ETL 91-6
3 JULY 1991

ENGINEERING TECHNICAL LETTER

CATHODIC PROTECTION

OFFICE of THE CIVIL ENGINEER

DIRECTORATE of MILITARY CONSTRUCTION

ENGINEERING DIVISION

AIR FORCE ENGINEERING & SERVICES CENTER

DIRECTORATE OF OPERATIONS & MAINTENANCE

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DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON DC

20330-5140

REPLY TO
ATTN OF: CEC

SUBJECT: Engineering Technical Letter (ETL) 91-6:
Cathodic Protection

TO: Distribution List

1. Purpose

*a. This letter provides the necessary criteria on cathodic protection (CP) and procedures that must be followed by the MAJCOMs, design managers, design agents, and designers for project designs. It also incorporates the CP check list of the superseded ETL and lessons learned from recent design and construction projects.

b. Supersedes ETL 88-5, dated 2 Aug 88, and identifies new or changed paragraphs with an asterisk "."

2. Effective Date. This publication is effective immediately for all projects which have not completed project definition (PD) by receipt of this letter.

3. Referenced Publications.

a. AFR 88-15 (Criteria and Standards for Air Force Construction), Chapter 15, Section K, Corrosion Prevention and Control.

*b. MIL-HDBK-1004/10, Electrical Engineering Cathodic Protection.

c. AFM 85-5, Maintenance and Operation of Cathodic Protection Systems.

d. AFM 85-16, Maintenance of Petroleum Systems.

e. National Association of Corrosion Engineers (NACE) Standard RP-01-69, Control of External Corrosion on Underground or Submerged Metallic Piping Systems.

4. Requirements.

a. General.

*(1) Satisfactory design and construction of CP, protective coatings, and water treatment are functional requirements for virtually all projects. Project design and construction without these items is not acceptable.

*(2) CP shall be provided, where applicable, on all new facilities, and repair or replacement of existing facilities.

*(3) All CP surveys and designs must be performed by a NACE Accredited Corrosion Specialist, NACE Certified CP Specialist, or Registered Professional Corrosion Engineer. The corrosion specialist must have a minimum of five years experience in the design of CP systems.

*(4) All CP designs must be based upon specific field tests made at the proposed construction site. Tests would include, but not limited to, soil corrosivity (resistivity) and water chemistry/corrosivity (pH).

*(5) Under no circumstances will submerged or buried coated metallic facilities be installed without CP.

*(6) All installed CP systems must be based on providing a protective potential to meet the requirements of NACE Standard RP-01-69. All structure-to-earth potentials to be potential drop (IR) free.

*(7) Use of unbonded coatings, such as loose polyethylene wraps, is not endorsed by NACE as an effective corrosion control means. Unbonded coatings will not be used.

*(8) New or supplemental CP will be compatible to the existing CP systems.

*(9) When plastic pipe is used to extend or add onto a steel gas distribution main, an insulated No. 8 AWG copper wire shall be thermit-welded to the existing steel main and run the length of the new plastic main. This wire can be used as a locator tracer wire and to maintain continuity to any future steel gas main extension.

b. Application.

*(1) CP and protective coatings shall both be provided for the following buried/submerged metallic facilities, regardless of soil or water corrosivity:

*Natural Gas Piping

*Liquid Fuel Piping

*Oxygen Piping

*Underground Storage Tanks

*Fire Protection Piping

*Ductile or Cast Iron Pressurized Piping Under Floor (Slab on Grade)

*Underground Heat Distribution and Chill Water Piping in Metallic Conduit.

*Other Facilities with Hazardous Products as Identified by the MAJCOMs.

*(2) Ductile or cast iron pipe will require CP, bonding of joints, and protective coatings in soil resistivities below 10,000 ohm-cm at installation depth at any point along the pipeline. When soil resistivities are above 10,000 ohm-cm at installation depth along the entire pipeline, ductile or cast iron pipe will require bonded joints only. Joint bonds will be No. 4 AWG insulated wire. Exothermic welds and exposed copper wire will be coated. Copper water service lines and brass valves will be dielectrically-isolated from ferrous pipe or be covered with a protective coating.

*(3) The results of an economic analysis and the recommendations by a qualified corrosion engineer shall govern the application of CP and protective coatings on gravity sewer lines, regardless of soil resistivity, and the following facilities in soil resistivities above 10,000 ohm-cm:

Potable Water Lines

Concentric Neutral Cable

Other Buried/Submerged Metallic Facilities Not Covered Above.

*(4) Above ground tanks in contact with the earth built to present criteria (on an oil-filled sand pad with plastic liner underneath) do not require CP. All other ferrous tanks in contact with earth will be cathodically protected. All steel water distribution storage tanks shall be cathodically protected on the interior.

*(5) A metallic ferrous pipe passing through concrete shall not be in contact with the concrete. A sleeve shall be provided with waterproof dielectric insulation between the pipe and the sleeve.

*(6) Ferrous metal piping passing through a concrete thrust block will be insulated from the concrete or cathodically protected.

