SECTION 33 11 50

CATHODIC PROTECTION SYSTEM

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Providing a complete galvanic cathodic protection system for the new buried ductile iron pipeline, fittings and appurtenances, as shown on the Drawings and as specified herein. The work includes testing of the system during installation and final system check-out.

B. If the products installed as part of this Section are found to be defective or damaged or if the work of this Section is not in conformance with these Specifications then the products and work shall be corrected at the Contractor's expense.

C. Any retesting required due to inadequate installation or defective materials shall be paid for by the Contractor.

D. The work also requires that one Supplier or Subcontractor accept responsibility for the work as indicated, but without altering or modifying the Contractor's responsibilities under the Contract Documents.

E. The work also requires coordination of assembly, installation, and testing between the pipeline Contractor and any cathodic protection material supplier or Subcontractor.

1.02 REFERENCED SECTIONS

A. The following Section is referenced in this Section

1. Section 01 33 00 – Submittal Procedures

B. The work of the following Sections applies to the work of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this work.

1. Site Safety and Regulatory Requirements
2. Coatings
3. Piping
4. Excavation, Trenching, Backfilling, and Compacting
5. Cast-In-Place Concrete

1.03 REFERENCED SPECIFICATIONS, CODES, AND STANDARDS

A. Comply with the current editions of the following codes and standards:

1. ASTM – ASTM International

a. B3 – Standard Specification for Soft or Annealed Copper Wire

b. B8 – Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

c. C94 – Standard Specification for Ready-Mixed Concrete

d. D1248 – Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable

2. NEC – National Electrical Code

3. NACE – International, the Corrosion Society

a. SP0169-2007 – Recommended Practice, Control of External Corrosion on Underground or Submerged Metallic Piping Systems

b. SP0286-2007 – Electrical Isolation of Cathodically Protected Pipelines

c. RP0375 – Wax Coating Systems for Underground Piping Systems

d. TM0497 – Measurement Techniques Related to Criteria for Cathodic Protection on Underground or Submerged Metallic Piping System

4. Whenever the Drawings or these Specifications require a higher degree of workmanship or better quality of material than indicated in the above codes and standards, these Drawings and Specifications shall prevail.

1.04 QUALITY ASSURANCE

A. Installation of the cathodic protection equipment shall be performed by individuals having at least 5 years of experience in the installation of the cathodic protection equipment described herein.

B. Traffic control shall satisfy the requirements of the governing locality.

C. All testing required to be performed by a “qualified corrosion technician” shall be performed under the supervision of a Corrosion Engineer. A Corrosion Engineer is a Registered Professional Corrosion Engineer or a Certified NACE Cathodic Protection Specialist.

1.05 SUBMITTALS

A. The following shall be submitted to the Engineer prior to any equipment installation:

1. Catalog cuts, bulletins, brochures, or data sheets for all materials specified herein.

2. Certification that the equipment and materials proposed meet the Specifications and the intent of the Specifications.

3. Written certification of experience required.

B. The following shall be submitted to the Engineer after completion of the work.

1. Wire connection testing.
2. Insulating joint testing, before and after backfill.
3. Joint bond testing, before and after backfill.
4. System check-out report.
5. Record Drawings shall be submitted to and approved by the Engineer before the work is considered complete.

1.06 INTERFERENCE AND EXACT LOCATIONS

A. The locations of cathodic protection equipment, test stations, devices, outlets, and appurtenances as indicated are approximate only. Exact locations shall be determined by the Contractor in the field subject to the approval of the Engineer.

B. The Contractor shall field verify all data and final locations of work done under other Sections of the Specifications required for placing of the electrical work.

C. In case of interference with other work or erroneous locations with respect to equipment or structures, the Contractor shall furnish all labor and materials necessary to complete the work in an acceptable manner.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials installed must be new. All equipment and materials supplied shall be similar to that which has been in satisfactory service for at least 5 years.

2.02 CONCRETE TRAFFIC VALVE BOXES

A. The traffic valve boxes:

1. G5 Utility Boxes manufactured by Christy Concrete Products; Inc.,
2. No. 3-RT Utility Box manufactured by Brooks Products;
3. or approved equivalent.

