment alignment and vibration measurement records

4. Logs of electrical measurements and tests

5. Instrumentation calibration and testing logs

6. Testing and validation of SCADA inputs, outputs, logic functions, status indications,

and alarms

7. Factory and field equipment settings

8. Log of problems encountered and adjustments made

9. Other records, logs, and checklists as required by the Contract Documents

3.2 SYSTEM TESTING

A. After individual equipment items have been tested and certified as required by the Technical Specifications, tests of systems comprised of single or multiple equipment items with appurtenant equipment and instruments and controls shall be conducted. All items of equipment shall be tested as part of a system to the maximum extent possible.

B. The CONTRACTOR shall demonstrate the manual and automatic modes of operation to verify proper control sequences, software interlocks, proper operation of software logic and controllers, etc. System testing shall include the use of water or other process media, as applicable, to simulate the actual conditions of operation.

C. All systems testing activities shall follow the detailed test procedures and checklists in the Testing and Startup Plan. Completion of systems testing shall be documented by a report.

D. The CONTRACTOR shall system test the utility, safety equipment, and other support systems before testing the process system.

E. Furnish the CONTRACTING OFFICER at least 10 days written notice confirming the start of system testing. The GOVERNMENT'S staff will observe systems testing.

F. The CONTRACTOR shall arrange for manufacturer's representative to revisit the Site as often as necessary to correct malfunctions to the CONTRACTING OFFICER'S satisfaction.

G. Each system shall be tested for a continuous, 7-day, 24-hour/day period. If any system malfunctions during the test, the item or equipment shall be repaired and the test restarted at time zero with no credit given for the elapsed time before the malfunction.

3.3 STARTUP AND ACCEPTANCE TESTING

A. The CONTRACTOR shall start up the plant and operate it at rates directed by the CONTRACTING OFFICER without malfunction for a continuous 8-day, 24 hour/day acceptance test period. If any equipment item, sub system, or system malfunctions during the test period, the item shall be repaired and the test restarted at time zero with no credit given for the elapsed time before the malfunction.

B. Defects in material or workmanship which appear shall be promptly corrected. Time lost for wiring corrections, control point settings, or other reasons which interrupt the test may, at the judgement of the CONTRACTING OFFICER, be cause for extending the test period an equal amount of time.

C. Acceptance testing shall not begin until all leakage tests, instrumentation tests and adjustments, electrical tests and adjustments, equipment field tests, and system tests have been completed to the satisfaction of the CONTRACTING OFFICER.

D. **Detail Requirements:** Prior to starting the test, all process units shall be thoroughly cleaned and all debris removed and then filled with clean water.

E. The CONTRACTOR shall furnish the services of manufacturer's representatives, if necessary, to correct equipment malfunctions.

F. The GOVERNMENT'S certified treatment plant operators will be present during normal working hours during the test period. The CONTRACTOR shall furnish continuous, 24-hour staffing at the facility if requested by the CONTRACTING OFFICER.

G. During acceptance testing, the CONTRACTOR shall:

1. Lubricate and maintain all equipment in accordance with the manufacturers' recommendations.

- END OF SECTION -

SECTION 01700 - PROJECT CLOSEOUT

PART 1 -- GENERAL

1.1 FINAL CLEANUP

A. The CONTRACTOR shall promptly remove from the vicinity of the completed WORK, all rubbish, unused materials, concrete forms, construction equipment, and temporary structures and facilities used during construction. Final acceptance of the WORK by the GOVERNMENT will be withheld until the CONTRACTOR has satisfactorily performed the final cleanup of the Site.

1.2 CLOSEOUT TIMETABLE

A. The CONTRACTOR shall establish dates for equipment testing, acceptance periods, and on-site instructional periods (as required under the Contract). Such dates shall be established not less than one week prior to beginning any of the foregoing items, to allow the CONTRACTING OFFICER and its authorized representatives sufficient time to schedule attendance at such activities.

1.3 TECHNICAL MANUAL SUBMITTAL

A. The CONTRACTOR's attention is directed to the condition that one percent of the Contract Price will be retained from any monies due the CONTRACTOR as progress payments, if at the 75 percent construction completion point, the approved Technical Manual complying with Section 01300 has not been submitted. The aforementioned amount will be retained by the GOVERNMENT as the agreed, estimated value of the approved Technical Manual. Any such retention of money for failure to submit the approved Technical Manual on or before the 75 percent construction completion point shall be in addition to the retention of any payments due to the CONTRACTOR.

1.4 FINAL SUBMITTALS

A. The CONTRACTOR, prior to requesting final payment, shall obtain and submit the following items to the CONTRACTING OFFICER:

1. Written guarantees, where required.

2. Technical Manuals and instructions.

3. New permanent cylinders and key blanks for all locks.

4. Maintenance stock items; spare parts; special tools.

5. Completed record drawings.

6. Bonds for roofing, maintenance, etc., as required.

7. Certificates of inspection and acceptance by local governing agencies having jurisdiction.

8. Releases from all parties who are entitled to claims against the subject project, property, or improvement pursuant to the provisions of law.

1.5 NOTICE OF DEFECTIVE WORK

A. Prompt notice of Defective Work known to the GOVERNMENT or CONTRACTING OFFICER will be given to the CONTRACTOR. All Defective Work, whether or not in place, may be rejected, corrected, or accepted. Defective Work may be rejected even if approved by prior inspection.

1.6 ACCESS TO WORK

A. GOVERNMENT, CONTRACTING OFFICER, their consultants, subconsultants, other representatives and personnel of the GOVERNMENT, independent testing laboratories, and governmental agencies with jurisdictional interests shall have access to the WORK at reasonable times for their observation, inspecting, and testing. CONTRACTOR shall provide them proper and safe conditions for such access and advise them of CONTRACTOR's Site safety procedures and programs so that they may comply therewith as applicable.

1.7 INSPECTIONS AND TESTS

A. The CONTRACTOR shall give the CONTRACTING OFFICER not less than 24 hours notice of readiness of the WORK for all required inspections, tests, or approvals, and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.

B. The GOVERNMENT shall employ and pay for the services of an independent testing laboratory to perform all inspections, tests, or approvals required by the Contract Documents except:

1. For inspection, tests, or approvals covered by Paragraphs 1.7C. and 1.7D. below;

2. That costs incurred in connection with tests or inspections conducted pursuant to Paragraph 1.7G. shall be paid as provided in said Paragraph 1.7G.; and

3. As otherwise provided in the Contract Documents.

C. If Laws and Regulations of any public body having jurisdiction require any WORK (or any part thereof) to be inspected, tested, or approved by an employee or other representative of such public body, CONTRACTOR shall assume full responsibility for arranging and obtaining such inspections, tests or approvals; pay all costs in connection therewith; and furnish the CONTRACTING OFFICER the required certificates of inspection or approval.

D. The CONTRACTOR shall be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests, or approvals required for the CONTRACTING OFFICER's acceptance of materials or equipment to be incorporated in the WORK or acceptance of materials, mix designs, or equipment submitted for approval prior to the CONTRACTOR's purchase thereof for incorporation in the WORK. Such inspections, tests, or approvals shall be performed by organizations acceptable to the CONTRACTING OFFICER.

E. The CONTRACTING OFFICER will make, or have made, such inspections and tests as the CONTRACTING OFFICER deems necessary to see that the WORK is being accomplished in accordance with the requirements of the Contract Documents. Unless otherwise specified in the Supplementary General Conditions, the cost of such inspection and testing will be borne by the GOVERNMENT. In the event such inspections or tests reveal non-compliance with the requirements of the Contract Documents, the CONTRACTOR shall bear the cost of corrective measures deemed necessary by the CONTRACTING OFFICER, as well as the cost of subsequent reinspection and retesting. Neither observations by the CONTRACTING OFFICER nor inspections, tests, or approvals by others shall relieve the CONTRACTOR from the CONTRACTOR's obligation to perform the WORK in accordance with the Contract Documents.

F. If any WORK (including the work of others) that is to be inspected, tested, or approved is covered without written concurrence of the CONTRACTING OFFICER, it must, if requested by the CONTRACTING OFFICER, be uncovered for observation. Such uncovering shall be at the CONTRACTOR's expense unless the CONTRACTOR has given the CONTRACTING OFFICER not less than 24 hours notice of the CONTRACTOR's intention to perform such test or to cover the same and the CONTRACTING OFFICER has not acted with reasonable promptness in response to such notice.

G. If any WORK is covered contrary to the written request of the CONTRACTING OFFICER, it must, if requested by the CONTRACTING OFFICER, be uncovered for the CONTRACTING OFFICER's observation and recovered at the CONTRACTOR's expense.

H. If the CONTRACTING OFFICER considers it necessary or advisable that covered WORK be observed by the CONTRACTING OFFICER or inspected or tested by others, the CONTRACTOR, at the CONTRACTING OFFICER's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as the CONTRACTING OFFICER may require, that portion of the WORK in question, furnishing all necessary labor, material, and equipment. If it is found that such work is Defective Work, the CONTRACTOR shall bear all direct, indirect, and consequential costs and damages of such uncovering, exposure, observation, inspection, and testing and of satisfactory reconstruction, including but not limited to, fees and charges of engineers, architects, attorneys, and other professionals. However, if such work is not found to be Defective Work, the CONTRACTOR will be allowed an increase in the Contract Price or an extension of the Contract Time, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, and reconstruction.

1.8 GOVERNMENT MAY STOP THE WORK.

If Defective Work is identified, the GOVERNMENT or CONTRACTING OFFICER may order the CONTRACTOR to stop performance of the WORK, or any portion thereof, until the cause for such order has been eliminated; however, this right of the GOVERNMENT or CONTRACTING OFFICER to stop the WORK shall not give rise to any duty on the part of the GOVERNMENT or CONTRACTING OFFICER to exercise this right for the benefit of the CONTRACTOR or any other party.

1.9 CORRECTION OR REMOVAL OF DEFECTIVE WORK

If required by the CONTRACTING OFFICER, the CONTRACTOR shall promptly either correct all Defective Work, whether or not fabricated, installed, or completed, or, if the work has been rejected by the CONTRACTING OFFICER, remove it from the Site and replace it with non-defective WORK. The CONTRACTOR shall bear all direct, indirect, and consequential costs and damages of such correction or removal, including but not limited to fees and charges of engineers, architects, attorneys, and other professionals made necessary thereby.

1.10 ACCEPTANCE OF DEFECTIVE WORK

If, instead of requiring correction or removal and replacement of Defective Work, the GOVERNMENT prefers to accept the Defective Work, the GOVERNMENT may do so. The CONTRACTOR shall bear all direct, indirect, and consequential costs attributable to the GOVERNMENT's evaluation of and determination to accept such Defective Work. If any such acceptance occurs prior to final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the WORK, and the GOVERNMENT shall be entitled to an appropriate decrease in the Contract Price.

1.11 OWNER MAY CORRECT DEFECTIVE WORK

A. If the CONTRACTOR fails within a reasonable time after written notice from the CONTRACTING OFFICER to correct Defective Work, or to remove and replace Defective Work as required by the CONTRACTING OFFICER in accordance with Paragraph 1.9A., or if the CONTRACTOR fails to perform the WORK in accordance with the Contract Documents, or if the CONTRACTOR fails to comply with any other provision of the Contract Documents, the GOVERNMENT may, after seven days written notice to the CONTRACTOR, correct and remedy any such deficiency.

B. In exercising the rights and remedies under this paragraph, the GOVERNMENT shall proceed with corrective and remedial action. In connection with such corrective and remedial action, the GOVERNMENT may exclude the CONTRACTOR from all or part of the Site, take possession of all or part of the WORK, and suspend the CONTRACTOR's services related thereto and incorporate in the WORK all materials and equipment for which the GOVERNMENT has paid the CONTRACTOR whether stored at the Site or elsewhere. The CONTRACTOR shall provide the GOVERNMENT, GOVERNMENT's representatives, CONTRACTING OFFICER, and CONTRACTING OFFICER's consultants access to the Site to enable GOVERNMENT to exercise the rights and remedies under this paragraph.

C. All direct, indirect, and consequential costs and damages incurred by the GOVERNMENT in exercising the rights and remedies under this paragraph will be charged against the CONTRACTOR and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the WORK; and the GOVERNMENT shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount of the adjustment, the GOVERNMENT may make a claim. Such claim will include, but not be limited to, all costs of repair or replacement of work of others, destroyed or damaged by correction, removal, or replacement of CONTRACTOR's Defective Work and all direct, indirect, and consequential damages associated therewith.

D. The CONTRACTOR shall not be allowed an extension of Contract Times (or Milestones) because of any delay in the performance of the WORK attributable to the exercise by GOVERNMENT of GOVERNMENT's rights and remedies under this paragraph.

1.12 CORRECTION PERIOD

A. The correction period for Defective Work shall be the longer of:

1. One year after the date of final acceptance;

2. Such time as may be prescribed by Laws and Regulations;

3. Such time as specified by the terms of any applicable special guarantee required by the Contract Documents; or

4. Such time as specified by any specific provision of the Contract Documents.

B. If, during the correction period as defined in Paragraph 1.12A above, any work is found to be Defective Work, the GOVERNMENT shall have the same remedies as set forth in Paragraphs 1.9, 1.10, and 1.11 above.

C. Where Defective Work (and damage to other work resulting therefrom) has been corrected, removed, or replaced under this paragraph, the correction period hereunder with respect to such work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

D. Replacement of earth fill or backfill, where it has settled below the required finish elevations, shall be considered as a part of such required repair work, and any repair or resurfacing constructed by the CONTRACTOR which becomes necessary by reason of such settlement shall likewise be considered as a part of such required repair work.

E. The CONTRACTOR shall make all repairs and replacements promptly upon receipt of written order from the CONTRACTING OFFICER. If the CONTRACTOR fails to make such repairs or replacements promptly, the GOVERNMENT reserves the right to do the WORK and the CONTRACTOR and its surety shall be liable to the GOVERNMENT for the cost thereof.

1.13 BOND

A. The CONTRACTOR shall provide a bond to guarantee performance of the provisions contained in Paragraph 1.5 through 1.12 above.

1.14 WRITTEN GUARANTEES AND GUARANTOR'S LOCAL REPRESENTATIVE:

Prior to completion of the contract, the Contractor shall obtain and furnish to the Contracting Officer's representative written guarantees for all the equipment and/or appliances furnished under the contract. The Contractor shall furnish with each guarantee: The name, address, and telephone number of the guarantor's representative nearest to the location where the equipment and/or appliances are installed, who, upon request of the Using Service's representative, will honor the guarantee during the guaranty period and will provide the services prescribed by the terms of the guarantee.

1.15 PRICING OF CONTRACTOR-FURNISHED AND INSTALLED PROPERTY AND GOVERNMENT-FURNISHED CONTRACTOR-INSTALLED PROPERTY:

The Contractor shall promptly furnish and shall cause any sub-contractor or supplier to furnish, in like manner, unit prices and descriptive data required by the Government for Property Record purposes of fixtures and equipment furnished and/or installed by the Contractor or sub-contractor, except prices do not need to be provided for Government-Furnished Property.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

- END OF SECTION -

SECTION 02100 - SITE PREPARATION

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The WORK of this Section includes measures required during the CONTRACTOR's initial move onto the Site to protect existing fences, houses and associated improvements, streets, and utilities downslope of construction areas from damage due to boulders, trees or other objects dislodged during the construction process; clearing, grubbing and stripping; and regrading of certain areas to receive embankment fill.

1.2 SITE INSPECTION

A. Prior to moving onto the Site, the CONTRACTOR shall inspect the Site conditions and review maps of the existing plant site and off-site pipeline routes and facilities delineating the GOVERNMENT's property and right-of-way lines.

PART 2 -- PRODUCTS - NOT USED

PART 3 -- EXECUTION

3.1 PRIMARY PLANT SITE ACCESS

A. The CONTRACTOR shall develop any necessary access to the Site, including access barriers to prohibit entry of unauthorized persons.

B. **Utility Interference:** Where existing utilities interfere with the WORK, notify the utility owner and the CONTRACTING OFFICER before proceeding in accordance with the General Conditions.

3.2 CLEARING, GRUBBING, AND STRIPPING

A. Construction areas shall be cleared of grass and weeds to at least a depth of six inches and cleared of structures, pavement, sidewalks, concrete or masonry debris, trees, logs, upturned stumps, loose boulders, and any other objectionable material of any kind which would interfere with the performance or completion of the WORK, create a hazard to safety, or impair the subsequent usefulness of the WORK, or obstruct its operation. Loose boulders within 10 feet of the top of cut lines shall be incorporated in landscaping or removed from the Site. Trees and other natural vegetation outside the actual lines of construction shall be protected from damage during construction, as directed by the CONTRACTING OFFICER.

B. Within the limits of clearing, the areas below the natural ground surface shall be grubbed to a depth necessary to remove all stumps, roots, buried logs, and all other objectionable material. Septic tanks, drain fields, and connection lines and any other underground structures, debris or waste shall be removed if found on the Site. All objectionable material from the clearing and grubbing process shall be removed from the Site and wasted in approved safe locations.

C. The entire area to be affected by construction shall be stripped to a depth of [2.5] feet below the existing ground contours. The stripped materials shall be stockpiled and incorporated into landscaped areas or other non-structural embankments.

D. Unless otherwise indicated, native trees larger than three inches in diameter at the base shall not be removed without the CONTRACTING OFFICER's approval. The removal of any trees, shrubs, fences, or other improvements outside of rights-of-way, if necessary for the CONTRACTOR's choice of means and methods, shall be arranged with the owner of the property, and shall be removed and replaced, at no additional cost to the GOVERNMENT.

3.3 OVEREXCAVATION, REGRADING, AND BACKFILL UNDER FILL AREAS

A. After the fill areas have been cleared, grubbed, and excavated, the areas to receive fill will require overexcavation, regrading, and backfill, consisting of the removal and/or stockpiling of undesirable soils. The ground surface shall be recontoured for keying the fill and removing severe or abrupt changes in the topography of the Site. The overexcavated volumes to a level 2.5 feet below the existing ground contours shall be backfilled.

- END OF SECTION -

SECTION 02200 - EARTHWORK

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall perform all earthwork indicated and required for construction of the WORK, complete and in place, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

A. The CONTRACTOR's attention is directed to the provisions for "Shoring and Bracing Drawings" in Section 6705 of the California Labor Code. The CONTRACTOR, prior to beginning any trench or structure excavation 5 feet deep or over shall submit to the GOVERNMENT and shall be in receipt of the GOVERNMENT's written acceptance of the CONTRACTOR's detailed plan showing design of all shoring, bracing, sloping of the sides of excavation, or other provisions for worker protection against the hazard of caving ground during the excavation of such trenches or structure excavation. If such plan varies from the shoring system standards established in the Construction Safety Orders of the State of California, such alternative systems plans shall be prepared by a civil or structural engineer licensed in the State of California.

B. The CONTRACTOR shall submit a copy of the excavation permit issued by the California Department of Industrial Safety.

C. The CONTRACTOR shall submit samples of all materials proposed to be used in the work in accordance with the requirements in Section 01300 - Contractor Submittals. Sample sizes shall be as determined by the testing laboratory.

PART 2 -- PRODUCTS

2.1 SUITABLE FILL AND BACKFILL MATERIAL REQUIREMENTS

A. **General:** Fill, backfill, and embankment materials shall be selected or processed clean, fine earth, rock, or sand, free from grass, roots, brush, or other vegetation.

B. Fill and backfill materials to be placed within 6 inches of any structure or pipe shall be free of rocks or unbroken masses of earth materials having a maximum dimension larger than 3 inches.

C. **Suitable Materials:** Materials not defined as unsuitable below are defined as suitable materials and may be used in fills, backfilling, and embankment construction subject to the indicated limitations. In addition, when acceptable to the CONTRACTING OFFICER, some of the material listed as unsuitable may be used when thoroughly mixed with suitable material to form a stable composite.

D. Suitable materials may be obtained from on-site excavations, may be processed on-site materials, or may be imported. If imported materials are required by this Section or to meet the quantity requirements of the project, the CONTRACTOR shall provide the imported materials at no additional expense to the GOVERNMENT, unless a unit price item is included for imported materials in the bidding schedule.

E. The following types of suitable materials are defined:

1. Type A (three-quarters inch minus granular backfill): Crushed rock or gravel, and sand with the gradation requirements below. The material shall have a minimum sand equivalent value of 28 and a minimum R-value of 78. If the sand equivalent value exceeds 35 the R-value requirement is waived.

Sieve Size	Percentage Passing
3/4-inch	100
No. 4	30 - 50
No. 200	0 - 12

2. Type B (Class I crushed stone): Manufactured angular, crushed stone, crushed rock, or crushed slag with the following gradation requirements. The material shall have a minimum sand equivalent value of 75.

Sieve Size	Percentage Passing
3/4-inch	100
No. 4	30 - 50
No. 200	0 - 5

3. Type C (sand backfill): Sand with 100 percent passing a 3/8-inch sieve, at least 90 percent passing a Number 4 sieve, and a sand equivalent value not less than 30.

4. Type D: Not used

5. Type E (pea gravel backfill): Crushed rock or gravel the size gradation for Size Number 8 in ASTM C 33 – Concrete Aggregates.

6. Type F (coarse drainrock): Crushed rock or gravel with the size gradation for Size Number 4 in ASTM C 33

7. Type G (aggregate base): Crushed rock aggregate base material of such nature that it can be compacted readily by watering and rolling to form a firm, stable base for pavements. At the option of the CONTRACTOR, the grading for either the 1-1/2-inch maximum size or 3/4-inch maximum size gradation shall be used. The sand equivalent value shall be not less than 22, and the material shall meet the following gradation requirements:

	Percentage Passing	
Sieve Size	1-1/2-inch Max. Gradation	3/4-inch Max. Gradation
2-inch	100	-
1-1/2-inch	90 - 100	-
1-inch	-	100
3/4-inch	50 - 85	90 - 100
No. 4	25 - 45	35 - 55
No. 30	10 - 25	10 - 30
No. 200	2 - 9	2 - 9

8. Type H (graded drainrock): Drainrock shall be crushed rock or gravel, durable and free from slaking or decomposition under the action of alternate wetting or drying. The material shall be uniformly graded and shall meet the gradation requirements for Size Number 57 in ASTM C 33:

   The drainrock shall have a sand equivalent value not less than 75. The finish graded surface of the drainrock immediately beneath hydraulic structures shall be stabilized to provide a firm, smooth surface upon which to construct reinforced concrete floor slabs. The CONTRACTOR shall use, at its option, one of the asphalt types listed below:

	Type 1	Type 2	Type 3
Designation	SC-800	SC-250	RS-1
Spray Temperature (^{o}F)	175-255	165-200	70-120
Coverage (gal/sq yd)	0.50	0.50	0.50

   If the surface remains tacky, sufficient sand shall be applied to absorb the excess asphalt.

9. Type I: Any other suitable material as defined herein.

10. Type J (cement-treated backfill): Material which consists of Type H material, or any mixture of Types B, C, G, and H materials which has been cement-treated so that the cement content of the material is not less than 5 percent by weight when tested in accordance with ASTM D 2901 - Standard Test Method for Cement Content of Freshly Mixed Soil Cement. The ultimate compressive strength at 28 days shall be not less than 400 psi when tested in accordance with ASTM D 1633 - Standard Test Method for Compressive Strength of Molded Soil - Cement Cylinders.

11. Type K (topsoil): Stockpiled topsoil material which has been obtained at the site by removing soil to a depth not exceeding 2 feet. Removal of the topsoil shall be done after the area has been stripped of vegetation and debris.

12. Type L (controlled low strength material): Controlled low strength material shall be in accordance with Section 02210 - Controlled Low Strength Material.

13. Type M (aggregate subbase): Crushed rock aggregate subbase material that can be compacted readily by watering and rolling to form a firm stable base. The sand equivalent value shall be not less than 18 and the material shall meet the following gradation requirements:

Sieve Size	Percentage Passing
3-inch	100
2-1/2 inch	87 - 100
No. 4	35 - 95
No. 200	0 - 29

14. Type N (trench plug): Low permeable fill material, a non-dispersible clay material having a minimum plasticity index of 10.

2.2 UNSUITABLE MATERIAL

A. Unsuitable materials include the materials listed below.

1. Soils which, when classified under ASTM D 2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System), fall in the classifications of Pt, OH, CH, MH, or OL.

2. Soils which cannot be compacted sufficiently to achieve the density specified for the intended use.

3. Materials that contain hazardous or designated waste materials including petroleum hydrocarbons, pesticides, heavy metals, and any material which may be classified as hazardous or toxic according to applicable regulations.

4. Soils that contain greater concentrations of chloride or sulfate ions, or have a soil resistively or pH less than the existing on-site soils.

5. Topsoil, except as allowed below.

2.3 USE OF FILL, BACKFILL, AND EMBANKMENT MATERIAL TYPES

A. The CONTRACTOR shall use the types of materials as designated herein for all required fill, backfill, and embankment construction hereunder.

B. Where these Specifications conflict with the requirements of any local agency having jurisdiction or with the requirements of a pipe material manufacturer, the CONTRACTING OFFICER shall be immediately notified. In case of conflict between types of pipe embedment backfills, the CONTRACTOR shall use the agency-specified backfill material if that material provides a greater degree of structural support to the pipe, as determined by the CONTRACTING OFFICER. In case of conflict between types of trench or final backfill types, the CONTRACTOR shall use the agency-specified backfill material if that material provides the greater in-place density after compaction.

C. Fill and backfill types shall be used in accordance with the following provisions:

1. Embankment fills shall be constructed of Type I material, as defined herein, or any mixture of Type I and Type A through Type H materials.

2. Pipe zone backfill, as defined under "Pipe and Utility Trench Backfill" below, shall consist of the following materials for each pipe material listed below.

a. Mortar coated pipe, concrete pipe, and un-coated ductile iron pipe shall be provided with Type A or B material in the pipe zone.

b. Coal tar enamel coated pipe, polyethylene encased pipe, tape wrapped pipe, and other non-mortar-coated pipe shall be provided with Type C material in the pipe zone.

c. Plastic pipe and vitrified clay pipe shall be provided with Type B material in the pipe zone.

d. Where pipelines are installed on grades exceeding 4 percent, and where backfill materials are graded such that there is less than 10 percent passing a

Number 4 sieve, trench plugs of Type J, L, or N material shall be provided at maximum intervals of 200 feet unless indicated otherwise.

3. Trench zone backfill for pipelines as defined under "Pipe and Utility Trench Backfill" shall be Type I backfill material or any of Types A through H backfill materials or any mixture thereof, except:

   a. Type K material may be used for trench zone backfill in agricultural areas unless otherwise shown or specified.

4. Final backfill material for pipelines under paved areas, as defined under "Pipe and Utility Trench Backfill" shall be Type G backfill material. Final backfill under areas not paved shall be the same material as that used for trench backfill, except that Type K material shall be used for final backfill in agricultural areas unless otherwise indicated.

5. Trench backfill and final backfill for pipelines under structures shall be the same material as used in the pipe zone, except where concrete encasement is required by the Contract Documents.

6. Aggregate base materials under pavements shall be Type G material constructed to the thicknesses indicated. Aggregate subbase shall be Type M material.

7. Backfill around structures shall be Type I material, or Types A through Type H materials, or any mixture thereof, except as shown.

8. Backfill materials beneath structures shall be as follows:

   a. Drainrock materials under hydraulic structures or other water retaining structures with underdrain systems shall be Type H material.

   b. Under concrete hydraulic structures or other water retaining structures without underdrain systems, Types G or H materials shall be used.

   c. Under structures where groundwater must be removed to allow placement of concrete, Type F material shall be used. Before the Type F material is placed, filter fabric shall be placed over the exposed foundation.

   d. Under all other structures, Type G or H material shall be used.

9. Backfill used to replace pipeline trench over-excavation shall be a layer of Type F material with a 6-inch top filter layer of Type E material or filter fabric to prevent migration of fines for wet trench conditions or the same material as used for the pipe zone backfill if the trench conditions are not wet.

10. The top 6 inches of fill on reservoir roofs, embankment fills around hydraulic structures, and all other embankment fills shall consist of Type K material, topsoil.

11. Filter fabric shall be **Mirafi 140 N, Mirafi 700X,** or equal.

2.4 MATERIALS TESTING

A. All soils testing of samples submitted by the CONTRACTOR will be done by a testing laboratory of the GOVERNMENT's choice and at the GOVERNMENT's expense. At its

discretion, the CONTRACTING OFFICER may request that the CONTRACTOR supply samples for testing of any material used in the work.

B. Particle size analysis of soils and aggregates will be performed using ASTM D 422 - Standard Test Method for Particle-Size Analysis of Soils.

C. Determination of sand equivalent value will be performed using ASTM D 2419 - Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.

D. **Unified Soil Classification System:** References in this Section to soil classification types and standards shall have the meanings and definitions indicated in ASTM D 2487. The CONTRACTOR shall be bound by all applicable provisions of said ASTM D 2487 in the interpretation of soil classifications.

E. The testing for chloride, sulfate, resistively, and pH will be done in accordance with California Test Methods 532 and 643 of the California Department of Transportation.

2.5 IDENTIFICATION TAPE

A. Unless indicated otherwise, identification tape shall be placed above all buried pipelines which are not comprised at least in part of magnetic components. Identification tape shall be 6-inches wide, yellow in color, polyethylene, with integral metallic wire. Tape shall be labeled with CAUTION – BURIED UTILITIES.

PART 3 -- EXECUTION

3.1 EXCAVATION – GENERAL

A. **General:** Except when specifically provided to the contrary, excavation shall include the removal of all materials of whatever nature encountered, including all obstructions of any nature that would interfere with the proper execution and completion of the WORK. The removal of said materials shall conform to the lines and grades indicated or ordered. Unless otherwise indicated, the entire construction site shall be stripped of all vegetation and debris, and such material shall be removed from the site prior to performing any excavation or placing any fill. The CONTRACTOR shall furnish, place, and maintain all supports and shoring that may be required for the sides of the excavations. Excavations shall be sloped or otherwise supported in a safe manner in accordance with applicable State safety requirements and the requirements of OSHA Safety and Health Standards for Construction (29CFR1926).

B. **Removal and Exclusion of Water:** The CONTRACTOR shall remove and exclude water, including stormwater, groundwater, irrigation water, and wastewater, from all excavations. Dewatering wells, wellpoints, sump pumps, or other means shall be used to remove water and continuously maintain groundwater at a level at least two feet below the bottom of excavations before the excavation work begins at each location. Water shall be removed and excluded until backfilling is complete and all field soils testing has been completed.

3.2 STRUCTURE, ROADWAY, AND EMBANKMENT EXCAVATION

A. **Excavation Beneath Structures and Embankments:** Except where otherwise indicated for a particular structure or ordered by the CONTRACTING OFFICER, excavation shall be carried to the grade of the bottom of the footing or slab. Where

indicated or ordered, areas beneath structures or fills shall be over-excavated. The subgrade areas beneath embankments shall be excavated to remove not less than the top 6 inches of native material and where such subgrade is sloped, the native material shall be benched. When such over-excavation is indicated, both over-excavation and subsequent backfill to the required grade shall be performed by the CONTRACTOR. When such over-excavation is not indicated but is ordered by the CONTRACTING OFFICER, such over-excavation and any resulting backfill will be paid for under a separate unit price bid item if such bid item has been established; otherwise payment will be made in accordance with a negotiated price. After the required excavation or over-excavation has been completed, the exposed surface shall be scarified to a depth of 6 inches, brought to optimum moisture content, and rolled with heavy compaction equipment to obtain 95 percent of maximum density.

B. **Excavation Beneath Concrete Reservoirs:** Excavation under reservoirs shall extend to the bottom of the drainrock layer. After such excavation has been completed, the exposed surface shall be rolled with heavy compaction equipment to 95 percent of maximum density and then graded to provide a reasonably smooth surface for placement of the drainrock. Areas under the reservoir upon which fill is to be placed shall be scarified to a depth of 6 inches, brought to optimum moisture content, and compacted to obtain 95 percent of maximum density.

C. **Excavation Beneath Paved Areas:** Excavation under areas to be paved shall extend to the bottom of the aggregate base or subbase, if such base is called for; otherwise it shall extend to the paving thickness. After the required excavation has been completed, the top 12 inches of exposed surface shall be scarified, brought to optimum moisture content, and rolled with heavy compaction equipment to obtain 95 percent of maximum density. The finished subgrade shall be even, self-draining, and in conformance with the slope of the finished pavement. Areas that could accumulate standing water shall be regraded to provide a self-draining subgrade.

D. **Notification of** CONTRACTING OFFICER**:** The CONTRACTOR shall notify the CONTRACTING OFFICER at least 3 days in advance of completion of any structure excavation and shall allow the CONTRACTING OFFICER a review period of at least one day before the exposed foundation is scarified and compacted or is covered with backfill or with any construction materials.

3.3 PIPELINE AND UTILITY TRENCH EXCAVATION

A. Exploratory Excavation

1. The CONTRACTOR shall excavate and expose buried points of connection to existing utilities where indicated on the Drawings. Excavation shall be performed prior to preparation of Shop Drawings for connections and before fabrication of pipe, and the data obtained shall be used in preparing Shop Drawings.

2. Data, including dates, locations excavated, and sketches, shall be submitted to the CONTRACTING OFFICER within one week of excavation.

3. Damage to utilities from excavation activities shall be repaired by the CONTRACTOR.

B. **General:** Unless otherwise indicated or ordered, excavation for pipelines and utilities shall be open-cut trenches with widths as indicated.

C. **Trench Bottom:** Except when pipe bedding is required, the bottom of the trench shall be excavated uniformly to the grade of the bottom of the pipe bedding. Excavations for pipe bells and welding shall be made as required.

D. **Open Trench:** The maximum amount of open trench permitted in any one location shall be 500 feet, or the length necessary to accommodate the amount of pipe installed in a single day, whichever is greater. All trenches shall be fully backfilled at the end of each day or, in lieu thereof, shall be covered by heavy steel plates adequately braced and capable of supporting vehicular traffic in those locations where it is impractical to backfill at the end of each day. The above requirements for backfilling or use of steel plate will be waived in cases where the trench is located further than 100 feet from any traveled roadway or occupied structure. In such cases, however, barricades and warning lights meeting safety requirements shall be provided and maintained.

E. **Indicated Trench Over-Excavation:** Where trenches are indicated to be over-excavated, excavation shall be to the depth indicated, and backfill shall be installed to the grade of the bottom of the pipe bedding.

F. Over-Excavation (Not Indicated)

1. When ordered by the GOVERNMENT to over-excavate trenches deeper and/or wider than required by the Contract Documents, the CONTRACTOR shall over-excavate to the dimensions ordered and backfill to the indicated grade of the bottom of the pipe bedding.

2. Payment

a. Over-excavation less than 6-inches more than the indicated trench depth and/or width shall be done at no increase in cost. Additional payment will be made for over-excavation 6 inches or more than the indicated depth and/or width.

b. Additional payment will be based on unit price bid items for over-excavation if such bid items were established; otherwise payment will be based on a negotiated price. Volumes of material will be based on survey measurements of the over-excavated area.

G. Where pipelines are to be installed in embankments, fills, or structure backfills, the fill shall be constructed to a level at least one foot above the top of the pipe before the trench is excavated.

H. If a moveable trench shield is used during excavation operations, the trench width shall be wider than the shield so that the shield is free to be lifted and then moved horizontally without binding against the trench sidewalls. If the trench walls cave in or slough, the trench shall be excavated as an open excavation with sloped sidewalls or with trench shoring, as indicated and as required by the pipe structural design.

3.4 OVER-EXCAVATION NOT ORDERED OR INDICATED

A. Any over-excavation carried below the grade ordered or indicated, shall be backfilled and compacted to the required grade with the indicated material.

3.5 EXCAVATION IN LAWN AREAS

A. Where excavation occurs in lawn areas, the sod shall be carefully removed, dampened, and stockpiled to preserve it for replacement. Excavated material may be placed on the lawn; provided, that a drop cloth or other suitable method is employed to protect the lawn from damage. The lawn shall not remain covered for more than 72 hours. Immediately after completion of backfilling and testing of the pipeline, the sod shall be replaced and lightly rolled in a manner so as to restore the lawn as near as possible to its original condition. CONTRACTOR shall provide new sod if stockpiled sod has not been replaced within 72 hours.

3.6 EXCAVATION IN VICINITY OF TREES

A. Except where trees are indicated to be removed, trees shall be protected from injury during construction operations. No tree roots over 2 inches in diameter shall be cut without express permission of the CONTRACTING OFFICER. Trees shall be supported during excavation by any means previously reviewed by the CONTRACTING OFFICER.

3.7 ROCK EXCAVATION

A. Rock excavation shall include removal and disposal of the following: (1) all boulders measuring 1/3 of a cubic yard or more in volume; (2) all rock material in ledges, bedding deposits, and un-stratified masses which cannot be removed without systematic drilling and blasting; (3) concrete or masonry structures which have been abandoned; and (4) conglomerate deposits which are so firmly cemented that they possess the characteristics of solid rock and which cannot be removed without systematic drilling and blasting.

B. Rock excavation shall be performed by the CONTRACTOR; provided, that should the quantity of rock excavation be affected by any change in the scope of the work, an appropriate adjustment of the contract price will be made under a separate bid item if such bid item has been established; otherwise payment will be made in accordance with a negotiated price.

C. Explosives and Blasting

1. Blasting will not be permitted.

3.8 DISPOSAL OF EXCESS EXCAVATED MATERIAL

3.9 BACKFILL - GENERAL

A. Backfill shall not be dropped directly upon any structure or pipe. Backfill shall not be placed around or upon any structure until the concrete has attained sufficient strength to withstand the loads imposed. Backfill around water retaining structures shall not be placed until the structures have been tested, and the structures shall be full of water while backfill is being placed.

B. Except for drainrock materials being placed in over-excavated areas or trenches, backfill shall be placed after all water is removed from the excavation, and the trench sidewalls and bottom have been dried to a moisture content suitable for compaction.

C. If a moveable trench shield is used during excavation, pipe installation, and backfill operations, the shield shall be moved by lifting the shield free of the trench bottom or

backfill and then moving the shield horizontally, The CONTRACTOR shall not drag trench shields along the trench causing damage or displacement to the trench sidewalls, the pipe, or the bedding and backfill.

D. Immediately prior to placement of backfill materials, the bottoms and sidewalls of trenches and structure excavations shall have all loose sloughing, or caving soil and rock materials removed. Trench sidewalls shall consist of excavated surfaces that are in a relatively undisturbed condition before placement of backfill materials.

3.10 PLACING AND SPREADING OF BACKFILL MATERIALS

A. Backfill materials shall be placed and spread evenly in layers. When compaction is achieved using mechanical equipment, the layers shall be evenly spread so that when compacted each layer shall not exceed 6 inches in thickness.

B. During spreading, each layer shall be thoroughly mixed as necessary to promote uniformity of material in each layer. Pipe zone backfill materials shall be manually spread around the pipe so that when compacted the pipe zone backfill will provide uniform bearing and side support.

C. Where the backfill material moisture content is below the optimum moisture content, water shall be added before or during spreading until the proper moisture content is achieved.

D. Where the backfill material moisture content is too high to permit the specified degree of compaction the material shall be dried until the moisture content is satisfactory.

3.11 COMPACTION OF FILL, BACKFILL, AND EMBANKMENT MATERIALS

A. Each layer of Types A, B, C, G, H, I, and K backfill materials as defined herein, where the material is graded such that 10 percent or more passes a No. 4 sieve, shall be mechanically compacted to the indicated percentage of density. Equipment that is consistently capable of achieving the required degree of compaction shall be used and each layer shall be compacted over its entire area while the material is at the required moisture content.

B. Each layer of Type E, F, and J backfill materials shall be compacted by means of at least 2 passes from a flat plate vibratory compactor. When such materials are used for pipe zone backfill, vibratory compaction shall be used at vertical intervals of 24-inches, measured in the uncompacted state. In addition, these materials shall be subjected to vibratory compaction at the springline of the pipe and the top of the pipe zone backfill, regardless of whether that dimension is less than 24-inches or not.

C. Fill on reservoir and structure roofs shall be deposited at least 30 days after the concrete roof slab has been placed. Equipment weighing more than 10,000 pounds when loaded shall not be used on a roof. A roller weighing not more than 8,000 pounds shall be used to compact fill on a roof.

D. Flooding, ponding, or jetting shall not be used for fill on roofs, backfill around structures, backfill around reservoir walls, for final backfill materials, or aggregate base materials.

E. Equipment weighing more than 10,000 pounds shall not be used closer to walls than a horizontal distance equal to the depth of the fill at that time. Hand operated power

compaction equipment shall be used where use of heavier equipment is impractical or restricted due to weight limitations.

F. Backfill around and over pipelines that is mechanically compacted shall be compacted using light, hand operated, vibratory compactors and rollers. After completion of at least two feet of compacted backfill over the top of pipeline, compaction equipment weighing no more than 8,000 pounds may be used to complete the trench backfill.

G. **Compaction Requirements:** The following compaction test requirements shall be in accordance with ASTM D 1557 - Test Method for Laboratory Compaction Characteristics of Soils Using Modified Effort (56,000 ft - lbf/ft^3) (2,700 kN-m/m^3) for Type A, B, C, G, H, I, K, M, and N materials and in accordance with ASTM D 4253 - Standard Test Method for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table, and D 4254 - Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density, for Type B, E, F, and J materials. Where agency or utility company requirements govern, the highest compaction standards shall apply.

Location or Use of Fill	Percentage of Maximum Density	Percentage of Relative Density
Pipe embedment backfill for flexible pipe.	95	70
Pipe bedding and over-excavated zones under bedding for flexible pipe, including trench plugs.	95	70
Pipe embedment backfill for Steel Yard Piping	---	70
Pipe zone backfill portion above embedment for flexible pipe	95	70
Pipe embedment backfill for rigid pipe	90	55
Pipe zone backfill portion above embedment for rigid pipe.	95	70
Pipe bedding and over-excavated zones under bedding for rigid pipe.	95	70
Final backfill, beneath paved areas or structures.	95	70
Final backfill, not beneath paved areas or structures.	90	55
Trench zone backfill, beneath paved areas and structures, including trench plugs.	95	70
Trench zone backfill, not beneath paved		

areas or structures, including trench plugs.	95	70
Embankments and fills.	90	55
Embankments and fills beneath paved areas or structures.	95	70
Backfill beneath structures and hydraulic structures.	95	70
Backfill and fill around structures on reservoir or structure roof.	90	55
Topsoil (Type K material)	80	N.A.
Aggregate base or subbase (Type G or M material)	95	N.A.

3.12 PIPE AND UTILITY TRENCH BACKFILL

A. Pipe Zone Backfill

1. The pipe zone is defined as that portion of the vertical trench cross-section lying between a plane below the bottom surface of the pipe and a plane at a point above the top surface of the pipe as indicated. The bedding is defined as that portion of pipe zone backfill material between the trench subgrade and the bottom of the pipe. The embedment is defined as that portion of the pipe zone backfill material between the bedding and a level line as indicated.

2. After compacting the bedding the CONTRACTOR shall perform a final trim using a stringline for establishing grade, such that each pipe section when first laid will be continually in contact with the bedding along the extreme bottom of the pipe. Excavation for pipe bells and welding shall be made as required.

3. The pipe zone shall be backfilled with the indicated backfill material. The CONTRACTOR shall exercise care to prevent damage to the pipeline coating, cathodic bonds, and the pipe itself during the installation and backfill operations.

4. If a moveable trench shield is used during backfill operations the shield shall be lifted to a location above each layer of backfill material prior to compaction of the layer. The CONTRACTOR shall not displace the pipe or backfill while the shield is being moved.

B. **Trench Zone Backfill:** After the pipe zone backfills have been placed, backfilling of the trench zone may proceed. The trench zone is defined as that portion of the vertical trench cross-section lying as indicated between a plane above the top surface of the pipe and a plane at a point 18 inches below the finished surface grade, or if the trench is under pavement, 18 inches below the roadway subgrade.

C. **Final Backfill:** Final backfill is all backfill in the trench cross-sectional area within 18 inches of finished grade, or if the trench is under pavement, all backfill within 18 inches of the roadway subgrade.

D. Identification Tape: Install identification tape as indicated.

3.13 FILL AND EMBANKMENT CONSTRUCTION

A. The area where a fill or embankment is to be constructed shall be cleared of all vegetation, roots and foreign material. Following this, the surface shall be moistened, scarified to a depth of 6 inches, and rolled or otherwise mechanically compacted. Embankment and fill material shall be placed and spread evenly in approximately horizontal layers. Each layer shall be moistened or aerated, as necessary. Unless otherwise approved by the CONTRACTING OFFICER, each layer shall not exceed 6 inches of compacted thickness. The embankment, fill, and the scarified layer of underlying ground shall be compacted to 95 percent of maximum density under structures and paved areas, and 90 percent of maximum density elsewhere.

B. When an embankment or fill is to be made and compacted against hillsides or fill slopes steeper than 4:1, the slopes of hillsides or fills shall be horizontally benched to key the embankment or fill to the underlying ground. A minimum of 12-inches normal to the slope of the hillside or fill shall be removed and re-compacted as the embankment or fill is brought up in layers. Material thus cut shall be re-compacted along with the new material. Hillside or fill slopes 4:1 or flatter shall be prepared in accordance with Paragraph A, above.

C. Where embankment or structure fills are constructed over pipelines, the first 4 feet of fill over the pipe shall be constructed using light placement and compaction equipment that does not damage the pipe. Heavy construction equipment shall maintain a minimum distance from the edge of the trench equal to the depth of the trench until at least 4 feet of fill over the pipe has been completed.

3.14 FIELD TESTING

A. **General:** All field soils testing will be done by a testing laboratory of the GOVERNMENT's choice at the GOVERNMENT's expense except as indicated below.

B. Where soil material is required to be compacted to a percentage of maximum density, the maximum density at optimum moisture content will be determined in accordance with Method C of ASTM D 1557. Where cohesionless, free draining soil material is required to be compacted to a percentage of relative density, the calculation of relative density will be determined in accordance with ASTM D 4253 and D 4254. Field density in-place tests will be performed in accordance with ASTM D 1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method, ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place By Nuclear Methods (Shallow Depth), or by such other means acceptable to the CONTRACTING OFFICER.

C. In case the test of the fill or backfill show non-compliance with the required density, the CONTRACTOR shall accomplish such remedy as may be required to insure compliance. Subsequent testing to show compliance shall be by a testing laboratory selected by the GOVERNMENT and paid by the CONTRACTOR.

D. The CONTRACTOR shall provide test trenches and excavations including excavation, trench support, and groundwater removal for the GOVERNMENT's field soils testing operations. The trenches and excavations shall be provided at the locations and to the depths required by the GOVERNMENT. Lawn areas destroyed by test trenching and excavation shall be regraded and relandscaped with sod.

- END OF SECTION -

SECTION 02210 - CONTROLLED LOW STRENGTH MATERIAL

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide Controlled Low Strength Material (CLSM), complete and in place, in accordance with the Contract Documents.

B. CLSM shall be placed where indicated and may be used, if the CONTRACTING OFFICER approves, for the following purposes:

1. Normal CLSM with high slump, non-segregating consistency that readily flows and fills voids and difficult to reach places: pipe zone fill, trench zone fill, pipe abandonment, structure backfill, and structure cavity fill.

1.2 CONTRACTOR SUBMITTALS

A. Submittals shall be furnished in accordance with Section 01300 - Contractor Submittals.

B. Shop Drawings:

1. CLSM mix designs which show the proportions and gradations of all materials proposed for each type of CLSM indicated. Each mix design shall be accompanied by independent laboratory test results of the indicated properties.

2. If the CONTRACTOR proposes to provide lower strength CLSM with aggregates that do not conform to ASTM C 33 - Concrete Aggregate, Shop Drawings shall include a testing program that will be used to control the variability of the aggregates. The testing program shall be acceptable to the CONTRACTING OFFICER.

1.3 QUALITY ASSURANCE

A. All testing will be done by a testing laboratory selected by the GOVERNMENT at the GOVERNMENT's expense, except as otherwise indicated.

B. If tests of the CLSM show non-compliance with the specifications, the CONTRACTOR shall make changes as may be required to achieve compliance. Performing and paying for subsequent testing to show compliance shall be the CONTRACTOR's responsibility.

C. Correlation Tests

1. The CONTRACTOR shall perform a field correlation test for each mix of CLSM used in pipe zone, trench zone, or backfill used in amounts greater than 100 cubic yards or when CLSM is required to support traffic or other live loads on the fill less than 7 days after placing CLSM.

2. Field correlation tests shall be performed in a test pit similar in cross section to the WORK and at least 10-feet long at a location near the WORK. The proposed location shall be acceptable to the CONTRACTING OFFICER.

3. Laboratory and field tests shall be performed on samples taken from the same CLSM batch mix. All tests shall be performed by a laboratory at the CONTRACTOR'S expense.

4. Testing shall be performed once each 2-hours during the first 8 hours, once each 8-hours during the first week, and once each 24-hours until the CLSM mix reaches the maximum design strength.

    a. Compression testing shall be in accordance with ASTM D 4832 - Preparation and Testing of Soil-Cement Slurry Test Cylinders.

    b. Setting test shall be in accordance with ASTM C 403 - Time of Setting of Concrete Mixtures by Penetration Resistance

    c. Density tests shall be in accordance with ASTM C 138 - Unit Weight, Yield and Air Content (Gravimetric) of Concrete.

PART 2 -- PRODUCTS

2.1 CONTROLLED LOW STRENGTH MATERIAL

A. CLSM shall be a mixture of cement, pozzolan, coarse and fine aggregate, admixtures, and water, mixed in accordance with ASTM C 94 - Ready Mixed Concrete.

B. **Composition:** The following parameters shall be within the indicated limits and as necessary to produce the indicated compressive strengths.

1. Mix proportions as necessary

2. Entrained air content shall be between 20 percent minimum and 30 percent maximum.

3. Water reducing agent content as necessary

C. Properties

1. Density shall be between 120 PCF minimum and 145 PCF maximum

2. Slump shall be as required by the CONTRACTOR’s methods, but shall not promote segregation nor shall slump exceed 9 inches.

3. Compressive strength at 28 days:

    a. Normal CLSM: Between 100 psi minimum and 300 psi maximum. Unless specifically indicated otherwise, all CLSM shall be Normal CLSM.

2.2 CEMENT

A. Cement shall be Type II in accordance with ASTM C 150 - Portland Cement.

2.3 POZZOLAN

A. Pozzolan shall be Type F or C in accordance with ASTM C 618 - Flyash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete. Pozzolon content, by weight, in Normal CLSM shall not be greater than cement content.

2.4 AGGREGATE

A. Aggregate shall consist of a well graded mixture of crushed rock, soil, or sand, with a nominal maximum size of 3/8-inch. One hundred percent shall pass the □-inch sieve; no more than 30 percent shall be retained on the 3/8-inch sieve; and no more than 12 percent shall pass the number 200 sieve. If more than 5 percent of the aggregate passes the number 200 sieve, the material passing the number 200 sieve shall have a plasticity index of less than 0.73(liquid limit-20), when tested in accordance with ASTM D 4318 - Liquid Limit, Plastic Limit, and Plasticity Index of Soils. All aggregate shall be free from organic matter and shall not contain more alkali, sulfates, or salts than the native materials at the Site.

1.5 ADMIXTURES

A. Air entraining admixtures shall be in accordance with ASTM C 260 - Air-Entraining Admixtures for Concrete.

B. Water reducing admixtures shall be in accordance with ASTM C 494 - Chemical Admixtures for Concrete.

1.6 WATER

A. Water shall be potable, clean, free from objectionable quantities of silt, organic matter, alkali, salt, and other impurities.

PART 3 -- EXECUTION

3.1 PREPARATION

A. Subgrade and compacted fill to receive CLSM shall be prepared according to Section 02200 - Earthwork.

3.2 BATCHING, MIXING AND DELIVERY

A. Batching, mixing, and delivery of CLSM shall conform to ASTM C 94. CLSM shall be mixed at a batch plant acceptable to the CONTRACTING OFFICER and shall be delivered in standard transit mix trucks.

3.3 PLACEMENT

A. CLSM shall be placed by tailgate discharge, conveyor belts, pumped, or other means acceptable to the CONTRACTING OFFICER. CLSM shall be directed in place by vibrator, shovel, or rod to fill all crevices and pockets. Avoid over-consolidation which causes separation of aggregate sizes.

B. CLSM shall be continuously placed against fresh material unless otherwise approved by the CONTRACTING OFFICER. When new material is placed against existing CLSM,

the placement area shall be free from all loose and foreign material. The surface of the existing material shall be soaked a minimum of one hour before placement of fresh material but no standing water shall be allowed when placement begins.

C. Temperature of the CLSM shall be between 50 and 90 degrees F, when placed. CLSM shall not be placed when the air temperature is below 40 degrees F. No CLSM shall be placed against frozen subgrade or other materials having temperature less than 32 degrees F.

3.4 FINISHING

A. The finish surface shall be smooth and to the grade indicated or directed by the CONTRACTING OFFICER. Surfaces shall be free from fins, bulges, ridges, offsets, and honeycombing. Finishing by wood float, steel trowel, or similar methods is not required.

3.5 CURING

A. CLSM shall be kept damp for a minimum of 7 days or until final backfill is placed.

3.6 PROTECTION

A. CLSM shall be protected from freezing for 72 hours after placement.

B. No fill or loading shall be placed on CLSM until probe penetration resistance, as measured in accordance with ASTM C 803 - Standard Test Method for Penetration Resistance of Hardened Concrete, exceeds 650 psi.

C. CLSM shall be protected from running water, rain, and other damage until the material has been accepted and final fill completed.

- END OF SECTION -

SECTION 02490 - PRECAST CONCRETE MANHOLES AND VAULTS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide precast concrete manholes and vaults, complete and in place, in accordance with the Contract Documents.

1.2 SPECIFICATIONS, CODES AND STANDARDS

A. Commercial Standards

ASTM A 48	Gray Iron Castings
ASTM C 150	Portland Cement
ASTM C 443	Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C 478	Precast Reinforced Concrete Manhole Sections
ASTM C 923	Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals

1.3 CONTRACTOR SUBMITTALS

A. **General:** Furnish submittals in accordance with Section 01300 - Contractor Submittals.

B. Shop Drawings

1. Show dimensions, locations, lifting inserts, reinforcement, and joints.

2. Structural design calculations for vaults, signed by a registered engineer.

C. **Manufacturer's Certification for Vaults:** Written certification that the vault complies with the requirements of this Section.

1.4 QUALITY ASSURANCE

A. **Inspection:** After installation, the CONTRACTOR shall demonstrate that manholes and vaults have been properly installed, level, with tight joints, at the correct elevations and orientations, and that the backfilling has been carried out in accordance with the Contract Documents.

PART 2 -- PRODUCTS

2.1 MANHOLES

A. The CONTRACTOR shall provide precast manhole sections and conical sections conforming to ASTM C 478 and the requirements of this Section. Adjusting rings shall

be standard items from the manufacturer of the manhole sections. Minimum wall thickness of rings shall be 4-inches if steel reinforced and 6-inches if not reinforced.

B. Axial length of sections shall be selected to provide the correct total height with the fewest joints.

C. Conical sections shall be designed to support cast iron frames and covers under an H-20 loading, unless indicated otherwise.

D. Where the manhole barrel diameter is greater than 48-inches, a flat slab-transition, either concentric or eccentric, shall be used to transition to 48-inch diameter riser sections. Underside of the transition shall be at least 7-feet above the top of the bench.

E. **Design Criteria:** Manhole walls, transitions, conical sections, and base shall be designed per ASTM C 478 for the depths indicated and the following:

1. AASHTO H-20 loading applied to the cover.

2. Unit weight of soil of 120 pcf located above all portions of the manhole.

3. Lateral soil pressure based on saturated soil producing 100 pcf acting on an empty manhole.

4. Internal fluid pressure based on unit weight of 63 pcf with manhole filled from invert to cover with no balancing external soil pressure.

5. Dead load of manhole sections fully supported by the base and transition.

6. Additional reinforcing steel in walls to transfer stresses at openings.

7. The minimum clear distance between the edges of any 2 wall penetrations shall be 12-inches or one-half of the diameter of the smaller penetration, whichever is greater.

F. Joints shall be sealed with o-ring gaskets conforming to ASTM C 443.

G. Concrete for base and channel formation shall be 4000 psi concrete conforming to Section 03300 - Cast-In-Place Concrete.

H. Barrel section to sewer pipe connections shall be sealed with resilient connectors complying with ASTM C 923. Mechanical devices shall be stainless steel.

I. Manhole Manufacturers, or Equal

1. **Atlantic Concrete Products, Inc., Cockeysville, MD**

2. **Hanson Concrete Products, Inc., Milpitas, CA**

3. **Hardwall Fabricators, Inc., N. Miami, OK**

4. **Teichert Precast, Sacramento, CA**

2.2 FRAMES AND COVERS

A. **Castings:** Castings for manhole frames and covers shall be non-rocking and shall conform to the requirements of ASTM A 48, Class 30. Unless otherwise indicated, cast iron covers and frames shall be heavy traffic type, 30 inches in diameter. Frame and cover shall be designed for H-20 traffic loading.

B. Castings Manufacturers, or Equal

1. **Alhambra Foundry Co., Ltd.**

2. **Neenah Foundry Co.**

3. **Vulcan Foundry, Inc.**

2.3 VAULTS

A. The CONTRACTOR shall provide precast vaults designed for the indicated applications and of the sizes indicated.

B. The minimum structural member thickness for vaults shall be 5-inches. Cement shall be Type V portland cement as specified in ASTM C 150. The minimum 28-day concrete compressive strength shall be 4,000 psi. All reinforcing steel shall be embedded in the concrete with a minimum clear cover as recommended by ACI 318.

C. **Design Loading:** Vaults in areas subject to vehicular traffic shall be designed for H-20 traffic loading. Vaults in other areas shall be designed for a vertical live load of [300] psf. Lateral loads on vaults in all areas shall be calculated from:

$$L = 90\,h, \text{ plus surcharge of } 240 \text{ psf in areas of vehicular traffic}$$

Where L = loading in psf

h = depth of fill in feet

D. Where joints are designed in pre-cast concrete vaults, such joints shall be interlocking to secure proper alignment between members and prevent migration of soil through the joint. Structural sections at joints shall be sized sufficiently to reinforce the section against localized distress during transportation and handling and against excess contact bearing pressures through the joint.

E. Where openings for access to the vault are required, the full clear space opening indicated shall be provided, without obstructions from brackets or supports. For large openings where brackets or supports are designed to protrude into the opening for support of required covers, such brackets or supports shall be designed to be easily removed and replaced with a minimum of effort and without cutting or welding.

F. Covers for access openings shall be provided. Frames for covers shall be fabricated from steel, galvanized after fabrication, and shall be integrally cast into the vault concrete sections. All covers shall be tight fitting to prevent the entrance of dirt and debris. Where edge seams are permitted, no gaps greater than 1/16-inch between edges will be accepted. All covers, except round, heavy-weight, cast iron manhole

covers, shall have securing mechanisms to hold the covers firmly in place against the effects of repetitious live loads such as pedestrian or vehicle traffic.

G. Where penetration of the pre-cast concrete vault are required for piping, conduit, or ducts, such penetrations shall be accommodated through pre-cast openings or thin-wall knock-out sections. All openings for penetrations shall be smooth and free of surface irregularities and without exposed steel reinforcing. Vaults need not be designed to resist thrust from piping passing through the vault.

H. Warning Signs

1. The entrance to every manhole and vault shall be fitted with a permanently affixed, plastic warning sign, located above and centered on the top step. Each sign shall be in accordance with Section 10400 - Identifying Devices.

2. Sign Manufacturer, or Equal

a. W. H. Brady Company

b. Seton Nameplate Corporation

PART 3 -- EXECUTION

3.1 GENERAL

A. Pre-cast concrete sections shall be transported and handled with care in accordance with the manufacturer's written recommendations. Where lifting devices are provided in pre-cast sections, such lifting devices shall be used as intended. Where no lifting devices are provided, the CONTRACTOR shall follow the manufacturer's recommendations for lifting procedures to provide proper support during lifting.

B. Buried pre-cast concrete vaults shall be assembled and placed in excavations on properly compacted soil foundations as indicated. Pre-cast concrete vaults shall be set to grade and oriented to provide the required dimensions and clearances from pipes and other structures.

C. Prior to backfilling, all cracks and voids in pre-cast concrete vaults shall be filled with non-shrink grout or polyurethane sealant, or both. Around pipe and conduit penetrations, openings shall be sealed with polyurethane sealant. With the authorization of the CONTRACTING OFFICER, grout or a closed-cell flexible insulation may be used as filler material prior to placing a final bed of polyurethane sealant.

- END OF SECTION -

SECTION 02565 - DUCTILE IRON PIPE (AWWA C151, MODIFIED)

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide ductile iron pipe and appurtenant work, complete in place, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards

AWWA C104	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C105	Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C110	Ductile-Iron and Gray-Iron Fittings, 3 in through 48 in for Water
AWWA C111	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115	Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C116	Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service.
AWWA C150	Thickness Design of Ductile-Iron Pipe
AWWA C151	Ductile-Iron Pipe, Centrifugally Cast for Water
AWWA C153	Ductile-Iron Compact Fittings. for Water Service
AWWA C600	Installation of Ductile Iron Water Mains and Their Appurtenances
AWWA C606	Grooved and Shouldered Joints
ASTM C 150	Portland Cement

1.3 CONTRACTOR SUBMITTALS

A. Furnish Shop Drawings of pipe and fittings in accordance with Section 01300 - Contractor Submittals, the requirements of the referenced standards and the following supplemental requirements as applicable:

1. Certified dimensional drawings of all valves, fittings, and appurtenances.

2. For pipe 12-inches in diameter and larger, line layout and marking diagrams which indicate the specific number of each fitting and the location and the direction of each fitting in the completed line. In addition, the line layouts shall include: the pipe station and invert elevation at all changes in grade or horizontal alignment; all elements of curves and bends, both in horizontal and vertical alignment; and the limits of each reach of restrained joints, or of concrete encasement.

B. **Certifications:** The CONTRACTOR shall furnish a certified affidavit of compliance for all pipe and other products or materials furnished under this Section and as specified in the referenced standards and the following supplemental requirements:

1. Physical and chemical properties.

2. Hydrostatic test reports.

C. The CONTRACTOR shall be responsible for performing and paying for sampling and testing as necessary for the certifications.

1.4 QUALITY ASSURANCE

A. **Tests:** Except as modified herein, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of the referenced standards as applicable.

B. The CONTRACTOR shall perform said material tests at no additional cost to the GOVERNMENT. The CONTRACTING OFFICER shall have the right to witness all testing conducted by the CONTRACTOR; provided, that the CONTRACTOR's schedule is not delayed for the convenience of the CONTRACTING OFFICER.

C. In addition to those tests specifically required, the CONTRACTING OFFICER may request additional samples of any material including lining and coating samples for testing by the GOVERNMENT. The additional samples shall be furnished as a part of the WORK.

D. **Inspection:** Pipe shall be subject to inspection at the place of manufacture in accordance with the provisions of the referenced standards, as supplemented by the requirements herein. The CONTRACTOR shall notify the CONTRACTING OFFICER in writing of the manufacturing starting date not less than 14 calendar days prior to the start of any phase of the pipe manufacture.

E. During the manufacture of the pipe, the CONTRACTING OFFICER shall be given access to all areas where manufacturing is in process and shall be permitted to make all inspections necessary to confirm compliance with the Specifications.

PART 2 -- PRODUCTS

2.1 PIPE GENERAL

A. Mortar-lined and polyethylene-wrapped ductile iron pipe shall conform to AWWA C151, C104, and C105, subject to the supplemental requirements in this Section. The pipe shall be of the diameter and class indicated, shall be provided complete with rubber gaskets, specials, and fittings as required under the Contract Documents.

B. **Markings:** The CONTRACTOR shall legibly mark specials 24-inches in diameter and larger in accordance with the laying schedule and marking diagram. Each fitting shall be marked at each end with top field centerline.

C. **Handling and Storage:** The pipe shall be handled as a minimum at the 1/3 points by use of wide slings, padded cradles, or other devices designed and constructed to prevent damage to the pipe coating/exterior. The use of chains, hooks, or other equipment that might injure the pipe coating/exterior will not be permitted. Stockpiled pipe shall be supported on padded skids, sand or earth berms free of rock exceeding 3 inches in diameter, sand bags, or suitable means so that the coating will not be damaged. The pipe shall not be rolled and shall be secured to prevent accidental rolling

D. **Laying Lengths:** Nominal pipe laying lengths shall be 20 ft.

E. **Finish:** The pipe shall have smooth dense interior surfaces and shall be free from fractures, excessive interior surface crazing, and roughness.

F. **Bonding and Electrical Conductivity:** All pipe joints shall be prepared for bonding for electrical conductivity in accordance with the details indicated. The CONTRACTOR shall furnish all materials required for joint bonding and electrolysis test station installations.

G. **Closures and Correction Pieces:** Closures and correction pieces shall be provided as required so that closures may be made due to different headings in the pipe laying operation and so that correction may be made to adjust the pipe laying to conform to pipe stationing on the Drawings. The locations of correction pieces and closure assemblies are shown on the Drawings. Any change in location or number of said items shall only be as accepted by the CONTRACTING OFFICER.

2.2 SPECIALS AND FITTINGS

A. Fittings for ductile iron pipe shall conform to the requirements of AWWA C153 or AWWA C110 and shall have a minimum pressure rating of 250 psi. Ductile iron fittings larger than 48-inches shall conform to AWWA C153.

2.3 DESIGN OF PIPE

A. The pipe shall be designed, manufactured, tested, inspected, and marked according to AWWA C150 and C 151 except where modified by this Section.

B. **Pipe Dimensions:** The pipe shall be of the diameter and class indicated.

C. **Fitting Dimensions:** The fittings shall be of the diameter and class indicated.

D. **Joint Design:** Ductile iron pipe and fittings shall be furnished with mechanical joints, push-on joints, flanged joints, or restrained joints as required.

1. Mechanical and push-on joints shall conform to AWWA C111.

2. Flanged joints shall conform to AWWA C115. Where threaded flanges are provided, the pipe wall thickness under the cut threads shall not be less than the calculated net thickness required for the pressure class of the pipe.

3. All yard piping in the Treatment Plant shall be restrained joints with **"Lok-Ring"** restrained joint by **American Ductile Iron Pipe**, **"TR FLEX"** restrained joint by **U.S. Pipe**, or equal. All other piping outside the Treatment Plant may be retained joints or push-on joints with concrete thrust blocks.

4. Joint restraining devices that impart point loads and/or wedging action on the pipe wall as a means of joint restraint shall not be allowed unless there are no other options for joint restraint available. Under such circumstances, the CONTRACTOR may propose such devices provided the following conditions are met and the request is made as a substitution:

    a. A formal request for substitution is submitted stating the location(s) where the devices are intended to be used and a statement from the device manufacturer and the pipe manufacturer that the proposed device is appropriate for the intended installation and rated at least for the class of the pipe being supplied.

    b. A statement from the pipe manufacturer is provided accepting the use of the retaining devices and indicating that the use of such devices will in no way affect the warranty of the pipe and/or the performance of the pipe.

    c. The manufacturer of the device and the pipe manufacturer jointly provide instruction on the proper installation of the device to the personnel installing the units and provide certification to the GOVERNMENT that the installers are adequately trained in the installation of the units and that all warranties are in full affect for the project.

    d. The devices shall be **MegaLug Model 1100** as manufactured by **EBAA Iron** or equal.

E. For bell-and-spigot ends with rubber gaskets, the clearance between the bells and spigots shall be such that when combined with the gasket groove configuration and the gasket itself, will provide watertight joints under all operating conditions when properly installed. The CONTRACTOR shall require the pipe manufacturer to submit details complete with significant dimensions and tolerances and also to submit performance data indicating that the proposed joint has performed satisfactorily under similar conditions. In the absence of a history of field performance, the results of a test program shall be submitted.

F. Shop-applied interior linings and exterior coatings shall be held back from the ends of the pipe as indicated.

2.4 CEMENT-MORTAR LINING

A. **Cement-Mortar Lining for Shop Application:** Except as otherwise provided herein, interior surfaces of all ductile iron pipe, fittings, and specials shall be cleaned and lined in the shop with cement-mortar lining applied centrifugally in conformity with AWWA C104. During the lining operation and thereafter, the pipe shall be maintained in a round condition by suitable bracing or strutting. The lining machines shall be of a type that has been used successfully for similar work. Every precaution shall be taken to prevent damage to the lining. If lining is damaged or found faulty at the Site, the damaged or unsatisfactory portions shall be replaced with lining conforming to these Specifications.

    1. **Cement:** Cement for mortar lining shall conform to the requirements of AWWA C104; provided, that cement for mortar lining shall be Type II or V. Cement shall not originate from kilns that burn metal-rich hazardous waste fuel, nor shall a fly ash or pozzolan be used as a cement replacement.

B. The minimum lining thickness shall be as follows:

Nominal Pipe Diameter (in)	Minimum Lining Thickness (in)
3-12	1/16
14-24	3/32
30-64	1/8

2.5 POLYURETHANE LINING

A. All ductile iron force mains shall be polyurethane lined. Polyurethane lining shall be in accordance with Section 09813.

2.6 EXTERIOR PROTECTION OF PIPE

A. **Exterior Coating of Exposed Piping:** The exterior surfaces of pipe which will be exposed to the atmosphere inside structures or above ground shall be thoroughly cleaned and then given a shop coat of rust-inhibitive primer conforming to the requirements of Section 09800 - Protective Coating.

B. **Exterior Coating of Buried Piping:** The exterior coating shall be an asphaltic coating a minimum thickness of 1 mil per AWWA C151, AWWA 115, AWWA C110, and AWWA C153.

C. **Polyethylene Sleeve:** Sleeves shall conform to the requirements of AWWA C105, CONTRACTOR's choice between tubular 8 mil thick linear low-density film or 4 mil thick high-density cross-laminated film. Color shall be black.

PART 3 -- EXECUTION

3.1 INSTALLATION OF PIPE

A. The CONTRACTOR shall inspect each pipe and fitting prior to installation to insure that there are no damaged portions of the pipe. Pipe damaged prior to Substantial Completion shall be repaired or replaced by the CONTRACTOR.

B. Before placement of pipe in the trench, each pipe or fitting shall be thoroughly cleaned of any foreign substance which may have collected thereon and shall be kept clean at all times thereafter. For this purpose, the openings of all pipes and fittings in the trench shall be closed during any interruption to the WORK.

C. **Pipe Laying:** The pipe shall be installed in accordance with AWWA C600.

D. Pipe shall be laid directly on the bedding material. No blocking will be permitted, and the bedding shall be such that it forms a continuous, solid bearing for the full length of the pipe. Excavations shall be made as needed to facilitate removal of handling devices after the pipe is laid. Bell holes shall be formed at the ends of the pipe to prevent point loading at the bells or couplings. Excavation shall be made as needed outside the

normal trench section at field joints to permit adequate access to the joints for field connection operations and for application of coating on field joints.

E. Each section of pipe 12-inches in diameter and larger shall be laid in the order and position shown on the laying schedule. Each section shall be laid to the set line and grade, within approximately one inch plus or minus.

F. Where necessary to raise or lower the pipe due to unforeseen obstructions or other causes, the CONTRACTING OFFICER may change the alignment and/or the grades. Such change shall be made by the deflection of joints, by the use of bevel adapters, or by the use of additional fittings. However, in no case shall the deflection in the joint exceed 75 percent of the maximum deflection recommended by the pipe manufacturer. No joint shall be misfit any amount that will be detrimental to the strength and water tightness of the finished joint.

G. Except for short runs that may be permitted by the CONTRACTING OFFICER, pipes shall be laid uphill on grades exceeding 10 percent. Pipe that is laid on a downhill grade shall be blocked and held in place until sufficient support is furnished by the following pipe to prevent movement. Bends shall be properly installed as indicated.

H. **Cold Weather Protection:** No pipe shall be installed upon a foundation into which frost has penetrated or at any time that there is a danger of the formation of ice or penetration of frost at the bottom of the excavation before backfilling occurs.

I. **Pipe and Specials Protection:** The openings of all pipe and specials shall be protected with suitable bulkheads to prevent unauthorized access by persons, animals, water or any undesirable substance. At all times, means shall be provided to prevent the pipe from floating.

J. **Pipe Cleanup:** As pipe laying progresses, the CONTRACTOR shall keep the pipe interior free of all debris. The CONTRACTOR shall completely clean the interior of the pipe of all sand, dirt, mortar splatter, and any other debris following completion of pipe laying and shall perform any necessary interior repairs prior to testing and disinfecting the completed pipeline.

3.2 RUBBER GASKETED JOINTS

A. **Rubber Gasketed Joints:** Immediately before jointing pipe, the bell end of the pipe shall be thoroughly cleaned, and a clean rubber gasket shall be placed in the bell groove. The spigot end of the pipe and the inside surface of the gasket shall be carefully cleaned and lubricated. The lubricant shall be suitable for lubricating the parts of the joint for assembly and be a compound listed as in compliance with NSF Standard 61. The lubricant shall be nontoxic, shall not support the growth of bacteria, and shall have no deleterious effects on the gasket material. The lubricant shall not impart taste or odor to water in the pipe. The spigot end of the pipe section shall then be inserted into the bell of the previously laid joint and telescoped into its proper position. Tilting of the pipe to insert the spigot into the bell will not be permitted.

3.3 POLYETHYLENE SLEEVE PROTECTION

A. Buried ductile iron pipe shall be polyethylene encased in accordance with the requirements of AWWA C105, CONTRACTOR's choice between Method A or Method B.

3.4 INSTALLATION OF PIPE APPURTENANCES

A. **Protection of Appurtenances:** Where the joining pipe is dielectric-coated, buried appurtenances shall be coated in kind. Where pipe is encased in polyethylene sleeves, buried appurtenances shall also be encased in polyethylene.

B. **Installation of Valves:** Valves shall be handled in a manner to prevent any injury or damage to any part of the valve. Joints shall be thoroughly cleaned and prepared prior to installation. The CONTRACTOR shall adjust all stem packing and operate each valve prior to installation to insure proper operation.

C. Valves shall be installed so that the valve stems are plumb and in the location indicated.

3.5 CORROSION CONTROL

A. **Joint Bonding/Electrolysis Test Stations:** Except where otherwise indicated, all joints shall be bonded. The pipe shall be cleaned to bare bright metal at the point where the bond is installed. In addition, electrolysis test stations shall be installed where indicated.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 02572 - STEEL PIPE FABRICATED SPECIALS (AWWA C200, MODIFIED)

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide bends, reducers, wyes, tees, crosses, outlets, manifolds, and other steel plate specials, complete in place, in accordance with the Contract Documents.

B. A single pipe manufacturer shall be made responsible for furnishing all the specials.

1.2 CONTRACTOR SUBMITTALS

A. **Shop Drawings:** The CONTRACTOR shall submit Shop Drawings and laying diagrams of pipe, joints, bends, reducers, wyes, tees, crosses, outlets, manifolds, and other steel plate specials in accordance with Section 01300 - Contractor Submittals.

B. Design calculations shall be submitted to the CONTRACTING OFFICER for review prior to manufacture of pipe specials.

C. **Certifications:** A certified affidavit of compliance shall be furnished for all steel plate specials and other products or materials furnished under this Section.

D. **Manufacturer's Qualifications:** Furnish a copy of manufacturer's certification by SPFA or LRQA and documentation of manufacturer's experience in fabricating AWWA C200 pipe.

1.3 QUALITY ASSURANCE

A. **Manufacturer Qualifications:** The manufacturer shall be certified by the Steel Plate Fabricator's Association (SPFA) or Lloyd's Register Quality Assurance (LRQA) and shall be experienced in fabrication of AWWA C200 pipe of similar diameters, lengths, and wall thickness to the WORK. Experience shall be in the production facilities and personnel, not the name of the company that owns the production facility or employs the personnel.

B. Shop Testing of Steel Plate Specials

1. If any special has been fabricated from straight pipe not previously tested and is of the type listed below, the special shall be hydrostatically tested with a pressure equal to 1-1/2 times the design working pressure: all bends, wyes, crosses, tees with side outlet diameter greater than 30 percent of the main pipe diameter, and manifolds.

2. All specials not required to be hydrostatically tested shall be tested by liquid dye penetrant inspection method in accordance with ASTM E 165 - Standard Test Methods for Liquid Penetrant Examination, Method A or the magnetic particle method in ASME Section VIII, Division 1, Appendix VI.

3. Reinforcing plates shall be tested by the solution method using approximately 40 psi air pressure introduced between the plates through a threaded test hole. Test hole shall be properly plugged following successful testing.

4. Any weld defects, cracks, leaks, distortion, or signs of distress during testing shall require corrective measures. Weld defects shall be gouged out and rewelded. After corrections, the special shall be retested.

5. Where welded test heads or bulkheads are used, extra length shall be provided to each opening of the special. After removal of each test head, the special shall be trimmed back to the design points with all finished plate edges ground smooth, straight, and prepared for the field joint.

6. Testing shall be performed before joints have been coated or lined.

C. Ultrasonic Examination:

1. Steel plate that will be in welded joints or welded stiffener elements shall be examined ultrasonically for laminar discontinuities where both of the following conditions exist:

   a. Any plate in the welded joint has a thickness exceeding 1/2-inch.

   b. Any plate in the welded joint is subject to transverse tensile stress through its thickness during the welding or service.

2. Ultrasonic examination may be waived where joints are designated to minimize potential laminar tearing.

3. The ultrasonic examination shall be in accordance with ASTM A 578 - Straight Beam Ultrasonic Examination of Plain and Clad Steel Plates for Special Applications with a Level I acceptance standard.

4. Plates that are not in conformance with the acceptance criteria in ASTM A 578 may be used in the WORK if the areas that contain the discontinuities are a distance at least four times the greatest dimension of the discontinuity away from the weld joint.

D. **Field Testing:** Field testing shall conform to the requirements of Section 01656 - Pressure Pipe Testing and Disinfection.

E. **Welding Requirements:** Welding procedures used to fabricate pipe shall be prequalified under the provisions of ANSI/AWS D1.1 or ASME Pressure Vessel Code, Section 9. Welding procedures shall be required for longitudinal and girth or spiral welds for pipe cylinders, spigot and bell ring attachments, reinforcing plates and ring flange welds, and plates for lug connections.

F. **Welder Qualifications:** Welding shall be done by skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used. Welders shall be qualified under the provisions of ANSI/AWS D1.1 or ASME Pressure Vessel Code, Section 9 by an independent local, approved testing agency not more than 6 months prior to commencing work on the pipeline. Machines and electrodes similar to those used in the WORK shall be used in qualification tests. The CONTRACTOR shall be responsible for the expense of qualifying welders as part of the WORK.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Specials are defined as fittings, closure pieces, bends, reducers, wyes, tees, crosses, outlets, manifolds, and other steel plate specials wherever located, and all piping above ground or in structures.

2.2 DESIGN

A. **Design:** Except as otherwise indicated, materials, fabrication and shop testing of straight pipe shall conform to the requirements of ANSI/AWWA C200 - Steel Water Pipe 6 in and Larger, and shall conform to the dimensions of ANSI/AWWA C208 - Dimensions for Fabricated Steel Water Pipe Fittings. The minimum thickness of plate for pipe from which specials are to be fabricated shall be the greatest of those determined by the following 4 criteria:

1. Working and Transient Pressure Design

$$T = \frac{P_w D/2}{Y/S_w} \qquad T = \frac{P_t D/2}{Y/S_t}$$

Where:
- T = Steel cylinder thickness in inches
- D = Outside diameter of steel cylinder in inches
- P_w = Design working pressure in psi
- P_t = Design transient pressure in psi
- Y = Specified minimum yield point of steel in psi
- S_w = Safety factor of 2.5 at design working pressure
- S_t = Safety factor at design transient pressure; for elbows 1.875, and 2.0 for other specials

2. Mainline Pipe Thickness: Plate thickness for specials shall not be less than for the adjacent mainline pipe.

3. Thickness based on Pipe Diameter:

Nominal Pipe Diameter (in)	**Pipe Manifolds, Piping Above Ground, Piping Structures**	**Elbows, Bends, Reducers**
24 and under	3/16-in	10-ga
25 to 48	1/4-in	1/4-in
over 48	5/16-in	5/16-in

B. Specials installed on saddle supports shall be designed to limit the longitudinal bending stress to a maximum of 10,000 psi. Design shall be in accordance with the provisions of Chapter 7 of AWWA M-11.

2.3 FABRICATION AND MATERIALS

A. General

1. Mortar: Materials for mortar shall conform to the requirements of ANSI/AWWA C205 - Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4-inch and Larger -Shop Applied; provided, that cement for mortar coating shall be Type II, and mortar lining shall be Type II or V. Cement in mortar lining and coating shall not originate from kilns that burn metal-rich hazardous waste fuel, nor shall a fly ash or pozzolan be used as a cement replacement. Admixtures shall contain no calcium chloride.

2. Reinforcement for wyes, tees, outlets, and nozzles shall be designed in accordance with AWWA Manual M-11. Reinforcement shall be designed for the design pressure indicated and shall be in accordance with the Drawings. Specials and fittings shall be equal in pressure design strength and shall have the same lining and coating as the adjoining pipe. Unless otherwise indicated, the minimum radius of elbows shall be 2.5 times the pipe diameter and the maximum miter angle on each section of the elbow shall not exceed 11-1/4 degrees.

B. Specials and fittings that cannot be mechanically lined and coated shall be lined and coated by hand-application using the same materials as used for the pipe and in accordance with the applicable AWWA or ASTM Standards, as modified by the applicable pipe section in these Specifications. Coating and lining applied in this manner shall provide protection equal to that for the pipe. Fittings may be fabricated from pipe that has been mechanically lined and/or coated. Areas of lining and coating that have been damaged by such fabrication shall be repaired by hand-applications.

C. Access manholes with covers shall be as indicated. Threaded outlets shall be forged steel suitable for 3000 psi service, and shall be as manufactured by **Vogt** or equal.

D. Moderate deflections and long radius curves may be made by means of beveled joint rings, by pulling standard joints, by using short lengths or pipe, or a combination of these methods; provided that pulled joints shall not be used in combination with bevels. The maximum total allowable angle for beveled joints shall be 5 degrees per pipe joint. Bevels shall be provided on the bell ends. Mitering of the spigot ends will not be permitted. The maximum allowable angle for pulled joints shall be in accordance with the manufacturer's recommendations or the angle which results from a 3/4-inch pull out from normal joint closure, whichever is less. All horizontal deflections or fabricated angles shall fall on the alignment. In congested city streets or at other locations where underground obstructions may be encountered, the chord produced by deflecting the pipe shall be no further than 6 inches from the alignment indicated.

E. Vertical deflections shall fall on the alignment and at locations adjacent to underground obstructions, points of minimum earth cover, and pipeline outlets and structures. The pipe angle points shall match the angle points indicated.

F. Outlets, Tees, Wyes, and Crosses

1. Outlets 12-inch and smaller may be fabricated from Schedule 30 or heavier steel pipe in the standard outside diameters, i.e., 12-3/4-inch, 10-3/4-inch, 8-5/8-inch, 6-5/8-inch, and 4-1/2-inch. Minimum plate thickness for reinforcements shall be 10-gauge.

2. The design of outlet reinforcement shall be in accordance with the procedures given in Chapter 13 of AWWA Manual M-11, and the design pressures and factors of safety above.

3. In lieu of saddle or wrapper reinforcement as provided by the design procedure in Manual M-11, pipe or specials with outlets may be fabricated in their entirety of steel plate having a thickness equal to the sum of the pipe wall plus the required reinforcement.

4. Where Manual M-11 requires the design procedure for crotch plate reinforcement, such reinforcement shall be provided.

5. Outlets shall be fabricated so that there is always at least a 12-inch distance between the outer edge of the reinforcing plate and any field welded joints. For outlets without reinforcing plates, outlets shall penetrate the steel cylinders so that there is at least a 12-inch clearance between the outlet and any field-welded joints.

6. Tees, wyes, crosses, elbows, and manifolds shall be fabricated so that the outlet clearances and reinforcing plates from any weld joints are a minimum of 5 times cylinder thickness or 2-inches, whichever is greater. Longitudinal weld joints in adjacent cylinder sections shall be oriented so that there is a minimum offset of 5 times cylinder thickness or 2-inches, whichever is greater.

G. **Steel Welding Fittings:** Steel welding fittings shall conform to ASTM A 234 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

H. **Ends for Mechanical-Type Couplings:** Except as otherwise indicated, where mechanical-type couplings are indicated, the ends of pipe shall be banded with Type C collared ends using double fillet welds. Where pipe 12-inch and smaller is furnished in standard schedule thicknesses, and where the wall thickness equals or exceeds the coupling manufacturer's minimum wall thickness, the pipe ends may be grooved.

I. Lining shall conform to the requirements of ANSI/AWWA C205 - Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 in and Larger - Shop Applied, for lining of specials.

J. **Coating:** All requirements pertaining to thickness and application of coating of adjacent straight pipe shall apply to specials. Unless otherwise indicated, the coating on the buried portion of a pipe section passing through a structure wall shall extend to the center of the wall, or to a wall flange, if one is indicated. Pipe above ground or in structures shall be field-painted in accordance with Section 09800 - Protective Coating.

K. **Marking:** A mark indicating the true vertical axis of the special shall be placed on the top and bottom of the special.

PART 3 -- EXECUTION

3.1 GENERAL

A. The CONTRACTOR shall provide all fittings, closure pieces, bends, reducers, wyes, tees, crosses, outlets, manifolds, and other steel plate specials, bolts, nuts, gaskets, jointing materials, and all other appurtenances as required to provide a complete and

workable installation. Where pipe support details are indicated, the supports shall conform thereto and shall be placed as indicated; provided, that the support for all exposed piping shall be complete and adequate regardless of whether or not supporting devices are specifically indicated. Where indicated, concrete thrust blocks and welded joints shall be provided. At all times when the WORK of installing pipe is not in progress, openings into the pipe and the ends of the pipe in trenches or structures shall be kept tightly closed to prevent entrance of animals and foreign materials. The CONTRACTOR shall take all necessary precautions to prevent the pipe from floating due to water entering the trench from any source, shall assume full responsibility for any damage due to this cause, and shall at its own expense restore and replace the pipe to its required condition and grade if it is displaced due to floating. The CONTRACTOR shall maintain the inside of the pipe free from foreign materials and in a clean and sanitary condition until acceptance by the GOVERNMENT.

3.2 LAYING

A. Trenches shall be in a reasonably dry condition when the pipe special is laid. Necessary facilities including slings shall be provided for lowering and properly placing the pipe sections in the trench without damage. The pipe and specials shall be laid to the line and grade indicated and shall be closely jointed to form a smooth flow line. Immediately before placing each section of pipe in final position for jointing, the bedding shall be checked for firmness and uniformity of surface.

- END OF SECTION -

SECTION 02574 - STEEL YARD PIPING

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide yard piping and fittings including welded steel pipe, complete in place, in accordance with the Contract Documents.

B. A single pipe manufacturer shall be made responsible for furnishing all the steel pipe and smaller diameter appurtenant steel pipe, if appurtenant steel pipe is required by the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards

ANSI/ASTM A 139	Electric-Fusion (Arc) - Welded Steel Pipe (Sizes 4-in and over)
ANSI/ASTM E 165	Standard Test Method for Liquid Penetrant Examination
ANSI/AWS D1.1	Structural Welding Code
ANSI/AWWA C200	Steel Water Pipe 6 Inches and Larger
ANSI/AWWA C205	Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 Inches and Larger - Shop Applied
ANSI/AWWA C206	Field Welding of Steel Water Pipe
ASTM A 36	Carbon Structural Steel
ASTM A 283	Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A 570	Steel Sheet and Strip, Carbon, Hot-Rolled, Structural Quality
ASTM A 572	High-Strength Low-Alloy Columbium-Vanadium Structural Steel
AWWA M 11	Steel Pipe - A Guide for Design and Installation.

1.3 CONTRACTOR SUBMITTALS

A. **Shop Drawings:** The CONTRACTOR shall submit Shop Drawings of pipe and fittings in accordance with the requirements of Section 01300 - Contractor Submittals, the requirements of the referenced standards, and the following supplemental requirements as applicable:

1. Certified dimensional drawings of all valves, fittings, and appurtenances.

2. Joint and pipe wall construction details which indicate the type and thickness of pipe cylinder; the position, type, size, and area of wire or reinforcement, as applicable; manufacturing tolerances; and all other pertinent information required for the manufacture of the product.

3. Design calculations to ascertain conformance of pipe and fittings with the Specifications.

4. Reinforcement on all fittings to withstand the internal pressure, both circumferential and longitudinal, and the external loading conditions indicated.

5. Material lists and steel reinforcement schedules as applicable.

6. Line layout and marking diagrams.

7. Location, type, size, and extent of all welds distinguishing between shop and field welds.

B. **Certifications:** The CONTRACTOR shall furnish a certified affidavit of compliance for all pipe and other products or materials furnished under this Section of the Specifications, as specified in the applicable referenced standards, and the following supplemental requirements:

1. Physical and chemical properties of all steel and/or ductile iron.

2. Hydrostatic test reports.

3. Results of production weld tests as applicable.

C. **Manufacturer's Qualifications:** Furnish a copy of manufacturer's certification by SPFA or LRQA and documentation of manufacturer's experience in fabricating AWWA C200 pipe.

1.4 QUALITY ASSURANCE

A. **Pipe Manufacturer Qualifications:** The pipe manufacturer shall be certified by the Steel Plate Fabricator's Association (SPFA) or Lloyds Register Quality Assurance (LRQA) and shall be experienced in fabrication of AWWA C200 pipe of similar diameters, lengths, and wall thicknesses to the WORK. Experience shall be in the production facilities and personnel, not the name of the company that owns the production facility or employs the personnel.

B. **Inspection:** All pipe shall be subject to inspection at the place of manufacture in accordance with the provisions of the applicable referenced standards as supplemented by the requirements herein. The CONTRACTOR shall notify the CONTRACTING OFFICER in writing of the manufacturing starting date not less than 14 calendar days prior to the start of any phase of the pipe manufacture.

C. **Tests:** Unless otherwise indicated, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of the applicable reference standards. The CONTRACTOR shall be responsible performing and paying for said material tests. The CONTRACTING OFFICER shall have the right to witness all testing conducted by the CONTRACTOR; provided that the CONTRACTOR's schedule is not delayed for the convenience of the CONTRACTING OFFICER. In addition to those tests

specifically required, the CONTRACTING OFFICER may request additional samples of any material including mixed concrete and lining and coating samples for testing by the GOVERNMENT. The additional samples shall be furnished as a part of the WORK.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Yard piping shall conform to the applicable reference standards and as indicated below.

2.2 WELDED STEEL PIPE AND FITTINGS

A. General

1. Buried welded steel pipe and fittings, mortar lined and mortar coated, shall conform to ANSI/AWWA C200 and C205, Section 02572 - Steel Pipe Fabricated Specials, and the following applicable supplemental requirements.

2. Above-ground or exposed welded steel pipe and fittings mortar lined and paint coated shall conform to ANSI/AWWA C200 and C205, Section 02572 - Steel Pipe Fabricated Specials, Section 09800 - Protective Coating, and the following applicable supplemental requirements.

3. For pipe 14-inches in diameter and larger, the inside diameter after lining shall not be less than the nominal diameter indicated. Pipe smaller than 14-inches in diameter may be furnished in standard outside diameters.

4. Cement for mortar shall conform to ANSI/AWWA C205; provided that cement for mortar coating and mortar lining shall be Type II or V. A fly ash or pozzolan shall not be used as a cement replacement.

5. All welding procedures used to fabricate pipe shall be prequalified under the provisions of ANSI/AWS D1.1. Welding procedures shall be required for, but not necessarily limited to, longitudinal and girth or spiral welds for pipe cylinders, spigot and bell ring attachments, reinforcing plates and ring flange welds, and plates for lug connections.

6. All welding shall be done by skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used. Welders shall be qualified under the provisions of ANSI/AWS D1.1 by an independent local, approved testing agency not more than 6 months prior to commencing the pipe work. Machines and electrodes similar to those used in the WORK shall be used in qualification tests. The CONTRACTOR shall furnish all material and bear the expense of qualifying welders.

7. In addition to the tests required under ANSI/AWWA C200, weld tests shall be conducted on each 5,000-feet of production welds and at other times there is a change in the grade of steel, welding procedure, or welding equipment.

8. The CONTRACTOR shall legibly mark all pipes and specials in accordance with the laying schedule and marking diagram. Each pipe shall be numbered in sequence and said number shall appear on the laying schedule and marking diagram in its proper location for installation. All special pipe sections and fittings shall be marked at each end with top field centerline.

9. Closures and correction pieces shall be provided as required so that closures may be made due to different headings in the pipe laying operation and so that correction may be made to adjust the pipe laying to conform to pipe stationing shown. The locations of correction pieces and closure assemblies are shown. Any change in location or number of said items will have to be approved by the CONTRACTING OFFICER.

10. Maximum pipe laying lengths shall be 40-feet with shorter lengths provided as required by the Drawings.

11. Details of the strutting assembly shall be submitted for review by the CONTRACTING OFFICER prior to start of pipe manufacture.

B. **Design Criteria:** Pipe shall be designed in accordance with AWWA Manual M 11 as modified hereinbelow. Unless otherwise indicated, the minimum thickness of the steel cylinder for welded steel pipe shall be the greater of the following criteria:

1. For resistance to internal pressure, the thickness of the steel cylinder shall be the greater of that determined by the following 2 formulas:

$$T = \frac{P_w D/2}{Y/S_w} \quad \text{or} \quad T = \frac{P_t D/2}{Y/S_t}$$

Where:
- T = Steel cylinder thickness in inches.
- D = Outside diameter of steel cylinder in inches.
- P_w = Design working pressure in psi.
- P_t = Design transient pressure in psi.
- Y = Yield point of steel in psi.
- S_w = Safety factor of 2.5 at design working pressure.
- S_t = Safety factor of 1.875 at design transient pressure.

In no case shall the design stress for mortar coated welded steel pipe exceed 16,500 psi at design working stress (Y/S_w) or 22,000 psi at design transient stress (Y/S_t). Unless otherwise specified, P_w shall be assumed to equal the pipe class and P_t shall be assumed to equal 1.33 P_w.

2. For resistance to external load on buried pipe and for handling and transport, the thickness of the steel cylinder shall not be less than the thickness of adjacent mainline pipe or the cylinder thicknesses in the following table:

Nominal Pipe Diameter (in)	Minimum Cylinder Thickness at 95% Std. Proctor (in)	Cover Where Lean Concrete Encasement Required (ft)	Cover Where Reinf. Concrete Encasement Required (ft)
18 and under	0.1875	over 38	over 43
over 18 to 24	0.1875	over 22	over 27
over 24 to 36	0.250	over 15	over 20
over 36 to 48	0.250	over 11	over 17
over 48 to 60	0.3125	over 11	over 16
over 60 to 72	Nom. Diam./192	over 10	over 16

In no case shall the vertical deflection of the pipe exceed 1.5 percent of the nominal diameter.

3. For above-ground/exposed pipe on saddle supports, the thickness of the steel cylinder shall also be designed to limit the longitudinal bending stress to a maximum of 10,000 psi. Design shall be in accordance with the provisions of Chapter 7 of AWWA Manual M 11.

C. Steel Cylinder

1. Welded steel pipe conforming to ANSI/AWWA C200 shall be fabricated from sheet conforming to ASTM A 570, Grades 30, 33, 36 or 40; or from plate conforming to ASTM A 36, A 283, Grades C or D, or A 572, Grade 42; or coil conforming to ANSI/ASTM A 139, Grades B or C.

2. All steel used for the fabrication of pipe shall have a maximum carbon content of 0.25 percent and shall have a minimum elongation of 22 percent in a 2-inch gage length.

3. All steel exceeding 1/2-inch in thickness used in fabricating pipe shall be tested for notch toughness using the Charpy V-Notch test (transverse). The steel shall withstand a minimum impact of 25 ft-lbs at a temperature of 30 degrees F.

D. Lining

1. Unless otherwise indicated, welded steel pipe, whether buried or aboveground/ exposed, shall be lined with cement mortar in accordance with ANSI/AWWA C205 except the lining thickness shall be as follows, and the cement shall not originate from kilns which burn metal-rich hazardous waste fuel.

Nominal Pipe Diameter (in)	Lining Thickness (in)	Lining Tolerance (in)
4-11	5/16	plus and minus 5/64
12-16	3/8	plus and minus 3/32
17-24	1/2	plus and minus 1/8
over 24	3/4	plus and minus 3/16

2. In the case of a steel reservoir, the drain line and overflow line shall be lined with the same material and to the same thickness as indicated for the interior of the reservoir shell. The inlet-outlet line shall be cement mortar lined.

3. In the case of pump barrels, thickness of interior mortar lining shall be 3/4-inch.

E. Coating

1. All buried pipe, pipe to be installed in concrete encasement, and pipe larger than 2-inch in diameter inside concrete reservoirs and inside concrete hydraulic structures, shall receive a 1-inch thick reinforced cement mortar coating. The coating shall be reinforced with spirally-wound No. 14 gage steel wire spaced at 1/2-inch centers or No. 12 gage steel wire spaced at 1-inch centers, positioned approximately at the center of the mortar coating; or in lieu of the spirally-wound wire, the coating shall be reinforced with 2-inch by 4-inch No. 12 welded wire fabric crimped or otherwise fastened with welded clips or strips or metal so as to hold the wire approximately at the center of the mortar coating. The wires spaced 2 inches on centers shall extend circumferentially around the pipe with the fabric securely fastened to the pipe. Splices shall be lapped 4 inches and the free ends tied or looped to assure continuity. Cement, sand, and water shall be mixed in the proportions of one part cement to not more than 2 parts sand. After the cement mortar coating has been applied, the pipe shall be cured to 7 days under sprinklers. Provision shall be made to protect the coating from erosion during sprinkling. The date of coating shall be plainly marked on the inside of each pipe length. Unless otherwise shown, pipe passing through structure walls shall be cement mortar coated from the center of the wall or from the wall flange to the end of the underground portion of the pipe.

2. Aboveground or exposed welded steel pipe shall be cleaned, primed, and finish-painted in accordance with Section 09800 - Protective Coating.

3. In the case of a steel reservoir, unless otherwise indicated, the exterior surfaces of welded steel pipe inside the reservoir shall be thoroughly cleaned and coated with the same material and to the same thickness as the interior of the reservoir shell.

F. Joints

1. Unless otherwise indicated, all joints in welded steel pipe shall be rubber gasketed joints, circumferentially welded in the field using slip-bell joints or butt-welding straps. Where butt straps are used, 5-inch diameter hand holes shall be provided to facilitate repair of the mortar lining.

2. Lap joints prepared for field welding shall be in accordance with ANSI/AWWA C200. The method used to form, shape, and size weld ends shall be such that the physical properties of the steel are not substantially altered. Unless otherwise approved by the CONTRACTING OFFICER, bell ends shall be formed by an expanding press or by being moved axially over a die in such a manner as to stretch the steel plate beyond its elastic limit to form a truly round bell of suitable diameter and shape. No process will be permitted in which the bell is formed by rolling. Faying surfaces of the bell and spigot shall be essentially parallel, but in no case shall the bell slope vary more than 2 degrees from the longitudinal axis of the pipe.

3. Moderate deflections and long radius curves may be made by means of beveled joint rings, by pulling standard joints, by using short lengths of pipe, or a combination of these methods; provided that pulled joints shall not be used in combination with bevels. The maximum total allowable angle for beveled joints shall be 5 degrees per pipe joint. Where bells are fabricated by expansion only, bevels shall be provided on the bell ends and mitering of the spigot ends will not be permitted. For Carnegie joint ring ends, the bevel may be fabricated on the spigot ends. The maximum allowable angle for pulled joints shall be in accordance with the Manufacturer's recommendations or the angle which results from a 3/4-inch pull out from normal joint closure, whichever is less. All horizontal deflections of fabricated angles shall fall on the alignment. All vertical deflections shall fall on the alignment and at locations adjacent to underground obstructions, points of minimum earth cover, and pipeline outlets and structures, the pipe angle points shall meet the angle points indicated.

4. Unless otherwise indicated, where mechanical-type couplings are shown, the end of the pipe shall be banded with Type C collared ends using double fillet welds. Where pipe 12-inch and smaller is furnished in standard schedule thicknesses and where the wall thickness equals or exceeds the coupling manufacturers' minimum wall thickness, the pipe ends may be grooved.

G. **Pipe Appurtenances:** Pipe appurtenances shall be in accordance with Section 15000 - Piping, General.

H. **Fittings:** Fittings shall be in accordance with Section 02572 - Steel Pipe Fabricated Specials.

I. **Corrosion Control:** All unwelded pipe joints shall be designed to be bonded for electrical conductivity in accordance with the details shown. In addition, electrolysis test stations shall be in accordance with the details shown.

PART 3 -- - EXECUTION

3.1 GENERAL

A. General

1. Pipe shall be installed in accordance with the applicable reference standards and the supplemental requirements herein.

2. Where necessary to raise or lower the pipe due to unforeseen obstructions or other causes, the CONTRACTING OFFICER may change the alignment and/or the grades. Such change shall be made by the deflection of joints, by the use of bevel adapters, or by the use of additional fittings. However, in no case shall the deflection in the joint exceed the maximum deflection recommended by the pipe manufacturer. No joint shall be misfit any amount that will be detrimental to the strength and water tightness of the finished joint.

3. Except for short runs, which may be permitted by the CONTRACTING OFFICER, pipe shall be laid uphill if on grades exceeding 10 percent. Pipe that is laid on a downhill grade shall be blocked and held in place until sufficient support is furnished by the following pipe to prevent movement.

4. No pipe shall be installed upon a foundation into which frost has penetrated or at any time that there is a danger of the formation of ice or penetration of frost at the bottom of the excavation. No pipe shall be laid unless it can be established that the trench will be backfilled before the formation of ice and frost occurs.

5. As pipe laying progresses, the CONTRACTOR shall keep the pipe interior free of all debris. The CONTRACTOR shall completely clean the interior of the pipe of all sand, dirt, and any other debris following completion of pipe laying, pointing or joints as applicable, and any necessary interior repairs prior to testing and disinfecting the completed pipeline.

B. Installation of Pipeline Appurtenances

1. Unless otherwise indicated, buried appurtenances shall be coated with the same material and thickness as the adjoining pipe.

2. All valves shall be handled in a manner to prevent any injury or damage to any part of the valve. The CONTRACTOR shall adjust all stem packing and operate each valve prior to installation to insure proper operation. All valves shall be installed so that the valve stems are plumb and in the location shown.

C. **Testing and Disinfection:** The completed pipeline shall be tested and disinfected in accordance with Section 01656 - Pressure Pipe Testing and Disinfection.

3.2 WELDED STEEL PIPE AND FITTINGS

A. **General:** Pipe shall be installed in accordance with AWWA Manual M 11 as modified below.

B. Handling and Storage

1. The pipe shall be handled by use of wide fabric slings, padded cradles, or other devices acceptable to the CONTRACTING OFFICER, which are designed and constructed to prevent damage to the pipe coating. The use of chains, hooks, or other equipment that might injure the pipe coating will not be permitted. Stockpiled pipe shall be supported on sand or earth berms free of rock exceeding 3-inches in diameter. The pipe shall not be rolled and shall be secured to prevent accidental rolling.

2. Adequate strutting shall be provided so as to avoid damage to the pipe and fittings during handling, storage, hauling, and installation. The strutting shall be placed as soon as practicable after the mortar lining has been applied and shall remain in place while the pipe is loaded, transported, unloaded, installed, and backfilled at the jobsite. The strutting materials, size, and spacing shall be adequate to support the earth backfill plus any greater loads that may be imposed by the backfilling and compaction equipment.

3. The CONTRACTOR shall inspect each pipe and fitting to ensure that there are no damaged portions of the pipe. No pipe or fitting shall be installed where the lining or coating shows cracks that may be harmful as determined by the CONTRACTING OFFICER. The CONTRACTOR shall remove or smooth out any burrs, gouges, weld splatter, or other small defects prior to laying the pipe. At all times when the installation of the pipe is not in progress, all openings into the pipe and the ends of the pipe in the trenches shall be kept tightly closed with suitable bulkheads to prevent entrance of animals and foreign materials and to maintain a moist atmosphere to prevent drying out of the interior of the pipe.

C. Pipe Laying

1. Trench excavation, bedding, and backfill shall be in accordance with Section 02200 -Earthwork.

2. The CONTRACTOR shall take all necessary precautions to prevent the pipe from floating due to water entering the trench from any source, shall assume full responsibility for any damage due to this cause, and shall restore and replace the pipe to its required condition and grade if it is displaced due to flotation.

3. Each section of pipe shall be laid in the order and position shown on the laying diagrams and to the line and grade shown. Pipe shall be laid directly on the bedding material. No blocking will be permitted, and the bedding shall be such that it forms a continuous, solid bearing for the full length of the pipe. Excavations shall be made as needed to facilitate removal of handling devices after the pipe is laid. Bell holes shall be formed at the ends of the pipe to prevent point loading at the bells or couplings. Excavation shall be made as needed outside the normal trench section at field joints to permit adequate access to the joints for field welding or connection operations and for application of coating on field joints.

4. Pipe struts shall be left in place until backfilling operations have been completed for pipe 42-inches in diameter and larger. After the backfill has been placed, the struts shall be removed. Struts in pipe smaller than 42-inches in diameter may be removed immediately after laying; provided that the deflection of the pipe during and after backfilling does not exceed that specified.

5. Where required by the CONTRACTING OFFICER, all pipe, 36-inches in diameter and larger, which has been installed and backfilled to the minimum required compaction, shall be tested by the CONTRACTOR in the presence of the CONTRACTING OFFICER to insure that the vertical deflections for welded steel pipe do not exceed the maximum allowable deflection specified. Deflection tests shall be performed not sooner than 30 days after completion of placement and densification of backfill and removal of pipe struts, if any. The CONTRACTOR shall submit to the CONTRACTING OFFICER for acceptance, the method proposed to determine the deflections. Unless otherwise permitted by the CONTRACTING

OFFICER, any overdeflected pipe shall be uncovered and, if not damaged, reinstalled. Damaged pipe shall not be reinstalled but shall be removed from the jobsite. Any pipe subjected to any method or process other than removal, which attempts, even successfully, to reduce or cure any over deflection, shall be uncovered, removed from the jobsite, and replaced with new pipe. All costs incurred by the CONTRACTOR attributable to deflection testing, including any delays, shall be borne by the CONTRACTOR at no cost to the GOVERNMENT.

D. Joints

1. Welded Joints: Field welded joints shall be in accordance with ANSI/AWWA C206. During installation of welded steel pipe in either straight alignment or on curves, the pipe shall be laid so that, at any point around the circumference of the joint, there is a minimum lap of 1/2-inch and a minimum space of 3/4-inch plus the thickness of the steel pipe wall between the spigot end of the pipe and the nearest tangent to a bell radius. Butt-straps, where used or required, shall be a minimum of 6-inches wide, the same thickness as the pipe wall, and shall provide for a minimum 3/4-inch lap at each pipe joint. After the pipe sections are properly positioned in the trench, the length of pipe between joints shall be backfilled to at least one foot above the top of the pipe. Care shall be exercised during the initial backfilling to prevent movement of the pipe and to prevent any backfill material from being deposited on the joint. Prior to beginning the welding procedure, any tack welds used to position the pipe during laying shall be removed. Any annular space between the faying surfaces of the bell and spigot shall be equally distributed around the circumference of the joint by shimming, jacking, or other suitable means. Where more than one weld pass is required, each pass, except the first and final one, shall be peened to relieve shrinkage stresses; and all dirt, slag, and flux shall be removed before the succeeding bead is applied. Unless double fillet welds are shown, field welded lap joints may, at the CONTRACTOR's option, be made on either the inside or outside of the pipe.

2. Flexible Coupled Joints: When installing flexible couplings, care shall be taken that the connecting pipe ends, couplings, and gaskets are clean and free of all dirt and foreign matter with special attention being given to the contact surfaces of the pipe, gaskets, and couplings. The couplings shall be assembled and installed in conformance with the written instructions of the coupling manufacturer. All bolts shall be tightened in a progressive diametrically opposite sequence so as to secure a uniform annular space between the follower rings and the body of the pipe. Final tightening shall be done with a suitable calibrated torque wrench. All clamping torque shall be applied to the nuts only.

3. Flanged Joints: Before the joint is assembled, the flange faces shall be thoroughly cleaned of all foreign material with a power wire brush. The gasket shall be centered and the connecting flanges drawn up watertight without unnecessarily stressing the flanges. All bolts shall be tightened in a progressive diametrically opposite sequence and torqued with a suitable calibrated torque wrench. All clamping torque shall be applied to the nuts only.

E. Joint Coating and Pointing

1. In the case of mortar lined pipe in sizes smaller than 24-inches in diameter, before the spigot is inserted into the bell, the bell end of the pipe shall be daubed with mortar containing one part of a non-shrink, non-metallic cement to not more than 3

parts of sand, inserted into the bell, and forced to the bottom of the bell. In the case of mortar lined pipe in sizes 24-inches and larger, the joints shall be pointed on the inside with non-shrink grout as specified in Section 03315 - Grout, after backfill has been placed. Excess mortar on the inside shall be swabbed out.

2. In the case of mortar coated pipe, after the welding is completed, the outside annular spaces between pipe sections shall be completely filled with grout. The grout shall be poured in such a manner that all exposed portions of the metal joint shall be completely protected with cement mortar. Grout used on the outside of joints shall be a non-shrink grout as specified in Section 03315 - Grout, sufficiently fluid to permit it to be poured down one side of the pipe and allowed to flow up the other side.

    a. The outside mortar joints shall be properly formed by the use of heavy duty diapers.

3. Similarly, in the case of mortar coated pipe, after the coupled or flanged joint is completed, the coupling, flange, or bare metal of the pipe shall be cleaned, primed, and coated with a minimum thickness of 1-inch of cement mortar, having one part cement to not more than 2 parts plaster sand.

4. Where butt-straps or closure pieces are used, both the interior and exterior surfaces of the butt-straps or closure pieces shall be given a coating equivalent to the factory-applied coating of the adjoining pipe sections. Any exterior cement mortar coating in such cases shall be reinforced with wire mesh. Any interior cement mortar lining shall be similarly reinforced, where the exposed length of the butt-straps or closure piece, as measured between the ends of connected pipe sections, exceeds 4-inches.

F. Corrosion Control

1. All unwelded pipe joints shall be bonded in accordance with the details indicated. In addition, electrolysis test stations shall be installed where indicated.

2. Insulated joints shall be installed where indicated. The CONTRACTOR shall exercise special care when installing these joints to prevent electrical conductivity across the joint. After the insulated joint is completed, an electrical resistance test will be performed by the GOVERNMENT. Should the resistance test indicate a short circuit, the CONTRACTOR shall remove the insulating units to inspect for damages, replace all damaged portions and reassemble the insulating joint. The insulated joint shall then be retested to assure proper insulation.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 02595 - SMALL PVC NONPRESSURE PIPE, RUBBER JOINTS (ASTM D 3034, MODIFIED)

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide PVC solid wall nonpressure pipe and appurtenant work, complete and in place, in accordance with the Contract Documents.

B. This Section covers pipe from 4- to 15-inches diameter nominal size.

1.2 CONTRACTOR SUBMITTALS

A. Submittals shall be in accordance with Section 01300 - Contractor Submittals.

B. **Shop Drawings:** The CONTRACTOR shall submit Shop Drawings and laying diagrams of pipe, joints, bends, special fittings, and piping appurtenances.

C. **Certificates:** The CONTRACTOR shall submit manufacturer's certificate that pipe conforms to these specifications.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Pipe shall be continuously and permanently marked with the manufacturer's name, pipe size, and minimum pipe stiffness in psi.

B. The CONTRACTOR shall also require the manufacturer to mark the date of extrusion on the pipe. This dating shall be done in conjunction with records to be held by the manufacturer for 2 years, covering quality control tests, raw material batch number, and other information deemed necessary by the manufacturer.

2.2 PIPE

A. Pipe shall conform to the requirements of ASTM D 3034 - Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings, SDR 26. Material for PVC pipe shall conform to the requirements of ASTM D 1784 - Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds, for cell classification 12454-B or 12454-C as defined therein. The manufacturer shall test a sample from each batch according to ASTM D 2444 - Test Method for Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight).

B. Joints shall conform to ASTM D 3212 - Joints for Drain and Sewer Plastic Pipe Using Flexible Elastomeric Seals. Elastomeric seals for compression type joints shall conform to the requirements of ASTM F 477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe or ASTM F 913 - Thermoplastic Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

2.3 FITTINGS

A. All fittings shall conform to the requirements of ASTM D 3034. The ring groove and gasket ring shall be compatible with PVC pipe ends. The flanged fittings shall be compatible with cast-iron or ductile iron pipe fittings.

B. The stiffness of the fittings shall be not less than the stiffness of adjoining pipe.

2.4 BEDDING MATERIAL

A. Unless otherwise indicated, material used for pipe bedding shall conform to Section 02200 - Earthwork.

2.5 FLEXIBLE COUPLINGS

A. Flexible couplings shall be neoprene, full-circle, clamp-on type conforming to ASTM C 425 - Compression Joints for Vitrified Clay Pipe and Fittings and provided with two stainless steel band screw-clamps to secure the coupling tightly to entering and exiting pipes. All screw-clamp hardware shall be Type 304 or Type 316 stainless steel. Neoprene material shall be suitable for sewage service.

PART 3 -- EXECUTION

3.1 TRENCHING AND BACKFILL

A. Trench excavation and backfill shall conform to the requirements of Section 02200 - Earthwork and the Drawings.

3.2 LAYING PIPE

A. Pipe shall be installed in accordance with the requirements of ASTM D 2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications and as indicated. Pipe sections shall be closely jointed to form a smooth flow line. Immediately before placing each section of pipe in final position for jointings, the bedding for the pipe shall be checked for firmness and uniformity of slope.

B. Handling

1. Handling of the PVC pipe shall be done with implements, tools, and facilities as recommended by the pipe manufacturer to insure that the pipe is not damaged in any manner during storage, transit, loading, unloading, and installation.

2. Pipe shall be inspected both prior to and after installation in the ditch and all defective lengths shall be rejected and immediately removed from the working area.

3. Fittings shall be lowered into trench by means of rope, cable, chain, or other means without damage. Cable, rope, or other devices used for lowering fitting into trench, shall be attached around exterior of fitting for handling. Under no circumstances shall the cable, rope, or other device be attached through the fitting interior for handling or shall pipe or fittings be dropped or dumped into the trench.

C. Cutting and machining of the pipe shall be accomplished in accordance with the pipe manufacturer's standard procedures. Pipe shall not be cut with a cold chisel, standard iron pipe cutter, or any other method that may fracture the pipe or will produce ragged, uneven edges.

D. All foreign matter or dirt shall be removed from the interior of the pipe before lowering into position in the trench. Pipe shall be kept clean during and after laying. All openings in the pipeline shall be closed with watertight expandable type sewer plugs or PVC test plugs at the end of each day's operation or whenever the pipe openings are left unattended. The use of burlap, wood, or other similar temporary plugs will not be permitted.

E. Adequate protection and maintenance of all underground and surface utility structures, drains, sewers, and other obstructions encountered in the progress of the WORK shall be the CONTRACTOR's responsibility.

F. Where the grade or alignment of the pipe is obstructed by existing utility structures such as conduits, ducts, pipes, branch connections to main sewers, or main drains, the obstruction shall be permanently supported, relocated, removed, or reconstructed by the CONTRACTOR in cooperation with owners of such utility structures. Unless otherwise indicated, protection of existing utility structures shall be the CONTRACTOR's responsibility.

3.3 FIELD JOINTING

A. Each pipe compression type joint shall be joined with a lock-in rubber ring and a ring groove that is designed to resist displacement during pipe insertion.

B. The ring and the ring seat inside the bell shall be wiped clean before the gasket is inserted. A thin film of lubricant shall be applied to the exposed surface of the ring and to the outside of the clean pipe end. Lubricant other than that furnished with the pipe shall not be used. The end of the pipe shall be then forced into the ring to complete the joint.

C. The pipe shall not be deflected either vertically or horizontally in excess of the printed recommendations of the manufacturer of the coupling.

D. Fittings shall be carefully connected to pipe, and joint shall be checked to insure a sound and proper joint.

E. When pipe laying is not in progress, the open ends of the pipe shall be closed to prevent trench water from entering pipe. Adequate backfill shall be deposited on pipe to prevent floating of pipe. Any pipe that has floated shall be removed from the trench, cleaned, and relaid in an acceptable manner. No pipe shall be laid when, in the opinion of the CONTRACTING OFFICER, the trench conditions or weather are unsuitable.

3.4 TESTING

A. Field testing of gravity sewer pipe shall conform to the requirements of Section 01655 - Gravity Pipeline Testing.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 02597 - PVC PRESSURE PIPE, RUBBER JOINTS (AWWA C900, MODIFIED)

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide polyvinyl chloride (PVC) pressure pipe, complete in place, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards

ANSI/AWWA C104/A21.5	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
ANSI/AWWA C110/A21.10	Ductile-Iron and Gray-Iron Fittings 3-in Through 48-in for Water and Other Liquids
ANSI/AWWA C111/A21.11	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
ANSI/AWWA C600	Installation of Ductile-Iron Water Mains and Appurtenances
ANSI/AWWA C900	Polyvinyl Chloride (PVC) Pressure Pipe 4-in Through 12-in for Water Distribution
ASTM D 2584	Test Method for Ignition Loss of Cured Reinforced Resins
PPI Technical Report TR 3/4	Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Materials
AWWA Manual M23	PVC Pipe - Design and Installation

1.3 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01300 - Contractor Submittals.

B. **Shop Drawings:** Drawings of pipe, fittings, and appurtenances. Design calculations to demonstrate compliance of pipe and fittings with this Section. Manufacturer's literature for metallic locating tape.

C. **Certifications:** A certified affidavit of compliance for pipe and other products or materials under this Section and the following supplemental requirements:

1. Hydrostatic proof test reports.

2. Sustained pressure test reports.

3. Burst strength test reports.

D. The CONTRACTOR shall be responsible for performing and paying for sampling and testing as necessary for the certifications.

1.4 QUALITY ASSURANCE

A. **Inspection:** Pipe shall be subject to inspection at the place of manufacture. The CONTRACTOR shall notify the CONTRACTING OFFICER in writing of the manufacturing starting date not less than 14 calendar days prior to the start of any phase of the pipe manufacture.

B. During manufacture of the pipe, the CONTRACTING OFFICER shall be given access to all areas where manufacturing is in process and shall be permitted to make all inspections necessary to confirm compliance with the Specifications.

C. **Tests:** Materials used in manufacture of the pipe shall be tested in accordance with the requirements of this Section and the referenced standards, as applicable.

D. The CONTRACTOR shall perform said material tests. The CONTRACTING OFFICER shall have the right to witness testing; provided, that the CONTRACTOR'S schedule is not delayed for the convenience of the CONTRACTING OFFICER.

E. In addition to those tests specifically required, the CONTRACTING OFFICER may request additional samples of any material for testing by the GOVERNMENT. The additional samples shall be furnished as a part of the WORK.

PART 2 -- PRODUCTS

2.1 GENERAL

A. PVC pressure pipe (4-inch through 12-inch) shall conform to the applicable requirements of ANSI/AWWA C900 subject to additional requirements herein.

2.2 PIPE DESIGN CRITERIA

A. **General:** PVC pressure pipe shall be designed in accordance with the requirements of Appendix A of ANSI/AWWA C900, as applicable, and the supplemental requirements in this Section.

B. **Pipe Wall Thickness for Internal Pressure:** The pipe shall be designed with a minimum thickness (t) or dimension ratio (DR) in accordance with paragraph A.3 of the above referenced Appendix A.

C. **Determination of External Loads:** Instead of the equations in paragraph A.4 of the above referenced Appendix A, the dead (earth) loads shall be computed using the following 2 equations for trench or embankment conditions as applicable:

1. Trench Condition:

$$W_d = C_d w B_d^2$$

Where: W_d = Earth load in pounds per linear foot
C_d = Calculation coefficient

Ku'	=	0.13
w	=	130 lb/ft^3
B_d	=	Trench width at top of pipe, feet

2. Positive Projecting Embankment Condition:

$$W_c = C_c w B_c^2$$

Where:	W_c	=	Earth load in pounds per linear foot
	C_c	=	Calculation coefficient (based on $r_{sd}P$ of 0.75)
	Ku	=	0.19
	w	=	130 lb/ft^3
	B_c	=	Outside diameter of pipe, feet

D. Instead of the equations in paragraph A.4, the truck live loads shall be determined using the method recommended by AASHTO in "Standard Specifications for Highway Bridges." For depths of cover less than 10 feet HS-20 live loads shall be added to the earth loads to determine the total load. For depths of cover 3 feet or less, HS-20 live load plus impact shall be included.

E. **Deflection Control:** With reference to paragraph A.5, the deflection of the pipe after installation shall not exceed 0.03 times the outside diameter. If the calculated deflection exceeds 0.03 times the outside diameter the pipe class shall be increased or the quality of the pipe zone backfill shall be improved to achieve a higher modulus of soil reaction, E'. For purposes of calculation, values of E' shall be 1100 psi at 90 percent Standard Proctor; 1500 psi at 95 percent Standard Proctor; and 2500 psi at 100 percent Standard Proctor. Similarly, the deflection lag factor shall be 1.5.

2.3 PIPE

A. The pipe shall be of the diameter and pressure class indicated, shall be furnished complete with rubber gaskets, and all specials and fittings shall be provided as required in the Contract Documents. The dimensions and pressure classes for Dimension Ratios for large PVC pressure pipe with Cast-Iron Pipe Equivalent O.D.'s shall conform to the requirements of AWWA C900.

B. **Additives and Fillers:** Unless otherwise allowed in alternate qualification procedures of PPI-TR3, compounds which have a Hydrostatic Design Basis (HDB) of 4000 psi at 73.4 degrees F and for water shall not contain additives and fillers that exceed the recommended values in Table 1, Part Y of PPI-TR3 (e.g., allowable content range for calcium carbonate is 0.0-5.0 parts per hundred of resin). If requested by the CONTRACTING OFFICER, the additive and filler content shall be determined using the pyrolysis method as specified in ASTM D 2584.

C. **Joints:** Joints for the buried PVC pipe shall be either an integral bell manufactured on the pipe or a separate coupling both employing a rubber ring joint. The bell and coupling shall be the same thickness as of the pipe barrel, or greater thickness. The sealing ring groove in the coupling shall be of the same design as the groove in cast iron fittings and valves available from local water works supply distributors. Where indicated, restrained joint pipe shall be ductile iron pipe. No restrained joint PVC pipe will be allowed.

D. **Joint Deflection:** Deflection at the joint shall not exceed 1.5 degrees or the maximum deflection recommended by the manufacturer. No deflection of the joint shall be allowed for joints that are over-belled or not belled to the stop mark.

2.4 FITTINGS

A. Fittings shall be ductile iron and shall conform to the requirements of AWWA C110, Class 250. PVC pipefittings shall be mechanical joint.

B. All fittings shall be lined and coated in accordance with the requirements of Section 09800 - Protective Coating.

C. Each fitting shall be clearly labeled to identify its size and pressure class.

PART 3 -- EXECUTION

3.1 GENERAL

A. Laying, jointing, testing for defects and for leakage shall be performed in the presence of the CONTRACTING OFFICER, and shall be subject to approval before acceptance. Material found to have defects will be rejected and the CONTRACTOR shall promptly remove such defective materials from the Site.

B. Installation shall conform to the requirements of AWWA M23, instructions furnished by the pipe manufacturer, and to the supplementary requirements herein. Wherever the provisions of this Section and the aforementioned requirements are in conflict, the more stringent provision shall apply.

3.2 HANDLING AND STORAGE

A. **Handling:** Pipe, fittings and accessories shall be carefully inspected before and after installation and those found defective shall be rejected. Pipe and fittings shall be free from fins and burrs. Before being placed in position, pipe, fittings, and accessories shall be cleaned, and shall be maintained in a clean condition. Proper facilities shall be provided for lowering sections of pipe into trenches. Under no circumstances shall pipe, fittings or any other material be dropped or dumped into trenches.

B. **Storage:** Pipe should be stored, if possible, at the Site in unit packages provided by the manufacturer. Caution should be exercised to avoid compression damage or deformation to bell ends of the pipe. Pipe should be stored in such a way as to prevent sagging or bending and be protected from exposure to direct sunlight by covering with an opaque material while permitting adequate air circulation above and around the pipe. Gaskets should be stored in a cool, dark place out of the direct rays of the sun, preferably in original cartons.

3.3 TRENCHING AND BACKFILL

A. Trench excavation and backfill shall conform to the requirements of Section 02200 - Earthwork.

3.4 INSTALLATION

A. Bell-and-spigot pipe shall be laid with the bell end pointing in the direction of laying. Pipe shall be graded in straight lines, taking care to avoid the formation of any dips or low points. Pipe shall not be laid when the conditions of trench or weather are unsuitable. At the end of each day's work, open ends of pipe shall be closed temporarily with wood blocks or bulkheads.

B. Pipe shall be supported at its proper elevation and grade, care being taken to secure firm and uniform support. Wood support blocking will not be permitted. The full length of each section of pipe and fittings shall rest solidly on the pipe bed, with recessed excavation to accommodate bells, joints, and couplings. Anchors and supports shall be provided where indicated and where necessary for fastening work into place. Fittings shall be independently supported.

C. Short lengths of pipe shall be used in and out of each rigid joint or rigid structure. Piping that does not allow sufficient space for proper installation of jointing material shall be replaced by one of proper dimensions. Blocking or wedging between bells and spigots will not be permitted.

D. Joints shall be installed according to manufacturer's recommendations. Trenches shall be kept free of water until joints have been properly made. The maximum combined deflection at any coupling shall be in accordance with the manufacturer's recommendations.

E. Pipe shall be cut by means of saws, power driven abrasive wheels, or pipe cutters, which will produce a square cut. No wedge-type roller cutters will be permitted. After cutting, the end of the pipe shall be beveled using a beveling tool, portable type sander, or abrasive disc.

3.5 INSTALLATION OF COPPER WIRE

A. Polyvinyl chloride pipelines shall be provided with No. 10 AWG bare copper wire laid along the top of the pipe and held in place with ties or hitches of the same kind of wire spaced not more than 13-feet apart, or metallic locating tape laid along the centerline of the pipe trench at a depth of 18-inches below finish grade. In such case, the CONTRACTOR shall furnish manufacturer's literature, completely describing the tape proposed to be furnished. No tape shall be used prior to receipt of written approval of the CONTRACTING OFFICER.

3.6 SERVICE CONNECTIONS

A. **Service Connections:** Direct tapping will not be permitted. Double strap bronze service clamps shall be used for all service connections. Service clamps shall have a bearing area of sufficient width along the axis of the pipe, so that the pipe will not be distorted when the saddle is made tight. An internal shell cutter shall be used to drill through the corporation stop to minimize PVC shavings, retain the coupon, and reduce stress. Single fluted shell cutters or twist drills are not acceptable. Lubricate the cutting and tapping edges of the tool with cutting lubricant. Make the cuts slowly and use the follower very lightly - do not force cutter through pipe wall. Shell cutter shall have sufficient throat depth to handle the heavy wall PVC pipe. Maximum outlet size permitted with service clamps or saddle is 2-inches.

B. Tapping sleeves and valves shall be used for all outlet sizes greater than 2-inches in diameter. Tapping sleeves shall be assembled and installed in accordance with the manufacturer's recommendations.

3.7 CONNECTIONS TO EXISTING WATERLINES

A. The CONTRACTOR shall locate all underground improvements and install the pipelines to the depths indicated. Where the new work is to be connected to existing pipelines, the CONTRACTOR shall make its arrangements with the serving utility well in advance of the connections, to allow adequate time for dewatering of the existing line, if necessary, and shall expedite the work to minimize water outages to the users. Where sections of existing distribution mains are taken permanently out of service and abandoned in place, the cut ends shall be plugged solid with concrete to a depth of not less than one pipe diameter.

3.8 FIELD TESTING AND DISINFECTION

A. Field testing and disinfection and water mains shall conform to the requirements of Section 1656 -Pressure Pipe Testing and Disinfection.

- END OF SECTION -

SECTION 02776 - POND LINER

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide flexible membrane lining in the areas shown. All work shall be done in strict accordance with the Contract Documents and reviewed shop drawings.

B. Sufficient lining material shall be furnished to cover all lined areas shown, including seam overlaps, anchor trenches and field testing. One percent shall be added to the length of each panel to allow for shrink and wrinkles. The liner shall be installed in a relaxed condition and shall be free of tension or stress upon completion of the installation.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards

ASTM D 413	Test Methods for Rubber Property - Adhesion to Flexible Substrate
ASTM D 751	Method of Testing Coated Fabrics
ASTM D 1204	Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature
ASTM D 2136	Method of Testing Coated Fabrics - Low Temperature Bend Test
NSF Standard 54	Flexible Membrane Liners

1.3 SHOP DRAWINGS

A. The fabricator of panels used in this work shall prepare shop drawings with a proposed panel layout to cover the lined area shown. Shop drawings indicate the direction of factory seams and shall show panel sizes consistent with the material quantity requirements. Details shall be included to show the termination of panels at the perimeter of lined areas and methods of sealing around penetrations.

B. Placement of the lining shall not commence until the shop drawings and details have been reviewed by the CONTRACTING OFFICER.

1.4 QUALIFICATIONS OF MANUFACTURERS

A. **Qualification of Manufacturers:** The fabricator of the panels used in this work shall be approved in writing by the membrane manufacturer and shall provide evidence to the CONTRACTING OFFICER that it has fabricated not less than 5 million square feet of reinforced synthetic membrane lining.

The installer of the lining shall be experienced in the installation of flexible membrane lining and shall provide the CONTRACTING OFFICER with a list of not less than 10 projects and not less than 5 million square feet of successfully installed reinforced synthetic lining. The project list shall show the name, address, and telephone number of an appropriate party to contact in each case. The lining shall be as furnished by **Palco Lining, Inc.; Watersaver Company, Inc.; C.W. Neal Corporation; Staff Industries, Inc.; or equal.**

1.5 QUALITY ASSURANCE

A. **Testing of Roll Goods Prior to Fabrication:** The fabricator of panels used in this work shall take samples from every 10,000 pounds of roll goods received from the manufacturer. Samples shall be tested by a qualified laboratory for the following properties as provided in the table in Part 2.

1. Thickness

2. Breaking strength

3. Adhesion to flexible substrate (ply bond)

4. Dimensional stability

5. Low temperature bend

B. **Inspection of Roll Goods Prior to Fabrication:** Prior to factory seaming, all roll goods shall be unwound and inspected on both sides for unmixed or poorly dispersed ingredients, exposed scrim, pin holes, or the presence of contaminants or foreign particles. All defects and impurities shall be removed or repaired before the membrane is fabricated into panels. Thickness shall be measured in accordance with ASTM D 751 at the center and each edge of the beginning and end of each roll of material used in this work. A log shall be maintained showing the material type, roll number, lot number, and 3 thickness measurements at the beginning and end of each roll. This log shall be made available to the CONTRACTING OFFICER upon request.

C. **Inspection and Testing of Factory Seams:** The fabricator shall perform 100 percent continuous visual inspection of each lineal foot of seam as it is produced. Upon discovery of any defective seam, the fabricator shall stop production of panels used in this work and shall repair the seam and determine and rectify the cause of the defect prior to continuation of the seaming process. As evidence that the fabricator has complied with the inspection requirement, a mark which identifies the inspector by name or number shall be hand stamped with indelible ink no less frequently than 5 feet on center along each factory seam. A 48-inch sample shall be taken from each factory seam welding unit used in this work at the beginning of every work shift and every 4 hours of production thereafter. Samples shall be non-destructive, i.e., will not require patching of fabricated panels. Test specimens shall be cut at quarter points from each 48-inch seam sample (a total of 3 places) and tested for factory seam strength and peel adhesion as specified in the table in Part 2, "Minimum Factory Seam Requirements." A log shall be maintained showing the date, time, panel number and test results. This log shall be made available to the CONTRACTING OFFICER upon request.

D. **Certification and Test Reports:** Prior to installation of the panels, the fabricator shall provide the CONTRACTING OFFICER with the following certification and test reports:

1. Written certification that the material meets all of the requirements of Part 2.

2. Written test results for the testing of roll goods required by Part 1.

3. Written certification that inspection and thickness measurements have been performed as required in Part 1. The CONTRACTING OFFICER may, at his discretion, require that a copy of the log specified be submitted for review.

4. Written certification that the factory seams were inspected and tested in as required in Part 1. The CONTRACTING OFFICER may at his discretion, require that a copy of the log specified be submitted for review.

E. **Panel Packaging and Storage:** Factory fabricated panels shall be accordion-folded onto a sturdy wooden pallet designed to be moved by a forklift or similar equipment. Each factory fabricated panel shall be prominently and indelibly marked with the panel size. Panels shall be fully enclosed in heavy, water resistant cardboard and protected to prevent damage to the panel during shipment. The outside of each container shall also be prominently marked with the panel size.

Panels which have been delivered to the project site shall be stored in their original unopened containers in a dry area and protected from the direct heat of the sun where possible, especially when stored for a long period of time. Pallets shall not be stacked.

1.6 WARRANTY

A. A 10-year warranty shall be provided for the liner and it shall warrant the liner (1) to be free of any defects in materials and/or workmanship at the time of sale and (2) to have a useful life from the date of sale for a period of 10 years under the normal uses and services for which it is intended. Should defects or premature loss of use within the scope of the above warranty occur, repair and/or replacement of damaged material shall be performed at no cost to the GOVERNMENT.

PART 2 -- PRODUCTS

2.1 GENERAL

Products: The lining material shall be a reinforced polypropylene (RPP) membrane. The membrane shall be manufactured by the calendering process and shall be uniform in color, thickness, and surface texture. The finished lining shall be a sunlight and weather resistant membrane that is flexible, durable, watertight, and free from pinholes, blisters, and contaminants.

A. The membrane shall be manufactured from high quality ingredients specifically compounded for use in hydraulic structures. Only domestic resins shall be used. Reprocessed materials will not be acceptable.

B. The finished membrane liner shall consist of 2 calendered plies of RPP synthetic membrane laminated over one ply of polyester reinforcing fabric. The reinforcing fabric shall be a 10 by 10-1,000 denier woven polyester. RPP 45 resin shall comprise greater than 45 percent by weight of the liner compound.

C. Unreinforced material shall fully encapsulate the reinforcing fabric at roll edges and shall extend a minimum of 1/8-inch beyond the reinforcing fabric. Exposed fabric will not be accepted.

D. **Fabrication:** The individual widths of calendered shall be factory fabricated into large sheets custom designed for this project so as to minimize field seaming. All factory seams shall provide a bond between the sheets sufficiently strong to meet the test requirements of these Specifications. The factory seaming shall be accomplished by the use of dielectric fusion welding. The dielectric weld shall be a nominal one-inch wide (1/2-inch min) continuous bond.

The finished lining shall have the minimum property values shown in the following table.

RPP POND LINER SPECIFICATIONS
REINFORCED MEMBRANE PHYSICAL PROPERTIES

Property	Test Method	Test Value
Gage (nominal)		36 mils
Plies (reinforcing)		1
Scrim (reinforcing fabric)		10 by 10-1,000 Denier Polyester
Thickness, (mils min)		
1. Overall	ASTM D 751	34 mils
2. Over Scrim	(NSF Optical Method)	11 mils
Breaking Strength (min)	ASTM D 751 Method A	225lb
Tear Strength (min)	ASTM D5884	55 lb
Low Temperature	ASTM D 2136	-40 degrees F
Puncture resistance, (min.)	FTMS 101C, Method 2031	300 lb
Dimensional Stability (each direction)	ASTM D 1204 212 degrees F, 1 hr.	1.0 percent, max
Hydrostatic Resistance (lbs/sq in min)	ASTM D 751 Method A, Proc. 1	325 psi
Ply Adhesion (ea. dir. lbs/in width min)	ASTM D 413 Machine Mtd. Type A, (as modified by NFS)	20 lb/in width or Film Tearing Bond
UV resistance	ASTM G26, Xenon Arc, 80°C/4000 hours	Pass

MINIMUM FACTORY SEAM REQUIREMENTS

Factory Seaming Method		Dielectric Fusion Weld
Bonded Seam Strength Factory seam breaking strength	ASTM D 751 (as modified by NSF Standard 54 pg. A2)	200 lbf
Peel Adhesion	ASTM D 413 (as modified by NSF Standard 54 pg. A4)	Ply Separation in plane of scrim or 20 lb/in

PART 3 -- EXECUTION

3.1 INSTALLATION

A. **General:** The lining shall be installed in accordance with the following Specifications and approved procedures submitted with the shop drawings.

B. **Subgrade Preparation:** Lining installation shall not begin until a proper base has been prepared to accept the membrane lining. Base material shall be free from angular rocks, roots, grass, and vegetation. Foreign materials and protrusions shall be removed and all cracks and voids shall be filled and the surface made level or uniformly sloping as shown. The prepared surface shall be free from loose earth, rocks, rubble, and other foreign matter. The subgrade shall be uniformly compacted to ensure against settlement and shall be steel wheel rolled prior to liner installation. The surface on which the lining is to be placed shall be maintained in a firm, clean, dry, and smooth condition during lining installation. If groundwater is present within 12 inches below the surface to be lined, the CONTRACTOR shall dewater the area prior to and during installation of the liner.

C. **Lining Installation:** The lining shall be placed over the prepared surface in such a manner as to assure minimum handling. Anchor trench excavation and any structure seal preparation should be completed before lining installation begins. The sheets shall be of such lengths and widths and shall be placed in such a manner as to minimize field seaming. Horizontal field seams on the slopes shall not be allowed. Only those sheets of lining material which can be anchored and sealed together that same day shall be unpackaged and placed in position.

D. In areas where wind is prevalent lining installation should be started at the upwind side of the project and proceed downwind. The leading edge of the liner shall be secured at all times with sandbags or other means sufficient to hold it down during high winds.

E. Sandbags or rubber tires may be used as required to hold the lining in position during installation. Tires shall not have exposed steel cords or other sharp edges which may snag or cut the lining. Materials, equipment, or other items shall not be dragged across the surface of the liner or be allowed to slide down slopes on the lining. All persons walking or working upon the lining material shall wear soft-sole shoes.

F. Lining sheets shall be closely fitted and sealed around inlets, outlets, and other projections through the lining. Lining to concrete seals shall be made with a mechanical anchor or as shown. All piping, structures, and other projections through the lining shall be sealed with approved sealing methods.

G. **Field Seams:** All seaming adhesives, mastics, and sealants shall be of a type or types recommended and supplied by the manufacturer or fabricator and shall be delivered in containers with indelible labels bearing the brand name and complete directions as to proper storage, use, and application.

H. Field lap joints used to seal factory-fabricated panels shall be formed by lapping the edges of panels a minimum of 6 inches. The contact surfaces of panels to be seamed shall be wiped clean to remove all dirt, dust, moisture and other foreign materials. A pre-wipe solution of a type recommended by the manufacturer or fabricator shall be used to remove the surface cure on the contact surfaces. Scrubbing of the membrane with the pre-wipe solution shall be completed not more than 10 minutes prior to application of the sealing adhesive.

I. Sufficient liner to liner bonding adhesive shall be applied to the joint area to form a continuous weld. A minimum 3-inch width of reinforced fabric overlap shall be fully bonded. In applying adhesive, care must be taken to tie-in to the end of the previously completed seamed area so that leak points in the seam do not occur. The surfaces should be pressed down immediately and a roller or flat wooden paddle used to squeeze the adhesive toward the leading edge of the panel. Any wrinkles shall be smoothed out. A small amount of adhesive should extrude and appear at the seam edge to indicate that sufficient adhesive has been applied. Excess adhesive should be wiped off with a clean rag. Seams should be inspected after the initial seal and any loose edges resealed using the same procedure. Extreme care shall be taken throughout the work to avoid fishmouths in the field seams. Where fishmouths do occur, they shall be slit out far enough from the seam to dissipate them, lapped, seamed together in the lapped area and patched. Any portion of the lining damaged during installation shall be removed or repaired by using an additional piece of lining as specified in Paragraph entitled "Patching."

J. **Destructive testing**: a total of 8 field seam samples will be collected for destructive testing. Two samples shall be obtained from the pond bottom and two from the side slope of each equalization pond basin. The locations of the samples shall be determined by the CONTRACTING OFFICER's representative. Each sample shall be centered lengthwise along the seam and will be tested for shear and peel strength with five specimens for each method. The sample shall be large enough to include portions for the installer, government and archive. If permitted by the CONTRACTING OFFICER, the CONTRACTOR's installer will be allowed to conduct seam strength and peel adhesion tests for the GOVERNMENT only with the CONTRACTING OFFICER's representative present, otherwise the testing must be performed by an approved independent laboratory at the CONTRACTOR's expense. If a failure is determined by the destructive testing, the CONTRACTING OFFICER's representative will outline applicable procedures and may increase the test frequency based on the test results. Repair of the hole from the destructive sample shall be accomplished immediately and in accordance with the repairs in this section.

K. **Field Inspection:** Upon completion of the liner installation the CONTRACTOR shall fully test all factory and field seams with an air lance tester, hook, or other CONTRACTING OFFICER-approved method. Once the seams have been tested, the CONTRACTOR and the CONTRACTING OFFICER shall fully inspect every lineal foot of field seam and all seals to penetrations. Any doubtful areas shall be tested with a vacuum seam tester or other device as directed by the CONTRACTING OFFICER.

L. **Patching:** Repairs to the lining shall be made with the parent lining material and liner to liner bonding adhesive. The patch material shall have rounded corners and shall extend a minimum of 4 inches in each direction from the damaged area. After scrubbing with pre-wipe, the bonding adhesive shall be applied to the contact surfaces of both the patch and lining to be repaired and the 2 surfaces pressed together immediately. Any wrinkles shall be smoothed out. Exposed scrim at patch edges shall be caulked or flood coated with seaming adhesive.

M. All joints shall be tightly bonded upon completion of the work. Any lining surface showing injury due to scuffing, penetration by foreign objects, or distress from rough subgrade shall, as directed by the CONTRACTING OFFICER, be replaced or covered and sealed with an additional layer of lining of the proper size in accordance with the patching procedures.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 02831 – CHAIN LINK FENCING AND GATES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide chain link fencing and gates and appurtenant WORK, complete and operable, in accordance with the Contract Documents.

B. **Single Manufacturer:** Chain link fencing, gates, accessories, fittings, and fastenings shall be products of a single manufacturer.

1.2 CONTRACTOR SUBMITTALS

A. **General:** Furnish submittals in accordance with Section 01300 - Contractor Submittals.

B. Shop Drawings

1. Manufacturer's technical data, product specifications, standard details, certified product test results, installation instructions and general recommendations.

2. Scale layout of fencing, gates, and accessories. Drawings shall show fence height, post layout, including sizes and sections; post setting and bracing configuration, details of gates and corner construction, barbed wire support arms; and other accessories which may be necessary.

C. **Samples:** Samples of proposed fence components, at least 12-inches long, to illustrate the selected color and finish.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Dimensions indicated herein for roll-formed pipe and H-sections are outside dimensions, excluding coatings.

B. Fence fabric height shall be 8 feet or matching existing, unless otherwise indicated.

C. Fencing materials shall be hot-dip galvanized after fabrication.

D. PVC coatings, if indicated, shall be the color indicated. PVC coatings shall be made from virgin PVC resin with plasticizer, stabilizers, and ultraviolet inhibitor. Coatings shall have a tensile strength of 2500 psi, maximum elongation of 200 percent, and a shore durometer hardness of 40 to 46.

E. Fencing shall be topped with 3 lines of barbed wire on single, 45 degree supporting arms, sloped outward.

2.2 STEEL FABRIC

A. Fence fabric shall be No. 9 gauge steel wire, 2-inch mesh, with top selvages knuckled and bottom selvages twisted and barbed.

B. **Fabric Finish**: Fabric shall be galvanized in conformance with ASTM A 392 - Zinc-Coated Steel Chain Link Fence Fabric, Class II, with not less than 2.0 ounces zinc per square foot of coated surface.

2.3 FRAMING AND ACCESSORIES

A. **Steel Framework, General**: Unless otherwise indicated, framework components shall be fabricated of galvanized steel conforming to ASTM A 53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless, or ASTM A 123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products, with not less than 1.8 ounces zinc per square feet of coated surface.

1. Fittings and accessories shall be galvanized in accordance with ASTM A 153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware, with zinc weights per Table I of that standard, except that no coating shall be less than 1.8-ounce zinc per square foot of coated surface.

B. **End, Corner and Pull Posts**: Posts shall be one-piece without circumferential welds, 3-inch schedule 40 pipe, 5.79 pounds per linear foot.

C. **Line Posts**: Line posts shall be spaced no more than 10-feet on center and shall be 2-1/4 inch “H” column section, 4.1-pounds per linear foot, or schedule 40, 2-1/2 inch pipe, 3.65-pounds per linear foot.

D. **Gate Posts**: Gate posts shall be 4-inch schedule 40 pipe, 9.1-pounds per linear foot.

E. **Top Rail**: Top railing shall be provided in manufacturer’s longest lengths, with expansion type couplings, approximately 6-inches long, for each joint. Fence design shall provide positive, secure attachment of top rail to each gate post, corner post, pull post and end post. Top rail and braces shall be 1-5/8 inch schedule 40 pipe, 2.27-pounds per linear foot, or 1-1/2 inch “H” column section, 2.00-pounds per linear foot.

F. **Tension Wire**: Tension wire shall be located at the bottom of the fabric and shall consist of No. 7 gauge coated coil spring wire of metal and finish to match fabric. Tension wire shall be interlaced with the fabric or attached to the fabric along the extreme bottom of the fence. Tension wire attachment shall be with fabric tie wires at a spacing of no more than 24-inches apart.

G. **Fabric Tie Wires**: Fabric tie wires shall be No. 9 gauge galvanized steel wire of the same finish as the fabric. Aluminum ties shall not be used. Ties shall be spaced 14-inches apart on posts and 24-inches apart on rails.

H. **Post Brace Assembly**: Post brace assembly shall be manufacturer’s standard adjustable brace assembly provided at each end post, gate post and at both sides of each corner post and intermediate brace post. Material used for brace shall be same as top rail. Truss bracing between line posts shall be achieved with 0.375-inch diameter rod and adjustable tensioner.

I. **Post Tops**: Post tops shall be weather-tight closure caps, designed for containment of top rail and positive permanent attachment to post. One cap shall be provided for each post.

J. **Stretcher Bars**: Stretcher bars shall be one-piece lengths equal to the full height of the fabric, with minimum cross-section of 3/16-inch by 3-1/2 inch. One stretcher bar shall be provided for each gate and end post, and 2 for each corner and intermediate brace post.

K. **Stretcher Bar Bands**: Stretcher bar bands shall be one-piece fabrications designed to secure stretcher bars to end, corner, intermediate brace, and gate posts. Bands shall have a minimum cross-section of 1/8-inch by 3/4-inch. Stretcher bar bands shall be spaced no more than 15-inches on center.

L. **Barbed Wire Supporting Arms**: Supporting arms shall be manufacturer's standard fabrication, of metal and finish to match fence framework, with provision for anchorage to each post and attachment of three rows of barbed wire to each arm. Supporting arms may be either attached to posts or integral with post top weather cap. Supporting arm shall be single 45-degree arm type and shall be capable of withstanding 250 pounds of downward pull at outermost end.

M. **Barbed Wire**: Barbed wire shall be 2-strand, No. 12-1/2 gauge zinc-coated steel or iron wire with four-point, 14-gauge barbs spaced no more than 5-inches apart.

2.4 GATES

A. **Fabrication**: Perimeter frames of gates shall be fabricated from same metal and finish as fence framework. Gate frames shall be assembled by welding or with fittings and rivets for rigid, secure connections. Welds shall be ground smooth. Gate frames and any ungalvanized hardware, shall be hot-dip galvanized after fabrication. Horizontal and vertical members shall be provided to ensure proper gate operation and attachment of fabric, hardware and shall be hot-dip galvanized after fabrication.

1. Fabric for gates shall match fence fabric, unless otherwise indicated. Fabric shall be installed with stretcher bars at all perimeter edges. Stretcher bars shall be attached to gate frame with stretcher bar bands spaced no more than 15-inches on center.

2. Each gate shall be diagonally cross-braced with a 3/8-inch diameter adjustable length truss rod to ensure frame rigidity without sag or twist.

3. Where barbed wire is indicated above gates, vertical members shall be extended and fabricated as required to receive barbed wire supporting arms.

B. **Swing Gates**: Perimeter frames of swing gates shall be constructed of the same pipe or "H" column members as the top rails and shall be fabricated by welding. Welds shall be ground smooth prior to hot-dip galvanizing.

