

DEPARTMENT OF THE ARMY
Omaha District, Corps of Engineers
106 South 15th Street
Omaha, Nebraska 68102-1618

:NOTICE: Failure to acknowledge : Solicitation No. DACA45-02-B-0009
:all amendments may cause rejec- :
:tion of the bid. See FAR : Date of Issue: 05 JUNE 2002
:52.214-3 of Section 00100 : **Date of Opening: 15 JULY 2002**

Amendment No. 0003
05 July 2002

SUBJECT: **Amendment No. 0003** to Specifications and Drawings for Construction of
LIVE ORDNANCE LOADING AREA (LOLA), ELLSWORTH AFB, SD
Solicitation No. DACA45-02-B-0009

TO: Prospective Bidders and Others Concerned

1. The specifications and drawings for subject project are hereby modified as follows (revise all specification indices, attachment lists, and drawing indices accordingly).

a. Specifications. (Descriptive Changes.)

1. Page 00800-5, Paragraph 1.10, delete "NOT USED" and substitute the following:

"1.10 QUANTITY SURVEYS (APR 1984)

- a. Quantity surveys shall be conducted, and the data derived from these surveys shall be used in computing the quantities of work performed and the actual construction completed and in place.
- b. The Contractor shall conduct the original and final surveys and surveys for any periods for which progress payments are requested. All these surveys shall be conducted under the direction of a representative of the Contracting Officer, unless the Contracting Officer waives this requirement in a specific instance. The Government shall make such computations as are necessary to determine the quantities of work performed or finally in place. The Contractor shall make the computations based on the surveys for any periods for which progress payments are requested.
- c. Promptly upon completing a survey, the Contractor shall furnish the originals of all field notes and all other records relating to the survey or to the layout of the work to the Contracting Officer, who shall use them as necessary to determine the amount of progress payments. The Contractor shall retain copies of all such material furnished to the Contracting Officer."

2. **Page 00800-11**, Paragraph 1.30, delete "NOT USED" and substitute the following:

"1.30 PARTNERING

- a. The Government intends to encourage the formation of a cohesive partnership with the Contractor. This partnership will be structured to draw on the strengths of each organization to identify and achieve reciprocal goals. The objective is effective contract performance in achieving completion within budget, on schedule and in accordance with plans and specifications. This partnership between the Contractor and the Government will be voluntary and its implementation will not be part of the contract requirements nor will it result in a change to contract price or terms.
- b. It is anticipated that immediately after the preconstruction conference, the appropriate Contractor's key personnel and Government key personnel will attend a 2-day team building workshop. Follow-up workshops of 1 or 2 days duration may be held periodically throughout the duration of the contract as agreed to by the Contractor and the Government. Costs of the facilitator and facilities for the workshops will be shared equally by the participants."

3. **Page 2753-12**, delete contents of paragraph 1.4.1.4 and substitute:

"The quantity of steel reinforcement used in the work will not be measured for payment but will be considered as a subsidiary obligation of the Contractor, covered under the price per cubic meter for concrete."

4. **Page 16415-34**, paragraph 3.2.1, add the following to the paragraph:

"Conduit routed exposed in wet interior, dry interior, or exterior areas shall be rigid galvanized steel (RGS) conduit. EMT shall be routed in stud framed walls and above acoustical tile ceilings, and PVC-40 shall be routed in brick/block walls, poured concrete walls and floors, and underground."

- b. Specifications (New and/or Revised and Reissued). Delete and substitute specification sections as noted below. The substituted sections are revised and reissued with this amendment.

Sections Deleted	Sections Substituted
Pages 00010-3&4	Pages 00010-3&4
-----	Section 13111A

c. Drawings (Not Reissued). The following drawings of drawing code AF116-90-06 are revised as indicated below with latest revision date of 05 July 2002. These drawings are not reissued with this amendment.

