AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE	OF	PAGES
	1		2

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. *(If applicable)*
0007	15 SEP 2003		

6. ISSUED BY CODE

US ARMY ENGINEER DISTRICT, FORT WORTH
ATTN: CESWF-CT (RM 2A19)
PO BOX 17300
FORT WORTH, TX 76102-0300

7. ADMINISTERED BY *(If other than Item 6)* CODE

8. NAME AND ADDRESS OF CONTRACTOR *(No., street, county, State and ZIP Code)*

CODE FACILITY CODE

(X)

☒ 9A. AMENDMENT OF SOLICIATION NO. DACA63-03-B-0008

9B. DATED *(SEE ITEM 11)* 11 AUGUST 2003

☐ 10A. MODIFICATION OF CONTRACT/ORDER NO.

10B. DATED *(SEE ITEM 11)*

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☒ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☐ is extended, ☒ is not extended.

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods:

(a)By completing items 8 and 15, and returning 1 copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment your desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA *(If required)*

13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

CHECK ONE	
	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: *(Specify authority)* THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES *(such as changes in paying office, appropriation date, etc.)* SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
	D. OTHER *(Specify type of modification and authority)*

E. IMPORTANT: Contractor ☐ is not, ☐ is required to sign this document and return _____ copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (*Organized by UCF section headings, including solicitation/contract subject matter where feasible.)*

The Solicitation for Water System Upgrade, Fort Bliss, Texas, is amended as follows:

See Continuation Sheet.

NOTE: Bid opening date and time remain 19 September 2003 at 2 p.m. local time, as previously announced.

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER *(Type or print)*		16A. NAME AND TITLE OF CONTRACTING OFFICER *(Type or print)*	
15B. CONTRACTOR/OFFEROR *(Signature of person authorized to sign)*	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA *(Signature of Contracting Officer)*	16C. DATE SIGNED

Item 14. Continued.

CHANGES TO THE SPECIFICATIONS:

1. Replacement Sections: Replace the following sections with the accompanying new sections of the same number and title, bearing the notation "ACCOMPANYING AMENDMENT NO. 0007 TO SOLICITATION NO. DACA63-03-B-0008:"

02510A	WATER DISTRIBUTION SYSTEM
13110	CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE)
16488	INSTRUMENTATION AND CONTROLS

CHANGES TO THE DRAWINGS:

2. Reference Sequence No. 061; Drawing S-501, Work Area D, Detail 4: Change the finished floor elevation of tank bottom to 3995.00.

3. Reference Sequence No. 062; Drawing S-502, Work Area D, Detail 2: Change the finished floor elevation of tank bottom to 3995.00 and the finished grade outside the tank to 3994.50.

4. Reference Sequence No. 063; Drawing S-503, Work Area D:

   a. Detail 1: Delete finished grade elevation 3894.00 from bottom of tank and change bottom of tank elevation to 3995.00.

   b. Detail 2: Change finished grade outside tank to elevation 3994.50.

   c. Detail 3: Change finished grade outside tank to elevation 3994.50.

END OF AMENDMENT 0007

SECTION 02510A

WATER DISTRIBUTION SYSTEM
05/02
AMENDMENT NO. 0002, 0003 & 0007

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 WATER WORKS ASSOCIATION(AWWA)

AWWA B300	(1999) Hypochlorites
AWWA B301	(1999) Liquid Chlorine
AWWA C104	(1995) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C105	(1999) Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C110	(1998) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (76 mm through 1219 mm), for Water
AWWA C111	(2000) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115	(1999) Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C151	(2002) Ductile-Iron Pipe, Centrifugally Cast, for Water
AWWA C153	(2000) Ductile-Iron Compact Fittings for Water Service
AWWA C500	(2002; A C500a-95) Metal-Seated Gate Valves for Water Supply Service
AWWA C502	(1994) Dry-Barrel Fire Hydrants
AWWA C509	(2001) Resilient-Seated Gate Valves for Water Supply Service
AWWA C600	(1999) Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C606	(1997) Grooved and Shouldered Joints

AWWA C651	(1999) Disinfecting Water Mains
AWWA C800	(2001) Underground Service Line Valves and Fittings
AWWA C900	(1997) Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Distribution
AWWA C905	(1997) Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings 14 In. Through 48 In. (350 mm through 1,200 mm)
AWWA M23	(2002) Manual: PVC Pipe - Design and Installation

ASBESTOS CEMENT PRODUCT PRODUCERS ASSOCIATION (ACPPA)

ACPPA 1344	(1988) Recommended Work Practices for A/C Pipe

ASME INTERNATIONAL (ASME)

ASME B1.20.1	(1983; R 2001) Pipe Threads, General Purpose, Inch
ASME B16.1	(1998) Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes

ASTM INTERNATIONAL (ASTM)

ASTM B 88	(2002) Seamless Copper Water Tube
ASTM B 88M	(1999) Seamless Copper Water Tube (Metric)
ASTM D 1784	(1999ae1) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 1785	(1999) Poly(Vinyl Chloride)(PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2241	(2000) Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2464	(1999) Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	(2002) Poly(Vinyl Chloride)(PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	(2002) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80

ASTM D 2564	(2002) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2855	(1996; R 2002) Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM F 477	(2002e1) Elastomeric Seals (Gaskets) for Joining Plastic Pipe

DUCTILE IRON PIPE RESEARCH ASSOCIATION (DIPRA)

DIPRA TRD	(2002) Thrust Restraint Design for Ductile Iron Pipe

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-80	(1997) Bronze Gate, Globe, Angle and Check Valves

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 24	(1995) Installation of Private Fire Service Mains and Their Appurtenances
NFPA 325-1	(1994) Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids
NFPA 49	(1994) Hazardous Chemicals Data
NFPA 704	(2001) Identification of the Fire Hazards of Materials for Emergency Response

NSF INTERNATIONAL (NSF)

NSF 14	(20029) Plastics Piping Components and Related Materials
NSF 61	(2001; Addendum 1 - Sep 2001) Drinking Water System Components - Health Effects

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 21	(1982; R 2000) White or Colored Silicone Alkyd Paint
SSPC Paint 25	(1997; R 2000) Zinc Oxide, Aklyd, Linseed Oil Primer for Use Over Hand Cleaned Steel, Type I and Type II

1.2 PIPING

This section covers water distribution and service lines, and connections to building service at a point approximately 5 feet outside buildings and structures to which service is required. The Contractor shall have a copy of the manufacturer's recommendations for each material or procedure to be utilized available at the construction site at all times.

1.2.1 Service Lines

Piping for water service lines less than 3 inchesin diameter shall be polyvinyl chloride (PVC) plastic, or copper tubing, unless otherwise shown or specified. Piping for water service lines 3 inchesand larger shall be ductile iron or polyvinyl chloride (PVC) plastic.

1.2.2 Distribution Lines 80 mm (3 Inches) or Larger

Piping for water distribution lines 3 inches or larger shall be ductile iron **[AM#3]** **or** polyvinyl chloride (PVC) through 36 inch nominal diameter plastic, **[AM#3]** _____ unless otherwise shown or specified.

1.2.3 Supply Lines 80 mm (3 Inches) or Larger

Piping for water supply lines 3 inches or larger shall be ductile iron or polyvinyl chloride (PVC) plastic, through 36 inch nominal diameter.

1.2.4 Sprinkler Supply Lines

Piping for water lines supplying sprinkler systems for building fire protection shall conform to NFPA 24 from the point of connection with the water distribution system to the building 5 foot line.

1.2.5 Potable Water Lines

Piping and components of potable water systems which come in contact with the potable water shall conform to NSF 61.

1.2.6 Plastic Piping System

Plastic piping system components (PVC) intended for transportation of potable water shall comply with NSF 14 and be legibly marked with their symbol.

1.2.7 Excavation, Trenching, and Backfilling

Excavation, trenching, and backfilling shall be in accordance with the applicable provisions of Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, except as modified herein.

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Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Installation;

The manufacturer's recommendations for each material or procedure to be utilized.

Waste Water Disposal Method;

The method proposed for disposal of waste water from hydrostatic tests and disinfection, prior to performing hydrostatic tests.

Satisfactory Installation;

A statement signed by the principal officer of the contracting firm stating that the installation is satisfactory and in accordance with the contract drawings and specifications, and the manufacturer's prescribed procedures and techniques, upon completion of the project and before final acceptance.

SD-06 Test Reports

Bacteriological Disinfection;

Test results from commercial laboratory verifying disinfection.

SD-07 Certificates

Meters;

Manufacturer's certificate stating that each meter furnished has been tested for accuracy of registration and compliance with the accuracy and capacity requirements of the appropriate AWWA standard.

1.4 HANDLING

Pipe and accessories shall be handled to ensure delivery to the trench in sound, undamaged condition, including no injury to the pipe coating or lining. If the coating or lining of any pipe or fitting is damaged, the repair shall be made by the Contractor in a satisfactory manner, at no additional cost to the Government. No other pipe or material shall be placed inside a pipe or fitting after the coating has been applied. Pipe shall be carried into position and not dragged. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional expense to the Government. Rubber gaskets that are not to be installed immediately shall be stored in a cool and dark place.

1.4.1 Miscellaneous Plastic Pipe and Fittings

Polyvinyl Chloride (PVC) pipe and fittings shall be handled and stored in accordance with the manufacturer's recommendations. Storage facilities shall be classified and marked in accordance with NFPA 704, with classification as indicated in NFPA 49 and NFPA 325-1.

PART 2 PRODUCTS

2.1 PIPE

Pipe shall conform to the respective specifications and other requirements specified below.

2.1.1 Plastic Pipe

2.1.1.1 PVC Plastic Pipe

Pipe, couplings and fittings shall be manufactured of material conforming to ASTM D 1784, Class 12454B.

a. Pipe Less Than 4 inch Diameter:

(1) Screw-Joint: Pipe shall conform to dimensional requirements of ASTM D 1785 Schedule 80, with joints meeting requirements of 150 psi working pressure, 200 psi hydrostatic test pressure, unless otherwise shown or specified. Pipe couplings when used, shall be tested as required by ASTM D 2464.

(2) Elastomeric-Gasket Joint: Pipe shall conform to dimensional requirements of ASTM D 1785 Schedule 40, with joints meeting the requirements of 150 psi working pressure, 200 psi hydrostatic test pressure, unless otherwise shown or specified, or it may be pipe conforming to requirements of ASTM D 2241, elastomeric joint, with the following applications:

SDR	Maximum Working Pressure psi	Minimum Hydrostatic Pressure psi
17	150	200

(3) Solvent Cement Joint: Pipe shall conform to dimensional requirements of ASTM D 1785 or ASTM D 2241 with joints meeting the requirements of 150 psi working pressure and 200 psi hydrostatic test pressure.

b. Pipe 4 through 12 inch Diameter: Pipe, couplings and fittings shall conform to AWWA C900, Class 150, CIOD pipe dimensions, elastomeric-gasket joint, unless otherwise shown or specified.

c. Pipe 14 through 36 inch Diameter: Pipe shall conform to AWWA C905 **[AM#3] DR 21,** unless otherwise shown or specified.

2.1.2 Ductile-Iron Pipe

[AM#3] For pipe 14 inches and larger (and where shown on the drawings), Ductile-iron pipe shall conform to AWWA C151, working pressure not less than 150 psi, unless otherwise shown or specified. Pipe shall be cement-mortar lined in accordance with AWWA C104. Linings shall be standard. When installed underground, pipe shall be coated in accordance with Section 13110

CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE). Flanged ductile iron pipe with threaded flanges shall be in accordance with AWWA C115.

2.1.3 Copper Tubing

Copper tubing shall conform to ASTM B 88, Type K, annealed.

2.2 FITTINGS AND SPECIALS

2.2.1 PVC Pipe System

a. For pipe less than 4 inch diameter, fittings for threaded pipe shall conform to requirements of ASTM D 2464, threaded to conform to the requirements of ASME B1.20.1 for use with Schedule 80 pipe and fittings; fittings for solvent cement jointing shall conform to ASTM D 2466 or ASTM D 2467; and fittings for elastomeric-gasket joint pipe shall be iron conforming to AWWA C110 or AWWA C111. Iron fittings and specials shall be cement-mortar lined (standard thickness) in accordance with AWWA C104.

b. For pipe 4 inch diameter and larger, fittings and specials shall be iron, bell end in accordance with AWWA C110, 150 psi pressure rating unless otherwise shown or specified, except that profile of bell may have special dimensions as required by the pipe manufacturer; or fittings and specials may be of the same material as the pipe with elastomeric gaskets, all in conformance with AWWA C900. Iron fittings and specials shall be cement-mortar lined (standard thickness) in accordance with AWWA C104. Fittings shall be bell and spigot or plain end pipe, or as applicable. Ductile iron compact fittings shall be in accordance with AWWA C153.

[AM#7] c. All buried iron fittings shall be encased in polyethylene tubing.

2.2.2 Ductile-Iron Pipe System

Fittings and specials shall be suitable for 150 psi pressure rating, unless otherwise specified. Fittings and specials for mechanical joint pipe shall conform to AWWA C110. Fittings and specials for use with push-on joint pipe shall conform to AWWA C110 and AWWA C111. Fittings and specials for grooved and shouldered end pipe shall conform to AWWA C606. Fittings and specials shall be cement-mortar lined (standard thickness) in accordance with AWWA C104. Ductile iron compact fittings shall conform to AWWA C153.

2.2.2.1 Dielectric Fittings

Dielectric fittings shall be installed between threaded ferrous and nonferrous metallic pipe, fittings and valves, except where corporation stops join mains. Dielectric fittings shall prevent metal-to-metal contact of dissimilar metallic piping elements and shall be suitable for the required working pressure.

2.2.3 Copper Tubing System

Fittings and specials shall be flared and conform to ASME B16.26.

2.3 JOINTS

2.3.1 Plastic Pipe Jointing

2.3.1.1 PVC Pipe

Joints, fittings, and couplings shall be as specified for PVC pipe. Joints connecting pipe of differing materials shall be made in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer.

2.3.2 Ductile-Iron Pipe Jointing

a. Mechanical joints shall be of the stuffing box type and shall conform to AWWA C111.

b. Push-on joints shall conform to AWWA C111.

c. Rubber gaskets and lubricants shall conform to the applicable requirements of AWWA C111.

2.3.3 Bonded Joints

For ductile iron pipe installed underground, a metallic bond shall be provided at each joint, including joints made with flexible couplings, caulking, or rubber gaskets, of ferrous metallic piping to effect continuous conductivity. The bond wire shall be Size 1/0 copper conductor suitable for direct burial shaped to stand clear of the joint. The bond shall be of the thermal weld type.

2.3.4 Isolation Joints

Isolation joints shall be installed between nonthreaded ferrous and nonferrous metallic pipe, fittings and valves. Isolation joints shall consist of a sandwich-type flange isolation gasket of the dielectric type, isolation washers, and isolation sleeves for flange bolts. Isolation gaskets shall be full faced with outside diameter equal to the flange outside diameter. Bolt isolation sleeves shall be full length. Units shall be of a shape to prevent metal-to-metal contact of dissimilar metallic piping elements.

a. Sleeve-type couplings shall be used for joining plain end pipe sections. The two couplings shall consist of one steel middle ring, two steel followers, two gaskets, and the necessary steel bolts and nuts to compress the gaskets.

b. Split-sleeve type couplings may be used in aboveground installations when approved in special situations and shall consist of gaskets and a housing in two or more sections with the necessary bolts and nuts.

2.3.5 Copper Tubing Jointing

Joints shall be compression-pattern flared and shall be made with the specified fittings.