1. Hardware and accessories shall be provided for each gate, galvanized in conformance with ASTM A 153, and in accordance with the following:

a. Hinges: Hinges shall be of size and material to suit gate size, non-lift-off type, offset to permit 180-degree gate opening. Three hinges shall be provided for each leaf 6-feet or more in height.

b. Latch: Latch shall be forked type or plunger-bar type, permitting operation from either side of the gate, with padlock eye as an integral part of the latch.

c. Keeper: Keeper shall be provided which automatically engages the gate leaf and holds it in the open position until it is manually released.

d. Double Gates: Gate stops shall be provided for double gates, consisting of mushroom type flush plate with anchors, set in concrete, and designed to engage center drop rod or plunger bar. Locking device and padlock eyes shall be provided as an integral part of the latch, permitting both gate leaves to be locked with a single padlock.

2.5 RELATED ITEMS

A. **Concrete:** Concrete shall be provided according to Section 03300 - Cast-In-Place Concrete.

B. Nuts, bolts and screws shall be steel, minimum size 3/8-inch diameter, hot-dip galvanized after fabrication.

2.6 MANUFACTURERS

A. **Manufacturer's Qualifications**: Chain link fencing and gates shall be products of a single manufacturer which has been successfully engaged in the production of such items for a period of at least 5 years.

B. **Installer's Qualifications**: Installation of the chain link fence shall be by the manufacturer or by a firm accepted and licensed by the manufacturer.

C. Manufacturers, or equal

1. **American Fence Corp.**

2. **Anchor Fence, Inc.**

3. **United States Steel**

PART 3 -- EXECUTION

3.1 INSPECTION

A. Prior to commencing installation, require Installer to inspect all areas and conditions within which WORK of this Section will be performed. Dimensions and clearances shall be verified. Final grading shall be completed and all earth, brush, or other obstructions which interfere with the proper alignment and construction of fencing shall be removed.

3.2 INSTALLATION

A. **General**: Unless otherwise indicated, all posts shall be set in concrete. Gate and related posts, corner posts, and other critical elements shall be provided with concrete foundations which are designed by an engineer to safely accommodate the loads to which they will be subjected.

B. **Excavation**: Holes for posts shall be drilled or hand excavated to the diameters and spacings indicated, in firm, undisturbed or compacted soil. Post foundations which are not designed by an engineer shall comply with the following:

1. Holes shall be excavated to a diameter not less than 12-inches or not less than 5 times the largest dimension of the item being anchored, whichever is larger.

2. Depth for holes shall be not less than 40-inches; excavated approximately 4-inches lower than the post bottom, with bottom of posts set not less than 36-inches below finish grade surface.

C. **Setting Posts**: Line posts shall be spaced at not more than 10-foot intervals, measured from center to center of the posts, parallel to the ground slope. Posts shall be set plumb and shall be centered in holes, 4-inches above the bottom of the excavation, with posts extending not less than 36-inches below finish grade surface.

1. Corner posts shall be installed where changes in the fence lines equal or exceed 15 degrees, measured horizontally.

2. Each post shall be properly aligned vertically and its top aligned parallel to the ground slope. Posts shall be maintained in proper position during placement and finishing operations.

D. Concrete

1. Concrete for footings may be placed without forms, providing the ground is firm enough to permit excavation to neat line dimensions. Prior to placing concrete, the earth around the hole shall be thoroughly moistened.

2. Encasement concrete for footings shall be placed immediately after mixing in a manner such that there will be no concentration of the large aggregates. The concrete shall be consolidated by tamping or vibrating.

3. Concrete footings shall have a neat appearance and shall be extended 2-inches above grade and troweled to a crown to shed water.

4. A minimum of 7 days shall elapse after placing the concrete footings before the fence fabric or barbed wire is fastened to the posts.

E. **Bracing**: Bracing shall be provided at all ends, corners, gates, and intermediate brace posts. Corner posts and intermediate brace posts shall be braced in both directions. Horizontal brace rails shall be set midway between the top rail and the ground, running from the corner, end, intermediate brace or gate post to the first line post. Diagonal tension members shall connect tautly between posts below horizontal braces.

1. Braces shall be so installed that posts remain plumb when diagonal rod is under proper tension.

F. **Intermediate Brace Posts**: Where straight runs of fencing exceed 500-feet, intermediate brace posts shall be installed, spaced equally between ends or corners; with additional posts provided as required, such that the spacing between intermediate brace posts does not exceed 500-feet. Intermediate brace posts shall be equivalent in size to corner posts and shall be braced with horizontal brace rails and diagonal tension members in both directions.

G. **Top Rails**: Top rails shall be run continuously through post caps, bending to radius for curved runs. Expansion couplings shall be provided as recommended by the fencing manufacturer.

H. **Center Rails**: Center rails shall be provided where indicated. Rails shall be installed in one piece, between posts and flush with posts on fabric side, using special offset fittings where necessary.

I. **Tension Wire**: Continuous bottom tension wire shall be stretched tight with turnbuckles at end, gate, intermediate, and corner posts. Tension wire shall be installed on a straight grade between posts, with approximately 2-inches of space between finish grade and bottom selvage, unless otherwise indicated. Tension wire shall be tied to each post with not less than 6 gauge galvanized wire.

J. Fabric

1. Chain-link fabric shall be fastened on the secured side of the posts.

2. Fabric shall be stretched and securely fastened to posts. Between posts, top and bottom edges of the fabric shall be fastened to the top rail and bottom tension wire, respectively.

3. Fabric shall be stretched and anchored in such a manner that it remains in tension after the pulling force is released.

K. **Tie Wires**: Tie wire shall be bent to conform to the diameter of the pipe to which it is attached, clasping pipe and fabric firmly with ends twisted at least two full turns. Ends of wire shall be bent back to minimize hazard to persons or clothing.

1. Fabric shall be tied to line posts with tie wires spaced at 12-inches on center.

2. Fabric shall be tied to rails and braces with tie wires spaced at 24-inches on center.

3. Fabric shall be tied to tension wires, with hog rings spaced 24-inches on center.

L. **Stretcher Bars**: Fabric shall be fastened to end, corner, intermediate brace, and gate posts with stretcher bars. Bars shall be threaded through or clamped to fabric at 4-inches on center and secured to posts with stretcher bar bands spaced no more than 14-inches on center.

M. **Fasteners:** Nuts for tension bands and hardware bolts shall be installed on the side of fence opposite the fabric side. Ends of bolts shall be peened or the threads scored to prevent removal of nuts.

N. Galvanized coating damaged during construction of the fencing shall be repaired by application of **Galvo-Weld**; **Galvinox**; or equal.

O. Damage to PVC coating shall be repaired with material equivalent in color and thickness to the original coating.

3.3 GROUNDING

A. Fences crossed by powerlines of 600 volts or more shall be grounded at or near the point of crossing and at distances not exceeding 150-feet on each side of the crossing.

B. Fences, gates and appurtenances enclosing electrical equipment areas, gas yards, or other hazardous areas shall be electrically continuous and grounded.

C. Ground conductor shall consist of No. 8 AWG solid copper wire. Grounding electrodes shall be 3/4-inch by 10-foot long copper-clad steel rod. Electrodes shall be driven into the earth so that the top of the electrode is at least 6-inches below grade.

   1. Where driving is impracticable, electrodes shall be buried a minimum of 12-inches deep and radically from the fence. Top of electrode shall be not less than 2-feet or more than 8-feet from the fence.

D. Ground conductor shall be clamped to the fence and electrodes with bronze grounding clamps so as to create electrical continuity between fence posts, fence fabric, and ground rods. After installation, the total resistance of fence to ground shall not be greater than 25 ohms.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 03100 - CONCRETE FORMWORK

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall furnish concrete formwork, bracing, shoring, and supports for cast-in-place concrete and shall design and construct falsework in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01300 - Contractor Submittals.

B. Manufacturer's information demonstrating compliance with requirements for the following:

1. Form ties and related accessories, including taper tie plugs, if taper ties are used.

2. Form gaskets.

3. Form release agent, including NSF certification if not using mineral oil.

4. List of form materials and locations for use.

C. **Shop Drawings:** Detailed plans for the fabrication and erection of falsework to be used. Such plans shall be in sufficient detail to indicate the general layout, sizes of members, anticipated stresses, grade of materials to be used in the falsework, means of protecting existing construction which supports falsework, and typical soil conditions. Include a list of form materials and locations for use.

D. **Falsework Calculations and Drawings:** The CONTRACTOR's attention is directed to the provisions of Section 1717 of the Division of Industrial Safety, Construction Safety Orders, as revised November 1973, which requires that all falsework or vertical shoring installations where the height of the falsework or vertical shoring, as measured from the top of the sills to the soffit of the superstructure, exceeds 14 feet, or where individual horizontal span lengths exceed 16 feet, or provision for vehicular or railroad traffic through falsework or vertical shoring is made, shall be approved and signed by a civil engineer, registered in the State of California; provided further, that a copy of the falsework plan or shoring layout shall be available on the job site at all times.

1.3 QUALITY ASSURANCE

A. **Tolerances:** The variation from required lines or grade shall not exceed 1/4-inch in 10 feet, non-cumulative, and there shall be no offsets or visible waviness in the finished surface. All other tolerances shall be within the tolerances of ACI 117 - Standard Tolerances for Concrete Construction and Materials

PART 2 -- PRODUCTS

2.1 GENERAL

A. Except as otherwise expressly accepted by the CONTRACTING OFFICER, lumber brought on the Site for use as forms, shoring, or bracing shall be new material. Forms shall be smooth surface forms and shall be of the following materials:

Walls	-	Steel, fiberglass, or plywood panel
Columns	-	Steel, plywood or fiberglass
Roof and floor	-	Plywood
All other work	-	Steel panels, fiberglass, plywood or tongue and groove lumber

B. Form materials which may remain or leave residues on or in the concrete shall be certified as compliant with NSF Standard 61 – Drinking Water System Components.

2.2 FORM AND FALSEWORK MATERIALS

A. Materials for concrete forms, formwork, and falsework shall conform to the following requirements:

1. Lumber shall be Douglas Fir or Southern Yellow Pine, construction grade or better, in conformance with U.S. Product Standard PS 20 - American Softwood Lumber Standard

2. Plywood for concrete formwork shall be new, waterproof, synthetic resin bonded, exterior type Douglas Fir or Southern Yellow Pine plywood manufactured especially for concrete formwork, shall conform to the requirements of PS 1 – Construction and Industrial Plywood, for Concrete Forms, Class I, and shall be edge sealed.

3. Form materials shall be metal, wood, plywood, or other material that will not adversely affect the concrete and will facilitate placement of concrete to the shape, form, line, and grade indicated. Metal forms shall accomplish such results. Wood forms for surfaces to be painted shall be Medium Density Overlaid plywood, MDO Ext. Grade.

B. Unless otherwise indicated, exterior corners in concrete members shall be provided with 3/4-inch chamfers or be tooled to 1/2-inch radius. Re-entrant corners in concrete members shall not have fillets unless otherwise indicated.

C. Forms and falsework to support the roof and floor slabs shall be designed for the total dead load, plus a live load of 50 psf minimum. The minimum design load for combined dead and live loads shall be 100 psf.

2.3 FORM TIES

A. Form ties shall be provided with a plastic cone or other suitable means for forming a conical hole to insure that the form tie may be broken off back of the face of the concrete. The maximum diameter of removable cones for rod ties, or of other removable form-tie fasteners having a circular cross-section, shall not exceed 1-1/2 inches; and all such fasteners shall be such as to leave holes of regular shape for reaming. Form ties for water-retaining structures shall have integral waterstops that tightly fit the form tie so

that they cannot be moved from mid-point of the tie. Form ties shall be **Wrench Head Snap Tie** by **MeadowBurke; Snap-Ties** by **Dayton/Richmond;** or equal.

B. Removable taper ties may be used when approved by the CONTRACTING OFFICER. A preformed neoprene or polyurethane tapered plug sized to seat at the center of the wall shall be inserted in the hole left by the removal of the taper tie**.** Use **Taper-Tie** by **MeadowBurke; Taper-Tie** by **Dayton/Richmond;** or equal.

PART 3 -- EXECUTION

3.1 GENERAL

A. Forms to confine the concrete and shape it to the required lines shall be used wherever necessary. The CONTRACTOR shall assume full responsibility for the adequate design of all forms, and any forms which are unsafe or inadequate in any respect shall promptly be removed from the WORK and replaced. Provide worker protection from protruding reinforcement bars in accordance with applicable safety codes. A sufficient number of forms of each kind shall be available to permit the required rate of progress to be maintained. The design and inspection of concrete forms, falsework, and shoring shall comply with applicable local, state, and Federal regulations. Plumb and string lines shall be installed before concrete placement and shall be maintained during placement. Such lines shall be used by CONTRACTOR's personnel and by the CONTRACTING OFFICER and shall be in sufficient number and properly installed. During concrete placement, the CONTRACTOR shall continually monitor plumb and string line form positions and immediately correct deficiencies.

B. Concrete forms shall conform to the shape, lines, and dimensions of members required, and shall be substantial, free from surface defects, and sufficiently tight to prevent leakage. Forms shall be properly braced or tied together to maintain their position and shape under a load of freshly-placed concrete. If adequate foundation for shores cannot be secured, trussed supports shall be provided.

3.2 FORM DESIGN

A. Forms shall be true in every respect to the required shape and size, shall conform to the established alignment and grade, and shall be of sufficient strength and rigidity to maintain their position and shape under the loads and operations incident to placing and vibrating the concrete. Suitable and effective means shall be provided on all forms for holding adjacent edges and ends of panels and sections tightly together and in accurate alignment so as to prevent the formation of ridges, fins, offsets, or similar surface defects in the finished concrete. Plywood, 5/8-inch and greater in thickness, may be fastened directly to studding if the studs are spaced close enough to prevent visible deflection marks in the concrete. The forms shall be tight so as to prevent the loss of water, cement, and fines during placing and vibrating of the concrete. Specifically, the bottom of wall forms that rest on concrete footings or slabs shall be provided with a gasket to prevent loss of fines and paste during placement and vibration of concrete. Such gasket may be a 1- to 1-1/2-inch diameter polyethylene rod held in position to the underside of the wall form. Adequate clean-out holes shall be provided at the bottom of each lift of forms. The size, number, and location of such clean-outs shall be as acceptable to the CONTRACTING OFFICER. Whenever concrete cannot be placed from the top of a wall form in a manner that meets the requirements of the Contract Documents, form windows shall be provided in the size and spacing needed to allow placement of concrete to the

requirements of Section 03300 - Cast-in-Place Concrete. The size, number, and location of such form windows shall be as acceptable to the CONTRACTING OFFICER.

3.3 CONSTRUCTION

A. **Vertical Surfaces:** All vertical surfaces of concrete members shall be formed, except where placement of the concrete against the ground is indicated. Not less than 1-inch of concrete shall be added to the indicated thickness of a concrete member where concrete is permitted to be placed against trimmed ground in lieu of forms. Permission to do this on other concrete members will be granted only for members of comparatively limited height and where the character of the ground is such that it can be trimmed to the required lines and will stand securely without caving or sloughing until the concrete has been placed.

B. **Construction Joints:** Concrete construction joints will not be permitted at locations other than those indicated, except as may be acceptable to the CONTRACTING OFFICER. When a second lift is placed on hardened concrete, special precautions shall be taken in the way of the number, location, and tightening of ties at the top of the old lift and bottom of the new to prevent any unsatisfactory effect whatsoever on the concrete. Pipe stubs and anchor bolts shall be set in the forms where required.

C. Form Ties

1. Embedded Ties: Holes left by the removal of form tie cones shall be reamed with suitable toothed reamers so as to leave the surface of the holes clean and rough before being filled with mortar. Wire ties for holding forms will not be permitted. No form-tying device or part thereof, other than metal, shall be left embedded in the concrete. Ties shall not be removed in such manner as to leave a hole extending through the interior of the concrete members. The use of snap-ties which cause spalling of the concrete upon form stripping or tie removal will not be permitted. If steel panel forms are used, rubber grommets shall be provided where the ties pass through the form in order to prevent loss of cement paste. Where metal rods extending through the concrete are used to support or to strengthen forms, the rods shall remain embedded and shall terminate not less than 1-inch back from the formed face or faces of the concrete.

2. Removable Ties: Where taper ties are approved for use, the larger end of the taper tie shall be on the wet side of walls in water retaining structures. After the taper tie is removed, the hole shall be thoroughly cleaned and roughened for bond. A precast neoprene or polyurethane tapered plug shall be located at the wall centerline. The hole shall be completely filled with non-shrink grout for water bearing and below-grade walls. The hole shall be completely filled with non-shrink or regular cement grout for above-grade walls which are dry on both sides. Exposed faces of walls shall have the outer 2 inches of the exposed face filled with a cement grout which shall match the color and texture of the surrounding wall surface.

3.4 REUSE OF FORMS

A. Forms may be reused only if in good condition and only if acceptable to the CONTRACTING OFFICER. Light sanding between uses will be required wherever necessary to obtain uniform surface texture on all exposed concrete surfaces. Exposed concrete surfaces are defined as surfaces which are permanently exposed to view. In the case of forms for the inside wall surfaces of hydraulic/water retaining structures, unused tie rod holes in forms shall be covered with metal caps or shall be filled by other methods acceptable to the CONTRACTING OFFICER.

3.5 REMOVAL OF FORMS

A. Careful procedures for the removal of forms shall be strictly followed, and this WORK shall be done with care so as to avoid injury to the concrete. No heavy loading on green concrete will be permitted. In the case of roof slabs and above-ground floor slabs, forms shall remain in place until test cylinders for the roof concrete attain a minimum compressive strength of 75 percent of the 28-day strength in Section 03300. No forms shall be disturbed or removed under an individual panel or unit before the concrete in the adjacent panel or unit has attained 75 percent of the 28-day strength and has been in place for a minimum of 7 days. The time required to establish said strength shall be as determined by the CONTRACTING OFFICER who will make several test cylinders for this purpose from concrete used in the first group of roof panels placed. If the time so determined is more than the 7-day minimum, then that time shall be used as the minimum length of time. Forms for vertical walls of water holding structures shall remain in place at least 36 hours after the concrete has been placed. Forms for parts of the WORK not specifically mentioned herein shall remain in place for periods of time as recommended in ACI 347 - Guide to Formwork for Concrete.

3.6 MAINTENANCE OF FORMS

A. Forms shall be maintained at all times in good condition, particularly as to size, shape, strength, rigidity, tightness, and smoothness of surface. Before concrete is placed, the forms shall be thoroughly cleaned. The form surfaces shall be treated with a nonstaining mineral oil or other lubricant acceptable to the CONTRACTING OFFICER. Any excess lubricant shall be satisfactorily removed before placing the concrete. Where field oiling of forms is required, the CONTRACTOR shall perform the oiling at least two weeks in advance of their use. Care shall be exercised to keep oil off the surfaces of steel reinforcement and other metal items to be embedded in concrete.

3.7 FALSEWORK

A. The CONTRACTOR shall be responsible for the design, engineering, construction, maintenance, and safety of all falsework, including staging, walkways, forms, ladders, and similar appurtenances, which shall equal or exceed the applicable requirements of the provisions of the OSHA Safety and Health Standards for Construction, the requirements of the Construction Safety Orders of the California Division of Industrial Safety, and the requirements herein.

B. Falsework shall be designed and constructed to provide the necessary rigidity and to support the loads. Falsework for the support of a superstructure shall be designed to support the loads that would be imposed if the entire superstructure were placed at one time.

C. Falsework shall be placed upon a solid footing, safe against undermining, and protected from softening. When the falsework is supported on timber piles, the maximum calculated pile loading shall not exceed 20 tons. When falsework is supported on any portion of the structure which is already constructed, the load imposed by the falsework shall be spread, distributed, and braced in such a way as to avoid any possibility of damage to the structure.

- END OF SECTION -

SECTION 03200 - REINFORCEMENT STEEL

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide reinforcement steel and appurtenant work, complete and in place, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01300 - Contractor Submittals.

B. Shop Drawings

1. Shop bending diagrams, placing lists, and drawings of all reinforcement steel prior to fabrication. The shop bending diagrams shall show the actual lengths of bars, to the nearest inch measured to the intersection of the extensions (tangents for bars of circular cross section) of the outside surface. Include bar placement diagrams which clearly indicate the dimensions of each bar splice.

2. Details of the concrete reinforcement steel and concrete inserts shall be submitted at the earliest possible date after receipt by the CONTRACTOR of the Notice to Proceed. Said details of reinforcement steel for fabrication and erection shall conform to ACI 315 - Details and Detailing of Concrete Reinforcement, and the requirements herein.

3. Where mechanical couplers are required or permitted to be used to splice reinforcement steel, the CONTRACTOR shall submit manufacturer's literature which contains instructions and recommendations for installation for each type of coupler used; certified test reports which verify the load capacity of each type and size of coupler used; and Shop Drawings which show the location of each coupler with details of how they are to be installed in the formwork.

4. If reinforcement steel is spliced by welding at any location, the CONTRACTOR shall submit mill test reports which shall contain the information necessary for the determination of the carbon equivalent per AWS D1.4 - Structural Steel Welding Code - Reinforcing Steel. The CONTRACTOR shall submit a written welding procedure for each type of weld for each size of bar which is to be spliced by welding; merely a statement that AWS procedures will be followed is not acceptable.

5. If reinforcement steel is spliced by welding at any location, the CONTRACTOR shall submit certifications of procedure qualifications for each welding procedure and certification of welder qualifications, for each welding procedure, and for each welder performing the work.

1.3 QUALITY ASSURANCE

A. If requested by the CONTRACTING OFFICER, the CONTRACTOR shall furnish samples from each heat of reinforcement steel in a quantity adequate for testing. Costs of initial tests will be paid by the GOVERNMENT. Costs of additional tests if material fails initial tests shall be the CONTRACTOR’s responsibility.

B. Welder qualifications and procedure qualifications shall be as specified in AWS D1.4.

C. If requested by the CONTRACTING OFFICER, the CONTRACTOR shall furnish samples of each type of welded splice in a quantity and of dimensions adequate for testing. At the discretion of the CONTRACTING OFFICER, radiographic testing of direct butt welded splices will be performed. The CONTRACTOR shall provide assistance necessary to facilitate testing. The CONTRACTOR shall repair any weld which fails to meet the requirements of AWS D1.4. The costs of testing will be paid by the GOVERNMENT, but the costs of tests which fail to meet requirements shall be the CONTRACTOR's responsibility.

PART 2 -- PRODUCTS

2.1 MATERIAL REQUIREMENTS

A. Materials which may remain or leave residues on or within the concrete shall be certified as compliant with NSF Standard 61- Drinking Water System Components.

2.2 REINFORCEMENT STEEL

A. Reinforcement steel for cast-in-place reinforced concrete construction shall conform to the following requirements:

1. Bar reinforcement shall conform to the requirements of ASTM A 615 - Deformed and Plain Billet - Steel Bars, for Grade 60 reinforcement unless otherwise indicated.

2. Welded wire fabric reinforcement shall conform to the requirements of ASTM A 185 - Welded Steel Wire Fabric, Plain, for Concrete Reinforcement, and the details indicated. Welded wire fabric with longitudinal wire of W4 size wire and smaller shall be in flat sheets or in rolls with a core diameter of not less than 10 inches. Welded wire fabric with longitudinal wires larger than W4 size shall be in flat sheets only.

3. Spiral reinforcement shall be cold-drawn steel wire conforming to the requirements of ASTM A 82 - Steel Wire, Plain, for Concrete Reinforcement.

B. Accessories

1. Accessories shall include all necessary chairs, slab bolsters, concrete blocks, tie wires, dips, supports, spacers, and other devices to position reinforcement during concrete placement. Bar supports shall meet the requirements of the CRSI Manual of Standard Practice including special requirements for supporting epoxy coated reinforcing bars. Wire bar supports shall be CRSI Class 1 for maximum protection with a 1/8-inch minimum thickness of plastic coating which extends at least 1/2-inch from the concrete surface. Plastic shall be gray in color.

2. Concrete blocks (dobies) used to support and position reinforcement steel shall have the same or higher compressive strength as required for the concrete in which they are located. Wire ties shall be embedded in concrete block bar supports.

C. Epoxy coating for reinforcing and accessories, where indicated, shall conform to ASTM A 775 - Epoxy - Coated Reinforcing Steel Bars.

2.3 MECHANICAL COUPLERS

A. Mechanical couplers shall be provided where indicated and where approved by the CONTRACTING OFFICER. The couplers shall develop a tensile strength which exceeds 125 percent of the yield strength of the reinforcement bars being spliced at each splice.

B. Where the type of coupler used is composed of more than one component, all components required for a complete splice shall be provided. This shall apply to all mechanical splices, including those splices intended for future connections.

C. The reinforcement steel and coupler used shall be compatible for obtaining the required strength of the connection. Straight threaded type couplers shall require the use of the next larger size reinforcing bar or shall be used with reinforcing bars with specially forged ends which provide upset threads which do not decrease the basic cross section of the bar.

D. Couplers shall be **Lenton Form Saver** by **Erico Products; Dowel Bar Splicer System** by **Dayton/Richmond**; or equal.

2.4 WELDED SPLICES

A. Welded splices shall be provided where indicated and where approved by the CONTRACTING OFFICER. All welded splices of reinforcement steel shall develop a tensile strength which exceeds 125 percent of the yield strength of the reinforcement bars which are connected.

B. Materials required to conform the welded splices to the requirements of AWS D1.4 shall be provided.

2.5 EPOXY GROUT

A. Epoxy for grouting reinforcing bars shall be specifically formulated for such application, for the moisture condition, application temperature, and orientation of the hole to be filled. Epoxy grout shall meet the requirements in Section 03315 - Grout.

PART 3 -- EXECUTION

3.1 GENERAL

A. Reinforcement steel, welded wire fabric, couplers, and other appurtenances shall be fabricated, and placed in accordance with the requirements of the Building Code and the supplementary requirements herein.

3.2 FABRICATION

A. General

1. Reinforcement steel shall be accurately formed to the dimensions and shapes indicated, and the fabricating details shall be prepared in accordance with ACI 315 and ACI 318 - Building Code Requirements for Reinforced Concrete, except as modified by the Drawings. Bars shall be bent cold. Bars shall be bent per ACI 318.

2. The CONTRACTOR shall fabricate reinforcement bars for structures in accordance with bending diagrams, placing lists, and placing drawings.

B. **Fabricating Tolerances:** Bars used for concrete reinforcement shall satisfy the following fabricating tolerances:

1. Sheared length: plus and minus 1 inch

2. Depth of truss bars: plus 0, minus 1/2 inch

3. Stirrups, ties, and spirals: plus and minus 1/2 inch

4. All other bends: plus and minus 1 inch

3.3 PLACING

A. Reinforcement steel shall be accurately positioned as indicated, and shall be supported and wired together to prevent displacement, using annealed iron wire ties or suitable clips at intersections. Reinforcement steel shall be supported by concrete, plastic or metal supports, spacers or metal hangers which are strong and rigid enough to prevent any displacement of the reinforcement steel. Where concrete is to be placed on the ground, supporting concrete blocks (or dobies) shall be used in sufficient numbers to support the bars without settlement, but in no case shall such support be continuous. Concrete blocks used to support reinforcement steel shall be tied to the steel with wire ties which are embedded in the blocks. For concrete over formwork, the CONTRACTOR shall provide concrete, metal, plastic, or other acceptable bar chairs and spacers.

B. Limitations on the use of bar support materials shall be as follows.

1. Concrete Dobies: permitted at all locations except where architectural finish is required.

2. Wire Bar Supports: permitted only at slabs over dry areas, interior dry wall surfaces, and exterior wall surfaces.

3. Plastic Bar Supports: permitted at all locations except on grade.

C. Tie wires shall be bent away from the forms in order to provide the required concrete coverage.

D. Bars additional to those indicated which may be found necessary or desirable by the CONTRACTOR for the purpose of securing reinforcement in position shall be provided by the CONTRACTOR at its own expense.

E. Unless otherwise indicated, reinforcement placing tolerances shall be within the limits in Section 7.5 of ACI 318 except where in conflict with the requirements of the Building Code.

F. Bars may be moved as necessary to avoid interference with other reinforcement steel, conduits, or embedded items. If bars are moved more than one bar diameter, or enough to exceed the above tolerances, the resulting arrangement of bars shall be as reviewed and accepted by the CONTRACTING OFFICER.

G. Welded wire fabric reinforcement placed over horizontal forms shall be supported on slab bolsters. Slab bolsters shall be spaced not more than 30 inches on centers, shall extend continuously across the entire width of the reinforcement mat, and shall support the reinforcement mat in the plane indicated.

H. Welded wire fabric placed over the ground shall be supported on wired concrete blocks (dobies) spaced not more than 3 feet on centers in any direction. The construction practice of placing welded wire fabric on the ground and hooking into place in the freshly placed concrete shall not be used.

I. Epoxy coated reinforcing bars shall be stored, transported, and placed in such a manner as to avoid chipping of the epoxy coating. Non-abrasive slings made of nylon and similar materials shall be used. Specially coated bar supports shall be used. Chips or cracks in the epoxy coating shall be repaired with a compatible epoxy repair material prior to placing concrete.

J. Accessories supporting reinforcing bars shall be spaced such that there is no deflection of the accessory from the weight of the supported bars. When used to space the reinforcing bars from wall forms, the forms and bars shall be located so that there is no deflection of the accessory when the forms are tightened into position.

3.4 SPACING OF BARS

A. The clear distance between parallel bars (except in columns and between multiple layers of bars in beams) shall be not less than the nominal diameter of the bars nor less than 1-1/3 times the maximum size of the coarse aggregate, nor less than one inch.

B. Where reinforcement in beams or girders is placed in 2 or more layers, the clear distance between layers shall be not less than one inch.

C. In columns, the clear distance between longitudinal bars shall be not less than 1-1/2 times the bar diameter, nor less than 1-1/2 times the maximum size of the coarse aggregate, nor less than 1-1/2 inches.

D. The clear distance between bars shall also apply to the distance between a contact splice and adjacent splices or bars.

3.5 SPLICING

A. General

1. Reinforcement bar splices shall only be used at locations indicated. When it is necessary to splice reinforcement at points other than where indicated, the character of the splice shall be as reviewed and accepted by the CONTRACTING OFFICER.

2. Unless otherwise indicated, dowels shall match the size and spacing of the spliced bar.

B. Splices of Reinforcement

1. The length of lap for reinforcement bars, unless otherwise indicated, shall be in accordance with ACI 318, Section 12.15.1 for a Class B splice.

2. Laps of welded wire fabric shall be in accordance with ACI 318. Adjoining sheets shall be securely tied together with No. 14 tie wire, one tie for each 2 running feet. Wires shall be staggered and tied in such a manner that they cannot slip.

3. Splices in column spiral reinforcement, when necessary, shall be made by welding or by a lap of 1-1/2 turns.

C. **Bending or Straightening:** Reinforcement shall not be straightened or rebent in a manner which will injure the material. Bars shall be bent or straight as indicated. Do not use bends different from the bends indicated. Bars shall be bent cold, unless otherwise permitted by the CONTRACTING OFFICER. No bars partially embedded in concrete shall be field-bent except as indicated or specifically permitted by the CONTRACTING OFFICER.

D. Couplers which are located at a joint face shall be a type which can be set either flush or recessed from the face as indicated. The couplers shall be sealed during concrete placement to completely eliminate concrete or cement paste from entering. Couplers intended for future connections shall be recessed a minimum of 1/2 inch from the concrete surface. After the concrete is placed, the coupler shall be plugged with plastic plugs which have an O-ring seal and the recess filled with sealant to prevent any contact with water or other corrosive materials. Threaded couplers shall be plugged .

E. Unless indicated otherwise, mechanical coupler spacing and capacity shall match the spacing and capacity of the reinforcing indicated for the adjacent section.

3.6 CLEANING AND PROTECTION

A. Reinforcement steel shall at all times be protected from conditions conducive to corrosion until concrete is placed around it.

B. The surfaces of reinforcement steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar, and other foreign substances immediately before the concrete is placed. Where there is delay in depositing concrete, reinforcement shall be reinspected and, if necessary, recleaned.

3.7 EMBEDMENT OF DRILLED REINFORCING STEEL DOWELS

A. Hole Preparation

1. The hole diameter shall be as recommended by the epoxy manufacturer but shall be no larger than 0.25 inch greater than the diameter of the outer surface of the reinforcing bar deformations.

2. The depth of the hole shall be as recommended by the epoxy manufacturer to fully develop the bar but shall not be less than 12 bar diameters, unless indicated otherwise.

3. The hole shall be drilled by methods which do not interfere with the proper bonding of epoxy.

4. Existing reinforcing steel in the vicinity of proposed holes shall be located prior to drilling. The location of holes shall be adjusted to avoid drilling through or nicking any existing reinforcing bars.

5. The hole shall be blown clean with clean, dry compressed air to remove all dust and loose particles.

B. Embedment

1. Epoxy shall be injected into the hole through a tube placed to the bottom of the hole. The tube shall be withdrawn as epoxy is placed but kept immersed to prevent formation of air pockets. The hole shall be filled to a depth that insures that excess material will be expelled from the hole during dowel placement.

2. Dowels shall be twisted during insertion into the partially filled hole so as to guarantee full wetting of the bar surface with epoxy. The bar shall be inserted slowly enough to avoid developing air pockets.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 03290 - JOINTS IN CONCRETE

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide joints in concrete, complete and in place, in accordance with the Contract Documents.

B. Joints in concrete structures shall be the types defined below and will be permitted only where indicated, unless specifically accepted by the CONTRACTING OFFICER.

1.2 TYPES OF JOINTS

A. **Construction Joints:** When fresh concrete is placed against a hardened concrete surface, the joint between the two pours is called a construction joint. Unless otherwise indicated, joints in water bearing members shall be provided with a waterstop and/or sealant groove of the shape indicated. The surface of the first pour may also be required to receive a coating of bond breaker as indicated.

B. **Contraction Joints:** Contraction joints are similar to construction joints except that the fresh concrete shall not bond to the hardened surface of the earlier pour, which shall be coated with a bond breaker. The slab reinforcement shall be stopped 4-1/2 inches from the joint; which is provided with a sleeve-type dowel, to allow shrinkage of the concrete of the later pour. Waterstop and/or sealant groove shall also be provided when indicated.

C. **Expansion Joints:** To allow the concrete to expand freely, a space is provided between the two pours, and the joint shall be formed as indicated. The space is obtained by placing a filler joint material against the earlier pour, to act as a form for the later pour. Unless otherwise indicated, expansion joints in water bearing members shall be provided with a center-bulb type waterstop as indicated.

1. Premolded expansion joint material shall be installed with the edge at the indicated distance below or back from finished concrete surface, and shall have a slightly tapered, dressed, and oiled wood strip secured to or placed at the edge thereof during concrete placement, which shall later be removed to form space for sealing material.

2. The space so formed shall be filled with a joint sealant material as indicated below. In order to keep the two wall or slab elements in line the joint shall also be provided with a sleeve-type dowel as indicated.

D. **Control Joints:** The function of the control joint is to provide a weaker plane in the concrete, where shrinkage cracks will probably occur. A groove, of the shape and dimensions indicated, is formed or saw-cut in the concrete. This groove is afterward filled with a joint sealant material.

1.3 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01300 - Contractor Submittals.

B. Shop Drawings

1. Placement drawings showing the location and type of all joints for each structure.

2. Certified test reports from the sealant manufacturer on the actual batch of material being supplied indicating compliance with requirements shall be furnished before the sealant is used on the job.

3. Copies of Waterstop Welding Certification to be provided by manufacturer or authorized agent of manufacturer. Every person who is to be involved with waterstop installation is required to have individual Certification on file with CONTRACTING OFFICER, which states said individuals are certified and trained to install waterstop per manufacturer's recommendations and specifications.

4. Manufacturer's information demonstrating compliance of the following with indicated requirements:

   a. Bearing Pad

   b. Neoprene Sponge

   c. Preformed Joint Filler

   d. Hypalon Sheeting Expansion Joint System

   e. Backing Rod

   f. Bond Breaker

   g. Waterstop

   h. Slip Dowels

   i. PVC Tubing

C. Samples

1. Prior to production of the material required under this Section, qualification samples of waterstops shall be submitted which represent in all respects the material proposed. Such samples shall consist of extruded or molded sections of each size or shape to be used. The balance of the material to be used shall not be produced until after the CONTRACTING OFFICER has reviewed the qualification samples.

D. **Certificates:** Written certification from the manufacturer as an integral part of the shipping form, to show that all of the material shipped to this project meets or exceeds the physical property requirements of the Contract Documents. Supplier certificates are not acceptable.

1.4 QUALITY ASSURANCE

A. **Waterstop Inspection:** It is required that all waterstop field joints shall be subject to rigid inspection, and no such WORK shall be scheduled or started without having made prior arrangements with the CONTRACTING OFFICER for the required inspections. Not less than 24 hours notice shall be given for scheduling such inspections.

B. Field joints in waterstops shall be subject to rigid inspection for misalignment, bubbles, inadequate bond, porosity, cracks, offsets, and other defects which would reduce the potential resistance of the material to water pressure at any point. Defective joints shall be replaced with material which passes inspection; faulty material shall be removed from the Site and disposed of.

C. The following waterstop defects represent a partial list of defects which shall be grounds for rejection:

1. Offsets at joints greater than 1/16-inch or 15 percent of material thickness, at any point, whichever is less.

2. Exterior crack at joint, due to incomplete bond, which is deeper than 1/16-inch or 15 percent of material thickness, at any point, whichever is less.

3. Any combination of offset or exterior crack which will result in a net reduction in the cross section of the waterstop in excess of 1/16-inch or 15 percent of material thickness at any point, whichever is less.

4. Misalignment of joint which results in misalignment of the waterstop in excess of 1/2-inch in 10 feet.

5. Porosity in the welded joint as evidenced by visual inspection.

6. Bubbles or inadequate bonding which can be detected with a penknife test. (If, while prodding the entire joint with the point of a pen knife, the knife breaks through the outer portion of the weld into a bubble, the joint shall be considered defective.)

7. Visible signs of separation when the cooled splice is bent by hand at any sharp angle.

8. Any evidence of burned material.

D. **PVC Waterstop Samples:** Prior to use of the waterstop material in the field, a sample of a prefabricated (shop made fitting) mitered cross and a tee constructed of each size or shape of material to be used shall be submitted. These samples shall be prefabricated (shop made fitting) so that the material and workmanship represent in all respects the fittings to be provided. Field samples of prefabricated (shop made fitting) fittings (crosses, tees, etc.) will also be selected at random by the CONTRACTING OFFICER for testing by a laboratory at the GOVERNMENT's expense. When tested, tensile strength across the joints shall be at least 1120 psi.

E. **Construction Joint Sealant:** The CONTRACTOR shall prepare adhesion and cohesion test specimens as required herein, at intervals of 5 working days while sealants are being installed.

F. The sealant material shall show no signs of adhesive or cohesive failure when tested in accordance with the following procedure in laboratory and field tests:

1. Sealant specimen shall be prepared between 2 concrete blocks (1-inch by 2-inch by 3-inch). Spacing between the blocks shall be 1-inch. Coated spacers (2-inch by 1-1/2-inch by 1/2-inch) shall be used to insure sealant cross-sections of 1/2-inch by 2 inches with a width of 1-inch.

2. Sealant shall be cast and cured according to manufacturer's recommendations except that curing period shall be not less than 24 hours.

3. Following curing period, the gap between blocks shall be widened to 1-1/2-inch. Spacers shall be used to maintain this gap for 24 hours prior to inspection for failure.

1.5 SPECIAL WARRANTY REQUIREMENTS

A. The CONTRACTOR shall furnish a 5-year written warranty of the entire sealant installation against faulty and/or incompatible materials and workmanship, together with a statement that it agrees to repair or replace, to the satisfaction of the GOVERNMENT, any such defective areas which become evident within said 5-year guarantee period.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Joint materials shall be listed as compliant with NSF Standard 61.

2.2 WATERSTOPS

A. **PVC Waterstops:** Waterstops shall be extruded from an elastomeric polyvinyl chloride compound containing the plasticizers, resins, stabilizers, and other materials necessary to meet the requirements of this Section. No reclaimed or scrap material shall be used. The CONTRACTOR shall obtain from the waterstop manufacturer and shall furnish to the CONTRACTING OFFICER for review, current test reports and a written certification of the manufacturer that the material to be shipped to the job meets the physical requirements as outlined in the U.S. Army Corps of Engineers Specification CRD-C572-PVC Waterstops, and those listed herein.

1. Flatstrip and Center-Bulb Waterstops: Flatstrip and center-bulb waterstops shall be as manufactured by **Greenstreak Plastic Products Co., Profiles 646, 679,732, and 735; Tamms Horn/Durajoint Types 9,10,11, and 11A** ; or equal; provided, that at no place shall the thickness of flat strip waterstops, including the center bulb type, be less than 3/8-inch. Waterstop shall be provided with factory installed hog rings at 12 inches on centers along the waterstop.

2. Multi-Rib Waterstops: Multi-rib waterstops, where required, shall be as manufactured by **Greenstreak Plastic Products Co., Profiles 789 and 790; Tamms Horn/Durajoint Types 25 and 26;** or equal. Prefabricated (shop made fitting) joint fittings shall be used at all intersections of the ribbed-type waterstops.

3. Retrofit Waterstops: Retrofit waterstops and batten bars shall be as manufactured by **Greenstreak Plastic Products Co.**, **Style #609**, or equal. Waterstop shall be supplied as a complete system including waterstop, SS batten bar, SS anchor bolts, and epoxy gel.

4. Waterstop Testing Requirements: When tested in accordance with the test standards, the waterstop material shall meet or exceed the following requirements:

Physical Property, Sheet Material	Value	ASTM Std.
Tensile Strength-min (psi)	2000	D 638, Type IV
Ultimate Elongation-min (percent)	350	D 638, Type IV
Low Temp Brittleness-max (degrees F)	-35	D 746
Stiffness in Flexure-min (psi)	600	D 747
Accelerated Extraction (CRD-C572)		
Tensile Strength-min (psi)	1500	D 638, Type IV
Ultimate Elongation-min (percent)	300	D 638, Type IV
Effect of Alkalies (CRD-C572)		
Change in Weight (percent)	plus 0.25/minus 0.10	------
Change in Durometer, Shore A	plus and minus 5	D 2240
Finish Waterstop		
Tensile Strength-min (psi)	1400	D 638, Type IV
Ultimate Elongation-min (percent)	280	D 638, Type IV

B. **Pre-formed Hydrophilic Waterstop:** Hydrophilic (bentonite-free) waterstops shall be **Hydrotite CJ10202k** as manufactured by **Greenstreak Plastic Products Co**., **or Adeka Ultraseal MC2010** as manufactured by **Asahi Denka.**

1. Hydrophilic waterstop shall be the type which expands in the presence of water to form a watertight joint seal without damaging the concrete in which it is cast.

2. Waterstop shall be manufactured from chloroprene rubber and modified chloroprene rubber with hydrophilic properties. Waterstop shall have a delay coating to inhibit initial expansion due to moisture present in fresh concrete. The minimum expansion ratio of modified chloroprene shall be not less than 2 to 1 volumetric change in distilled water at 70 degrees F (21 degrees C).

Physical Property, Chloroprene	Value	ASTM Std.
Tensile Strength-min (psi)	1275	D 412
Ultimate Elongation-min (percent)	350	D 412
Hardness, Shore A	55 plus and minus 5	D 2240

Physical Property, Modified Chloroprene	Value	ASTM Std.
Tensile Strength-min (psi)	300	D 412
Ultimate Elongation-min (percent)	600	D 412
Hardness, Shore A	55 plus and minus 5	D 2240

3. Bonding agent for hydrophilic waterstop shall be the manufacturer's recommended adhesive for wet, rough concrete.

C. **Other Types of Waterstops:** When types of waterstops not listed above are indicated, they shall be subjected to the same requirements as those listed herein.

2.3 JOINT SEALANT FOR WATER BEARING JOINTS

A. Joint sealant shall be polyurethane polymer designed for bonding to concrete which is continuously submerged in water. No material will be acceptable which has an unsatisfactory history as to bond or durability when used in the joints of water retaining structures.

B. Joint sealant material shall meet the following requirements (73 degrees F and 5percent R.H.):

Work Life	45 - 180 minutes
Time to Reach 20 Shore "A" Hardness (at 77 degrees F, 200 gr quantity)	24 hours, maximum
Ultimate Hardness (ASTM D 2240)	20 - 45 Shore "A"
Tensile Strength (ASTM D 412)	175 psi, minimum
Ultimate Elongation (ASTM D 412)	400 percent, minimum
Tear Resistance (Die C, ASTM D 624)	75 pounds per inch of thickness, minimum
Color	Light Gray

C. Polyurethane sealants for waterstop joints in concrete shall conform to the following requirements:

1. Sealant shall be 2-part polyurethane with the physical properties of the cured sealant conforming to or exceeding the requirements of ANSI/ASTM C 920 – Elastomeric Joint Sealant, or Federal Specification TT-S-0227 E(3) - Sealing Compound, Elastomeric Type, Multicomponent, for Caulking, Sealing, and Glazing Buildings and Other Structures, for 2-part material, as applicable.

2. For vertical joints and overhead horizontal joints, only "non-sag" compounds shall be used; all such compounds shall conform to the requirements of ANSI/ASTM C 920 Class 25, Grade NS, or Federal Specification TT-S-0227 E(3), Type II, Class A.

3. For plane horizontal joints, the self-leveling compounds which meet the requirements of ANSI/ASTM C 920 Class 25, Grade P, or Federal Specification TT-S-0227 E(3), Type I shall be used. For joints subject to either pedestrian or vehicular traffic, a compound providing non-tracking characteristics, and having a Shore "A" hardness range of 35 to 45, shall be used.

4. Primer materials, if recommended by the sealant manufacturer, shall conform to the printed recommendations of the manufacturer.

D. Sealants, indicated, shall be **PSI-270** as manufactured by **Polymeric Systems Inc., Sikaflex 2C,** as manufactured by **Sika Corporation,** or equal.

E. Sealants for non-waterstop joints in concrete shall conform to Section 07920 - Sealants and Caulking.

2.4 JOINT MATERIALS

A. **Bearing Pad:** Bearing pad shall be neoprene conforming to ASTM D 2000 - Standard Classification System for Rubber Products in Automotive Applications, BC 420, 40 durometer hardness unless otherwise indicated.

B. **Neoprene Sponge:** Sponge shall be neoprene, closed-cell, expanded, conforming to ASTM D 1056 - Flexible Cellular Materials - Sponge or Expanded Rubber, type 2C5-E1.

C. Hypalon Sheeting Expansion Joint System, indicated, shall be **Sikadur Combiflex by Sika Corporation,** or equal.

D. Joint Filler

1. Joint filler for expansion joints in waterholding structures shall be neoprene conforming to ASTM D1056, Type 2C5-E1.

2. Joint filler material in other locations shall be of the preformed non-extruding type joint filler constructed of cellular neoprene sponge rubber or polyurethane of firm texture. Bituminous fiber type will not be permitted. All non-extruding and resilient-type preformed expansion joint fillers shall conform to the requirements and tests set forth in ASTM D 1752 - Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction, for Type I, except as otherwise indicated.

2.5 BACKING ROD

A. Backing rod shall be an extruded closed-cell, polyethylene foam rod. The material shall be compatible with the joint sealant material and shall have a tensile strength of not less than 40 psi and a compression deflection of approximately 25 percent at 8 psi. The rod shall be 1/8-inch larger in diameter than the joint width except that a one-inch diameter rod shall be used for a 3/4-inch wide joint.

2.6 BOND BREAKER

A. Bond breaker shall be **Super Bond Breaker** as manufactured by **Burke Company; Select Cure CRB** as manufactured by **Select Products Co.**; or equal. It shall contain a fugitive dye so that areas of application will be readily distinguishable.

B. Bonding agent for hydrophilic waterstop shall be the manufacturer's recommended adhesive for wet, rough concrete.

2.7 SLIP DOWELS

A. Slip dowels in joints shall be smooth epoxy-coated bars, conforming to ASTM A 775 - Epoxy Coated Reinforcing Steel Bars.

2.8 PVC TUBING

A. PVC tubing in joints shall be Sch. SDR 13.5, conforming to ASTM D 2241 - Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).

PART 3 -- EXECUTION

3.1 GENERAL

A. Waterstops shall be embedded in the concrete across joints as indicated. Waterstops shall be fully continuous for the extent of the joint. Splices necessary to provide such continuity shall be accomplished in conformance to printed instructions of manufacturer of the waterstops. The CONTRACTOR shall take suitable precautions and means to support and protect the waterstops during the progress of the work and shall repair or replace at its own expense any waterstops damaged during the progress of the work. Waterstops shall be stored so as to permit free circulation of air around the waterstop material.

B. When any waterstop is installed in the concrete on one side of a joint, while the other half or portion of the waterstop remains exposed to the atmosphere for more than 2 days, suitable precautions shall be taken to shade and protect the exposed waterstop from direct rays of the sun during the entire exposure and until the exposed portion of the waterstop is embedded in concrete.

3.2 SPLICES IN PVC WATERSTOPS

A. Splices in PVC waterstops shall be performed by heat sealing the adjacent waterstop sections in accordance with the manufacturer's printed recommendations. It is essential that:

1. The material not be damaged by heat sealing.

2. The splices have a tensile strength of not less than 80 percent of the unspliced material tensile strength.

3. The continuity of the waterstop ribs and of its tubular center axis be maintained. No edge welding is allowed.

B. Butt joints of the ends of 2 identical waterstop sections may be made while the material is in the forms.

C. All joints with waterstops involving more than 2 ends to be jointed together, and all joints which involve an angle cut, alignment change, or the joining of 2 dissimilar waterstop sections shall be prefabricated (shop made fitting) prior to placement in the forms, allowing not less than 24-inch long strips of waterstop material beyond the joint. Upon being inspected and approved, such prefabricated (shop made fitting) waterstop joint assemblies shall be installed in the forms and the ends of the 24-inch strips shall be butt welded to the straight run portions of waterstop in place in the forms.

D. Where a centerbulb waterstop intersects and is jointed with a non-centerbulb waterstop, care shall be taken to seal the end of the centerbulb, using additional PVC material if needed.

3.3 JOINT CONSTRUCTION

A. **Setting Waterstops:** In order to eliminate faulty installation that may result in joint leakage, particular care shall be taken of the correct positioning of the waterstops during installation. Adequate provisions must be made to support and anchor the waterstops during the progress of the WORK and to insure the proper embedment in the concrete.

The symmetrical halves of the waterstops shall be equally divided between the concrete pours at the joints. The center axis of the waterstops shall be coincident with the joint openings. Maximum density and imperviousness of the concrete shall be insured by thoroughly working it in the vicinity of all joints.

B. In placing PVC waterstops in the forms, means shall be provided to prevent them from being folded over by the concrete as it is placed. Waterstops shall be held in place with light wire ties on 12-inch centers which shall be passed through hog rings at the edge of the waterstop and tied to the curtain of reinforcing steel. Horizontal waterstops, with their flat face in a vertical plane, shall be held in place with continuous supports to which the top edge of the waterstop shall be tacked. In placing concrete around horizontal waterstops, with their flat face in a horizontal plane, concrete shall be worked under the waterstops by hand so as to avoid the formation of air and rock pockets.

C. In placing centerbulb waterstops in expansion joints, the centerbulb shall be centered on the joint filler material.

D. Waterstop in vertical wall joints shall stop 6 inches from the top of the wall where such waterstop does not connect with any other waterstop and is not to be connected to a future concrete placement.

E. **Joint Location:** Construction joints and other types of joints shall be provided where indicated. When not indicated, construction joints shall be provided at 25-foot maximum spacing for all concrete construction. Where joints are indicated spaced greater than 40 feet apart, additional joints shall be provided to maintain the 25-foot maximum spacing. The location of all joints, of any type, shall be submitted for acceptance by the CONTRACTING OFFICER.

F. **Joint Preparation:** Special care shall be used in preparing concrete surfaces at joints where bonding between 2 sections of concrete is required. Unless otherwise indicated, such bonding will be required at all horizontal joints in walls. Surfaces shall be prepared in accordance with the requirements of Section 03300 - Cast-in-Place Concrete. Except on horizontal wall construction joints, wall to slab joints, or where otherwise indicated, at all joints where waterstops are required, the joint face of the first pour shall be coated with a bond breaker as indicated herein.

G. **Retrofit Joint Preparation:** Existing surfaces to receive a retrofit waterstop shall be clean and free from any loose or foreign material. Surface shall be given a light sandblast or hydroblast finish to 1/8-inch amplitude prior to application of epoxy and waterstop.

H. **Construction Joint Sealant:** Construction joints in water-bearing floor slabs, and elsewhere as indicated, shall be provided with tapered grooves which shall be filled with a construction joint sealant. The material used for forming the tapered grooves shall be left in the grooves until just before the grooves are cleaned and filled with joint sealant. After removing the forms from the grooves, all laitance and fins shall be removed, and the grooves shall be sand-blasted. The grooves shall be allowed to become thoroughly dry, after which they shall be blown out; immediately thereafter, they shall be primed, bond breaker tape placed in the bottom of the groove, and filled with the construction joint sealant. The primer shall be furnished by the sealant manufacturer. No sealant will be permitted to be used without a primer. Care shall be used to completely fill the sealant grooves. Areas designated to receive a sealant fillet shall be thoroughly cleaned, as outlined for the tapered grooves, prior to application of the sealant.

I. The primer and sealant shall be placed strictly in accordance with the printed recommendations of the manufacturer, taking special care to properly mix the sealant prior to application. The sides of the sealant groove shall not be coated with bond breaker, curing compound, or any other substance which would interfere with proper bonding of the sealant. Sealant shall achieve final cure at least 7 days before the structure is filled with water.

J. Sealant shall be installed by a competent waterproofing specialty contractor who has a successful record of performance in similar installations.

K. Thorough, uniform mixing of 2-part, catalyst-cured materials is essential; special care shall be taken to properly mix the sealer before its application. Before any sealer is placed, the CONTRACTOR shall arrange to have the crew doing the WORK carefully instructed on the proper method of mixing and application by a representative of the sealant manufacturer.

L. Any joint sealant which fails to fully and properly cure after the manufacturer's recommended curing time for the conditions of the WORK hereunder shall be completely removed; the groove shall be thoroughly sandblasted to remove all traces of the uncured or partially cured sealant and primer, and shall be re-sealed with the indicated joint sealant. Costs of such removal, joint treatment, re-sealing, and appurtenant work shall be the CONTRACTOR’s responsibility.

M. Hydrophilic Waterstop

1. Where a hydrophilic waterstop is called for in the Contract Documents, it shall be installed with the manufacturer's instructions and recommendations except as modified herein.

2. When requested by the CONTRACTING OFFICER, the CONTRACTOR shall arrange for the manufacturer to furnish technical assistance in the field.

3. Hydrophilic waterstop shall only be used where complete confinement by concrete is provided. Hydrophilic waterstop shall not be used in expansion or contraction joints nor in the first 6 inches of any non-intersecting joint.

4. The hydrophilic waterstop shall be located as near as possible to the center of the joint and it shall be continuous around the entire joint. The minimum distance from the edge of the waterstop to the face of the member shall be 5 inches.

5. Where the thickness of the concrete member to be placed on the hydrophilic waterstop is less than 12 inches, the waterstop shall be placed in grooves formed or ground into the concrete. The groove shall be at least 3/4 inch deep and 1-1/4 inches wide. When placed in the groove, the minimum distance from the edge of the waterstop to the face of the member shall be 2.5 inches.

6. Where a hydrophilic waterstop is used in combination with PVC waterstop, the hydrophilic waterstop shall overlap the PVC waterstop for a minimum of 6 inches and shall be adhered to PVC waterstop with single component water-swelling sealant as recommended by manufacturer.

7. The hydrophilic waterstop shall not be installed where the air temperature falls outside the manufacturer's recommended range.

8. The concrete surface under the hydrophilic waterstop shall be smooth and uniform. The concrete shall be ground smooth if needed. Alternately, the hydrophilic waterstop shall be bonded to the surface using an epoxy grout which completely fills all voids and irregularities beneath the waterstop material. Prior to installation, the concrete surface shall be wire brushed to remove any laitance or other materials that may interfere with the bonding of epoxy.

9. The hydrophilic waterstop shall be secured in place with concrete nails and washers at 12-inch maximum spacing. This shall be in addition to the adhesive recommended by the manufacturer.

N. **Retrofit Waterstop:** Retrofit waterstops shall be set in a bed of epoxy over a sandblasted surface with stainless steel batten bars and 1/4-inch diameter stainless steel anchors at 6 inches on center, staggered, and in accordance with the manufacturer's written recommendations.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 03300 - CAST-IN-PLACE CONCRETE

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide cast-in-place concrete in accordance with the Contract Documents.

B. The following types of concrete are covered in this Section:

1. Structural Concrete: Concrete to be used in all cases except where indicated otherwise in the Contract Documents.

2. Pea Gravel Concrete: Concrete in thin sections and areas with congested reinforcing, at the option of the CONTRACTOR and with written approval of the CONTRACTING OFFICER for the specific location.

3. Sitework Concrete: Concrete to be used for curbs, gutters, catch basins, sidewalks, pavements, fence and guard post embedment, underground pipe encasement, underground duct bank encasement and all other concrete appurtenant to electrical facilities unless otherwise indicated.

4. Lean Concrete: Concrete to be used for thrust blocks, pipe trench cut-off blocks and cradles that are indicated on the Drawings as unreinforced. Lean concrete shall be used as protective cover for dowels intended for future connection.

C. The term "hydraulic structure" used in these specifications means environmental engineering concrete structures for the containment, treatment, or transmission of water, wastewater, other fluids, or gases.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01300 – Contractor Submittals.

B. **Mix Designs:** Prior to beginning the WORK and within 14 days of the Notice to Proceed, submit preliminary concrete mix designs which shall show the proportions and gradations of all materials proposed for each class and type of concrete. Mix designs shall be checked by an independent testing laboratory acceptable to the CONTRACTING OFFICER. All costs related to such checking shall be CONTRACTOR's responsibility. Since laboratory trial batches require 35 calendar days to complete, the CONTRACTOR shall test a minimum of two mix designs for each class of concrete.

C. **Delivery Tickets:** Where ready-mix concrete is used, the CONTRACTOR shall furnish delivery tickets at the time of delivery of each load of concrete. Each ticket shall show the state certified equipment used for measuring and the total quantities, by weight, of cement, sand, each class of aggregate, admixtures, and the amounts of water in the aggregate added at the batching plant, and the amount allowed to be added at the Site for the specific design mix. In addition, each ticket shall state the mix number, total yield in cubic yards, and the time of day, to the nearest minute, corresponding to the times when the batch was dispatched, when it left the plant, when it arrived at the Site, when unloading began, and when unloading was finished.

D. Test data relating to the cement, aggregate, and admixtures shall be less than six months old. Furnish the following submittals in accordance with ACI 301 – Structural Concrete for Buildings:

1. Mill tests for cement.

2. Admixture certification. Chloride ion content shall be included.

3. Aggregate gradation test results and certification.

4. Materials and methods for curing.

1.3 CONCRETE CONFERENCE

A. A meeting to review the detailed requirements of the CONTRACTOR's proposed concrete design mixes and to determine the procedures for producing proper concrete construction shall be held no later than 14 days after the Notice to Proceed.

B. All parties involved in the concrete work shall attend the conference, including the following at a minimum:

1. CONTRACTOR's representative

2. Testing laboratory representative

3. Concrete subcontractor

4. Reinforcing steel subcontractor and detailer

5. Concrete supplier

6. Admixture manufacturer's representative

C. The conference shall be held at a mutually agreed upon time and place. The CONTRACTING OFFICER shall be notified no less than 5 days prior to the date of the conference.

1.4 QUALITY ASSURANCE

A. General

1. Tests on component materials and for compressive strength and shrinkage of concrete shall be performed as indicated. Tests for determining slump shall be in accordance with the requirements of ASTM C 143 – Test Method for Slump of Hydraulic Cement Concrete.

2. Testing for aggregate shall include sand equivalence, reactivity, organic impurities, abrasion resistance, and soundness, according to ASTM C 33 – Concrete Aggregates.

3. The cost of laboratory tests on cement, aggregates, and concrete, will be the CONTRACTOR’s responsibility. The CONTRACTOR shall pay the cost of any additional tests and investigation on WORK that does not meet the specifications. The laboratory will meet or exceed the requirements of ASTM C 1077 – Practice for

Laboratories Testing Concrete and Concrete Aggregates for use in Construction and Criteria for Laboratory Evaluation.

4. Concrete for testing shall be furnished by the CONTRACTOR, and the CONTRACTOR shall assist the CONTRACTING OFFICER in obtaining samples, and disposal and cleanup of excess material.

B. **Inspections:** Continuous inspection by a special inspector approved by the local building department having jurisdiction and by the CONTRACTING OFFICER will be required where necessary to conform with code requirements. Costs of the special inspector shall be paid for by the CONTRACTOR. Inspection reports shall be submitted to the CONTRACTING OFFICER. The special inspector shall observe the following work for conformance with the design drawings and specifications:

   a. During the preparation and taking of all required test specimens.

   b. Placing of all concrete except Sitework concrete fully supported on earth.

C. Field Compression Tests

1. Compression test specimens shall be taken during construction from the first placement of each class of concrete and at intervals thereafter as selected by the CONTRACTING OFFICER to insure continued compliance with these specifications. Each set of test specimens shall be a minimum of 5 cylinders.

2. Compression test specimens for concrete shall be made in accordance with Section 9.2 of ASTM C 31 – Practices for Making and Curing Concrete Test Specimens in the Field. Specimens shall be 6-inch diameter by 12-inch high cylinders.

3. Compression tests shall be performed in accordance with ASTM C 39 – Test Method for Compressive Strength of Cylindrical Concrete Specimens. One test cylinder will be tested at 7 days and 2 at 28 days. The remaining cylinders will be held to verify test results, if needed.

D. Evaluation and Acceptance of Concrete

1. Evaluation and acceptance of the compressive strength of concrete will be according to the requirements of ACI 318 – Building Code Requirements for Reinforced Concrete, Chapter 5 "Concrete Quality," and as indicated.

2. A statistical analysis of compression test results will be performed according to the requirements of ACI 214 – Recommended Practice for Evaluation of Strength Test Methods. The standard deviation of the test results shall not exceed 640 psi, when ordered at equivalent water content as estimated by slump.

3. If any concrete fails to meet these requirements, immediate corrective action shall be taken to increase the compressive strength for all subsequent batches of the type of concrete affected.

4. When the standard deviation of the test results exceeds 640 psi, the average strength for which the mix is designed shall be increased by an amount necessary to satisfy the statistical requirement that the probability of any test being more than 500 psi below or the average of any 3 consecutive tests being below the required

compressive strength is 1 in 100. The required average strength shall be calculated by Criterion No. 3 of ACI 214 using the actual standard of deviation.

5. Concrete that fails to meet the ACI requirements and these Specifications is subject to removal and replacement.

E. Shrinkage Tests

1. Drying shrinkage tests shall be performed for the trial batches indicated in Part 2, in the Article entitled "Trial Batch and Laboratory Tests," the first placement of each class of structural concrete, and during construction to insure continued compliance with these Specifications.

2. Drying shrinkage specimens shall be 4-inch by 4-inch by 11-inch prisms with an effective gauge length of 10-inches; fabricated, cured, dried, and measured in accordance with ASTM C 157 – Test Method for Length Change of Hardened Hydraulic Cement Mortar and Concrete, modified as follows: specimens shall be removed from molds at an age of 23 plus or minus 1 hours after trial batching, shall be placed immediately in water at 70 degrees F plus or minus 3 degrees F for at least 30 minutes, and shall be measured within 30 minutes thereafter to determine original length and then submerged in saturated lime water at 73 degrees F plus or minus 3 degrees F. Measurement to determine expansion expressed as a percentage of original length shall be made at age 7 days. This length at age 7 days shall be the base length for drying shrinkage calculations ("0" days drying age). Specimens then shall be stored immediately in a humidity control room maintained at 73 degrees F plus or minus 3 degrees F and 50 percent plus or minus 4 percent relative humidity for the remainder of the test. Measurements to determine shrinkage expressed as percentage of base length shall be made and reported separately for 7, 14, 21, and 28 days of drying after 7 days of moist curing.

3. The drying shrinkage deformation of each specimen shall be computed as the difference between the base length (at "0" days drying age) and the length after drying at each test age. The average drying shrinkage deformation of the specimens shall be computed to the nearest 0.0001 inch at each test age. If the drying shrinkage of any specimen departs from the average of that test age by more than 0.0004-inch, the results obtained from that specimen shall be disregarded. Results of the shrinkage test shall be reported to the nearest 0.001 percent of shrinkage. Compression test specimens shall be taken in each case from the same concrete used for preparing drying shrinkage specimens. These tests shall be considered a part of the normal compression tests for the project. Allowable shrinkage limitations shall be as indicated in Part 2 below.

F. **Aggregate Testing:** Aggregate testing shall be made for the trial batch in Part 2, in the Article entitled “Trial Batch and Laboratory Tests,” prior to construction and every 12 months during construction to insure continued compliance with these Specifications.

G. **Construction Tolerances:** The CONTRACTOR shall set and maintain concrete forms and perform finishing operations to ensure that the completed WORK is within tolerances. Surface defects and irregularities are defined as finishes and are to be distinguished from tolerances. Tolerance is the permissible variation from lines, grades, or dimensions indicated on the Drawings. Where tolerances are not stated in the specifications, permissible deviations will be in accordance with ACI 117 – Standard Tolerance for Concrete Construction and Materials.

1. The following non-cumulative construction tolerances apply to finished walls and slab unless otherwise indicated:

Item	Tolerance
Variation of the constructed linear outline from the established position in plan.	In 10-feet: 1/4-inch; In 20-feet or more: 1/2-inch
Variation from the level or from the grades indicated.	In 10-feet: 1/4-inch; In 20-feet or more: 1/2-inch
Variation from plumb	In 10-feet: 1/4-inch; In 20-feet or more: 1/2-inch
Variation in the thickness of slabs and walls.	Minus 1/4-inch; Plus 1/2-inch
Variation in the locations and sizes of slabs and wall openings	Plus or minus 1/4-inch

PART 2 -- PRODUCTS

2.1 CONCRETE MATERIALS

A. General

1. All materials shall be classified as acceptable for potable water use according to NSF Standard 61.

2. Cement for concrete that will contact potable water shall not be obtained from kilns that burn metal rich hazardous waste fuel.

3. Materials shall be delivered, stored, and handled so as to prevent damage by water or breakage. Cement reclaimed from cleaning bags or leaking containers shall not be used. Cement shall be used in the sequence of receipt of shipments.

B. Materials shall comply with the requirements of Sections 201, 203, and 204 of ACI 301, as applicable.

C. Storage of materials shall conform to the requirements of Section 205 of ACI 301.

D. Materials for concrete shall conform to the following requirements:

1. Cement shall be standard brand portland cement conforming to ASTM C 150 – Portland Cement, for Type II or Type V, including Table 2 optional requirements. A minimum of 85 percent of cement by weight shall pass a 325 screen. A single brand of cement shall be used throughout the WORK, and prior to its use, the brand shall be accepted by the CONTRACTING OFFICER. The cement shall be suitably protected from exposure to moisture until used. Cement that has become lumpy shall not be used. Sacked cement shall be stored in such a manner so as to permit access for inspection and sampling. Certified mill test reports, including fineness, for each shipment of cement to be used shall be submitted to the CONTRACTING OFFICER, if requested, regarding compliance with these Specifications.

2. Water for mixing and curing shall be potable, clean, and free from objectionable quantities of silty organic matter, alkali, salts, and other impurities. The water shall be considered potable, for the purposes of this Section only, if it meets the

requirements of the local governmental agencies. Agricultural water with high total dissolved solids (over 1000 mg/l TDS) shall not be used.

3. Aggregates shall be obtained from pits acceptable to the CONTRACTING OFFICER, shall be non-reactive, and shall conform to the requirements of ASTM C 33 – Concrete Aggregates. Maximum size of coarse aggregate shall be as indicated. Lightweight sand for fine aggregate will not be permitted.

    a. Coarse aggregates shall consist of clean, hard, durable gravel, crushed gravel, crushed rock, or a combination thereof. The coarse aggregates shall be prepared and handled in 2 or more size groups for combined aggregates with a maximum size greater than 3/4-inch. When the aggregates are proportioned for each batch of concrete, the 2 size groups shall be combined. See the article below entitled "Trial Batch and Laboratory Tests" for the use of the size groups.

    b. Fine aggregates shall be natural sand or a combination of natural and manufactured sand that is hard and durable. When tested in accordance with ASTM D 2419 – Test Methods for Sand Equivalent Value of Soils and Fine Aggregate, the sand equivalency shall not be less than 75 percent for an average of 3 samples, nor less than 70 percent for an individual test. Gradation of fine aggregate shall conform to ASTM C 33 when tested in accordance with ASTM C 136 for the fineness modulus of the sand used, including the optional grading in Section 6.2. The fineness modulus of sand used shall not be over 3.1.

    c. Combined aggregates shall be well graded from coarse to fine sizes and shall be uniformly graded between screen sizes to produce a concrete that has optimum workability and consolidation characteristics. Where a trial batch is required for a mix design, the final combined aggregate gradations will be established during the trial batch process.

    d. When tested in accordance with ASTM C 33, the ratio of silica released to reduction in alkalinity shall not exceed 1.0.

    e. When tested in accordance with ASTM C 33, the fine aggregate shall produce a color in the supernatant liquid no darker than the reference standard color solution.

    f. When tested in accordance with ASTM C 33, the coarse aggregate shall show a loss not exceeding 42 percent after 500 revolutions, or 10.5 percent after 100 revolutions.

    g. When tested in accordance with ASTM C 33, the loss resulting after 5 cycles of the soundness test, shall not exceed 10 percent for fine aggregate and 12 percent for coarse aggregate, when using sodium sulfate.

4. Ready-mix concrete shall conform to the requirements of ASTM C 94 – Ready Mixed Concrete.

5. Admixtures: All admixtures shall be compatible and be furnished by a single manufacturer capable of providing qualified field service representation. Admixtures shall be used in accordance with manufacturer's recommendations. If the use of an admixture is producing an inferior end result, the CONTRACTOR shall discontinue

use of the admixture. Admixtures shall not contain thiocyanates nor more than 0.05 percent chloride ion, and shall be non-toxic after 30 days.

a. Air-entraining agent meeting the requirements of ASTM C 260 – Air Entraining Admixtures for Concrete shall be used. Sufficient air-entraining agent shall be used to provide a total air content of 3 to 5 percent. Concrete floors to receive a dry-shake floor hardener shall have an air content not to exceed 3 percent. The GOVERNMENT reserves the right, at any time, to sample and test the air-entraining agent. The air-entraining agent shall be added to the batch in a portion of the mixing water. The solution shall be batched by means of a mechanical batcher capable of accurate measurement. Air content shall be tested at the point of placement. Air entraining agent shall be **Micro-Air** by **Master Builders; Daravair** by **W.R. Grace; Sika AEA-15** by **Sika Corporation;** or equal.

b. Set controlling and water reducing admixtures: Admixtures may be added at the CONTRACTOR's option, subject to the CONTRACTING OFFICER's approval, to control the set, effect water reduction, and increase workability. The cost of adding an admixture shall be the CONTRACTOR's responsibility. Concrete containing an admixture shall be first placed at a location determined by the CONTRACTING OFFICER. Admixtures shall conform to the requirements of ASTM C 494 – Chemical Admixtures for Concrete. The required quantity of cement shall be used in the mix regardless of whether or not an admixture is used.

    1) Concrete shall not contain more than one water reducing admixture.

    2) Set controlling admixture may be either with or without water-reducing properties. Where the air temperature at the time of placement is expected to be consistently greater than 80 degrees F, a set retarding admixture such as **Plastocrete 161MR by Sika Corporation; Pozzolith 300R by Master Builders; Daratard by W.R. Grace;** or equal shall be used. Where the air temperature at the time of placement is expected to be consistently less than 40 degrees F, a non-corrosive set accelerating admixture such as **Plastocrete 161FL by Sika Corporation; Pozzutec 20 by Master Builders; Polarset by W.R. Grace;** or equal shall be used.

    3) Normal range water reducer shall conform to ASTM C 494, Type A. **WRDA 64 or 79 by W.R. Grace; Pozzolith 322-N by Master Builders; Plastocrete 161 by Sika Corporation;** or equal. The quantity of admixture used and the method of mixing shall be in accordance with the manufacturer's instructions and recommendations.

    4) High range water reducer shall conform to ASTM C 494, Type F or G. **Daracem 100 or ADVA 100 by W.R. Grace; Sikament FF or Sikament 86 by Sika Corporation; Rheobuild 1000 by Master Builders**; or equal. High range water reducer shall be added to the concrete after all other ingredients have been mixed and initial slump has been verified. No more than 14 ounces of water reducer per sack of cement shall be used. Water reducer shall be considered as part of the mixing water when calculating the water/cement ratio.

5) If the high range water reducer is added to the concrete at the Site, it may be used in conjunction with the same water reducer added at the batch plant. Concrete shall have a slump of 3 inches plus or minus 1/2-inch prior to adding the high range water reducing admixture at the Site. The high range water reducing admixture shall be accurately measured and pressure injected into the mixer as a single dose by an experienced technician. A standby system shall be provided and tested prior to each day's operation of the primary system.

6) Concrete shall be mixed at mixing speed for a minimum of 70 mixer revolutions or 5 minutes after the addition of the high range water reducer, unless recommended otherwise by the manufacturer.

7) Flyash: Flyash shall not be used.

1.2 CURING MATERIALS

A. Materials for curing concrete shall conform to the following requirements and ASTM C 309 – Liquid Membrane – Forming Components for Curing Concrete.

1. Curing compounds shall be white pigmented, resin based, and compliant with local VOC requirements. Sodium silicate compounds shall not be allowed. Concrete curing compound shall be **Kurez VOX White Pigmented** by **Euclid Chemicals Company; L&M Cure R-2 by L&M Construction Chemicals; 1200-White by W.R. Meadow;** or equal. When curing compound must be removed for finishes or grouting, compounds shall be **Korez DR VOX** by **Euclid Chemical Company; Masterkure-100W** by **ChemRex MBT; L&M Cure R-2 by L & M Construction Chemicals;1100-Clear by W.R. Meadows;** or equal.

2. Polyethylene sheet for use as concrete curing blanket shall be white and shall have a nominal thickness of 6 mils. The loss of moisture when determined in accordance with the requirements of ASTM C 156 – Test Method for Water Retention by Concrete Curing Materials, shall not exceed 0.055 grams per square centimeter of surface.

3. Polyethylene-coated waterproof paper sheeting for use as concrete curing blanket shall consist of white polyethylene sheeting free of visible defects, uniform in appearance, have a nominal thickness of 2 mils, and be permanently bonded to waterproof paper conforming to the requirements of Federal Specification UU-B-790A – Building Paper, Vegetable Fiber (Kraft, Waterproofed, Water Repellant and Fire Resistant). The loss of moisture, when determined in accordance with the requirements of ASTM C 156, shall not exceed 0.055 gram per square centimeter of surface.

4. Polyethylene-coated burlap for use as concrete curing blanket shall be 4-mil thick, white opaque polyethylene film impregnated or extruded into one side of the burlap. Burlap shall weigh not less than 9 ounces per square yard. The loss of moisture, when determined in accordance with the requirements of ASTM C 156, shall not exceed 0.055 grams per square centimeter of surface.

5. Curing mats for use in Curing Method 6 below, shall be heavy shag rugs or carpets or cotton mats quilted at 4-inches on center. Curing mats shall weigh a minimum of 12 ounces per square yard when dry.

6. Evaporation retardant shall be a material such as **Confilm** by **ChemRex MBT; Eucobar** by **Euclid Chemical Company; E-CON** by **L & M Construction Chemicals, Inc.;** or equal.

2.3 NON-WATERSTOP JOINT MATERIALS

A. Materials for non-waterstop joints in concrete shall conform to the following requirements:

1. Preformed joint filler shall be a non-extruding, neoprene sponge or polyurethane type conforming to Section 03290 - Joints in Concrete.

2. Elastomeric joint sealer shall conform to the requirements of Section 07920 - Sealants and Caulking.

3. Mastic joint sealer shall be a material that does not contain evaporating solvents; that will tenaciously adhere to concrete surfaces; that will remain permanently resilient and pliable; that will not be affected by continuous presence of water and will not in any way contaminate potable water; and that will effectively seal the joints against moisture infiltration even when the joints are subject to movement due to expansion and contraction. The sealer shall be composed of special asphalts or similar materials blended with lubricating and plasticizing agents to form a tough, durable mastic substance containing no volatile oils or lubricants and shall be capable of meeting the test requirements set forth below, if testing is required by the CONTRACTING OFFICER.

2.4 MISCELLANEOUS MATERIALS

A. Dampproofing agent shall be an asphalt emulsion such as **Hydrocide 600 by ChemRex Sonneborn; Emulsified Asphalt by Euclid Chemical Company; Sealmastic by W. R. Meadows Inc.**, or equal.

B. Bonding agents shall be epoxy adhesives conforming to the following:

1. For bonding freshly-mixed, plastic concrete to hardened concrete, **Sikadur 32 Hi-Mod Epoxy Adhesive** by **Sika Corporation; Concresive Liquid (LPL)**, by **ChemRex MBT; BurkEpoxy MV** by **Burke by Edoco**; or equal.

2. For bonding hardened concrete or masonry to steel, **Sikadur 31 Hi-Mod Gel** by **Sika Corporation; BurkEpoxy NS** by **Burke** by **Edoco; Concresive Paste (LPL)** by **ChemRex MBT;** or equal.

C. **Vapor Retarder:** Vapor retarder shall be 30-mil thick, Class A, 3 ply, nylon or polyester cord reinforced high density polyethylene sheet laminated to a non-woven geotextile fabric, in accordance with ASTM E 1745 - Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs. **Reef Industries, Inc., Griffolyn T-65 G** or equal.

D. **Granular Material Above Vapor Retarder:** Crushed stone, gravel, or sand with the following size distribution and meeting the deleterious substance limits of ASTM C 33 for fine aggregates.

Sieve Size	Percentage Passing

3/8-inch	100
4.75 mm	85-100
No. 100	10 – 30

E. Seams in vapor retarder sheet shall be sealed with tape, adhesive, or other material as recommended by sheet manufacturer for the areas to be sealed and sheet material.

F. Colorant for duct bank concrete shall be an integral red oxide coloring pigment used in the proportion of 8 pounds per cubic yard of concrete.

2.5 CONCRETE DESIGN REQUIREMENTS

A. **General:** Concrete shall be composed of cement, admixtures, aggregates, and water of the qualities indicated. The exact proportions in which these materials are to be used for different parts of the WORK will be determined during the trial batch. In general, the mix shall be designed to produce a concrete capable of being deposited so as to obtain maximum density and minimum shrinkage, and, where deposited in forms, to have good consolidation properties and maximum smoothness of surface. The aggregate gradations shall be formulated to provide fresh concrete that will not promote rock pockets around reinforcing steel or embedded items. The proportions shall be changed whenever necessary or desirable to meet the required results. All changes shall be subject to review by the CONTRACTING OFFICER.

B. **Fine Aggregate Composition:** In mix designs for structural concrete, the percentage of fine aggregate in total aggregate by weight, shall be as indicated in the following table.

FINE AGGREGATE	
Fineness Modulus	**Maximum Percent**
2.7 or less	41
2.7 to 2.8	42
2.8 to 2.9	43
2.9 to 3.1	44

1. For other concrete, the maximum percentage of fine aggregate of total aggregate, by weight, shall not exceed 50.

C. Duct bank concrete shall contain an integral red-oxide coloring pigment. Concrete shall be dyed red throughout; Surface treatment to color duct banks will not be acceptable.

D. **Water/Cement Ratio and Compressive Strength:** Water/cement ratio is given for aggregates in saturated-surface dry condition and total moisture of all aggregates, calculated by ASTM C 566 -Test Method for Total Moisture Content of Aggregate by Drying, less the absorption of the aggregate as calculated by ASTM C 127 – Test Method for Specific Gravity and Absorption of Coarse Aggregate and C 128 – Test Method for Specific Gravity and Absorption of Fine Aggregate shall represent total free moisture in the aggregate determine the water/cement ratio, total free moisture of aggregates shall be added to batch water to estimate water content of concrete. Concrete shall have the following minimum properties:

Type of Work	Min 28-Day Compressive Strength (psi)	Maximum Size Aggregate (in)	Cement Content per cubic yd (lbs)	Maximum W/C Ratio (by weight)
Structural Concrete				
Roof, floor slabs, columns, walls, and all other concrete items not indicated elsewhere.	4,000	1	564 to 600	0.40
12-inch and thicker walls, slabs on grade, and footings (optional)	4,000	1-1/2	564 to 600	0.40
Pea Gravel Concrete				
Thin sections and areas with congested reinforcing, at the CONTRACTOR'S option and with the written approval of the CONTRACTING OFFICER for The specific location. Maximum fine aggregate 50 percent by weight of aggregate.	4,000	3/8	752 to 788	0.40
Sitework concrete	3,000	1	470 (min)	0.50
Lean concrete	2,000	1	376 (min)	0.60

NOTE: The CONTRACTOR is cautioned that the limiting parameters above are not a mix design. Admixtures may be required to achieve workability required by the CONTRACTOR'S construction methods and aggregates. The CONTRACTOR is responsible for providing concrete with the required workability.

E. **Adjustments to Mix Design:** The CONTRACTOR may elect to decrease the water/cement ratio to achieve the strength and shrinkage requirements and/or add water reducers, as required to achieve workability. The mixes shall be changed whenever such change is necessary or desirable to secure the required strength, density, workability, and surface finish, and the CONTRACTOR shall be entitled to no additional

compensation because of such changes. Any changes to the accepted concrete mix design shall be submitted to the CONTRACTING OFFICER for review and shall be tested again in accordance with these Specifications.

2.6 CONSISTENCY

A. The quantity of water in a batch of concrete shall be just sufficient, with a normal mixing period, to produce a concrete which can be worked properly into place without segregation and which can be compacted by vibratory methods to give the desired density, impermeability, and smoothness of surface. The quantity of water shall be changed as necessary, with variations in the nature or moisture content of the aggregates, to maintain uniform production of a desired consistency. The consistency of the concrete in successive batches shall be determined by slump tests in accordance with ASTM C 143 – Test Method for Slump of Hydraulic Cement Concrete. The slumps shall be as follows:

Part of Work	Slump (in)
All concrete, unless indicated otherwise	3-inches plus or minus 1-inch
With high range water reducer added	7-inches plus or minus 2-inches
Pea gravel mix	7-inches plus or minus 2-inches
Ductbank and pipe encasement	5-inches plus or minus 1-inch

2.7 TRIAL BATCH AND LABORATORY TESTS

A. The CONTRACTOR shall only use a mix design for construction that has first met the trial batch testing requirements.

B. Before placing any concrete, a testing laboratory selected by the CONTRACTING OFFICER shall prepare a trial batch of each class of structural concrete, based on the preliminary concrete mixes submitted by the CONTRACTOR. During the trial batch the aggregate proportions may be adjusted by the testing laboratory using the two coarse aggregate size ranges to obtain the required properties. If one size range produces an acceptable mix, a second size range need not be used. Such adjustments will be considered refinements to the mix design and will not be the basis for extra compensation to the CONTRACTOR. Concrete shall conform to the requirements of this Section, whether the aggregate proportions are from the CONTRACTOR's preliminary mix design, or whether the proportions have been adjusted during the trial batch process. The trial batch shall be prepared using the aggregates, cement, and admixture proposed for the project. The trial batch materials shall be of a quantity such that the testing laboratory can obtain 3 drying shrinkage, and 6 compression test specimens from each batch.

C. The determination of compressive strength will be made by testing 6-inch diameter by 12-inch high cylinders; made, cured and tested in accordance with ASTM C 192 - Practice for Making and Curing Concrete Test Specimens in the Laboratory and ASTM C 39. Three compression test cylinders will be tested at 7 days and 3 at 28 days. The

average compressive strength for the 3 cylinders tested at 28 days for any given trial batch shall not be less than 125 percent of the indicated compressive strength.

D. A sieve analysis of the combined aggregate for each trial batch shall be performed according to the requirements of ASTM C 136 – Method for Sieve Analysis of Fine and Coarse Aggregates. Values shall be given for percent passing each sieve.

2.8 SHRINKAGE LIMITATION

A. The maximum concrete shrinkage for specimens cast in the laboratory from the trial batch, as measured at 21 day drying age or at 28 day drying age shall be 0.030 percent or 0.038 percent, respectively. Standard deviation will not be considered. The CONTRACTOR shall only use a mix design for construction that has first met the trial batch shrinkage requirements. Shrinkage limitations apply only to structural concrete.

B. The maximum concrete shrinkage for specimens cast in the field shall not exceed the trial batch maximum shrinkage requirement by more than 25 percent.

C. If the required shrinkage limitation is not met during construction, the CONTRACTOR shall take any or all of the following actions to reestablish compliance. These actions may include changing the source of aggregates, cement and/or admixtures; reducing water/cement ratio; washing of coarse and/or fine aggregate to reduce fines; increasing the number of construction joints; modifying the curing requirements; or other actions designed to minimize shrinkage or the effects of shrinkage.

2.9 MEASUREMENT OF CEMENT AND AGGREGATE

A. The amount of cement and of each separate size of aggregate entering into each batch of concrete shall be determined by direct weighing equipment furnished by the CONTRACTOR and acceptable to the CONTRACTING OFFICER.

B. Weighing tolerances

Material	Percent of Total Weight
Cement	1
Aggregates	3
Admixtures	3

2.10 MEASUREMENT OF WATER

A. The quantity of water entering the mixer shall be measured by a suitable water meter or other measuring device of a type acceptable to the CONTRACTING OFFICER and capable of measuring the water in variable amounts within a tolerance of one percent. The water feed control mechanism shall be capable of being locked in position so as to deliver constantly any required amount of water to each batch of concrete. A positive quick-acting valve shall be used for a cut-off in the water line to the mixer. The operating mechanism shall prevent leakage when the valves are closed.

2.11 READY-MIXED CONCRETE

A. At the CONTRACTOR'S option, ready-mixed concrete may be used if it meets the requirements as to materials, batching, mixing, transporting, and placing as indicated herein and is in accordance with ASTM C 94, including the following supplementary requirements.

B. Ready-mixed concrete shall be delivered to the WORK, and discharge shall be completed within one hour after the addition of the cement to the aggregates or before the drum has been revolved 250 revolutions, whichever is first.

C. Truck mixers shall be equipped with electrically actuated counters by which the number of revolutions of the drum or blades may be readily verified. The counter shall be of the resettable, recording type, and shall be mounted in the driver's cab. The counters shall be actuated at the time of starting mixers at mixing speeds.

D. Each batch of concrete shall be mixed in a truck mixer for not less than 70 revolutions of the drum or blades at the rate of rotation designated by the manufacturer of equipment. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed. All materials including mixing water shall be in the mixer drum before actuating the revolution counter for determining the number of revolution of mixing.

E. Truck mixers and their operation shall be such that the concrete throughout the mixed batch as discharged is within acceptable limits of uniformity with respect to consistency, mix, and grading. If slump tests taken at approximately the 1/4 and 3/4 points of the load during discharge give slumps differing by more than one-inch when the required slump is 3-inches or less, or if they differ by more than 2-inches when the required slump is more than 3-inches, the mixer shall not be used on the WORK unless the causative condition is corrected and satisfactory performance is verified by additional slump tests. Mechanical details of the mixer, such as water measuring and discharge apparatus, condition of the blades, speed of rotation, general mechanical condition of the unit, and clearance of the drum, shall be checked before a further attempt to use the unit will be permitted.

F. Each batch of ready-mixed concrete delivered to the Site shall be accompanied by a delivery ticket furnished to the CONTRACTING OFFICER in accordance with the Paragraph above entitled "Delivery Tickets."

G. The use of non-agitating equipment for transporting ready-mixed concrete will not be permitted. Combination truck and trailer equipment for transporting ready-mixed concrete will not be permitted. The quality and quantity of materials used in ready-mixed concrete and in batch aggregates shall be subject to continuous inspection at the batching plant by the CONTRACTING OFFICER.

PART 3 -- EXECUTION

3.1 PROPORTIONING AND MIXING

A. **Proportioning:** Proportioning of the mix shall conform to the requirements of Chapter 3 "Proportioning" of ACI 301.

B. **Mixing:** Mixing shall conform to the requirements of Chapter 7 of ACI 301.

C. **Slump:** Slumps shall be as indicated herein.

D. **Retempering:** Retempering of concrete or mortar that has partially hardened shall not be permitted.

3.2 PREPARATION OF SURFACES FOR CONCRETING

A. **General:** Earth surfaces shall be thoroughly wetted by sprinkling prior to the placing of any concrete, and these surfaces shall be kept moist by frequent sprinkling up to the time of placing concrete thereon. The surface shall be free from standing water, mud, and debris at the time of placing concrete.

B. Vapor Retarder Sheet

1. Sheet shall be installed under on-grade building floor slabs of occupiable (non-hydraulic) structures and at other locations indicated.

2. Sand base shall be at least 2-inches thick within the foundation line after moistening and compaction by mechanical means. Sand surface shall be flat and level within a tolerance of plus 0-inches to minus 3/4-inch.

3. Place, protect, and repair defects in sheet according to ASTM E 1643 – Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs, and the manufacturer's written instructions. Seams shall be lapped and sealed in accordance with ASTM E 1643.

4. Granular material above the sheet shall be moistened and compacted to 2-inches thickness within the same flatness criteria as the sand base.

C. **Joints in Concrete:** Concrete surfaces upon or against which concrete is to be placed, where the placement of the concrete has been stopped or interrupted so that, as determined by the CONTRACTING OFFICER, the new concrete cannot be incorporated integrally with that previously placed, are defined as construction joints. The surfaces of horizontal joints shall be given a compacted, roughened surface for good bonding. Except where the Drawings call for joint surfaces to be coated, the joint surfaces shall be cleaned of all laitance, loose or defective concrete, foreign material, and be roughened to a minimum 1/4-inch amplitude. Such cleaning and roughening shall be accomplished by hydroblasting or sandblasting (exposing aggregate) followed by thorough washing. Pools of water shall be removed from the surface of construction joints before the new concrete is placed.

D. After the surfaces have been prepared, all approximately horizontal construction joints shall be covered with a 6-inch lift of a pea gravel mix. The mix shall be placed and spread uniformly. Wall concrete shall follow immediately and shall be placed upon the fresh pea gravel mix.

E. **Placing Interruptions:** When placing of concrete is to be interrupted long enough for the concrete to take a set, the working face shall be given a shape by the use of forms or other means that will secure proper union with subsequent work; provided that construction joints shall be made only where acceptable to the CONTRACTING OFFICER.

F. **Embedded Items:** No concrete shall be placed until all formwork, installation of parts to be embedded, reinforcement steel, and preparation of surfaces involved in the placing

have been completed and accepted by the CONTRACTING OFFICER at least 4 hours before placement of concrete. Surfaces of forms and embedded items that have become encrusted with dried grout from previous usage shall be cleaned before the surrounding or adjacent concrete is placed.

G. Inserts or other embedded items shall conform to the requirements herein.

H. Reinforcement, anchor bolts, sleeves, inserts, and similar items shall be set and secured in the forms at locations indicated on the Drawings or shown by Shop Drawings and shall be acceptable to the CONTRACTING OFFICER before any concrete is placed. Accuracy of placement is the responsibility of the CONTRACTOR.

I. **Casting New Concrete Against Old:** Where concrete is to be cast against old concrete (any concrete which is greater than 60 days of age), the surface of the old concrete shall be thoroughly cleaned and roughened by hydroblasting or sandblasting to expose aggregate. The joint surface shall be coated with an epoxy bonding agent unless indicated otherwise by the CONTRACTING OFFICER.

J. No concrete shall be placed in any structure until all water entering the space to be filled with concrete has been properly cut off or has been diverted by pipes, or other means, and carried out of the forms, clear of the WORK. No concrete shall be deposited underwater nor shall the CONTRACTOR allow still water to rise on any concrete until the concrete has attained its initial set. Water shall not be permitted to flow over the surface of any concrete in such manner and at such velocity as will injure the surface finish of the concrete. Pumping or other necessary dewatering operations for removing ground water, if required, shall be subject to the review of the CONTRACTING OFFICER.

K. **Corrosion Protection:** Pipe, conduit, dowels, and other ferrous items required to be embedded in concrete construction shall be so positioned and supported prior to placement of concrete that there will be a minimum of 2-inches clearance between said items and any part of the concrete reinforcement. Securing such items in position by wiring or welding them to the reinforcement will not be permitted.

L. Openings for pipes, inserts for pipe hangers and brackets, and anchors shall, where practicable, be provided during the placing of concrete.

M. Anchor bolts shall be accurately set and shall be maintained in position by templates while being embedded in concrete.

N. **Cleaning:** The surfaces of metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar, and other foreign substances immediately before the concrete is placed.

3.3 HANDLING, TRANSPORTING, AND PLACING

A. **General:** Placing of concrete shall conform to the applicable requirements of Chapter 8 of ACI 301 and the requirements of this Section. No aluminum materials shall be used in conveying any concrete.

B. **Non-Conforming Work or Materials:** Concrete which during or before placing is found not to conform to the requirements indicated herein shall be rejected and immediately removed from the WORK. Concrete which is not placed in accordance with these Specifications, or which is of inferior quality, shall be removed and replaced.

C. **Unauthorized Placement:** No concrete shall be placed except in the presence of a duly authorized representative of the CONTRACTING OFFICER. The CONTRACTOR shall notify the CONTRACTING OFFICER in writing at least 24 hours in advance of placement of any concrete.

D. **Placement in Wall and Column Forms:** Concrete shall not be dropped through reinforcement steel or into any deep form, nor shall concrete be placed in any form in such a manner as to leave accumulation of mortar on the form surfaces above the placed concrete. In such cases, means such as hoppers and, if necessary, vertical ducts of canvas, rubber, or metal shall be used for placing concrete in the forms in a manner that it may reach the place of final deposit without separation. In no case shall the free fall of concrete below the ends of ducts, chutes, or buggies exceed 4-feet in walls and 8-feet in columns. Concrete shall be uniformly distributed during the process of depositing and in no case after depositing shall any portion be displaced in the forms more than 6-feet in horizontal direction. Concrete in wall forms shall be deposited in uniform horizontal layers not deeper than 2-feet; and care shall be taken to avoid inclined layers or inclined construction joints except where such are required for sloping members. Each layer shall be placed while the previous layer is still soft. The rate of placing concrete in wall forms shall not exceed 5-feet of vertical rise per hour. Sufficient illumination shall be provided in the interior of all forms so that the concrete at the places of deposit is visible from the deck or runway.

E. **Casting New Concrete Against Old:** Epoxy adhesive bonding agent shall be applied to the old surfaces according to the manufacturer's written recommendations. This provision shall not apply to joints where waterstop is provided. See Section 03290 - Joints in Concrete.

F. **Conveyor Belts and Chutes:** Ends of chutes, hopper gates, and all other points of concrete discharge throughout the CONTRACTOR'S conveying, hoisting, and placing system shall be designed and arranged so that concrete passing from them will not fall separated into whatever receptacle immediately receives it. Conveyor belts, if used, shall be of a type acceptable to the CONTRACTING OFFICER. Chutes longer than 50 feet will not be permitted. Minimum slopes of chutes shall be such that concrete of the indicated consistency will readily flow in them. If a conveyor belt is used, it shall be wiped clean by a device operated in such a manner that none of the mortar adhering to the belt will be wasted. All conveyor belts and chutes shall be covered.

G. **Placement in Slabs:** Concrete placed in sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement. As the work progresses, the concrete shall be vibrated and carefully worked around the slab reinforcement, and the surface of the slab shall be screeded in an up-slope direction.

H. **Temperature of Concrete:** The temperature of concrete when it is being placed shall be not more than 90 degrees F nor less than 55 degrees F for sections less than 12-inches thick nor less than 50 degrees for all other sections. Concrete ingredients shall not be heated to a temperature higher than that necessary to keep the temperature of the mixed concrete, as placed, from falling below the minimum temperature. When the temperature of the concrete is 85 degrees F or above, the time between the introduction of the cement to the aggregates and discharge shall not exceed 45 minutes. If concrete is placed when the weather is such that the temperature of the concrete would exceed 90 degrees F, the CONTRACTOR shall employ effective means, such as precooling of aggregates and mixing water using ice or placing at night, as necessary to maintain the temperature of the concrete below 90 degrees F as it is placed. The CONTRACTOR

shall be entitled to no additional compensation on account of the foregoing requirements.

I. Cold Weather Placement

1. Placement of concrete shall conform to ACI 306.1 - Cold Weather Concreting, and the following.

2. Remove all snow, ice, and frost from the surfaces, including reinforcement, against which concrete is to be placed. Before beginning concrete placement, thaw the subgrade to a minimum depth of 6-inches. Reinforcement and embedded items shall be warmed to above 32 degrees F prior to concrete placement.

3. Maintain the concrete temperature above 50 degrees F for at least 72 hours after placement.

3.4 PUMPING OF CONCRETE

A. **General:** If the pumped concrete does not produce satisfactory end results, the CONTRACTOR shall discontinue the pumping operation and proceed with the placing of concrete using conventional methods.

B. **Pumping Equipment:** The pumping equipment shall have 2 cylinders and be designed to operate with one cylinder in case the other one is not functioning. In lieu of this requirement, the CONTRACTOR may have a standby pump on the Site during pumping.

C. The minimum diameter of the hose conduits shall be in accordance with ACI 304.2R – Placing Concrete by Pumping Methods.

D. Pumping equipment and hose conduits that are not functioning properly shall be replaced.

E. Aluminum conduits for conveying the concrete shall not be permitted.

F. **Field Control:** Concrete samples for slump, air content, and test cylinders will be taken at the placement end of the hose.

3.5 ORDER OF PLACING CONCRETE

A. The order of placing concrete in all parts of the WORK shall be acceptable to the CONTRACTING OFFICER. In order to minimize the effects of shrinkage, the concrete shall be placed in units as bounded by construction joints at the indicated locations. The placing of units shall be done by placing alternate units in a manner such that each unit placed shall have cured at least 5 days for hydraulic structures and 2 days for all other structures before the contiguous unit or units are placed, except that the corner sections of vertical walls shall not be placed until the 2 adjacent wall panels have cured at least 10 days for hydraulic structures and 4 days for all other structures.

B. The surface of the concrete shall be level whenever a run of concrete is stopped. To insure a level, straight joint on the exposed surface of walls, a wood strip at least 3/4-inch thick shall be tacked to the forms on these surfaces. The concrete shall be carried about 1/2-inch above the underside of the strip. About one hour after the concrete is placed, the strip shall be removed and any irregularities in the edge formed by the strip shall be leveled with a trowel and laitance shall be removed.

3.6 TAMPING AND VIBRATING

A. As concrete is placed in the forms or in excavations, it shall be thoroughly settled and compacted throughout the entire depth of the layer which is being consolidated, into a dense, homogeneous mass, filling all corners and angles, thoroughly embedding the reinforcement, eliminating rock pockets, and bringing only a slight excess of water to the exposed surface of concrete. Vibrators shall be Group 3 per ACI 309 – Consolidation of Concrete, high speed power vibrators (8000 to 12,000 rpm) of an immersion type in sufficient number and with at least one standby unit as required. Group 2 vibrators may be used only at specific locations when accepted by the CONTRACTING OFFICER.

B. Care shall be used in placing concrete around waterstops. The concrete shall be carefully worked by rodding and vibrating to make sure that all air and rock pockets have been eliminated. Where flat-strip type waterstops are placed horizontally, the concrete shall be worked under the waterstops by hand, making sure that air and rock pockets have been eliminated. Concrete surrounding the waterstops shall be given additional vibration over and above that used for adjacent concrete placement to assure complete embedment of the waterstops in the concrete.

C. Concrete in walls shall be internally vibrated and at the same time rammed, stirred, or worked with suitable appliances, tamping bars, shovels, or forked tools until it completely fills the forms or excavations and closes snugly against all surfaces. Subsequent layers of concrete shall not be placed until the layers previously placed have been worked thoroughly. Vibrators shall be provided in sufficient numbers, with standby units as required, to accomplish the required results within 15 minutes after concrete of the prescribed consistency is placed in the forms. The vibrating head shall not contact the surfaces of the forms. Care shall be taken not to vibrate concrete excessively or to work it in any manner that causes segregation of its constituents.

3.7 FINISHING CONCRETE SURFACES

A. **General:** Surfaces shall be free from fins, bulges, ridges, offsets, honeycombing, or roughness of any kind, and shall present a finished, smooth, continuous hard surface. Allowable deviations from plumb or level and from the alignment, profiles, and dimensions indicated are defined as tolerances and are indicated above. These tolerances are to be distinguished from irregularities in finish as described herein. Aluminum finishing tools shall not be used.

B. **Formed Surfaces:** No treatment is required after form removal except for curing, repair of defective concrete, and treatment of surface defects. Where architectural finish is required, it shall be as indicated.

C. **Unformed Surfaces:** After proper and adequate vibration and tamping, unformed top surfaces of slabs, floors, walls, and curbs shall be brought to a uniform surface with suitable tools. Immediately after the concrete has been screeded, it shall be treated with a liquid evaporation retardant. The retardant shall be used again after each work operation as necessary to prevent drying shrinkage cracks. The classes of finish for unformed concrete surfaces are designated and defined as follows:

1. Finish U1 - Sufficient leveling and screeding to produce an even, uniform surface with surface irregularities not to exceed 3/8-inch. No further special finish is required.

2. Finish U2 - After sufficient stiffening of the screeded concrete, surfaces shall be float finished with wood or metal floats or with a finishing machine using float blades. Excessive floating of surfaces while the concrete is plastic and dusting of dry cement and sand on the concrete surface to absorb excess moisture will not be permitted. Floating shall be the minimum necessary to produce a surface that is free from screed marks and is uniform in texture. Surface irregularities shall not exceed 1/4-inch. Joints and edges shall be tooled where indicated or as determined by the CONTRACTING OFFICER.

3. Finish U3 - After the Finish U2 surface has hardened sufficiently to prevent excess of fine material from being drawn to the surface, steel troweling shall be performed with firm pressure such as will flatten the sandy texture of the floated surface and produce a dense, uniform surface free from blemishes, ripples, and trowel marks. The finish shall be smooth and free of all irregularities.

4. Finish U4 - Trowel the Finish U3 surface to remove local depressions or high points. In addition, the surface shall be given a light broom finish with brooming perpendicular to drainage unless otherwise indicated. The resulting surface shall be rough enough to provide a nonskid finish.

5. Unformed surfaces shall be finished according to the following schedule:

UNFORMED SURFACE FINISH SCHEDULE	
Area	**Finish**
Grade slabs and foundations to be covered with concrete or fill Material	U1
Floors to be covered with grouted tile or topping grout	U2
Water bearing slabs with slopes 10 percent and less	U3
Water bearing slabs with slopes greater than 10 percent	U4
Slabs not water bearing	U4
Slabs to be covered with built-up roofing	U2
Interior slabs and floors	U3
Top surface of walls	U3

3.8 ARCHITECTURAL FINISH

A. **General:** Architectural finishes shall be provided only where specifically indicated below. In all other locations, the paragraph entitled Finishing Concrete Surfaces, shall apply.

B. Immediately after the forms have been stripped, the concrete surface shall be inspected and any poor joints, voids, rock pockets, or other defective areas shall be repaired and form-tie holes filled as indicated herein.

C. Architectural finishes shall not be applied until the concrete surface has been repaired as required and the concrete has cured at least 14 days.

D. Architecturally treated concrete surfaces shall conform to the accepted sample in texture, color, and quality. It shall be the CONTRACTOR's responsibility to maintain and protect the concrete finish.

E. Smooth Concrete Finish

1. The concrete surface shall be wetted, and a grout shall be applied with a brush. The grout shall be made by mixing one part portland cement and one part of fine sand that will pass a No. 16 sieve with sufficient water to give it the consistency of thick paint. The cement used in said grout shall be 1/2 gray and 1/2 white portland cement, or other proportion as determined by the CONTRACTING OFFICER. White portland cement shall be **Atlas white,** or equal. Calcium chloride at 5 percent by volume of the cement shall be used in the brush coat. The freshly applied grout shall be vigorously rubbed into the concrete surface with a wood float filling all small air holes. After all the surface grout has been removed with a steel trowel, the surface shall be allowed to dry and, when dry, shall be vigorously rubbed with burlap to remove completely all surface grout so that there is no visible paint-like film of grout on the concrete. The entire cleaning operation for any area shall be completed the day it is started, and no grout shall be left on the surface overnight.

2. Cleaning operations for any given day shall be terminated at panel joints. It is required that the various operations be carefully timed to secure the desired effect which is a light-colored concrete surface of uniform color and texture without any appearance of a paint or grout film.

3. In the event that improper manipulation results in an inferior finish, the CONTRACTOR shall rub such inferior areas with carborundum bricks.

4. Before beginning any of the final treatment on exposed surfaces, the CONTRACTOR shall treat in a satisfactory manner a trial area of at least 200 square feet in some inconspicuous place selected by the CONTRACTING OFFICER and shall preserve said trial area undisturbed until the completion of the job.

F. Sandblasted Concrete Finish

1. Sandblasting shall be done in a safe manner acceptable to local authorities and per OSHA requirements. The sandblasting shall be a light sandblast to remove laitance and to produce a uniform fine aggregate surface texture with approximately 1/32- to 1/16-inch of surface sandblasted off. Corners, patches, form panel joints, and soft spots shall be sandblasted with care.

2. A 3-sq ft sample panel of the sandblasted finish shall be provided by the CONTRACTOR for acceptance by the CONTRACTING OFFICER prior to starting the sandblasting work. The sample panel shall include a corner, plugs, and joints and shall be marked after approval. All other sandblasting shall be equal in finish to the sample panel.

3. Protection against sandblasting shall be provided on all adjacent surfaces and materials not requiring sandblasting. After sandblasting, the concrete surfaces shall be washed with clean water and excess sand removed.

3.9 CURING AND DAMPPROOFING

A. **General:** Concrete shall be cured for not less than 7 days after placing, in accordance with the methods indicated below for the different parts of the WORK.

Surface to be Cured or Dampproofed	Method
Unstripped forms	1
Wall sections with forms removed	6
Construction joints between footings and walls, and between floor slab and columns	2
Encasement and ductbank concrete and thrust blocks	3
All concrete surfaces not specifically indicated in this Paragraph	4
Floor slabs on grade in hydraulic structures	5
Slabs not on grade	6

B. **Method 1:** Wooden forms shall be wetted immediately after concrete has been placed and shall be kept wet with water until removal. If steel forms are used the exposed concrete surfaces shall be kept continuously wet until the forms are removed. If forms are removed within 7 days of placing the concrete, curing shall be continued in accordance with Method 6 below.

C. **Method 2:** The surface shall be covered with burlap mats which shall be kept wet with water for the duration of the curing period, until the concrete in the walls has been placed. No curing compound shall be applied to surfaces cured under Method 2.

D. **Method 3:** The surface shall be covered with moist earth not less than 4 hours nor more than 24 hours after the concrete is placed. Earthwork operations that may damage the concrete shall not begin until at least 7 days after placement of concrete.

E. **Method 4:** The surface shall be sprayed with a liquid curing compound.

1. It shall be applied in accordance with the manufacturer's printed instructions at a maximum coverage rate of 200 square feet per gallon and in such a manner as to cover the surface with a uniform film that will seal thoroughly.

2. Where the curing compound method is used, care shall be exercised to avoid damage to the seal during the 7-day curing period. If the seal is damaged or broken before the expiration of the curing period, the break shall be repaired immediately by the application of additional curing compound over the damaged portion.

3. Wherever curing compound has been applied by mistake to surfaces against which concrete subsequently is to be placed and to which it is to adhere, compound shall be entirely removed by wet sandblasting just prior to the placing of new concrete.

4. Curing compound shall be applied as soon as the concrete has hardened enough to prevent marring on unformed surfaces and within 2 hours after removal of forms. Repairs to formed surfaces shall be made within the 2 hour period; provided, however, that any such repairs which cannot be made within the said 2 hour period shall be delayed until after the curing compound has been applied. When repairs are to be made to an area on which curing compound has been applied, the area involved shall first be wet-sandblasted to remove the curing compound.

5. At locations where concrete is placed adjacent to a panel which has been coated with curing compound, the panel shall have curing compound reapplied to an area within 6-feet of the joint and to any other location where the curing membrane has been disturbed.

6. Prior to final acceptance of the WORK, all visible traces of curing compound shall be removed from all surfaces in such a manner that does not damage the surface finish.

F. **Method 5**

1. Until the concrete surface is covered with curing compound, the entire surface shall be kept damp by applying water using nozzles that atomize the flow so that the surface is not marred or washed. The concrete shall be given a coat of curing compound in accordance with Method 4 above. Not less than one hour nor more than 4 hours after the curing compound has been applied, the surface shall be wetted with water delivered through a fog nozzle, and concrete-curing blankets shall be placed on the slabs. The curing blankets shall be polyethylene sheet, polyethylene-coated waterproof paper sheeting, or polyethylene-coated burlap. The blankets shall be laid with the edges butted together and with the joints between strips sealed with 2-inch wide strips of sealing tape or with edges lapped not less than 3-inches and fastened together with a waterproof cement to form a continuous watertight joint.

2. The curing blankets shall be left in place during the 7-day curing period and shall not be removed until after concrete for adjacent work has been placed. If the curing blankets become torn or otherwise ineffective, the CONTRACTOR shall replace damaged sections. During the first 3 days of the curing period, no traffic of any nature and no depositing, temporary or otherwise, of any materials shall be permitted on the curing blankets. During the remainder of the curing period, foot traffic and temporary depositing of materials that impose light pressure will be

permitted only on top of plywood sheets 5/8-inch minimum thickness, laid over the curing blanket. The CONTRACTOR shall add water under the curing blanket as often as necessary to maintain damp concrete surfaces at all times.

G. **Method 6:** This method applies to both walls and slabs.

1. The concrete shall be kept continuously wet by the application of water for a minimum period of at least 7 consecutive days beginning immediately after the concrete has reached final set or forms have been removed.

2. Until the concrete surface is covered with the curing medium, the entire surface shall be kept damp by applying water using nozzles that atomize the flow so that the surface is not marred or washed.

3. Heavy curing mats shall be used as a curing medium to retain the moisture during the curing period. The curing medium shall be weighted or otherwise held substantially in contact with the concrete surface to prevent being dislodged by wind or any other causes. Edges shall be continuously held in place.

4. The curing blankets and concrete shall be kept continuously wet by the use of sprinklers or other means both during and after normal working hours.

5. Immediately after the application of water has terminated at the end of the curing period, the curing medium shall be removed, any dry spots shall be rewetted, and curing compound shall be immediately applied in accordance with Method 4 above.

6. The CONTRACTOR shall dispose of excess water from the curing operation to avoid damage to the WORK.

H. Dampproofing

1. The exterior surfaces of buried roof slabs shall be dampproofed as follows.

2. Immediately after completion of curing the surface shall be sprayed with a dampproofing agent consisting of an asphalt emulsion. Application shall be in 2 coats. The first coat shall be diluted to one-half strength by the addition of water and shall be sprayed on so as to provide a maximum coverage rate of 100 square feet per gallon of dilute solution. The second coat shall consist of an application of the undiluted material, and shall be sprayed on so as to provide a maximum coverage rate of 100 square feet per gallon. Dampproofing material shall be as indicated in Part 2.

3. As soon as the material has taken an initial set, the entire area thus coated shall be coated with whitewash. Any formula for mixing the whitewash may be used if it produces a uniformly coated white surface and remains until placing of the backfill. If the whitewash fails to remain on the surface until the backfill is placed, the CONTRACTOR shall apply additional whitewash.

3.10 PROTECTION

A. The CONTRACTOR shall protect concrete against injury until final acceptance.

B. Fresh concrete shall be protected from damage due to rain, hail, sleet, or snow. The CONTRACTOR shall provide such protection while the concrete is still plastic and whenever precipitation is imminent or occurring.

3.11 CURING IN COLD WEATHER

A. Water curing of concrete may be reduced to 6 days during periods when the mean daily temperature in the vicinity of the Site is less than 40 degrees F; provided that, during the prescribed period of water curing, when temperatures are such that concrete surfaces may freeze, water curing shall be temporarily discontinued.

B. Concrete cured by an application of curing compound will require no additional protection from freezing if the protection at 50 degrees F for 72 hours is obtained by means of approved insulation in contact with the forms or concrete surfaces; otherwise the concrete shall be protected against freezing temperatures for 72 hours immediately following 72 hours protection at 50 degrees F. Concrete cured by water shall be protected against freezing temperatures for 72 hours immediately following the 72 hours of protection at 50 degrees F.

C. Discontinuance of protection against freezing temperatures shall be such that the drop in temperature of any portion of the concrete will be gradual and will not exceed 40 degrees F in 24 hours. In the spring, when the mean daily temperature rises above 40 degrees F for more than 3 successive days, the required 72-hour protection at a temperature not lower than 50 degrees F may be discontinued for as long as the mean daily temperature remains above 40 degrees F; provided, that the concrete shall be protected against freezing temperatures for not less than 48 hours after placement.

D. Where artificial heat is employed, special care shall be taken to prevent the concrete from drying. Use of unvented heaters will be permitted only when unformed surfaces of concrete adjacent to the heaters are protected for the first 24 hours from an excessive carbon dioxide atmosphere by application of curing compound; provided, that the use of curing compound for such surfaces is otherwise permitted by these Specifications.

3.12 TREATMENT OF SURFACE DEFECTS

A. As soon as forms are removed, exposed surfaces shall be carefully examined and any irregularities shall be immediately rubbed or ground in a satisfactory manner in order to secure a smooth, uniform, and continuous surface. Plastering or coating of surfaces to be smoothed will not be permitted. No repairs shall be made until after inspection by the CONTRACTING OFFICER. In no case will extensive patching of honeycombed concrete be permitted. Concrete containing minor voids, holes, honeycombing, or similar depression defects shall be repaired as indicated below. Concrete containing extensive voids, holes, honeycombing, or similar depression defects shall be completely removed and replaced. Repairs and replacements shall be performed promptly.

B. Defective surfaces to be repaired shall be cut back from trueline a minimum depth of 1/2-inch over the entire area. Feathered edges will not be permitted. Where chipping or cutting tools are not required in order to deepen the area properly, the surface shall be prepared for bonding by the removal of all laitance or soft material, plus not less than 1/32-inch depth of the surface film from all hard portions by means of an efficient sandblast. After cutting and sandblasting, the surface shall be wetted sufficiently in advance of shooting with shotcrete or with cement mortar so that while the repair material is being applied, the surfaces underneath will remain moist but not so wet as to

overcome the suction upon which a good bond depends. The material used for repair shall consist of a mixture of one sack of cement to 3 cubic feet of sand. For exposed walls, the cement shall contain such a proportion of Atlas white portland cement as is required to make the color of the patch match the color of the surrounding concrete.

C. Holes left by tie-rod cones shall be reamed with suitable toothed reamers so as to leave the surfaces of the holes clean and rough. Holes then shall be repaired in an approved manner with dry-packed cement grout. Holes left by form-tying devices having a rectangular cross-section and other imperfections having a depth greater than their least surface dimension shall not be reamed but shall be repaired in an approved manner with dry-packed cement grout.

D. Repairs shall be built up and shaped in such a manner that the completed WORK will conform to the requirements of this Section, as applicable, using approved methods which will not disturb the bond, cause sagging, or cause horizontal fractures. Surfaces of repairs shall receive the same kind and amount of curing treatment as required for the concrete in the repaired section.

E. Prior to filling any structure with water, cracks shall be "vee'd" as indicated and filled with sealant conforming to the requirements of Section 03290 - Joints in Concrete. This repair method shall be done on the water bearing face of members. Prior to backfilling, faces of members in contact with fill which are not covered with a waterproofing membrane shall also have cracks repaired as indicated herein.

3.13 PATCHING HOLES IN CONCRETE

A. Patching Small Holes

1. Holes that are less than 12-inches in the least dimension and extend completely through concrete members shall be filled.

2. Small holes in members that are water-bearing or in contact with soil or other fill material shall be filled with non-shrink grout. Where a face of the member is exposed to view, the non-shrink grout shall be held back 2-inches from the finished surface. The remaining 2-inches shall then be patched according to the Article above entitled "Treatment of Surface Defects."

3. Small holes through all other concrete members shall be filled with non-shrink grout, with exposed faces treated as above.

B. Patching Large Holes

1. Holes which are larger than 12-inches in the least dimension shall have a keyway chipped into the edge of the opening all around, unless a formed keyway exists. The holes shall then be filled with concrete as indicated herein.

2. Holes which are larger than 24-inches in the least dimension and which do not have reinforcing steel extending from the existing concrete, shall have reinforcing steel set in grout in drilled holes. The reinforcing added shall match the reinforcing in the existing wall unless indicated otherwise.

3. Large holes in members that are water bearing or in contact with soil or other fill shall have a hydrophilic type waterstop material placed around the perimeter of the

hole in accordance with Section 03290 - Joints in Concrete, unless there is an existing waterstop in place.

3.14 CARE AND REPAIR OF CONCRETE

A. The CONTRACTOR shall protect concrete against injury or damage from excessive heat, lack of moisture, overstress, or any other cause until final acceptance. Particular care shall be taken to prevent the drying of concrete and to avoid roughening or otherwise damaging the surface. Any concrete found to be damaged, or which may have been originally defective, or which becomes defective at any time prior to the final acceptance of the completed WORK, or which departs from the established line or grade, or which, for any other reason, does not conform to the requirements of the Contract Documents, shall be satisfactorily repaired or removed and replaced with acceptable concrete.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 03315 - GROUT

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide grout, complete and in place, in accordance with the Contract Documents.

B. The following types of grout are covered in this Section:

1. Non-Shrink Grout: This type of grout shall be used wherever grout is indicated, unless another type is specifically referenced.

2. Cement Grout

3. Epoxy Grout

4. Topping Grout and Concrete Fill

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Specifications, codes, and standards shall be as listed in Section 03300 - Cast-in-Place Concrete, and as indicated herein.

1.3 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01300 - Contractor Submittals

B. **Shop Drawings:** Include certified test results verifying compliance with the compressive strength, shrinkage, and expansion requirements; and manufacturer's literature containing instructions and recommendations on the mixing, handling, placement, and appropriate uses for each proposed type of non-shrink and epoxy grout.

C. Provide manufacturer’s independent certification of ASTM C 1107 - Packaged Dry, Hydraulic-Cement Grout (Nonshrink), compliance without modification of the standard methods certifying that the Class B or C grout post hardening non-shrink properties are not based on gas expansion, grouts have strengths of 3500 psi at 1 day, 6500 psi at 3 days and 7500 psi at 28 days when cured at 72 degrees F as well as meeting the 3,7, and 28 day strengths when tested and cured at the 45 degree and 95 degree limits and all other requirements of ASTM C 1107.

D. The CONTRACTOR shall engage an independent testing laboratory to run a 24 hour grout evaluation in accordance with ASTM C 1107 of each grout submitted for approval showing compliance to all aspects of the evaluation and submit results to the CONTRACTING OFFICER for review.

1.4 QUALITY ASSURANCE

A. Field Tests

1. Compression test specimens will be taken during construction from the first placement of each type of grout and at intervals thereafter selected by the

CONTRACTING OFFICER to insure continued compliance with these specifications. The specimens will be made by the CONTRACTING OFFICER or its representative.

2. Compression tests and fabrication of specimens for cement grout and non-shrink grout will be performed in accordance with ASTM C 109 - Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in or 50-mm Cube Specimens) at intervals during construction selected by the CONTRACTING OFFICER. A set of three specimens will be made for testing at 7 days, 28 days, and each additional time period as appropriate.

3. Compression tests and fabrication of specimens for epoxy grout will be performed in accordance with ASTM C 579 - Test Method for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings and Polymer Concretes, Method B, at intervals during construction selected by the CONTRACTING OFFICER. A set of three specimens will be made for testing at 7 days, and each earlier time period as appropriate.

4. Grout which fails to meet requirements is subject to removal and replacement.

5. The cost of laboratory tests on grout will be paid by the GOVERNMENT except where test results show the grout to be defective. In such case, the CONTRACTOR shall pay for the tests, removal and replacement of Defective Work, and retesting, all at no increased cost to the GOVERNMENT.

6. The CONTRACTOR shall assist the CONTRACTING OFFICER in obtaining specimens for testing and shall furnish all materials necessary for fabricating the test specimens.

B. **Construction Tolerances:** Construction tolerances shall be in accordance with Section 03300, unless indicated otherwise.

PART 2 -- PRODUCTS

2.1 CEMENT GROUT

A. **Cement Grout:** Cement grout shall be composed of one part cement, three parts sand, and the minimum amount of water necessary to obtain the desired consistency. Where needed to match the color of adjacent concrete, white portland cement shall be blended with regular cement as needed. The minimum compressive strength at 28 days shall be 4000 psi.

B. Cement grout materials shall be as indicated in Section 3300, except that no cement from kilns burning metal-rich hazardous waste fuel shall be used.

2.2 PREPACKAGED GROUTS

A. Non-Shrink Grout

1. Non-shrink grout shall be a prepackaged, inorganic, non-gas-liberating, non-metallic, cement-based grout requiring only the addition of water. Cement from kilns burning metal-rich hazardous waste fuel shall not be used. Manufacturer's instructions shall be printed on each bag or other container in which the materials

are packaged. The specific formulation for each class of non-shrink grout herein shall be that recommended by the manufacturer for the particular application. All grouts (Grade A, B, C) shall be tested for height change of the hardened grout at 1, 3, 14, and 28 days in accordance with ASTM C 1090 - Test Method for Measuring Changes in Height of Cylindrical Specimens from Hydraulic-Cement Grout, and shall be tested for compression at 1, 3, 7, and 28 days in accordance with the modified ASTM C 109 testing procedure.

2. Class A non-shrink grouts shall have a minimum 28 day compressive strength of 5000 psi and shall meet the requirements of ASTM C 1107 when mixed to a flowable, plastic, or stiff consistency. When tested in accordance with ASTM C 1090, grout shall have a maximum of 4.0 percent expansion in the pre-hardened state.

3. Class B or C high precision, fluid, extended working time, non-shrink grouts shall have a minimum 28 day compressive strength of 7500 psi; shall have no shrinkage (0.0 percent) and a maximum 4.0 percent expansion in the plastic state when tested in accordance with ASTM C 827 - Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures; and shall have no shrinkage (0.0 percent) and a maximum of 0.2 percent expansion in the hardened state; and when mixed to a fluid consistency of 20 to 30 seconds per ASTM C 939 – Test Method for Flow of Grout for Preplaced – Aggregate (Flow Cone Method), at temperature extremes of 45 to 90 degrees F shall have an extended working time of 30 minutes when tested in accordance with ASTM C 1107. Class B or C non-shrink grout shall be **Master Builders Masterflow 555** by **Master Builders**; **Sika Grout 212** by **Sika Corporation**.

4. Application

   a. Class A non-shrink grout shall be used for the repair of holes and defects in concrete members which are not water-bearing and not in contact with soil or other fill material, and grouting railing posts in place.

   b. Class B or C non-shrink grout shall be used for the repair of holes and defects in concrete members which are water bearing or in contact with soil or other fill material, grouting under all base plates for structural steel members, grouting under all equipment base plates, and at all locations where grout is required by the Contract Documents except where epoxy grout is specifically required. Class B or C non-shrink grout may be used in place of Class A non-shrink grout for all applications. Class B or C non-shrink grout shall not be used for dry packing applications.

B. Epoxy Grout

1. Epoxy grout shall be a pourable, non-shrink, 100 percent solids system. The epoxy grout system shall have three components: resin, hardener, and specially blended aggregate, all premeasured and prepackaged. The resin component shall not contain any non-reactive diluents. Variation of component ratios is not permitted unless specifically recommended by the manufacturer. Manufacturer's instructions shall be printed on each container in which the materials are packaged. Epoxy grout shall be **Master Builders Ceilcote 648 CP+** by **Master Builders; Sikadur 42, Grout-Pak** by **Sika Corporation.**

2. The chemical formulation of the epoxy grout shall be that recommended by the manufacturer for the particular application.

3. The mixed epoxy grout system shall have a minimum working life of 90 to 120 minutes at 70 degrees F.

4. The epoxy grout shall develop a compressive strength of 9000 psi in 24 hours and 13,000 psi in seven days when tested in accordance with ASTM C 579, Method B. There shall be no shrinkage (0.0 percent) and a maximum 4.0 percent expansion when tested in accordance with ASTM C 827.

5. The epoxy grout shall exhibit a minimum effective bearing area of 90 percent. This shall be determined by testing in accordance with ASTM C 1339 - Test Method for Flowability and Bearing Area of Chemical-Resistant Polymer Machinery Grouts, for bearing area and flow.

6. Application: Epoxy grout shall be used to embed all anchor bolts and reinforcing steel required to be set in grout, and for other applications specifically required in the Contract Documents.

2.3 TOPPING GROUT AND CONCRETE FILL

A. Grout for topping of slabs and concrete fill for built-up surfaces of tank, channel, and basin bottoms shall be composed of cement, fine aggregate, coarse aggregate, water, and admixtures. All materials and procedures for concrete in Section 03300 shall apply except as noted otherwise herein.

B. Topping grout and concrete fill shall contain a minimum of 564 pounds of cement per cubic yard with a maximum water/cement ratio of 0.45. Where concrete fill is thicker than 3 inches, sitework concrete in accordance with Section 03300 may be used if accepted by the CONTRACTING OFFICER.

C. Coarse aggregate shall be graded as follows:

U.S. STANDARD SIEVE SIZE	PERCENT BY WEIGHT PASSING
1/2"	100
3/8"	90-100
No. 4	20-55
No. 8	5-30
No. 16	0-10
No. 30	0-10

D. Final mix design shall be determined by trial mix design under supervision of the approved testing laboratory.

E. **Strength:** Minimum compressive strength of topping grout and concrete fill at the end of 28 days shall be 3000 psi.

2.4 CURING MATERIALS

A. Curing materials shall be in accordance with Section 03300 for cement grout and be as recommended by the manufacturer of prepackaged grouts.

2.5 CONSISTENCY

A. The consistency of grout shall be as necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is such that the grout is plastic and moldable but will not flow. Where "dry pack" is required by the Contract Documents, it shall mean a grout of that consistency; the type of grout to be used shall be as indicated herein for the particular application.

B. The slump for topping grout and concrete fill shall be adjusted to match placement and finishing conditions but shall not exceed 4 inches.

2.6 MEASUREMENT OF INGREDIENTS

A. Measurements for cement grout shall be made accurately by volume using containers. Shovel measurement shall not be allowed.

B. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

PART 3 -- EXECUTION

3.1 GENERAL

A. Surface preparation, curing, and protection of cement grout shall be in accordance with Section 03300. The finish of the grout surface shall match that of the adjacent concrete unless otherwise indicated.

B. The manufacturer of Class B or C non-shrink grout and epoxy grout shall provide on-Site technical assistance upon request at no cost to the GOVERNMENT.

C. Base concrete or masonry shall have attained its design strength before grout is placed, unless authorized otherwise by the CONTRACTING OFFICER.

3.2 GROUTING PROCEDURES

A. **Prepackage Grouts:** Mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.

B. All structural, equipment, tank, and piping support bases shall be grouted, unless indicated otherwise.

1. The original concrete shall be blocked out or finished off a sufficient distance below the plate to provide for a one-inch thickness of grout or a thickness as indicated on the Drawings.

2. After the base plate has been set in position at the proper elevation by steel wedges or double nuts on the anchor bolts, the space between the bottom of the plate and the original pour of concrete shall be filled with non-shrink-type grout. The mixture shall be of a trowelable consistency and be tamped or rodded solidly into the space between the plate and the base concrete. A backing board or stop shall be provided at the back side of the space to be filled with grout. Where this method of

placement is not practical or where required by the CONTRACTING OFFICER, alternate grouting methods shall be submitted for acceptance.

C. Topping Grout

1. All mechanical, electrical, and finish work shall be completed prior to placement of topping or concrete fill. The base slab shall be given a roughened textured surface by sandblasting or hydroblasting, exposing the aggregates to ensure bonding to the base slab.

2. The minimum thickness of grout topping and concrete fill shall be one inch. Where the finished surface of concrete fill is to form an intersecting angle of less than 45 degrees with the concrete surface it is to be placed against, a key shall be formed in the concrete surface at the intersection point. The key shall be a minimum of 3-1/2-inches wide by 1-1/2-inches deep.

3. The base slab shall be thoroughly cleaned, at saturated surface dry (SSD) condition per ICRI standards for surface preparation, and be free from standing pools or ponds of water prior to placing topping and fill. A thin coat of neat cement grout shall be broomed into the surface of the slab just before topping of fill placement. The topping and fill shall be compacted by rolling or tamping, brought to established grade, and floated. Grouted fill for tank and basin bottoms where scraping mechanisms are to be installed shall be screened by blades attached to the revolving mechanism of the equipment in accordance with the procedures outlined by the equipment manufacturer after the grout is brought to the established grade.

4. Topping grout placed on sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement.

5. The surface shall be tested with a straight edge to detect high and low spots which shall be immediately eliminated. When the topping and fill has hardened sufficiently, it shall be steel troweled to a smooth surface free from pinholes and other imperfections. An approved type of mechanical trowel may be used as an assist in this operation, but the last pass over the surface shall be by hand-troweling. During finishing, no water, dry cement, or mixture of dry cement and sand shall be applied to the surface.

3.3 CONSOLIDATION

A. Grout shall be placed in such a manner, for the consistency necessary for each application, so as to assure that the space to be grouted is completely filled.

- END OF SECTION -

SECTION 04232 - REINFORCED CONCRETE BLOCK MASONRY

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide concrete masonry and other appurtenant work, complete and in place, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards

ANSI/ASTM C 5	Quicklime for Structural Purposes
ASTM A 615	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C 90	Load-Bearing Concrete Masonry Units
ASTM C 129	Non load bearing Concrete Masonry Units
ASTM C 140	Test Methods of Sampling and Testing Concrete Masonry and Related Units
ASTM C 144	Aggregate for Masonry Mortar
ASTM C 150	Portland Cement
ASTM C 207	Hydrated Lime for Masonry Purposes
ASTM C 404	Aggregates for Masonry Grout
ASTM C 1314	Test Methods for Compressive Strength of Masonry Prisms
UBC 21-16	Field Test Specimens for Mortar

1.3 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01300 - Contractor Submittals.

B. Samples

1. Samples of concrete masonry unit colors with texture ranges indicated for selection of color. Full size samples of the blocks selected shall be submitted for final approval by the CONTRACTING OFFICER after color selection, if requested. If the specified product is a colored and textured unit, the samples shall be colored and textured units.

2. Samples of mortar colors for color selection.

3. A 4-ft minimum square free-standing sample panel shall be prepared for approval before starting masonry work. The panel shall remain at the Site for reference until all masonry work is completed.

C. Documentation

1. Reports from testing masonry units

2. Reports from mortar and grout testing.

3. Reports from prism testing.

D. Grout and mortar mix design

1. Proportions for all components

2. Mill tests for cement

3. Admixture certification. Include chloride ion content.

4. Aggregate graduation and certification

5. Lime certification

1.4 QUALITY ASSURANCE

A. **Applicable Standards:** Concrete masonry shall conform to the Building Code, the Masonry Design Manual published by the Masonry Industry Advancement Committee, and other applicable codes and standards of governing authorities.

B. All work shall conform to the standard of quality established by the approved free-standing sample panel.

C. Concrete block masonry units shall be sampled and tested in accordance with ASTM C 140.

D. **Testing of Mortar and Grout:** The CONTRACTOR shall have the mortar and grout tested to assure compliance with the Specifications and the governing codes by a recognized testing laboratory approved by the CONTRACTING OFFICER. Test reports shall be submitted to the CONTRACTING OFFICER.

1. Tests shall be taken at the following times:

a. At commencement of masonry work, at least 2 test samples each of mortar and grout shall be taken on 3 successive working days.

b. At any change in materials or job conditions, at least 2 samples of each modified material, grout, and mortar shall be tested.

c. Four random tests each of mortar and grout shall be made. The random test samples shall be taken when requested by the CONTRACTING OFFICER.

d. Additional samples and tests may be required whenever, in the judgment of the CONTRACTING OFFICER, additional tests (beyond the random tests) are necessary to determine the quality of the materials.

e. The costs of tests and test reports, except for any additional tests requested by the CONTRACTING OFFICER, shall be paid by the CONTRACTOR. The costs of the additional tests and reports, when reports verify compliance with the Contract Documents, will be paid by the GOVERNMENT. When tests or reports do not verify compliance, the cost of all additional tests and reports shall be paid by the CONTRACTOR.

2. Test samples shall be stored in a moist environment until tested, unless directed otherwise by the CONTRACTING OFFICER or the testing laboratory. Tests shall be in accordance with Uniform Building Code Standard No. 21-16 for mortar.

E. Test of Masonry Prisms: the GOVERNMENT will test masonry prisms to assure compliance with the Specifications and the governing codes by a recognized testing laboratory.

1. Tests will be made of the following items:

a. At the time of the construction of the sample panel above, at least 5 masonry prisms shall be made for each type of block herein, except separate prisms are not required for block which only varies by texture.

b. At any change in materials during construction, at least 5 masonry prisms will be made for each type of block affected.

c. One set of at least 5 masonry prisms will be made for each masonry structure, besides the structure that the sample is part of, or for each week in which block is laid, for each type of block involved; whichever occurs first.

d. Additional sets of at least 5 masonry prisms may be required whenever, in the judgement of the CONTRACTING OFFICER, additional tests are necessary to determine the quality of the materials.

2. The prisms shall be constructed by the CONTRACTOR in the presence of the CONTRACTING OFFICER. The same personnel who are laying the block in the structure shall construct the masonry prism.

3. The masonry prism shall be constructed and will be tested in accordance with ASTM C 1314, except as modified herein. The prisms shall be composed of one complete cell using full-size blocks which are saw-cut. The minimum ratio of height to smaller width dimension shall be 1.5. The prism shall be at least 15 inches high. A minimum of two horizontal bed joints shall be used to form the prism. The prism shall be grouted, after the required 24-hour minimum cure period, using the same grout used in the walls.

4. Compression tests made on sets of specimens made during construction shall include 2 prisms tested at 7 days after grouting and 3 prisms tested at 28 days after grouting.

5. The average compressive strength of prisms tested at 28 days after grouting, multiplied by the appropriate correction factor as given in the UBC, shall not be less than the indicated masonry compressive strength.

6. If the compressive strength of the prisms fails to meet or exceed that required, adjustments shall be made to the mix designs for the mortar, or grout, or both, as needed to produce the required strength. The masonry units shall also be retested to verify compliance to the requirements of ASTM C 90.

7. If the compressive strength of the prism fails to meet or exceed that required, prisms or cores shall be cut from the walls in sufficient numbers and in sufficient locations to adequately determine the strength of the walls. Those portions of the walls represented by specimens failing to meet the required compressive strength are subject to being removed and replaced.

F. **Inspection:** Whenever required under the provisions of the Building Code, work hereunder will be subject to continuous inspection by a Special Inspector selected by the CONTRACTING OFFICER and approved by the local Building Official having jurisdiction. Costs of such inspection will be paid by the GOVERNMENT. The Special Inspector will work under the supervision of the CONTRACTING OFFICER.

G. **Weather Conditions:** Concrete masonry units shall not be placed when air temperature is below 40 degrees F (4 degrees C) and shall be protected against direct exposure to the wind and sun when erected when the ambient air temperature exceeds 99 degrees F (37 degrees C) in the shade with relative humidity less than 50 percent. Cold weather installation shall be per code and Reference Standards and as approved by the CONTRACTING OFFICER.

H. **Product Storage:** Cement, lime, and other cementitious materials shall be delivered and stored in dry, weather-tight sheds or enclosures, in unbroken bags, barrels, or other approved containers, plainly marked and labeled with the manufacturers' names and brands. Mortar and grout shall be stored and handled in a manner which will prevent the inclusion of foreign materials and damage by water or dampness. Masonry units shall be handled with care to avoid chipping and breakage, and shall be stored as directed in the Masonry Design Manual. Materials stored on newly constructed floors shall be stacked in such manner that the uniformly-distributed loading does not exceed 30 psf. Masonry materials shall be protected from contact with the earth and exposure to the weather and shall be kept dry and clean until used.

PART 2 -- PRODUCTS

2.1 CONCRETE MASONRY UNITS

A. Concrete masonry units shall conform to ASTM C 90 with maximum linear shrinkage of 0.6 percent from standard to oven-dried condition. Units shall be medium weight units unless indicated otherwise.

B. Concrete masonry units shall be 8-inch by 8-inch by 16-inch modular size, with split faces. Units shall be integrally-colored with color selections from light and medium color range (white, black and dark green not included in color range.)

C. All bond beam, corner, lintel, sill, and other specially shaped blocks shall be provided where required or necessary. Specially shaped non-structural blocks may be constructed by saw cutting. Color and texture shall match that of adjacent units.

D. Concrete masonry units hidden from view entirely may be natural color units the same size as other adjacent masonry units.

E. Concrete masonry units at interior walls shall be normal weight block 8-inch by 8-inch by 16-inch modular size of color matching the integrally colored block.

F. Specified Compression Strength of Masonry (f'm) shall not be less than 2500 psi.

2.2 MATERIALS

A. Portland cement shall be Type I or II, low alkali, conforming to ASTM C 150.

B. Lime paste shall be made with pulverized quicklime or with hydrated lime which shall be allowed to soak not less than 72 hrs before use except that hydrated lime processed by the steam method shall be allowed to soak not less than 24 hrs and shall be made by adding the lime to the water. In lieu of hydrated lime paste for use in mortar, the hydrated lime may be added in the dry form. Hydrated lime shall be Type S, conforming to ASTM C 207. Pulverized quicklime shall conform to ANSI/ASTM C 5, shall pass a No. 20 sieve, and 90 percent shall pass a No. 50 sieve.

C. Sand shall conform to ASTM C 144. Coarse aggregate shall conform to ASTM C 404.

D. Water for mixing shall be clear potable water.

E. Reinforcing steel shall be deformed bars conforming to ASTM A 615, Grade 60.

F. Admixture for mortar shall be **Master Builders "PS-235 or Rheomix-235";" Sika Co., "Sika Red Label,"** or equal. The admixture shall not be detrimental to the bonding or help the process of efflorescence.

G. Admixture for grout shall be **Sika Co., "Sika Grout Aid," Type II; Master Builders "Pozzolith" normal**; or equal.

2.3 MORTAR

A. Mortar for concrete block masonry shall be Type M, with a minimum 28-day compressive strength of 2500 psi. Proportions shall be one part portland cement, 1/4- to 1/2-part lime paste or hydrated lime, and damp, loose sand in an amount (by volume) of not less than 2-1/4 nor more than 3 times the sum of the volumes of cement and lime used, with the precise amount of water required to produce the required workability and strength.

B. Mortar for use with colored masonry units shall have integral color as approved by the CONTRACTING OFFICER.

2.4 GROUT

A. Grout shall have a minimum 28-day compressive strength of 2500 psi. Proportions shall be one part portland cement, not more than 1/10-part lime paste or hydrated lime, 2-1/4 to 3 parts damp, loose sand, not more than 2 parts pea gravel, and water in the amount

necessary to produce a consistency for pouring without segregation of components. Where the grout space is less than 4 inches, pea gravel shall be omitted.

B. Admixtures may only be used when approved by the CONTRACTING OFFICER. When approved for use, admixtures shall be used in accordance with the manufacturer's published recommendations for the grout.

PART 3 -- EXECUTION

3.1 GENERAL

A. Measurements for mortar and grout shall be accurately made. Shovel measurements are not acceptable. Mortar proportions shall be accurately controlled and maintained.

B. Work shall be performed in accordance with the provisions of the applicable code for reinforced concrete hollow-unit masonry.

C. The CONTRACTOR shall set or embed all anchors, bolts, reglets, sleeves, conduits, and other items as required.

D. All block cutting shall be by machine.

E. Masonry units shall be supported off the ground and shall be covered to protect them from rain. Only clean, dry, uncracked units shall be incorporated.

F. Reinforcing steel shall be cleaned of all loose rust and scale, and all oil, dirt, paint, laitance, or other substances which may be detrimental to or reduce bonding of the steel and concrete.

G. Immediately before starting work, the concrete upon which the masonry will be laid shall be cleaned with water under pressure.

H. Full mortar joint for first course shall be provided.

I. Units shall be shoved tightly against adjacent units to assure good mortar bond.

J. All equipment for mixing and transporting the mortar and grout shall be clean and free from set mortar, dirt, or other foreign matter.

3.2 MIXING

A. Mortar shall be mixed by placing 1/2 of the water and sand in the operating mixer, following which the cement, lime, and remainder of the sand and water shall be added. After all ingredients are in the mixer, they shall be mechanically mixed for not less than 5 minutes. Retempering shall be done on the mortar board by adding water within a basin formed within the mortar, and the mortar reworked into the water. Mortar which is not used within one hour shall be discarded.

3.3 ERECTION OF CONCRETE BLOCK MASONRY

A. Masonry work shall be erected in-plane, plumb, level, straight, and true to dimensions and executed in accordance with acceptable practices of the trade.

B. Unless indicated otherwise, masonry shall be laid up in straight uniform courses with running bond.

C. All masonry shall be erected to preserve the unobstructed vertical continuity of the cells measuring not less than 3-inch by 3-inch in cross-section. Walls and cross webs shall be full bedded in mortar. All head (or end) joints shall be solidly filled with mortar for a distance in from the face of the wall or unit not less than the thickness of the longitudinal face shells.

3.4 JOINTS

A. Vertical and horizontal joints shall be uniform and approximately 3/8-inch wide. Exterior joints and interior exposed block joints shall be concave-tooled to a dense surface. Special care shall be used in tooling joints so as to match existing construction. Interior or exterior non-exposed masonry and masonry behind plaster shall have flush joints.

3.5 CLEANOUTS

A. Cleanout openings shall be provided at the bottoms of all cells to be filled at each lift or pour of grout, where such lift or pour is over 4 ft in height. Any overhanging mortar or other obstructions or debris shall be removed from the insides of such cell walls. The cleanouts shall be sealed before grouting and after inspection. Cleanout openings shall match the finished wall in exposed masonry.

3.6 REINFORCEMENT

A. Deep cut bond beam blocks shall be used where horizontal reinforcing steel is embedded. H-block bond beams may be used at locations other than openings.

B. Knock-out openings shall have no steel or joint reinforcing running through the opening. Head, jambs, and sill blocks shall be used to provide an even finish surface to install window when blocks are removed. Joints at head, jambs, and sills shall be stacked and continuous.

C. Vertical reinforcement shall be held in position at top and bottom and at intervals not exceeding 192 diameters of the reinforcement.

3.7 GROUTING

A. All cells and bond beam spaces shall be filled solidly with grout unless indicated otherwise. Grouting shall not be started until the wall has cured for 24 hours. Grout shall not be poured in more than 8-ft lifts.

B. All grout shall be consolidated at time of pouring by puddling or vibrating. Where the grouting operation has been stopped for one hour or longer, horizontal construction joints shall be formed by stopping the grout pour 1-1/2 inches below the top of the uppermost unit.

3.8 PROTECTION

A. Wall surfaces shall be protected from droppings of mortar or grout during construction.

B. FINISHING AND CLEANING

C. Masonry shall not be wet-finished unless exposed to extreme hot weather or hot wind and then only by using a nozzle-regulated fog spray sufficient only to dampen the face but not of such quantity to cause water to flow down over the masonry.

D. Finish masonry shall be cleaned and pointed in a manner satisfactory to the CONTRACTING OFFICER, based upon the standards established by the approved sample panel.

E. All interior and exterior colored masonry work exposed to view shall be cleaned by whip light sandblasting to remove all stains and other imperfections.

F. All exposed masonry surfaces of openings and window and door openings such as sills, heads, and jambs shall be finish block surfaces, not formed surfaces, unless indicated otherwise. Closed bottom bond beam blocks shall be used at heads and sills. Pour holes may be used at the sill under window frame and where approved by the CONTRACTING OFFICER.

3.9 VENEER TIES

A. Veneer ties shall be provided per Building Code and trade standards where veneered surfaces are indicated.

- END OF SECTION -

SECTION 05100 - STRUCTURAL STEEL FRAMING

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide structural steel framing and appurtenant metal parts required for permanent connection of the structural steel system, complete and in place, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. References herein to "Building Code" or UBC shall mean the Uniform Building Code of the International Conference of Building Officials (ICBO). The edition of the codes adopted as of the date of award of this contract shall apply to the WORK herein.

B. Federal Specifications and Commercial Standards

AISC	Code of Standard Practice for Steel Buildings and Bridges
AISC	Structural Steel Buildings-Allowable Stress Design and Plastic Design
AISC	Allowable Stress Design Specifications for Structural Joints Using ASTM A325 and A490 Bolts approved by the Research Council on Structural Connections of the Engineering Foundation
ASTM A 36	Structural Steel
ASTM A 53	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 307	Carbon Steel Bolts and Studs
ASTM A 325	Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 500	Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 501	Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A 992	Steel for Structural Shapes for Use in Building Framing
AWS D1.1	Structural Welding Code – Steel

1.3 CONTRACTOR SUBMITTALS

A. Submit in accordance with Section 01300 - Contractor Submittals.

B. Shop Drawings shall conform to AISC recommendations and specifications and shall show all holes, etc. required for other work. Drawings shall include complete details showing all members and their connections, anchor bolt layouts, schedules for fabrication procedures, and diagrams showing the sequence of erection.

C. Testing laboratory certifications for shop and field welders shall be submitted in triplicate directly to the CONTRACTING OFFICER with copies to the CONTRACTOR and others as required.

PART 2 -- PRODUCTS

2.1 MATERIALS

A. Structural steel

Wide Flange Shapes	ASTM A 992
Other Shapes, Plates, Bars	ASTM A 36
Pipe, Pipe Columns, Bollards	ASTM A 53, Type E or S, Grade B standard weight unless noted otherwise
HSS	ASTM A 500 Grade B

B. Bolts for connections shall be ASTM A 325, unless indicated otherwise. Bolts used to connect dissimilar metals shall be ASTM A 193 and A 194, Type 316 stainless steel.

C. Welded anchor studs shall be headed concrete anchor studs (HAS), or deformed bar anchors (DBA), or threaded studs (TAS), as indicated on the Drawings and as supplied by **Nelson Stud Welding Company**, Lorain, OH; **Omark Industries, KSM Fastening Systems Division**, Seattle, WA, or Portland, OR; or equal.

D. Structural steel shall be cleaned and coated in accordance with Section 09800 - Protective Coating.

E. Steel members in contact with aluminum shall be galvanized per Section 05500 - Miscellaneous Metalwork, unless indicated otherwise.

F. Structural members shall be furnished full length without splices unless otherwise indicated or approved by the CONTRACTING OFFICER.

2.2 INSPECTION AND TESTING

A. Shop inspection may be required by the GOVERNMENT at its own expense. The CONTRACTOR shall give ample notice to the CONTRACTING OFFICER prior to the beginning of any fabrication work so that inspection may be provided. The CONTRACTOR shall furnish all facilities for the inspection of materials and workmanship in the shop, and inspectors shall be allowed free access to the necessary parts of the WORK. Inspectors shall have the authority to reject any materials or WORK which does not meet the requirements of these Specifications. Inspection at the shop is intended as a means of facilitating the work and avoiding errors, but it is expressly understood that it

will in no way relieve the CONTRACTOR from responsibility for proper materials or workmanship under this Specification.

B. The GOVERNMENT may engage inspectors to inspect welded connections and high-strength bolted connections, and to perform tests and prepare test reports.

1. Ten percent of all butt and bevel welds which extend continuously for 24-inches or less shall be completely tested in accordance with AWS D1.1, Part B, Radiographic Testing of Welds, Chapter 6. All butt and bevel welds which extend continuously for more than 24-inches shall be spot tested at intervals not exceeding 36-inches.

2. Welds that are required by the CONTRACTING OFFICER to be corrected shall be corrected or redone and retested as directed, at the CONTRACTOR'S expense and to the satisfaction of the CONTRACTING OFFICER and/or approved independent testing lab.

3. The CONTRACTOR shall test to failure three bolts from each heat lot of bolts furnished to the job to verify compliance with this Specification. The testing laboratory shall be approved by the CONTRACTING OFFICER and all test reports shall be supplied to the CONTRACTING OFFICER in accordance with Section 01300. In addition, high-strength bolts shall be inspected using one of the methods set forth in the AISC Specification "Structural Joints Using ASTM A 325 or A 490 Bolts."

C. The costs for all initial testing will be paid by the GOVERNMENT. However, the CONTRACTOR shall pay for all costs for any additional testing and investigation on WORK which does not meet Specifications. The CONTRACTOR shall supply material for testing at no cost to the GOVERNMENT and shall assist the CONTRACTING OFFICER in obtaining material for test samples.

PART 3 -- EXECUTION

3.1 MEASUREMENT

A. The CONTRACTOR shall verify all dimensions and shall make any field measurements necessary and shall be fully responsible for accuracy and layout of work. The CONTRACTOR shall review the Drawings, and any discrepancies shall be reported to the CONTRACTING OFFICER for clarification prior to starting fabrication.

1.2 FABRICATION

A. Structural steel shall be fabricated in accordance with the Drawings, AISC Specifications, and as shown on the Shop Drawings.

B. Materials shall be properly marked and match-marked for field assembly.

C. Where finishing is required, assembly shall be completed including bolting and welding of units, before start of finishing operations.