1. Drawing C1.01, at drawing coordinate 6E, revise leader:

Delete:

"Temporary security fence contractor to install temporary fencing before the existing fence is to be removed"

Substitute:

"Temporary Security Fence - Contractor to install temporary security fencing. Existing fence fabric from existing fencing to be removed along Schilling Road may be used at the option of the Contractor. All other new permanent fencing as shown on the drawings shall be installed prior to removing any existing fence."

2. Drawings Q3.01, Q32.02, Q3.03, Q3.05, Q06, Q3.07, Add the following new notes (2. & 3.) to the sheets:

"2. All airfield pavement abutting blast deflectors shall be thickened edge expansion joints. Intersecting joints shall be perpendicular to the blast deflector foundation for a minimum 0.91 meters.

3. All slabs other than 6.09m x 6.09m in size abutting blast deflector foundations shall be reinforced (r). See reinforcing details on Sheet QC.01."

3. Drawing Q3.01, add note:

"4. All longitudinal and transverse joints shall be sealed with preformed elastomeric joint seals unless otherwise noted. See Section 02760 and sheet QC.01 for details."

4. Drawings QH.01, QH.02, QH.03, add drawing sheet note:

"Sheet Note: 152mm solid yellow centerline striping see Section 02763 for material details"

Add leader note to lines coming from all aircraft tail to nose positions and centerline to apron taxiway exit as follows:

"New apron centerline striping to tie into existing parallel taxiway centerline"

Add leader note at junction of new and existing centerlines as follows: "All radius are 27.4m"

5. **Drawing RD.00**, Add the following General Note to the drawing:

"The existing obstacle course will be removed and replaced with all new stages as shown on drawings RD.01 through RD.05. The new location shown on this sheet is proposed. Exact location may vary for final layout within this area. Coordinate final location with the Contracting Officer's Representative during construction."

Also, delete note: "Approximate limits of concrete replacement of Menoher Road".

6. **Drawing A1.01 and A3.01**, PLAN NORTH and TRUE NORTH ARROWS as indicated shall be utilized for building directional reference, and shall supercede PLAN NORTH ARROW direction indicated on Sht. S2.01.
7. **Drawing A1.01**, Enlarged Plan, at drawing coordinate F3, for leader note: "Standard 8" [203] smooth face CMU...Ref Detail A/A3.01". Delete reference to "Detail A/A3.01" and substitute "Detail 1/A3.01".
8. **Drawing A1.01**, Floor Plan at drawing coordinate A5, delete Detail Reference D/A1.01/A3.01 and outline boundary. Detail is not applicable.
9. **Drawings A1.01**, under Floor Plan title add the following floor plan notes:

"Floor Plan Notes

1. Pipe Bollards shall be located and placed so as to prevent interference with the building foundation and/or footing below.
 2. Refer Sht. A2.01 for Exterior Wall/Building Elevations, and Sheet A4.01 for Interior Wall Elevations."
10. **Drawing A2.01**, add the following to Key Note 10:
- "Masonry Control Joints (MCJ's) shall be placed a minimum of 2' from any opening and shall not be jogged or staggered. The horizontal reinforcement in adjacent lintel(s) shall extend not less than 40 bar diameters or 2' past the opening (whichever is larger) and shall not be crossed by a MCJ."
11. **Drawing A3.01**, Detail 4, add sheet reference "A3.01" in addition to "A5.01", since the section cut is referenced on A3.01 Roof Plan.
12. **Drawing A3.01**, modify Detail B - Masonry Control Joint (M.C.J.) as follows: At typical MCJ locations, the first 2 cells on each side of the joint shall be vertically reinforced and grouted full. The key shall contain a prefabricated flexible control joint key (gasket), and not

be filled with grout.

13. **Drawing A3.01**, Detail B, sheet reference, delete "A4.01" and substitute "A3.01". Detail B is a TYPICAL Masonry Control Joint (MCJ) as referenced in KEY NOTE No.10 on A2.01. Delete Detail C in its entirety, not applicable.
14. **Drawings A3.01, S2.01 & M3.01**, add the following sheet note to the drawing sheets:

"Sheet Note: Contractor and/or Pre-engineered building manufacturer is required to design/engineer all roof opening support framing integral to the roof framing system as required in the specifications, and as indicated in the STRUCTURAL NOTES (See Sheets. S1.01 and S1.02)."