2.4 VALVES

2.4.1 Check Valves

Check valves shall be designed for a minimum working pressure of 150 psi or as indicated. Valves shall have a clear waterway equal to the full nominal diameter of the valve. Valves shall open to permit flow when inlet pressure is greater than the discharge pressure, and shall close tightly to prevent return flow when discharge pressure exceeds inlet pressure. The size of the valve, working pressure, manufacturer's name, initials, or trademark shall be cast on the body of each valve. Valves 2 inches and larger shall be outside lever and weight type.

a. Valves 2 inches and smaller shall be all bronze designed for screwed fittings, and shall conform to MSS SP-80, Class 150, Types 3 and 4 as suitable for the application.

b. Valves larger than 2 inches shall be iron body, bronze mounted, shall have flanged ends, and shall be the non-slam type. Flanges shall be the Class 125 type conforming to ASME B16.1.

2.4.2 Gate Valves

Gate valves shall be designed for a working pressure of not less than 150 psi. Valve connections shall be as required for the piping in which they are installed. Valves shall have a clear waterway equal to the full nominal diameter of the valve, and shall be opened by turning counterclockwise. The operating nut or wheel shall have an arrow, cast in the metal, indicating the direction of opening.

a. Valves smaller than 3 inches shall be all bronze and shall conform to MSS SP-80, Type 1, Class 150.

b. Valves 3 inches and larger shall be iron body, bronze mounted, and shall conform to AWWA C500. Flanges shall not be buried. An approved pit shall be provided for all flanged connections.

c. Resilient-Seated Gate Valves: For valves 3 inches and larger in size, resilient-seated gate valves shall conform to AWWA C509.

[AM#7] d. All buried iron body valves shall be encased in polyethylene tubing.

2.4.3 Indicator Post for Valves

[AM#3] **Where** shown on the drawings **valves** shall be equipped with indicator post conforming to the requirements of NFPA 24. Operation shall be by a wrench which shall be attached to each post. **[AM#7] Post indicator valves shall be encased in polyethylene tubing below grade.**

2.5 VALVE BOXES

Valve boxes shall be cast iron or concrete, except that concrete boxes may be installed only in locations not subjected to vehicular traffic. Cast-iron boxes shall be extension type with slide-type adjustment and with flared base. The minimum thickness of metal shall be 3/16 inch. Concrete boxes shall be the standard product of a manufacturer of precast concrete equipment. The word "WATER" shall be cast in the cover. The box length shall adapt, without full extension, to the depth of cover required over the pipe at the valve location.

2.6 VALVE PITS

Valve pits shall be constructed at locations indicated or as required above and in accordance with the details shown. Concrete shall have compressive strength of 3000 psi in accordance with Section 03300CAST-IN-PLACE STRUCTURAL CONCRETE.

2.7 FIRE HYDRANTS

Hydrants shall be dry-barrel type conforming to AWWA C502 with valve opening at least 5 inches in diameter and designed so that the flange at the main valve seat can be removed with the main valve seat apparatus remaining intact, closed and reasonably tight against leakage and with a breakable valve rod coupling and breakable flange connections located no more than 8 inches above the ground grade . Hydrants shall have a 6 inch bell connection, two 2-1/2 inch hose connections and one 4-1/2 inch pumper connection. Outlets shall have American National Standard fire-hose coupling threads. Working parts shall be bronze. Design, material, and workmanship shall be equal to the latest stock pattern ordinarily produced by the manufacturer. Hydrants shall be painted with 1 coat of red iron oxide, zinc oxide primer conforming to SSPC Paint 25 and 2 finish coats of silicone alkyd paint conforming to SSPC Paint 21, color in accordance with NFPA recommendations. Suitable bronze adapter for each outlet, with caps, shall be furnished. **[AM#7] Fire hydrants shall be encased in polyethylene tubing below grade.**

2.8 MISCELLANEOUS ITEMS

2.8.1 Service Clamps

Service clamps shall have a pressure rating not less than that of the pipe to be connected and shall be either the single or double flattened strap type. Clamps shall have a galvanized malleable-iron body with cadmium plated straps and nuts. Clamps shall have a rubber gasket cemented to the body.

2.8.2 Corporation Stops

Corporation stops shall have standard corporation stop thread conforming to AWWA C800 on the inlet end, with flanged joints, compression pattern flared tube couplings, or wiped joints for connections to goosenecks.

2.8.3 Goosenecks

Copper tubing for gooseneck connections shall conform to the applicable requirements of ASTM B 88, Type K, annealed. Length of cable requirement connections shall be in accordance with standard practice.

2.8.4 Service Stops

Service stops shall be water-works inverted-ground-key type, oval or round flow way, tee handle, without drain. Pipe connections shall be suitable for the type of service pipe used. All parts shall be of bronze with female iron-pipe-size connections or compression-pattern flared tube couplings, and shall be designed for a hydrostatic test pressure not less than 200 psi.

2.8.5 Tapping Sleeves

Tapping sleeves of the sizes indicated for connection to existing main shall be the cast gray, ductile, or malleable iron, split-sleeve type with flanged or grooved outlet, and with bolts, follower rings and gaskets on each end of the sleeve. Construction shall be suitable for a maximum working pressure of 150 psi. Bolts shall have square heads and hexagonal nuts. Longitudinal gaskets and mechanical joints with gaskets shall be as recommended by the manufacturer of the sleeve. When using grooved mechanical tee, it shall consist of an upper housing with full locating collar for rigid positioning which engages a machine-cut hole in pipe, encasing an elastomeric gasket which conforms to the pipe outside diameter around the hole and a lower housing with positioning lugs, secured together during assembly by nuts and bolts as specified, pretorqued to 50 foot-pound. **[AM#7] Tapping sleeves shall be encased in polyethylene tubing.**

2.8.6 Service Boxes

Service boxes shall be cast iron or concrete and shall be extension service boxes of the length required for the depth of the line, with either screw or slide-type adjustment. The boxes shall have housings of sufficient size to completely cover the service stop or valve and shall be complete with identifying covers.

2.8.7 Disinfection

Chlorinating materials shall conform to the following:

Chlorine, Liquid: AWWA B301.

Hypochlorite, Calcium and Sodium: AWWA B300.

2.8.8 Meters

Meters shall conform to AWWA C700. Meter shall be positive displacement, oscillating piston, or nutating disc type; magnetic drive with magnetic shielding, straight reading sealed register graduated in cubic feet, all bronze split case, integral strainer, threaded ends, and pulse switch initiator. Meter shall be suitable for accurately measuring and handling water at pressure, temperatures and flow rates to be encountered. The pulse initiator shall provide the maximum number of pulses up to 500 per minute that is obtainable from the manufacturer. It shall not provide less than 1 pulse per 100 gallons.

2.8.9 Meter Boxes

Meter boxes shall be of cast iron or concrete. The boxes shall be of sufficient size to completely enclose the meter and shutoff valve or service stop. Meter boxes set in paved areas subject to vehicular traffic shall be cast iron, or concrete with cast iron lid and cast iron meter reader lid. Boxes set in sidewalks, not subject to vehicular traffic, shall use concrete covers with cast iron meter reader lids . Box height shall extend from invert of the meter to final grade at the meter location. The lid shall have the word "WATER" cast in it.

2.9 [AM#7] POLYETHYLENE TUBING MATERIAL

[AM#7] Polyethylene material for the encasement of ductile iron valves, fittings, and fire hydrants shall conform to AWWA C105. Tape for field applications shall be at least 2 inches wide.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Cutting of Pipe

Cutting of pipe shall be done in a neat and workmanlike manner without damage to the pipe. Unless otherwise recommended by the manufacturer and authorized by the Contracting Officer, cutting shall be done with an approved type mechanical cutter. Wheel cutter shall be used when practicable. Copper tubing shall be cut square and all burrs shall be removed. Squeeze type mechanical cutters shall not be used for ductile iron.

3.1.2 Adjacent Facilities

3.1.2.1 Sewer Lines

Where the location of the water pipe is not clearly defined in dimensions on the drawings, the water pipe shall not be laid closer horizontally than 10 feet from a sewer except where the bottom of the water pipe will be at least 12 inches above the top of the sewer pipe, in which case the water pipe shall not be laid closer horizontally than 6 feet from the sewer. Where water lines cross under gravity-flow sewer lines, the sewer pipe, for a distance of at least 10 feet each side of the crossing, shall be fully encased in concrete or shall be made of pressure pipe with no joint located within 3 feet horizontally of the crossing. Water lines shall in all cases cross above sewage force mains or inverted siphons and shall be not less than 2 feet above the sewer main. Joints in the sewer main, closer horizontally than 3 feet to the crossing, shall be encased in concrete.

3.1.2.2 Water Lines

Water lines shall not be laid in the same trench with sewer lines, gas lines, fuel lines, or electric wiring.

3.1.2.3 Copper Tubing Lines

Copper tubing shall not be installed in the same trench with ferrous piping materials.

3.1.2.4 Nonferrous Metallic Pipe

Where nonferrous metallic pipe, e.g. copper tubing, crosses any ferrous piping material, a minimum vertical separation of 12 inchesshall be maintained between pipes.

3.1.2.5 **[AM#3] DELETED**

\\PRINT_SRV2\Specwork\SISGML\JOBS\02092\prntdata\02630.sec\\PRINT_SRV2\Specwork\SISGML\JOBS\02092\prntdata\13110.sec3.1.3 Joint Deflection

3.1.3.1 Offset for Flexible Plastic Pipe

Maximum offset in alignment between adjacent pipe joints shall be as recommended by the manufacturer and approved by the Contracting Officer, but shall not exceed 5 degrees.

3.1.3.2 Allowable for Ductile-Iron Pipe

The maximum allowable deflection shall be as given in AWWA C600. If the alignment requires deflection in excess of the above limitations, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within the limit set forth.

3.1.4 Placing and Laying

Install pipe and appurtenances in a coarse sand envelope, with the minimum thickness of the sand envelope being at least 6 inches. Pipe and accessories shall be carefully lowered into the trench by means of derrick, ropes, belt slings, or other authorized equipment. Water-line materials shall not be dropped or dumped into the trench. Abrasion of the pipe coating shall be avoided. Except where necessary in making connections with other lines or as authorized by the Contracting Officer, pipe shall be laid with the bells facing in the direction of laying. The full length of each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate bells, couplings, and joints. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid. Pipe shall not be laid in water or when trench conditions are unsuitable for the work. Water shall be kept out of the trench until joints are complete. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no trench water, earth, or other substance will enter the pipes or fittings. Where any part of the coating or lining is damaged, the repair shall be made by and at the Contractor's expense in a satisfactory manner. Pipe ends left for future connections shall be valved, plugged, or capped, and anchored, as shown.

3.1.4.1 Plastic Pipe Installation

PVC pipe shall be installed in accordance with AWWA M23.

3.1.4.2 Piping Connections

Where connections are made between new work and existing mains, the connections shall be made by using specials and fittings to suit the actual conditions. When made under pressure, these connections shall be installed using standard methods as approved by the Contracting Officer. Connections to existing asbestos-cement pipe shall be made in accordance with ACPPA 1344.

3.1.4.3 Penetrations

Pipe passing through walls of valve pits and structures shall be provided with ductile-iron or Schedule 40 steel wall sleeves. Annular space between walls and sleeves shall be filled with rich cement mortar. Annular space between pipe and sleeves shall be filled with mastic.

3.1.4.4 Flanged Pipe

Flanged pipe shall only be installed above ground or with the flanges in valve pits.

3.1.5 Jointing

3.1.5.1 PVC Plastic Pipe Requirements

a. Pipe less than 4 inch diameter: Threaded joints shall be made by wrapping the male threads with approved thread tape or applying an approved lubricant, then threading the joining members together. The joint shall be tightened using strap wrenches to prevent damage to the pipe and/or fitting. To avoid excessive torque, joints shall be tightened no more than one thread past hand-tight. Preformed rubber-ring gaskets for elastomeric-gasket joints shall be made in accordance with ASTM F 477 and as specified. Pipe ends for push-on joints shall be beveled to facilitate assembly and marked to indicate when the pipe is fully seated. The gasket shall be prelubricated to prevent displacement. The gasket and ring groove in the bell or coupling shall match. The manufacturer of the pipe or fitting shall supply the elastomeric gasket. Couplings shall be provided with stops or centering rings to assure that the coupling is centered on the joint. Solvent cement joints shall use sockets conforming to ASTM D 2467. The solvent cement used shall meet the requirements of ASTM D 2564; the joint assembly shall be made in accordance with ASTM D 2855 and the manufacturer's specific recommendations.

b. Pipe 4 through 12 inch diameter: Joints shall be elastomeric gasket as specified in AWWA C900. Jointing procedure shall be as specified for pipe less than 4 inch diameter with configuration using elastomeric ring gasket.

c. Pipe 14 through 36 inch diameter: Joints shall be elastomeric gasket push-on joints made in accordance with AWWA M23.

3.1.5.2 Ductile-Iron Pipe Requirements

Mechanical and push-on type joints shall be installed in accordance with AWWA C600 for buried lines or AWWA C606 for grooved and shouldered pipe above ground or in pits.

3.1.5.3 Copper Tubing Requirements

Joints shall be made with flared fittings. The flared end tube shall be pulled tightly against the tapered part of the fitting by a nut which is part of the fitting, so there is metal-to-metal contact.

3.1.5.4 Bonded Joints Requirements

Bonded joints shall be installed in accordance with details specified for joints in paragraph JOINTS.

3.1.5.5 Isolation Joints and Dielectric Fittings

Isolation joints and dielectric fittings shall be installed in accordance with details specified in paragraph JOINTS. Dielectric unions shall be

encapsulated in a field-poured coal-tar covering, with at least 1/8 inch thickness of coal tar over all fitting surfaces.

3.1.5.6 Transition Fittings

Connections between different types of pipe and accessories shall be made with transition fittings approved by the Contracting Officer.

3.1.6 Installation of Service Lines

Service lines shall include the pipeline connecting building piping to water distribution lines to the connections with the building service at a point approximately 5 feet outside the building where such building service exists. All service stops and valves shall be provided with service boxes. Service lines shall be constructed in accordance with the following requirements:

3.1.6.1 Service Lines 50 mm (2 Inches) and Smaller

Service lines 2 inches and smaller shall be connected to the main by a directly-tapped corporation stop for ductile iron pipeor by a service clamp for PVC pipe. A corporation stop and a copper gooseneck shall be provided with either type of connection. Maximum sizes for directly-tapped corporation stops and for outlets with service clamps shall be as in TABLE I. Where 2 or more gooseneck connections to the main are required for an individual service, such connections shall be made with standard branch connections. The total clear area of the branches shall be at least equal to the clear area of the service which they are to supply.

TABLE I. SIZE OF CORPORATION STOPS AND OUTLET

Pipe Size Inches	Corporation Stops, Inches For Ductile-Iron Pipe	Outlets w/Service Clamps, Inches Single & Double Strap
3	--	1
4	1	1
6	1-1/4	1-1/2
8	1-1/2	2
10	1-1/2	2
12 & larger	2	2

NOTE:

a. Service lines 1-1/2 inches and smaller shall have a service stop.

b. Service lines 2 inches in size shall have a gate valve.

3.1.6.2 Service Lines Larger than 50 mm (2 Inches)

Service lines larger than 2 inches shall be connected to the main by a tapped saddle, tapping sleeve and valve, service clamp or reducing tee, depending on the main diameter and the service line diameter, and shall have a gate valve.