3.3 CONNECTIONS

A. Shop and field connections shall be bolted or welded as indicated. All connections shall develop full strength of members joined and shall conform to AISC standard connections.

B. Unless otherwise indicated, welds shall conform to AISC LRFD Specification for Structural Steel Buildings.

3.4 WELDED CONSTRUCTION

A. The CONTRACTOR shall comply with the current AWS D1.1 Code for procedures, appearance, and quality of welds and welders, and methods used in correcting welding work. All welded architectural metal work where exposed to view shall have welds ground smooth. Shielded metal arc welding method or gas metal arc welding methods shall be used for welding structural steel.

B. Unless otherwise indicated, all butt and bevel welds shall be complete penetration.

3.5 HOLES FOR OTHER WORK

A. Holes shall be provided as necessary or as indicated for securing other work to structural steel framing, and for the passage of other work through steel framing members. No torch cut holes will be permitted.

3.6 SHOP PAINT PRIMER

A. Shop paint primer shall be applied in accordance with Section 09800. Omit shop applied primer at field weld locations, for the portion of a member to be embedded in concrete, and where galvanizing with no further coating is required.

3.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Structural members shall be loaded in such a manner that they may be transported and unloaded without being excessively stressed, deformed, or otherwise damaged.

B. Structural steel members and packaged materials shall be protected from corrosion and deterioration. Material shall be stored in a dry area and shall not be placed in direct contact with the ground. Materials shall not be placed on the structure in a manner that might cause distortion or damage to the members or the supporting structures. Repair or replace damaged materials or structures as directed.

3.8 ERECTION

A. The CONTRACTOR shall comply with the AISC Specifications and Code of Standard Practice, and with indicated requirements.

B. High-strength bolts shall be installed in accordance with the AISC Specification for Structural Joints using ASTM A 325 Bolts. The connections shall be the friction type, unless indicated otherwise.

C. Anchor bolts and other connectors required for securing structural steel to in-place WORK and templates and other devices for presetting bolts and other anchors to accurate locations shall be furnished by the CONTRACTOR.

D. The CONTRACTOR shall be responsible for designing and installing any temporary bracing required for the safe erection of all structural steel members.

3.9 SETTING BASES AND BEARING PLATES

A. Prior to the placement of non-shrink grout beneath base and bearing plates, the bottom surface of the plates shall be cleaned of all bond-reducing materials, and concrete and masonry bearing surface shall also be cleaned of all bond-reducing materials and roughened to improve bonding.

B. Loose and attached baseplates and bearing plates for structural members shall be set on wedges, leveling nuts, or other adjustable devices.

C. Anchor bolts shall be tightened after the supported members have been positioned and plumbed and the non-shrink grout has attained its indicated strength.

D. Baseplates shall be grouted with non-shrink grout to assure full uniform bearing. Grouting shall be done prior to placing loads on the structure.

3.10 FIELD ASSEMBLY

A. Structural frames shall be set accurately to the lines and elevations indicated. The various members shall be aligned and adjusted to form a part of a complete frame or structure before permanently fastening. Bearing surfaces and other surfaces which will be in permanent contact shall be cleaned before assembly. Necessary adjustments to compensate for discrepancies in elevations and alignments shall be performed.

B. Individual members of the structure shall be leveled and plumbed within AISC tolerances.

C. Required leveling and plumbing measurements shall be established on the mean operating temperature of the structure.

3.11 MISFITS AT BOLTED CONNECTIONS

A. Where misfits in erection bolting are encountered, the CONTRACTING OFFICER shall be immediately notified. The CONTRACTOR shall submit a method to remedy the misfit for review by the CONTRACTING OFFICER. The CONTRACTING OFFICER will determine whether the remedy is acceptable or if the member must be refabricated.

B. Incorrectly sized or misaligned holes in members shall not be enlarged by burning or by the use of drift pins.

C. Correction of misfits is part of the WORK.

3.12 GAS CUTTING

A. Gas cutting torches shall not be used in the field for correcting fabrication errors in the structural framing, except when approved by the CONTRACTING OFFICER. Gas-cut sections shall be finished equal to a sheared appearance.

3.13 TOUCH-UP PAINTING

A. Immediately after erection, field welds, bolted connections, and abraded areas shall be cleaned of the shop paint primer. Touch-up paint primer shall be applied by brush or spray which is the same thickness and material as that used for the shop paint. Galvanized surfaces which have been field welded or damaged shall be repaired in accordance with Section 05500.

B. Finish painting of all structural steel shall be as indicated in Section 09800.

- END OF SECTION -

SECTION 05500 - MISCELLANEOUS METALWORK

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide miscellaneous metalwork and appurtenances, complete and in place, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Federal Specifications

MIL-G-18015 A (3)	(Ships) Aluminum Planks. (6063-T6)
MIL-A-907E	Antiseize Thread Compound, High Temperature

B. Commercial Standards

AA-M32C22A41	Aluminum Assn.
AASHTO HS-20	Truck Loading
AISC	Manual of Steel Construction
AISI	Design of Light Gauge, Cold-Formed Steel Structural Members
ASTM A 36	Carbon Structural Steel
ASTM A 48	Gray Iron Castings
ASTM A 53	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 123	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 193	Alloy Steel and Stainless Steel Bolting Materials for High Temperature Service
ASTM A 194	Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service
ASTM A 307	Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A 325	Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 500	Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 992	Steel for Structural Shapes for Use in Building Framing

ANSI/AWS D1.1 Structural Welding Code - Steel

ANSI/AWS D1.2 Structural Welding Code - Aluminum

ANSI/AWS QC1 Qualification and Certification of Welding Inspectors

1.3 CONTRACTOR SUBMITTALS

A. **Shop Drawings:** Shop Drawings of all miscellaneous metalwork shall be submitted in accordance with Section 01300 - Contractor Submittals.

B. Layout drawings for grating shall be submitted showing the direction of span, type and depth of grating, size and shape of grating panels, seat angle details, and details of grating hold down fasteners. Load and deflection tables shall be submitted for each style and depth of grating used.

C. An ICBO report listing the ultimate load capacity in tension and shear for each size and type of concrete anchor shall be submitted. CONTRACTOR shall submit manufacturer's recommended installation instructions and procedures for adhesive anchors. Upon review, by CONTRACTING OFFICER, these instructions shall be followed specifically.

D. No substitution for the indicated adhesive anchors will be considered unless accompanied with ICBO report verifying strength and material equivalency, including temperature at which load capacity is reduced to 90 percent of that determined at 75 degrees F.

1.4 QUALITY ASSURANCE

A. All weld procedures and welder qualifications shall be available in the CONTRACTOR'S field office for review.

B. All welding shall be inspected by a CONTRACTOR-furnished inspector qualified in accordance with AWS requirements and approved by the CONTRACTING OFFICER.

PART 2 -- PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Steel

Wide Flange Shapes	ASTM A 992
Shapes, Plates, Bars	ASTM A 36
Pipe, Pipe Columns, Bollards	ASTM A 53, Type E or S, Grade B standard weight unless noted otherwise
HSS	ASTM A 500 Grade B

B. **Corrosion Protection:** Unless otherwise indicated, fabricated steel metalwork which will be used in a corrosive environment and/or will be submerged in water/wastewater shall be coated in accordance with Section 09800 -Protective Coating and shall not be galvanized prior to coating. All other miscellaneous steel metalwork shall be hot-dip galvanized after fabrication.

C. **Stainless Steel:** Unless otherwise indicated, stainless steel metalwork and bolts shall be of Type 316 stainless steel. Where anaerobic conditions are noted, Type 304 stainless steel shall be used.

D. **Aluminum:** Unless otherwise indicated, aluminum metalwork shall be of Alloy 6061-T6. Aluminum in contact with concrete, masonry, wood, porous materials, or dissimilar metals shall have contact surfaces coated in accordance with Section 09800.

E. **Cast Iron:** Unless otherwise indicated, iron castings shall conform to the requirements of ASTM A 48, Class 50B or better.

2.2 METAL STAIRS

A. **Metal Stairs:** Metal stairs shall be composed of steel or aluminum stringers and supports, be fabricated in accordance with standard practice of the National Association of Ornamental Metal Manufacturers, and be as indicated. Steel stair members shall be hot-dip galvanized after fabrication.

2.3 GRATING STAIR TREADS

A. Grating stair treads shall be designed to support a live load of 100 psf or a concentrated load at mid-span of 1000 pounds, whichever creates the higher stress. The maximum deflection due to the uniform live load shall be as required for metal grating below. All grating stair treads shall have an integral non-slip nosing.

2.4 SAFETY STAIR NOSINGS

A. Safety stair nosing shall be provided on all concrete stairs and other locations as indicated. The nosing shall be 3-inch wide, extruded aluminum with cast-in abrasive strips and integral extruded anchors. The color of the cast abrasive shall be as selected by the CONTRACTING OFFICER from the manufacturer's standard colors. The nosing shall be **American Abrasive Metals Company, Style "231-A"; American Mason Safety Tread Company, Figure "31A"** or equal.

2.5 LADDERS

A. Ladders which may be partially or wholly submerged, or which are located inside a hydraulic structure, shall be entirely of Type 316 stainless steel. All other ladders shall be of aluminum or as indicated.

B. Every ladder that does not have an exterior handhold shall be equipped with a pop-up extension. Pop-up extension device shall be manufactured of the same material and finish as the ladder with telescoping tubular section that locks automatically when fully extended. Upward and downward improvement shall be controlled by stainless steel spring balancing mechanisms. Units shall be completely assembled with fasteners for securing to the ladder rungs in accordance with the manufacturer’s instructions.

2.6 METAL GRATING

A. **General:** Metal grating shall be of the design, sizes, and types indicated. Grating shall be completely banded at all edges and cutouts using material and cross-section equivalent to the bearing bars. Such banding shall be welded to each cut bearing bar. Grating shall be supported on all sides of an opening by support members. Where grating is supported on concrete, embedded support angles matching grating material shall be used on all sides, unless indicated otherwise. Such angles shall be mitered and welded at corners.

1. All pieces of grating shall be fastened in two locations to each support.

2. Where grating forms the landing at the top of a stairway, the edge of the grating, which forms the top riser, shall have an integral non-slip nosing, width equal to that of the stairway.

3. Where grating depth is not given, grating shall be provided which will be within allowable stress levels, and which shall not exceed a deflection of 1/4-inch or the span divided by 180, whichever is less. For standard duty plank, and safety grating, the loading to be used for determining stresses and deflections shall be the uniform live load of the adjacent floor or 100 psf, whichever is greater or a concentrated load of 1000 pounds. For heavy duty grating, the loading used for determining stresses and deflections shall be AASHTO HS-20.

B. Material

1. Except where indicated otherwise, bar grating shall be fabricated entirely of aluminum as follows: Bearing and banding bars, alloy 6061-T6; cross bars, alloy 6063-T5.

2. Safety grating shall be fabricated of aluminum alloy 5052-H32.

3. Plank grating shall be fabricated of aluminum alloy 6063-T6.

4. Grating which may be partially or wholly submerged shall be fabricated entirely of stainless steel, Type 316.

C. Standard-Duty Grating

1. No single piece of grating shall weigh more than 80 pounds, unless indicated otherwise. Standard duty grating shall be serrated bar grating.

2. Cross-bars shall be welded or mechanically locked tightly into position so that there is no movement allowed between bearing and cross bars.

D. Safety Grating

1. Safety grating shall be made of aluminum alloy sheets punched into an open serrated diamond pattern and formed into plank sections. The open diamond shapes shall be approximately 1-7/8 inch by 11/16-inch in size. Safety grating shall be **Grip Strut by Metal Products Division, United States Gypsum Company; Deck Span by IKG Industries**, or equal.

E. **Heavy-Duty Grating:** Heavy-duty grating shall be of welded steel, galvanized after fabrication. Cross-bars shall be welded in position.

F. Plank Grating

1. Plank grating shall be extruded in 6-inch widths with a minimum of 6 integral 1-bar type-bearing bars per plank. The top surface shall be solid with raised ribs, unless indicated otherwise. Where punched grating is required, the top surface shall be provided with a pattern of 3-inch by 19/32-inch rectangular openings spaced at 4 inches on center. The planks shall have continuous tongue and groove type interlock at each side; except that interlocking planks shall be arranged so that any 4-foot wide section may be removed independently from the other grating sections.

2. Plank grating shall be provided with a clear anodized finish, except that punched grating may have standard mill finish.

2.7 CHECKERED PLATE

A. Checkered plate shall have a pattern of raised lugs on one face and shall be smooth on the opposite face. Lugs shall be a minimum of one inch in length and raised a minimum of 0.050 inch above the surface. The lugs shall be located in a pattern in which the lugs are oriented at 90 degrees from the adjacent lugs in two orthogonal directions. The rows of lugs shall be oriented at 45 degrees from the edges of the plates.

B. Where no plate material is indicated on the Drawings, aluminum shall be provided. Unless indicated otherwise, the minimum plate thickness shall be as required to limit deflection resulting from a live load of 100 psf to 1/4-inch or the span divided by 240, whichever is less.

2.8 FLOOR HATCHES

A. Where access hatches are mounted on a floor slab (including top slabs, which are not covered with a roofing membrane) or on a concrete curb, the hatch shall be a flush type as indicated herein. A hatch mounted on a roof surface, which has a membrane or other roofing material covering it, shall be the integral raised curb type in accordance with Section 07720 - Roof Accessories.

B. Hatches shall be fabricated from aluminum 5086 H34, 6063 T5 or 6061 T6, unless otherwise indicated. Hatch hardware shall be Type 316 stainless steel. Hatches shall be gutter-type; **Bilco Type "J" or "JD," Babcock-Davis Type B-FGA** or equal.

C. The design live load shall be 300 psf, unless indicated otherwise.

D. Hatch opening sizes, number and swing direction of door leaves, and locations, shall be as indicated. Sizes are for the clear opening. Where the number of leaves is not given, openings larger than 42-inches in either direction shall have double-leaf doors. Unless indicated otherwise, hinges shall be located on the longer dimension side. Unless indicated otherwise, ladder hatches shall be a minimum of 30-inches wide by 36-inches long, with the ladder centered on the shorter dimension, and the door hinge opposite the ladder.

E. Door leaves shall be a minimum of 1/4-inch thick checkered pattern plate. Channel frames shall be a minimum of 1/4-inch material with an anchor flange around the perimeter. Hatches shall be provided with an automatic hold-open arm with release handle. Hatches shall be designed for easy opening from both inside and outside.

F. Hatches shall be designed to be watertight and shall be equipped with a joint gutter and moat-type edge drain. A minimum 1-1/2 inch diameter drain connection shall be provided, located by the manufacturer.

G. Hatches for submersible pump stations shall include a unistrut channel around the frame perimeter. The face of the unistrut channel shall be flush with the face of the frame and be compatible with the upper guide rail bracket of the submersible wastewater pump manufacturer.

H. Hatches shall include a recessed hasp for a padlock that is covered by a hinged lid flush with the surface.

I. Unless indicated otherwise, hatch nets shall be installed on floor hatches. Hatch nets shall conform to OSHA requirements and shall be **Hatch Net 121**, as manufactured by **Safe Approach, Inc,** Auburn, ME, or equal.

2.9 IRON CASTINGS

A. Iron castings shall be of uniform quality, free from blowholes, porosity, hard spots, shrinkage, distortion, or other defects. They shall be smooth and well cleaned by shotblasting.

B. Covers and grates shall fit together evenly, so that the cover fits flush with the surrounding finished surface and so that the cover does not rock or rattle when loading is applied. Round covers and frames shall have machined bearing surfaces.

C. Covers and grates with matching frames shall be designed to support the following loadings:

1. Where located within a structure, the design loading shall match that required for the adjacent floor area, or, if no floor loading is given, a minimum of 300 pounds per square foot.

2. Exterior covers and grates shall be designed for AASHTO HS-20 loading unless indicated otherwise.

2.10 FALL PREVENTION SYSTEM

A. The fall protection system at each ladder shall include a carrier rung, ladder ring clamps, 2 sleeves and full body harnesses, dismount section, and components as necessary for a complete system. The carrier rail shall be the same material as the ladder, except for fiberglass ladders, which shall have stainless steel carrier rails, and shall be the length recommended by the manufacturer for the ladder dimensions, including extensions. Include an extension for each ladder. The fall protection system shall be **2000 Climb Rite by Sellstrom Manufacturing Company, Saf-T-Climb by North Safety Products Ltd.,** or equal.

2.11 BOLTS AND ANCHORS

A. **Standard Service (Non-Corrosive Application):** Unless otherwise indicated, bolts, anchor bolts, washers, and nuts shall be steel as indicated herein. Threads on galvanized bolts and nuts shall be formed with suitable taps and dies such that they retain their normal clearance after hot-dip galvanizing. Except as otherwise indicated, steel for bolt material, anchor bolts and cap screws shall be in accordance with the following:

1. Structural connections: ASTM A 307, Grade A or B, hot-dip galvanized.

2. Anchor Bolts: ASTM A 307, Grade A or B, or ASTM A 36, hot-dip galvanized.

3. High strength bolts where indicated: ASTM A 325.

4. Pipe and equipment flange bolts: ASTM A 193, Grade B-7.

B. **Corrosive Service:** All bolts, nuts, and washers in the locations listed below shall be stainless steel as indicated below.

1. All buried locations.

2. All submerged locations.

3. All locations subject to seasonal or occasional flooding.

4. Inside hydraulic structures below the top of the structure.

5. Inside buried vaults, manholes, and structures which do not drain through a gravity sewer or to a sump with a pump.

6. All chemical handling areas.

7. Inside trenches, containment walls, and curbed areas.

8. Locations indicated by the Contract Documents or designated by the CONTRACTING OFFICER to be provided with stainless steel bolts.

C. Unless otherwise indicated, stainless steel bolts, anchor bolts, nuts, and washers shall be Type 316 stainless steel, Class 2, conforming to ASTM A 193 for bolts and to ASTM A 194 for nuts. All threads on stainless steel bolts shall be protected with an antiseize lubricant suitable for submerged stainless steel bolts, to meet government specification MIL-A-907E. Buried bolts in poorly drained soil shall be coated the same as the buried pipe.

1. Antiseize lubricant shall be classified as acceptable for potable water use by the NSF.

2. Antiseize lubricant shall be "PURE WHITE" by **Anti-Seize Technology,** Franklin Park, IL, 60131, AS-470 by **Dixon Ticonderoga Company,** Lakehurst, NJ, 08733, or equal.

D. Bolt Requirements

1. The bolt and nut material shall be free-cutting steel.

2. The nuts shall be capable of developing the full strength of the bolts. Threads shall be Coarse Thread Series conforming to the requirements of the American Standard for Screw Threads. All bolts and cap screws shall have hexagon heads and nuts shall be Heavy Hexagon Series.

3. Bolts and nuts shall be installed with washers fabricated of material matching the base material of bolts; except that hardened washers for high strength bolts shall conform to the requirements of the AISC Specification. Lock washers fabricated of material matching the bolts shall be installed where indicated.

4. The length of each bolt shall be such that after the joint is made up, the bolt extends through the entire nut, but in no case more than 1/2-inch beyond the nut.

E. **Adhesive Anchors:** Unless otherwise indicated, all drilled, concrete or masonry anchors shall be adhesive anchors. No substitutions will be considered unless accompanied with ICBO report verifying strength and material equivalency.

1. Epoxy adhesive anchors are required for drilled anchors for indoor installations, in submerged, wet, splash, overhead, and corrosive conditions, and for anchoring handrails and reinforcing bars. Epoxy shall comply with Section 03315 - Grout. Threaded rod shall be galvanized for general-purpose applications and stainless steel Type 316 for corrosive applications. Epoxy anchors shall not be permitted in areas where the concrete temperature is in excess of 100 degrees F or higher than the limiting temperature recommended by the manufacturer, whichever is lower. Epoxy anchors shall not be used where anchors are subject to vibration or fire. Embedment depth shall be as the manufacturer recommends for the load to be supported.

2. Unless otherwise indicated, glass capsule, polyester resin adhesive anchors will be permitted in locations not included above and shall be **Hilti HVA**, **Covert Injection Adhesive Anchors,** or equal. Threaded rod shall be galvanized steel.

F. **Expanding-Type Anchors:** Expanding-type anchors if indicated or permitted, shall be galvanized steel expansion type **ITW Ramset/Redhead "Trubolt" anchors; McCullock Industries "Kwick-Bolt;"** or equal. Lead caulking anchors will not be permitted. Size shall be as indicated. Embedment depth shall be as the manufacturer recommends for the load to be supported. Expansion type anchors, which are to be embedded in grout, may be steel. Non-embedded buried or submerged anchors shall be stainless steel.

G. **Non-Shrink Grouted Anchors**: Anchors, if indicated or permitted, shall be grouted with a non-shrink cementitious grout in accordance with the manufacturer's recommendation. Embedment depth shall be as the manufacturer recommends for the load to be supported. Non-shrink grout material shall be Class B or C in accordance with Section 03315 - Grout.

2.12 POWDER-DRIVEN PINS

A. **Materials:** Powder-driven pins for installation in concrete or steel shall be heat-treated steel alloy. If the pins are not inherently sufficiently corrosion-resistant for the conditions to which they are to be exposed, they shall be protected in an acceptable manner. Pins shall have capped or threaded heads capable of transmitting the loads the shanks are required to support. Pins that are connected to steel shall have longitudinal serrations around the circumference of the shank.

2.13 IMPACT ANCHOR

A. Impact anchors shall be an expansion type anchor in which a nail type pin is driven to produce the expansive force. The pin shall have a zinc sleeve with a mushroom style head and stainless steel nail pin. Anchors shall be **Metal Hit Anchors,** manufactured by **Hilti, Inc., Rawl Zamac Nailin,** manufactured by **the Rawlplug Company;** or equal.

PART 3 -- EXECUTION

3.1 FABRICATION AND INSTALLATION REQUIREMENTS

A. **Fabrication and Erection:** Except as otherwise indicated, the fabrication and erection of structural steel shall conform to the requirements of the American Institute of Steel Construction "Manual of Steel Construction."

B. **Aluminum Railings:** Aluminum railing fabrication and installation shall be performed by craftsmen experienced in the fabrication of architectural metalwork. Exposed surfaces shall be free from defects or other surface blemishes. Dimensions and conditions shall be verified in the field. All joints, junctions, miters and butting sections shall be precision fitted with no gaps occurring between sections, and with all surfaces flush and aligned. Electrolysis protection of materials shall be provided.

C. **Floor Hatches:** Unless otherwise indicated, the CONTRACTOR shall provide a 1/2-inch drain line to the nearest floor drain for all floor hatches.

D. **Powder-Driven Pins:** Powder-driven pins shall be installed by a craftsperson certified by the manufacturer as being qualified to install the manufacturer's pins. Pins shall be driven in one initial movement by an instantaneous force that has been carefully selected to attain the required penetration. Driven pins shall conform to the following requirements where "D" = pin's shank diameter:

Material Penetrated by Pin	**Material Minimum Thickness**	**Pin Shank Penetration in Supporting Material**	**Minimum Space From Pin's CL to Edge of Penetrated Material**	**Minimum Pin Spacing**
Concrete	16D	6D minimum	14D	20D
Steel	1/4-inch	Steel thickness	4D	7D

3.2 WELDING

A. **Method:** Welding shall be by the metal-arc method or gas-shielded arc method as described in the American Welding Society's "Welding Handbook" as supplemented by other pertinent standards of the AWS. Qualification of welders shall be in accordance with the AWS Standards governing same.

B. **Quality:** In assembly and during welding, the component parts shall be adequately clamped, supported, and restrained to minimize distortion and for control of dimensions. Weld reinforcement shall be as indicated by the AWS Code. Upon completion of welding, weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance, with uniform weld contours and dimensions. All sharp corners of material, which is to be painted or coated, shall be ground to a minimum of 1/32-inch on the flat.

3.3 GALVANIZING

A. Structural steel plates shapes, bars, and fabricated assemblies required to be galvanized shall, after the steel has been thoroughly cleaned of rust and scale, be galvanized in accordance with the requirements of ASTM A 123. Any galvanized part that becomes warped during the galvanizing operation shall be straightened. Bolts, anchor bolts, nuts and similar threaded fasteners, after being properly cleaned, shall be galvanized in accordance with the requirements of ASTM A 153.

B. Field repairs to damaged galvanizing shall be made by preparing the surface and applying a coating.

1. Surface preparation shall consist of removing oil, grease, soil, and soluble material by cleaning with water and detergent (SSPC SP1) followed by brush off blast cleaning (SSPC SP7), over an area extending at least 4-inches in all directions into the undamaged area.

2. Coating shall be applied to at least 3 mils dry film thickness. Use **Zinc-Clad XI** by **Sherwin-Williams**, **Galvax** by **Alvin Products**, or **Galvite** by **ZRC Worldwide**.

3.4 DRILLED ANCHORS

A. Drilled anchors and reinforcing bars shall be installed in strict accordance with the manufacturer's instructions. Holes shall be roughened with a brush on a power drill, cleaned and dry. Drilled anchors shall not be installed until the concrete has reached the required 28-day compressive strength. Adhesive anchors shall not be loaded until the adhesive has reached its indicated strength in accordance with the manufacturer's instructions.

3.5 FALL PREVENTION SYSTEM

A. Fall prevention systems shall be provided on all ladders used to ascend heights exceeding 20 feet.

- END OF SECTION -

SECTION 07410 – METAL ROOFING

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall furnish and install all metal roofing WORK and appurtenant WORK, complete, all in accordance with the requirements of the Contract Documents.

B. The principal items of sheet metal WORK included in the metal roofing system shall include sheet metal flashing, covers, trim, enclosure batts, collars and sleeves at all roof penetrations, and all other sheet metal items necessary for a complete and watertight metal roofing system.

C. The metal roofing applicator shall coordinate his WORK with sheet metal gutter WORK and shall report to the CONTRACTOR and CONTRACTING OFFICER if any sheet metal WORK provided by others affects his WORK negatively.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of other requirements of the specifications, all WORK specified herein shall conform to exceed the requirements of the Building Code and the applicable requirements of the following documents to the extent that the provisions of such documents are not in conflict with the requirements of this Section.

B. Products and their installation shall be in accordance with the following trade standards, as applicable.

1. Manufacturer's printed recommendations and specifications

2. Sheet Metal and Air Conditioning Contractors National Association Architectural Sheet Metal Manual" (ASMM)

3. NAAMM, "Metal Finishes Handbook"

4. ASTM A653, "Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process"

5. Standards, publications and reports of the American Society for Testing and Materials (ASTM)

6. AA, Aluminum Construction Manual: Aluminum Sheet Metal Work and Building Construction

7. ASTM B209, "Aluminum Alloy Sheet and Plate"

8. Underwriters Laboratories (UL)

1.3 QUALITY ASSURANCE

A. Where possible, prior to fabrication of the prefabricated metal roofing system, the CONTRACTOR shall take field measurements of structure or substrates to receive the

roofing system. He shall verify dimensions, details and other items that affect the roofing system and watertightness of the system.

B. The CONTRACTOR shall coordinate the design details of the Contract Documents with the details required by the roofing system manufacturer for watertightness and warranty enforcement. He shall make all modifications required by the selected manufacturer to make the system meet the manufacturer's needs. However, these modifications shall not affect the architectural design and must be approved by the CONTRACTING OFFICER.

C. The CONTRACTOR shall provide the GOVERNMENT with a twenty-year metal coating (finish) guarantee on the prefinish coating on the galvanized steel. The warranty shall guarantee the coating under normal range of weathering conditions to be without significant peel, blister, flake, chip, crack or check in the finish and without chalking in excess of 8 (ASTM D 659), and without fading in excess of 5 NBS units.

D. The MANUFACTURER shall have had at least fifteen- (15) year's experience in architectural roofing, and the specified panel itself shall have been in use for a minimum of fifteen (15) years.

E. The MANUFACTURER shall submit the names and addresses of five- (5) previous standing seam metal roofing projects of comparable size, scope, and complexity.

F. The INSTALLER shall have a minimum of five- (5) year's experience in the installation of concealed clip, structural standing seam roofing.

1.4 CONTRACTOR SUBMITTALS

A. **General:** The following shall be submitted to the CONTRACTING OFFICER for review, approval, or verification in accordance with Section 01300, Contractor Submittals".

B. **Samples:** Color samples and samples shall be submitted where required for color selections and approval by the CONTRACTING OFFICER. Two 12-inch square samples of the selected trim color and roofing color shall be submitted after color selection. Not less than 10 colors shall be submitted for color selection by the CONTRACTING OFFICER.

C. **Shop Drawings:** Shop drawings showing materials, gages, finishes, layout, corners, trim, flashing, enclosures, edge conditions, jointing, profiles, supports, fasteners, fabrication of special shapes, and method of attachment to adjacent construction shall be submitted.

D. **Manufacturer's Information:** Manufacturer's literature indicating materials, finish, construction, and method of installation of prefabricated items and sealant.

E. **Test Reports:** Submit the following Test Reports, certified by an Independent Testing Laboratory or a professional engineer, to verify that the proposed roofing will meet performance requirements of this Specification.

1. Thermal Cycle Test

2. ASTM E-330 Adapted to Test Formed Metal Panels

3. Clip Fastener Pull-Out Tests and Calculations

4. UL 90 Classification Test Data

5. Concentrated Load Test Data

6. Air Infiltration (E-283) and Water Penetration (E-331) Test Results

7. Coating Performance Testing

F. **Certification:** Certification by the MANUFACTURER that the roofing assembly is listed in the UL Building Materials Directory with a Class 90 wind uplift rating, including relevant construction number. Certified statements from the manufacturer are not acceptable in lieu of a UL 90 classification.

G. **Warranty:** The CONTRACTOR shall submit the product warranty for evaluation with warranty requirements.

1.5 STORAGE AND HANDLING

A. The metal roofing system products shall be stored in a dry location per manufacturer's instruction.

B. The materials shall be stored in a manner that will prevent twisting, bending, or abrasion, and provides ventilation.

C. The products shall not be stored in contact with materials or in such a manner that the metal roofing products or the stored material (unless discardable) is discolored or stained during storage.

PART 2 -- PRODUCTS

2.1 GENERAL

A. **Available Manufacturers:** Subject to compliance with the requirements, manufacturers who may offer metal roofing systems and products, which may be incorporated in the WORK, include the following:

1. **Tomen Building Components, Inc. – Architectural Panels 305**

2. **Fabral – Slim Seam Panel System**

3. Or equal.

2.2 SHEET MATERIAL

A. Metal roofing shall be minimum 20-gage structural steel with G90 hot dipped galvanized coating, conforming to ASTM A 653.

B. Sheet metal trim and accessories shall be the same material as the metal roofing.

2.3 ACCESSORY MATERIALS

A. Fasteners shall be concealed stainless steel.

B. Underlayment (weather resistive barrier) material shall be No. 30 asphalt saturated roofing felt conforming to ASTM D226.

C. Protective backing paint for dissimilar materials shall be zinc chromate alkyd.

D. Sealant shall be factory applied in longitudinal female ribs. Other sealant shall be as specified in Section 07920, “Sealant and Caulking”, and shall be used as recommended by the metal roofing manufacturer for the job conditions and warranty requirements and when approved by the CONTRACTING OFFICER.

E. Gaskets, joint fillers, and separation strips shall be as recommended by the roofing system manufacturer.

F. Sealing tapes for the vapor/air retarder shall be 4-inches wide and as recommended by the vapor retarder membrane manufacturer.

2.4 METAL FINISH

A. All metal roofing system components shall be coated either before or after forming and fabrication, as required by coating process and as required for maximum coating performance capability. The coating shall be promptly protected after application and curing, by application of strippable film or removable adhesive cover, and retained until installation has been completed.

B. The color shall be as selected by the CONTRACTING OFFICER from the manufacturer’s standard colors.

C. All exposed-to-view metal roofing system components such as, but not limited to, metal roofing, trim, enclosure batts, flashing and covers, shall be hot-dipped galvanized steel provided with a fluoropolymer coating full-strength 70 percent Kynar 500” coating, baked-on finish.

D. All non-visible metal roofing system components, supports, clips, anchors and fasteners shall be hot-dipped galvanized sheet metal galvanized steel or stainless steel.

2.5 FABRICATION AND DESIGN

A. The metal roofing system shall be standing seam-roofing system with all components necessary to provide a watertight roofing system. It shall be designed for 90-mph wind loads, and loads required by the UBC. It shall be designed to facilitate the thermal expansion and construction needs for the maximum and minimum temperatures of the region (site location). The roofing sheets shall be not less than 20-gage galvanized steel with minimum 1-inch high standing seams spaced at not more than 12-inches on center.

B. The metal roofing system shall have a UL Class 90 rating.

C. The UBC requirements for wind uplifts in 90-mph winds and 35-feet building eave heights shall be followed for the roof fasteners.

D. The metal roofing system shall include all connecting flashing, trim, enclosures, cleats, starter strips, end closures batts, and other sheet metal fabricated items. They shall be fabricated from the same material as the roofing system and be provided with interlockable joints and details.

E. The metal roofing system components shall be formed in full lengths with no end laps.

F. All exposed edges shall be provided on the underside with 1/2-inch hemmed edge. Corners shall be mitered and sealed.

G. Concealed metal surfaces shall be provided with protective backing painting.

H. System components shall be provided with permanent separation materials on concealed surfaces where panels or other components would otherwise be in direct contact with substrate materials which are noncompatible or could result in corrosion or deterioration of either material or finish.

I. Panel joints shall be fabricated with captive gaskets or separator strips, which provide a tight seal and prevent metal-to-metal contact in a manner that will minimize noise form movement with the system.

J. The metal roofing system panels shall be fabricated to control condensation, including vapor inclusion of seals and provisions for breathing, venting, weeping and draining.

K. The metal roofing system shall include all stainless steel fasteners necessary to attach to the structural deck or framing system through the ridge board insulation system.

L. The metal roofing system shall include an underlayment system (weather resistive barrier) of not less than one layer of underlayment material.

PART 3 -- EXECUTION

3.1 INSPECTION

A. The roofing deck shall be inspected to make sure that it is clean, smooth, and free of depressions, waves, or projection, is properly sloped to drain and is acceptable to receive the roofing system. The CONTRACTOR and/or his installer shall notify the CONTRACTING OFFICER of any unsatisfactory deck conditions. No WORK shall proceed until the subsupports, decking system is accepted.

B. Roofing openings, curbs, pipes, sleeves, ducts or vents through the roof shall be solidly set, cant strips and reglets in place, and nailing strips located.

C. The deck shall be dry and free of moisture. Flutes in steel deck shall be clean and dry.

3.2 GENERAL

A. The metal roofing, system shall be installed by an applicator and fabricator approved by the roofing system manufacturer who is familiar with the roofing system (working experience). The CONTRACTOR shall provide a letter signed by the roofing system manufacturer that the installer is an approved applicator and fabricator of his roofing system.

B. The metal roofing system shall be installed in accordance with the fabricator's and roofing system manufacturer's instruction and recommendations for installation, as applicable to job conditions and supporting substrates.

C. The panels and other components of the system shall be securely anchored and placed with concealed fasteners and shall be provided with provisions for thermal/structural movement.

D. Shim and align panel units within installed tolerances of 1/4-inch in 20-feet 0-inches on level/plumb/slope and location/line as indicated, and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

E. Joint sealers such as, but not limited to, gaskets, joint filters and sealant, shall be furnished and installed where indicated, necessary or where required for weatherproofing of the system.

3.3 INSTALLATION

A. The roofing installer shall inspect the metal deck substrate to ensure that the deck is free of any protrusions, sharp edges, or debris. Any unsatisfactory conditions shall be corrected prior to installation of the roofing system.

B. The roofing system shall be installed in accordance with the approved shop drawings and the MANUFACTURER'S recommendations.

C. All attachments shall allow for thermal expansion and contraction of the roofing panels.

D. A single layer felt underlayment system shall be provided under the metal roofing over the rigid roof insulation system. The felts shall be provided with no less than 2-inch edge laps and 4-inch side laps.

E. The panels shall be installed over the rigid insulation and underlayment in one continuous length from ridge to eave.

F. Seal the top and bottom of the metal closure with **Butyl Tape (7/8" x1/8") caulking,** or equal.

G. Dissimilar materials shall be back painted with protective coating.

3.4 CLEANING AND PROTECTION

A. Panels and other components of the WORK which have been damaged or have deteriorated beyond successful repair by means of finish touch-ups or similar minor repair procedures, shall be removed and replaced at no cost to the GOVERNMENT.

B. Temporary protective coverings and strippable films shall be removable from the materials during installation. Upon completion of the WORK, the roofing system shall be cleaned as recommended by the roofing manufacturer and shall be maintained in a clean condition until acceptance of the job by the GOVERNMENT.

- END OF SECTION -

SECTION 07920 - SEALANTS AND CAULKING

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide caulking, sealing, and appurtenant work, complete and in place, in accordance with the Contract Documents.

1.2 REFERENCE STANDARDS

A. **General:** Portions of the following standards are incorporated into this Section by references below. The standards are listed here for convenience.

B. Federal Specifications:

TT-S-1543A	Sealing Compound, Silicone Rubber Base, (For Caulking, Sealing and Glazing in Buildings and Other Structures)
SS-S-200D	Sealants, Joint, Two Compound, Jet Blast Resistant, Cold Applied for Portland Cement Concrete Pavement.
TT-S-227E	Sealing Compound, Elastomeric Type, Multi-Component, (For Caulking, Sealing and Glazing in Buildings and Other Structures)
TT-S-230C	Sealing Compound, Elastomeric Type, Single Component, (For Caulking, Sealing, and Glazing in Buildings and Other Structures)

C. Commercial Standards:

ASTM C 834	Latex Sealant
ASTM C 920	Elastomeric Joint Sealants
ASTM D 1752	Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

1.3 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01300 - Contractor Submittals.

B. **Technical Data:** A complete materials list along with the manufacturer's technical data and literature, specifications, joint width and depth tables, and installation instructions.

C. **Samples:** Samples (including color samples) of all the caulking and sealant materials and other materials proposed for use on the WORK. The samples shall be clearly marked with the manufacturer's name and product identification.

D. **Certificates:** If requested by the ENGINEER, certificates from an independent testing laboratory approved by the ENGINEER, certifying that the submitted materials meet all the requirements of the ASTM and Federal Specifications cited.

E. **Warranty:** A copy of the manufacturer's warranty covering all sealant, caulking materials, and other materials against defects in materials.

PART 2 -- PRODUCTS

2.1 SEALANTS AND CAULKING MATERIALS

A. General:

1. Manufacturer's Standards: In addition to the standards listed below, the sealant and caulking products and application shall be in accordance with the manufacturer's published recommendations and specifications.

2. Wherever manufacturer's names and products are listed in this Section, "or equal" products will be considered in accordance with Section 01300 - Contractor Submittals.

B. Materials shall conform to the following requirements:

1. Significant Movement Sealants (plus or minus 25 percent movement capability)

a. For expansion wall joints; masonry and metal curtainwall joints; precast concrete joints and concrete panels; perimeter sealing (windows, doors, and panels); control joints; interior and non-traffic horizontal joints.

1) Two component, non-sag, polyurethane or polysulfide sealant conforming to Federal Specification TT-S-227E, Class A, Type II, and ASTM C 920, Type M, Class 25, Grade NS.

Products Research & Chemical Corp. "RC-2"
Progress Unlimited "Iso-Flex 2000"

2) One component, non-sag, low modulus, polyurethane or polysulfide sealant conforming to Federal Specification TT-S230C, Class A, Type II, and ASTM C 920, Type S, Class 25, Grade NS.

Products Research & Chemical Corp. "RC-1"
Tremco "Dymonic"

3) One component, non-sag, medium modulus, neutral cure, silicone sealant conforming to Federal Specification TT-S-1543A, Class A, and ASTM C 920, Type S, Class 25, Grade NS.

Products Research & Chemical Corp. "PRC-4000"
Dow Corning "795"

b. For horizontal joints exposed to fuel spillage.

1) Two component, self-leveling, fuel resistant, polyurethane or polysulfide sealant conforming to Federal Specification SS-S-200D, Type H, and ASTM C 920, Type M, Class 25, Grade P.

Products Research & Chemical Corp. "3105-S"

c. For horizontal joints not exposed to fuel spillage.

1) Two component, self-leveling, polyurethane or polysulfide sealant conforming to Federal Specification TT-S-227E, Class A, Type I, and ASTM C 920, Type M, Class 25, Grade P.

Products Research & Chemical Corp. "RC-2SL"
Bostic "Chem-Calk 550"

2) One component, self-leveling, polyurethane or polysulfide sealant conforming to Federal Specification TT-S-230C, Class A, Type I, and ASTM C 920, Type S, Class 25, Grade P.

Products Research & Chemical Corp. "6006"
Mameco "Vulkem 45"

2. Interior Sealant and Caulking

a. For general applications

1) One component, acrylic latex caulking conforming to ASTM C 834

Pecora Corp. "AC-20"
Bostic "Chem-Calk 600"

3. Preformed Sealant: Preformed sealant shall be polybutylene or isoprene-butylene based pressure sensitive weather resistant tape or bead sealant capable of sealing out moisture, air, and dust when installed as recommended by the manufacturer. At temperatures from minus 30 to plus 160 degrees F, the sealant shall be non-bleeding and shall have no loss of adhesion.

4. Tape Sealant: Dimensions shall be as required for application conditions. Tape sealant shall be type recommended by tape manufacturer for connecting and bonding to surfaces.

5. Joint backing (backer rod) material shall be resilient, closed-cell polyethylene foam conforming to ASTM D 1752, Type II or III, and/or bond breakers of proper size for joint widths. Joint backing shall be compatible with sealant manufacturer's product and shall not stain the sealant nor the materials to which applied.

6. Primer: Primers shall be as recommended in the manufacturer's printed instructions for caulking and sealant, and shall not stain the sealant nor the materials to which applied. Manufacturer shall be consulted for all surfaces not specifically covered in submittal application instructions. Primer shall be used in accordance with manufacturer's instructions with all primers being applied prior to the installation of any backer rod or bond breaker tape.

7. Cleaning and cleanup solvents, agents, and accessory materials shall be as recommended in the manufacturer's printed instructions for cleaning up.

2.2 COLOR OF SEALANT

A. Color of sealant that is visible after installation shall match adjacent building finish. If in doubt of color match, obtain color approval from ENGINEER.

PART 3 -- EXECUTION

3.1 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. **Delivery of Materials:** Manufactured materials shall be delivered in original, unbroken packages or containers bearing the manufacturer's label. Packages or containers shall be delivered to the Site with seals unbroken.

B. **Shelf Life:** Materials whose shelf life dates have expired shall not be used in the WORK. Such materials shall be promptly removed from the Site.

C. **Storage:** All materials shall be carefully stored in accordance with the manufacturer's instructions, in an area that is protected from deleterious elements, and in a manner that will prevent damage to the product. Materials shall be stored at temperatures between 40 and 90 degrees unless otherwise specified by the manufacturer.

3.2 INSTALLATION

A. **Manufacturer's Recommendations:** All work under this Section and all testing, where applicable, shall be performed in accordance with manufacturer's printed recommendations, specifications, and installation instructions except where more stringent requirements are indicated herein; and, except where project conditions require extra precautions or provisions to assure performance of the waterproofing system.

B. **Authorized Installers:** Caulking and sealant shall be complete systems and be installed only by installers authorized and approved by the respective manufacturers.

C. Surface Preparation

1. General: The surfaces of joints to be sealed shall be dry. Oil, grease, dirt, chalk, particles of mortar, dust, loose rust, loose mill scale, and other foreign substances shall be removed from surfaces of joints which will be in contact with the sealant. Ferrous metal surfaces shall be cleaned of all rust, mill scale, and other coatings by wire brush, grinding, or sandblasting. Oil and grease shall be removed by cleaning in accordance with sealant manufacturer's printed recommendations. Protective coatings shall be removed from all aluminum surfaces against which caulking or sealing compound is to be placed. Bituminous or resinous materials shall be removed from surfaces to receive caulking or sealant.

2. Concrete and Masonry Surfaces: Where surfaces have been treated with curing compounds, oil, or other such materials, the materials shall be removed by sandblasting or wire brushing. Laitance, efflorescence, and loose mortar shall be removed from the joint cavity.

3. Steel Surfaces: Steel surfaces to be in contact with sealant shall be sandblasted or, if sandblasting would not be practical or would damage adjacent finish WORK, the metal shall be scraped and wire brushed to remove loose mill scale. Protective coatings on steel surfaces shall be removed by sandblasting or by a solvent that leaves no residue.

4. Aluminum Surfaces: Aluminum surfaces to be in contact with sealant shall be cleaned of temporary protective coatings. When masking tape is used for a protective cover, the tape and any residual adhesive shall be removed just prior to applying the sealant. Solvents used to remove protective coating shall be as recommended by the manufacturer of the aluminum work and shall be non-staining.

D. **Joint Types and Sizes:** Joint shapes and sizes shall be as indicated or as necessary for job conditions where not indicated. Joints to be caulked or sealed include through-bolt holes, door frames, louver and ventilator frames, joints between openings where items pass through exterior walls, concrete masonry, or combination of these surfaces, and as otherwise indicated or required for watertightness, weatherproofing, or airtightness. Use sealing compound at both exterior and interior surfaces of exterior wall penetrations.

3.3 SEALANT FILLED JOINTS

A. **Manufacturer's Representative:** The CONTRACTOR shall furnish the on-site services of the sealant manufacturer's representative prior to sealant work for inspection of the joints to be sealed and for instructing the installer in the proper use of the materials if requested by the ENGINEER.

B. **Sealant:** Sealant shall be used before expiration of shelf life. Multi-component sealant shall be mixed according to manufacturer's printed instructions. Sealant in guns shall be applied with a nozzle of proper size to fit the width of joint. Sealant shall be installed to the required depth without displacing the backing. Unless otherwise indicated or recommended by the manufacturer, the installed sealant shall be tooled so that the surface is uniformly smooth and free of wrinkles and to assure full adhesion to the sides of the joint. Sealant shall be installed free of air pockets, foreign embedded matter, ridges, and sags. Sealer shall be applied over the sealant if recommended by the sealant manufacturer.

C. **Sealant Depth:** Sealant depth in joints shall be 1/2 the width of joint, but not less than 1/8-inch deep and 1/4-inch wide nor more than 1/2-inch deep and 1-inch wide. All joints shall have rigid filler material installed to proper depth prior to application of sealant.

D. **Masking Tape:** Masking tape shall be placed on the finish surface on one or both sides of a joint cavity to protect adjacent finish surfaces from primer or sealant smears. Masking tape shall be removed within 10 minutes after joint has been filled and tooled.

E. **Backing:** Backing shall be installed to provide the indicated sealant depth. The installation tool shall be shaped to avoid puncturing the backing.

F. **Bond-Breaker:** Bond-breaker shall be applied to fully cover the bottom of the joint without contaminating the sides where sealant adhesion is required.

G. **Primer:** Primer shall be used on concrete masonry units, wood, or other porous surfaces in accordance with instructions furnished with the sealant. Primer shall be applied to the joint surfaces to be sealed. Surfaces adjacent to joints shall not be primed.

H. **Applications:** A full bead of sealant shall be applied into the joint under sufficient pressure, with the nozzle drawn across sealant, to completely fill the void space and to ensure complete wetting of contact area to obtain uniform adhesion. During application, the tip of the nozzle shall be kept at the bottom of the joint thereby forcing the sealant to fill from the bottom to the top. Sealant shall be tooled immediately after exposure with a caulking tool or soft bristled brush moistened with solvent. The finished sealant-filled joint shall be slightly concave unless otherwise indicated.

3.4 CLEANING

A. After application of sealant and caulking materials, adjacent materials, which have been soiled, shall be cleaned and left in a neat, clean, undamaged, or unstained condition. On porous surfaces, excess sealant shall be removed per sealant or caulking manufacturer's printed instructions.

- END OF SECTION -

SECTION 09800 - PROTECTIVE COATING

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide protective coatings, complete and in place, in accordance with the Contract Documents.

B. Definitions

1. The term "paint," "coatings," or "finishes" as used herein, shall include surface treatments, emulsions, enamels, paints, epoxy resins, and all other protective coatings, excepting galvanizing or anodizing, whether used as a pretreatment, primer, intermediate coat, or finish coat.

2. The term "DFT" means minimum dry film thickness, without any negative tolerance.

C. The following surfaces shall not be protective coated:

1. Concrete, unless required by items on the concrete coating schedule below or the Drawings.

2. Stainless steel

3. Machined surfaces

4. Grease fittings

5. Glass

6. Equipment nameplates

7. Platform gratings, stair treads, door thresholds, and other walk surfaces, unless specifically indicated to be coated.

D. The coating system schedules summarize the surfaces to be coated, the required surface preparation, and the coating systems to be applied. Coating notes on the Drawings are used to show or extend the limits of coating schedules, to show exceptions to the schedules, or to clarify or show details for application of the coating systems.

E. Where protective coatings are to be performed by a subcontractor, the subcontractor shall possess a valid state license as required for performance of the painting and coating work called for in this specification and shall provide 5 references which show that the painting subcontractor has previous successful experience with the indicated or comparable coating systems. Include the name, address, and the telephone number for the owner of each installation for which the painting subcontractor provided the protective coating.

1.2 CONTRACTOR SUBMITTALS

A. **General:** Submittals shall be furnished in accordance with Section 01300 - Contractor Submittals, unless indicated otherwise below.

B. Submittals shall include the following information and be submitted at least 30 days prior to protective coating work:

1. Coating Materials List: Eight copies of a coating materials list showing the manufacturer and the coating number keyed to the coating systems herein. The list shall be submitted prior to or at the time of submittal of samples.

2. Paint Manufacturer's Information: For each coating system to be used, the following data:

a. Paint manufacturer's data sheet for each product proposed, including statements on the suitability of the material for the intended use.

b. Technical and performance information that demonstrates compliance with the system performance and material requirements.

c. Paint manufacturer's instructions and recommendations on surface preparation and application.

d. Colors available for each product (where applicable).

e. Compatibility of shop and field applied coatings (where applicable).

f. Material Safety Data Sheet for each product used.

C. Samples

1. Samples of all paint, finishes, and other coating materials shall be submitted on 8-1/2 inch by 11-inch sheet metal. Each sheet shall be completely coated over its entire surface with one protective coating material, type, and color.

2. Two sets of color samples to match each color selected by the CONTRACTING OFFICER from the manufacturer's standard color sheets. If custom mixed colors are indicated, the color samples shall be made using color formulations prepared to match the color samples furnished by the CONTRACTING OFFICER. The color formula shall be shown on the back of each color sample.

3. One 15 pound sample of each abrasive proposed to be used for surface preparation for submerged and severe service coating systems.

1.3 SPECIAL CORRECTION OF DEFECTS REQUIREMENTS

A. **Warranty Inspection:** A warranty inspection may be conducted during the eleventh month following completion of all coating and painting work. The CONTRACTOR and a representative of the coating material manufacturer shall attend this inspection. All defective work shall be repaired in accordance with these specifications and to the satisfaction of the GOVERNMENT. The GOVERNMENT may, by written notice to the CONTRACTOR, reschedule the warranty inspection to another date within the one-year correction period, or may cancel the warranty inspection altogether. If a warranty

inspection is not held, the CONTRACTOR is not relieved of its responsibilities under the Contract Documents.

PART 2 -- PRODUCTS

2.1 GENERAL

A. **Suitability:** The CONTRACTOR shall use suitable coating materials as recommended by the manufacturer. Materials shall comply with Volatile Organic Compound (VOC) limits applicable at the Site.

B. **Material Sources:** Where manufacturers and product numbers are listed, it is to show the type and quality of coatings that are required. If a named product does not comply with VOC limits in effect at the time of bid opening, that product will not be accepted, and the CONTRACTOR shall propose a substitution product of equal quality that does comply. Unless indicated otherwise, proposed substitute materials will be considered as indicated above. Coating materials shall be materials that have a record of satisfactory performance in industrial plants, manufacturing facilities, and water and wastewater treatment plants.

C. **Compatibility:** In any coating system only compatible materials from a single manufacturer shall be used in the work. Particular attention shall be directed to compatibility of primers and finish coats. If necessary, a barrier coat shall be applied between existing prime coat and subsequent field coats to ensure compatibility.

D. **Containers:** Coating materials shall be sealed in containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, and name of manufacturer, all of which shall be plainly legible at the time of use.

E. **Colors:** All colors and shades of colors of all coats of paint shall be as indicated or selected by the CONTRACTING OFFICER. Each coat shall be of a slightly different shade, to facilitate inspection of surface coverage of each coat. Finish colors shall be as selected from the manufacturer's standard color samples by the CONTRACTING OFFICER.

F. Substitute or "Or-Equal" Products

1. To establish equality under Section 01600 - Products, Materials, Equipment and Substitutions, the CONTRACTOR shall furnish satisfactory documentation from the manufacturer of the proposed substitute or "or-equal" product that the material meets the indicated requirements and is equivalent or better in the following properties:

    a. Quality

    b. Durability

    c. Resistance to abrasion and physical damage

    d. Life expectancy

    e. Ability to recoat in future

f. Solids content by volume

g. Dry film thickness per coat

h. Compatibility with other coatings

i. Suitability for the intended service

j. Resistance to chemical attack

k. Temperature limitations in service and during application

l. Type and quality of recommended undercoats and topcoats

m. Ease of application

n. Ease of repairing damaged areas

o. Stability of colors

2. Protective coating materials shall be standard products produced by recognized manufacturers who are regularly engaged in production of such materials for essentially identical service conditions. Where requested, the CONTRACTOR shall provide the CONTRACTING OFFICER with the names of not less than 10 successful applications of the proposed manufacturer's products that comply with these requirements.

3. If a proposed substitution requires changes in the WORK, the CONTRACTOR shall bear all such costs involved as part of the WORK.

2.2 INDUSTRIAL COATING SYSTEMS

A. System 1 – Not Used

B. System 2 – Not Used

C. System 3 – Not Used

D. **System 4 - Aliphatic Polyurethane:** Two component aliphatic acrylic polyurethane coating material shall provide superior color and gloss retention, resistance to splash from acid and alkaline chemicals, resistance to chemical fumes and severe weathering and with a minimum solids content of 58 percent by volume. Primer shall be a rust inhibitive two component epoxy coating with a minimum solids content of 68 percent by volume.

1. Prime coat DFT = 4 mils, **Ameron 385, Carboline 893, Tnemec 69**, or equal.

2. Finish coat (one or more, DFT = 3 mils), **Ameron Amershield, Carboline 134 HS, Tnemec 74,** or equal.

3. Total system DFT = 7 mils.

4. More than one finish coat shall be applied as necessary to produce a finish with uniform color and texture.

E. System 5 – Not Used

F. System 6 – Not Used

G. **System 7 - Acrylic Latex:** Single component, water based acrylic latex with a fungicide additive shall have a minimum solids content of 35 percent by volume. Prime coat shall be as recommended by manufacturer. The coating material shall be available in the ANSI safety colors.

1. Prime coat DFT = 2 mils, as recommended by manufacturer.

2. Finish coats (2 or more, DFT = 6 mils), **Ameron Amercoat 220, Carboline 3359, Tnemec 6,** or equal.

3. Total system DFT = 8 mils.

H. **System 8 - Epoxy, Equipment:** Two component, rust inhibitive polyamide cured epoxy coating material shall provide a recoatable finish that is available in a wide selection of colors. The coating material shall have a minimum solids content of 66 percent by volume and be resistant to service conditions of condensing moisture, splash and spillage of lubricating oils, and frequent washdown and cleaning.

1. Prime coat DFT = 3 mils, **Ameron 385, Tnemec 69,** or equal.

2. Prime coat, where shop applied. (DFT = 3 mils), universal primer, **Ameron 185 HS, Tnemec 50-330 or 161,** or equal.

3. Finish coats (2 or more, DFT = 6 mils), **Ameron 385, Tnemec 69,** or equal.

4. Total system DFT = 9 mils.

I. System 9 – Not Used

J. System 10 – Not Used

K. **System 11 - Aliphatic Polyurethane, Concrete:** Two component aliphatic polyurethane coating material shall provide superior color and gloss retention, resistance to splash from acid and alkaline chemicals, resistance to chemical fumes and severe weathering, and contain a minimum solids content of 65 percent by volume. Filler-sealer compound shall be a two component epoxy material used to provide a smooth surface for the epoxy intermediate coat. The filler-sealer is applied to the entire concrete surface and worked into the concrete surface with a wide blade putty knife or squeegee. The intermediate coat shall be a high-build epoxy coating with a minimum solids content of 70 percent by volume.

1. Prime coat (Filler-sealer**), Ameron Nu-Klad 105A followed by Nu-Klad 114, Tnemec 54-660,** or equal.

2. Intermediate coat DFT = 4 mils, **Ameron Amerlock 400, Tnemec 104 HS,** or equal.

3. Finish coats (2 or more, DFT = 3 mils), **Ameron Amershield, Tnemec 74,** or equal.

L. **System 12 - Aliphatic Polyurethane, Fiber Glass:** Two-component aliphatic polyurethane coating material shall provide superior color and gloss retention, resistance to splash from acid and alkaline chemicals, and resistance to chemical fumes and

severe weathering. A primer, tie coat, or mist coat shall be used as recommended by the manufacturer.

1. Prime coat (Tie coat), **Ameron 385, Tnemec 66**, or equal.

2. Finish coats (2 or more, DFT = 3 mils), **Ameron Amershield, Tnemec 74,** or equal.

2.3 SUBMERGED AND SEVERE SERVICE COATING SYSTEMS

A. **Material Sources:** The manufacturers' products listed in this paragraph are materials which satisfy the material descriptions of this paragraph and have a documented successful record for long term submerged or severe service conditions. Proposed substitute products will be considered as indicated above.

B. **System 100 - Amine Cured Epoxy:** High build, amine cured, epoxy resin shall have a solids content of at least 80 percent by volume, and shall be suitable for long-term immersion service in potable water and municipal wastewater. For potable water service, the coating material shall be listed by the NSF International as in compliance with NSF Standard 61 - Drinking Water System Components - Health Effects.

1. Prime coat and finish coats (3 or more, DFT = 16 mils), **Ameron 395, Tnemec 139,** or equal.

2. For coating of valves and non-submerged equipment, DFT = 12 mils.

C. System 101 – Not Used

D. **System 102 - Polyamide Cured Epoxy:** High-build, polyamide epoxy resin shall have a solids content of at least 56 percent by volume, and shall be suitable for long-term immersion in potable water and municipal wastewater. For potable water service, the coating material shall be listed by the NSF International as in compliance with NSF Standard 61.

1. Prime coat and finish coats (3 or more, DFT = 12 mils), **Tnemec Pota-Pox N140,** or equal.

E. **System 103 - System 103 - Coal Tar Epoxy:** High build, 2-component amine cured coal tar epoxy shall have a solids content of at least 68 percent by volume, suitable for long term immersion in wastewater and for coating of buried surfaces, and conforming to DOD-P-23236, Class 2, or to SSPC Paint 16. Prime coats are for use as a shop primer only. Prime coat shall be omitted when both surface preparation and coating are to be performed in the field.

1. Prime coat (DFT = 1.5 mils), **Amercoat 71, Engard 422, Koppers 654, Tnemec P66**, or equal.

2. Finish coats (2 or more, DFT = 16 mils), **Amercoat 78 HB, Engard 464, Koppers 300-M, Tnemec 46 H-413**, or equal.

3. Total system DFT = 17.5 mils.

F. System 104 - Not Used

G. System 105 – Not Used

H. **System 106 - Fusion Bonded Epoxy:** The coating material shall be a 100 percent powder epoxy, certified as compliant with NSF Standard 61, applied in accordance with the ANSI/AWWA C213 - Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines, except that the surface preparation shall be as listed in the coating system schedule of this Section. The coating shall be applied using the fluidized bed or electrostatic spray process.

1. Coating DFT = 16 mils, **Scotchkote 134 or 206N,** or equal.

2. For coating of valves, DFT = 12 mils.

3. Liquid Epoxy: For field repairs, the use of a liquid epoxy will be permitted, applied in not less than 3 coats to provide a DFT of 15 mils. The liquid epoxy shall be a 100 percent solids epoxy recommended by the powder epoxy manufacturer.

I. System 107 – Not Used

J. **System 108 - Epoxy, Concrete:** The coating material shall be an amino cured epoxy material suitable for long-term immersion in water and wastewater and for service where subjected to occasional splash and spillage of water and wastewater treatment chemicals. The finish coating material shall have a minimum solids content of 80 percent by volume. If used for potable water service the finish coating material shall be listed by the NSF International as in compliance with NSF Standard 61, and shall conform with state and local health regulations and policies for service in potable water. The filler-sealer shall be a 100 percent solids amine-cured epoxy material with silica and inert fillers. A 100 percent solids epoxy surfacer shall be used to fill holes and patch the concrete surface after abrasive blasting.

1. Filler-sealer: Plasite 9029 (applied by squeegee): Tnemec 69-1211 (6-8 mils) followed by Tnemec 63-1500; Ameron Nu-Klad 105A followed by Nu-Klad 114A (two coats) or equal.

2. Finish coats (2 or more, DFT = 12 mils): **Plasite 9133; Tnemec 69; Ameron Amercoat 395**, or equal**.** On walking surfaces use a non-skid additive such as **Ameron 886** in the final coat.

K. System 109 - Not Used

L. System 110 - Not Used

M. System 111 – Not Used

N. System 112 – Not Used

2.4 SPECIAL COATING SYSTEMS

A. **System 200 - PVC Tape:** Prior to wrapping the pipe with PVC tape, the pipe and fittings first shall be primed using a primer recommended by the PVC tape manufacturer. After being primed, the pipe shall be wrapped with a 20-mil adhesive PVC tape, half-lapped, to a total thickness of 40 mils.

B. **System 201 - Rich Portland Cement Mortar:** Rich Portland cement mortar coating shall have a minimum thickness of 1/8-inch, followed by enclosure in an 8-mil thick polyethylene sheet with all joints and edges lapped and sealed with tape.

C. System 202 – Not Used

D. System 203 – Not Used

E. System 204 - Water-Retardant:

1. Two coats (or single coat if manufacturer recommends in writing) of a clear, non-staining, silane-modified-siloxane masonry water-retardant material. The water-retardant system after application shall be provided with not less than a five-year warranty on the performance of the product.

2. Surfaces shall be cleaned with a chemical cleaner approved by the manufacturer and power wash. Surfaces shall be clean and dry before application of the material. Method and rate of application shall be in accordance with manufacturer's published instructions. A manufacturer's representative shall be present during applications if necessary for warranty.

3. TAMMS Barricade Series, **Rainguard "Blok-Lok";** or equal.

F. **System 205 - Polyethylene Encasement:** Application of polyethylene encasement shall be in accordance with ANSI/AWWA C105 using Method C.

G. **System 206 - Cement Mortar Coating:** A 1-1/2-inch minimum thickness mortar coating reinforced with 3/4-inch galvanized welded wire fabric shall be provided. The cement mortar shall contain no less than one part Type V cement to 3 parts sand. The cement mortar shall be cured by a curing compound meeting the requirements of "Liquid Membrane Forming Compounds for Curing Concrete," ASTM C 309, Type II, white pigmented, or by enclosure in an 8-mil thick polyethylene sheet with all edges and joints lapped by at least 6-inches.

H. System 207 - Not Used

I. **System 208 - Aluminum Metal Isolation:** Two coats of a high build polyamide epoxy paint, such as **Tnemec 66,** or equal (8 mils). Total thickness of system DFT = 8.0 mils.

J. System 209 – Not Used

K. System 210 – Not Used

L. **System 211 - Acrylic-Drywall:** Single component, water-based acrylic latex coating material with a fungicide additive and a minimum solids content of 35 percent by volume. Primer shall be a PVA sealer as recommended by the manufacturer.

1. Prime coat DFT = 1.5 mils.

2. Finish coats (two or more, DFT = 6 mils), **Amerguard 220, Carboline 3300, Tnemec 6,** or equal.

3. Total system DFT = 7.5 mils.

PART 3 -- EXECUTION

3.1 MANUFACTURER'S SERVICES

A. The CONTRACTOR shall require the protective coating manufacturer to furnish a qualified technical representative to visit the Site for technical support as may be necessary to resolve field problems attributable or associated with the manufacturer's products.

B. For submerged and severe service coating systems, the CONTRACTOR shall require the paint manufacturer to furnish the following services:

1. The manufacturer's representative shall provide at least 6 hours of on-site instruction in the proper surface preparation, use, mixing, application, and curing of the coating systems.

2. The manufacturer's representative shall observe the start of surface preparation, mixing, and application of the coating materials for each coating system.

3.2 WORKMANSHIP

A. Skilled craftsmen and experienced supervision shall be used on all WORK.

B. Coating shall be done in a workmanlike manner so as to produce an even film of uniform thickness. Edges, corners, crevices, and joints shall receive special attention to insure thorough cleaning and an adequate thickness of coating material. The finished surfaces shall be free from runs, drops, ridges, waves, laps, brush marks, and variations in color, texture, and finish. The hiding shall be so complete that the addition of another coat would not increase the hiding. Special attention shall be given to insure that edges, corners, crevices, welds, and similar areas receive a film thickness equivalent to adjacent areas, and installations shall be protected by the use of drop cloths or other precautionary measures.

C. All damage to surfaces resulting from the WORK shall be cleaned, repaired, and refinished to original condition.

3.3 STORAGE, MIXING, AND THINNING OF MATERIALS

A. **Manufacturer's Recommendations:** Unless otherwise indicated, the coating manufacturer's printed recommendations and instructions for thinning, mixing, handling, applying, and protecting its coating materials, for preparation of surfaces for coating, and for all other procedures relative to coating shall be strictly observed.

B. All protective coating materials shall be used within the manufacturer's recommended shelf life.

C. **Storage and Mixing:** Coating materials shall be stored under the conditions recommended by the Material Safety Data Sheets, and shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Coatings of different manufacturers shall not be mixed together.

3.4 PREPARATION FOR COATING

A. **General:** All surfaces to receive protective coatings shall be cleaned as indicated prior to application of coatings. The CONTRACTOR shall examine all surfaces to be coated, and

shall correct all surface defects before application of any coating material. All marred or abraded spots on shop-primed and on factory-finished surfaces shall receive touch-up restoration prior to any coating application. Surfaces to be coated shall be dry and free of visible dust.

B. **Protection of Surfaces not to be Coated:** Surfaces that are not to receive protective coatings shall be protected during surface preparation, cleaning, and coating operations.

C. All hardware, lighting fixtures, switchplates, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not to be painted shall be removed, masked or otherwise protected. Drop cloths shall be provided to prevent coating materials from falling on or marring adjacent surfaces. The working parts of all mechanical and electrical equipment shall be protected from damage during surface preparation and coating operations. Openings in motors shall be masked to prevent entry of coating or other materials.

D. Care shall be exercised not to damage adjacent work during blast cleaning operations. Spray painting shall be conducted under carefully controlled conditions. The CONTRACTOR shall be fully responsible for and shall promptly repair any and all damage to adjacent work or adjoining property occurring from blast cleaning or coating operations.

E. **Protection of Painted Surfaces:** Cleaning and coating shall be coordinated so that dust and other contaminants from the cleaning process will not fall on wet, newly coated surfaces.

3.5 SURFACE PREPARATION STANDARDS

A. The following referenced surface preparation specifications of the Steel Structures Painting Council shall form a part of this specification:

1. Solvent Cleaning (SSPC SP1): Removal of oil, grease, soil, salts, and other soluble contaminants by cleaning with solvent, vapor, alkali, emulsion, or steam.

2. Hand Tool Cleaning (SSPC SP2): Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by hand chipping, scraping, sanding, and wire brushing.

3. Power Tool Cleaning (SSPC SP3): Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by power tool chipping, descaling, sanding, wire brushing, and grinding.

4. White Metal Blast Cleaning (SSPC SP5): Removal of all visible rust, oil, grease, soil, dust, mill scale, paint, oxides, corrosion products and foreign matter by blast cleaning.

5. Commercial Blast Cleaning (SSPC SP6): Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 33 percent of each square inch of surface area.

6. Brush-Off Blast Cleaning (SSPC SP7): Removal of all visible oil, grease, soil, dust, loose mill scale, loose rust, and loose paint.

7. Near-White Blast Cleaning (SSPC SP10): Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 5 percent of each square inch of surface area.

3.6 METAL SURFACE PREPARATION (UNGALVANIZED)

A. The minimum abrasive blasting surface preparation shall be as indicated in the coating system schedules included at the end of this Section. Where there is a conflict between these specifications and the coating manufacturer's printed recommendations for the intended service, the higher degree of cleaning shall apply.

B. Workmanship for metal surface preparation shall be in conformance with the current SSPC Standards and this Section. Blast cleaned surfaces shall match the standard samples available from the National Association of Corrosion Engineers, NACE Standard TM-01-70 - Visual Standard for Surfaces of New Steel Airblast Cleaned with Sand Abrasive and TM-01-75 - Visual Standard for Surfaces of New Steel Centrifugally Blast Cleaned with Steel Grit.

C. All oil, grease, welding fluxes, and other surface contaminants shall be removed by solvent cleaning per SSPC SP1 - Solvent Cleaning prior to blast cleaning.

D. All sharp edges shall be rounded or chamfered and all burrs, and surface defects and weld splatter shall be ground smooth prior to blast cleaning.

E. The type and size of abrasive shall be selected to produce a surface profile that meets the coating manufacturer's recommendation for the particular coating and service conditions. Abrasives for submerged and severe service coating systems shall be clean, hard, sharp cutting crushed slag. Automated blasting systems shall not be used for surfaces that will be in submerged service. Metal shot or grit shall not be used for surfaces that will be in submerged service, even if subsequent abrasive blasting is planned to be one with hard, sharp cutting crushed slag.

F. The abrasive shall not be reused unless an automated blasting system is used for surfaces that will be in non-submerged service. For automated blasting systems, clean oil-free abrasives shall be maintained. The abrasive mix shall include at least 50 percent grit.

G. The CONTRACTOR shall comply with the applicable federal, state, and local air pollution control regulations for blast cleaning.

H. Compressed air for air blast cleaning shall be supplied at adequate pressure from well maintained compressors equipped with oil and moisture separators that remove at least 95 percent of the contaminants.

I. Surfaces shall be cleaned of all dust and residual particles of the cleaning operation by dry air blast cleaning, vacuuming, or another approved method prior to painting.

J. Enclosed areas and other areas where dust settling is a problem shall be vacuum cleaned and wiped with a tack cloth.

K. Damaged or defective coating shall be removed by the blast cleaning to meet the clean surface requirements before recoating.

L. If the required abrasive blast cleaning will damage adjacent work, the area to be cleaned is less than 100 square feet, and the coated surface will not be submerged in service, then SSPC SP2 or SSPC SP3 be used.

M. Shop applied coatings of unknown composition shall be completely removed before the indicated coatings are applied. Valves, castings, ductile or cast iron pipe, and fabricated pipe or equipment shall be examined for the presence of shop-applied temporary coatings. Temporary coatings shall be completely removed by solvent cleaning per SSPC SP1 before the abrasive blast cleaning work has been started.

N. Shop primed equipment shall be solvent cleaned in the field before finish coats are applied.

3.7 SURFACE PREPARATION FOR GALVANIZED FERROUS METAL

A. Galvanized ferrous metal shall be alkaline cleaned per SSPC SP1 to remove oil, grease, and other contaminants detrimental to adhesion of the protective coating system to be used, followed by brush off blast cleaning per SSPC SP7.

B. Pretreatment coatings of surfaces shall be in accordance with the printed recommendations of the coating manufacturer.

3.8 SURFACE PREPARATION OF FERROUS SURFACES WITH EXISTING COATINGS, EXCLUDING STEEL RESERVOIR INTERIORS

A. **General:** All grease, oil, heavy chalk, dirt, or other contaminants shall be removed by solvent or detergent cleaning prior to abrasive blast cleaning. The generic type of the existing coatings shall be determined by laboratory testing.

B. **Abrasive Blast Cleaning:** The CONTRACTOR shall provide the degree of cleaning indicated in the coating system schedule for the entire surface to be coated. If the degree of cleaning is not indicated in the schedule, deteriorated coatings shall be removed by abrasive blast cleaning to SSPC SP6. Areas of tightly adhering coatings shall be cleaned to SSPC SP7, with the remaining thickness of existing coating not to exceed 3 mils.

C. **Incompatible Coatings:** If coatings to be applied are not compatible with existing coatings the CONTRACTOR shall apply intermediate coatings per the paint manufacturer's recommendation for the indicated coating system or shall completely remove the existing coating prior to abrasive blast cleaning. A small trial application shall be conducted for compatibility prior to painting large areas.

D. **Unknown Coatings:** Coatings of unknown composition shall be completely removed prior to application of new coatings.

E. **Water Abrasive or Wet Abrasive Blast Cleaning:** Where indicated or where Site conditions do not permit dry abrasive blasting for industrial coating systems due to dust or air pollution considerations, water abrasive blasting or wet abrasive blasting may be used. In both methods, paint-compatible corrosion inhibitors shall be used, and coating application shall begin as soon as the surfaces are dry. Water abrasive blasting shall be done using high-pressure water with sand injection. In both methods, the equipment used shall be commercially produced equipment with a successful service record. Wet blasting methods shall not be used for submerged and severe service coating systems unless indicated.

3.9 CONCRETE AND CONCRETE BLOCK MASONRY SURFACE PREPARATION

A. Surface preparation shall not begin until at least 30 days after the concrete or masonry has been placed.

B. All oil, grease, and form release and curing compounds shall be removed by detergent cleaning per SSPC SP1 before abrasive blast cleaning.

C. Concrete, concrete block masonry surfaces and deteriorated concrete surfaces to be coated shall be abrasive blast cleaned to remove existing coatings, laitance, deteriorated concrete, and to roughen the surface equivalent to the surface of the No. 80 grit flint sandpaper.

D. If acid etching is required by the coating application instructions, the treatment shall be made after abrasive blasting. After etching, rinse surfaces with water and test the pH. The pH shall be between neutral and 8.

E. Surfaces shall be clean and as recommended by the coating manufacturer before coating is started.

F. Unless required for proper adhesion, surfaces shall be dry prior to coating. The presence of moisture shall be determined with a moisture detection device such as **Delmhorst Model DB,** or equal.

3.10 PLASTIC, FIBER GLASS AND NONFERROUS METALS SURFACE PREPARATION

A. Plastic and fiber glass surfaces shall be sanded or brush off blast cleaned prior to solvent cleaning with a chemical compatible with the coating system primer.

B. Non-ferrous metal surfaces shall be solvent-cleaned SSPC SP1 followed by sanding or brush-off blast cleaning SSPC SP7.

C. All surfaces shall be clean and dry prior to coating application.

3.11 ARCHITECTURAL CONCRETE BLOCK MASONRY SURFACE PREPARATION

A. The mortar surfaces shall be cured at least 14 days before surface preparation work is started.

B. Dust, dirt, grease, and other foreign matter shall be removed prior to abrasive blasting.

C. The masonry surfaces shall be prepared in accordance with the material manufacturer's printed instructions.

3.12 SHOP COATING REQUIREMENTS

A. Unless otherwise indicated, all items of equipment, or parts of equipment which are not submerged in service, shall be shop primed and then finish coated in the field after installation with the indicated or selected color. The methods, materials, application equipment and all other details of shop painting shall comply with this section. If the shop primer requires top-coating within a specified period of time, the equipment shall be finish coated in the shop and then touch-up painted after installation.

B. All items of equipment, or parts and surfaces of equipment which are submerged or inside an enclosed hydraulic structure when in service, with the exception of pumps and valves, shall have all surface preparation and coating work performed in the field.

C. The interior surfaces of steel water reservoirs, except for Part A surfaces, shall have all surface preparation and coating work performed in the field.

D. For certain pieces of equipment it may be undesirable or impractical to apply finish coatings in the field. Such equipment may include engine generator sets, equipment such as electrical control panels, switchgear or main control boards, submerged parts of pumps, ferrous metal passages in valves, or other items where it is not possible to obtain the indicated quality in the field. Such equipment shall be primed and finish coated in the shop and touched up in the field with the identical material after installation. The CONTRACTOR shall require the manufacturer of each such piece of equipment to certify as part of its Shop Drawings that the surface preparation is in accordance with these specifications. The coating material data sheet shall be submitted with the Shop Drawings for the equipment.

E. For certain small pieces of equipment the manufacturer may have a standard coating system that is suitable for the intended service conditions. In such cases, the final determination of suitability will be made during review of the Shop Drawing submittals. Equipment of this type generally includes only indoor equipment such as instruments, small compressors, and chemical metering pumps.

F. Shop painted surfaces shall be protected during shipment and handling by suitable provisions including padding, blocking, and the use of canvas or nylon slings. Primed surfaces shall not be exposed to the weather for more than 2 months before being topcoated, or less time if recommended by the coating manufacturer.

G. Damage to shop-applied coatings shall be repaired in accordance with this Section and the coating manufacturer's printed instructions.

H. The CONTRACTOR shall make certain that the shop primers and field topcoats are compatible and meet the requirements of this Section. Copies of applicable coating manufacturer's data sheets shall be submitted with equipment Shop Drawings.

3.13 APPLICATION OF COATINGS

A. The application of protective coatings to steel substrates shall be in accordance with SSPC PA1 - Paint Application Specification No. 1.

B. Cleaned surfaces and all coats shall be inspected prior to each succeeding coat. The CONTRACTOR shall schedule such inspection with the CONTRACTING OFFICER in advance.

C. Blast cleaned ferrous metal surfaces shall be painted before any rusting or other deterioration of the surface occurs. Blast cleaning shall be limited to only those surfaces that can be coated in the same working day.

D. Coatings shall be applied in accordance with the manufacturer's instructions and recommendations, and this Section, whichever has the most stringent requirements.

E. Special attention shall be given to edges, angles, weld seams, flanges, nuts and bolts, and other places where insufficient film thickness are likely to be present. Use stripe painting for these areas.

F. Special attention shall be given to materials that will be joined so closely that proper surface preparation and application are not possible. Such contact surfaces shall be coated prior to assembly or installation.

G. Finish coats, including touch-up and damage repair coats shall be applied in a manner that will present a uniform texture and color matched appearance.

H. Coatings shall not be applied under the following conditions:

1. Temperature exceeding the manufacturer's recommended maximum and minimum allowable.

2. Dust or smoke laden atmosphere.

3. Damp or humid weather.

4. When the substrate or air temperature is less than 5 degrees F above dewpoint.

5. When air temperature is expected to drop below 40 degrees F or less than 5 degrees F above the dewpoint within 8 hours after application of coating.

6. When wind conditions are not calm.

I. Dewpoint shall be determined by use of a sling psychrometer in conjunction with U.S. Dept. of Commerce, Weather Bureau psychometric tables.

J. Unburied steel piping shall be abrasive blast cleaned and primed before installation.

K. The finish coat on all work shall be applied after all concrete, masonry, and equipment installation is complete and the work areas are clean and dust free.

3.14 CURING OF COATINGS

A. The CONTRACTOR shall maintain curing conditions in accordance with the conditions recommended by the coating material manufacturer or by this Section, whichever is the most stringent, prior to placing the completed coating system into service.

B. In the case of enclosed areas, forced air ventilation, using heated air if necessary, may be required until the coatings have fully cured.

C. **Forced Air Ventilation of Steel Reservoirs and Enclosed Hydraulic Structures:** Forced air ventilation is required for the application and curing of coatings on the interior surfaces of steel reservoirs and enclosed hydraulic structures. During application and curing periods, continuously exhaust air from a manhole in the lowest shell ring, or in the case of an enclosed hydraulic structure, from the lowest level of the structure using portable ducting. After all interior coating operations have been completed, provide a final curing period for a minimum of 10 days, during which the forced ventilation system shall operate continuously. For additional requirements, refer to the specific coating system requirements in Part 2 above.

3.15 IDENTIFICATION OF PIPING

A. Identification of piping shall be in accordance with Section 15005 - Piping Identification Systems.

B. Every valve or connection, where it may be possible for a worker to be exposed to a hazardous substance, shall be labeled per General Industry Safety Orders, Articles 112 and 5194.

C. All unburied chemical pipes, including chemical pipes in structures and chemical pipe trenches shall be color-code painted. Colors shall be as selected by the CONTRACTING OFFICER, or as indicated.

3.16 SHOP AND FIELD INSPECTION AND TESTING

A. General: The CONTRACTOR shall give the CONTRACTING OFFICER a minimum of 3 days advance notice of the start of any field surface preparation work or coating application work, and a minimum of 7 days advance notice of the start of any shop surface preparation work.

B. All such work shall be performed only in the presence of the CONTRACTING OFFICER, unless the CONTRACTING OFFICER has granted prior approval to perform such work in its absence.

C. Inspection by the CONTRACTING OFFICER, or the waiver of inspection of any particular portion of the WORK, shall not relieve the CONTRACTOR of its responsibility to perform the work in accordance with these Specifications.

D. Scaffolding shall be erected and moved to locations where requested by the CONTRACTING OFFICER to facilitate inspection. Additional illumination shall be furnished to cover all areas to be inspected.

E. **Inspection Devices:** The CONTRACTOR shall furnish, until final acceptance of such coatings, inspection devices in good working condition for the detection of holidays and measurement of dry-film thickness of protective coatings. Dry-film thickness gauges shall be made available for the CONTRACTING OFFICER'S use at all times while

coating is being done, until final acceptance of such coatings. The CONTRACTOR shall furnish the services of a trained operator of the holiday detection devices until the final acceptance of such coatings. Holiday detection devices shall be operated only in the presence of the CONTRACTING OFFICER.

F. **Holiday Testing:** The CONTRACTOR shall holiday test all coated ferrous surfaces inside a steel reservoir, other surfaces which will be submerged in water or other liquids, or surfaces which are enclosed in a vapor space in such structures and surfaces coated with any of the submerged and severe service coating systems. Areas that contain holidays shall be marked and repaired or recoated in accordance with the coating manufacturer's printed instructions and then retested.

1. Coatings With Thickness Exceeding 20 Mils: For surfaces having a total dry film coating thickness exceeding 20 mils: pulse-type holiday detector such as **Tinker & Rasor Model AP-W, D.E. Stearns Co. Model 14/20,** or equal shall be used. The unit shall be adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the required coating thickness.

2. Coatings With Thickness of 20 Mils or Less: For surfaces having a total dry film coating thickness of 20 mils or less: **Tinker & Rasor Model M1 non-destructive type holiday detector, K-D Bird Dog,** or equal shall be used. The unit shall operate at less than 75-volts. For thickness between 10 and 20 mils, a non-sudsing type wetting agent, such as **Kodak Photo-Flo,** or equal, shall be added to the water prior to wetting the detector sponge.

G. **Film Thickness Testing:** On ferrous metals, the dry film coating thickness shall be measured in accordance with the SSPC "Paint Application Specification No. 2" using a magnetic-type dry film thickness gauge such as **Mikrotest model FM, Elcometer model 111/1EZ,** or equal. Each coat shall be tested for the correct thickness. No measurements shall be made until at least 8 hours after application of the coating. On non-ferrous metals and other substrates, the coating thickness shall be measured at the time of application using a wet film gauge.

H. **Surface Preparation:** Evaluation of blast cleaned surface preparation work will be based upon comparison of the blasted surfaces with the standard samples available from the NACE, using NACE standards TM-01-70 and TM-01-75.

3.17 COATING SYSTEM SCHEDULES - FERROUS METALS

A. Coating System Schedule, Ferrous Metal - Not Galvanized:

	Item	**Surface Prep.**	**System No.**
FM-1	All surfaces indoors and outdoors, exposed or covered, except those	Commercial blast cleaning SSPC SP6	(4) aliphatic polyurethane

	included below.		
FM-2	Surfaces in chlorination room, chlorine storage room.	Commercial blast cleaning SSPC SP6	(100) amine-cured epoxy
FM-3	Surfaces of equipment and ferrous surfaces submerged or intermittently submerged in potable water, utility water, and wastewater including all surfaces lower than 2 feet above high water level in hydraulic structures, and all surfaces inside enclosed hydraulic structures and vents (excluding shop-coated valves, couplings, pumps).	White metal blast cleaning SSPC SP5	(100) amine-cured epoxy
FM-6	Buried small steel pipe.	Removal of dirt, grease, oil	(200) PVC tape
FM-7	Where indicated, ferrous surfaces in water passages of all valves 2-inch size and larger, exterior surfaces of submerged valves.	White metal blast cleaning SSPC SP5	(102) polyamide-cured epoxy
FM-8	Where indicated, ferrous surfaces in water passages and submerged surfaces of all pumps which have discharge size of 4 inches or larger.	White metal blast cleaning SSPC SP5	(100) amine-cured epoxy
FM-9	Ferrous surfaces of sleeve couplings.	Solvent cleaning SSPC SP1, followed by white metal blast cleaning SSPC-SP10	(106) fusion-bonded epoxy
FM-10	All ferrous surfaces of sluice gates, flap gates, and shear gates, including wall thimbles.	White metal blast cleaning SSPC SP5	(102) polyamide-cured epoxy
FM-11	Buried surfaces that are not indicated to be	Near white metal blast cleaning SSPC SP10	(100) amine-cured epoxy

	coated elsewhere.		
FM-14	Structural steel, miscellaneous metalwork, and supports for prefabricated metal buildings.	Per pre-engineered metal building fabricator.	Per pre-engineered metal building fabricator.
FM-16	Surfaces of indoor equipment, not submerged	Commercial blast cleaning SSPC SP6	(8) epoxy, equipment
FM-18	Buried pipe couplings, valves, fittings, and flanged joints (where piping is plastic).	Removal of dirt, grease, oil	(201) rich Portland cement mortar
FM-19	Buried pipe couplings, valves, and flanged joints (where piping is ductile or cast iron, not tape-coated), including factory-coated surfaces.	As specified by reference specification	(205) polyethylene encasement
FM-20	Buried pipe couplings, valves, and flanged joints (where piping is mortar-coated steel or reinforced concrete), including factory-coated surfaces.	Removal of dirt, grease, oil	(206) cement-mortar coating

B. **Coating System Schedule, Ferrous Metal - Galvanized:** Pretreatment coatings, barrier coatings, or washes shall be applied as recommended by the coating manufacturer. All galvanized surfaces shall be coated except for the following items which shall be coated only if required by other Sections: (1) Floor gratings and frames, (2) Handrails, (3) Stair treads, (4) Chain link fencing and appurtenances.

	Item	**Surface Prep.**	**System No.**
FMG-1	All exposed surfaces indoors and outdoors, except those included below.	Solvent cleaning SSPC SP1	(4) aliphatic polyurethane
FMG-2	Surfaces in chlorinator room, chlorine storage room.	Solvent cleaning SSPC SP1	(100) amine-cured epoxy
FMG-3	Buried small steel pipe.	Removal of dirt, grease, oil	(200) PVC tape
FMG-4	Surfaces buried or	Solvent cleaning SSPC SP1	(100)

	submerged in water or wastewater, including all surfaces lower than two feet above high water level and all surfaces inside enclosed hydraulic structures and vents.	followed by brush-off grade blast cleaning SSPC SP7	amine-cured epoxy

3.18 COATING SYSTEM SCHEDULE, NON-FERROUS METAL, PLASTIC, FIBER GLASS

A. Where isolated non-ferrous parts are associated with equipment or piping, the CONTRACTOR shall use the coating system for the adjacent connected surfaces. Do not coat handrails, gratings, frames or hatches. Only primers recommended by the coating manufacturer shall be used.

	Item	**Surface Prep.**	**System No.**
NFM-1	All exposed surfaces, indoors and outdoors, except those included below.	Solvent cleaned SSPC SP1	(4) aliphatic polyurethane
NFM-2	Chlorination room, chlorine storage room.	Solvent cleaned SSPC SP1	(100) amine-cured epoxy
NFM-3	Aluminum surfaces in contact with concrete, or with any other metal except galvanized ferrous metal.	Solvent cleaned SSPC SP1	(208) aluminum metal isolation
NFM-4	Polyvinyl chloride plastic piping, indoors and outdoors, or in structures, not submerged.	Solvent cleaned SSPC SP1	(7) acrylic latex
NFM-5	Fiber glass surfaces.	Per paragraph 3.10	(12) aliphatic polyurethane fiber glass
NFM-6	Buried non-ferrous metal pipe.	Removal of dirt, grease, oil	(200) PVC tape

3.19 COATING SYSTEM SCHEDULE-CONCRETE

	Item	**Surface Prep.**	**System No.**
C-1	All surfaces indoors and outdoors, where indicated.	Per paragraph 3.9	(11) aliphatic polyurethane, concrete
C-2	Submerged in water or	Per paragraph 3.9	(108)

	wastewater including surfaces up to 2 feet above high water line and down to 2 feet below low water line and all surfaces in an enclosed structure.		epoxy, concrete
C-3	Floor slab and walls, exposure to chemicals, where indicated.	Per paragraph 3.9	(108) epoxy, concrete
C-4	Walls, floors, exposure to chemical splash, washdown, where indicated	Per paragraph 3.9	(11) aliphatic polyurethane, concrete

3.20 COATING SYSTEM SCHEDULE-CONCRETE BLOCK MASONRY

	Item	**Surface Prep.**	**System No.**
CBM-1	All surfaces, indoors and outdoors, where indicated.	Per paragraph 3.9	(11) aliphatic polyurethane, concrete
CBM-2	Not used.		
CBM-3	Exterior surfaces, above grade, where indicated.	Per paragraph 3.11	(204) water-retardant

3.21 COATING SYSTEM SCHEDULE - MISCELLANEOUS SURFACES

	Item	**Surface Prep.**	**System No.**
MS-2	Drywall	Per manufacturer's printed instructions	(211) acrylic-drywall

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 09813 - POLYURETHANE COATING ON PIPE

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide pipe coating, complete and in place, in accordance with the Contract Documents.

B. Definitions: The term "DFT" means minimum dry film thickness, without any negative tolerance.

1.2 CONTRACTOR SUBMITTALS

A. **General:** Submittals shall be furnished in accordance with Section 01300 - Contractor Submittals, unless indicated otherwise below.

B. Submittals shall include the following information and be submitted at least 30 days prior to coating the pipe.

1. Manufacturer's data sheet for each product proposed, including statements on the suitability of the material for the intended use.

2. Technical and performance information that demonstrates compliance with the system performance and material requirements.

3. Manufacturer's instructions and recommendations on surface preparation and application.

4. Colors available for each product (where applicable).

5. Compatibility of shop and field applied coatings (where applicable).

6. Material Safety Data Sheet for each product.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Coating materials shall be standard products produced by recognized manufacturers who are regularly engaged in production of such materials for essentially identical service conditions. Where requested, the CONTRACTOR shall provide the CONTRACTING OFFICER with the names of not less than 10 successful applications of the proposed manufacturer's products that comply with these requirements.

B. Substitute or "Or-Equal" Products

1. To establish equality under Section 01600 - Products, Materials, Equipment and Substitutions, the CONTRACTOR shall furnish satisfactory documentation from the manufacturer of the proposed substitute or "or-equal" product that the material meets the indicated requirements and is equivalent or better in the following properties:

a. Quality

b. Durability

c. Resistance to abrasion and physical damage

d. Life expectancy

e. Ability to recoat in future

f. Solids content by volume

g. Dry film thickness per coat

h. Suitability for the intended service

i. Resistance to chemical attack

j. Temperature limitations in service and during application

k. Ease of application

l. Ease of repairing damaged areas

2. If a proposed substitution requires changes in the WORK, the CONTRACTOR shall bear all such costs involved, as part of the WORK.

2.2 POLYURETHANE SYSTEM

A. **General:** Pipe, fittings, and specials shall be lined and coated with polyurethane complying with AWWA C222 - Polyurethane Coatings for the Interior and Exterior of Steel Water Pipe and Fittings. Surfaces in contact with potable water shall receive a coating which is certified under NSF Standard 61.

B. **Material:** The coating material shall be a 1 to 1 disphenylmethane diisocyanate to polyol resin, 2 component, fast set, Type V according to ASTM D 16 - Standard Terminology Relating to Paint, Varnish, Lacquer, and Related Products. Solids content shall be no less than 98 percent by volume.

C. Performance

Property	Requirement
Impact Resistance	No less than 50 inch-pounds when tested according to ASTM D 2794 for 40 mil thickness
Adhesion	No less than 2000 psi when tested according to ASTM D 4541
Hardness	70 (plus or minus 5) Shore D, at 70 degrees F, when tested according to ASTM D 2240

Abrasion Resistance	Less than 100 mg weight loss per 1000 revolutions of a CS-17 wheel, 1 kg weight, when tested according to ASTM D 4060
Chemical Resistance	Less than 5 percent weight change after 30 days tested according to ASTM D 543, Procedure 1
Water Absorption	Less than 3 percent by weight when tested according to ASTM D 570
Dielectric Strength	No less than 200 volts per mil of coating

D. Thicknesses

Interior of pipe and fittings	40 mils DFT
Sealing areas on bells and spigots	8 mils DFT. Thicker coating which does not compromise joint tightness may be accepted.

E. Cutbacks For Field Welds

1. If the pipe sections are to be joined together by field welding, a 3-inch band of substrate on the internal and/or the external shall be left uncoated. This band shall receive the same surface preparation as the rest of the pipe.

F. Non Welded Joints

1. If mechanical couplings or gaskets are used to connect the pipe sections together, the pipe shall be lined and/or coated to its ends, including sealing area, with not cut back.

G. Manufacturers, or equal

1. **Madison Chemical Industries**

2. **US Pipe**

3. **American Pipe**

PART 3 -- EXECUTION

3.1 WORKMANSHIP

A. Skilled manufacturer trained and certified craftsmen and experienced supervision shall be used on coating WORK.

B. Coating shall be done in a workmanlike manner so as to produce an even film of uniform thickness. The finished surfaces shall be free from runs, drops, ridges, waves, laps, brush marks, and variations in color, texture, and finish. Special attention shall be given

to insure that edges, corners, crevices, welds, and similar areas receive a film thickness equivalent to adjacent areas.

3.2 STORAGE AND MIXING OF MATERIALS

A. **Manufacturer's Recommendations:** Unless otherwise indicated, the coating manufacturer's printed recommendations and instructions for thinning, mixing, handling, applying, and protecting its coating materials, for preparation of surfaces for coating, and for all other procedures relative to coating shall be strictly observed.

B. Materials shall be used within the manufacturer's recommended shelf life.

C. **Storage and Mixing:** Materials shall be stored under the conditions recommended by the Material Safety Data Sheets, and shall be thoroughly stirred and kept at a uniform consistency during application.

3.3 SURFACE PREPARATION

A. Pipe surfaces shall be cleaned with water and detergent in accordance with NAPF 500-03-01 to remove oil, grease, and other soluble contaminants. No residue shall remain on the pipe. Remove burrs, weld splatter, and gouges. Prepare the metal surface to achieve a metal finish in accordance with NAPF 03-04 for pipe and NAPF 03-05 for fittings to an angular profile of 2.5 mils.

B. Pipe temperatures shall be at least 5 degrees F warmer than the dewpoint temperature in the area of the application equipment. Pipe shall be warmed if necessary.

C. Pipe shall not be allowed to flash rust before coating is applied.

3.4 APPLICATION

A. Apply the coating and lining in strict conformance to the manufacturer's recommendations.

B. Recoating may be permitted if the maximum recoating time specified by the manufacturer has not expired, or the time has expired but the manufacturer's recommended surface preparation has been performed. No different formulation shall be applied over a prior coat.

3.5 FACTORY TESTING

A. The entire coated surface shall be tested in accordance with NACE RP-0188 at 100 volts per mil for holidays after curing. Every holiday shall be marked and repaired.

B. Each pipe section shall be inspected visually. Pipe with sharp protuberances or significant sags, dimples, or curtains will not be accepted.

C. The CONTRACTING OFFICER may select one section of pipe from each lot of 10 sections for thickness testing by the CONTRACTOR. Tests shall be made by a Type 1 magnetic thickness gauge. The CONTRACTING OFFICER will designate locations for spot measurements to be taken at the points of an equilateral triangle 3 inches on a

side; the triangles shall be located at both ends, in the middle, and at the midpoints of each half of the pipe, plus randomly selected individual points.

1. No single spot measurement shall be less than 75 percent of the indicated DFT.

2. The average of 3 spot measurements from any triangle shall not be less than 80 percent of the indicated DFT.

3. The average of all spot measurements on a pipe section shall not be less than the indicated DFT.

D. Sections of pipe tested for coating thickness will also be tested by the CONTRACTING OFFICER for delamination by scoring with a pocket knife and prying with a putty knife.

E. If the tested pipe complies with the thickness criteria and shows no sign of delamination by knife test, all pipe sections in the lot will be considered compliant, and the CONTRACTOR may repair the damage and ship the tested pipe. If the tested pipe fails either test, 5 additional sections from the same lot will be tested in similar fashion, and if all 5 sections pass all tests, then the lot, except for the pipe which failed, will be considered compliant. If any of the additional sections fail either test, the entire lot will be considered non-compliant and shall not be installed.

F. Repair: Holidays and cut ends shall be repaired by solvent cleaning, roughening with coarse sandpaper, and application of brushable 2-component material recommended by the manufacturer for repair. Prepare and coat the existing areas at least one-inch in all directions around the defect. Mix repair material and apply in accordance with the manufacturer's recommendation to a thickness at least equal to the indicated DFT for the new coating. Inspect repaired areas for holidays.

3.6 FIELD INSTALLATION

A. Pipe shall be handled at all times to minimize damage to the lining and coating. Damaged lining and coating shall be repaired.

B. Repair of Field Welded Joints and Damaged Areas.

1. Weld sparks and splatter shall not be allowed to damage existing lining or coating.

2. After welding, prepare the weld, holdback areas, and defects as indicated above for factory operations. Abrade the exiting coating and lining 2-inches from the edge of the holdback to a 2.5 mil profile.

3. Use only material recommended by the manufacturer for repair.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 10520 - FIRE PROTECTION SPECIALTIES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide fire protection equipment and appurtenant WORK, complete and in place, in accordance with the Contract Documents.

B. All fire protection equipment shall be products of a single manufacturer.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Codes

1. National Fire Protection Association publications (NFPA), as referenced herein.

2. Uniform Fire Code (UFC) as published by the Western Fire Chiefs Association, Inc. and the International Conference of Building Officials.

1.3 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01300 - Contractor Submittals.

B. **Literature:** Manufacturer's literature, installation instructions, and details shall be submitted.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Fire prevention equipment and installation shall comply with the Code, NFPA Pamphlet No 10, and the manufacturer's published recommendations and specifications.

2.2 MATERIALS

A. **Fire Extinguisher Designated FE-1:** FE-1 fire extinguishers shall be 20-pound minimum capacity, ABC dry-chemical type with minimum UL rating of 20A:120BC.

B. **Bracket:** Mounting brackets shall be specially designed for extinguisher.

C. **Other Materials:** All other materials, not specifically described but required for a complete and proper installation of fire fighting devices shall be as selected by the CONTRACTOR, subject to the review of the ENGINEER.

2.3 MANUFACTURERS

A. Fire protection items shall be from the following manufacturers, or equal:

1. **Larsen's Manufacturing Co.**

2. **Potter-Roemer**

3. **General Fire Extinguisher Co.**

PART 3 -- EXECUTION

3.1 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. **Delivery of Materials:** Manufactured materials shall be delivered in original unbroken packages, or containers, bearing the manufacturer's label with manufacturer's name, product description, and rating.

B. **Storage:** All materials shall be carefully stored in an area that is protected from deleterious elements as recommended by the material manufacturer. Storage shall be in a manner that will prevent damage to the material and its finish.

3.2 LOCATIONS AND INSTALLATION

A. **Installation:** Installation shall be per NFPA Pamphlet No. 10 unless directed otherwise by the local Fire Marshall.

B. **Brackets:** All fire extinguishers shall be provided with and installed on brackets or brackets within cabinets. The CONTRACTOR shall block and reinforce walls to support the fire extinguishers.

- END OF SECTION -

SECTION 11000 - EQUIPMENT GENERAL PROVISIONS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide all equipment and appurtenant work, complete and operable, in accordance with the Contract Documents.

B. The provisions of this Section shall apply to all equipment except where otherwise indicated.

C. **Equipment Arrangement:** Unless specifically indicated otherwise, the arrangement of equipment shown on the Drawings is based upon information available at the time of design and is not intended to show exact dimensions particular to a specific manufacturer in all cases. Some aspects of the Drawings are diagrammatic and some features of the illustrated equipment arrangement may require revision to meet the actual equipment requirements. Structural supports, foundations, piping and valve connections, and electrical and instrumentation connections indicated may have to be altered to accommodate the equipment provided. No additional payment will be made for such revisions and alterations. Substantiating calculations and drawings shall be submitted prior to beginning the installation of equipment.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Equipment shall be in accordance with the following standards, as applicable and as indicated in each equipment specification:

1. American Society for Testing and Materials (ASTM).
2. American National Standards Institute (ANSI).
3. American Society of Mechanical Engineers (ASME).
4. American Water Works Association (AWWA).
5. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE).
6. American Welding Society (AWS).
7. National Fire Protection Association (NFPA).
8. Federal Specifications (FS).
9. National Electrical Manufacturers Association (NEMA).
10. Manufacturer's published recommendations and specifications.
11. General Industry Safety Orders (OSHA).

B. The following standards are referenced in this Section:

ANSI B16.1 Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800

ANSI B16.5 Pipe Flanges and Flanged Fittings, Steel, Nickel Alloy and other Special Alloys

ANSI B46.1 Surface Texture

ANSI S12.6 Method for the Measurement of the Real-Ear Attenuation of Hearing Protectors

ASME B1.20.1 General Purpose Pipe Threads (Inch)

ASME B31.1 Power Piping

AWWA C206 Field Welding of Steel Water Pipe

AWWA C207 Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144 In. (100 mm through 3,600 mm)

AWWA D100 Welded Steel Tanks for Water Storage

ASTM A 48 Gray Iron Castings

ASTM A 108 Steel Bars, Carbon, Cold-Finished, Standard Quality

1.3 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01300 - Contractor Submittals.

B. **Shop Drawings:** Furnish complete drawings and technical information for equipment, piping, valves, and controls. Where indicated or required by the CONTRACTING OFFICER, Shop Drawings shall include clear, concise calculations showing equipment anchorage forces and the capacities of the anchorage elements proposed by the CONTRACTOR.

C. **Spare Parts List:** The CONTRACTOR shall obtain from the manufacturer and submit at the same time as Shop Drawings a list of suggested spare parts for each piece of equipment. CONTRACTOR shall also furnish the name, address, and telephone number of the nearest distributor for each piece of equipment.

D. Torsion and Vibration Analyses

1. The CONTRACTOR shall arrange for and submit torsional and lateral vibration analyses for the following equipment types:

a. Engine drives except engine generators.

b. Pumps, blowers, and compressors with constant speed drives of 500 horsepower and greater.

c. Pumps, blowers and compressors with variable speed drives of 100 horsepower and greater.

d. Vertical pumps with universal joints and extended shafts.

e. Other equipment as indicated.

2. An experienced specialist from the equipment manufacturer shall perform a complete torsional and lateral vibration analysis of each distinct equipment, motor, and variable speed drive. These analyses shall identify the dry and wet lateral critical speeds plus the torsional critical speeds of the system. Appropriate lateral and critical speed maps shall be produced and submitted.

3. No active critical speed shall be allowed within 25 percent of the operating speed range. No fabrication of the equipment shall be started until the analyses have been approved by the CONTRACTING OFFICER.

1.4 QUALITY ASSURANCE

A. **Costs:** Responsibility shall be the CONTRACTOR's for performing and paying the costs of inspection, startup, testing, adjustment, and instruction services performed by factory representatives. The GOVERNMENT will pay for costs of power and water. If available, the GOVERNMENT'S operating personnel will provide assistance in the field testing.

B. **Inspection:** The CONTRACTOR shall inform the local authorities, such as building and plumbing inspectors, fire marshall, OSHA inspectors, and others, to witness all required tests for piping, plumbing, fire protection systems, pressure vessels, safety systems, and related items to obtain all required permits and certificates, and shall pay all inspection fees.

C. **Quality and Tolerances:** Tolerances and clearances shall be as shown on the Shop Drawings and shall be closely adhered to.

1. Machine work shall in all cases be of high-grade workmanship and finish, with due consideration to the special nature or function of the parts. Members without milled ends and which are to be framed to other steel parts of the structure may have a variation in the detailed length of not greater than 1/16-inch for members 30-feet or less in length, and not greater than 1/8-inch for members over 30-feet in length.

2. Castings shall be homogeneous and free from non-metallic inclusions and defects. Surfaces of castings which are not machined shall be cleaned to remove foundry irregularities. Casting defects not exceeding 12.5 percent of the total thickness and where defects will not affect the strength and serviceability of the casting may be repaired by approved welding procedures. The CONTRACTING OFFICER shall be notified of larger defects. No repair welding of such defects shall be carried out without the CONTRACTING OFFICER'S written approval. If the removal of metal for repair reduces the stress resisting cross-section of the casting by more than 25 percent or to such an extent that the computed stress in the remaining metal exceeds the allowable stress by more than 25 percent, then the casting may be rejected. Costs of casting new material shall be the CONTRACTOR'S responsibility.

3. All materials shall meet the physical and mechanical properties in accordance with the reference standards.

D. **Machine Finish:** The type of finish shall be the most suitable for the application and shall be shown in micro-inches in accordance with ANSI B46.1. The following finishes shall be used:

1. Surface roughness not greater than 63 micro-inches shall be required for all surfaces in sliding contact.

2. Surface roughness not greater than 250 micro-inches shall be required for surfaces in contact where a tight joint is not required.

3. Rough finish not greater than 500 micro-inches shall be required for other machined surfaces.

4. Contact surfaces of shafts and stems which pass through stuffing boxes and contact surfaces of bearings shall be finished to not greater than 32 micro-inches.

E. **Manufacturer's Experience:** Equipment manufacturer shall have a record of at least 5 years of successful, troublefree operation in similar applications and size equal or larger than the equipment in this contract.

PART 2 -- PRODUCTS

2.1 GENERAL REQUIREMENTS

A. **Noise Level:** When in operation, no single piece of equipment shall exceed the OSHA noise level requirement of 105 dBA for one hour exposure per day.

B. **High Noise Level Location:** The CONTRACTOR shall provide one personal hearing protection station at each high noise level location. Locations are defined as follows:

1. Outdoor Location: Any single equipment item or any group of equipment items that produce noise exceeding OSHA noise level requirements for a 2 hour exposure. Where such equipment is separated by a distance of more than 20-feet, measured between edges of footings, each group of equipment shall be provided with a separate hearing protection station.

2. Indoor Location

a. Any single equipment item or any group of equipment items located within a single room not normally occupied, that produces noise exceeding OSHA noise level requirements for a 2 hour exposure.

b. Any single equipment item or any group of equipment items located within a single room normally occupied by workers, that produces noise exceeding OSHA noise level requirements for an 8 hour exposure.

C. **Personal Hearing Protection:** The CONTRACTOR shall furnish 3 pairs of high attenuation hearing protectors in the original unopened packaging. The ear protectors shall be capable of meeting the requirements of ANSI S12.6 and shall produce a noise level reduction of 25 dBA at a frequency of 500 Hz. The hearing protectors shall have fluid filled ear cushions and an adjustable, padded headband. The protectors shall be stored in a weatherproof, labeled, steel cabinet, provided at an approved location near the noise producing equipment.

D. **Drive Trains and Service Factors:** Service factors shall be applied in the selection or design of mechanical power transmission components. All components of drive train assemblies between the prime mover and the driven equipment shall be designed and rated to deliver the maximum peak or starting torque, speed, and horsepower. All of the applicable service factors shall be considered, such as mechanical (type of prime mover), load class, start frequency, ventilation, ambient temperature, and fan factors. Drive train components include couplings, shafts, gears and gear drives, drive chains, sprockets, and V-belt drives. Unless otherwise indicated, the following load classifications shall apply in determining service factors:

Type of Equipment	Service Factor	Load Classification
Reciprocating Air Compressors		
multi-cylinder	2.0	Heavy Shock
single-cylinder	2.0	Heavy Shock
Pumps		
centrifugal or rotary	1.0	Uniform
reciprocating	1.8	Moderate Shock
progressing cavity	1.0	Uniform
Mixers		
constant density	1.0	Uniform
variable density	1.25	Moderate Shock
rapid mixer	1.25	Moderate Shock
flocculator	1.25	Moderate Shock
sludge mixer	2.5	Moderate Shock
surface aerator	2.5	Heavy Shock
Cranes or Hoists	1.25	Moderate Shock

E. Mechanical Service Factors

	Mechanical Service Factors	
	Electric Motor	**Internal Combustion Engine**
Uniform	1.25	1.50
Moderate Shock	1.50	1.75
Heavy Shock	2.00	2.25

F. For thermal rating adjustments such as start frequency, ambient temperature, and hourly duty cycle factor, ventilation factor, and fan factor, refer to gear manufacturer sizing information.

G. For service factors of electric motors, see Section 16460 - Electric Motors.

H. Where load classifications are not indicated, service factors based on AGMA 514.02 shall be used for standard load classifications and for flexible couplings.

I. **Welding:** Unless otherwise indicated, welding shall conform to the following:

1. Latest revision of AWWA D100.

2. Latest revision of AWWA C206.

3. Composite fabricated steel assemblies that are to be erected or installed inside a hydraulic structure, including any fixed or movable structural components of mechanical equipment, shall have continuous seal welds to prevent entrance of air or moisture.

4. Welding shall be by the metal-arc method or gas-shielded arc method as described in the American Welding Society's "Welding Handbook" as supplemented by other pertinent standards of the AWS. Qualification of welders shall be in accordance with the AWS Standards.

5. In assembly and during welding, the component parts shall be adequately clamped, supported, and restrained to minimize distortion and for control of dimensions. Weld reinforcement shall be as specified by the AWS code. Upon completion of welding, weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance, with uniform weld contours and dimensions. Sharp corners of material that is to be painted or coated shall be ground to a minimum of 1/32-inch on the flat.

J. **Protective Coating:** Equipment shall be painted or coated in accordance with Section 09800 - Protective Coating, unless otherwise indicated. Non-ferrous metal and corrosion-resisting steel surfaces shall be coated with grease or lubricating oil. Coated surfaces shall be protected from abrasion or other damage during handling, testing, storing, assembly, and shipping.

K. **Protection of Equipment:** Equipment shall be boxed, crated, or otherwise protected from damage and moisture during shipment, handling, and storage. Equipment shall be protected from exposure to corrosive fumes and shall be kept thoroughly dry at all times. Pumps, motors, drives, electrical equipment, and other equipment having anti-friction or sleeve bearings shall be stored in weathertight storage facilities prior to installation. For extended storage periods, plastic equipment wrappers should be avoided, to prevent accumulation of condensate in gears and bearings. In addition, motor space heaters shall be energized and shafts shall be rotated. Equipment delivered to the Site with rust or corroded parts shall be rejected. If equipment develops defects during storage, it shall be disassembled, cleaned, and recoated to restore it to original condition.

L. Identification of Equipment Items

1. At the time of shipping, each item of equipment shall have a legible identifying mark corresponding to the equipment number in the Contract Documents for the particular item.

2. After installation, each item of equipment shall be given permanent identification.

a. Pumps, compressors, and blowers smaller than 100 horsepower shall receive acrylic plastic nametags in accordance with Section 10400 – Identifying Devices.

b. Pumps, compressors, and blowers larger than 150 horsepower shall receive stainless steel plate nametags in accordance with Section 10400.

M. **Vibration Isolators:** Air compressors, blowers, engines, inline fans shall be provided with restrained spring-type vibration isolators or pads per manufacturer's written recommendations. Vibration isolations shall be provided with seismic restraint.

N. **Shop Fabrication:** Shop fabrication shall be performed in accordance with the Contract Documents and the Shop Drawings.

O. **Controls:** Equipment and system controls shall be in accordance with Division 17 - Instrumentation.

1.2 EQUIPMENT SUPPORTS AND FOUNDATIONS

A. **Equipment Supports:** Unless otherwise indicated, equipment supports, anchors, and restrainers shall be adequately designed for static, dynamic, wind, and seismic loads. The design horizontal seismic force shall be the greater of: that noted in the general structural notes or as required by the governing building code, or 10 percent of gravity. Submitted design calculations for equipment supports shall bear the signature and seal of an engineer registered in the State wherein the project is to be built, unless otherwise indicated.

B. **Anchors:** Anchor bolts shall be in accordance with Section 05500 - Miscellaneous Metalwork.

C. **Equipment Foundations:** Mechanical equipment, tanks, control cabinets, enclosures, and related equipment shall be mounted on minimum 3.5-inch high concrete bases, unless otherwise indicated. Equipment foundations are indicated on Drawings. The CONTRACTOR through the equipment manufacturer shall verify the size and weight of equipment foundation to insure compatibility with equipment.

2.3 COUPLINGS

A. Mechanical couplings shall be provided between the driver and the driven equipment. Flexible couplings shall be provided between the driver and the driven equipment to accommodate slight angular misalignment, parallel misalignment, end float, and to cushion shock loads. Unless otherwise indicated or recommended by the equipment manufacturer, coupling type shall be furnished with the respective equipment as follows:

Equipment Type	Coupling Type
Horizontal and end suction pumps	Gear or flexible spring
Vertical turbine pumps	3 piece spacer for solid shaft or double nut for hollow shaft
Vertical nonclog pumps, close coupled	Flexible disc pack

Screw pumps	Flexible spring, gear coupling, fluid coupling
Vertical nonclog pumps with extended shaft	Flexible disc pack or Universal joint with carbon fiber composite shaft and steady bearing support(s)
Belt conveyors	Gear coupling for fractional to 7.5 horsepower, Silicone filled fluid coupling for 10 hp and larger
Sludge collector	Gear coupling or jaw clutch
Engine driven pumps	Universal joint type or elastomeric flexible type
Single stage centrifugal blowers	Flexible disc pack
Air compressors	Gear or flexible disc pack

B. Each coupling size shall be determined based on the rated horsepower of the motor, speed of the shaft, and the load classification service factor. The CONTRACTOR shall have the equipment manufacturer select or recommend the size and type of coupling required to suit each specific application.

C. **Differential Settlement:** Where differential settlement between the driver and the driven equipment may occur, 2 sets of universal type couplings shall be provided.

D. **Taper-Lock** or equal bushings may be used to provide for easy installation and removal of shafts of various diameters.

2.4 SHAFTING

A. **General:** Shafting shall be continuous between bearings and shall be sized to transmit the power required. Keyways shall be accurately cut in line. Shafting shall not be turned down at the ends to accommodate bearings or sprockets whose bore is less than the diameter of the shaft. Shafts shall rotate in the end bearings and shall be turned and polished, straight, and true.

B. **Design Criteria**: All shafts shall be designed to carry the steady state and transient loads suitable for unlimited number of load applications, in accordance with ASME B106.1M - Design of Transmission Shafting. Where shafts are subjected to fatigue stresses, such as frequent start and stop cycles, the mean stress shall be determined by using the modified Goodman Diagram. The maximum torsional stress shall not exceed the endurance limit of the shaft after application of the factor of safety of 2 in the endurance limit and the stress concentration factor of the fillets in the shaft and keyway. Stress concentration factor shall be in accordance with ASME Standard B17.1 - Keys and Keyseats.

C. **Materials:** Shafting materials shall be appropriate for the type of service and torque transmitted. Environmental elements such as corrosive gases, moisture, and fluids shall be taken into consideration. Materials shall be as indicated unless furnished as part of an equipment assembly.

1. Low carbon cold-rolled steel shafting shall conform to ASTM A 108, Grade 1018.

2. Medium carbon cold-rolled shafting shall conform to ASTM A 108, Grade 1045.

3. Other grades of carbon steel alloys shall be suitable for service and load.

4. Corrosion-resistant shafting shall be stainless steel or Monel, whichever is most suitable for the intended service.

D. **Differential Settlement:** Where differential settlement between the driver and the driven equipment may occur, a shaft of sufficient length with 2 sets of universal type couplings shall be provided.

2.5 GEARS AND GEAR DRIVES

A. Unless otherwise indicated, gears shall be of the spur, helical, or spiral-bevel type, designed and manufactured in accordance with AGMA Standards, with a service factor suitable for load class, mechanical service and thermal rating adjustment, a minimum L-10 bearing life of 60,000 hours, and a minimum efficiency of 94 percent. Peak torque, starting torque, and shaft overhung load shall be checked when selecting the gear reducer. Worm gears shall not be used unless specifically approved by the CONTRACTING OFFICER.

B. Gear speed reducers or increasers shall be of the enclosed type, oil- or grease-lubricated and fully sealed, with a breather to allow air to escape but keep dust and dirt out. The casing shall be of cast iron or heavy-duty steel construction with lifting lugs and an inspection cover for each gear train. An oil level sight glass and an oil flow indicator shall be provided, located for easy reading.

C. Gears and gear drives that are part of an equipment assembly shall be shipped fully assembled for field installation.

D. Material selections shall be left to the discretion of the manufacturer, provided the above AGMA values are met. Input and output shafts shall be adequately designed for the service and load requirements. Gears shall be computer-matched for minimum tolerance variation. The output shaft shall have 2 positive seals to prevent oil leakage.

E. Oil level and drain locations shall be easily accessible. Oil coolers or heat exchangers with all required appurtenances shall be provided when necessary.

F. Where gear drive input or output shafts from one manufacturer connect to couplings or sprockets from a different manufacturer, the CONTRACTOR shall have the gear drive manufacturer furnish a matching key taped to the shaft for shipment.

2.6 DRIVE CHAINS

A. Power drive chains shall be commercial type roller chains meeting ANSI Standards.

B. A chain take-up or tightener shall be provided in every chain drive arrangement to provide easy adjustment.

C. A minimum of one connecting or coupler link shall be provided in each length of roller chain.

D. Chain and attachments shall be of the manufacturer's best standard material and be suitable for the process fluid.

2.7 SPROCKETS

A. **General:** Sprockets shall be used in conjunction with chain drives and chain-type material handling equipment.

B. **Materials:** Unless otherwise indicated, materials shall be as follows:

1. Sprockets with 25 teeth or less, normally used as a driver, shall be made of medium carbon steel in the 0.40 to 0.45 percent carbon range.

2. Type A and B sprockets with 26 teeth or more, normally used as driven sprockets, shall be made of minimum 0.20 percent carbon steel.

3. Large diameter sprockets with Type C hub shall be made of cast iron conforming to ASTM A 48, Class 30.

C. Sprockets shall be accurately machined to ANSI Standards. Sprockets shall have deep hardness penetration in tooth sections.

D. Finish bored sprockets shall be furnished complete with keyseat and set screws.

E. To facilitate installation and disassembly, sprockets shall be of the split type or shall be furnished with **Taper-Lock** bushings as required.

F. Idler sprockets shall be provided with brass or Babbitt bushings, complete with oil hole and axial or circumferential grooving with stainless steel tubing and grease fitting extended to an accessible location. Steel collars with set screws may be provided in both sides of the hub.

2.8 V-BELT DRIVES

A. V-belts and sheaves shall be of the best commercial grade and shall conform to ANSI, MPTA, and RMA Standards.

B. Unless otherwise indicated, sheaves shall be machined from the finest quality gray cast iron.

C. Sheaves shall be statically balanced. In some applications where vibration is a problem, sheaves shall be dynamically balanced. Sheaves operating at belt speeds exceeding 6,500 fpm may be required to be of special materials and construction.

D. To facilitate installation and disassembly, sheaves shall be provided complete with **Taper-Lock** or **QD** bushings as required.

E. Finish bored sheaves shall be complete with keyseat and set screws.

F. Sliding motor bases shall be provided to adjust the tension of V-belts.

2.9 DRIVE GUARDS

A. Power transmission trains, prime movers, machines, shaft extensions, and moving machine parts shall be guarded to conform with the Division of Industrial Safety General Industrial Safety Orders latest edition and OSHA Safety and Health Standards (29CFR1910). The guards shall be constructed of minimum 10 gauge expanded, flattened steel with smooth edges and corners, galvanized after fabrication, and securely fastened. Where required for lubrication or maintenance, guards shall have hinged and latched access doors.

2.10 BEARINGS

A. **General:** Bearings shall conform to the standards of the Anti-Friction Bearing Manufacturers Association, Inc. (AFBMA).

B. To assure satisfactory bearing application, fitting practice, mounting, lubrication, sealing, static rating, housing strength, and lubrication shall be considered in bearing selection.

C. Re-lubricatable type bearings shall be equipped with a hydraulic grease fitting in an accessible location and shall have sufficient grease capacity in the bearing chamber.

D. Lubricated-for-life bearings shall be factory-lubricated with the manufacturer's recommended grease to insure maximum bearing life and best performance.

E. **Anti-Friction Type Bearing Life:** Except where otherwise indicated, bearings shall have a minimum L-10 life expectancy of 5 years or 20,000 hours, whichever occurs first. Where so indicated, bearings shall have a minimum rated L-10 life expectancy corresponding to the type of service, as follows:

Type of Service	Design Life, years	L-10 Design Life, hours
	(whichever comes first)	
8-hour shift	10	20,000
16-hour shift	10	40,000
Continuous	10	60,000

F. Bearing housings shall be of cast iron or steel and bearing mounting arrangement shall be as indicated or as recommended in the published standards of the manufacturer. Split-type housings may be used to facilitate installation, inspection, and disassembly.

G. **Sleeve Type Bearings**: Sleeve-type bearings shall have a cast iron or ductile iron housing and Babbitt or bronze liner. Bearing housing shall be bolted and doweled to the lower casing half. These housings shall be provided with cast iron caps bolted in place and the bearing end caps shall be bored to receive the bearing shells. Sleeve bearings shall be designed on the basis of the maximum allowable load permitted by the bearing manufacturer. If the sleeve bearing is connected to an equipment shaft with a coupling, the coupling transmitted thrust will be assumed to be the maximum motor or equipment thrust. Lubricant, lubrication system, and cooling system shall be as recommended by the bearing manufacturer.

H. **Plate Thrust Bearings**: Thrust bearings shall be the **Kingsbury** Type, designed and manufactured to maintain the shaft in the fixed axial position without undue heating or the necessity of adjustment or attention. Bearings shall be oil lubricated to suit the manufacturer's standard method of lubrication for the specific bearing. If bearing cooling is required, manufacturer shall provide necessary piping, filters, and valves.

2.11 PIPING CONNECTIONS

A. **Pipe Hangers, Supports, and Guides:** Pipe connections to equipment shall be supported, anchored, and guided to avoid stresses and loads on equipment flanges and equipment. Supports and hangers shall be in accordance with Section 15006 - Pipe Supports.

B. **Flanges and Pipe Threads:** Flanges on equipment and appurtenances shall conform to ANSI B16.1, Class 125, or B16.5, Class 150, unless otherwise indicated. Pipe threads shall be in accordance with ANSI/ASME B1.20.1 and Section 15000 - Piping, General.

C. **Flexible Connectors:** Flexible connectors shall be installed in all piping connections to engines, blowers, compressors, and other vibrating equipment and in piping systems in accordance with the requirements of Section 15000. Flexible connectors shall be harnessed or otherwise anchored to prevent separation of the pipe where required by the installation.

D. **Insulating Connections:** Insulating bushings, unions, couplings, or flanges, as appropriate, shall be used in accordance with the requirements of the Section 15000.

2.12 GASKETS AND PACKINGS

A. Gaskets shall be in accordance with Section 15000.

B. Packing around valve stems and reciprocating shafts shall be of compressible material, compatible with the fluid being used. Chevron-type "V" packing shall be **Garlock No. 432, John Crane "Everseal,"** or equal.

C. Packing around rotating shafts (other than valve stems) shall be "O"-rings, stuffing boxes, or mechanical seals, as recommended by the manufacturer and approved by the CONTRACTING OFFICER, in accordance with Section 11100 - Pumps, General.

2.13 NAMEPLATES

A. Equipment nameplates of stainless steel shall be engraved or stamped and fastened to the equipment in an accessible location with No. 4 or larger oval head stainless steel screws or drive pins. Nameplates shall contain the manufacturer's name, model, serial number, size, characteristics, and appropriate data describing the machine performance ratings.

2.14 TOOLS AND SPARE PARTS

A. **Tools:** The CONTRACTOR shall furnish one complete set of special wrenches and other special tools necessary for the assembly, adjustment, and dismantling of the equipment. Tools shall be of best quality hardened steel forgings with bright finish. Wrench heads shall have work faces dressed to fit nuts. Tools shall be suitable for professional work and manufactured by **Snap On, Crescent, Stanley,** or equal. The set

of tools shall be neatly mounted in a labeled toolbox of suitable design provided with a hinged cover.

B. Spare parts shall be furnished as indicated in the individual equipment sections. All spare parts shall be suitably packaged in a metal box and labeled with equipment numbers by means of stainless steel or solid plastic nametags attached to the box.

2.15 EQUIPMENT LUBRICANTS

A. The CONTRACTOR shall install lubricants for all equipment during storage and prior to initial testing of the equipment. After successful initial testing, final testing, and satisfactory completion startup testing as specified in Section 01660 - Equipment Testing and Plant Startup, the CONTRACTOR shall conduct one complete lubricant change on all equipment. In addition, the CONTRACTOR shall be responsible for the proper disposal of all used lubricants. The GOVERNMENT will then be responsible for subsequent lubricant changes

PART 3 -- EXECUTION

3.1 SERVICES OF MANUFACTURER

A. **Inspection, Startup, and Field Adjustment**: Where required by individual sections, an authorized, experienced, and competent service representative of the manufacturer shall visit the Site for the number of days indicated in those sections to witness or perform the following and to certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation.

1. Installation of equipment

2. Inspection, checking, and adjusting the equipment and approving its installation

3. Startup and field testing for proper operation, efficiency, and capacity

4. Performing field adjustments during the test period to ensure that the equipment installation and operation comply with requirements

B. Instruction of the GOVERNMENT's Personnel

1. Where required by the individual equipment sections, an authorized training representative of the manufacturer shall visit the Site for the number of days indicated in those sections to instruct the GOVERNMENT's personnel in the operation and maintenance of the equipment, including step-by-step troubleshooting with necessary test equipment. Instruction shall be specific to the models of equipment provided.

2. The representative shall have at least 2 years experience in training. A resume of the representative shall be submitted.

3. Training shall be scheduled 3 weeks in advance of the scheduled session.

4. Proposed training material and a detailed outline of each lesson shall be submitted for review. Review comments from the CONTRACTING OFFICER shall be incorporated into the material.

5. The training materials shall remain with the trainees after the session.

6. The GOVERNMENT may videotape the training for later use by the GOVERNMENT's personnel.

C. **Vibration Monitoring**: For the equipment types listed in paragraph 1.3D, the CONTRACTOR shall arrange for at least two Site visits by the manufacturer's specialist during testing of the equipment covered by torsional and vibration analysis submittals to measure the amount of vibration and prepare written recommendations for keeping the vibration within acceptance limits. If vibration readings exceed the specified or the applicable referenced standard vibration limits for the type of equipment, the CONTRACTOR shall make necessary corrections for the equipment to meet the acceptance criteria.

3.2 INSTALLATION

A. **General:** Equipment shall be installed in accordance with the manufacturers written recommendations.

B. **Alignment**: Equipment shall be field tested to verify proper alignment.

3.3 PACKAGED EQUIPMENT

A. When any system is furnished as pre-packaged equipment, the CONTRACTOR shall coordinate all necessary space and structural requirements, clearances, utility connections, signals, and outputs with subcontractors to avoid later change orders.

B. If the packaged system has any additional features (as safety interlocks, etc.) other than required by the Contract Documents, the CONTRACTOR shall coordinate such features with the CONTRACTING OFFICER and provide all material and labor necessary for a complete installation as required by the manufacturer.

3.4 FIELD ASSEMBLY

A. Studs, cap screws, bolt and nuts used in field assembly shall be coated with "**Never Seize"** compound or equal.

3.5 WELDING

A. Welds shall be cleaned of weld-slag, splatter, etc. to provide a smooth surface.

3.6 FIELD TESTS

A. Where indicated by the individual equipment sections, equipment shall be field tested after installation to demonstrate satisfactory operation without excessive noise, vibration, or no overheating of bearings or motor.

B. The following field testing shall be conducted:

1. Start equipment, check, and operate the equipment over its entire operating range. Vibration level shall be within the amplitude limits as indicated or as recommended by the reference applicable Standards..

2. Obtain concurrent readings of motor voltage, amperage, capacity, vibration and bearing temperatures.

3. Operate equipment indicated in Section 01660.

C. The CONTRACTING OFFICER shall witness field-testing. The CONTRACTOR shall notify the CONTRACTING OFFICER of the test schedule three days in advance.

D. In the event that any equipment fails to meet the test requirements, the equipment shall be modified and resettled until it satisfies the requirement.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 11036 - DC-SCR DRIVES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide variable speed, DC-SCR drive equipment complete with drive motor, speed control unit, accessories, connections, supports, drive housing, and appurtenances, complete and workable, in accordance with the Contract Documents.

1.2 REFERENCE CODES AND STANDARDS

A. **Standards:**

ANSI/NFPA 70	National Electric Code
UL	Underwriter's Laboratories, Inc.

1.3 QUALITY ASSURANCE

A. The drive system shall be manufactured by firms that are regularly engaged in the production of SCR variable speed drive systems for at least 10 years.

B. Operation of the drive system shall be demonstrated to the CONTRACTING OFFICER to prove that, under normal conditions, variable speed drive will perform flawlessly throughout the speed range specified.

C. Variable speed drive equipment shall be UL listed.

1.4 CONTRACTOR SUBMITTALS

A. The CONTRACTOR shall provide and submit shop drawings, equipment, tools, and spare parts as referenced above, according to the requirements of Section 01300 - Contractor Submittals.

B. Shop Drawings shall show physical appearance and dimensions, schematic diagrams, pertinent data such as horsepower, voltage, efficiencies, types of enclosures, signal interfacing devices, wire numbers, etc.

1.5 MAINTENANCE AND WARRANTY

A. The system warranty shall be no less than one year after initial startup and shall include all costs for repair, parts, travel and living expenses, and labor.

B. The CONTRACTOR shall submit operation and maintenance procedures for the CONTRACTING OFFICER to review. The data sheets shall be supplemented by written text and shall include the following:

1. Operating procedures.

2. Maintenance procedures.

3. Original manufacturer's parts list, illustrations, assembly drawings, and diagrams.

C. The CONTRACTOR shall respond to trouble calls with a competent repair person at the project site within 24 hours; CONTRACTOR shall maintain a full inventory of replacement parts so that all routine repairs can be completed within 24 hours.

PART 2 -- PRODUCTS

2.1 GENERAL

A. **Equipment Compatibility:** Each variable speed drive shall be compatible with the equipment it serves and the supplier of the driven equipment shall have unit responsibility for the entire package.

2.2 DESIGN AND CONSTRUCTION

A. **Drives:** The variable speed drives shall be SCR drives which utilizes silicon controlled rectifiers a-c to d-c power conversion. Controlled d-c power shall be supplied to a d-c drive motor which shall provide a 20 to 1 regulated speed range. The drive speed shall be adjusted over the speed range by control of armature voltage and motor field current. Armature voltage shall be controlled from zero to maximum providing smooth starting from zero speed. The drive unit shall be designed for continuous, full-torque operation at slow speed. The unit shall receive remote speed control signal (4-20 mA) for speed control and shall have 4-20 mA speed signal output for remote indication.

The drives shall be coated in accordance with Section 09800 - Protective Coating.

B. The control system shall be arranged and wired in accordance with the diagrams shown on the Contract Documents. Equipment components in the control units shall be as follows:

1. Variable speed drive panel shall be complete with speed-adjusting potentiometer, speed indicator, and on-off switch. The variable speed drive panel and accessories shall be **DCI V-S drive; MINPAK Plus by Reliance Electric Co.; STATOTROL II by General Electric; or equal**.

2. Manual selector switch, two-position rated 120-volt and suitable for switching control for the variable speed drive panel from local to remote location.

3. Indicating lights, oil tight, heavy-duty type.

4. Circuit breakers, molded case type, single pole, 120-volt, as required.

5. Timers for controlling utility water shall be pneumatic type, off-delay, with time range as shown and time adjusting dial **Agastat Series 7000, or equal**.

6. Relays, rated 300-volt, 10 amperes, with field convertible contacts, **Allen Bradley Type N; Square D Type M; or equal**.

7. Dry type transformer shall be 480-volt/120-volt sized for the chemical feed equipment with grounded secondary.

8. All necessary dry contacts for remote status and alarm indications. All necessary interphase points for external connections as shown on the Drawings.

9. All components for each unit shall be mounted in enclosures with NEMA ratings in accordance with the area designations of Section 16050 - Electrical General Provisions.

10. Some additional features required include:

    a. Remote operator adapter kit for buffering and filtering of external signals.

    b. Tachometer feedback kit for accuracy of speed regulation to 0.5 percent with 95 percent load change.

    c. Instrument interface/preset speed kit.

    d. Auxiliary contact kit for interconnection with external signalling devices.

    e. Torque taper kit for changing speed torque relationship to allow motor speed decrease as the load increases.

    f. Separate operator control stations for remote operation of the drive.

C. **Motor:** Electric motors for chemical feed equipment shall be as specified herein and shall meet the performance criteria specified above. Direct current motors shall comply with the requirements of NEMA Standard MGI-12 and shall be rated for ambient temperature of 40 degrees C, and minimum service factor of 1.0. Direct current motors shall be provided with Class F insulation, bearings rated for minimum AFBMA L-10 life of 20,000 hours, TEFC enclosures, and gasketed conduit boxes.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. DC-SCR drives shall be installed in strict accordance with the manufacturer's printed instructions.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 11052 - AUTOMATIC, REFRIGERATED SAMPLERS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide automatic sampling units and appurtenances, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 11000 - Equipment General Provisions apply to the WORK of this Section.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards:

SSPC-SP-6	Steel Structures Painting Manual

1.3 CONTRACTOR SUBMITTALS

A. Complete data and Shop Drawings with detailed specifications for samplers, refrigerated sample collectors, and manufacturer's published specifications shall be submitted for approval according to Section 01300 - Contractor Submittals.

1.4 MANUFACTURER'S REPRESENTATIVE

A. The CONTRACTOR shall furnish the services of a qualified representative of the manufacturer for not less than one day to check the installed units and instruct the GOVERNMENT's operating personnel.

PART 2 -- PRODUCTS

2.1 SAMPLERS

A. **General:** Each sampler shall be a self-contained, factory pre-wired, floor-standing unit with the sampler located above the refrigerated sample collector. The sampler shall be the vacuum/pressure or peristaltic pump type. Each unit shall be mounted in a frame or cabinet that provides a minimum of one inch of clearance between the floor and the bottom of the refrigerated sample collector.

B. **Sampling Capacity:** Each sampler shall be capable of drawing a liquid sample a vertical height of 20 feet through a minimum 3/8-inch inside diameter tube at a rate not less than 3 ft/sec.

C. **Power Supply:** Each sampler shall operate on 115-volt, single-phase, 60-Hz power, and it shall be provided with a waterproof electrical junction box attached to the exterior for pickup of power cord and plug, and flow signal, status signal, and grounding wires.

D. **Enclosure:** Each sampler/controller shall be enclosed in a watertight coated steel, stainless steel, or reinforced fiber glass cabinet and shall comply with NEMA 4 or 6 specifications. The cabinet shall contain access doors with locking mechanism. All equipment within the cabinet shall be easily accessible for maintenance.

E. **Sample Tube:** Each sampler shall be equipped with a length of vinyl, Teflon, or black PVC nylon-reinforced flexible plastic tubing suitable for connection with the sampling chamber. Inside diameter of the tubing shall not be less than 3/8-inch. The tubing shall be connected using stainless steel hose clamps.

F. **Operating Modes:** Each sampler shall be capable of operating in any of the following 3 modes:

1. Flow proportional basis from an external signal in accordance with Section 17100 - Process Control and Instrumentation Systems.

2. Time proportional basis from an internal timer.

3. Manual basis by activation of a switch on the sampler.

G. **Sampling Cycle:** Each sampler shall be capable of taking a sample from 50 ml to 500 ml per sampling cycle. The sampling cycle shall be initiated by the external flow signal, or from the internal timer, or by the manual switch and shall involve the following processes in order:

1. The 3-way or 4-way solenoid valve or pump shall operate to purge the sample line with compressed air.

2. At a preset time, the solenoid valve or pump shall switch the compressor line to create a vacuum in the sample line and metering chamber (if any), to cause the sample to flow to and fill the metering chamber.

3. If necessary (with metering chamber), air pressure shall be applied to the metering chamber and sample line to vent excess sample from the metering chamber and leave a predetermined volume in the metering chamber.

4. The contents of the metering chamber shall be discharged into the refrigerated sample collector.

5. After re-purging the suction line, all electrical timers, switches, and valves shall reset to the appropriate settings to begin another sampling cycle.

H. **Sample Correction for Vacuum/Pressure Type:** The procedures above shall not require more than 5 minutes. In the event that insufficient sample volume is taken during step 2 of the above procedures, such that the metering chamber is not filled, the sampler shall return to step 1 of the sampling process and shall not proceed to step 3 until the metering chamber has been filled.

I. **Control:** Flow signals to the sampler shall be 4-20 mA converted as required within the sampler. The sampler shall be capable of operation from the flow signal.

J. **Timer:** The internal timers shall be capable of initiating the sampling sequence after a preset time has elapsed. This preset time shall be variable from 4 minutes min. to at least 12 hours.

K. **Status Monitoring:** Each sampler shall be provided with a dry set of electrical contacts for operational status monitoring, closing at the start of the sampling sequence, and

remaining closed until the entire sampling sequence has been completed. The electrical contacts shall be rated for 5-amps, 115-volts continuous duty.

2.2 REFRIGERATED SAMPLE COLLECTOR

A. Each refrigerated sample collector shall be located below its respective sampler. If not supplied as one unit, the sampler and refrigerated sample collector shall be securely attached to each other and the assembly of both rigidly attached to the foundation. Each refrigerated collector shall have the capacity to hold a 5-gallon container. The container shall have two carrying handles and fully removable lids for cleaning. The container shall be constructed of polyethylene plastic or stainless steel, cylinder shaped. Each refrigerated collector shall be capable of maintaining a temperature in the collector compartment between 4 degrees C and 10 degrees C and shall operate on 115 Volt single phase 60-Hz power. The sampler control shall automatically shut down when the collector is full.

2.3 SAMPLING PUMPS

A. **General:** Each sampler shall be equipped with a sampling pump to alternately produce a suction and a pressure condition in the sampling line, as outlined above.

B. **Pump Design and Construction:** Each pump shall be of the peristaltic or positive displacement type with a capacity, suction lift, and discharge head sufficient for the sampling system of the unit. The pump shall be one of the following types:

1. A progressing cavity pump with cast iron body, chrome-plated steel rotor, Buna "N" stator, mechanical carbon and ceramic seal, and flexible coupling.

2. A peristaltic pump made of reinforced engineering plastic for corrosion resistance.

3. A diaphragm pump with valves made of stainless steel.

C. **Pump Motor:** Each motor shall be 1800 rpm, TEFC and shall not be overloaded when the pump is operated at any point on the H/Q curve within the recommended operating range of the pump. The motor shall operate on 115-volt, single-phase, 60-Hz power.

2.4 ACCESSORIES

A. **Spare Parts:** Each sampler shall be furnished with one year's supply of the manufacturer's suggested spare parts and any other elements subject to wear or frequent replacement. All parts shall be properly labeled and identified with the name and number of the equipment to which they belong.

B. **Tools:** The CONTRACTOR shall furnish one complete set of special wrenches or other special tools necessary for the assembly, adjustment, and dismantling of the equipment. All tools shall be of best quality and furnished in labeled tool boxes of suitable design.

2.5 MANUFACTURERS, OR EQUAL

1. **American Sigma - 900 series**

2. **Isco, Inc., model 3710R**

3. **Quality Control Equipment Co., model "Century 2581"**

4. **Sirco Controls, model B/ST-VS**

PART 3 -- EXECUTION

3.1 SAMPLER INSTALLATION SCHEDULE

A. Samplers shall be installed in locations as indicated on drawings.

3.2 PROTECTIVE COATING

A. **General:** Protective coating of samplers shall conform to the requirements of this Section. All other equipment shall be coated in accordance with the requirements of Section 09800 - Protective Coating.

B. **Fasteners:** All anchor bolts, nuts, and washers shall be hot-dip galvanized.

C. **Surface Preparation:** All steel surfaces of samplers and refrigerated sample collectors shall be blast cleaned in the shop to a commercial blast cleaned surface conforming to SSPC-SP-6. All dust shall be removed prior to coating. Surfaces shall be coated the same day sandblasting is performed.

D. **Protective Coating:** All steel surfaces of samplers, refrigerated sample collectors and supporting framework, if any, shall be shop coated with a baked epoxy powder coating to a minimum dry film thickness of 12 mils. Powder coating shall be applied by the fluidized bed or electrostatic spray method by qualified, experienced personnel. Oven curing shall conform to the recommendations of the epoxy powder manufacturer. Interior surfaces of samplers and sample collectors shall be white.

E. The CONTRACTOR is cautioned to use care during installation to avoid damage to the protective coatings on this equipment. If the coating is damaged during installation, the CONTRACTOR will be required to return the equipment to the manufacturer for recoating. Field touchup will not be acceptable.

3.3 OPERATIONAL TESTS

A. Upon completion of the installation, each piece of equipment and each system shall be field-tested for satisfactory operation without excessive noise, vibration, overheating, etc. All equipment must be adjusted and checked for misalignment, clearances, supports, and adherence to safety standards.

- END OF SECTION -

SECTION 11100 - PUMPS, GENERAL

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide all pumps and pumping appurtenances, complete and operable, in accordance with the Contract Documents.

B. The provisions of this Section shall apply to all pumps and pumping equipment except where otherwise indicated in the Contract Documents.

C. The requirements of Section 11000 – Equipment General Provisions apply to this Section.

D. **Unit Responsibility:** The pump manufacturer shall be made responsible for furnishing the WORK and for coordination of design, assembly, testing, and installation of the WORK of each pump Section; however, the CONTRACTOR shall be responsible to the GOVERNMENT for compliance with the requirements of each pump Section.

E. **Single Manufacturer:** Where 2 or more pump systems of the same type or size are required, the pumps shall all be produced by the same manufacturer.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01300 - Contractor Submittals.

B. **Shop Drawings:** Shop Drawings shall contain the following information:

1. Pump name, identification number, and specification Section number.

2. Performance data curves showing head, capacity, horsepower demand, NPSH required, and pump efficiency over the entire operating range of the pump. The equipment manufacturer shall indicate separately the head, capacity, horsepower demand, overall efficiency, and minimum submergence required at the design flow conditions and the maximum and minimum flow conditions. Performance curves at intervals of 100 rpm from minimum speed to maximum speed shall be furnished for each centrifugal pump equipped with a variable speed drive.

3. The CONTRACTOR shall require the manufacturer to indicate the limits on the performance curves recommended for stable operation without surge, cavitation, or excessive vibration. The stable operating range shall be as wide as possible based on actual hydraulic and mechanical tests.

4. Assembly and installation drawings including shaft size, seal, coupling, bearings, anchor bolt plan, part nomenclature, material list, outline dimensions, and shipping weights.

5. Data, in accordance with Section 16460 - Electric Motors, for the electric motor proposed for each pump.

6. Elevation of proposed local control panel showing panel-mounted devices, details of enclosure type, single line diagram of power distribution, and current draw of panel, and list of all terminals required to receive inputs or to transmit outputs from the local control panel.

7. Wiring diagram of field connections with identification of terminations between local control panels, junction terminal boxes, and equipment items.

8. Complete electrical schematic diagram.

C. **Technical Manual:** The Technical Manual shall contain the required information for each pump Section.

D. **Spare Parts List:** A spare parts list shall contain the required information for each pump Section.

E. **Factory Test Data:** Signed, dated, and certified factory test data for each pump system which requires factory testing, submitted before shipment of equipment.

F. Certifications

1. Manufacturer's certification of proper installation.

2. CONTRACTOR'S certification of satisfactory field testing.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Compliance with the requirements of the individual pump Sections may necessitate modifications to the manufacturer's standard equipment.

B. **Performance Curves:** All centrifugal pumps shall have a continuously rising curve or the system operating range shall not cross the pump curve at two different capacities or “dip region.” Unless indicated otherwise, the required pump shaft horsepower at any point on the performance curve shall not exceed the rated horsepower of the motor or engine or encroach on the service factor.

C. All components of each pump system provided under the pump Sections shall be entirely compatible. Each unit of pumping equipment shall incorporate all basic mechanisms, couplings, electric motors or engine drives, variable speed controls, necessary mountings, and appurtenances.

D. The acceptable minimum NPSHA-NPSHR margin shall be 5 feet at any specified operating condition falling within 85 percent and 115 percent of best efficiency capacity at the speed required to achieve the specified condition and not less than 8 feet for any specified condition falling outside that zone. However, under no circumstances shall NPSH margin be less than that stipulated on table 9.6.1.1 in ANSI/HI 9.6.1 for specified operating conditions within ± 15 percent of the pump’s best efficiency capacity and 125 percent of the value stipulated in table 9.6.1.1 in ANSI/HI 9.6.1 for all specified operating conditions falling outside the ± 15 percent capacity zone at best efficiency on the pump’s head capacity curve.

2.2 MATERIALS

A. All materials shall be suitable for the intended application; materials not indicated shall be high-grade, standard commercial quality, free from all defects and imperfections that might affect the serviceability of the product for the purpose for which it is intended, and shall conform to the following requirements:

1. Cast iron pump casings and bowls shall be of close-grained gray cast iron, conforming to ASTM A 48 - Gray Iron Castings, Class 30, or equal.

2. Bronze pump impellers shall conform to ASTM B 62 - Composition Bronze or Ounce Metal Castings, or B 584 - Copper Alloy Sand Castings for General Applications, where dezincification does not occur.

3. Stainless steel pump shafts shall be Type 416 or 316. Miscellaneous stainless steel parts shall be Type 316.

4. Anchor bolts, washers, and nuts in Standard Service (Non-Corrosive Application) shall be galvanized steel in accordance with the requirements of Section 05500 - Miscellaneous Metalwork. Anchor bolts, washers, and nuts in Corrosive Service as defined in Section 05500 shall be stainless steel in accordance with that Section.

B. Materials in contact with potable water shall be listed as compliant with NSF Standard 61.

2.3 PUMP COMPONENTS - GENERAL

A. **Flanges and Bolts:** Suction and discharge flanges shall conform to ANSI/ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800 or ANSI/ASME B16.5 - Pipe Flanges and Flanged Fittings dimensions. Bolts shall be in accordance with Section 05500.

B. **Lubrication:** Vertical pump shafts of clean water pumps shall be product water-lubricated, unless otherwise indicated. Deep-well pumps and pumps with dry barrels shall have water- or oil-lubricated bearings and seals and enclosed line shafts. Pumps for sewage, sludge, and other process fluids shall be lubricated as indicated.

C. **Handholes:** Handholes on pump casings shall be shaped to follow the contours of the casing to avoid any obstructions in the water passage.

D. **Drains:** All gland seals, air valves, cooling water drains, and drains from variable speed drive equipment shall be piped to the nearest floor sink or drain, with galvanized steel pipe or copper tube, properly supported with brackets.

E. **Grease Lubrication:** For all vertical propeller, mixed-flow, and turbine pumps, other than deep well pumps, of bowl sizes 10-inches and larger, the CONTRACTOR shall provide a stainless steel tube attached to the column for grease lubrication of the bottom bearing.

F. **Stuffing Boxes:** Where stuffing boxes are indicated for the pump seal, they shall be of the best quality, using the manufacturer's suggested materials best suited for the specific application. For sewage, sludge, drainage, and liquids containing sediments,

the seals shall be fresh-water flushed, using lantern rings. If fresh water is not available, the seal shall be flushed with product water cleaned by a solids separator as manufactured by **John Crane Co., Lakos (Claude Laval Corp.),** or equal.

1. Conventional Packing Gland Type Seal: Unless otherwise indicated, the packing material shall be interlaced Teflon braiding, containing 50 percent ultrafine graphite impregnation to satisfy the following. Acceptable ring materials are asbestos-free die-molded packing rings of braided graphite material free of PTFE, **Chesterton 1400R**, or equal for non-potable water service and braided PTFE material, **Chesterton 1725** or equal that is listed under NSF Standard 61 for potable water service.

Shaft speeds	up to 2500 fpm
Temperature	up to 500 degrees F
pH range	0-14

2. Mechanical Seals (Conventional Non-Split Type): Mechanical seals shall be fresh water-flushed unless indicated otherwise; in which case product water cleaned by a solids separator as above shall be used. Mechanical seals shall be as manufactured by the following, or equal:

Sewage, Sludge, or Wastewater Pumps	Double seals	**John Crane Type 88, Flowserve Type ISCPP, Chesterton Type GDS** or **255**
Abrasives, Grit, or Lime Slurry Pumps	Double seals	**John Crane Type 88** (hard faces)**, Flowserve Type ISCPP** or **SLC** (check with pump manufacturer)**, Chesterton Type GDS** or **255**
Chemicals or Corrosive Liquid Pumps	Single seals	**John Crane Type 8-1** or **9, Flowserve Type ISCPX,** or **Chesterton Type UV, GSS,** or **155**
Water Pumps (hot and cold)	Single seals	**John Crane Type 88SRS, Flowserve Type ISCPX, Chesterton Type UV, GSS,** or **155**

3. Mechanical Seals (Split Type): Split type mechanical seals shall be fresh water flushed unless indicated otherwise; in which case product water cleaned by a solids separator as above shall be used. Mechanical seals shall be as manufactured by the following or equal

Sewage, Sludge, or	Double seals	**John Crane Type 3710,**

Wastewater Pumps		**Flowserve Type PSS2, Chesterton Type 442**
Abrasives, Grit, or Lime Slurry Pumps	Double seals	Split seals are not recommended.
Chemicals or Corrosive Liquid Pumps	Single seals	Split seals are not recommended because of leakage.
Water Pumps (Hot and cold)	Single seals	**John Crane Type 3710, Flowserve Type PSS II, Chesterton Type 442**

G. Where indicated, a buffer fluid must be circulated a minimum 20 psi above discharge pressure, or as required by the manufacturer, in order to maintain reliable seal performance.