B. Traffic box covers for test stations shall be cast iron with welded bead legend and labeled “CP TEST.”

C. Traffic valve boxes shall be rated to withstand an H-20 loading.

D. Valve boxes shall not be located in driveways or roadways.

2.03 READY MIXED CONCRETE

A. Ready-mixed concrete shall be in accordance with ASTM C94.

2.04 PANEL BOARDS

A. Panel boards shall be made of ¼-inch thick phenolic plastic sized as indicated on the Drawings.

B. Connection hardware shall be nickel-plated brass. All connections shall be double-nutted bolts with lock washers.

C. Copper bus bar shall be 1/8-inch thick and sized to fit.

2.05 SOLDERLESS LUG CONNECTORS

A. Solderless lug connector shall be made of brass or copper with a brass screw. The lug shall be designed for direct burial and shall be appropriately sized for the connection wire. The lug shall be ILSCO Type XT-6DB or approved equivalent.

2.06 SHUNTS

A. Shunts shall be 0.01 ohm, 6 ampere, manganin wire type, as indicated. Shunts shall be Type RS as manufactured by Holloway or equivalent.

2.07 WIRE

A. Conductors shall consist of stranded copper of the gauge indicated. Wire sizes shall be based on American Wire Gauge (AWG). Copper wire shall be in conformance with ASTM Designations B3 and B8.

B. All wires terminating in a junction box or test station shall have a wire identifier attached within 4 inches from the end of wire at the terminal board, prior to backfill, as specified under "Wire Identification."

C. High molecular weight polyethylene (HMWPE) insulating jackets shall conform to ASTM D-1248.

2.08 WIRE IDENTIFICATION

A. Wire identifiers shall be the wrap-around type with a high resistance to oils, solvents, and mild acids. Wrap-around markers shall fully encircle the wire with imprinted alpha-numeric characters for pipe identification. The letters and numbers shall be printed, minimum 3/16-inch in size.

2.09 EXOTHERMIC WELDS

A. Exothermic welds shall be in accordance with the manufacturer’s recommendations. Exothermic welds shall be Cadweld, as manufactured by Erico Products, Inc. or Thermoweld as manufactured by Continental Industries, Inc., or approved equivalent. Duxseal packing as manufactured by Johns-Manville or approved equivalent shall be used where necessary to prevent leakage of molten weld metal. Exothermic welds to DIP shall use XM weld metal for cast iron.

B. The shape and charge of the exothermic weld shall be chosen based on the following parameters:

1. Pipe material

2. Pipe size
3. Wire material/size and requirement for sleeves
4. Number of strands to be welded
5. Orientation of weld (vertical or horizontal)

2.10 BITUMASTIC COATING

A. Bitumastic coating shall be TC Mastic, as manufactured by Tapecoat Company, Bitumastic 50 as manufactured by Kopcoat Inc., or approved equivalent.

2.11 WELD CAPS

A. Weld caps shall be Royston Handy Cap, as manufactured by Royston Laboratories, Inc.; Thermit Weld Cap, as manufactured by Phillips Petroleum Co.; or approved equivalent.

B. Dielectric Insulating Flange Kits

1. Insulating flange gaskets shall include full faced gaskets, insulating sleeves and washers and 316 stainless steel bolts, nuts and washers.
2. The complete assembly shall have a pressure rating equal to or greater than the flanges between which it is installed.
3. Insulating Gasket shall be neoprene faced phenolic, 1/8-inch thick having a high dielectric constant.
4. Insulating sleeves shall be Mylar, 1/32-inch thick. Insulating washers shall be 2 sets of 1/8-inch thick phenolic, having a high dielectric constant.
5. Stainless steel washers shall fit well within the bolt facing on the flange.
6. Insulating washers shall fit within the bolt facing the flange over the outside diameter of the sleeve.

2.12 PETROLATUM TAPE

A. Petrolatum tape system shall be Trenton Primer and #1 Wax-tape, as manufactured by Trenton Corp., or Denso Paste and Densyl Tape by Denso North America, Inc., or approved equivalent.

2.13 DIELECTRIC BARRIER

A. The dielectric barrier between the project pipeline and foreign pipelines crossings shall consist of a 25-mil neoprene sheet.

B. The sheet shall measure 3 feet wide (length as shown on the Drawings) and shall be installed midway between the project pipeline and the foreign pipeline.