3.1.6.3 Service Lines for Sprinkler Supplies

Water service lines used to supply building sprinkler systems for fire protection shall be connected to the water distribution main in accordance with NFPA 24.

3.1.7 Setting of Fire Hydrants, Valves and Valve Boxes

3.1.7.1 Location of Fire Hydrants

Fire hydrants shall be located and installed as shown. Each hydrant shall be connected to the main with a 6 inch branch line having at least as much cover as the distribution main. Hydrants shall be set plumb with pumper nozzle facing the roadway, with the center of the lowest outlet not less than 18 inches above the finished surrounding grade, and the operating nut not more than 48 inches above the finished surrounding grade. Except where approved otherwise, the backfill around hydrants shall be thoroughly compacted to the finished grade immediately after installation to obtain beneficial use of the hydrant as soon as practicable. The hydrant shall be set upon a slab of concrete not less than 4 inches thick and 15 inchessquare. Not less than 7 cubic feet of free-draining broken stone or gravel shall be placed around and beneath the waste opening of dry barrel hydrants to ensure drainage.

3.1.7.2 Location of Meters

Meters and meter boxes shall be installed at the locations shown on the drawings. The meters shall be centered in the boxes to allow for reading and ease of removal or maintenance.

3.1.7.3 Location of Valves

After delivery, valves, including those in hydrants, shall be drained to prevent freezing and shall have the interiors cleaned of all foreign matter before installation. Stuffing boxes shall be tightened and hydrants and valves shall be fully opened and fully closed to ensure that all parts are in working condition. Valves and valve boxes shall be installed where shown or specified, and shall be set plumb. Valve boxes shall be centered on the valves. Boxes shall be installed over each outside gate valve unless otherwise shown. Where feasible, valves shall be located outside the area of roads and streets. Earth fill shall be tamped around each valve box or pit to a distance of 4 feet on all sides of the box, or the undisturbed trench face if less than 4 feet.

3.1.7.4 Location of Service Boxes

Where water lines are located below paved streets having curbs, the boxes shall be installed directly back of the curbs. Where no curbing exists, service boxes shall be installed in accessible locations, beyond the limits of street surfacing, walks and driveways.

3.1.8 Tapped Tees and Crosses

Tapped tees and crosses for future connections shall be installed where shown.

3.1.9 Thrust Restraint

Plugs, caps, tees and bends deflecting 11.25 degrees or more, either vertically or horizontally, on waterlines 4 inches in diameter or larger, and fire hydrants shall be provided with thrust restraints. Valves shall be securely anchored or shall be provided with thrust restraints to prevent movement. Thrust restraints shall be either thrust blocks or, for ductile-iron pipes, restrained joints.

3.1.9.1 Thrust Blocks

Thrust blocking shall be concrete of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 2,000 psi after 28 days. Blocking shall be placed between solid ground and the hydrant or fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of thrust blocks shall be poured directly against undisturbed earth. The sides of thrust blocks not subject to thrust may be poured against forms. The area of bearing shall be as shown or as directed. Blocking shall be placed so that the fitting joints will be accessible for repair. Steel rods and clamps, protected by galvanizing or by coating with bituminous paint, shall be used to anchor vertical down bends into gravity thrust blocks.

3.1.9.2 Restrained Joints

For ductile-iron pipe, restrained joints shall be designed by the Contractor or the pipe manufacturer in accordance with DIPRA TRD.

3.2 HYDROSTATIC TESTS

Where any section of a water line is provided with concrete thrust blocking for fittings or hydrants, the hydrostatic tests shall not be made until at least 5 days after installation of the concrete thrust blocking, unless otherwise approved.

3.2.1 Pressure Test

After the pipe is laid, the joints completed, fire hydrants permanently installed, and the trench partially backfilled leaving the joints exposed for examination, the newly laid piping or any valved section of piping shall, unless otherwise specified, be subjected for 1 hour to a hydrostatic pressure test of 200 psi. Water supply lines designated on the drawings shall be subjected for 1 hour to a hydrostatic pressure test of 200 psi. Each valve shall be opened and closed several times during the test. Exposed pipe, joints, fittings, hydrants, and valves shall be carefully examined during the partially open trench test. Joints showing visible leakage shall be replaced or remade as necessary. Cracked or defective pipe, joints, fittings, hydrants and valves discovered in consequence of this pressure test shall be removed and replaced with sound material, and the test shall be repeated until the test results are satisfactory. The requirement for the joints to remain exposed for the hydrostatic tests may be waived by the

Contracting Officer when one or more of the following conditions is encountered:

a. Wet or unstable soil conditions in the trench.

b. Compliance would require maintaining barricades and walkways around and across an open trench in a heavily used area that would require continuous surveillance to assure safe conditions.

c. Maintaining the trench in an open condition would delay completion of the project.

The Contractor may request a waiver, setting forth in writing the reasons for the request and stating the alternative procedure proposed to comply with the required hydrostatic tests. Backfill placed prior to the tests shall be placed in accordance with the requirements of Section 02316EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

3.2.2 Leakage Test

Leakage test shall be conducted after the pressure tests have been satisfactorily completed. The duration of each leakage test shall be at least 2 hours, and during the test the water line shall be subjected to not less than 200 psi pressure. Water supply lines designated on the drawings shall be subjected to a pressure equal to 200 psi. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved or approved section, necessary to maintain pressure within 5 psi of the specified leakage test pressure after the pipe has been filled with water and the air expelled. Piping installation will not be accepted if leakage exceeds the allowable leakage which is determined by the following formula:

L = 0.0001351ND(P raised to 0.5 power)

L = Allowable leakage in gallons per hour
N = Number of joints in the length of pipeline tested
D = Nominal diameter of the pipe in inches
P = Average test pressure during the leakage test, in psi gauge

Should any test of pipe disclose leakage greater than that calculated by the above formula, the defective joints shall be located and repaired until the leakage is within the specified allowance, without additional cost to the Government.

3.2.3 Time for Making Test

Except for joint material setting or where concrete thrust blocks necessitate a 5-day delay, pipelines jointed with rubber gaskets, mechanical or push-on joints, or couplings may be subjected to hydrostatic pressure, inspected, and tested for leakage at any time after partial completion of backfill. Cement-mortar lined pipe may be filled with water as recommended by the manufacturer before being subjected to the pressure test and subsequent leakage test.

3.2.4 Concurrent Hydrostatic Tests

The Contractor may elect to conduct the hydrostatic tests using either or both of the following procedures. Regardless of the sequence of tests

employed, the results of pressure tests, leakage tests, and disinfection shall be as specified. Replacement, repair or retesting required shall be accomplished by the Contractor at no additional cost to the Government.

a. Pressure test and leakage test may be conducted concurrently.

b. Hydrostatic tests and disinfection may be conducted concurrently, using the water treated for disinfection to accomplish the hydrostatic tests. If water is lost when treated for disinfection and air is admitted to the unit being tested, or if any repair procedure results in contamination of the unit, disinfection shall be reaccomplished.

3.3 BACTERIAL DISINFECTION

3.3.1 Bacteriological Disinfection

Before acceptance of potable water operation, each unit of completed waterline shall be disinfected as prescribed by AWWA C651. The disinfection shall be repeated until tests indicate the absence of pollution for at least 2 full days. The unit will not be accepted until satisfactory bacteriological results have been obtained.

3.4 [AM#3] DISCHARGE OF WATER FROM HYDROSTATIC TESTS AND BACTERIAL DISINFECTION

Water wasted for testing and sterilization will be wasted as directed by the Contracting Officer in order of priority to:

1. Storm drains.

2. Ponding areas.

Or

3. Streets.

3.5 CLEANUP

Upon completion of the installation of water lines, and appurtenances, all debris and surplus materials resulting from the work shall be removed.

-- End of Section --

SECTION 13110

CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE)
11/98
AMMENDMENT NO. 0002, 0003 & 0007

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.

ASTM INTERNATIONAL (ASTM)

ASTM B 418	(2001) Cast and Wrought Galvanic Zinc Anodes
ASTM B 843	(1993; R 1998) Magnesium Alloy Anodes for Cathodic Protection
ASTM D 1248	(2002) Polyethylene Plastics Extrusion Materials for Wire and Cable

NACE INTERNATIONAL (NACE)

NACE RP0169	(1996) Control of External Corrosion on Underground or Submerged Metallic Piping Systems
NACE RP0177	(2000) Mitigation of Alternating Current and Lightning Effects on Metallic Structures and Corrosion Control Systems
NACE RP0188	(1999) Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates
NACE RP0190	(1995) External Protective Coatings for Joints, Fittings, and Valves on Metallic Underground or Submerged Pipelines and Piping Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA TC 2	(1998) Electrical Polyvinyl Chloride (PVC) Tubing (EPT) and Conduit (EPC-40 and EPC-80)
NEMA WC 5	(1992; Rev 2 1996) Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 510	(1994; Rev thru Apr 1998) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape
UL 514A	(1996; Rev thru Nov 2001) Metallic Outlet Boxes
UL 6	(2000) Rigid Metal Conduit

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Drawings; G

Six copies of detail drawings consisting of a complete list of equipment and material including manufacturer's descriptive and technical literature, catalog cuts, results of system design calculations including soil-resistivity, installation instructions and certified test data stating the maximum recommended anode current output density and the rate of gaseous production if any at that current density. Detail drawings shall contain complete wiring and schematic diagrams and any other details required to demonstrate that the system has been coordinated and will function properly as a unit.

Contractor's Modifications; G

Six copies of detail drawings showing proposed changes in location, scope of performance indicating any variations from, additions to, or clarifications of contract drawings. The drawings shall show proposed changes in anode arrangement, anode size and number, anode materials and layout details, conduit size, wire size, mounting details, wiring diagram, method for electrically-isolating each pipe, and any other pertinent information to proper installation and performance of the system.

SD-03 Product Data

Equipment; G

Within 30 days after receipt of notice to proceed, an itemized list of equipment and materials including item number, quantity, and manufacturer of each item. The list shall be accompanied by a description of procedures for each type of testing and adjustments, including testing of coating for thickness and holidays. Installation of materials and equipment shall not commence until this submittal is approved.

Spare Parts; G

Spare parts data for each different item of material and equipment specified, after approval of detail drawings and not later than six (6) months prior to the date of beneficial occupancy. The data shall include a complete list of parts, special tools, and supplies, with current unit prices and source of supply. One (1) spare anode of each type shall be furnished.

SD-06 Test Reports

Tests and Measurements; G

Test reports in booklet form tabulating all field tests and measurements performed, upon completion and testing of the installed system and including close interval potential survey, **[AM#3]** _____ interference tests, final system test verifying protection, insulated joint and bond tests, and holiday coating test. A certified test report showing that the connecting method has passed a 120-day laboratory test without failure at the place of connection, wherein the anode is subjected to maximum recommended current output while immersed in a three percent sodium chloride solution.

Contractor's Modifications; G

Final report regarding Contractor's modifications. The report shall include pipe-to-soil measurements throughout the affected area, indicating that the modifications improved the overall conditions, and current measurements for anodes. The following special materials and information are required: taping materials and conductors; zinc grounding cell, installation and testing procedures, and equipment; coating material; system design calculations for anode number, life, and parameters to achieve protective potential; backfill shield material and installation details showing waterproofing; bonding and waterproofing details; insulated resistance wire; exothermic weld equipment and material.

SD-07 Certificates

Cathodic Protection System; G

Proof that the materials and equipment furnished under this section conform to the specified requirements contained in the referenced standards or publications. The label or listing by the specified agency will be acceptable evidence of such compliance.

Services of "Corrosion Expert"; G

Evidence of qualifications of the "corrosion expert."

a. The "corrosion expert's" name and qualifications shall be certified in writing to the Contracting Officer prior to the start of construction.

b. Certification shall be submitted giving the name of the firm, the number of years of experience, and a list of not less than five (5) of the firm's installations three (3) or more years old that have been tested and found satisfactory.

SD-10 Operation and Maintenance Data

Cathodic Protection System; G

Before final acceptance of the cathodic protection system, six copies of operating manuals outlining the step-by-step procedures required for system startup, operation, adjustment of current flow, and shutdown. The manuals shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Six copies of maintenance manual, listing routine maintenance procedures, recommendation for maintenance testing, possible breakdowns and repairs, and troubleshooting guides. The manuals shall include single-line diagrams for the system as installed; instructions in making pipe-to-reference cell and tank-to-reference cell potential measurements and frequency of monitoring; instructions for dielectric connections, interference and sacrificial anode bonds; instructions shall include precautions to ensure safe conditions during repair of pipe or other metallic systems. The instructions shall be neatly bound between permanent covers and titled "Operating and Maintenance Instructions." These instructions shall be submitted for the Contracting Officer's approval. The instructions shall include the following:

a. As-built drawings, to scale of the entire system, showing the locations of the piping, location of all anodes and test stations, locations of all insulating joints, and structure-to-reference cell potentials as measured during the tests required by Paragraph: TESTS AND MEASUREMENTS, of this section.

b. Recommendations for maintenance testing, including instructions in making pipe-to-reference cell potential measurements and frequency of testing.

c. All maintenance and operating instructions and nameplate data shall be in English.

d. Instructions shall include precautions to insure safe conditions during repair of pipe system.

Training Course; G

The proposed Training Course Curriculum (including topics and dates of discussion) indicating that all of the items contained in the operating and maintenance instructions, as well as demonstrations of routine maintenance operations, including testing procedures included in the maintenance instructions, are to be covered.

1.3 GENERAL REQUIREMENTS

The Contractor shall furnish and install a complete, operating, sacrificial anode cathodic protection system in complete compliance with NFPA 70, with all applicable Federal, State, and local regulations and with minimum requirements of this contract. The services required include planning, installation, adjusting and testing of a cathodic protection system, using sacrificial anodes for cathodic protection of the **[AM#7] ferrous** pipes. The cathodic protection system shall include anodes, cables, connectors, corrosion protection test stations, and any other equipment required for a complete operating system providing the NACE criteria of protection as specified. Insulators are required whenever needed to insulate the pipes from any other structure. Any pipe crossing the **[AM#7] ferrous** pipe shall have a test station. The cathodic protection shall be provided on **[AM#7] ferrous** pipes.

1.3.1 Services of "Corrosion Expert"

The Contractor shall obtain the services of a "corrosion expert" to supervise, inspect, and test the installation and performance of the cathodic protection system. "Corrosion expert" refers to a person, who by thorough knowledge of the physical sciences and the principles of engineering and mathematics, acquired by professional education and related practical experience, is qualified to engage in the practice of corrosion control of buried or submerged metallic surfaces. Such a person must be accredited or certified by the National Association of Corrosion Engineers (NACE) as a NACE Accredited Corrosion Specialist or a NACE certified Cathodic Protection (CP) Specialist or be a registered professional engineer who has certification or licensing that includes education and experience in corrosion control of buried or submerged metallic piping and tank systems, if such certification or licensing includes 5 years experience in corrosion control on underground metallic surfaces of the type under this contract. The "corrosion expert" shall make at least 3 visits to the project site. The first of these visits shall include obtaining soil resistivity data, acknowledging the type of pipeline coatings to be used and reporting to the Contractor the type of cathodic protection required. Once the submittals are approved and the materials delivered, the "corrosion expert" shall revisit the site the ensure the Contractor understands installation practices and laying out the components. The third visit shall involve testing the installed cathodic protection systems and training applicable personnel on proper maintenance techniques. The "corrosion expert" shall supervise installation and testing of all cathodic protection.