15. **Drawing A4.01**, add the following sheet notes to the drawing sheet:

"Sheet Notes

1. Details C, D, and E are applicable to Rooms 106 and 107.
2. Detail F, mounting heights for various items (such as light switches) are applicable to all rooms within the building, toilet accessory item mounting heights are applicable to Rooms 106 and 107."

16. **Drawing A5.01**, Wall Detail B, delete sheet reference "A1.01" and substitute "A5.01".
17. **Drawing A5.01**, BUILDING SECTION 1, Detail Reference located at the upper left building wall (at building high roof eave and Vestibule 110 roof) shall be to Detail "4" on A5.01/A3.01.
18. **Drawing S1.01**, Note GN-5 (1D), ground snow loads for Ellsworth AFB, delete "20/(0.96)" and substitute "30/(1.44)".
19. **Drawing S1.02**, add the following to Note MG-2: after "...structural contract documents" add:

"and shall be in conformance with the requirements indicated for vertical reinforcement in CMU walls on Sheet S2.01/Section 1. This wall reinforcement is typical for all CMU walls."
20. **Drawing S2.01**, At drawing coordinate D5, interior footing shown on the foundation plan located between and parallel to grid lines 4 & 5, for Detail 1 delete sheet reference "S2.02" and substitute "S2.01".
21. **Drawing S2.01**, Foundation Plan, add the following to note 1:

"Final footings for columns on grid lines 1,2,3, & 4 of the

foundation plan shall be adjusted accordingly by pre-engineered building manufacturer to accommodate the portal frames of the pre-engineered building.

22. **Drawing S2.01**, add the following additional foundation plan note:

"3. Where construction joints (CJ) and sawed joints (SJ) are shown on the floor slab, they shall be constructed in accordance with Details 7 and 8 of Sheet S2.02."

23. **Drawing S2.01**, on the FOUNDATION PLAN, at approximately drawing coordinate 4A/4B, leader not reading:

"PROVIDE 2#4 (13) x 4'-0" (1219)...(102) O.C."

Add:

"for additional slab reinforcement requirements at all perimeter columns and other re-entrant corners."

24. **Drawing S2.02**, add the following detail notes under the applicable detail:

For Detail 2 add:

"Detail 2 Note:

1. Provides typical reinforcement layout for CMU walls and shall be used for the placement of reinforcement in masonry walls."

For Detail 5 add this third note:

3. Detail 5 provides typical information regarding the placement and reinforcement of equipment pads, (Contractor to reference electrical and mechanical drawings for the locations of these pads).

For Detail 6 add this note:

"Detail 6 Note:

1. Detail 6 provides information regarding the installation of pipe sleeves through the footing walls, (the requirements set forth in this detail shall apply whenever a pipe is going through a footing wall, Contractor to reference mechanical drawings for the locations and sizes of pipes (maximum pipe diameter = 4 inches)."

25. **Drawing ED.01**, Maintenance Pole Lighting Detail, revise to indicate 4 additional fixtures (10 total) on the detail. Add leader note to each of the 4 additional fixtures as follows:

"All four type 'A' fixtures shall be at a 71 degree tilt where 0 degrees is the fixture's lens parallel with ground. With a 0 degree orientation defined as the fixture is aimed perpendicular with edge of concrete pad and looking at poles from above, orient two of the fixtures at 37 degrees and 45 degrees counterclockwise. Orient the other two fixtures at pole 3 at 37 degrees and 45 degrees clockwise at each maintenance pole."