C. The pipeline trench shall be extended as required to lay the neoprene sheet flat.

D. The Contractor shall not cut or damage the sheet.

E. The sheet shall be installed at all metallic foreign pipeline crossings at the locations indicated on the Drawings.

PART 3 - EXCAVATION

3.01 EXCAVATION AND BACKFILL

A. Buried wires shall have a minimum cover of 24 inches.

B. Red caution tape (3 inches wide) shall be installed above buried wire and conduits shall be installed at a maximum depth of 18 inches below grade over the wire and conduit location.

C. Anode wire identification tags shall be placed on the wires prior to placing wire in conduit or backfilling.

3.02 TEST STATIONS

A. Test stations shall be installed at the approximate locations shown on the Drawings. Flush mounted test stations shall be located in paved areas, in the sidewalk, or other areas not subject to vehicular traffic. Final location of test stations shall be approved by the Engineer prior to installation. Wire identifiers shall be placed on all wire prior to backfill and installation of test stations.

3.03 WIRES

A. Buried wires shall be laid straight without kinks. Each wire run shall be continuous in length and free of joints or splices, unless otherwise indicated. Care shall be taken during installation to avoid punctures, cuts, or other damage to the wire insulation. Damage to insulation shall require replacement of the entire length of wire at the Contractor’s expense.

B. At least 18 inches of slack (coiled) shall be left for each wire at each test station. Wire slack shall be sufficient to allow removal of the test board for testing. Wire shall not be bent into a radius of less than 8 times the diameter of the wire.

3.04 WIRE IDENTIFICATION

A. All wires shall be coded with wire identifiers.

B. Wire identifiers shall be placed on the wires prior to backfill.

3.05 EXOTHERMIC WELD CONNECTIONS

A. Exothermic weld connections shall be installed in the manner and at the locations indicated. Coating materials shall be removed from the surface over an area of sufficient size to make the connection. The surface shall be cleaned to bare metal by grinding or filing prior to welding the

conductor. The use of resin impregnated grinding wheels will not be allowed. A copper sleeve shall be fitted over the conductor. Only enough insulation shall be removed such that the copper conductor can be placed in the welding mold.

B. The Contractor shall be responsible for testing all test lead and bond wire welds. The Engineer, at his or her discretion, shall witness these tests.

C. After the weld has cooled, all slag shall be removed and the metallurgical bond shall be tested for adherence by the Contractor. A 22-ounce hammer shall be used for adherence testing by striking a blow to the weld. Care shall be taken to avoid hitting the wires. All defective welds shall be removed and replaced.

D. After backfilling pipe, all test lead pairs shall be tested for broken welds using a standard ohmmeter. The resistance shall not exceed 150 percent of the theoretical wire resistance as determined from published wire data.

E. The Contractor shall inspect both the interior and exterior of the pipe to confirm that all coatings and linings removed or damaged as a result of the welding have been repaired. The Contractor shall furnish all materials, clean surfaces and repair protective coatings and linings damaged as a result of the welding. Repair of any coating or lining damaged during welding shall be performed in accordance with coating or lining manufacturer's recommendations.

F. All exposed surfaces of the copper and steel shall be covered with insulating materials as indicated.

G. A bitumastic coating shall be applied to all exothermic weld locations. The coating shall be covered with a plastic weld cap. All surfaces must be clean, dry and free of oil, dirt, loose particles, and all other foreign materials prior to application of the coating.

3.06 JOINT BONDS

A. Bond wires shall be provided across flexible couplings and all nonwelded joints, as necessary to ensure electrical continuity, except where insulating joints have been installed to provide electrical isolation. Joint bonds shall be of the size and number shown on the Drawings and installed as indicated. The bond wires shall be at least 18 inches long and shall be installed so as to allow for movement of at least 2 inches in the pipe joint. The wire shall be attached by exothermic welding. At least 2 bonds shall be provided between non-welded and non-insulated pipe joints to provide electrical continuity of the pipe and fire hydrant laterals.

B. For ductile iron pipe, the Contractor may, at his own expense, provide weld plates at the spigot end of the pipe, installed by the manufacturer of the pipe. Provision of the weld plates does not relieve the Contractor from responsibility for repair of damage to the coating or lining as a result of exothermic welding of the pipe. Coating repairs shall be performed in accordance with coating manufacturer's recommendations.