H. Mechanical seals for all services shall be equipped with nonclogging, flexible–mounted seats with elastomer secondary seals. Wetted metal parts shall be Type 316 stainless steel, Alloy 20, or Hastelloy B or C, whichever has the best corrosion resistance to the pumped fluid. Dual cartridge seals shall be double balanced to allow for seal integrity in case of flush water pressure reversal. All single and double seals shall have springs in the non-wetted end of the seal.

I. Fresh water shall be delivered to the seals through appropriate size piping with plug valves, strainers, pressure regulators, electrically operated solenoid valves, and rotameters. Wiring shall comply with Division 16 and solenoid control shall comply with Division 17.

2.4 PUMP APPURTENANCES

A. **Nameplates:** Each pump shall be equipped with a stainless steel nameplate indicating serial numbers, rated head and flow, impeller size, pump speed, and manufacturer's name and model number.

B. **Solenoid Valves:** The pump manufacturer shall provide solenoid valves on the water or oil lubrication lines and on all cooling water lines. Solenoid valve electrical ratings shall be compatible with the motor control voltage.

C. Gauges

1. All pumps (except sample pumps, sump pumps, and hot water circulating pumps) shall be equipped with pressure gauges installed at pump discharge lines. Pump suction lines shall be provided with compound gauges. Gauges shall be located in a representative location, where not subject to shock or vibrations, in order to achieve true and accurate readings.

2. Where subject to shock or vibrations, the gauges shall be wall-mounted or attached to galvanized channel floor stands and connected by means of flexible connectors.

3. Pressure and compound gauges shall be provided in accordance with Section 17108 - Pressure Measuring Systems.

2.5 FACTORY TESTING

A. The following tests shall be conducted on each indicated pump system:

1. Motors: Electric motors shall be tested in accordance with Section 16460. Test results shall be furnished to the pump manufacturer prior to the pump test.

2. Pump Systems: All centrifugal pump systems with drives 10 hp up to and including 125 hp shall be tested at the pump factory in accordance with the American National Standard for Centrifugal Pump Tests (ANSI/HI 1.6) acceptance Level "A" or the American National Standard for Vertical Pump Tests (ANSI/HI 2.6) as approved by ANSI and published by the Hydraulic Institute. For sump pumps, acceptance shall be in accordance with Level "B" of ANSI/HI 1.6 unless indicated otherwise. Tests shall be performed using the complete pump system to be furnished, including the project motor and variable speed drive if equipped with variable speed drive. For pumps with motors smaller than 100 hp, the manufacturer's certified test motor shall be acceptable. Testing of prototype models will not be acceptable. The following minimum test results shall be submitted:

   a. Hydrostatic test results

   b. At maximum speed, a minimum of five hydraulic test readings between shutoff head and 25 percent beyond the maximum indicated capacity, recorded on data sheets as defined by the Hydraulic Institute. For variable speed driven pumps, each pump shall be tested between maximum and minimum speed at 100 rpm increments.

   c. Pump curves showing head, flow, bhp, and efficiency requirements.

   d. NPSH required test curve if required by the pump specification. Otherwise, a calculated NPSH required curve may be submitted.

   e. Certification that the pump shaft horsepower demand did not exceed the rated motor horsepower of 1.0 service rating at any point on the curve.

3. Factory Witnessed Tests: All pumps, variable speed drives, and motors, 150 hp and larger shall be factory-tested as complete assembled systems and may be witnessed by the GOVERNMENT and CONTRACTING OFFICER. The CONTRACTOR shall give the CONTRACTING OFFICER a minimum of 2 weeks notification prior to the test. All costs for GOVERNMENT and CONTRACTING OFFICER shall be borne by the CONTRACTOR and shall be included in the bid price. Such costs shall include travel and subsistence for two people excluding salaries. Test results shall be submitted to the CONTRACTING OFFICER. No equipment shall be shipped until the test data have been approved by the CONTRACTING OFFICER.

4. Acceptance: In the event of failure of any pump to meet any of the requirements, the CONTRACTOR shall make all necessary modifications, repairs, or

replacements to conform to the requirements of the Contract Documents and the pump shall be re-tested until found satisfactory.

PART 3 -- EXECUTION

3.1 SERVICES OF MANUFACTURER

A. **Inspection, Startup, and Field Adjustment:** Where required by the individual pump Sections, an authorized service representative of the manufacturer shall visit the Site for the number of days indicated in those sections to witness the following and to certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation.

1. Installation of the equipment

2. Inspection, checking, and adjusting the equipment

3. Startup and field testing for proper operation

4. Performing field adjustments to ensure that the equipment installation and operation comply with requirements

B. Instruction of the GOVERNMENT's Personnel

1. Where required by the individual pump Sections, an authorized training representative of the manufacturer shall visit the Site for the number of days indicated in those Sections to instruct the GOVERNMENT'S personnel in the operation and maintenance of the equipment, including step-by-step troubleshooting with necessary test equipment. Instruction shall be specific to the models of equipment provided.

2. The representative shall have at least 2 years experience in training. A resume for the representative shall be submitted.

3. Training shall be scheduled a minimum of 3 weeks in advance of the first session.

4. Proposed training material and a detailed outline of each lesson shall be submitted for review. Comments shall be incorporated into the material.

5. The training materials shall remain with the trainees.

6. The GOVERNMENT may videotape the training for later use with the GOVERNMENT'S personnel.

3.2 INSTALLATION

A. **General:** Pumping equipment shall be installed in accordance with the manufacturer's written recommendations.

B. **Alignment:** All equipment shall be field tested to verify proper alignment and freedom from binding, scraping, shaft runout, or other defects. Pump drive shafts

shall be measured just prior to assembly to ensure correct alignment without forcing. Equipment shall be secure in position and neat in appearance.

C. **Lubricants:** The CONTRACTOR shall provide the necessary oil and grease for initial operation.

3.3 PROTECTIVE COATING

A. Materials and equipment shall be coated as required in Section 09800 - Protective Coating.

3.4 FIELD TESTS

A. Each pump system shall be field tested after installation to demonstrate:

1. Satisfactory operation without excessive noise and vibration.

2. No material loss caused by cavitation.

3. No overheating of bearings.

4. Indicated head, flow, and efficiency at design point.

B. The following field testing shall be conducted:

1. Startup, check, and operate the pump system over its entire speed range. If the pump is driven by a variable speed drive, the pump and motor shall be tested at 100 RPM increments. If the pump is driven at constant speed, the pump and motor shall be tested at max RPM. Unless otherwise indicated, vibration shall be within the amplitude limits recommended by the Hydraulic Institute Standards at a minimum of four pumping conditions defined by the CONTRACTING OFFICER.

2. Obtain concurrent readings of motor voltage, amperage, pump suction head, and pump discharge head for at least 4 pumping conditions at each pump rotational speed if variable speed at 100 RPM increment or at max RPM if constant speed. Check each power lead to the motor for proper current balance.

3. Determine bearing temperatures by contact type thermometer. A run time until bearing temperatures have stabilized shall precede this test, unless insufficient liquid volume is available.

4. Electrical and instrumentation tests shall conform to the requirements of the sections under which that equipment is specified.

C. Field testing will be witnessed by the CONTRACTING OFFICER. The CONTRACTOR shall furnish 3 days advance notice of field testing.

D. In the event any pumping system fails to meet the indicated requirements, the pump shall be modified or replaced and re-tested as above until it satisfies the requirements.

E. After each pumping system has satisfied the requirements, the CONTRACTOR shall certify in writing that it has been satisfactorily tested and that all final adjustments have been made. Certification shall include the date of the field tests, a listing of all persons present during the tests, and the test data.

F. The CONTRACTOR shall be responsible for all costs of field tests, including related services of the manufacturer's representative, except for power and water, which the GOVERNMENT will bear. If available, the GOVERNMENT'S operating personnel will provide assistance in field testing.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 11103 - VERTICAL TURBINE PUMPS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide vertical turbine pumps and drives with associated piping, controls, wiring, and appurtenances, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 11100 - Pumps, General apply to this Section.

C. The Supplier shall examine the site conditions, intended application, and operation of the pump system and recommend the pump which will best satisfy the indicated requirements.

PART 2 -- PRODUCTS

2.1 GENERAL DESCRIPTION

A. **Identification:**

1.	Pump Name	-	Recycled Water Jockey Pump	Recycled Water Duty Pump
2.	Equipment Number	-	9-P-11	9-P-12, 9-P-13 9-P-14
3.	Quantity	-	1	3
4.	Location	-	Recycled Water Pump Station	Recycled Water Pump Station

B. **Operating Conditions:** The WORK of this Section shall be suitable for long term operation under the following conditions:

1.	Duty	-	Continuous	Intermittent
2.	Drive	-	Variable Speed	Variable Speed
3.	Ambient environment	-	Outdoors	Outdoors
4.	Ambient temperature, (degrees F)	-	20 to 130	20 to 130
5.	Fluid service	-	Tertiary Treated Water	Tertiary Treated Water

6.	Fluid temperature, (degrees F)	-	60 to 80	60 to 80
7.	Fluid pH range	-	6.5 to 7.5	6.5 to 7.5
8.	Fluid specific gravity	-	1.0	1.0
9.	Project site elevation (m.s.l) (ft)	-	2376	2376

C. **Performance Requirements:**

1.	Design flow capacity (gpm)	-	500	1000
2.	Design flow pump head TDH (ft)	-	396	504
3.	Design flow minimum bowl efficiency (percent)	-	80	82
4.	Minimum flow bowl efficiency (percent)	-	60	60
5.	Maximum pump speed (rpm)	-	1770	1770
6.	Maximum motor speed (rpm)	-	1800	1800
7.	Minimum motor size (hp)	-	125	200

D. **Pump Dimensions:**

1.	Length from base plate to suction inlet (ft)	-	22	22
2.	Minimum column diameter (in)	-	6	8
3.	Minimum discharge diameter (in)	-	6	8
4.	Discharge flange rating ANSI (psi)	-	250	250
5.	Minimum column shaft diameter (in)	-	1-7/16	1-11/16
6.	Maximum bowl diameter (in)	-	10	10

2.2 PUMP REQUIREMENTS

A. **Pump Construction:** Construction of vertical turbine pumps shall conform to the following requirements:

1.	Bowls	-	Cast-iron, vitreous-enameled for sizes 18 inches in diameter and smaller; larger sizes lined with 3 coats of epoxy having a total thickness of 25 mils. The exterior surfaces of the bowl units shall be coated with 8 mils of epoxy in accordance with Section 09800 - Protective Coating.
2.	Impeller	-	Bronze statically and dynamically balanced
3.	Wear rings	-	Bronze
4.	Bowl shaft	-	Stainless Steel 416
5.	Suction bell and strainer	-	Cast iron bell, with bottom bearing and streamlined ribs, lining and coating , see bowls Stainless Steel strainer, Type 316
6.	Column	-	Steel pipe, not less than Schedule 30, epoxy-lined and coated, in maximum 10-ft lengths, threaded
7.	Line shaft and couplings	-	Carbon Steel, ASTM A108, Grade 1045 shaft in maximum 10-ft lengths, sized for a critical speed of min 20 percent above max operating speed
8.	Shaft lubrication	-	Product water
9.	Shaft enclosing tube	-	Steel, schedule 80, for sizes 3-1/2 inches and larger to be integrally welded with outer column
10.	Shaft seal	-	Packing with lantern ring
11.	Line shaft bearings	-	Rubber with bronze retainers at each joint for open lineshaft
12.	Discharge head	-	Cast iron, reinforced to withstand pipe thrust, epoxy-lined with flange, base plate, and minimum 1-1/4-inch, 3000 lb forged steel half-couplings for air valve, pressure switch, and drain connections
13.	Motor shaft coupling	-	4-piece, heavy-duty adjustable spacer coupling, with registered fit, to allow for impeller adjustment

14.	Bottom bearing	-	Close tolerance sleeve type with length min 2-1/2 times shaft diameter, permanently grease lubricated for suction case with non-soluble grease, or bronze sleeve with Type 316 stainless steel grease tube and fitting, extended to base plate
15.	Bowl and suction case bearings	-	Product-lubricated bronze sleeves

B. **Drive:**

1. Each pump shall be provided with a vertical, solid shaft, high efficiency, high thrust, 230/460 volt, 3-phase, 60 Hertz heavy duty, electric motor in accordance with Section 16460 - Electric Motors. Each electric motor shall be designed to accept the total, unbalanced thrust imposed by the pump. Motors shall be suitable for use with VFDs.

2.3 SPARE PARTS

The Non-Potable Water Pumps shall be provided with the following spare parts:

A. One suction bell bearing assembly

B. One set of all bowl and discharge case bearings

C. One set of impellers

D. One set of all wear rings

E. One set of all pump shaft bearings

F. One packing assembly

G. Two sets of all gaskets and o-rings

2.4 MANUFACTURERS OR EQUAL

A. **Byron Jackson (BW/IP International, Inc.)**

B. **Goulds Pumps, Inc.**

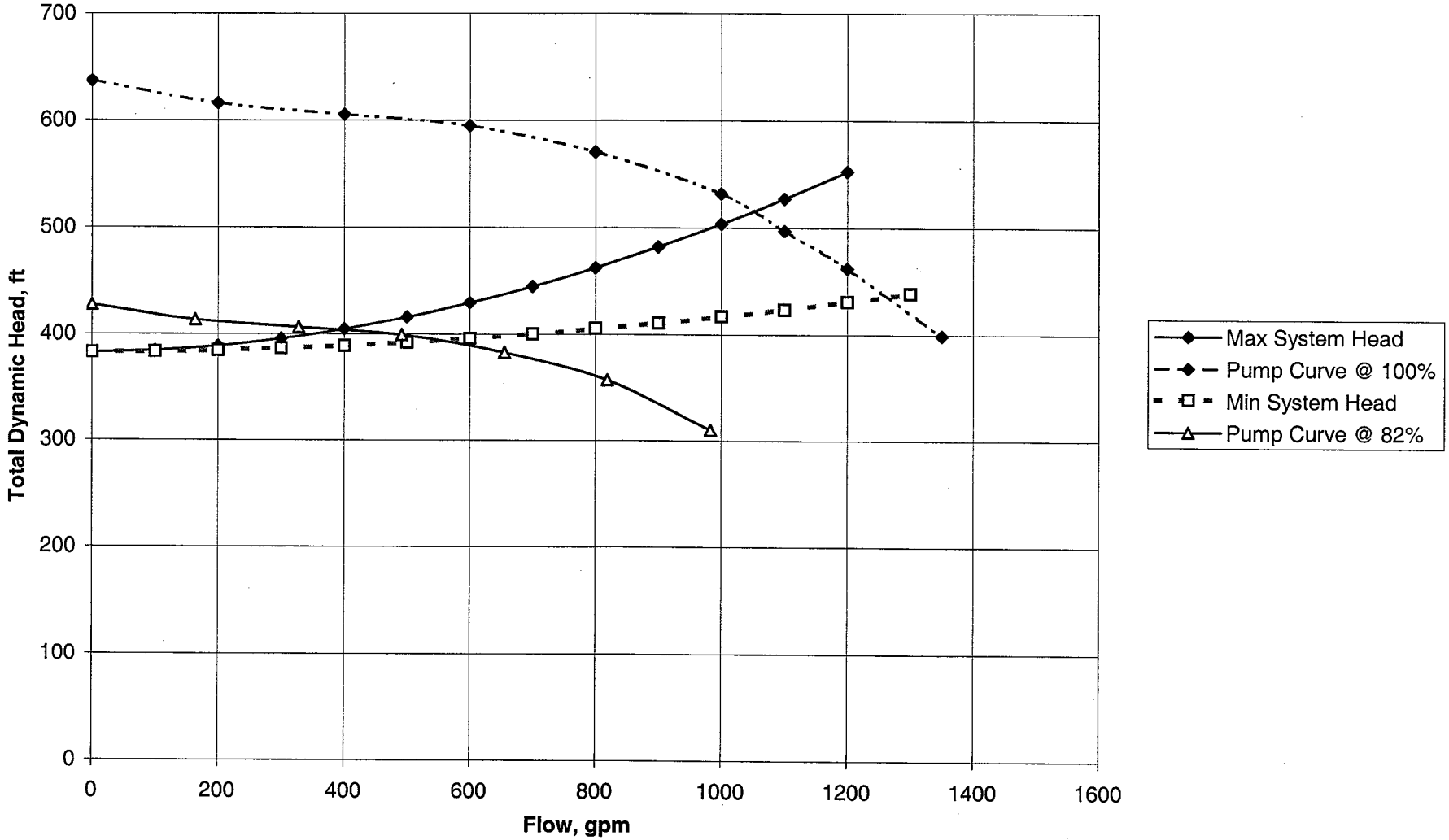
C. **Fairbanks Morse**

D. **Peerless Pumps**

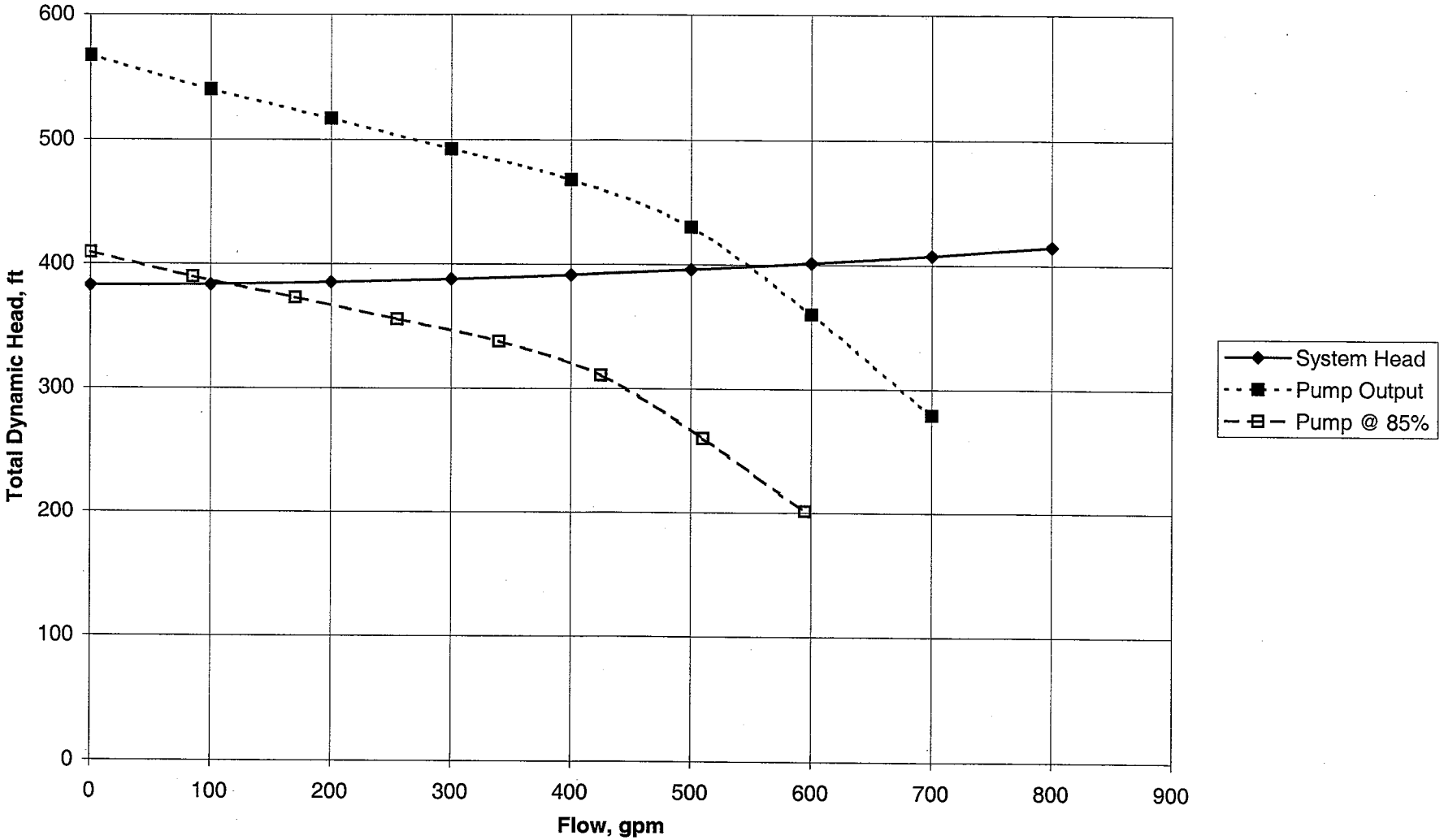
E. **Worthington (Ingersoll-Dresser Pump Company)**

F. **Johnston Pump**

Recycled Water Distribution System
Duty Pump Curve



Recycled Water Distribution System
Jockey Pump Curve - 16-inch line



PART 3 -- EXECUTION

3.1 SERVICES OF MANUFACTURER

A. **Inspection, Startup, and Field Adjustment:** The service representative of the Manufacturer shall be present at the site for 1 work day, to furnish the services required by Section 11100 - Pumps, General.

B. **Instruction of GOVERNMENT's Personnel:** The training representative of the Manufacturer shall be present at the site for 1 work day to furnish the services required by Section 11100 - Pumps, General.

C. For the purposes of this paragraph, a work day is defined as an eight hour period at the site, excluding travel time.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 11110 - HORIZONTAL CLOSE-COUPLED END SUCTION PUMPS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide horizontal close-coupled end suction pumps, with horizontal electric motors and all appurtenant work, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 11100 - Pumps, General apply to this Section.

C. The Supplier shall examine the Site conditions, intended application, and operation of the pump system and recommend the pump which will best satisfy the indicated requirements.

PART 2 -- PRODUCTS

2.1 GENERAL DESCRIPTION

A. **Identification:**

1.	Pump Name	-	flash mix pump
2.	Equipment Number	-	6-P-1
3.	Quantity	-	2 (1 installed; 1 loose back-up)
4.	Location	-	flash mix pump station

A. **Operating Conditions:** The WORK of this Section shall be suitable for long term operation under the following conditions:

1.	Duty	-	Continuous
2.	Drive	-	Constant speed
3.	Ambient environment	-	Outdoors
4.	Ambient temperature (degrees F)	-	20 to 130
5.	Ambient relative humidity (percent)	-	20 to 100
6.	Fluid service	-	Secondary Effluent
7.	Fluid temperature (degrees F)	-	60 to 85
8.	Fluid pH range	-	6.5 to 8.5

9.	Fluid specific gravity	-	1.0
10.	Project site elevation (m.s.l)	-	600
11.	Minimum available NPSH (ft)	-	42

B. **Performance Requirements:**

1.	Approximate shutoff head (ft)	-	23
2.	Design flow capacity (gpm)	-	56
3.	Design flow pump head (ft)	-	15
4.	Design flow minimum pump efficiency (percent)	-	45
5.	Maximum pump speed (rpm)	-	1,200
6.	Maximum motor speed (rpm)	-	1,200
7.	Minimum motor size (hp)	-	1

C. **Pump Dimensions:**

1.	Suction flange, min size (in)	-	1.5
2.	Discharge flange, min size (in)	-	1.25
3.	Suction flange rating, ANSI (psi)	-	150
4.	Discharge flange rating, ANSI (psi)	-	150

2.2 PUMP REQUIREMENTS

A. **Construction:** Construction of horizontal close-coupled end-suction pumps shall conform to the following requirements:

1.	Casing	-	Cast iron ASTM A 48
2.	Pump base	-	Cast iron or steel base plate with drain rim or pan

3.	Impeller	-	Type 316 stainless steel statically and dynamically balanced, enclosed
4.	Case wearring	-	Type 316 stainless steel
5.	Shaft	-	Steel AISI C1045 or SAE 1112 or 4140, designed for max 0.002-inch deflection at sealing face at max load
6.	Shaft sleeve	-	Type 316 stainless steel
7.	Seal	-	Mechanical seal
8.	Mounting	-	Close-coupled
9.	Bearings	-	Ball bearings as specified in Section 16460 - Electric Motors
10.	Lubrication	-	Grease

B. **Drive:** Direct drive with heavy duty, horizontal, electric motor suitable for 480-volt, 3-phase, 60-Hz power supply, in accordance with Section 16460 -Electric Motors.

2.3 PUMP CONTROLS

A. Pumps shall be controlled in accordance with Section 17100 - Process Control and Instrumentation System

2.4 SPARE PARTS: The following spare parts shall be furnished for each pump:

A. One mechanical seal

B. One casing wearring

C. Two sets of all gaskets, seals, and O-rings

2.5 MANUFACTURERS OR EQUAL

A. **Goulds Pumps, Inc.**

B. **Peerless Pump Company**

C. **Worthington (Ingersoll-Dresser Pump Company)**

PART 3 -- EXECUTION

3.1 SERVICES OF MANUFACTURER

A. **Inspection, Startup, and Field Adjustment:** The service representative of the Manufacturer shall be present at the Site for three work days, to furnish the services required by Section 11100.

B. **Instruction of GOVERNMENT'S Personnel:** The training representative of the Manufacturer shall be present at the Site for one work day to furnish the services required by Section 11100.

C. For the purpose of this paragraph, a work day is defined as an eight hour period at the Site, excluding travel time.

D. The CONTRACTING OFFICER may require that the inspection, startup, and field adjustment services above be furnished in three separate trips.

- END OF SECTION -

SECTION 11148 - SUBMERSIBLE NON-CLOG PUMPS

PART 1 -- PRODUCTS

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide heavy-duty submersible non-clog pumps with submersible electric motors, drives, controls, wiring, and associated piping, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 11100 - Pumps, General apply to this Section.

C. The Supplier shall examine the site conditions, intended application, and operation of the pump system and recommend the pump which will best satisfy the indicated requirements.

1.2 EXTENDED PERIOD FOR CORRECTION OF DEFECTS

A. The CONTRACTOR shall correct all defects in the pumping system upon notification from the GOVERNMENT within five years from the date of Substantial Completion. Corrections shall be completed within 5 days after notification.

PART 2 -- GENERAL

2.1 GENERAL DESCRIPTION

A. **Filter Influent Pumps:**

1.	Equipment number	-	5-P-1; 5-P-2
2.	Quantity	-	2
3.	Location	-	Filter Influent Pump Station wet well

B. **Reject Water Pumps:**

1.	Equipment number	-	8-P-1; 8-P-2
2.	Quantity	-	2
3.	Location	-	Reject Water Pump Station wet well

C. **Operating Conditions:** The WORK of this Section shall be suitable for long term operation under the following conditions:

			5-P-1; 5-P-2	8-P-1; 8-P-2
1.	Duty	-	Continuous	Intermittent
2.	Drive	-	Variable speed	Constant speed
3.	Ambient environment	-	Submerged	Submerged

4.	Ambient temperature, (degrees F)	- 20 to 130	20 to 130
5.	Fluid service	- Secondary effluent	Filter backwash and plant drains
6.	Fluid temperature, (degrees F)	- 60 to 80	60 to 80
7.	Fluid pH range	- 6.5 to 7.5	6.5 to 7.5
8.	Fluid specific gravity	- 1.0	1.0
9.	Project site elevation (m.s.l)	- 2375	2375
10.	Pump removal method	- Rails	Rails
11.	Power supply	- 480-volt, 3-phase, 60 Hz	480-volt, 3-phase, 60 Hz
12.	Minimum available NPSH (ft.)	- 34	34
13.	Maximum size spheres to pass (in. diameter)	- 2	2
14.	Sump classification in accordance with NFC	- Unclassified	Unclassified

D. **Performance Requirements:**

			5-P-1; 5-P-2	8-P-1; 8-P-2
1.	Shutoff head (ft)	-	98	45
2.	Design flow capacity (gpm)	-	1600	250
3.	Design flow pump head (TDH ft)	-	47	32
4.	Design flow minimum pump efficiency (percent)	-	70	70
5.	Maximum flow capacity at maximum speed (gpm)	-	1700	---
6.	Maximum flow pump head (TDH ft) plus/minus 5 ft.	-	40	---
7.	Maximum flow minimum pump efficiency (percent)	-	70	---

8.	Maximum flow NPSH required (ft)	- 12	---
9.	Minimum flow pump efficiency (percent)	- 50	---
10.	Maximum pump speed (rpm)	- 1200	1800
11.	Maximum motor speed (rpm)	- 1200	1800
12.	Minimum motor size (hp)	- 40	7.5

E. **Pump Dimensions:**

1.	Size of discharge flange (inches)	- 6	4
2.	Flange rating, ANSI (psi)	- 125	125

2.2 PUMP REQUIREMENTS

A. **General:**

1. Each pump shall be capable of continuous operation at full load with a water level of 36 inches above the invert of the wet pit for pumps 5-P-1; 5-P-2 and 24 inches for pumps 8-P-1; 8-P-2, without cavitation or overheating of the motor.

2. Each pump, with its cable and appurtenances, shall be able to withstand continuous submergence to a minimum depth of 65 feet, when running or off, without leakage.

3. Each pump shall be able to operate for short periods at zero static suction head without causing any damage to any part of the unit.

B. **Pump Construction:** Construction of submersible non-clog pumps shall conform to the following requirements:

1.	Connections	-	Machined metal-to-metal quick disconnect type, for withdrawal of unit from above without disconnecting pipe. When lowered into place, the pump shall automatically connect and lock into the discharge pipe, allowing for zero leakage at all anticipated pump heads.
2.	Pump Design	-	Single stage, centrifugal type, close-coupled to sealed or submersible electric motor, for operation in dry or wet pit, without external cooling.

3.	Impeller	-	Maximum 3-port non-clog type with replaceable wear rings on impeller and in casing, to handle raw unscreened sewage, solids, and fibrous materials.
4.	Bearings	-	Permanently lubricated, heavy-duty axial and radial ball or roller bearings, top and bottom, with a minimum L-10 life of 50,000 hours, at continuous, maximum load and speed, supported by detailed calculations, to be submitted with the shop drawings.
5.	Seals	-	Dual mechanical tandem, one stationary and one revolving shaft seals with individual springs, tungsten carbide or silicon carbide ring, each not requiring any maintenance, and capable of withstanding 1.5 times pump shutoff head. The seals shall be oil lubricated, with moisture detector probes, alarm, and test circuits.
6.	Oil Chamber	-	To supply oil for lubrication and cooling of the shaft seals.
7.	Support	-	Cast duckfoot bend or discharge elbow with machined face, anchored to sump floor.
8.	Cables	-	Include necessary cables for power connection, moisture detection, and overload protection, sheathed, coded, and suitable for submersible pumps, and of sufficient length for direct connection to the terminal boxes indicated. All cables shall be connected to the pumps and tested at the factory.
9.	Lifting Devices	-	Type 316 stainless steel guide rails with brackets and stainless steel lifting system of sufficient operating length, or with a stainless steel guide cable system with hooks and tension device.

C. **Materials:**

1.	Pump, volute, oil casing, sliding bracket, motor frame	-	cast iron
2.	Impeller	-	cast iron, statically and dynamically balanced
3.	Pump shaft	-	Type 420 stainless steel, or 1045 carbon steel with Type 420 stainless steel sleeve
4.	Exposed bolts, nuts, washers	-	Type 316 stainless steel

5.	Mechanical seals	-	Independently operating tandem tungsten-carbide or silicon carbide and carbon rings with stainless steel springs
6.	Wear rings	-	Type 304 or 416 stainless steel and nitrile rubber with steel insert, with a Brinell hardness of 300 on impeller and 350 on case

2.3 MOTOR

A. **Approval:** The pumping system, including the motor and wiring, shall be approved by a nationally approved testing agency for explosion-proof service. The system shall be classified per the operating conditions specified. The CONTRACTOR shall include in the bid a copy of the certificate of approval.

B. **Insulation:** The pump motors shall be designed for continuous duty in hazardous locations. The stator and stator leads shall be moisture-resistant, triple varnished and insulated according to Class F, capable of withstanding a temperature rise of up to 155 degrees C. The allowable temperature rise of the motor at full load condition shall not exceed 80 degrees C.

C. **Stator:** The motor stator shall be mounted in an air-filled, watertight casing, and shall not be fixed in place by externally-mounted screws which may cause leakage in the motor.

D. **Rating:** The motor shall be non-overloading all throughout the pump curve and shall have a combined service factor of 1.10 or greater.

E. **Junction Box:** The motor shall have a junction box capable of being sealed completely from the stator casing to prevent leakage through the junction box into the stator housing should a motor cable be damaged, or some other means to prevent leakage into the junction box under any condition.

F. **Cable Entry:** The cable entry water seal design shall be such that it precludes specific torque requirements to ensure a watertight and submersible seal. It shall permit no entry of water into any high voltage area even if the cable is severed below the water levels.

G. **Cooling System:** Each pump shall be provided with an adequately designed cooling system using a wastewater jacket and thermal radiator integrally cast with the stator casing. Cooling medium channels and ports shall be non-clogging by virtue of their dimensions. Wastewater jackets are not required for motors which are designed to operate continuously at full load with ambient cooling.

H. **Motor Protection:** Integral thermal sensors in the motors, one for each phase, shall be provided to monitor stator temperatures. These sensors shall be used in conjunction with and supplemented by external motor over-current protection fitted at the control panel.

I. **Moisture Sensor**: The motor shall have a sensor to detect moisture in the motor and appropriate relay to provide contact closure upon sensing moisture.

2.4 PUMP CONTROLS FOR FILTER INFLUENT PUMPS (5-P-1, 5-P-2)

A. **General:** Pump controls shall be resident on the VFD.

2.5 PUMP CONTROLS FOR REJECT WATER PUMPS (8-P-1, 8-P-2)

A. The CONTRACTOR shall provide a complete control system housed in a weatherproof cabinet with a hinged, gasketed door and mounting brackets or a pedestal, complying with the area designation in Section 16050 – Electrical, General Provisions, and all necessary components to provide the following functions for each pump:

1. Magnetic starter

2. Circuit breakers

3. Hand-off-automatic selector switch

4. Pilot lights

5. Pump control and alarm contacts as shown on instrumentation and mechanical drawings.

6. Alarm reset switch

7. Tipping float level control switches with sealed cables and a stainless steel wall bracket in accordance with Section 17107.

8. Level control relays shall be intrinsically safe.

9. Electric alternator / Lead-Lag switch

10. Provide for external contact closures from pump discharge check valves for “NO FLOW “ shutdown of each pump.

2.6 SPARE PARTS

A. **General:** The pumps shall be backed by supplies of spare parts from stock, and after-sales service from a factory trained and authorized maintenance facility.

B. **Parts to be furnished for each type of pump:**

1. One set of mechanical shaft seals.

2. One set of wear rings.

3. One set of bearings.

4. Three sets of O-rings and gaskets.

2.7 FACTORY TESTING AND SHIPMENT

A. In addition to the factory tests specified in Section 11100 - Pumps, General, the following procedures shall be included with the factory test prior to shipment:

1. Verification of the pump characteristic curves by testing at 1/4, 1/2, 3/4, and full flow and recording the measured head and motor current for each flow.

2. Verification of cavitation-free service and absence of motor overheating during conditions simulating the actual operating conditions after installation, whether submerged, semi-submerged, or dry.

3. Pump seals shall be designed for complete water tightness at 65 feet submergence for 30 minutes and data on factory testing and quality control shall be submitted with the shop drawings.

4. All parts shall be properly lubricated and protected so that no damage or deterioration will occur even during a prolonged delay from the time of shipment until installation is completed and the pumps are ready for operation.

5. Finished ferrous surfaces not painted shall be properly protected to prevent rust and corrosion.

6. The finished surfaces of all exposed flanges shall be protected by strong wooden blind flanges.

7. Each pump shall be properly crated to protect the units against damage during shipment.

2.8 MANUFACTURERS, OR EQUAL

A. **Fairbanks Morse Pump;**

B. **Flygt Corporation;**

C. **K.S.B. Pumps;**

D. **Pumpex, Inc.**

PART 3 -- EXECUTION

3.1 INSTALLATION

A. In addition to the requirements of Section 11100 - Pumps General, the CONTRACTOR shall ensure that all anchor bolts be set only after the discharge piping has been properly installed, to ensure exact fit with embedded piping components.

3.2 SERVICES OF MANUFACTURER

A. **Inspection, Startup, and Field Adjustment:** The service representative of the Manufacturer shall be present at the site for 1 work day, to furnish the services required by Section 11100 - Pumps, General.

B. **Instruction of GOVERNMENT'S Personnel:** The training representative of the Manufacturer shall be present at the site for 1 work day to furnish the services required by Section 11100 - Pumps, General.

C. For the purposes of this paragraph, a work day is defined as an eight hour period, at the site, excluding travel time.

- END OF SECTION -

SECTION 11200 - MIXERS AND FLOCCULATORS, GENERAL

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide mixers, flocculators and appurtenances, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 11000 - Equipment General Provisions apply to the WORK of this Section.

C. This Section applies to all mixers and flocculators in the Contract Documents, unless indicated otherwise.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

ANSI/NFPA 70	National Electric Code
ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800
ANSI B16.5	Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and Other Special Alloys
ANSI/ASME B31.1	Power Piping
ANSI/ASME B73.1	Specifications for Horizontal End Suction Centrifugal Pumps for Chemical Process
ANSI/IEEE 112	Test Procedure for Polyphase Induction Motors and Generators
ANSI/IEEE 115	Test Procedure for Synchronous Machines
ASTM A 48	Gray Iron Castings
ASTM A 470	Vacuum-Treated Carbon and Alloy Forgings for Turbine Rotors and Shafts
ASTM A 536	Ductile Iron Castings
ASTM B 62	Composition Bronze or Ounce Metal Castings
Latest Edition	Hydraulic Institute Standards for Centrifugal, Rotary, and Reciprocating Pumps

1.3 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01300 - Contractor Submittals.

B. Shop Drawings

1. Equipment name, identification number and specification number.

2. Performance data.

3. The CONTRACTOR shall require the manufacturer to indicate the limits recommended for stable operation between which the pumps, mixers, and flocculators may be operated without surge, cavitation, or vibration. The stable operating range shall be as wide as possible based on actual hydraulic and mechanical tests.

4. Equipment detailed description and specification.

5. Electrical data including control and wiring diagrams.

6. Assembly and installation drawings including shaft size, seal, coupling, anchor bolt plan, part nomenclature, material list, outline dimensions and shipping weights.

7. Drive and motor data in accordance with Section 16460 - Electric Motors.

C. **Certification:** The CONTRACTOR shall obtain written certification from the manufacturer, addressed to the GOVERNMENT, stating that the equipment will efficiently and thoroughly perform the required functions and that the manufacturer accepts joint responsibility with the CONTRACTOR for coordination of all equipment, including motors, drives, controls, and services required for proper installation and operation of the completely assembled and installed units. The CONTRACTOR shall submit all such certificates to the CONTRACTING OFFICER.

D. **O & M Manuals:** Prior to start-up, furnish complete operations and maintenance manuals in accordance with Section 01300. Printed instructions relating to proper maintenance, including lubrication, and parts lists indicating the various parts by name, number, and diagram where necessary, shall be furnished in duplicate with each unit or set of identical units. Instructions for field procedures for erection, adjustments, inspection, and testing shall be provided prior to installation of the equipment.

1.4 MANUFACTURER'S SERVICE REPRESENTATIVE

A. **Erection and Startup Assistance:** Service and instruction assistance by the manufacturer's engineering representative for each piece of equipment 10 hp and larger shall be furnished by the CONTRACTOR during the following periods:

1. One day during erection.

2. One day during startup.

B. **Instruction of GOVERNMENT's Personnel:** The CONTRACTOR shall furnish the services of a factory service representative to instruct the GOVERNMENT'S personnel in the operation and maintenance of the equipment. This service shall consist of a one day's visit to the plant for each type of similar equipment.

1.5 GUARANTEES, WARRANTIES

A. After completion, the CONTRACTOR shall furnish to the GOVERNMENT the manufacturer's written guarantees, that the equipment will meet the published data and

these Specifications. The CONTRACTOR shall also furnish the manufacturer's warranties as published in its literature and as specified.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Equipment provided under this Section shall be new, current models of reputable manufacturers specializing in such products; and having had previous experience in such manufacture. Upon request of the CONTRACTING OFFICER, the manufacturer shall furnish the names of not less than 5 successful installations of its equipment of comparable nature to that in this Section.

B. Where 2 or more units of the same type and/or size of equipment are required, such units shall all be produced by the same manufacturer.

2.2 MATERIALS

A. Materials shall be suitable for the intended application; material not specifically called for shall be high-grade, standard commercial quality, free from all defects and imperfections that might affect the serviceability of the product for the purpose for which it is intended. Unless otherwise indicated, materials shall conform to the following requirements:

1. Cast iron casings shall be of close-grained gray cast iron, conforming to ASTM A 48, or equal.

2. Bronze impellers shall conform to ASTM B 62.

3. Stainless steel shafts shall be of Type 300 or 400 Series, as best suited for the purpose. Miscellaneous stainless steel parts shall be of Type 316 except in septic environment.

4. All anchor bolts, nuts and washers shall be in accordance with Section 05500 - Miscellaneous Metalwork.

2.3 APPURTENANCES

A. **Nameplates:** Each piece of equipment shall be equipped with a stainless steel nameplate indicating rated performance, size, speed, and manufacturer's name and model number.

B. **Solenoid Valves:** The equipment manufacturer shall provide any solenoid valves on water or oil lubrication lines and on all cooling water lines. Solenoid valve electrical rating shall be compatible with the motor control voltage and shall be provided complete with all necessary conduit and wiring installation from control panel to solenoid.

C. **Pressure Gauges:** All pumps shall be equipped with pressure gauges installed at pump suction and discharge lines. Pressure gages shall be located in a representative location, where not subject to shock or vibrations, in order to achieve true and accurate readings. Pressure gauges shall be furnished in conformance with Section 17108 - Pressure Measuring Systems.

D. **Variable Speed Drives:** Variable speed drives, speed control equipment, and accessories shall be provided in accordance with Section 16455 - Variable Frequency Drive Units.

E. **Motors:** Motors shall be heavy duty and shall comply with Section 16460.

F. **Flanges:** Equipment flanges shall conform to ANSI B16.1 or B16.5 dimensions.

G. **Lubrication:** Equipment shafts, bearings, gears, and other moving parts shall be grease, oil, or product lubricated. All lubricating points shall be filled with the recommended lubricants.

H. **Equipment:** Gland seals, air valves, and cooling water drains, and drains from variable speed drive equipment shall be piped to the nearest floor sink or drain, with galvanized steel pipe or copper tube, properly supported with brackets.

I. **Equipment Seals:** Seals on equipment shafts shall be the manufacturer's suggested best quality mechanical seals or stuffing boxes, as best suited for each individual application. Where necessary, such seals shall be oil lubricated or water-flushed.

2.4 TOOLS AND SPARE PARTS

A. **Tools:** Special tools necessary for maintenance and repair of the equipment and one pressure grease gun for each type of grease required for pumps, mixers, flocculators, and motors shall be furnished as a part of the work hereunder; such tools shall be suitably stored in metal tool boxes, and identified with the equipment number by means of stainless steel or solid plastic name tags attached to the box.

B. **Spare Parts:** Furnish the following, in addition to the requirements of the individual mixer and flocculator sections. Package the spare parts in a labeled box as required above for tools.

1. Seals, packing, gaskets, wear rings

2. Other parts subject to wear

3. Parts specific to mixers

    a. 1 impeller

    b. 1 gearbox

    c. 1 set of printed circuit control boards, if applicable.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. **General:** Equipment shall be installed in accordance with the Shop Drawings and as indicated.

B. **Alignment:** Equipment shall be field tested to verify proper alignment, operation as indicated, and freedom from binding, scraping, overheating, vibration, shaft runout, or

other defects. Drive shafts shall be measured just prior to assembly to ensure correct alignment without forcing. Equipment shall be secure in position and neat in appearance.

C. **Lubricants:** Installation shall include the necessary oil and grease for initial filling and one year's operation.

3.2 ACCEPTANCE

A. In the event of failure of any equipment to meet any of the above requirements or efficiencies, the CONTRACTOR shall make all necessary modifications, repairs, or replacements to conform to the requirements of the Contract Documents and the equipment shall be re-tested until found satisfactory.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 11210 - VERTICAL-SHAFT FLOCCULATOR UNITS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide vertical-shaft flocculating assemblies and appurtenant equipment, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 11000 - Equipment General Provisions, apply to this Section.

C. The requirements of Section 11200 - Mixers and Flocculators, General, apply to this Section.

1.2 CONTRACTOR SUBMITTALS

A. Submittals shall be in accordance with Section 11200.

B. **Calculations**: The CONTRACTOR shall submit the Manufacturer's calculations, certified by a professional engineer, for the gear rating and bearing life of the unit.

PART 2 -- PRODUCTS

2.1 GENERAL

A. **Design:** All flocculators shall be hydrofoil-type impeller units of the same design and manufacture. All parts shall be designed and proportioned for ample strength, stability, and stiffness for the intended purpose. Ample space and access shall be provided for inspection, repairs, lubrication, and adjustment. Each flocculator and drive assembly shall be designed for 24-hour-a-day continuous service and shall be built in accordance with the current AGMA Standards. The assemblies shall be suitable for out-of-doors service and shall be of weatherproof construction.

B. **Motors:** All motors shall be of the heavy-duty (high-efficiency) TEFC type, in accordance with Section 16460 - Electric Motors.

C. **Anchorage:** The CONTRACTOR shall provide equipment Manufacturer recommended stainless steel anchor bolts, nuts, and washers, but the Manufacturer shall furnish templates necessary for setting the equipment. Placement of the anchor bolts shall be performed by the CONTRACTOR from certified dimension prints supplied by the equipment Manufacturer. Anchor bolts shall be in accordance with Section 05500 - Miscellaneous Metalwork.

D. **Factory Test:** Each flocculation unit shall be subjected to a full size scale factory test by the Manufacturer of the units, in the exact field dimensions.

2.2 FLOCCULATOR UNITS

A. **General:** Each flocculator unit shall consist of an impeller mounted on a vertical shaft, suspended from a pedestal, and shall include a speed reducing drive unit with shaft

bearings, coupling, electric motor, a mounting flange and a CONTRACTOR furnished cover plate, and a base. No underwater bearings will be permitted.

1. The units shall be designed to transmit to the water the indicated velocity gradient "G" based on the minimum water temperature indicated below, to provide an adequate pumping capacity, and to produce eddies which are essential to the flocculation process, at a minimum shear.

B. **Criteria:** The flocculators shall meet the following design criteria:

1.	Identification number(s)	-	7-ME-1; 7-ME-2
2.	Total number of units	-	2
	Stage 1 - number of units	-	1 (7-ME-1)
	Stage 2 - number of units	-	1 (7-ME-2)
3.	Compartment dimensions for each flocculator (ft by ft)	-	10 by 10
4.	Approximate water depth (ft)	-	9.5
5.	Top of tank to bottom of tank (ft)	-	11.5
6.	Ratio of impeller diameter to tank diameter (min)	-	0.35
7.	Maximum impeller tip speed (fps)	-	6.0
8.	Maximum velocity gradients "G" - for 2 stages only (sec^{-1})		
	Stage 1	-	15 to 90
	Stage 2	-	15 to 90
9.	Minimum motor horsepower per unit		
	Stage 1 flocculators	-	½
	Stage 2 flocculators	-	½

C. **Drive:** Flocculators shall be driven by a heavy-duty direct drive (high efficiency) electric motor with coupling and gear reducer and a DC-SCR type variable speed control unit capable of an infinitely variable speed control unit within the “G” value specified.

1. The drive unit motor or VFD shall include an external on-off switch and an internal contact for remote indication of operation.

2. Each drive assembly shall be of ample capacity to supply the required power and torque output at all speed settings within the speed range. Motor and gear reducer shall be equipped with lifting lugs.

D. **Gear Reducer:** Each gear reducer shall be of the horizontal right-angle type, ruggedly encased in a cast iron or fabricated steel heavy duty housing designed for the conditions it will encounter. Gears shall be helical or spiral bevel type or a combination of both. Worm gear arrangements will not be acceptable. The reducer shall be designed and manufactured in accordance with the AGMA Standard and shall have a service factor of 1.5 based upon the full motor nameplate horsepower at maximum operating speed.

Bearings shall be grease- or oil-lubricated with a minimum L-10 life of 100,000 hours, sufficiently sized to stabilize the impeller assembly under all operating conditions.

E. **Setting:** Each drive assembly shall be furnished with a CONTRACTOR supplied and Manufacturer approved steel base for mounting to the supporting structure, and with a cover plate to support the unit. The cover plate shall be drilled and cut to match the mixer base, and it shall have anchor bolts set into the concrete slab.

F. **Lubrication:** Lubrication of each speed reducer shall be by means of an efficient oil splash mechanism. The drive shall be provided with a dip stick to observe oil level. Each drive must have an effective drywell feature to eliminate oil leakage down the output shaft. Output shaft bearings may be grease lubricated, including a high quality lip seal to retain grease. All oil fill and drain lines and grease fittings shall be in easily accessible locations, at a minimum of 10 inches above the mixer mounting surface.

G. **Impeller and Shaft:** Mounted at the end of each flocculator shaft shall be a stainless steel impeller bolted to a cast hub. All submerged nuts, bolts, and washers shall be Type 316 stainless steel. The hub shall be of sufficiently large diameter, and impellers shall be designed to assure maximum efficiency by preventing central backflow. The impeller assembly shall be securely keyed to the shaft. Shaft stresses shall be limited to 9,000 psi and impeller stresses to 12,000 psi.

H. **Impeller Adjustment:** The impeller shaft shall be of Type 316 stainless steel. The impeller shall be connected to the shaft with a hook key for security. An extended keyway shall be provided to allow for vertical adjustment of each impeller in 3-inch increments 12 inches from its recommended position.

I. **Shaft Coupling:** The lower mixer shaft shall be connected to the upper, or drive output shaft, by means of a rigid flanged coupling, of either the welded or interference fit hub type. Mating coupling faces shall have a rabbeted male and female pivoted connection for accurate concentricity, and shall not require match marks for alignment. The coupling shall be designed to minimize shaft run-out, and it shall be located near the tank deck level.

J. **Structural Strength and Stability:** Structural members and connections shall be designed to withstand, within normal working stresses and deflections, all loads imposed on them by rotation of the assembly at maximum design speeds submerged and dry, as well as loads which may be superimposed during or subsequent to erection while the basins are empty. The shaft shall be designed for a maximum stress not to exceed 11,000 psi while under maximum operating loads. The shaft shall be of the overhung design and the use of bottom steady bearings shall not be permitted. The shaft impeller design shall be such that the operating speed shall not exceed 70 percent of the first lateral critical speed. Lower shaft straightness, rigid coupling squareness, and output shaft accuracy shall give a maximum runout at the lower end of the shaft of 1/8-inch for every 10 feet of overhang, as measured when turning over by hand.

2.3 MANUFACTURERS, OR EQUAL

A. Chemineer, Inc. (Robbins and Meyers)

B. Lightnin;

C. Philadelphia Mixer Corporation

PART 3 -- EXECUTION

3.1 INSTALLATION

A. General installation requirements shall be in accordance with Sections 11000 and 11200.

B. Placement of the anchor bolts shall be determined by the CONTRACTOR from certified dimension prints supplied by the equipment Manufacturer.

- END OF SECTION -

SECTION 11214 - SUBMERSIBLE SAMPLING PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish submersible sampling pumps, manufactured in the United States, in accordance with the drawings and specifications. All pumps shall equal or exceed the requirements set forth herein. All pumps shall be new and currently under manufacture. Each pumping unit shall be complete with a pump, electric motor, and all other appurtenances specified or otherwise required for proper operation.

1.2 CONTRACTOR SUBMITTALS

A. Submit manufacturer's shop drawings, installation instruction, and operation and maintenance manual in accordance with Section 01330. Shop drawings shall include all information necessary to verify compliance with these specifications.

PART 2 - PRODUCTS

2.1 SYSTEM CAPACITY AND ELECTRICAL REQUIREMENTS

A. The submersible pump and motor shall be designed for continuous submerged operation. The pump shall be driven by a motor attached below the pump section. The pump unit shall be a Grundfos Pump, Model no. 5S03-9, or equal.

B. The pump shall have a capacity of 5 gpm when operating against a total dynamic head of 40 feet of water.

C. The motor shall be 1/2 horsepower or less, rated for 115 volts, 1 phase, 60 hertz.

D. The cable between the motor and service entry shall be as indicated on the drawings.

2.2 PUMP DESIGN

A. Each pump shall have a check valve integrally designed into the pump discharge housing.

B. The pumping downthrust shall be absorbed by the motor thrust bearing.

C. Each impeller shall be fitted with a seal ring around its eye or skirt to prevent hydraulic losses.

D. A filter screen shall be included as part of the suction inlet assembly.

2.3 MATERIALS OF CONSTRUCTION

A. The pump bowls, impellers, guide vanes, strainer, and check valve shall be 300 series stainless steel. No moving parts shall be constructed from plastic or other brittle materials.

B. The intermediate and top bearings shall be Nitrite Rubber.

2.4 MOTOR DESIGN

A. The motor shall be a squirrel-cage induction motor designed for continuous underwater operation in conformance with NEMA standards.

B. The motor shall have a Kingsbury-type thrust bearing capable of carrying the maximum pump thrust loads.

C. The motor shall be water filled for cooling and lubrication. No oils or grease lubrication shall be used.

D. A flexible diaphragm shall be provided to permit expansion and contraction of the internal motor fluid when the motor heats and cools during operation.

E. A shaft seal shall be provided to ensure that the internal motor fluid is not mixed with the pumped fluid.

2.5 MOTOR MATERIALS OF CONSTRUCTION

A. The motor diaphragm shall be Nitrite Rubber or Type 100 Hydrin.

B. The shaft seal shall be a Nitrite Rubber lip seal or a Nitrite, Carbon, Carbide, and/or Ceramic face seal.

C. The motor shall be 200 or 300 Series stainless steel.

2.6 ELECTRICAL PROTECTION

A. Electrical protection shall be in accordance with the motor manufacturer's recommendations.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation of submersible sampling pumps shall be in accordance with the CONTRACTING OFFICER - approved manufacturer's installation instructions.

- END OF SECTION -

SECTION 11237 - ROTATING PIPE SKIMMERS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall furnish and install lever operated rotating pipe scum skimmers complete with appurtenances as shown on the drawings and specified herein, for installation in chlorine contact tank.

1.2 RELATED WORK SPECIFIED ELSE WHERE

A. Equipment General Provisions 11000

B. Protective Coating 09800

PART 2 -- PRODUCTS

2.1 DESIGN

A. **Rotating Pipe:** Each skimmer shall be 10-inch diameter Schedule 40 Stainless Steel Type 316 pipe with 60^0 accurately machined slots. There will be a 4" long continuous band of steel between adjacent slots. Slots in the pipe shall have milled edges which are straight and true with the centerline of the pipe. Both ends shall be perpendicular to the axis of the pipe and shall be smooth and free from burrs.

B. **Wall Brackets:** The wall bracket shall be made of Stainless Steel Type 316 with neoprene seals and shall have a flat surface for attaching to the wall of the tank. The wall brackets are to have slotted holes to permit vertical alignment of the skimmer. The sleeve shall be made of 316 Stainless Steel and have four lugs to receive adjustment bolts to compress the seals.

C. **Seals:** The glands shall have 1/2" diameter round neoprene gaskets and 1/4" thick neoprene gasket material shall be provided between the wall bracket and the concrete walls of the tank to provide an effective seal.

D. **Handle:** The skimmer shall have a welded handle of suitable length for turning the skimmer conveniently from the operating floor. The handle shall be made of 1-1/4" standard Schedule 40 Stainless Steel Type 316 and attached in a manner so that skimming operation may be performed in either direction.

E. **Wall Sleeves:** Pipe walls sleeves shall extend through the walls where required to permit flow between skimmers and the discharge of skimmings from the tanks.

F. **Manufacturer or Equal:** Eimco Process Equipment Company

PART 3 -- EXECUTION - (Not Used)

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 11258 – CHEMICAL FEEDING EQUIPMENT, GENERAL

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall furnish and install all chemical feeding equipment shown and specified, complete with metering and transfer pumps, tanks, motors, drives, mixers, feeders, meters, conveyors, control panels, piping, valves, controls, and accessories to transfer, dilute, mix, and feed chemicals and solutions, complete and operable, in accordance with the requirements of the Contract Document.

B. All equipment and items furnished shall be from manufacturers with a minimum of 5 years of experience in the manufacture and assembly of similar products, with a record of successful installations. Such manufacturers shall maintain a well established, authorized, local service agency with sufficient spare parts and personnel to respond within 48 hours to any service calls.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Codes:** All codes, as referenced herein, are specified in Section 01090, "Reference Standards."

ANSI/NFPA 70	The National Electric Code

1.3 CONTRACTOR SUBMITTALS

A. **Shop Drawings:** Complete fabrication, assembly, foundation, and installation drawings, together with detailed specifications and data covering materials used, power drive assemblies, parts, devices, pumps, tanks, mixers, supports, panels, and other accessories forming a part of the equipment furnished as well as schematics, diagrams, and panel layouts, shall be submitted for review in accordance with Section 01300, "Contractor Submittals."

B. **Certification:** The CONTRACTOR shall obtain written certification from the manufacturer, addressed to the GOVERNMENT, stating that the equipment will efficiently and thoroughly perform the required functions in accordance with these specifications and as indicated on the drawings, that all the materials are best suited for the chemicals handled, and that the manufacturer accepts joint responsibility with the CONTRACTOR for coordination of all equipment, including motors, variable speed drives, controls, and services required for proper installation and operation of the completely assembled and installed unit. The CONTRACTOR shall submit all such certificates to the CONTRACTING OFFICER.

C. **O & M Manuals:** Prior to start-up the CONTRACTOR shall furnish to the GOVERNMENT complete operations and maintenance manuals in accordance with Section 01300, "Contractor Submittals.

D. **Tools:** Special tools necessary for maintenance and repair of the equipment and one pressure grease gun for each type of grease required for the equipment, shall be furnished as a part of the WORK hereunder; such tools shall be suitably stored in metal

tool boxes, and identified with the equipment number by means of stainless steel or solid plastic name tags attached to the box.

E. **Spare Parts:** The CONTRACTOR shall obtain from the manufacturer a list of suggested spare parts of all items of each piece of equipment subject to wear, such as seals, packing, gaskets, nuts, bolts, washers, wear rings, etc., as well as a set of spare bearings. He shall furnish all these parts suitably packaged and labelled in a box as described above for tools.

F. **Maintenance:** Printed instructions relating to proper maintenance, including lubrication, and parts lists indicating the various parts by name, number, and diagram where necessary, shall be furnished in duplicate with each unit or set of identical units. A recommended spare parts list shall be included.

G. **Field Procedures:** Instructions for field procedures for erection, adjustments, inspection, and testing shall be provided prior to installation of the equipment.

H. **Calibration Graphs:** The manufacturer's representative shall prepare a calibration graph from field tests for each chemical feed unit which does not have a rate set device reading in pounds per hour for dry feeders, or in gallons per hour for liquid feeders. The graph shall show the rate setter graduation conversion to pounds per hour or gallons per hour throughout the range of the feed unit. Each graph shall be furnished on hard paper and sealed in clear plastic.

1.4 MANUFACTURER'S SERVICE REPRESENTATIVE

A. **Erection and Startup Assistance:** Service and instruction assistance by the manufacturer's engineering representative for each equipment unit shall be provided by the CONTRACTOR during the following period:

One day during erection, unless otherwise specified.

One day during startup, unless otherwise specified.

B. **Instruction of GOVERNMENT's Personnel:** The CONTRACTOR shall provide for the services of a factory service representative to instruct the GOVERNMENT's personnel in the operation and maintenance of the equipment. This service shall consist of a minimum one-day's visit to the plant for each type of similar equipment.

1.5 CLEANUP

A. After completion of the installation and testing, the CONTRACTOR shall remove all debris from the site, clean all the equipment and controls, and hand over the work in perfect operating condition.

1.6 GUARANTEES, WARRANTIES

A. After completion, the CONTRACTOR shall furnish to the GOVERNMENT the manufacturer's written guarantees that the equipment will operate with the published efficiencies, heads, criteria, and flow ranges and meets these specifications. The CONTRACTOR shall also furnish the manufacturer's warranties as published in its literature and as specified.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Wherever it is specified that a single manufacturer shall be responsible for the compatible and successful operation of the various components of any equipment unit, it shall be understood to mean that the CONTRACTOR shall furnish and install only such equipment as the designated manufacturer will certify is suitable for use with its equipment and with the further understanding that this in no way constitutes a waiver of any specified requirements.

B. All manufactured items provided under this Section shall be new, of current manufacture, and shall be the products of reputable manufacturers specializing in the manufacture of such products.

C. Where 2 or more units of the same type and/or size of equipment are required, such units shall all be produced by the same manufacturer.

2.2 MATERIALS

A. **General:** All materials employed in the equipment shall be suitable for the intended application; materials not specifically called for shall be high-grade, standard commercial quality, free from all defects and imperfections that might affect the serviceability of the product for the purpose for which it is intended.

B. **Corrosion Resistance:** All materials used in the construction of chemical feeding equipment shall be resistant to corrosive attacks from the chemicals. The following table lists the most commonly used chemicals for water and wastewater treatment and some of the suitable materials for the construction of chemical feeding equipment. Unless the manufacturer suggests more suitable, approved materials, the following table shall be adhered to:

Chemical	Suitable Handling Material
Alum: (Al_2 (SO_4)3.XH_2O) solution	Hastelloy C Type 316 stainless steel Carpenter 20 (stainless steel) Lead Titanium FRP PVC, CPVC Teflon EPDM Buna N Neoprene Viton Saran Hypalon Tyril Rubber

Polymers:	Type 316 stainless steel
(Ionic)	PVC
(Cationic)	FRP (suitable grade)
(Nonionic)	Teflon
	Polypropylene
Sodium Hypochlorite:	Hastelloy C
(NaOCl)	Titanium
	PVC
	Viton
	Penton
	Hypalon
	Vinyl
	Saran
	Rubber
	Polyethylene
	Tyril
	Glass

2.3 APPURTENANCES

A. **Nameplate:** Each piece of equipment shall be equipped with a stainless steel nameplate, indicating equipment characteristics, capacity, motor horsepower, speed, electrical characteristics, manufacturer, model number, and serial number.

B. **Solenoid Valves:** The equipment manufacturer shall furnish and install all solenoid valves which are part of the chemical feeding unit. The solenoid valve electrical rating shall be compatible with the equipment voltage and valves shall be furnished complete with the necessary conduit and wiring from the control panel to the solenoids. The valve material shall be suitable for the intended service in accordance with the Section 15230 - Miscellaneous Valves.

C. **Pressure Gages:** All chemical transfer and metering pumps, and other equipment, where shown, shall be equipped with pressure gages with diaphragm seals in accordance with Section 17108 - Gages, except that the size of gages on small metering pumps may be smaller than specified in the above section.

D. **Equipment Supports:** All chemical feeding equipment and piping shall be firmly supported on concrete equipment pads and anchored down. Fabricated metal supports exposed to chemical spills shall be of type 316 stainless steel or enameled steel. All anchor bolts, nuts, and washers of such supports shall be of type 316 stainless steel, with an antiseize compound on the threads.

E. **Variable Speed Drives:** Variable speed drives, drive motors, speed control equipment, and accessories shall be furnished in accordance with Section 16455 - Variable Frequency Drive Units.

F. **Controls:** Controls shall be housed in enclosures with NEMA ratings which comply with the area designations of Section 16050 - Electrical General Provisions.

G. **Safety Equipment:** Where required by Code, all chemical unloading, storage, and feeding equipment shall be furnished with the necessary safety devices and warning signs, clearly visible.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. **General:** Chemical feeding equipment shall be installed in accordance with governing safety standards and approved procedures submitted with the shop drawings and as indicated on the drawings, unless otherwise approved by the CONTRACTING OFFICER.

B. **Alignment:** Equipment shall be field tested to verify proper alignment, operation as specified, and freedom from binding, scraping, vibration, shaft runout, or other defects. Drive shafts shall be measured just prior to assembly to ensure correct alignment without forcing. Equipment shall be secure in position and neat in appearance.

C. **Lubricants:** The installation work shall include furnishing the necessary oil and grease for initial lubrication and testing of all equipment.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 11259 – METERING PUMPS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall furnish and install chemical metering pumps, together with all drives, motors, valves, supports, controls, accessories, and appurtenances necessary for feeding chemical solutions in treatment plants, complete and operable, in accordance with the requirements of the Contract Documents.

PART 2 -- PRODUCTS

2.1 GENERAL

A. The pumps shall be of corrosion-resistant construction, and diaphragm and seals shall be a suitable material for the chemicals indicated. The pumps shall be constructed of suitable material for the ambient environment, including temperature ranges between 20 - 130 degrees F. Each pump shall be complete with pump base, drive, diaphragm, check valves, back-pressure valve, internal relief valve, pulsation dampener, coupling guard and electric motor. A complete set of extra diaphragms and seals shall be furnished with each pump. Size and characteristics of the pumps shall be as specified herein.

2.2 CONSTRUCTION

A. **Type and Range:** The pumps shall be of hydraulically actuated diaphragm type, suitable for metering service, with an adjustable stroke (dosage) control range of 10:1 with accuracy of 1.0 percent of the full-scale range. Pumps requiring variable speed drives shall have a set speed range of 10:1 which, in conjunction with the stroke control, shall provide a total feeding range of 100:1, minimum. Pump speed shall be less than 60 strokes per minute.

B. **Materials:** Wetted parts of all metering pumps shall be selected by the manufacturer to ensure optimum, corrosion-free, and erosion-free operation for the chemicals involved. Pumps for polymer service shall be suitable for feeding cationic, nonionic, or anionic polymer solutions having a maximum viscosity of 3,000 centipoise.

2.3 CONTROL

A. The dosage of metering pumps shall be set at each metering pump control station. The drive speed of each metering pump shall vary automatically in response to a 4-20 mA flow signal input from a flow meter (see control descriptions for appropriate flow meter) and shall be adjusted manually in order to maintain a pre-set dosage.

2.4 SCHEDULE OF METERING PUMPS

I.D. No.	Chemical	Feed Range (gph)	Min Head (psi)	Min Motor (hp)	Installation	Type of Drive
10-FD-1	Alum / Polymer Blend	0-10	100	½	Outdoor	Variable Speed (DC-SCR)
10-FD-2	Alum / Polymer Blend	0-10	100	½	Outdoor	Variable Speed (DC-SCR)
11-FD-3	Sodium Hypochlorite	0-10	100	¾	Indoor	Variable Speed (DC-SCR)
11-FD-4	Sodium Hypochlorite	0-10	100	¾	Outdoor	Variable Speed (DC-SCR)
11-FD-5	Sodium Hypochlorite	0-10	100	¾	Outdoor	Variable Speed (DC-SCR)

2.5 PUMP ACCESSORIES

A. **Mounting and Connections:** Unless otherwise shown, all metering pumps shall be mounted on stainless steel pedestals and provided by supplier. They shall be provided with corrosion-resistant pulsation dampeners, sample valves, pressure gages with diaphragm seals, shut-off valves, check valves, relief valves, valved and graduated calibration chambers in pump suction, flush connections with check and solenoid valves, to stay open long enough after each pump shutdown to flush out the line. Dilution lines shall be connected by means of PVC injectors. All pipe connections to feeders must be firmly supported to avoid any stress on the feeder.

2.6 SPARE PARTS

A. All chemical feeders shall be furnished with a complete set of one year's manufacturer suggested spare parts, such as seals, packing, gaskets, belts, and any other parts subject to wear. Where applicable, one set of spare bearings shall be furnished with each piece of equipment.

2.7 MANUFACTURER

A. **Manufacturer's Experience:** The chemical feeding equipment shall be the product of a manufacturer who has designed and manufactured similar equipment and has a record of at least 5 years of successful operation of this type of process. The CONTRACTOR may be required to submit evidence to this effect together with a representative list of installations. The pump manufacturer shall maintain a permanent, local service department and a spare parts department.

B. Manufacturers**,** or Equal:

1. **Milton Roy;**

2. **Pulsafeeder (Chemwest);**

3. **Wallace and Tiernan (Pennwalt).**

C. **Unit Responsibility:** The CONTRACTOR shall assign to a single manufacturer full responsibility for the furnishing and functional operation of the chemical feeder system along with all related tanks, mixers, pumps, piping, valves and controls. The designated single manufacturer, however, need not manufacture more than one part of the system but shall coordinate the design, assembly, testing, and erection of the system as specified herein. The manufacturer of the metering pump shall also manufacture the dry chemical feeders.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Pumping equipment shall be installed in accordance with approved procedures submitted with the shop drawings and as shown, unless otherwise approved.

B. General installation requirements shall be as specified for "Execution" in Section 11100 - Pumps, General.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 11364 - FLOCCULATION SYSTEM

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall furnish and install and place into service a complete, operating flocculation system as shown and specified. The flocculation system shall consist of a two-stage flocculation tank with an overflow and effluent chamber. The system shall include, but is not necessarily limited to, the flocculation tank welded steel tank, two (2) vertical shaft flocculators with control panels, aluminum stairs, aluminum handrails, aluminum grating, supports, piping, pipe nozzles, one slide gate, an adjustable overflow weir, a high water alarm switch and any appurtenant items required for a complete and workable system.

1.2 CONTRACTOR SUBMITTALS

A. **Shop Drawings:** Shop drawings of all mechanical, electrical and instrumentation systems, equipment and parts thereof shall be submitted in accordance with Section 01300 entitled "Contractor Submittals." Shop drawings shall also include structural calculations. Shop drawings shall be submitted complete in a bound package. Partial submittals shall not be acceptable and shall be rejected without review.

B. **Special Tools:** The CONTRACTOR shall furnish one set of any special tools necessary for routine maintenance of the equipment specified. These tools shall be supplied in a metal box properly labeled and identified.

C. **Spare Parts:** The CONTRACTOR shall provide a list of manufacturer's recommended spare parts for one year's service and, after the CONTRACTING OFFICER's approval, shall furnish all recommended spare parts suitably packaged and labeled.

1.3 QUALITY ASSURANCE

A. The entire flocculation system package shall be the sole responsibility of a single supplier.

PART 2 -- PRODUCTS

2.1 GENERAL SYSTEM DESCRIPTION

A. The flocculation system shall be a two-stage flocculation arrangement capable of supplying an infinitely variable velocity gradient over the range of 15 to 90 s^{-1} in each stage. A baffle wall, as shown, shall be provided between stages.

B. The flocculation tank shall include an effluent chamber. The chamber will include an overflow weir and a shut-off slide gate.

C. The flocculation system shall include all stairway, landings, handrails, and grating shown and necessary to adequately access and maintain the system.

D. The flocculation system shall include control panels for each vertical shaft flocculators as described in Section 11210 entitled "Vertical Shaft Flocculator Units.

2.2 SYSTEM REQUIREMENTS

A. The flocculation system shall be designed in accordance with the following criteria.

System Flow

Average	2.0 mgd
Peak	2.0 mgd
Overall Detention Time (Average Flow)	10 min
Number of Stages	2
Stage Dimension (L x W x Water D)	10' x 10' x 9.5
Velocity Gradient Range (Infinitely Variable over Range)	
Stage 1	15 to 90s^{-1}
Stage 2	15 to 90s^{-1}

B. **Modifications:** The drawings illustrate a general system meeting the criteria and intents of this specification. Any modifications as approved by the CONTRACTING OFFICER, to accommodate the equipment supplied shall be executed by the CONTRACTOR without any additional cost to the GOVERNMENT.

C. **Flocculators:** The flocculation system shall employ vertical shaft flocculator units conforming to Section 11200 entitled "Mixers and Flocculators, General" and Section 11210 entitled "Vertical-Shaft Flocculator Units."

D. **Utility Water:** The flocculation system shall include a utility water supply system which will include a hose bib and a foam spray distribution pipe. The flocculation system supplier shall be responsible for the support and attachment supply of the utility water supply system throughout the flocculation system from the point of connection to the utility water supply system indicated on the mechanical drawings.

E. **Slide Gate:** The slide gate shall conform to Section 15254 entitled "Slide/Stop Gates."

F. **Drain Valve:** The two-stage flocculation section of the flocculation tank shall be furnished with a 4-inch drain valve. The drain valve shall be a gate valve conforming to the requirements of Section 15206 entitled "Gate Valves."

G. **High Water Alarm Switch:** The flocculation system will be provided with a high water alarm switch. The switch will be used to provide an alarm to the local HMI and the PLC.

H. **Wiring:** The flocculator control panels and all associated wiring, conduits and devices from the panels to the units shall be designed and supplied by the supplier per criteria shown and specified. Wiring for power to the control panels and wiring and fixtures for lighting at the flocculation tank shall be provided by the CONTRACTOR.

2.3 CONSTRUCTION

A. **Flocculation Tank:** The flocculation tank shall be fabricated of all steel construction. It shall be designed and constructed to be installed on a concrete foundation as shown. The flocculation tank shall be fabricated from steel plate with a minimum thickness of 1/4-inch and shall be suitably reinforced to withstand the hydrostatic pressures and seismic loads encountered.

The design shall consider earthquake forces based on a lateral acceleration of 0.39 g. Special attention shall be given to the situation in which the two-stage flocculation area is drained and the effluent chamber contains fluid to the maximum possible water depth. The flocculation tanks shall be provided with all necessary compartments, flanged piping attachments, overflow weir, baffle walls, plates and the like to form a complete and operable system as shown and specified.

B. **Utility Water and Foam Spray System:** The utility system within the flocculation system shall include all appurtenant piping, valves and supports necessary for a complete and operable system.

C. **Stairs and Elevated Walkways:** Stairs, landings, walkways, grating and handrails shown in the flocculation tank area shall be designed, furnished and installed as part of the flocculation system package. These items shall conform to the requirements of Division 5. The design and construction of these items shall conform to all CAL-OSHA and UBC requirements. Handrails shall be aluminum, three-rail system with kick plate. All grating shall be suitably supported and suitably designed grating made of aluminum. Certain portions of the grating shall be removable so that access to each area of the tank may be achieved. Other items shall be painted steel. The support structure shall also be so designed to support the flocculators and control panels. The design shall include seismic forces of 0.39 g. The stairs, walkways and other portions of the system will require field erection. This field work will be performed by the CONTRACTOR, at the direction of the system supplier.

D. **Protective Coatings:** Protective coating of the flocculation tanks and all elements of the flocculation system shall be as specified in Section 09800, "Protective Coating." Interior surfaces shall be prime and finished coated in the shop. Exterior surfaces shall be prime coated in the shop by the system supplier and finished coated in the field by the CONTRACTOR. The CONTRACTOR shall inform the CONTRACTING OFFICER three (3) weeks in advance of any surface preparation and coating so appropriate inspections may be made.

2.4 OPERATING CONTROLS

A. **General:** The flocculation system supplier shall furnish a complete control system as shown and specified.

B. **Control Mode:** The flocculation system shall be manually controlled at the individual flocculator control panels. Each panel shall allow for start, stop and manual adjustment. of flocculator speed. The panel shall include an on/off selector switch and speed control potentiometer. The control panel shall indicate flocculator speed (as percentage of full speed). The flocculator manufacturer shall provide written indication of velocity gradient value (G) as a function of flocculator speed.

2.5 SUPPLIERS OR EQUAL

A. Eimco Process Equipment Company

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Installation shall be per the supplier's recommendations and as shown.

B. The flocculation system supplier shall be responsible to ensure the flocculation system is installed, inspected and tested to the degree specified and necessary to ensure a complete and operable system.

3.2 SERVICES OF THE SUPPLIER

A. The supplier shall provide the services of a representative for a two-day period to supervise the field erection of the system components. The cost of this service is to be included in the bid price.

B. The system supplier shall provide the services of a representative for a two-day period to supervise the start-up of the system and train the GOVERNMENT's operational staff in its operation. This period may need not be directly following the period described in paragraph 3.1.A. The cost of this service is to be included in the bid price.

- END OF SECTION -

SECTION 11365 - FILTRATION SYSTEM

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. General: The CONTRACTOR shall furnish and install 4 upflow type continuously backwashed sand filters to be operated in parallel, each with an influent silo structure to allow for the equal distribution of flow between filters. Filters will include all necessary filter components, filter media, piping, valves, fittings, controls, gauges, supports, walkways, handrails, and appurtenances to provide a complete and workable system as specified herein, all in accordance with the requirements of the Contract Documents.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Equipment General Provisions. 11000

B. Division 5 - Metals

C. Protective Coatings. 09800

D. Miscellaneous Valves. 15115

1.3 WARRANTY

A. The filter supplier shall provide to the GOVERNMENT a written warranty that the Filter specified herein shall meet the performance and capacity requirements as described in paragraph 2.1 (A) below. The written warranty shall state that In the event of non-compliance to the specified performance, the filter supplier shall make all necessary adjustments and repairs to meet the requirements. If it is determined that the filter is unable to meet the performance and capacity requirement, the filter supplier shall be responsible to provide and install a filter system that will comply.

B. The written warranty shall be submitted to the CONTRACTING OFFICER in accordance with Section 01300 entitled "Contractor Submittals."

1.4 EXPERIENCE

A. The filter supplier shall have had a comprehensive test performed on the filter system by an independent third party in the State of California to show capabilities with the Title 22 requirements.

B. The filter supplier shall have installed in Title 22 applications a minimum of three installations operating for two years or more with filters of the size required for this project. Reference installations shall all have continuous turbidity monitoring capability and coagulant feed capabilities.

PART 2 -- PRODUCTS

2.1 GENERAL SYSTEM DESCRIPTION

A. The filtration system shall be of an upflow, one meter deep bed, monomedia sand, continuous backwash design. The system shall consist of Filters with influent silo

structures designed to split influent flows equally among the filters (see drawings). The drawings and specifications for the filters and related equipment are based on the Parkson Corporation DynaSand Filter equipment. The CONTRACTING OFFICER may consider alternate equipment manufacturers for the filters, should that equipment meet the specifications described herein at the CONTRACTING OFFICER's sole discretion. For consideration of alternate equipment, the proposed filter must be approved for Title 22 applications by the California Department of Health Services. Any costs resulting from the changes to the structure, piping and related equipment required for other acceptable filter equipment, shall be borne by the CONTRACTOR. The CONTRACTOR shall submit drawings to the CONTRACTING OFFICER for approval, showing proposed changes in the design.

B. The filtration system shall include all components necessary for a complete system including but not limited to steel tanks, bottom cones, feed inlet pipes, feed distribution; radials, airlift pipes, internal sand washers, sand distributor cones, reject compartments with weirs and flumes, filter control stations, filter air piping, filter media, reject water piping, filter supports, walkways, steps, handrails and float switches.

2.2 PERFORMANCE AND CAPACITY REQUIREMENTS

A. Each filter shall meet or exceed the following performance and capacity requirements:

Identification No.	-	8-ME-1 to 8-ME-4
Number of Filters	-	4
Filtration Area/Filter (sq. ft.)	-	92
Loading Rate Based on Three Filters in Service @ 2.0 MGD (gpm/sq.ft.)	-	4.63
Filter Application	-	Tertiary Treatment of Secondary Effluent
Average Influent Turbidity (NTU)	-	10
Average Effluent Turbidity (NTU)	-	2
Maximum Head Loss Through the Filter (in)	-	24

2.3 DESIGN AND CONSTRUCTION

A. **Filters:** The factory built filters shall be steel tanks, coated in accordance with Section 09800, "Protective Coatings," with fiberglass internals and PVC airlifts, polyethylene Sand Washer Inserts. The four influent structures shall also be of steel construction and shall be coated in accordance with Section 09800, "Protective Coatings." Internal surfaces shall be prime and finish coated in the shop by the supplier. External surfaces shall be prime coated in the shop by the supplier and finish coated in the field by the CONTRACTOR. The filters shall be capable of withstanding all loads encountered due to hydrostatic forces, the weight of the sand media and seismic forces. The filter tanks and influent structures shall be fabricated from steel plate with a minimum thickness of 1/4-inch. The design shall consider earthquake forces based on a lateral acceleration of 0.39 g. The filter modules shall consist of a bottom cone for supporting the sand media,

feed inlet pipe and a distribution radial, airlift pipe, internal sand washer, sand distributor cones, and reject compartment with weir and flume.

The sand bed shall be continuously backwashed internally and redistributed on top of the sand bed an average of 4-6 times per 24 hours. No external sand movement or washing will be allowed. Continuous sand cleaning shall be accomplished within the filter using filtered water. Filter influent (feed) shall not be used for sand cleaning. The filter shall operate countercurrently. The water level in the filter shall be maintained by a fixed effluent weir in the filter. Modulating valves or other electromechanical control devices are not allowed.

B. **Control Station:** Each of the filters (four modules per filter) shall have a compressed air control station located as shown on the drawings. The control station, consisting of airflow rotameters, solenoid valves and pressure gages (one each per filter module) shall be installed in a weatherproof NEMA 3R type enclosure with a window to allow observation of airflow rate to each filter module without opening the enclosure door. The station shall also include an air filter and pressure regulator. Solenoid valves shall be activated by float switches mounted under the filter walkway per supplier's recommendation and shall include "Help Start" - pulsed air start control provisions. A 120V, single phase electrical supply shall be provided to each station.

C. **Air Piping:** Filter Air to each control station shall be as shown on the drawings. Filter Air from the control stations to the support structure near each filter module shall be steel ASTM 53, Schedule 40 welded, galvanized. Airlift tube shall be PVC.

D. **Filter Supports, Walkways, Handrails and Stairs:** All walkways, walkway supports, reject trough supports, handrails and stairs shall be aluminum in accordance with Division 5, as shown on the drawings. The design and construction of these items shall conform to all OSHA and UBC requirements. Handrails shall be a three-rail system with kick plate. Three-rail aluminum railing gates, conforming to Section 05500, "Miscellaneous Metalwork," shall be provided at both ends of the filter walkway. The gates shall open on to the walkway. All walkway decking shall be suitably supported and suitably designed grating. Field erection of the walkways, handrails and stairs shall be performed by the CONTRACTOR, under the supervision of the supplier.

E. The filter supplier shall provide appropriate supports to support air piping, backwash piping and utility water piping, as shown and specified. The CONTRACTOR shall supply and install this piping.

F. Filter Media: Filter media shall be provided by filter supplier as follows:

Type:	Sand
Filtration Bed Depth	40 Inches
Media Density	124 Ib./Ft.3 Wet Effective Size: 0.9 mm
Uniformity Coefficient	1.5
Shipping Weight:	48 tons for 4 Filters

All media shall meet with the requirements of AWWA specification B-100. Media shall be high grade silica sand. Specific gravity shall be 2.5 or more. Media hardness shall

be 6.5 or greater on the Moh's scale. Grain shape shall be round to sub-angular. Acid solubility shall be less then 5% total loss in mass after 30 minutes immersion in a concentrated hydrochloric acid solution.

Filter media shall be handled on site, placed into the filter cells and washed in accordance with the filter manufacturer's recommendation. Filter supplier shall provide 800 pounds of spare sand, in 100 pound sacks.

G. **Fiberglass Removable Cover:** The CONTRACTOR shall provide removable fiberglass covers as shown in the drawings. The fiberglass covers shall have a thickness 1/4-inch minimum.

H. **Tools and Spare Parts:** Provide protecting as per Section 09800. The CONTRACTOR shall provide a list of manufacturer's recommended spare parts and, after the CONTRACTING OFFICER'S approval, shall furnish all spare parts suitably packaged and labeled. As applicable, special tools shall be furnished and shop drawings of equipment and parts shall be submitted as outlined in Section 01300 entitled "Contractor Submittals." There shall be a minimum of one set of spare O-rings and gaskets, Airlift pump screen, regulator for the air control panel, and Air flow indicator for the air control panel.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Installation shall be per the manufacturer's printed recommendations and as shown.

3.2 START-UP SUPERVISION AND INSTRUCTION.

A. The services of a qualified representative of the manufacturer shall be provided by the CONTRACTOR for 6 days in 3 trips to check the installation, start-up the equipment and instruct personnel in proper operation and maintenance.

B. Three copies of final drawings, operations and maintenance manuals shall be furnished.

END OF SECTION -

SECTION 11500 - BLOWERS, COMPRESSORS, AND VACUUM PUMPS, GENERAL

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide blowers, compressors, and vacuum pumps and appurtenances, complete and operable, in accordance with the Contract Documents.

B. The provisions of this Section shall apply to all blowers, compressors, and vacuum pumps, except where otherwise indicated.

C. The requirements of Section 11000 - Equipment General Provisions apply to the WORK of this Section.

D. The CONTRACTOR shall assign to a single manufacturer full responsibility for the furnishing and functional operation of the blower, compressor, or vacuum pump unit(s) including drives, drive motors, speed control equipment (where variable speed drives are required), and accessories. The designated single Manufacturer, however, need not manufacture more than one part of the unit(s) (blower, or motor and drive), but shall coordinate the design, assembly, testing, and erection of the unit(s).

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards:

ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800
ANSI B16.5	Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and Other Special Alloys
ANSI/ASME PTC 9	Performance Test Code - Displacement Compressors, Vacuum Pumps and Blowers
ANSI/ASME PTC 10	Performance Test Code - Compressors and Exhausters
ANSI/ASME B31.1	Power Piping
ANSI/IEEE 112	Test Procedure for Polyphase Induction Motors and Generators
ASTM A 48	Gray Iron Castings.

1.3 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01300 - Contractor Submittals.

B. **Shop Drawings:** Shop Drawings shall contain the following information:

1. Equipment name, identification number and specification number.

2. Performance curve and data.

3. The CONTRACTOR shall require the manufacturer to indicate points on the H/Q curves, and the limits recommended for stable operation between which the blowers may be operated without surge and vibration. The stable operating range shall be as wide as possible based on actual tests, performed at the factory in accordance with the ANSI/ASME PTC 9 and 10 test codes.

4. Equipment detailed description and specification.

5. Electrical data including control and wiring diagrams.

6. Assembly and installation drawings including shaft size, seal, coupling, anchor bolt plan, part nomenclature, material list, outline dimensions and shipping weights.

7. Equipment drive and motor in accordance with Section 16460 - Electric Motors.

C. **Certification:** The CONTRACTOR shall obtain written certification from the designated single manufacturer, addressed to the GOVERNMENT, stating that the equipment will efficiently and thoroughly perform the required functions and that the designated single manufacturer accepts the CONTRACTOR'S assignment of full responsibility for coordination of all equipment, including motors, variable speed drives, controls, and services required for proper installation and operation of the completely assembled and installed unit(s). The CONTRACTOR shall submit all such certificates to the CONTRACTING OFFICER.

D. **O & M Manuals:** Prior to start-up, furnish complete operations and maintenance manuals in accordance with Section 01300. Printed instructions relating to proper maintenance, including lubrication, and parts lists indicating the various parts by name, number, and diagram where necessary, shall be furnished in duplicate with each unit or set of identical units in each station. A recommended spare parts list shall be included. Instructions for field procedures for erection, adjustments, inspection, and testing shall be provided prior to installation of each piece of equipment.

1.4 QUALITY ASSURANCE

A. **Equipment Testing:** The CONTRACTOR shall be responsible for the coordination of the following tests of each blower, compressor, and vacuum pump, drive, and motor:

1. General: Tests shall be performed in accordance with the ANSI/ASME PTC 9 and 10 Performance Test Codes. Tests shall be performed on the actual assembled unit from surge condition to 25 percent above the required design capacity. Prototype model tests will not be acceptable. Equipment shall be factory witness-tested, as defined herein.

2. Factory Tests of Blowers and Compressors: All blowers, compressors, and motors of sizes 10 to 125 hp (inclusive) shall be factory-tested in accordance with the above requirements. Seven sets of certified test data shall be submitted to the CONTRACTING OFFICER.

3. Factory Tests of Motors: Motors of size 10 hp and larger shall be assembled, tested, and certified at the factory and the working clearances checked to insure that all parts are properly fitted. The tests shall be in accordance with ANSI/IEEE 112 standards, including heat run and efficiency tests. All computations shall be

recorded and 7 certified and dated copies of the test results shall be furnished to the CONTRACTING OFFICER.

4. Factory Witnessed Tests: Blowers and compressors, variable speed drives, and motors 150 hp and larger, shall be factory-tested as complete, assembled units, as indicated above, and witnessed by the CONTRACTING OFFICER. The CONTRACTOR shall give the CONTRACTING OFFICER a minimum of 2 weeks notification prior to the test. All costs for GOVERNMENT and CONTRACTING OFFICER representative expenses shall be borne by the CONTRACTOR and included in the bid price. Such costs shall include travel and subsistence for 2 persons but shall exclude salaries. Test results in triplicate shall be submitted to the CONTRACTING OFFICER and no equipment shall be shipped until the test data have been approved by the CONTRACTING OFFICER.

5. Acceptance: In the event of failure of any blower or compressor to meet any of the above requirements or efficiencies, the CONTRACTOR shall make all necessary modifications, repairs, or replacements to conform to the requirements of the Contract Documents and the equipment shall be re-tested at no additional compensation, until found satisfactory.

B. **Field Tests:** Units shall be field tested after installation, in accordance with the Contract Documents, to demonstrate satisfactory operation, without causing excessive noise, vibration, and overheating of the bearings. The field testing shall be performed by the CONTRACTOR in the presence of a factory-trained, experienced field representative of the manufacturer, who shall supervise the following tasks and shall certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation:

1. Start-up, check, and operate the equipment over the entire speed range. The vibration shall be within acceptable limits.

2. Equipment performance shall be documented by obtaining concurrent readings, showing motor voltage, amperage, and discharge head. Each power lead to the motor shall be checked for proper current balance.

3. Bearing temperatures shall be determined by a contact-type thermometer. A running time of at least 20 minutes shall be maintained for this test.

4. Electrical and instrumentation testing shall conform to other applicable Sections of the Specifications.

5. The field testing will be witnessed by the GOVERNMENT or its representative. In the event any of the equipment fails to meet the above test requirements, it shall be modified and retested in accordance with the requirements of this Section. The CONTRACTOR shall then certify in writing that the equipment has been satisfactorily tested, and that final adjustments thereto have been made. Certification shall include date of final acceptance test, as well as a listing of all persons present during tests, and resulting test data. The costs of all work by factory-trained representatives shall be borne by the CONTRACTOR. The GOVERNMENT will pay for power costs. When available, the GOVERNMENT'S operating personnel will provide assistance in the field testing.

1.5 MANUFACTURER'S SERVICE REPRESENTATIVE

A. **Erection and Startup Assistance:** Service and instruction assistance by the manufacturer's service representative for each blower and compressor unit 10 hp and larger shall be provided by the CONTRACTOR during the following periods:

1. One day (minimum) during erection.

2. One day (minimum) during startup.

B. **Instruction of GOVERNMENT's Personnel:** The CONTRACTOR shall provide for the services of a factory service representative to instruct the **GOVERNMENT**'s personnel in the operation and maintenance of the equipment.

1.6 GUARANTEES, WARRANTIES

A. After completion, the CONTRACTOR shall furnish to the **GOVERNMENT** the manufacturer's written guarantees, that the equipment will operate with the published efficiencies, heads, and flow ranges and meet these specifications. The CONTRACTOR shall also furnish the manufacturer's warranties as published in its literature.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Wherever it is required that a single designated manufacturer shall be responsible for the compatible and successful operation of the various components of any equipment, it shall be understood to mean that the CONTRACTOR shall provide only such equipment as the manufacturer will certify is compatible with its equipment and with the further understanding that this in no way constitutes a waiver of any requirements.

B. All manufactured items provided under this Section shall be new, current models, and the products of reputable companies specializing in the manufacture of such products, with previous experience in such manufacture. The CONTRACTOR shall, upon request of the CONTRACTING OFFICER, furnish the names of not less than 5 successful installations of its equipment of comparable nature to that offered under this Contract.

C. Where 2 or more units of the same type and/or size of equipment are required, such units shall be from the same manufacturer.

2.2 MATERIALS

A. Materials employed in the blower, compressor, and vacuum pump equipment shall be suitable for the intended application; material not indicated shall be high-grade, standard commercial quality, free from any defects and imperfections that might affect the serviceability of the product for the purpose for which it is intended, and shall conform to the following requirements:

1. Cast iron casings shall be of close-grained gray cast iron, conforming to ASTM A 48, or equal.

2. Stainless steel shafts shall be of Type 400, Series. Miscellaneous stainless steel parts shall be Type 316.

3. Anchor bolts, nuts, and washers shall be hot-dip galvanized, unless otherwise indicated in individual equipment specifications.

2.3 APPURTENANCES

A. **Nameplates:** Each blower, compressor, vacuum pump, and motor shall be equipped with a stainless steel nameplate indicating rated head and capacity, impeller size, speed, and manufacturer's name, serial, and model number. Nameplates for electric motors shall be in accordance with Section 16460 - Electric Motors.

B. **Solenoid Valves:** Solenoid valves shall be provided on the water or oil lubrication and cooling lines. Solenoid valve electrical rating shall be compatible with the motor control voltage and shall be provided complete with all necessary conduit and wiring installation from control panel to solenoid.

C. **Gauges:** Blowers, compressors, and vacuum pumps shall be equipped with pressure or vacuum gauges, respectively, installed in the discharge lines. Pressure gauges shall be located in a representative location, where not subject to shock or vibrations, in order to achieve true and accurate readings. Pressure gauges shall conform to Section 17108 - Pressure Measuring Systems. Where subject to shock or vibrations, the pressure gauges shall be wall-mounted or attached to galvanized channel floor stands and connected by means of flexible connectors.

D. **Variable Speed Drives:** Variable speed drives, drive motors, speed control equipment, and accessories shall be in accordance with Section 16455 - Variable Frequency Drive Units.

E. Controls shall be in accordance with Section 17100 - Process Control and Instrumentation Systems.

F. **Electric Motors:** Electric motors shall comply with the requirements of Section 16460.

G. **Flanges:** Suction and discharge flanges shall conform to ANSI B16.1 or B16.5 dimensions.

H. **Lubrication:** Blowers, compressors, vacuum pumps, and motors shall be oil- or-grease-lubricated per individual specifications.

I. **Drains:** Cooling water drains and drains from variable speed drive equipment shall be piped to the nearest floor sink or drain with galvanized steel pipe or copper tube, properly supported with brackets.

2.4 TOOLS AND SPARE PARTS

A. **Tools:** Special tools necessary for maintenance and repair of the equipment and one pressure grease gun for each type of grease required for blowers, compressors, and motors shall be furnished as a part of the WORK hereunder; such tools shall be suitably stored in metal tool boxes, and identified with the equipment number by means of stainless steel or solid plastic name tags attached to the box.

B. **Spare Parts:** The CONTRACTOR shall furnish spare parts subject to wear, such as seals, packing, gaskets, nuts, bolts, washers, wear rings, etc., as well as a set of spare bearings, and one year's supply of filter elements. Furnish parts suitably packaged and labelled in a box as described above for tools.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. **General:** Blowers, compressors, and vacuum pump equipment shall be installed in accordance with the Shop Drawings and as indicated. General installation requirements shall be as indicated in Section 11000.

B. **Alignment:** Equipment shall be field tested to verify proper alignment and operation as specified, and freedom from binding, scraping, excessive noise, overheating, vibration, shaft runout, or other defects. Drive shafts shall be measured just prior to assembly to ensure correct alignment without forcing. Equipment shall be secure in position and neat in appearance.

C. **Piping and Mounting:** Piping shall be provided with sufficient expansion joints, guides, and anchors and be supported so as to preclude the possibility of exerting undue forces and moments on the equipment flanges. Suitable flexible connectors shall be provided to isolate the equipment from the piping system. Each unit shall be mounted on a flat and level concrete pad capable of supporting the dead weight of the unit, by means of restrained vibration isolators or resilient pads of suitable design.

D. **Lubricants:** The installation work shall include furnishing the necessary oil and grease for initial operation and for one year's operation.

- END OF SECTION -

SECTION 11511 - COMPRESSORS, TANK-MOUNTED, RECIPROCATING

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide tank-mounted compressors, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 11000 - Equipment General Provisions apply to the WORK of this Section.

PART 2 -- PRODUCTS

2.1 COMPRESSORS, TANK-MOUNTED

A. **Operating Conditions:** Compressor operating conditions shall be as follows:

Identification number	-	8-ME-5; 8-ME-6
Location	-	Filter Pad
Service	-	Filter Air
Elevation above sea (ft)	-	2375
Piston displacement (cfm)	-	50
Discharge pressure (psig)	-	125
Motor size, min (hp)	-	15
Compressor speed, max (rpm)	-	1100
Size of receiver (gal)	-	240
Pressure rating of receiver (psig)	-	125

B. **Equipment Requirements:** The compressors shall consist of tank-mounted compressor units of the vertical, reciprocating, air-cooled, single-stage, V-belt driven, lubricated type with alternator.

C. **Receivers:** The Duplex compressors shall be securely mounted on an ASME approved horizontal welded steel tank with integral legs, suitable for the working pressure and size specified above. The tank shall have threaded connections for an inlet, outlet, drain, pressure gage, and pressure switch. The outlet shall have an ASME approved pressure relief valve. The drain connection shall have a plug valve, a strainer, and a condensate trap piped to the nearest floor drain or similar drainage point. The receiver shall be securely mounted to the floor with restrained, heavy-duty spring-type vibration isolators and anchor bolts.

D. **Control Panels:** Each pair of compressors shall be controlled from a wall- or floor-mounted control panel in an enclosure complying with the area designations in Section 16050 - Electrical Work, General with hinged door and enamel finish. The panel shall be completely pre- wired to provide a fully automatic operation and include the following features for each compressor:

1. Circuit breaker,

2. Magnetic starter,

3. Push buttons in front panel,

4. Running light in front panel,

5. Warning lights for low oil and high temperature,

6. Contact for remote indication of failure,

7. Stainless steel or heavy plastic labels for all controls and functions.

8. Electric alternator

E. The control panel shall be connected to the pressure switches and the compressors, as shown.

F. Controls shall be in accordance with Section 17100 - Process Control and Instrumentation System.

G. **Drive:** Drive shall be a V-belt-type with heavy-duty electric motor suitable for installation in the area shown, for 460-volt, 3-phase, 60-Hz supply.

H. **Accessories:** Units shall be furnished and installed complete with the following accessories, each, as shown:

1	-	air receiver with condensate trap and drain,
1	-	set of restrained, heavy-duty spring-type vibration isolators,
1	-	set of galvanized anchor bolts and nuts,
1	-	flexible connector, stainless steel, corrugated or braided,
1	-	pressure relief valve,
1	-	check valve, silent, spring-loaded
1	-	shut-off valve,
1	-	pressure switches,
1	-	safety guard
1	-	pressure gage with valve, and all other controls and appurtenances, shown.

I. **Equipment Construction:** Basic equipment construction and materials required shall be as follows:

Common base-plate (mounted on receiver)	-	cast-iron or steel, with sliding motor base
Crankcase	-	cast-iron
Cylinders	-	precision-honed, with radial fins
Pistons	-	cast-iron or aluminum
Rings	-	oil control and compression rings
Heads	-	cast-iron or aluminum
Crankshaft	-	ductile iron or carbon steel
Bearings	-	heavy duty anti-friction bearings

Lubrication	-	splash-type lubrication
Valves	-	stainless steel
Flywheel	-	cast-iron
Suction filter-silencer	-	dry-type
Starting unloader	-	built-in centrifugal type
Intercooler (if 2-stage)	-	finned copper tubes
Safety shut-down switches	-	low oil level and high temperature.

J. Manufacturers, or Equal:

1. **Gardner-Denver Co.;**
2. **Ingersoll-Rand;**
3. **Kellogg-American;**
4. **Quincy (Colt Industries);**
5. **Worthington.**

PART 3 -- EXECUTION

3.1 INSTALLATION

A. All equipment shall be installed in strict accordance with the shop drawings and approved written procedures submitted with the shop drawings; provided, that nothing contained in said procedures or shop drawings shall authorize the CONTRACTOR to vary from the requirements of the Contract Documents.

B. General installation requirements shall be as specified in Section 11000.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 11522 - REFRIGERATED AIR DRYER AND COALESCING FILTER

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. **General:** The CONTRACTOR shall provide a refrigerated type air dryer, suitable for wall- or floor-mounting, to provide dry, compressed air for the instrument air system, with all accessories and appurtenances, complete and operable, in accordance with the Contract Documents.

PART 2 -- PRODUCTS

2.1 REFRIGERATED AIR DRYER AND COALESCING FILTER

A. **Design:** The dryer shall have a capacity of 100 scfm with a 100 psig pressure dewpoint of 35 degrees F or an atmospheric dewpoint of -12 degrees F. Maximum pressure loss through unit shall be 5 psi. Refrigeration compressor shall be 1/2 hp. Electric supply shall be 120-volt, 60-Hz, single-phase.

B. **Construction:** The air dryer shall be a corrosion-resistant, self-contained unit, mounted in a steel cabinet and suitable for continuous operation. The dryer shall include a hermetically sealed refrigeration compressor, an air-cooled condenser, an evaporator, a strainer and filter unit, a moisture separator, a re-heater to prevent pipe condensation, an automatic condensate trap with drain to floor drain, a temperature sensor and switch, automatic timer, switch, starter, pressure regulator, solenoid, pressure and temperature gages and all necessary piping, fittings, valves, and interwiring. The unit shall be suitable for an operating pressure of not less than 150 psig..

C. **Coalescing Filter :** The coalescing filter shall be oil removal type and shall sized to match the air dryer capacity. Filter housing shall be of aluminum or steel construction and filter head shall include threaded mounting holes with pressure differential gauge. Filter shall be capable of automatic or manual draining and manual drain valve shall be included. Element shall be equipped with fiberglass prefiltration layer, micro-glass coalescing media and outer support cores. Maximum oil carryover shall not exceed 0.1 parts per million by weight

D. **Spare Parts:** The CONTRACTOR shall furnish spare parts subject to wear, such as seals, packing, gaskets, nuts, bolts, washers, wear rings, etc, and two additional filter elements. Spare parts shall be packaged and labeled in a box.

E. Manufacturers, or Equal:

1. **Deltech Engineering, Inc.,**

2. **Ingersoll-Rand, model ;**

3. **Hankison Corporation, ;**

4. **Sahara Air Dryers/Div. of Henderson Engineering;**

5. **Zurn Industries, Inc., (General).**

PART 3 -- EXECUTION

3.1 INSTALLATION

A. All equipment shall be installed in accordance with approved procedures submitted with the shop drawings and as shown, unless otherwise approved.

B. General installation requirements shall be as specified in Section 11000, "Equipment General Provisions."

- END OF SECTION -

SECTION 11602 – VACUUM INDUCTION MIXER

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide and install a vacuum induction mixer assembly complete and operable, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

A. Prior to ordering of equipment, the CONTRACTOR shall submit shop drawings of all mixer equipment in accordance with Section 01300 - Contractor Submittals.

PART 2 -- PRODUCTS

2.1 MIXER ASSEMBLIES

A. Each vacuum induction mixer shall be of the submersible design capable of operating at a minimum depth of 18 inches below the water surface, and able to transport the chemical to be flash mixed from the source to the point of application at or above a minimum vacuum required, from chemical feed equipment.

B. **Motor Performance Requirements:**

1.	Motor Size (HP)	-	3
2.	Voltage	-	460
3.	Phase (60 Hz)	-	3
4.	Motor Speed (RPM)	-	3450

C. The mixer motor shall have a water-cooled corrosion resistant stainless steel outer shell, hermetically sealed stator, liquid lubricated carbon sleeve, and kingsbury type thrust bearings. Motor shall be supplied with a motor monitoring protection device to monitor high/low amperage, high/low voltage, phase loss, phase imbalance, temperature and give indication and memory of fault condition.

D. The motor shall be a titanium-short coupled shaft to ensure the integrity and specification performances of the motor. The mixer shall be of the imbedded shaft style and the shaft shall not be exposed to or be within the gas flash mixer area, or liquid process path. The use of exposed shafts shall not be acceptable.

E. The mixer shall have dual high-performances mechanical seals consisting of a 99% pure ceramic seat and pure carbon seal fully compatible with specified gases or liquids. The mechanical seal shall be arranged for internal/external cooling and lubrication of both seal and seat.

F. All materials in direct contact with the product gas/liquid or mixing pattern of the discharge shall be nonmetallic inert molded (Schedule 80 PVC). Materials without excellent or good compatibility ratings with specified chemical shall not be acceptable.

The short-coupled rotating distributor shall be configured using parabolic suction creating cavities to prevent fouling. No protruding blades, propellers, impellers, or screws shall be used that could cause fouling. The discharge cone shall be of a (ASTM D-1784 PVC) quadi-cut design characterized for directing of the discharge mix pattern.

G. The mixer shall be supplied with 25 feet of submersible pump cable. Cable shall be 4 conductor with 12-gauge wire.

H. **Guide Rails and Lifting Stanchion/Winch:** The CONTRACTOR shall furnish and install a stainless steel guide rail and lifting assembly. The assembly shall be located and installed as shown on the Contract Documents.

1. The guide rails shall be fabricated of stainless steel and installed as shown on the Contract Documents.

2. The mixer motor mounting bracket assembly shall be stainless steel and shall be field adjustable to allow for the mixer to lower in a vertical position and pivot to a horizontal position at the guide rail stops.

3. The lifting stanchion shall be stainless steel and shall have sufficient height to raise the entire unit above grade. Winch and stainless steel cable shall be rated for lifting at least 4 times the weight of the mixer.

4. All mounting bolts, washer, nuts, and drop-in anchors shall be stainless steel as shown on the Contract Documents.

I. **Flexible Vacuum Hose:** Vacuum hose shall be a minimum 1 inch diameter flexible PVC hose with smooth inside bore, helical wound reinforcement, quick disconnect fittings and be suitable for the chemical use and service conditions specified. Vacuum hose shall be a minimum 25 feet in length.

2.2 CONTROLS

A. The controls shall be as indicated in the Local Control Panel Datasheet provided as Appendix A. The CONTRACTOR shall provide all wiring, conduit and accessory items between the control panel and the mixer.

2.3 TOOLS

A. The CONTRACTOR shall supply one complete set of special wrenches or other special tools necessary for the assembly, adjustment, and dismantling of the equipment. All tools shall be of best quality and furnished in labeled tool boxes of suitable design.

2.4 MANUFACTURERS, OR EQUAL

A. **The Mastrrr Company (Gas Mastrrr);**

B. **Gardiner Equipment Company, Inc. (Water Champ)**

PART 3 -- EXECUTION

3.1 QUALITY ASSURANCE

A. The manufacturer shall be experienced in the design and fabrication of vacuum induction mixers.

B. The manufacturer shall submit operational test results to include motor amp draw and vacuum produced.

3.2 INSTALLATION

A. Installation of mixer assemblies shall be in strict accordance with the manufacturer's printed recommendations. CONTRACTOR shall provide start-up, inspection and certifications as to the correct operation of the unit.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 13122 – PRE-ENGINEERED METAL BUILDING

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide and install one pre-engineered metal building as indicated and in accordance with the WORK, and as specified herein.

B. For the purposes of this specification, the Metal Building Supplier shall be an assignee of the CONTRACTOR, and shall be a certified representative of a member of the Metal Building Manufacturer's Association.

C. The Metal Building Supplier shall design, furnish, and install, complete, the pre-engineered metal building in accordance with the Contract Documents. The building shall be designed and provided complete with all necessary component parts and appurtenances, in accordance with the requirements of the Contract Documents.

D. The pre-engineered metal building shall be provided with all warranties specified. The warranties shall be signed by authorized representatives of the Metal Building Supplier and the pre-engineered metal building manufacturer. The warranties shall be submitted to the CONTRACTING OFFICER for review prior to issuance of the final warranties to the GOVERNMENT.

E. The scope of WORK shall include the following:

1. All documents required for the erection of the building.

2. Coordination of all items to be connected, embedded or installed in the buildings such as mechanical equipment, piping vents, HVAC, and electrical systems.

3. Anchor bolt design and detailing which is compatible with concrete foundation system indicated on the Drawings.

4. The complete roof and wall system design and details for building configurations as indicated on the Drawings.

5. The miscellaneous accessories necessary for a complete and watertight building such as closure strips, flashing, gutters, downspouts, trim, sealant, and coating systems.

F. The building shall be designed and furnished by a pre-engineered building manufacturer who is a member of the Metal Building Manufacturers Association (MBMA).

G. The building manufacturer shall approve the erector of the pre-engineered metal building, in writing.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Codes:** All codes, as referenced herein, shall be or specified in Section 01090 - Reference Standards.

B. Commercial Standards:

AISC	Specification for Structural Steel Buildings - Allowable Stress Design and Plastic Design
AISC	Code of Standard Practice for Steel Buildings and Bridges
AISC	Specification for Structural Joints Using ASTM A325 or A490 Bolts approved by the Research Council on Structural Connections of the Engineering Foundation
AISI	Specification for the Design of Cold Formed Steel Structural Members
AISI	Design of Light Gage Steel Diaphragms
ASTM A 36	Specification for Structural Steel
ASTM A 307	Specification for Carbon Steel bolts and Studs
ASTM A 325	Specification for High Strength Bolts for Structural Steel Joints
ASTM A 446	Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural Quality
ASTM A 529	Specification for Structural Steel with 42 ksi Minimum Yield Point
ASTM A 570	Specification for Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality
ASTM A 572	Specification for High Strength Low-Alloy Columbium-Vanadium Steels of Structural Quality
ASTM A 607	Specification for Steel Sheet and Strip, Hot-Rolled and Cold-Rolled, High-Strength, Low-Alloy Columbium and or Vanadium
AWS D1.1	Structural Welding Code-Steel
MBMA	Metal Building Systems Manual, Metal Building Manufacturers Association
MBMA	Design Practices Manual, Metal Building Manufacturers Association
AAMA	Architectural Aluminum Manufacturers Association

1.3 CONTRACTOR SUBMITTALS

A. All submittals shall be provided to the CONTRACTING OFFICER for review in accordance with Section 01300 - Contractor Submittals.

B. **Shop Drawings:** Shop drawings submitted shall be coordinated to show all components, including doors and other accessories; structural calculations; material types; finishes; fastenings; methods of joining; and sealants. All shop drawings shall be stamped and signed by the design engineer. The shop drawings shall include, as a minimum, the following drawings:

1. Foundation anchor bolt plan with anchor bolt, shear angle (if required), and base plate details for this project. A diagram shall be included showing the vertical and lateral loads applied on the foundation at each column for each load combination.

2. Erection drawings for the building

3. Transverse cross sections

4. Roof plans showing sizes and locations of all structural members and bracing.

5. Elevations of all walls showing sizes and locations of all structural members and bracing, openings for HVAC and other mechanical or electrical equipment.

6. Calculations signed and stamped by a civil engineer registered to practice in the State of California and who specializes in structural design. Calculations shall include a complete structural stress and deflection analysis of structural components and connections. General calculations that have not been specifically prepared or assembled for this project will be returned for compliance with this Specification.

7. ICBO research reports, product data, installation instructions, and other information for the building system, roof panels, wall panels, and accessories as necessary to review in accordance with the Specifications herein.

8. Details of all door and other openings and other accessories.

9. Specifications for the painting system including paint manufacturer's name, product trade name, and preparation for shop and field coats.

C. **Standard Details:** Manufacturer's standard details may be used in addition to the shop drawings listed above provided that the portions that apply are clearly marked and those parts that do not apply are clearly marked.

D. **Certification:** Submit written certification prepared and signed by a civil engineer, registered to practice in the State of California and who specializes in structural design, verifying that the building design meets specified loading requirements and codes of authorities having jurisdiction.

1.4 QUALITY ASSURANCE

A. **Erector's Qualifications:** The erector of the prefabricated metal building shall be licensed by the metal building manufacturer and shall have not less than 5 years successful experience in the erection of prefabricated buildings similar to that required for this project.

B. **Manufacturer's Qualifications**: The manufacturer of the prefabricated metal building shall be a current member of the Metal Building Manufacturer's Association (MBMA) with not less than 5 years successful experience in the design and fabrication of prefabricated metal buildings of the type and quality required.

1.5 WARRANTY

A. The prefabricated building manufacturer shall warrant that the materials furnished will be free from defects in material and workmanship on the shipment date and further warrant that it will correct, by repair or replacement, any such defect within one year from the shipment date.

B. The prefabricated building manufacturer shall warrant that the exterior finish coating for roof and wall panels will not, under normal weather and atmospheric conditions for the design location, crack, check, blister, peel, flake, chip, or lose adhesion for a period of 20 years from the shipment date.

C. Should failure be reported within such period as enumerated above, the prefabricated metal building manufacturer shall repair in accordance with original requirements any such panels at no cost to the GOVERNMENT.

1.6 MAINTENANCE

A. **Maintenance Stock:** The CONTRACTOR shall furnish at least 5 percent in excess over the required amount of nuts, bolts, screws, washers, and other required fasteners for each building. Such items shall be packed in labeled cartons and stored on the site where directed by the CONTRACTING OFFICER.

PART 2 -- PRODUCT

2.1 GENERAL

A. The buildings shall be provided complete with wall and roof panel systems, gutters and downspout, door frames, doors, and all necessary trim and accessories.

B. Structural System:

1. The building’s structural system shall be a self framing type consisting of wall and roof panels that combine the full structural support and covers as a complete assembly.

C. **Dimensions:** The dimensions shall be as indicated on the drawings. The minimum clear height to the underside of the roof members at their lowest point (eave height) shall be as necessary to meet all mechanical and electrical requirements and comply with codes. The pitch height shall be a minimum of 3:12 and meet code requirements. Requests for a small deviation of the pitch to match the manufacturer's standard may be submitted for review by the CONTRACTING OFFICER.

2.2 MATERIALS

A. Metals:

1. Hot rolled structural shapes: ASTM A36 or A529.

2. Members fabricated from plate or bar stock: provide 42,000-psi minimum yield strength and comply with the requirements of ASTM A529, A570, or A572.

3. Members fabricated by cold forming: ASTM A607, Grade 50.

4. Galvanized Steel Sheet: ASTM A446 with G90 coating.

5. Bolts for Structural Framing: ASTM A307 or A325 as necessary for design loads and connection details.

2.3 DESIGN CRITERIA

A. Design Loads:

1. Roof live load: As required by the UBC.

2. Wind load: 90 MPH, exposure C, as required by the UBC.

3. Seismic load: As required by the UBC.

4. Collateral loads shall include dead loads resulting from HVAC, piping, and other items suspended from the roof. This loading shall be coordinated with the drawings of all disciplines and manufacturer's shop drawings.

B. Design Requirements:

1. Design structural members and exterior covering materials for applicable loads and combinations of loads in accordance with the MBMA Design Practices Manual.

2. For design of structural steel members, comply with the requirements of the AISC.

3. For design of light gage steel members, comply with AISI for design requirements and allowable stresses.

4. Welded connections shall comply with AWS.

5. Design each member to withstand stresses resulting from combinations of loads that produce the maximum allowable stresses in that member as prescribed in MBMA Design Practices Manual.

6. The building shall be designed to withstand all loading conditions both with and without wall panels in place.

2.4 FOUNDATION

A. The CONTRACTOR shall review the foundation for the steel buildings and make any recommendations for revision, based on actual loading.

B. The CONTRACTOR shall design and coordinate the details of anchorage of the steel building to its foundation. The CONTRACTOR shall provide the anchor bolts and layout templates and allow for any foundation revisions necessary to adapt or support the building as constructed as accepted by the CONTRACTING OFFICER. Variation in quantities of concrete required to adapt the building to the foundation shall be at no additional cost to the GOVERNMENT.

2.5 STRUCTURAL FRAMING

A. **Rigid Frames:** Rigid frames shall be fabricated from hot rolled structural steel, square sections. Provide frames that are factory welded and shop primed. Primer to be compatible with finish coating. Furnish frames complete with attachment plates, bearing plates, and splice members. Factory drill frames for bolted field assembly.

B. **Braced Frame:** Knee and/or diagonal bracing shall be provided as required and shall not interfere with equipment. Bracing shall be structural shape.

C. Secondary Framing:

1. Provide framing for wall openings where windows, personnel doors, ventilation equipment overhead doors and louvers occur shall be stiffened flange channels and shall be provided by the prefabricated metal building manufacturer.

2. Provide not less than 16 gage shop painted cold formed sections for the following secondary framing members: purlins, eave struts, end wall beams, flange bracing, and sag bracing.

3. Base channel shall not be less than 14-gauge shop painted cold-formed sections.

D. **Bolts:** Provide shop painted bolts, except that when structural framing components are in direct contact with roofing or siding panels, hot dip galvanized bolts shall be provided.

E. **Shop Painting:** Shop painting shall be per Section 09800 - Protective Coatings.

2.6 PRE-ENGINEERED METAL ROOFING SYSTEM

A. **General:** The roof shall be a standing seam metal roof system as manufactured by **Butler Manufacturing Company, "CMR-24" Roofing System**, equivalent product as manufactured by **AEP-Span**, or equal. Panels of maximum possible lengths shall be used to minimize endlaps; eave panels shall extend beyond the structural line of the sidewall. Panels shall be factory-prepunched at panel end to match prepunched holes in the eave structural member. Panel end splices shall be factory-prepunched and prenotched. Panel end splices shall allow the roof panels to expand and contract with roof panel temperature changes. Ridge assembly shall be designed to allow roof panels to move lengthwise with expansion/contraction as the roof panel temperature changes. Parts shall be factory-prepunched for correct field assembly.

1. Insulation Board: Insulation board shall be rigid, glass fiber-reinforced polyisocyanurate foam plastic core, and covered with aluminum facing both sides.

2. Vapor Retarder: Vapor retarder shall be 0.0032-inch minimum thick vinyl.

3. Liner Panel: Interior liner panel shall be formed from 0.015-inch (minimum thickness) coated steel with minimum yield strength of 80,000 psi. Painted panels shall be G-60 galvanized steel.

B. System Design:

1. All components of the roof paneling system shall be designed in accordance with sound engineering methods and practices.

2. Roof panels and liner panels shall be designed in accordance with AISI "Specification" for the Design of Light Gauge Cold Formed Steel Structural Members, latest edition.

3. Paneling system shall be designed to support design live loads.

C. Fasteners:

1. Insulation board, bearing plates, and panel clips shall be fastened to structural members with fasteners as per manufacturer's erection drawings, using factory prepunched holes in structural members.

2. All connections of roof panels to structural members except at eave shall be made with clips with movable tabs that are seamed into the standing seam sidelap.

3. Roof panel-to-panel connections shall be made with a positive, field-formed standing double-lock seam, formed by a special seaming device.

D. **UL Uplift Ratings:** The roof system shall carry a UL wind uplift classification Class 90 rating.

E. Provision for Expansion Contraction:

1. Provision for thermal expansion movement of the roof panel shall be accomplished by the use of clips with a movable tab. The stainless steel tabs shall be factory centered on the roof clip when installed to ensure full movement in either direction. A force of no more than 8 pounds will be required to initiate tab movements.

2. The roof shall provide for thermal expansion/contraction without detrimental effect of the roof panel when there is a $\pm$ 100^0 F temperature difference between the inside structural framework of the building and the temperature of the exterior roof panel.

F. **Thermal Performance:** The roof assembly shall have a minimum R-value of 19.

2.7 WALL SIDING PANELS

A. **General:** Wall panels shall be one piece from base to eave, except where interrupted by openings. Wall panels shall be of the maximum length to minimize or eliminate end laps, and shall be of a ribbed design with recessed exposed fasteners. Wall panels shall be **Butler "Thermawall" Wall System**; equivalent product as manufactured by **AEP-Span**; or equal. Wall panels shall be provided with interior liner metal panels with 4" metal base and with R-11 fiberglass batt insulation sandwiched between exterior and interior panels.

B. **Steel Sheets:** Provide structural quality hot-dip galvanized steel sheets complying with requirements of ASTM A446, Grade C, with G90 coating.

1. Metal thickness not less than 26 gage for exterior sheets. Rod sheet thickness shall be designed for the dead load plus live load as specified in Section 2.3.

C. **Thermal Stresses:** Panels and connections shall be designed to either allow for movement or to resist stresses resulting from a temperature range of 80 degrees F without causing harmful buckling, opening of joints, or other detrimental effects.

D. **Accessories:** Provide the following sheet metal accessories factory formed of the same material and finish as the roofing and siding: flashing, closers, fillers, metal expansion joints, ridge covers, and fascias.

E. **Flexible Closure Strips:** Provide closed-cell, expanded cellular rubber, self-extinguishing flexible closure strips. Cut or premold closure strips to match corrugation configuration of roofing and siding sheets. Provide closure strips where indicated or necessary to ensure weathertight construction.

F. **Interior Metal Liner Panels:** Interior liner panels shall be painted metal liner panels with 4-inch high metal base molding.

G. **Sealing Tape:** Provide pressure sensitive 100 percent solids grey polyisobutylene compound sealing tape with release paper backing. Provide permanently elastic, non-sag, non toxic, non staining tape not less than 1/2-inch wide and 1/8-inch thick.

H. **Joint Sealant:** Provide one-part elastomeric polyurethane, polysulfide or silicone rubber sealant as recommended by the building manufacturer.

I. **Wall Insulation:** Wall thermal insulation shall be R-11 fiberglass batt insulation. Wall insulation shall be wrapped in polyethylene film with maximum perm rating of 0.5 (**Johns Manville, Comfort-therm**; or equal.)

2.8 WALL AND ROOF PANEL FINISH

A. **Panel Finish:** Provide shop-applied full-strength 70% Kynar 500 fluoropolymer finish coating (**Butler-Cote 500 FP;** or equal) to galvanized steel roofing and wall panels, and related trim and accessory elements.

B. For roofing and wall, apply finish coat on exterior facings and manufacturer's standard polyester paint finish on reverse face.

C. Colors shall be as selected by the CONTRACTING OFFICER from the manufacturer's full range of colors (including optional and special-order colors).

2.9 SHEET METAL ACCESSORIES

A. **General:** Provide coated steel sheet metal accessories with coated steel roofing and siding panels. Finish and color of accessories shall match wall and roof panels.

B. **Gutters and Trim:** Gutters and trim shall be of not less than 26-gage steel. Form gutters in sections not less than 8 feet in length, complete with end pieces, outlet tubes and the special pieces as may be required. Join sections with riveted and soldered or sealed joints. Provide expansion-type slip joint at center of runs. Furnish gutter supports spaced at 36 inch on centers, constructed of the same metal as the gutters. Provide bronze, copper, or aluminum wire ball strainers at each outlet. Finish to match roof fascia and rake.

C. **Downspout:** Downspouts shall be of not less than 0.019-inch prepainted steel or aluminum. Form downspout in sections approximately 10 feet long, complete with elbows and offsets. Join sections with not less than 1-1/2 inch telescoping joints. Provide fasteners, designed to securely hold downspout not less than 1-inch away from walls; locate fasteners at top and bottom and at approximately 5 feet on center in between.

2.10 FABRICATION

A. **General:** Design prefabricated components and necessary field connections required for erection to permit easy assembly and disassembly. Fabricate components in such a manner that once assembled, they may be disassembled, repackaged and reassembled with a minimum amount of labor.

1. Clearly and legibly mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams and instruction manuals.

2.11 BUILDING ACCESSORIES

A. Personnel Doors:

1. Personnel doors shall be self-framing and self-flashing made from 20-gage galvanized steel. They shall carry the steel Door Institute label. Doors shall be flush with vertical seams on both hinged and lock edges. The top- and bottom-reinforcing channel shall be 14-gage steel minimum and spot-welded within the door. Doors shall be stiffened and sound deadened with impregnated honeycomb core, laminated to the inside full width of door. Doors shall be mortised and reinforced for hinges and locks, door frames shall be double-rabbit style made of 16-gage steel.

2. Doors and door frames shall be bonderized and prime coated ready to receive an alkyd enamel finish system as specified in Section 09800 - Protective Coating.

B. Each personnel door shall be provided with the following finish hardware in stainless steel satin finish (630), unless otherwise noted:

1. Single Exterior Door:

a. (3) Hinges: 4-1/2-inch by 4-1/2-inch, ball bearing type, heavy-duty, with non-removable pins and security studs, **Hager "BB1199"**, or CONTRACTING OFFICER approved equal.

b. Lockset: Mortise-type, Function F05 (Classroom), provided with ADA-compliant lever, Best 7 pin with key removable type cores, or CONTRACTING OFFICER approved equal.

c. Closer: Overhead, surface-mounted, 180-degree open, **Sargent "250"**, **LCN "4040"**, or CONTRACTING OFFICER approved equal. Closer shall be painted per Section 09800 to match the color of the door.

d. Holder: Overhead, concealed type, **RIXSON "Standard Duty 2 Series"**, **Sargent "690 Series"** or CONTRACTING OFFICER approved equal.

e. Weatherseals: Seals shall be **Pemko "S88D", NGP "5050B"** or CONTRACTING OFFICER approved equal. Seals shall be provided at the door head and jambs.

f. Door Drip (Head): **Pemko "346A"** or CONTRACTING OFFICER approved equal. Drip shall be painted per Section 09800 to match the color of the door.

g. Door Drip (Bottom): **Pemko "345A"** or CONTRACTING OFFICER approved equal. Drip shall be painted per Section 09800 to match the color of the door.

h. Threshold: **Pemko "2001AT"** or CONTRACTING OFFICER approved equal.

i. Kickplate: **Trimco "KM050"**, **BBW "37-W"**, **Quality "48/49"** or CONTRACTING OFFICER approved equal. Kickplate shall be located on the interior side of the door.

2. Pair Exterior Doors:

a. (8) Hinges: 4-1/2-inch by 4-1/2-inch, ball bearing type, heavy-duty, with non-removable pins and security studs, **Hager "BB1199"**, or CONTRACTING OFFICER approved equal.

b. (2) Lockset: Mortise-type, Function F05 (Classroom), provided with ADA-compliant lever, Best 7 pin with key removable type cores, or CONTRACTING OFFICER approved equal.

c. (2) Closers: Overhead, surface-mounted, 180-degree open, **Sargent "250"**, **LCN "4040"**, or CONTRACTING OFFICER approved equal. Closer shall be painted per Section 09800 to match the color of the door.

d. (2) Holders: Overhead, concealed type, **RIXSON "Standard Duty 2 Series"**, **Sargent "690 Series"** or CONTRACTING OFFICER approved equal.

e. Weatherseals: Seals shall be **Pemko "S88D", NGP "5050B"** or CONTRACTING OFFICER approved equal. Seals shall be provided at the door head, jambs and astragal.

f. Door Drip (Head): **Pemko "346A"** or CONTRACTING OFFICER approved equal. Drip shall be painted per Section 09800 to match the color of the door.

g. (2) Door Drip (Bottom): **Pemko "345A"** or CONTRACTING OFFICER approved equal. Drip shall be painted per Section 09800 to match the color of the door.

h. Astragal: "T"-type, **Pemko "355CS"** or CONTRACTING OFFICER approved equal.

i. Door Coordinator: **Trimco "3094-B3"** or CONTRACTING OFFICER approved equal.

j. Automatic Flush Bolts with Strike: **Trimco "3810 x 3911"** or CONTRACTING OFFICER approved equal.

k. (2) Kickplates: **Trimco "KM050"**, **BBW "37-W"**, **Quality "48/49"** or CONTRACTING OFFICER approved equal. Kickplate shall be located on the interior side of the door.

2.12 ELECTRICAL REQUIREMENTS

A. **General:** The Contractor shall provide all wiring, conduit, and miscellaneous electrical components necessary for the pre-engineered metal building to function as designed. All materials and WORK shall conform to applicable provisions of City, State, and National Electric Codes. Components shall be UL listed, and shall include the following:

1. Interior and exterior light fixtures, which provide sufficient light as required by codes. Light fixtures shall be of heavy-duty, industrial-type, and weather- and water-tight design, **Lightolier** or CONTRACTING OFFICER approved equal.

2. Appropriate circuit breakers for Contractor supplied equipment (lighting and convenience outlets).

PART 3 -- EXECUTION

3.1 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver and store prefabricated components, sheets, panels and the manufactured items so they will not be damaged or deformed.

B. Stack materials on platforms or pallets, covered with tarpaulins or other suitable weathertight ventilated covering. Store metal sheets or panels so that water accumulations will drain freely. Do not store sheets or panels in contact with other materials that may cause staining.

3.2 FABRICATION

A. The building shall be factory fabricated to the manufacturer's written standards and shall be in accordance with AISC and MBMA standards.

B. All material shall be completely fabricated and prepared for shipment including any necessary crating or bundling. All parts of the building shall be accurately made and true to dimension so that all parts will easily fit during erection.

3.3 INSTALLATION AND ERECTION

A. Installation and erection of the building shall be in accordance with the manufacturer's standards and shall be workmanship of the highest quality. No field cutting of structural parts will be permitted. Field cutting and patching of panels and accessories will not be permitted unless authorized by the CONTRACTING OFFICER. Such field modifications, when authorized, shall be performed in a manner which will not impair the appearance, weather tightness, or structural quality of the material. Erection shall be accomplished in sufficient time to meet the schedule specified.

B. **Framed Openings:** Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical or electrical WORK. Securely attach to building structural frame.

3.4 ROOFING AND WALL SIDING

A. **General:** Arrange and nest sidelap joints so that prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full rib corrugation. Apply panels and

associated items for neat and weathertight enclosure. Avoid "panel creep" or application not true to line. Protect factory finishes from damage.

1. Flash and seal roof panels at eave and rake with rubber, neoprene or other closures to exclude weather.

B. **Roof Sheets:** Provide sealant tape at lapped joints of ribbed or fluted roof sheets, and between roof sheeting and protruding equipment, vents, and accessories.

1. Apply continuous ribbon of sealant tape to clean, dry surface of weather side of fastenings on end laps, and on side laps of corrugated nesting type, ribbed or fluted panels and elsewhere as necessary to make roof sheets weatherproof to driving rains.

2. At end laps of panels, install tape caulk between panels.

3. Install factory-caulked cleats at standing seam joints. Machine seam cleats to the panels to provide a weather-tight joint.

C. **Wall Sheets:** Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete and elsewhere as necessary for waterproofing. Handle and apply sealant and back-up in accordance with the sealant manufacturer's recommendations.

1. Align bottoms of wall panels and fasten panels with blind rivets, bolts or self-tapping screws. Fasten flashing, trim around openings, and similar elements with self-tapping screws. Fasten window and door frames with machine screws or bolts. When building height requires two rows of panels at gable ends, align lap of gable panels over wall panels at eave height.

2. Install screw fasteners with power tool having controlled torque adjusted to compress neoprene washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.

D. **Sheet Metal Accessories:** Install gutters, downspout, ventilators, louvers, and other sheet metal accessories in accordance with manufacturer's recommendations for positive anchorage to building and weathertight mounting. Adjust operating mechanism for precise operation.

3.5 CLEANING

A. Keep building and premises free from accumulated waste materials, rubbish and debris resulting from WORK herein, and, upon completion of said WORK, remove tools, appliances, surplus materials, waste materials, rubbish, debris and accessory items used in or resulting from said WORK, and legally dispose of off site.

B. Protect WORK and materials of this Section prior to and during installation, and protect the installed WORK and materials of other trades.

C. In the event of damage, make all repairs and replacements necessary to the approval of the CONTRACTING OFFICER at no additional cost to the GOVERNMENT.

D. Clean exposed panel surface promptly after completion of installation in accordance with recommendations of panel and coating manufacturer.

- END OF SECTION -

SECTION 13675 - POLYETHYLENE TANKS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide cross-linked, high density polyethylene tanks and accessories, complete and in place, in accordance with the Contract Documents.

B. **Unit Responsibility:** The CONTRACTOR shall assign responsibility for furnishing the tank system as indicated to the tank manufacturer.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Commercial Standards:**

1.	ASTM C 177	Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
2.	ASTM C 273	Test Method for Shear Properties of Sandwich Core Materials
3.	ASTM D 638	Test Method for Tensile Properties of Plastics
4.	ASTM D 746	Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
5.	ASTM D 790	Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
6.	ASTM D 1505	Test Methods for Density of Plastics by the Density-Gradient Technique
7.	ASTM D 1525	Test Method for Vicat Softening Temperature Plastics
8.	ASTM D 1998	Polyethylene Upright Storage Tanks
9.	ASTM D 1621	Test Method for Compressive Properties of Rigid Cellular Plastics
10.	ASTM D 1622	Test Method for Apparent Density of Rigid Cellular Plastics
11.	ASTM D 1623	Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics
12.	ASTM D 1693	Test Method for Environmental Stress-Cracking of

		Ethylene Plastics
13.	ASTM D 2126	Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging
14.	ASTM D 2842	Test Method for Water Absorption of Rigid Cellular Plastics
15.	ASTM D 2856	Test Method for Open Cell Content of Rigid Cellular Plastics by the Air Pycnometer
16.	ASTM E 84	Test Method for Surface Burning Characteristics of Building Materials
17.	NEMA ICS 6	Enclosures for Industrial Control and Systems

1.3 CONTRACTOR SUBMITTALS

A. Submit the following in compliance with Section 01300 - Contractor Submittals.

B. **Shop Drawings:**

1. Tank manufacturer's data and dimensions showing locations of all openings, locations of level indicators, seismic support structure and anchoring system details, and location of tank accessories.

2. Details on inlet and outlet fittings, manways, flexible connections, vents and level indicators.

3. Tank pad requirements such as pads and blockouts.

C. **Manufacturer’s Qualifications:**

1. List of installations in compliance with manufacturer's experience requirements per paragraph 1.4.

D. **Owner's Manual:** Include the following in the OWNER'S MANUAL:

1. Part 2 - Operational Procedures

a. Manufacturer's recommendations for installation.

b. Fitting installation and adjustment procedures.

c. Repair procedures for typical situations including small holes, pinholes, and minor cracks in the tank.

2. Part 8 - Documentation

a. Certification signed by the manufacturer that the tanks have been factory tested and meet the requirements indicated.

b. Seismic restraint plans and instructions as specified in paragraph 2.5.

c. Calculations used to determine wall thickness. Hoop stress shall be indicated. Calculations shall be signed by a California Registered Structural Engineer.

d. A representative of the manufacturer shall certify in writing that the tank has been installed in accordance with the manufacturer's recommendations. Certification shall be submitted.

1.4 MANUFACTURER'S QUALIFICATIONS

A. The tank manufacturer shall have a record of at least ten installations during the previous 5 years for the tank sizes indicated. The manufacturer shall furnish names and telephone numbers of locations which can be visibly inspected.

1.5 SPECIAL WARRANTY REQUIREMENT

A. The tank shall be warranted for 5 years to be free of defects in material and workmanship. Warranty may be prorated over the last 3 years.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Tanks shall be circular in cross-section, vertical, complete with piping inlets and outlets, drains, overflows, and anchoring system. Covered tanks shall be vented, and where indicated, tanks shall be provided with entrance manways, level indicators, and exterior coating. Tanks shall be marked to identify the manufacturer, date of manufacture, serial number, and capacity. Tanks shall meet the requirements of ASTM D 1998 unless otherwise indicated.

2.2 TANKS

A. **Materials**: Polyethylene shall be the cross-linked, high density type meeting or exceeding the following:

Parameter	ASTM Test Method	Value
Density, gm/cc	D 1505	0.937 to 0.945
Tensile strength at yield, psi minimum	D 638	2600
Elongation at break, min percent	D 638	400
Stress-crack resistance, min hours for F_{50}	D 1693	1000
Vicat softening temperature, deg. F	D 1525	230
Brittleness temperature, deg. F, maximum	D 746	-180
Flexural modulus, psi	D 790	100,000

B. Resin used in the tank shall be **Phillips Chemical Marlex CL-200 or CL-250, PAXON grade 7004 or 7204**, or equal, and shall contain a minimum of 0.3 percent ultraviolet stabilizer as recommended by the manufacturer. Where black tanks are indicated, the black resin shall contain 2 percent carbon black blended into the resin.

C. **Operating Conditions:** Storage tanks shall be suitable for the following operating conditions:

Equipment numbers	-	10-T-1, 10-T-2
Liquid stored	-	Alum 50%
Unit weight, lb/gal	-	11
Design specific gravity	-	1.34
Solution pH	-	3
Maximum fluid temperature, deg. F	-	100
Minimum fluid temperature, deg. F	-	40
ambient air temperature, deg. F	-	20 - 130

D. **Construction**: Tanks shall be constructed using a rotationally molded fabrication process. Wall thickness of the tank shall be designed by the manufacturer with a hoop stress no greater than 600 psi using 1.5 times the specific gravity indicated.

E. Tanks shall have the following characteristics:

1.	Equipment No.	-	10-T-1, 10-T-2
2.	Type (see Note 1)	-	CD
3.	Nominal diameter, ft	-	7’-6”
4.	Nominal height (see Note 2)	-	10’-2”
5.	Nominal capacity, gallons	-	3,000
6.	Liquid depth, maximum, ft	-	8’-2”
7.	Manway (see Note 3)		
	Mounting	-	TM
	Diameter, inches	-	24
8.	Exposure	-	Outdoor
9.	Color	-	Per client

Note 1: CD = closed, domed top; CF = closed, flat top; OIF = open, internal flange; OEF

= open, external flange; FLR = flat lid removable; FLH = flat lid hinged.

Note 2: Nominal height of domed top tanks is the dimension measured along the straight cylindrical portion of the tank and does not include the rounded end.

Note 3: TM = top mount; TSM = top and side mount
Unless otherwise indicated, manways shall be integrally molded with the tank.

2.3 TANK FITTINGS

A. Refer to drawings for tank fitting size and orientation.

B. Tank fittings shall be according to the fitting schedule below. Gasket material shall be closed cell, cross-linked polyethylene material equal to the tank material indicated. PVC fittings shall be compression type Schedule 80 long shank high-torque design with minimum of 85 percent threaded contact. Any screwed fittings shall use American Standard Pipe Threads. No metals shall be exposed to tank contents. If tanks are insulated, fittings shall be installed at the factory prior to application of the insulation.

Item		Fitting Type (Note 4)	
1.	Equipment No.	-	10-T-1, 10-T-2
2.	Fill	-	BF-SS
3.	Overflow	-	BF-SS
4.	Tank drain	-	BF-SS
5.	U-vent	-	PVC
6.	Outlet to pump	-	IMFO
7.	Level indication	-	BF-SS

Note 4: Refer to drawings for fitting size and location. Abbreviations for fittings are:

BF-H: Bolted flanged fitting with Hastelloy-C studs and polyethylene encapsulated heads.

BF-SS: Bolted flanged fitting with 316 SS studs and polyethylene encapsulated heads.

IMFO: Integrally molded flanged outlet.

DB-SD: Double bolt with siphon drain, 316 SS studs, and polyethylene encapsulated heads.

PVC: Double-nut PVC fitting.

2.4 LEVEL INDICATION

A. Provide an ultrasonic level indication system as well as any other level devices in accordance with Division 17 of the specifications.

2.5 SEISMIC AND WIND RESTRAINT SYSTEM

A. The tanks shall be provided with seismic restraint systems manufactured in conformance with plans and instructions prepared and stamped by a registered structural engineer. The lateral restraint assembly shall be designed for seismic Zone 4 and shall conform to the Uniform Building Code.

B. Wind restraint for outdoor tanks shall be designed to resist a wind velocity of 80 miles per hour. Wind restraint shall be designed to restrain an empty tank.

2.6 FACTORY TESTING

A. **Material Testing**: Material taken from each tank shall be tested for the following:

Parameter	Test Standard	Value
Impact	ASTM D 1998	120 ft-lb, min
Gel, minimum percent	ASTM D 1998	1/32-inch of inner wall: 65 outer wall: 90 total wall: 70

B. Following fabrication, the tanks, including factory applied inlet and outlet fittings, shall be hydraulically tested with water. The factory test shall compensate for the difference in specific gravity between the test water and chemical stored to simulate actual maximum operating pressures. Test methods may include adding a 2.5 psi air pad to a filled tank or filling the tank with standpipes, raising the maximum water surface approximately 5 feet higher than the normal maximum tank level. The test duration shall be 24 hours. Following successful testing, the tank shall be emptied and dried prior to shipment.

C. An affidavit signed by the tank manufacturer shall be furnished indicating that the factory tests have been performed and the indicated conditions have been met.

2.7 MANUFACTURERS, OR EQUAL

A. **Poly Processing Company;**

B. **Central California Container Mfg.;**

C. **Nalgene;**

D. **Core-Rosion Products.**

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with the manufacturer's recommendations.

3.2 FIELD TESTING

A. After installation of tank and all fittings, the tank shall be water tested by filling the entire tank with water and monitoring the tank as well as all fitting connections for at least 24 hours. Any leaks shall be corrected prior to acceptance. Following successful field testing, the tank shall be completely emptied and dried.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 15000 - PIPING, GENERAL

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide all piping systems indicated, complete and operable, in accordance with the Contract Documents.

B. The provisions of this Section shall apply to all piping sections in Divisions 2 and 15.

C. The mechanical drawings define the general layout, configuration, routing, method of support, pipe size, and pipe type. The mechanical drawings are **not** pipe construction or fabrication drawings. Where pipe supports and spacings are indicated on the Drawings and referenced to a Standard Detail, the CONTRACTOR shall use that Detail. Where pipe supports are not indicated on the Drawings, it is the CONTRACTOR's responsibility to develop the details necessary to design and construct all mechanical piping systems, to accommodate the specific equipment provided, and to provide all spacers, adapters, and connectors for a complete and functional system.

1.2 CONTRACTOR SUBMITTALS

A. **General:** Submittals shall be furnished in accordance with Section 01300 - Contractor Submittals.

B. **Shop Drawings:** Shop Drawings shall contain the following information:

1. Drawings: Layout drawings including all necessary dimensions, details, pipe joints, fittings, specials, bolts and nuts, gaskets, valves, appurtenances, anchors, guides, and material lists. Fabrication drawings shall indicate all spacers, adapters, connectors, fittings, and pipe supports to accommodate the equipment and valves in a complete and functional system.

2. Thermoplastic Pipe Joints: Submit solvent cement manufacturer's catalog indicating that the recommended product is suitable for each fluid service application.

3. Gasket Material: Submit gasket manufacturer's catalog indicating that the recommended product is suitable for each fluid service application.

C. **Samples:** Performing and paying for sampling and testing as necessary for certifications are the CONTRACTOR'S responsibility.

D. Certifications

1. All necessary certificates, test reports, and affidavits of compliance shall be obtained by the CONTRACTOR.

2. A certification from the pipe fabricator that all pipes will be manufactured subject to the fabricator’s or a recognized Quality Control Program. An outline of the program shall be submitted to the CONTRACTING OFFICER for review prior to the manufacture of any pipe.

PART 2 -- PRODUCTS

2.1 GENERAL

A. **Extent of Work:** Pipes, fittings, and appurtenances shall be provided in accordance with the requirements of the applicable Sections of Divisions 2 and 15 and as indicated. Materials in contact with potable water shall be listed as compliant with NSF Standard 61.

B. **Pipe Supports:** Pipes shall be adequately supported, restrained, and anchored in accordance with Section 15006 - Pipe Supports, and as indicated. Supports shall resist stresses created by a 60 percent maximum seismic load.

C. **Lining:** Application, thickness, and curing of pipe lining shall be in accordance with the applicable Sections of Division 2, unless otherwise indicated.

D. **Coating:** Application, thickness, and curing of pipe coating shall be in accordance with the applicable Sections of Division 2, unless otherwise indicated. Pipes above ground or in structures shall be field-coated in accordance with Section 09800 - Protective Coating.

E. **Pressure Rating:** Piping systems shall be designed for the maximum expected pressure as defined in Section 01656 - Pressure Pipe Testing and Disinfection, or as indicated on the Piping Schedule.

F. **Inspection:** Pipe shall be subject to inspection at the place of manufacture. During the manufacture of the pipe, the CONTRACTING OFFICER shall be given access to all areas where manufacturing is in progress and shall be permitted to make all inspections necessary to confirm compliance with requirements.

G. **Tests:** Except where otherwise indicated, materials used in the manufacture of the pipe shall be tested in accordance with the applicable specifications and standards. The CONTRACTOR shall be responsible for performing material tests.

H. **Welding Requirements:** Qualification of welding procedures used to fabricate pipe shall be in accordance with the provisions of ANSI/AWS D1.1 - Structural Welding Code. Welding procedures shall be submitted for the CONTRACTING OFFICER's review.

I. **Welder Qualifications:** Welding shall be done by skilled welders and welding operators who have adequate experience in the methods and materials to be used. Welders shall be qualified under the provisions of ANSI/AWS D1.1 or the ASME Boiler and Pressure Vessel Code, Section 9, by an independent local, approved testing agency not more than 6 months prior to commencing work on the pipeline. Machines and electrodes similar to those used in the WORK shall be used in qualification tests. Qualification testing of welders and materials used during testing are part of the WORK.

2.2 PIPE FLANGES

A. **General:** Flanges shall have flat faces and shall be attached with bolt holes straddling the vertical axis of the pipe unless otherwise indicated. Attachment of the flanges to the pipe shall conform to the applicable requirements of ANSI/AWWA C207. Flange faces shall be perpendicular to the axis of the adjoining pipe. Flanges for miscellaneous small pipes shall be in accordance with the standards indicated for these pipes.

B. Pressure Ratings

1. 150 psi or less: Flanges shall conform to either ANSI/AWWA C207 - Steel Pipe Flanges for Waterworks Service--Sizes 4 In. Through 144 In., Class D, or ANSI/ASME B16.5 - Pipe Flanges and Flanged Fittings, 150 lb class.

2. 150 psi to 275 psi: Flanges shall conform to either ANSI/AWWA C207 Class E or Class F, or ANSI/ASME B16.5 150 lb class.

3. 275 psi to 700 psi: Flanges shall conform to ANSI/ASME B16.5, 300 lb class.

4. Selection based on test pressure: AWWA flanges shall not be exposed to test pressures greater than 125 percent of rated capacity. For higher test pressures, the next higher rated AWWA flange or an ANSI-rated flange shall be selected.

C. **Blind Flanges:** Blind flanges shall be in accordance with ANSI/AWWA C207, or as indicated for miscellaneous small pipes. Blind flanges for pipe sizes 12-inches and greater shall be provided with lifting eyes in the form of welded or screwed eye bolts.

D. **Flange Coating:** Machined faces of metal blind flanges and pipe flanges shall be coated with a temporary rust-inhibitive coating to protect the metal until the installation is completed.

E. **Flange Bolts:** Bolts and nuts shall conform to Section 05500 - Miscellaneous Metalwork. Studs and bolts shall extend through the nuts a minimum of 1/4-inch. All-thread studs shall be used on all valve flange connections, where space restrictions preclude the use of regular bolts.

F. **Insulating Flanges:** Insulated flanges shall have bolt holes 1/4-inch diameter greater than the bolt diameter.

G. **Insulating Flange Sets:** Insulating flange sets shall be provided where indicated. Each insulating flange set shall consist of an insulating gasket, insulating sleeves and washers and a steel washer. Insulating sleeves and washers shall be one piece when flange bolt diameter is 1-1/2 inch or smaller and shall be made of acetal resin. For bolt diameters larger than 1-1/2 inch, insulating sleeves and washers shall be 2 piece and shall be made of polyethylene or phenolic material. Steel washers shall be in accordance with ASTM A 325 - Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength. Insulating gaskets shall be full-face.

H. Insulating Flange Manufacturers, or equal

1. **JM Red Devil, Type E**

2. **Maloney Pipeline Products Co., Houston**

3. **PSI Products, Inc., (Frost Engineering Service Co., Costa Mesa, California.)**

I. Flange Gaskets

1. Gaskets for flanged joints used in general water and wastewater service shall be full-faced type, with material and thickness in accordance with ANSI/AWWA C207, suitable for temperatures to 700 degrees F, a pH of one to eleven, and pressures to 1000 psig. Blind flanges shall have gaskets covering the entire inside face of the

blind flange and shall be cemented to the blind flange. Ring gaskets shall not be permitted, unless otherwise indicated. Flange gaskets shall be as manufactured by **John Crane, Style 2160, Garlock, Style 3000,** or equal**.**

2. Gaskets for flanged joints used in water with chloramines shall be **Gylon, Style 3500** as manufactured by **Garlock** or **Crane**, or equal.

3. Gaskets for flanged joints used in chemicals, air, solvents, hydrocarbons, steam, chlorine and other fluids shall be made of materials compatible with the service, pressure, and temperature.

2.3 THREADED INSULATING CONNECTIONS

A. **General:** Threaded insulating bushings, unions, or couplings, as appropriate, shall be used for joining threaded pipes of dissimilar metals and for piping systems where corrosion control and cathodic protection are involved.