26. **Drawing ED.01**, At drawing coordinate C5, leader note reading: "6 type 'A' fixtures..." change tilt from "75 degrees" to "70 degrees".
27. **Drawing ED.01**, Title of clearance elevation table, change correct spelling by revising "CLEARENACE" to "CLEARANCE". On clearance elevation table, change column heading "FIXTURE" to "POLE". In column 1, delete "POLE A (FUTURE)" and substitute "POLE 5 (FUTURE)". Delete "POLE B (FUTURE)" and substitute "POLE 6 (FUTURE)".
28. **Drawing E1.01**, At drawing coordinate 2D, delete leader note: "Four conduits stubbed out underground and capped" and revise to read: "Four empty conduits routed underground to handhole HH #7."
29. **Drawing E2.01**, at drawing coordinate H3, for the four future hardstand lighting with 1 ½" (38.1 mm) empty conduits shown and routed to HH #7, change the cap symbol on end of each conduit to a break symbol.
30. **Drawing E4.01**, Under supplemental legend for ground rod test box, delete "See detail sheet ??.??" and substitute "Quazite PC1212BA12 base and Quazite PC1212WA00 cover with 'GROUND' logo".

2. This amendment is a part of the bidding papers and its receipt shall be acknowledged on the Standard Form 1442. All other conditions and requirements of the specifications remain unchanged. If the bids have been mailed prior to receiving this amendment, you will notify the office where bids are opened, in the specified manner, immediately of its receipt and of any changes in your bid occasioned thereby.

a. Hand-Carried Bids shall be delivered to the U.S. Army Corps of Engineers, Omaha District, Contracting Division (Room 301), 106 South 15th Street, Omaha, Nebraska 68102-1618.

b. Mailed Bids shall be addressed as noted in Item 8 on Page 00010-1 of Standard Form 1442.

3. **Bids will be received until 2:00 p.m., local time at place of bid opening, 15 JULY 2002.**

Attachments

Section and pages listed in 1.b. above

U.S. Army Engineer District, Omaha
Corps of Engineers
106 South 15th Street
Omaha, Nebraska 68102-1618

05 July 2002
mrp/4413

BIDDING SCHEDULE

Item No.	Description of Item	Estimated Quantity	Unit	Unit Price	Amount
BASIC					
1.	Entire Work Complete for the Live Ordnance Loading Area (LOLA), excluding Basic Items 2 & 3 and Option Items listed Below.	XXXX	JOB	L.S.	\$ _____
2.	Concrete Paving for four (4) Aircraft Parking Aprons (see drawings for thickness)	41,400	Sq. Meter	\$ ____	\$ _____
3.	Bituminous Paving for four (4) Aircraft Parking Shoulders and Road "A" (see drawings for thickness)	16,500	Sq. Meter	\$ ____	\$ _____
4.	Petroleum Hydrocarbon Contaminated Soil (Note: Price to include excavation, loading, transporting and disposal)	38	Cu. Meter	\$ ____	\$ _____
TOTAL BASIC (Items 1. + 2. + 3. + 4.)					\$ _____
OPTIONS					
O-1	Entire Work Complete for installing two (2) additional parking aprons/shoulders for Aircraft and two (2) blast deflectors. (see items below)				
	O-1a. Concrete Paving for two (2) Aircraft Parking Aprons (see drawings for thickness)	19,400	Sq. Meter	\$ ____	\$ _____
	O-1b. Bituminous Paving for two (2) Aircraft Parking Shoulders (see drawings for thickness)	5,500	Sq. Meter	\$ ____	\$ _____
	O-1c. Two (2) Blast Deflectors	XXXX	JOB	L.S.	\$ _____
TOTAL O-1 (Items O-1a. + O1-b. + O1-c.)					\$ _____
O-2	Entire Work Complete for the installation of four (4) hydrant fuel pits.	XXXX	JOB	L.S.	\$ _____
O-3	Entire Work Complete for the installation of two (2) hydrant fuel pits.	XXXX	JOB	L.S.	\$ _____
O-4	Entire Work Complete for relocating and reinstalling Obstacle Course Equipment.	XXXX	JOB	L.S.	\$ _____
GRAND TOTAL AMOUNT (BASIC+ O-1, O-2, O-3 & O-4)					\$ _____