3.07 PETROLATUM TAPE SYSTEM APPLICATION

A. Petrolatum tape system shall be applied on insulating joints and as indicated in the Drawings. Petrolatum tape system shall be applied in accordance with NACE RP0375, and these specifications. The materials shall be applied according to the Manufacturer's recommendations.

B. All loose scale shall be removed from the surface to be coated with hand tools (wire brush, scraper, and rags).

C. Debris and moisture shall be wiped from surface with clean rag.

D. Petrolatum tape shall be applied immediately after applying the primer, using a 1-inch overlap.

E. A spiral wrap shall be used and a slight tension shall be applied to ensure that there are no air pockets or voids.

F. After applying the tape the applicator shall firmly press and smooth out all lap seams and crevice areas.

G. The tape shall be in tight intimate contact with all surfaces.

3.08 WIRE CONNECTIONS

A. After installation, all wire connections shall be tested at the test station locations to verify that wires are broken. Broken wires are shall be replaced at the Contractor's expense.

3.09 INSULATING JOINTS

A. Insulating joints shall be installed to effectively isolate metallic piping from foreign metallic structures. The Contractor shall test the performance of these insulating joints before and after backfill.

B. Before backfill, the Contractor shall test the insulating joint using a Gas Electronics Model No. 601 Insulation Checker, or approved equivalent. If the testing results indicate less than 100 percent insulation, the insulating joints shall be repaired and retested at the Contractor's expense.

C. After backfill, testing shall be performed by measurement of native pipe-to-soil potentials at both sides of the insulating joint.

1. If the differences in native pipe-to-soil potentials on both sides of the insulating joint are within +/- 50 millivolts, then additional testing shall be performed as follows.

    a. Temporary cathodic protection current shall be circulated on one side of the insulating joint.

    b. "On" and "Instant Off" pipe-to-soil potentials shall be measured on the other side of the insulating joint.

    c. If the "Instant Off" potential is more negative than the native potential, the insulating joint shall be considered deficient and shall be repaired and retested at the Contractor's expense.

3.10 CONTINUITY TESTING

A. After backfill, the pipe shall be tested for electrical continuity.

B. Current shall be applied through the pipe and the measured resistance shall be compared to the theoretical resistance of the pipe and bond wires.

C. If the measured resistance exceeds 150 percent of the theoretical resistance, then the joint bonds shall be considered deficient and shall be repaired and retested at the Contractor's expense.

D. The electrical continuity test may be performed before backfill at the Contractor's option.

3.11 SYSTEM CHECK-OUT

A. Upon completion of the installation, the Contractor shall provide testing of the completed system by a qualified corrosion technician and the data shall be reviewed by a Corrosion Engineer to ensure conformance with the Contract Documents, NACE SP0169, and NACE SP0286.

B. The testing described herein shall be in addition to and not substitution for any required testing of individual items at the manufacturer's plant and during installation.

C. Testing shall be performed at all test leads of all test stations and at the locations of exposed pipe as soon as possible after installation of the cathodic protection system.

D. Testing shall include the following and shall be conducted in accordance with NACE TM0497:

1. Verify electrical isolation at all insulating joints per NACE SP0286.
2. Confirm electrical continuity of the buried pipeline in accordance with this section.
3. Measure and record native structure-to-soil potentials at each location.
4. Measure and record the "On" and "Instant Off" structure-to-soil potentials at each location.
5. Measure and record the current outputs of each anode.

E. Test results shall be analyzed to determine compliance with NACE SP0169.

F. Test results shall be analyzed to determine if stray current interference is present. Stray current interference is defined as a ±50 mV shift in a pipeline's pipe-to-soil potential that is caused by a foreign current source. Stray current interference shall be tested on the project pipeline and foreign pipelines that have a reasonable chance of being affected by stray currents.

G. The Contractor shall provide a written report, prepared by the Corrosion Engineer documenting the results of the testing and recommending corrective work, as required to comply with the contract documents. At a minimum, the report shall include the following:

1. Each test station point of connection to the pipeline.
2. Test station location
3. Continuity testing results
4. Potential and other reading results.
5. Corrosion Engineer review certification

H. Any deficiencies of systems tested shall be repaired and re-tested by the Contractor at no additional cost to the City.

I.

- END OF SECTION -