B. **Materials:** Threaded insulating connections shall be of nylon, Teflon, polycarbonate, polyethylene, or other non-conductive materials, and shall have ratings and properties to suit the service and loading conditions.

2.4 MECHANICAL-TYPE COUPLINGS (GROOVED OR BANDED PIPE)

A. **General:** Cast mechanical-type couplings shall be provided where indicated. The couplings shall conform to the requirements of ANSI/AWWA C606 - Grooved and Shouldered Joints. Bolts and nuts shall conform to the requirements of Section 05500 - Miscellaneous Metalwork. Gaskets for mechanical-type couplings shall be compatible with the piping service and fluid utilized, in accordance with the coupling manufacturer's recommendations. The wall thickness of grooved piping shall conform with the coupling manufacturer's recommendations to suit the highest expected pressure. To avoid stress on equipment, equipment connections with mechanical-type couplings shall have rigid-grooved couplings or flexible type coupling with harness in sizes where rigid couplings are not available, unless thrust restraint is provided by other means. Mechanical-type couplings shall be bonded. The CONTRACTOR shall have the coupling manufacturer's service representative verify the correct choice and application of couplings and gaskets, and the workmanship, to assure a correct installation. To assure uniform and compatible piping components, all grooved fittings, couplings, and valves shall be from the same manufacturer.

B. Manufacturers of Couplings for Steel Pipe, or equal

1. **Gustin-Bacon (Aeroquip Corp.) (banded or grooved)**

2. **Victaulic Style 41 or 44 (banded, flexible)**

3. **Victaulic Style 77 (grooved, flexible)**

4. **Victaulic Style 07 or HP-70 (grooved, rigid)**

C. Manufacturers of Ductile Iron Pipe Couplings, or equal

1. **Gustin-Bacon, (Aeroquip Corp.)**

2. **Victaulic Style 31 (flexible or rigid grooving)**

Note: Ductile iron pipe couplings shall be furnished with flush seal gaskets.

D. Manufacturers of Couplings for PVC Pipe, or equal

1. **Gustin-Bacon, (Aeroquip Corp)**

2. **Victaulic Style 775**

Note: Couplings for PVC pipe shall be furnished with radius cut or standard roll grooved pipe ends.

2.5 SLEEVE-TYPE COUPLINGS

A. **Construction:** Sleeve-type couplings shall be provided where indicated, in accordance with ANSI/AWWA C219 - Standard for Bolted Sleeve-Type Couplings for Plain-End Pipe. Couplings shall be steel with steel bolts, without pipe stop. Couplings shall be of sizes to fit the pipe and fittings indicated. The middle ring shall be not less than 1/4-inch thick or at least the same wall thickness as the pipe to which the coupling is connected. If the strength of the middle ring material is less than the strength of the pipe material, the thickness of the middle ring shall be increased to have the same strength as the pipe. The coupling shall be either 5 or 7-inches long for sizes up to and including 30-inches and 10-inches long for sizes greater than 30-inches, for standard steel couplings, and 16-inches long for long-sleeve couplings. The followers shall be single-piece contoured mill sections welded and cold-expanded as required for the middle rings, and of sufficient strength to accommodate the number of bolts necessary to obtain adequate gasket pressures without excessive rolling. The shape of the follower shall be of such design as to provide positive confinement of the gasket. Bolts and nuts shall conform to the requirements of Section 05500. Buried sleeve-type couplings shall be epoxy-coated at the factory as indicated.

B. **Pipe Preparation:** Where indicated, the ends of the pipe shall be prepared for flexible steel couplings. Plain ends for use with couplings shall be smooth and round for a distance of 12-inches from the ends of the pipe, with outside diameter not more than 1/64-inch smaller than the nominal outside diameter of the pipe. The middle ring shall be tested by cold-expanding a minimum of one percent beyond the yield point, to proof-test the weld to the strength of the parent metal. The weld of the middle ring shall be subjected to air test for porosity.

C. **Gaskets**

1. Gaskets for sleeve-type couplings shall be rubber-compound material that will not deteriorate from age or exposure to air under normal storage or use conditions. Gaskets for wastewater and sewerage applications shall be Buna "N," Grade 60, or equivalent suitable elastomer. The rubber in the gasket shall meet the following specifications:

a. Color - Jet Black

b. Surface - Non-blooming

c. Durometer Hardness - 74 plus and minus 5

d. Tensile Strength - 1000 psi Minimum

e. Elongation - 175 percent Minimum

2. The gaskets shall be immune to attack by impurities normally found in water or wastewater. All gaskets shall meet the requirements of ASTM D 2000 - Classification System for Rubber Products in Automotive Applications, AA709Z, meeting Suffix B13 Grade 3, except as noted above. Where sleeve couplings are used in water containing chloramine or other fluids which attack rubber materials, gasket material shall be compatible with the piping service and fluid utilized.

3. Gasket materials used in water with chloramines shall be **Gylon Style 3500** by **Garlock** or **Crane,** or equal.

D. **Insulating Sleeve Couplings:** Where insulating couplings are required, both ends of the coupling shall have a wedge-shaped gasket which assembles over a sleeve of an insulating compound material compatible with the fluid service in order to obtain insulation of all coupling metal parts from the pipe.

E. **Restrained Joints:** Sleeve-type couplings on pressure lines shall be harnessed unless thrust restraint is provided by other means. Harnesses shall be designed by the pipe manufacturer in accordance with Manual M11, or as indicated. Harness sets shall be designed for the maximum test pressure of the pipe in which they are installed. Where harness sets are installed near the suction and discharge of the pump, harness bolts shall have zero elongation to prevent misalignment of the pump imparted by the thrust within the piping system.

F. Manufacturers, or equal

1. **Dresser, Style 38**

2. **Ford Meter Box Co., Inc., Style FC1 or FC3**

3. **Smith-Blair, Style 411**

2.6 FLEXIBLE CONNECTORS

A. **Low Temperatures:** Flexible connectors shall be installed in all piping connections to engines, blowers, compressors, and other vibrating equipment, and where indicated. Flexible connectors for service temperatures up to 180 degrees F shall be flanged, reinforced Neoprene or Butyl spools, rated for a working pressure of 40 to 150 psi, or reinforced, flanged duck and rubber, as best suited for the application. Flexible connectors for service temperatures above 180 degrees F shall be flanged, braided stainless steel spools with inner, annular, corrugated stainless steel hose, rated for minimum 150 psi working pressure, unless otherwise indicated. The connectors shall be a minimum of 9-inches long, face-to-face flanges, unless otherwise indicated. The final material selection shall be approved by the manufacturer. The CONTRACTOR shall submit manufacturer's shop drawings and calculations.

2.7 EXPANSION JOINTS

A. Piping subject to expansion and contraction shall be provided with sufficient means to compensate for such movement without exertion of undue forces to equipment or structures. This may be accomplished with expansion loops, bellow-type expansion joints, or sliding-type expansion joints. Expansion joints shall be flanged end, stainless steel, Monel, rubber, or other materials best suited for each individual service. The

CONTRACTOR shall submit detailed calculations and manufacturer's Shop Drawings of all proposed expansion joints, piping layouts, and anchors and guides, including information on materials, temperature and pressure ratings.

2.8 PIPE THREADS

A. Pipe threads shall be in accordance with ANSI/ASME B1.20.1 - Pipe Threads, General Purpose (inch), and be made up with Teflon tape unless otherwise indicated.

2.9 PIPE INSULATION

A. Piping shall be insulated as indicated, in accordance with the requirements of Section 15145 - Pipe and Equipment Insulation. No unprotected hot piping shall be within reach of operating personnel or other persons.

B. Preinsulated pipe for underground service shall be in accordance with Section 02550 - Preinsulated Pipe.

2.10 Clear Vinyl Tubing with Nylon Reinforcement.

A. Vinyl tubing shall be a clear, flexible tubing with constructed of plasticized PVC with Nylon Reinforcements. The tubing shall be rated for 150 psi at 70 deg. F for 1-inch diameter tubing.

2.11 AIR AND GAS TRAPS

A. Air and gas pipes shall slope to low points and be provided with drip legs, shut-off valves, strainers, and traps. The traps shall be piped to the nearest drain. Air and gas traps shall be not less than 150 lb iron body float type with copper or stainless steel float. Bracket, lever, and pins shall be of stainless steel. Drain traps shall have threaded connections.

B. Manufacturers, or equal

1. **Armstrong International, Inc.**

2. **Spirax Sarco, Inc.**

PART 3 -- EXECUTION

3.1 MATERIAL DELIVERY, STORAGE, AND PROTECTION

A. Piping materials, fittings, valves, and accessories shall be delivered in a clean and undamaged condition and stored off the ground for protection against oxidation caused by ground contact. Defective or damaged materials shall be replaced with new materials.

3.2 GENERAL

A. Piping, fittings, and appurtenances shall be installed in accordance with the requirements of applicable Sections of Division 2 and Division 15. Care shall be taken to insure that piping flanges, mechanical-type couplings, sleeve-type couplings, flexible connectors, and expansion joints are properly installed as follows:

1. Gasket surfaces shall be carefully cleaned and inspected prior to making up the connection. Each gasket shall be centered properly on the contact surfaces.

2. Connections shall be installed to prevent inducing stress to the piping system or the equipment to which the piping is connected. Contact surfaces for flanges, couplings, and piping ends shall be aligned parallel, concentric, and square to each axis at the piping connections.

3. Bolts shall be initially hand-tightened with the piping connections properly aligned. Bolts shall be tightened with a torque wrench in a staggered sequence to the AISC recommended torque for the bolt material.

4. After installation, joints shall meet the indicated leakage rate. Flanges shall not be deformed nor cracked.

B. **Lined Piping Systems:** The lining manufacturer shall take full responsibility for the complete, final product and its application. Pipe ends and joints of lined pipes at screwed flanges shall be epoxy-coated to assure continuous protection.

C. **Core Drilling:** Where core drilling is required for pipes passing through existing concrete, core drilling locations shall be determined by radiograph of concrete construction to avoid damage to embedded raceways and reinforcing bars.

D. **Cleanup:** After completion of the WORK, cuttings, joining and wrapping materials, and other scattered debris shall be removed from the Site. The entire piping system shall be handed over in a clean and functional condition.

- END OF SECTION -

SECTION 15005 - PIPING IDENTIFICATION

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide identification for exposed piping and valves, complete and in place, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards

ANSI A13.1 Scheme for the Identification of Piping Systems

1.3 CONTRACTOR SUBMITTALS

A. Submittals shall be in accordance with Section 01300 - Contractor Submittals.

B. Shop Drawings: A list of suggested wording for each valve tag, prior to fabrication.

C. Samples

1. One sample of each type of identification device.

PART 2 -- PRODUCTS

2.1 IDENTIFICATION OF PIPING

A. Except as indicated below for very short pipe lengths, identify exposed piping larger than 2-inches nominal size for the pipe contents and direction of flow.

1. Marker Type

a. Snap Around: Vinyl or polyester sheet with UV- resistant ink, preshaped and sized to tightly curl around the pipe and remain in position.

b. Adhesive: Vinyl or polyester sheet with UV- resistant ink, shaped similar to pipe curvature and coated with pressure sensitive adhesive.

c. Stencil: Lettering painted directly on surface of pipe inside color coded marker area.

2. Marker Area: Sized per pipe size according to ANSI A13.1; color from the table below.

3. Lettering: Sized per pipe size according to ANSI A13.1; color from the table below.

4. Arrows: Arrows at each marker area, showing direction of flow.

B. Pipe 2-inches and smaller shall be identified by plastic plates made from laminated 3-layer plastic with engraved black letters on white background.

C. Pipe identification shall be as manufactured by **Brady, Seton,** or equal.

2.2 EXISTING IDENTIFICATION SYSTEMS

A. In installations where existing piping identification systems have been established, the CONTRACTOR shall follow the existing system. Where existing identification systems are incomplete, utilize the existing system as far as practical and supplement with the indicated system.

2.3 IDENTIFICATION OF VALVES AND SHORT PIPE LENGTHS

A. Identifying devices for valves and the sections of pipe that are too short to be identified with markers and arrows shall be identified with metal or plastic tags.

B. Metal tags shall be stainless steel with embossed lettering. Plastic tags shall be solid black plastic laminate with white embossed letters. Tags shall be designed to be firmly attached to the valves or short pipes or to the structure immediately adjacent to such valves or short pipes.

C. Wording on the valve tags shall describe the exact function of each valve, e.g., "HWR-BALANCING," "CLS THROTTLING", "RAS-PUMP SHUT-OFF," etc.

PART 3 -- EXECUTION

3.1 GENERAL

A. Markers and identification tags shall be installed in accordance with the manufacturer's printed instructions, and shall be neat and uniform in appearance. Tags and markers shall be readily visible from all normal working locations.

3.2 VALVE TAGS

A. Valve tags shall be permanently attached to the valve or structure by means of 2 stainless steel bolts or screws.

3.3 MARKER LOCATIONS

A. Each pipe shall be marked at:

1. Intervals of 20-feet in straight runs.

2. At least once in every room.

3. Within 2-feet of turns, elbows, and valves.

4. On the upstream side of tees, branches, and other distribution points.

5. On both sides of walls and floors through which the piping passes.

3.4 IDENTIFICATION COLORS

A. Conform to the following color codes.

Color Schedule				
Pipe Contents		**Pipe Color**	**Marker Color**	**Letter Color**
Abbreviation	**Identification**			
AW	Filter air wash		blue	white
BD	Bottom drain		green	white
BP	Plant bypass		green	white
BW	Filter backwash		green	white
CD	Chemical drain and vent		yellow	black
DW	Domestic Water		yellow	black
FE	Final effluent		green	white
FI	Filter influent		green	white
FM	Force Main		green	white
H	Sodium Hypochlorite		yellow	Black
LA	Liquid alum		yellow	black
PA	Plant air		blue	white
PD	Plant drain		green	white
PEC	Polymer-cationic		green	white
PI	Plant influent		yellow	black
PO	Plant overflow		green	white
REW	Recycled water		purple	white
RWL	Rain water leader		green	white
S	Scum		yellow	black
SA	Sample lines		yellow	black

SD	Sanitary drains and vents		yellow	black
SDR	Storm drain		green	white
SE	Secondary effluent		yellow	black
SPD	Sump pump discharge		green	white
SS	Sanitary sewer		yellow	black
SUC	Structure underdrain collector		green	white
SW	Filter surface wash		green	white
V	Vacuum		blue	white
WW	Filter waste washwater		yellow	black

- END OF SECTION -

SECTION 15006 - PIPE SUPPORTS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide pipe supports, hangers, guides, and anchors, complete, in accordance with the Contract Documents.

B. Where pipe support systems are not indicated on the Drawings, the CONTRACTOR shall design and provide the supports in accordance with this Section.

1.2 CONTRACTOR SUBMITTALS

A. **General:** Submittals shall be in accordance with Section 01300 - Contractor Submittals.

B. **Shop Drawings:** Shop Drawings shall include the following information:

1. Drawings of pipe supports, hangers, anchors, and guides

2. Calculations for special supports and anchors.

PART 2 -- PRODUCTS

2.1 GENERAL REQUIREMENTS

A. **Code Compliance:** All piping systems and pipe connections to equipment shall be properly anchored and supported to prevent undue deflection, vibration, dislocation due to seismic events and line pressures, and stresses on piping, equipment, and structures. All supports and parts thereof shall conform to the requirements of ANSI/ASME B31.1 - Power Piping, except as supplemented or modified below. Supports for plumbing piping shall be in accordance with the latest edition of the applicable plumbing code or local administration requirements.

B. **Structural Members:** Wherever possible, pipes shall be supported from structural members. Where it is necessary to frame structural members between existing members, such supplementary members shall be provided by the CONTRACTOR. All supplementary members shall be in accordance with the requirements of the building code and the American Institute of Steel Construction and shall be acceptable to the CONTRACTING OFFICER.

C. **Pipe Hangers:** Pipe hangers shall be capable of supporting the pipe in all conditions of operation, allowing free expansion and contraction of the piping, and preventing excessive stress on equipment. All hangers shall have a means of vertical adjustment after erection. Hangers shall be designed to prevent becoming disengaged by any movement of the supported pipe. Hangers subject to shock, seismic disturbances, or thrust imposed by the actuation of safety valves, shall include hydraulic shock suppressors. All hanger rods shall be subject to tensile loading only.

D. **Hangers Subject to Horizontal Movements:** At hanger locations where lateral or axial movement is anticipated, suitable linkage shall be provided to permit such movement. Where horizontal pipe movement is greater than 1/2-inch, or where the hanger rod deflection from the vertical is greater than 4 degrees from the cold to the hot position of

the pipe, the hanger rod and structural attachment shall be offset in such a manner that the rod is vertical in the hot position.

E. **Spring-Type Hangers:** Spring-type pipe hangers shall be provided for piping subject to vibration or vertical expansion and contraction, such as engine exhausts and similar piping. All spring-type hangers shall be sized to the manufacturer's printed recommendations and the loading conditions encountered. Variable spring supports shall be provided with means to limit misalignment, buckling, eccentric loading, or to prevent overstressing of the spring, and with means to indicate at all times the compression of the spring. Supports shall be capable of accommodating at least 4 times the maximum travel due to thermal expansion.

F. **Thermal Expansion:** Wherever expansion and contraction of piping is expected, a sufficient number of expansion loops or expansion joints shall be provided, together with the necessary rolling or sliding supports, anchors, guides, pivots, and restraints permitting the piping to expand and contract freely in directions away from the anchored points. All components shall be structurally suitable to withstand all loads imposed.

G. **Heat Transmission:** Supports, hangers, anchors, and guides shall be so designed and insulated, that excessive heat will not be transmitted to the structure or to other equipment.

H. **Riser Supports:** Where practical, risers shall be supported on each floor with riser clamps and lugs, independent of the connected horizontal piping.

I. **Freestanding Piping:** Free-standing pipe connections to equipment such as chemical feeders and pumps shall be firmly attached to steel frames fabricated from angles, channels, or I-beams anchored to the structure. Exterior, free-standing overhead piping shall be supported on fabricated pipe stands consisting of pipe columns anchored to concrete footings, with horizontal, welded steel angles and U-bolts or clamps securing the pipes.

J. Materials of Construction

1. General: All pipe support assemblies, including framing, hardware, and anchors, shall be steel construction, galvanized after fabrication, unless otherwise indicated.

2. Submerged Supports: All submerged piping, as well as piping, conduits, and equipment in hydraulic structures within 24-inches of the water level, shall be supported with support, assemblies, including framing, hardware, and anchors, constructed of Type 316 stainless steel, unless otherwise indicated.

3. Corrosive: All piping in chemical and corrosive areas shall be supported with support assemblies, including framing, hardware, and anchors, constructed of Type 316 stainless steel or FRP, unless otherwise indicated.

K. **Point Loads:** Any meters, valves, heavy equipment, and other point loads on PVC, FRP, and other plastic pipes, shall be supported on both sides, according to manufacturer's recommendations to avoid undue pipe stresses and failures. To avoid point loads, all supports on PVC, FRP, and other plastic piping shall be equipped with extra wide pipe saddles or galvanized steel shields.

L. **Concrete Anchors:** Unless otherwise indicated, concrete anchors for pipe supports shall be according to the following table. Consult the CONTRACTING OFFICER for any anchor applications not on the table. Anchor embedment shall comply with Section 05500.

Pipe Support Application	Type of Concrete Anchor
New Concrete	Use embedded concrete insert anchors on a grid pattern. Use **Grinnell (Anvil International), Tolco**, or equal.
Existing Concrete	Use non-shrink grouted anchors, metallic type expansion anchors, or epoxy anchors. Exceptions: Metallic type expansion anchors and epoxy anchors are not permitted for pipe supports subject to vibrating loads. Epoxy anchors are not permitted where the concrete temperature is in excess of 100 degrees F or higher than the limiting temperature recommended by the manufacturer. Epoxy anchors are not accepted where anchors are subject to vibration or fire.
Vibratory Loads and High Temperature Conditions	Use non-shrink grouted anchors

M. **Noise Reduction:** To reduce transmission of noise in piping systems, all copper tubes in buildings and structures shall be wrapped with a 2-inch wide strip of rubber fabric or similar, suitable material at each pipe support, bracket, clip, or hanger.

2.2 SUPPORT SPACING

A. Supports for piping with the longitudinal axis in approximately a horizontal position shall be spaced to prevent excessive sag, bending, and shear stresses in the piping, with special consideration given where components such as flanges and valves impose concentrated loads. Pipe support spacing shall not exceed the maximum spans in the tables below. For temperatures other than ambient temperatures, or those listed, and for other piping materials or wall thicknesses, the pipe support spacings shall be modified in accordance with the pipe manufacturer's recommendations. Vertical supports shall be provided to prevent the pipe from being overstressed from the combination of all loading effects.

B. Where support spacing is not indicated on the Drawings, the CONTRACTOR shall use the spacing below.

1. Support Spacing for Schedule 40 and Schedule 80 Steel Pipe:

Nominal Pipe Diameter (inches)	Maximum Span (feet)
1/2	6

3/4 and 1	8
1-1/4 to 2	10
3	12
4	14
6	17
8 and 10	19
12 and 14	23
16 and 18	25
20 and greater	30

2. Support Spacing for Welded Fabricated Steel Pipe:

Maximum Spans for Pipe Supported in Minimum
120 degree Contact Saddles (feet)

Nominal Pipe Diameter (inches)	**Wall Thickness (inches)**									
	3/16	1/4	5/16	3/8	7/16	1/2	5/8	¾	7/8	1
24	33	37	41	43	45	47				
26	34	38	41	44	46	48				
28	34	38	41	44	47	49				
30	34	38	42	45	48	49				
32	34	39	42	45	48	50				
34	35	39	43	46	48	50				
36	35	39	43	46	49	51	55			
38	35	39	43	46	49	51	55			
40	35	40	43	47	49	52	56			
42	35	40	44	47	50	52	56			

For steel pipe sizes not presented in this table, the support spacing shall be designed so that the stress on the pipe does not exceed 5,000 psi. Maximum deflection of pipe shall be limited to 1/360th of the span and shall be calculated by using the formula:

$$L = (7500tD/(32t+D))^{1/2}$$

where: t = Thickness (inches)
D = Diameter (inches)
L = Maximum span (feet)

3. Support Spacing for Ductile-Iron Pipe:

Nominal Pipe Diameter (inches)	Maximum Span (feet)
All Diameters	Two supports per pipe length or 10 feet (one of the 2 supports located at joint)

4. Support Spacing for Copper Tubing:

Nominal Pipe Diameter (inches)	Maximum Span (feet)
1/2 to 1-1/2	6
2 to 4	10
6 and greater	12

5. Support Spacing for Schedule 80 PVC Pipe:

Nominal Pipe Diameter (inches)	Maximum Span (at 100 degrees F) (feet)
1/2	4
3/4	4.5
1	5
1-1/4	5.5
1-1/2	5.5
2	6
3	7
4	8
6	10
8	11
10	12
12 and greater	13

6. Support Spacing for Fiberglass Reinforced Plastic (FRP) Pipe:

Nominal Pipe Diameter (inches)	Maximum Span (at 100 degrees F) (feet)
2	8
3	10
4	11
6	12
8	13
10	14
12	15
14	16
16	17
18 and greater	18

2.3 MANUFACTURED SUPPORTS

A. **Stock Parts:** Where not specifically indicated, designs which are generally accepted as exemplifying good engineering practice and use stock or production parts, shall be utilized wherever possible. Such parts shall be locally available, new, of best commercial quality, designed and rated for the intended purpose.

B. Manufacturers, or Equal:

1. **Basic Engineers Inc**., Pittsburgh, PA;

2. **Bergen-Paterson Pipesupport Corp**., Woburn, MA;

3. **Grinnell Corp. (Anvil International)**, Cranston, RI;

4. **NPS Products, Inc**., Westborough, MA;

5. **Power Piping Company**, Pittsburgh, PA.

6. **Tolco Incorporated**, Corona, CA

2.4 COATING

A. **Galvanizing:** Unless otherwise indicated, all fabricated pipe supports other than stainless steel or non-ferrous supports shall be blast-cleaned after fabrication and hot-dip galvanized in accordance with ASTM A 123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

B. **Other Coatings:** Other than stainless steel or non-ferrous supports, all supports shall receive protective coatings in accordance with the requirements of Section 09800 - Protective Coating.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. **General:** All pipe supports, hangers, brackets, anchors, guides, and inserts shall be fabricated and installed in accordance with the manufacturer's printed instructions and ANSI/ASME B31.1 - Power Piping. All concrete inserts for pipe hangers and supports shall be coordinated with the formwork.

B. **Appearance:** Pipe supports and hangers shall be positioned to produce an orderly, neat piping system. All hanger rods shall be vertical, without offsets. Hangers shall be adjusted to line up groups of pipes at the proper grade for drainage and venting, as close to ceilings or roofs as possible, without interference with other work.

3.2 FABRICATION

A. **Quality Control:** Pipe hangers and supports shall be fabricated and installed by experienced welders and fitters, using the best welding procedures available. Fabricated supports shall be neat in appearance without sharp corners, burrs, and edges.

- END OF SECTION -

SECTION 15025 - STEEL PIPE
(ASTM A 53 / A 106, MODIFIED)

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide steel pipe and appurtenances, complete and in place, in accordance with the Contract Documents.

B. The requirements of Section 15000 - Piping, General apply to the WORK of this Section.

PART 2 -- PRODUCTS

2.1 PIPE MATERIAL

A. **Water, Air, Fuel Gas, Oil, Steam, and Waste Service:** Unless otherwise indicated, galvanized and black steel pipe shall conform to ASTM A 53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless or ASTM A 106 - Seamless Carbon Steel Pipe for High Temperature Service, Grade B, and shall be Schedule 40 or 80, as indicated in the Piping Schedule. Galvanized steel pipe shall not be cement mortar lined unless so indicated.

B. **Chlorine and Sulfur Dioxide Pressure Service:** Black steel pipe shall conform to Chlorine Institute Pamphlet 6, ASTM A 106, Grade A or B, and shall be Schedule 80.

2.2 PIPE JOINTS

A. Black steel pipe for general service shall have screwed ends with NPT threads, welded joints, or flanged joints. Screwed joints shall be made up with Teflon tape and welded joints may have butt-weld fittings, socket-weld fittings, or flanges. Where indicated, black steel pipe shall have grooved ends for shouldered couplings or plain ends for sleeve-type couplings.

B. Black steel pipe for chlorine or sulfur dioxide pressure service shall be socket-welded except where required to match mating fittings of vacuum regulator-check units, gas filters, valves, diaphragm units, gauges, and switches.

C. Galvanized steel pipe shall have screwed ends with NPT threads made up with Teflon tape. Where indicated, galvanized steel pipe shall have grooved ends for shouldered couplings or plain ends for sleeve-type couplings.

D. Where pressure conditions permit, black and galvanized steel pipe may have push-on joints for compression type fittings. For high pressure service these joints shall be harnessed.

2.3 FITTINGS

A. **Common Use:** The following fittings shall be provided for galvanized or black steel pipe, as indicated in the Piping Schedule:

1. Threaded malleable iron fittings conforming to ANSI/ASME B 16.3 - Malleable-Iron Threaded Fittings, Classes 150 and 300.

2. Threaded cast iron fittings conforming to ANSI/ASME B 16.4 - Cast Iron Threaded Fittings, Class 125 and 250.

3. Forged steel socket welded fittings conforming to ANSI/ASME B 16.11 - Forged Fittings, Socket - Welding and Threaded.

4. Butt welding fittings conforming to ANSI/ASME B 16.9 - Factory-Made Wrought Steel Butt Welding Fittings, Schedule 40 or 80, as indicated.

5. Threaded cast iron drainage fittings conforming to ANSI/ASME 16.12 - Cast Iron Threaded Drainage Fittings.

6. Flanged cast iron fittings conforming to ANSI/ASME B 16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800.

7. Flanged steel fittings conforming to ANSI/ASME B 16.5 - Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and Other Special Alloys.

8. Grooved ductile iron fittings with grooving dimensions conforming to ANSI/AWWA C 606 - Joints, Grooved and Shouldered Type.

9. Compression-type steel fittings with armored Buna S gaskets for plain end pipe.

B. Special Applications

1. Fittings for chlorine and sulfur dioxide under pressure shall be 3,000 lb. forged steel socket welded fittings conforming to ASTM A 105, Grade 2 - Forgings, Carbon Steel, for Piping Components, and 300 lb. forged steel fittings conforming to ANSI/ASME B 16.11, as indicated in the Piping Schedule.

2. Flanges for chlorine and sulfur dioxide pressure service shall conform to ASTM A 105, ANSI/ASME B 16.5, Class 300, with 1/16-inch raised face, with 1/16-inch high temperature, compressed, self-centering ring type gaskets to ANSI/ASME B 16.21 - Nonmetallic Flat Gaskets for Pipe Flanges. Unions shall be four bolt tongue and groove, ammonia type, suitable for chlorine and sulfur dioxide service, with female threads and lead gaskets.

3. High tensile alloy steel corrosion-resistant bolts and nuts shall be used with each set of flanged unions. Unions shall be rated for 500-lb. CWP service pressure, reducing-type, straight-type or blind-type, as required for the installation. Blind unions shall be provided as cleanouts where indicated, and straight unions shall be provided adjacent to each threaded valve or piece of equipment. Unions shall be as manufactured by **Henry Valve Company; Vogt Valve Co.;** or equal.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. **General:** All steel pipes shall be installed in a neat and workmanlike manner, properly aligned, and cut from measurements taken at the site, to avoid interferences with structural members, architectural features, openings, and equipment. Exposed pipes shall afford maximum headroom and access to equipment, and where necessary, all piping shall be installed with sufficient slopes for venting or drainage of liquids and

condensate to low points. All installations shall be acceptable to the CONTRACTING OFFICER.

B. **Supports and Anchors:** All piping shall be firmly supported with fabricated or commercial hangers or supports in accordance with Section 15006 - Pipe Supports. Where necessary to avoid stress on equipment or structural members, the pipes shall be anchored or harnessed. Expansion joints and guides shall compensate for pipe expansion due to temperature differences.

C. **Valves and Unions:** Water, steam, condensate, gas, vacuum, and air supply piping to fixtures, groups of fixtures, and equipment shall be provided with a shutoff valve and union, unless the valve has flanged ends. Low points in water systems and driplegs in steam, gas, and air systems shall have drainage valves. Unions shall be provided at threaded valves, equipment, and other devices requiring occasional removal or disconnection.

D. **Branch Connections:** Branch connections in horizontal runs of air and gas piping shall be made from the top of the pipe, to avoid drainage of condensate into the equipment.

3.2 PIPE PREPARATION

A. Prior to installation, each pipe length shall be carefully inspected, be flushed clean of any debris or dust, and be straightened if not true. Ends of threaded pipes shall be reamed and filed smooth. All pipefittings shall be equally cleaned before assemblage.

3.3 PIPE JOINTS

A. **Threaded Joints:** Pipe threads shall conform to ANSI/ASME B 1.20.1 - Pipe Threads, General Purpose (inch), and shall be full and cleanly cut with sharp dies. Not more than three threads shall remain exposed after installation.

B. **Welded Joints:** Welded joints shall conform to the specifications and recommendations of ANSI/ASME B 31.1 - Power Piping. All welding shall be done by skilled and qualified welders per Section 15000 - Piping, General.

C. **Grooved Joints:** Grooves for grooved couplings and fittings shall be made with specially designed grooving tools to the Manufacturer's recommendations and conform to ANSI/AWWA C 606. All grooves shall be clean and sharp without flaws, and the pipe ends shall be accurately cut at 90 degrees to the pipe axis.

D. **Push On Joints:** Push on joints and gasket installation shall be in accordance with the Manufacturer's recommendations and lubricants. Pipe ends shall be beveled to facilitate assembly. Lubricants shall be suitable for potable water service and shall be kept clean in closed containers.

3.4 INSPECTION AND FIELD TESTING

A. **Inspection:** All finished installations shall be carefully inspected for proper supports, anchoring, interferences, and damage to pipe, fittings, and coating. Any damage shall be repaired to the satisfaction of the CONTRACTING OFFICER.

B. **Field Testing:** Prior to enclosure or burying, all piping systems shall be pressure tested as required in the Piping Schedule, for a period of not less than one hour, without exceeding the tolerances listed in the Piping Schedule. Where no pressures are indicated, the pipes shall be subject to 1-1/2 times the maximum working pressure. The CONTRACTOR shall furnish all test equipment, labor, materials, and devices at no extra cost to the GOVERNMENT. For additional testing requirements, refer to Section 01656 - Pressure Pipe Testing and Disinfection.

1. Leakage may be determined by loss of pressure, soap solution, chemical indicator, or other positive and accurate method. All fixtures, devices, or other accessories which are to be connected to the lines and which would be damaged if subjected to the test pressure shall be disconnected and ends of the branch lines plugged or capped as required during the testing procedures.

2. After completion of the pressure tests, all chlorine gas piping shall be tested for leakage using chlorine gas under operating pressures. Piping shall be thoroughly clean and dry before admitting chlorine gas into the system. Chlorine shall be slowly admitted to the piping system. Leakage shall be checked with a swab soaked in aqua ammonia solution and waved in the vicinity of each fitting. Ammonia solution shall not be applied to the fittings. Formation of white fumes will be evidence of leaks. All chlorine gas shall be purged from the line before leaks are repaired.

3. Leaks shall be repaired to the satisfaction of the CONTRACTING OFFICER, and the system shall be re-tested until no leaks are found.

- END OF SECTION -

SECTION 15030 - STAINLESS STEEL PIPE
(ASTM A 312, MODIFIED)

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide stainless steel pipe and appurtenances, complete and in place, in accordance with the Contract Documents.

B. The requirements of Section 15000 - Piping, General apply to the WORK of this Section.

PART 2 -- PRODUCTS

2.1 PIPE MATERIAL

A. Unless otherwise indicated, stainless steel pipe shall be in accordance with ASTM A 312 - Seamless and Welded Austenitic Stainless Steel Pipe, Type 316, seamless, Schedule 40, with screwed fittings for sizes up to and including 2-1/2 inches, and welded fittings or flanged fittings for sizes 3 inches and larger. Stainless steel pipe 12 inches in diameter and larger shall be in accordance with ASTM A 409 - Welded Large Diameter Austenitic Steel Pipe for Corrosive or High-Temperature Service, or A 778 - Welded, Unannealed Austenitic Stainless Steel Tubular Products, Type 316, of the schedules indicated, with welded or flanged joints.

2.2 PIPE JOINTS

A. Stainless steel pipe for sizes 2-1/2 inches and smaller shall have screwed ends with NPT threads made up with Teflon tape. Stainless steel pipe 3-inches and larger and where indicated shall have welded joints with socket-welding fittings, butt-welding fittings, or socket welding flanges. Stainless steel flanges shall have stainless steel bolts and nuts. Where indicated, stainless steel pipe shall have grooved ends for shouldered couplings, except that no pipe with less than Schedule 40 wall thickness shall be grooved. Where indicated, stainless steel pipe shall have plain ends for sleeve-type couplings.

2.3 FITTINGS

A. **Threaded Fittings:** Forged stainless steel fittings conforming to ANSI/ASME B 16.11 - Forged Fittings, Socket-Welding and Threaded, Type 316.

B. **Socket-Welding Fittings:** Forged stainless steel fittings conforming to ANSI/ASME B 16.11, Type 316.

C. **Butt-Welding Fittings:** Wrought stainless steel butt-welding fittings conforming to ASTM A 403 - Wrought Austenitic Stainless Steel Piping Fittings, and ANSI/ASME B 16.9 - Factory-Made Wrought Steel Butt-Welding Fittings, Type 316.

D. **Grooved Fittings:** Wrought stainless steel grooved fittings conforming to ASTM A 403 and ANSI/ASME B 16.9, with grooving conforming to ANSI/AWWA C606-Grooved and Shouldered Joints, Type 316.

E. **Flanged Fittings:** Type 316 stainless steel flanged fittings and flanges conforming to ANSI/ASME B 16.5 - Pipe Flanges and Flanged Fittings.

F. **Pressure Class:** Unless otherwise indicated, fittings shall be in accordance with the pressure classes called for in the Piping Schedule. Where not indicated, the fittings shall have the same pressure rating as the pipe.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. **General:** Stainless steel pipe shall be installed in a neat and workmanlike manner, properly aligned and cut from measurements taken at the Site to avoid interferences with structural members, architectural features, openings, and equipment. Exposed pipe shall afford maximum headroom and access to equipment, and where necessary all piping shall be installed with sufficient slopes for venting or drainage of liquids and condensate to low points. Installation shall be acceptable to the CONTRACTOR OFFICER.

B. **Supports and Anchors:** Piping shall be firmly supported with fabricated or commercial hangers or supports in accordance with Section 15006 - Pipe Supports. Where necessary to avoid stress on equipment or structural members, the pipe shall be anchored or harnessed. Expansion joints and guides shall compensate for pipe expansion due to temperature differences.

C. **Valves and Unions:** Unless otherwise indicated, connections to fixtures, groups of fixtures, and equipment shall be provided with a shutoff valve and union, unless the valve has flanged ends. Unions shall be provided at threaded valves, equipment, and other devices requiring occasional removal or disconnection.

3.2 PIPE PREPARATION

A. Prior to installation, each pipe length shall be carefully inspected, be flushed clean of any debris or dust, and be straightened if not true. Ends of threaded pipes shall be reamed and filed smooth. Pipefittings shall be equally cleaned before assembly.

3.3 PIPE JOINTS

A. **Threaded Joints:** Pipe threads shall conform to ANSI/ASME B 1.20.1 - Pipe Threads, General Purpose (inch), and shall be full and cleanly cut with sharp dies. Not more than three threads shall remain exposed after installation.

B. **Welded Joints:** Welded joints shall conform to the specifications and recommendations of ANSI/ASME B 31.1 - Power Piping. Welding shall be done by skilled and qualified welders per Section 15000 - Piping, General.

1. Field welding shall be minimized to the greatest extent possible by use of couplings and prefabrication of pipe systems at the factory. Pipe butt welds may be performed at the Site, providing the butt welds are performed only with an inert gas shielded process and that other indicated welding requirements are followed rigidly.

2. Residue, oxide, and heat stain shall be removed from any type of field weld and the affected areas adjacent by the use of stainless steel wire brushes, followed by cleaning with an agent such as **Eutectic Company's "Euclean"** or equal, followed by complete removal of the agent.

C. **Grooved Joints:** Grooves for grooved couplings and fittings shall be made with specially designed grooving tools to the manufacturer's recommendations and conforming to ANSI/AWWA C606. Grooves shall be clean and sharp without flaws, and the pipe ends shall be accurately cut at 90 degrees to the pipe axis.

3.4 INSPECTION AND FIELD TESTING

A. **Inspection:** The finished installation shall be carefully inspected for proper supports, anchoring, interferences, and damage to pipe, fittings, and coating. Damage shall be repaired to the satisfaction of the CONTRACTOR OFFICER.

B. **Field Testing:** Prior to enclosure or burying, piping systems shall be pressure tested as required in the Piping Schedule, for a period of not less than one hour, without exceeding the tolerances listed in the Piping Schedule. Where no pressures are indicated, the pipes shall be subject to 1-1/2 times the maximum working pressure. The CONTRACTOR shall furnish all test equipment, labor, materials, and devices at no extra cost to the GOVERNMENT. For additional testing requirements refer to Section 01656 - Pressure Pipe Testing and Disinfection.

1. Leakage may be determined by loss of pressure, soap solution, chemical indicator, or other positive and accurate method. All fixtures, devices, or other accessories which are to be connected to the lines and which would be damaged if subjected to the test pressure shall be disconnected and ends of the branch lines plugged or capped as required during the testing procedures.

2. Leaks shall be repaired to the satisfaction of the CONTRACTOR OFFICER and the system shall be re-tested until no leaks are found.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 15037 - COPPER WATER TUBE
(ASTM B 88, MODIFIED)

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide copper tube for water, gas, and vacuum service, complete and in place, in accordance with the Contract Documents

B. The requirements of Section 15000 - Piping, General apply to the WORK of this Section.

PART 2 -- PRODUCTS

2.1 PIPE MATERIAL

A. Copper water tube shall conform to the requirements of ASTM B 88 - Seamless Copper Water Tube, and shall be soft temper tube in rolls for buried locations, or hard drawn lengths for all other applications. Unless otherwise indicated, all copper water tube shall be of Type K wall thickness.

2.2 JOINTS

A. Copper water tube shall have either soldered joints, flared ends and fittings, or compression type joints. Soldered joints shall be made with 95 - 5 percent tin-antimony solder or with silver solder. Buried piping shall have flared or compression type joints. No soft-soldered joints will be allowed on buried piping. No solders containing more than 0.2 percent of lead shall be used.

2.3 FITTINGS

A. **Soldered Fittings:** Soldered fittings shall conform to ANSI B 16.18 - Cast Copper Alloy Solder Joint Pressure Fittings, or to ANSI/ASME B 16.22 - Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings. The soldering flux shall be the Manufacturer's approved type for the fitting and solder used.

B. **Flared Fittings:** Flared fittings shall conform to ANSI/ASME B 16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.

C. **Compression Fittings:** Compression type fittings shall be brass fittings as manufactured by **Crawford Company - SWAGELOK, Parker-Hannifin - CPI**, or equal.

D. **Flanged Fittings:** Cast copper alloy flanges and flanged fittings shall be in accordance with ANSI/ASME B 16.24 - Cast Copper Alloy Pipe Flanges and Flanged Fittings, and ASTM B 62 - Standard Specification for Composition Bronze or Ounce Metal Castings, with 150 lb. ratings, or as indicated.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. **General:** All copper tubes shall be installed in a neat and workmanlike manner, properly aligned, and cut from measurements taken at the site, to avoid interferences with structural members, architectural features, openings, and equipment. Exposed tubing shall afford maximum headroom and access to equipment, and where necessary all tubing shall be installed with sufficient slopes for venting or drainage of liquids and condensate to low points. All installations shall be acceptable to the CONTRACTING OFFICER.

B. **Supports and Anchors:** All tubing shall be firmly supported with fabricated or commercial hangers, brackets, or supports in accordance with Section 15006 - Pipe Supports. Where necessary to avoid stress on equipment or structural members, the tubes shall be anchored or harnessed. Expansion joints and guides shall compensate for expansion due to temperature differences.

C. **Valves and Unions:** Unless otherwise indicated, tubing to fixtures, groups of fixtures, and equipment shall be provided with a shutoff valve and union, unless the valve has flanged ends. Low points in water systems and driplegs in steam, gas, and air systems shall have drainage valves. Unions shall be provided at threaded valves, equipment, and other devices requiring occasional removal or disconnection.

3.2 PREPARATION

A. Prior to installation, each tube length shall be carefully inspected, flushed clean of any debris or dust, and be straightened, if not true. Ends of tubes shall be reamed and filed smooth. All fittings shall be equally cleaned before assembly.

3.3 JOINTS

A. **Brazed and Soldered Joints:** Brazed and soldered joints shall conform to the manufacturer's recommendations and to the specifications and recommendations of ANSI/ASME B 31.1 - Power Piping. All brazing shall be done by skilled and qualified welders per Section 15000 - Piping, General. Prior to the application of flux, the end of all tubes shall be thoroughly dried and cleaned.

3.4 INSPECTION AND FIELD TESTING

A. **Inspection:** All finished installations shall be carefully inspected for proper joints and supports, anchoring, interferences, and damage to tubing, fittings, and coating. Damage shall be repaired to the satisfaction of the CONTRACTING OFFICER.

B. **Field Testing:** Prior to enclosure or burying, all tubing systems shall be pressure tested as required in the Piping Schedule, for a period of not less than one hour, without exceeding the tolerances listed in the Piping Schedule. Where no pressures are indicated, the tubes shall be subject to 1-1/2 times the maximum working pressure. The CONTRACTOR shall furnish all test equipment, labor, materials, and devices at no extra cost to the GOVERNMENT. For additional testing requirements refer to Section 01656 - Pressure Pipe Testing and Disinfection.

1. Leakage may be determined by loss of pressure, soap solution, chemical indicator, or other positive and accurate method. All fixtures, devices, or other accessories

which are to be connected to the lines and which would be damaged if subjected to the test pressure shall be disconnected and ends of the branch lines be plugged or capped as required during the testing procedures.

2. Leaks shall be repaired to the satisfaction of the CONTRACTING OFFICER, and the system shall be re-tested until no leaks are found.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 15045 - CAST IRON SOIL PIPE
(ASTM A 74, MODIFIED)

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide cast iron soil pipe, complete and in place, in accordance with the Contract Documents.

B. The requirements of Section 15000 - Piping, General apply to the WORK of this Section.

PART 2 -- PRODUCTS

2.1 PIPE MATERIAL

A. Unless otherwise indicated, cast iron waste and vent piping shall be service weight cast iron soil pipe with hub and spigot ends in accordance with ASTM A 74 - Cast Iron Soil Pipe and Fittings, or hubless pipe per Standard 301 of the Cast Iron Soil Pipe Institute. All pipes and fittings shall be lined and coated with the manufacturer's standard protective coating.

B. Cast iron drains and vents indicated for chemical service shall be in accordance with Section 15046 - Corrosion Resistant Cast Iron Soil Pipe.

2.2 PIPE JOINTS

A. Hub and spigot pipe shall have joints caulked with jute and lead per Cast Iron Soil Pipe Institute standards, or rubber compression gaskets in accordance with ASTM C 564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

B. Hubless pipe shall have joints made up with Neoprene sleeves and Type 304 or 316 stainless steel clamps with stainless steel bolts per Standard 301 of the Cast Iron Soil Pipe Institute.

2.3 FITTINGS

A. Cast iron soil pipe shall have drainage pattern hub and spigot, hub and hub, or hubless fittings per ASTM A 74, or Standard 301 of the Cast Iron Soil Pipe Institute, respectively. Fittings shall be made of gray cast iron and be of service weight, unless otherwise indicated.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. **General:** Cast iron soil pipes shall be installed in a neat and workmanlike manner, in accordance with the prevailing plumbing and building codes. Pipes shall have the required grades for proper drainage. Pipes inside buildings shall be coordinated with the work from all other trades to avoid interferences and to provide sufficient headroom. Installations shall be acceptable to the CONTRACTING OFFICER and to the local plumbing inspector.

B. **Supports:** Pipes shall be firmly supported with fabricated or commercial hangers and supports in accordance with Section 15006 - Pipe Supports. Horizontal runs shall have at least one support for each length of pipe.

3.2 COATING

A. Exposed pipes shall be coated over the pipe manufacturer's standard protective coating, with the manufacturer's recommended prime coat and a finished coat per Section 09800 - Protective Coating.

3.3 INSPECTION AND FIELD TESTING

A. **Inspection:** Field installations shall be carefully inspected for proper joints and supports, interferences, and damage to pipe, fittings, and coating. Temporary plugs and covers shall be removed from openings and floor drains. Damage shall be repaired to the satisfaction of the CONTRACTING OFFICER and the plumbing inspector.

B. **Field Testing:** Prior to enclosure or burying, drains and vents shall be tested in the presence of the local plumbing inspector and the CONTRACTING OFFICER as required in the Piping Schedule, for a period of not less than one hour, or as requested by the plumbing inspector. The CONTRACTOR shall furnish all test equipment, labor, material, and devices at no extra cost to the GOVERNMENT. Leaks shall be repaired to the satisfaction of the CONTRACTING OFFICER and the plumbing inspector, and the system shall be re-tested until no leaks are found.

- END OF SECTION -

SECTION 15060 - PVC PRESSURE PIPE (ASTM D 1785, MODIFIED)

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide polyvinyl chloride (PVC) pressure pipe, complete and in place, in accordance with the Contract Documents.

B. The requirements of Section 15000 - Piping, General, apply to the WORK of this Section.

PART 2 -- PRODUCTS

2.1 PIPE MATERIAL

A. PVC pipe shall be made from all new rigid unplasticized polyvinyl chloride and shall be normal impact Type 1, Grade 1, class 12454, Schedule 80, listed as compliant with NSF Standard 61, unless otherwise indicated, in accordance with ASTM D 1785-Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

2.2 PIPE JOINTS

A. Pipe joints shall be solvent-welded type with solvent cement and primer as recommended by the pipe manufacturer for the chemical in the pipe.

B. Screwed joints that are necessary to match up to threaded valves or fittings shall be made up with appropriate thread sealant, either paste or tape.

C. Flanged joints shall be made with solvent-welded PVC flanges, drilled to ANSI/ASME B 16.5 - Pipe Flanges and Flanged Fittings, Class 150, unless otherwise indicated. Gaskets shall be ANSI 150 lb. full face, 1/8-inch thick Neoprene for water or wastewater service. Gasket material for chemicals shall be suitable for the chemical service.

2.3 FITTINGS

A. **Solvent Welded and Threaded Fittings:** Solvent-welded and threaded fittings shall be Schedule 80 PVC fittings in accordance with ASTM D 2467 - Socket-Type Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

B. **Flanged Fittings:** Flanged fittings shall be Schedule 80 fabricated PVC fittings with 150 lb. flanges to ANSI/ASME B 16.5.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. **General:** PVC pipe shall be installed in a neat and workmanlike manner, properly aligned, and cut from measurements taken at the Site to avoid interferences with structural members, architectural features, openings, and equipment. Exposed pipe shall afford maximum headroom and access to equipment, and where necessary, piping shall be installed with sufficient slopes for venting or drainage of liquids and condensate

to low points. It is recommended that the CONTRACTOR obtain the assistance of the pipe manufacturer's field representative to instruct the pipefitters in the correct installation and support of PVC piping.

B. **Supports and Anchors:** Piping shall be firmly supported with fabricated or commercial hangers or supports in accordance with Section 15006 - Pipe Supports. Where necessary to avoid stress on equipment or structural members, the pipe shall be anchored or harnessed. Expansion joints and guides shall compensate for pipe expansion due to temperature changes.

C. **Valves and Unions:** Unless otherwise indicated, connections to fixtures, groups of fixtures, and equipment shall be provided with a shutoff valve and union, unless the valve has flanged ends. Unions shall be provided at threaded valves, equipment, and other devices requiring occasional removal or disconnection. Valves and flanges attached to PVC pipe shall be provided with adequate supports.

3.2 PIPE PREPARATION

A. Prior to installation, each pipe length shall be carefully inspected, flushed clean of any debris or dust, and be straightened, if not true. Ends of threaded pipes shall be reamed and filed smooth. Pipe fittings shall be equally cleaned before assembly.

3.3 PIPE JOINTS

A. **Threaded Joints:** Pipe threads shall conform to ASTM F 1498 - Taper Pipe Threads 60 Degrees for Thermoplastic Pipe and Fittings, and shall be full and cleanly cut with sharp dies or molded. Joints shall be made with Teflon tape or thread sealant.

B. **Solvent-Welded Joints:** Solvent-welded joints shall be made with fresh primer and solvent cement on clean, dry pipe ends. The primer and cement cans shall be kept closed at all times and the joints shall be made up at the recommended ambient temperatures, to the pipe or cement manufacturer's written recommendations. Pipe ends shall be inserted to the full depth of the socket.

C. **Flange Joints:** Flanged joints shall be made with gaskets and Type 316 stainless steel bolts and nuts. Care shall be taken not to over-torque the bolts, in accordance with the manufacturer's written recommendations.

3.4 INSPECTION AND FIELD TESTING

A. **Inspection:** Finished installations shall be carefully inspected for proper joints and sufficient supports, anchoring, interferences, and damage to pipe, fittings, and coating. Damage shall be repaired to the satisfaction of the CONTRACTING OFFICER.

B. **Field Testing:** The CONTRACTOR shall allow adequate time for the solvent cement joints to cure. Curing time shall be per the solvent cement manufacturer's recommendation. Prior to enclosure or burying, piping systems shall be pressure tested as required in the Piping Schedule, for a period of not less than one hour, without exceeding the tolerances listed in the Piping Schedule. Caution - Do not use air or gas for testing PVC pipe. Where no pressures are indicated, the pipes shall be subject to 1-1/2 times the maximum working pressure. The CONTRACTOR shall furnish all test equipment, labor, materials, and devices.

C. Leakage shall be determined by loss of pressure. Fixtures, devices, or other accessories that would be damaged if subjected to the test pressure shall be disconnected and ends of the branch lines shall be plugged or capped as appropriate during the testing procedures.

D. Leaks shall be repaired to the satisfaction of the CONTRACTING OFFICER, and the system shall be re-tested until no leaks are found.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 15065 - CPVC PRESSURE PIPE (ASTM F 441, MODIFIED)

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide Chlorinated Polyvinyl Chloride (CPVC) pressure pipe, complete and in place, in accordance with the Contract Documents.

B. The requirements of Section 15000 - Piping, General, apply to the WORK of this Section.

PART 2 -- PRODUCTS

2.1 PIPE MATERIAL

A. CPVC pipe shall be in accordance with ASTM F 441 - Chlorinated Poly (Vinyl Chloride) (CPVC), Plastic Pipe, Schedules 40, and 80, from all new compounds, meeting the requirements of Class 23447 per ASTM D 1784 - Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (PVC) Compounds. All CPVC pipes shall be Schedule 80 pipe, unless otherwise indicated. CPVC material shall be listed as compliant with NSF Standard 61.

2.2 PIPE JOINTS

A. Pipe joints shall be solvent-welded with solvent cement in accordance with ASTM F 493 - Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings, and with primer in accordance with ASTM F 656 - Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings. Screwed joints which are necessary to match up to threaded valves or fittings shall be made up with appropriate thread sealant, either paste or tape. Flanged joints shall be made with solvent-welded CPVC flanges, drilled to ANSI/ASME B 16.5 - Pipe Flanges and Flanged Fittings, Class 150, unless otherwise indicated.

2.3 FITTINGS

A. **Solvent-Welded Fittings:** Solvent-welded fittings shall be Schedule 80 CPVC fittings in accordance with ASTM F 439 - Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.

B. **Threaded Fittings:** Threaded fittings shall be Schedule 80 CPVC fittings in accordance with ASTM F 437 - Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.

C. **Flanged Fittings:** Flanged fittings shall be fabricated Schedule 80 CPVC fittings with 150 lb. flanges to ANSI/ASME B 16.5. Gaskets shall be ANSI 150 lb. full face, 1/8-inch thick Neoprene for water or wastewater service. Gasket material for chemicals shall be suitable for the chemical service.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. **General:** CPVC pipes shall be installed in a neat and workmanlike manner, properly aligned, and cut from measurements taken at the site to avoid interferences with structural members, architectural features, openings, and equipment. Exposed pipes shall afford maximum headroom and access to equipment, and where necessary piping shall be installed with sufficient slopes for venting or drainage of liquids and condensate to low points. The entire installation shall be acceptable to the CONTRACTING OFFICER. It is recommended that the CONTRACTOR obtain the assistance of the pipe manufacturer's field representative to instruct the pipe fitters in the correct installation and support of all CPVC piping.

B. **Supports and Anchors:** Piping shall be firmly supported with fabricated or commercial hangers or supports in accordance with Section 15006 - Pipe Supports. Where necessary to avoid stress on equipment or structural members, the pipes shall be anchored or harnessed. Expansion joints and guides shall compensate for pipe expansion due to temperature differences.

C. **Valves and Unions:** Unless otherwise indicated, connections to fixtures, groups of fixtures, and equipment shall be provided with a shutoff valve and union, unless the valve has flanged ends. Unions shall be provided at threaded valves, equipment, and other devices requiring occasional removal or disconnection. Valves and flanges attached to CPVC pipe shall be provided with adequate supports.

3.2 PIPE PREPARATION

A. Prior to installation, each pipe length shall be carefully inspected, flushed clean of any debris or dust, and straightened, if not true. Ends of threaded pipes shall be reamed and filed smooth. Pipe fittings shall be equally cleaned before assembly.

3.3 PIPE JOINTS

A. **Threaded Joints:** Pipe threads shall conform to ASTM F 1498-Taper Pipe Threads 60^0 for Thermoplastic Pipe and Fittings, and shall be full and cleanly cut with sharp dies or molded. Joints shall be mode with Teflon tape or thread sealant.

B. **Solvent-Welded Joints:** Solvent-welded joints shall be made with fresh primer and solvent cement on clean, dry pipe ends. The primer and cement cans shall be kept closed at all times and the joints shall be made up at the recommended ambient temperatures, to the pipe or cement manufacturer's written recommendations. Pipe ends shall be inserted to the full depth of the socket.

C. **Flanged Fittings:** Flanged joints shall be made with gaskets and Type 316 stainless steel bolts and nuts. Care shall be taken not to over-torque the bolts, in accordance with the manufacturer's written recommendations.

3.4 INSPECTION AND FIELD TESTING

A. **Inspection:** Finished installations shall be carefully inspected for proper joints and sufficient supports, anchoring, interferences, and damage to pipe, fittings, and coating. Damage shall be repaired to the satisfaction of the CONTRACTING OFFICER.

B. **Field Testing:** The CONTRACTOR shall allow adequate time for the solvent cement joints to cure. Curing time shall be per the solvent cement manufacturer's recommendation. Prior to enclosure or burying, piping systems shall be pressure tested as required in the Piping Schedule for a period of not less than one hour, without exceeding the tolerances listed in the Piping Schedule. Caution - Do not use air or gas for testing CPVC pipe. Where no pressures are indicated, the pipes shall be subject to 1-1/2 times the maximum working pressure. The CONTRACTOR shall furnish all test equipment, labor, materials, and devices.

C. Leakage shall be determined by loss of pressure. Fixtures, devices, or other accessories which are to be connected to the lines and which would be damaged if subjected to the test pressure shall be disconnected and ends of the branch lines plugged or capped as required during the testing procedures.

D. Leaks shall be repaired to the satisfaction of the CONTRACTING OFFICER and the system shall be re-tested until no leaks are found.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 15075 - METERS, GENERAL

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide meters and flow measurement devices, complete and operable, in accordance with the Contract Documents.

B. Unless indicated otherwise, the requirements of this Section apply to all meters in Division 15 of the Specifications.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards

ISA - S 5.1	Instrumentation Symbols and Identification
ANSI - B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800
ANSI/AWWA C207	Steel Pipe Flanges for Waterworks Service - Sizes 4 In Through 144 In.
ANSI/AWWA C701	Cold-Water Meters - Turbine Type for Customer Service
ANSI/AWWA C702	Cold-Water Meters - Compound Type
AWWA C704	Cold-Water Meters - Propeller Type for Main Line Applications
ASME REPORT	Fluid Meters, Sixth Edition, 1971

1.3 CONTRACTOR SUBMITTALS

A. **General:** Furnish submittals in accordance with Section 01300 - Contractor Submittals.

B. **Shop Drawings:** Each meter shall be identified with its equipment number, as indicated.

C. **Manufacturer's Data:** With the Shop Drawings, furnish certified curves indicating flow versus differential pressure and any other information called for in the individual meter specifications.

D. **Operation Manual:** Furnish 5 identical copies of complete operation and maintenance instructions of all the metering systems including instrumentation and controls, in accordance with the paragraph “Operational Procedures” in Section 01300.

E. **Spare Parts List:** The CONTRACTOR shall furnish a list of manufacturer's recommended spare parts.

F. **Special Tools:** A list of special tools shall be submitted to the CONTRACTING OFFICER.

G. **Documentation:** After completion the CONTRACTOR shall furnish to the GOVERNMENT the manufacturer's written guarantees, that the metering systems will operate within the published accuracies and flow ranges and meet these Specifications. The CONTRACTOR shall also furnish the manufacturer's warranties as published in its literature and as specified.

1.4 QUALITY ASSURANCE

A. **Accuracy Requirements:** Unless otherwise indicated, flow meters shall be guaranteed to register flow to an accuracy of plus and minus 2 percent of actual flow throughout the range indicated. Density measuring equipment shall have a degree of accuracy within plus and minus 2 percent of actual solids content over the range indicated.

PART 2 -- PRODUCTS

2.1 SPARE PARTS AND SPECIAL TOOLS

A. Furnish the spare parts listed in the individual meter sections. Spare parts shall be suitably packaged and labeled by part name and associated equipment number.

B. The CONTRACTOR shall furnish special tools suitably wrapped and identified for application.

PART 3 -- EXECUTION

3.1 SERVICES OF MANUFACTURER

A. After installation, the CONTRACTOR shall obtain the services of an experienced factory service representative to inspect the installation and test all meters for proper performance.

B. **Instruction of GOVERNMENT's Personnel:** After completion of the installation and during startup of the plant, the CONTRACTOR shall instruct the **GOVERNMENT**'s personnel in the proper operation, maintenance and repair of all metering equipment. For this purpose, the CONTRACTOR shall obtain the services of an experienced factory service representative, who shall spend sufficient time on the Site to fully instruct the **GOVERNMENT**'s operating personnel on all phases of the metering equipment.

3.2 INSTALLATION

A. The CONTRACTOR shall assemble and install equipment in strict accordance with the manufacturer's published instructions, under the supervision of the manufacturer's representative. Installation shall be accomplished by competent craftsmen in a workmanlike manner.

B. Meters shall be installed in easily accessible locations for ease of reading and maintenance, and, where shown, for balancing of flow in several lines, in conjunction with throttling and shut-off valves. Wherever possible, all meters shall be installed in such a way to provide the manufacturer's recommended straight approach and straight piping downstream. Meters and shut-off and balancing valves shall be firmly supported from the structure or from the floor with approved supports. In-line meters shall be installed to provide full-line flow and not less than the manufacturer's recommended head at all times.

3.3 TESTING

A. Equipment shall be prepared for operational use in accordance with manufacturer's instructions, including bench test and calibration, where required.

B. Each item shall be subjected to an operating test over the total range of capability of the equipment. Where applicable, tests shall be conducted in accordance with the Test Code of the Standards of the Hydraulic Institute. The CONTRACTOR shall obtain copies of factory test certifications and shall notify the CONTRACTING OFFICER one week in advance of all tests to be conducted on Site.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 15081 - MAGNETIC FLOW METERS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide magnetic flow measuring systems, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 17100 - Process Control and Instrumentation Systems apply to this Section.

1.2 CONTRACTOR SUBMITTALS

A. **General:** Submittals shall be furnished in accordance with Section 01300 - Contractor Submittals.

B. **Shop Drawings:** Shop drawings for magnetic flow meters shall be included in the Analog Hardware Submittal required by Section 17100 - Process Control and Instrumentation Systems.

PART 2 -- PRODUCTS

2.1 MAGNETIC FLOW METERS

A. General

1. Magnetic flowmeter systems shall be of the low frequency electromagnetic induction type and produce a DC pulsed signal directly proportional to and linear with the liquid flow rate. Complete zero stability shall be an inherent characteristic of the flowmeter system. Each magnetic flow metering system shall include a metering tube, signal cable, transmitter and flowmeter grounding rings.

2. Magnetic flow meters and electronics shall be manufactured at facilities certified to the quality standards of ISO Standard 9001 - Quality Systems - Model for Quality Assurance in Design/Development, Production, Installation, and Servicing.

B. **Metering Tube:** The metering tube shall have the following:

1. Constructed of 304 or 316 stainless steel with flanged connections

2. Utilize a minimum of 2 bullet-nosed, self-cleaning electrodes

3. Liner in conformance with the Manufacturer's recommendation for the meter's intended service

4. Electrodes constructed of materials which are in conformance with the Manufacturer's recommendation for the meter's intended service

5. Meter housing rated for NEMA 6 submergence conditions

6. Meter coating consisting of epoxy painted finish

7. Two grounding rings which are in conformance with the Manufacturer's bore and material recommendation for the meter's intended service. Grounding rings shall be designed to protect and shield from process abrasion the liner's edge interface at the meter's end.

C. **Transmitter:** The microprocessor-based signal converter/transmitter shall have the following:

1. Utilize DC pulse technique to drive flux-producing coils

2. Convert DC pulse signal from the tube to a standard 4-20 mA signal into a minimum of 700 ohms.

3. A 6-digit LCD display for flowrate, percent of span, and totalizer

4. An operator interface consisting of keypads which respond to English text entry

5. Integral zero return to provide a consistent zero output signal in response to an external dry contact closure

6. Integral low flow cut-off and zero return

7. Automatic range change

8. Capable of measuring flow in both directions

9. Programmable parameters including meter size, full scale Q, magnetic field frequency, primarily constant, time constant

10. Data retention for a minimum of 5 years without auxiliary main or battery power

11. Self diagnostics and automatic data checking

12. Protected terminals and fuses in a separate compartment which isolates field connection from electronics

13. Utilizes "Smart" technology which employs a hand-held configuration terminal and outputs a digital flow signal superimposed on 4-20 mA signal and complies to HART protocol.

14. Produces a scalable frequency output, 0 to 100 Hz, transistor switch closure up to 5.75 W externally powered, 5 to 24 VDC.

15. Can tolerate ambient temperature operating limits of -20 to 140 degrees F (-29 to 60 degrees C).

D. Performance Requirements

1. Time Constant: 0.5 to 1000 seconds

2. Accuracy: 0.50 percent of flow rate from 10 to 100 percent of full scale for velocities over 3 ft/sec.

3. Repeatability: 0.25 percent of full scale

4. Isolation: either galvanic or optic

5. Power consumption: 30 watts max

6. Power supply: 120 VAC, plus or minus 10 percent

E. Factory Testing:

1. Each flow metering system shall be hydraulically calibrated at a facility which is traceable to the National Institute of Testing Standards. The calibrations procedure shall conform to the requirements of MIL-STD-45662A. A real-time computer generated printout of the actual calibration data indicating apparent and actual flows at 20%, 40%, 60%, 80% and 100% of the calibrated range shall be submitted to the CONTRACTING OFFICER at least thirty (30) days prior to shipment of the meters to the project site.

F. Manufacturers, or Equal

1. **Bailey-Fischer & Porter**

2. **Foxboro**

3. **Yokogawa**

2.2 SCHEDULE

A. The following magnetic flow measuring systems shall be provided:

Tag No.	Size (in.)	Range (gpm)	Liner Material	Electrode Material	NEMA Rating (Body/Transmitter)	Pressure Rating (psi)
5-M-1	8	150-3000	Teflon	By Mftr	Nema 4X	150
9-M-1	12	333-5000	Teflon	By Mftr	Nema 4X	300

PART 3 -- EXECUTION

3.1 INSTALLATION

A. **General:** Magnetic flow measuring systems shall be handled, installed, calibrated, tested, precommissioned, and Manufacturer's service and training shall be furnished in accordance with Section 17100 - Process Control and Instrumentation Systems.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 15145 - PIPE AND EQUIPMENT INSULATION

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide pipe and equipment insulation, complete and in place, in accordance with the Contract Documents. In addition to the insulation indicated, the CONTRACTOR shall insulate any cold or hot piping and exhausts that could be hazardous to the OWNER's personnel upon contact.

1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Federal Specifications

HH-1-558B	Insulation Blocks, Boards, Blankets, Felts, Sleeving (Pipe and Tube Covering), and Pipe Fitting Covering, Thermal (Mineral Fiber, Industrial Type)

B. Commercial Standards

ASTM C 547	Mineral Fiber Pipe Insulation
ASTM E 84	Test Method for Surface Burning Characteristics of Building Materials

1.3 CONTRACTOR SUBMITTALS

A. The CONTRACTOR shall submit complete Shop Drawings of all thermal insulation, with manufacturer's data on materials, covering, jackets, and finish, in accordance with Section 01300 - Contractor Submittals.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Components of the insulation, including covering, mastics, and adhesives, shall have a flame-spread rating of not over 25 and a smoke development rating of not over 50. Ratings shall be as established by tests in accordance with ASTM E 84 and Federal Specification standards. The integrated insulation assemblies shall also conform to the above specifications. Insulation shall be applied in strict accordance with the manufacturer's instructions.

2.2 BASIC MATERIALS

A. **Standard Temperature Insulation:** This type of insulation shall be employed for process, cold and hot water, steam, and condensate piping and equipment with surface temperatures up to 850 degrees F. Pipe insulation and jacketing shall be applied to piping where indicated, including associated fittings, flanges, and valves. Pipe insulation shall be molded-type pipe covering, made of fibrous glass with a minimum k-factor of 0.23 at 75 degrees F mean temperature.

B. Unless otherwise indicated, the insulation thickness shall be as follows:

Pipe		Minimum Thickness of Insulation (inches)
All exposed outdoor piping	2-in and smaller	1

C. Insulation shall have a factory-applied white fire-retardant vapor-barrier jacket of kraft paper and aluminum foil laminated together and reinforced with fiberglass yarn. Fittings and valves shall be covered with the same material as the pipe, cut in segments to fit snugly without open spaces, held in place with copper wire or cement, and then be covered with the same jacketing material as the pipe. Insulated fittings adjacent to vapor-barrier insulation shall be sealed with acceptable vapor-barrier cement before installation of the finish jacket. Pipe insulation and vapor-barrier shall be continuous through hangers and supports. Insulation shall be coordinated with the pipe hangers and supports and where insulation protection shields are provided the top half section of pipe insulation at support locations shall be of the same density, and the bottom half insulation segments provided between the pipe and the insulation protection shields shall have a density of not less than 6 lb/cu ft. Insulation shall be covered with smooth aluminum weatherproof metal or plastic preformed jacketing with a factory-attached moisture barrier. Jackets for fittings shall consist of precision-formed smooth-sided sections and shall be sized to cover and protect the insulated fitting. Each section shall be manufactured from aluminum or PVC, and joints shall be sealed with silicone mastic or solvent welding to provide a continuous air and weathertight joint. Strapping shall be 1/2-inch wide, Type 3003 aluminum or stainless steel.

D. Manufacturers, or Equal

1. **Armstrong Contracting and Supply Corp.**
2. **Certain-Teed Corporation**
3. **Manville**
4. **Owens-Corning Fiber Glass Corp.**
5. **P.P.G. Industries, Inc.**

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Insulation shall be installed by a qualified insulation contractor in strict accordance with the manufacturer's recommendations.

- END OF SECTION -

SECTION 15180 – STRAINERS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide pipe strainers where indicated, complete and operable, in accordance with the Contract Documents.

B. Strainers shall be of ample size, with the perforations suitable for each individual service, and designed for easy cleaning and removal of the strainer basket.

1.2 CONTRACTOR SUBMITTALS

A. **General:** Submittals shall be in accordance with Section 01300 - Contractor Submittals.

B. **Shop Drawings:** Shop drawings shall include construction details, sizes, dimensions, materials, and pressure ratings, in accordance with Section 11000 - Equipment General Provisions.

PART 2 -- PRODUCTS

2.1 STRAINERS (METAL BODY)

A. **Equipment Requirements:** Strainers shall be of the wye-pattern or basket type, with flush connections, cast iron or bronze bodies, and screwed ends for sizes 3-inch and smaller, and flanged ends for sizes greater than 3-inch. They shall be designed for not less than 250 psi working pressure in sizes 3-inch and smaller, and 125 psi working pressure in sizes over 3-inch. Strainers shall be of the same size as the entering pipe and the screens shall have a free area of not less than three times the cross-sectional area of the pipe.

B. **Screens:** Unless otherwise indicated or required by the service fluid, the screens shall be of type 316 stainless steel or monel construction, easily removable, with the following mesh or perforations:

Strainer Size	Size of Perforations
1/4 - through 2-inch	20 mesh
2 1/2 through 5-inch	1/16-inch dia. or 3/64-inch
6 through 8-inch	1/8-inch dia.
over 8-inch	3/16-inch dia.

C. Manufacturers, or Equal

1. **Armstrong - Yoshitake, Inc.**

2. **Fisher Controls Company**

3. **G. A. Industries, Inc.**

4. **Mueller Steam Specialty**

5. **Watts Regulator Company**

2.2 STRAINERS (PLASTIC BODY)

A. **Equipment Requirements:** Strainers shall be of the Y-pattern type with removable screen, magnetic drain plug, cap, and EPDM or Viton O-ring seal, and [PVC] [CPVC] body with [solvent welded] [screwed] [flanged] ends, rated for the following pressures at 73 degrees F:

150 psi for sizes 1/2 to 2 inch
90 psi for sizes 1-1/2 to 2 inches
60 psi for sizes 3 to 4 inches

B. **Screen:** The screens shall be of PVC or stainless steel, with a free area of 6 times the cross-sectional area of the pipe and 1/16-inch perforations.

C. Manufacturers, or Equal

1. **ASAHI/AMERICA**

2. **Hayward Industrial Products, Inc.**

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Unless otherwise indicated, strainers shall be provided ahead of any control valves, regulators, steam and condensate traps, and where shown, and shall be preceded by shut-off valves.

B. All strainers shall be installed in accordance with the Manufacturer's written instruction, in easily accessible locations for cleaning.

- END OF SECTION -

SECTION 15200 - VALVES, GENERAL

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide all valves, actuators, and appurtenances, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 11000 - Equipment General Provisions, apply to the WORK of this Section.

C. The provisions of this Section shall apply to all valves and valve actuators except where otherwise indicated. Valves and actuators in particular locations may require a combination of units, sensors, limit switches, and controls indicated in other Sections of the Specifications.

D. Where a valve is to be supported by means other than the piping to which it is attached, the CONTRACTOR shall obtain from the valve manufacturer a design for support and foundation that satisfies the criteria in Section 11000. The design, including drawings and calculations sealed by an engineer, shall be submitted with the Shop Drawings. When the design is approved, the support shall be provided.

E. **Unit Responsibility:** A single manufacturer shall be made responsible for coordination of design, assembly, testing, and furnishing of each valve; however, the CONTRACTOR shall be responsible to the GOVERNMENT for compliance with the requirements of each valve section. Unless indicated otherwise, the responsible manufacturer shall be the manufacturer of the valve.

F. **Single Manufacturer:** Where two or more valves of the same type and size are required, the valves shall be furnished by the same manufacturer.

1.2 CONTRACTOR SUBMITTALS

A. **General:** Submittals shall be furnished in accordance with Section 01300 - Contractor Submittals.

B. **Shop Drawings:** Shop Drawings shall contain the following information:

1. Valve name, size, Cv factor, pressure rating, identification number (if any), and specification section number.

2. Complete information on valve actuator, including size, Manufacturer, model number, limit switches, and mounting.

3. Cavitation limits for all control valves.

4. Assembly drawings showing part nomenclature, materials, dimensions, weights, and relationships of valve handles, handwheels, position indicators, limit switches, integral control systems, needle valves, and control systems.

5. Data in accordance with Section 16460 - Electric Motors for all electric motor-actuated valves.

6. Complete wiring diagrams and control system schematics.

7. Valve Labeling: A schedule of valves to be furnished with stainless steel tags, indicating in each case the valve location and the proposed wording for the label.

C. **Technical Manual:** The Technical Manual shall contain the required information for each valve.

D. **Spare Parts List:** A Spare Parts List shall contain the required information for each valve assembly, where indicated.

E. **Factory Test Data:** Where indicated, signed, dated, and certified factory test data for each valve requiring certification shall be submitted before shipment of the valve. The data shall also include certification of quality and test results for factory-applied coatings.

PART 2 -- PRODUCTS

2.1 PRODUCTS

A. **General:** Valves and gates shall be new and of current manufacture. Shut-off valves 6-inches and larger shall have actuators with position indicators. Buried valves shall be provided with valve boxes and covers containing position indicators and valve extensions. Manual shut-off valves mounted higher than 7-feet above working level shall be provided with chain actuators.

B. **Valve Actuators:** Unless otherwise indicated, valve actuators shall be in accordance with Section 15201 - Valve and Gate Actuators.

C. **Protective Coating:** The exterior surfaces of all valves and the wet interior surfaces of ferrous valves of sizes 4 inches and larger shall be coated in accordance with Section 09800 - Protective Coating. The valve Manufacturer shall certify in writing that the required coating has been applied and tested in the manufacturing plant prior to shipment, in accordance with these Specifications. Flange faces of valves shall not be epoxy coated.

D. **Valve Labeling:** Except when such requirement is waived by the CONTRACTING OFFICER in writing, a label shall be provided on all shut-off valves and control valves except for hose bibs and chlorine cylinder valves. The label shall be of 1/16-inch plastic or stainless steel, minimum 2 inches by 4 inches in size, as indicated in Section 15005 - Piping Identification Systems, and shall by permanently attached to the valve or on the wall adjacent to the valve as directed by the CONTRACTING OFFICER.

E. **Valve Testing:** As a minimum, unless otherwise indicated or recommended by the reference Standards, valves 3 inches in diameter and smaller shall be tested in accordance with manufacturer's standard and 4 inches in diameter and larger shall be factory tested as follows:

1. Hydrostatic Testing: Valve bodies shall be subjected to internal hydrostatic pressure equivalent to twice the water rated pressure of the valve. Metallic valves

rating pressures shall be at 100 degrees F and plastic valves shall be 73 degrees, or at higher temperature according to type of material. During the hydrostatic test, there shall be no leakage through the valve body, end joints, or shaft seals, nor shall any part of the valve be permanently deformed. The duration shall be sufficient time to allow visual examination for leakage. Test duration shall be at least 10 minutes.

2. Seat Testing: Valves shall be tested for leaks in the closed position with the pressure differential across the seat equal to the water rated pressure of the valve. The duration of test shall be sufficient time to allow visual examination for leakage. Test duration shall be at least 10 minutes. Leakage past the closed valve shall not exceed 1 fluid ounce per hour per inch diameter for metal seated valves and drop-tight for resilient seated valves.

3. Performance Testing: All valves shall be shop operated from fully closed to fully open position and reverse under no-flow conditions in order to demonstrate the valve assembly operates properly.

F. **Certification:** Prior to shipment, the CONTRACTOR shall submit for valves over 12 inches in size, certified, notarized copies of the hydrostatic factory tests, showing compliance with the applicable standards of AWWA, ANSI, or ASTM.

G. **Valve Marking:** Valve bodies shall be permanently marked in accordance with MSS SP25 - Standard Marking Systems for Valves, Fittings, Flanges, and Unions.

2.2 MATERIALS

A. **General:** Materials shall be suitable for the intended application. Materials in contact with potable water shall be listed as compliant with NSF Standard 61. Materials not indicated shall be high-grade standard commercial quality, free from defects and imperfections that might affect the serviceability of the product for the purpose for which it is intended. Unless otherwise indicated, valve and actuator bodies shall conform to the following requirements:

1. Cast Iron: Close-grained gray cast iron, conforming to ASTM A 48 - Gray Iron Castings, Class 30, or to ASTM A 126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

2. Ductile Iron: ASTM A 536 - Ductile Iron Castings, or to ASTM A 395 - Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.

3. Steel: ASTM A 216 - Steel Castings, Carbon Suitable for Fusion Welding for High-Temperature Service, or to ASTM A 515 - Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service.

4. Bronze: ASTM B 62 - Composition Bronze or Ounce Metal Castings, and valve stems not subject to dezincification shall conform to ASTM B 584 - Copper Alloy Sand Castings for General Applications.

5. Stainless Steel: Stainless steel valve and operator bodies and trim shall conform to ASTM A 351 - Steel Castings, Austenitic, for High-Temperature Service, Grade CF8M, or shall be Type 316 stainless steel.

6. PVC: Poly Vinyl Chloride materials for valve body, flanges, and cover shall conform to Cell Classification 12454.

7. CPVC: Chlorinated Poly Vinyl Chloride materials for valve body, flanges, and cover shall conform to Cell Classification 23447.

8. NSF Standard 14: All materials shall be listed for use in contact with potable water.

2.3 VALVE CONSTRUCTION

A. **Bodies:** Valve bodies shall be cast, molded (in the case of plastic valves), forged, or welded of the materials indicated, with smooth interior passages. Wall thicknesses shall be uniform in agreement with the applicable standards for each type of valve, without casting defects, pinholes, or other defects that could weaken the body. Welds on welded bodies shall be done by certified welders and shall be ground smooth. Valve ends shall be as indicated, and be rated for the maximum temperature and pressure to which the valve will be subjected.

B. **Valve End Connections:** Unless otherwise indicated, valves 2-1/2 inches diameter and smaller may be provided with threaded end connections. Valves 3-inches and larger shall have flanged end connections.

C. **Bonnets:** Valve bonnets shall be clamped, screwed, or flanged to the body and shall be of the same material, temperature, and pressure rating as the body. The bonnets shall have provision for the stem seal with the necessary glands, packing nuts, or yokes.

D. **Stems:** Valve stems shall be of the materials indicated, or, if not indicated, of the best commercial material for the specific service, with adjustable stem packing, O-rings, Chevron V-type packing, or other suitable seal.

E. **Stem Guides:** Stem guides shall be provided, spaced 10-feet on centers unless the manufacturer can demonstrate by calculation that a different spacing is acceptable. Submerged stem guides shall be 304 stainless steel.

F. **Internal Parts:** Internal parts and valve trim shall be as indicated for each individual valve. Where not indicated, valve trim shall be of Type 316 stainless steel or other best suited material.

G. **Nuts and Bolts:** Nuts and bolts on valve flanges and supports shall be in accordance with Section 05500 - Miscellaneous Metalwork.

2.4 VALVE ACCESSORIES

A. Valves shall be furnished complete with the accessories required to provide a functional system.

2.5 SPARE PARTS

A. The CONTRACTOR shall furnish the required spare parts suitably packaged and labeled with the valve name, location, and identification number. The CONTRACTOR shall also furnish the name, address, and telephone number of the nearest distributor for the spare parts of each valve. Spare parts are intended for use by the GOVERNMENT, after expiration of the correction of defects period.

2.6 MANUFACTURERS

A. **Manufacturer's Qualifications:** Valve manufacturers shall have a successful record of not less than 5 years in the manufacture of the valves indicated.

PART 3 -- EXECUTION

3.1 VALVE INSTALLATION

A. **General:** Valves, actuating units, stem extensions, valve boxes, and accessories shall be installed in accordance with the Manufacturer's written instructions and as indicated. Gates shall be adequately braced to prevent warpage and bending under the intended use. Valves shall be firmly supported to avoid undue stresses on the pipe.

B. **Access:** Valves shall be installed with easy access for actuation, removal, and maintenance and to avoid interference between valve actuators and structural members, handrails, or other equipment.

C. **Valve Accessories:** Where combinations of valves, sensors, switches, and controls are indicated, the CONTRACTOR shall properly assemble and install such items so that systems are compatible and operating properly. The relationship between interrelated items shall be clearly noted on Shop Drawing submittals.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 15201 - VALVE AND GATE ACTUATORS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide valve and gate actuators and appurtenances, complete and operable, in accordance with the Contract Documents.

B. The provisions of this Section shall apply to all valves and gates, except where otherwise indicated in the Contract Documents.

C. **Unit Responsibility:** The valve or gate manufacturer shall be made responsible for coordination of design, assembly, testing, and installation of actuators on the valves and gates; however, the CONTRACTOR shall be responsible to the GOVERNMENT for compliance of the valves, gates, and actuators with the Contract Documents.

D. **Single Manufacturer:** Where 2 or more valve or gate actuators of the same types or sizes are required, the actuators shall be produced by the same manufacturer.

E. The requirements of Section 16485 - Local Control Stations and Miscellaneous Electrical Devices apply to the WORK of this Section.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01300 - Contractor Submittals and Section 15200 - Valves, General.

B. **Shop Drawings:** Shop Drawing information for all actuators shall be submitted together with the valve and gate submittals as a complete package.

C. **Calculations:** Selection calculations showing dynamic seating and unseating torques versus output torque of actuator.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Unless otherwise indicated, shut-off and throttling valves and externally actuated valves and gates shall be provided with manual or power actuators. The CONTRACTOR shall furnish actuators complete and operable with mounting hardware, motors, gears, controls, wiring, solenoids, handwheels, levers, chains, and extensions, as applicable. Actuators shall have the torque ratings equal to or greater than required for valve seating and dynamic torques, whichever is greater, and shall be capable of holding the valve in any intermediate position between fully-open and fully-closed without creeping or fluttering. Actuator torque ratings for butterfly valves shall be determined in accordance with AWWA C504 - Rubber-Seated Butterfly Valves. All wires of motor-driven actuators shall be identified by unique numbers.

B. **Manufacturers:** Where indicated, certain valves and gates may be provided with actuators manufactured by the valve or gate manufacturer. Where actuators are

furnished by different manufacturers, the CONTRACTOR shall coordinate selection to have the fewest number of manufacturers possible.

C. **Materials:** Actuators shall be current models of the best commercial quality materials and be liberally-sized for the required torque. Materials shall be suitable for the environment in which the valve or gate is to be installed.

D. **Actuator Mounting and Position Indicators:** Actuators shall be securely mounted by means of brackets or hardware specially designed and sized for this purpose and be of ample strength. The word "open" shall be cast on each valve or actuator with an arrow indicating the direction to open in the counter-clockwise direction. Gear and power actuators shall be equipped with position indicators. Where possible, manual actuators shall be located between 48- and 60-inches above the floor or the permanent working platform.

E. **Standard:** Unless otherwise indicated and where applicable, actuators shall be in accordance with AWWA C 540 - Power-Actuating Devices for Valves and Sluice Gates.

F. **Functionality:** Electric, pneumatic, and hydraulic actuators shall be coordinated with the power requirements of Division 16 and instrumentation equipment indicated in Section 17100 - Process Control and Instrumentation Systems.

G. Fasteners shall be in accordance with Section 05500 - Miscellaneous Metalwork.

H. Protective coatings shall be in accordance with Section 09800 - Protective Coatings.

2.2 MANUAL ACTUATORS

A. **General:** Unless otherwise indicated, valves and gates shall be furnished with manual actuators. Valves in sizes up to and including 4-inches shall have direct acting lever or handwheel actuators of the manufacturer's best standard design. Larger valves and gates shall have gear-assisted manual actuators, with an operating pull of maximum 60 pounds on the rim of the handwheel. Buried and submerged gear-assisted valves, gates, gear-assisted valves for pressures higher than 250 psi, valves 30 inches in diameter and larger, and where so indicated, shall have worm gear actuators, hermetically-sealed water-tight and grease-packed. All other valves 6-inches to 24-inches in diameter may have traveling-nut actuators, worm gear actuators, spur or bevel gear actuators, as appropriate for each valve.

B. **Buried Valves:** Unless otherwise indicated, buried valves shall have extension stems to grade, with square nuts or floor stands, position indicators, and cast-iron or steel pipe extensions with valve boxes, covers, and operating keys. Where so indicated, buried valves shall be in cast-iron, concrete, or similar valve boxes with covers of ample size to allow operation of the valve actuators. Covers of valve boxes shall be permanently labeled as required by the local Utility Company or the CONTRACTING OFFICER. Wrench-nuts shall comply with AWWA C 500 - Metal - Seated Gate Valves for Water Supply Service.

C. **Chain Actuator:** Manually-activated valves with the stem located more than 7-feet above the floor or operating level shall be provided with chain drives consisting of sprocket-rim chain wheels, chain guides, and operating chains provided by the valve manufacturer. The wheel and guide shall be of ductile iron, cast iron, or steel, and the chain shall be hot-dip galvanized steel or stainless steel, extending to 5-feet 6-inches

above the operating floor level. The valve stem of chain-actuated valves shall be extra strong to allow for the extra weight and chain pull. Hooks shall be provided for chain storage where chains interfere with pedestrian traffic.

D. **Floor Boxes:** Hot-dip galvanized cast iron or steel floor boxes and covers to fit the slab thickness shall be provided for operating nuts in or below concrete slabs. For operating nuts in the concrete slab, the cover shall be bronze-bushed.

E. **Tee Wrenches:** Buried valves with floor boxes shall be furnished with 2 operating keys or 1 key per 10 valves, whichever is greater. Tee wrenches, sized so that the tee handle will be 2 to 4 feet above ground, shall fit the operating nuts.

F. **Manual Worm Gear Actuator:** The actuator shall consist of a single or double reduction gear unit contained in a weather-proof cast iron or steel body with cover and minimum 12-inch diameter handwheel. The actuator shall be capable of 90-degree rotation and shall be equipped with travel stops capable of limiting the valve opening and closing. The actuator shall consist of spur or helical gears or worm gearing. The gear ratio shall be self-locking to prevent "back-driving." The spur or helical gears shall be of hardened alloy steel and the worm gear shall be alloy bronze. The worm gear shaft and the handwheel shaft shall be of 17-4 PH or similar stainless steel. All gearing shall be accurately cut with hobbing machines. Ball or roller bearings shall be used throughout. Output shaft end shall be provided with spline to allow adjustable alignment. Actuator output gear changes shall be mechanically possible by simply changing the exposed or helical gearset ratio without further disassembly of the actuator. All gearing shall be designed for a 100 percent overload. The entire gear assembly shall be sealed weatherproof.

2.3 ELECTRIC MOTOR ACTUATORS

A. General

1. Equipment Requirements: Where electric motor actuators are indicated, an electric motor-actuated valve control unit shall be attached to the actuating mechanism housing by means of a flanged motor adapter piece.

2. Gearing: The motor actuator shall include the motor, reduction gearing, reversing starter, torque switches, and limit switches in a weather-proof NEMA 4 assembly. The actuator shall be a single or double reduction unit consisting of spur or helical gears and worm gearing. The spur or helical gears shall be of hardened alloy steel and the worm gear shall be alloy bronze. All gearing shall be accurately cut with hobbing machines. All power gearing shall be grease- or oil-lubricated in a sealed housing. Ball or roller bearings shall be used throughout. Actuator output speed changes shall be mechanically possible by simply removing the motor and changing the exposed or helical gearset ratio without further disassembly of the actuator.

3. Starting Device: Except for modulating valves, the unit shall be so designed that a hammer blow is imparted to the stem nut when opening a closed valve or closing an open valve. The device should allow free movement at the stem nut before imparting the hammer blow. The actuator motor must attain full speed before stem load is encountered.

4. Switches

a. Mechanical Type Switches: The limit switches shall be gear open type actuated by a cam with four contacts to each cam or gear train. The torque switch shall be activated by a mechanical torque, developed in the seating of valve, or by an obstruction met in the opening and closing of the valve. Torque setting shall be adjustable and shall function without the use of auxiliary devices or relays. Position limit switches and associated gearing shall be an integral part of the valve actuator. To provide the best possible accuracy and repeatability, limit switch gearing shall be of the "counting" intermittent type, made of stainless steel, grease-lubricated, and enclosed in its own gear case to prevent dirt and foreign matter from entering the gear train. Valve actuators with mechanical type switches shall be as manufactured by **Limitorque, Rotork, EIM,** or **Auma Actuators, Inc**.

b. Electronic Type Switches: Limit switches or valve position shall be sensed by a 15 bit, optical, absolute position encoder. The open and closed positions shall be stored in a permanent, non-volatile memory. The encoder shall measure valve position at all times, including both motor and hand wheel operation, with or without use of battery. An electronic torque sensor shall be furnished. The torque limit may be adjusted from 40 to 100 percent of rating in 1 percent increments. The motor shall be de-energized if the torque limit is exceeded. A boost function shall be included to prevent torque trip during initial valve unseating, and a “jammed valve” protection feature with automatic retry sequence shall be incorporated to de-energize the motor if no movement occurs. Valve actuators with electronic type switches shall be as manufactured by **Limitorque, Rotork** or **Auma Actuators, Inc**.

c. The actuator shall be wired in accordance with the schematic diagram. All wiring for external connections shall be connected to marked terminals. One 1-inch and one 1-1/4-inch conduit connection shall be provided in the enclosing case. A calibration tag shall be mounted near each switch correlating the dial setting to the unit output torque. Switches shall not be subject to breakage or slippages due to over-travel. Traveling-nuts, cams, or micro switch tripping mechanisms shall not be used. Limit switches shall be of the heavy-duty open contact type with rotary wiping action.

5. Handwheel Operation: A permanently attached handwheel shall be provided for emergency manual operation. The handwheel shall not rotate during electrical operation. The maximum torque required on the handwheel under the most adverse conditions shall not exceed 60-lb.ft, and the maximum force required on the rim of the handwheel shall not exceed 60-lb. An arrow and either the word "open" or "close" shall be cast or permanently affixed on the handwheel to indicate the appropriate direction to turn the handwheel. A clutch lever shall be provided to put actuator into handwheel operation. All valves with electric motor activators with stems located more than 7-feet above the floor shall be provided with chain activator handwheels. The clutch lever shall be provided with a cable secured to the chain to allow disengagement for manual operation.

6. Motor: The motor shall be of the totally enclosed, non-ventilated, high-starting torque, low-starting current type for full voltage starting. It shall be suitable for operation on 480-volt, 3-phase or as indicated, 60-Hz current, and have Class F insulation and a motor frame with all dimensions in accordance with the latest revised NEMA MG Standards. The observed temperature rise by thermometer shall

not exceed 55 degrees C above an ambient temperature of 40 degrees C when operating continuously for 15 minutes under full rated load. With a line voltage ranging between 10 percent above to 10 percent below the rated voltage, the motor shall develop full rated torque continuously for 15 minutes without causing the thermal contact protective devices imbedded in the motor windings to trip or the starter overloads to drop-out. Bearings shall be of the ball type and thrust bearings shall be provided where necessary. All bearings shall be provided with suitable seals to confine the lubricant and prevent the entrance of dirt and dust. Motor conduit connections shall be watertight. Motor construction shall incorporate the use of stator and rotor as independent components from the valve operation such that the failure of either item shall not require actuator disassembly or gearing replacement. . Two Class B thermal contacts or solid state thermistors imbedded within the motor windings shall be provided to protect against over-temperature damage. The motor shall be provided with a space heater suitable for operation on 120-volt, single-phase, 60-Hz circuit unless the entire actuator is a hermetically sealed, non-breathing design with a separately sealed terminal compartment which prevents moisture intrusion. Each electric motor actuator shall be provided with a local disconnect switch or circuit breaker to isolate power from the motor and controller during maintenance activities.

7. Open/Close Operating Speed: Unless otherwise indicated, electric actuators shall provide a full close to full open or full open to full close operating time range from 30 to 55 seconds. Open/close speed of motor/power-actuated valves shall be indicated in the valves schedule.

8. Valves with electric motor actuators where the valve centerline is located at a height greater than 6-feet above the floor shall provide a remote actuator control station at a location no higher than 4-feet above the floor. The CONTRACTOR shall provide conduit and wiring between the actuator controls and the valve actuator for these applications. The actuator controls shall be wall mounted beneath the valve at a location approved by the CONTRACTING OFFICER.

B. Electric Motor Actuators (AC Reversing Control Type)

1. General: Where indicated, electric motor actuators shall be the AC reversing type complete with local control station with open/close and local/auto remote selector switches.

2. Actuator Appurtenances: The actuator for each valve shall be supplied with open and close status lights; open, close and lockout/stop push buttons; and other devices indicated.

3. Starter: The starter shall be a suitably sized amperage rated reversing starter with its coils rated for operation on 480-volt, 3-phase, 60-Hz current. A control power transformer shall be included to provide a 120-volt source, unless otherwise indicated. The starter shall be equipped with 3 overload relays of the automatic reset type. Its control circuit shall be wired as indicated. The integral weatherproof compartment shall contain a suitably sized 120-volt ac, single-phase, 60-Hz space heater to prevent moisture condensation on electrical components. A local power disconnect switch shall be provided with each actuator. A close-coupled, padlockable switch shall be provided with each actuator.

4. Local Control Station: Each actuator shall be provided with a local control station with the valve actuator assembly. The station shall include open, close, and stop push buttons and a local/remote selector switch. Where indicated on the Instrumentation Drawings, provide a two-wire control system as indicated above. This system shall allow communications to the PLC via a Modbus RS-485 protocol over a twisted shielded pair cable to monitor and control the valve as indicated above and in Section 17300 - Control Strategies. The local control station and local power disconnect may be provided as an integral part of the actuator or as otherwise indicated or required to permit operation by a person at floor elevation and within sight of the valve actuator.

5. Manufacturers, or equal

    a. **EIM**

    b. **Auma Actuators, Inc**.

    c. **Limitorque Corp**

    d. **Rotork**

C. Electric Motor Actuators (AC Modulating Control Type)

1. General: Where indicated, modulating electric motor actuators shall be the ac modulating type complete with a local control station with power disconnect switch or circuit breaker, Local/Remote switch, non-latching open/close pushbuttons, and open/close status lights

2. Actuator Appurtenances: The actuator for each valve shall be provided with a padlockable disconnect switch; open and closed status lights; open, close and lockout stop pushbuttons; local/remote selector switch; and other devices indicated.

3. Control Module: The control module shall be of the electronic solid-state ac type with control outputs for positioning the valve via 4 - 20 ma input signals.

4. Starter: The actuator shall control a solid-state reversing starter designed for minimum susceptibility to power line surges and spikes. The solid-state starter and control module shall be rated for continuous modulating applications. Power supply shall be 480-volt, 3-phase, 60-Hz. A disconnect switch shall be included with each actuator.

5. Construction: The control unit shall be microprocessor-based and shall contain an analog/digital converter, separate input-output switches, non-volatile random access memory for storage of calibration parameters and push-button calibration elements for field-setup. Potentiometer adjustments shall contain a PID control function internally. In addition, the controller shall contain as standard feature a loss of command signal protection selectable to lock in last or lock in pre-set valve position and a valve position output signal in 4-20 ma. As an alternative to the construction requirement, the motor shall be capable of modulating at a rate of 200 starts per hour at the 50 percent to 85 percent travel range of the valve. This system shall allow communications to the RTU via a Modbus RS-485 protocol over twisted shielded pair cable to monitor and control the valve as indicated. The system shall also allow control of the open, close, or percent open function when the local/remote

switch is in the remote position. Each actuator shall have a Frequency Shut Down system which when pre-programmed, shall function as directed upon receipt of an ESD signal.

6. Manufacturers, or equal

   a. EIM

   b. Limitorque

   c. Rotork

   d. **Auma Actuators, Inc.**

D. 120V Quarter-Turn and Multiturn Electric Valve Operators 6 Inches and Smaller

1. Provide 120V, single-phase motor operated valve operator suitable for use with quarter-turn ball valves, multiturn diaphragm valves, and multiturn globe valves. Operator shall have the following characteristics and features:

   a. Reversing capacitor-start motor rated for operation on 120V ac, 60 Hz, single phase. Output torque as required for valve application and pressure differential.

   b. Integral motor overload protection, with auto-reset

   c. Permanently-lubricated gear train

   d. For open/close control, provide four single-pole, double-throw cam actuated limit switches (2 OPEN, 2 CLOSED). One set of limit switches shall be used for both motor control and local indication. The other set shall be available for connection to remote monitoring. Limit switch contacts shall be adjustable and shall be rated for not less than 5 amps at 120V ac.

   e. Local Control Station: Open/Close: Corrosion-resistant, NEMA 4X, for mounting near valve actuator. Provide two-position selector switch for LOCAL-REMOTE selection and two pushbuttons, OPEN and CLOSE. In addition, provide OPEN and CLOSE indicating lights operating at 120V ac for connection to valve control limit switches.

   f. For modulating control, provide an electronic positioner and feedback potentiometer. The positioner shall utilize a 4 - 20 ma signal to adjust the valve opening. Feedback potentiometer shall be 0 -1000 ohms.

   g. Local Control Station Modulating: Corrosion resistant, NEMA 4X, for mounting near valve actuator. Provide two-position selector switch for LOCAL-REMOTE selection, one OPEN and one CLOSE push buttons, a resistance to current converter with 4 - 20 ma output and a 0 to 100 percent electronic valve position indicator.

   h. Local power disconnect switch (NEMA 4X) for disconnecting 120V ac power to valve. Disconnect shall be installed in the field within sight of the valve actuator, in accordance with the requirements of NPFA 70.

2. See Drawings for control diagram wiring interface.

3. Two-wire control systems are not required for this actuator.

4. Operators shall be **RCS, Asahi/America Quarter Master** or equal.

PART 3 -- EXECUTION

3.1 SERVICES OF MANUFACTURER

A. **Field Adjustments:** Field representatives of manufacturers of valves or gates with pneumatic, hydraulic, or electric actuators shall adjust actuator controls and limit-switches in the field for the required function.

3.2 INSTALLATION

A. Valve and gate actuators and accessories shall be installed in accordance with Section 15200 - Valves, General. Actuators shall be located to be readily accessible for operation and maintenance, without obstructing walkways. Actuators shall not be mounted where shock or vibrations will impair their operation, nor shall the support systems be attached to handrails, process piping, or mechanical equipment.

- END OF SECTION -

SECTION 15202 - BUTTERFLY VALVES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide butterfly valves and appurtenances, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 11000 – Equipment General Provisions apply to this Section.

C. The requirements of Section 15200 - Valves, General apply to this Section.

D. The requirements of Section 15201 - Valve Actuators apply to this Section.

1.2 CONTRACTOR SUBMITTALS

A. The CONTRACTOR shall furnish submittals in accordance with Section 15200.

B. Shop Drawings

1. Complete Shop Drawings of butterfly valves and actuators.

2. Drawings showing valve port diameter complete with dimensions, part numbers and materials of construction.

3. Certification of proof-of-design test from the valve manufacturer.

4. Manufacturer's Certification that the valve complies with all applicable provisions of AWWA C504 – Rubber-Seated Butterfly Valves.

1.3 QUALITY ASSURANCE

A. Valves shall be subjected to performance, leakage, and hydrostatic tests in accordance with procedures and acceptance criteria established by AWWA C504.

PART 2 -- PRODUCTS

2.1 RUBBER SEATED BUTTERFLY VALVES 25 TO 150 PSI (AWWA)

A. **General:** Butterfly valves for steady-state water working pressures and steady-state differential pressure up to 150 psi and for fresh water service having a pH range from 6 to 10 and temperature range from 33 to 125 degrees F shall conform to AWWA C504 and be as indicated.

B. Valves shall be of the body type, pressure class, end joint, and actuator indicated.

C. **Construction:** Unless otherwise indicated, all materials of construction shall be in accordance with AWWA C504, suitable for the service. The seats shall be positively clamped or bonded into the disc or body of the valve, but cartridge-type seats which rely on a high coefficient of friction for retention shall not be acceptable.

Description	Material Standards
Valve Bodies	ASTM A 48, Class 40 or Cast iron, ASTM A 126, Class B, or Ductile iron, ASTM A 536, grade 65-45-12 or 70-50-05
End flanges	The same material as the valve bodies
Valve shafts	Stainless steel ASTM A 276, Type 316
Valve discs	The same material as for the valve bodies.
Rubber seats	New natural or synthetic rubber
Seat mating surfaces	Stainless steel, ASTM A 276, Type 316
Clamps and retaining rings	Type 316 retaining rings and cap screws.
Valve bearings	Self lubricating materials per AWWA C504
Shaft seals	Resilient non-metallic materials suitable for service
Painting and coating	Refer to Section 09800 – Protective Coating

D. **Manual Actuators:** Unless otherwise indicated, all manually-actuated butterfly valves shall be equipped with a handwheel and 2-inch square actuating nut and position indicator. Screw-type (traveling nut) actuators will not be permitted for valves 30 inches in diameter and larger.

E. **Worm Gear Actuators**: Valves, 30 inch and larger, as well as all submerged and buried valves, shall be equipped with worm-gear actuators, lubricated and sealed to prevent entry of dirt or water into the housing.

F. **Electric Actuators:** Electric actuators shall meet the requirements of AWWA C540. Electric actuators shall be rated to produce output torque of at least 1.5 times the required valve maximum seating or maximum dynamic torque whichever is greater. For valves in modulating service with dynamic torque exceeding the seating torque, the rated output torque of the actuator shall be twice the dynamic torque required by the valve. Actuator rated torque is defined as pullout torque rated at 10 percent below the rated voltage of the motor.

G. Manufacturers, or Equal

1. **De Zurik Corporation**

2. **Kennedy Valve**

3. **K-FLO**

4. **M & H Valve Company**

5. **Mueller Company**

6. **Henry Pratt Company**

7. **Rodney Hunt Company** (24 inches and larger)

2.2 RUBBER SEATED BUTTERFLY VALVES, 250 PSI (AWWA).

A. **General:** Butterfly valves for steady-state water working pressures and steady-state differential pressure up to 250 psi and for fresh water service having a pH range from 6 to 10 and temperature range from 33 to 125 degrees F shall conform to AWWA C504. Valves shall be designed and manufactured in accordance with the intent of AWWA C504 except valves shall be suitable for 250 psi service and as indicated herein.

B. Valves shall be of the body type, pressure class, end joint, and actuator indicated.

C. One prototype valve for each size of valve required by the project shall be subjected to proof of design test in accordance with the procedures established by AWWA C504. Certificate of proof-of-design test shall be submitted to the CONTRACTING OFFICER prior to delivery of the valves.

D. **Construction:** Unless otherwise indicated, all materials of construction shall be in accordance with AWWA C 504, suitable for the service. The seats shall be positively clamped or bonded into the disc or body of the valve, but cartridge-type seats, which rely on a high coefficient of friction for retention, shall not be acceptable.

Designation	Materials Standards
Valve Bodies	ASTM A 48, Class 40 or Cast iron, ASTM A 126, Class B, Ductile iron, ASTM A 536, grade 65-45-12 or 70-50-05
End flanges	The same material as the valve bodies
Valve shafts	Stainless steel ASTM A 276, Type 316
Valve discs	The same material as for the valve bodies.
Rubber seats	New natural or synthetic rubber
Seat mating surfaces	Stainless steel, ASTM A 276, Type 316
Clamps and retaining rings	Type 316 retaining rings and cap screws.
Valve bearings	Self lubricating materials per AWWA C504

Shaft seals	Resilient non-metallic materials suitable for service
Painting and coating	Refer to Section 09800 – Protective Coating

E. **Manual Actuators:** Unless otherwise indicated, all manually-actuated butterfly valves shall be equipped with a handwheel and 2-inch square actuating nut and position indicator. Screw-type (traveling nut) actuators will not be permitted for valves 30 inches in diameter and larger.

F. **Worm Gear Actuators:** Valves, 30 inch and larger, as well as all submerged and buried valves, shall be equipped with worm-gear actuators, lubricated and sealed to prevent entry of dirt or water into the housing.

G. **Electric Actuators:** Electric actuators shall meet the requirements of AWWA C540. Electric actuators shall be rated to produce output torque of at least 1.5 times the required valve maximum seating or maximum dynamic torque whichever is greater. For valves in modulating service with dynamic torque exceeding the seating torque, the rated output torque of the actuator shall be twice the dynamic torque required by the valve. Actuator rated torque is defined as pullout torque rated at 10 percent below the rated voltage of the motor.

H. Manufacturers, or Equal

1. **De Zurik Corporation**

2. **Henry Pratt Company**

3. **Rodney Hunt Company** (24 inches and larger)

PART 3 -- EXECUTION

3.1 INSTALLATION

A. All exposed butterfly valves shall be installed with a means of removing the complete valve assembly without dismantling the valve or operator. The installation shall be in accordance with Section 15200.

- END OF SECTION -

SECTION 15203 - CHECK VALVES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide check valves and appurtenances, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 15200 - Valves, General apply to this Section.

1.2 CONTRACTOR SUBMITTALS

A. The CONTRACTOR shall furnish submittals in accordance with Section 15200.

PART 2 -- PRODUCTS

2.1 SWING CHECK VALVES (3-INCH AND LARGER)

A. **General:** Swing check valves for water, sewage, sludge, and general service shall be of the outside lever and spring or weight type, in accordance with ANSI/AWWA C 508 - Swing-Check Valves for Waterworks Service, 2 in. through 24 in. NPS, unless otherwise indicated, with full-opening passages, designed for a water-working pressure of 150 psi. They shall have a flanged cover piece to provide access to the disc.

B. **Body:** The valve body and cover shall be of cast iron conforming to ASTM A 126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings, with flanged ends conforming to ANSI/ASME B 16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800, or mechanical joint ends, as indicated.

C. **Disc:** The valve disc shall be of cast iron, ductile iron, or bronze conforming to ASTM B 62 - Composition Bronze or Ounce Metal Castings.

D. **Seat and Rings:** The valve seat and rings shall be of bronze to conforming ASTM B 62 or B 148 - Aluminum-Bronze Castings, or of Buna-N.

E. **Hinge Pin:** The hinge pin shall be of bronze or stainless steel.

F. Manufacturers, or Equal

1. **American Flow Control (Darling)**

2. **APCO (Valve and Primer Corp.)**

3. **Kennedy Valve**

4. **Mueller Company**

5. **Stockham Valves and Fittings**

2.2 SWING CHECK VALVES (2-1/2-INCH AND SMALLER)

A. **General:** Swing check valves for steam, water, oil, or gas in sizes 2-1/2 inch and smaller shall be suitable for a steam pressure of 150 psi and a cold water pressure of 300 psi. They shall have screwed ends, unless otherwise indicated, and screwed caps.

B. **Body:** The valve body and cap shall be of bronze conforming to ASTM B 61 - Steam or Valve Bronze Castings, or ASTM B 62 with threaded ends conforming to ANSI/ASME B1.20.1 - Pipe Threads, General Purpose (inch).

C. **Disc:** Valves for steam service shall have bronze or brass discs conforming to ASTM B 16 - Free-Cutting Brass Rod, Bar, and Shapes for Use in Screw Machines, and for cold water, oil, and gas service replaceable composition discs.

D. **Hinge Pin:** The hinge pins shall be of bronze or stainless steel.

E. Manufacturers, or Equal

1. **Crane Company**

2. **Milwaukee Valve Company**

3. **Stockham Valves and Fittings**

4. **Wm. Powell Company**

2.3 SLANTING DISC CHECK VALVES

A. **General:** Slanting disc check valves for water service shall have a seating angle of approximately 55 degrees. Valves shall have replaceable seat rings and disc rings. The water passage cross-sectional area shall be equal to the full pipe area. Valves shall have sufficient clearance around the pivot pins to permit free seating of the disc without binding and shall be guaranteed not to stick in the closed position. All slanting disc check valves shall have position indicators and two flanged connections for attachment of dashpots or hydraulic snubbers. The valves shall be designed for a water working pressure of 150 psi, unless otherwise indicated.

B. **Body:** The valve body shall be of cast iron conforming to ASTM A 48 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings, or A 126, Class B, with flanged ends conforming to ANSI/ASME B 16.1, Class 125, unless otherwise indicated.

C. **Disc:** The valve disc shall be designed with an "aerofoil" configuration of cast iron or ductile iron, with bronze seating face, except for valves 10-inches or smaller, which may have solid bronze or aluminum bronze discs. The disc shall be partially balanced with a short travel, to resist slamming.

D. **Seat Ring:** The seat ring shall be of centrifugally cast bronze, aluminum bronze, or stainless steel, with beveled edges, firmly clamped or screwed into the valve body.

E. **Pins:** The pivot pins and bushings shall be of stainless steel, bronze, or aluminum bronze, to allow free movement of the disc without binding.

F. **Dashpot:** A top mounted hydraulic dashpot shall be provided to control the opening and closing cycle of the valve to prevent surge and water hammer. The dashpot shall have two control flow rates: (1) 90 percent rapid rate and (2) 10 percent slow rate during shut down and start up. Each rate shall be infinitely and independently adjustable. The dashpot shall be a self contained oil system separate and independent from the water line media. The oil reservoir for the closing cycle shall be stainless steel and open to the atmosphere with an air breather cap to prevent oil spillage. The oil reservoir for the opening cycle shall be stainless steel and hermetically sealed to contain pressure (air over oil) and be equipped with a 3-inch diameter pressure gage and pneumatic fill valve. There shall be a provision for disconnecting the dashpot from the valve for servicing, without removal of the valve.

G. Manufacturers, or Equal

1. **APCO (Valve and Primer Corporation)**

2. **Crane Company** (Without Dashpot, Only)

3. **VAL-MATIC (Valve and Manufacturing Corporation)**

2.4 PLASTIC BALL CHECK VALVES

A. **General:** Plastic ball check valves for corrosive fluids, in sizes up to 4-inch, shall be used for vertical up-flow conditions only, unless the valves are provided with spring actions.

B. **Construction:** The valve bodies and balls shall be of polyvinyl chloride (PVC), chlorinated polyvinyl chloride (CPVC), polyvinylidene fluoride (PVDF), or polypropylene (PP) construction, as best suited for each individual service condition. They shall have unions with socket connections, or flanged ends conforming to ANSI/ASME B16.5 - Pipe Flanges and Flanged Fittings, class 150. Seals shall have Viton O-rings, and valve design shall minimize possibility of the balls sticking or chattering. The valves shall be suitable for a maximum working non-shock pressure of 150 psi at 73 degrees F.

C. Manufacturers, or Equal

1. **ASAHI-AMERICA**

2. **George Fischer, Inc.**

3. **NIBCO Inc. (Chemtrol Division)**

4. **Spears Mfg. Co.** (PVC, CPVC, AND PP only)

2.5 METALLIC BALL SEWAGE CHECK VALVES

A. **General:** Metallic ball check valves for sewage service, in sizes up to 24-inch, shall be used for vertical up-flow conditions and horizontal positions only.

B. **Construction:** The valve shall be designed with non-clogging feature for raw sewage. The ball shall be guided to and from its seat by smooth ribs integrally cast into the housing wall. An internal clog-proof design shall insure a completely free and unobstructed flow with no projections or pockets to trap solid material. The valve body

and cover shall be of cast or ductile iron and epoxy coated suitable for the service condition. They shall have flanged ends conforming to ANSI/ASME B16.5 - Pipe Flanges and Flanged Fittings, Class 150. Ball shall be made of hollow metal with vulcanized Buna-N rubber or hypalon cover suitable for the service. The valves shall be suitable for a maximum working non-shock pressure of 150 psi at 73 degrees F.

C. Manufacturers, or Equal

1. **Flygt (HDL)**

2. **Golden Anderson**

2.6 PLASTIC DIAPHRAGM CHECK VALVES

A. **General:** Plastic diaphragm check valves shall be the type which require no system pressure for sealing and operate silently with minimal pressure drop in either horizontal or vertical flow conditions. They shall utilize either an elastomer diaphragm or teflon encapsulated spring to effect closure.

B. **Construction:** The valve bodies shall be PVC, CPVC, polypropylene (PP), or polyvinylidene fluoride (PVPF) as indicated on the piping schedule. Union connections shall be either NPT or socket ends conforming to ANSI/ASME B 16.5 Class 150. They shall give bubble tight shutoff without dependence on gravity direction, mounting positon, or reverse flow. Seats and seals shall be EPDM, Buna-N, or Viton, as best suited for the service. Inlet pressure ratings shall be 150 psi at 73 degrees F for PVC and PVDF and 100 psi at 73 degrees F for PP.

C. Manufacturers or Equal

1. **Plastic-O-Matic Valves, Inc.**

2.7 PLASTIC SWING OR WYE-CHECK VALVES

A. **General:** Plastic swing or wye-check valves for corrosive fluids, in sizes up to 8 inches or as available, may be used for horizontal or vertical up-flow conditions.

B. **Construction:** The valve bodies and discs or piston shall be of PVC, PP, or PVDF construction, as best suited for each individual service condition. They shall have flanged ends conforming to ANSI/ASME B16.5 Class 150, and flanged top access covers, and they shall shut positively at no-flow conditions. The seats and seals shall be of EPDM, Teflon, or Viton. The PVC valves shall be rated for a maximum non-shock working pressure of 150 psi at 73 degrees F for sizes 3-inch and smaller. For larger sizes and other materials and temperatures the pressure rating may be lower.

C. Manufacturers, or Equal

1. **ASAHI-AMERICA**

2. **George Fischer, Inc.**

3. **Spears Mfg. Co.** (Plastic Swing Check only)

PART 3 -- EXECUTION

3.1 GENERAL

A. Valves shall be installed in accordance with provisions of Section 15200 - Valves, General.

- END OF SECTION –

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 15204 - BALL VALVES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide ball valves and appurtenances, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 15200 - Valves, General apply to this Section.

C. The requirements of Section 15201 - Valve and Gate Actuators apply to this Section.

D. The requirements of Section 11258 - Chemical Feeding Equipment, General apply to this Section.

1.2 CONTRACTOR SUBMITTALS

A. The CONTRACTOR shall furnish submittals in accordance with Section 15200 - Valves, General.

PART 2 -- PRODUCTS

2.1 METAL BALL VALVES (4-INCH AND SMALLER)

A. **General:** Unless otherwise indicated, general purpose metal ball valves in sizes up to 4-inch shall have actuators in accordance with Section 15201 - Valve and Gate Actuators.

B. **Body:** Ball valves up to 1-1/2-inch (incl.) in size shall have bronze or carbon steel 2-or 3-piece bodies with screwed ends for a pressure rating of not less than 600 psi WOG. Valves 2-inch to 4-inch in size shall have bronze or carbon steel 2-or 3-piece bodies with flanged ends for a pressure rating of ANSI 125 psi or 150 psi unless otherwise indicated.

C. **Balls:** The balls shall be solid chrome plated brass or bronze, or stainless steel, with standard port (single reduction) or full port openings.

D. **Stems:** The valve stems shall be of the blow-out proof design, of bronze, stainless steel, or other acceptable construction, with reinforced Teflon seal.

E. **Seats:** The valve seats shall be of Teflon or Buna-N, for bi-directional service and easy replacement.

F. Manufacturers, or Equal

1. **Conbraco Industries, Inc. (Apollo)**

2. **ITT Engineered Valves**

3. **Neles-Jamesbury, Inc.**

4. **Watts Regulator**

5. **Worcester Controls**

2.2 PLASTIC BALL VALVES

A. **General:** Plastic ball valves for corrosive fluids shall be made of polyvinyl chloride (PVC), chlorinated polyvinyl chloride (CPVC), polypropylene (PP), or polyvinylidene fluoride (PVDF), as recommended by the Manufacturer for the specific application. Valves shall have manual actuators in accordance with Section 15201 - Valve and Gate Actuators, unless otherwise indicated.

B. **Construction:** Plastic ball valves shall have union ends or flanged ends to mate with ANSI B 16.5, class 150 flanges, for easy removal. The balls shall have full size ports and Teflon seats. Body seals, union O-ring seals, and stem seals shall be in accordance with the corrosion resistance requirements of Section 11258. External (without entering into the wetted area) seat packing adjustment is preferred. Metal reinforced stems to prevent accidental breakage are preferred. The valves shall be suitable for a maximum working non-shock pressure of 150 psi at 73 degrees F for PVC and CPVC, with decreasing ratings for higher temperatures and other plastics.

C. Manufacturers, or Equal

1. **ASAHI-America**

2. **George Fischer, Inc.**

3. **NIBCO Inc., (Chemtrol)**

4. **Plast-O-Matic Valves, Inc.**

5. **Spears Mfg. Co.**

6. **Watts Regulator**

PART 3 -- EXECUTION

3.1 GENERAL

A. Valves shall be installed in accordance with Section 15200. Care shall be taken that valves in plastic lines are well supported at each end of the valve.

- END OF SECTION -

SECTION 15205 – DIAPHRAGM VALVES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide diaphragm valves and appurtenances, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 15200 - Valves, General apply to this Section.

C. The requirements of Section 15201 - Valve Actuators apply to this Section.

1.2 CONTRACTOR SUBMITTALS

A. The CONTRACTOR shall furnish submittals in accordance with Section 15200.

PART 2 -- PRODUCTS

2.1 GENERAL REQUIREMENTS

A. **Construction:** Diaphragm valves shall be of the weir type, unless otherwise indicated, and be of the material combination best suited for each individual application. They shall be suited for bi-directional throttling service and installation in any position, with bubble-tight shut-off. Valves on outlets and drain nozzles of storage tanks shall have lined metal bodies.

B. **Actuators:** Unless otherwise indicated, diaphragm valves shall have manual hand-wheel actuators with position indicators and transparent plastic stem covers of clear acrylic, polycarbonate, or similar material. Valve actuators shall be in accordance with Section 15201 - Valve Actuators. The handwheels shall be of cast-iron, aluminum, or polypropylene.

2.2 METAL BODY DIAPHRAGM VALVES

A. **Construction:** The valve body shall be of cast-iron to ASTM A 126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings, Class B, or of ductile iron to ASTM A 395 - Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures, with PVDF lining. The valve ends shall be flanged to ANSI/ASME B16.5 - Pipe Flanges and Flanged Fittings, 125 lb. rating, or screwed, as indicated. The valve bonnet shall be steel, with brass or bronze sleeve and a compressor of aluminum, brass, bronze, or cast-iron. The bolts and nuts shall be of stainless steel and the stem and bonnet seals of Viton O-rings.

B. **Diaphragm:** The diaphragms shall be of the best suitable material for any given service. Unless otherwise recommended by the manufacturer, the diaphragm material shall be chlorosulfonated polyethylene such as Hypalon or equal, except that the diaphragms for valves in chlorine solution and chlorine gas lines shall be Teflon. All diaphragms shall be of rugged, reinforced construction, be oil resistant, and be designed for long life.

C. Manufacturers, or Equal

1. **ITT Dia-Flo**

2. **Mc Canna, Inc.**

2.3 PLASTIC BODY DIAPHRAGM VALVES

A. **Construction:** Unless otherwise indicated, valve bodies shall be of PVC, CPVC, PP, or PVDF construction, as best-suited for each individual service, with union ends, screwed ends, socket-welded ends, spigot ends, or flanged ends to ANSI/ASME B16.5 - Pipe Flanges and Flanged Fittings, drilled to 150 lb. dimensions, as indicated. The valve bonnets shall be flanged and of PVC, PP, or PVDF construction. The valve compressor stem shall be the same material as the valve body or of a material compatible with the fluid service. The bolts, nuts, and washers shall be of stainless steel and the stem and bonnet seals of Viton or Buna-N O-rings. Valves in sizes 1/2-inch through 4-inch shall have a pressure rating of 150 psi at 73 degrees F, diminishing to not less than 50 psi for larger sizes.

B. **Diaphragm:** The diaphragms shall be of the best-suitable material for any given service. Unless otherwise recommended by the manufacturer, the diaphragm material shall be chlorosulfonated polyethylene such as Hypalon, Viton, or equal, except that the diaphragms for valves in chlorine solution and chlorine gas lines shall be laminated Teflon/EPDM: diaphragms shall be constructed with suitable lamination to prevent gas migration. Diaphragms shall be of rugged, reinforced construction, be oil resistant, and be designed for long life.

C. Manufacturers, or Equal

1. **ASAHI/America**

2. **George Fischer, Inc. (+GF+)**

3. **ITT Dia-Flo**

4. **Mc Canna, Inc.**

5. **Spears Mfg. Co.**

PART 3 -- EXECUTION

3.1 GENERAL

A. Valves shall be installed in accordance with provisions of Section 15200. Care shall be taken that all valves in plastic lines are well supported at each end of the valve.

- END OF SECTION -

SECTION 15206 - GATE VALVES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide gate valves and appurtenances, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 15200 - Valves, General apply to this Section.

C. The requirements of Section 15201 - Valve and Gate Actuators apply to this Section.

1.2 CONTRACTOR SUBMITTALS

A. The CONTRACTOR shall furnish submittals in accordance with Section 15200 - Valves, General.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Buried valves shall be of the inside screw, non-rising stem type. The valve actuators shall be as indicated, with counter-clockwise opening stems, in accordance with Section 15201.

2.2 METAL-SEATED GATE VALVES (3-INCH AND LARGER)

A. **Construction:** Metal-seated gate valves for water and sewage service shall conform to ANSI/AWWA C 500 - Metal-Seated Gate Valves for Water Supply Service. The valve bodies shall be of cast iron conforming to ASTM A 126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings, or ductile iron conforming either to ASTM A 395 - Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures, or to ASTM A 536 - Ductile Iron Castings, with flanged, bell and spigot, or mechanical joint-ends as indicated. Body and bonnet wall thickness shall be equal to or greater than the minimum wall thickness as listed in Table 2 of ANSI/AWWA C500. The design working water pressure shall be 200 psig for valves 12 inches and smaller and 150 psig for larger valves. The valves may be of the double-disc type for tighter shut-off, or of the solid-wedge type, with rising or non-rising stem. For sewage or fluids containing solids, an outside thread shall be used. Valves 14-inch and larger installed in vertical pipes shall be fitted with bronze slides, tracks, rollers, and scrapers to assist the travel of the gate assembly. Gate valves 14-inch and larger shall be furnished with bypass assemblies.

B. **Actuators:** Unless otherwise indicated, gate valves shall have manual actuators in accordance with Section 15201 - Valve and Gate Actuators.

C. Manufacturers, or Equal

1. **Clow Valve Co.**

2. **Kennedy Valve**

3. **M & H Valve Company**

4. **Milwaukee Valve Company, Inc.**

2.3 RESILIENT-SEATED GATE VALVES (3- to 16-inch)

A. **General:** Resilient-seated gate valves may be provided in lieu of metal-seated double-disc or solid-disc gate valves, at the discretion of the CONTRACTING OFFICER.

B. **Construction:** Resilient-seated gate valves shall conform to ANSI/AWWA C 509 - Resilient-Seated Gate Valves for Water and Sewerage Systems. The valves shall be suitable for a design working water pressure of 200 psig, with flanged, bell and spigot, or mechanical joint ends. The valve body, bonnet, and disc shall be of cast iron or ductile iron and the disc or body shall be rubber-coated. Body and bonnet wall thickness shall be equal to or greater than the minimum wall thickness as listed in Table 2 of ANSI/AWWA C509. The stem, stem nuts, glands, and bushings shall be of bronze, with the stem seal per ANSI/AWWA C 509.

C. **Actuators:** Unless otherwise indicated, resilient-seated gate valves shall have manual actuators in accordance with Section 15201 - Valve and Gate Actuators.

D. Manufacturers, or Equal

1. **American Flow Control**

2. **Clow Valve Co.**

3. **Kennedy Valve**

4. **M & H Valve Company**

5. **Mueller Company**

6. **Stockham Valves and Fittings**

7. **US Pipe**

2.4 GATE VALVES (SMALLER THAN 3-INCH)

A. **Construction:** Gate valves, smaller than 3-inch, for general purpose use, shall be non-rising stem, heavy-duty type for industrial service, with screwed or soldered ends to match the piping. The bodies shall have union bonnets of bronze conforming to ASTM B 62 - Composition Bronze or Ounce Metal Castings. The stems shall be of bronze conforming to ASTM B 62, or ASTM B 371 - Specification for Copper-Zinc-Silicon Alloy Rod. The solid wedges shall be of bronze conforming to ASTM B 62. The valves shall have malleable iron handwheels, unless otherwise indicated, and stem seals shall be of Teflon-impregnated or other acceptable non-asbestos packing. All valves shall have a pressure rating of minimum 125 psi steam, and 200 psi coldwater, unless otherwise indicated.

B. Manufacturers, or Equal

1. **Crane Company**

2. **Milwaukee Valve Company**

3. **Wm. Powell Company**

4. **Stockham Valves and Fittings**

5. **Walworth Company**

2.5 PLASTIC GATE VALVES (1-1/2- TO 14-INCH)

A. **Construction:** Plastic gate valves shall have PVC bodies with ANSI 150 lb. flanged ends, and polypropylene or CPVC-SBR-lined wedges for tight shut-off. The non-rising stem shall be of PVC or Type 304 stainless steel construction, with O-ring seal. The valves shall have a coldwater pressure rating of 150 psig for sizes 1-1/2- through 8-inch, 110 psig for size 10-inch, and 70 psig for sizes 12- and 14-inch.

B. **Actuators:** Unless otherwise indicated, PVC gate valves shall have manual handwheel actuators with position indicators, in accordance with Section 15201.

C. Manufacturers, or Equal

1. **ASAHI/America**

2. **Spears Mfg. Co.**

PART 3 -- EXECUTION

3.1 GENERAL

A. Gate valves shall be installed in accordance with the provisions of Section 15200. Care shall be taken that valves in plastic lines are well supported at each end of the valve.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 15207 - PLUG VALVES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide plug valves and appurtenances, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 15200 - Valves, General apply to this Section.

C. The requirements of Section 15201 - Valve and Gate Actuators apply to this Section.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 15200.

PART 2 -- PRODUCTS

2.1 ECCENTRIC PLUG VALVES (1/2-inch to 72-inch)

A. **Construction:** Eccentric plug valves shall be of the non-lubricated, eccentric plug design with cast iron bodies conforming to ASTM A 126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings, with ANSI 125 lb. flanged ends for valves 3-inch and larger, and screwed or flanged ends for smaller sizes. The plugs and shafts shall be of cast iron or ductile iron conforming to ASTM A 536 - Ductile Iron Castings, and the plugs shall be lined with a resilient coating, best suited for the specific service. The body shall be lined with a suitable elastomer, where required for a special service, or it shall be epoxy-lined in accordance with Section 09800 - Protective Coating. The seats shall be of nickel or stainless steel welded to the body. All top and bottom shaft bearings shall be of permanently lubricated stainless steel or Teflon coated stainless steel. Grit seals of Teflon, Nylatron, or similar suitable material shall be at the top and bottom plug journals. Valves up to and including 20-inch in size shall have an unobstructed port area of not less than 80 percent of full pipe area, and not less than 70 percent for larger valves. All eccentric plug valves shall have a pressure rating of not less than 150 psi WOG, for bubble-tight shut-off in the standard flow direction, and 25 psi WOG in the reverse flow direction. When equipped with worm gear actuator, the pressure rating shall be 150 psi WOG in both directions. The stem seal shall consist of field adjustable packing, replaceable without removal of the actuator, or of self-adjusting U-cup packing.

B. **Actuators:** Unless otherwise indicated, eccentric plug valves 3-inch and smaller shall have operating levers; larger valves shall have worm-gear actuators. Valve actuators shall be in accordance with Section 15201.

C. Manufacturers, or Equal

1. **DeZurik Corporation**

2. **Clow Valve Company**

3. **Pratt Valve**

4. **Victaulic**

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Plug valves shall be installed in strict accordance with the manufacturer's published recommendations and the applicable provisions of Section 15200.

B. **Eccentric Plug Valves:** Unless otherwise directed, the following rules shall be observed for the installation of eccentric plug valves on sewage, sludge, or other liquid systems containing solids, silt, or fine sand:

1. The valves shall be positioned with the stem in the horizontal direction.

2. In horizontal pipelines, the plug shall swing upwards when opening, to permit flushing out of solids.

3. The orientation of the valve shall prevent the valve body from filling up with solids when closed; however, where the pressure differential through the valve exceeds 25 psi, the higher pressure for valves without worm gear, electric, or air operators shall be through the valve to force the plug against the seat.

4. Valves which may be closed for extended periods (stand-by, bypass, or drain lines) and valves with reversed flow (higher pressure on downstream side, forcing the plug away from its seat), shall be equipped with worm gear operators for all sizes.

5. For special applications or when in doubt, consult with the manufacturer prior to installation.

- END OF SECTION -

SECTION 15215 - PRESSURE REDUCING VALVES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide pressure reducing valves and appurtenances, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 15200 - Valves, General, apply to this Section.

1.2 CONTRACTOR SUBMITTALS

A. The CONTRACTOR shall furnish submittals in accordance with Section 15200, including a cavitation study from the valve manufacturer.

PART 2 -- PRODUCTS

2.1 GENERAL

A. **Function:** Pressure reducing valves shall reduce a higher upstream pressure to a pre-set, lower, constant pressure, regardless of fluctuations in the upstream pressure.

B. **Operation:** The valves shall be hydraulically operated, with diaphragm or piston direct action, pilot-controlled, per paragraph 2.2, and shall be of the globe or angle pattern as indicated. All necessary repairs shall be possible without removing the valves from the pipeline. The smaller direct-acting valves with threaded ends per paragraph 2.3, shall be suitable for water or air service and shall be of the globe patterns.

2.2 FLANGED VALVES, SIZES 1 1/2 INCHES THROUGH 12 INCHES

A. **Valve Body:** The valve body shall be of cast iron to ASTM A 48 - Gray Iron Castings, or ASTM A 126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings, with 250 lb flanged ends to ANSI/ASME B 16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800, or the body shall be of ductile iron to ASTM A 536 - Ductile Iron Castings, with 300 lb flanged ends to ANSI/ASME B 16.42 - Ductile Iron Pipe Flanges and Flanged Fittings. The valve cover shall be flanged and be the same material as the body.

B. **Valve Trim:** The valve stems with position indication, springs, body seat rings, and all bolts, nuts, and washers shall be of Type 302, 303, or 316 stainless steel. The valve stems shall have top and bottom guides. All rubber parts shall be of Buna-N. The diaphragms shall be of Nylon-reinforced Buna-N, supported firmly between body and valve cover. The valve pistons and piston liners shall be bronze to ASTM B 62 - Composition Bronze or Ounce Metal Castings.

C. **Valve Controls:** The valve shall be provided with a complete, externally mounted control system, including speed control needle valves, strainers, check valve, isolation valves, and all necessary copper or stainless steel connecting tubing and fittings. The controls shall be capable of achieving all the flow and speed adjustment indicated.

D. **Factory Tests and Warranty:** All valves shall be factory tested with a hydrostatic test and a functional test and a test certificate shall be submitted to the CONTRACTING OFFICER prior to delivery of the valve. The valve shall be warranted for a period of 3 years from the date of shipment to be free of defects in materials and workmanship

E. **Operating Conditions:** The valve shall be designed to operate under the following conditions as indicated on drawings

F. **Spare Parts:** The following spare parts shall be furnished in accordance with Section 15200:

1. One set of all resilient seals and discs

2. One diaphragm (for diaphragm valves, only)

G. Manufacturers, or Equal

1. **Cla-Val Company**

2. **GA Industries**

3. **OCV Control Valves**

4. **Ross Valve Mfg. Co., Inc.**

5. **Singer Valve, Inc.**

6. **Watts, ACV**

2.3 THREADED VALVES, SIZES 1/2 TO 2-1/2 INCHES

A. **Valve Body:** The valve body shall be bronze to ASTM B 62 or cast steel, with a minimum pressure rating of 300 psi, and with threaded ends. The valve shall be provided with an integral or an attached strainer with access cap or plug and a flanged or threaded valve cover. The valve shall be actuated by a diaphragm or piston.

B. **Valve Trim:** The valve stems, springs, body seats, and washers shall be of Series 300 stainless steel. The strainers shall be of stainless steel or monel and the diaphragms shall be of reinforced neoprene. The valve pistons and piston liners shall be bronze to ASTM B 62.

C. **Operating Conditions:** The valve shall be designed to operate under the following conditions as indicated on drawings

D. **Spare Parts:** The following spare parts shall be furnished in accordance with Section 15200:

1. One set of all resilient seals and discs

2. One diaphragm (for diaphragm valves, only)

E. Manufacturers, or Equal

1. **Cla-Val Company**

2. **Fisher Controls**

3. **GA Industries**

4. **Watts, ACV**

5. **Wilkins Regulator Div. (Zurn Industries)**

2.4 PLASTIC VALVES, SIZES 1/4 TO 3 INCHES

A. Plastic pressure reducing valves shall be designed for not less than 150 psi water working pressure and shall be suitable for the fluid service. For chemicals and all corrosive fluids, solenoid valves shall be PVC, CPVC, polypropylene (PP), polyvinylidene fluoride (PVDF), or teflon materials of construction as recommended by the manufacturer for the specific application.

B. **Characteristics:** Valves shall open when the outlet pressure drops below a set minimum value, and maintain the pressure and open wide as flow requirements dictate. Valves shall be spring or hydraulically operated, direct acting, adjustable, diaphragm or piston type as indicated.

C. Manufacturers, or Equal

1. **Corrosive Fluids**

2. **Plast-O-Matic Valves, Inc.**

3. **George Fisher**

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Valves shall be installed in accordance with provisions of Section 15200.

3.2 SERVICES OF MANUFACTURERS

A. **Inspection, Startup, and Field Adjustment:** The service representative of the valve manufacturer shall be present at the Site for 1 work days, to assist the CONTRACTOR in the installation and adjustment of the valve(s).

B. **Instruction of GOVERNMENT's Personnel:** The training representative of the valve manufacturer shall be present at the Site for 1 work days to instruct the personnel in the operation, adjustment, and maintenance of the valve(s).

C. For the purpose of this paragraph, a workday is defined as an eight hour period, excluding travel time.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 15218 - PRESSURE RELIEF VALVES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide pressure relief valves and appurtenances, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 15200 - Valves, General, apply to this Section.

1.2 CONTRACTOR SUBMITTALS

A. The CONTRACTOR shall furnish submittals in accordance with Section 15200.

PART 2 -- PRODUCTS

2.1 FLANGED PRESSURE RELIEF VALVES, SIZES 1 1/2 INCHES THROUGH 42 INCHES

A. **Valve Characteristics:** The pressure relief valve shall open when the inlet pressure exceeds a set maximum level. It shall maintain that level and gradually close as the inlet pressure drops below the maximum pressure. The valve shall be a hydraulically operated, adjustable, pilot controlled, diaphragm or piston type globe or angle valve as indicated. All necessary repairs shall be possible without removing the valve from the pipeline.

B. **Valve Body:** The valve body shall be of cast iron, ASTM A 48 - Gray Iron Castings, or ASTM A 126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings, with 125 lb or 250 lb as indicated, flanged ends to ANSI/ASME B 16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800, or the body shall be of ductile iron to ASTM A 536 - Ductile Iron Castings, with 150 lb or 300 lb as indicated, flanged ends to ANSI/ASME B 16.42 - Ductile Iron Pipe Flanges and Flanged Fittings. The valve cover shall be flanged and be of the same material as the body.

C. **Valve Trim:** The valve stems, springs, body seat rings, and all bolts, nuts, and washers shall be of Type 302, 303, or 316 stainless steel. The valve stems shall have top and bottom guides. All rubber parts shall be of Buna-N. The diaphragms shall be of Nylon-reinforced Buna-N, supported firmly between body and valve cover. The valve pistons and piston liners shall be bronze to ASTM B 62 - Composition Bronze or Ounce Metal Castings.

D. **Valve Controls:** The valve shall be furnished with a complete, externally mounted control system, including adjustable speed control needle valves, strainer, and all necessary copper or stainless steel connecting tubing and fittings. The controls shall be capable of achieving all the flow and speed adjustment indicated.

E. **Factory Tests and Warranty:** Valves shall be factory tested with a hydrostatic test and a functional test and a test certificate shall be submitted to the CONTRACTING OFFICER prior to delivery of the valve. The valve shall be warranted for a period of 3 years from the date of shipment to be free of defects in materials and workmanship.

F. **Operating Conditions:** The valve shall be designed to operate under the following conditions:

1.	Total flow from pump station [gpm]	-	4000
2.	Maximum inlet pressure (psi)	-	300
3.	Maximum flow through valve (gpm)	-	1800
4.	Pressure relief set at (psi)	-	250
5.	Valve size (inches)	-	6
6.	Size of pipeline (inches diameter)	-	6

G. **Spare Parts:** The following spare parts shall be furnished in accordance with Section 15200:

1. 1 set of all resilient seals, and discs
2. 1 diaphragm (for diaphragm valves, only)

H. Manufacturers, or Equal

1. **Cla-Val Company**
2. **Golden-Anderson**
3. **OCV Control Valves**
4. **Ross Valve Mfg. Co., Inc.**
5. **Singer Valve, Inc.**
6. **Watts, ACV**

2.2 THREADED PRESSURE RELIEF VALVES, SIZES 1/2 THROUGH 2-1/2 INCHES

A. **Valve Characteristics:** The pressure relief valve shall open when the inlet water pressure exceeds a set maximum level. It shall maintain that level and gradually close as the inlet pressure drops below the maximum pressure. The valve shall be a spring and hydraulically operated, direct-acting, adjustable, diaphragm or piston type globe or angle valve as indicated.

B. **Valve Body:** The valve body shall be bronze with threaded inlet and outlet to standard NPT and with flanged top, suitable for an inlet pressure of 300 psi. The spring shall be adjustable with an adjusting screw, to regulate the pressure setting.

C. **Valve Trim:** The valve trim shall be of stainless steel or bronze with stainless steel spring. The rubber seat shall be replaceable.

D. **Pressure Setting:** The valve shall be set for a relief pressure as shown on drawings.

E. Manufacturers or Equal

1. **Cla-Val Company**

2. **Golden-Anderson**

3. **Ross Valve Mfg. Co., Inc.**

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Valves shall be installed in accordance with provisions of Section 15200.

3.2 SERVICES OF MANUFACTURER

A. **Inspection, Startup, and Field Adjustment:** The service representative of the valve manufacturer shall be present at the Site for 1 work days, to assist the CONTRACTOR in the installation and adjustment of the valve(s).

B. **Instruction of GOVERNMENT's Personnel:** The training representative of the valve manufacturer shall be present at the Site for 1 work days to instruct the personnel in the operation, adjustment, and maintenance of the valve(s).

C. For the purpose of this paragraph, a work day is defined as an eight hour period, excluding travel time.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 15230 - MISCELLANEOUS VALVES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide miscellaneous valves and appurtenances, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 15200 - Valves, General, apply to this Section.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 15200.

PART 2 -- PRODUCTS

2.1 AIR-VACUUM AND AIR-RELEASE VALVES

A. **Air and Vacuum Valves:** Air and vacuum valves shall be capable of venting large quantities of air while pipelines are being filled, and allowing air to re-enter while pipelines are being drained. They shall be of the size indicated, with flanged or screwed ends to match piping. Bodies shall be of high-strength cast iron. The float, seat, and all moving parts shall be constructed of Type 316 stainless steel. Seat washers and gaskets shall be of a material insuring water tightness with a minimum of maintenance. Valves shall be designed for minimum 150 psi water-working pressure, unless otherwise indicated.

B. **Air-Release Valves:** Air-release valves shall vent accumulating air while system is in service under pressure and be of the size indicated. Valves shall meet the same general requirements as indicated for air and vacuum valves except that the vacuum feature will not be required. Valves shall be designed for a minimum water-working pressure of 150 psi, unless otherwise indicated.

C. **Combination Air Valves:** Combination air valves shall combine the characteristics of air and vacuum valves and air release valves by exhausting accumulated air in systems under pressure and releasing or re-admitting large quantities of air while a system is being filled or drained, respectively. Valves shall have the same general requirements as indicated for air and vacuum valves.

D. **Sewage Air Release Valves:** Sewage air release valves shall vent accumulating gases during system operation. Valves shall have long float stems and bodies to minimize clogging. The same general requirements shall apply as indicated for air and vacuum valves. Each sewage air release valve shall be furnished with the following backwash accessories, fully assembled on the valve:

1. Inlet shut-off valve.

2. Blow-off valve.

3. Clear water inlet valve.

4. Rubber supply hose.

5. Quick disconnect couplings.

E. Manufacturers, or Equal

1. **APCO (Valve and Primer Corporation)**

2. **Crispin - Multiplex Manufacturing Company**

3. **GA Industries**

4. **Val-Matic (Valve and Manufacturing Corporation)**

2.2 AIR AND VACUUM VALVES FOR VERTICAL TURBINE PUMPS

A. An air and vacuum valve for the vertical turbine pump shall be installed on the pump discharge pipe indicated. The valve shall vent large quantities of air out through the orifice when pump starts, close tight when liquid enters, and permit and large quantities of air to re-enter through orifice when pump stops, to prevent vacuum forming in the pump column. They shall be of the size indicated, with flanged or screwed ends to match piping. Bodies shall be of high-strength cast iron. The float, seat, and all moving parts shall be constructed of Type 316 stainless steel. Seat washers and gaskets shall be of a material insuring water tightness with a minimum of maintenance. The discharge orifice shall be fitted with a double-acting throttling device to regulate and restrict air venting, which shall establish a pressure loading on the rising column of water and eliminate damaging shock to the pump, controls, and valves during pump start. On pump stop, a double-acting throttling device shall automatically open, allowing full line unrestricted air re-entry to prevent any vacuum to form in the pump column. The valve shall be designed for minimum 250 psi water-working pressure.

B. Manufacturer or Equal

1. **APCO (Valve and Primer Corporation**)

2. **Val-Matic (Valve and Manufacturing Corporation)**

2.3 VACUUM RELIEF/AIR INLET VALVE FOR SURGE TANK

A. A vacuum relief/air inlet valve shall be installed on the surge tank. The vacuum relief/air inlet valve shall be normally closed, capable of admitting large quantities of air into the system immediately should the system pressure become negative and preventing a vacuum from forming during draining, pipeline rupture, or water column separation. The valve shall be of the size indicated, with flanged ends to match piping connections. Bodies shall be of high-strength cast iron with a steel hood. The float, seat, spring, and all moving parts shall be constructed of Type 316 stainless steel. The internal valve-plug and seat shall be heavy cast brass. The plug shall be normally closed by means of a stainless steel spring and shall open when a vacuum/pressure differential exceeds 0.25 psi or less. Seat seal shall be of Buna-N providing a drip-tight seal. Valves shall be designed for minimum 250 psi water-working pressure, unless otherwise indicated.

B. Manufacturer or Equal

1. **APCO (Valve and Primer Corporation)**

2. **Val-Matic (Valve and Manufacturing Corporation)**

2.4 BACKFLOW PREVENTER VALVES

A. **General:** Backflow preventers shall work on the reduced pressure principle. They shall consist of 2 spring-loaded check valves, automatic differential pressure relief valve, drain valves, and shut-off valves. The body material shall be bronze or cast iron for a working pressure of not less than 150 psi, with bronze or stainless steel trim. Drain lines with air gaps shall be provided. The backflow preventer valves shall be in accordance with AWWA C511 standard.

B. Manufacturers, or Equal

1. **Cla-Val Company**

2. **Febco, (CMB Industries)**

3. **Hersey Products**

4. **Watts, ACV**

5. **Wilkins Regulator Division (Zurn Industries)**

2.5 CORPORATION STOPS

A. Unless otherwise indicated, corporation stops shall be made of solid brass for key operation, with screwed ends with corporation thread or iron pipe thread, as required.

B. Manufacturer, or Equal

1. **Ford Meter Box Company, Inc.**

2. **James Jones Company (Watts, ACV)**

3. **Mueller Company**

2.6 Mud Valves

A. Mud valves shall be flanged, non-rising stem type, with threaded stem, seat ring, and gate ring of bronze. Valves shall be provided with coupling nut, extension stem, stem guides, and operating stand, wheel, or wrench nut as indicated. Mud valve shall be installed with valve seats level.

B. Manufacturers or Equal

1. **Clow**

2. **Mueller**

2.7 SEWAGE SURGE RELIEF VALVES

A. **Operating Requirements:** The valve shall open immediately when the system pressure exceeds the load setting, 50 psi, of the counterweights and shall close slowly at an adjustable speed upon return of system pressure to normal.

B. **Valve Body:** Sewage surge relief valves shall be constructed of a heavy cast-iron or cast-steel body with a welded steel disc having rubber seating face, a non-corrosive shaft for attachment of counterweight or spring-loaded arms and lever, and a complete non-corrosive cushion chamber.

C. **Cushion Chamber:** The cushion chamber shall be attached to the side of the valve body externally and be constructed with a piston operating in a chamber that will effectively permit the valve to be operated without any hammering action. The cushioning shall be by oil stored in an oil reservoir attached by piping and fittings to the cushion chamber. The cushion chamber shall be so arranged that the closing speed will be adjustable to meet the service requirements.

D. Manufacturers, or Equal

1. **APCO (Valve and Primer Corporation)**

2. **GA Industries**

2.8 SOLENOID VALVES

A. Solenoid valves shall be of the size, type, and class indicated and shall be designed for not less than 150 psi water-working pressure. Valves for water, air, or gas service shall have brass or bronze body with screwed ends, stainless steel trim and spring, Teflon or other resilient seals with material best suited for the temperature and fluid handled. Unless otherwise indicated, for chemicals and all corrosive fluids, solenoid valves with PVC, CPVC, polypropylene (PP), polyvinylidene fluoride (PVDF), or Teflon materials of construction, suitable for the specific application shall be provided. Enclosures shall be NEMA rated in accordance with the area designations of Section 16050 - Electrical Work, General. All coil ratings shall be for continuous duty. For electrical characteristics see electrical drawings or specifications.

B. Manufacturers, or Equal

1. For general duty

a. Automatic Switch Co. (ASCO), Model "RED HAT"

b. Skinner Valve (Parker Hannifin Corporation)

c. Magnatrol Valve Corporation

d. **J. D. Gould Co.**

2. Metallic valves for corrosive fluids

a. Valcor Engineering Corporation

3. Plastic valves for corrosive fluids

a. +GF+ Plastic Systems, Inc.

b. Spears Mfg. Co.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Backflow preventers shall be installed in potable water lines where required by applicable codes or regulations, and wherever there is any danger of contamination, and where indicated.

B. Valves shall be installed in accordance with the manufacturer's printed recommendations, and with provisions of Section 15200.

C. Backflow preventers, as well as air and vacuum release valves, shall have piped outlets to the nearest acceptable drain, firmly supported, and installed in such a way as to avoid splashing and wetting of floors and obstruction of traffic.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 15235 - FIRE HYDRANTS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide fire hydrants, complete and operable, including all appurtenances and accessories, in accordance with the Contract Documents. This specification covers the dry-barrel as well as the wet-barrel fire hydrant, however, unless otherwise indicated, the dry-barrel hydrant shall be provided.

PART 2 -- PRODUCTS

2.1 DRY-BARREL FIRE HYDRANTS

A. **Construction:** Unless otherwise shown, all hydrants shall be of the dry-barrel type according to ANSI/AWWA C 502, with a minimum of one 4-inch or 4-1/2-inch steamer connection, one 2-1/2-inch hose connection, and a 6-inch diameter inlet, except where otherwise required by the local fire department. The hose and steamer connections shall be provided with cast iron caps and metal chains. The barrel shall have a cast iron breakaway section above ground and a lower barrel of ductile iron, with an elbow or tee-section at the base. The stem shall have a breakaway coupling, or there shall be some other safety device in case of a fracture. Each hydrant shall be isolated by an individual, buried gate valve, with cast iron box and cover. All bolts, nuts, and washers shall be of Type 316 stainless steel, except where otherwise required for structural reasons. The hydrants shall be tested to 300 psig and they shall be suitable for a working pressure of 150 psig. All interior and exterior surfaces shall be coated in accordance with AWWA C 550 and Section 09800 - Protective Coating.