NOTES:

1. See Section 00100, INSTRUCTIONS, CONDITIONS AND NOTICES OFFERORS, paragraph 3 EVALUATION OF OPTIONS for evaluation of bid items and options. The Government reserves the right to exercise the Options within 60 calendar days after Notice to Proceed (NTP). Evaluation of Options will not obligate the Government to exercise the option(s).
2. Quantities for unit priced items are estimated only and the respective unit price will prevail in the event of an overrun or underrun subject to Contract Clause "Variation in Estimated Quantities.
3. Bid prices must be entered for all items of the schedule. Additions and multiplications will be subject to verification by the Government. In case of variation between the lump-sum prices and the total amount, the lump-sum prices will be considered the amount proposed. In case of variation between the unit prices and the extensions, the unit prices will be considered the proposed unit price.
4. A modification to the Pricing Schedule, which provides for a single adjustment to the total amount to Pricing Schedule items, basic or options, should state the application of the adjustment to each respective lump-sum price affected.
5. Option O-3 can be awarded only if Option O-1 is awarded. The awarding of Option O-1 does not obligate the Government to award Option O-3 (*Note: Items a., b. and c. are all inclusive if the award of Option O-1 takes place*).

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STUB-OUTS

11/98

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SECTION 13111A

CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE) FOR HYDRANT FUEL PIPING
STUB-OUTS**11/98**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- ASTM B 843 (1993; R 1998) Magnesium Alloy Anodes for Cathodic Protection
- ASTM D 1248 (1998) Polyethylene Plastics Molding and Extrusion Materials

NACE INTERNATIONAL (NACE)

- NACE RP0169 (1996) Control of External Corrosion on Underground or Submerged Metallic Piping Systems
- NACE RP0177 (1995) Mitigation of Alternating Current and Lightning Effects on Metallic Structures and Corrosion Control Systems
- NACE RP0188 (1999) Discontinuity (Holiday) Testing of Protective Coatings

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 Dec 1999) Metallic Outlet Boxes

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-RE

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.

SD-03 Product Data

Equipment; G-RE

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.

SD-06 Test Reports

Tests and Measurements; G-RE

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, casing and 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.

SD-07 Certificates

Cathodic Protection System; G-RE,

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-RE

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-RE,

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.

1.3 GENERAL REQUIREMENTS

This specification covers only the protection of the hydrant fuel piping stub-outs from the hydrant fuel pits. 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 hydrant fuel lines, their connectors. 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 hydrant pipe shall have a test station. The cathodic protection shall be provided on hydrant fuel 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 to 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 Anode and Bond Wires

Wire size shall be as shown on the drawings. For each cathodic system, the

metallic components and structures to be protected shall be made electrically continuous. 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.

1.3.4 Summary of Services Required

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

- a. Not Used.
- b. Cathodic Protection Systems.
- c. System testing.
- d. Not Used.
- e. Interference testing.
- f. Training.
- g. Operating and maintenance manual.
- h. Not Used.
- i. Coating and holiday testing shall be submitted within 45 days of notice to proceed.

1.3.5 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.

1.3.6 Electrical Potential Measurements

All potential tests shall be made at a minimum of 3 meter 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.

1.3.7 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.

1.3.8 Metallic Component Coating

Coatings for the hydrant fuel piping is covered in the mechanical specifications.

PART 2 PRODUCTS

2.1 MAGNESIUM ANODES

The number of anodes indicated on the drawings shall be installed to protect the pipe lines.

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. kg.	APPROX. SIZE (mm)	NOMINAL GROSS WT kg PACKAGED IN BACKFILL	NOMINAL PACKAGE DIMENSIONS (mm)
1.4	76 X 76 X 127	3.6	133 X 133 X 203
2.3	76 X 76 X 203	5.9	133 X 133 X 286
4.1	76 X 76 X 356	12.3	133 X 508
5.5	102 X 102 X 305	14.5	191 X 457
7.7	102 X 102 X 432	20.5	191 X 610
14.5	127 X 127 X 521	30.9	216 X 711
22.7	178 X 178 X 406	45.5	254 X 610

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 Connecting Wire

2.1.4.1 Wire Requirements

Wire shall be No. 12 AWG solid copper wire, not less than 3 meters long, unspliced, complying with NFPA 70, Type TW 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.

2.2 MISCELLANEOUS MATERIALS

2.2.1 Electrical Wire

Wire shall be No. 12 AWG stranded copper wire with NFPA 70, Type TW 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.

2.2.2 Test Boxes and Junctions Boxes

Boxes shall be outdoor type conforming to UL 514A.

2.2.3 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 13 mm thick. Coating compound shall be cold-applied coal-tar base mastic .

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

2.2.4 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.

2.2.5 Epoxy Potting Compound

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

2.2.6 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 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. . Test stations installed in roads and aprons shall be rated for vehicular traffic.

2.2.7 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.

2.2.8 Underground Structure Coating

Hydrant fuel pipe coating requirements are covered in the mechanical specification on the fuel piping.

2.2.8.1 Field Joints

All field joints shall be coated with materials compatible with the pipeline coating compound. The joint coating material shall be applied to an equal thickness as the pipeline coating. Unbonded coatings shall not be used on these buried metallic components. This includes the elimination of all unbonded polymer wraps or tubes. Once the pipeline or vessel is set in the trench, an inspection of the coating shall be conducted. This inspection shall include electrical holiday detection. Any damaged areas of the coating shall be properly repaired. The Contracting Officer shall be asked to witness inspection of the coating and testing using a holiday detector.

2.2.8.2 Inspection of Pipe Coatings

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. All holidays in the protective covering shall be repaired immediately upon detection. Occasional checks of holiday detector potential will be made by the Contracting Officer's representative to determine suitability of the detector. All labor, materials, and equipment necessary for conducting the inspection shall be furnished by the Contractor.

2.2.9 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.

2.2.10 Electrical Tape

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

2.2.11 Casing

Where a pipeline is installed in a casing under a roadway or railway, the pipeline shall be electrically insulated from the casing, and the annular space sealed and filled with an approved corrosion inhibiting product against incursion of water.

PART 3 EXECUTION

3.1 CRITERIA OF PROTECTION

Acceptance criteria for determining the adequacy of protection on a buried underground tank 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.

3.2 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 be 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 150 mm layers and each layer shall be hand tamped. Care must be exercised not to strike the anode or connecting wire with the tamper. Approximately 20 liters of water shall be applied to each filled hole after anode backfilling and tamping has been completed to a point about 150 mm 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, spaced as shown, 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 150 mm 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 150 mm above the anode. Approximately 8 liters 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 2.5 meters and a maximum of 3 meters 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 610 mm in depth. The cable shall be No. 12 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.

3.2.7 Location of Test Stations

Test stations shall be located as shown.

3.3 TRENCHING AND BACKFILLING

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

3.4 TESTS AND MEASUREMENTS

3.4.1 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.

3.4.2 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.

3.4.2.1 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.

3.4.3 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.

3.4.4 Location of Measurements

3.4.4.1 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 [1.5][3] [____] meters . The Contractor may use a continuous pipe-to-soil potential profile in lieu of 1.5 meter 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.

3.4.4.2 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.

3.4.4.3 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.

3.4.4.4 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.

3.5 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 8 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.

3.6 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.

3.7 MISCELLANEOUS INSTALLATION AND TESTING

3.7.1 Coatings

All aboveground pipeline shall be coated as indicated or as approved. The coating shall have a minimum thickness of 0.18 mm . The pipeline coating shall be in accordance with all applicable Federal, State, and local regulations.

3.7.2 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.

3.8 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.

3.9 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.

-- End of Section --