1.3.2 Contractor's Modifications

The specified system is based on a complete system with magnesium sacrificial anodes. The Contractor may modify the cathodic protection system after review of the project, site verification, and analysis, if the proposed modifications include the anodes specified and will provide better overall system performance. The modifications shall be fully described, shall be approved by the Contracting Officer's representative, and shall meet the following criteria. The proposed system shall achieve a minimum pipe-to-soil "instant off" potential of minus 850 millivolts with reference to a saturated copper-copper sulfate reference cell on the underground components of the piping or other metallic surface. The Contractor shall take resistivity measurements of the soil in the vicinity of the pipes and ground bed sites. Based upon the measurements taken, the current and voltage shall be required to produce a minimum of minus 850 millivolts "instant off" potential between the structure being tested and the reference

cell. This potential shall be obtained over 95 percent of the metallic area. The anode system shall be designed for a life of twenty-five (25) years of continuous operation.

1.3.3 Isolators

Isolators are required to insulate the indicated pipes from any other structure. Isolators shall be provided with lightning protection and a test station as shown.

1.3.4 Anode and Bond Wires

Provide magnesium anodes in the quantity and sizes necessary to achieve full protection over a 30-year life span. A minimum of 2 test stations per encasement shall be used for these anodes. For each cathodic system, the metallic components and structures to be protected shall be made electrically continuous. This shall be accomplished by installing bond wires between the various structures. Bonding of existing buried structures may also be required to preclude detrimental stray current effects and safety hazards. Provisions shall be included to return stray current to its source without damaging structures intercepting the stray current. The electrical isolation of underground facilities in accordance with acceptable industry practice shall be included under this section. All tests shall be witnessed by the Contracting Officer.

1.3.5 Surge Protection

Approved zinc grounding cells or sealed weatherproof lightning arrestor devices shall be installed across insulated flanges or fittings installed in underground piping as indicated on the drawings. The arrestor shall be gapless, self-healing, solid state type. Zinc anode composition shall conform to ASTM B 418, Type II. Lead wires shall be number 6 AWG copper with high molecular weight polyethylene (HMWPE) insulation. The zinc grounding cells shall not be prepackaged in backfill but shall be installed as detailed on the drawings. Lightning arrestors or zinc grounding cells are not required for insulated flanges on metallic components used on nonmetallic piping systems.

1.3.6 Summary of Services Required

The scope of services shall include, but shall not be limited to, the following:

a. Close-interval potential surveys.

b. Cathodic Protection Systems.

c. System testing.

[AM#3] d. (_____.).

e. Interference testing.

f. Training.

g. Operating and maintenance manual.

h. Insulator testing and bonding testing.

i. Coating and holiday testing shall be submitted within 45 days of notice to proceed.

1.3.7 Nonmetallic Pipe System

In the event pipe other than metallic pipe is approved and used in lieu of metallic pipe, all metallic components of this pipe system shall be protected with cathodic protection. Detailed drawings of cathodic protection for each component shall be submitted to the Contracting Officer for approval within 45 days after date of receipt of notice to proceed, and before commencement of any work.

1.3.7.1 Coatings

Coatings for metallic components shall be as required for metallic fittings. Protective covering (coating and taping) shall be completed and tested on each metallic component (such as valves, hydrants and fillings). This covering shall be as required for underground metallic pipe. Each test shall be witnessed by the Contracting Officer. Coatings shall be selected, applied, and inspected in accordance with NACE RP0190 and as specified in these specifications. The use of nonmetallic pipe does not change other requirements of the specifications. Any deviations due to the use of nonmetallic pipe shall be submitted for approval.

1.3.7.2 Tracer Wire

When a nonmetallic pipe line is used to extend or add to an existing metallic line, an insulated No. 8 AWG copper wire shall be thermit-welded to the existing metallic line and run the length of the new nonmetallic line. This wire shall be used as a locator tracer wire and to maintain continuity to any future extensions of the pipe line.

1.3.8 Tests of Components

A minimum of four (4) tests shall be made at each metallic component in the piping system. Two (2) measurements shall be made directly over the anodes and the other two (2) tests shall be over the outer edge of the component, but at the farthest point from the anodes. Structure and pipes shall be shown with the cathodic protection equipment. All components of the cathodic protection system shall be shown on drawings, showing their relationship to the protected structure or component. A narrative shall describe how the cathodic protection system will work and provide testing at each component. Components requiring cathodic protection shall include but not be limited to the following:

a. **[AM#3]** (_____.).

b. **[AM#7]** (_____.)

c. **[AM#7]** (_____.)

d. Metallic pipe extended from aboveground locations.**[AM#4]**

e. **[AM#2]** (_____.)

f. Any metallic pipe **[AM#7]** _____ section.**[AM#4]**

g. **[AM#2]** (_____.)

h. **[AM#2]** (_____.)

1.3.9 Drawings

Detailed drawings shall be provided showing location of anodes, insulated fittings, test stations, permanent reference cells, and bonding. Locations shall be referenced to two (2) permanent facilities or mark points.

1.3.10 Electrical Potential Measurements

All potential tests shall be made at a minimum of 10 foot intervals witnessed by the Contracting Officer. Submittals shall identify test locations on separate drawing, showing all metal to be protected and all cathodic protection equipment. Test points equipment and protected metal shall be easily distinguished and identified.

1.3.11 Achievement of Criteria for Protection

All conductors, unless otherwise shown, shall be routed to or through the test stations. Each system provided shall achieve a minimum pipe-to-soil "instant off" potential of minus 850 millivolt potentials with reference to a saturated copper-copper-sulfate reference cell on all underground components of the piping. Based upon the measurements taken, the current and voltage of the anodes should be adjusted as required to produce a minimum of minus 850 millivolts "instant off" potential between the structure being tested and the reference cell. This potential should be obtained over 95 percent of the metallic area. This must be achieved without the "instant off" potential exceeding 1150 millivolts. Testing will be witnessed by the Contracting Officer. Additional anodes shall be provided by the Contractor if required to achieve the minus 850 millivolts "instant off". Although acceptance criteria of the cathodic protection systems are defined in NACE RP0169, for this project the "instant off" potential of minus 850 millivolts is the only acceptable criteria.

1.3.12 Metallic Components and Typicals

a. Metallic components: As a minimum, each metallic component shall be protected with two (2) magnesium anodes. This number of anodes is required to achieve minus 850 millivolts "instant off" potential on the metallic area and at the same time not provide overvoltage above 1150 millivolts "instant off." As a minimum, the magnesium anode unpackaged weight shall be 9 pounds. The magnesium anodes shall be located on each side of the metallic component and routed through a test station.

a. Metallic Pipe Component or Section: Each section of metallic pipe shall be protected with at least 2 magnesium anodes. The magnesium anodes shall have an unpackaged weight of at least 9 pounds.

b. Connectors or Change-of-Direction Devices: Each change-of-direction device shall be protected with 2 magnesium anodes. The magnesium anode shall have an unpackaged weight of 9 pounds.

1.3.13 Metallic Component Coating

Coatings for metallic components shall be as required for metallic fittings as indicated. This will include fire hydrants, T's, elbows, valves, etc. Coatings shall be selected, applied, and inspected in accordance with NACE RP0190 and as specified in these specifications.

PART 2 PRODUCTS

2.1 MAGNESIUM ANODES

A minimum of 2 anodes shall be installed on the encasement.

2.1.1 Anode Composition

Anodes shall be of high-potential magnesium alloy, made of primary magnesium obtained from sea water or brine, and not made from scrap metal. Magnesium anodes shall conform to ASTM B 843 and to the following analysis (in percents) otherwise indicated:

Aluminum, max.	0.010
Manganese, max.	0.50 to 1.30
Zinc	0.05
Silicon, max.	0.05
Copper, max.	0.02
Nickel, max.	0.001
Iron, Max.	0.03
Other impurities, max.	0.05 each or 0.3 max. total
Magnesium	Remainder

The Contractor shall furnish spectrographic analysis on samples from each heat or batch of anodes used on this project.

2.1.2 Dimensions and Weights

Dimensions and weights of anodes shall be approximately as follows:

TYPICAL MAGNESIUM ANODE SIZE

(Cross sections may be round, square, or D shaped)

NOMINAL WT. LBS.	APPROX. SIZE (IN)	NOMINAL GROSS WT lb PACKAGED IN BACKFILL	NOMINAL PACKAGE DIMENSIONS (IN)
3	3 X 3 X 5	8	5-1/4 X 5-1/4 X 8
5	3 X 3 X 8	13	5-1/4 X 5-1/4 X 11-1/4
9	3 X 3 X 14	27	5-1/4 X 20
12	4 X 4 X 12	32	7-1/2 X 18
17	4 X 4 X 17	45	7-1/2 X 24
32	5 X 5 X 20-1/2	68	8-1/2 X 28
50	7 X 7 X 16	100	10 X 24

2.1.3 Packaged Anodes

Anodes shall be provided in packaged form with the anode surrounded by specially-prepared quick-wetting backfill and contained in a water permeable cloth or paper sack. Anodes shall be centered by means of spacers in the backfill material. The backfill material shall have the following composition, unless otherwise indicated:

Material	Approximate Percent by Weight
Gypsum	75
Bentonite	20
Sodium Sulphate	5
Total	100

2.1.4 Zinc Anodes

Zinc anodes shall conform to ASTM B 418, Type II.

2.1.5 Connecting Wire

2.1.5.1 Wire Requirements

Wire shall be No. 10 AWG solid copper wire, not less than 10 feet long, unspliced, complying with NFPA 70, Type RHH insulation. Connecting wires for magnesium anodes shall be factory installed with the place or emergence from the anode in a cavity sealed flush with a dielectric sealing compound. Connecting wires for zinc anodes shall be factory installed with the place of connection to the protruding steel core completely sealed with a dielectric material.

2.1.5.2 Anode Header Cable

Cable for anode header and distribution shall be No. 6 AWG stranded copper wire with type CP high molecular weight polyethylene, 7/64 inch thick insulation, 600-volt rating, in accordance with NEMA WC 5.

2.2 MISCELLANEOUS MATERIALS

2.2.1 Electrical Wire

Wire shall be No. 10 AWG stranded copper wire with NFPA 70, Type RHW-USE insulation. Polyethylene insulation shall comply with the requirements of ASTM D 1248 and shall be of the following types, classes, and grades:

High-molecular weight polyethylene shall be Type I, Class C, Grade E5.

High-density polyethylene shall be Type III, Class C, Grade E3.

2.2.1.1 Wire Splicing

Connecting wire splicing shall be made with copper compression connectors or exothermic welds, following instructions of the manufacturer. Single split-bolt connections shall not be used. Sheaths for encapsulating electrical wire splices to be buried underground shall fit the insulated wires entering the spliced joints and epoxy potting compound shall be as specified below.

2.2.1.2 Test Wires

Test wires shall be AWG No. 12 stranded copper wire with NFPA 70, Type TW or RHW or polyethylene insulation.

2.2.1.3 Resistance Wire

Resistance wire shall be AWG No. 16 or No. 22 nickel-chromium wire.

2.2.2 Conduit

Rigid galvanized steel conduit and accessories shall conform to UL 6. Non metallic conduit shall conform to NEMA TC 2.

2.2.3 Test Boxes and Junctions Boxes

Boxes shall be outdoor type conforming to UL 514A.

2.2.4 Joint, Patch, Seal, and Repair Coating

Sealing and dielectric compound shall be a black, rubber based compound that is soft, permanently pliable, tacky, moldable, and unbacked. Compound shall be applied as recommended by the manufacturer, but not less than 1/2-inch thick. Coating compound shall be hot-applied coal-tar enamel. Pressure-sensitive vinyl plastic electrical tape shall conform to UL 510.

2.2.5 Backfill Shields

Shields shall consist of approved pipeline wrapping or fiberglass-reinforced, coal-tar impregnated tape, or plastic weld caps, specifically made for the purpose and installed in accordance with the manufacturer's recommendations. When joint bonds are required, due to the use of mechanical joints, the entire joint shall be protected by the use of a kraft paper joint cover. The joint cover shall be filled with poured-in, hot coat-tar enamel.

2.2.6 Epoxy Potting Compound

Compound for encapsulating electrical wire splices to be buried underground shall be a two package system made for the purpose.

2.2.7 Test Stations

Stations shall be of the flush-curb-box type and shall be the standard product of a recognized manufacturer. Test stations shall be complete with an insulated terminal block having the required number of terminals. The test station shall be provided with a lockable over and shall have an embossed legend, "C.P. Test." A minimum of one (1) test station shall be provided each component of the encasement. A minimum of six (6) terminals shall be provided in each test station. A minimum of two (2) leads are required to the metallic pipe from each test station. Other conductors shall be provided for each anode, other foreign pipe, and reference cells as required.

2.2.8 Joint and Continuity Bonds

Bonds shall be provided across all joints in the metallic encasement lines, across any electrically discontinuous connections and all other pipes and structures with other than welded or threaded joints that are included in this cathodic protection system. Unless otherwise specified in the specifications, bonds between structures and across joints in pipe with other than welded or threaded joints shall be No. 8 AWG stranded copper cable with polyethylene insulation. Bonds between structures shall contain sufficient slack for any anticipated movement between structures. Bonds across pipe joints shall contain a minimum of 4 inches of slack to allow for pipe movement and soil stress. Bonds shall be attached by exothermic welding. Exothermic weld areas shall be insulated with coating compound and approved, and witnessed by the Contracting Officer. Continuity bonds shall be installed as necessary to reduce stray current interference. Additional joint bondings shall be accomplished by the Contractor where the necessity is discovered during construction or testing or where the Contracting Officer's representative directs that such bonding be done. Joint bonding shall include all associated excavation and backfilling. There shall be a minimum of two (2) continuity bonds between each structure and other than welded or threaded joints. The Contractor shall test for electrical continuity across all joints with other than welded or threaded joints and across all metallic portions or components. The Contractor shall provide bonding as required and as specified above until electrical continuity is achieved. Bonding test data shall be submitted for approval.

2.2.9 Resistance Bonds

Resistance bonds should be adjusted as outlined in this specification. Alternate methods may be used if they are approved by the Contracting Officer.

2.2.10 Stray Current Measurements

Stray current measurements should be performed at each test station. Stray currents resulting from lightning or overhead alternating current (AC) power transmission systems shall be mitigated in accordance with NACE RP0177.

\\PRINT_SRV2\Specwork\SISGML\JOBS\02092\prntdata\09900.sec2.2.11 Resistance Wire

Wire shall be No. 16 or No. 22 nickel-chromium wire with TW insulation.

2.2.12 Electrical Connections

Electrical connections shall be done as follows:

a. Exothermic welds shall be "Cadweld"," Bundy", "Thermoweld" or an approved equal. Use of this material shall be in strict accordance with the manufacturer's recommendations.

b. Electrical-shielded arc welds shall be approved for use on steel pipe by shop drawing submittal action.

c. Brazing shall be as specified in Paragraph: Lead Wire Connections.

2.2.13 Electrical Tape

Pressure-sensitive vinyl plastic electrical tape shall conform to UL 510.

2.2.14 Permanent Reference Electrodes

Permanent reference electrodes shall be Cu-CuS04 electrodes suitable for direct burial. Electrodes shall be guaranteed by the supplier for 15 years' service in the environment in which they shall be placed. Electrodes shall be installed directly beneath pipe, or metallic component.

2.2.15 **[AM#3] DELETED**

PART 3 EXECUTION

3.1 CRITERIA OF PROTECTION

Acceptance criteria for determining the adequacy of protection on a buried underground metallic component shall be in accordance with NACE RP0169 and as specified below.