B. Manufacturers, or Equal

1. **American Flow Control (Darling)**

2. **American Valve and Hydrant**

3. **Dresser (M & H Valve Co.)**

4. **East Jordan Iron Works, Inc.**

2.2 WET-BARREL FIRE HYDRANTS

A. **Construction:** Fire hydrants in climates not subject to freezing, where required by the local fire department, or shown, shall be of the wet-barrel type, in accordance with ANSI/AWWA C 503, except where the local standard calls for steel-pipe risers with angle-valves. Wet-barrel fire hydrants shall have the buried section of ductile iron or steel and a breakaway flange connected to the hydrant head. Each hydrant shall be isolated by an individual, buried gate valve with cast iron box and cover. The hydrant head shall have a minimum of one 4-inch or 4-1/2-inch steamer connection and one 2-1/2-inch hose connection, except where otherwise required by the local fire department. The hydrant inlet shall be not less than 6-inch in diameter. The hose and steamer connections shall be provided with cast iron caps and metal chains. All bolts, nuts, and washers shall be of Type 316 stainless steel, unless otherwise required for structural reasons. The hydrants shall be tested to 300 psig and they shall be suitable for a

working pressure of 150 psig. All interior and exterior surfaces shall be coated in accordance with AWWA C 550 and Section 09800 - Protective Coating.

B. Manufacturers, or Equal

1. **Clow (Rich Valve Company)**

2. **James Jones Company (Watts Regulator Co.)**

3. **Mueller Company**

PART 3 -- EXECUTION

3.1 INSTALLATION

A. All fire hydrants shall be installed in strict accordance with the manufacturer's published recommendations, AWWA Standards, and all applicable codes, and the applicable provisions of Section 15200 - Valves, General. All installations shall be to the satisfaction of the local fire and building department.

B. All hydrant isolating valves with slip joints, friction type, or caulked joint connections shall be harnessed to the main pipe by means of welded steel harness sets, or clamps and steel rods, designed for this purpose. All hydrants with other than flanged inlets shall be installed with a concrete thrust block, calculated for the maximum expected water pressure. Dry-Barrel fire hydrants shall be set on a bed of pea gravel not less than 18-inches deep and 3-feet square, for drainage, or as required by local regulations and conditions.

- END OF SECTION -

SECTION 15250 - HYDRAULIC GATES, GENERAL

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide hydraulic gates with appurtenances, complete and operable, in accordance with the Contract Documents.

B. The provisions of this Section shall apply to all flap gates, slide gates, stop gates, sluice gates, and shear gates, except where otherwise indicated in the Contract Documents.

C. The requirements of Section 11000 - Equipment, General apply to this Section.

D. The requirements of Section 15201 - Valve and Gate Actuators apply to this Section.

E. The CONTRACTOR shall assign to a single manufacturer responsibility for furnishing and functional operation of the hydraulic gates including operators and accessories. The designated single manufacturer, however, need not manufacture more than one part of the units but shall coordinate the design, assembly, testing, and installation of the units.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards

AWWA C501	Cast Iron Sluice Gates
AWWA C 513	Open Channel Fabricated Metal Slide Gates
ASTM A 276	Stainless Steel Bars and Shapes
ASTM B 21	Naval Brass Rod, Bar, and Shapes
ASTM B 584	Copper Alloy Sand Castings for General Applications

1.3 CONTRACTOR SUBMITTALS

A. **General**: Furnish submittals in accordance with Section 01300 - Contractor Submittals.

B. **Shop Drawings:** Shop Drawings of all hydraulic gates.

C. **Technical Manuals:** Complete technical manuals, including printed instructions for proper maintenance, lubrication, and complete parts list indicating the various parts by name, number, and exploded view where necessary. A list of recommended spare parts for the GOVERNMENT to store at the facility shall be included

D. **Certification:** The CONTRACTOR shall obtain written certification from the designated single manufacturer, addressed to the GOVERNMENT, stating that the equipment will efficiently and thoroughly perform the required functions in accordance with these Contract Documents, and that the designated single manufacturer accepts the CONTRACTOR's assignment of responsibility for coordination of gate equipment,

including operators, controls, and services required for proper installation and operation. The CONTRACTOR shall submit all such certificates to the CONTRACTING OFFICER.

E. **Field Procedures:** Instructions for field procedures for installation, adjustments, inspection, and testing shall be provided prior to installation of the gates.

1.4 QUALITY ASSURANCE

A. **Equipment Field Testing:** The CONTRACTOR shall be responsible for the coordination of the tests of each hydraulic gate in the presence of the manufacturer's factory service representative. Excessive leaks shall be corrected and the equipment retested until found satisfactory.

1.5 MANUFACTURER'S SERVICE REPRESENTATIVE

A. **Installation and Startup Assistance:** Service and testing assistance by the manufacturer's engineering representative for each gate and valve shall be furnished by the CONTRACTOR during installation and startup.

B. **Instruction of GOVERNMENT's Personnel:** The CONTRACTOR shall arrange for the services of a factory service representative to instruct the **GOVERNMENT**'s personnel in the operation and maintenance of the equipment.

1.6 SPECIAL WARRANTY REQUIREMENT

A. The CONTRACTOR shall furnish the manufacturer's written guarantee that the hydraulic gates comply with these specifications. The CONTRACTOR shall also furnish the manufacturer's warranties as published in its literature.

PART 2 -- PRODUCTS

2.1 GENERAL

A. All equipment provided under this Section shall be new, of current manufacture, and shall be the products of reputable manufacturers specializing in the manufacture of such products and which have had previous experience in such manufacture. The CONTRACTOR shall, upon request, furnish the names of not less than 5 successful installations of the manufacturer's equipment of comparable nature to that offered under this contract.

B. All combinations of manufactured equipment which are provided under these Specifications shall be entirely compatible, and the CONTRACTOR and the manufacturer shall be responsible for the compatible and successful operation of the various components of the units. All necessary mountings and appurtenances shall be included.

2.2 MATERIALS

A. Materials employed in the manufacture and installation of the hydraulic gates and operators shall be suitable for the intended application. Material not specifically called for shall be high-grade, standard commercial quality, free from defects and imperfection that might affect the serviceability of the product for the purpose for which it is intended.

2.3 HARDWARE

A. Bolts and nuts shall comply with Section 05500 - Miscellaneous Metalwork.

2.4 PROTECTIVE COATING

A. Coat ferrous metal in accordance with Section 09800 - Protective Coating

2.5 TOOLS AND SPARE PARTS

A. **Tools:** Furnish special tools necessary for maintenance and repair of the gates. Such tools shall be suitably stored in metal tool boxes and identified with the equipment number by means of stainless steel or solid plastic name tags attached to the box.

B. **Spare Parts:** Furnish the following spare parts in a box as described above for tools, for air or hydraulic actuated gates for each type and size of gate:

1. One set of directional valves, solenoid or pilot actuated

2. One set of cylinder actuator seals

3. One set of filters

4. One repair kit for the hydraulic pump, containing seals or packing, gaskets, and O-rings.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Sluice and shear gates shall be installed in strict accordance with the manufacturer's printed recommendations and the requirements herein. Operators shall be located to avoid interference with handrails and structural members.

B. Shortly before setting each gate, a 1/8-inch thick layer of mastic grade polysulfide elastomeric sealant shall be applied to the back of the gate frame. After setting the gate, the nuts shall be turned down on the anchor bolts just far enough to make them snug and to cause the rubber sealant to begin to ooze out, but not far enough to produce any significant stress to the frame. Excess sealant at the edges shall be removed. The sealant shall be allowed to cure for at least 7 days, after which the anchor bolt nuts shall be tightened to their final positions. If gaskets are being used, they shall be installed over the studs in one piece, or dovetailed and cemented with a liquid-type gasket material.

C. Damage to surface coatings incurred during shipment and/or installation shall be repaired to the satisfaction of the CONTRACTING OFFICER prior to installation.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 15254 - SLIDE/STOP GATES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide slide/stop gates, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 15250 -Hydraulic Gates, General apply to this Section.

1.2 CONTRACTOR SUBMITTALS

A. **General:** Submittals shall be in accordance with Section 01300 - Contractor Submittals.

B. **Shop Drawings:** Submit complete Shop Drawings of gates, frames, slides, and actuators, as well as design load calculations for deflection at the maximum expected head, and calculations for the lifting force generated by 40 pounds effort on the handwheel or crank. to operate the gate.

C. **Certificates**: Factory test certificates

1.3 QUALITY ASSURANCE

A. The leakage allowance for slide gates under the design seating and unseating head shall not exceed 0.1 gpm/ft of seating perimeter or the leakage rate of AWWA C 513, whichever is the most stringent.

B. **Factory Testing**: Gates shall be factory assembled and functional tested prior to delivery to the Site. Test certificates shall be submitted.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Gates shall comply with ANSI/AWWA C513 unless indicated otherwise.

B. Gates shall be new and of current manufacture, and adequately braced to prevent warpage and bending under the intended use.

C. Gate actuators shall be sized, selected, and furnished by the gate manufacturer. All gate actuators on the project shall be products of a single manufacturer.

D. Guide frames shall be extended 3 feet 6 inches above the walkway to match the height of the handrail. Where a gate is mounted in an opening between 2 sections of handrailing, additional horizontal members shall be added to the gate frame to match the handrail, guardrail, and kickplate spacing of the adjacent railing. Horizontal members shall be arranged so that the railing will not interfere with operation of the actuator.

2.2 STAINLESS STEEL SLIDE GATES

A. **Construction:** Unless otherwise indicated, materials of construction shall be in accordance with AWWA C513, suitable for the service. Materials used in the fabrication of the slide gates shall conform to the requirements of the standards designated for each material indicated below:

Description	Material Standards
Stainless Steel Gates	
Slide	ASTM A 276, Type 316, or Type 316 L
Frame	ASTM A 276, Type 316, or Type 316 L
Stem and coupling	ASTM A 276, Type 316
Hardware	ASTM A 276, Type 316
Stem Cover	Aluminum pipe with slots and indicator
Guides and seats	UHMW Polyethylene, ASTM D 4020
Seals	"J" bulb Type, Neoprene, ASTM D 2000. Flat seals not acceptable

B. **Lifting Devices:** Lifting devices shall be provided complete with stem, lifting nut, intermediate supports with steady bushings, stem cover, indicator, gear reducer, hand wheel, crank, electric or hydraulic cylinder, where indicated. Lifting devices shall be weatherproof and shall be mounted on cast-iron or fabricated steel pedestals. The pedestals shall have an ample base or bracket area to evenly distribute the load to the supporting concrete structure. The center line of the manual actuator shall be approximately 3 feet above the base for pedestal mounted, and approximately 4 feet above the floor for frame mounted actuator. Power lifting devices shall be in accordance with Section 15201 – Valve and Gate Actuators. Slide gate hoist heads shall be cast iron. The operating nut shall be of solid bronze, ASTM B 584. Operating thrust shall be taken on roller or ball bearings. All parts shall be provided with an alternate lubrication system. The unit shall be designed for a maximum of 40 lb effort on the crank to operate the gate. Clockwise movement of the handwheel shall close the gate. The operating crank shall be easily removable to facilitate the use of a portable power operator.

C. Manufacturers, or Equal

1. **Rodney Hunt Company**
2. **Hydro Gate Corp.**
3. **Washington Aluminum Company, Inc. (WACO)**
4. **Waterman Industries, Inc.**

2.3 FIBER GLASS SLIDE GATES

A. **Construction:** Fiberglass slide gates shall be constructed of 1/4-inch thick (min) reinforced plastic laminate fiberglass adequately reinforced for the operating hydrostatic pressure. Reinforcing members shall consist of rigid sandwich core construction integrally-molded to provide a smooth vertical surface.

B. **Seals:** Gates shall be provided with “J” bulb type neoprene seals.

C. **Stem:** The gates shall be equipped with Type 316 or other stainless steel lift stems and bronze lift nuts, and stainless steel lift stem extensions and cast iron pedestal.

D. **Guide Frames:** The gates shall have concrete-wall-mounted type guide frames of proper size to allow lifting or lowering of the gates smoothly. The guide frames shall be fiberglass reinforced plastic with factory-bonded corners.

E. **Mounting Hardware:** Mounting hardware, if required, shall be of the size and type recommended by the gate manufacturer and shall be furnished as part of the guide frame.

F. Manufacturers, or Equal

1. **F.B. Leopold Co. (Division of Sybron Corp.)**

2. **Fischer & Porter Company (Warminster).**

1.4 ALUMINUM STOP GATES

A. **Construction:** Wall-mounted, hand-lift stop gates with handles shall be fabricated of 1/4-inch aluminum as indicated and shall be reinforced as necessary to assure long life under the indicated operating conditions. Gates shall be provided with “J” bulb type neoprene seals. Calculations, and detail drawings, as necessary, shall show the method of fabrication and verify that the plates will withstand any normal pressures or forces exerted without buckling or otherwise being damaged. Mounting hardware, if required, shall be of Type 316 stainless steel.

B. Manufacturers, or Equal

1. **F.B. Leopold Co. (Division of Sybron Corp.)**

2. **Washington Aluminum Co., Inc.**

3. **Waterman Industries, Inc.**

2.5 FIBER GLASS STOP GATES

A. Plastic and fiber glass items shall be manufactured with the "matched die-molded method," of material suitable for potable water, and shall be certified for such use on the Shop Drawings. Bolts, anchor bolts, nuts, washers, and supports shall be provided for all plastic and fiber glass items in accordance with the requirements of the manufacturers of the plastic and fiber glass items.

B. **Construction:** Fiber glass stop gates shall be manufactured of blue-green fiber glass reinforced polyester resin laminate material containing ultra-violet radiation deterioration and weathering inhibitors. Each gate shall be molded individually to the exact size required with handhole or T-handle and reinforced with integrally molded stiffeners or sandwich core construction and "J" bulb type neoprene seals. Details, calculations and drawings shall show the method of fabrication and verify that the plates will withstand any normal pressures or forces exerted without buckling or otherwise being damaged. Guide frames shall be of cast fiber glass reinforced polyester resin material, containing

weathering and ultra-violet radiation deterioration inhibitors. Guide frames shall have factory-bonded corners. Mounting hardware, if required, shall be of Type 316 stainless steel.

C. Manufacturers, or Equal

1. **Fischer & Porter (Warminster)**

2. **F. B. Leopold Co., (Division of Sybron Corp.)**

3. **Plasti-Fab, Inc.**

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Slide/stop gates shall be installed in strict accordance with Section 15250.

- END OF SECTION -

SECTION 15256 - SLUICE AND SHEAR GATES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide sluice and shear gates, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 15250 - Hydraulic Gates, General apply to this Section.

1.2 CONTRACTOR SUBMITTALS

A. **General:** Submittals shall be in accordance with Section 01300 - Contractor Submittals.

B. **Shop Drawings:** Submit complete Shop Drawings of gates, frames, slides, and actuators as well as design load calculations for deflection at the maximum expected head, and calculations for the lifting force generated by 40 pounds effort on the hand wheel or crank to lift the gate.

1.3 QUALITY ASSURANCE

A. Leakage criteria for field test

1. Seating Head: Under the seating head, the leakage shall not exceed 0.1 gpm per foot of seating perimeter.

2. Unseating Head

a. Under the unseating head, the leakage for heads of 20 feet or less shall not exceed 0.2 gpm per foot of seating perimeter.

b. For unseating heads greater than 20 feet, the allowable leakage rate shall not exceed the rate per foot of seating perimeter calculated from the equation in AWWA C501.

PART 2 -- PRODUCTS

2.1 CAST IRON SLUICE GATES

A. Gates shall comply with AWWA C513 unless indicated otherwise.

B. Gates shall be new and of current manufacture. They shall be adequately braced to prevent warping and bending under the intended usage.

C. Gate actuators shall be sized, selected, and furnished by the gate manufacturer. All gate actuators on the project shall be products of a single manufacturer.

D. Guide frames shall be extended 3 feet 6 inches above the walkway to match the height of the handrail. Where a gate is mounted in an opening between 2 sections of handrailing, additional horizontal members shall be added to the gate frame to match the

handrail, guardrail, and kickplate spacing of the adjacent railing. Horizontal members shall be arranged so that the railing will not interfere with operation of the actuator.

E. **Construction:** Unless otherwise indicated, materials of construction shall be in accordance with AWWA C501, suitable for the service. Materials used in the fabrication of the slide gates shall conform to the requirements of the standards designated for each material indicated below:

Description	**Material Standards**
Slide	Cast iron, ASTM A 48, Class 30
Frame and guides	Cast iron, ASTM A 48, Class 30
Wall thimble	Cast iron, ASTM A 48, Class 30
Stem and coupling	Stainless steel, ASTM A 276 Type 316
Stem guide bushings	Bronze, ASTM B 584
Flush bottom seals	Elastomeric material, ASTM D 2000
Stem Cover	Aluminum with slots and indicator
Guides and seats	Naval bronze, ASTM B 21, dovetailed to frame and slide
Operating nut	Bronze, ASTM B 584
Hardware	Stainless steel, ASTM A 276 Type 316

F. **Lifting Devices:** Lifting devices shall be provided complete with stem, lifting nut, intermediate supports with steady bushings, stem cover, indicator, gear reducer, hand wheel, crank, electric or hydraulic cylinder where indicated. Lifting devices shall be weatherproof and shall be mounted on cast-iron or fabricated steel pedestals. The pedestals shall have an ample base or bracket area to evenly distribute the load to the supporting concrete structure. The center line of the manual actuator shall be approximately 3 feet above the base for pedestal mounted, and approximately 4 feet above the floor for frame mounted actuator. Power lifting devices shall be in accordance with Section 15201 – Valve and Gate Actuators. Slide gate hoist heads shall be cast iron. The operating nut shall be of solid bronze, ASTM B 584. Operating thrust shall be taken on roller or ball bearings. All parts shall be provided with an alternate lubrication system. The unit shall be designed for a maximum of 40 lb effort on the crank to operate the gate. Clockwise movement of the handwheel shall close the gate. The operating crank shall be easily removable to facilitate the use of a portable power operator.

G. **Wall Thimbles:** Unless otherwise indicated, sluice gates shall be provided with cast iron, F-pattern, wall thimbles to match the thickness of the walls in which they are installed. Thimbles shall be furnished by the manufacturer of the gates and shall fit the bolt dimensions of the gates. Studs shall be of Type 316 stainless steel.

H. **Sealant:** The elastomeric sealant shall be **Rubber Caulk Sealer** as manufactured by **Product Research Company**, Los Angeles, or equal.

H. **Grout:** Gates mounted against concrete walls without wall thimbles shall be installed with one inch of non-shrink grout between the wall and the gate flange.

I. Manufacturers, or Equal

1. Rodney Hunt

2. Hydro Gate Corp.

3. Waterman Industries

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Sluice and shear gates shall be installed in strict accordance with Section 15250.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 15430 - PLUMBING PIPING AND SPECIALTIES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide plumbing piping and specialties, complete and operable, in accordance with the Contract Documents.

1.2 WORKMANSHIP AND MATERIALS

A. All work shall in strict accordance with the Uniform State Plumbing Code, and codes of the State of California, and any other authorities having jurisdiction. The CONTRACTOR shall have required certifications and be thoroughly familiar with the local codes. The CONTRACTOR shall obtain and pay for all necessary permits.

B. Care shall be taken at all times to protect floors, stairways, and walls during the make-up and erection of piping and placing of equipment. The CONTRACTOR shall remove all stains and repair all damage before final acceptance of the WORK.

C. If the CONTRACTING OFFICER finds materials that have identifying marks removed or lack such marks completely, such items will be rejected until the CONTRACTOR has furnished proof that said items conform to the Specifications. Adequacy and extent of such proof will be determined by the CONTRACTING OFFICER.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Plumbing piping, fixtures, specialties, and equipment shall be as recommended by the manufacturer for the intended usage.

B. Floor drains or floor sinks shall be provided for all equipment drains. No equipment drains shall discharge to floor slabs.

2.2 PIPING AND FITTINGS

A. Cast iron sanitary, storm, and vent pipe and fittings shall be manufactured in accordance with and shall meet the requirements of ASTM A 74 - Cast Iron Soil Pipe and Fittings. Dimensions of cast iron soil pipe and fittings shall be as given in Table 2 of ASTM A 74.

B. Hub-Less cast iron soil pipe and fittings with **Clamp-All** type pipe couplings, or equal, shall be used for above ground sanitary, storm, and vent piping where approved for use by local authorities. Hub-Less cast iron soil pipe and fittings shall meet CISPI Standard 301. Pipe couplings shall have high torque capacity and meet FM standard 1680.

C. Copper tubing and fittings for potable and service water 3-inches and smaller shall be Type K copper tube with soldered fittings.

D. Vent piping passing through the roof shall be flashed. Flashing shall extend a minimum 12-inches from the outer surface of the pipe in all directions. Flashing shall be fabricated from 4-pound lead sheet.

2.3 HANGERS, SUPPORTS, AND MISCELLANEOUS METAL WORK

A. **General:** The CONTRACTOR shall provide all necessary hangers and supports. No perforated strap hangers and no wire supports will be permitted. Pipe supports shall be as indicated in Section 15006 - Pipe Supports.

B. Hangers supporting insulated piping shall be sized to fit the pipe plus the insulation. Insulation at support points shall be provided with metal shields to prevent damage to the insulation.

C. Spacing

1. Pipe support spacing for steel and cast iron pipe is given in Section 15006.

2. Copper tube support spacing shall be not more than 6-feet between supports.

D. Rod sizes for pipe hangers shall be as recommended by the hanger manufacturer.

E. Pipe hangers used to support uninsulated copper tube shall be copper or copper plated.

F. Vertical piping shall be supported at the base with fittings made for this purpose or supported from the nearest horizontal member or floor with a riser extension pipe clamp.

G. Anchors that are installed into existing concrete shall be **Grinnel Figure 117, Modern Figure 740**, or equal expansion case inserts. Drill clean holes for insertion of case and patch concrete around hole as required.

H. Continuous slotted concrete inserts, if used, shall be **Crawford Figure 148, Fee & Mason Figure 9000**, or equal. The CONTRACTOR shall provide secondary angle supports between main inserts to handle the loads which can be properly supported by such arrangement.

I. Concrete inserts shall be as indicated in Section 15006. Inserts shall be galvanized.

2.4 PIPE SLEEVES

A. Where pipes pass through floors, sleeves shall extend 3-inches above the finished floor. Where pipes pass through walls, sleeves shall be flush with the wall surface.

B. Sleeves shall be Schedule 40 galvanized steel pipe, one size larger than the pipe passing through, or where pipe is insulated, one size larger than the pipe plus insulation.

C. At exposed wall or ceiling surfaces, the CONTRACTOR shall install a suitable chromium plated brass wall plate approved by the CONTRACTING OFFICER.

2.5 VALVES

A. **General:** Water shut off valves shall be the gate type, except on fixture supply piping where globe valves shall be used.

B. Interior hose valves shall be provided as indicated. The globe valve indicated shall be as given hereinbefore for valves. The hose nipple shown on the detail shall be a female iron pipe thread inlet with hose thread outlet. Hose bibbs shall be one-inch in size.

C. Valves shall be in accordance with the valves specifications.

D. The CONTRACTOR shall provide shutoff valves on cold water piping at entrances to pipe chases and other inaccessible areas and wherever indicated or required to obtain the maximum efficiency for shut-off control on the water system. Shut off valves shall be placed on all hot and cold water connections to equipment and fixtures. Lavatory and sink stops with wheel handle shall be brass with chrome plating. Extra long barrel stops shall be used where supply piping is concealed behind partitions.

E. Valves shall open by turning counterclockwise and shall have suitable handwheels or nuts as required.

2.6 ACCESS DOORS AND COVERS

A. Access doors, where required in ceilings for access to valves, controls, and other equipment, shall be **Karp Assoc., Style DSC-210, Inryco-Milcor, Style AT**, or equal. Doors shall be of sufficient size to allow access but shall be not less than 12-inches by 12-inches. Ceilings with lay-in acoustical tile will not require access panels. Valves and equipment located above ceiling tile shall have a 3/4-inch diameter blue plastic button with a letter "V" set in tile.

B. Floor access covers in unfinished concrete floors not exposed to chemicals shall be galvanized cast iron with a clear opening of not less than 8-inches by 8-inches, and shall be as manufactured by **Alhambra Foundry Company, Model A-2015; Neenah Foundry Co., No.R-6687**, or equal. In traffic or chemical areas, access covers shall be as manufactured by **Alhambra Foundry Company, Model A-1240; Neenah Foundry Co., Model R-1977**, or equal, with clear opening of not less than 10-inches in diameter.

2.7 ROOF DRAINS

A. Roof drains shall have galvanized cast iron drain bodies, threaded outlet, removable locking mushroom aluminum or brass stone strainers, clamping collars with integral gravel guards, receiver, deck clamp, and extension sleeves where required.

B. Manufacturers, or Equal

1. **Josam Mfg. Co., Series 21500**

2. **Jay R. Smith Mfg. Co., Fig. 1010**

3. **Zurn Industries, Inc., Series Z-100**

2.8 FLOOR DRAINS IN CONCRETE FLOORS

A. **General:** Floor drains in concrete floors shall be of cast iron, in the sizes indicated, with sediment buckets. Each floor drain located on an upper floor shall have a clamping collar, with 4-lb sheet lead flashing, 12 inches minimum all around.

B. Manufacturers, or Equal

1. **Josam Mfg. Co., Series 31120**

2. **Jay R. Smith Mfg. Co., Fig. 2350**

3. **Zurn Industries, Inc., Series Z-520-Y**

2.9 FLOOR DRAINS IN CHEMICAL AREAS

A. General: Floor drains in chemical handling areas subject to corrosive liquids shall be made of high silicon content corrosion-resistant cast iron with NO-HUB mechanical joints, in the sizes indicated.

B. Manufacturer, or Equal

1. **Flowserve Corp., Model 5502-CB,** for slab-on-grade drains.

2. **Flowserve Corp., Model 5501-CBF,** for drains on upper floors.

2.10 FLOOR SINKS

A. **General:** Floor sinks shall be 12-inch by 12-inch by 8-inch, of acid-resistant white enameled cast iron, with epoxy-coated, interior aluminum dome strainer, nickel-bronze or acid-resistant full-size, half, or quarter grating as required by the number of indirect wastes, and have a flashing clamp for upper floor locations, only.

B. Manufacturers, or Equal

1. **Josam Mfg. Co., Series 49040**

2. **Jay R. Smith Mfg. Co., 3150 Series**

3. **Zurn Industries, Inc., Series ZN-1806**

2.11 TRAP SEALS AND PRIMERS

A. Where required by code, floor drains and floor sinks connected to the sanitary sewer shall be protected by trap primers connected to the water supply to the nearest plumbing fixture. One half-inch copper tubes shall run from the primers to the traps. Trap primers shall be mounted in accessible locations.

B. Manufacturers, or Equal

1. **Josam Mfg. Co., Model 88250**

2. **Jay R. Smith Mfg. Co., Model 2699**

3. **Zurn Industries, Inc., Model Z-1022**

2.12 CLEANOUTS

A. **General:** Cleanouts shall be heavy plugs with tapered shoulders against caulked lead or heavy brass plugs. Where underground or concealed, cleanouts shall be brought to floor level and to accessible locations with access covers and frames.

B. Manufacturers, or Equal

	Josam Series	J.R. Smith No.	Zurn No.
Exposed Locations	**58500-20**	**4405**	**Z-1440-A**
Underground (finished floors)	**56010/30**	**4143**	**ZN-1400-2**
Walls, Concealed	**58790-20**	**4535**	**ZN-1445-1-A**
Traffic Areas	**56070**	**4240**	**Z-1420-27**

C. Clean outs shall have a minimum diameter of 3-inches.

D. Stack cleanouts shall be installed at the base of each stack. Cleanouts shall be galvanized cast iron with ABS plastic cleanout plugs.

2.13 HOSE BIBBS AND HYDRANTS

A. **General:** Hose bibbs and hydrants in exposed locations subject to freezing shall be the non-freeze type. Hose bibbs connected to a non-potable water supply shall be provided with plastic or stainless-steel warning signs reading "DO NOT DRINK" in clearly legible letters, permanently attached at the hose bibb. Where indicated, hose bibbs shall be provided with vacuum breakers as furnished by **Crane Co., American Standard**, or equal.

B. Manufacturers, or Equal

Drawing Callout	Fixture Type	Description
HB-1	Non-freeze Post-type	Exposed bronze hydrant, post-type, depth of bury to suit local conditions; minimum 4-feet. **Woodford Manufacturing Co., Model Iowa Y1**
HB-2	Non-freeze wall-type	Heavy duty bronze hydrant with nickel-bronze face, hinged cover, recessed box, and key. Length to suit wall. 1. **Josam Mfg. Co., Series 71000** 2. **Jay 5. Smith Mfg. Co., Fig. 5510/5511** 3. **Zurn Industries, Inc., Fig. Z-1300.**
HB-3	Hose valves	Heavy duty bronze hydrant, with composition disc, handwheel, cap and chain. Sizes 1-1/2 inch and 2-1/2 inch: 1. **Fire-End and Croker Corp, Model 180** Size 1-inch, without cap and chain: 1. **Apollo (Conbraco Industries,**

		Inc.) **Model 70-805** 2. **Fire-End and Croker Corp, Model 180**

2.14 WALL-MOUNTED HOSE RACKS

A. The CONTRACTOR shall provide wall-mounted hose racks at locations indicated. Racks shall be all welded steel construction, of minimum 8-gauge sheet steel, hot-dip galvanized after fabrication, and shall have a capacity to hold 100-feet of the hose indicated below. Racks located in the open shall be supported from two 2 by 2 by 1/4-inch galvanized steel angle posts set in a concrete base or as indicated.

2.15 HOSES AND NOZZLES

A. The CONTRACTOR shall furnish the following lengths of hose:

Six - 75 ft lengths of one-inch hose

B. Each length of hose shall be provided with male and female connectors and nozzle. Hoses shall be seamless extruded rubber with dacron cotton exterior designed for a working pressure of at least 200 psi.

C. Nozzles shall be capable of complete shut-off and shall produce a solid straight stream and up to a 90-degree conical fog. Nozzle material shall be polished brass. Nozzles shall have rubber bumpers.

D. Nozzle Manufacturers, or Equal

1. **W.D. Allen Mfg. Co.**

2. **Fire-End and Croker Corp.**

3. **Halprin Supply Co.**

4. **Western Fire Equipment Co.**

2.16 BACKFLOW PREVENTER

A. Provide reduced pressure backflow prevention units where indicated. The units shall be bronze body construction, with celcon check seats and stainless steel relief valve seats, shafts, and bolts. The units shall have tight seating check valve and relief assemblies, and bronze bodies with non rising stem ball valve test cocks. The units shall be **No. 909 series** as manufactured by **Watts Regulator Co.; Febco;** or equal. Installation shall meet all local code requirements.

2.17 PAINTING

A. All ferrous metal, except finished, galvanized and machine surfaces, shall have surfaces prepared and primed in the shop in accordance with the requirements of Section 09900 -

Architectural Finishes. Prime colors shall be compatible with finish coats to be applied in the field.

B. Self contained units such as wall-mounted hose racks shall be supplied with factory applied finish coats of baked enamel.

C. Field painting shall comply with Section 09900 - Architectural Finishes.

PART 3 -- EXECUTION

3.1 PREPARATION

A. The CONTRACTOR shall coordinate roughing-in with provisions for wall-and floor sleeves, pipe inserts, cutting of roof and floor penetrations so that drain lines will have the required invert elevations and slopes.

3.2 OPENINGS

A. The CONTRACTOR shall provide all necessary openings in walls, floors, and roofs for the passage of piping and plumbing equipment within and into the buildings. Openings shall be as indicated or as required to provide passage for the plumbing WORK.

3.3 INSTALLATION AND APPLICATION

A. The CONTRACTOR shall provide plumbing specialties in accordance with manufacturer's printed instructions.

B. Pipe shall be arranged in a neat and orderly manner to occupy the minimum amount of space and so that the pipe will not obstruct passageways and movement of building occupants or interfere with normal operation and maintenance of any equipment.

C. Pipe shall be carefully placed and properly sloped and shall be neatly and firmly supported by hangers or supports.

D. Piping in buildings shall be as close to the ceilings or walls as possible unless indicated otherwise.

E. Screwed joints shall be made with joint compound and be tight and leakproof. A sufficient number of brass to ferrous metal seat unions shall be placed in lines so that any pipe, valve, or piece of equipment may be easily disconnected.

F. Drainage and sanitary lines shall be properly run, trapped, and vented to conform with Code requirements. Changes in direction shall be made with "Y" branch fittings and shall be of the same size as the pipe. Changes in pipe size shall be made with reducing fittings. Minimum depth of cover shall be 3-feet.

G. Horizontal soil, drain, and waste pipes shall be given a slope of at least 1/4-inch per foot unless indicated otherwise.

H. Floor drains and cleanouts shall be installed so the tops of the drains are flush with the finished floor.

I. Plug each natural gas outlet, including valves, with a threaded plug or cap immediately after installation and retain the plugs until continuing piping or equipment connections are completed.

J. Joints in PE pipe shall be installed so that the longitudinal pull out resistance of each joint is at least equal to the tensile strength of the pipe

3.4 EQUIPMENT - DAMAGE AND REMOVAL

A. The CONTRACTOR'S operations shall be carried out in such a manner as to guard against damage to those portions of the structure and equipment which are to remain in the finished WORK. Any damage caused by the CONTRACTOR or subcontractor through their operations shall be repaired to the satisfaction of the CONTRACTING OFFICER.

3.5 TESTING

A. CONTRACTOR shall make such tests as are required by local ordinances and codes in the presence of a local governing authority inspector to show that piping is tight, leak free, and satisfactory, and shall also perform such tests as the CONTRACTING OFFICER may direct to insure that all fixtures and equipment operate properly. The CONTRACTOR shall pay all costs in making such tests and the costs of making all changes or repairs until the WORK is acceptable to the governing authorities.

3.6 DISINFECTION

A. After potable water supply lines are tested, they shall be disinfected by introducing HTH solution, liquid chlorine, or chlorine solution of sufficient strength. Then the line shall be filled with water and maintained under not less than 10 psi pressure, for not less than 48 hours, during which period all valves on the lines shall be opened and closed several times, after which it shall be flushed clean, and then tested by the GOVERNMENT. This procedure shall be repeated as often as necessary until the line is pronounced safe for use by the GOVERNMENT. No cross connection between the water mains and any pipe not yet disinfected will be permitted.

- END OF SECTION -

SECTION 15440 - PLUMBING FIXTURES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide plumbing fixtures, complete and operable, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01300 - Contractor Submittals.

B. **Shop Drawings:** Show complete details of the plumbing fixtures provided.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Plumbing piping, fixtures, specialties, and equipment shall be of the latest design, new, first-quality products, manufactured for the intended usage, and shall be compatible with elements of related or connected WORK.

B. Plumbing fixtures shall be without flaws and with white finish unless otherwise indicated. Exposed brass, faucets, valves, wastes, traps, piping, and escutcheons shall be chrome-plated. Each fixture shall be provided with individual stops and shall be anchored firmly to the building wall or floor.

2.2 FIXTURE SCHEDULE

Dwg. Callout	Fixture Type	Description
DS-2	Drench Shower (non-freeze type with eye wash and independent operated valves)	Emergency drench showers located in exposed areas outside of buildings subject to freezing with shower head, manual valve, eye wash and 1-1/4-inch supply shall be **HAWS Model No. 8300FP**; **Bradley Corp., Model S19-310NN;** or equal.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Each fixture shall be installed with trap, easily removable for servicing and cleaning, and be vented in accordance with the applicable plumbing code.

B. The CONTRACTOR shall provide chrome-plated rigid or flexible supplies to fixtures with angle stops, reducers, and escutcheons.

C. All components shall be installed level and plumb. Supplies and wastes shall be centered on or between the wall tiles.

D. All fixtures shall be installed and secured in place with [wall supports] [wall carriers][floor carriers] and bolts.

E. Fixtures shall be sealed to wall and floor surfaces with sealant as indicated in Section 07920-Sealants and Caulking. Color shall match fixture.

F. All fixtures shall be mounted to the following heights above finished floor:

Emergency Eye And Face Wash:

Standard	38 in.	(965 mm) to receptor rim

3.2 ADJUSTING AND CLEANING

A. Stops or valves shall be adjusted for intended water flow rate to fixtures without splashing, noise, or overflow.

B. At completion, the CONTRACTOR shall clean all plumbing fixtures and equipment.

- END OF SECTION -

SECTION 15500 - HEATING, VENTILATING, AND AIR CONDITIONING

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide air conditioning systems, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 11000 - Equipment General Provisions apply to the WORK of this Section.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. All WORK shall be in full accordance with the latest rules and regulations or publications of the State Energy Resources Conservation and Development Commission, the State Fire Marshall, the Industrial Safety Orders, the Health and Safety Rules (Air Conditioning Systems), the local Plumbing Code, the local Building Code, Fire Code, and all other local codes. Nothing in the Contract Documents shall be construed to permit WORK in violation of the above codes, rules, and regulations. In the absence of applicable codes, installation and workmanship shall follow the standards set by the American Society of Heating, Refrigeration, and Air Conditioning Engineers.

1.3 CONTRACTOR SUBMITTALS

A. Submit Shop Drawings in accordance with Section 01300 - Contractor Submittals.

B. **Equipment Numbers:** Equipment is identified by number code for reference and location purposes in the Contract Documents. The appropriate equipment numbers shall be included on the Shop Drawings and on other submittals.

1.4 WARRANTY

A. All equipment shall carry the manufacturer's standard warranty, and all such warranties shall be furnished to the CONTRACTING OFFICER before final acceptance. Reciprocating refrigerant compressors shall carry 5-year warranties by the manufacturers.

PART 2 -- PRODUCTS

2.1 GENERAL

A. **Quality:** All mechanisms and parts shall be amply proportioned for the stresses which may occur during operation and during fabrication and installation. Individual parts which are alike in all units shall be alike in materials workmanship, design and materials and shall be of the manufacturer's top of the line, industrial-commercial grade.

B. **Supports:** Equipment and appurtenances shall be firmly anchored or connected to supporting members. Supports required for the proper installation of the equipment, but not forming an integral part of the building structure, shall be provided by the heating and ventilating subcontractor, unless otherwise indicated. Equipment shall be supported on restrained spring-type vibration isolators.

C. **Noise/Vibration Control:** The system shall be free of any objectionable vibrations and noise. Flexible connections shall be provided in all ducts and piping connections to fans, compressors, and any other vibrating equipment.

D. **Electric Motors:** Electric motors shall be provided in accordance with Section 16460 - Electric Motors.

2.2 DUCTWORK AND MISCELLANEOUS ACCESSORIES

A. **Construction:** Sheet metal ducts and plenums shall be constructed with airtight joints and seams in accordance with ASHRAE standards and SMACNA Duct Construction Manual. Joints on concealed ducts shall be taped with pressureless tape and adhesive, except welded or soldered joints. Ductwork materials shall be galvanized steel or aluminum, unless otherwise indicated. Minimum duct gauges are as follows:

Maximum Dimension of Duct (inches)	Galvanized Steel U.S. Standard Gauge	Aluminum B and S Gauge
12 and less	26	24
13 through 30	24	22

B. Supports

1. Supports for horizontal ducts and plenums shall be galvanized steel angles with hanger rods. Band iron straps shall be allowed for duct sizes recommended by SMACNA. Supports for vertical ducts shall be band iron strap or angle bracket type. Inlet ducts shall be amply braced to withstand maximum negative pressure.

2. Seismic Restraints: Duct supports and restraints shall be designed for static, dynamic, and seismic loads in zone 4 per the Uniform Building Code. Seismic restraints shall not induce stresses in the ductwork caused by thermal expansion and contraction.

C. **Bird Screens:** Removable bird screens shall be provided on all outside air intakes and exhaust air discharges to outside air. Screens shall be secured in frames made from the same metal as the screens. Bird screens shall be 1/2-inch mesh by 14-gauge and shall be of same material and finish as duct, hood, louver, or equipment to which the screens are attached.

D. **Flexible Connectors:** Flexible duct connections shall be made with banded or flanged 8-oz canvas, reinforced plastic, or equal at each point where a blower unit is connected to a duct. A minimum clearance of 3 inches between the duct and source of vibration shall be maintained.

E. **Diffusers, Grilles, and Registers:** Supply air registers and diffusers, return air, and exhaust grilles shall be of aluminum construction with smooth corners, flanges, and sponge rubber gaskets. Supply and return air registers and diffusers shall have individually adjustable blades and volume control dampers. Ceiling-mounted outlets shall be off-white. Wall-mounted outlets shall be factory prime-coated. Terminals shall be **Titus**, **Agitair**, **Krueger**, or equal.

2.3 CONTROLS

A. **General:** Air conditioning equipment shall be provided with thermostats control systems as indicated. Room thermostats shall be digital type with cooling setpoints. Adjustment shall be by pressing the thermostat up or down arrows. Setpoints shall be adjustable from 60 to 95 degrees for room return air. An insulating back shall be provided where exterior wall mounting is indicated. Control system components and thermostats shall be as manufactured by **Honeywell, Johnson Controls Company, General Controls**, or equal

2.4 FANS

A. **General:** Location, type, capacity, and motor horsepower shall be as indicated. Fans shall be complete with motors, adjustable motor bases, adjustable drives, safety cages, belt guards, flexible connections to supply and/or suction ducts, vibration isolators, and necessary accessories. All fans shall be suitable for continuous operation.

B. **Performance:** Fans shall be guaranteed to deliver the quantities of standard air against the respective static pressure without deviating by more than 5 percent. Every fan wheel, regardless of size, shall be statically and dynamically balanced and shall be free from objectionable vibration or noises.

2.5 AIR CONDITIONERS

A. Air conditioning units shall be of single package type, wall-mounted, factory-assembled, precharged, prewired, tested and ready-to-operate design as indicated. The cabinet shall be single, enclosed, weatherproof heavy galvanized casing construction integral with full length side mounting brackets. Each exterior casing panel shall be finished with baked-on exterior polyester enamel paint. Top panel of the unit shall be sloped away from building to provide rain hood protection and shall include top rain flashing to minimize water leaks. Drain pans shall have galvanized steel or copper drain lines connected to the nearest floor sink or drain in accordance with the applicable Plumbing Code. The air conditioners shall be equipped with built-in economizer system with built-in exhaust air damper and low ambient control for operation down to 20 degree F. Units shall be controlled from cooling room-thermostats as indicated. Air conditioners shall be as manufactured by BARD – 6 Ton unit**,** or equal. See equipment schedule in drawings for the air conditioning system

B. Air conditioners shall be provided with filter compartments. Filters shall be of the one-inch washable filter and 2-inch pleated filter.

PART 3 -- EXECUTION

3.1 GENERAL

A. **Roughing-In:** The CONTRACTOR shall ascertain that all inserts, chassis, shafts, and openings are correctly located; if not, cut new openings as part of the WORK.

B. **Checking:** The CONTRACTOR shall test and tighten all WORK, furnish all equipment necessary to carry out the tests, and thoroughly clean the system before startup.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 16050 – ELECTRICAL WORK, GENERAL

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide electrical work, complete and operable, in accordance with the Contract Documents.

B. The provisions of this Section apply to all sections in Division 16, except as indicated otherwise.

C. The WORK of this Section is required for operation of electrically-driven equipment provided under specifications in other Divisions. The CONTRACTOR's attention is directed to the requirement for proper coordination of the WORK of this Section with the WORK of equipment specifications, the WORK of instrumentation sections, and the WORK of Section 16460 - Electric Motors.

D. Concrete, excavation, backfill, and steel reinforcement required for encasement, installation, or construction of the WORK of the various sections of Division 16 is included as a part of the WORK under the respective sections, including duct banks, manholes, handholes, equipment housekeeping pads, and light pole bases.

1.2 REFERENCE STANDARDS

A. The WORK of this Section and all sections in Division 16 shall comply with the following as applicable:

NEC (NFPA 70)	National Electrical Code
NETA	International Electrical Testing Association
NEMA 250	Enclosure for Electrical Equipment (1000 Volts Maximum)
Title 8, Subchapter 5, California Administrative Code	Electrical Safety Orders

B. Electrical equipment shall be listed by and shall bear the label of Underwriters' Laboratories, Inc. (UL) or an independent testing laboratory acceptable to the local code enforcement agency having jurisdiction.

C. Installation of electrical equipment and materials shall comply with OSHA Safety and Health Standards (29 CFR 1910 and 29 FR 1926, as applicable), state building standards, and applicable local codes and regulations.

D. Where the requirements of the specifications conflict with UL, NEMA, NFPA, or other applicable standards, the more stringent requirements shall govern.

1.3 SIGNAGE

A. Local Disconnect Switches

1. Each local disconnect switch for motors and equipment shall be legibly marked to indicate its purpose unless the purpose is indicated by the location and arrangement.

B. Warning Signs

1. 600 volts nominal, or less. – Entrances to rooms and other guarded locations that contain live parts shall be marked with conspicuous signs prohibiting unqualified persons to enter.

2. Over 600 volts – All buildings, room or enclosures containing exposed live parts or exposed conductors operating at over 600 volts nominal shall be lockable. Permanent and conspicuous warning signs shall be provided reading as follows: DANGER – HIGH VOLTAGE – KEEP OUT.

3. Indoor electrical installations that are open to unqualified persons and containing metal – enclosed switchgear, unit substations, transformers, and other similar associated equipment over 600 volts nominal shall be marked with appropriate caution signs.

4. Outside branch circuits and feeders – Over 600 volts – Warning signs shall be posted in plain view where unauthorized persons might come in contact with live parts – "WARNING – HIGH VOLTAGE – KEEP OUT"

C. Isolating Switches – Isolating switches not interlocked with an approved circuit interrupting device shall be provided with a sign warning against opening them under load.

1.4 PUBLIC UTILITIES REQUIREMENTS

A. The CONTRACTOR shall contact the serving utility and verify compliance with requirements before construction. The CONTRACTOR shall coordinate schedules and payments for work by all utilities.

B. Electrical service shall be as indicated and be as required by the serving utility.

C. The CONTRACTOR shall verify and provide all service conduits, fittings, transformer pad, grounding devices, and all service wires not provided by the serving utility.

D. The CONTRACTOR shall verify with the utility the exact location of each service point and type of service, and shall pay all charges levied by the serving utilities as part of the WORK.

1.5 PERMITS AND INSPECTION

A. Permits shall be obtained and inspection fees shall be paid according to Section 00700 - General Conditions

B. The CONTRACTOR shall pay all connection and turn-on service charges required by the utility company.

1.6 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01300 - Contractor Submittals.

B. **Shop Drawings:** Include the following:

1. Complete material lists stating manufacturer and brand name of each item or class of material.

2. Shop Drawings for all grounding WORK not specifically indicated.

3. Front, side, rear elevations, and top views with dimensional data.

4. Location of conduit entrances and access plates.

5. Component data.

6. Connection diagrams, terminal numbers, internal wiring diagrams, conductor size, and cable numbers.

7. Method of anchoring, seismic requirements, weight.

8. Types of materials and finish.

9. Nameplates.

10. Temperature limitations, as applicable.

11. Voltage requirement, phase, and current, as applicable.

12. Front and rear access requirements.

13. Test reports.

14. Grounding requirements.

15. Catalog cuts or photocopies of applicable pages of bulletins or brochures for mass produced, non-custom manufactured material. Catalog data sheets shall be stamped to indicate the project name, applicable Section and paragraph, model number, and options. This information shall be marked in spaces designated for such data in the CONTRACTING OFFICER's stamp.

C. Shop Drawings shall be custom prepared. Drawings or data indicating "optional" or "as required" equipment are not acceptable. Options not proposed shall be crossed out or deleted from Shop Drawings.

D. **Materials and Equipment Schedules:** The CONTRACTOR shall deliver to the CONTRACTING OFFICER within 30 days of the commencement date in the Notice to Proceed, a complete list of all materials, equipment, apparatus, and fixtures proposed for use. The list shall include type, sizes, names of manufacturers, catalog numbers, and such other information required to identify the items.

E. **Owner's Manuals:** Complete information in accordance with Section 01300.

F. **Record Drawings:** The CONTRACTOR shall show invert and top elevations and routing of all duct banks and concealed below-grade electrical installations. Record drawings shall be prepared, be available to the CONTRACTING OFFICER, and be submitted according to Section 01300.

1.7 AREA DESIGNATIONS

A. General

1. Raceway system enclosures shall comply with Section 16110 - Electrical Raceway Systems.

2. Electric WORK specifically indicated in sections within any of the Specifications shall comply with those requirements.

3. Other electrical WORK not included in 1.7A1 and 1.7A2 shall comply with this Paragraph 1.7A3.

4. Electrical WORK not included in 1.7A1, 1.7A2, or 1.7A3 shall be NEMA 4X.

5. Installations in hazardous locations shall conform strictly to the requirements of the Class, Group, and Division indicated.

B. Material Requirements

1. In chlorine and hydrofluosilicic (HFS) acid areas, sealing fittings shall be provided.

2. NEMA 4X enclosures shall be 304 stainless steel except in chlorine and HFS areas where non-metallic enclosures shall be provided (applicable to outdoor electrical enclosures).

3. NEMA 7 enclosures shall be cast aluminum where used with aluminum conduit; cast iron when used with galvanized steel conduit.

4. NEMA 1, 3R, and 12 enclosures shall be steel coated with ANSI 61 grey paint. NEMA 4X, 7, and 9 shall not be coated.

1.8 TESTS

A. The CONTRACTOR shall be responsible for factory and field tests required by specifications in Division 16 and by the CONTRACTING OFFICER or other authorities having jurisdiction. The CONTRACTOR shall furnish necessary testing equipment and pay costs of tests, including all replacement parts and labor, due to damage resulting from damaged equipment or from testing and correction of faulty installation.

B. Where test reports are indicated, proof of design test reports for mass-produced equipment shall be submitted with the Shop Drawings, and factory performance test reports for custom-manufactured equipment shall be submitted and be approved prior to shipment. Field test reports shall be submitted for review prior to Substantial Completion.

C. Equipment or material which fails a test shall be removed and replaced.

1.9 CONSTRUCTION SEQUENCING

A. Continuance of plant operation during the expansion process is critical. Therefore, CONTRACTOR shall carefully examine all work to be done in, on, or adjacent to existing equipment. Work shall be scheduled, subject to GOVERNMENT's approval, to minimize required plant shutdown time. The CONTRACTOR shall submit a written request, including sequence and duration of activities to be performed during plant shutdown.

B. All switching, safety tagging, etc., required for plant shutdown or to isolate existing equipment shall be performed by the GOVERNMENT. In no case shall the CONTRACTOR begin any work in, on, or adjacent to existing equipment without written authorization by the CONTRACTING OFFICER.

C. The CONTRACTOR shall make all modifications or alterations to existing electrical facilities required to successfully install and integrate the new electrical equipment as indicated. Modifications to existing equipment, panels, or cabinets shall be made in a professional manner with all coatings repaired to match existing. The costs for modifications to existing electrical facilities required for a complete and operating system shall be included in the CONTRACTOR's original bid amount and no additional payment for this WORK will be authorized. Extreme caution shall be exercised by the CONTRACTOR in digging trenches in order not to damage existing underground utilities. Cost of repairs of damages caused during construction shall be the CONTRACTOR's responsibility without any additional compensation from the GOVERNMENT.

D. The CONTRACTOR shall be responsible for identifying available existing circuit breakers in lighting panels for the intended use as required by the Drawings. CONTRACTOR shall also be responsible for field verifying the available space in substation switchboards to integrate new power circuit breakers. Costs for this WORK shall be included in the CONTRACTOR's original bid amount.

E. The CONTRACTOR shall visit the Site before submitting a bid to better acquaint itself with the WORK of this Contract. Lack of knowledge will not be accepted as a reason for granting extra compensation to perform the WORK.

F. Installation of Temporary Equipment

1. To facilitate continuous operation of existing equipment, the CONTRACTOR shall be required to provide the temporary equipment indicated. The CONTRACTOR shall submit installation and connection details for review and acceptance by the CONTRACTING OFFICER. Costs associated with these temporary installations shall be part of the original Bid.

2. Temporary wiring and equipment shall remain the property of the CONTRACTOR unless indicated otherwise.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Equipment and materials shall be new, shall be listed by UL, and shall bear the UL label where UL requirements apply. Equipment and materials shall be the products of experienced and reputable manufacturers in the industry. Similar items in the WORK shall be products of the same manufacturer. Equipment and materials shall be of industrial grade standard of construction.

B. Where a NEMA enclosure type is indicated in a non-hazardous location, the CONTRACTOR shall utilize that type of enclosure, despite the fact that certain modifications such as cutouts for control devices may negate the NEMA rating.

C. On devices indicated to display dates, the year shall be displayed as 4 digits.

2.2 MOUNTING HARDWARE

A. Miscellaneous Hardware

1. Nuts, bolts, and washers shall be stainless steel.

2. Threaded rods for trapeze supports shall be continuous threaded, galvanized steel, 3/8-inch diameter minimum.

3. Strut for mounting of conduits and equipment shall be galvanized steel. Where contact with concrete or dissimilar metals may cause galvanic corrosion, suitable non-metallic insulators shall be utilized to prevent such corrosion. Strut shall be as manufactured by **Unistrut, B-Line**, or equal.

4. Anchors for attaching equipment to concrete walls, floors and ceilings shall be stainless steel expansion anchors, such as **"Rawl-Bolt," "Rawl-Stud"** or **"Lok-Bolt"** as manufactured by **Rawl;** similar by **Star,** or equal. Wood plugs shall not be permitted.

2.3 ELECTRICAL IDENTIFICATION

A. **Nameplates:** Nameplates shall be fabricated from white-letter, black-face laminated plastic engraving stock, **Formica type ES-1,** or equal. Each shall be fastened securely, using fasteners of brass, cadmium plated steel, or stainless steel, screwed into inserts or tapped holes, as required. Engraved characters shall be block style with no characters smaller than 1/8-inch high.

B. **Conductor and Equipment Identification:** Conductor and equipment identification devices shall be either imprinted plastic-coated cloth marking devices such as manufactured by **Brady, Thomas & Betts,** or equal, or shall be heat-shrink plastic tubing, imprinted split-sleeve markers cemented in place, or equal.

PART 3 -- EXECUTION

3.1 GENERAL

A. **Incidentals:** The CONTRACTOR shall provide all materials and incidentals required for a complete and operable system, even if not required explicitly by the Specifications or the Drawings. Typical incidentals are terminal lugs not furnished with vendor supplied equipment, compression connectors for cables, splices, junction and terminal boxes, and control wiring required by vendor furnished equipment to connect with other equipment indicated in the Contract Documents.

B. **Field Control of Location and Arrangement:** The Drawings diagrammatically indicate the desired location and arrangement of outlets, conduit runs, equipment, and other items. Exact locations shall be determined by the CONTRACTOR in the field based on the physical size and arrangement of equipment, finished elevations, and other obstructions. Locations on the Drawings, however, shall be followed as closely as possible.

1. Where conduit development drawings or "home runs" are shown, the CONTRACTOR shall route the conduits in accordance with the indicated installation requirements. Routings shall be exposed or encased as indicated, except that conduit in finished areas shall be concealed unless specifically indicated otherwise. Conduits encased in a slab shall be sized for conduit OD to not exceed one-third of the slab thickness and be laid out and spaced to not impede concrete flow.

2. Conduit and equipment shall be installed in such a manner as to avoid all obstructions and to preserve head room and keep openings and passageways clear. Lighting fixtures, switches, convenience outlets, and similar items shall be located within finished rooms as indicated. Where the Drawings do not indicate exact locations, such locations shall be determined by the CONTRACTING OFFICER. If equipment is installed without instruction and must be moved, it shall be moved without additional cost to the GOVERNMENT. Lighting fixture locations shall be adjusted slightly to avoid obstructions and to minimize shadows.

3. Wherever conduits and wiring for lighting and receptacles are not indicated, it shall be the CONTRACTOR'S responsibility to provide all lighting and receptacle-related conduits and wiring as required, based on the actual installed fixture layout and the circuit designations as indicated. Wiring shall be #12 AWG minimum, and conduits shall be 3/4-inch minimum (exposed) and 1-inch minimum (encased). Where circuits are combined in the same raceway, the CONTRACTOR shall derate conductor ampacities in accordance with NEC requirements.

C. **Workmanship:** Materials and equipment shall be installed in strict accordance with printed recommendations of the manufacturer. Installation shall be accomplished by workers skilled in the work. Installation shall be coordinated in the field with other trades to avoid interferences.

D. **Protection of Equipment and Materials:** The CONTRACTOR shall fully protect materials and equipment against damage from any cause. Materials and equipment, both in storage and during construction, shall be covered in such a manner that no finished surfaces will be damaged, marred, or splattered with water, foam, plaster, or paint. Moving parts shall be kept clean and dry. The CONTRACTOR shall replace or refinish damaged materials or equipment, including face plates of panels and switchboard sections as part of the WORK.

E. The CONTRACTOR shall provide power wiring in conduit for the HVAC equipment in accordance with Section 15500 - Heating, Ventilating, and Air Conditioning. Starters shall be in accordance with Section 16480 - Low Voltage Motor Control Center, for starters in MCC's and Section 16485 - Local Control Stations and Miscellaneous Electrical Devices, for starters not in MCC's, except for starters in HVAC equipment which are indicated in Section 15500. Control wiring operating at 120 volts and less shall be as indicated in Section 15500.

3.2 CORE DRILLING

A. The CONTRACTOR shall perform core drilling required for installation of raceways through concrete walls and floors. Locations of floor penetrations, as may be required, shall be based on field conditions. Verify all exact core drilling locations based on equipment actually furnished as well as exact field placement. To the extent possible, identify the existence and locations of encased raceways and other piping in existing walls and floors with the GOVERNMENT prior to any core drilling activities. Damage to any encased conduits, wiring, and piping shall be repaired as part of the WORK.

3.3 CONCRETE HOUSEKEEPING PADS

A. Concrete housekeeping pads shall be provided for indoor floor standing electrical equipment. Housekeeping pads for equipment, including future units, shall be 4 inches above surrounding finished floor or grade and 2 inches larger in both dimensions than the equipment, unless otherwise indicated.

B. Concrete housekeeping curbs shall be provided for all conduit stub-ups in indoor locations that are not concealed by equipment enclosures. Such curbing shall be 3-inches above finished floor or grade.

3.4 EQUIPMENT ANCHORING

A. Floor supported, wall, or ceiling hung equipment and conductors shall be anchored in place by methods that will meet seismic requirements in the area where the project is located. Wall-mounted panels that weigh more than 500 pounds or which are within 18 inches of the floor shall be provided with fabricated steel support pedestals. If the supported equipment is a panel or cabinet enclosed within removable side plates, it shall match supported equipment in physical appearance and dimensions. Transformers hung from 4-inch stud walls and weighing more than 300 pounds shall have auxiliary floor supports.

B. Leveling channels anchored to the concrete pad shall be provided for switchgear and pad-mounted transformer installations.

C. Anchoring methods and leveling criteria in the printed recommendations of the equipment manufacturers are a part of the WORK of this Contract. Such recommendations shall be submitted as Shop Drawings under Section 01300.

3.5 EQUIPMENT IDENTIFICATION

A. **General:** Equipment and devices shall be identified as follows:

1. Nameplates shall be provided for all panelboards, control and instrumentation panels, starters, switches, and pushbutton stations. In addition to nameplates, control devices shall be equipped with standard collar-type legend plates.

2. Control devices within enclosures shall be identified as indicated. Identification shall be similar to the subparagraph above.

3. Toggle switches which control loads out of sight of switch and all multi-switch locations of more than 2 switches shall have suitable inscribed finish plates.

4. Equipment names and tag numbers, where indicated on the Drawings, shall be utilized on all nameplates.

5. The CONTRACTOR shall furnish typewritten circuit directories for panelboards; circuit directory shall accurately reflect the outlets connected to each circuit.

3.6 CLEANING

A. Before final acceptance, the electrical WORK shall be thoroughly cleaned. Exposed parts shall be thoroughly clean of cement, plaster, and other materials. Oil and grease spots shall be removed with a non-flammable cleaning solvent. Such surfaces shall be carefully wiped and all cracks and corners scraped out. Touch-up paint shall be applied to scratches on panels and cabinets. Electrical cabinets or enclosures shall be vacuum-cleaned.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 16110 - ELECTRICAL RACEWAY SYSTEMS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide electrical raceway systems, complete and in place, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Sections 01300 - Contractor Submittals, and 16050 - Electrical Work, General.

B. Shop Drawings

1. Complete catalog cuts of all raceways, fittings, boxes, supports, and mounting hardware, marked where applicable to show proposed materials and finishes.

2. Dimensioned layout drawings of all cable tray routings, including elevations.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Pull and junction boxes, fittings, and other indicated enclosures that are dedicated to the raceway system shall comply with this Section.

2.2 CONDUIT

A. Rigid Aluminum (RAL) Conduits

1. Rigid aluminum conduit shall be manufactured of 6063 alloy, temper T-1.

2. Rigid aluminum conduit shall be manufactured in accordance with ANSI C80.5 - Rigid Aluminum Conduit, and UL-6 - Rigid Metal Electrical Conduit.

3. Manufacturers, or Equal

a. **V.A.W. of America**

b. **Alcoa**

B. Rigid Galvanized Steel (RGS) Conduit

1. Rigid steel conduit shall be mild steel, hot-dip galvanized inside and out.

2. Rigid steel conduit shall be manufactured in accordance with ANSI C80.1 - Rigid Steel Conduit, Zinc Coated, and UL-6.

3. Manufacturers, or Equal

a. **LTV Steel**

b. **Triangle**

c. **Wheatland Tube**

C. Rigid Non-Metallic Conduit

1. Rigid non-metallic conduit shall be Schedule 40 PVC, sunlight resistant.

2. Rigid non-metallic conduit shall be manufactured in accordance with NEMA TC-2 - Electrical Plastic Tubing and Conduit, and UL-651 - Standard for Rigid Non-metallic Conduit.

3. Manufacturers, or Equal

a. **Carlon**

b. **Condux**

D. Rigid PVC Coated Galvanized Steel (RPGS) Conduit

1. The conduit, prior to PVC coating, shall meet the requirements for RGS conduit above.

2. A PVC coating shall be bonded to the outer surface of the galvanized conduit. The bond between the coating and the conduit surface shall be greater than the tensile strength of the coating. The inside surface of the conduit shall have a urethane coating.

3. PVC coating thickness shall be not less than 40 mils.

4. PVC coated RGS shall be manufactured in accordance with the following standards:

a. UL-6

b. ANSI C80.1

c. Federal Specification WW-C-581E.

d. NEMA RN1 - PVC Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit

5. Manufacturers, or Equal

a. Robroy

b. Thomas & Betts

E. Liquidtight Flexible Conduit

1. Liquidtight flexible conduit shall be constructed of a flexible galvanized metal core with a sunlight resistant thermoplastic outer jacket.

2. Liquidtight flexible conduit shall be manufactured in accordance with UL-360 - Steel Conduits, Liquid-Tight Flexible.

3. Manufacturers, or Equal

    a. **Anaconda, Sealtite**

    b. **Electriflex, Liquatite**

F. Electrical Metallic Tubing (EMT) or Intermediate conduit (IMC) will not be accepted.

2.3 FITTINGS AND BOXES

A. General

1. Cast and malleable iron fittings for use with metallic conduit shall be the threaded type with five full threads.

2. Fittings and boxes shall have neoprene gaskets and non-magnetic stainless steel screws. Covers shall be attached by means of holes tapped into the body of the fitting. Covers for fittings attached by means of clips or clamps will not be acceptable.

3. Boxes larger than standard cast or malleable types shall be 304 stainless steel, NEMA 4X.

4. In outdoor areas, conduit shall be terminated in raintight hubs as manufactured by **Myers, O.Z. Gedney**, **Appleton,** or equal. In other than outdoor areas, sealed locknuts and bushings shall be used.

5. Conduit, fittings, and boxes in hazardous locations shall be suitable for the Class and Division indicated.

B. Cast Aluminum Fittings and Boxes

1. Cast aluminum boxes and fittings shall have less than 0.40 percent copper content and shall be utilized with aluminum conduit.

2. Manufacturers, or Equal

    a. **O.Z. Gedney**

    b. **Appleton**

    c. **Crouse-Hinds**

C. Malleable Iron Fittings and Boxes

1. Fittings and boxes for use with galvanized steel conduit shall be of malleable iron or gray-iron alloy with zinc plating.

2. Manufacturers, or Equal

    a. O.Z. Gedney

    b. Crouse-Hinds

c. **Appleton**

D. PVC Fittings and Boxes

1. Fittings for use with rigid non-metallic conduit shall be PVC, solvent welded type.

2. Boxes shall be PVC or fiberglass reinforced polyester (FRP).

3. Manufacturers, or Equal

a. **Carlon**

b. **Crouse-Hinds**

c. **Hoffman**

4. Provide welding solvent as required for installation of non-metallic conduit and fittings.

E. PVC Coated Fittings

1. Fittings for use with PVC coated RGS shall be PVC coated and shall be products of the same manufacturer as the conduit.

F. Stainless Steel Boxes

1. Stainless steel boxes shall be used with PVC coated RGS conduit and where indicated.

2. Stainless steel boxes shall be NEMA 4X, Type 304.

3. Stainless steel shall be minimum 14-gauge thickness, with a brushed finish.

4. Doors shall have full length stainless steel piano hinges. Non-hinged boxes are not acceptable.

5. Manufacturers, or Equal

a. **Hoffman**

b. **Rohn**

c. **Hammond**

G. Sheet Steel Boxes

1. Sheet steel boxes shall be galvanized steel outlet and switch boxes.

2. Manufacturers, or Equal

a. **Raco**

b. **Steel City**

c. **Appleton Electric**

PART 3 -- EXECUTION

3.1 GENERAL

A. All wiring shall be run in raceway unless indicated otherwise.

B. Raceways shall be installed between equipment as indicated. Raceway systems shall be electrically and mechanically complete before conductors are installed. Bends and offsets shall be smooth and symmetrical, and shall be accomplished with tools designed for this purpose. Factory elbows shall be utilized wherever possible.

C. Where raceway routings are indicated on plan views, follow those routings to the extent possible.

D. Where raceways are indicated but routing is not shown, such as home runs or on conduit developments and schedules, raceway routings shall be the CONTRACTOR's choice and in strict accordance with the NEC and customary installation practice. Raceway shall be encased, exposed, concealed, or under floor as indicated, except that conduit in finished areas shall be concealed unless specifically indicated otherwise.

E. Routings shall be adjusted to avoid obstructions. Coordinate between trades prior to installation of raceways. Lack of such coordination shall not be justification for extra compensation, and removal and re-installation to resolve conflicts shall be by the CONTRACTOR as part of the WORK.

F. Support rod attachment for ceiling-hung trapeze and cable tray installations shall meet the seismic requirements in the area where the project is located.

G. Exposed raceways shall be installed parallel or perpendicular to structural beams.

H. Install expansion fittings with bonding jumpers wherever raceways cross building expansion joints.

I. Exposed raceways shall be installed at least 1/2-inch from walls or ceilings except that at locations above finished grade where damp conditions do not prevail, exposed raceways shall be installed 1/4-inch minimum from the face of walls or ceilings by the use of clamp backs or struts.

J. Wherever contact with concrete or dissimilar metals can produce galvanic corrosion of equipment, suitable insulating means shall be provided to prevent such corrosion.

3.2 CONDUIT

A. Exposed conduit shall be rigid PVC coated RGS except as follows, unless indicated otherwise:

1. In areas with chlorine or hydrofluosilicic acid, schedule 80 PVC shall be utilized.

2. In lime or ferric chloride areas, PVC coated RGS Schedule 80 PVC shall be utilized.

3. In Class I, Div. I or Div. II hazardous locations, rigid aluminum conduit shall be utilized.

B. Conduit concealed, buried, or encased in concrete, except for analog control conduit which shall be PVC-coated RGS, shall be rigid galvanized steel. Where conduit emerges from concrete encasement, a PVC coated RGS elbow shall be utilized for transition from the concrete. Conduit shall emerge from the concrete perpendicular to the surface whenever possible.

C. Exposed conduit shall be 3/4-inch minimum trade size. Encased conduit shall be one-inch minimum trade size. Supports shall be installed every ten feet per the NEC.

D. Conduit shall not be encased in the bottom floor slab below grade.

E. Concrete cover for conduit and fittings shall not be less than 1-1/2 inches for concrete exposed to earth or weather, or less than 3/4-inch for concrete not exposed to weather or in contact with the ground.

F. Conduits passing through a slab, wall, or beam shall not impair significantly the strength of the construction.

G. Conduits embedded within a slab, wall, or beam (other than those merely passing through) shall satisfy the following:

1. Conduits with their fittings embedded within a column shall not displace more than 4 percent of the gross area of cross section.

2. Conduits shall not be larger in outside dimension than one third the overall thickness of slab, wall, or beam in which embedded.

3. Conduits shall not be spaced closer than 3 outside diameters on centers.

H. Conduit shall be placed so that cutting, bending, or displacing reinforcement from its proper location will not be required.

I. Threads shall be coated with a conductive lubricant before assembly.

J. Joints shall be tight, thoroughly grounded, secure, and free of obstructions in the pipe. Conduit shall be adequately reamed to prevent damage to the wires and cables inside. Strap wrenches and vises shall be used to install conduit to prevent wrench marks on conduit. Conduit with wrench marks shall be replaced.

K. Wherever possible, conduit runs shall slope to drain at one or both ends of run. Wherever conduit enters substructures below grade, the conduit shall be sloped to drain water away from the structure. Extreme care shall be taken to avoid pockets or depressions in conduit.

L. Installation of rigid steel conduit though a core-drilled hole in an exterior wall below grade shall utilize a sealing device as manufactured by **Link Seal** or equal.

M. Connections to lay-in type grid lighting fixtures shall be made using flexible metal conduit not exceeding 4-feet in length. Connections to motors and other equipment subject to

vibration shall be made with liquid-tight flexible conduit not exceeding 3-feet in length. Equipment subject to vibration that is normally provided with wiring leads shall be provided with a cast junction box for the make-up of connections.

N. Conduit passing through walls or floors shall have plastic sleeves. Core drilling shall be performed in accordance with Section 16050.

O. Provide conduit seal fittings at the following locations:

1. In hazardous classified locations, in strict accordance with the NEC.

2. In chlorine, ammonia, sulfur dioxide, and hydrofluosilicic acid areas to prevent passage of gases to other areas.

P. Conduit, fittings, and boxes required in hazardous classified areas shall be suitably rated for the area and shall be provided in strict accordance with NEC requirements.

Q. Empty conduits shall be tagged at both ends to indicate the final destination. Where it is not possible to tag the conduit, destination shall be identified by a durable marking on an adjacent surface. A pull-cord shall also be installed in each empty conduit. This shall apply to conduits in floors, panels, manholes, equipment, etc.

3.3 CABLE TRAYS

A. Provide cable trays in strict accordance with the manufacturer's printed instructions. Allowable cable fill areas shall meet NEC Article 318 - Cable Trays requirements. Verify cable tray fills prior to installation based on cables and trays actually provided.

B. Maintain continuous grounding of cable trays including bonding jumpers in accordance with NEC Article 318.

C. Install cable trays using hangers and supports on 8-foot centers, maximum.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 16111 - UNDERGROUND RACEWAY SYSTEMS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide underground raceway systems, complete and in place, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

A. **General:** Submittals shall be furnished in accordance with Sections 01300 - Contractor Submittals, and 16050 - Electrical Work, General.

B. Shop Drawings

1. Complete catalog cuts of all raceways, fittings, pullboxes, manholes, and handholes, marked where applicable to show proposed materials and finishes.

PART 2 -- PRODUCTS

2.1 GENERAL:

A. Manholes, handholes, pullboxes and fittings that are dedicated to the underground raceway system shall comply with the requirements of this Section.

2.2 MANHOLES AND HANDHOLES

A. Manholes and pullboxes shall be precast with construction and load rating as indicated.

1. Covers shall be traffic type, H-20 loading, except as indicated otherwise. Manhole and pullbox covers shall be identified as "Electric" by raised letters cast into the covers. Manhole frames and covers shall be **Neenah Foundry No. R-1755-G** or equal.

2. Manholes shall have frost-proof and water-tight grey iron frames and covers with solid lids and inner lids with 28-inch clear openings. Covers and lids shall be bolted to cast-in-place steel frames with corrosion resistant hardware. Frames shall be factory-primed; covers shall be cast-iron and shall have pick-holes.

B. Manholes and pullboxes shall be equipped with pulling-in irons opposite and below each ductway entrance.

C. PVC ductbank conduits shall be provided with end bells. Brackets, **Unistrut Cat. No. P2515** or equal and 60-inch concrete inserts, **Unistrut Cat. NO. P3261** or equal, shall be provided in manholes as required for racking wiring through manholes.

D. Precast manholes and pullboxes shall be **Brooks Mack, Quikset, U.S. Precast**, or equal. Cast-iron covers shall be by **U.S. Foundry,** or equal.

2.3 DUCTBANKS

A. Underground ducts shall be Schedule 40 PVC.

B. Ducts shall be encased in red-dyed concrete with steel reinforcing bars. Concrete shall have 3,000 psi compressive strength conforming to Section 03300. Colorant shall be an integral red-oxide coloring pigment in the proportion of 8 pounds per cubic yard of concrete. Concrete shall be dyed red throughout the ducts. Surface treatment will not be accepted. The costs, if any, of cleaning coloring pigment from the concrete delivery equipment and other related cleanings shall be included in the Bid.

C. Ductbanks shall contain a No. 4/O bare stranded copper ground wire. The ground wire shall be continuous through the ductbank and terminate at power distribution equipment and grounding grid.

D. **Identification Tape:** Continuous lengths of underground warning tapes shall be installed 12-inches above and parallel to all ductbanks. Tape shall be 6-inches wide polyethylene film imprinted "CAUTION - ELECTRIC UTILITIES BELOW." Tape shall be as manufactured by **Brady,** or equal.

PART 3 -- EXECUTION

3.1 GENERAL

A. Underground raceways shall be installed between manholes, handholes, and pullboxes as indicated. Raceway systems shall be electrically and mechanically complete before conductors are installed. Bends and offsets shall be smooth and symmetrical, and shall be fabricated with tools designed for this purpose. Factory elbows shall be utilized wherever possible.

B. Raceway routings on plan views shall be followed to the extent possible.

C. Routings shall be adjusted to avoid obstructions. Coordinate the trades prior to installation of raceways. Lack of coordination shall not be justification for extra compensation, and removal and re-installation to resolve conflicts shall be performed by the CONTRACTOR as part of the WORK.

3.2 DUCTBANKS

A. Ductbanks shall be installed in accordance with the criteria below:

1. Duct shall be assembled using high impact non-metallic spacers and saddles to provide conduits with vertical and horizontal separation. Plastic spacers shall be set every 5-feet. The duct array shall be anchored every 5-feet to prevent movement during placement of concrete.

2. The duct shall be laid on a grade line of at least 3-inches per 100-feet, sloping towards pullboxes or manholes. Duct shall be installed and pullbox and manhole depths adjusted so that the top of the concrete envelope is a minimum of 18-inches below grade and a minimum of 24-inches below roadways.

3. Changes in direction of the duct envelope by more than 10 degrees horizontally or vertically shall be accomplished using bends with a minimum radius 24 times the duct diameter.

4. Duct couplings shall be staggered a minimum of 6-inches.

5. The bottom of trench shall be of select backfill or sand.

6. Each bore of the completed ductbank shall be cleaned by drawing through it a standard flexible mandrel one foot long and 1/4-inch smaller than the nominal size of the duct. After passing of the mandrel, a wire brush and swab shall be drawn through.

7. Spare raceways that are not indicated to contain conductors shall have a 1/8-inch polypropylene pull cord installed throughout the entire length of the raceway.

B. Duct entrances shall be grouted smooth; ducts shall be terminated with flush end bells. Sections of pre-fabricated manholes and pullboxes shall be assembled with waterproof mastic and shall be set on a 12-inch bed of gravel as recommended by the manufacturer or as required by field conditions.

C. Ductbank penetration through walls of manholes, pullboxes, and building walls below grade shall be watertight.

D. Concrete encased ductbank shall terminate at building foundations. When duct enters the building on a concrete slab on grade, duct shall not be encased, but shall transition to rigid steel PVC-coated conduits on all stub-ups.

E. Where an underground conduit enters a structure through a concrete roof or a membrane waterproofed wall or floor, provide a **Link-Seal**, or equal sealing device. The sealing device shall be utilized with rigid steel conduit. Transition from PVC to rigid steel conduit prior to building entry.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 16120 - WIRES AND CABLES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide wires and cable, complete and operable, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

A. The CONTRACTOR shall submit Shop Drawings in accordance with Sections 01300 - Contractor Submittals and 16050 - Electrical Work, General.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Conductors, include grounding conductors, shall be copper. Aluminum conductor wire and cable will not be permitted. Insulation shall bear UL label, the manufacturer's trademark, and identify the type, voltage, and conductor size. All conductors except flexible cords and cables, fixture wires, and conductors that form an integral part of equipment such as motors and controllers shall conform to the requirements of Article 310 of the National Electric Code, latest edition, for current carrying capacity. Flexible cords and cables shall conform to Article 400, and fixture wires shall conform to Article 402. Wiring shall have wire markers at each end.

2.2 LOW VOLTAGE WIRE AND CABLE

A. Power and Lighting Wire

1. Wire rated for 600 volts in duct or conduit for all power and lighting circuits shall be Class B Type XHHW cross-linked polyethylene conforming to UL-44-UL Standard for Safety Rubber Insulated Wires and Cables. THHN/THWN wire shall not be permitted to be used for any power or control wiring in this project, except as specifically permitted within control panels per Section 17200 - Control Panels.

2. Conductors for feeders as defined in Article 100 of the NEC shall be sized to prevent a voltage drop exceeding 3 percent at the farthest outlet of power, heating, and lighting loads, or combinations of such loads, and where the maximum total voltage drop on both feeders and branch circuits to the farthest connected load does not exceed 5 percent.

3. Conductors for branch circuits as defined in Article 100 of the NEC, shall be sized to prevent voltage drop exceeding 3 percent at the farthest connected load or combinations of such loads and where the maximum total voltage drop on both feeders and branch circuits to the farthest connected load does not exceed 5 percent.

4. Wiring for 600 volt class power and lighting shall be as manufactured by **General Cable, Okonite**, or **Rome Cable**.

B. Control Wire

1. Control wire in duct or conduit shall be the same type as power and lighting wire indicated above.

2. Control wiring shall be No.14 AWG.

3. Control wires at panels and cabinets shall be machine tool grade type MTW, UL approved, rated for 90 degrees C at dry locations, and be as manufactured by **American, Carol Cable,** or equal.

C. Instrumentation Cable

1. Instrumentation cable shall be rated at 600 volts.

2. Individual conductors shall be No. 16 AWG stranded, tinned copper. Insulation shall be color coded polyethylene: black-red for two-conductor cable and black-red-white for three-conductor cable.

3. Instrumentation cables shall be composed of the individual conductors, an aluminum polyester foil shield, a No. 18 AWG stranded tinned copper drain wire, and a PVC outer jacket with a thickness of 0.048-inches.

4. Single pair, No. 16 AWG, twisted, shielded cable shall be **Belden Part No. 9342,** or equal.

5. Single triad, No. 16 AWG, twisted, shielded cable shall be **Belden Part No. 1119A,** or equal.

D. Tray Cable

1. Multi-conductor tray cable shall be rated 600 volts, listed by UL as Type TC cable per Article 340 of the NEC. The individual conductors shall be UL listed as Type XHHW, with a sunlight-resistant overall jacket.

2. Conductor sizes shall be the same as for power and lighting wire and control wire above.

2.3 MEDIUM VOLTAGE CABLE

A. General

1. Individual conductors shall be copper, Class B, stranded.

B. 5 KV Cable

1. Cable used in conduit or duct shall be composed of a single conductor, ethylene-propylene rubber (EPR) insulation rated at 90 degrees C, shield, and black polyvinyl chloride (PVC) jacket. Insulation level shall be 133 percent, 115 mil. Shield shall be copper tape type, or corrugated drain wire type **Unishield** as manufactured by **General Cable**. Cable shall be UL Type MV-90 in accordance with UL 1072 and ICEA-S-93-639/NEMA-WC74 - Medium Voltage Power Cables, as manufactured by **General Cable, Okonite,** or **Rome Cable**.

2. Tray cable shall be composed of one or three conductors, a copper grounding conductor, ethylene-propylene rubber (EPR) insulation rated at 90 degrees C, interlocked aluminum armor, and yellow PVC outer jacket. Insulation level shall be 133 percent, 115 mil. Tray cable shall be UL Type MV-90 in accordance with UL 1072 and ICEA-S-96-639/NEMA-WC74 as manufactured by **General Cable, Okonite,** or **Rome Cable**.

C. 15 KV Cable

1. Cable used in conduit or duct shall be composed of a single conductor, ethylene-propylene rubber (EPR) insulation rated at 90 degrees C, shield and black polyvinyl chloride (PVC) outer jacket. Insulation level shall be 133 percent. Shield shall be copper tape type, corrugated drain wire type **Unishield** as manufactured by **General Cable**. Cable shall be UL Type MV-90 in accordance with UL 1072 and ICEA-S-93-639/NEMA-WC74 as manufactured by **General Cable, Okonite,** or **Rome Cable**.

2.4 CABLE TERMINATIONS

A. Compression connectors shall be **Burndy "Hylug", Thomas & Betts "Sta-Kon,",** or equal. Threaded connectors shall be split bolt type of high strength copper alloy. Pressure type, twist-on connectors will not be acceptable.

B. Pre-insulated fork tongue lugs shall be **Thomas & Betts, Burndy,** or equal.

C. General purpose insulating tape shall be **Scotch No. 33, Plymouth "Slip-knot",** or equal. High temperature tape shall be polyvinyl as manufactured by **Plymouth, 3M,** or equal.

D. Labels for coding 600 volt wiring shall be computer printable or pre-printed, self-laminating, self-sticking, as manufactured by **W.H. Brady, 3M,** or equal.

E. Stress cone material for make-up of medium voltage shielded cable shall be as manufactured by **Raychem, 3M,** or equal.

PART 3 -- EXECUTION

3.1 GENERAL

A. The CONTRACTOR shall provide and terminate all power, control, and instrumentation conductors except where indicated.

3.2 INSTALLATION

A. Conductors shall not be pulled into raceway until raceway has been cleared of moisture and debris.

B. Pulling tensions on raceway cables shall be within the limits recommended by the cable manufacturer. Wire pulling lubricant, where needed, shall be UL approved.

C. Instrumentation wire shall not be run in the same raceway with power and control wiring except where specifically indicated.

D. Wire in panels, cabinets, and wireways shall be neatly grouped using nylon tie straps, and shall be fanned out to terminals.

E. Single conductor cable in cable trays shall be No. 1/0 or larger and shall be of a type listed and marked for use in cable trays. Tray cable smaller than 1/0 shall be multi-conductor, with outer jacket.

3.3 SPLICES AND TERMINATIONS

A. General

1. Wire taps and splices shall be properly taped and insulated according to their respective classes.

2. In general, there shall be no cable splices in underground manholes or pullboxes. If splices are necessary, the cables shall be brought aboveground and terminated in a NEMA 4X, stainless steel terminal or splice cabinet on a concrete pad. Splices in underground manholes and pullboxes may be made only with the approval of the CONTRACTING OFFICER.

3. Stranded conductors shall be terminated directly on equipment box lugs making sure that all conductor strands are confined within lug. Use forked-tongue lugs where equipment box lugs have not been provided.

4. Excess control and instrumentation wire shall be properly taped and terminated as spares.

B. Control Wire and Cable

1. Control conductors shall be spliced or terminated only at the locations indicated and only on terminal strips or terminal lugs of vendor furnished equipment.

2. In junction boxes, motor control centers, and control panels, control wire and spare wire shall be terminated to terminal strips.

C. Instrumentation Wire and Cable

1. Shielded instrumentation cables shall be grounded at one end only, preferably the receiving end on a 4-20 mA system.

2. Two- and three-conductor shielded cables installed in conduit runs which exceed available standard cable lengths may be spliced in pullboxes. Such cable runs shall have only one splice per conductor.

D. Power Wire and Cable

1. All 120/208-volt, 120/240-volt, and 480/277-volt branch circuit conductors may be spliced in suitable fittings at locations determined by the CONTRACTOR. Cables rated above 2,000 volt shall be spliced or terminated only at equipment terminals indicated.

2. Splices to motor leads in motor terminal boxes shall be wrapped with mastic material to form a mold and then shall be taped with a minimum of two layers of varnished cambric tape overtaped with a minimum of two layers of high temperature tape.

3. Shielded power cable shall be terminated with pre-assembled stress cones in a manner approved by the cable and terminal manufacturer. The CONTRACTOR shall submit the proposed termination procedure as a Shop Drawing.

3.4 CABLE IDENTIFICATION

A. **General:** Wires and cables shall be identified for proper control of circuits and equipment and to reduce maintenance effort.

B. **Identification Numbers:** The CONTRACTOR shall assign to each control and instrumentation wire and cable a unique identification number. Numbers shall be assigned to all conductors having common terminals and shall be shown on "as built" drawings. Identification numbers shall appear within 3-inches of conductor terminals. "Control Conductor" shall be defined as any conductor used for alarm, annunciator, or signal purposes.

1. Multiconductor cable shall be assigned a number which shall be attached to the cable at intermediate pull boxes and at stub-up locations beneath free-standing equipment. It is expected that the cable number shall form a part of the individual wire number. Individual control conductors and instrumentation cable shall be identified at pull points as described above. The instrumentation cable numbers shall incorporate the loop numbers assigned in the Contract Documents.

2. All 120/208-volt system feeder cables and branch circuit conductors shall be color coded as follows: Phase A - black, Phase B - red, Phase C - blue, and Neutral - white. The 480/277-volt system conductors shall be color coded as follows: Phase A - Brown, Phase B - Orange, Phase C - Yellow, and Neutral - Gray. Color coding tape shall be used where colored insulation is not available. Branch circuit switch shall be yellow. Insulated ground wire shall be green, and neutral shall be gray. Color coding and phasing shall be consistent throughout the Site, but bars at panelboards, switchboards, and motor control centers shall be connected Phase A-B-C, top to bottom, or left to right, facing connecting lugs.

3. General purpose AC control cables shall be red. General purpose DC control cables shall be blue.

4. Spare cable shall be terminated on terminal screws and shall be identified with a unique number as well as with destination.

5. Terminal strips shall be identified by computer printable, cloth, self-sticking marker strips attached under the terminal strip.

3.5 TESTING

A. **Cable Assembly and Testing:** Cable assembly and testing shall comply with applicable requirements of ICEA Publication No. S-68-516 - Ethylene-Propylene-Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy. Factory test results shall be submitted in accordance with Section 01300 prior to shipment of cable. The following field tests shall be the minimum requirements:

1. Insulation resistance testing, using a DC megohmeter, shall be performed on all cables operating at more than 2,000 volts to ground. Time-resistance readings shall be taken and recorded at intervals of 30 seconds and one minute. Time-resistance voltage levels shall be per the cable manufacturer's recommendations.

2. Power cable rated at 600 volts shall be tested for insulation resistance between phases and from each phase to a ground using a megohmeter.

3. Field testing shall be done after cables are installed in the raceways.

4. Field tests shall be performed by a certified test organization acceptable to the cable manufacturer. Test results shall be submitted to the CONTRACTING OFFICER for review and acceptance.

5. Cables failing the tests shall be replaced with a new cable or be repaired. Repair methods shall be as recommended by the cable manufacturer and shall be performed by persons certified by the industry.

B. **Continuity Test:** Control and instrumentation cables shall be tested for continuity, polarity, undesirable ground, and origination. Such tests shall be performed after installation and prior to placing cables in service.

- END OF SECTION -

SECTION 16140 - WIRING DEVICES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide wiring devices, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 16050 – Electrical Work, General apply to this Section.

C. **Single Manufacturer:** Like products shall be the end product of one manufacturer in order to achieve standardization of appearance, operation, maintenance, spare parts, and manufacturer's services.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01300 - Contractor Submittals.

B. Shop Drawings

1. Complete catalog cuts of switches, receptacles, enclosures, covers, and appurtenances, marked to clearly identify proposed materials.

2. Documentation showing that proposed materials comply with the requirements of NEC and U.L.

3. Documentation of the manufacturer's qualifications.

PART 2 -- PRODUCTS

2.1 GENERAL

A. All devices shall carry the U.L. label.

B. General purpose duplex receptacles and toggle switch handles shall be brown everywhere except in finished rooms where they shall be ivory. Special purpose receptacles shall have a body color as indicated. Receptacles and switches shall be specification grade and conform to NEMA WD-1, Federal Specifications W-C-596E and W-S-896E, respectively.

2.2 LIGHTING SWITCHES

A. Local branch switches shall be toggle type, rated at 20 amperes, 120-277 vAC, and shall be **General Electric Cat. No. GE-5951-1** for single pole, **GE-5953-1** for three-way and **GE-5954-1** for four-way, or similar types as manufactured by **Hubbell, Leviton,** or equal.

B. Switches for hazardous locations shall be factory sealed, rated at 20 amperes, 120-277 vAC, capable of controlling 100 percent tungsten filament, fluorescent and HID lamp loads and shall be as manufactured by **Crouse-Hinds**, **Appleton,** or **Killark.**

2.3 GENERAL PURPOSE RECEPTACLES

A. Duplex receptacles rated 125 V, 20 amperes shall be polarized 3 wire type for use with 3 wire cord with grounded lead and 1 designated stud shall be permanently grounded to the conduit system (NEMA 5-20R). Duplex 120 V receptacles shall be **G.E. 5362, Hubbell 5362,** or equal. Single receptacles shall be **G.E. 4102, Hubbell 4102,** or equal.

B. Ground-fault circuit interrupting receptacles (GFCI's) shall be installed at the locations indicated and as required by the NEC. GFCI's shall be duplex, specification grade, tripping at 5 mA. Ratings shall be 125 V, 20 amperes, NEMA WD-1, Configuration 5-20R, capable of interrupting 5,000 amperes without damage. Feed-through type GFCI's serving standard receptacles will not be permitted. GFCI's shall be as manufactured by **Hubbell, Bryant, Leviton,** or equal.

C. Receptacles for hazardous locations shall be single gang receptacles with spring door. Receptacles shall have a factory sealed chamber. The receptacles shall have a delayed action feature requiring the plug to be inserted in the receptacle and rotated before the electrical connection is made. The receptacle shall not work with non-hazardous rated plugs. One plug shall be furnished with each receptacle. The receptacles shall be rated for 20 amps at 125 VAC. Hazardous location receptacles shall be **Appleton EFSB, Crouse-Hinds ENR,** or equal.

D. Where indicated, hazardous location receptacles shall be provided with ground fault protection. Ground fault protection shall be **Appleton EFSR-GFI, Crouse-Hinds GFS-1,** or equal.

2.4 FLOOR RECEPTACLE BOXES

A. Floor receptacles and jacks shall be installed in rectangular floor boxes. Floor boxes shall be 1, 2, or 3 gang as required for each installation. Floor boxes shall be cast iron and sized for the depth of the floor slab. Carpet flanges shall be provided. Covers shall be brass, with openings for a duplex receptacle voice and data jacks. Floor boxes shall be **Hubbell** or equal.

2.5 ENCLOSURES AND COVERS

A. Surface mounted switches and receptacles shall be in FS or FD type weatherproof conduit fittings.

B. Switch and receptacle covers on surface mounted boxes shall be die cast copper-free aluminum.

C. In finished areas, switch and receptacle boxes shall be provided with SUPER STAINLESS STEEL COVERS as manufactured by **Harvey Hubbell, Arrow Hart, Bryant,** or equal.

D. In areas where cast boxes are used, switch and receptacle covers shall be **Crouse-Hinds Catalogue No. DS185 and WLRD-1, or Adalet No. WSL** and **WRD,** or equal.

E. Receptacles in wet locations shall be with a hinged cover/enclosure marked "Suitable for Wet Locations when in use" and "UL Listed." There shall be a gasket between the enclosure and the mounting surface and between the hinged cover and mounting plate/base. The cover shall be **TayMac Specification Grade**, or equal.

2.6 WELDING RECEPTACLES

A. Welding receptacles shall be rated 60 amperes, 600 vAC, three wire, four pole, heavy duty circuit breaking type, complete with outlet box and be connected for 480 volt service. A matching plug shall also be furnished for each three receptacles. The outlets shall be **Crouse Hinds "Arktite" ARE-6424,** with plug **APJ-6485**.

2.7 RECEPTACLE – TRANSIENT VOLTAGE SURGE SUPPRESSOR (TVSS)

A. Transient voltage surge suppressors shall be duplex style, rated for 80 joules (minimum) of energy absorption in each of three modes. Units shall be rated 125 volts AC, sized for installation in 2-inch by 4-inch outlet boxes, and as manufactured by **Arrow Hart, Pass & Seymour,** or **Hubbell**.

2.8 RECEPTACLE – SPECIAL PURPOSE

A. Special purpose receptacles shall have ratings and number of poles as indicated or required for anticipated purpose.

B. Matching plug with cord-grip features shall be provided with each special-purpose receptacle.

2.9 NAMEPLATES

A. Provide nameplates or equivalent markings on switch enclosures to indicate ON and OFF positions of each switch. ON and OFF for 3-way or 4-way switches is not acceptable. Provide receptacles for special purposes with nameplates indicating their use. Conform to requirements of Section 16050.

PART 3 -- EXECUTION

3.1 GENERAL

A. Perform work in accordance with the National Electrical Code.

3.2 CONNECTION

A. Rigidly attach wiring devices in accordance with National Electrical Code, and as indicated, avoiding interference with other equipment.

B. Securely fasten nameplates using screws, bolts, or rivets centered under or on the device, unless otherwise indicated.

3.3 GROUNDING

A. Ground all devices, including switches and receptacles, in accordance with NEC, ART 250, and Section 16450 - Grounding.

B. Ground switches and associated metal plates through switch mounting yoke, outlet box, and raceway system.

C. Ground flush receptacles and their metal plates through positive ground connections to outlet box and grounding system. Maintain ground to each receptacle by spring-loaded

grounding contact to mounting screw or by grounding jumper, each making positive connection to outlet box and grounding system at all times.

3.4 FIELD TESTING

A. Provide checkout, field, and functional testing of wiring devices in accordance with Section 16050.

B. Test each receptacle for polarity and ground integrity with a standard receptacle tester.

- END OF SECTION -

SECTION 16425 – 480V MAIN SWITCHGEAR

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide the 480V main switchgear(s), complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 16050 - Electrical Work, General, apply to the WORK of this Section.

C. The switchgear assembly shall bear a UL label. Certified copies of design test reports shall be supplied demonstrating compliance with these standards.

D. The switchgear shall be suitable for use as service entrance equipment and be labeled in accordance with UL requirements.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Reference Codes:** All work specified herein shall conform to or exceed the applicable requirements of the National Electrical Code (NEC); provided, that where a local code or ordinance is in conflict with the NEC, the provisions of said local code or ordinance shall take precedence. For additional requirements, see paragraph Reference Codes and Standards, Section 16050.

B. Commercial Standards:

ANSI/NFPA 70	National Electrical Code
UL 1558	Low Voltage Switchgear
ANSI/IEEE C37.20.1	Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear
ANSI Z55.1	Gray Finishes for Industrial Apparatus and Equipment

1.3 CONTRACTOR SUBMITTALS

A. Submittals shall conform to the requirements of Section 16050, Section 01300 - Contractor Submittals, and the additional requirements specified below:

1. Complete list of special tools required for the operation and maintenance of the unit.

2. Engineering data to include voltage, current, and short-circuit ratings.

3. Certified outline drawings complete with dimensions, available space for conduits, cable terminations, bus terminations, weights and cable supports.

4. Complete one-line diagram showing all protective and control devices, metering, and terminal numbers.

5. Interconnection diagrams.

6. Design certification of the anchoring systems for seismic requirements as required by Section 16050 for the equipment specified in this Section.

7. Submit spare parts data listing source and prices of recommended replacement parts and supplies and recommended maintenance procedures and intervals.

8. Written descriptions, explaining ladder diagrams, control operation, and system operation.

9. Certified factory design test report.

10. Material list and catalog data.

1.4 QUALITY ASSURANCE

A. **General:** All materials shall be tested and inspected in accordance with Section 16050 and the following requirements.

B. Unit substation(s) shall be stored in a clean, dry space. Factory wrapping shall be maintained or a heavy plastic cover shall be provided to protect units from dirt, water, construction debris, and traffic. Storage space shall have heated or space heaters shall be energized.

C. Factory Tests:

1. A certificate of design tests previously conducted on one air-break circuit breaker and switchgear assembly of each rating essentially similar to that specified herein shall be submitted. The design testing program shall conform to ANSI/IEEE Standard C37.20.1, and shall include, but not be limited to, the following tests: dielectric, continuous current, withstand, and endurance.

2. The low voltage switchgear section, including the transition section, shall be completely assembled, wired, adjusted, and tested at the factory. After assembly, the complete switchboard shall be tested for operation under simulated service conditions to assure the accuracy of the wiring and the functioning of all equipment

3. Production tests shall be conducted on each low voltage switchgear assembly and a certificate of each test shall be submitted.

4. The production testing program shall conform to ANSI/IEEE Standard C37.20.1 and other related ANSI standards, as well as the applicable standards of IEEE and of NEMA SG-5 and shall include, but not be limited to, the following tests: contact resistance measurement of all 3 phases, operation of each electrically-operated breaker with the control power supply voltage adjusted to the limits specified, and check of safety interlocks and interchangeability of circuit breakers of the same ratings in various cubicles.

D. **Environmental Conditions:** 480V switchgear shall be designed for continuous duty service in the environmental conditions specified in Section 16050.

1.5 MAINTENANCE AND GUARANTEE

A. The CONTRACTOR shall submit a recommended spare parts list.

B. The CONTRACTOR shall guarantee that the furnished equipment shall meet the requirements specified herein and specified elsewhere in the Contract Documents.

1.6 COORDINATION STUDIES

A. Coordination studies for electrical distribution system protection are specified in Section 16431 - Protective Device Studies.

PART 2 -- PRODUCTS

2.1 REQUIREMENTS

A. The main switchgear shall be suitable for indoors. The main bus shall be double-ended with main circuit breakers and tie circuit breaker, and the main bus capacity shall be 480/277V, 4-wire. The switchgear shall be front accessible, with a NEMA 1enclosure.

B. The main switchgear shall be a product of the manufacturer of the power air circuit breaker contained herein. The switchgear shall be manufactured by **Cutler-Hammer, General Electric, Square D,** or equal**.**

2.2 SWITCHGEAR CONSTRUCTION FEATURES

A. The switchgear shall consist of free standing vertical sections with the complement of circuit breakers and accessories indicated by Drawing E-3. The construction shall facilitate addition of future sections where shown.

B. The vertical sections shall be fabricated, rigidly braced, structural steel framework with interior barriers and breaker module side sheets of not less than 12 gauge sheet steel and external panels and covers of not less than 14 gauge sheet steel with the side and top sheets removable. Compartment doors shall be hinged, flanged, dead-front panels. Hinged, flanged doors shall also be provided on the rear of those sections having external power connections and on sections in which the rear cover plates exceed 60 pounds in weight. Panels shall be reinforced with stiffening members to minimize vibration. All steel shall be select quality, free of dents and true to level after forming.

C. The metering equipment and all draw out circuit breakers shall be housed in separate sections or compartments within vertical sections and shall be isolated from adjacent elements by steel or appropriate insulated barriers.

D. Bus compartments shall be provided to fully enclose the incoming line and main bus from the cable termination area.

E. The incoming and main bus shall be welded or bolted copper. All bolted or pressure joints for buses, interconnections, disconnecting devices, and external connections to the equipment shall be copper with silver-to-silver torqued contacts. Insulated bus supports shall be flame retardant polyester glass, designed and tested to withstand the mechanical stress produced by fault currents as required.

F. Each low-voltage circuit breaker compartment shall have a drawout mechanism consisting of an integral racking device to lock the removable element in the connected position and to overcome the mechanical resistance of making and breaking the contacts of the disconnecting devices. Positive mechanical interlocks of rugged design shall prevent the breaker from being racked in or out unless the breaker is tripped, and shall prevent the breaker from being closed while it is being racked in or out. The

breaker drawout mechanism shall be of a design that permits the breaker to be racked from the connected to the test and disconnected positions and then have the door closed. A manual release shall be provided to hold the breaker in test and disconnected positions. A limit stop shall be provided in the fully withdrawn position. In this position, there shall be provisions for easy maintenance and inspection or removal.

G. Control Wiring:

1. Control wiring shall be provided to all auxiliary relays and devices indicated to be furnished with the equipment. Control buses and wiring for each vertical section shall be enclosed in panduit or in compartments isolated from the primary circuits.

2. All control wiring shall be brought to identified terminal blocks; every cubicle containing control wiring which extends to other cubicles shall have terminal blocks. Connection made on terminal blocks and on internal devices shall be by means of locking spade-type pre-insulated terminals.

3. Control and secondary wiring shall be 600 V flame-retardant switchboard-type, minimum size No. 14 AWG, stranded tinned copper. Hinge wiring shall be extra-flexible stranding. The wire shall be SIS, gray color, with both ends of the wire identified with labels approved by the CONTRACTING OFFICER.

H. Equipment Enclosure:

1. Enclosure shall be indoor type as indicated.

2. Indoor type shall be NEMA 1 gasketed. The enclosure shall include a maintenance aisle wide enough to permit interchanging removable equipment between compartments, with a hinged gasketed door at each end of the aisle. The doors shall have provisions for locking on the outside and panic egress from the inside, even if locked outside. Ventilating openings shall have screens and replaceable filters. Lights, switches, and convenience receptacles shall be provided in the aisle. The bottom of the entire housing shall be undercoated for rust prevention.

I. Circuit Breakers and Circuit Breaker Compartments:

1. Main and feeder circuit breakers shall be air power-type, 100 percent rated, draw-out, 3-pole, 2-position, conforming to those ANSI and NEMA standards, which apply. Power circuit breakers shall be **Cutler-Hammer DS, GE AKR, Square D,** or equal.

2. Circuit breaker trip settings shall be as indicated in Section 16431.

3. The trip units shall be RMS sensing, microprocessor based, self-powered, programmable. The main circuit breakers shall have adjustable pick-up settings for long time, short time, and ground fault trips and adjustable time delay settings for short time, long time, and ground fault settings. Short time and ground fault trip functions shall include I^2t slopes as part of the trip unit programming functions. The feeder circuit breaker trip units shall be as described for main circuit breakers, except they shall also be provided with adjustable instantaneous pick-up, except where deletion is recommended by the coordination study. The circuit breakers shall have trip targets.

4. All circuit breakers shall have mechanically trip-free operating mechanisms of the stored energy type and shall be provided with self-aligning primary and secondary

disconnecting devices, trip button, position indicator lamps, mechanically-operated devices as listed hereinafter, and other specified accessories. Manually operated breakers shall be charged from the handle. All power circuit breakers shall have bell alarms and form "C" auxiliary contacts wired to an identified terminal strip. Three N.O. (Normally Open) and 3 N.C. (Normally Closed) dry contacts for main, tie, and feeder circuit breakers for remote indication shall be provided.

5. Main and tie circuit breakers shall be manually operated; feeder circuit breakers shall be manually operated. Charging or energy storage springs shall be manually charged from an operating handle.

6. The short circuit interrupting rating of the breakers shall be not less than 65,000 amperes symmetrical, but no less than required by Section 16431. Include current limiters, integrally mounted or on a drawout truck where necessary to meet the short circuit rating. Limiters shall be coordinated with the breaker trips to avoid unnecessary blowing of the limiters. Provide anti-single phase protection and blown fuse indication interlocked with the breakers.

7. Mechanical interlocks shall be provided to prevent the removable element from being moved to or from the operating position with the circuit breaker closed and to prevent the circuit breaker from being closed unless primary disconnecting devices are fully engaged or separated a safe distance.

8. It shall not be possible to withdraw the breaker with the breaker in the closed position.

9. Circuit breaker elements of the same frame size shall be interchangeable.

10. Each low voltage power circuit breaker shall be mounted in an individually grounded metal barriered compartment; an insulating flame retardant barrier shall also be provided at the rear of each compartment.

11. Each cubicle shall have protection shutters to automatically cover primary line and secondary load studs when the circuit breaker is withdrawn from the cubicle.

12. The breakers shall have high endurance characteristics being capable of no load and full load interruptions at rated current equal to or exceeding the UL endurance ratings for power circuit breakers without maintenance.

13. A 120 V ac static trip calibration and portable test unit shall be furnished per switchgear. The unit shall be as designed and built specifically for the type of circuit breakers being furnished and shall contain all necessary cables, plugs and instruction manuals required for operating it. Test sets will not be necessary when the circuit breakers trip units include internal test capabilities by an operator.

J. Utility Metering

1. Where indicated, a separate barriered-off utility metering compartment complete with hinged sealable door shall be provided. Bus work shall include provisions for mounting utility company current transformers and potential transformers or potential taps as required by the utility company. The utility metering section shall bear a service entrance UL label.

K. Control Power Transformers

1. Control power transformers shall be provided in each main circuit breaker section to supply power for circuit breaker control and space heaters.

2. The transformer shall be protected by current limiting fuses in a dead front holder on both the primary and secondary.

3. Distribution of control power shall be through use of panel mounted fusible switches, or circuit breakers, properly coordinated.

L. Switchgear Bus

1. Buses shall be of high conductivity copper, sized for the rated continuous and momentary currents within allowable temperature rise and shall not be tapered.

2. Buses shall be braced to withstand a short circuit current of 100,000 amperes symmetrical, minimum.

3. Bus joints shall be welded, brazed, or bolted. Bolted joints shall be silver surfaces. Bolts and associated hardware shall be corrosion-resistant and shall be rear accessible.

4. Insulating barriers shall be provided where primary buses pass from one compartment to another. The main and riser bus shall be fully isolated from the circuit breaker and instrument and auxiliary compartments. The bus bar shall be bolted where horizontal and vertical buses are joined. All bolted connections shall be silver-plated. Solid vertical insulating barriers shall be provided in the section between the cable and bus compartments. A barrier system shall be provided that isolates the bus from the cable compartment.

5. A copper ground bus extending the entire length of the switchgear assembly and incoming line compartment shall be provided, and it shall have clamp type terminal lugs adjustable between 4/0 AWG and 500 MCM at each end for external cable connections. All the metal parts of the structure shall be effectively connected to this bus. The ground bus shall be of rectangular cross section, not less than 1/4-inch by 1-1/2 inches.

6. Provide a full-capacity neutral bus where a neutral bus is indicated.

M. Terminal Blocks

1. Terminal blocks for all external control connections shall be 600 V, barrier type, having a minimum rating of 20 amperes with marker strips identifying all internal and external wiring. Terminal blocks shall be sized to have at least 20 percent unused spare connections after completion of wiring.

2. Terminal blocks for current transformer secondary connections shall be of the short-circuiting type. One 4-pole block shall be used for each current transformer set.

N. Meters and Instruments

1. Meters and instruments shall be provided as indicated. These shall be installed and wired on hinged front panels. Arrangement of these devices is subject to approval by the CONTRACTING OFFICER.

2. Instruments and meters shall be of the semi-flush switchboard type, with rectangular dustproof enclosing cases and antiglare glass.

3. Indicating instruments shall have white dials with black marking, scales approximately 250 degrees and 7 inches long, accuracy within +1 percent of full scale, and external zero adjustment.

4. Instruments and meters shall be suitable for operating from instrument transformers with nominal 5 ampere and 120 V secondaries. Scale ranges and dial constants shall be provided to match the primary current and voltage ratings.

5. Multi-function microprocessor based electronic metering panels are acceptable in lieu of analog type instruments.

6. The CONTRACTOR shall provide transducers, which produce a 4 - 20 mA analog signal proportional to the electrical parameters required. Transducers shall be **Kratos, Square D, Esterline-Angus,** or equal**.** Transducers shall be provided for:

   a. Voltage at Bus A and Bus B main circuit breaker, 3-phase.

   b. Voltage at Bus A and Bus B main circuit breaker, 3-phase.

   c. Kilowatts, 3-phase, instantaneous, through Bus A and Bus B main circuit breaker.

O. Instrument Transformers

1. Potential Transformers: The quantity, ratio, and connection of potential transformers shall be provided as indicated. Potential transformers shall be provided with current-limiting high interrupting capacity primary fuses in dead front-holders, and shall be mounted in the auxiliary section.

2. Current Transformers: The quantity and ratio of current transformers shall be as indicated. Current transformers shall have thermal and mechanical ratings and insulation class not less than those of the associated circuit breakers. Current transformers shall be mounted in such a way as to provide easy access for inspection and maintenance.

3. Provide test blocks and plugs for current and potential circuits for the main breaker(s).

P. Spare and Space Cubicles

1. Circuit breaker compartments when specified future shall be completely equipped with draw-out rails for future addition of circuit breakers, including all electrical connections. Insulating sleeves shall be furnished over the main stationary disconnect studs.

2. Circuit breaker compartments indicated as spares shall have spare circuit breakers of the rating shown installed and wired.

Q. Lifting Device

   a. Provide a top of switchgear rail mounted overhead lighting device and transport dolly for removing circuit breaker.

R. Nameplates

1. Nameplates shall be provided for front and rear face of each cubicle and for major devices thereon, such as meters, instruments, control switches, and relays. Nameplates shall also be provided for major internal devices such as relays, instrument and control power transformer, fuse blocks, switches, and transformers. Cubicle nameplates shall be 3-layer laminated phenolic plastic, black front and back, white case, engraved to show white lettering. Lettering shall be upper case as follows:

   a. 1-inch high for switchgear identification.

   b. 7/16-inch high for compartment identification.

   c. 1/8-inch high for component nameplate.

2. Nameplates 1-1/2 inches tall and smaller shall be 1/16-inch thick. Nameplates larger than 1-1/2 inches tall shall be 1/8-inch thick. Edges of nameplates shall be beveled. Nameplates shall be fastened by black anodized screws.

S. **Surface Preparation, Painting, and Cleanliness:** Metal surfaces shall be smooth and free of all foreign matter such as scale, sand, blisters, weld splatter, metal chips and shavings, oil, grease, organic matter, and rust, and shall be chemically cleaned and treated in a process which provides a phosphate coating. Immediately after the treatment process, the surfaces shall be sprayed with a coating each of primer and finish paint; both shall be baked. Electrostatically deposited powder coated epoxy finishes, oven baked and 1-mill minimum thickness indoor and 2 mills minimum thickness outdoor, are acceptable.

1. All surfaces shall be finish painted light gray No. 61. The manufacturer's standard practice of double-tone finish on the low voltage switchgear section is acceptable.

2. Two spray cans of air-drying paint of each color tone shall be furnished to the CONTRACTING OFFICER.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. The CONTRACTOR shall install the switchgear in accordance with the manufacturer's instructions. The CONTRACTOR shall provide floor channels and shall secure the switchgear to the channels by bolting or track welding at the front and the rest.

B. Prior to energizing, all equipment shall be cleaned, inspected for loose connections, checked out for electrical and mechanical operations, and phase-sequenced, and all circuits made free of any shorts of ground connections following field testing.

C. CONTRACTOR shall anchor substation in conformance with "Anchoring" criteria stated in Section 16050 - Electrical General Provisions.

3.2 MANUFACTURER'S REPRESENTATIVE

A. The CONTRACTOR shall arrange for a technical service representative of the manufacturer for pre-commissioning checkout of the equipment and to instruct the

operating personnel in the operation, shutdown, startup, and maintenance of the equipment.

3.3 FIELD TESTING

A. The CONTRACTOR shall perform all testing required by Section 16950 - Electrical Tests.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 16431 – PROTECTIVE DEVICE STUDIES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall perform short circuit and protective device studies for the electrical power system in accordance with the Contract Documents.

B. The study shall include all portions of the electrical distribution system for normal and standby power sources down to and including the 480 V distribution system.

C. The WORK of this Section shall include protection studies for motors with solid state overload and overcurrent protection devices.

D. It is the responsibility of the CONTRACTOR to obtain the information required from the electric utility and appropriate vendors.

1.2 QUALIFICATIONS

A. Short circuit studies, protective device evaluation studies, and protective device coordination studies shall be performed by a manufacturer who has been regularly engaged in short circuit and protective device coordination services for a period of at least 15 years.

B. Studies shall utilize proven computer programs for making 3 - phase fault duty calculations.

1.3 CONTRACTOR SUBMITTALS

A. The Report shall be submitted and approved prior to final approval of the distribution equipment Shop Drawings and release of equipment for manufacture. Approval from the CONTRACTING OFFICER shall be obtained to ensure that equipment withstand and interruption ratings will be adequate.

B. The Report shall be approved by the CONTRACTING OFFICER prior to releasing distribution equipment for manufacture.

1.4 SERVICES OF MANUFACTURERS

A. The low voltage switchgear manufacturer shall furnish the services of a qualified field engineer and necessary tools and equipment to test, calibrate, and adjust the protective relays and circuit breaker trip devices as recommended in the power system coordination study.

B. The motor control center manufacturer shall furnish the services of a qualified field engineer to calibrate all MCPs as recommended in the power system study.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION

3.1 GENERAL

A. The study shall include development of single-line and impedance diagrams of the power system. Diagrams shall identify all components considered in the study and the ratings of all power devices, including transformers, circuit breakers, relays, fuses, busses, and cables. The resistances, and reactances of cables shall be identified in the impedance diagram. The study shall contain written data from the electric utility company regarding maximum available short circuit current, voltage, and X/R ratio of the utility power system.

B. The study shall include every protective device and feeders included in the WORK. The first upstream overcurrent device outside the WORK shall be used as a fixed reference.

3.2 SHORT CIRCUIT STUDY

A. The short circuit study shall be performed with the aid of a digital computer program, and shall be in accordance with:

ANSI/IEEE 141	Recommended Practice for Electrical Power Distribution for Industrial Plants
ANSI/IEEE 242	Recommended Practice for Protection, and Coordination of Industrial, and Commercial Power Systems
ANSI/IEEE C 37.010	Application Guide for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis
ANSI/IEEE C 37.13	Low-Voltage AC Power Circuit Breakers Used in Enclosures

3.3 PROTECTIVE DEVICE EVALUATION STUDY

A. A protective device evaluation study shall be performed to determine the adequacy of circuit breakers, molded case switches, and fuses. Any problem areas or inadequacies in the equipment due to prospective short-circuit currents shall be promptly brought to the CONTRACTING OFFICER's attention.

B. Do not utilize series rated circuit breakers to meet short circuit requirements for this project. Devices shall be fully rated to withstand available fault currents.

3.4 PROTECTIVE DEVICE COORDINATION STUDY

A. A protective device coordination study shall be performed to develop the necessary calculations to select power fuse ratings, protective relay characteristics and settings, ratios and characteristics of associated current transformers, and low-voltage breaker trip characteristics and settings.

3.5 TIME/CURRENT COORDINATION CURVES

A. As a minimum, the time/current coordination curves for the power distribution system shall include the following on 5-cycle log-log graph paper:

1. Time/current curves for each protective relay, circuit breaker, or fuse showing graphically that the settings will provide protection and selectivity within industry standards. Each curve shall be identified, and tap and time dial settings shall be specified. Provide individual curves for each feeder unless identical to others.

2. Time/current curves for each device shall be positioned to provide the maximum selectivity to minimize system disturbances during fault clearing. Where selectivity cannot be achieved, the CONTRACTING OFFICER shall be notified as to the cause. Recommendations shall be included for alternate methods that would improve selectivity.

3. Time/current curves and points for cable and equipment damage.

4. Circuit interrupting device operating and interrupting times.

5. Indicate maximum fault values on the graph.

6. Sketch of bus and breaker arrangement.

7. Magnetizing inrush points of transformers.

8. Thermal limits of dry type and liquid insulated transformers. (ANSI damage curve).

9. All restrictions of the ANSI and National Electrical Code shall be followed, and proper coordination intervals and separation of characteristics curves shall be maintained.

3.6 REPORT

A. The results of the power system studies shall be summarized in a final Report. Eight bound copies of the Report shall be submitted. The Report shall include the following:

1. Single-line diagram

2. Impedance diagram

3. Tabulation of all protective devices identified on the single line diagram

4. Time/current coordination curves

5. Specific recommendations, if any

6. Test instrumentation, condition, and connections, as applicable, for each study.

B. The Report shall include information concerning the computer program used for the study and also shall include a general discussion of the procedure, items, and data considered in preparing the study.

C. The CONTRACTOR shall indicate in the Report suggested changes to the protection scheme or equipment selection that will result in improved system reliability and safety.

3.7 PROTECTIVE DEVICE TESTING, CALIBRATION, AND ADJUSTMENT

A. Test, calibrate, and adjust the protective relays and circuit breaker trip devices as recommended in the power system coordination study.

B. Calibrate all MCPs as recommended in the power system study.

C. Adjustments shall be made prior to energization of any electrical equipment.

- END OF SECTION –

SECTION 16450 – GROUNDING

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide the electrical grounding system, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 16050 - Electrical Work, General apply to this Section.

C. **Single Manufacturer:** Like products shall be the end product of one manufacturer in order to achieve standardization of appearance, operation, maintenance, spare parts and manufacturer's services.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with the requirements of Section 01300 - Contractor Submittals and Section 16050.

B. **Shop Drawings:** Manufacturer's product information for connections, clamps, and grounding system components, showing compliance with the requirements of this Section.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Components of the grounding electrode system shall be manufactured in accordance with ANSI/UL 467 - Standard for Safety Grounding and Bonding Equipment, and shall conform to the applicable requirements of National Electrical Code Article 250 and local codes.

2.2 GROUNDING ELECTRODE SYSTEM

A. Grounding loop conductors shall be bare annealed copper conductors suitable for direct burial. Conductors shall be #4/0 unless indicated otherwise.

B. Ground Rods

1. Unless indicated otherwise, the ground rod shall be a minimum of 3/4-inch in diameter, 10-feet long, and have a uniform covering of electrolytic copper metallically bonded to a rigid steel core. The copper to steel bond shall be corrosion resistant.

2. Conform to ANSI/UL 467.

3. Sectional type joined by threaded copper alloy couplings.

C. Buried cable-to-cable and cable-to-ground rod connections shall be made using exothermic welds by **Cadweld, Enrico Products,** or equal.

D. Exposed grounding connectors shall be of the compression type (connector to cable), made of high copper alloy, and be manufactured specifically for the particular grounding application. The connectors shall be **Burndy, O.Z. Gedney**, or equal.

E. Grounding clamps shall be used to bond each separately derived system to the grounding electrode conductors.

F. Equipment Grounding Circuit Conductors

1. These conductors shall be the same type and insulation as the load circuit conductors. The minimum size shall be as outlined in Table 250.122 of the National Electrical Code, unless indicated otherwise.

2. Present in all raceways. The conduit system is not an allowable equipment ground.

G. Manufacturers of grounding materials shall be **Copperweld, Blackburn, Burndy,** or equal.

PART 3 -- EXECUTION

3.1 GROUNDING

A. Provide a separate grounding conductor, securely grounded in each raceway independent of raceway material.

B. Provide a separate grounding conductor for each motor and connect at motor box. Do not use bolts securing motor box to frame or cover for grounding connectors.

C. Size as given on the conduit schedule and in accordance with the NEC-Article 250.

D. Route conductors inside raceway.

E. Provide a grounding type bushing for secondary feeder conduits which originate from the secondary section of each MCC section, switchboard, or panelboard.

F. Individually bond these raceways to the ground bus in the secondary section.

G. Provide a green insulated wire as grounding jumper from the ground screw to a box grounding screw and, for grounding type devices, to equipment grounding conductor.

H. Provide a separate grounding conductor in each individual raceway for parallel feeders.

I. Interconnect the secondary switchgear neutral bus to the ground bus in the secondary switchgear compartment only at service entrance point or after a transformer.

J. Bond cold water pipe system and building structure to separate grounding electrode per NEC.

K. Provide the duct bank ground system indicated, including, trenching, splices, ground rods, and connections to equipment and structures.

L. Measure ground impedance in accordance with IEEE STD 81 after installation but before connecting the electrode to the remaining grounding system.

M. **Low Voltage Grounded System (600V or less):** A low voltage grounded system is a system where the local power supply is a transformer with the transformer secondary grounded.

1. The first disconnecting means on the load side of this transformer shall provide the point where the neutral conductor is grounded.

2. The neutral shall be connected to the Equipment Grounding Circuit Conductor only at one point, which is within the enclosure of the disconnecting means.

3. The Grounding Electrode Conductor or the Equipment Grounding Circuit Conductor shall not be used as the neutral.

N. Embedded Ground Connections

1. Underground and grounding connections embedded in concrete shall be UL listed compression type ground grid connectors.

2. The connection shall be made in accordance with the manufacturer's instructions.

3. The CONTRACTOR shall not conceal or cover any ground connections until the CONTRACTING OFFICER or his authorized representative has established that every grounding connection conforms to the Contract Documents and has given the CONTRACTOR written confirmation.

O. Ground Ring

1. Furnish trenching and materials necessary to install the ground ring as indicated.

2. Bonding conductor shall be in direct contact with the earth and be of the size indicated.

3. Minimum burial depth 36-inches or as indicated on the Drawings, whichever is greater.

4. Re-compact disturbed soils to original density in 6-inch layers.

P. **Duct Bank Ground:** A grounding conductor shall be embedded in every duct bank as indicated.

Q. Ground Rods

1. Locations shall be as indicated.

2. Rods forming an individual ground array shall be equal in length.

R. Shield Grounding

1. Shielded instrumentation cable shall have its shield grounded at one end only unless Shop Drawings indicate the shield will be grounded at both ends.

2. The grounding point shall be at the control panel or otherwise at the receiving end of the signal carried by the cable.

3. Termination of shield drain wire shall be on its own terminal screw.

4. All terminal screws shall be jumpered together using manufactured terminal block jumpers.

5. Connection to the ground bus shall be via a green No. 12 conductor to the main ground bus for the panel.

- END OF SECTION -

SECTION 16455 – VARIABLE FREQUENCY DRIVE UNITS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. **General:** The CONTRACTOR shall provide variable frequency drive (VFD) units, complete and operable, in accordance with the Contract Documents. It is the intent of this Section to require complete, reliable, fully tested variable frequency drive systems suitable for attended or unattended operation.

B. The requirements of Section 16050 - Electrical Work, General, apply to the WORK of this Section.

C. **Single Manufacturer:** Like products shall be the end product of one manufacturer in order to standardize appearance, operation, maintenance, spare parts, and manufacturer's services. This requirement, however, does not relieve the CONTRACTOR of overall responsibility for the WORK.

D. **Coordination:** The equipment provided under this Section shall operate the electric motor driver with the driven equipment as indicated under other equipment specifications. The CONTRACTOR'S attention is specifically directed to the need for proper coordination of the WORK under this Section and the WORK under the equipment section with the WORK under Section 16460 - Electric Motors.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01300 - Contractor Submittals, except that Shop Drawing information for the drives shall be submitted as part of the information for the driven equipment.

B. **Shop Drawings:** Shop Drawings shall include the following information:

1. Equipment information

    a. Name of drive manufacturer

    b. Type and model

    c. Assembly drawing and nomenclature

    d. Maximum heat dissipation capacity in KW

2. Conduit entrance provisions

3. Circuit breaker type, frames, and settings

4. Information related to relays, timers, pilot devices, control transformer VA, and fuse sizes. Include catalog cuts.

5. System schematic ladder diagram and interconnection diagrams. The schematic ladder diagram shall include all remote devices. The ladder diagram shall incorporate the control logic on the corresponding elementary schematic on the Contract Drawings. Submittals with drawings not meeting this requirement will not

be reviewed further and will be returned to the CONTRACTOR stamped "REJECTED"

6. Factory test data certifying compliance of similar equipment from the same manufacturer with requirements of this Section.

C. The Technical Manual shall contain the following documentation:

1. Manufacturer's two-year warranty.

2. Harmonic analysis report

3. Field test report.

4. Programming procedure and program settings.

D. **Spare Parts List:** Information for parts required by this Section plus any other spare parts recommended by the controller manufacturer.

PART 2 -- PRODUCTS

2.1 GENERAL

A. The CONTRACTOR shall provide a total of 8 variable frequency drives. Equipment to be operated through variable frequency drives include the following:

Quantity	Equipment	HP	Constant or Variable Torque (C/V)	RPM	Enclosure Type
3	VFD	200	VT	3600	NEMA1
1	VFD	125	VT	3600	NEMA1
2	VFD	40	CT	3600	NEMA1
2	VFD	½	CT	3600	NEMA1

2.2 EQUIPMENT

A. The power supply shall be an adjustable frequency inverter designed to convert incoming 3 phase, 480 volt, 60 Hertz power to a DC voltage and then to adjustable frequency AC by use of a 3 phase inverter. The inverter shall be a voltage source design producing a pulse-width-modulated type output. The inverters shall be designed to operate 460 volt, 3 phase, 60 Hertz, NEMA-B, open drip-proof (1.15 SF) or TEFC (1.15 SF), squirrel-cage high efficiency inverter duty induction motors over the range of 50-100 percent of base speed without derating or requiring any motor modifications, inverters shall be capable of delivering nameplate horsepower exclusive of service factor without the need for mandatory thermostats or feedback tachometers. The VFD shall vary both the AC voltage and frequency simultaneously to operate the motor at required speeds. Current source inverters will not be acceptable. Inverters shall be sized to match the KVA and inrush characteristics of the motors actually furnished. The CONTRACTOR shall be responsible for matching the controller to the load (variable torque or constant torque) as well as the speed and current of the actual motor being controlled. The CONTRACTOR shall provide "clean power" 18 pulse VFD's for VFD's operating motors greater than 100 HP.

B. The minimum VFD inverter efficiency shall be 95 percent at 100 percent speed and load, and 85 percent at 50 percent speed and load.

C. The VFD shall shut down in an orderly manner when a power outage occurs on one or more phases. Upon restoration of power and a "start" signal, the motor shall restart and run at the speed corresponding to the current process input signal.

D. The VFD shall be provided with additional features described below:

1. Inrush current adjustment between 50 and 110 percent of motor full load current (factory set at 100 percent).

2. Overload capability at 110 percent for 60 seconds for variable torque loads and 150 percent for constant torque loads.

3. Adjustable acceleration and deceleration.

4. Input signal of 4 - 20 mA from process.

5. Output speed signal of 4 - 20 mA. Signals other than 4 - 20 mA are not acceptable.

6. On loss of input signal, the VFD shall operate at a preset speed.

7. A minimum of two selectable frequency jump points to avoid critical resonance frequency of the driven system.

8. Additional devices and functions as indicated.

9. RS-485/Modbus/Remote I/O communications to transmit VFD data to/from a plant PLC-based control system.

E. **Protection:** The VFD shall have, as a minimum, the following protection features:

1. Input line protection shall be provided with metal oxide varistor (MOV) and RC network.

2. Protection against single phasing.

3. Instantaneous overcurrent protection.

4. Electronic overcurrent protection.

5. Ground fault protection.

6. Overtemperature protection for electronics.

7. Protection against internal faults.

8. Ability to start into rotating motor (forward or reverse rotation).

9. Additional protection and control as indicated and as required by the motor and driven equipment.

F. **Service Conditions:** The VFD shall be designed and constructed to satisfactorily operate within the following service conditions.

1. Elevation to 3300 feet – For elevation greater than 3300 ft, the VFD shall be derated per the manufacturer recommendation.

2. Ambient temperature - 0 degree C to 40 degrees C

3. Humidity: 0 to 95 percent, non-condensing

4. AC line voltage variation: plus 10 percent to minus 10 percent.

5. AC line frequency variation: plus and minus 2 hertz.

G. Electrical equipment provided in addition to the adjustable frequency inverter for each drive shall include:

1. 2 1/2 percent (minimum) Line Reactor integral to the drive enclosure.

2. Fused 480-120 volt control transformer to provide system control power for the logic and pilot lamps.

3. Bypass Starters

a. Bypass starters and circuit breakers shall be provided for VFD's where indicated. Starters shall be NEMA rated, Size 1 minimum. Starters shall be FVNR-type for motors less than 200 HP, and solid-state reduced-voltage type for motors 200 HP and above. A NEMA rated output contactor shall be provided with the VFD to allow disconnection of the inverter output while operating on the bypass starter. IEC rated devices are not acceptable.

b. Overload protection will be provided for bypass starters in accordance with NEC requirements.

c. The bypass contactor and related circuitry shall be mounted in a segregated compartment of the VFD enclosure.

4. Input circuit breaker.

5. Provide overload heaters with auxiliary contacts to protect the motors in both VFD and bypass modes. Refer to Elementary Schematics on the Contract Drawings for details. Heaters shall be sized for the motor actually furnished.

H. The inverter signal circuits shall be isolated from the power circuits and designed to accept an isolated 4 - 20 mA signal in the automatic mode of operation. The inverter shall follow the setting of a remote or local potentiometer control when in the manual mode. Refer to the Electrical Elementary Schematic drawings for speed control and start/stop methods. The following operator devices for the inverter shall be mounted and wired at locations indicated:

1. Auto/Hand selection from a remote logic relay or switch. In "Auto", the inverter shall operate from the remote 4 - 20 mA input, where applicable, and in "Hand" control, shall be from a local or remote manually operated speed potentiometer. Speed pot ratings shall be coordinated with the supplier of the Local Control Station.

2. Speed meter calibrated in percent speed

3. Inverter fault trip pilot light and output alarm contacts

4. Trip reset pushbutton

5. "Run" and "Off" indicating lights

6. Other controls and readouts normally furnished as standard equipment, or as otherwise indicated on the Electrical Contract Drawing Elementary Schematics

I. Screw type terminal boards, properly identified, shall be provided for interconnection to remote controls and instrumentation

J. Pilot devices, control relays, time delay relays, elapsed time meters, and indicators supplied as a part of the VFD equipment package shall meet the requirements of Section 16485 – Local Control Stations and Miscellaneous Electrical Devices.

2.3 HARMONIC ANALYSIS FOR DRIVES

A. The CONTRACTOR shall perform a harmonic study of the facilities included in this Contract.

B. The following assumptions shall be utilized:

1. The distribution system is a "general" system as classified by IEEE 519 under low voltage systems.

2. Assume 90 percent of total plant operating load is motor load and 10 percent is resistive.

3. Assume a 70 percent plant diversity factor (70 percent of total plant load is operating). Motors other than VFD's shall operate at 90 percent of name plate horsepower.

4. Assume all VFD's are operating.

5. Results shall be submitted prior to VFD shipment. Excessive harmonic distortion shall be specifically denoted and recommended. Corrective measures shall be submitted for action by the CONTRACTING OFFICER.

2.4 SPARE PARTS

A. The CONTRACTOR shall furnish the spare parts listed below, suitably packaged and labeled with the corresponding equipment number.

B. During the term of this Contract, the CONTRACTOR shall notify the CONTRACTING OFFICER in writing about any manufacturer's modification of spare part numbers, interchangeabilities, or model changes. If the CONTRACTING OFFICER determines that the modified parts no longer apply to the equipment provided, the CONTRACTOR shall furnish other applicable parts at no increase in cost to the GOVERNMENT.

C. The following spare parts shall be furnished:

1. One set of spare fuses of each size

2. One set of spare fuses of each size

3. Two dozen pilot lamps

4. One of each type of circuit board

a. Control board

b. Power board

c. Diode bridge

d. Transistor module

5. One of each size and type power diode and transistor

6. One set of tools for maintenance of VFD units

2.5 MANUFACTURERS

A. The variable frequency drive units shall be **Cutler-Hammer, Allen-Bradley**, **Robicon**, or equal.

PART 3 -- EXECUTION

3.1 SERVICES OF MANUFACTURER

A. **General:** An authorized service representative of the manufacturer shall be present at the site for 3 work days to furnish the services listed below. For the purpose of this paragraph, a work day is defined as an 8-hour period excluding travel time.

B. **Inspection, Startup, Field Adjustment:** The authorized service representative shall supervise the following and certify the equipment and controls have been properly installed, aligned, and readied for operation.

1. Installation of the equipment

2. Inspection, checking, and adjusting the equipment

3. Startup and field testing for proper operation

4. Performing field adjustments to insure that the equipment installation and operation comply with requirement

C. **Instruction of GOVERNMENT's Personnel:** The authorized representative shall instruct the GOVERNMENT's personnel in the operation and maintenance of the equipment, including step by step troubleshooting with test equipment. Instruction shall be specific to the VFD models provided. Training shall be scheduled a minimum of 3 weeks in advance of the first session. Training shall include individual sessions for 4 shifts of plant personnel. Proposed training materials shall be submitted for review, and comments shall be incorporated. Training materials shall remain with the trainees. The GOVERNMENT may videotape the training for later use with the GOVERNMENT's personnel.

3.2 INSTALLATION

A. Conduit stub-ups for interconnected cables and remote cables shall be located and terminated in accordance with the drive manufacturer's recommendation.

B. The CONTRACTOR shall perform all programming of drive parameters required for proper operation of the VFD's included in this project. Submit records of programming data in the equipment Technical Manual.

3.3 FIELD TESTING

A. Testing, checkout, and startup of the VFD equipment in the field shall be performed under the technical direction of the manufacturer's service engineer. Under no circumstances shall any portion of the drive system be energized without authorization from the manufacturer's representative.

B. The CONTRACTOR shall test the completed installation for actual harmonic distortion at the point of common coupling.

1. Harmonic analysis shall be performed in accordance with IEEE 519-Harmonic Control and Reactive Compensation of Static Power Converters at unit full load using a harmonic analyzer by **Hewlett Packard**, or equal

C. Tests shall prove that the harmonic voltage distortion at the 480 volt distribution bus of the panelboard, motor control center, or switchgear serving the VFD is limited to a magnitude of 5 percent of the fundamental with the isolation transformer in the circuit as indicated and with the maximum number of drives, as permitted by the process, in operation. The report shall include the following:

1. Expected harmonic voltage (THD) through the 35th harmonic, calculated with isolation transformers

2. Actual RMS value and measured percentage of the THD in the field.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 16460 - ELECTRIC MOTORS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. **General:** The CONTRACTOR shall provide electric motors, accessories, and appurtenances complete and operable, in conformance with the individual driven equipment specifications and the Contract Documents.

B. The provisions of this Section apply to all low voltage AC squirrel cage induction motors except as indicated otherwise.

C. The CONTRACTOR shall assign to the equipment supplier the responsibility to select suitable electric motors for the equipment. The choice of motor manufacturer shall be subject to review by the CONTRACTING OFFICER. Such review will consider future availability of replacement parts and compatibility with driven equipment.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01300-Contractor Submittals.

B. Complete motor data shall be submitted with the driven machinery Shop Drawings. Motor data shall include:

1. Machine name and specification number of driven machine
2. Motor manufacturer
3. Motor type or model and dimension drawing. Include motor weight.
4. Nominal horsepower
5. NEMA Design
6. Enclosure
7. Frame Size
8. Winding insulation class and temperature rise class
9. Voltage, phase and frequency ratings
10. Service factor
11. Full load current at rated horsepower for application voltage
12. Full load speed
13. Guaranteed minimum full load efficiency. Also nominal efficiencies at 1/2 and 3/4 load.
14. Type of thermal protection or overtemperature protection, if included

15. Wiring diagram for devices such as motor leak detection, temperature, or zero speed switches, as applicable

16. Bearing data. Include recommendation for lubricants of relubricatable type bearings.

17. If utilized with a variable frequency controller, verify motor is inverter duty type. Include minimum speed at which motor may be operated for the driven machinery.

18. Power factor at 1/2, 3/4 and full load

19. Recommended size for power factor correction capacitors to improve power factor to 0.95 (lagging) when operated at full load.

C. If water cooling is required for motor thrust bearings, the Shop Drawing submittals shall indicate this requirement.

PART 2 -- PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Electric motors driving identical machines shall be identical.

B. Maximum motor loading shall in all cases be equal to nameplate horsepower rating or less, exclusive of service factor and be verifiable from the submittal data of the driven machinery.

C. Motor Capacity

1. The CONTRACTOR shall size motors for the larger of the following criteria:

a. Size motors to continuously carry the maximum load that develops across the full range of driven equipment operation.

b. Size motors for minimum size indicated

2. In all cases, motor sizes shall be derated from nameplate values as follows:

a. Ambient Temperature

1) For ambient temperatures up to but not exceeding 40 degrees C, no derating is required.

2) For ambient temperatures exceeding 40 degrees but less than 50 degrees C, derate nameplate HP ratings to 85 percent.

b. Site Altitude: No derating is required for altitudes less than 3300 feet (1000 meters). Higher altitudes require the following derating factors:

Altitude	1.0 Service Factor	1.15 Service Factor
3300 to 9000 ft	93 percent	100 percent

9000 to 13,200 ft	91 percent	98 percent

3. Increased circuit breaker, magnetic starter, and conductor and conduit capacities required for motors larger than the indicated sizes shall be provided as part of the WORK.

D. **Exempt Motors:** Motors for valve operators, submersible pumps, or motors which are an integral part of standard manufactured equipment, i.e., non-NEMA mounting, common shaft with driven element, or part of domestic or commercial use apparatus may be excepted from these specifications to the extent that such variation reflects a necessary condition of motor service or a requirement of the driven equipment.

2.2 DESIGN REQUIREMENTS

A. **General:** Electric motors shall comply with ANSI/NEMA MG-1 - Motor and Generator. Motors used with adjustable frequency drives shall comply with ANSI/NEMA MG-1, Part 31.

B. **NEMA Design:** Electric motors shall be NEMA Design B, unless otherwise indicated. In no case shall starting torque or breakdown torque be less than the value in ANSI/NEMA MG 1. Motors shall be suitable for the indicated starting method.

C. **Motor Voltage Ratings:** Motors shall have voltage ratings in accordance with the following, unless otherwise indicated:

1. Motors below 1/2-HP shall be rated 115 volts, single-phase, 60-Hz. Dual voltage motors rated 115/230-volts, 115/208-volts, or 120-240 volts are acceptable, provided all leads are brought out to the conduit box.

2. Motors 1/2-HP and larger shall be rated 230 volts, 460 volts, or 4160 volts, 3-phase, 60-Hz. Dual voltage motors rated 230/460 volts or 208/230/460 volts are acceptable, provided all loads are brought out to the conduit box.

D. **Insulation:** All 3-phase motors shall be provided with Class F insulation, rated to operate at a maximum ambient temperature of 40 degrees C and at the altitudes where the motors will be installed and operated, without exceeding Class B temperature rise limits stated in ANSI/NEMA MG 1-12.44. Single phase motors shall have Class F insulation with temperature rise not to exceed the insulation class. Motors to be operated from adjustable frequency drives shall be provided with insulation systems to withstand 1600 volt spikes, with dV/dt as defined in NEMA MG 1-31.

E. Motors 50 HP or smaller located in non-hazardous areas shall be totally enclosed, fan cooled (TEFC) with a Service Factor of 1.15 unless otherwise indicated.

F. Motors 50 HP and greater located in non-hazardous areas shall be TEFC, with a service factor of 1.15.

G. Motors for use in hazardous locations shall have enclosures suitable for the classification indicated. Such motors shall be U.L. listed and be stamped as such.

H. Motors larger than 50 HP installed outdoors or in unheated areas shall be provided with 120-volt AC space heaters, wired to a terminal strip in a low voltage motor junction box.

I. High Efficiency Motors

1. Motors with a nameplate rating of 1 HP and larger shall be "high efficiency" units. Motors shall be stamped with the efficiency on the nameplate with the caption "NEMA Nominal Efficiency" or "NEMA Nom. Eff." Such motors shall have efficiencies determined by the test as set forth in ANSI/IEEE 112 -Standard Test Procedure for Polyphase Induction Motors and Generators, Method B.

2. Efficiency: Nominal efficiency and minimum efficiency shall be defined in accordance with ANSI/NEMA MG 1-12.60 - Efficiency Levels of Energy Efficient Polyphase Squirrel-Cage Induction Motors: these 2 values shall be stated in the Shop Drawing submittal.

3. High Efficiency motors shall conform to the following guaranteed minimum efficiency requirements which are full load values:

TOTALLY ENCLOSED - FAN COOLED (TEFC)								
ENCLOSED MOTORS								
	2 POLE		4 POLE		6 POLE		8 POLE	
HP	Nom. Effic.	Min. Effic.	Nom. Effic.	Min. Effic.	Nom. Effic.	Min. Effic.	Nom. Effic.	Min. Effic.
1.0	75.5	72.0	82.5	80.0	80.0	77.0	74.0	70.0
1.5	82.5	80.0	84.0	81.5	85.5	82.5	77.0	74.0
2.0	84.0	81.5	84.0	81.5	86.5	84.0	82.5	80.0
3.0	85.5	82.5	87.5	85.5	87.5	85.5	84.0	81.5
5.0	87.5	85.5	87.5	85.5	87.5	85.5	85.5	82.5
7.5	88.5	86.5	89.5	87.5	89.5	87.5	85.5	82.5
10.0	89.5	87.5	89.5	87.5	89.5	87.5	88.5	86.5
15.0	90.2	88.5	91.0	89.5	90.2	88.5	88.5	86.5
20.0	90.2	88.5	91.0	89.5	90.2	88.5	89.5	87.5
25.0	91.0	89.5	92.4	91.0	91.7	90.2	89.5	87.5
30.0	91.0	89.5	92.4	91.0	91.7	90.2	91.0	89.5
40.0	91.7	90.2	93.0	91.7	93.0	91.7	91.0	89.5
50.0	92.4	91.0	93.0	91.7	93.0	91.7	91.7	90.2
60.0	93.0	91.7	93.6	92.4	93.6	92.4	91.7	90.2
75.0	93.0	91.7	94.1	93.0	93.6	92.4	93.0	91.7
100.0	93.6	92.4	94.5	93.6	94.1	93.0	93.0	91.7
125.0	94.5	93.6	94.5	93.6	94.1	93.0	93.6	92.4
150.0	94.5	93.6	95.0	94.1	95.0	94.1	93.6	92.4
200.0	95.0	94.1	95.0	94.1	95.0	94.1	94.1	93.0
250.0	95.4	94.5	95.0	94.1	95.0	94.1	94.5	93.6
300.0	95.4	94.5	95.4	94.5	95.0	94.1	--	--
350.0	95.4	94.5	95.4	94.5	95.0	94.1	--	--
400.0	95.4	94.5	95.4	94.5	--	--	--	--
450.0	95.4	94.5	95.4	94.5	--	--	--	--
500.0	95.4	94.5	95.8	95.0	--	--	--	--

J. All two-speed motors shall be the two-winding types.

2.3 ACCESSORY REQUIREMENTS

A. **General:** Horizontal motors 3 HP and larger, and all vertical motors, shall have split-type cast metal conduit boxes. Motors less than 3 HP shall have the manufacturer's standard conduit boxes. Motors other than open drip-proof shall be gasketed.

B. **Lifting Devices:** Motors weighing 265 lb (120 Kg) or more shall have suitable lifting eyes for installation and removal.

C. **Special Requirements:** The CONTRACTOR shall refer to individual equipment specifications for special requirements such as motor winding thermal protection or multi-speed windings.

D. **Grounding Lugs:** Provide motor grounding lug suitable to terminate ground wire, sized as indicated.

E. **Nameplate:** Motors shall be fitted with permanent stainless steel nameplates indelibly stamped or engraved with NEMA Standard motor data, in conformance with NEMA MG-1-10.40.

F. The motor manufacturer shall furnish for installation by the Electrical Subcontractor power factor correction capacitors for each motor 10 HP and larger. For motors controlled through FVNR, RVR or FVTS (two-speed, high speed winding connected) starters, the capacitors shall be wired to the output of the motor starter. The capacitors shall be fused, with internal resistors, suitable enclosed for mounting adjacent to the starter, MCC, or motor. Motors controlled through FVNR-AT (auto-transformer) or solid-state starters or VFD's shall be provided with a dedicated contactor, wired to close when the motor is started and open when the motor is stopped and connected to the load side of the circuit breaker or fused disconnect at the input to the controller. The capacitors shall be sized as recommended by the motor manufacturer to improve power factor to not less than 95 percent lagging, at rated full load. The capacitor dielectric materials shall be non-PCB type, non-flammable, and biodegradable.

G. Where motors are indicated by elementary schematics or specifications to have zero speed switches, the switches shall be factory mounted integral to the motors. Switches shall close contact when the motor is at zero speed.

2.4 MOTOR THERMAL PROTECTION

A. **Single Phase Motors:** Single phase 120, 208, or 230 volt motors shall have integral thermal overload protection or shall be inherently current limited.

B. **Thermostats:** Winding thermostats shall be snap action, bi-metallic, temperature-actuated switch. Thermostats shall be provided with one normally closed contact. The thermostat switch point shall be precalibrated by the manufacturer.

C. **RTDs**: Bearing RTDs and/or winding RTDs (two per phase) shall be provided where indicated. RTDs shall be 100 ohm platinum.

2.5 MOTOR BEARINGS

A. **General:** Bearings shall conform to Section 11000 - Equipment General Provisions, except as indicated herein.

B. Motors greater than 2 HP shall have bearings designed for 17,500 hours (belted) or 100,000 hours (coupled) L-10 life.

C. **Fractional Horsepower:** Motors with fractional horsepower through 2 HP shall be provided with Lubricated-for-Life ball bearings.

D. **Horizontal Motors Over 2 HP:** Motors larger than 2 HP shall be provided with relubricatable ball bearings. Lubrication shall be per manufacturer's recommendation for smooth operation and long life of the bearings.

E. **Vertical Motors Over 2 HP:** Vertical motors larger than 2 HP shall be provided with relubricatable ball, spherical, roller, or plate type thrust bearings. Lubrication shall be per manufacturer's recommendation for smooth operation and long life of the bearings.

F. **Water Cooled Motors:** If water cooling is required for the thrust bearings, cooling water lines shall be provided complete with shut-off valve, strainer, solenoid valve, flow indicator, thermometer, throttling valve, and, (where subject to freezing), insulation with heat tracing.

2.6 MANUFACTURERS, OR EQUAL

A. **U.S. Motors**

B. **Reliance Electric**

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Motor installation shall be performed in accordance with the motor manufacturer's written recommendations and the written requirements of the manufacturer of the driven equipment.

B. Related electrical work involving connections, controls, switches, and disconnects shall be performed in accordance with the applicable sections of Division 16.

C. For motors utilizing power factor correction capacitors connected to the starter output terminals, the motor overload elements or trip settings shall be adjusted downwards to reflect the reduction in line current resulting from power factor correction.

3.2 FACTORY TESTING

A. Motors rated 100 HP and larger shall be factory tested in conformance with ANSI/IEEE 112, IEEE 43 - Recommended Practice for Testing Resistance of Rotating Machinery, and NEMA MG-2. Except where specific testing or witnessed shop tests are required by the specifications for driven equipment, factory test reports may be copies of routine test reports of electrically duplicate motors. Test report shall indicate test procedure and instrumentation used to measure and record data. Test report shall be certified by the motor manufacturer's test personnel and be submitted to the CONTRACTING OFFICER.

3.3 FIELD TESTING

A. The CONTRACTOR shall perform the following field tests:

1. Inspect each motor installation for any deviation from rated voltage, phase, or frequency and improper installation.

2. Visually check for proper phase and ground connections. Verify that multi-voltage motors are connected for proper voltage.

3. Check winding and bearing temperature detectors and space heaters for functional operation.

4. Test for proper rotation prior to connection to the driven equipment.

5. Test insulation (megger test) of all new and re-used motors in accordance with NEMA MG-1. Test voltage shall be 1000 VAC plus twice the rated voltage of the motor.

- END OF SECTION -

SECTION 16470 - PANELBOARDS AND GENERAL PURPOSE DRY TYPE TRANSFORMERS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide panelboards and general purpose dry-type transformers, complete and operable, in accordance with the Contract Documents.

B. **Single Manufacturer:** Like products shall be the end product of one manufacturer in order to achieve standardization of appearance, operation, maintenance, spare parts, and manufacturer's services.

1.2 CONTRACTOR SUBMITTALS

A. **General:** Submittals shall be in accordance with Section 01300 - Contractor Submittals and Section 16050 - Electrical Work, General.

B. Shop Drawings

1. Transformers

a. Dimension drawings
b. Technical certification sheets
c. Drawing of conduit entry/exit locations
d. Transformer ratings, including:

1) Voltage
2) Continuous current
3) Basic impulse level for equipment over 600 volts
4) Kva

e. Descriptive bulletins
f. Product sheets

2. Panelboards

a. Breaker layout drawings with dimensions and nameplate designations
b. Component list
c. Drawings of conduit entry/exit locations
d. Assembly ratings including:

1) Short circuit rating
2) Voltage
3) Continuous current

e. Cable terminal sizes
f. Descriptive bulletins
g. Product sheets
h. Installation information
i. Seismic certification and equipment anchorage details

PART 2 -- PRODUCTS

2.1 GENERAL

A. Transformers

1. The transformers shall be dry-type, designed, manufactured, and tested in accordance with the latest applicable standards of ANSI and NEMA.