*(7) The need for lightning and fault current protection at isolating devices (dielectrically insulated flanges) should be considered.

Where a combustible atmosphere may be encountered, a sealed, weatherproof lightning arrester must be installed across each isolating device. The arrester should be the gapless, self-healing, solid state type (metal oxide varistor). Cable connections from arresters to isolating devices should be short, direct, and of a size suitable for short-term, high current loading.

5. Implementation.

a. MAJCOM Responsibilities.

*(1) Copies of DD Form 1391 will be provided to HQ USAF/CEC and HG AFESC/EN.

*(2) All design submittals will be reviewed by the MAJCOM corrosion engineer.

(3) Ensure CP narrative and cost are provided on the DD Form 1391 under supporting utilities where the CP impact is vital to the project, e.g., new underground heat distribution system or replacement thereof, jet fuel hydrant systems, natural gas lines, etc.

*(4) Assure the assignment of the Base Corrosion Engineer and/or CP Technician as technical advisor(s) to the inspector for construction surveillance during installation of all CP systems, testing, and final acceptance. The assignment is applicable for even very minor CP installations. The advisor(s) should be present at all times when CP work is being accomplished.

*b. Design Manager and/or Agent (Air Force, Army or Navy) Responsibilities.

(1) Advertisement for the design of a project that involves piping and tanks as listed in paragraph 4b above will include the following qualifying clause: "The cathodic protection (CP) survey and design must be performed by a National Association of Corrosion Engineers (NACE) Accredited Corrosion Specialist, NACE Certified CP Specialist, or a Registered Professional Corrosion Engineer. This accreditation and/or registration must have been obtained in the field of CP."

*(2) Design will be IAW publications referenced in paragraph 3. CP survey and design will be accomplished prior to construction contract advertisement and must be performed by a NACE Accredited Corrosion Specialist, NACE Certified CP Specialist, or a Registered Professional Corrosion Engineer. This accreditation and/or registration must have been obtained in the field of CP.

*(3) Ensure early preliminary design submittal includes soil corrosivity (resistivity, pH, etc.) data, current requirement tests (if applicable), and all design calculations for CP in the basis of design.

*(4) The basis of design must be provided to the MAJCOM corrosion engineer for review.

*(5) Deletion of CP work shall not be made without the specific approval of the MAJCOM or HQ AFESC/EN corrosion engineer.

(6) If the project contains an underground heat distribution system (prefabricated steel heat conduit system), the conduit system supplier is responsible for the preliminary survey, design, and testing of the CP system. In addition, ensure that the construction contract specifications specifically provide for the following:

*(a) That the system supplier shall use a NACE Accredited Corrosion Specialist, NACE Certified CP Specialist, or a Registered Professional Corrosion Engineer for the survey, design, inspection, and testing of the CP system required for protection of the conduit. The latest revision of NACE Standard RP-01-69 criteria shall be used. The system supplier shall be held responsible for correction all CP construction deficiencies.

(b) That the construction contractor shall not proceed with the CP work until the CP system shop drawings have been approved by the contracting officer's representative. Representative shall be knowledgeable in the installation of CP systems.

*(c) That the contractor must notify the contracting officer 24 hours in advance (minimum) prior to starting any installation of CP systems, CP testing, or final acceptance.

*(7) Ensure the construction inspection is accomplished by a person knowledgeable in CP system installations or ensure the involvement of the Base Corrosion Engineer and/or CP Technician as technical advisor(s) to the inspector for construction surveillance during installation of all CP systems, testing and final acceptance. If the construction agent cannot employ a full-time inspector, the construction agent shall use Type II or

Type C inspection services to obtain a full time qualified inspector.

(8) Ensure all potential readings on the entire CP

system are taken at the proper locations and are in accordance with the contract specifications prior to acceptance of the system.

(9) Ensure as-builts provide for the location of rectifiers, test stations, anodes, insulated fittings, etc., as applicable. Locations will be shown referenced to two permanent facilities or marker points.

(c) Designer Responsibilities.

*(1) In addition to soil and water corrosivity survey, current requirement tests and design, the designer shall provide for recommended tests, formats, required methodology, etc., for the final acceptance of the CP System.

*(2) Guidance in paragraphs 3 and 4 shall be followed.

(3) Provide detailed/sufficient calculations and one line diagrams at the early preliminary design stage to show the magnitude and layout of the CP system.

*(4) Design drawings must show location anodes, rectifiers, etc, installation details, insulators, and bond connections.

(5) Identify all locations for interference tests (all pipe that passed within 1000 feet of an impressed current anode bed and then crosses the cathodically protected line).

*(6) Identify all locations where structure-to-soil potential measurements are needed to assure complete protection and/or to ensure maximum allowed potentials have not been exceeded. Provide pavement inserts to allow structure-to-soil potential testing over concrete and asphalt.

*(7) All piping systems and cable within 1000 feet of proposed groundbeds must be considered to prevent interference problems.

6. Point of contact for this ETL is Tom Lewicki, DSN 523-6359 or Ron Wong, DSN 297-4082.

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Director, Military Construction
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