3.1.1 Iron and Steel

The following method (a) shall be used for testing cathodic protection voltages. If more than one method is required, method (b) shall be used.

a. A negative voltage of at least minus 850 millivolts as measured between the underground component and a saturated copper-copper sulphate reference electrode connecting the earth (electrolyte) directly over the underground component. Determination of this voltage shall be made with the cathodic protection system in operation. Voltage drops shall be considered for valid interpretation of this voltage measurement. A minimum of minus 850 millivolts "instant off" potential between the underground component being tested and the reference cell shall be achieved over 95 percent of the area of the structure. Adequate number of measurements shall be obtained over the entire structure, pipe, tank, or other metallic component to verify and record achievement of minus 850 millivolts "instant off." This potential shall be obtained over 95 percent of the total metallic area without the "instant off" potential exceeding 1200 millivolts.

b. A minimum polarization voltage shift of 100 millivolts as measured between the underground component and a saturated copper-copper sulphate reference electrode contacting the earth directly over the underground component. This polarization voltage shift shall be determined by interrupting the protective current and measuring the polarization decay. When the protective current is interrupted, an immediate voltage shift will occur. The voltage reading, after the immediate shift, shall be used as the base reading from which to measure polarization decay. Measurements achieving 100 millivolts decay shall be made over 95 percent of the metallic surface being protected.

c. For any metallic component, a minimum of four (4) measurements shall be made using subparagraph (a), above, and achieving the "instant off" potential of minus 850 millivolts. Two (2) measurements shall be made over the anodes and two (2) measurements shall be made at different locations near the component and farthest away from the anode.

3.1.2 **[AM#2] DELETED**

3.1.3 **[AM#2] DELETED**

3.2 ANODE STORAGE AND INSTALLATION

3.2.1 Anode Storage

Storage area for magnesium anodes will be designated by the Contracting Officer. If anodes are not stored in a building, tarps or similar protection should be used to protect anodes from inclement weather. Packaged anodes, damaged as a result of improper handling or being exposed to rain, shall be resacked by the Contractor and the required backfill added.

3.2.2 Anode Installation

Unless otherwise authorized, installation shall not proceed without the presence of the Contracting Officer. Anodes of the size specified shall be installed to the depth indicated and at the locations shown. Locations may be changed to clear obstructions with the approval of the Contracting Officer. Anodes shall be installed in sufficient number and of the required type, size, and spacing to obtain a uniform current distribution over the surface of the structure. The anode system shall e designed for a life of 25 years of continuous operation. Anodes shall be installed as indicated in a dry condition after any plastic or waterproof protective covering has been completely removed from the water permeable, permanent container housing the anode metal. The anode connecting wire shall not be used for lowering the anode into the hole. The annular space around the anode shall be backfilled with fine earth in 6 inch layers and each layer shall be hand tamped. Care must be exercised not to strike the anode or connecting wire with the tamper. Approximately 5 gallonsof water shall be applied to each filled hole after anode backfilling and tamping has been completed to a point about 6inches above the anode. After the water has been absorbed by the earth, backfilling shall be completed to the ground surface level.

3.2.2.1 Single Anodes

Single anodes shall be connected through a test station to the pipeline, allowing adequate slack in the connecting wire to compensate for movement during backfill operation.

3.2.2.2 Groups of Anodes

Groups of anodes, in quantity and location shown, shall be connected to an anode header cable. The anode header cable shall make contact with the structure to be protected only through a test station. Anode lead connection to the anode header cable shall be made by an approved crimp connector or exothermic weld and splice mold kit with appropriate potting compound.

3.2.2.3 Welding Methods

Connections to ferrous pipe shall be made by exothermic weld methods manufactured for the type of pipe supplied. Electric arc welded connections

and other types of welded connections to ferrous pipe and structures shall be approved before use.

3.2.3 Anode Placement - General

Packaged anodes shall be installed completely dry, and shall be lowered into holes by rope sling or by grasping the cloth gather. The anode lead wire shall not be used in lowering the anodes. The hole shall be backfilled with fine soil in 6inch layers and each layer shall be hand-tamped around the anode. Care must be exercised not to strike the anode or lead wire with the tamper. If immediate testing is to be performed, water shall be added only after backfilling and tamping has been completed to a point 6 inches above the anode. Approximately 2 gallons of water may be poured into the hole. After the water has been absorbed by the soil, backfilling and tamping may be completed to the top of the hole. Anodes shall be installed as specified or shown. In the event a rock strata is encountered prior to achieving specified augered-hole depth, anodes may be installed horizontally to a depth at least as deep as the bottom of the pipe, with the approval of the Contracting Officer.

3.2.4 Underground Pipeline

Anodes shall be installed at a minimum of 8 feet and a maximum of 10 feet from the line to be protected.

3.2.5 Installation Details

Details shall conform to the requirements of this specification. Details shown on the drawings are indicative of the general type of material required, and are not intended to restrict selection to material of any particular manufacturer.

3.2.6 Lead Wire Connections

3.2.6.1 Underground Pipeline (Metallic)

To facilitate periodic electrical measurements during the life of the sacrificial anode system and to reduce the output current of the anodes, if required, all anode lead wires shall be connected to a test station and buried a minimum of 24 inches in depth. The cable shall be No. 10 AWG, stranded copper, polyethylene or RHW-USE insulated cable. The cable shall make contact with the structure only through a test station. Resistance wire shall be installed between the cable and the pipe cable, in the test station, to reduce the current output, if required. Anode connections, except in the test station, shall be made with exothermic welding process, and shall be insulated by means of at least three (3) layers of electrical tape; and all lead wire connections shall be installed in a moistureproof splice mold kit and filled with epoxy resin. Lead wire-to-structure connections shall be accomplished by an exothermic welding process. All welds shall be in accordance with the manufacturer's recommendations. A backfill shield filled with a pipeline mastic sealant or material compatible with the coating shall be placed over the weld connection and shall be of such diameter as to cover the exposed metal adequately.

3.2.6.2 Resistance Wire Splices

Resistance wire connections shall be accomplished with silver solder and the solder joints wrapped with a minimum of three (3) layers of pressure-sensitive tape. Lead wire connections shall be installed in a moistureproof splice mold kit and filled with epoxy resin.

3.2.7 Location of Test Stations

Test stations shall be curb box mounted. Buried insulating joints shall be provided with test wire connections brought to a test station. Unless otherwise shown, other test stations shall be located as follows:

a. At 1,000-foot intervals or less.

b. Where the pipe or conduit crosses any other metal pipe.

c. **[AM#3] DELETED**.

d. Where both sides of an insulating joint are not accessible above ground for testing purposes.

3.2.8 Underground Pipe Joint Bonds

Underground pipe having other than welded or threaded coupling joints shall be made electrically continuous by means of a bonding connection installed across the joint.

3.3 ELECTRICAL ISOLATION OF STRUCTURES

3.3.1 Isolation Joints and Fittings

Isolating fittings, including main line isolating flanges and couplings, shall be installed aboveground, or within manholes, wherever possible. Where isolating joints must be covered with soil, they shall be fitted with a paper joint cover specifically manufactured for covering the particular joint, and the space within the cover filled with hot coal-tar enamel. Isolating fittings in lines entering buildings shall be located at least 12 inches above grade of floor level, when possible. Isolating joints shall be provided with grounding cells to protect against over-voltage surges or approved surge protection devices. The cells shall provide a low resistance across isolating joint without excessive loss of cathodic current.

3.3.2 **[AM#2] DELETED**

3.4 TRENCHING AND BACKFILLING

Trenching and backfilling shall be in accordance with Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITY SYSTEMS.

3.5 TESTS AND MEASUREMENTS

3.5.1 Baseline Potentials

Each test and measurement will be witnessed by the Contracting Officer. The Contractor shall notify the Contracting Officer a minimum of five (5) working days prior to each test. After backfill of the pipe, the static potential-to-soil of the pipe shall be measured. The locations of these measurements shall be identical to the locations specified for pipe-to-

reference electrode potential measurements. The initial measurements shall be recorded.

3.5.2 Isolation Testing

Before the anode system is connected to the pipe, an isolation test shall be made at each isolating joint or fitting. This test shall demonstrate that no metallic contact, or short circuit exists between the two isolated sections of the pipe. Any isolating fittings installed and found to be defective shall be reported to the Contracting Officer.

3.5.2.1 Insulation Checker

A Model 601 insulation checker, as manufactured by "Gas Electronics", or an approved equal, using the continuity check circuit, shall be used for isolating joint (flange) electrical testing. Testing shall conform to the manufacturer's operating instructions. Test shall be witnessed by the Contracting Officer. An isolating joint that is good will read full scale on the meter. If an isolating joint is shorted, the meter pointer will be deflected or near zero on the meter scale. Location of the fault shall be determined from the instructions, and the joint shall be repaired. If an isolating joint is located inside a vault, the pipe shall be sleeved with insulator when entering and leaving the vault.

3.5.2.2 Cathodic Protection Meter

A Model B3A2 cathodic protection meter, as manufactured by "M.C. Miller", or an approved equal, using the continuity check circuit, shall be used for isolating joint (flange) electrical testing. This test shall be performed in addition to the Model 601 insulation checker. Continuity is checked across the isolation joint after the test lead wire is shorted together and the meter adjusted to scale. A full-scale deflection indicates the system is shorted at some location. The Model 601 verifies that the particular insulation under test is good and the Model B3A2 verifies that the system is isolated. If the system is shorted, further testing shall be performed to isolate the location of the short.

3.5.3 Anode Output

As the anodes or groups of anodes are connected to the pipe, current output shall be measured with an approved clamp-on milliammeter, calibrated shunt with a suitable millivoltmeter or multimeter, or a low resistance ammeter. (Of the three methods, the low-resistance ammeter is the least desirable and most inaccurate. The clamp-on milliammeter is the most accurate.) The valves obtained and the date, time, and location shall be recorded.

3.5.4 Reference Electrode Potential Measurements

Upon completion of the installation and with the entire cathodic protection system in operation, electrode potential measurements shall be made using a copper-copper sulphate reference electrode and a potentiometer-voltmeter, or a direct-current voltmeter having an internal resistance (sensitivity) of not less than 10 megohms per volt and a full scale of 10 volts. The locations of these measurements shall be identical to the locations used for baseline potentials. The values obtained and the date, time, and locations of measurements shall be recorded. No less than eight (8) measurements shall be made over any length of line or component. Additional measurements shall

be made at each distribution service riser, with the reference electrode placed directly over the service line.

3.5.5 Location of Measurements

3.5.5.1 Piping or Conduit

For coated piping or conduit, measurements shall be taken from the reference electrode located in contact with the earth, directly over the pipe. Connection to the pipe shall be made at service risers, valves, test leads, or by other means suitable for test purposes. Pipe-to-soil potential measurements shall be made at intervals not exceeding 5 feet. The Contractor may use a continuous pipe-to-soil potential profile in lieu of 5 foot interval pipe-to-soil potential measurements. Additional measurements shall be made at each distribution service riser, with the reference electrode placed directly over the service line adjacent to the riser. Potentials shall be plotted versus distance to an approved scale. Locations where potentials do not meet or exceed the criteria shall be identified and reported to the Contracting Officer's representative.

3.5.5.2 **[AM#2] DELETED**

3.5.5.3 **[AM#3] DELETED**

3.5.5.4 Interference Testing

Before final acceptance of the installation, interference tests shall be made with respect to any foreign pipes in cooperation with the owner of the foreign pipes. A full report of the tests giving all details shall be made. Stray current measurements shall be performed at all isolating locations and at locations where the new pipeline crosses foreign metallic pipes. The method of measurements and locations of measurements shall be submitted for approval. As a minimum, stray current measurements shall be performed at the following locations:

a. Connection point of new pipeline to existing pipeline.

b. Crossing points of new pipeline with existing lines.

Results of stray current measurements shall also be submitted for approval.

3.5.5.5 Holiday Test

Any damage to the protective covering during transit and handling shall be repaired before installation. After field-coating and wrapping has been applied, the entire pipe shall be inspected by an electric holiday detector with impressed current in accordance with NACE RP0188 using a full-ring, spring-type coil electrode. The holiday detector shall be equipped with a bell, buzzer, or other type of audible signal which sounds when a holiday is detected. Holidays in the protective covering shall be repaired upon detection. Occasional checks of holiday detector potential will be made by the Contracting Officer to determine suitability of the detector. Labor, materials, and equipment necessary for conducting the inspection shall be furnished by the Contractor. The coating system shall be inspected for holes, voids, cracks, and other damage during installation.

3.5.5.6 Recording Measurements

All pipe-to-soil potential measurements, including initial potentials where required, shall be recorded. The Contractor shall locate, correct and report to the Contracting Officer any short circuits to foreign pipes encountered during checkout of the installed cathodic protection system. Pipe-to-soil potential measurements shall be taken on as many pipes as necessary to determine the extent of protection or to locate short-circuits.

3.6 TRAINING COURSE

The Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total of 4 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. The field instructions shall cover all of the items contained in the operating and maintenance instructions, as well as demonstrations of routine maintenance operations, including testing procedures included in the maintenance instructions. At least 14 days prior to date of proposed conduction of the training course, the training course curriculum shall be submitted for approval, along with the proposed training date. Training shall consist of demonstration of test equipment, providing forms for test data and the tolerances which indicate that the system works.

3.7 CLEANUP

The Contractor shall be responsible for cleanup of the construction site. All paper bags, wire clippings, etc., shall be disposed of as directed. Paper bags, wire clippings and other waste shall not be put in bell holes or anodes excavation.

3.8 MISCELLANEOUS INSTALLATION AND TESTING

3.8.1 Coatings

All aboveground pipeline shall be coated as indicated or as approved. The coating shall have a minimum thickness of 7 mil. The pipeline coating shall be in accordance with all applicable Federal, State, and local regulations.

3.8.2 Excavation

In the event rock is encountered in providing the required depth for anodes, the Contractor shall determine an alternate approved location and, if the depth is still not provided, an alternate plan shall be submitted to the Contracting Officer. Alternate techniques and depths must be approved prior to implementation.

3.9 SPARE PARTS

After approval of shop drawings, and not later than three (3) months prior to the date of beneficial occupancy, the Contractor shall furnish spare parts data for each different item of material and equipment specified. The data shall include a complete list of parts, special tools, and supplies, with current unit prices and source of supply. In addition, the Contractor shall supply information for material and equipment replacement for all other components of the complete system, including anodes, cables, splice

kits and connectors, corrosion test stations, and any other components not listed above.

3.10 **[AM#2] DELETED**

3.11 SYSTEM TESTING

The Contractor shall submit a report including potential measurements taken at adequately-close intervals to establish that minus 850 millivolts potential, "instant-off" potential, is provided, and that the cathodic protection is not providing interference to other foreign pipes causing damage to paint or pipes. The report shall provide a narrative describing how the criteria of protection is achieved without damaging other pipe or structures in the area.

3.12 **[AM#2] DELETED**

-- End of Section --

SECTION 16488

INSTRUMENTATION AND CONTROLS
AMENDMENT NO. 0002, 0005 & 0007

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 within the text by the basic designation only.

1.2 DEFINITIONS

Symbols, Definitions, and Abbreviations: All symbols, definitions, and engineering unit abbreviations utilized shall conform to IEEE 100-84, S50.1, and S51.1, where applicable.

1.3 SYSTEM DESCRIPTION

Design Requirements:

a. Provide analog field instruments with transmitters which condition the signal to output a 4-20mA signal linear to the measured variable.

b. Similar instruments shall be by the same manufacturer to the extent practical.

1.3.1 Supervisory Control and Data Aquisition System (SCADA)

The Supervisory Control and Data Acquisition System (SCADA) shall provide computer system monitoring functions, record historical data, and provide operator interfaces for control of plant and remote functions. The SCADA system includes, but is not limited to the:

1. Computer workstations designated Human Machine Interfaces (HMI's) and their interface to the Plant Control Network.
2. Plant Control Network,
3. Plant Control Network interfaces to Programmable Logic Controllers and other plant equipment,
4. Programmable Logic Controllers at remote sites and at plant
5. Radio communication equipment at remote sites and at plant

The Contractor shall employ the services of a qualified System Integrator with experience in providing computer based data acquisition systems for industrial control systems. [AM#2] (_____.)

Any system varying from these specifications as to principle of operation, control and indication features or suitability for the particular application shall not be accepted.

Instrumentation: Provide analog field instruments with transmitters which condition the signal to output a 4-20mA signal linear to the measured variable.

Similar instruments shall be by the same manufacturer to the extent practical.

1.4 PERFORMANCE REQUIREMENTS

Accuracy shall be as defined in ISA S51.1 and ISA S51.1, Sec. 5. Provide a complete and operating instrument installation with measurement accuracy determined by adding the accuracy of the element and the transmitter and any wiring to the field terminal enclosure of 0.75% of calibrated span or better , unless specified otherwise below, at any environmental condition specified.

1.5 PATENTS

If the manufacturer is required or desires to use any design, device, material, or process covered by letter, patent, or copyright, the manufacturer shall provide for such use by suitable legal agreement with the patentee or owner, and the prices bid hereunder shall, without exception, indemnify and save the Government from any and all claims for infringement by reason of the use of any such patented design, device, material, or process, or any trademark or copyright used in connection with any equipment to be furnished hereunder.

1.6 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submit compact disc and color printouts of all screens for goverment approval.

Quality Control Data:

a. Design Data:
b. Test Reports:
c. Certificates:
d. Manufacturer's Instructions:
e. Manufacturer's Field Reports:

[AM#2] Qualifications:

Provide System Integrator's qualifications in accordance with Part 1 paragraph "Quality Assurance", subparagraph "Qualifications".

SD-03 Product Data

Instrument Installation Details
Instrument Specification Sheets See attached.
Certified Calibration Sheets

Complete and detailed instruction manuals on each item furnished including but not limited to all devices and instruments. Information to be contained in the instruction manuals shall include but not be limited to drawings, dimensions, manufacturer's recommendations, ratings, performance charts, power requirements, schematics, maintenance requirements and procedures, calibration recommendations and procedures, repair instructions, complete and recommended spare parts lists and related information.

a. Proposed tagging and attachment materials and methods.
b. Shop Drawings shall be submitted for approval by the Government.

The Contractor shall submit to the Government, for approval, Shop Drawings of the equipment he proposes to install to meet the Specifications. The Drawings shall be supported by notes or written directions as required to fully define the installation.

The submission shall be made as soon as feasible after award of the Contract and, in any event, shall be submitted and approval obtained before installation of the equipment. The Contractor shall furnish the Government with six (6) copies of the submission.

The information required on the Shop Drawings shall include, but is not necessarily limited to, the following:

a. Full and complete Specifications covering the equipment proposed to be furnished: G
b. Detail Drawings showing plan, network connections and elevation dimensions of the equipment proposed to be furnished: G
c. Guarantees of performance of the equipment proposed to be furnished: G
d. Nearest location of factory maintenance and service facilities that will be available to service the equipment offered: G

SD-11 Contract Closeout

Project Record Documents: G
Operating and Maintenance Data: G
Warranty: G

1.7 QUALITY ASSURANCES

1.7.1 Qualifications

The system integrator shall have a minimum of 5 years of experience with the equipment and software to be installed. The system integrator shall have a minimum of 10 years of experience in providing computer-based data acquisition systems for industrial control systems. The system integrator shall have a full-time staffed office within [AM#2] the continental United States.

1.7.1.1 Base Line Testing

Base-line testing shall be performed on all existing field instruments and any other equipment connected to the existing I/O. Testing is to be completed before any modification of existing control equipment. Equipment to be tested includes but, is not limited to: all field instruments such as level, pressure, or flow transmitters, and equipment such as motor starters, digital sensors, manual controls, detectors, and valves. Provide a minimum of 14 days notice to Contracting Officer before start of testing. The Government reserves the right to have the Contracting Officer be present during any testing and to verify the results. Tests shall be performed at the existing terminal cabinet. All inputs and outputs shall be tested to ensure that the signal conforms to the requirements of the actual PLC I/O cards used. A signal conditioner shall be provided for any input or output that does not meet this requirement. All inputs shall be tested to ensure that actuation of the equipment causes a corresponding signal at the terminal box. All outputs shall be tested to ensure that a signal at the terminal box causes a corresponding activation of the equipment. All analog inputs and outputs shall be tested for linear operation, scale, and offset. Six (6) copies of the test results shall be submitted to the Government in paper and electronic formats. Electronic formats allowed are Microsoft Excel, comma-separated-variable, Adobe PDF or as otherwise directed by Contracting Officer. Each test result shall include the site name, equipment/instrument name, equipment/instrument description, test procedure description, test results, scale and offset (for analog equipment), and shall be signed and dated by the tester.

1.8 DELIVERY, STORAGE, AND HANDLING

1. Packing and Shipping:

2. Acceptance at Site:

3. Storage and Protection: Delivery, storage, and handling shall be in accordance with manufacturers recommendation and the requirements of General and other sections herein.

1.9 PROJECT AND SITE CONDITIONS

Environmental Requirements: Instrumentation and control elements will be installed outdoors exposed to sun, rain and excessive humidity and shall be capable of continuous operation without significant reduction of their operating life under the following ambient conditions:

Temperature: -25 degrees C. to 80 degrees C.

Pressure: 650 mm Hg to 800 mm Hg

Relative Humidity: 20% to 100% condensing

Vibration Frequency: 10 - 2000 Hz.

Vibration Position: 1.5 mm peak-to-peak

Vibration Acceleration: 10 G.

Where the ratings of individual components cannot meet the requirements, provide suitable means of physical protection. Suitable physical protection shall consist of an assembly which meets the requirements listed, while limiting the ambient conditions at the non-conforming component to 90% of the component's rating (Example: A component rated for vibration at only 5 G. acceleration would be required to be combined with vibration isolation to limit the acceleration of the component to 4.5 G. when subjected to ambient acceleration of 10 G. from 10 - 2000 Hz).

Operating Environmental Conditions: All instruments and control devices provided shall be rated for continuous operation in their installed operating environment and shall be capable of continuous operation at the operating conditions without significant reduction of their operating life.

PART 2 PRODUCTS

2.1 [AM#2] INSTRUMENTS

Furnish instruments specified in Appendix 1 Instrument Specification Sheets. Instruments for services not listed shall be equal in quality, performance, and environmental and functional characteristics as instruments listed and shall be approved in writing by the Contracting Officer.

2.2 CONTROL PANEL MATERIALS

2.2.1 Enclosures for Indoor Use

Furnish and install NEMA 12 enclosures.

2.2.2 Enclosures for Outdoor Use

Furnish and install NEMA 12 stainless steel enclosures with NEMA 4 gaskets [AM#2] and top and side sun shields.

2.2.3 Nameplates

Each enclosure shall be identified by a nameplate including its designation and service name as specified. Local Control Panels shall be identified by a nameplate identifying the associated control panel. Panel mounted instruments and control devices shall be identified by a nameplate including the tag number and service name. Control devices shall be provided with manufacturer's standard legends indicating function (example: STOP, START, HAND-OFF-AUTO, etc.) Provide engraved, acrylic plastic laminate nameplates, 1/16-inch thick, 1" x 6" minimum for junction boxes and panels, sized to fit for control devices and stations, engraved in black letters on white face and punched for and fastened with self-tapping 10/32 stainless steel screws and silicone adhesive.

2.2.4 Grounding

Each enclosure shall be provided with a copper equipment grounding bar, ground lugs, and bonding cable and fittings as required. Ground control panels to earth with #2 stranded connectors and driven copper rods to less than 10 ohms.

2.2.5 Terminal Strips and Accessories

Provide DIN rail mounted terminal strips including fused terminals with blown fuse indication, ground terminals, terminal groups for each incoming or outgoing device circuit including group tag identifying the device and identified terminals for each incoming or outgoing wire. Provide terminal end, partition and separation plates as required. Provide pre-engraved vinyl marking strips with terminal and group identification as shown on the submittal drawings. Provide group tags and terminals or as indicated on the drawings or approved equals. Do not splice control wires. Provide DIN rail mounted relay bases with LED coil indicators and arc suppression for plug-base relays. Identify each terminal with the wire designator from the wire number i.e. "+", "-", "SH", "NO", "NC", "COM", "L1", "N", etc. Provide 20% spare terminals and I.D. tags of each designation. Provide 20% spare connectors, fittings, wire ties, labels and markers of each type provided.

2.2.6 Indicating Lights and Industrial Control Devices

Indicating lights and control devices shall be furnished as indicated with push-to-test feature. Use 120 VAC devices of the oil-tight, industrial duty type equal to Allen Bradley 800T or equal. Provide manufacturer's standard engraved legend plate suitable for 2 lines of 14 characters each for each device furnished. Provide custom engraving where function names indicated have no reasonable match with manufacturers standard engraving.

a. Normal run lights shall be steady, alarm lights indicating interlocks shall be flashing type. Three position switches shall be maintained contact unless otherwise indicated.

2.2.7 Relays

Provide relays as required to implement indicated control Functions. General purpose and time delay relays may be used within their ratings for logic, timing and sequencing but shall not be used to drive loads in excess of 80% of their contact "make" or "break" ratings. Provide interposing power relays to drive loads such as starters larger than NEMA size 1 and all other utilization equipment with loads greater than specified for general purpose and time delay relays. Provide relays rated to drive the load as required.

2.2.7.1 General Purpose Relays

Provide tube-base relays rated 120VAC, DPDT or 3PDT, 10 Amp contacts rated to break inductive loads of 3 Amperes. Provide Allen-Bradley 700 Type HA, Potter Brumfield or as indicated on drawings or equal. Provide additional relays as required to obtain sufficient numbers of contacts.

2.2.7.2 Time Delay Relays

Provide relays for which the time delay is based on the presence or absence of control voltage at the relay. Unless indicated otherwise provide DIP switch programmable multifunction relays including time delay on energization, time delay on de-energization or one-shot timing as indicated. Provide continuous control power to the relay if required, whether indicated or not. The shop drawings shall reflect the actual proposed connection and timing diagram for the specific relays to be provided. Provide relays rated

120VAC, DPDT or 3PDT, 10 Amp contacts rated to break inductive loads of 3 Amperes. Provide SSAC or approved equal tube-base relays.

2.2.7.3 Power Relays

Provide heavy-duty solenoid type relays with contacts rated not less than 10 amperes continuous at 300 volts AC. Provide a minimum of four reversible poles or four universal or double-throw poles. Relays shall be as manufactured by Allen Bradley, Type 700N, or approved equal.

2.2.8 Signal Converters and Isolators

Provide signal isolators as required for all new and existing circuits to provide standard controller inputs or outputs. Signal converters and isolators shall be as manufactured by AGM, Action Instruments, or approved equal.

2.2.9 [AM#2] Surge Protection

Provide surge protectors to protect RTUs and master PLC cabinet. Surge protector to be 120VAC, DIN-rail mounted, MOV-based, industrial grade and UL1449 Second Edition compliant. Provide Phoenix Contact, Weidmuller, Transtector or approved equal.

2.2.10 **[AM#7] Battery Backup Operation**

[AM#7] All RTU's shall be supplied with battery backup operation. The rechargeable batteries shall be the sealed solid gel electrolyte type, 12V, designed for float or standby service. Unless noted otherwise in the RTU descriptions, batteries shall be sized to maintain 48-hour service. The RTU shall include a plug-in charging module to recharge the battery when power is resumed, maintain the charge between outages, and provide a low voltage cut-off to protect the battery from excessive discharge during prolonged outages. Radio communications, RTU controller processes, and analog loop functions shall continue to function on battery backup.

2.3 PROGRAMMABLE LOGIC CONTROLLER

The contractor shall furnish, install, configure, startup, and test the programmable controller to be located in each remote or master control. Provide controllers mounted inside the Control Panels to provide data acquisition functions as specified and shown.

The PLC controllers shall have the following characteristics:

a. Microprocessor based
b. 64K program memory size
c. Programmable including:
d. ladder logic
e. arithmetic functions
f. on-line configuration and program editing
g. PID for closed loop control
h. Control of up to 4096 input and output points
i. Built in 10BaseT Ethernet channel
j. Built in RS-232 channel supporting DF1 Full-Duplex communication, DF1 Half-Duplex Master/Slave communication, DH-485, and ASCII I/O
k. Real-time clock

l. Battery backed RAM
m. Flash EPROM memory
n. Input/Output capability as follows:

1. Discrete Inputs (120Vac) - must accept direct 120VAC power for status without using relays.
2. Discrete Outputs (120Vac)
3. Analog Inputs (4-20mA)
4. Analog Outputs (4-20mA)

The contractor shall furnish the following spare parts:

a. Two (2) Power suppl ies
b. Two (2)CPU modules
c. Two (2) I/O modules of each type furnished

Provide PLC inputs and outputs at each site of quantity and type shown on I/O List appended to this specification. Provide a minimum of 25% spare I/O points of each type at each site in addition to spare parts listed in this section.

Control Configuration: The controllers and computer shall be networked and programmed as indicated. Control and interlocking functions shall be implemented in the PLC, not the HMI.

Provide PLC with accessory EEPROM memory chip configured to clear errors and write the original program to the RAM memory chip when main control power is cycled.

In the event of loss of communications with the HMI, the PLC controller shall retain last setpoint and control at that setting until manually overridden or communications is restored.

The Programmable Logic Controllers (PLC) shall be Allen-Bradley SLC 5/05 or approved equal.

2.4 UPS SYSTEM

[AM#2] Furnish and install an Uninterruptible Power Supply (UPS) to power the secondary SCADA node. Furnish [AM#2] and install a UPS to power the primary SCADA node and master PLC cabinet.

a. Technical requirements:

1. 120V, 1-phase input
2. 120V, 1-phase output
3. Capacity: [AM#2] 650VA minimum for secondary SCADA node, 1500VA _____ minimum for primary SCADA node and master PLC cabinet
4. Runtime: [AM#2] 6 minutes full load / 20 minutes half load; 6 minutes at full load / 22 minutes at half load

The UPS shall have the following standard features:

1. Surge Protection, Cat. A and B ANSI/IEEE C62.41 and .45
2. UL 1449 listed.
3. Output Voltage regulation: "3% (ANSI C84.1.4)

4. Minimum Efficiency: 90% on-line
5. Continuous, no-break power.
6. Computer grade sine wave power (5% THD).
7. Rated for switch-mode power supplies for use with computer loads.
8. Automatic battery check.
9. Automatic inverter check (adjustable cycle time).
10. Monitor runtime during an outage and display value based on battery capacity with respect to load.
11. Electronic communications port for connection to HMI computer. UPS shall include Windows based software for monitoring and diagnostic functions. Provide automatic orderly shutdown of HMI software upon depletion of UPS batteries.
12. Batteries and UPS in single enclosure.

Windows based software for monitoring functions and automatic shutdown shall be PowerChute or approved equal. Utilize Windows shutdown software connected to the UPS via standard RS-232 interface. The UPS shall be American Power Conversion (APC) or approved equal.

2.5 RADIO TELEMETRY SYSTEM

Radio System Installation: Radio systems shall be installed by a qualified radio system installer who holds all FCC or other licenses covering the installation and startup operation of the radio system. The installer shall have factory training or equivalent experience in startup and operation of the radio system specified.

The System Integrator shall be responsible for ensuring that any radios provided shall have been approved by the Government for spectrum supportability before being placed in operation. Additionally, the System Integrator shall be responsible for coordinating all radio frequency usage with the Contracting Officer and Fort Bliss' Office of Frequency Management.

Path Considerations: The system integrator shall adjust the orientation of directional antennas, transmit power, and variable attenuation to achieve a fade margin of 20dB.

Interference Considerations: The system integrator shall adjust the transmit power (primarily) and variable attenuation (secondary) to prevent causing interference to other radio systems. Each radio shall only radiate enough power to achieve the required 20dB fade margin.

Provide radio network RTU's and MTU with spare parts, path assessment, interface cards, UPS equipment, batteries, antenna, antenna coaxial cable, surge arrestors, cabinets, including subpanels, PLC, I/O cards and slots as scheduled in the drawings, power supply, drawings, radio transceiver, auxiliary terminal blocks and wire markers, connections, testing, related HMI configuration and database integration, coordination of outages and all materials, methods and labor to demonstrate the reliable operation of each RTU.

General: Radio System Installation: The system integrator shall place in satisfactory service a Radio Telemetry Network which efficiently conveys data from RTU's at field sites designated, by radio-modem to a master unit

located as designated and thence by the Plant Control Network to the HMI's where the data can be processed as indicated. Radio systems shall be installed by a qualified radio system installer who holds all FCC or other licenses covering the installation and startup operation of the radio system. The installer shall have factory training or equivalent experience in startup and operation of the radio system specified.

The system integrator shall obtain in the Government's name any required FCC licensing and shall coordinate with the Contracting Officer.

Communications Protocols: The RTU's shall communicate to the master PLC and thence to the HMI in open DF1 protocol. The system integrator shall set up DF1 and RSLinx drivers in the PLC's and HMI with consideration to timing and polling issues. All communications shall enable 16bit Cyclic Redundancy Checking as a minimum for error checking and correction.

RTU radio modems shall be Esteem Model 192F or approved equal. Radio modems shall incorporate packet burst narrow band technology to establish a "radio area network" of up to 255 users on a single frequency. The network shall incorporate forward error correction and CRC error checking. Radio protocol shall be Carrier-Sensed-Multiple-Access (CSMA) communication protocol. The radio shall be able to operate as an operating node, a repeater node, or both simultaneously. The radio shall be able to read addressed DF1 packets [AM#2] received from another radio, store those packets, then forward those packets to the addressee. [AM#2] All radios shall operate on the same frequency or as otherwise directed by Contracting Officer. The radio shall have the following features:

internal non-volatile memory
19,200 bps RF data rate
400 to 420 MHz UHF operating frequencies
integral Digi-Repeater
Frequency of operation software programmable
Remote programmability of all features over the RF interface
Radio diagnostics program
 Radio self-test
Packet monitor
 Received signal to noise ratio
Received signal strength output
RS-232C, RS-422, and RS-485 communications
Second local port for local programming and diagnostics
 Point to point protocol
 Point to multipoint protocol
 Transparent protocol

The System Integrator shall furnish a fully functional, complete, reliable and robust radio telemetry system.

The System Integrator shall provide a minimum of 8 hours training on the radio telemetry system including demonstration of radio configuration and diagnostics software.

2.6 RADIO ANTENNA

Refer to Drawings for antenna types and locations. The contractor shall provide all masts, lightning suppressors, and other apparatuses required to make a complete and operable radio system.

2.6.1 Omnidirectional

Frequency range: 400 to 420 MHz.
Gain: 5 dB, minimum
Maximum Power Input: 100 watts
Lightning Protection: Direct ground protection to mast.
Front-to-Back Ratio: 20 dB, min.
Connector: Type N, female.

The contractor shall provide all masts, lightning suppressors, and other apparatuses required to make a complete and operable radio system.

2.6.2 Directional - Yagi

Frequency range: 400 to 420 MHz.
Gain: 10 dB, minimum
Maximum Power Input: 100 watts
Lightning Protection: Direct ground protection to mast.
Front-to-Back Ratio: 20 dB, min.
Connector: Type N, female.

The contractor shall provide all masts, lightning suppressors, and other apparatuses required to make a complete and operable radio system.

2.6.3 Mounting Hardware

Stainless steel clamps and hardware suitable for direct mount to antenna towers and water tank structure.

2.7 ANTENNA LIGHTNING PROTECTION

Coaxial connection to the radio enclosure shall be by means of a coaxial type bulkhead lightning arrester with type N connections. The lightning arrester shall be rated at 1 kilowatt with a minimum 500V and maximum 2000V breakdown voltage. Coaxial lightning arrester shall be PolyPhaser or equal .

2.8 TRANSMISSION CABLE FOR RTU RADIO

50-ohm Ultra low attenuation coaxial cable with Type N connections.

Feeder Coax: 5/8 inch foam dielectric heliax. Maximum attenuation: 1.05 dB/100 feet at 450 MHz.

Jumper Coax: [AM#2] 1/4 inch super flexible foam dielectric heliax. Maximum attenuation: [AM#2] 3.91 dB/100 ft at 450 Mhz.

Provide suitable grounding kits for cable as manufactured by Andrew Corp. Grounding kits shall be located at the top and bottom of the tower, and at 200ft intervals if tower is more than 200ft. Grounding kits shall be grounded to ground bars by a #2 solid copper jumper. Ground bars shall be grounded to each other and to the site's ground ring by #2 solid copper wire.

Mount coaxial cable to water tower and radio tower using all stainless steel hardware. Submit mounting details for approval.

Provide a section of 1/4-inch diameter "superflexible" transmission cable for routing within the RTU cabinet from the radio's antenna port to the enclosing cabinet's surge arrester connector.

2.9 HMI HARDWARE

The Human Machine Interface (HMI) Hardware shall consist of one primary SCADA node and one secondary SCADA node. The primary SCADA node shall be a server-class windows-based PC. The secondary SCADA node shall be a workstation-class windows-based PC. The following represents the minimum configuration for current hardware and software.

Primary SCADA Node

Form Factor:	19" Rackmount
Processor(s):	Two (2) Intel Xeon processors,2.8GHz,
Front Side Bus:	400MHz
Memory :	4GB,DDR SDRAM
Hard Drive:	5 bay hot plug SCSI backplane with three 73GB Ultra 320 SCSI drives operating in RAID 5 configuration with PERC3 RAID controller
CD/DVD Drives:	4x DVD+RW/+R w/ CD-RW
Floppy Drive:	3.5" 1.44MB Floppy Drive
Operating System:	Microsoft® Windows® 2000, CD (Service Pack 5)
Power Supply:	2x500W Dual Redundant AC Power Supply
Network Card:	Dual onboard 10/100 Ethernet NICs with load balancing and failover
Modem :	56k PCI (Winmodem not allowed)
Monitor :	17" (16" vis) Flat CRT, 1024x768, .25 mm pixel pitch
Service:	3 Yr Same Day 4-Hour 5x10 On-Site Parts & Labor
Miscellaneous:	2-button w/scroll Intellimouse; keyboard; speakers; mouse pad
Application Software:	SCADA Server software, Autodialer software, Microsoft Office 2000 Pro with Access, McAfee VirusScan and PC Anywhere
Utility programs	as required to manage system re-start and recovery after a power or network failure
Accessories	The HMI computer shall be furnished with all required hardware, software and peripherals for operation and maintenance. These items include: All required software interfaces and drivers. All required cables and connectors Operation Manual (Owners' Guide)
Full documentation for all software	
	Software License Registration forms (Completed and mailed. Provide copies of all completed forms to the Government for records.) HMI Software:

Secondary SCADA Node

Form Factor:	Mini Tower
Processor(s):	Intel Xeon processor,2.8GHz,
Front Side Bus:	533MHz
Memory :	4GB,DDR SDRAM
Hard Drive:	146GB Ultra 320 SCSI drive
CD/DVD Drives:	4x DVD+RW/+R w/ CD-RW
Floppy Drive:	3.5" 1.44MB Floppy Drive
Operating System:	Microsoft® Windows® 2000, CD (Service Pack 5)
Power Supply:	460W
Network Card:	10/100 Ethernet NIC
Modem :	56k PCI (Winmodem not allowed)
Monitor :	[AM#2] 17" (17" vis) LCD Flat panel, 1024x768 native, 500:1 contrast
Service:	3 Yr Same Day 4-Hour 5x10 On-Site Parts & Labor
Miscellaneous:	2-button w/scroll Intellimouse; keyboard; speakers; mouse pad; non-integrated soundcard and video card
Application Software	SCADA Server software, Autodialer software, Microsoft Office 2000 Pro with Access, McAfee VirusScan and PC Anywhere
Utility programs	as required to manage system re-start and recovery after a power or network failure
Accessories	The HMI computer shall be furnished with all required hardware, software and peripherals for operation and maintenance. These items include: All required software interfaces and drivers. All required cables and connectors Operation Manual (Owners' Guide)
Full documentation for all software	
	Software License Registration forms (Completed and mailed. Provide copies of all completed forms to the Government for records.)
HMI Software:	

The HMI Computers shall have an internal communications interface card for communication with the PLC control network. The communication card shall be approved by the PLC [AM#2] manufacturer and the HMI software manufacturer.

2.10 HMI SOFTWARE

Rockwell Software RSView, Wonderware Intouch, or Intellution Fix Dynamics, Development and Runtime software packages [AM#2] for both primary and secondary SCADA nodes and all required drivers and accessory software packages for graphical HMI, trending of all points, alarming of all points. HMI software shall be fully compatible with and specifically designed for Windows 2000 operating system.

Reports to include:

Daily [AM#2] ____ trend chart indicating all flows, (Avg., Min.,Max., Totalized)
Daily [AM#2] ____ trend charts indicating all levels, (Avg., Min.,Max., Totalized)
5 additional reports of the Government's request.

2.11 PLANT ALARMS

The Contractor shall install audible plant alarms for the Control System so that operators will be alerted to system alarms when they are not in the control room. Install one interior audible alarm in the building (not in the Control Room) and install one exterior audible alarm in a weatherproof housing. The alarms shall have adjustable volumes. The audible alarms shall be field located as directed by the Contracting Officer. These alarms shall be operated from a Programmable Logic Controller output. The HMI shall be configured with an alarm area designated for 'plant alarms'. The HMI plant alarm area will allow any appropriate HMI database tag to be set to that alarm area. The HMI plant alarm area will set the PLC output for the alarms. The Contractor shall coordinate all alarm summary screens and alarm features with the Contracting Officer.

2.12 AUTODIALER

The Automatic Dialing and Voice Annunciation Alarm Management System shall consist of a true 32 bit Microsoft Windows based software. The Alarm Management System shall be capable of bi-directional communication with other 32 bit Application Software Packages. Software and hardware must be capable of accomplishing the following tasks:

a. Upon Alarm condition: facilitate the display of alarm information to the screen of a Windows based computer system. Must additionally be able to display alarm information to the screen while other Windows based application software is running.

b. Upon Alarm condition: facilitate the compilation and transmission of alarm information over standard telephone lines to residential or commercial sites, or cellular phones, provide for verbalization of alarm information and allow for the password secured remote acknowledgment of such alarms.

c. Allows for Voice Dial-in Connection via telephone line to facilitate the Acknowledgment of active alarms.

d. Allows for Voice Dial-in Connection via telephone line to facilitate the inquiry of and the alteration of values of digital or analog tags.

e. Both Voice Dial-in and Voice Dial-out access modes shall be protected by mandatory redundant password entry system.

f. Allow for the creation of "DDE Watchdog Alarms". A Watchdog Alarm is a special DDE monitoring function which makes it possible to test the connection and functionality of a DDE link to device drivers. Detection includes faulty or cut cabling to the device as well as loss of the DDE connection. Upon the activation of any Watchdog Alarm, facilitate the compilation and transmission of an alarm to any valid output media identical to either analog or digital alarms.

g. Autodialer Software Shall be 32 bit Microsoft Windows based in both configuration and execution modes. The installation process shall occur in the Windows environment and automatically install all required

software onto the destination computer and create all necessary Windows groups and icons.

h. Configuration Software Shall be configurable to be compatible with 110, 300, 600, 1200, 2400, 4800, 9600, 19200 or 38400 BAUD Paging Systems and shall adhere to the TAP protocol standard. It shall be configurable to be compatible with most major brands of data modem by allowing individual configuration of baud rate, modem initialization string, dialing prefix, dialing suffix and modem hang-up strings and accommodate paging systems requiring "passwords".

i. Shall allow for the creation and maintenance of a "phone book" of destinations for alarm transmissions. The phone book shall be independently configurable for and shall maintain day of the week, time of the day and type of transmission eligibility for each phone book entrant. The quantity of eligibility entries in the phone book shall be unlimited.

j. Shall provide for the creation of "Groups" consisting of selected entries from the Phone Book. A "Group" may be considered to be a logical grouping of alarms, based upon the type of transmission desired as a result of any alarm condition. Group configuration shall allow for:

1. Allow for selection of recipient list for alarm transmissions along with recipient priority determination.

2. Allow for user enable/disable of: printer output, datalogging to disk file, automatic acknowledgment upon return to normal of alarm condition, mandatory user acknowledgment of alarms.

3. Shall allow for the creation and maintenance of "reports" or organized collections of tags. Such reports may be Voice accessed via telephone line employing a mandatory password protection system. The report feature shall make it possible to inquire and receive a verbalization of the description of the tag requested, along with the current value. It shall also be possible to alter any analog or digital value through a verbalized verification process. This alteration process calls for the pre-configuration of the tag, making it available for inquiry and/or change. A triple redundant password protection scheme must be satisfied in order to change values.

k. Execution Software Shall be capable of displaying on screen, current alarm status and alarm history status of a minimum of 1500 simultaneous DDE or Direct Connected alarm tags, depending on Windows/Operating System limitations. Maximum is dependent upon number of free Windows "handles".. the more programs running at one time, the fewer the available handles.

l. Autodialer I/O database is direct connected to HMI process database to avoid duplication of tags for ease of maintenance.

m. Shall allow for manual transmission of user entered alphanumeric or numeric pages by selection of destination from the phone book and message entry.

n. Autodialer shall be Specter Instruments TeleDAC-50/32 or equal.

2.13 INSTRUMENT ACCESSORIES

2.13.1 Instrument and Control Device Tags

Each field mounted field device shall be identified by its unique tag number as it appears on the original P&I diagrams and the Instrument Loop Diagram. The tag number shall be stamped on a 1" x 2" stainless steel tag permanently attached to the instrument by braided stainless steel wire which has been sealed by an approved method such that the wire must be cut or the seal broken to remove the tag. The tag number shall not be stamped on the nameplate of the instrument. This requirement shall be documented on the Instrumentation Specification Sheet.

2.13.2 Process Tubing

Stainless Steel, ASTM A 269, TP316, seamless, annealed, 1/2" x 0.065" W.T. minimum.

2.13.3 Pneumatic Supply Tubing

Stainless Steel, ASTM A 269, TP316, seamless, annealed, 1/2" x 0.065" W.T., 3/8" x 0.049" W.T. and 1/4" x 0.035" W.T. minimum.

2.13.4 Fittings

316 Stainless Steel ferrule type, SWAGELOCK or approved equal.

2.13.5 Pipe Stand Type Supports for Instrumentation

Pipe stands shall be hot dipped galvanized and welded fabrications with 2" sch. 40 pipe, 2" square tube x 0.188 inch thick, 3/8 zinc/cadmium plated hardware, 1/2 inch expansion anchors, 12 gage mounting channel and 1/4 inch thick steel plate as a minimums. Supply u-bolt or cable mounts as necessary. Acceptable alternatives include engineered pipe stand systems such as O'brien Saddlepak.

2.14 CALIBRATION

Order instruments factory calibrated to the range indicated on the loop diagram and with calibration sheets indicating certification of traceability to National Institute of Standards and Technology (NIST).

2.15 FABRICATION

1. Shop Assembly:

2. Shop and Factory Finishing:

3. Tolerances:

4. Materials of Construction: Provide 316 Stainless Steel for wetted and other parts unless otherwise specified.

2.16 SOURCE QUALITY CONTROL

1. Tests

2. Inspections

3. Verification of Performance

PART 3 EXECUTION

3.1 APPLICATION

3.1.1 Installation

Install sensing elements at the point of measurement and route sensing line or cable to the transmitter. Install transmitters 4'-6" above grade or platform in an easily accessible location adjacent to the sensor location. Mount on pipe stanchion or steel support designed for the purpose individually or grouped with other transmitters. Route signal cable in conduit from transmitter to terminal cabinet or control panel for termination to test terminals. Steel supports shall be in accordance with this Section, and all other sections and specification requirements. Process connections for instrumentation shall be in accordance with piping sections and all other specification requirements. Provide block valves at taps for pressure or sampling sensor lines. Provide plugged tees at taps suitable for rodding or blowing out taps. Make pipe taps with weldolet type fittings or equal. Install block valves suitable for the service and rated as the pipe at each tap, generally use NPT threaded ball valves. Use materials rated for the service. Transition to tubing for sensor runs. Use 1/2" OD 316 SS tubing or as shown on drawing details.

3.1.2 Flow instruments

[AM#2] Mount flow switch according to manufacturer's instructions with all hardware necessary. Flow switch to be paddle-type. Tap process pipe and provide all fittings necessary.

3.1.3 Pressure Instruments

Make pressure taps in top of pipe for gas service and side of pipe for liquid or steam service.

3.1.4 Pressure Guages

Use 1/2" NPT pipe and ball or needle valve for pressure guage taps. Mount guages vertically; provide 90 degree fitting, seal, snubber or siphon tube as required. Where 90 degree fitting is required, install a tee-fitting with plug.

3.1.5 Differential Pressure and Level Transmitters

Use 1/2" tubing and ball or needle valves for pressure taps. Slope tubing runs 1" per foot to drain the sensing line to the pipe where the transmitter is higher than the tap and to drain the line to the transmitter where the transmitter is lower than the tap. At the transmitter connection provide a valve manifold that can block, bleed, vent, purge and provide calibration ports to the transmitter. For gas service transmitters, route 1/2" tubing straight up from the tap for a minimum of 12" to a high point in the line,

then with a minimum slope of 1" per foot to the transmitter connection. Provide an automatic condensate drain at the transmitter.

3.1.6 Temperature Instruments

Generally mount thermocouple assemblies in the side of the pipe at a minimum angle of 15 degrees up from horizontal and route thermocouple or RTD cable to the transmitter in conduit. Do not mount thermocouples absolutely horizontal or at angles below horizontal. Provide adequate clearance for removal of head assembly and extraction of sensor.

3.1.7 pH Elements

For pH elements mounted in sample lines, mount according to manufacturer's instructions in an insertion assembly which permits removal of the element while the process line is pressurized. Mount with the element vertical and in a trap to keep electrodes hydrated. Arrange taps and sensor lines to keep flow velocity at sensor below 10 ft./sec.

Mount all instrumentation according to manufacturer's instructions except as specified.

3.1.8 Tubing and Fittings

Install tubing and fittings in a neat, orderly and functional manner; level and plumb except as required, noted on approved drawings, or specified. Make offsets required for fittings or equipment level in the horizontal plane to prevent high or low spots.

3.1.9 Conduit and Fittings

Install conduit as required. Provide a cast body tee fitting at the instrument connections at The low point of all conduit runs below the instrument with a drain fitting for condensate. Make connections from instrument to tee with liquid-tight flexible conduit and use sealing compound inside the conduit and shrink-fit tubing over the outside of the connection to prevent entry of water into the instrument. Heat trace and insulate all liquid filled lines and the sensing body of all instruments connected to liquid service in exterior locations.

3.1.10 Calibration

Calibrate each and every instrument furnished under this contract, and fill out a signed and dated five point calibration sheet and install an initialed and dated calibration sticker.

3.2 SCADA

3.2.1 Graphical Screen Configuration Requirements

Provide a tree-type hierarchy menuing structure based on; plant overview, individual process or system overview, and detailed process drawings. Provide a menu button bar (composed of icons) which will allow the operator to quickly move between frequently used functions and coordinate these functions with the Plant Supervisor. Make provisions for and train operators in the operations of adding menu bar functions.

All alarms should be available to the operator at all times.

3.2.1.1 General Guidelines

The Contractor shall follow these general guidelines for building ALL graphical screens:

Use Instrument Society of America (ISA) standard symbols as indicated by the Process & Instrumentation Diagram Symbol Legend Symbols wherever possible, especially for drawing P&ID screens shown on the Plans.

Use consistent color schemes throughout. The status of the equipment shall be indicated by the color of the symbol shown on the display. The following colors shall be used consistently in all displays to indicate the status of equipment:

Motors:

Called For - Blue
Running - Red
Off - Green
Failed - White
Signal Loss - Yellow (out of service)

Alarms:

High Level - Red
Low Level - Green
Signal Loss - Yellow (out of service)

Provide high quality graphic screens which use animated objects using dynamic levels, pipe flows, and status information. Pipes, tanks, vessels, and similar objects shall utilize animated color fill techniques where applicable (i.e. one-line figures are not acceptable).

All screens shall be demonstrated and the Contracting Officer may offer suggested screen layouts and features.

3.2.1.2 Configuration Requirements

The contractor shall provide the following specific configuration requirements to the human-machine interface:

Overall System:

[AM#2] System map showing all sites.
Active alarm summary page common to all screens.

Individual Systems

Develop multiple screens showing the [AM#2] _____ process at each site. One screen minimum per [AM#2] site.

Display status of levels, pumps and valves and all analog values [AM#2] graphically and numerically.

Develop auxiliary screens as follows:

Personnel Phone Directory
On-call personnel
Production personnel phone numbers
Emergency Phone Numbers
Individual Unit page summaries and Alarm summary page.
Develop a text page to allow for operator instructions, comments, or troubleshooting information.

Additionally the Government shall be able to provide specification of five additional but presently undefined screens, which will not exceed the complexity of any of the above.

Use appropriate symbols for process equipment that accurately shows the type of equipment.

Configure all analog points including PID controller set point, process variable, controller output and valve position variables for trending, (trend blocks) and configure screens to display all trend data. Include a trend screen, which allows the user to assign as many traces as he wishes by simply assigning a trace color to a tag number. Trend screens shall include a legend with the tag number, service [AM#2] , and pencolor.

3.2.1.3 Final Acceptance Test

The Contractor shall conduct a 10 day Final Acceptance test of the completed installation. The test shall start after the Contracting Officer has received marked record (as-built) drawings from the Contractor and when directed by the Contracting Officer. The contractors personnel shall be on site 24 hours each day during the acceptance test.

The system shall operate with 100 percent reliability during the test period. Failure shall be defined as the inability to control or indicate status of specified inputs or outputs or any specified function of the control systems as described herein caused by defective hardware or software furnished in this project. Failure of hardware or software shall require repair or remedy of the defect to the satisfaction of the Contracting Officer within a two hour period. If the problem cannot be repaired in this time, the test shall be aborted and restarted after the problem is corrected and when directed by the Contracting Officer. Restarting and satisfactory completion of the test shall be conducted at no additional cost to the Government.

The Contractor shall complete the Operations and Maintenance Manuals including all updated documentation of programmable devices to the satisfaction of the Contracting Officer.

The Contractor will be allowed two attempts at successfully completing the Final Acceptance Test. After that time, he will be become responsible to reimburse the Government for liquidated damages.

3.2.1.4 Service and Training

Manufacturers shall provide as part of the equipment cost sufficient days of service by a factory-trained service engineer specifically trained on the type equipment herein specified to assist the Contractor during installation and start-up. The service time shall be sufficient to place the units in

satisfactory service and instruct the Government's personnel in proper operation and maintenance of the equipment.

A minimum of three (3) days' service Engineer time shall be provided.

Maintenance Instruction: Operating and maintenance instructions, along with a separate parts list, shall be furnished in three (3) copies to the Government. Operating instructions shall also incorporate a functional description of the system, including the system schematics which reflect "as-built" modifications. Maintenance requirements particular to the system shall be clearly defined, along with calibration and test procedures.

3.2.2 Control Sequence

The SCADA system shall provide automatic and manual operation both locally and remotely for each site within the water system, and for the water system as a whole as selected by the operator. When automatic control is selected, each pump station or well shall be activated based on the level in that pump's control tank. Setpoints shall be easily changeable by the operator through the HMI. Controllers at pump stations composed of multiple pumps shall locally, automatically coordinate the operation of each pump as directed by the Contracting Officer. [AM#2] Chlorine feed shall be controlled by the ON/OFF status of wells. (_____.) **[AM#5] The control tank for each pump station shall be easily changeable by the operator through the HMI. Initial control sequence shall match existing system or as otherwise directed by the Contracting Officer.**

In the absence of communication with the master controller (1318), the RTU's at 7094 (Beaumont), 4318 (Logan Heights), 11171 (Biggs), 3695 (Tobin), and 8102 (Dona Ana) shall control the operation of tanks and pumps within their respective areas as shown on the network topology drawing. These areas shall operate autonomously from the master controller and report all data to the master controller and also allow control from the master controller. This autonomous operation shall occur automatically and shall not require operator intervention in the event of communication failure with the master.

3.2.3 [AM#2] SCADA Construction Phasing

Retain existing system in operational order until existing operational capability is proven to exist in new system. Coordinate with Contracting Officer and water plant staff before removing any piece of existing SCADA equipment. Construct, install and fully configure HMI computers and master PLC cabinet before installation of RTUs. RTUs shall be fully constructed before field installation. Install RTU at nearby site of Contracting Officer’s choice. Prove reliable communication and operation. Install RTUs first at Logan Heights Tank 4899, then, at Logan Heights Pump Station / Tank 4318. Prove operation of store and forward capability and robust communication from 4899, through 4318, to 1318 with simultaneous communication between 4318 and 1318. Furthermore, demonstrate communications failure between 4318 and 1318 with continuation of operations between 4899 and 4318. Next, install RTU at McGregor Communication Building 9600 and McGregor Tank 9494. Prove robust operation. After successful demonstration of these initial test sites to the satisfaction of the Contracting Officer, proceed with installation of remaining RTUs. Replace existing sub-masters only after all RTUs that communicate through that site have been replaced. New RTUs that communicate through a repeater shall temporarily communicate through another RTU or directly to 1318 until new repeater has been

installed. RTUs at range camps shall all be installed together with minimal down-time to that system. Coordinate all work well in advance with Contracting Officer. After all RTUs have been installed demonstrate communication failures to each hydraulic system. (Logan, Beaumont, Biggs, Tobin, and each range camp). Communications failures shall allow continued communication between tanks and pump stations in each hydraulic system.

3.3 DEMONSTRATION

3.3.1 System Demonstration

The system shall operate with 100 percent reliability during the test period. Failure shall be defined as the inability to control or indicate status of specified inputs or outputs or any specified function of the control systems as described herein caused by defective hardware or software furnished in this project. Failure of hardware or software shall require repair or remedy of the defect to the satisfaction of the Contracting Officer within a two hour period. If the problem cannot be repaired in this time, the test shall be aborted and restarted after the problem is corrected and when directed by the Contracting Officer. Restarting and satisfactory completion of the test shall be conducted at no additional cost to the Government.

3.3.2 Final Acceptance Test

The Contractor shall conduct a 10 day Final Acceptance test of the completed installation. The test shall start after the Contracting Officer has received marked record (as-built) drawings from the Contractor and when directed by the Contracting Officer. The contractors personnel shall be on site 24 hours each day during the acceptance test.

a. The Contractor shall complete the Operations and Maintenance Manuals including all updated documentation of programmable devices to the satisfaction of the Engineer.

b. The Contractor will be allowed two attempts at successfully completing the Final Acceptance Test. After that time, he will be become responsible to reimburse the Government for liquidated damages.

3.3.3 Service

Manufacturers shall provide as part of the equipment cost sufficient days of service by a factory-trained service engineer specifically trained on the type equipment herein specified to assist the Contractor during installation and start-up. The service time shall be sufficient to place the units in satisfactory service and instruct the Government's personnel in proper operation and maintenance of the equipment.

a. A minimum of three (3) days' service Engineer tim shall be provided.

3.3.4 Maintenance Instruction

Operating and maintenance instructions, along with a separate parts list, shall be furnished in six (6) copies to the Government. Operating instructions shall also incorporate a functional description of the system, including the system schematics which reflect "as-built" modifications.

Maintenance requirements particular to the system shall be clearly defined, along with calibration and test procedures.

3.3.5 Warranty

All equipment and workmanship furnished under this contract shall be guaranteed to be free of defects in materials and workmanship for a period of one (1) year from and after the date of final acceptance of the work by the Government, and any such defects which appear within the stipulated guaranty period shall be repaired, replaced or made good without charge. This guarantee shall include the capacity and integrated performance of the component's parts.

3.4 INSTRUMENT SPECIFICATION SHEET

Level Indicating Transmitter: The transmitter shall meet the following specifications:

LEVEL INDICATING TRANSMITTER [AM#2] (LIT)

Range	[AM#2] 0-200 ft H2O
Operating Temperature	-40 degrees F to 185 degrees F
Input	Differential Pressure
Output	4-20mA dc user selectable for linear or square root output. Process variable superimposed on the 4-20mA signal, vailable to any host that conforms to the HART protocol.
Power Supply	12 to 45 Vdc
Features	3 valve stainless steel manifold
Display	Analog indicator scaled to match application
Suppliers	Rosemount 3051 or approved equal
Scope	Refer to Plans

3.3 INSTRUMENT SPECIFICATION SHEET

Submersible Level Transmitter: The transmitter shall meet the following specifications:

LEVEL TRANSMITTER [AM#2] (LT)

Range	[AM#2] 0-40 ft H2O
Operating Temperature	-5 degrees F to +140 degrees F
Input	Pressure
Output	4-20mA dc user selectable for linear or square root output.
Power Supply	9 to 32 Vdc
Accuracy	< plus or minus 0.25 percent of full scale
Features	3 valve stainless steel manifold
Display	Analog indicator scaled to match application

Suppliers	Druck PTX 1290 or approved equal
Scope	Refer to Plans

3.5 SCADA I/O POINT LIST

The Fort Bliss SCADA I/O Point List follows at the end of this section. [AM#2] This list was created from the existing as-built drawings and has some new I/O points added. Contractor to verify all existing physical I/O plus additional I/O required on new RTUs for determining I/O card requirements. Contractor shall provide HMI programming for all existing I/O and shall provide I/O cards, wiring and PLC programming for all existing physical I/O plus new plus 25% spare.

-- End of Section --