2. Transformers shall be UL-listed and bear the UL label.

B. Panelboards

1. Panelboards shall be dead front factory assembled. Panelboards shall comply with NEMA PB-1-Panelboards, as well as the provisions of UL 50 - Safety Enclosures for Electrical Equipment and UL 67 - Safety Panelboards. Panelboards used for service equipment shall be UL labeled for such use. Lighting panelboards shall be rated for 120/208-volt, 3-phase operation or 120/240-volt for single phase operation as indicated. Power panelboards shall be rated for 480 volts, 3-phase, 3-wire operation.

2. The manufacturer of the panelboard shall be the manufacturer of the major components within the assembly, including circuit breakers.

2.2 TRANSFORMERS

A. Ratings

1. KVA and voltage ratings shall be as indicated.

2. Transformers shall be designed for continuous operation at rated kVA, for 24 hours a day, 365 days a year operation, with normal life expectancy as defined in ANSI C57.96 - Guide for Loading Dry Type Distribution and Power Transformers

3. Transformer sound levels shall not exceed the following ANSI and NEMA levels for self-cooled ratings:

Up to 9 kVA	40 db
10to50 kVA	45 db
51to150 kVA	50 db

B. Construction

1. Insulation Systems

a. Transformers shall be insulated as follows:

1) 2 kVA and below: 150 degrees C insulation system based upon 80 degree C rise.

2) 3 to 15 kVA: 185 degrees C insulation system based upon 115 degree C rise.15 kVA and above: 220 degrees C insulation system based upon 150 degree C rise.

b. Required performance shall be obtained without exceeding the above indicated temperature rise in a 40 degrees C maximum ambient.

c. All insulation materials shall be flame-retardant and shall not support combustion as defined in ASTM D 635 - Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position.

2. Transformer windings shall be copper.

3. Transformers shall have four 2-1/2 percent taps, two above and two below 480 volts.

C. Manufacturers: Transformers shall be floor or wall-mounted type by **General Electric, Cutler-Hammer, Square D,** or equal.

2.3 PANELBOARDS

A. Ratings

1. Panelboards rated 240 VAC or less shall have short circuit ratings not less than 10,000 amperes RMS symmetrical or as indicated by the Short Circuit Study, whichever is greater.

2. Panelboards rated 480 VAC shall have short circuit ratings not less than 25,000 amperes RMS symmetrical or as indicated by the Short Circuit Study, whichever is greater.

3. Panelboards shall be labeled with a UL short circuit rating. Series ratings are not acceptable.

B. Construction

1. All lighting and power distribution panels shall have copper busbars.

2. Breakers shall be one, two, or three pole as indicated, with ampere trip ratings as required by the equipment. Breakers shall be quick-make and quick-break, inverse time trip characteristics, to trip free on overload or short circuit, and to indicate trip condition by the handle position.

3. The panels shall have hinged doors with combination catch and latch. The front panels shall be so arranged that when the plates are removed, the gutters, terminals and wiring will be exposed and accessible. The doors shall have inner doors within the plates to have only the breaker operating mechanism exposed when they are opened. Live conductors and terminals shall be concealed behind the plates.

4. All panelboards shall be rated for the intended voltage.

5. All circuit breakers shall be interchangeable and capable of being operated in any position as well as being removable from the front of the panelboard without disturbing adjacent units. No plug-in circuit breakers will be acceptable.

6. Lighting and power distribution panels which are not part of a motor control center shall be constructed in accordance with Section 16050. Panels shall have the necessary barriers, supports, and liberal wiring gutters. Trim screws shall be stainless steel. All panelboard parts of metal other than copper, aluminum, or stainless steel shall be cadmium plated. Panelboards shall be as manufactured by **General Electric or Cutler-Hammer**.

7. Panelboards shall be UL listed except for special enclosures which are not available with UL listing.

8. Panelboards shall be suitable for use as service entrance as indicated or as otherwise required by the N.E.C.

PART 3 -- EXECUTION

3.1 GENERAL

A. All WORK of this Section shall be installed as indicated in Section 16050.

- END OF SECTION -

SECTION 16480 – LOW VOLTAGE MOTOR CONTROL CENTERS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide motor control centers (MCC's), complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 16050 - Electrical Work, General, apply to the WORK of this Section.

C. In the event that motors provided are larger horsepower than motors indicated, raceways, conductors, starters, overload elements, and branch circuit protectors shall be revised as necessary to control and protect the increased motor horsepower according to Section 16460-Electric Motors. Adjustments shall be made as a part of the WORK.

1.2 CONTRACTOR SUBMITTALS

A. **General:** Submittals shall be in accordance with Sections 01300-Contractor Submittals and 16050.

B. Shop Drawings

1. Enclosure NEMA rating and color

2. Horizontal and vertical bus ampacities, voltage rating and interrupting capacity. Include materials of construction

3. Ground bus size and material of construction

4. Conduit entrance provisions

5. Main incoming line entry provision (top or bottom)

6. Control unit nameplate schedule

7. All circuit breaker types, frames and settings

8. All starter NEMA sizes, auxiliary contact provisions, coil voltage

9. Relays, timers, pilot devices, control transformer VA and fuse sizes

10. Elementary schematic ladder diagrams for each compartment. Custom schematics shall be furnished. Diagrams shall include all remote devices. Submittals with drawings not meeting this requirement will not be reviewed further and will be returned to the CONTRACTOR stamped "REJECTED-RESUBMIT".

11. Short circuit rating of the complete assembly

12. Replacement parts lists and operation and maintenance procedures

13. Seismic design certification of the anchoring system in accordance with 16050.

14. Time-current curves for all protective devices

PART 2 -- PRODUCT

2.1 GENERAL

A. The manufacturer of the low voltage motor control center shall also be the manufacturer of at least the following:

1. Molded case circuit breakers up to and including 225 ampere frame size

2. Disconnect switches

3. Magnetic motor starters

4. Control and timing relays rated at 600 volts AC

5. Pushbuttons, lights, and selector switches, including remote mounted control stations

6. Meters, including ammeter, voltmeter, and solid-state metering devices

B. Devices of the same type shall be products of the same manufacturer. This requirement applies to all control devices, and insofar as practical, to equipment manufactured on a production basis. It also applies without exception to equipment custom fabricated for this project.

C. Motor control centers shall conform to the standards for NEMA Class IIS, type B diagrams and wiring.

D. MCC Schedule

MCC DESIGNATION	LOCATION
MCC–A	Electrical Building

2.2 DESIGN, CONSTRUCTION, AND MATERIAL REQUIREMENTS

A. The motor control centers shall be 600-volt class suitable for operation on a three-phase, 60-Hz system. The system operating voltage and number of wires shall be as indicated.

B. The motor control center shall receive power from a three phase, wye connected 277/480 volt transformer with a grounded neutral. Power distribution from the MCC shall be 480 volt, three-phase, three-wire, however the MCC shall include provision for termination of an incoming neutral conductor in conformance to NEC requirements for service entrance.

C. Enclosure shall be NEMA Type 1, gasketed enclosure. Compartment doors shall be interlocked with compartment circuit breakers. The interlock shall be fitted with a maintenance override.

D. Size and Arrangement

1. Motor control centers shall be of mechanical groupings of control center units, assembled into a lineup of control center sections. Each control section shall be nominally 90-inches tall by minimum 20-inches deep.

2. MCC's shall be designed to not exceed the space requirements as indicated on the Contract Drawings, including spaces, spares, and future compartments. MCC's shall be subject to rejection for exceeding the lengths indicated where allotted space is critical.

3. Equipment within the MCC may be rearranged at the discretion of the manufacturer, providing the MCC provides the spares, space, and future provisions indicated.

4. All switches and circuit breakers used as switches shall be located so that the center of the grip of the operating handle of the switch or circuit breaker, when in its highest position, will not be more than 6 feet 7 inches above the floor, including the height of the concrete pad.

E. Components

1. Busses

a. A continuous copper ground bus shall be provided with full width of the motor control center line-up.

b. The main horizontal bus shall be tin-plated copper located within an isolated compartment. The bus shall be rated 600 amperes minimum, but in no instance less than the main lug or main breaker frame size.

c. The vertical bus in each section shall consist of a single tin-plated copper conductor per phase with a current capacity of not less than 300 amps. The vertical bus shall be completely isolated and insulated, and shall extend the full height of the section wherever possible.

d. Fully rated continuous copper neutral bus shall be provided through the control center. Lugs of appropriate capacity shall also be provided.

e. All power buses shall be braced to withstand 65,000 amperes, minimum.

2. Wireways: A separate vertical wireway shall be provided adjacent to each vertical unit, and shall be covered by a hinged door. Each individual unit compartment shall be provided with a side barrier to permit pulling wire in the vertical wireway without disturbing adjacent unit components.

F. Cabinet

1. Structural members shall be fabricated of not less than 12 gauge steel and side and top panels and doors shall be not less than 14 gauge steel.

2. Spaces designated as "SPACE" or "BLANK" shall include blank hinged doors and vertical bus bars.

3. Control units inside compartments shall be clearly identified with tags or stencil markings.

4. Each control unit including spares, spaces and blanks, lights, and devices shall be identified by an engraved nameplate. Identification shall include circuit number as indicated.

5. Each motor control center shall be fitted with the manufacturer's nameplate which shall include the NEMA Standard electric rating and other pertinent data, including manufacturer, sales order number, date of manufacture, and place of manufacture.

6. Where "L" or "U" shaped MCC layouts are indicated, corner compartments shall have similar current and short circuit ratings as functional compartments.

7. Fans, heat exchangers, transformers, capacitors, junction boxes, or other devices may not be mounted on the outside of the motor control center enclosure.

8. Finish for motor control center shall be light grey, ANSI 61. The panels shall be given 2 coats of primer inside and out and 2 coats of enamel finish. External colors other than ANSI 61 will not be acceptable.

2.3 MOTOR STARTERS

A. Motor starters shall be mounted in standard motor control center assemblies, arranged as indicated.

B. Each motor starter unit shall consist of a combination magnetic contactor and short circuit protective device, mounted in a completely enclosed cubicle. Short circuit protective device shall be an instantaneous, magnetic only circuit breaker, **Cutler-Hammer Type HMCP, G.E. Mag-Break Motor Circuit Protector**, or equal. All circuit breakers provided as part of a motor starter unit shall be capable of being padlocked in the open position. Reset of thermal overload elements shall be possible with unit door closed. Three phase overload trip units shall be furnished to suit the full load current of the equipment installed. Overload trip unit shall be adjusted as required for power factor correction capacitors.

C. Magnetic starters shall have auxiliary contacts as required by electrical motor control diagrams, including N-O and N-C contacts as indicated, plus one each spare N-O and N-C contact. The combination motor starters shall be drawout-type for size 5 and below. The fixed-type unit assembly shall be constructed so that it can be easily removed from its panel after disconnecting the wires to the terminal block and withdrawing from the primary bus. Removal of a unit assembly shall be possible without rear access and without disturbing any other unit in the motor control center.

D. Each starter unit shall have its own control power transformer. It shall have a 115-volt grounded secondary. One secondary fuse and 2 primary fuses shall be provided. Control power transformers shall be sized to accommodate the control devices indicated. Local control devices shall be mounted independently of the cover door. All starters shall have a local red "running" lamp and a green "off" light to indicate the presence of control power when the motor is not running. Starters shall be provided with elapsed time meters, hand/off/auto selector switches, and other devices as indicated. All cubicle control wires shall be terminated at a pull apart disconnecting terminal block at the cubicle.

E. The motor control center manufacturer shall be responsible for identifying each control wire within each motor starter unit with wrap-around permanent plastic markers. Each control wire shall be identified at both ends.

F. Full voltage motor starter units shall be NEMA Size 1 or larger. Each combination starter shall be rated for a minimum 65,000 RMS symmetrical amperes.

G. Motor starters shall be designed to NEMA ratings. Starters designed to IEC ratings or with dual IEC/NEMA ratings will not be acceptable, either as part of any MCC, as remote starters, or as part of any equipment package.

H. Reduced voltage auto-transformer starters shall consist of a molded-case motor circuit protector in combination with a closed transition type auto-transformer starter with 50 percent, 65 percent, and 80 percent taps, and shall be set on the 65 percent tap. The starter shall have three phase overload relays, and shall be ambient temperature-compensated with manual reset. The auto-transformer shall include a thermal switch wired to protect itself from overheating. Timing of the starting period shall be controlled by an adjustable accelerating relay.

I. Solid state reduced voltage starters shall be UL listed and shall consist of an incoming power circuit breaker, a power section, logic board, and paralleling bypass contactor to be energized when the motor reaches full voltage. Solid state starters shall include adjustments for starting torque, acceleration rate control by voltage ramps, and current limit. Output contactors shall be provided where indicated.

J. Two speed starters shall be of the two-winding type unless otherwise indicated.

K. Variable Speed Drives (VFD's) shall be in conformance as applicable to Section 16455 – Variable Frequency Drives. Externally mounted line reaction, cooling fan, and bypass contactor will not be acceptable.

2.4 MAIN AND FEEDER CIRCUIT BREAKERS (480 V)

A. Circuit breakers having a frame size of 150 amperes or less shall be molded-case type with thermal magnetic non-interchangeable, trip-free, sealed trip units.

B. Circuit breakers with a frame size of 225 amperes to 1,200 amperes shall be molded case with RMS sensing electronic trip elements.

C. The interrupting capacity of all main, and feeder branch circuit breakers shall be a minimum of 65,000 RMS symmetrical amperes. Service disconnects rated 1000A or more shall provide ground fault protection of equipment.

D. Circuit breaker disconnect operators shall be capable of accommodating 3 padlocks for locking in the "open" position.

2.5 CONTROL DEVICES

A. All control devices shall conform to the requirements of Section 16485 - Local Control Stations and Miscellaneous Electrical Devices.

B. Provide solid state type metering where indicated. Include CT's and PT's of ratios as indicated.

1. Solid state metering shall be **G.E. "PQM", Cutler-Hammer "DP-4000," Square D "Power-Logic**," or equal.

2.6 FACTORY TESTS

A. All motor control centers and their components shall be given manufacturer's standard electrical and mechanical production tests and inspections. The tests shall include electrical continuity check, dielectric tests for each circuit, and inspection for proper functioning of all components including controls, protective devices, metering, and alarm devices.

2.7 SPARE PARTS

A. The CONTRACTOR shall furnish the following for each MCC:

1. One unit control transformer of each size furnished in magnetic starters installed

2. Three bezels of each color installed for pilot indicators

3. One dozen panel lamps

4. One dozen control fuses of each size installed

B. Spare parts shall be identified by MCC number, type, size, and manufacturer.

2.8 MANUFACTURERS, OR EQUAL

A. Motor control centers shall be **Cutler-Hammer "2100" Series, General Electric "8000 Line,"** or **Square D, Model 6.**

PART 3 -- EXECUTION

3.1 GENERAL

A. The CONTRACTOR shall install motor control centers in accordance with manufacturer's published instructions. Conduit installation shall be coordinated with manufacturer's as-fabricated drawings so that all conduit stub-ups are within the area allotted for conduit. Conduit shall be stubbed up in the section that contains the devices to which conductors are terminated.

B. If stored at the Site, motor control centers shall be stored in a clean, dry space. Factory wrapping shall be maintained or an additional heavy plastic cover shall be provided to protect units from dirt, water, construction debris, and traffic. Storage space shall be heated or MCC space heaters shall be energized.

C. Motor control centers shall be handled carefully to avoid damage to motor control center components, enclosure, and finish. Damage shall be repaired before installation.

3.2 INSTALLATION

A. Motor control centers shall be installed on 3-1/2-inch concrete pads. After leveling and shimming, the CONTRACTOR shall anchor motor control centers to concrete pads, and shall grout so that no space exists between the pad and support beams.

B. The CONTRACTOR shall:

1. .Torque all bus bar bolts to manufacturer's recommendations. Tighten all sheet metal and strcture assembly bolts.

2. Adjust all Motor Circuit Protector (MCP) devices to the instantaneous trip setting position recommended for the actual horsepower and full load amps of the motor. Verify that overload devices are proper for equipment installed; make necessary changes in overload devices as required for motors having power factor correcting capacitors.

3. After equipment is installed, touch up scratches and verify that nameplate, and other identification is accurate.

4. Provide high voltage switchboard matting in front of the MCC. The mat shall be 1/4-inch thick and 36-inches wide and shall be **Model M36** as manufactured by **W.H. Salisbury & Co.,** or equal.

3.3 FIELD TESTS

A. Visual and mechanical inspection after installation

1. Inspect for physical damage, proper anchorage, and grounding

2. Verify that the ratings of the thermal overload heaters match the motor full-load current nameplate data.

3. Check tightness of bolted connections.

B. Electrical Tests

1. Insulation tests

a. Measure insulation resistance of each bus section phase to phase and phase to ground for one minute. Test voltage and minimum acceptable resistance shall be in accordance with manufacturer's recommendations.

b. Measure insulation resistance of each starter section phase to phase and phase to ground with the starter contacts closed and the protective device open. Test voltage and minimum acceptable resistance shall be in accordance with the manufacturer's recommendations.

c. Measure insulation resistance of each control circuit with respect to ground

2. Verify proper operation of control logic in all modes of control.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 16485 – LOCAL CONTROL STATIONS AND MISCELLANEOUS ELECTRICAL DEVICES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide complete local control stations as indicated herein or in other Sections of the Specifications. The stations shall be designed to provide the sequence of operation in Section 17100 - Process Control and Instrumentation Systems, and the P&ID drawings.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Local control panels shall comply with the requirements of NEC, NEMA, and UL.

1.3 CONTRACTOR SUBMITTALS

A. Furnish Shop Drawings in accordance with Sections 01300 - Contractor Submittals and 16050 - Electrical Work, General.

1. Ladder diagrams and written descriptions explaining ladder diagram operation and system operation.

2. Include catalog cuts of all control equipment including enclosures, overcurrent devices, relays, pilot devices, terminations, and wire troughs.

PART 2 -- PRODUCTS

2.1 GENERAL

A. The CONTRACTOR shall provide the stations to satisfy the functional requirements in the relevant mechanical equipment and Instrumentation & Control specifications and the Electrical Elementary Schematics. Each station shall be fabricated with UL labeled components. Stations not specifically indicated as being WORK of other Sections shall be provided under this Section. All stations shall be wired under this Section.

B. The controls shall be 120 V maximum. Where the electrical power supply is 240 V, single phase or 480 V, 3-phase, the station shall be provided with a fused control power transformer. Control conductors shall be provided in accordance with Section 16050.

C. Each station shall be provided with identified terminal strips for the connection of external conductors. The CONTRACTOR shall provide sufficient terminal blocks to connect 25 percent additional conductors for future use. Termination points shall be identified in accordance with Shop Drawings. The stations shall be the source of power for all 120 vAC solenoid valves interconnected with the stations. All equipment associated with the stations shall be ready for service after connection of conductors to equipment, controls, and stations.

D. Wiring to door-mounted devices shall be extra flexible and anchored to doors using wire anchors cemented in place. Exposed terminals of door-mounted devices shall be guarded to prevent accidental personnel contact with energized terminals.

E. Enclosures

1. In finished rooms, enclosures shall be NEMA 12 steel enclosures painted with ANSI 61 exterior and white interior.

2. In all other non-hazardous areas, enclosures shall be NEMA 4X stainless steel (prior to modifications) with brushed finish. Where possible, penetrations shall be made in such a manner to maintain the NEMA 4X rating. If this is not possible, the penetrations shall be made in such a manner to minimize entry of foreign materials into the enclosure.

3. Enclosures shall be freestanding, pedestal-mounted, or equipment skid-mounted, as indicated. Internal control components shall be mounted on a removable mounting pan. Mounting pan shall be finished white.

F. Disconnect Switches

1. Heavy duty, non-fusible, single throw

2. Horsepower rated

3. UL listed

4. Padlockable in OFF position and door interlock

5. Enclosure per area classification in Section 16050.

6. 408 V, 3 phase, 3-pole (6-pole when used with 2-speed motor).

7. Auxiliary control contact as applicable and as indicated.

8. As manufactured by **G.E., Cutler-Hammer,** or **Square D**.

G. Identification of panel-mounted devices, conductors, and electrical components shall be in accordance with Section 16050.

H. Panel-mounted devices shall be mounted a minimum of 3 feet above finished floor elevation.

2.2 STATION COMPONENTS

A. Pushbuttons, selector switches, and pilot lights shall be the heavy-duty, oil-tight type, sized to 30 mm. Miniature style devices are not acceptable. Devices shall be as manufactured by **G.E., Cutler-Hammer,** or equal.

1. Lens colors shall be red for "run," "open," or "on"; green for "stopped," "closed," or "off"; and amber for alarm.

2. Pilot lights shall be low voltage, transformer, push-to-test type.

3. Provide hazardous location type pilot devices in classified locations.

B. Relays shall be 3 PDT with 10 amp contacts, plug-in type utilizing rectangular blades and provided with sockets for screw-type termination and hold-down clips. Relays shall be as manufactured by **Square D, Potter Brumfield,** or equal.

C. Elapsed time meters shall be non-resettable type, read to a maximum of 99999.9 hours and shall be as manufactured by **G.E., Cutler-Hammer,** or equal.

D. Magnetic starters shall be:

1. NEMA rated. IEC or dual NEMA/IEC rated type are not acceptable.

2. FVNR type unless indicated otherwise.

3. Combination starters with magnetic only instantaneous trip circuit breakers such as **Cutler-Hammer "MCP," G.E., "Mag-Break,"** or equal.

4. Control transformers shall be provided with primary and secondary fuses, 120 V maximum control voltage.

E. Terminal strips shall be provided for all panels and shall be the flanged fork or ring lug type suitable for No. 12 AWG stranded wire minimum. Provide 25 percent spare terminals in each panel.

F. Current-to-current converter/isolators shall be 4 - 20 mA input, 4 - 20 mA output for operation from 120 V power, and shall be by **Moore, A.G.M.,** or equal.

G. Process alarm relays shall have a 4 - 20 mA input and 2 independent SPST contact outputs as manufactured by **A.G.M.,** or equal. Power input shall be 120 V.

H. Digital indicators shall have 4 - 20 mA input and shall display the signal in process units. Zero to 100 percent as a displayed signal shall only be acceptable to indicate speed. Indicators shall be as manufactured by **Newport, Red Lion,** or equal, for operation from 120 V. Provide splash-proof covers in NEMA 4X panels, and viewing windows in NEMA 7 panels.

I. Time delay relays shall be combination on delay and off delay (selectable) with adjustable timing ranges. Provide socket with screw terminal connections and retaining strap. Time delay relays shall be **Square D JCK70** or similar by **ATC**.

2.3 FACTORY TESTING

A. Each LCS shall be factory assembled and tested for sequence of operation prior to delivery.

2.4 SPARE PARTS

A. Provide a minimum of 10 percent spare lamps (minimum 2) and one spare lens for each color pilot lamp in each panel.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Stations shall be installed in accordance with in Section 16050 and in accordance with the manufacturer's recommendations.

B. Stations shall be protected at the Site from loss, damage, and the effects of weather. Stations shall be stored in an indoor, dry location. Heating shall be provided in areas subject to corrosion and humidity.

C. Station interiors and exteriors shall be cleaned, and coatings shall be touched up to match original finish upon completion of the WORK.

D. Conduit, conductors, and terminations shall be installed in accordance with Section 16050.

3.2 FIELD TESTING

A. Each station shall be tested again for functional operation in the field after the connection of external conductors and prior to equipment startup.

- END OF SECTION -

SECTION 16500 - LIGHTING

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide lighting fixtures, and accessories, complete and operable, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Codes

NFPA 70	National Electric Code
NEMA 250	Enclosures for Electrical Equipment (1,000 Volts Maximum)
Uniform Building Code (UBC) Section 2329	Earthquake Requirements
Underwriters Laboratories, Inc. (UL)	
UL – 595	Standard for Safety Marine-Type Electric Lighting Fixtures
UL – 844	Standard for Safety Electric Lighting Fixtures for Use in Hazardous (Classified Locations)
UL – 924	Standard for Safety Emergency Lighting and Power Equipment
ANSI C82.1	Specifications for Fluorescent Lamp Ballasts
ANSI C84.4	Specifications for High-Intensity-Discharge Lamp Ballasts (Multiple SupplyType)

Standards of the Certified Ballast Manufacturer's Association

1.3 CONTRACTOR SUBMITTALS

A. Furnish the following product information in accordance with Section 01300 - Contractor Submittals.

1. Interior luminaires

a. Catalog data sheets and pictures.

b. Luminaire finish and metal gauge.

c. Lens material, pattern, and thickness.

d. Candle power distribution curves in two or more planes.

e. Candle power chart 0 to 90 degrees.

f. Lumen output chart.

g. Average maximum brightness data in foot lamberts.

h. Coefficients of utilization for zonal cavity calculations.

i. Mounting or suspension details.

j. Heat exchange and air handling data.

2. Exterior luminaires

a. Catalog data sheets and pictures.

b. Luminaire finish and metal gauge.

c. Lens material, pattern, and thickness.

d. IES lighting classification and isolux diagram.

e. Fastening details to wall or pole.

f. Ballast type, location, and method of fastening.

g. For light poles, submit wind loading, complete dimensions, and finish.

3. Lamps

a. Voltages.

b. Colors.

c. Approximate life (in hours).

d. Approximate initial lumens.

e. Lumen maintenance curve.

f. Lamp type and base.

4. Ballasts

a. Type.

b. Wiring diagram

c. Nominal watts and input watts.

d. Input voltage and power factor.

e. Starting current, line current, and restrike current values.

f. Sound rating.

g. Temperature rating.

h. Efficiency ratings.

i. Low temperature characteristics.

j. Emergency ballasts rating and capacity data.

5. Photocells

a. Voltage and power consumption.

b. Capacity.

c. Contacts and time delay.

d. Operating levels.

e. Enclosure type and dimensions.

f. Temperature range.

PART 2 -- PRODUCTS

2.1 LUMINAIRES

A. Specific requirements relative to execution of WORK of this section are located in the Luminaire Schedule on Drawings.

B. Feed-through type or separate junction box.

C. Ballasts: Two-lamp when possible.

D. Tandem wired for three-lamp fluorescent fixtures.

E. Wire Leads: Minimum 18 AWG.

F. Component Access: Accessible and replaceable without removing luminaire from ceiling.

G. Soffit Installations

1. UL Labeled: SUITABLE FOR DAMP LOCATIONS.

2. Ballast: Removable, prewired.

H. Exterior Installations

1. UL Labeled: SUITABLE FOR WET LOCATIONS.

2. Ballast: Removable, prewired.

3. When factory-installed photocells are provided, entire assembly shall have UL label.

I. Marine Environments

1. UL Labeled: MARINE, OUTSIDE TYPE.

2. Housing: Copper-free, aluminum in accordance with UL - 595.

J. Emergency Lighting

1. Power Pack: Self-contained, 120/277 V, selectable input transformer, with 6-V sealed nickel cadmium battery, and indicator switch in accordance with UL 924.

2. Lighted, push-to-test pushbutton and indicator.

3. Capable of providing full illumination for 1-1/2 hours in emergency mode.

4. Capable of full recharge in 24 hours, automatically upon resumption of normal line voltage.

5. Capable of protecting against excess charging and discharging.

6. Twin halogen sealed lighting heads.

7. Solid state charger.

8. Normal and emergency LED indicating lights.

9. Three wire power cord and plug set.

10. Mounting stand

11. Time delay relays to maintain emergency lighting in areas illuminated by HID luminaires for 5 minutes after normal power has been re-stored.

12. NEMA rated enclosures in accordance with the area classifications in which they are installed.

K. Exit Signs

1. Internally illuminated

2. Universal mounting type.

3. Internal 6 V nickel cadmium battery.

4. Battery charger.

5. LED type emergency and normal indicating lights.

6. Press to test button

7. Directional arrows.

8. Green letters on a white panel.

L. Hazardous Classified Areas

1. UL Labeled: CLASS I, DIVISION 1, GROUPS C AND D.

2. Fixture Enclosure and Fittings: Copper-free, cast aluminum in accordance with UL - 844.

2.2 LAMPS

A. Fluorescent

1. Fluorescent

a. Type T-8, energy efficient

b. Color, K-4100

c. Lengths 48 inches.

d. Rated burning life 20,000 hours.

2. Compact Fluorescent

a. Type, double biax.

b. Color, K-4100

c. Rated burning life, 10,000 hours.

3. Electronic Biax Lamps

a. Type, double biax with screw shell for replacement of incandescents.

b. Color, K-2700 or higher

c. Rated burning life 10,000 hours.

B. High Intensity Discharge

1. Type: High pressure sodium and metal halide.

2. Color: Color corrected.

C. Incandescent

1. Type Efficiency: Energy.

2. Color: Inside frosted.

3. Rated burning life 2,500 hours.

D. Tungsten Halogen

1. Type Efficiency: Energy.

2. Color: Clear.

E. Manufacturers, or equal

1. **General Electric**

2. **Sylvania.**

3. **North American Philips**.

2.3 BALLASTS

A. General

1. UL Listed, ETL certified.

2. High power factor, energy efficient type.

3. Meeting requirements for fixture light output, reliable starting, radio interference, total harmonic distortion, electromagnetic interference, and dielectric rating.

4. Exterior ballasts to produce reliable starting and produce full output of lamps when ballasts and lamps are operating in an ambient temperature of minus 40 degrees F at 90 percent of normal line voltage.

B. Fluorescent

1. Type: Electronic, high frequency, full output rapid start, for use with 265 mA, T-8 lamps.

2. Sound Rating: Minimum A, maximum allowable noise level of 30 decibels measured two feet from the fixture.

3. Class: P.

4. Current crest factor: 1.7

5. Manufacturers, or equal

a. **Advance Mark V**.

b. **Valmont**.

c. **Osram/Sylvania**.

C. Metal Halide

1. High power factor, normal ambient, 180 degrees C insulation class.

2. Types

a. Auto transformer with capacitor and ignitor for lamps 150 watts and less.

b. Constant wattage auto transformer with capacitor for lamps greater than 150 watts.

3. Manufacturers, or equal

    a. **MagneTec Jefferson**.

    b. **Advance Transformer**.

    c. **Universal**.

D. High Pressure Sodium

1. High power factor, normal ambient, 180 degrees C insulation class, with capacitor and ignitor.

2. Type

    a. Auto transformer for 50-watt lamps.

    b. Constant wattage auto transformer for lamps 70 watts and greater.

2.4 LIGHTING CONTROL

A. Time Switch

1. Time dial indicated.

2. Bypass Switch: Prewired, externally operated ON/AUTO/OFF, for each circuit indicated.

3. Contact configuration and rating for circuits as required.

4. Enclosure: NEMA 250, Type 3R.

5. Reserve Power: Spring driven, capable of operating time switch for 16 hours after power failure.

6. Wired for use with photocell indicated.

7. Manufacturers, or equal

    a. **Tork**.

    b. **Paragon**.

B. Photo Cell

1. Automatic ON/OFF switch photo control.

2. Housing: Self contained, die cast aluminum, unaffected by moisture, vibration, or temperature changes.

3. Setting: ON at dusk at OFF at dawn.

4. Time delay feature to prevent false switching

5. Field adjustable to control operating levels.

6. Manufacturers, or equal

    a. **Tork**.

    b. **Paragon**.

2.5 POLES

A. Rating (with Luminaire): 100 mph steady winds, without incurred damage.

B. Material: Extruded aluminum, and Concrete.

C. One piece stationary type.

PART 3 -- EXECUTION

3.1 LUMINAIRES

A. General

1. Install in accordance with manufacturer's recommendations.

2. Provide necessary hangers, pendants, and canopies.

3. Provide additional ceiling bracing, hanger supports, and other structural reinforcements to building and to concrete pole bases required to safely mount.

4. Install plumb and level.

5. Mounting heights indicated for wall mounted or pendant mounted luminaries are measured from bottom of luminaire to finished floor or finished grade, whichever is applicable.

6. Install each luminaire outlet box with galvanized stud.

B. Pendant Mounted

1. Provide swivel type hangers and canopies to match luminaries, unless otherwise indicated.

2. Space single stem hangers on continuous row florescent luminaries normally 48 inches apart.

3. Provide twin stem hangers on single luminaries.

C. Pole Mounted

1. Provide cast-in-place concrete base.

2. Pole base to be installed flush with finished grade where located in grassy areas not subject to vehicular traffic and 30-inches above finished grade when the pole is located in areas subject to damage from vehicular traffic.

3. Fixture poles shall be set on anchor bolts and secured with double nuts on each bolt. After fixture has been leveled and plumbed, the fixture base shall be dry-packed with grout.

D. Finished Areas

1. Install symmetrically with tile pattern.

2. Locate with centerlines whether on centerline of tile or on joint between adjacent tile runs.

3. Install recessed luminaires tight to finished surface such that no spill light will show between ceilings and sealing rings.

4. Combustible low density cellulose fiberboard: Provide spacers and mount luminaires 1-1/2 inches from ceiling surface, or use fixtures suitable for mounting on low density ceilings.

5. Junction Boxes

   a. Flush and recessed luminaires: Locate minimum 1 foot from luminaire.

   b. In concealed locations, install junction boxes to be accessible by removing luminaire.

6. Wiring and Conduit

   a. Provide wiring of temperature rating required by luminaire.

   b. Provide flexible steel conduit.

7. Provide plaster frames when required by ceiling construction.

8. Independent Supports

   a. Provide each recessed fluorescent luminaire with 2 safety chains or 2 No. 12 soft annealed galvanized steel wires of length needed to secure luminaire to building structure independent of ceiling structure.

   b. Tensile strength of chain or wire, and method of fastening to structure shall be adequate to support weight of luminaire.

   c. Fasten chain or wire to each end of luminaire.

E. Unfinished Areas: Locate luminaires to avoid both conflict with other building systems and blockage of luminaire light output.

1. Fixture Suspension: Provide 3/8-inch threaded steel hanger rods. Scissor type hangers not permitted.

2. Attachment to Steel Beams: Provide flanged beam clips and straight or angled hangers.

3.2 LAMPS

A. Provide in each fixture, the number and type for which the fixture is designed, unless otherwise indicated.

3.3 BALLASTS

A. Install in accordance with manufacturer's recommendations.

B. Utilize all ballast mounting holes to fasten securely within luminaire.

C. Replace noisy or defective ballasts.

3.4 LIGHTING CONTROL

A. Outdoor Luminaires: Photocells switch lights ON at dusk and OFF at dawn.

B. Dimming Systems

1. Install in accordance with manufacturer's recommendations.

2. Do not connect ballasts or equipment to dimming system unless acceptable to dimming system manufacturer.

3.5 CLEANING FOLLOWING CONSTRUCTION

A. Remove all labels and other markings, except UL listing mark.

B. Wipe luminaires inside and out to remove construction dust.

C. Clean luminaire plastic lenses with antistatic cleaners only.

D. Touch up all painted surfaces of luminaires and poles with matching paint ordered from manufacturer.

E. Replace all defective lamps at time of Substantial Completion.

- END OF SECTION -

SECTION 16950 – ELECTRICAL TESTS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. This Section specifies the WORK necessary to test, commission, and demonstrate that the electrical work satisfies the criteria of these Specifications and functions as required by the Contract Documents.

B. The WORK of this Section includes furnishing the labor, equipment, and power required to support the testing specified in other Divisions of these Specifications. Electrical testing indicated herein, and functional testing of all power and controls not tested under Division 17 - Instrumentation, shall be completed before commencement of the 7-day test of Section 01660 - Equipment Testing and Plant Startup. This scope may require the CONTRACTOR to activate circuits, shutdown circuits, and run equipment, make electrical measurements, replace blown fuses, install temporary jumpers, etc.

C. The requirements of Section 16050 - Electrical Work, General, apply to the WORK of this Section.

1.2 TESTING

A. The following test requirements supplement test and acceptance criteria that may be stated elsewhere.

1. Lighting: Switching, including remote control, if indicated. Circuitry is in accordance with panel schedules.

2. Power Instrumentation: Demonstrate that voltmeter and ammeter switches are functional. Demonstrate that kilowatt meters are within catalog accuracy as installed.

3. Demonstrate mechanical and/or electrical interlocking by attempting to subvert the intended sequence.

4. Activate ground fault tripping by operating test features provided with ground current protective systems and by injecting a known and reasonable current in the ground current sensor circuit. In general, ground fault tripping should occur at a ground current equivalent to 20 percent of phase current. Current injection is not required of circuit 400 amperes or less.

5. Cable Testing: 480-volt circuits shall be tested for insulation resistance with a 1000-volt megohm meter. Testing shall be done after the 480-volt equipment is terminated. Phase-to-phase A-B, B-C, A-C and phase-to-ground insulation resistance tests shall be performed on each cable prior to 5-kV and 25-kV cable termination at equipment but subsequent to stress cone makeup. Test results shall be submitted for review 30 days prior to plant operation and any system testing. Equipment which may be damaged during this test shall be disconnected. Perform tests with all other equipment connected to the circuit. In order to be acceptable, the cable must withstand the test high voltage without breakdown, have steady or decreasing leakage current during the high potential test, and have satisfactory comparable megger readings in each megger test. Test results shall be submitted to the CONTRACTING OFFICER, stating equipment used and time of test. Cable

operating at more than 2,000 volts shall be tested in accordance with ICEA publications S-68-61, S-61-402, S-19-81, and S-68-516. Cable testing and report submittal shall be performed by an organization sanctioned by the manufacturer of the cable to be tested. Testing shall verify the quality of cable terminations. Test results for medium and high voltage cable shall be submitted to the CONTRACTING OFFICER 30 days prior to the time schedule for equipment energization.

6. Test ground interrupter (GFI) receptacles and circuit breakers for proper operation by methods sanctioned by the receptacle manufacturer.

7. A functional test and check of all electrical components is required prior to performing subsystem testing and commissioning. Compartments and equipment shall be cleaned as required by other provisions of these Specifications before commencement of functional testing. Functional testing shall comprise:

    a. A functional test and check of all electrical components is required prior to performing subsystem testing and commissioning. Compartments and equipment shall be cleaned as required by other provisions of these Specifications before commencement of functional testing. Functional testing shall comprise:

    b. Setting of protective relays in conformance with results of the Short Circuit Study required by Section 16431 - Protective Device Studies and testing of relays to assure that relays will trip at the current value and time required by the Study.

    c. Circuit breakers which have adjustable time or pick-up settings for ground current, instantaneous overcurrent, short-time overcurrent, or long-time overcurrent, shall be field adjusted by a representative of the circuit breaker manufacturer. Time and pickup setting shall correspond to the recommendations of the Short Circuit Study. Setting shall be tabulated and proven for each circuit breaker in its installed position; test results shall be certified by the testor and transmitted to the CONTRACTING OFFICER (7 copies).

8. Complete ground testing of all grounding electrodes per requirements below prior to operating the equipment.

B. Subsystem testing shall occur after the proper operation of alarm and status contacts has been demonstrated or otherwise accepted by the CONTRACTING OFFICER and after process control devices have been adjusted as accurately as possible. It is intended that the CONTRACTOR will adjust limit switches and level switches to their operating points prior to testing and will set pressure switches, flow switches, and timing relays as dictated by operating results.

C. After initial settings have been completed, each subsystem shall be operated in the manual mode and it shall be demonstrated that operation is in compliance with the Contract Documents. Once the manual mode of operation has been proven, automatic operation shall be demonstrated to verify such items as proper start and stop sequence of pumps, proper operation of valves, proper speed control, etc.

D. Motor operated valves shall be tested after having been phased and tested for correct motor rotation and after travel and torque limit switches have been adjusted by a

representative of the valve manufacturer. Tests shall verify status indication, proper valve travel, and correct command control from local and remote devices.

E. Provide ground resistance tests on the main grounding electrode or system in the presence of the CONTRACTING OFFICER and submit results. Utilize the fall-of-potential method or alternative, in accordance with IEEE Standard 81.

F. Subsystems shall be defined as individual and groups of pumps, conveyor systems, chemical feeders, air conditioning units, ventilation fans, air compressors, etc.

G. **General:** Carry out tests indicated herein for individual items of materials and equipment in other Sections.

1.3 COMMISSIONING

A. Commissioning during the 7-day test in Section 01660 shall not be attempted until all subsystems have been found to operate satisfactorily; commissioning shall only be attempted as a function of normal plant operation in which plant process flows and levels are routine and equipment operates automatically in response to flow and level parameters or computer command, as applicable. Simulation of process parameters shall be considered only upon receipt of a written request by the CONTRACTOR.

B. The motor current tabulation required by Section 16431 shall reflect the values occurring during commissioning. The indications of all switchboard ammeters and kilowattmeters shall be recorded every half-hour during commissioning.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 17100 - PROCESS CONTROL AND INSTRUMENTATION SYSTEMS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide all Process Control and Instrumentation Systems (PCIS) complete and operable, of the tertiary upgrade project in accordance with the Contract Documents.

B. The requirements of this Section apply to all components of the PCIS unless indicated otherwise.

C. Responsibilities

1. The CONTRACTOR, through the use of an Instrumentation Supplier and qualified electrical and mechanical installers, shall be responsible to the GOVERNMENT for the implementation of the PCIS and the integration of the PCIS with other required instrumentation and control devices.

2. Due to the complexities associated with the interfacing of numerous control system devices, it is the intent of these specifications that the Instrumentation Supplier be responsible to the CONTRACTOR for the integration of the PCIS with existing devices and devices provided under other sections with the objective of providing a completely integrated control system free of signal incompatibilities.

3. As a minimum, the Instrumentation Supplier shall perform the following WORK:

a. Implementation of the PCIS

1) prepare analog hardware submittals

2) design, develop, and electronically draft loop drawings and control panel designs

3) prepare the test plan, the training plan, and the spare parts submittals

4) procure hardware

5) fabricate panels

6) perform factory tests on panels

7) perform bench calibration and verify calibration after installation

8) oversee and certify installation

9) oversee, document, and certify loop testing

10) oversee, document, and certify system commissioning

11) conduct the performance test

12) prepare Technical Manuals

13) conduct training classes

14) prepare record drawings

b. Integration of the PCIS with instrumentation and control devices being provided under other sections;

1) Develop all requisite loop drawings and record loop drawings associated with equipment provided under other Divisions of these Specifications and GOVERNMENT-furnished and existing equipment.

2) Resolve signal, power, or functional incompatibilities between the PCIS and interfacing devices.

4. Any Instrumentation Supplier responsibilities in addition to the list above are at the discretion of the CONTRACTOR and the Instrumentation Supplier. Additional requirements in this Section and throughout Division 17 that are stated to be the CONTRACTOR's responsibility may be performed by the Instrumentation Supplier if the CONTRACTOR and Instrumentation Supplier so agree.

D. Certification of Intent

1. Each bidder shall include with the bid the following Certification from the selected Instrumentation Supplier:

a. The Certification shall be typed on the Instrumentation Supplier firm letterhead.

b. It shall be signed by an authorized representative of the Instrumentation Supplier's firm.

c. It shall include the following statements:

1) (Corporate name of Instrumentation Supplier) "hereby certifies intent to assume and execute full responsibility to the CONTRACTOR to perform all tasks defined under Section 17100 - Paragraph 1.1C3 in full compliance with the requirements of the Contract Documents."

2) It is certified that the quotation to the CONTRACTOR includes full and complete compliance with the requirements of the Contract Documents without exception."

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01300 - Contractor Submittals and the following:

1. The CONTRACTOR shall coordinate the instrumentation work so that the complete instrumentation and control system will be provided and will be supported by accurate Shop Drawings and record drawings.

2. Exchange of Technical Information: During the period of preparation of these submittals, the CONTRACTOR shall authorize a direct, informal liaison with the CONTRACTING OFFICER for exchange of technical information. As a result of this liaison, certain minor refinements and revisions in the systems as indicated may be

authorized informally by the CONTRACTING OFFICER, but will not alter the scope of work or cause increase or decrease in the Contract Price. During this informal exchange, no oral statement by the CONTRACTING OFFICER shall be construed to give approval of any component or method, nor shall any statement be construed to grant exception to or variation from these Contract Documents.

3. Symbology and Nomenclature: In these Contract Documents, all systems, all meters, all instruments, and all other elements are represented schematically, and are designated by symbology as derived from Instrument Society of America Standard ANSI/ISA S5.1 - Instrumentation Symbols and Identification. The nomenclature and numbers designated herein and on the Drawings shall be employed exclusively throughout Shop Drawings, and similar materials. No other symbols, designations, or nomenclature unique to the manufacturer's standard methods shall replace those prescribed above, used herein, or on the Drawings.

B. Shop Drawings

1. General

a. Shop Drawings shall include the letter head or title block of the Instrumentation Supplier. The title block shall include, as a minimum, the Instrumentation Supplier's registered business name and address, project name, drawing name, revision level, and personnel responsible for the content of the drawing. The quantity of submittal sets shall be as indicated in Section 01300 - Contractor Submittals.

b. Organization of the Shop Drawing submittals shall be compatible with eventual submittals for later inclusion in the Technical Manual. Submittals not so organized and incomplete submittals for a given loop will not be accepted.

c. Shop Drawing information shall be bound in standard size, 3 ring, looseleaf, vinyl plastic, hard cover binders suitable for bookshelf storage. Binder ring size shall not exceed 3 inches.

d. Interfaces between instruments, motor starters, control valves, variable speed drives, flow meters, chemical feeders and other equipment related to the PCIS shall be included in the Shop Drawing submittal.

2. Analog Hardware Submittal: The CONTRACTOR shall submit an analog hardware submittal as a complete bound package at one time within 60 calendar days after the commencement date stated in the Notice to Proceed, including:

a. A complete index which lists each device by tag number, type, and manufacturer. A separate technical brochure or bulletin shall be included with each instrument data sheet. The data sheets shall be indexed in the submittal by systems or loops, as a separate group for each system or loop. If, within a single system or loop, a single instrument is employed more than once, one data sheet with one brochure or bulletin may cover all identical uses of that instrument in that system. Each brochure or bulletin shall include a list of tag numbers for which it applies. System groups shall be separated by labeled tags.

b. Fully executed data sheets according to ISA S20 - Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves, for each component, together with a technical product brochure or bulletin. The technical product brochures shall be complete enough to verify conformance to Contract Document requirements. The data sheets, as a minimum, shall show:

   1) Component functional description used in the Contract Documents

   2) Manufacturer's model number or other product designation

   3) Project tag number used in the Contract Documents

   4) Project system or loop of which the component is a part

   5) Project location or assembly at which the component is to be installed

   6) Input and output characteristics

   7) Scale, range, units, and multiplier (if any)

   8) Requirements for electric supply (if any)

   9) Requirements for air supply (if any)

   10) Materials of component parts to be in contact with or otherwise exposed to process media and corrosive ambient air

   11) Special requirements or features

c. Flow meter sizing calculations. Calculations shall be submitted on the instrument manufacturer letterhead and shall include the following:

   1) Proposed meter size based on indicated minimum, maximum and average flow rates

   2) Guaranteed meter accuracy based on the upstream and downstream straight runs associated with the location of each meter

   3) Permanent head loss associated with each meter

   4) Flow vs. differential pressure curves for all head-type devices. For compressible fluids, curves shall be pressure and temperature compensated.

   5) References to ISA standard equations used

   6) Values used for all parameters used in calculations

d. Priced list of spare parts for all devices

e. Instrument installation, mounting, and anchoring details shall be submitted in an electronic AutoCAD and hard copy format. Each instrument shall have a dedicated 8-1/2 inch by 11-inch detail that only pertains to the specific

instrument by tag number. Each detail shall be certified by the instrument manufacturer that the proposed installation is in accordance with the instrument manufacturer's recommendations and is fully warrantable. These certifications shall be embedded in the CAD files and also appear as a stamp on the hard copies. As a minimum, each detail shall have the following contents;

1) show necessary sections and elevation views required to define instrument location by referencing tank, building or equipment names and numbers, and geographical qualities such as north, south, east, west, basement, first floor.

2) ambient temperature and humidity of the environment that the instrument is to be installed in.

3) corrosive qualities of the environment that the instrument is to be installed in.

4) hazardous rating of the environment that the instrument is to be installed in.

5) process line pipe or tank size, service and material.

6) process tap elevation and location.

7) upstream and downstream straight pipe lengths between instrument installation and pipe fittings and valves.

8) routing of tubing and identification of supports.

9) mounting brackets, stands, and anchoring devices.

10) conduit entry size, number, location, and delineation between power and signal.

11) NEMA ratings of enclosures and all components.

12) clearances required for instrument servicing.

13) list itemizing all manufacturer makes, model numbers, quantities, lengths required, and materials of each item required to support the implementation of the detail.

3. Project-Wide Loop Drawing Submittal: The CONTRACTOR shall furnish a Project-wide Loop Drawing Submittal (PLDS) which completely defines and documents the contents of each monitoring, alarming, interlock, and control loop associated with equipment provided under Division 17 sections, equipment provided under sections in other Divisions, existing, and GOVERNMENT furnished equipment which is to be incorporated into the PCIS. The PLDS shall be a singular complete bound package electronically drafted in AutoCAD, submitted within 120 days after Contract Award, and shall include the following:

a. A complete index in the front of each bound volume. The loop drawings shall be indexed by systems or process areas. Loops shall be tagged in a manner consistent with the Contract Documents. Loop drawings shall be submitted for every analog and discrete monitoring and control loop.

b. Drawings showing definitive diagrams for every analog and discrete instrumentation loop system. These diagrams shall show and identify each component of each loop or system using legend and symbols from ANSI/ISA S5.4 - Instrument Loop Drawings as defined by the most recent revision in ISA. Panel drawings showing PLC I/O card wiring and field terminations are not acceptable as loop drawings. Each system or loop diagram shall be drawn with no more than ten loops per drawing. Loop drawings shall be developed for loops in equipment vendor supplied packages, equipment provided under Division 17, and GOVERNMENT furnished equipment. The loop drawings shall also show software modules and linkages. In addition to the expanded ISA S5.4 requirements, the loop diagrams shall also show the following details:

    1) Functional name of each loop

    2) Reference name, drawing, and loop diagram numbers for any signal continuing off the loop diagram sheet.

    3) MCC panel, circuit, and breaker numbers for power feeds to the loops and instrumentation.

    4) Designation, and if appropriate, terminal assignments associated with every manhole, pullbox, junction box, conduit, and panel through which the loop circuits pass.

    5) Vendor panel, instrument panel, conduit, junction boxes, equipment and SCADA terminations, termination identification wire numbers and colors, power circuits, and ground identifications.

c. Itemized instrument summary. The summary shall be prepared with Microsoft Access software and shall be submitted on a CD and hard copy. The instrument summary shall list all of the key attributes of each instrument provided under this Contract. As a minimum, attributes shall include:

    1) Tag number

    2) Manufacturer

    3) Model number

    4) Service

    5) Area location

    6) Calibrated range

    7) Loop drawing number

    8) Associated LCP or PLC

4. Test Procedure Submittals

    a. The CONTRACTOR shall submit the proposed procedures to be followed during tests of the PCIS and its components.

    b. Preliminary Submittal: Outlines of the specific proposed tests and examples of proposed forms and checklists.

    c. Detailed Submittal: After approval of the Preliminary Submittal, the CONTRACTOR shall submit the proposed detailed test procedures, forms, and checklists. This submittal shall include a statement of test objectives with the test procedures.

5. Training Submittals: Subsequent to the receipt of the GOVERNMENT's and CONTRACTING OFFICER's inputs made at the Presubmittal Conference, the CONTRACTOR shall submit a training plan which includes:

    a. A resubmittal of the training plan overview from the Presubmittal Conference with incorporation of all modifications agreed upon at that meeting.

    b. Schedule of training courses including dates, durations, and locations of each class.

    c. Resumes of the instructors who will actually implement the plan.

C. Technical Manual

1. General: Information in the Technical Manual shall be based upon the approved Shop Drawing submittals as modified for conditions encountered in the field during the WORK.

2. The Technical Manual shall have the following organization for each process:

    a. Section A - Process and Instrumentation Diagrams

    b. Section B - Loop Descriptions

    c. Section C - Loop Drawings

    d. Section D - Instrument Summary

    e. Section E - Instrument Data Sheets

    f. Section F - Sizing Calculations

    g. Section G - Instrument Installation Details

    h. Section H - Test Results

3. Signed results from Loop Testing, Precommissioning, and Performance Testing shall be included in Section H.

4. Initially, 2 sets of draft Technical Manuals shall be submitted for review after return of favorably reviewed Shop Drawings and data required herein. Following the CONTRACTING OFFICER's review, one set will be returned to the CONTRACTOR with comments. The Manuals shall be revised and amended as required and the final Manuals shall be submitted 15 days prior to startup of systems.

D. Record Drawings

1. The CONTRACTOR shall keep current a set of complete loop and schematic diagrams which shall include all field and panel wiring, piping and tubing runs, routing, mounting details, point-to-point diagrams with cable, wire, tube and termination numbers. These drawings shall include all instruments and instrument elements. One set of drawings electronically formatted in AutoCAD and 2 hard copies shall be submitted after completion of all Precommissioning tasks but prior to Performance Testing. All such drawings shall be submitted for review prior to acceptance of the completed WORK by the GOVERNMENT.

1.3 COST LOADING AND CASH FLOW

A. **General:** The CONTRACTOR shall develop a schedule, schedule of values, and cash flow summary for inclusion in the submittals of Section 01301 - Schedule of Values and Section 01311 - Scheduling and Reporting. Failure to submit the schedule, schedule of values, or cash flow summary shall be cause for withholding any progress payment due for instrumentation work under sections in this Division.

B. **Cash Flow Summary:** The cash flow summary shall be based on the submitted Schedule and equal in total to the CONTRACTOR's instrumentation bid price plus approved contract modifications. Expected payment requests for each month shall be included, as well as the cumulative payment requests to date for each month of the project. The net payment requests for each month after deducting retainage and the cumulative payment requests to date shall also be shown.

1.4 SPECIAL WARRANTY REQUIREMENTS

A. **Extended Period for Correction of Defects:** The CONTRACTOR shall correct all defects in the PCIS upon notification from the GOVERNMENT within 2 years from the date of Substantial Completion. Corrections shall be completed within 5 days after notification.

PART 2 -- PRODUCTS

2.1 GENERAL

A. **Code and Regulatory Compliance:** PCIS WORK shall conform to or exceed the applicable requirements of the National Electrical Code. Conflicts between the requirements of the Contract Documents and any codes or referenced standards or specifications shall be resolved according to Section 01090 - Reference Standards.

B. **Current Technology:** Meters, instruments, and other components shall be the most recent field-proven models marketed by their manufacturers at the time of submittal of the Shop Drawings unless otherwise required to match existing equipment.

C. **Hardware Commonality:** Instruments which utilize a common measurement principle (for example, d/p cells, pressure transmitters, level transmitters that monitor hydrostatic head) shall be furnished by a single manufacturer. Panel mounted instruments shall have matching style and general appearance. Instruments performing similar functions shall be of the same type, model, or class, and shall be from a single manufacturer.

D. **Loop Accuracy:** The accuracy of each instrumentation system or loop shall be determined as a probable maximum error; this shall be the square root of the sum of the squares of certified "accuracies" of the designated components in each system, expressed as a percentage of the actual span or value of the measured variable. Each individual instrument shall have a minimum accuracy of plus and minus 0.5 percent of full scale and a minimum repeatability of plus and minus 0.25 percent of full scale unless otherwise indicated. Instruments that do not conform to or improve upon these criteria are not acceptable.

E. **Instrument and Loop Power:** Power requirements and input/output connections for all components shall be verified. Power for transmitted signals shall, in general, originate in and be supplied by the control panel devices. The use of "2-wire" transmitters is preferred, and use of "4-wire" transmitters shall be minimized. Individual loop or redundant power supplies shall be provided as required by the manufacturer's instrument load characteristics to ensure sufficient power to each loop component. Power supplies shall be mounted within control panels or in the field at the point of application.

F. **Instrument Air:** Dry, filtered control air at 30 psig nominal pressure shall be piped to field instruments and instrument panels requiring air. Each field instrument shall be provided with an integral, non-adjustable filter/regulator assembly to provide regulated air. Each instrument panel requiring air shall be provided with an adjustable filter/regulator assembly with gauge and an air manifold to provide air to pneumatic instruments. Air shall be filtered to 5 micron maximum particle size. Pressure reducers and regulators shall be furnished with additional instrumentation as required.

G. **Loop Isolators and Converters:** Signal isolators shall be provided as required to ensure adjacent component impedance match where feedback paths may be generated, or to maintain loop integrity during the removal of a loop component. Dropping precision wirewound resistors shall be installed at all field side terminations in the control panels to ensure loop integrity. Signal conditioners and converters shall be provided where required to resolve any signal level incompatibilities or provide required functions.

H. **Environmental Suitability:** Indoor and outdoor control panels and instrument enclosures shall be suitable for operation in the ambient conditions associated with the locations designated in the Contract Documents. Heating, cooling, and dehumidifying devices shall be provided in order to maintain all instrumentation devices 20 percent within the minimums and maximums of their rated environmental operating ranges. The CONTRACTOR shall provide power wiring for these devices. Enclosures suitable for the environment shall be furnished. All instrumentation in hazardous areas shall be suitable for use in the particular hazardous or classified location in which it is to be installed.

I. **Signal Levels:** Analog measurements and control signals shall be as indicated herein, and unless otherwise indicated, shall vary in direct linear proportion to the measured variable. Electrical signals outside control panels shall be 4 to 20 milliamperes dc except as indicated. Signals within enclosures may be 1 to 5 volts dc. Electric signals shall be electrically or optically isolated from other signals. Pneumatic signals shall be 3 to 15 psig with 3 psig equal to 0 percent and 15 psig equal to 100 percent.

J. **Control Panel Power Supplies:** Control panels shall be provided with redundant power supplies which are configured in a fault-tolerant manner to prevent interruption of service upon failure and interruption of service necessitated by the replacement of a power supply. Power supplies shall have an excess rated capacity of 40 percent. The failure of a power supply shall be annunciated at the control panel and repeated to the SCADA System.

K. **Alternative Equipment and Methods:** Equipment or methods requiring redesign of any project details are not acceptable without prior written approval of the CONTRACTING OFFICER through the "or equal" process of Section 01600 - Products, Materials, Equipment, and Substitutions. Any proposal for approval of alternative equipment or methods shall include evidence of improved performance, operational advantage, and maintenance enhancement over the equipment or method indicated, or shall include evidence that an indicated component is not available.

2.2 OPERATING CONDITIONS

A. The PCIS shall be designed and constructed for satisfactory operation and long, low maintenance service under the following conditions:

Environment	a wastewater treatment facility
Temperature Range	20 through 130 Degrees F
Thermal Shock	1 degree F per minute, max
Relative Humidity	20 through 90 percent, non-condensing

2.3 SPARE PARTS AND SPECIAL TOOLS

A. The CONTRACTING OFFICER will select the required spare parts from the priced list of spare parts in the Analog Hardware Submittals, and the CONTRACTOR shall furnish them. The CONTRACTOR will be paid from the corresponding allowance item in the Bid, and the total price will not exceed the amount of the allowance item.

B. The CONTRACTOR shall furnish a priced list of all special tools required to calibrate and maintain the instrumentation provided under the Contract Documents. After approval the CONTRACTOR shall furnish tools on that list.

C. In addition to the CONTRACTOR proposed special tools, the CONTRACTOR shall furnish the following:

1. One electronic magnetic flowmeter calibration device per manufacturer of flow meters.

2. One portable instrument calibrator current simulator with charger and carrying case (**RIS 4500, Fluke**, or equal).

D. Special tools and spare parts shall be submitted before startup commences, suitably wrapped and identified.

2.4 FACTORY TESTING

A. The CONTRACTOR shall arrange for the manufacturers of the equipment and fabricators of panels and cabinets supplied under this Section to allow the CONTRACTING OFFICER and GOVERNMENT to inspect and witness the testing of the equipment at the site of fabrication. Equipment shall include the cabinets, special control systems, flow measuring devices, and other pertinent systems and devices. A minimum of 10 working days notification shall be furnished to the CONTRACTING OFFICER prior to testing. No shipments shall be made without the CONTRACTING OFFICER's approval.

PART 3 -- EXECUTION

3.1 PRODUCT HANDLING

A. **Shipping Precautions**: After completion of shop assembly, factory test, and approval, equipment, cabinets, panels, and consoles shall be packed in protective crates and enclosed in heavy duty polyethylene envelopes or secured sheeting to provide complete protection from damage, dust, and moisture. Dehumidifiers shall be placed inside the polyethylene coverings. The equipment shall then be skid-mounted for final transport. Lifting rings shall be provided for moving without removing protective covering. Boxed weight shall be shown on shipping tags together with instructions for unloading, transporting, storing, and handling at the Site.

B. **Special Instructions:** Special instructions for proper field handling, storage, and installation required by the manufacturer shall be securely attached to each piece of equipment prior to packaging and shipment.

C. **Tagging:** Each component shall be tagged to identify its location, instrument tag number, and function in the system. A permanent stainless steel or other non-corrosive material tag firmly attached and permanently and indelibly marked with the instrument tag number, as given in the tabulation, shall be provided on each piece of equipment in the PCIS. Identification shall be prominently displayed on the outside of the package.

D. **Storage:** Equipment shall not be stored outdoors. Equipment shall be stored in dry permanent shelters, including in-line equipment, and shall be adequately protected against mechanical injury. If any apparatus has been damaged, such damage shall be repaired by the CONTRACTOR. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried out and put through tests as directed by the CONTRACTING OFFICER. If such tests reveal defects, the equipment shall be replaced.

3.2 MANUFACTURER'S SERVICES

A. The CONTRACTOR shall furnish the following manufacturer's services for the instrumentation listed below:

1. Perform bench calibration

2. Oversee installation

3. Verify installation of installed instrument

4. Certify installation and reconfirm manufacturer's accuracy statement

5. Oversee loop testing, prepare loop validation sheets, and certify loop testing

6. Oversee precommissioning, prepare precommissioning validation sheets, and certify precommissioning

7. Train the GOVERNMENT's personnel

B. Manufacturer's services shall be furnished for the following equipment:

3.3 INSTALLATION

A. General

1. Instrumentation, including instrumentation furnished under other Divisions, shall be installed under Division 17 and the manufacturers' instructions.

2. Equipment Locations: The monitoring and control system configurations indicated are diagrammatic. The locations of equipment are approximate. The exact locations and routing of wiring and cables shall be governed by structural conditions and physical interferences and by the location of electrical terminations on equipment. Equipment shall be located and installed so that it will be readily accessible for operation and maintenance. Where job conditions require reasonable changes in approximated locations and arrangements, or when the GOVERNMENT exercises the right to require changes in location of equipment which do not impact material quantities or cause material rework, the CONTRACTOR shall make such changes without additional cost to the GOVERNMENT.

B. Conduit, Cables, and Field Wiring

1. Conduit shall be provided under Division 16 without delay to the WORK of Division 17.

2. Process equipment control wiring, 4-20 mA signal circuits, signal wiring to field instruments, PLC input and output wiring and other field wiring and cables shall be provided under Division 16.

3. PLC equipment cables, data highway and communication networks shall be provided under Division 17.

4. Terminations and wire identification at PCIS equipment furnished under this or any other Division shall be provided under Division 17.

C. **Instrumentation Tie-Downs:** Instruments, control panels, and equipment shall be anchored by methods that comply with seismic requirements applicable to the Site.

D. **Existing Instrumentation:** Each existing instrument to be removed and reinstalled shall be cleaned, reconditioned, and recalibrated by an authorized service facility of the instrument manufacturer. The CONTRACTOR shall provide certification of this work prior to reinstallation of each instrument.

E. **Ancillary Devices:** The Contract Documents show all necessary conduit and instruments required to make a complete instrumentation system. The CONTRACTOR shall be responsible for providing any additional or different type connections as required by the instruments and specific installation requirements. Such additions and such changes, including the proposed method of installation, shall be submitted to the CONTRACTING OFFICER for approval prior to commencing the work. Such changes shall not be a basis of claims for extra work or delay.

F. **Installation Criteria and Validation:** Field-mounted components and assemblies shall be installed and connected according to the requirements below:

1. Installation personnel have been instructed on installation requirements of the Contract Documents.

2. Technical assistance is available to installation personnel at least by telephone.

3. Installation personnel have at least one copy of the approved Shop Drawings and data.

4. Instrument process sensing lines shall be installed in conduit under Section 16050 - Electrical General Provisions. Individual tubes shall run parallel and near the surfaces from which they are supported. Supports shall be used at intervals of not more than 3 feet of rigid tubing.

5. Bends shall be formed to uniform radii with the proper tool without deforming or thinning the walls of the tubing. Plastic clips shall be used to hold individual plastic tubes parallel. Ends of tubing shall be square cut and cleaned before being inserted in the fittings. Bulkhead fittings shall be provided at panels requiring pipe or tubing entries.

6. Differential pressure elements shall have 3 valve manifolds.

7. Flexible cables and capillary tubing shall be installed in flexible conduits. The lengths shall be sufficient to withdraw the element for periodic maintenance.

8. Power and signal wires shall be terminated with crimped type lugs.

9. Connectors shall be, as a minimum, water tight.

10. Wires shall be mounted clearly with an identification tag that is of a permanent and reusable nature.

11. Wire and cable shall be arranged in a neat manner and securely supported in cable groups and connected from terminal to terminal without splices unless specifically approved by the CONTRACTING OFFICER. Wiring shall be protected from sharp edges and corners.

12. Mounting stands and bracket materials and workmanship shall comply with requirements of the Contract Documents.

13. Verify the correctness of each installation, including polarity of electric power and signal connections, and make sure process connections are free of leaks. The CONTRACTOR shall certify in writing that discrepancies have been corrected for each loop or system checked out.

14. The GOVERNMENT will not be responsible for any additional cost of rework attributable to actions of the CONTRACTOR or the Instrumentation Supplier.

3.4 CALIBRATION

A. **General:** Devices provided under Division 17 shall be calibrated according to the manufacturer's recommended procedures to verify operational readiness and ability to meet the indicated functional and tolerance requirements.

B. **Calibration Points:** Each instrument shall be calibrated at 20,40,60, 80 and 100 percent of span using test instruments to simulate inputs. The test instruments shall have accuracies traceable to National Institute of Standards and Testing.

C. **Bench Calibration:** Instruments that have been bench-calibrated shall be examined in the field to determine whether any of the calibrations are in need of adjustment. Such adjustments, if required, shall be made only after consultation with the CONTRACTING OFFICER.

D. **Field Calibration:** Instruments which were not bench-calibrated shall be calibrated in the field to insure proper operation in accordance with the instrument loop diagrams or specification data sheets.

E. **Analyzer Calibration:** Each analyzer system shall be calibrated and tested as a workable system after installation. Testing procedures shall be directed by the manufacturers' technical representatives. Samples and sample gases shall be furnished by the manufacturers.

F. **Calibration Sheets:** Each instrument calibration sheet shall provide the following information and a space for sign-off on individual items and on the completed unit:

1. Project name

2. Loop number

3. Tag number

4. Manufacturer

5. Model number

6. Serial number

7. Calibration range

8. Calibration data: Input, output, and error at 10 percent, 50 percent, and 90 percent of span

9. Switch setting, contact action, and deadband for discrete elements

10. Space for comments

11. Space for sign-off by Instrumentation Supplier and date

12. Test equipment used and associated serial numbers

G. **Calibration Tags:** A calibration and testing tag shall be attached to each piece of equipment or system at a location determined by the CONTRACTING OFFICER. The CONTRACTOR shall have the Instrumentation Supplier sign the tag when calibration is complete. The CONTRACTING OFFICER will sign the tag when the calibration and testing has been accepted.

3.5 LOOP TESTING

A. **General:** Individual instrument loop diagrams per ISA Standard S5.4 - Instrument Loop Diagrams, expanded format, shall be submitted to the CONTRACTING OFFICER for review prior to the loop tests. The CONTRACTOR shall notify the CONTRACTING OFFICER of scheduled tests a minimum of 30 days prior to the estimated completion date of installation and wiring of the PCIS. After the CONTRACTING OFFICER's review of the submitted loop diagrams for correctness and compliance with the specifications, loop testing shall proceed. The loop check shall be witnessed by the CONTRACTING OFFICER.

B. **Control Valve Tests:** Control valves, cylinders, drives and connecting linkages shall be stroked from the operator interface units as well as local control devices and adjusted to verify proper control action, hand switch action, limit switch settings, torque settings, remote control actions, and remote feedback of valve status and position. Control valve actions and positioner settings shall be checked with the valves in place to insure that no changes have occurred since the bench calibration.

C. **Interlocks:** All hardware and software interlocks between the instrumentation and the motor control circuits, control circuits of variable-speed controllers and packaged equipment controls shall be checked to the maximum extent possible.

D. **Instrument and Instrument Component Validation:** Each instrument shall be field tested, inspected, and adjusted to its indicated performance requirement in accordance its manufacturer's specifications and instructions. Any instrument which fails to meet any Contract requirement, or, in the absence of a Contract requirement, any published manufacturer performance specification for functional and operational parameters, shall be repaired or replaced, at the discretion of the CONTRACTING OFFICER.

E. **Loop Validation:** Controllers and electronic function modules shall be field tested and exercised to demonstrate correct operation. Control loops shall be checked under simulated operating conditions by impressing input signals at the primary control elements and observing appropriate responses of the respective control and monitoring elements, final control elements, and the graphic displays associated with the SCADA. Actual signals shall be used wherever available. Following any necessary corrections, the loops shall be retested. Accuracy tolerances for each analog network are defined as the root-mean-square (RMS) summation of individual component accuracy requirements. Individual component accuracy requirements shall be as indicated by Contract requirements or by published manufacturer accuracy specifications, whenever Contract accuracy requirements are not indicated. Each analog network shall be tested

by applying simulated analog or discrete inputs to the first element of an analog network. For networks which incorporate analog elements, simulated sensor inputs corresponding to 20, 40, 60, 80 and 100 percent of span shall be applied, and the resulting element outputs monitored to verify compliance to calculated RMS summation accuracy tolerance requirements. Continuously variable analog inputs shall be applied to verify the proper operation and setting of discrete devices. Provisional settings shall be made on controllers and alarms during analog loop tests. Analog loop test data shall be recorded on test forms attached at the end of this section which include calculated RMS summation system accuracy tolerance requirements for each output.

F. **Loop Validation Sheets:** The CONTRACTOR shall prepare loop confirmation sheets for each loop covering each active instrumentation and control device except simple hand switches and lights. Loop confirmation sheets shall form the basis for operational tests and documentation. Each loop confirmation sheet shall cite the following information and shall provide spaces for sign-off on individual items and on the complete loop by the Instrumentation Supplier:

1. Project name
2. Loop number
3. Tag number, description, manufacturer, and model number for each element
4. Installation bulletin number
5. Specification sheet number
6. Loop description number
7. Adjustment check
8. Space for comments
9. Space for loop sign-off by Instrumentation Supplier and date
10. Space for CONTRACTING OFFICER witness signature and date

G. **Loop Certifications:** When installation tests have been successfully completed for all individual instruments and all separate analog control networks, a certified copy of each test form signed by the CONTRACTING OFFICER or the CONTRACTING OFFICER's representative as a witness, with test data entered, shall be submitted to the CONTRACTING OFFICER together with a clear and unequivocal statement that the instrumentation has been successfully calibrated, inspected, and tested.

3.6 PRECOMMISSIONING

A. **General:** Precommissioning shall commence after acceptance of all wire test, calibration tests and loop tests, and inspections have demonstrated that the instrumentation and control system complies with Contract requirements. Precommissioning shall demonstrate proper operation of all systems with process equipment operating over full operating ranges under conditions as closely resembling actual operating conditions as possible.

B. **Precommissioning Procedures and Documentation:** Precommissioning and test activities shall follow detailed test procedures and check lists accepted by the CONTRACTING OFFICER. Test data shall be acquired using equipment as required and shall be recorded on test forms accepted by the CONTRACTING OFFICER, which include calculated tolerance limits for each step. Completion of system precommissioning and test activities shall be documented by a certified report, including test forms with test data entered, delivered to the CONTRACTING OFFICER with a clear and unequivocal statement that all system precommissioning and test requirements have been satisfied.

C. **Operational Validation:** Where feasible, system precommissioning activities shall include the use of water to establish service conditions that simulate, to the greatest extent possible, normal final control element operating conditions in terms of applied process loads, operating ranges, and environmental conditions. Final control elements, control panels, and ancillary equipment shall be tested under startup and steady state operating conditions to verify that proper and stable control is achieved using motor control center and local field mounted control circuits. Hardwired and software control circuit interlocks and alarms shall be operational. The control of final control elements and ancillary equipment shall be tested using both manual and automatic (where provided) control circuits. The stable steady state operation of final control elements running under the control of field mounted automatic analog controllers or software based controllers shall be assured by adjusting the controllers as required to eliminate oscillatory final control element operation. The transient stability of final control elements operating under the control of field mounted, and software based automatic analog controllers shall be verified by applying control signal disturbances, monitoring the amplitude and decay rate of control parameter oscillations (if any), and making necessary controller adjustments as required to eliminate excessive oscillatory amplitudes and decay rates.

D. **Loop Tuning:** Electronic control stations incorporating proportional, integral or differential control circuits shall be optimally tuned, experimentally, by applying control signal disturbances and adjusting the gain, reset, or rate settings as required to achieve a proper response. Measured final control element variable position/speed setpoint settings shall be compared to measured final control element position/speed values at 20, 40, 60, 80 and 100 percent of span and the results checked against indicated accuracy tolerances.

E. **Precommissioning Validation Sheets:** Precommissioning shall be documented on one of two types of test forms as follows:

1. For functions which can be demonstrated on a loop-by-loop basis, the form shall include:

    a. Project name

    b. Loop number

    c. Loop description

    d. Tag number, description, manufacturer, and data sheet number for each component.

    e. Space for sign-off and date by both the Instrumentation Supplier and CONTRACTING OFFICER.

2. For functions that cannot be demonstrated on a loop-by-loop basis, the test form shall be a listing of the specific tests to be conducted. With each test description the following information shall be included:

    a. Specification page and paragraph of function demonstrated

    b. Description of function

    c. Space for sign-off and date by both the Instrumentation Supplier and CONTRACTING OFFICER

F. **Precommissioning Certification:** The CONTRACTOR shall submit an instrumentation and control system precommissioning completion report which shall state that all Contract requirements have been met and shall include a listing of instrumentation and control system maintenance and repair activities conducted during the precommissioning testing. Acceptance of the instrumentation and control system precommissioning testing must be provided in writing by the CONTRACTING OFFICER before the performance testing may begin. Final acceptance of the control system shall be based upon plant completion as stated in the General Conditions.

3.7 ON-SITE SUPERVISION

A. The CONTRACTOR shall furnish the services of an on-site resident engineer to supervise and coordinate installation, adjustment, testing, and start-up of the PCIS. The resident engineer shall be present during the total period required to effect a complete operating system. A team of engineering personnel shall be on site for 80 hours to check all equipment, perform the tests indicated in this Section, and furnish startup services.

3.8 PERFORMANCE TEST

A. The entire PCIS shall operate for 30 days without failure.

B. The CONTRACTOR shall furnish support staff as required to operate the system and to satisfy the repair or replacement requirements.

C. If any component fails during the performance test, it shall be repaired or replaced and the PCIS shall be restarted on another 30 day period.

3.9 TRAINING

A. **General:** The CONTRACTOR shall train the GOVERNMENT's personnel on the maintenance, calibration, and repair of instruments provided under this Contract.

B. **Instructions:** The training shall be performed by qualified representatives of the equipment manufacturers and shall be specific to each piece of equipment.

C. **Duration:** Each training class shall be a minimum of 8 hours in duration and shall cover, as a minimum, operational theory, maintenance, trouble shooting/repair, and calibration of the instrument.

D. **Schedule:** Training shall be performed during the precommissioning phase of the project. The training sessions shall be scheduled a minimum of 3 weeks in advance of when the courses are to be initiated. The CONTRACTING OFFICER will review the course outline for suitability and provide comments that shall be incorporated.

E. **Agenda:** The training shall include operation and maintenance procedures, trouble shooting with necessary test equipment, and changing set points, and calibration for that specific piece of equipment.

F. **Documentation:** Within 10 days after the completion of each session the CONTRACTOR shall submit the following:

1. A list of all GOVERNMENT personnel who attended the session.

2. An evaluation of GOVERNMENT personnel via written testing or equivalent evaluation.

3. A copy of the training materials utilized during the lesson with notes, diagrams, and comments.

3.10 ACCEPTANCE

A. For the purpose of this Section, the following conditions shall be fulfilled before the WORK is considered substantially complete:

1. Submittals have been completed and approved.

2. The PCIS has been calibrated, loop tested, and precommissioned.

3. The GOVERNMENT training has been performed.

4. Spare parts and expendable supplies and test equipment have been delivered to the CONTRACTING OFFICER.

5. The performance test has been successfully completed.

6. Punch-list items have been corrected.

7. Record drawings both hard copy and electronic format have been submitted.

8. Revisions to the Technical Manuals that may have resulted from the field tests have been made and reviewed.

9. Debris associated with installation of instrumentation has been removed.

10. Probes, elements, sample lines, transmitters, tubing, and enclosures have been cleaned and are in like-new condition.

- END OF SECTION -

FORT IRWIN WASTEWATER TREATMENT PLANT
TERTIARY UPGRADE
INSTRUMENT LIST

Instrument Tag	Description	Spec	Set Point	Range	PID No.
AE-501	FILTER INFL. TURB. ANALYZER SENSOR	17112, 2.2	N/A	0-20 NTU	05I-1
AIT-501	FILTER INFL. TURB. ANALYZER TRANSMITTER	17112, 2.2	N/A	0-20 NTU	05I-1
FIT-519	FILTER INFL. PS FLOW/TRANSMITTER	15081	N/A	300-3000 gpm	05I-1
LE-519	FILTER INFL. PS LEVEL SENSOR	17107, 2.1	N/A	0-20 ft	05I-1
LIT-519	FILTER INFL. PS LEVEL TRANSMITTER	17106, 2.1	N/A	0-20 ft	05I-1
LSH-519	FILTER INFL. PS HI LEVEL SWITCH	17107, 2.2	EL 2374.00		05I-1
LSHH-519	FILTER INFL. PS HI-HI LEVEL SWITCH	17107, 2.2	EL 2374.50		05I-1
LSL-519	FILTER INFL. PS LO LEVEL SWITCH	17107, 2.2	EL 2362.50	N/A	05I-1
ME-516	FILTER INFL. PUMP 1 MOISTURE SENSOR	FURNISHED W/ PUMP	N/A	N/A	05I-1
ME-517	FILTER INFL. PUMP 2 MOISTURE SENSOR	FURNISHED W/ PUMP	N/A	N/A	05I-1
PI-516	FILTER INFL. PUMP 1 PRESSURE GAUGE	17108, 2.2 & 2.3	N/A	0-60 psi	05I-1
PI-517	FILTER INFL. PUMP 2 PRESSURE GAUGE	17108, 2.2 & 2.3	N/A	0-60 psi	05I-1
SK-516	FILTER INFL. PUMP 1 SPEED CONTROL	FURNISHED W/ PUMP VFD	N/A	0-100%	05I-1
SK-517	FILTER INFL. PUMP 2 SPEED CONTROL	FURNISHED W/ PUMP VFD	N/A	0-100%	05I-1
SI-516	FILTER INFL. PUMP 1 SPEED INDICATOR	FURNISHED W/ PUMP VFD	N/A	0-100%	05I-1
SI-517	FILTER INFL. PUMP 2 SPEED INDICATOR	FURNISHED W/ PUMP VFD	N/A	0-100%	05I-1
TSH-516	FILTER INFL. PUMP 1 HI TEMP. SWITCH	FURNISHED W/ PUMP	PER VENDOR	PER VENDOR	05I-1
TSH-517	FILTER INFL. PUMP 2 HI TEMP. SWITCH	FURNISHED W/ PUMP	PER VENDOR	PER VENDOR	05I-1
ZSC-516	FILTER INFL. PUMP 1 VALVE CLOSED	FURNISHED W/ VALVE	N/A	N/A	05I-1
ZSC-517	FILTER INFL. PUMP 2 VALVE CLOSED	FURNISHED W/ VALVE	N/A	N/A	05I-1
HS-701	FLOCC. 1 LOCKOUT/STOP SWITCH	FURNISHED W/ FLOCC.	N/A	N/A	06I-1
HS-701A	FLOCC. 1 ON/OFF SWITCH	FURNISHED W/ FLOCC.	N/A	N/A	06I-1
HS-702	FLOCC. 2 LOCKOUT/STOP SWITCH	FURNISHED W/ FLOCC.	N/A	N/A	06I-1
HS-702A	FLOCC. 2 ON/OFF SWITCH	FURNISHED W/ FLOCC.	N/A	N/A	06I-1
LSH-700	FLOCC. BASIN HI LEVEL SWITCH	FURNISHED W/ BASIN	EL 2393.50	N/A	06I-1
PI-600A	FLASH MIX PUMP SUCTION PRESS GAUGE	17108, 2.2 & 2.3	N/A	30"HG VAC/0/30 PSIG	06I-1
PI-600B	FLASH MIX PUMP DISCHARGE PRESSURE GAUGE	17108, 2.2 & 2.3	N/A	0-30 PSIG	06I-1
PSL-600	FLASH MIX PUMP SEAL WATER LO PRESS. SWITCH	17109, 2.1 & 2.2	10 PSIG	0-30 PSIG	06I-1
SI-701	FLOCC. 1 SPEED INDICATOR	FURNISHED W/ FLOCC.	N/A	0-100%	06I-1
SI-702	FLOCC. 2 SPEED INDICATOR	FURNISHED W/ FLOCC.	N/A	0-100%	06I-1
SK-701	FLOCC. 1 SPEED CONTROL	FURNISHED W/ FLOCC.	N/A	0-100%	06I-1
SK-702	FLOCC. 2 SPEED CONTROL	FURNISHED W/ FLOCC.	N/A	0-100%	06I-1

FORT IRWIN WASTEWATER TREATMENT PLANT
TERTIARY UPGRADE
INSTRUMENT LIST

Instrument Tag	Description	Spec	Set Point	Range	PID No.
YA-701	FLOCCULATOR 1 FAIL	FURNISHED W/ FLOCC.	N/A	N/A	06I-1
YA-702	FLOCCULATOR 2 FAIL	FURNISHED W/ FLOCC.	N/A	N/A	06I-1
YL-701	FLOCCULATOR 1 RUNNING	FURNISHED W/ FLOCC.	N/A	N/A	06I-1
YL-702	FLOCCULATOR 2 RUNNING	FURNISHED W/ FLOCC.	N/A	N/A	06I-1
AE-801	FILTER NO.1 TURB. ANALYZER SENSOR	17112, 2.2	N/A	0-10 NTU	08I-1
AE-802	FILTER NO.2 TURB. ANALYZER SENSOR	17112, 2.2	N/A	0-10 NTU	08I-1
AE-803	FILTER NO.3 TURB. ANALYZER SENSOR	17112, 2.2	N/A	0-10 NTU	08I-1
AE-804	FILTER NO.4 TURB. ANALYZER SENSOR	17112, 2.2	N/A	0-10 NTU	08I-1
AIT-801	FILTER NO.1 TURB. ANALYZER TRANSMITTER	17112, 2.2	N/A	0-10 NTU	08I-1
AIT-802	FILTER NO.2 TURB. ANALYZER TRANSMITTER	17112, 2.2	N/A	0-10 NTU	08I-1
AIT-803	FILTER NO.3 TURB. ANALYZER TRANSMITTER	17112, 2.2	N/A	0-10 NTU	08I-1
AIT-804	FILTER NO.4 TURB. ANALYZER TRANSMITTER	17112, 2.2	N/A	0-10 NTU	08I-1
HS-800A	AIR COMP. 1 HAND/OFF/AUTO SWITCH	FURNISHED W/ COMP. SYST.	N/A	N/A	08I-1
HS-800B	AIR COMP. 2 HAND/OFF/AUTO SWITCH	FURNISHED W/ COMP. SYST.	N/A	N/A	08I-1
LALL-800A	AIR COMP. 1 LO OIL LVL ALARM	FURNISHED W/ COMP. SYST.	PER VENDOR	PER VENDOR	08I-1
LALL-800B	AIR COMP. 2 LO OIL LVL ALARM	FURNISHED W/ COMP. SYST.	PER VENDOR	PER VENDOR	08I-1
LSH-801	FILTER NO. 1 HIGH LEVEL SWITCH	17107, 2.1	EL 2389.42	N/A	08I-1
LSH-802	FILTER NO. 2 HIGH LEVEL SWITCH	17107, 2.1	EL 2389.42	N/A	08I-1
LSH-803	FILTER NO. 3 HIGH LEVEL SWITCH	17107, 2.1	EL 2389.42	N/A	08I-1
LSH-804	FILTER NO. 4 HIGH LEVEL SWITCH	17107, 2.1	EL 2389.42	N/A	08I-1
LSL-800A	AIR COMP. 1 LO OIL LEVEL SWITCH	FURNISHED W/ COMP. SYST.	PER VENDOR	PER VENDOR	08I-1
LSL-800B	AIR COMP. 2 LO OIL LEVEL SWITCH	FURNISHED W/ COMP. SYST.	PER VENDOR	PER VENDOR	08I-1
PI-800	AIR COMP. TANK PRESS. GAUGE	FURNISHED W/ COMP. SYST.	N/A	0-200 PSIG	08I-1
PI-801A	FILTER NO.1 PRESSURE GAUGE	FURNISHED W/ FILTER	PER VENDOR	PER VENDOR	08I-1
PI-801B	FILTER NO.1 PRESSURE GAUGE	FURNISHED W/ FILTER	PER VENDOR	PER VENDOR	08I-1
PI-801C	FILTER NO.1 PRESSURE GAUGE	FURNISHED W/ FILTER	PER VENDOR	PER VENDOR	08I-1
PI-801D	FILTER NO.1 PRESSURE GAUGE	FURNISHED W/ FILTER	PER VENDOR	PER VENDOR	08I-1
PI-802A	FILTER NO.2 PRESSURE GAUGE	FURNISHED W/ FILTER	PER VENDOR	PER VENDOR	08I-1
PI-802B	FILTER NO.2 PRESSURE GAUGE	FURNISHED W/ FILTER	PER VENDOR	PER VENDOR	08I-1
PI-802C	FILTER NO.2 PRESSURE GAUGE	FURNISHED W/ FILTER	PER VENDOR	PER VENDOR	08I-1
PI-802D	FILTER NO.2 PRESSURE GAUGE	FURNISHED W/ FILTER	PER VENDOR	PER VENDOR	08I-1
PI-803A	FILTER NO.3 PRESSURE GAUGE	FURNISHED W/ FILTER	PER VENDOR	PER VENDOR	08I-1

FORT IRWIN WASTEWATER TREATMENT PLANT
TERTIARY UPGRADE
INSTRUMENT LIST

Instrument Tag	Description	Spec	Set Point	Range	PID No.
PI-803B	FILTER NO.3 PRESSURE GAUGE	FURNISHED W/ FILTER	PER VENDOR	PER VENDOR	08I-1
PI-803C	FILTER NO.3 PRESSURE GAUGE	FURNISHED W/ FILTER	PER VENDOR	PER VENDOR	08I-1
PI-803D	FILTER NO.3 PRESSURE GAUGE	FURNISHED W/ FILTER	PER VENDOR	PER VENDOR	08I-1
PI-804A	FILTER NO.4 PRESSURE GAUGE	FURNISHED W/ FILTER	PER VENDOR	PER VENDOR	08I-1
PI-804B	FILTER NO.4 PRESSURE GAUGE	FURNISHED W/ FILTER	PER VENDOR	PER VENDOR	08I-1
PI-804C	FILTER NO.4 PRESSURE GAUGE	FURNISHED W/ FILTER	PER VENDOR	PER VENDOR	08I-1
PI-804D	FILTER NO.4 PRESSURE GAUGE	FURNISHED W/ FILTER	PER VENDOR	PER VENDOR	08I-1
PSH-800	AIR COMP. TANK HI PRESS. SWITCH	FURNISHED W/ COMP. SYST.	120 PSIG	0-150 PSIG	08I-1
PSHH-800	AIR COMP. TANK HI-HI PRESS. SWITCH	FURNISHED W/ COMP. SYST.	125 PSIG	0-150 PSIG	08I-1
PSL-800	AIR COMP. TANK LO PRESS. SWITCH	FURNISHED W/ COMP. SYST.	90 PSIG	0-150 PSIG	08I-1
PSLL-800	AIR COMP. TANK LO-LO PRESS. SWITCH	FURNISHED W/ COMP. SYST.	85 PSIG	0-150 PSIG	08I-1
PSLL-801	AIR FILTER LOW PRESS. SWITCH	17109, 2.1	80 PSIG	0-150 PSIG	08I-1
TAHH-800A	AIR COMP. 1 HI TEMP. ALARM	FURNISHED W/ COMP. SYST.	PER VENDOR	N/A	08I-1
TAHH-800B	AIR COMP. 2 HI TEMP. ALARM	FURNISHED W/ COMP. SYST.	PER VENDOR	N/A	08I-1
TSH-800A	AIR COMP. 1 HI TEMP. SWITCH	FURNISHED W/ COMP. SYST.	PER VENDOR	N/A	08I-1
TSH-800B	AIR COMP. 2 HI TEMP. SWITCH	FURNISHED W/ COMP. SYST.	PER VENDOR	N/A	08I-1
YA-800A	AIR COMPRESSOR NO. 1 FAIL	FURNISHED W/ COMP. SYST.	N/A	N/A	08I-1
YA-800B	AIR COMPRESSOR NO. 2 FAIL	FURNISHED W/ COMP. SYST.	N/A	N/A	08I-1
YL-800A	AIR COMPRESSOR NO. 1 RUNNING	FURNISHED W/ COMP. SYST.	N/A	N/A	08I-1
YL-800B	AIR COMPRESSOR NO. 2 RUNNING	FURNISHED W/ COMP. SYST.	N/A	N/A	08I-1
HS-810A	REJECT WATER PS PUMP SELECTION SWITCH	FURNISHED W/ PUMP	N/A	N/A	08I-2
HS-811	REJECT WATER PS PUMP NO.1 HAND/OFF/AUTO SW	FURNISHED W/ PUMP	N/A	N/A	08I-2
HS-812	REJECT WATER PS PUMP NO.2 HAND/OFF/AUTO SW	FURNISHED W/ PUMP	N/A	N/A	08I-2
LAHH-810A	REJECT WATER PS HI-HI LEVEL ALARM	FURNISHED W/ PUMP	N/A	N/A	08I-2
LALL-810A	REJECT WATER PS LO-LO LEVEL ALARM	FURNISHED W/ PUMP	N/A	N/A	08I-2
LSH-810	REJECT WATER PS HI LEVEL SWITCH	FURNISHED W/ PUMP	?	N/A	08I-2
LSHH-810	REJECT WATER PS HI-HI LEVEL SWITCH	FURNISHED W/ PUMP	?	N/A	08I-2
LSL-810	REJECT WATER PS LO LEVEL SWITCH	FURNISHED W/ PUMP	?	N/A	08I-2
LSLL-810	REJECT WATER PS LO-LO LEVEL SWITCH	FURNISHED W/ PUMP	?	N/A	08I-2
LSM-810	REJECT WATER PS MED. LEVEL SWITCH	FURNISHED W/ PUMP	?	N/A	08I-2
ME-811	REJECT WATER PS PUMP NO. 1 MOIST. SENSOR	FURNISHED W/ PUMP	N/A	N/A	08I-2
ME-812	REJECT WATER PS PUMP NO. 2 MOIST. SENSOR	FURNISHED W/ PUMP	N/A	N/A	08I-2

FORT IRWIN WASTEWATER TREATMENT PLANT
TERTIARY UPGRADE
INSTRUMENT LIST

Instrument Tag	Description	Spec	Set Point	Range	PID No.
MSH-811	REJECT WATER PS PUMP NO. 1 HI MOIST. SWITCH	FURNISHED W/ PUMP	N/A	N/A	08I-2
MSH-812	REJECT WATER PS PUMP NO. 2 HI MOIST. SWITCH	FURNISHED W/ PUMP	N/A	N/A	08I-2
PI-811	REJECT WATER PS PUMP NO.1 PRESS. GAUGE	FURNISHED W/ PUMP	N/A	0-30 PSIG	08I-2
PI-812	REJECT WATER PS PUMP NO.2 PRESS. GAUGE	FURNISHED W/ PUMP	N/A	0-30 PSIG	08I-2
YA-811A	REJECT WATER PS PUMP NO.1 FAIL	FURNISHED W/ PUMP	N/A	N/A	08I-2
YA-812A	REJECT WATER PS PUMP NO.2 FAIL	FURNISHED W/ PUMP	N/A	N/A	08I-2
YL-811A	REJECT WATER PS PUMP NO.1 RUNNING	FURNISHED W/ PUMP	N/A	N/A	08I-2
YL-812A	REJECT WATER PS PUMP NO.2 RUNNING	FURNISHED W/ PUMP	N/A	N/A	08I-2
ZSO-811	REJECT WATER PS PUMP NO.1 VA. POS. OPEN	FURNISHED W/ VALVE	N/A	N/A	08I-2
ZSO-812	REJECT WATER PS PUMP NO.2 VA. POS. OPEN	FURNISHED W/ VALVE	N/A	N/A	08I-2
AE-900	CL2 TANK INFL. TURB. ANALYZER SENSOR	17112, 2.2	N/A	0-10 NTU	09I-1
AE-901	CL2 TANK INFL. CL2 ANALYZER SENSOR	17112, 2.3	N/A	0-20 PPM	09I-1
AE-902	CL2 TANK EFFL. CL2 ANALYZER SENSOR	17112, 2.3	N/A	0-20 PPM	09I-1
AE-903	CL2 TANK EFFL. pH ANALYZER SENSOR	17112, 2.4	N/A	2-12 Ph	09I-1
AE-904	CL2 TANK EFFL. COND. ANALYZER SENSOR	17112, 2.5	N/A		09I-1
AIT-900	CL2 TANK INFL. TURB. ANALY. TRANSMITTER	17112, 2.2	N/A	0-10 NTU	09I-1
AIT-901	CL2 TANK INFL. CL2 ANALYZER TRANSMITTER	17112, 2.3	N/A	0-20 PPM	09I-1
AIT-902	CL2 TANK EFFL. CL2 ANALYZER TRANSMITTER	17112, 2.3	N/A	0-20 PPM	09I-1
AIT-903	CL2 TANK EFFL. pH ANALYZER TRANSMITTER	17112, 2.4	N/A	2-12 Ph	09I-1
AIT-904	CL2 TANK EFFL. COND. ANALY. TRANSMITTER	17112, 2.5	N/A		09I-1
FIT-900	CL2 EFFL. STRUCTURE FLOW TRANSMITTER	17101, 2.1	N/A	0-3 MGD	09I-1
HS-900	CL2 CONTACT TANK MIXER ON/OFF SWITCH	FURNISHED W/ MIXER	N/A	N/A	09I-1
HS-900A	DOM. WATER SUPPLY VA. OPEN/CLOSE SWITCH	FURNISHED W/ VALVE	N/A	N/A	09I-1
HS-900B	DOM. WATER SUPPLY VA. LOC./REM. SWITCH	FURNISHED W/ VALVE	N/A	N/A	09I-1
HS-901	CL2 CONTACT TANK PUMP NO.1 ON/OFF SWITCH	FURNISHED W/ PUMP	N/A	N/A	09I-1
HS-902	CL2 CONTACT TANK PUMP NO.2 ON/OFF SWITCH	FURNISHED W/ PUMP	N/A	N/A	09I-1
LE-900	CL2 EFFL. STRUCTURE LEVEL SENSOR	17107, 2.2	?	N/A	09I-1
LSL-900	CL2 EFFL. STRUCTURE LO LVL SWITCH	17107, 2.2	?	N/A	09I-1
LSLL-900	CL2 EFFL. STRUCTURE LO-LO LVL SWITCH	17107, 2.2	?	N/A	09I-1
YA-901	CL2 CONTACT TANK MIXER FAIL	FURNISHED W/ MIXER	N/A	N/A	09I-1
YL-901	CL2 CONTACT TANK MIXER RUNNING	FURNISHED W/ MIXER	N/A	N/A	09I-1
YL-902	CCT TANK INFLUENT SAMPLE PUMP RUNNING	FURNISHED W/ PUMP	N/A	N/A	09I-1

FORT IRWIN WASTEWATER TREATMENT PLANT
TERTIARY UPGRADE
INSTRUMENT LIST

Instrument Tag	Description	Spec	Set Point	Range	PID No.
YL-903	CCT TANK EFFLUENT SAMPLE PUMP RUNNING	FURNISHED W/ PUMP	N/A	N/A	09I-1
ZSC-900	DOM. WATER SUPPLY VA. POS. CLOSED	FURNISHED W/ VALVE	N/A	N/A	09I-1
ZSO-900	DOM. WATER SUPPLY VA. POS. OPEN	FURNISHED W/ VALVE	N/A	N/A	09I-1
FIT-911	RECYCLE PS DISCH. FLOW/TRANSMITTER	15081	N/A	0-4000 GPM	09I-2
FSL-911	RECYCLE PS PUMP NO.11 DISCH. LO FLOW SWITCH	FURNISHED W/ PUMP	100 GPM	N/A	09I-2
FSL-912	RECYCLE PS PUMP NO.12 DISCH. LO FLOW SWITCH	FURNISHED W/ PUMP	300 GPM	N/A	09I-2
FSL-913	RECYCLE PS PUMP NO.13 DISCH. LO FLOW SWITCH	FURNISHED W/ PUMP	301 GPM	N/A	09I-2
FSL-914	RECYCLE PS PUMP NO.14 DISCH. LO FLOW SWITCH	FURNISHED W/ PUMP	302 GPM	N/A	09I-2
LSL-911	RECYCLE PS LO LEVEL SWITCH	17107, 2.2	?	N/A	09I-2
PI-911	RECYCLE PS PUMP NO.11 DISCH. PRESS. GAUGE	FURNISHED W/ PUMP	N/A	0-400 PSIG	09I-2
PI-912	RECYCLE PS PUMP NO.12 DISCH. PRESS. GAUGE	FURNISHED W/ PUMP	N/A	0-400 PSIG	09I-2
PI-913	RECYCLE PS PUMP NO.13 DISCH. PRESS. GAUGE	FURNISHED W/ PUMP	N/A	0-400 PSIG	09I-2
PI-914	RECYCLE PS PUMP NO.14 DISCH. PRESS. GAUGE	FURNISHED W/ PUMP	N/A	0-400 PSIG	09I-2
PIT-911	RECYCLE PS DISCH. PRESS. TRANSMITTER	17108, 2.4	N/A	0-250 PSIG	09I-2
PSH-911	RECYCLE PS DISCH. HI PRESS. SWITCH	17109, 2.1	240 PSIG	0-400 PSIG	09I-2
PSL-911	RECYCLE PS DISCH. LO PRESS. SWITCH	17109, 2.1	130 PSIG	0-400 PSIG	09I-2
SC-911	RECYCLE PS PUMP NO.11 SPEED CONTROL	FURNISHED W/ PUMP VFD	N/A	0-100%	09I-2
SC-912	RECYCLE PS PUMP NO.12 SPEED CONTROL	FURNISHED W/ PUMP VFD	N/A	0-100%	09I-2
SC-913	RECYCLE PS PUMP NO.13 SPEED CONTROL	FURNISHED W/ PUMP VFD	N/A	0-100%	09I-2
SC-914	RECYCLE PS PUMP NO.14 SPEED CONTROL	FURNISHED W/ PUMP VFD	N/A	0-100%	09I-2
SI-911	RECYCLE PS PUMP NO.11 SPEED INDICATOR	FURNISHED W/ PUMP VFD	N/A	0-100%	09I-2
SI-912	RECYCLE PS PUMP NO.11 SPEED INDICATOR	FURNISHED W/ PUMP VFD	N/A	0-100%	09I-2
SI-913	RECYCLE PS PUMP NO.11 SPEED INDICATOR	FURNISHED W/ PUMP VFD	N/A	0-100%	09I-2
SI-914	RECYCLE PS PUMP NO.11 SPEED INDICATOR	FURNISHED W/ PUMP VFD	N/A	0-100%	09I-2
TSH-911A	RECYCLE PS PUMP NO.11 HI BRG. TEMP. SWITCH	FURNISHED W/ PUMP	PER VENDOR	PER VENDOR	09I-2
TSH-911B	RECYCLE PS PUMP NO.11 HI WIND. TEMP. SWITCH	FURNISHED W/ PUMP	PER VENDOR	PER VENDOR	09I-2
TSH-912A	RECYCLE PS PUMP NO.12 HI BRG. TEMP. SWITCH	FURNISHED W/ PUMP	PER VENDOR	PER VENDOR	09I-2
TSH-912B	RECYCLE PS PUMP NO.12 HI WIND. TEMP. SWITCH	FURNISHED W/ PUMP	PER VENDOR	PER VENDOR	09I-2
TSH-913A	RECYCLE PS PUMP NO.13 HI BRG. TEMP. SWITCH	FURNISHED W/ PUMP	PER VENDOR	PER VENDOR	09I-2
TSH-913B	RECYCLE PS PUMP NO.13 HI WIND. TEMP. SWITCH	FURNISHED W/ PUMP	PER VENDOR	PER VENDOR	09I-2
TSH-914A	RECYCLE PS PUMP NO.14 HI BRG. TEMP. SWITCH	FURNISHED W/ PUMP	PER VENDOR	PER VENDOR	09I-2
TSH-914B	RECYCLE PS PUMP NO.14 HI WIND. TEMP. SWITCH	FURNISHED W/ PUMP	PER VENDOR	PER VENDOR	09I-2

FORT IRWIN WASTEWATER TREATMENT PLANT
TERTIARY UPGRADE
INSTRUMENT LIST

Instrument Tag	Description	Spec	Set Point	Range	PID No.
VSH-911	RECYCLE PS PUMP NO.11 HI VIBR. TEMP. SWITCH	FURNISHED W/ PUMP	PER VENDOR	PER VENDOR	09I-2
VSH-912	RECYCLE PS PUMP NO.12 HI VIBR. TEMP. SWITCH	FURNISHED W/ PUMP	PER VENDOR	PER VENDOR	09I-2
VSH-913	RECYCLE PS PUMP NO.13 HI VIBR. TEMP. SWITCH	FURNISHED W/ PUMP	PER VENDOR	PER VENDOR	09I-2
VSH-914	RECYCLE PS PUMP NO.14 HI VIBR. TEMP. SWITCH	FURNISHED W/ PUMP	PER VENDOR	PER VENDOR	09I-2
ZSC-911	RECYCLE PS DISCH. RELIEF VALVE CLOSED SW	FURNISHED W/ VALVE	N/A	N/A	09I-2
FSH-1001	LA/PEC FEED AREA SHOWER HI FLOW ALARM	FURNISHED W/ SHOWER	1 FT/SEC	N/A	10I-1
FSH-1002	LA/PEC FEED AREA SHOWER HI FLOW ALARM	FURNISHED W/ SHOWER	1 FT/SEC	N/A	10I-1
HS-1001A	LA/PEC METERING PUMP NO.1 HAND/OFF/AUTO SW	FURNISHED W/ PUMP	N/A	N/A	10I-1
HS-1001B	LA/PEC METERING PUMP NO.1 LOC./REM SWITCH	FURNISHED W/ PUMP	N/A	N/A	10I-1
HS-1002A	LA/PEC METERING PUMP NO.2 HAND/OFF/AUTO SW	FURNISHED W/ PUMP	N/A	N/A	10I-1
HS-1002B	LA/PEC METERING PUMP NO.2 LOC./REM SWITCH	FURNISHED W/ PUMP	N/A	N/A	10I-1
LE-1001	LA/PEC DAY TANK 1 LVL SENSOR	FURNISHED W/ TANK	N/A	0-12 FT	10I-1
LE-1002	LA/PEC DAY TANK 2 LVL SENSOR	FURNISHED W/ TANK	N/A	0-12 FT	10I-1
LI-1001	LA/PEC DAY TANK 1 LVL INDICATOR	FURNISHED W/ TANK	N/A	0-15 FT	10I-1
LI-1002	LA/PEC DAY TANK 2 LVL INDICATOR	FURNISHED W/ TANK	N/A	0-15 FT	10I-1
LIT-1001	LA/PEC DAY TANK 1 LVL TRANSMITTER	FURNISHED W/ TANK	N/A	0-12 FT	10I-1
LIT-1002	LA/PEC DAY TANK 2 LVL TRANSMITTER	FURNISHED W/ TANK	N/A	0-12 FT	10I-1
LSH-1001	LA/PEC PIT HI LVL SWITCH	17107, 2.1	2" ABOVE FLOOR	N/A	10I-1
LSH-1002	LA/PEC LEAK DET. HI LVL SWITCH 1	17107, 2.3	2" IN WELL	N/A	10I-1
LSL-1001	LA/PEC DAY TANK 1 LO LVL SWITCH	FURNISHED W/ TANK	?	N/A	10I-1
LSL-1002	LA/PEC DAY TANK 2 LO LVL SWITCH	FURNISHED W/ TANK	?	N/A	10I-1
LSLL-1001	LA/PEC DAY TANK 1 LO-LO LVL SWITCH	FURNISHED W/ TANK	?	N/A	10I-1
LSLL-1002	LA/PEC DAY TANK 2 LO-LO LVL SWITCH	FURNISHED W/ TANK	?	N/A	10I-1
PI-1001	LA/PEC METERING PUMP NO.1 FEED PRESS. GAUGE	17108, 2.2 & 2.3	N/A	0-200 PSIG	10I-1
PI-1002	LA/PEC METERING PUMP NO.2 FEED PRESS. GAUGE	17108, 2.2 & 2.3	N/A	0-200 PSIG	10I-1
PSH-1001	LA/PEC METERING PUMP NO.1 FEED HI PRESS. SW	17109, 2.1 & 2.2	50 PSIG	0-100 PSIG	10I-1
PSH-1002	LA/PEC METERING PUMP NO.2 FEED HI PRESS. SW	17109, 2.1 & 2.2	50 PSIG	0-100 PSIG	10I-1
SI-1001A	LA/PEC METERING PUMP NO.1 SPEED INDICATOR	FURNISHED W/ PUMP	N/A	0-100%	10I-1
SI-1002A	LA/PEC METERING PUMP NO.2 SPEED INDICATOR	FURNISHED W/ PUMP	N/A	0-100%	10I-1
SK-1001A	LA/PEC METERING PUMP NO.1 SPEED CONTROL	FURNISHED W/ PUMP	N/A	0-100%	10I-1
SK-1002A	LA/PEC METERING PUMP NO.2 SPEED CONTROL	FURNISHED W/ PUMP	N/A	0-100%	10I-1
YA-1001A	LA/PEC METERING PUMP NO.1 FAIL	FURNISHED W/ PUMP	N/A	N/A	10I-1

FORT IRWIN WASTEWATER TREATMENT PLANT
TERTIARY UPGRADE
INSTRUMENT LIST

Instrument Tag	Description	Spec	Set Point	Range	PID No.
YA-1002A	LA/PEC METERING PUMP NO.2 FAIL	FURNISHED W/ PUMP	N/A	N/A	10I-1
YL-1001A	LA/PEC METERING PUMP NO.1 RUNNING	FURNISHED W/ PUMP	N/A	N/A	10I-1
YL-1002A	LA/PEC METERING PUMP NO.2 RUNNING	FURNISHED W/ PUMP	N/A	N/A	10I-1
HS-1103A	SHC METERING PUMP NO.3 ON/OFF SW	FURNISHED W/ PUMP	N/A	N/A	11I-1
HS-1103B	SHC METERING PUMP NO.3 AUTO/MANUAL SW	FURNISHED W/ PUMP	N/A	N/A	11I-1
LSH-1101	SHC LEAK DET. HI LEVEL SWITCH 1	17107, 2.3	2" IN WELL	N/A	11I-1
PI-1103	SHC METERING PUMP NO.3 FEED PRESS. GAUGE	17108, 2.2 & 2.3	N/A	0-100 PSIG	11I-1
PSH-1103	SHC METERING PUMP NO.3 FEED HI PRESS. SW	17109, 2.1 & 2.2	0-50 PSIG	0-100 PSIG	11I-1
SI-1103A	SHC METERING PUMP NO.3 SPEED INDICATOR	FURNISHED W/ PUMP	N/A	0-100 %	11I-1
SK-1103A	SHC METERING PUMP NO.3 SPEED CONTROL	FURNISHED W/ PUMP	N/A	0-100 %	11I-1
YA-1103A	SHC METERING PUMP NO.3 FAIL	FURNISHED W/ PUMP	N/A	N/A	11I-1
YL-1103A	SHC METERING PUMP NO.3 RUNNING	FURNISHED W/ PUMP	N/A	N/A	11I-1
HS-1104A	SHC METERING PUMP NO.4 ON/OFF SW	FURNISHED W/ PUMP	N/A	N/A	11I-2
HS-1104B	SHC METERING PUMP NO.4 AUTO/MANUAL SW	FURNISHED W/ PUMP	N/A	N/A	11I-2
HS-1105A	SHC METERING PUMP NO.5 ON/OFF SW	FURNISHED W/ PUMP	N/A	N/A	11I-2
HS-1105B	SHC METERING PUMP NO.5 AUTO/MANUAL SW	FURNISHED W/ PUMP	N/A	N/A	11I-2
PI-1104	SHC METERING PUMP NO.4 FEED PRESS. GAUGE	17108, 2.2 & 2.3	N/A	0-100 PSIG	11I-2
PI-1105	SHC METERING PUMP NO.5 FEED PRESS. GAUGE	17108, 2.2 & 2.3	N/A	0-100 PSIG	11I-2
PSH-1104	SHC METERING PUMP NO.4 FEED HI PRESS. SW	17109, 2.1 & 2.2	17109, 2.1 & 2.2	0-50 PSIG	11I-2
PSH-1105	SHC METERING PUMP NO.5 FEED HI PRESS. SW	17109, 2.1 & 2.2	17109, 2.1 & 2.2	0-50 PSIG	11I-2
SI-1104A	SHC METERING PUMP NO.4 SPEED INDICATOR	FURNISHED W/ PUMP	N/A	0-100 %	11I-2
SI-1105A	SHC METERING PUMP NO.5 SPEED INDICATOR	FURNISHED W/ PUMP	N/A	0-100 %	11I-2
SK-1104A	SHC METERING PUMP NO.4 SPEED CONTROL	FURNISHED W/ PUMP	N/A	0-100 %	11I-2
SK-1105A	SHC METERING PUMP NO.5 SPEED CONTROL	FURNISHED W/ PUMP	N/A	0-100 %	11I-2
YA-1104A	SHC METERING PUMP NO.4 FAIL	FURNISHED W/ PUMP	N/A	N/A	11I-2
YA-1105A	SHC METERING PUMP NO.5 FAIL	FURNISHED W/ PUMP	N/A	N/A	11I-2
YL-1104A	SHC METERING PUMP NO.4 RUNNING	FURNISHED W/ PUMP	N/A	N/A	11I-2
YL-1105A	SHC METERING PUMP NO.5 RUNNING	FURNISHED W/ PUMP	N/A	N/A	11I-2

FORT IRWIN WASTEWATER TREATMENT PLANT
TERTIARY UPGRADE
I/O SUMMARY

I/O Tag	Description	Equipment	I/O Type	PLC	Drawing No.	Remarks
AI-501A	FILTER INFL. TURBIDITY INDICATOR	AE/AIT 501	AI	1	05I-1	
AI-801A	FILTER NO.1 TURB. ANALYZER INDICATOR	AE/AIT 801	AI	1	08I-1	
AI-802A	FILTER NO.2 TURB. ANALYZER INDICATOR	AE/AIT 802	AI	1	08I-1	
AI-803A	FILTER NO.3 TURB. ANALYZER INDICATOR	AE/AIT 803	AI	1	08I-1	
AI-804A	FILTER NO.4 TURB. ANALYZER INDICATOR	AE/AIT 804	AI	1	08I-1	
AI-900A	CL2 CONTACT TANK INFL. TURB. ANALYZER	AE/AIT 900	AI	1	09I-1	
AI-901A	CL2 CONTACT TANK INFL. CL2 ANALYZER	AE/AIT 901	AI	1	09I-1	
AI-902A	CL2 TANK EFFL. CL2 ANALYZER	AE/AIT 902	AI	1	09I-1	
AI-903A	CL2 TANK EFFL. pH ANALYZER	AE/AIT 903	AI	1	09I-1	
AI-904A	CL2 TANK EFFL. COND. ANALYZER	AE/AIT 904	AI	1	09I-1	
FI-519A	FILTER INFL. PS PUMP NO.1 FLOW	5-M-1/FIT 519	AI	1	05I-1	
FI-900A	CL2 EFFLUENT STRUCTURE FLOW	FIT 900	AI	1	09I-1	
FI-911A	REW PS DISCHARGE FLOW	9-M-1/FIT911	AI	1	09I-2	
LI-1001A	LA/PEC DAY TANK 1 LEVEL	LE/LIT 101	AI	1	10I-1	
LI-1002A	LA/PEC DAY TANK 2 LEVEL	LE/LIT 101	AI	1	10I-1	
LI-519A	FILTER INFL. PS LEVEL	LIT/LE 519	AI	1	05I-1	
PI-911A	REW PS DISCHARGE PRESSURE	PIT 911	AI	1	09I-2	
SI-1001B	LA/PEC METERING PUMP NO.1 SPEED	10-FD-1 LCP	AI	1	10I-1	
SI-1002B	LA/PEC METERING PUMP NO.2 SPEED	10-FD-2 LCP	AI	1	10I-1	
SI-1101B	SHC METERING PUMP NO.1 SPEED	11-FD-1 LCP	AI	1	11I-1	
SI-1102B	SHC METERING PUMP NO.2 SPEED	11-FD-2 LCP	AI	1	11I-1	
SI-1103B	SHC METERING PUMP NO.3 SPEED	11-FD-3 LCP	AI	1	11I-1	
SI-1104B	SHC METERING PUMP NO.4 SPEED	11-FD-4 LCP	AI	1	11I-2	
SI-1105B	SHC METERING PUMP NO.5 SPEED	11-FD-5 LCP	AI	1	11I-2	
SI-516A	FILTER INFL. PS PUMP NO.1 SPEED	5-P-1 VFD	AI	1	05I-1	
SI-517A	FILTER INFL. PS PUMP NO.2 SPEED	5-P-2 VFD	AI	1	05I-1	
SI-701A	FLOCCULATOR NO.1 SPEED	7-ME-1 VFD	AI	1	06I-1	
SI-702A	FLOCCULATOR NO.2 SPEED	7-ME-2 VFD	AI	1	06I-1	
SI-911A	REW PS PUMP NO. 11 SPEED	9-P-11 VFD	AI	1	09I-2	
SI-912A	REW PS PUMP NO. 12 SPEED	9-P-12 VFD	AI	1	09I-2	

FORT IRWIN WASTEWATER TREATMENT PLANT
TERTIARY UPGRADE
I/O SUMMARY

I/O Tag	Description	Equipment	I/O Type	PLC	Drawing No.	Remarks
SI-913A	REW PS PUMP NO. 13 SPEED	9-P-13 VFD	AI	1	09I-2	
SI-914A	REW PS PUMP NO. 14 SPEED	9-P-14 VFD	AI	1	09I-2	
FI-901	FILTER INFL. PS FLOW SIGNAL FEED	9-ME-2	AO	1	09I-1	
SC-1001B	LA/PEC METERING PUMP NO.1 SPEED CONTROL	10-FD-1 LCP	AO	1	10I-1	
SC-1002B	LA/PEC METERING PUMP NO.2 SPEED CONTROL	10-FD-2 LCP	AO	1	10I-1	
SC-1101B	SHC METERING PUMP NO.1 SPEED CONTROL	11-FD-1 LCP	AO	1	11I-1	
SC-1102B	SHC METERING PUMP NO.2 SPEED CONTROL	11-FD-2 LCP	AO	1	11I-1	
SC-1103B	SHC METERING PUMP NO.3 SPEED CONTROL	11-FD-3 LCP	AO	1	11I-1	
SC-1104B	SHC METERING PUMP NO.4 SPEED CONTROL	11-FD-4 LCP	AO	1	11I-2	
SC-1105B	SHC METERING PUMP NO.5 SPEED CONTROL	11-FD-5 LCP	AO	1	11I-2	
SC-516A	FILTER INFL. PS PUMP NO.1 SPEED CONTROL	5-P-1 VFD	AO	1	05I-1	
SC-517A	FILTER INFL. PS PUMP NO.2 SPEED CONTROL	5-P-2 VFD	AO	1	05I-1	
SC-911A	REW PS PUMP NO. 11 SPEED CONTROL	9-P-11 VFD	AO	1	09I-2	
SC-912A	REW PS PUMP NO. 12 SPEED CONTROL	9-P-12 VFD	AO	1	09I-2	
SC-913A	REW PS PUMP NO. 13 SPEED CONTROL	9-P-13 VFD	AO	1	09I-2	
SC-914A	REW PS PUMP NO. 14 SPEED CONTROL	9-P-14 VFD	AO	1	09I-2	
FAH-1001A	LA/PEC FEED AREA SHOWER HI FLOW ALARM	FSH 100	DI	1	10I-1	
FAH-1002A	LA/PEC FEED AREA SHOWER HI FLOW ALARM	FSH 100	DI	1	10I-1	
LAH-1001A	LA/PEC PIT HI LEVEL ALARM	LSH 101	DI	1	10I-1	
LAH-1002A	LA/PEC LEAK DET. HI LVL ALARM 1	LSH 104	DI	1	10I-1	
LAH-1101A	SHC LEAK DET. HI LVL ALARM 1	LSH 1101	DI	1	11I-1	
LAH-519A	FILTER INFL. PS HI LEVEL ALARM	LSH 519	DI	1	05I-1	
LAH-700A	FLOCCULATOR BASIN HI LEVEL ALARM	LSH 700	DI	1	06I-1	
LAH-801A	FILTER NO.1 HI LEVEL ALARM	LSH 801	DI	1	08I-1	
LAH-802A	FILTER NO.2 HI LEVEL ALARM	LSH 802	DI	1	08I-1	
LAH-803A	FILTER NO.3 HI LEVEL ALARM	LSH 803	DI	1	08I-1	
LAH-804A	FILTER NO.4 HI LEVEL ALARM	LSH 804	DI	1	08I-1	
LAHH-519A	FILTER INFL. PS HI-HI LEVEL ALARM	LSHH 519	DI	1	05I-1	
LAHH-810B	REJECT WATER PS HI LEVEL ALARM	8-P-1&2 LCP	DI	1	08I-2	
LAL-1001A	LA/PEC DAY TANK 1 LO LEVEL ALARM	LSL 101A	DI	1	10I-1	

FORT IRWIN WASTEWATER TREATMENT PLANT
TERTIARY UPGRADE
I/O SUMMARY

I/O Tag	Description	Equipment	I/O Type	PLC	Drawing No.	Remarks
LAL-1002A	LA/PEC DAY TANK 2 LO LEVEL ALARM	LSL 101A	DI	1	10I-1	
LAL-519A	FILTER INFL. PS LO LEVEL ALARM	LSL 519	DI	1	05I-1	
LAL-911A	REW PS LO LEVEL ALARM	LSL 911	DI	1	09I-2	
LALL-1001A	LA/PEC DAY TANK 1 LO-LO LEVEL ALARM	LSLL 101A	DI	1	10I-1	
LALL-1002A	LA/PEC DAY TANK 2 LO-LO LEVEL ALARM	LSLL 101A	DI	1	10I-1	
PAH-911A	REW PS DISCHARGE HI PRESS. SW.	PSH 911	DI	1	09I-2	
PAHH-800A	AIR COMPRESSOR HI-HI PRESS. ALARM	8-LCP-100	DI	1	08I-1	
PAL-911A	REW PS DISCHARGE LO PRESS. SW.	PSL 911	DI	1	09I-2	
PALL-800A	AIR COMPRESSOR LO-LO PRESS. ALARM	8-LCP-100	DI	1	08I-1	
PALL-801A	AIR FILTER LO-LO PRESS. ALARM	PSLL 801	DI	1	08I-1	
YA-1001B	LA/PEC METERING PUMP NO.1 FAIL	10-FD-1 LCP	DI	1	10I-1	
YA-1002B	LA/PEC METERING PUMP NO.2 FAIL	10-FD-2 LCP	DI	1	10I-1	
YA-1101B	SHC METERING PUMP NO.1 FAIL	11-FD-1 LCP	DI	1	11I-1	
YA-1102B	SHC METERING PUMP NO.2 FAIL	11-FD-2 LCP	DI	1	11I-1	
YA-1103B	SHC METERING PUMP NO.3 FAIL	11-FD-3 LCP	DI	1	11I-1	
YA-1104B	SHC METERING PUMP NO.4 FAIL	11-FD-4 LCP	DI	1	11I-2	
YA-1105B	SHC METERING PUMP NO.5 FAIL	11-FD-5 LCP	DI	1	11I-2	
YA-516A	FILTER INFL. PS PUMP NO.1 FAIL	5-P-1 VFD	DI	1	05I-1	
YA-517A	FILTER INFL. PS PUMP NO.2 FAIL	5-P-2 VFD	DI	1	05I-1	
YA-600A	FLASH MIX PUMP FAIL	6-P-1 MCC	DI	1	06I-1	
YA-701A	FLOCCULATOR NO.1 FAIL	7-ME-1 VFD	DI	1	06I-1	
YA-702A	FLOCCULATOR NO.2 FAIL	7-ME-2 VFD	DI	1	06I-1	
YA-800C	AIR COMPRESSOR NO.1 FAIL	8-LCP-100	DI	1	08I-1	
YA-800D	AIR COMPRESSOR NO.2 FAIL	8-LCP-100	DI	1	08I-1	
YA-811B	REJECT WATER PS PUMP NO.1 FAIL	8-P-1&2 LCP	DI	1	08I-2	
YA-812B	REJECT WATER PS PUMP NO.2 FAIL	8-P-1&2 LCP	DI	1	08I-2	
YA-900A	CL2 CONTACT TANK MIXER FAIL	9-ME-1 MCC	DI	1	09I-1	
YA-911A	REW PS PUMP NO. 11 FAIL	9-P-11 VFD	DI	1	09I-2	
YA-911B	REW PS PUMP NO. 11 O/L	9-P-11 VFD	DI	1	09I-2	
YA-912A	REW PS PUMP NO. 12 FAIL	9-P-12 VFD	DI	1	09I-2	

FORT IRWIN WASTEWATER TREATMENT PLANT
TERTIARY UPGRADE
I/O SUMMARY

I/O Tag	Description	Equipment	I/O Type	PLC	Drawing No.	Remarks
YA-912B	REW PS PUMP NO. 12 O/L	9-P-12 VFD	DI	1	09I-2	
YA-913A	REW PS PUMP NO. 13 FAIL	9-P-13 VFD	DI	1	09I-2	
YA-913B	REW PS PUMP NO. 13 O/L	9-P-13 VFD	DI	1	09I-2	
YA-914A	REW PS PUMP NO. 14 FAIL	9-P-14 VFD	DI	1	09I-2	
YA-914B	REW PS PUMP NO. 14 O/L	9-P-14 VFD	DI	1	09I-2	
YL-1001B	LA/PEC METERING PUMP NO.1 RUNNING	10-FD-1 LCP	DI	1	10I-1	
YL-1002B	LA/PEC METERING PUMP NO.2 RUNNING	10-FD-2 LCP	DI	1	10I-1	
YL-1101B	SHC METERING PUMP NO.1 RUNNING	11-FD-1 LCP	DI	1	11I-1	
YL-1102B	SHC METERING PUMP NO.2 RUNNING	11-FD-2 LCP	DI	1	11I-1	
YL-1103B	SHC METERING PUMP NO.3 RUNNING	11-FD-3 LCP	DI	1	11I-1	
YL-1104B	SHC METERING PUMP NO.4 RUNNING	11-FD-4 LCP	DI	1	11I-2	
YL-1105B	SHC METERING PUMP NO.5 RUNNING	11-FD-5 LCP	DI	1	11I-2	
YL-516A	FILTER INFL. PS PUMP NO.1 RUNNING	5-P-1 VFD	DI	1	05I-1	
YL-517A	FILTER INFL. PS PUMP NO.2 RUNNING	5-P-2 VFD	DI	1	05I-1	
YL-600A	FLASH MIX PUMP RUNNING	6-P-1 MCC	DI	1	06I-1	
YL-701A	FLOCCULATOR NO.1 RUNNING	7-ME-1 VFD	DI	1	06I-1	
YL-702A	FLOCCULATOR NO.2 RUNNING	7-ME-2 VFD	DI	1	06I-1	
YL-800C	AIR COMPRESSOR NO.1 RUNNING	8-LCP-100	DI	1	08I-1	
YL-800D	AIR COMPRESSOR NO.2 RUNNING	8-LCP-100	DI	1	08I-1	
YL-811B	REJECT WATER PS PUMP NO.1 RUNNING	8-P-1&2 LCP	DI	1	08I-2	
YL-812B	REJECT WATER PS PUMP NO.2 RUNNING	8-P-1&2 LCP	DI	1	08I-2	
YL-901A	CL2 CONTACT TANK MIXER RUNNING	9-ME-1 MCC	DI	1	09I-1	
YL-902A	CCT TANK INFLUENT SAMPLE PUMP RUNNING	9-P-1	DI	1	09I-1	
YL-903A	CCT TANK EFFLUENT SAMPLE PUMP RUNNING	9-P-2	DI	1	09I-1	
YL-911A	REW PS PUMP NO. 11 RUNNING	9-P-11 VFD	DI	1	09I-2	
YL-912A	REW PS PUMP NO. 12 RUNNING	9-P-12 VFD	DI	1	09I-2	
YL-913A	REW PS PUMP NO. 13 RUNNING	9-P-13 VFD	DI	1	09I-2	
YL-914A	REW PS PUMP NO. 14 RUNNING	9-P-14 VFD	DI	1	09I-2	
ZL-1001A	LA/PEC METERING PUMP NO.1 AUTO	10-FD-1 VSD	DI	1	10I-1	
ZL-1001C	LA/PEC METERING PUMP NO.1 IN REMOTE	10-FD-1 LCP	DI	1	10I-1	

FORT IRWIN WASTEWATER TREATMENT PLANT
TERTIARY UPGRADE
I/O SUMMARY

I/O Tag	Description	Equipment	I/O Type	PLC	Drawing No.	Remarks
ZL-1002A	LA/PEC METERING PUMP NO.2 AUTO	10-FD-2 LCP	DI	1	10I-1	
ZL-1002C	LA/PEC METERING PUMP NO.2 IN REMOTE	10-FD-2 LCP	DI	1	10I-1	
ZL-1101A	SHC METERING PUMP NO.1 AUTO	11-FD-1 LCP	DI	1	11I-1	
ZL-1102A	SHC METERING PUMP NO.2 AUTO	11-FD-2 LCP	DI	1	11I-1	
ZL-1103A	SHC METERING PUMP NO.3 AUTO	11-FD-3 LCP	DI	1	11I-1	
ZL-1104A	SHC METERING PUMP NO.4 AUTO	11-FD-4 LCP	DI	1	11I-2	
ZL-1105A	SHC METERING PUMP NO.5 AUTO	11-FD-5 LCP	DI	1	11I-2	
ZL-516A	FILTER INFL. PS PUMP NO.1 IN REMOTE	5-P-1 VFD	DI	1	05I-1	
ZL-517A	FILTER INFL. PS PUMP NO.2 IN REMOTE	5-P-2 VFD	DI	1	05I-1	
ZL-900A	DOM. WATER SUPPLY VA. IN REM. STATUS	HS 900B	DI	1	09I-1	
ZL-911A	REW PS PUMP NO. 11 IN REM. STATUS	9-P-11 VFD	DI	1	09I-2	
ZL-912A	REW PS PUMP NO. 12 IN REM. STATUS	9-P-12 VFD	DI	1	09I-2	
ZL-913A	REW PS PUMP NO. 13 IN REM. STATUS	9-P-13 VFD	DI	1	09I-2	
ZL-914A	REW PS PUMP NO. 14 IN REM. STATUS	9-P-14 VFD	DI	1	09I-2	
ZLC-900A	DOM. WATER SUPPLY VA. POS. CLOSED	ZSC 900	DI	1	09I-1	
ZLC-911A	REW PS DISCH. PRESS. REG. CLOSED STATUS	ZSC 911	DI	1	09I-2	
ZLO-900A	DOM. WATER SUPPLY VA. POSITION OPEN	ZSO 900	DI	1	09I-1	
HS-1001C	LA/PEC METERING PUMP NO.1 START/STOP SW.	10-FD-1 LCP	DO	1	10I-1	
HS-1002C	LA/PEC METERING PUMP NO.2 START/STOP SW.	10-FD-2 LCP	DO	1	10I-1	
HS-1103C	SHC METERING PUMP NO.3 START/STOP SW.	11-FD-3 LCP	DO	1	11I-1	
HS-1104C	SHC METERING PUMP NO.4 START/STOP SW.	11-FD-4 LCP	DO	1	11I-2	
HS-1105C	SHC METERING PUMP NO.5 START/STOP SW.	11-FD-5 LCP	DO	1	11I-2	
HS-516B	FILTER INFL. PS PUMP NO.1 ON/OFF	5-P-1 VFD	DO	1	05I-1	
HS-517B	FILTER INFL. PS PUMP NO.2 ON/OFF	5-P-2 VFD	DO	1	05I-1	
HS-900C	DOM. WATER SUPPLY VA. OPEN COMMAND	HS 900A	DO	1	09I-1	
HS-900D	DOM. WATER SUPPLY VA. CLOSE COMMAND	HS 900A	DO	1	09I-1	
HS-911A	REW PS PUMP NO. 11 ON/OFF SWITCH	9-P-11 VFD	DO	1	09I-2	
HS-912A	REW PS PUMP NO. 12 ON/OFF SWITCH	9-P-12 VFD	DO	1	09I-2	
HS-913A	REW PS PUMP NO. 13 ON/OFF SWITCH	9-P-13 VFD	DO	1	09I-2	
HS-914A	REW PS PUMP NO. 14 ON/OFF SWITCH	9-P-14 VFD	DO	1	09I-2	

FORT IRWIN WASTEWATER TREATMENT PLANT
TERTIARY UPGRADE
I/O SUMMARY

I/O Tag	Description	Equipment	I/O Type	PLC	Drawing No.	Remarks
I/O Summary :	**AI = 32 AO = 14**	**DI = 91**	**DO = 13**	**MODI = 0**	**MODO = 0**	

SECTION 17101 - OPEN CHANNEL FLOW MEASURING SYSTEMS

1.1 THE REQUIREMENT

A. **General:** The CONTRACTOR shall provide open channel flow measuring systems, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 17100 - Process Control and Instrumentation Systems apply to this Section.

1.2 CONTRACTOR SUBMITTALS

A. In addition to the shop drawing requirements of Section 17100, the CONTRACTOR shall submit certified curves or tables relating liquid level to flow rate at 0.1-foot intervals for each size and type of flow measuring system.

PART 2 -- PRODUCTS

2.1 RECTANGULAR WEIR FLOW MEASUREMENT SYSTEM

A. **General:** A rectangular weir plate and level sensing instrumentation shall be provided in the chlorine contact effluent structure as indicated for measurement of the flow rate through the chlorine contact structure.

B. **Weir:** The rectangular weir shall be a fabricated plate in front of the concrete opening in the structure. An ultrasonic level sensing system shall measure the level, calculate the flow rate, indicate the flow rate, and transmit the flow rate across the weir.

C. **Calibration Tolerances:** The level above the top of the weir plate shall be measured and the flow rate calculated by the transmitter to produce a flow signal output plus or minus 3 percent of published rating curves for rectangular weirs. Calibration curves or tables shall be submitted with the flow transmitter.

D. **Flow Measuring Instrumentation:** The ultrasonic flow measuring systems shall consist of a non-contact sonic transducer, an electronic transmitter, and interconnecting cables. The transmitter shall generate the sonic signal to drive the transducer, detect the return echo, and convert the elapsed time first to a level signal and second to a linearized flow signal based on the type of weir in which it is installed. The transmitter shall be of solid state design, have an integral flow rate indicator and totalizer, removable keypad for calibration and configuration, thermostatically controlled heaters, an isolated 4-20 Ma output signal linearly proportional to the flow rate, transducer temperature compensation and a contact output upon transmitter failure (loss of echo). Input power shall be 120 VAC 60 Hz. The sonic transducer shall be housed in a NEMA 4 watertight enclosure and be constructed of corrosion resistant materials.

E. Sonic level measuring flow rate system shall be **Milltronics HydroRanger, Endress + Hauser Prosonic Ultrasonic Level Measurement System,** or equal.

PART 3 -- EXECUTION

3.1 GENERAL

A. Open channel flow measuring systems shall be executed according to Section 17100.

- END OF SECTION -

SECTION 17103 – LIQUID FLOW DETECTION DEVICES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. **General:** The CONTRACTOR shall provide liquid flow detection devices, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 17100 - Process Control and Instrumentation Systems apply to this Section.

PART 2 -- PRODUCTS

2.1 THERMAL FLOW SWITCHES

A. Thermal flow switches shall function based on heat transfer between probes in the flow stream. The probes, electronic circuits, and relay shall all be part of an integral unit with a non-ferrous cast housing. Process fluid wetted parts shall be 316 stainless steel. In horizontal pipe runs the unit shall be side mounted. Switches shall be capable of functioning in an environment where the probes are not always immersed. Output relay shall be configurable to energize on increasing flow and have SPDT contacts rated 2 A, 120 VAC minimum. The actuation point shall be field adjustable from .015 to 5 ft/sec in water. Response time shall be adjustable from 1 to 150 seconds. The actuation point shall not be affected by process fluid temperature changes in the range of 32 to 140 degrees F and shall have a repeatability of plus or minus 5 percent. The Contact unit shall operate with the indicated repeatability in an ambient temperature range of 25 to 120 degrees F. The power supply shall be 120 VAC.

B. Thermal flow switches shall be **FCI Model 12-64**, Thermal Flow Instruments, or equal.

PART 3 -- EXECUTION

3.1 GENERAL

A. Liquid flow detection devices shall be executed according to the requirements of Section 17100.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 17106 - LEVEL MEASURING SYSTEMS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. **General:** The CONTRACTOR shall provide level measuring systems, complete and operable in accordance with the Contract Documents.

B. “Smart” transmitters shall be furnished when or where ever possible.

C. The requirements of Section 17100 - Process Control and Instrumentation Systems apply to this Section.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 17100.

PART 2 -- PRODUCTS

2.1 NON-CONTACT SONIC LEVEL MEASUREMENT

A. Sonic level measuring systems shall consist of an electronic controller-transmitter, a non-contact sonic transducer, and interconnecting cables. The controller-transmitter shall generate the sonic signal to drive the transducer, detect the return echo and convert the elapsed time to a level signal. The controller-transmitter shall have the following features; solid state design, integral level indicator, removable keypad for calibration and configuration, thermostatically controlled heaters, isolated, 4-20 Ma output signal linearly proportional to level, transducer temperature compensation and a contact output upon transmitter failure (loss of echo). Input power shall be 120 VAC 60 Hz. The sonic transducer shall be housed in a NEMA 4 watertight enclosure and be constructed of corrosion resistant materials.

B. Sonic level measuring systems shall be **Endress + Hauser, Milltronics** or equal.

PART 3 -- EXECUTION

3.1 GENERAL

A. Level measuring systems shall be executed according to Section 17100.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 17107 - LEVEL DETECTION SWITCHES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. **General:** The CONTRACTOR shall provide all level detection switches complete and operable in accordance with the Contract Documents.

B. The requirements of Section 17100 - Process Control and Instrumentation Systems apply to this Section.

1.2 CONTRACTOR SUMITTALS

A. Furnish submittals in accordance with Section 17100.

PART 2 -- PRODUCTS

2.1 TIPPING FLOAT LEVEL SWITCHES

A. Tipping float level switches shall consist of a switch, a moving float, and a connecting cable which is anchored at the midpoint of a differential band. As the level rises and falls the float rights itself or inverts causing switching actions. The cable anchoring point shall be protected by strain relief. The hermetically sealed switches shall be SPDT with a minimum rating of 10 Amps at 120 VAC.

B. Manufacturer shall be **MAGNETROL T10, FLYGT ENM-10, KARI**, or equal.

2.2 CONDUCTANCE PROBE

A. Switch shall be of the conductance type with PVC sheath and 0.25-inch stainless steel rod electrodes for lengths up through 6 feet. For lengths greater than 6 feet, wire suspension type with stainless steel shield electrodes shall be provided. Electrode fitting enclosure shall be an epoxy coated and gasketed cast aluminum housing of suitable configuration for the application. Induction relays shall be two winding type. Primary power supply shall be 120 volts, 60 Hz. Secondary potential shall not exceed 300 volts AC and short circuit current shall not exceed 25 milliamperes.

B. Manufacturer shall be be **B/W 1500 Series, Warrick Series 1G,** or equal.

2.3 LEAK DETECTION LEVEL SWITCH

A. The leak detection level switch shall be of the frequency shift tuning fork type. Sensing liquid or air changes the frequency of vibration and therefore, detects a change of media. The switch shall be immune to foam, turbulence, air bubbles, suspended solids or trash, and uneffected by changes in viscosity or density.

B. The level switch shall have its electronics housed in a single compartment NEMA 4X housing made of plastic. The wetted part of the switch shall be 316L Stainless Steel. The instrument shall have a .75-inch or 1-inch NPT process connection with an extension of 13-inches from the threaded process connection to the sensing point. The power input shall be 120VAC, 60 Hz. The output contacts shall be from a DPDT relay.

C. Manufacturer shall be **Endress + Hauser, Model Liquiphant M FTL51-AGM2CB4E4A** with an insertion length of 13 inches.

PART 3 -- EXECUTION

3.1 GENERAL

A. Level detection switches shall be executed according to Section 17100.

- END OF SECTION -

SECTION 17108 - PRESSURE MEASURING SYSTEMS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. **General:** The CONTRACTOR shall provide pressure measuring systems, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 17100 - Process Control and Instrumentation Systems apply to the WORK of this Section.

1.2 CONTRACTOR SUBMITTALS

A. Shop Drawings, Owner's Manual, and Record Drawings shall be submitted in conformance with Section 17100 and Section 01300 - Contractor Submittals.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Electrical interface and code compliance shall conform to the requirements of Section 17100.

2.2 PRESSURE GAUGES

A. Pressure gauges shall be 4-1/2 inches in diameter, bottom connected, with white laminated dials and black graduations. Gauges shall have a blowout disc and safety glass, encased in phenolic, steel or cast iron. Measuring element shall be a stainless steel bourdon tube with welded, stress-relieved joints. Socket shall have wrench flats. Movement shall be rotary geared, all stainless steel material. All pressure gauges shall be provided with a pulsation snubber constructed of 316 stainless steel and an isolation valve. Accuracy shall be plus and minus 1/2 percent range. The pressure gauge shall be **Ashcroft 1279, Ametek Solfrunt Series 1900,** or equal.

2.3 PRESSURE DIAPHRAGM SEALS

A. Diaphragm seals shall consist of bottom housing, lower ring, diaphragm capsule, fill screw, fusing connection, and a top housing. The diaphragm seal shall attach to the inlet connection of a pressure instrument to isolate its measuring element from the process fluid. The space between the diaphragm and the instrument pressure element shall be completely filled with a suitable liquid. Displacement of the liquid fill in the pressure element through the movement of the diaphragm shall transmit process pressure changes directly to a gauge, transmitter, switch or any other pressure instrument. The diaphragm seal shall have a removable bottom housing to permit the servicing of the diaphragm capsule without the need to refill. All surfaces exposed to process fluids shall be Type 316 stainless steel or other compatible material suitable for the process connection.

B. Pressure diaphragm seals shall be **Ashcroft 50-100 SS-02T-CG** for stainless steel diaphragm seals. The model number may vary with process compatibility.

2.4 ELECTRONIC DIFFERENTIAL PRESSURE TRANSMITTERS

A. **Components:** Electronic differential transmitters shall consist of a capsule assembly, bottom works, vent plug, drain plug, cover flange, process connector and connection, amplifier unit, integral indicator, terminal box with cover, block and bleed valves, and conduit connections.

B. **Operating Principles:** Pressure applied to the unit shall be transmitted by a sealed fill fluid to both sides of a sensing diaphragm. The sensing diaphragm and the sensor body shall function as the moving and fixed electrodes, respectively, of a differential capacitor. As the applied pressure causes the diaphragm to move, the capacitance of the cell shall change.

C. Performance Requirements

1. The amplifier unit shall convert the change in capacitance to a 4-20 mA DC signal, e wire type, with an allowable loop load of no less than 600 ohms.

2. Static pressure rating shall be a minimum of 500 psig.

3. The maximum overrange pressure limit shall be a minimum of 150 percent of the minimum range.

4. Span shall be adjustable over a minimum of 5:1 range

5. External adjustments shall include zero and span.

6. Damping shall be provided as an internal adjustment.

7. All equipment shall be suitable for an ambient operating range of minus 40 degree F to plus 212 degrees F.

8. The integral indicator shall be calibrated in process units.

9. Power supply shall be 24 VDC.

10. Accuracy, including linearity and repeatability, shall be a plus or minus 0.2 percent of span.

D. **Materials:** All wetted parts including block and bleed valves parts shall be constructed of 316 stainless steel.

E. Manufacturers, or Equal

1. **Foxboro Series 821**

2. **Rosemont 1151GP**

3. **Yokogawa Ya 43/44**

2.5 ANNULAR RING SEALS FOR PRESSURE MEASURING SYSTEMS

A. Components

1. Flanges: Where seal elements are used to isolate pipeline flow media from a gauge the sensor shall be flanged and bolted directly into ANSI flanged pipelines. Face to face distance shall not be greater than a wafer style of a butterfly valve. The flanges shall have through bolt bolts to enable positive alignment in the pipeline. Flanges shall conform to pipe specifications.

2. Sensor: Inside diameter of the sensor shall be the same as the mating pipe for a full uninterrupted flow. There shall be no dead ends or crevices, and flow passage shall make the sensor self-cleaning. The sensor shall have an auxiliary tapped and plugged port to allow connection or other equipment.

B. **Operating Principles:** The pressure sensing ring shall measure pressure for 360 degrees around the full inside circumference of the pipeline. The sensing ring shall also be clamped into the body for the full radial width of the sensor. Pressure shall be transmitted to the gauge by a locked in and sealed fluid such as ethylene glycol or silicone oil.

C. **Performance:** Wetted parts (liner) shall be capable for continuous duty handling a slurry containing 15 percent solids in a hydrocarbon oil similar to kerosene at temperatures up to 225 degrees F.

D. Manufacturers, or Equal

1. **Red Valve Co.**

2. **Ronningen-Petter**

PART 3 -- EXECUTION

3.1 GENERAL

A. Pressure measuring systems shall be handled, installed, calibrated, loop-tested, pre-commissioned, and performance tested according to Section 17100. The manufacturer shall furnish the manufacturer's service, supervision, and training indicated by Section 17100.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 17109 - PRESSURE DETECTION SWITCHES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. **General:** The CONTRACTOR shall provide pressure detection switches, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 17100 - Process Control and Instrumentation Systems apply to this Section.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 17100.

PART 2 -- PRODUCTS

2.1 ADJUSTABLE PRESSURE SWITCH

A. Adjustable pressure switches shall be diaphragm actuated, dual adjustment pressure switches with SPDT contacts rated for a minimum of 5 Amps at 120 VAC. The dead band shall be adjustable up to 60 percent of full scale. Set points shall fall between 20 and 80 percent of the adjustable range. The diaphragm shall be Buna-N, and the lower housing shall be brass with a 1/4-inch bottom sensing connection, unless otherwise indicated

B. Manufacturer shall be **United Electric Series 400, Ashcroft Series L/Series B,** or equal.

2.2 DIAPHRAGM SEALS FOR PRESSURE DETECTION SWITCHES

A. **Components:** Diaphragm seals shall consist of bottom housing, lower ring, diaphragm capsule, fill screw, flushing connection, and a top housing.

B. **Operating Principles:** The diaphragm seal shall attach to the inlet connection of a pressure instrument to isolate its measuring element from the process fluid. The space between the diaphragm and the pressure element shall be completely filled with a suitable liquid. Displacement of the liquid fill in the pressure element through the movement of the diaphragm shall transmit process pressure changes directly to a gauge, transmitter, switch or other pressure instrument. The diaphragm seal shall have a removable bottom housing to permit servicing and refilling.

C. **Materials:** All exposed surfaces, housings, and diaphragm shall be constructed of 316 stainless steel.

D. Manufacturers, or Equal

1. **Ashcroft 100**

2.3 ANNULAR RING SEALS FOR PRESSURE DETECTION SWITCHES

A. Components

1. Flanges: Where seals are used to isolate pipeline flow media from a gauge, the sensor shall be flanged and bolted directly into ANSI flanged pipelines. Face to face distance shall not be greater than a wafer style of a butterfly valve. The flanges shall have through-holes to enable positive alignment in the pipeline. Flanges shall conform to pipe specifications.

2. Sensor: Inside diameter of the sensor shall be the same as the mating pipe for a full uninterrupted flow. There shall be no dead ends or crevices, and flow passage shall make the sensor self-cleaning. The sensor shall have an auxiliary tapped and plugged port to allow connection or other equipment.

B. **Operating Principles:** The pressure sensing ring shall measure pressure for 360 degrees around the full inside circumference of the pipeline. The sensing ring shall also be clamped into the body for the full radial width of the sensor. Pressure shall be transmitted to the gauge by a locked in and sealed fluid such as ethylene glycol or silicone oil.

C. **Performance:** Wetted parts (liner) shall be capable of continuous duty handling a slurry containing 15 percent solids in a hydrocarbon oil similar to kerosene at temperatures up to 225 degrees F.

D. Manufacturers, or Equal

1. **Red Valve Co.**

2. **Ronningen-Petter**

PART 3 -- EXECUTION

3.1 GENERAL

A. Pressure measuring systems shall be handled, installed, calibrated, loop-tested, pre-commissioned, and performance tested according to Section 17100. The manufacturer shall furnish the manufacturer's service, supervision, and training indicated by Section 17100.

- END OF SECTION -

SECTION 17112 - PROCESS ANALYZER MEASURING SYSTEMS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. **General:** The CONTRACTOR shall provide all Process Analyzer Measuring Systems, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 17100 - Process Control and Instrumentation Systems apply to this Section.

PART 2 -- PRODUCTS

2.1 GENERAL

A. **Power Input:** Analyzers shall be the fully isolated 2-wire type, unless the type is not available, in which case the analyzer shall be the fully isolated four wire type with power supply of 115 volts plus and minus 10 percent, 60 Hz plus and minus 5 percent.

B. **Signal Output:** Outputs shall be current regulated 4-20 mA DC capable of driving 0 to 600 ohms.

C. **Ambient Conditions:** Analyzers shall be suitable for continuous automatic on-line analysis of the indicated parameter under the conditions indicated.

1. Equipment shall operate satisfactorily in ambient temperatures between 20 degrees and plus 130 degrees F or shall be provided with isothermal enclosures so that accuracies will not exceed one percent of span.

2. Process fluid temperatures will range between 40 and 100 degrees F unless indicated otherwise.

D. **Sample Flow:** Samples shall not pass through housings containing electronics unless indicated otherwise.

E. **Local Indication:** Each analyzer shall be provided with local indication scaled in process units.

F. **Calibration:** Each analyzer shall be fitted with calibration connections at the analyzer.

G. **Single Manufacturer:** All electrodes, fittings, and transmitters on analyzers measuring the same parameter shall be products of a single manufacturer.

2.2 LOW RANGE TURBIDITY MEASURING SYSTEMS

A. The turbidimeter shall be a microprocessor-based, continuous-reading, on-line nephelometric instrument meeting all design and performance criteria specified by USEPA method 180.1. Light shall be directed through the surface of the sample and the detector shall be immersed in the sample, eliminating glass windows and flow cells. Optical components shall be mounted in a sealed head assembly that can be removed easily for calibration/service, without disturbing sample flow. The turbidimeter body shall

be constructed of corrosion-resistant polystyrene, and shall include an internal bubble trap to vent entrained air from the sample stream. The turbidimeter shall offer the choice of formazin-based (20 or 1 NTU) or instrument comparison-based calibration methods.

Accuracy shall be ± 2% of reading or ± 0.020 NTU (whichever is greater) from 0 to 40 NTU, and ± 5% of reading from 41 to 100 NTU. Resolution shall be 0.001 NTU and repeatability shall be better than ± 1.0% of reading or ±0.002 NTU (whichever is greater). User selectable signal averaging, bubble rejection, alarm and recorder output hold, and self-test diagnostics shall be provided.

B. Calibration shall be based on Formazin via comparison to a laboratory turbidimeter or with reflectance rods which are furnished as an accessory. The control unit shall be capable of offsetting the turbidity of pure water to read 0.0000 on particle free water. An auto-ranging digital display shall read from 0 to 100 NTU, and the output shall be capable of driving an 800 ohm load. The output shall be programmable over any portion of the output range, and self test diagnostics shall be provided to indicate malfunctions. The control unit shall be provided in a wall mounted fiberglass enclosure which permits unobstructed viewing of all readouts. The turbidimeter shall have a 2 year Manufacturer's warranty.

C. **Aquatrend Interface Module:** The graphical interface unit shall be a microprocessor-based device capable of functioning in a single sensor. The interface unit shall allow operators to control sensor functions with user-friendly, menu-driven software, and shall provide datalogging of measurement data for 1 hour, 24 hours or 30 days, and the capability to transfer data to a computer or printer via an RS232 serial input/output device. The interface unit and separate DC power supply shall be housed in NEMA-4X (indoor) industrial plastic enclosures, and the power supply shall automatically accept input in the range of 95 to 240 Vac, 50/60 Hz. The Interface module shall be provided with a 4-20 mA signal output module and a PS1201 power supply.

D. Turbidimeter shall be **HACH Model 1720D/52001-00.**

E. An additional piece of equipment supplied with the units shall be a **ICE-PIC Calibration/Verification module (52250-00).**

2.3 CHLORINE RESIDUAL MEASURING SYSTEMS

A. **Sensor:** Residual chlorine analyzers shall be the amperometric type designed to measure total chlorine in a continuous sample of raw water. The measuring cell shall have gold and copper electrodes with automatic temperature change compensation and a continuous direct drive cleaning system including rotating striker and plastic cleaning balls. Gravity flow to the cell shall be approximately 350 - 500 ml per minute from a built-in constant head tank. Potassium and/or buffer iodide reagents, if required, shall be fed by gravity through a rotary valve from a container with a minimum capacity of 7 days of reagent. Reagent level shall be visible from the front of the unit. Sample piping shall include self-flushing "Y" strainers and pressure reducing valves.

B. **Transmitter:** The transmitter shall produce an isolated current output proportional to chlorine residual. Sensitivity shall be 0.01 mg/l; accuracy shall be plus and minus 2 percent of reading or 0.01 mg/l, whichever is greater. Range shall be 0-20 mg/l. A local 3.5 digit LCD indicator or grapical display scaled in mg/l residual chlorine shall be provided. Microprocessor and other components shall be provided with battery backup to retain setpoints, calibration, and other information during extended power outages.

Each analyzer shall be a factory wired and piped, wall mounted unit all provided by the Manufacturer. All materials in the analyzer system shall be corrosion resistant and suitable for environments containing chlorine and sulfur dioxide vapors. Each analyzer unit shall be furnished with a 16 week supply of buffer solution plus 1.0 lb. of potassium chloride and 1.0 kg of glycine.

C. Manufacturer: Chlorine residual monitoring systems shall be **Capital Controls Aztec CL 1000, Wallace & Tiernan Micro 2000.**

2.4 pH MONITORING SYSTEM

A. The ph sensor shall be of a Differential Electrode Technique design, which shall use two electrodes to compare the process value to a stable internal reference standard buffer solution. The sensor body shall be constructed of liquid crystal polymer (LCP). The sensor's electronics shall be completely encapsulated and resistant to moisture and humidity. The sensor shall be temperature compensated and include a metal ground electrode to eliminate ground loop currents in the measuring electrodes.

B. The sensor shall be union mounted to a flow-through 2-inch PVC threaded tee pipe fitting furnished with the pH sensor. The union at the top of the tee connection shall provide easy removal of the sensor.

C. The sensor shall be connected to a local indicating analyzer and transmitter measuring a range of 2 to 12 pH. The analyzer shall be microprocessor based with a graphical dot matrix LCD display and LED backlighting. Menu screens shall contain up to six full lines of conversational text. The analyzer shall have predictive diagnostics to forecast the end of sensor life and reactive diagnostics to alert the operator to changes in vital electrode data including measuring and reference electrode impedances, zero and slope. The analyzer shall also have an automatic logbook for recording up to 100 system events including calibrations, electrode performance statistics, warning and failure messages, power-up and power down events, and configuration activity. Each event shall be logged with the date and time of the event.

D. Two isolated output signals, one of the pH and one of the measured temperature, shall be transmitted as 4-20 mA into a maximum load of 900 ohms each. The span may be calibrated anywhere within the range of the sensors. The accuracy shall be +/-0.05% of span. The temperature drift shall be 0.01% of span per degree of C. The temperature shall be automatically compensated –10 to+110 degrees C; (14-230 degrees F).

E. The pH Monitoring System shall be **Great Lakes Instrument Model P63A1A1A1 pH Analyzer** with a **Great Lakes Instrument Model 6058P0** pH probe or equal.

2.5 CONDUCTIVITY MONITORING SYSTEM

A. The electrodeless conductivity sensor shall measure from 0-200 to 0-2,000,000 microSiemens/cm, and shall have a built-in Pt 1000 RTD element to compensate measured conductivity for changes in process temperature. The sensor shall be constructed of only one wetted body material which shall be polypropylene. The sensor cable shall be rated to 150 degrees C. The sensor's electronics shall be completely encapsulated and resistant to moisture and humidity. The sensor shall be union mounted to a flow-through 2-inch PVC threaded tee pipe fitting furnished with the conductivity sensor. The union at the top of the tee connection shall provide easy removal of the sensor.

B. The sensor shall be connected to a local indicating analyzer and transmitter measuring a maximum range of 0-2,000,000 microSiemens/cm. The analyzer shall be micro-processor based with a graphical dot matrix LCD display and LED backlighting. Menu screens shall contain up to six full lines of conversational text. The analyzer shall have predictive diagnostics to alert the operator to sensor problems, including a disconnected sensor, incorrect sensor wiring, or an open or shorted temperature compensator.

C. The analyzer shall also have an automatic logbook for recording up to 100 system events including calibrations, warning and failure messages, power-up and power down events, and configuration activity. Each event shall be logged with the date and time of the event.

D. Two isolated output signals, one of the conductivity and one of the measured temperature, shall be transmitted as 4-20 mA into a maximum load of 900 ohms each. The span may be calibrated anywhere within the range of the sensors. The accuracy shall be +/-0.5% of span. The temperature drift shall be 0.02% of span per degree of C. The temperature shall be automatically compensated –10 to+200 degrees C; (14-392 degrees F).

E. The conductivity Monitoring System shall be **Great Lakes Instrument Model E63FIN1A1A1N** conductivity Analyzer with a **Great Lakes Instrument Model 3725E2T** conductivity probe, or equal.

PART 3 -- EXECUTION

3.1 GENERAL

A. Process analyzer measuring systems shall be executed according to Section 13300 - Process Control and Instrumentation Systems.

- END OF SECTION -

SECTION 17200 – CONTROL PANELS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. **General:** The CONTRACTOR shall provide control panels, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 17100 - Process Control and Instrumentation Systems apply to this Section.

C. The provisions of this Section apply to Section 17201 - Control Panel Instrumentation except where indicated otherwise.

D. The provisions of this Section apply to local panels provided in equipment systems specified in other sections unless indicated otherwise in those sections.

1.2 CONTRACTOR SUBMITTALS

A. **General:** Submittals shall be furnished in accordance with Section 01300 - Contractor Submittals.

B. **Control Panel Engineering Submittal:** The CONTRACTOR shall submit a control panel engineering submittal (CPES) for each control panel and enclosure provided under Division 17. The CPES shall completely define and document the construction, finish, layout, power circuits, signal and safety grounding circuits, fuses, circuit breakers, signal circuits, internally mounted instrumentation and SCADA system components, face plate mounted instrumentation components, internal panel arrangements, and external panel arrangements. All panel drawings shall, as a minimum, be "B" size with all data sheets and manufacturer specification sheets being "A" size. The submittal shall be in conformance with ISA-S20 - Standard Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves, shall be submitted as a singular complete bound volume or multi-volume package within 120 calendar days after Notice to Proceed, and shall have the following contents:

1. A complete index shall appear in the front of each bound volume. Drawings and data sheets associated with a panel shall be grouped together with the panels being indexed by systems or process areas. Panel tagging and nameplate nomenclature shall be consistent with the requirements of the Contract Documents.

2. Scale construction drawings which define and quantify the type and gauge of steel to be used for panel fabrication, the ASTM grade to be used for structural shapes and straps, panel door locks and hinge mechanisms, type of bolts and bolt locations for section joining and anchoring, details and proposed locations for "UNISTRUT" members, stiffener materials and locations, electrical terminal box and outlet locations, electrical access locations, print pocket locations, writing board locations, and lifting lug material and locations.

3. Scaled physical arrangement drawings drawn to scale which define and quantify the physical groupings comprising control panel sections, auxiliary panels, subpanels, and racks. Cutout locations with nameplate identifications shall be shown.

4. Front of panel layouts for all control panels.

5. Schematic/elementary diagrams shall depict all control devices and circuits and their functions.

6. Wiring/connection diagrams shall locate and identify electrical devices, terminals, and interconnecting wiring. These diagrams shall show interconnecting wiring by lines, designate terminal assignments, and show the physical location of all electrical and control devices.

7. Interconnection diagrams shall locate and identify all external connections between the control panel/control panel devices and associated equipment. These diagrams shall show interconnecting wiring by lines, designate terminal assignments, and show the physical location of all panel ingress and egress points.

8. Control sequence diagrams to portray the contact positions or connections required to be made for each successive step of the control action. Written descriptions explaining the control sequence diagrams and system operation shall be furnished.

9. Completed ISA S20 data sheets for all instrumentation devices associated with each control panel supplemented with manufacturer specification sheets which verify conformance to the requirements of the Contract Documents

10. A bill of material which enumerates all devices associated with the control panel.

11. A priced listing of analog spare parts in conformance with Section 17100.

1.3 EXTENDED PERIOD FOR CORRECTION OF DEFECTS

A. The CONTRACTOR shall correct all defects in accordance with Section 17100.

PART 2 -- PRODUCTS

2.1 GENERAL

A. **Environmental Suitability:** Indoor and outdoor control panels and instrument enclosures shall be suitable for operation in the ambient conditions associated with the locations designated in the Contract Documents. Heating, cooling, and dehumidifying devices shall be provided in order to maintain all instrumentation devices 20 percent within the minimums and maximums of their rated environmental operating ranges. The CONTRACTOR shall provide all power wiring for these devices. Enclosures suitable for the environment shall be provided. Instrumentation in hazardous areas shall be suitable for use in the particular hazardous or classified location in which it is to be installed.

B. The control panel controls shall be 120 VAC. Where the electrical power supply to the control panel is 240 VAC single phase or 480 VAC 3-phase, the control panel shall be provided with a control panel transformer. Control conductors shall be provided in accordance with the indicated requirements.

C. The control panel shall be the source of power for any 120 VAC solenoid valves interconnected with the control panel. Equipment associated with the control panel shall be ready for service after connection of conductors to equipment, controls, and control panel.

D. The main feeder disconnect shall have a door-mounted handle unless otherwise indicated.

E. Unless indicated otherwise, control panels shall be housed in NEMA rated enclosures in accordance with Section 16050 – Electrical Work, General. Control panels shall be either freestanding, pedestal-mounted or equipment skid-mounted, as indicated. Internal control components shall be mounted on an internal back-panel or side-panel as required.

F. Each source of foreign voltage shall be isolated by providing disconnecting or pull-apart terminal blocks or a disconnect operable from the control panel front. Each control panel shall be provided with identified terminal strips for the connection of all external conductors. The CONTRACTOR shall provide sufficient terminal blocks to connect 25 percent additional conductors for future use.

G. Motor starters, where required, shall be in accordance with Section 16480 - Low Voltage Motor Control Center. Each motor starter shall be provided with contact closures for motor overload, local indication, and remote alarm. Electrical components shall be of standard American manufacture.

H. Discrete outputs from the control panel shall be provided by electrically isolated contacts rated for 5 amps at 120 VAC. Analog inputs and outputs shall be isolated 4-20 mA, 2-wire signals with power supply.

I. Programmable Logic Controllers (PLCs) may be supplied in lieu of relays, provided the programmable logic controllers match the PLCs provided under Section 17520 - PLC-Based Control Systems Hardware.

J. Control panel mounted devices shall be mounted a minimum of 3 feet above finished floor elevation. Provide all combination motor starters not furnished in a MCC but specified in Section 11000 - Equipment General Provisions.

K. **Painting:** Steel control panels shall be thoroughly cleaned and sand blasted per Society for Protective Coatings SP 6 (Commercial Blast) after which surfaces shall receive a prime coat of **Amercoat 185** or equal, 3-mils DFT, for a total thickness of the prime plus finish system of 6 mils. The finished color of the outside surfaces shall be selected by the CONTRACTING OFFICER, unless otherwise indicated. Interior of the control panel, back-panel, and side panels shall have a white finish coat. The CONTRACTOR shall furnish 2 one-pint containers of the finish coat for future maintenance purposes.

2.2 CONTROL PANELS

A. Materials

1. Steel panel section faces shall be No. 10 gauge minimum thickness for free standing panels and No. 14 gauge minimum thickness for wall mounted or pedestal mounted panels. Materials shall be selected for levelness and smoothness.

2. Relay rack high density type panels shall utilize standard relay racks with No. 14 gauge steel frame and supports.

3. Structural shapes and strap steel shall comply with ASTM A 283 - Low and Intermediate Tensile Strength Carbon Steel Plates, Grade C.

a. Bolting Material: Commercial quality carbon steel bolts, nuts, and washers shall be 1/2-inch diameter with UNC threads. Carriage bolts shall be used for attaching end plates. All other bolts shall be hex end machine bolts. Nuts shall be hot pressed hex, American Standard, heavy. Standard wrought washers shall be used for foundation bolts and attachments to building structures. Other bolted joints shall have SAE standard lock washers.

4. Construction: Dimensions shall be in accordance with vendor's requirements. Elevations and horizontal spacing shall be subject to CONTRACTING OFFICER's approval.

B. Fabrication

1. End plates, top plates, and top closure panels (to hung ceiling) shall be provided when required by the material requisition. End plates, top plates, and top closure panels shall be removable with countersunk bolts to match panels. Top closure panels shall be furnished in lengths which match the widths of standard panels, except that one top closure panel may extend across two 4-foot 6-inch wide or five 2-foot wide standard panels. The vertical joints of these panels shall align with the vertical joints of the standard panels.

2. End closure or rear closure doors shall be provided where required. Such doors shall be flush fitting, gasketed, and be of the hinged lift-off type with lockable door handles. A common key shall be provided for all doors on one panel assembly. Removable access panels shall be provided with dished handle fasteners. Screw driver 1/4 turn or Dzus type fasteners are not acceptable.

a. The flanged edges of all panels shall be straight and smooth. Corners shall be welded and ground smooth.

b. The face of the panel shall be true and level after flanging.

c. All panel cutouts and holes may be cut or drilled by any standard method that does not cause deformation. Burrs shall be ground smooth.

d. Adjacent panels shall assemble with faces flush. Gaps or cracks shall not be visible from the front of the assembled instrument board.

e. Stiffeners shall be welded to the back of panels, as required to prevent panel deformation due to the weight of face mounted instruments.

f. Panels shall be self-supporting as defined below.

C. Framework and Supports

1. The rear of each panel section shall have a steel framework assembled to it for supporting conduit, wireways, switches, piping, and instrument accessory items such as relay or terminal enclosures, transducers, pressure switches, valves, and air relays. The main frame work shall be constructed of standard structural shapes. Special shapes such as "**Unistrut**" may be used for secondary supports. Framework must neither interfere with instrument connections nor interfere with access needed for maintenance or adjustments.

2. Steel framework shall extend 2-feet 4-inches back from the panel face or as indicated in the material requisition. Where indicated, individual adjustable leg supports shall be provided at the back of the framework so that the entire panel is self-supporting.

D. Preparation of Panel Surface

1. The following requirements apply to the front and rear face of the panel, both sides and the edges of all flanges, and the periphery of all holes or cutouts.

a. High spots, burrs, and rough spots shall be ground smooth.

b. The surfaces shall be sanded or sandblasted to a smooth, clean, bright finish.

c. All traces of oil shall be removed with a solvent.

d. The first coat of primer shall be applied immediately.

E. **Instrument Finishing:** The final coats applied to painted surface of instrument cases, doors, or bezels which are visible from the front of panels shall be manufacturer's standard unless otherwise indicated. Black japan or "crinkle" finishes on instrument cases are not acceptable.

F. Mounting of Instruments

1. The panel vendor shall provide cutouts, and shall mount all instrument items indicated to be panel mounted, including any instruments indicated to be furnished by other vendors but installed in the panel.

2. The panel vendor shall also mount behind the panels other instrument accessory items as required for functionality as indicated.

3. Equipment mounted at the rear of panel shall be installed to allow for commissioning adjustments, servicing requirements, and cover removal.

4. Spare space shall be kept clear of wiring, etc., to give maximum space for future additions.

G. Electrical Requirements

1. The CONTRACTOR shall provide conduit, wireways, switches, wire, and electrical fittings for 120 volt circuits to instruments and other electrical devices as required for a complete and operable installation.

2. Conduit, wireways, junction boxes and fittings shall be provided for signal wire, thermocouple, or resistance thermometer lead wire. Conduit or wireway runs shall include those required between temperature sensors and temperature transmitters and between the thermocouple wireway or junction box and instruments.

3. Each terminal connection shall have a plastic plate with a terminal and instrument tag number. Wiring shall be identified with stamped tubular wire end markers.

4. Freestanding panels shall be provided with switched 100 watt incandescent back-of-panel lights. One light shall be provided for every 4-feet of panel width and shall be mounted inside and in the top of the back-of-panel area.

5. Freestanding panels shall be provided with a 15 amp, 120 volt, service outlet circuit within the back-of-panel area. The circuit shall be provided with 3 wire, 120 volt, 15 ampere, duplex receptacles, one for every 4-feet of panel width (one minimum per panel), spaced evenly along the back-of-panel area.

6. Wall mounted or pedestal mounted panels shall be so sized as to adequately dissipate heat generated by equipment mounted in or on the panel.

7. Wall mounted or pedestal mounted panels mounted outside or in unshaded areas shall be provided with thermostatically controlled heaters that maintain inside temperature above 40 degrees F.

8. Provide a hand switch controlled 100 watt incandescent light and a breaker protected 120 volt, 15 amp duplex receptacle within each wall mounted or pedestal mounted panel larger than 4 cubic feet volume.

9. Wiring Methods: Wiring methods and materials for all panels shall be in accordance with the NEC requirements for General Purpose (no open wiring) unless otherwise indicated.

10. Signal and Control Circuit Wiring

    a. Wire type and sizes: Conductor shall be flexible stranded copper machine tool wire, UL listed Type MTW, and shall be rated 600 volts. Wires for instrument signal circuits and alarm input circuits shall be No. 14 AWG. All other wires, including shielded cables, shall be No. 16 AWG minimum.

    b. Wire Insulation Colors: Conductors supplying 120 VAC power on the line side of a disconnecting switch shall have a black insulation for the ungrounded conductor. Grounded circuit conductors shall have white insulation. Insulation for ungrounded 120V AC control circuit conductors shall be red. Wires energized by a voltage source external to the control panel shall have yellow insulation. Insulation for DC conductors shall be blue.

    c. Wire Marking: Wire numbers shall be marked using white numbered wire markers made from plastic-coated cloth, **Brady Type B 500** or equal, or shall be heat shrink plastic.

    d. Flexible conduit is not acceptable except when specifically approved by the CONTRACTING OFFICER in writing.

    e. Conduit fittings shall be **Crouse Hinds** cast fittings or equal.

    f. Splicing of wires will only be allsowed in junction boxes. Splices shall be either soldered or pressure crimped type.

    g. For case grounding, panels shall be provided with a 1/4-inch by 1-inch copper ground bus complete with solderless connector for one No. 4 AWG bare stranded copper cable. The copper cable shall be provided by the CONTRACTOR and be connected to a system ground loop.

11. Electrical Locations

    a. When the Contract Documents call for thermocouple actuated instruments, the thermocouple lead wire shall be installed without junction by the CONTRACTOR. The panel vendor shall provide dedicated empty conduits or wireways running from the instrument(s) to the top or bottom of the panel as called for in the material specifications or as otherwise required. Sizing of the conduit or wireway shall be in accordance with the capacity of the instrument(s).

    b. Single case (no remote logic) annunciator units shall be installed at the top of panel and may be considered as a terminal box when top of panel wire entry is indicated. If bottom of panel entry is indicated, a terminal box shall be provided at the bottom of the panel and be wired to the annunciator unit. Terminals shall be identified with plastic marker strips.

    c. Terminal boxes for incoming and outgoing signal leads shall be located at the top or bottom of the panel as indicated in the material specification, or as otherwise required.

12. Power Supply Wiring

    a. Unless otherwise indicated, instruments, alarm systems, and motor controls shall operate on 120 volt, 60 Hz circuits.

    b. At a location near the top of the panel (or bottom), the panel fabricator shall provide terminal box connections for the main power supply entry.

    c. Power supply switches for alarm units shall be 3 pole type, arranged to open both power circuits and alarm circuits. Each annunciator unit shall be equipped with a separate switch.

    d. Instruments located on the same panel section and serving the same process unit may be connected to a common branch circuit from the power supply. The number of circuits depends on the circuit load as noted herein. A 15 amp, 2 pole circuit breaker shall be provided in each branch circuit. The circuit load shall not exceed 10 amp. Different panel sections or different process units must not use common branch circuits. When instruments do not come equipped with integral fuses, provide fuses as required for the protection of individual instruments against fault currents. Fuses shall be mounted on the back of the panel in a fuse holder, and each fuse shall be identified by a service name tag. Fuses shall be as manufactured by **Bussmann Manufacturing Division, Type KAW TRON** or equal.

    e. Each potentiometer type instrument, electronic transducer, controller, or analyzer shall have an individual disconnect switch. Disconnect switches shall have metal or plastic tags indicating instrument tag numbers. Individual plug and cord set power supply connections may be used without switches when indicated in the material specification.

    f. Where alarm units are single unit types, one switch may be used to disconnect not more than 6 alarm units located on the same or adjacent panels.

13. Alarm Wiring: The panel vendor shall install and wire alarms including light cabinets, audible signal units, test and acknowledge switches, and remote logic units as indicated. Interconnecting wiring to panel mounted initiating devices shall also be wired by the panel vendor. The wiring from external initiating devices shall be provided by the CONTRACTOR. Where plug and cord sets are provided for component interconnection, the panel vendor shall harness and support the cables in neat and orderly fashion. Where separate wire is required, panel vendor shall install No. 16 AWG with THWN or THHN insulation between all components.

14. Signal Wiring

    a. Signal Wire - Non Computer Use

        1) Signal wire shall be twisted pair or triads in conduit or troughs. Cable shall be constructed of No. 16 AWG copper signal wires with THWN or THHN insulation.

        2) Color code for instrument signal wiring shall be as follows:

            Positive (+) – Black
            Negative (-) - White

        3) Multiconductor cables where indicated shall consist of No. 16 AWG copper signal wires twisted in pairs, with 90-C, 600 V fault insulation. A copper drain wire shall be provided for the bundle with a wrap of aluminum polyester shield. The overall bundle jacket shall be PVC.

    b. Signal Wire - Computer Use

        1) Signal wires shall be similar to those for non-computer use but each pair shall be triplexed with a copper drain wire and aluminum polyester tape shall be applied over the triplexed group. Cable shields, including thermocouple extension leads shall be terminated in the central control room at the computer system grounding bus. Continuity of the shield shall be maintained throughout the cable runs.

    c. Multi-conductor cables, wireways and conduit shall be sized to allow for 10 percent spare signal wire.

H. **Labor and Workmanship:** Panels shall be fabricated, piped, and wired by fully qualified workmen who are properly trained, experienced, and supervised.

2.3 SCADA SYSTEM ENCLOSURES

A. Each SCADA system PLC and remote I/O system and corresponding housing, I/O modules, power supply modules, communication interface devices, and peripheral equipment shall be mounted inside a NEMA enclosure in accordance with Section 16050. I/O wiring from the field to the remote I/O system shall be terminated on terminal blocks in the lower portion of the enclosure. A nameplate shall be mounted on the outside of the door of the enclosure and be engraved with "PLC-X" or "RIO-X" where "X" is the number as shown on the Drawings. Where indicated, PLCs mounted in free standing enclosures shall be 84-inches tall by 26-inches wide by 24-inches deep, minimum. Where indicated, PLCs mounted in wall or pedestal mounted enclosures shall

be 36-inches tall by 24-inches wide by 24-inches deep, minimum. Enclosures shall be as manufactured by **Hoffman**, or equal.

2.4 SPARE PARTS AND SPECIAL TOOLS

A. Control panel spare parts selected by the CONTRACTING OFFICER and special tools shall be furnished in accordance with Section 17100.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Preparation for Shipment and Shipping

1. Panels shall be crated for shipment using a heavy framework and skids. Panel sections shall be cushioned to protect the finish of the instruments and panel during shipment. Instruments which are shipped with the panel shall further have suitable shipping stops and cushioning material installed to protect parts which could be damaged due to mechanical shock. Each separate panel unit shall be provided with removable lifting lugs to facilitate handling.

2. Shipments shall be by air ride van unless otherwise indicated.

3. Control panel testing and inspection shall be performed prior to shipping.

4. Control panels shall be installed in accordance with Section 17100.

3.2 CONTROL PANEL SIGNAL AND CONTROL CIRCUIT WIRING

A. **Wiring Installation:** Wires shall be run in plastic wireways except (1) field wiring, (2) wiring between mating blocks in adjacent sections, (3) wiring from components on a swing out panel to components on a part of the fixed structure, and (4) wiring to panel mounted components. Wiring run from components on a swing out panel to other components on a fixed panel shall be made up in tied bundles. These bundles shall be tied with nylon wire ties and shall be secured to panels at both sides of the "hinge loop" so that conductors are not strained at the terminals.

B. Wiring run to control devices on the front panels shall be tied together at short intervals with nylon wire ties and be secured to the inside face of the panel using adhesive mounts.

C. Wiring to rear terminals on panel-mount instruments shall be in plastic wireways secured to horizontal brackets above or below the instruments in about the same plane as the rear of the instruments.

D. Shop Drawings shall show conformance to the above wiring installation requirements.

E. **Wire Marking:** Each signal, control, alarm, and indicating circuit conductor connected to a given electrical point shall be designated by a single unique number which shall be shown on Shop Drawings. These numbers shall be marked on conductors at every terminal.

3.3 CALIBRATION, TESTING, AND INSTRUCTION

A. **General:** Calibration, testing, and instruction shall be performed in accordance with Section 17100.

B. Inspection and Approval

1. Panel fabricator shall conduct the following tests prior to arrival of the CONTRACTING OFFICER or before shipment, if the CONTRACTING OFFICER chooses not to witness factory testing.

   a. Alarm circuits rung out to determine their operability.

   b. Electrical circuits checked for continuity and where applicable, operability.

   c. Any other test required to place the panel in an operating condition.

2. It shall be the responsibility of the CONTRACTOR to furnish all necessary testing devices and sufficient manpower to perform the tests required by the CONTRACTING OFFICER.

3. Field Testing: Each control panel shall be tested again for functional operation in the field after the connection of external conductors and prior to equipment startup.

- END OF SECTION -

SECTION 17201 - CONTROL PANEL INSTRUMENTATION

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. **General:** The CONTRACTOR shall provide control panel instrumentation, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 17100 - Process Control and Instrumentation Systems apply to the WORK of this Section.

C. The requirements of Section 17200 - Control Panels apply to the WORK of this Section.

1.2 CONTRACTOR SUBMITTALS

A. **General:** Submittals shall be included within the submittals of Section 17200 - Control Panels.

PART 2 -- PRODUCTS

2.1 GENERAL

A. **Power Supplies:** Power supplies shall conform with the requirements of Section 17100.

2.2 INDICATORS

A. **Indicators, Digital Process:** Digital process indicators shall be self-contained instruments that display process signals directly in engineering units. The unit shall be suitable for panel mounting and shall utilize a 3-1/2 digit LED display of no less than 0.5-inch height. The input signal to the digital process indicator shall be 4-20 mA DC or 1-5 VDC as indicated. The input sample rate of the unit shall be a minimum of 2 per second. The unit shall have an auto-zeroing feature and shall have provisions for field adjustable scaling and/or offset. Accuracy shall be plus and minus 1 least significant digit. Input power to the digital indicator shall be 120 VAC, 60 Hz. Digital process indicators shall be as manufactured by **Digitec Corp., Action Instruments Co.**, or equal.

B. **Indicators, Pointer Type:** Indicators shall be pointer type indicating meters suitable for panel mounting with a minimum scale length of 3-inches. Scales shall be in engineering units as indicated. Accuracy shall be plus and minus 2 percent of span. The unit shall accept an input of 4-20 mA DC and shall have an input impedance of 100 ohms maximum. Indicators shall be **Bristol Babcock Series 830, Foxboro Series 65P**, or equal.

2.3 FUNCTION MODULES

A. **Current Alarm Trips**: Current alarm trips shall be single or dual type as indicated. Units shall accept voltage or current input signals. Dead bands shall be factory set at 1 percent of full span for dual trips and adjustable over 100 percent of span for single trips. Alarm trips shall be equipped with 10 A DPDT contacts. Alarm trips shall include setpoint dials scaled 0-100 percent for each trip point. Single alarm trips shall include a

dead band adjustment dial scaled 0-100 percent. Alarm trips shall be **AGM Electronics Model TA-4030, Moore Industries Model DCA**, or equal.

2.4 CONVERTERS

A. **Resistance/Current Signal Converter**: The signal converters shall accept potentiometer signals and produce a voltage or current signal output in linear proportion to the input signal. Output span and zero shall be adjustable and accuracy shall be plus and minus 0.1 percent of span. The unit shall be surface or rack mounted. Power input shall be 120 VAC, 60 Hz. The signal converters shall be **Moore Industries Model PTT, AGM Electronics Model TA-4003**, or equal.

PART 3 -- EXECUTION

3.1 GENERAL

A. Control panel instrumentation shall be executed in accordance with Section 17100.

- END OF SECTION -

SECTION – 17300 CONTROL STRATEGIES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide all PLC-based Control System (PLCS) application programming required to implement the control strategies described in this section, the functions shown on the drawings and I/O schedules complete and operable in accordance with the Contract Documents.

B. The requirements of Section 17100 – Process Instrumentation and Control Systems, Section 17510 – PLC-Based Control Systems Hardware, and Section 17520 – PLC-Based Control Systems Software apply to this Section.

C. The requirement includes all PLC and Workstation programming and all other programming of PLCS interface, network and communication devices.

1.2 COMMON FUNCTIONS

A. Common functions that are generally applicable to all loops or to many similar loops are described under the heading "General Control Loop Functions." These functions are not repeated in the descriptions for each individual control strategy.

B. General Control Loop Functions

1. The following terms are used in the descriptions of PLC functions:

a. Operator Settings: Operator set or entered values shall be constants that are adjustable or set from operator displays. Examples of operator set or entered values are controller set points, batch set points, etc. Specific values that are required to be operator set are noted in the process control strategy descriptions.

b. Tunable Values: Tunable values are constants that are adjustable at engineer level displays without requiring any software reconfiguration. These values are not adjustable from operator level displays.

2. The following general control system functions shall be provided:

a. All analog and discrete inputs to the PLC shall be displayed. Both RUNNING and OFF input states shall be displayed.

b. All analog inputs shall have instrument failure alarms when the input is below 0 percent or above 100 percent for a tunable time initially set at 10 seconds.

c. All discrete FAIL inputs shall be alarmed. Other discrete inputs shall be alarmed as noted in the control strategy descriptions.

d. Where alarms are specified in the control strategy descriptions, alarms shall be initiated from the applicable inputs. If discrete inputs are not available, the specified alarms shall be initiated from the applicable analog input; alarm setpoints shall be operator adjustable.

e. All analog inputs shall be trended.

f. All flow inputs and equipment run times shall be totalized and recorded. All totalized values shall be displayed.

g. Displays shall be grouped functionally for ease of operation. Both analog and discrete functions associated with an item of equipment or a group of equipment shall be provided on the same display.

h. Unless otherwise stated or shown, all discrete outputs shall be maintained outputs. For START/STOP PLC functions, the PLC shall issue a maintained START command until a FAIL state is detected or when a STOP command is issued. When a momentary command is required, the PLC shall issue the command for two (2) seconds, then remove the signal.

i. For equipment that is controllable from the PLC, a control mode status signal shall be sent to the PLC to indicate when the PLC is allowed to control the equipment. The PLC shall monitor the control mode status (LOCAL/ REMOTE) and attempt to control only that equipment which is in the REMOTE mode.

j. For equipment that the PLC is allowed to control, the PLC shall provide a FAIL alarm if the equipment fails to comply with a PLC command signal (START, STOP, OPEN, CLOSE) that has been present for more than a tunable time period. In this event, the command shall be removed subsequent to the expiration of the tunable time period.

k. For equipment that is controllable from the PLC in either a MANUAL or AUTOMATIC mode, the operator shall be provided with a software AUTO/MANUAL selector switch at the operator workstation. Transfer between the MANUAL and AUTOMATIC modes shall be bumpless.

l. All PID control functions (P, PI, and PID) shall be provided with standard analog controller functions and operator interfaces including, but not limited to, the following;

    1) AUTO/MANUAL mode selection: In AUTO, the output of controller shall be based on the PID control calculation. In MANUAL, the output of the controller shall be operator adjustable. Transfer between operational modes shall be bumpless.

    2) LOCAL/REMOTE set point selection: In LOCAL, the set point shall be operator adjustable from the equipment. In REMOTE, the set point shall be adjustable from a REMOTE set point input.

    3) Set point, process variable, and controller output shall be displayed.

    4) Provisions shall be included to prevent reset windup.

m. When equipment is tagged OUT OF SERVICE, by the operator, all associated equipment shall have their alarms inhibited until the tagged equipment is re-tagged IN SERVICE.

n. Speed indications and speed control setpoints shall be displayed in RPM.

o. Wherever two or more pieces of equipment are provided for the same functions, for example air scour blowers, the SCADA system shall alternate the equipment after each use.

p. For all chemical storage tanks, the SCADA system shall calculate volume, amount used per shift and amount used per day.

q. All chemical feeders shall be immediately restarted following restoration of power – either from the utility or the generator.

C. The following abbreviations are used throughout this section:

SS: Selector Switch

HOR: HAND/OFF/REMOTE

RVS: Reduced Voltage Starter

VFD: Variable Frequency Drive

LR: Local/Remote

HOA: Hand/Off/Auto

MOV: Motor Operated Valve

LOS: Lock-Out Stop

1.3 SCOPE OF THIS SECTION

A. These control strategies are intended to address systems that will be installed or modified as part of the Fort Irwin Wastewater Treatment Plant Tertiary Upgrade project and to describe the general operation of the systems and processes. These control strategies are not intended to be all-inclusive operational procedures for the operation of the complete facility. The CONTRACTOR shall make refinements, modifications and additions to these strategies as needed.

PART 2 -- PRODUCTS – NONE

PART 3 -- EXECUTION

3.1 **5-CS-1 - FILTER INFLUENT PUMP STATION**

A. **Reference Drawing:** 5I-1

B. **Description:** There are two variable speed filter influent pumps which are operated automatically by the PLC in order to deliver a setpoint flow to the filters. The pumps are manually started by an operator and then controlled automatically by the PLC in a duty standby configuration. Two equalization basins float on the filter influent pump station wet well. Fluctuations in the wetwell level will be rather slow in response to pumping. Using a software PID controller, the PLC will modulate the speed of the duty pump in order to maintain a setpoint flow to the filters. If level in the wetwell rises or falls out of

an operator selected level band, the flow setpoint used for flow control may be automatically trimmed upward or downward by the PLC proportional to level. A magmeter is installed at the discharge side of the filter influent pump station to monitor flow to the filters. This flow meter is also used to pace all chemicals fed at the flash mix area.

C. **Local Controls:** Local control for the Filter Influent Pump Station is performed by placing the individual pump HAND/OFF/REMOTE selector switch to the HAND mode to start the pump and into the OFF mode to stop the pump. The speed adjustment will be made directly at the variable speed drive (VFD) panel with the potentiometer.

D. **Local Automatic Control Mode:** There are no local automatic controls for the filter influent pumps.

E. **SCADA Inputs/Manual Control Mode:** When the HAND/OFF/REMOTE switch for each pump at the VFD is in REMOTE mode, the SCADA system receives an IN REMOTE status input from the VFD for indication at the operator workstation. A pump RUN status input for indication and run time accumulation at the operator workstation, a pump FAIL alarm input and analog speed value is also received by the SCADA system for indication at the operator workstation. The pump can manually be started and stopped from the operator workstation with the AUTO/MANUAL selector switch at the HMI in the MANUAL mode and toggling the START/STOP selector at the HMI. The speed is manually set at the speed control field with a 0-100% speed setting.

F. The Filter Influent Pump Station wetwell level is measured, locally indicated and transmitted to the SCADA system for display and control of the pumps at the HMI workstation. The flow rate from the Filter Influent Pump Station is also measured, locally indicated, totalized and the transmitted to the SCADA system for display, totalization and control of the pump station through the HMI workstation. In addition, the flow rate signal shall be utilized to flow pace two of the sodium hypochlorite feed pumps and both the LA/PEC feed pumps.

G. High, high-high and low level switches are also located in the pump station wetwell for backup alarms and shutdown of the pump station should the ultrasonic level transmitter fail. The turbidity of the pump station discharge is measured, locally indicated and transmitted to the SCADA system for display at the HMI workstation.

H. **SCADA Automatic Control Mode:** The following SCADA automatic control mode functions shall be programmed:

1. The operator will make the following ON/OFF selections via the HMI:

   a. LVL_TRIMON_HI = Selecting as ON enables automatic trimming of flow setpoint based on wetwell level above the normal level band. Selecting as OFF disables automatic trimming.

   b. LVL_TRIMON_LO = Selecting as ON enables automatic trimming of flow setpoint based on wetwell level below the normal level band. Selecting as OFF disables automatic trimming.

   c. AUTSTOPON = Selecting as ON enables automatic stop function. When ON, PLC will automatically stop duty pump after an operator selected run time has elapsed. Selecting as OFF disables automatic stop function.

2. The operator will select the following setpoint values via the HMI:

    a. FLOWSP = Operator selected flow setpoint to deliver to filters, (GPM).

    b. MINFLOWSP = Supervisor selected minimum allowable setpoint to deliver to filters, (GPM).

    c. LSTOP = Automatic pump stop level, stops all pumps in auto.

    d. LNORM_MIN = Level corresponding with bottom of normal flow control band (feet, XX.X).

    e. LNORM_MAX = Level corresponding with top of normal flow control band (feet, XX.X).

    f. MAXTRIM = Maximum trim value PLC will apply to operator selected flow SP (GPM).

    g. LMAX = Level at which maximum positive flow setpoint trim factor is applied (feet, XX.X).

    h. LMIN = Level at which maximum negative flow setpoint trim factor is applied (feet, XX.X).

    i. AUTOSTOPTIME = Run duration if auto stop is selected as active (HH:MM).

3. As a minimum, the HMI will display the following key parameters:

    a. FLOWSP = Operator selected setpoint

    b. TRIMVAL = Current trim value applied to FLOWSP, (+/- XXXX.X gpm)

    c. NEWFLOWSP = Trimmed SP calculated by PLC

    d. RUNCTDWN = Countdown timer till auto stop occurs, display only if AUTOSTOPON is active. (HH:MM)

4. The flow setpoint used by the PLC for flow control will be NEWFLOWSP. NEWFLOWSP is calculated using the following relationship:

    a. NEWFLOWSP = FLOWSP +/- TRIMVAL

    b. If the automatic trimming function is selected as OFF, TRIMVAL will be set to zero.

    c. The PLC will not allow NEWFLOWSP to be less that MINFLOWSP, regardless of the result of this calculation or operator selection.

    d. When automatic setpoint trimming is selected as ON, TRIMVAL is determined based on wetwell level. As wetwell level rises above LNORM_MAX, TRIMVAL is a positive number which, when applied, increases the flow setpoint. When wetwell level falls below LNORM_MIN, TRIMVAL is a negative number which when applied, decreases the flow setpoint.

e. Whenever the level in the wetwell is between LNORM_MIN and LNORM_MAX, the trim factor applied, TRIMVAL, will be set to zero.

5. If the current wetwell level (LVL) is above LNORM_MAX, trim value is calculated using the following relationship:

   a. TRIMVAL = [(LVL - LNORM_MAX) / (LMAX - LNORM_MAX)] * MAXTRIM

   b. As can be seen, TRIMVAL will vary proportionally between 0 and MAXTRIM as the wetwell level (LVL) varies between LNORM and LMAX. In this case TRIMVAL will be a positive number, increasing the flow setpoint in response to the rising wetwell level.

6. If the current wetwell level (LVL) is below LNORM_MIN, trim value is calculated using the following relationship:

   a. TRIMVAL = [(LVL - LNORM_MIN) / (LNORM_MIN - LMIN)] * MAXTRIM

   b. In this case TRIMVAL will be a negative number, decreasing the flow setpoint in response to falling wetwell level. TRIMVAL will vary proportional between 0 and -MAXTRIM as the wetwell level (LVL) varies between LNORM and LMIN.

   c. As a minimum, the HMI will provide the following alarm outputs:

      1) LALL = Low-Low wetwell level alarm, operator selectable setpoint

      2) LAL = Low wetwell level alarm, operator selectable setpoint

      3) LAH = Hi wetwell level alarm, operator selectable setpoint

      4) LAHH = Hi-Hi wetwell level alarm, operator selectable setpoint

      5) LSH = Hardwired high level alarm active

      6) LSHH = Hardwired high-high level alarm active

      7) POSITIVE TRIM ACTIVE = Warning alarm anytime positive trim value is being applied by PLC

      8) NEGATIVE TRIM ACTIVE = Warning alarm anytime negative trim value is being applied by PLC.

   d. As a minimum, the HMI will provide historical logging and trending for the following:

      1) Pump speeds

      2) Wetwell level

      3) FLOWSP = Operator selected flow setpoint to deliver to filters

      4) TRIMVAL = Trim value applied to FLOWSP

      5) NEWFLOWSP = Trimmed SP calculated by PLC

7. Filter influent flow totalization: The HMI shall display an elapsed totalized filter influent flow during each filter influent feed cycle. This total will be reset each time a new filter influent feed cycle starts or upon operator command from the HMI. Filter influent flow totals for each filter feed cycle will be trended and logged to the historical database by the plant SCADA.

8. Rotation of Pumps: The operator will manually select the duty pump by equipment number. PLC will automatically promote the standby pump to duty upon a failure of the duty pump.

I. **Interlocks:** The following interlocks shall be made:

1. A low level at the pump station wet well will shut the pump station down and send an alarm if the level falls below its set point. The pump station will restart automatically when the level rises above the set point deadband.

2. The individual pump will shut down and send an alarm on LOW FLOW detected at the pump check valve. The individual pump will also shut down if moisture is detected within the submersible pump casing or there is a high temperature sensed at the pump motor windings.

3. The pump station shall be shut down on a LO-LO CT alarm calculated from the PLC based on chlorine contact tank effluent chlorine residual analyzer and chlorine contact tank flow. The pump station shall also be shut down by a high turbidity alarm from the filter effluent turbidity analyzer. Both alarms shall be provided with a preset time delay period before the pump station shutdown occurs. The pump station shall not be allowed to automatically restart until the alarms are manually reset at the HMI.

J. **Alarms:** The following alarms shall be provided:

1. OVERFLOW, HIGH and LOW level switches at the influent pump station wet well shall provide alarm inputs to the SCADA system operator workstation to alert the operator that the wet well is not within its normal operating zone.

2. Each pump has a common FAIL alarm status input provided to the SCADA system for indication at the operator workstation.

3.2 CS-2 FLASH MIX PUMP

A. **Reference Drawing:** 6I-1

B. **Description:** The Flash Mix pump is manually started locally at the MCC when there is flow pumped to the filters.

C. **Local Controls:** Local control for the flash mix pump is performed by placing the pump ON/OFF selector switch at the Motor Control Center (MCC) to the ON position to start the pump and into the OFF position to stop the pump.

D. **Local Automatic Control Mode:** There is no local automatic control for the flash mix pump.

E. **SCADA Inputs/Manual Control Mode:** There is no remote manual control of the flash mix pump. A pump RUN status input and the pump FAIL alarm input is received by the SCADA system for status indication and run time accumulation at the operator workstation.

F. **SCADA Automatic Control Mode:** There is no SCADA automatic control for the flash mix pump.

G. **Interlocks:** None.

H. **Alarms:** The pump has a common FAIL alarm status input provided to the SCADA system for indication at the operator workstation.

3.3 CS-3 FLOCCULATORS

A. **Reference Drawing:** 6I-1

B. **Description:** The flocculators are started manually when there is flow pumped to the filters. Their speed can also be adjusted.

C. **Local Controls:** Local control for each of the flocculators is performed by placing the flocculator ON/OFF selector switch at VFD to the ON mode to start the flocculator and into the OFF mode to stop the flocculator. The speed of the flocculator is adjusted locally at the VFD.

D. **Local Automatic Control Mode:** There are no local automatic controls for the flocculators.

E. **SCADA Inputs/Manual Control Mode:** There are no remote controls for the flocculators. The SCADA system receives a flocculator RUN status input for status indication and run time accumulation at the operator workstation and the flocculator FAIL alarm input from the VFD. The flocculator speed can be monitored at the HMI workstation.

F. **SCADA Automatic Control Mode:** There are no SCADA automatic controls for the flocculators.

G. **Interlocks:** There are no interlocks for the flocculators. There is a local Lock-out stop pushbutton near each of the flocculators to shut it down in the field.

H. **Alarms:** Each flocculator has a common FAIL alarm status input provided to the SCADA system for indication at the operator workstation. There is a high level alarm switch at the overflow structure at the flocculator effluent. The alarm is directed to the SCADA system for indication at the operator workstation.

3.4 CS-4 FILTERS

A. REFERENCE DRAWING: 8I-1

B. **Description:** The filters are a continuous backwashing type filter, with a complete local operating system controlled with a pneumatic air supply and water hydraulics.

C. **Local Controls:** Local control for each of the filters is performed at the filter's respective LCP. The system is furnished as specified under Division 11365.

D. **Local Automatic Control Mode:** There are local regulating valves to maintain a constant continuous flow of air to the filters. Each filter is manually put on line or off line at the LCP.

E. **SCADA Inputs/Manual Control Mode:** There are no remote controls for the filters. The SCADA system receives a measured value of the filter effluent turbidity at each filter. A combined effluent turbidity value is also transmitted to the SCADA system from the chlorine contact basin influent sample pump described in 3.8 of this section. The turbidity of each filter and the combined turbidity will be monitored at the HMI workstation. A high level alarm is also monitored at each filter and transmitted to the SCADA system.

F. **SCADA Automatic Control Mode:** There are no SCADA automatic controls for the filters.

G. **Interlocks:** None.

H. **Alarms:** Each filter has a HIGH LEVEL alarm status input provided to the SCADA system for indication at the operator workstation. There is also a low air pressure supply alarm input to the SCADA system for indication at the operator workstation.

3.5 CS-4 FILTER AIR COMPRESSOR

A. **Reference Drawing:** 8I-1

B. **Description:** The air compressors and air receiver are a complete local operating system controlled with a LCP. The compressors provide the air supply for the filters.

C. **Local Controls:** Local control for each compressor is performed at the compressor system's LCP. Each compressor shall be locally operated with its HAND/OFF/AUTO selector switch. The system is furnished as specified under Division 11511.

D. **Local Automatic Control Mode:** Pressure switches furnished with the compressor system maintain the air supply in the air receiver. The compressors will run in a one plus one control mode. The compressors shall operated as specified in Division 11511.

E. **SCADA Inputs/Manual Control Mode:** There are no remote controls for the air compressors. The SCADA system receives a compressor RUN status input for status indication and run time accumulation at the operator workstation and the compressor FAIL alarm input from the LCP. The SCADA system also receives a HIGH-HIGH PRESSURE and a LOW-LOW PRESSURE alarm from the LCP.

F. **SCADA Automatic Control Mode:** There are no SCADA automatic controls for the air compressor system.

G. **Interlocks:** None.

H. **Alarms:** Each air compressor has a FAIL alarm status input and the system has a HIGH-HIGH PRESSURE and a LOW-LOW pressure alarm status provided to the SCADA system for indication at the operator workstation.

3.6 CS-5 REJECT WATER PUMP STATION

A. **Reference Drawing:** 8I-2

B. **Description:** The Reject Water Pump Station will have its own LCP which will start and stop the two pumps based on the float level switches in the wet well.

C. **Local Controls:** Local controls for the pumps is performed at the system's LCP. Each pump shall be locally operated with its HAND/OFF/AUTO selector switch. The system is furnished as specified under Division 11148.

D. **Local Automatic Control Mode:** Level float switches furnished with the reject water pump system pump out the wet well of the pump station. The pumps will run in a one plus one control mode. The pumps shall operate as specified in Division 11148.

E. **SCADA Inputs/Manual Control Mode:** There are no remote controls for the reject pumps. The SCADA system receives a pump RUN status input for status indication and run time accumulation at the operator workstation and the pump FAIL alarm input from each pump at the LCP. The SCADA system also receives a HIGH-HIGH LEVEL alarm from the LCP.

F. **SCADA Automatic Control Mode:** There are no SCADA automatic controls for the reject pump station system.

G. **Interlocks:** None.

H. **Alarms:** Each reject water pump has a FAIL alarm status input and the system has a HIGH-HIGH LEVEL alarm status provided to the SCADA system for indication at the operator workstation.

3.7 CS-6 CHLORINE MIXER

A. **Reference Drawing:** 9I-1

B. **Description:** The Chlorine Mixer is started manually when there is flow pumped to the filters.

C. **Local Controls:** Local control for the Chlorine mixer is performed by placing the mixer ON/OFF selector switch at the Motor Control Center (MCC) to the ON mode to start the mixer and into the OFF mode to stop the mixer.

D. **Local Automatic Control Mode:** There is no local automatic control for the chlorine mixer.

E. **SCADA Inputs/Manual Control Mode:** There is no SCADA manual control of the chlorine mixer. A mixer RUN status input for status indication and run time accumulation at the operator workstation and the mixer FAIL alarm input is also received by the SCADA system.

F. **SCADA Automatic Control Mode:** There is no SCADA automatic control for the chlorine mixer.

G. **Interlocks:** None.

H. **Alarms:** Mixer has a common FAIL alarm status input provided to the SCADA system for indication at the operator workstation.

3.8 CS-7 SAMPLE PUMPS/CHLORINE EFFLUENT WEIR STRUCTURE

A. **Reference Drawing:** 9I-1

B. **Description:** Each of the sample pumps is started manually when there is water in the chlorine contact tank. The sample pump (9-P-1) will pump a chlorine contact inlet sample downstream of the sodium hypochlorite injection point to a chlorine residual analyzer and turbidity analyzer measuring the combined filter effluent turbidity. The second sample pump (9-P-2) will pump a chlorine contact tank effluent sample at the chlorine effluent weir structure to a chlorine residual analyzer, a conductivity analyzer, a pH analyzer and a sampler.

C. **Local Controls:** Local control for each sample pump is performed by placing the pump ON/OFF selector switch near the sample pump to the ON mode to start the pump and into the OFF mode to stop the pump.

D. **Local Automatic Control Mode:** There are no local automatic controls for the sample pump. The sampler will have a flow pace signal direct to it from the flow meter located at the chlorine effluent weir structure. The signal will come via the PLC.

E. **SCADA Inputs/Manual Control Mode:** There are no SCADA controls of the sample pumps. A sample pump RUN status input for status indication and run time accumulation at the operator workstation. The chlorine residuals at the inlet of the chlorine contact tank and at the effluent weir structure of the chlorine contact tank are measured and their values are transmitted to the SCADA system for monitoring. A combined effluent turbidity measurement from the filter effluent is also transmitted to the SCADA system from the chlorine contact tank influent sample line. The turbidity will be monitored at the HMI workstation. The sample water at the effluent weir structure is also measured for conductivity and pH values. These values are transmitted to the SCADA system for monitoring. An ultrasonic level/flow transmitter shall be located upstream of the chlorine effluent weir structure to measure the flow over the weir. The level over the weir shall be measured, converted by calculation to flow rate, totalized and transmitted to the SCADA system. The flow rate shall be directed to the sampler which is receiving the pumped effluent sample from the chlorine effluent weir structure. The measured flow rate shall also pace two of the sodium hypochlorite feeders feeding chemical to the chlorine contact tank influent injection.

F. **SCADA Automatic Control Mode:** There are no SCADA automatic controls for the sample pump.

G. **Interlocks:** None.

H. **Alarms:** Each sample pump shall alarm if there is not a RUN status present for the sample pumps at the SCADA system. When there is a RUN status, the status shall be indicated at the operator workstation. There shall be a HIGH CONDUCTIVITY alarm switch generated from the conductivity measurement at the PLC and directed to the SCADA system for the alarm. Similarly, the Effluent pH HIGH and pH LOW alarm switches shall be generated from the Effluent pH measurement at the PLC and directed to the SCADA system for the alarms. Similarly, the EFFLUENT CHLORINE RESIDUAL LOW and EFFLUENT CHLORINE RESIDUAL LO-LO alarm switch shall be generated

from the Effluent Chlorine Residual measurement at the PLC and directed to the SCADA system for the alarm.

The PLC shall continuously calculate and trend the C x T of the chlorine contact tank. C is defined as the effluent chlorine residual at the end of the chlorine contact tank and is measured in mg/L by the chlorine residual analyzer connected to sample pump 9-P-2. The contact time in minutes, T, is calculated as follows: T = 180/Q where Q is the flow in mgd over the chlorine contact effluent weir. Note that the value 180 will be modified as needed based on the results of a tracer study performed by others following construction of the tank. There shall be a LOW CT alarm switch generated if the C x T value calculated as above falls below an operator-adjustable value of 500 mg-min/L. The PLC shall not allow operator entry of a LOW CT setpoint below 475 mg-min/L. A LO-LO CT alarm switch shall be generated when the C x T value falls below 450 mg-min/L (not operator adjustable) and shall shut down the Filter Influent Pump Station and the Recycled Water Pump Station. There shall also be a LOW C alarm generated if the C value measured by the analyzer falls below an operator-adjustable value (in mg/L).

3.9 CS-8 RECYCLED WATER PUMP STATION (RWPS)

A. **Reference Drawing:** 9I-2

B. **Description:** There are 4 VFD equipped recycled water pumps which pump reclaimed water from the Fort Irwin Wastewater Treatment Plant to the recycled water distribution system. The pumps are controlled automatically to maintain an operator selected system pressure from the RWPS to the recycle water distribution system. Monitoring of the RWPS will be as shown on the P&ID's and as described in the I/O schedule.

C. **Local Controls:** Local control for the Recycled Water Pump Station is performed by placing the individual pump HAND/OFF/REMOTE selector switch to the HAND mode to start the pump and into the OFF mode to stop the pump. The speed adjustment will be made directly at the variable speed drive (VFD) panel with the potentiometer.

D. **Local Automatic Control Mode:** There are no local automatic controls for the recycled water pumps.

E. **SCADA Inputs/Manual Control Mode:** The following SCADA inputs and controls shall be furnished:

1. When the HAND/OFF/REMOTE switch for each pump at the VFD is in REMOTE mode, the SCADA system receives an IN REMOTE status input from the VFD for indication at the operator workstation. A pump RUN status input for indication and run time accumulation at the operator workstation, a pump FAIL alarm input and analog speed value is also received by the SCADA system for indication at the operator workstation. The pump can manually be started and stopped from the operator workstation with the AUTO/MANUAL selector switch at the HMI in the MANUAL mode and toggling the START/STOP selector at the HMI. The speed is manually set at the speed control field with a 0-100% speed setting.

2. The pressure relief valve (9-V-33) on the pump station discharge header shall transmit the CLOSED status to the SCADA system. The valve is hydraulically controlled to open with its local pilot equipment.

3. The pressure measurement and flow rate measurement shall be transmitted to the SCADA system for monitoring the values. The pressure transmitter shall provide the feedback to the RWPS pressure controller. The flow rate and the totalization of the flow shall be displayed at the SCADA system.

4. Independent HIGH PRESSURE and LOW PRESSURE switches at the RWPS discharge header shall transmit the alarms to the SCADA system.

F. **SCADA Automatic Control Mode:** The following SCADA automatic control mode functions shall be programmed:

1. The operator will select the following setpoint values via the HMI:

a. PRESSURESP = Operator selected pressure setpoint to deliver to the recycle distribution system, (PSI).

b. MINPRESSURESP = Supervisor selected minimum allowable pressure setpoint to deliver to recycle distribution system, (PSI).

c. LEADMAXOUTPUT% = Maximum output signal from the pressure controller before the large lead pump will be called to start with the jockey pump running and the pressure is below MINPRSSURESP value. (% speed).

d. LEADMINOUTPUT% = Minimum output signal from the pressure controller before the large lead pump will be called to stop and the jockey pump restarted. (% speed).

e. LAGMAXOUTPUT% = Maximum output signal from the pressure controller before the large lag pump will be called to start with the lead large pump running and the pressure is below MINPRSSURESP value. (% speed).

f. LAGMINOUTPUT% = Minimum output signal from the pressure controller before the large lag pump will be called to stop and the lead large pump continues to run. (% speed).

2. As a minimum, the HMI will display the following key parameters:

a. PRESSURESP = Operator selected setpoint

b. RUNCTDWNLEADSTART = Countdown timer till auto start occurs for the lead large pump (HH:MM)

c. RUNCTDWNLEADSTOP = Countdown timer till auto stop occurs for the lead large pump (HH:MM)

d. RUNCTDWNLAGSTART = Countdown timer till auto start occurs for the lag large pump (HH:MM)

e. RUNCTDWNLAGSTOP = Countdown timer till auto stop occurs for the lag large pump (HH:MM)

f. Lead/Lag/Standby order of the three large pumps.

3. The RWPS will be run in a pressure control mode. The operator shall select the order of the large Lead/Lag/Standby pumps in sequence at the HMI. The lead pump in the pumping sequence shall normally always be the small jockey pump. The jockey pump will normally run continuously until its capacity is reached or unless one of the larger pumps begins to run. After the confirmation of a running status of one of the large pumps is received by the PLC, the jockey pump shall reduce its speed to the minimum allowable speed and then be shut down. The reverse shall occur when the last large pump is called to shut down. The jockey pump shall be called to start before the large pump is staged off. When the jockey pump's running status is received by the PLC, the large pump shall reduce its speed to the minimum speed and then shut down.

4. In the pressure control mode, the RWPS shall be automatically controlled to maintain a pressure set point in the recycle water system. When placed into the automatic mode via the HMI, a single software PID pressure controller in the PLC will provide a common speed control output which will modulate the speed of all selected and running pumps in order to maintain the operator selected pressure setpoint. The PLC will continuously compare the actual RWPS discharge pressure as measured by the pressure transmitter, located on the pump station discharge header, to the setpoint pressure. If the measured pressure is below setpoint, the PID loop will increase the speed of the pumps. If the measured pressure is above setpoint, the PID loop will decrease the speed of the pumps. If the pump speed is reduced to the minimum speed allowed to the VFD and the measured pressure is above the pressure setpoint of the pressure relief valve, the pressure relief valve will open and allow the excess pressure to flow back to the pump station suction line.

5. The output of the software PID pressure controller shall be utilized to stage the Lead/Lag/Standby pumps in sequence as the demand in the recycle water system increases. Each stage, except for the first stage, shall have its own setpoints for starting and stopping the pump in percent output of speed from the pressure controller output. Time delays of up to 5 minutes each, for starting or stopping a pump, shall be programmed to allow the next pump to be added or dropped. This will give the pressure system time to stabilize to the required speed of the pumps to maintain the setpoint pressure. All adjustments shall be made at the HMI. The large pumps shall be automatically rotated in their lead/lag/standby assignment once every 3 days at noon when the HMI selector is selected to AUTO.

6. Recycle flow rate and totalization: The HMI shall display the recycle water flow rate and an accumluative totalized recycle water flow. The recycle water flow rate and total shall be trended and logged to the historical database by the plant SCADA.

7. Rotation of Pumps: The operator will manually select the duty pump by equipment number. PLC will automatically promote the standby pump to duty upon a failure of the duty pump.

G. **Interlocks:** The following interlocks shall be made:

1. A common low-low level switch at the pump station suction line will shut the RWPS down and send an alarm if the level falls below its set point. The pump station will restart automatically when the level rises above the set point deadband. This function shall be configured at the VFD and will be triggered regardless of PLC commands.

2. The pump station shall be shut down on LO-LO CT alarm from the PLC or a high turbidity alarm from the filter effluent turbidity analyzer. Both alarms shall be provided with a preset time delay period before the pump station shutdown occurs. The pump station shall not be allowed to automatically restart until the alarms are manually reset at the HMI.

3. The individual pumps will shut down and send an alarm on LOW FLOW detected at each of the pump discharge lines. Other pump shutdown alarms are HIGH VIBRATION, HIGH BEARING TEMPERATURE, or HIGH WINDING TEMPERATURE.

4. As a backup to the RWPS water supply, an automatic supplemental water supply from the domestic water will be furnished through a motorized butterfly valve (9-V-8) actuated as described below. The pumps will stop anytime the low level switch is activated.

H. **Alarms:** The following alarms shall be provided:

1. Each pump has a common FAIL alarm status input provided to the SCADA system for indication at the operator workstation

3.10 CS-9 DOMESTIC WATER MAKEUP VALVE (9-V-8)

A. **Reference Drawing:** 9I-1

B. **Description:** The domestic water makeup valve shall open automatically and conditionally to furnish supplemental water should the demand for recycled water exceed the stored supply of recycled water. The valve shall open when the level downstream of the chlorine contact effluent weir is detected to be below the probes and the low level occurs during a specified time-of-day period. The valve shall reclose when the water level rises above the level probes or the permissible time-of-day period ends. The time-of-day period can be selected OFF, so the valve will open and close according to the level control only.

C. **Local Controls:** Local control for the motorized valve shall be at the valve operator. The valve shall be open when the LOCAL/REMOTE selector switch on the valve operator is selected to the LOCAL mode, and the OPEN or CLOSE pushbutton on the operator is pressed. The valve travel can be stopped by pressing the STOP pushbutton on the valve operator. The valve shall automatically stop when it reaches its open or closed limit switches. The status of the valve shall be monitored by the SCADA system.

D. **Local Automatic Control Mode:** There are no local automatic controls for the motorized valve.

E. **SCADA Inputs/Manual Control Mode:** The valve shall be open when the LOCAL/REMOTE selector switch on the valve operator is selected to the REMOTE mode, and the OPEN or CLOSE switches on the SCADA system are actuated. The valve shall automatically stop when it reaches its open or closed limit switches. The valve OPEN and CLOSED status shall be transmitted and displayed at the SCADA system.

F. **SCADA Automatic Control Mode:** The domestic water supply valve shall be actuated to open by a level probe sensing low water level in the chlorine effluent weir structure

and the event occurs during a specified time-of-day period. The valve shall reclose when the water level submerges the high level probe or the permissible time-of-day period ends. The time-of-day period can be selected OFF, so the valve will open and close according to the level control only.

G. **Interlocks:** None.

H. **Alarms:** None.

3.11 CS-10 LIQUID ALUM/CATIONIC POLYMER (LA/PEC) FEED SYSTEM

A. **Reference Drawing:** 10I-1

B. **Description:** The liquid alum/cationic polymer (LA/PEC) feed system has a single storage tank and two variable speed metering pumps. The metering pumps shall automatically flow pace chemical to the flash mixer. The chemical sump shall have a high level detection switch to notify the operator of a liquid presence in the containment area. There shall be a leak detection system for the double wall piping leading out of the containment area to the point of application.

C. **Local Controls:** Local control for each of the LA/PEC metering pumps is performed by placing the individual pump HAND/OFF/REMOTE selector switch to the HAND mode to start the metering pump and into the OFF mode to stop the pump. The speed of the metering pump will be made by placing the individual pump LOCAL/AUTO speed selector switch to the LOCAL mode, and adjusting the local potentiometer at the variable speed drive (VSD) panel.

D. **Local Automatic Control Mode:** There are no local automatic controls for LA/PEC metering pumps.

E. **SCADA Inputs/Manual Control Mode:** The following SCADA inputs and controls shall be furnished:

1. The level in the LA/PEC storage tank shall be measured and its value shall be transmitted to the SCADA system. The local level gauge on the tank shall be equipped with HIGH LEVEL and LOW LEVEL switches that shall transmit the alarm signals to the SCADA system.

2. The chemical metering pumps shall have a Local Control Panel. When the HAND/OFF/REMOTE switch for each pump at the LCP is in REMOTE mode, the SCADA system receives an IN REMOTE status input from the LCP for indication at the operator workstation. A pump RUN status input for indication and run time accumulation at the operator workstation, a pump FAIL alarm input and analog speed value is also received by the SCADA system for indication at the operator workstation. When the speed control LOCAL/AUTO selector switch for each pump at the LCP is in AUTO mode, the SCADA system receives an IN AUTO status input from the LCP for indication at the operator workstation. The pump speed can be remotely manually adjusted from the operator workstation with the speed AUTO/MANUAL selector switch at the HMI in the MANUAL mode and entering a speed value at the speed control field with a 0-100% speed setting.

3. Other monitored points are a HIGH SUMP LEVEL alarm in the containment area, a LEAK DETECTION alarm in the double wall piping system, and a FLOW alarm at the emergency eyewash shower station.

F. **SCADA Automatic Control Mode:** All feeders shall be controlled to maintain an operator selected dosage rate for the feed point at the flash mixer.

1. Dosage control - Feeders shall feed chemical to the flash mix and be flow paced to the filter influent flowmeter FE/FIT-519 to provide the operator selected dosage in mg/L. Based on the selected dosage, pump characteristics, and pacing signal, the PLC will calculate the required pump speed to provide the selected dosage. The relationship for determining pump speed is shown below. All variables in this equation will be adjustable from the HMI.

2. The pump pacing signal is determined in accordance with the following equation:

$$Sd = \frac{(D)\,(Q)\,(8.34)}{(St)\,(Q100)\,(C)\,(24)}$$

Where:

Sd	=	Pump speed pacing signal in percent of maximum.
D	=	Chemical feed dosage in mg/l. Operator input.
Q	=	Pacing flow rate in mgd. Signal from the flow meter.
St	=	Pump stroke in percent of maximum. Operator input.
Q100	=	Pump output in gal/hr at 100% stroke and 100% speed. Operator input.
C	=	Chemical concentration in lb/gal. Operator input.
24	=	Constant (no. of hrs/day)
8.34	=	Constant

3. Duty pump failover –The PLC shall switchover to the standby pump upon failure of the duty pump.

G. **Interlocks:** None.

H. **Alarms:** The following alarms shall be provided:

1. The LA/PEC storage tank has a HIGH LEVEL and LOW LEVEL alarm status input provided to the SCADA system for indication at the operator workstation.

2. Each metering pump has a common FAIL alarm status input provided to the SCADA system for indication at the operator workstation.

3. The containment area has a sump HIGH LEVEL alarm status input provided to the SCADA system for indication at the operator workstation.

4. The double wall chemical line has a leak detection system that will transmit a LEAK alarm status input provided to the SCADA system for indication at the operator workstation.

5. The two emergency eyewash showers each have a HIGH FLOW alarm status input provided to the SCADA system for indication at the operator workstation.

3.12 CS-11 SODIUM HYPOCHLORITE FEED SYSTEMS

A. **Reference Drawings:** 11I-1 and 11-I-2

B. **Description:** There is an existing sodium hypochlorite feed system that will be expanded and modified, and a new emergency backup sodium hypochlorite feed system that will be installed. The existing sodium hypochlorite feed system has an on site hypochlorite generator, and two sodium hypochlorite storage tanks. There are two existing variable speed metering pumps, one of which will have a new flow pacing signal directed to it and its pump discharge directed to the new chlorine contact tank. The second existing metering pump discharging to the RAS/WAS pump station, will not be changed. In addition, a third new variable speed metering pump, matching the two existing units, will be added and it will discharge chemical to the new flash mix pump area and have a flow pacing signal directed to it too.

C. The new emergency backup sodium hypochlorite feed system will utilize a quick connect system to the existing hypochlorite storage tanks for the chemical supply, or utilize the quick connect for a portable tote storage container to the two new variable speed metering pumps. One of the dedicated metering pumps shall automatically flow pace chemical to the flash mixer and the other to the chlorine contact tank. There shall be a leak detection system for the double wall piping leading out of the containment area to the point of application.

D. **Local Controls:** Local control for each of the sodium hypochlorite metering pumps is performed by placing the individual pump ON/OFF selector switch to the ON mode to start the metering pump and into the OFF mode to stop the pump. The speed of the metering pump will be made by placing the individual pump AUTO/MANUAL speed selector switch to the MANUAL mode and adjusting the local potentiometer at the variable speed drive (VSD) panel.

E. **Local Automatic Control Mode:** There are no local automatic controls for the sodium hypochlorite metering pumps.

F. **SCADA Inputs/Manual Control Mode:** The following SCADA inputs and controls shall be furnished:

1. The chemical metering pumps shall have a Local Control Panel. When the ON/OFF switch for each pump at the LCP is in ON mode, the SCADA system receives a pump RUN status input for indication and run time accumulation at the operator workstation. A pump FAIL alarm input and analog speed value is also received by the SCADA system for indication at the operator workstation. When the speed control AUTO/MANUAL selector switch for each pump at the LCP is in AUTO mode, the SCADA system receives an IN AUTO status input from the LCP for indication at the operator workstation. The pump speed can be remotely manually adjusted from the operator workstation with the speed AUTO/MANUAL selector switch at the HMI in the MANUAL mode and entering a speed value at the speed control field with a 0-100% speed setting.

2. Another monitored point is a LEAK DETECTION alarm in the double wall piping system.

G. **SCADA Automatic Control Mode:** All feeders, except the RAS/WAS metering pump, shall be controlled by the SCADA system to maintain an operatorselected dosage rate

for the feed point at the flash mixer or operator-selected C x T value at the chlorine contact tank as listed below. C = chlorine concentration at the end of the chlorine contact tank. T = contact time = 180/Q, where Q is the flow over the chlorine contact tank effluent weir in mgd.

1. Dosage control - Feeders shall be flow paced to the flowmeters listed below to provide the operator selected dosage in mg/L. Based on the selected dosage, pump characteristics, and pacing signal, the PLC will calculate the required pump speed to provide the selected dosage. The relationship for determining pump speed is shown below. All variables in this equation will be adjustable from the HMI.

2. The pump pacing signal is determined in accordance with the following equation:

$$Sd = \frac{(D)\,(Q)\,(8.34)}{(St)\,(Q100)\,(C)\,(24)}$$

Where:

Sd	=	Pump speed pacing signal in percent of maximum.
D	=	Chemical feed dosage in mg/l. Operator input (flash mixer feeder) or calculated by the PLC from the C x T operator input value (chlorine contact tank feeder)
Q	=	Pacing flow rate in mgd. Signal from the flow meter.
St	=	Pump stroke in percent of maximum. Operator input.
Q100	=	Pump output in gal/hr at 100% stroke and 100% speed. Operator input.
C	=	Chemical concentration in lb/gal. Operator input.
24	=	Constant (no. of hrs/day)
8.34	=	Constant

3. The metering pumps shall be paced to the flow signals as follows:

   a. 11-FD-1 shall feed chemical to the chlorine contact tank influent and be flow paced by the chlorine contact tank effluent flow meter FE/FIT 900.

   b. 11-FD-3 shall feed chemical to the flash mix and be flow paced by the filter influent flow meter FE/FIT 519.

   c. 11-FD -4 shall feed chemical to the chlorine contact tank influent and be flow paced by the chlorine contact tank effluent flow meter FE/FIT 900.

   d. 11-FD-5 shall feed chemical to the flash mix and be flow paced by the filter influent flow meter FE/FIT 519.

H. **Interlocks:** None.

I. **Alarms:** The following alarms shall be provided:

1. Each metering pump shall have a common FAIL alarm status input provided to the SCADA system for indication at the operator workstation.

2. The double wall chemical line has a leak detection system that will transmit a LEAK alarm status input provided to the SCADA system for indication at the operator workstation.

3. The two emergency eyewash showers each have a HIGH FLOW alarm status input provided to the SCADA system for indication at the operator workstation.

- END OF SECTION -

SECTION 17510 - PLC-BASED CONTROL SYSTEMS HARDWARE

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR, through the use of an instrumentation supplier and qualified electrical installers, shall furnish, supervise installation, assemble, configure, program, and place into service the PLC-based control system, hereafter called the PLC specified under this Section and in Section 17100 – Process Control and Instrumentation Systems, all in accordance with the requirements of the Contract Documents. The CONTRACTOR shall also reference the I/O lists in Appendix A.

B. **Instrumentation Supplier:** The Instrumentation Supplier shall be responsible for selecting, configuring, and verifying correct operation of compatible hardware and software to provide a functional PLC system.

C. Herein in after, the term Contractor shall be used to represent the party responsible to the GOVERNMENT for the Work of this division.

D. **Scope of Work:** The CONTRACTOR shall furnish and install the PLC system as specified within the Contract Documents. The CONTRACTOR shall be responsible for supplying all equipment, preparation of hardware and software submittals, system integration, PLC programming, supervision of installation, testing, training, start-up and implementation activities for all PLC systems being furnished under this Contract. The PLC hardware and software shall be a standardized system, which utilizes off-the-shelf commercially available configurations of hardware and software modules.

E. The CONTRACTOR shall provide all installation, labor and engineering required to assure the proper installation and operation of the entire PLC. The CONTRACTOR shall be responsible for providing and installing a complete and operational system, fully programmed to meet all the requirements of the Contract Documents. The following work, equipment and services shall be included but not be limited to:

1. Prepare and submit for approval PLC hardware and software shop drawings.

2. Furnish, install and/or modify the existing PLC to provide a complete and operational PLC, including all peripherals and other equipment specified herein.

3. Perform all required PLC tests, adjustments, and calibrations.

4. Furnish qualified labor to perform PLC installation and start-up.

5. Furnish qualified instructors to provide PLC instruction and training.

6. Furnish all required PLC tools, test equipment, spare parts, supplies, operations and maintenance manuals, reproducible "as-built" drawings, and program listings as specified herein.

F. The CONTRACTOR's attention is directed to the construction sequencing requirements contained within the Contract Documents. The CONTRACTOR shall provide on-loan, any PLC system equipment required for partial start-up of a process area or system.

G. **System Responsibility:** All PLC hardware and software furnished in accordance with the Contract Documents shall be done so by the CONTRACTOR. The CONTRACTOR shall have responsibility for providing a fully annotated, integrated and properly operating PLC system. The CONTRACTOR shall coordinate the Work of CONTRACTOR's personnel and the instrumentation supplier's personnel for the installation, interconnection, testing, calibration, and operation of all PLC equipment and coordinate the scheduling. The CONTRACTOR shall be responsible for providing equipment that properly meets the functional intent of the Contract Documents. Substitutions for PLC functions specified are not permitted.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. PLC-based control systems-hardware reference specifications, codes, and standards shall be provided in accordance with Section 17100 - Process Control and Instrumentation Systems.

1.3 CONTRACTOR SUBMITTALS

A. **Shop Drawings:** PLC System submittals shall be in accordance with the applicable requirements of Section 17100 - Process Control and Instrumentation Systems. PLC submittals shall be made separately from other process control and instrumentation system submittals.

B. **Hardware Submittals:** The PLC hardware submittal shall be a singular all inclusive submittal which shall include but not be limited to:

1. A complete index appearing in the front of each bound submittal volume. System groups shall be separated by labeled tags.

2. Complete grounding requirements for the entire PLC including any requirements for PLCs communication networks and control room equipment.

3. Requirements for physical separation between PLC components and 120 volt, 480 volt, and 12 KV power cables.

4. Control room floor plans drawn to scale. Drawings shall be drawn in a ½ inch = 1 foot scale.

5. UPS and battery load calculations to show that the backup capacity and time meet the specified requirements.

6. A complete set of PLC system diagrams which depict:

   a. All PLCs, communication devices, and communication links.

   b. All cables required supporting the communication requirements. A separate diagram shall be submitted for each component fully annotated with conduit size and number associated with the power source.

7. Data sheets shall be included for each PLC component together with a technical product brochure or bulletin. These data sheets shall show the component name as used within the Contract Documents, the manufacturer's model number or other identifying product designation, the project tag number, the project system of which it is a part, the project site to which it applies, the input and output characteristics,

the requirements for electric power, the specifications for ambient operating conditions, and details on materials of construction.

8. Complete and detailed bills of materials: A bill of material list, including quantity, description, manufacturer, and part number, shall be submitted for each component of the PLC system. Bills of material shall include all items within an enclosure. The bill of material shall be recorded on disks in Excel format for delivery to the GOVERNMENT.

9. Site-specific arrangement and construction drawings for all equipment cabinets, including dimensions, identification of all components, preparation and finish data, nameplates, and the like. All drawings shall be scaled and show the position of the equipment on its intended installation location. All drawings must show a scaled representation of the placement of all equipment and its spatial relationship to all other equipment located in the abutting and adjoining areas. All acquired access and clearances associated with the equipment must be shown with a statement of compliance to manufacturer's recommendations, NEC, and other applicable codes.

10. Calibration, adjustment, and test details for all PLC components.

C. **GOVERNMENT's Manuals:** General requirements for GOVERNMENT's Manuals are as described in Section 17100 - Process Control and Instrumentation Systems. The following items shall also be included in the software manual:

1. A documented PLC program listing including the I/O list and housing configuration for each PLC, a memory usage report for each PLC, and a register layout list for each PLC.

2. A complete PLC program description documenting the attributes of each line of programming and any changes of the existing program to accommodate the controls described within the contract documents.

3. Operation and maintenance manuals for both the PLCs and all other PLC system hardware.

D. **System Test Procedures:** System test procedures shall be developed by the CONTRACTOR in accordance with the requirements for system testing specified in Paragraph 3.2.C herein, shall be submitted to the CONTRACTING OFFICER for review. An approved submittal shall be required prior to the commencement of system testing.

E. Procedures shall be prepared for each process system. The procedures shall be in narrative form, describe sequentially the operational steps to be followed in verifying the correct operation of each process system, including all features described in the control strategies contained in Specifications Section 17300. All equipment, including the PLC system and its various workstation displays, which function together to form a complete process system shall be tested together, including interlocks between devices performed by the PLC system.

F. **Factory Test Procedure:** The CONTRACTOR shall prepare and submit a factory test procedure which incorporates test sequences, test forms, samples of database lists, a PLC system testing block diagram, and an estimated test duration which comply with the requirements of the factory test specified herein.

1.4 MANUFACTURER'S REPRESENTATIVE

A. The CONTRACTOR shall provide visits by, and services of, technical field representatives of the PLC manufacturer for installation certification, system testing, training, and start-up. These visits shall be at no separate additional cost to the GOVERNMENT.

1.5 STORAGE AND HANDLING

A. All equipment and materials delivered to the job site shall be stored in a location that shall not interfere with the operations of the GOVERNMENT's personnel or interfere with construction. Storage and handling shall be performed in manners that shall afford maximum protection to the equipment and materials. It is the CONTRACTOR's responsibility to assure proper handling and on-site storage.

1.6 WARRANTY

A. The complete PLC system included therein shall be guaranteed to meet or exceed the design requirements set forth in the Contract Documents.

B. Equipment and materials which do not achieve design requirements after installation shall be replaced or modified by the instrumentation supplier to attain compliance, at no additional cost to the GOVERNMENT. Following replacement or modification, the CONTRACTOR shall retest the system and perform any additional procedures needed to place the complete PLC system in satisfactory operation and attain design compliance approval from the CONTRACTING OFFICER.

C. The CONTRACTOR warrants the materials and workmanship used for the PLC equipment and materials. In addition, the CONTRACTOR shall guarantee the materials and workmanship used for any equipment and materials produced and furnished hereunder as a part of the Work, to be as herein specified and agreed upon, free from injurious defects and in all respects satisfactory for the service required.

D. The CONTRACTOR warrants/guarantees the satisfactory performance of the equipment and materials under operating conditions for a period of one year after the date of final acceptance of the entire PLC system, i.e., completion of all contractual items, including a successful full system-wide 90 day performance test as specified in Part 3. In the event that tests and inspections disclose latent defects of failure to meet the specified requirements, the instrumentation supplier, upon notification by the CONTRACTING OFFICER, shall proceed at once to correct or repair any such defects or non-conformance, or to furnish at the delivery point named in the Contract Documents, such new equipment or parts as may be necessary for conformity to the specified requirements, and receive no additional compensation thereof. In case of any required repairs or other corrective or remedial work covered under warranty, the warranties on all such corrections, repairs, new equipment, or parts shall be extended for an additional 12 months from the date of final acceptance, or 12 months from the date of completion of any such corrections, repairs, new equipment, or parts, whichever date is later. The CONTRACTOR shall reimburse the GOVERNMENT for all costs incurred in the removal of the defective material and installation of the replacement.

PART 2 -- PRODUCTS

2.1 GENERAL

A. All materials and all PLC system equipment furnished under this Contract shall be new, free from defects, of first quality, and produced by manufacturers regularly engaged in the manufacture of these products.

B. All PLC equipment shall be purchased from a single vendor as specified within the contract documents.

2.2 PLC ENCLOSURES

A. PLC-based control systems-hardware PLC enclosures shall be provided in accordance with Section 17200 - Control Panels.

2.3 UNINTERRUPTIBLE POWER SUPPLY

A. **General:** Completely static uninterruptible AC power systems (UPS) shall be provided for power to the PLC. The UPS system shall be a self-contained unit consisting of a static inverter, batteries, bypass switch, rectifier charger and static transfer switch.

1. The PLC panel shall be furnished with a UPS to provide backup power at full load for 30 minutes.

2. The contractor shall submit PLC cabinet load calculations per Section 17100.

B. **Operation:** In normal power, the PLC panel load shall be supplied from the AC power line through the static inverter and the rectifier charger which shall also maintain the battery in a fully charged “float” condition. During line power failure, the UPS shall provide same wave AC power to the load. It shall also provide the local PLC with a dry contact output for alarm and monitoring through the SCADA system. Upon return of normal power, the UPS shall recharge the battery in preparation for future AC power line failure.

C. **Requirements:** The UPS shall have the following requirements:

Input / Output Voltage:	120 VAC, 60Hz, Single Phase
Brownout Protection	
Lighting and Surge Protection	
Noise Isolation:	38 dB common mode, 47dB normal mode
Output Capacity:	Based on load calculation
Efficiency:	95% on line
Alarms:	Low Backup time, overload, replace battery low battery

The UPS system shall be **FERRUPS**, or equal.

2.4 HARDWARE

A. All hardware shall operate at an ambient temperature of 0 to 60 degrees C (32 to 140 degrees F), with an ambient temperature rating for storage of - 40 to + 85 degrees C (-40 to + 185 degrees F), and shall function continuously in the relative humidity range of

5 to 95 percent with no condensation. The PLC system shall be designed and tested to operate in the high electrical noise environment of an industrial plant.

B. Programmable Logic Controller

1. The Controller will be a manufactured and specific part of the PLC system so that it plugs into the chassis and is keyed to allow installation in only one direction. All system and signal power to the controller and support modules shall be distributed on a single backplane. No interconnecting wiring between these modules via plug-terminated jumpers shall be acceptable.

2. The user program and data shall be contained in non-volatile, battery backed memory. The operating system shall be contained in non-volatile firmware

3. The memory containing the operating system shall be capable of being updated via a separate update software tool. This update tool will be available by accessing the Manufacturer's electronic internet site or E-mail, or by mail from the Manufacturer to allow for easy field updates

4. The controller shall contain a minimum of 160 Kbytes of base memory. Memory expansion cards shall be available to be added to the controller. These expansion cards shall include at a minimum of: 512 Kbytes, 1 Mbyte, and 2 Mbytes of added memory

5. The CPU within the system shall perform internal diagnostic checking and give visual indication to the user by illuminating a "green" (OK) indicator when no fault is detected and a "red" indicator when a fault is detected

6. The front panel on the controller shall include color indicators showing the following status indicators:

   a. Program or Run mode of the controller.

   b. The fault status of the controller.

   c. I/O status.

   d. RS-232 activity.

   e. Battery status.

7. The front panel of the controller shall include a mounted keyswitch. The key shall select the following Controller modes: RUN – No control logic edits possible, program always executing; PROGRAM- Programming allowed, program exection disabled; and REMOTE – Programming terminal can make edits and change processor mode, including test mode, whereby the logic executes and inputs are monitored, but edits are not permanently active unless assembled.

8. The front panel of the controller shall include a holder and connector for a lithium battery. The battery shall provide power backup for user programs and data when the main power is not available. No memory or program loss shall occur and user shall be allowed to stay in online "Run mode "during the changing of the battery.

9. All modules shall have the capability to be removed or inserted into the chassis, while power is being supplied to the chassis without faulting the processor or damaging the modules. Upon startup after insertion of the module, while power is applied, dependent on the programmed function of the error subroutine, the processor is capable of starting online or offline.

10. The controller shall have the capability of addressing at least 128,000 discrete points of Discrete Input and Discrete Output (DI/DO) or 4,000 analog points. It shall also have the ability to communicate with at least 250 Physical nodes (Control Net) that contain I/O. These calculations are based upon the connection limitation of the controller (i.e., 250 connections * 16 channels per module = 4,000 analog inputs).

11. The controller shall provide the capability of addressing remote input and output modules,(250 x 16 points) without distance limitations on Ethernet and Control Net communication modes.

12. The controller shall use multiple independent, asynchronous scans of routines, subroutines, interrupts, messages, and program communications. These continuous scans shall be designated for processing of input and output information, program logic, and background processing of other processor functions. Input and output devices, located in the same backplane (local I/O) as the CPU, will produce at the rate of configured RPI (Requested Packet Interval), and for inputs enabled for Change of States (COS), at the time any point changes state.

13. The controller shall have backward compatibility allowing it to communicate to any module within the Logix family manufactured by Allen Bradley, or equal, or third-party devices, (I/O or communication) regardless of firmware version or series.

14. The controller shall have one dedicated serial port which supports RS-232-C, RS-422, and RS-423A signals. It shall be accessible in control logic and provide support for Slave SCADA communication protocol systems. Alternatively, it must be usable for programming purposes or for access to peripheral devices such as bar code scanners, CRTs, etcthe following communication interfaces.

15. The controller shall have communication interface module for communication with HMI workstation. The module shall be ControlLogix 1756–ENBT Ethernet module, manufactured by Allen Bradley, or equal. The CONTRACTOR shall provide all necessary communication cabling.

16. Manufacturer: Controller (CPU Module) shall be a ControlLogix, Model 1756, manufactured by Allen Bradley, or equal.

17. All PLC components shall be purchased by the CONTRACTOR.

C. PLC Input/Output (I/O) Modules

1. I/O Modules General: All I/O housings and modules shall be suitable for hostile industrial environments. All I/O modules shall be isolated and conform to surge withstand standards and noise immunity standards. The I/Os shall be 4-20 mA DC for all analog inputs and outputs and shall be 24 VDC for discrete inputs and dry relay contacts for safe discrete outputs. Modules shall be removable without having to disconnect wiring from the module's terminals by means of a swing-arm or plug-in wiring connector. Each PLC I/O location shall contain the I/O modules required to provide all of the I/O points contained in the I/O Lists. As a minimum, each PLC I/O

location shall contain an installed spare capacity as described in Section 2.4, Paragraph A, Item 1 above. During normal operation, a malfunction in any remote input/output channel shall affect the operation of only that channel and not the operation of the CPU or any other channel. Any remote input/output channel shall be field selectable to shut down the CPU upon failure of that channel. Upon remote channel shutdown the CPU shall see all inputs on the malfunctioning channel as they were when the shutdown occurred and all outputs shall de-energize on that channel. Circuit components for both remote input and output shall be mounted on plug-in modules and keyed to prevent module insertion into the wrong slot. Isolation shall be used between all internal logic and external power circuits. This isolation shall meet the minimum specification of 1500 VRMS.

2. Discrete Input Modules: Defined as contact closure inputs from devices external to the programmable controller module. Individual inputs shall be optically isolated from low energy common mode transients to 1500 volts peak from users wiring or other I/O Modules. The modules shall have LED's to indicate status of each discrete input. Input signal level shall be 120 VAC. Discrete Input modules shall be ControlLogix Series, Model 1756, manufactured by Allen Bradley, or equal.

3. Discrete Output Modules: Defined as contact closure outputs for ON/OFF operation of devices external to the programmable controller module. The output modules shall be optically isolated from inductively generated, normal mode and low energy, common mode transients to 1500 volts peak. All output modules shall have LED's to indicate status of each output point. Output contact rating shall be 2A minimum, 24V AC. Each output point shall be individually isolated and fused. **Note:** Discrete output contacts which are used to operate motors greater than 10 HP or with size 2 or larger starters shall be provided with interposing relays in the VFD. Both the automatic start/stop output contacts and the safety/power system permissive output contacts shall be provided with relays when the above condition is met. Relays shall be in accordance with in Section 17201 - Control Panel Instrumentation. Discrete Output modules shall be ControlLogix Series, Model 1756, manufactured by Allen Bradley, or equal.

4. Analog Input Modules: Defined as 4 to 20 mA DC signals, where an analog to digital conversion is performed with 16-bit precision and the digital result is entered into the processor. All inputs shall be isolated input points. The analog to digital conversion shall be updated with each scan of the processor. Input modules shall be source or sink to handle 2-wire or 4-wire transmitters respectively. Analog Input modules shall be ControlLogix Series, Model 1756, manufactured by Allen Bradley, or equal.

5. Analog Output Modules Defined as 4 to 20 mA DC output signals where each output circuit performs a digital to analog conversion minimum of 16-bit precision with each scan of the processor. All outputs shall be isolated output points which shall be rated for loads of up to 1200 ohms. The CONTRACTOR shall provide current loop isolators as required to break ground loops. Analog Output modules shall be ControlLogix Series, Model 1756, manufactured by Allen Bradley, or equal.

D. PLC chassis/backplane (housing):

1. The PLC, power supply, and I/O modules shall be mounted in a suitable standard housing. Individual housing slots shall be mechanically configurable to prevent

insertion of incorrect modules. Each PLC location shall have a minimum of 3 empty I/O module slots.

2. The chassis/backplane shall allow access to I/O points or any device within any network in the system directly from remote processors with one or more communication links such as Ethernet, ControlNet, DeviceNet. DH+, or Remote I/O.

3. The chassis/backplane shall be the ControlLogix Series, Model 1756, manufactured by Allen Bradley, or equal.

2.5 WORKSTATION HARDWARE

A. General: The workstation shall communicate with the PLC. If the communication between the PLC and the workstation is lost, an alarm shall be annunciated. The workstation shall function with equal process monitoring and manipulation capability thereby giving complete flexibility to assign any mix of displays. The workstation operating as a developing station shall be capable of displaying operational reference data, procedure libraries, system design, system configuration and documentation, process performance, and a system diagnostics Graphic User Interface. The development workstation shall function as a system configuration station used to construct:

1. HMI configurations.

2. Control strategies (i.e. ladder logic), using SFC, Basic, C++, etc.

3. Data base manipulations.

B. The workstation shall be an IBM compatible personal computers and shall be furnished with Microsoft Windows 2000 operating system and the latest version of Microsoft Office installed. All applicable software and hardware manuals, disks and CD's shall be provided. Each workstation shall consist, as a minimum, of the following:

1. 2.2 GHz Pentium 4 processor.

2. 512 MB, PC800 RDRAM.

3. 64 MB 3D Video Card.

4. 80G Ultra ATA/100 Hard Drive.

5. 21-inch Monitor with .24 AG.

6. DVD-R/RW Combo Drive.

7. 104-key Keyboard.

8. 3-button with scroll mouse.

9. 10/100 PCI network interface card (UTP) (Qty. 2 ea.).

10. 3.5 floppy drive.

11. 266 MB FSB.

12. 20 GB uncompressed – 4MM DAT tape drive – Manufacturer to be HP or Seagate.

C. Workstation shall be manufactured by **Dell, Micron, or Gateway**, or equal**.**

2.6 PERIPHERAL DEVICES AND AUXILIARY EQUIPMENT.

A. **Alarm/Event Printer:** A printer shall be supplied to print alarms/events generated by the man-machine interface (MMI) system. It shall be letter quality 24-pin impact matrix printer with wide carriage tractor feed capability. It shall have a speed of 440 cps or greater in draft mode. It shall have the capability to print ladder logic listings generated by the PLC programming software and alarm logs generated by the MMI system software specified herein. The printer shall be supplied complete with an interconnecting parallel cable, manufacturer recommended black ribbon (quantity 2), standard cut sheet feeder, and sufficient paper for all system and plant operation testing. The printer shall be the **Epson LQ 2180**, or equal. Support for I0 Base-T network connectivity shall also be provided.

B. **Color and Report Printer:** A printer shall be supplied to print reports and color documents generated by the MMI System. It shall produce laser quality monochrome print at a minimum output rate of 10 ppm. It shall also produce laser quality color prints with a minimum resolution of 1200 dpi at a minimum rate of 2-3 ppm. It shall accommodate 11”x17” paper media (monochrome only), support duplex print output and shall be Energy Star compliant. The printer shall be RISC based and support Ethernet connectivity. The printer shall be supplied complete (i.e. ready to operate) with a minimum of 36M RAM, interconnecting parallel cable and spare monochrome and color toner cartridges. The printer shall be the **Hewlett Packard LaserJet 5500DN Printer**, or equal.

C. **Unshielded Twisted Pair Cable:** All unshielded twisted pair network cabling shall be rated EIA/TIA 568 Category 5.

D. **RS 232/422/485 Cable:** The RS 232/422/485 cable shall be model 9841 cable, manufactured by **Belden,** or equal.

E. Test Requirements

1. The CONTRACTOR shall perform end-to-end test on each communication cable that is furnished by the CONTRACTOR. Testing shall be performed after field connectors have been installed. Testing shall include testing for continuity, opens, shorts and split pairs.

2.7 SPARE PARTS

A. PLC system spare parts shall be provided in accordance with Section 17100 - Process Control and Instrumentation Systems.

B. In addition to the above, the CONTRACTOR shall deliver to the GOVERNMENT prior to project completion a floppy disk drive cleaning kit.

2.8 FACTORY TEST

A. **General:** Prior to the delivery and installation of the PLCS at the Site, but after the procurement, assembly, and configuration of all components, the CONTRACTOR shall conduct a factory test. This test shall be witnessed by representatives of the

AUTHORITY and the CONTRACTING OFFICER. The factory test is intended to be a complete PLCS. The factory test shall demonstrate the functionality and performance of specified features of the PLC. The test shall include verification of all workstation, PLCs, and remote I/O system I/O points along with their respective workstation status and/or control displays. Each display shall be checked. A complete system checklist shall be available during the test for recording results of selected points.

B. **Test Setup:** The complete PLCS system as shown on the block diagram I-1 shall be assembled and interconnected on the CONTRACTOR's factory floor. The interconnection shall include communication cable segments for the LANs and the workstation network to simulate as closely as possible the eventual Site installation. The PLCs, PLC programming terminal, workstation, and communication devices shall be loaded with their applicable software packages and configuration programming. PLC input and output modules shall be installed in their assigned housings and wired to field termination points in the enclosures. The CONTRACTOR shall have a complete, up to date set of wiring drawings, a PLC register list, a workstation database list, and a listing of workstation displays for review throughout the test.

C. CONTRACTOR shall schedule the factory test after receiving approval of the factory test procedures submittal. The CONTRACTOR shall provide the CONTRACTING OFFICER and GOVERNMENT with written notice of the start and expected duration of the factory test at least 30 days prior to the start of the test.

D. **Test Procedure:** The factory test shall be conducted in accordance with the previously submitted and approved test procedures. The test procedures shall include written descriptions of how individual tests shall be performed and shall incorporate testing the following features as a minimum. All testing shall be completed in one continuous factory test which may extend over several continuous days if necessary.

1. Communication: Verification that an alarm is generated upon loss of communication with any PLCS component.

2. Alarm handling: Verification of alarm logging, summary display, outputs to horn, lights, and the ability to disable alarms. Silencing and acknowledging of alarms shall also be tested. Refer to the Control Strategy for any additional specified features.

3. Display Screens: Verification of all points on each display screen, and the ability to call up displays via point and click targets or function keys. The ability to print out a display screen shall also be tested.

4. Trend Displays: Preconfigured displays shall be checked for functionality including both historical and real time data and trend printing. A demonstration of the generation of a custom configured trend with all variables shall be performed.

5. Control Displays: The ability to enter new setpoints, vary control modes, and adjust control parameters shall be demonstrated. The lack of ability to change these items without the correct security level shall also be demonstrated. Confirmation of changes shall be obtained by checking appropriate PLC registers.

6. Reports: The test shall include displaying and manually printing preconfigured reports.

7. Failure Tolerance: The PLCS shall be demonstrated to comply with fault tolerance requirements by simulating the failure of one workstation or PLC processor at a time and observing the affect on the PLCS.

8. Power Failure: External power to enclosures and/or workstation shall be turned off and back on in order to test the operation of the UPS units.

E. **Test Report:** The CONTRACTOR shall record the results of all factory testing on preapproved test forms which the GOVERNMENT's and CONTRACTING OFFICER's representatives shall sign. A copy of the completed test forms and a report certifying the results shall be provided to the CONTRACTING OFFICER within 10 days of completing the test.

F. **Rework and Retest:** If the PLC system does not operate as required, the CONTRACTOR shall make whatever corrections are necessary, and the failed part of the tests shall be repeated. If, in the opinion of CONTRACTING OFFICER's representative, the changes made by the CONTRACTOR to effect such a correction are sufficient in kind or scope to effect parts of system operation already tested, then the effected parts shall be retested also. If a reliable determination of the effect of changes made by the CONTRACTOR cannot be made, then the CONTRACTING OFFICER's representative may require that all operations be retested. The CONTRACTOR shall bear all of its own costs for the factory test, including any required retesting.

G. All of the CONTRACTING OFFICER's/GOVERNMENT's travel and per diem costs associated with all factory testing and retesting shall be borne by the CONTRACTOR.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. The CONTRACTOR shall utilize personnel to accomplish, or supervise the physical installation of all elements, components, accessories, or assemblies which it furnishes. The CONTRACTOR shall employ installers who are skilled and experienced in the installation and connection of all elements, components, accessories, and assemblies it furnishes.

B. All components of the PLC System including all communication cabling shall be the installation responsibility CONTRACTOR unless specifically noted otherwise. The installation of the communication network shall be the complete installation responsibility of the CONTRACTOR including all cables, connectors, transceivers, and any required electrical grounds. Grounding shall be shown on submittal drawings. After installation of the PLC System is completed, the installation shall be inspected jointly by the CONTRACTOR and the Equipment Manufacturer's representatives. Any problems shall be corrected, and when both are satisfied with the installation, a written certification of the installation shall be delivered to the CONTRACTING OFFICER. The certification shall state that all PLCs communication and I/O modules, modems, system grounds, communication network and all other components of the PLC System have been inspected and are installed in accordance with the manufacturer's guidelines.

3.2 CALIBRATION, TESTING, AND INSTALLATION

A. **Calibration:** All analog inputs and outputs of the PLC shall have their calibration checked at a minimum of 4 points to verify consistency with the balance of the analog loop. This calibration check shall be done in conjunction with the analog loop tests specified in Section 17100 - Process Control and Instrumentation Systems. Workstation displays and PLC registers shall both be verified for correctness.

B. **Field Testing:** After the PLC installation has been certified and the analog points have been calibrated, the PLC shall be tested to verify that all discrete inputs and outputs of both the PLC system and the OIS are correct. As much as possible, points shall be checked "end to end." For example, valve status inputs shall be checked by stroking the valve, and a pump start output shall be checked by using it to start the pump. Simulated testing shall be allowed only when no practical alternative exists. Workstation displays shall be verified for correctness at the same time. An I/O checklist shall be used to record test results and a copy provided to the CONTRACTING OFFICER upon completion.

C. **System Testing:** When the PLC installation has been certified and analog loop calibration and discrete I/O testing have been completed, system testing shall be performed in accordance with the approved test procedures. System testing shall operate the various process systems of the treatment plant to verify compliance with all functional requirements specified, including the automatic control modes and PLC interlocks described in the control strategies contained in Section 17300 of this Specification. Tests which fail to demonstrate the required operation shall be repeated in their entirety or continued after corrective action has been completed at the discretion of the CONTRACTING OFFICER.

D. Each workstation display, including trend screens, control screens, and alarm summaries and logs shall be verified for correctness during the system testing phase of this project. Any corrective changes to the displays requested by a representative of the GOVERNMENT shall be done by the CONTRACTOR. During system tests, the CONTRACTOR shall have a representative on site continuously who is capable of trouble-shooting and modifying the PLC system configuration programming.

E. The CONTRACTOR shall submit to the CONTRACTING OFFICER a system testing completion report when each process system and all aspects of the configuration software have been successfully tested as described herein. The report shall note any problems encountered and what action was required to correct them. It shall include a clear and unequivocal statement that the process systems have has been thoroughly tested and are complete and functional in accordance with all specification requirements.

F. **Plant Start-Up Test:** The CONTRACTOR shall provide start-up support to include the instrumentation supplier's personnel, electrical personnel, and the PLC system manufacturer's representative as required during the testing period to produce a fully operational treatment plant. This support shall be provided at no additional cost to the GOVERNMENT.

G. Performance Test

1. Subsequent to the system and plant start-up testing of process areas at the Encina Wastewater plant and associated lift stations, the CONTRACTOR shall conduct a successful 30 day final acceptance test for the PLC system furnished under this

contract. In the test, the entire PLC system shall be continuously operated and maintained (i.e., 7 days per week, 24 hours per day) during the test period with zero downtime resulting from system failures. If a system failure occurs, the 30 day test shall be considered a failure and not acceptable. The CONTRACTOR shall repeat the 30 day test. The PLC system shall be acceptable only after all equipment and software has satisfied the performance test requirements.

2. Downtime resulting from the following shall be considered system failures:

   a. If a component or PLC software failure cannot be repaired/replaced within 2 hours.

   b. Downtime of any component (exclusive of I/O) whose failure results in the inability of the Operator to monitor and manipulate control loops from the associated workstation using standard workstation interface procedures.

   c. Downtime resulting from concurrent failure of any CRT, keyboard, or mouse which is associated with the workstation.

   d. Downtime in excess of 2 hours resulting from any I/O component failure.

   e. Downtime resulting from concurrent failure of 2 or more I/O components in a single PLC.

   f. Downtime of any component/peripheral associated with the communication network if the failed component (1) results in a disabling of the historical functions and (2) the failed component is not repaired or replaced within 8 hours.

3. The CONTRACTOR shall submit a final performance test completion report which shall state that all contract requirements have been met and which shall include (1) a listing of all PLC system equipment maintenance/repair activities conducted during testing and (2) a listing of all components which were unable to operate successfully. Final acceptance, in writing, of the PLC system shall be provided by the CONTRACTING OFFICER if the results of all of the performance tests are acceptable.

4. The CONTRACTOR shall guarantee the entire PLC system for a period of one year.

5. After acceptance of all required performance tests, the CONTRACTOR shall be responsible for furnishing the spare parts/tools on site at an inventory level the CONTRACTOR determines is sufficient. All spare parts/tools stored on-site shall become the property of the GOVERNMENT upon completion of the guarantee period. The CONTRACTOR shall guarantee that the completed system shall perform all of the data acquisition, and control functions as shown and specified.

H. **Training:** The CONTRACTOR shall provide training for the purpose of familiarizing the GOVERNMENT's maintenance, and operating personnel total of 5 person with the use, maintenance, calibration, and repair of all components of the PLC system.

I. The training shall be scheduled concurrent with the calibration, equipment testing, and process system testing phases of the project.

J. The training shall be performed by qualified representatives of the CONTRACTOR or the Manufacturer as noted in the table below. Training shall be specifically tailored to this project and reflect the PLC system installation and configuration. The table below summarizes training hours required, which shall be provided at no additional cost to the GOVERNMENT. All training shall be conducted at the job site unless another location is approved by the CONTRACTING OFFICER and GOVERNMENT.

Training Classes Required	Maintenance and Operator's Class (Hrs.)	Conducted By
1. PLC System Hardware/Software General Familiarity	8	Contractor
2. Troubleshooting and Repair of PLCs	8	Manf.
3. PLC System Programming Specific To This Project - I/O, ladder logic, symbols, architecture	16	Contractor

K. Each training class shall be a minimum of 8 hours in duration. Separate classes shall be conducted for the GOVERNMENT's maintenance and operating personnel. Maintenance classes shall stress troubleshooting, repair, calibration, and other technical aspects of the PLC. Each of the training classes listed above for operators shall be conducted twice during separate weeks to allow for scheduling of GOVERNMENT personnel.

L. The training classes shall be scheduled a minimum of 3 weeks in advance of when they are to be given. Proposed training material, including a resume for the proposed instructor(s) (indicating previous instructional experience) and a detailed outline of each lesson shall be submitted to the CONTRACTING OFFICER at least 30 days in advance of when the lesson is to be given. The CONTRACTING OFFICER shall review the submitted data for suitability and provide comments that shall be incorporated into the course. Final materials will be provided at least two weeks in advance of the training sessions.

M. Within 10 days after the completion of each class, the CONTRACTOR shall present to the CONTRACTING OFFICER the following:

1. A list of all GOVERNMENT personnel that attended the class.

2. An evaluation of GOVERNMENT personnel that attended the class via written testing or equivalent evaluation.

3. A copy of the hard copy text utilized during the class with all notes, diagrams, and comments. This documentation shall be contained in the Training Manual.

N. The GOVERNMENT reserves the right to videotape and record any or all portions of training performed for future usage.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 17520 - PLC/COMPUTER SOFTWARE

PART 1 -- GENERAL

1.1 DESCRIPTION

A. The CONTRACTOR, through the use of the Instrumentation Supplier shall furnish, install, assemble, configure, program, and place into service all programmable logic control system (PLCS) software in this section.

1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. PLC-based control systems-software reference specifications, codes, and standards shall be in accordance with Specifications, Section 17100, General Instrument System Requirements.

1.3 SUBMITTALS

A. **Shop Drawings:** PLCS submittals shall be in accordance with Specification Section 17100, General Instrument System Requirements. PLCS software submittals shall, however, be made separately from other process control and instrumentation system submittals.

B. **Software Submittal:** The Software Submittal shall be a singular all inclusive submittal which shall include at least the following:

1. Complete description of the standard application software programs, operating system, and utility program to be furnished, including modifications and explanation of how the specific functional requirement will be met. A cross reference between the specification and the software submittal shall be provided in order to provide the CONTRACTING OFFICER the ability to identify how each specified section or function is being met by the CONTRACTOR.

2. A complete set of all available software algorithms with:

   a. Individual coil register and variable description.

   b. Program, group of program, subroutine, and complete rung detail comments.

   c. Memory, coil, register, and variable usage mapping.

   d. Source code of all high-level program language that is specifically created by the CONTRACTOR for this project.

3. A complete set of control strategies that depict all monitoring and control functions on a loop by loop basis.

4. An English language narrative of each data acquisition or control loop mission and anticipated action. Narratives shall enumerate the signal point name, signal description, associated PLC number, associated graphic displays, system functions activated by the signal (i.e., interlocks, alarms, logs, etc.).

5. A complete set of module configuration sheets depicting each loop linkage.

6. A complete listing of the PLC data base for each data point with relevant parameters such as range, active state, contact orientation, limits, incremental limits, I/O card byte, I/O hardware address and PLC assignment. The list shall be divided and grouped by PLC, and divided into type of I/O. In addition to the active I/Os, the list shall also include implemented spare I/Os. Final format shall be approved by the CONTRACTING OFFICER.

7. Detailed descriptions of procedures used to implement and modify control strategies and data base construction.

8. One complete set of all workstation accessible displays which are unique to this project. These displays shall be a full size color graphic format arranged in hierarchical order.

C. **Display and Report Submittals:** After all Software Submittals have been approved by the CONTRACTING OFFICER, the CONTRACTOR shall submit the following items. Favorable review and implementation of these submittals is required prior to the start of system testing (i.e., the DCS must be operational prior to any process system test).

1. All workstation display (both graphic displays and trend displays) submittals shall be in full color as they will appear on the CRT. This submittal shall be prepared after the requisite Graphics Meetings in this section.

2. Each display shall be uniquely titled. Locations for process data shall be clearly identified either through the use of simulated data or by showing variables on the displays and providing a reference list describing those variables. All dynamic points shall be identified by tag number as a minimum and their operation shall be described on separate sheets (color change, symbol change, etc). Three sets of submittals (with screen prints in color) are required for review by the CONTRACTING OFFICER. One set will be returned with comments.

3. All periodic reports for the entire PLC system. Locations for process data shall be clearly identified, either through the use of simulated data or by showing variables on the report and providing a reference list describing those variables. Three sets of reports shall be submitted for review by the CONTRACTING OFFICER. One set will be returned with comments.

D. **Operations Reference Manual:** The CONTRACTOR shall prepare and submit an Operations Manual for the workstation system for use by the plant operators. This manual shall be a white view binder, K&M VS11-20WE, or equal and shall contain the following:

1. An index to the manual.

2. Software – Related: Submit 15 days prior to the plant operational test

   a. All program manuals supplied by the Manufacturer(s) with the standard software packages.

   b. All original program disks supplied by the Manufacturer(s) with the standard software packages, including any program revisions or updates issued by the Manufacturer(s) during the construction period.

c. All PLC program and workstation configuration program files stored on labeled disks. The PLC program and workstation configuration file disks shall also be updated as required if any changes or corrections are required in this programming prior to project completion.

d. A change of ownership registration form for each standard software package supplied under this project to allow the GOVERNMENT to register the software with the Manufacturer

3. A list of workstation display screens, trends, and reports, with display name and description.

4. A list of the control screens with the display names and description. It shall also provide a summary of possible commands and operator inputs to these screens including setpoints. All control actions shall be included.

5. A PLC block diagram with names and locations of major components.

6. Input/output diagrams and ladder logic diagrams.

7. Instructions for manually printing screens or reports, both real time and historical as applicable.

8. A summary of security levels and their privileges and limitations.

9. Spaces for operators to make notes.

10. A copy of this manual shall be provided to each operator during training on the workstation operations. The training class shall include a review of this manual with the operators in addition to more detailed instruction on the workstation configuration and its use.

1.4 SERVICES OF MANUFACTURER'S REPRESENTATIVE

A. PLC-based control systems-software Manufacturer's representative services shall be provided in accordance with with Specifications, Section 17510 - PLC-Based Control Systems-Hardware.

PART 2 -- MATERIALS

2.1 GENERAL

A. This section covers the furnishing of standard software fully installed and configured in the control system specified herein. It is the intent of this Specification to have the CONTRACTOR furnish the latest generation, standard, field proven, fully debugged and supported PLC software package for this application with a minimum of additions or changes. Customized or specially written software shall be furnished if required to meet all of the functional requirements indicated. Any custom applications software required shall be fully integrated into the basic software and shall not require unique command structures. No attempt has been made to list all software or list all characteristics of software required by the instrumentation supplier to meet the functional requirements specified herein.

1. Software is described in broad, functional categories. The Instrumentation Supplier shall furnish a complete software package including the functional requirements along with whatever additional software is required for proper and efficient operation of the DCS System.

2. The software package shall provide a system capable of controlling system level activities, and a higher level process control language allowing the operator to monitor and control the process through an interactive human interface. The software environment shall support a multi-programming atmosphere allowing concurrent execution of more than one program in a background/foreground mode or multi-tasking mode.

3. Throughout the execution of all software modules, the operator shall be presented with all of the command or operation choices available at that point in the program using sufficient verbiage or symbols to make the choices self-explanatory and unambiguous. Question and answer or fill-in-the-blank requests shall only be permitted where file names, tag names, or other unique text or numerical information is required.

2.2 HARDWARE

A. **General:** All PLCs, remote I/O systems, workstations, communication equipment, etc., shall be provided under Specifications, Section 17510 - PLC-Based Control Systems-Hardware.

2.3 PLC SOFTWARE

A. PLC Programming Software: All PLC programming shall be accomplished using a standard software package developed for this purpose. The software package shall be installed on the hard disk of the PLC programming terminal and workstations.

1. All programming, monitoring, searching, and editing shall be accomplished using this PLC programming software. The PLC programming software shall display multiples of series and parallel contacts, coils, timers, counters, and mathematical function blocks. The software shall be able to monitor the status of all inputs, outputs, timers, counters, and coils. It shall have the capability to disable/force all inputs, outputs, and coils to simulate the elements of the ladder logic by means of color change. It shall include a search capability to locate any address or element and its program location. PLC status information, such as error indication and amount of memory remaining shall be shown on the display screen.

2. The PLC programming software shall have the capability to generate a PLC program printout, which is fully documented. Fully documented program listings shall have appropriate rungs, address, and coils shown with labels, descriptors and identifiers. Comments shall clarify to a reader what each segment of the program accomplishes. A fully documented listing shall also include a cross-reference report of program addresses.

3. The PLC programming software package shall be able to monitor and/or control PLCs via the communication network. It shall contain diagnostics to collect troubleshooting and performance data and display it in easy to understand graphs and tables. It shall also monitor devices at each drop on the communication link for proper communication.

B. **Network Configuration Software:** Network configuration software shall be provided allowing configuration management and diagnostic capabilities for the PLC network. The software shall be capable of "drag & drop" actions allowing manual configurations of the network and automatic configuration of devices that are present on the network.

1. All software shall be provided by the CONTRACTOR to the GOVERNMENT with the original manufacture's disks, CDs and or other media and documentation. All licensing shall be to the GOVERNMENT.

2. The network configuration software shall be Rockwell Software's RSNetworx for ControlNet and RSLinx.

C. **System Level Software:** System-level software shall include a complete and unmodified operating system furnished by the CONTRACTOR that provides system-level functions as indicated. Operating system software shall function automatically without operator intervention, except as required to establish file names and similar information. System-level software shall include a real time operating system, a calendar/time program, a file management program, and a system of diagnostic routines in addition to any compilers, editors, loaders, or assemblers required to support the PLC software.

D. **Operating System Software:** The real-time operating system software shall be the standard uncorrupted product of the PLC and shall provide the following minimum functions:

1. Respond to demands from a program request.

2. Dynamic allocation of the resources available in the PLC. These resources shall include main memory usage, computation time, peripheral usage, and I/O channel usage.

3. Allotment of system resources on the basis of task priority levels such that a logical allocation of resources and suitable response times are assured.

4. Queuing of requests in order of priority if one or more requested resources are unavailable.

5. Resolution of contending requests for the same resource in accordance with priority.

6. Service requests for execution of one program by another.

7. Transfer data between programs as requested.

8. Management of all information transfers to and from peripheral devices.

9. Control and recovery from all program fault conditions.

10. Diagnose and report real-time hardware device errors.

E. **Program Execution:** Program execution shall be scheduled on a priority basis. A multilevel priority interrupt structure is required. A program interrupted by a higher priority program shall be entered into a list of pending programs. Its execution shall be resumed once it becomes the currently highest priority program. The system shall allow periodic programs to be scheduled. The allocation of resources to a time-scheduled

program shall be based on its relative priority and the availability of computer system resources. Initiation of programs shall, as a minimum, be activated in the following ways:

1. In response to external interrupts.

2. At a scheduled time of the day.

3. On an elapsed time interval basis.

4. On request by another program.

5. On request from the data access panel.

F. **Operator Control:** All programming commands related to changing system configuration or controlling field devices shall be performed only through the PLC system and shall require more than one keystroke to protect against inadvertent operations. The PLC system configuration commands shall require operator confirmation of a requested action before any change is made. This shall apply to changes in the algorithms, control sequences, and similar configuration related actions, as well as file copy and file delete commands. If any sequence requiring operator conformation, the operator shall be able to cancel the operation at any point prior to executing the command.

G. PLC programming software shall be Rockwell Software's RSLogix 5000, version 7.02.00 or later.

2.4 WORKSTATION AND HUMAN MACHINE INTERFACE (HMI) SOFTWARE

A. General SCADA Software Requirements:

1. The SCADA software shall consist of a human machine interface (HMI) system with support for supervisory and process control, real-time data acquisition, alarm and event management, historical data collection, report generation, local or remote telemetry communications to PLCs/RTUs, and internet/intranet access. The software shall be easy-to-use, with an object-oriented graphics development environment and have an open architecture, which utilizes the latest in Windows NT client/server networking technology from Microsoft. The system shall have the built-in flexibility to permit easy configuration of the system in accordance with the specific end user requirements as well as quick and easy modification by the end user in the field.

2. The software shall consist of a suite of off-the-shelf modular components that are tightly integrated together to perform all SCADA system functions and be provided from a single software Manufacturer. The HMI system shall be the process visualization component of an automation software suite that also includes components for historical data collection and reporting, communications to PLC/RTUs, remote telephonic alarm and data messaging and Internet access. It shall be scaleable so that a small, stand alone application can easily be expanded into a large distributed control network with either single or redundant database servers, single or redundant communication servers providing information to multiple workstation clients. The software shall also have the ability to easily interface with mainstream third party database and spreadsheet applications from Microsoft and Oracle.

B. HMI Runtime User Interface Software Requirements:

1. This section describes the various user interface functions of the SCADA system in the runtime mode. The software shall be licensed to support three levels of user interface in any combination as follows:

    a. Full function SCADA workstation for system operators

    b. View-only graphics workstations for users who want to view the system displays

    c. Process data analysis workstations for users who need to access process data and reports but do not need to view graphics.

2. The SCADA system software as described in the following sections shall be capable of running over an Intranet/Internet. Security for this type of connection shall use Secure Socket Layer (SSL). A user shall be able to view the SCADA System application from their desktop within MS Internet Explorer.

3. Full Function Operator Workstation:

    a. The SCADA system operator shall be able to execute all monitoring and supervisory control functions from this workstation. Typical operator commands include modifying setpoints for control loops, alarm acknowledgment and setpoint adjustment, auto/manual switching and on/off control of field devices and taking points or devices on/off scan. The operator shall be able to access all SCADA process tagnames or graphic displays from any workstation on the network without knowing which data historian or server the point or display resides on.

    b. Display Navigation:

        1) Operators shall interface to all process and SCADA activities through easily recognized icons, pull down or full screen menus.

        2) The system runtime software shall support operator access to multiple displays at one time, including split screens where the operator may view more than one process area at a time. In addition, the system shall support unlimited use of pop-up displays for additional help or diagnostic information.

        3) The operator shall be able to have access to context sensitive on-line help or instructions from any display at any time during operation of the system with a single keystroke or mouse click.

        4) The operator shall be able to access displays via a pointing device and/or soft key menus with a choice of function keys, cursor control keys, or any single key on the keyboard. Display navigation shall not normally require the use of typing text commands into an alphanumeric keyboard. Supported pointing devices shall include a mouse, touchscreen, lightpen, or trackball.

        5) The operator shall be able to easily identify which objects are selectable from any display by simply dragging the pointing device over the object. Displaying a halo around the object shall provide confirmation that an object can be selected. Typical objects include process device symbols (pumps, motors, etc.) controller faceplates, buttons, switches, or sliders.

c. Runtime Security:

1) The runtime software shall include a security system under Windows NT security to enable various operator tasks based on the user level and password. Access to all displays and to all command functions shall be based on the operator's security level to protect against unauthorized use. After initial creation, only an assigned user with proper authorization or the system administrator shall modify the password.

2) The security system shall be capable of disabling access to all Microsoft Windows controls (file menu, close, minimize, etc.) and keyboard commands (Ctrl-ESC, Alt-Tab, and Ctrl-Alt-Del).

3) At least 100 levels of security protection shall be provided. Visibility and operation of command buttons, setpoints, symbols, or entire displays shall be enabled or disabled based upon the operator's security level. The security level shall be established during the operator log-on procedure.

d. Windows NT Service Support:

1) The operator interface workstation shall be able to be run as a Microsoft Windows NT service. This provides NT service capabilities for key HMI components such as historical logging, alarms and I/O communications. The service capabilities allow continuous operation through operating system logons and logoffs such as operator shift changes.

2) The HMI and supporting applications running as an NT service shall provide automatic start-up in the runtime mode following power failure or, when the machine is turned off/on. This function assures unmanned station startup without compromising NT operating system security.

e. Logging Operator Actions:

1) All operator actions shall be logged to an event logger. The event logger shall keep track of each new operator log-on, log-off, setpoint change, or device control.

2) Each event log shall record the date, time, operator logged in and the type of action taken (setpoint change, state change, etc.).

f. Alarm Management Functions:

1) The operator shall be able to view current and historical alarm information from a full screen alarm-summary display or on a small scrolling region and the bottom of any display. The alarm information shall be displayed in chronological order with the most recent alarm at the top. The information displayed for each alarm shall include the time and date, description, tagname, alarm state, alarm type (lo, lo-lo, hi, hi-hi, rate-of-change, etc.), value, priority level and class.

2) It shall be possible for the operator to filter the alarm display based on priority level, groups or process area. In distributed network systems, alarms shall be viewed and acknowledged from any workstation and the information shall be distributed to all clients.

3) It shall be possible to configure the system such that the operator is notified of an alarm no matter which display the operator is currently viewing. Notification shall include the option of a pop-up alarm display window, a flashing process symbol such as a process vessel, an alarm text message that is available on each display, or a dedicated alarm display window anywhere on the screen.

4) The alarm summary display shall provide the built-in horizontal and vertical scroll bars to page through alarms. The display of these scroll bars shall be user-configurable.

5) The alarm summary display shall allow for dynamic re-sizing at runtime of the column widths simply by selecting a column line and dragging it to set the column width.

6) The alarm display shall support up to eight different combinations of colors based on the priority of the alarm and whether it is acknowledged or unacknowledged. The colors shall be user-selectable via configuration from a total of 256 colors.

7) The system shall provide a method of notifying the user when a new alarm has occurred. The alarm display object shall automatically scroll to a new alarm when the user has scrolled down the alarm list from the top.

8) The alarm display shall retrieve alarm information by submitting an alarm query to the alarm server. The alarm query shall allow specifying a "priority" range, alarm acknowledge state, alarm group, alarm history or summary. Combinations of the parameters can be specified for the query to produce selected results.

9) The operator shall be able to select and acknowledge alarms individually, by group or process area. The operator shall also be able to acknowledge only those alarms visible in the display, only those selected, only the most recent alarm or all alarms in the system. The alarm display shall allow alarms to be selected by clicking on them with the mouse at runtime.

10) The operator shall be able to select an alarm from the alarm summary display and the system shall switch to the corresponding screen as to the particular section of the control system where the alarm originated.

11) It shall be possible to inform the operator of an alarm condition via an audible tone, a pop-up display, or any combination of animation types on the screen.

4. Process Data Analysis Workstation:

a. The SCADA system software shall include a set of easy-to-use client software tools for real-time and historical data analysis and system reports. This client analysis software may be used by engineering, maintenance or supervisory personnel who need information from the SCADA system but do not require access to graphic displays. The client tools shall be able to access data from any Data Historian on the SCADA system network. Users shall be required to log in with a password to access the database server. The user shall not have to know the location of the server on the network, only the name of the server.

The client analysis software shall include tools for advanced trending analysis, X-Y plotting of process tagnamesstag names, and viewing of reports in spreadsheet or free form format. All tools shall support full right mouse-click capability for quick menu selection of available functions. The client tools shall be available as a stand-alone program or as an Active X control for imbedding into the HMI so that any full function or view only operator workstation may have the same capability.

b. Real-Time and Historical Trend Analysis Tool:

1) A client tool shall be included that allows users to view any or all of the process tagnames in either a trend chart or tabular format. The client tool shall have a user interface that allows for easy selection of process tagnames using a Windows Explorer-like browser with a search filter to quickly find process tagnames in Data Historians with thousands of points. The user shall be able to create folders for selected groups of process tagnames and plot them individually or in groups by dragging them into the trend area. The user shall be able to save trend files for recall at a later time. It shall be possible for the user to switch from the real time to the historical viewing mode using a simple check box. The user shall be able to toggle from viewing trends either in the superimposed or the stacked mode. In the superimposed mode, all trends overlap and are in a single scale range based on the largest vertical scale range in the group. In the stacked mode, each trend has its own vertical scale range. Trend plots shall automatically be scaled based on the widest vertical range of the process tagname or optimized based on the maximum and minimum range within the selected period.

2) Real-time Trend Viewing:

a) The user shall be able to trend up to 40 different process tagnames in real time including analog and discrete process tagnames within the same trend. The user shall pick process tagnames from the browser. The time span and vertical range of the trend shall be user configurable at run time. Standard time spans shall be configured for the last 5, 10, 30 or 60 minutes or the last 2, 4 or 8 hours. The user shall be able to adjust the range of the process tagnames in run time.

3) Historical Trend Viewing:

a) The user shall be able to plot historical data for any process tagname or groups of process tagnames in the database based any user-selected start and stop time. Two hairline cursors may be turned on and dragged across the trend area to provide the user with the exact value for each trended process tagname at the point of intersection. The time span between the cursors shall also be displayed. The trend tool shall display statistical data for each trended analog process tagname within the time period selected. Statistical values shall include the minimum, maximum, average, and standard deviation. Icons or menu pull down commands shall be available for analyzing the data such as horizontal, vertical or rubberband zooming, pan left or right and zoom between the hairline cursors. It shall also be possible for the user to create text annotations

anywhere on the trend. These annotations shall be visible from other workstations on the network with the same trend tool. It shall be possible to export the data in the trend area into a CSV file. Printing of the trends with all statistical data shall be supported.

4) X-Y Plotting Tool:

a) A client tool shall be included that allows users to view two process tagnames in an XY Plot. The client tool shall have a user interface that allows selection of process tagnames and storage of the XY plot in a folder for re-selection at a later time. The user shall be able to create a background image of the expected XY plot so the user can see if the current values are outside of the expected values.

5) Active X Tool for SQL Queries:

a) An Active X tool shall be included to allow the user to execute SQL queries that returns a result set from any SQL Server database. The data returned to the Active X Tool shall be in a tabular data grid. Multiple sources (multiple servers) of the data shall be available to the Active X tool.

6) HTML Reporting Client Tool:

a) A client tool shall be included that allows users to generate reports on any tagnames. The client tool shall have a user interface that allows selection of tagnames and previously created reports and report formats. The report tool shall allow you to set up, modify, and generate reports that present report data professionally and reliably. Types of information supported shall include historical and current data values, tagname configuration information, graphs, statistics, annotations, event and summary information and results from a query. Reports shall be generated based on data stored over a specified period in minutes, or hours, days, weeks or months. It shall also be possible to generate reports on demand by the user at runtime. Finished reports shall be formatted in HTML so that they can be viewed with a Web Browser, stored on the server disk or sent to a printer.

7) Excel Reporting Tools:

a) A client tool shall be included that allows users to easily select process tagnames from the real time or historical database via a browser and then utilize them in a standard Microsoft Excel spreadsheet for reporting or presentation to management. The selection of process tagnames shall be accomplished by use of drag and drop or point and click commands. It shall not be required to write any macros to retrieve the data. The process tagnames selected can be output to specific cells in the spreadsheet and processed as number data types. The user shall have the choice of selecting real time for the most recent data values in seconds or minutes. The user shall be able to select historical data for the most recent values in minutes or hours or go back and select any start or

stop time as far back as the data is available. The historical data can be recalled at the granularity that it was stored or in a selected number of data points over a period. The user shall be able to retrieve raw historical data or summarized data such as the minimum, maximum or average over a predetermined period. Updates to the current values once they are in the spreadsheet shall be refreshed with one click of the mouse. The quality of the data shall be analyzed and displayed. The user shall be able to select if poor quality data is to be displayed or replaced with an interpolated value. The user shall be able to specify relative or absolute value choices.

8) Retrieval of Live Data for Viewing:

a) A client tool shall be included that allows users to view any or all of the process tagnames and their current values, without building an SQL call to the Historian. Process tagnames shall update in real-time or at the scan rate specified during configuration. The client tool shall have a user interface that allows selection of process tagnames and storage of groups of process tagnames for re-selection at a later time. Values to be displayed using this tool shall be selected by dragging a process tagname from the browser into the viewing area.

C. View-only Graphics Display Workstation:

1. The SCADA system software shall support view-only graphics workstations for managers or supervisory personnel who wish to have access to all displays and trends but do not have process control or alarm acknowledgement responsibilities.

D. HMI Development Software Requirements:

1. This section describes the engineering development requirements of all SCADA system software functions. This includes development of color graphic displays, configuration of the real-time and historical database, alarms, I/O communications to field devices and application setup of clients and servers on the SCADA network.

E. Graphics Display Development

1. The SCADA system software shall include an object-oriented color graphics display generator with full animation capabilities to provide users with a realistic visualization of the SCADA system process. All graphical editing operations shall be point and click selecting icons from a floating and docking tool bars, pull down menus or keyboard commands. It shall be possible to perform a functional test of any graphic display by switching to the runtime mode with a single mouse click. The display editor shall include the following tools for display drawing, linking and animation.

2. Graphical Objects:

a. The graphics editor shall include a set of basic drawing tools to create simple or complex objects. Simple objects shall be easily created by selecting an icon on the drawing toolbar which include lines, rectangles, polygons, ellipses, circles, filled shapes or text. Any of these objects can be assigned various attributes such as line color, fill color, size, and orientation and can be made static or dynamic. Text objects shall be scaleable and use true fonts in bold italic or

underline. All objects shall be scaleable and moved in any direction one pixel at a time or dragged with a mouse.

b. The graphics editor shall support standard object manipulation functions such as cut, copy, paste and delete. Alignment tools shall be included to simplify proper placement and arrangement of objects. Align commands shall be included to align objects based on justification to the left, right, center, top or bottom. Object commands shall also be included to space them vertically, horizontally, move to back, move to front, rotate or group and ungroup.

c. The graphics editor shall include a broad library of complex objects and process symbols such as meters, pushbuttons, sliders, gauges, pumps, motors, tanks, valves, trends, alarms, controller faceplates and bitmaps. All complex objects shall be scaleable to any size and may include animation links to provide dynamic response based on real time data or user action

d. Object Animation: Objects shall be animated based on the following attributes:

1) Color change of the object. Up to 256 colors, 128 standard colors and up to 128 user-defined colors. A user defined color palette can be created, exported and imported. The color palette shall be based on 16.7 million colors. System must also support the user choosing transparent colors for all graphical objects and backgrounds.

2) Percentage of fill for objects up, down, left or right direction based on a process tagname.

3) Blinking of the object based upon any alarm or event or upon a designated group of alarms. The blink shall be adjustable to slow, medium or fast.

4) Each object shall have a visibility attribute option allowing for visibility of the object based upon the status of a discrete point, alarm, or operator security level.

5) The system shall support animation of objects via re-sizing, moving, and/or rotating based upon a change in a process tagname.

6) Objects shall be animated based upon any user-defined criteria made up of process tagnames in the system. This includes the use of expressions containing all mathematical functions and the status of analog and discrete values in the system.

e. Graphics Editor shall allow layering of objects to activate specific objects based upon conditions in the process.

f. Graphics development tools shall allow object placement via a “snap-to-grid” feature with configurable grid spacing.

g. Graphics development tools shall support an “undo/redo” feature with a configurable number of levels and command displays.

h. The system shall support a library of “self configuring” objects that change properties based on dialog box entries made during development. For example,

consider a standard setpoint loader object that has a graduated scale and a default range of 0 to 100.0. Dialog box entries shall allow changes to the range of the setpoint loader, the number of major and minor divisions on the scale, and change the text font used for the labels. The object shall then redraw itself with new number of tick marks, new spacing, new labels, and new font.

i. The system shall support the import of .DXF files with the drawing elements imported as native objects. It shall be possible to animate these objects using the full set of object animation properties as specified herein.

j. Graphics editor shall also allow the user to import drawings and images in .BMP. JPEG .PCX and .TGA file format.

k. The graphics development environment shall support the copy of single or multiple animated graphic objects and symbols with just two keystrokes, and immediate substitution of process tagnames for the duplicated object shall be possible without leaving the graphics editor.

l. The graphics development environment shall support the copy of single or multiple animated graphic objects and symbols from one window or display to another retaining all of the animation characteristics, links and attributes. This function will eliminate duplication of effort. In addition, it shall be possible to import windows from another application in this same fashion.

m. User shall have the capability to add process tagname entries while building a display without exiting the graphics editor.

n. User shall have the capability to search for process tagnames while building a display and then get the exact detail of the item (alarm setpoints, I/O address, and all other database details) while building a display without exiting the graphics editor.

o. On-line context sensitive help shall support display building. Users shall be able to obtain immediate help on all configuration subjects by pressing a single function key.

p. The user shall be able to define graphic screens while the system is monitoring the process

3. Alarm Summary Object:

a. Alarms shall be displayed by configuring a user-defined alarm summary object, which may be placed by itself or along with other objects in a window. The object can be sized and then double-clicked to launch a configuration dialog. Default alarm object configurations shall be displayed with the option of changing any configuration parameter for runtime viewing. The alarm object configuration shall include parameters with check boxes to select and enable or disable how the alarms appear at runtime. Alarms shall be color coded according to the state and priority of the alarm including an acknowledged alarm, unacknowledged alarm, and an alarm that has returned to normal but is not yet acknowledged. The user shall be able to choose from 256 different colors for display of each of these alarm states. The alarm display object shall also support event display, with the color used for events also being one of the

256 different colors. The alarm display object shall support up to eight different combinations of alarm severity.

4. Process Tagname Database and Alarm Configuration:

   a. The SCADA system software shall include a database configuration interface to define all parameters for each process tagname and alarm point. Tagnames shall be defined with up to 32 alphanumeric characters. Configuration of the database shall be through fill-in-the-blanks dialog boxes. Process tagnames shall only need to be typed once. All process tagnames shall be selected from a browser with a context sensitive search filter to quickly find any process tagname in databases many points. The system database shall support the following database process tagname types: analog (integer or real), discrete or digital and strings with up to 132 characters.

   b. Analog Process Tagnames:

      1) Text fields shall be included to define the tagname and description, Engineering units, alarm group name and the I/O access name for the field device to which the analog value is connected.

      2) Numeric data entry fields shall be included to define alarm and event priority levels, initial value upon startup, deadband, min and max raw, main and max Engineering units, alarm set point values or percentages for each alarm type and the alarm deadband value

      3) Check boxes shall be included to enable/disable the following functions at runtime: Historical data and event logging, last value is restored upon power loss, changing of alarm limits, and all alarm types including lo, lo-lo, hi, hi-hi, rate of change and deviation.

   c. Digital or Discrete Process Tagnames:

      1) Text fields shall be included to define the process tagname and description, on/off messages for alarms and events, alarm group name and the I/O access name for the field device to which the discrete point is connected

      2) Check boxes shall be included to enable/disable runtime functions such as event logging, restoring the last value upon power loss, initial value upon startup and the alarm state.

   d. Import/Export Utility:

      1) The database shall include a utility to support import or export into a .csv file format for editing in a spreadsheet application such as Microsoft Excel.

F. Application Manager

1. Each application shall include an application manager with a Windows Explorer-like browser to simplify management of windows (displays), scripts, tagnames, alarms and application documentation. A tagname cross-referencing index shall provide and efficient means identifying where all tags, links and objects are used throughout

all windows in the application. The application manager shall provide the capability to dynamically change the resolution of the application windows. This will allow graphic displays to be developed on workstations with different display resolutions and convert them to the desired resolution quickly so that they are all consistent in look and feel.

2. Distributed Network Application Management:

    a. The SCADA software shall provide standard functionality that will simplify the configuration, operation, troubleshooting and maintenance of the application by providing means of distributing the application in network environments. The Distributed Network Application (DNA) management software shall adhere to client-server architecture while allowing a single master application to be developed and maintained on the network. The DNA manager shall automatically distribute of the master application to all nodes on the SCADA control network.

    b. Application Locations:

        1) Master applications shall be maintained on a server that each client node can access, which provides ease of maintenance and unrestricted editing. The DNA manager will allow client nodes to run the application from the server, it will distribute the server application to a user-defined location that each client node can specify. This approach inherently provides the client-based advantage of redundancy.

    c. Notification of Application Changes to Client:

        1) When a client node loads an application from the network server, the client shall maintain a copy of the application on its local hard drive and become registered as a user of that application. When a change to the server application is detected, each registered user node shall be notified of the change. The DNA manager shall allow the user to define how the client node is notified of the change in the application. The client node shall either automatically load the new application, prompt the user to load changes or ignore, or automatically ignore such changes. If a network failure occurs between the server and client, then the client shall continue to run the last distributed application. When the network is restored and the server application has changed the DNA manager will distribute the server application to the client.

3. Dynamic Display Resolution Management:

    a. The software shall provide an automated solution for resolution exchange for multiple graphical capabilities within a multi-node application deployment. A Dynamic Display Resolution Manager between the server application resolution and the client application resolution eliminate the need for the user to import or export displays. Each client node shall have an independent, configurable dynamic resolution display mode.

    b. Identical Resolution Mode:

        1) The client node shall run the server application only if the resolution of the client node is identical to the developed server application resolution. If

the server and client node resolutions are different, then the system shall prompt the user, by means of a pop-up display, to scale the server application to the client resolution.

c. Server Resolution Mode:

1) The client node shall run the application only at the developed server application resolution. The system will ignore the local resolution, use the server resolution for the client node and not scale the server application.

d. Different Resolution Mode:

1) The client node shall run the server application at the resolution of the client node and ignore the developed server application resolution. If the client node is running at 640x480 and the application was developed at 1280x1024, then the system will dynamically scale the server application (smaller) to fit the 640x480 display of the client node.

4. Application Log Files:

a. Application log files shall reside on the local hard drive for a user-defined number of days. Each network node shall maintain an independent log file for the applications that are unique to each node. A new log file will be created and archived daily according to the user specified time and location. The viewer shall support color distinctions for different threads, processes or programs. The log file viewer shall support viewing remote node application log files.

5. ActiveX Extensions:

a. The SCADA software shall provide extensibility by providing integrated support for OLE Controls (OCX's) technology. The SCADA software shall be an ActiveX container supporting methods, properties and events of ActiveX objects. The support of ActiveX technology shall provide application developers immediate access to hundreds of OCXs developed by dozens of Independent Software Developers. Registering an OCX for use within an application system shall be an automatic process. Registered OCXs shall be displayed in a dialog box for adding/removing OCXs to/from the application. OCXs added to the application shall be contained within a dialog box to be quickly added to new and/or existing applications. At design time, the user is focused on selecting an OCX for placement, mapping OCX properties, events and methods to process tagnames and writing logic to control OCX behavior via OCX properties and methods.

G. Application Control Logic:

1. The SCADA system software shall include a scripting language that allows execution of commands and mathematical and logical operations based on specified system conditions or user actions. The scripting shall be easy to program using English-like statements and shall not require any knowledge of any other programming logic. The user shall be able to edit or modify the logic scripts while the system is monitoring the process. Furthermore, it shall not be necessary to invoke any other application to compile the changes. The scripting language shall include selection boxes and pull-down menus to permit statements to be created without having to type process tagnames or specific commands. Buttons shall be

available for easy selection of basic commands and operations such as IF, THEN, ELSE, ELSE IF, AND, OR, NOT, ADD, SUBTRACT, MULTIPLY, DIVIDE, EQUAL TO, NOT EQUAL TO, GREATER THAN, and LESS THAN. Additionally there shall be a full library of more complex math and system script functions available. A validate button shall be included to ensure proper syntax and provide indication of errors to eliminate any problems at runtime. On-line help for each script function shall include actual working examples that can be copied and pasted into the script editor.

2. Application Logic Scripts:

    a. System shall have the ability to execute user defined logic scripts. Logic scripts shall be created in a statement based programming environment. No compilers or linkers shall be required.

    b. System logic shall be able to automatically perform functions such as increase setpoints, perform totalization, and check the status of process setpoints to take action.

    c. System Logic shall be able to monitor the status of each process tagname in the system and perform specific functions based on the type and status of an alarm condition. Alarm type may be lo, lo-lo, hi, hi-hi, deviation or rate of change. Alarm status may be acknowledged or unacknowledged.

    d. System shall have the capability to perform application control to turn on/off discrete points, show windows, download recipes, etc. This application logic shall also start and stop other application programs such as Excel, Word and other applications like Crystal Reports.

    e. System shall have the ability to execute user definable logic on the parameters of On Application Startup, While Application Running and On Application Shutdown.

3. Conditional Control Logic:

    a. System shall have the capability to perform application control based upon a user definable state of a process tagname or the result of an expression involving multiple process tagnames; including discrete tagname on/off state, alarm states such as lo, lo-lo, hi, hi-hi, or equivalence to a specific value. It shall be possible to define Condition Logic scripts which execute once when the condition expression becomes true, once when the condition expression becomes false or while the condition is true or while the condition is false at a user definable rate of 50 milliseconds minimum.

4. Keyboard Control Logic:

    a. System shall have the capability to perform application control whenever a user presses a key on the keyboard. This includes whenever the key is pressed, released, or while the key is held down at a definable interval. The system will support any of the keys on a standard PC-compatible keyboard.

5. Data Change and Window Logic:

a. System shall have the ability to execute System Logic when the value of a process tagname changes. System shall have the ability to execute a Window Logic script upon a user definable state of a process tagname or the result of an expression.

6. Function Logic:

a. System shall support creating of logic blocks and saving the logic as a function. Function scripts shall run on a process thread independent of the HMI process. Function logic running on a separate process thread shall not impact the performance of the HMI operations. Function logic shall be able to be called from any of the logic types defined herein., including a call from a function logic block to another function logic block.

H. MANUFACTURER:

1. Wonderware or equal.

2.5 WORKSTATION NON-HMI SOFTWARE

A. The following operation system and application software shall be provided for the workstation:

SOFTWARE	QUANTITY
Windows 2000 Professional	1
Microsoft Office XP Professional (includes Word, Excel, Outlook, Powerpoint, Access)	1

PART 3 -- EXECUTION

3.1 INSTALLATION

A. The PLC-based control systems-software installation shall be provided in accordance with Specifications, Section 17510 - PLC-Based Control Systems-Hardware.

3.2 FACTORY TEST

A. **General:** The PLC-based control systems-software factory test shall be provided in accordance with Specifications, Section 17510 - PLC-Based Control Systems-Hardware.

3.3 PROGRAMMING, TESTING, AND INSTRUCTION

A. **General:** The PLC-based control systems-software calibration, testing, and instruction shall be provided in accordance Specifications, Section 17510 - PLC-Based Control Systems-Hardware.

3.4 SOFTWARE LICENSE AND REGISTRATION

A. All software provided shall be installed and used within the terms of the software Manufacturer's license agreement. All software purchased by the CONTRACTOR shall

be registered to the CONTRACTOR during the construction phase of this project. During that time, the CONTRACTOR shall be responsible for providing and incorporating minor software package updates issued by the software Manufacturer. For example, if version 3.1 of a program is purchased, and version 3.2 and 3.3 were released prior to project completion, the CONTRACTOR shall be responsible for incorporating these later versions into the final project. The CONTRACTOR would not be responsible for incorporating major software revisions such as the release of a version 4.0 or 4.1.

B. Prior to substantial completion of this project, the CONTRACTOR shall re-register all provided software packages to the GOVERNMENT and provide the CONTRACTING OFFICER and GOVERNMENT with written confirmation of having done so.

3.5 WORKSTATION SOFTWARE APPLICATION CONFIGURATION (PROGRAMMING)

A. **Workstation Graphics Generation:** It is the responsibility of the CONTRACTOR to configure the workstations and to develop, design, CONTRACTING OFFICER, configure and test all of the CRT-based graphic displays required for this project. All of this work shall take into account the specific needs of the end user. In order to facilitate this work the CONTRACTOR shall conduct the following meetings with the GOVERNMENT groups:

1. Graphics Meeting No. 1:

a. The CONTRACTOR shall chair and develop an agenda for a meeting, which shall address the basic criteria to be adhered to in the configuration and development of CRT-based graphic displays. At this meeting, which shall be attended by plant managerial personnel, the CONTRACTOR shall distribute sample display formats for illustration purposes. As a minimum, this meeting shall address the following issues:

b. All In-plant and remote site areas and conventions for identifying tag names and descriptors.

1) Designation of groups within each plant area along with tag names and descriptors.

2) The assignment of individual control loops and inputs to specific groups.

3) Organization of the systems universal display hierarchy.

4) Paging schemes to be used to enable the movement from one display to another.

5) An itemization of the type of display to be used at each level in the graphic hierarchy (e.g., pre-formatted displays, templates, custom graphics, etc.)

6) Color convention to be employed on all graphics for the annotation of various status information, differentiation between alarms on the basis of alarm priority, background colors, static field colorization and dynamic field colorization.

7) The utilization of blinking and conditional text.

8) Definition of graphic symbolism to be used on the project. This listing shall include but not be limited to symbols to be used for process instrumentation, process equipment, piping, vessels and valves. All symbolism must be specific as opposed to generic in that shapes must define both function and type (e.g., specific symbols for each valve design, each pump design, each type of flow meter, etc.). If the CONTRACTOR's library of shapes does not adequately describe plant or pipeline conditions, the CONTRACTOR shall develop additional shapes to meet the plants or pipelines requirements.

9) Definition of all display select commands that enable the operator to move within the display hierarchy.

10) The utilization of cursor movement commands which enable the operator to move within a display.

11) Definition of control input commands that enable the operator to interact with faceplate control stations and custom graphic displays to implement control outputs/functions.

12) Definition of data input commands that enable the operator to enter numeric values into the PLC system.

13) Definition of the utilization of "poke" points or fields that are dynamically sensitive to operator inputs to facilitate operator entry directly into graphic displays.

14) A review of graphic generation procedures.

c. Subsequent to the adjournment of graphics meeting No. 1 the CONTRACTOR shall prepare and formalize a document titled "GRAPHICS CRITERIA" which shall contain detailed meeting minutes and a definition of all graphic guidelines to be adhered to. This report shall be supplemented by graphic examples that illustrate the incorporation and application of each graphic criterion. The report shall be submitted within 30 calendar days of the meeting's adjournment.

2. Graphics Meeting No. 2:

a. Subsequent to the finalization of the overall system-wide graphics criteria, the CONTRACTOR shall develop graphic packages for all of the workstations being furnished under this project. At this meeting the CONTRACTOR shall submit 5 copies including:

1) A review of the graphic package developed for the process areas for content and completeness.

2) A review of all data fields that display automatically updated process information

3) A review of all required input commands associated with the graphic access and control manipulation.

b. Subsequent to the adjournment of graphics meeting No. 2 the CONTRACTOR shall prepare a formalized submittal of the graphic package for review along

with the detailed meeting minutes. The report shall be submitted within 30 calendar days of the meeting's adjournment.

3. The CONTRACTOR shall allow 2 days for each meeting.

4. The following CRT based graphic displays shall be developed for this project (as minimum):

   a. All plant process includes all existing interfacing to the PCIS of this project.

   b. All group alarm displays.

   c. All control loop tuning displays.

   d. All analog faceplate displays.

   e. All database archiving control displays.

   f. All customer displays for operator to enter all set points and recipe displays.

   g. Historical trending displays.

   h. Control system network configuration and diagnostics.

   i. All local node diagnostics (include PLCs, Operator Interfacing Units and Instruments).

B. **PLC System Data Base:** The workstation software shall incorporate a disk memory resident data base which shall store all software elements necessary to implement all data acquisition, calculation, logging and reporting functions. The system database shall be comprised of the following elements:

   1. Current data base; includes process status information.

   2. Historical data base; includes non-current process status information.

C. **PLC System Documenter:** Subsequent to system configuration or configuration updates, all information which defines the hardware, control and display configuration of the PLC system shall be stored in mass memory within the workstations. The workstations shall be provided with all of the intelligence and printing/plotting capabilities to enable the automatic generation of system documentation. All documentation shall be printed/plotted in both a text and graphic format. All documentation shall be accessible in report formats. It is not acceptable to utilize screen prints as a documentation report method. The workstation shall provide the means to produce the following documentation.

   1. Current control system databases, (including tags, descriptors, alarm limits, engineering units, associated alarm priority, logical states, etc.) control loops, and ladder logic.

   2. Definition of the current display hierarchy and all displays currently in the system.

   3. Data Base Generation: All software shall be provided to enable historical data base

D. **Data Acquisition:** Scan blocks shall extract data from the communications network at specific rates, condition the signals, convert the data to engineering units in a floating point format, and store the data to produce a PLC system data base. Typical input signals to be scanned include:

1. Limit, status, or position information from open/close valves, motors and process monitoring devices such as flow, temperature, and pressure switches.

2. Measured variables such as flows, pressures, levels, temperatures, etc.

3. Measurements, set points, and outputs from all PLCs.

4. Computed values such as inferential measurements.

5. Operational commands from workstation's keyboards.

E. **Data Collection:** The CONTRACTOR shall provide programming that collects current values of specified variables from on line data storage areas, statistically manipulates data, and creates and maintains an historical data base of collected values. Statistical manipulation shall include linear averaging, filtered averaging, and noting of "bad" values. Statistically manipulated data shall then be stored in a historical database.

1. The frequency of historical collection shall be CONTRACTING OFFICER selectable between once per second to once per month. The type and quantity of historical data shall be selectable by addition and deletion to/from the historical data base.

2. The CONTRACTOR shall provide adequate on-line storage to retain 60 days of 6-minute average values for 2,000 variables and hourly maximum, minimum, and average values of 2,000 variables.

3. The CONTRACTOR shall provide adequate on-line storage to retain 2 years of daily average values for 2,000 variables and monthly maximum, minimum, and average values for 2,000 variables.

4. Historical records (daily) shall be transferred to a magnetic tape drive and shall be an automatic function.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK