DEPARTMENT OF THE ARMY
U.S. Army Corps of Engineers
Washington, DC 20314-1000

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Manual
No. 1110-2-2704

12 July 2004

Engineering and Design
CATHODIC PROTECTION SYSTEMS FOR CIVIL WORKS STRUCTURES

1. Purpose. This manual provides guidance for the selection, design, installation, operation, and maintenance of cathodic protection systems (CPSs) for navigation lock gates and other civil works hydraulic structures.

2. Applicability. This manual applies to all USACE Commands having civil works responsibilities.

3. Discussion. The primary corrosion control method for civil works hydraulic structures is a protective coating system, most often paint. Where the paint system and structure are submerged in water, a combination of the anodic and cathodic properties of materials, the liquid electrolyte, and external electrical circuits combine to form electrochemical corrosion cells, and corrosion naturally follows. CPSs can supplement the paint coating system to mitigate corrosion damage.

4. Distribution. Approved for public release; distribution is unlimited.

FOR THE COMMANDER:

6 Appendixes
(See Table of Contents)

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Table of Contents

CHAPTER 1

INTRODUCTION

1-1. Purpose and Scope. This manual provides guidance for the selection, design, installation, operation, and maintenance of cathodic protection systems (CPSs) used to supplement paint systems for corrosion control on civil works hydraulic structures. It also discusses possible solutions to some of the problems with CPSs that may be encountered at existing projects.

1-2. Applicability. This manual applies to all USACE Commands having civil works responsibilities.

1-3. References.

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

b. EM 1110-2-3400, Painting: New Construction and Maintenance.

c. ETL 1110-9-10, Cathodic Protection Systems Using Ceramic Anodes.

d. UFGS-09965A, Painting; Hydraulic Structures and Appurtenant Works.

e. UFGS-13113A, Cathodic Protection Systems (Impressed Current) for Lock Miter Gates.

f. TN ZMR-3-05, Components of Hydropower Projects Sensitive to Zebra Mussel Infestations.

g. NACE International Recommended Practice RP0169-2002, Control of External Corrosion on Underground or Submerged Metallic Piping Systems.

h. PROSPECT course handbook 009, 2003-01 et seq., Corrosion Control.

i. ERDC/CERL TR-01-73, Low-Maintenance Remotely Monitored Cathodic Protection Systems Requirements, Evaluation, and Implementation Guidance (Vicki L. Van Blaricum, William R. Norris, James B. Bushman, and Michael J. Szeliga), November 2001.

j. Calculations of Resistances to Ground (H. B. Dwight), Journ. AIEE Trans., vol 55, 1939, pp 1319 – 1328.

1-4. Background.

a. General. USACE uses CPSs in combination with protective coatings to mitigate corrosion of hydraulic structures immersed in fresh, brackish, or salt water. Protective coatings alone generally cannot offer complete corrosion protection because they usually contain some pinholes, scratches, and connected porosity, and over time these imperfections become increasingly permeable. As coatings degrade with time, these imperfections, commonly known as holidays, have a profound effect on overall coating integrity because of underfilm corrosion. CPSs, when used in conjunction with protective coatings, have been effective in controlling corrosion. CPSs consist of anodes that pass a protective current to the structure through the electrolyte environment. CPSs can be one of two types, sacrificial anode or impressed current anode. Hybrid CPSs installed on structures can include both types of anodes to provide protective current.

(1) Sacrificial CPSs. Sacrificial CPSs, also referred to frequently as galvanic CPSs, employ sacrificial anodes such as specific magnesium- or zinc-based alloys, which are anodic relative to the ferrous structure they are installed to protect. This inherent material property enables sacrificial anodes to function without an external power source, so they generally need very little maintenance after installation. However, by design, sacrificial anodes are consumed by corrosion during their service life and must be replaced periodically in order to ensure continuing protection of the structure. Therefore, these anodes should be installed in accessible locations on the structure. Sacrificial anode CPSs are generally recommended for use with a well coated structure that is expected to be well maintained or subjected to a minimum of damaging wear during its design life. (Note that in this EM the terms “sacrificial” and “galvanic” may be used interchangeably.)

(2) Impressed current CPSs. Impressed current systems employ anodes that are made of durable materials that resist electrochemical wear or dissolution. The impressed current is supplied by a power source such as a rectifier. All impressed current CPSs require periodic maintenance because they employ a power supply and are more complex than sacrificial systems. However, impressed current CPSs can be used effectively with bare or poorly coated structures because these systems include much flexibility in terms of the amount of protective current delivered and the ability to adjust it over time as conditions change.

b. Locations. Since 1950, USACE has used impressed current CPSs with graphite or high-silicon, chromium-bearing cast iron (HSCBCI) anodes. The first systems were installed on the Mississippi River near Rock Island, IL, on an experimental basis. Since then, CPSs have been used widely. About 22 CPSs were installed and are currently functioning on structures on the Tennessee-Tombigbee Waterway, the Alabama River, and the Black Warrior River in the Mobile District. CPSs have been used successfully on the Intercoastal Waterway on seven sector gates in the Jacksonville District and on miter gates in the New Orleans District. Impressed current systems have also been installed on three lock gates on the Columbia River in the Northwest.

Similarly, impressed current systems using both graphite and HSCBCI anodes were installed on lock gates on the Ohio River during the 1970s. However, ice and debris damage has made most of these systems inoperable. Since the early 1980s, a new type of ceramic-coated composite anode material has been used for various electrochemical processes, particularly in the electrolytic production of chlorine and cathodic protection systems, including off-shore, water tank, and groundbed applications. The mixed metal oxide ceramic-coated anodes consist of a conductive coating of iridium or ruthenium oxide (IrO2 and RuO2, respectively) applied by thermal decomposition onto specially prepared titanium substrates. The coatings are applied by spraying aqueous metallic salts onto the titanium substrates and heating to several hundred degrees Celsius. Multiple layers of coating material may be applied by the process to provide a maximum coating thickness of approximately 0.025 mm (1 mil). This type of impressed current CPS anode has been used at Pike Island and other locations with good results.

c. Inoperable impressed current systems. Most of the known inoperable impressed current systems utilized graphite anodes that were more than 20 years old. Only a few navigation structures have had systems that used ‘sausage string’ cast iron anodes provided with impact protection. Properly maintained and protected cast iron anode systems used in high-impact debris areas have provided good results. Graphite systems in low-impact debris areas have also shown good results.

d. Inoperable sacrificial anode systems. Zinc or magnesium sacrificial anodes provide some benefits, but they typically protect only smaller areas of bare metal and, consistent with their inherent material properties, they are consumed at higher rates than impressed current anodes. In order to be beneficial, sacrificial anodes must continue to apply current to the structure by design. Voltage testing must be conducted periodically and consumed anodes must be replaced promptly to keep the system operating in accordance with applicable criteria.

e. Solutions.

(1) Restoration of systems. Most existing inoperable CPSs at navigation structures can be restored. This approach is less expensive than installing complete new systems, and therefore should be considered first. When graphite anode strings are consumed or destroyed, they can be replaced with impact-protected cast iron sausage strings or ceramic-coated wire anodes. In many cases, anode strings can be replaced and systems can be repaired without dewatering a lock.

(2) New or replacement systems. Designers should use UFGS-13113A with this manual for new CPS installation or for complete system replacement when necessary.

f. Effective techniques. National Association of Corrosion Engineers (NACE) Recommended Practice RP0169-2002 specifies techniques for control of external corrosion on civil works hydraulic structures. It includes criteria for both coatings and cathodic protection, and should be used in conjunction with guidance in this manual and with painting design guidance in Engineer Manual EM 1110-2-3400. NACE RP0169-2002 should also be used as guidance unless noted otherwise, and designers should become familiar with it.

g. Resistivity policy. Cathodic protection should be provided on all submerged metallic structures. If, after performing a corrosion mitigation survey, an NACE-certified corrosion specialist or a professional engineer deems cathodic protection unnecessary due to a noncorrosive water, a statement to that effect should be prepared and sent to the district project manager as a part of the corrosion plan.

CHAPTER 2

CORROSION MITIGATION PLAN

2-1. Corrosion Protection Coordinator. Each district should designate a person who has experience and is familiar with cathodic protection techniques to serve as the district corrosion protection coordinator. Such a person may be a licensed professional engineer or a person certified as being qualified by NACE International as a cathodic protection specialist, corrosion specialist, or senior corrosion technologist. This individual will be responsible for ensuring that the CPSs are tested against the applicable corrosion protection criteria and for ensuring that reports on the results of these tests are prepared and maintained at the district for review and reference.

2-2. Plan.

a. Development. A corrosion mitigation plan should be developed by the district corrosion protection coordinator for each hydraulic structure.

(1) New projects. A corrosion mitigation plan should be developed and included in the design memorandum. For a previously completed design memorandum, the plan should be developed and submitted as a supplement to the design memorandum prior to completion of plans and specifications.

(2) Existing projects. A corrosion mitigation plan should be developed and presented as an appendix in a Periodic Inspection Report for reference in subsequent inspections. Corrosion mitigation plans should consider the condition of existing structures, factors that affect the rate of corrosion, methods of corrosion control, and cathodic protection of the structure.

b. Execution. The following policy on optimization, testing, and reporting of the CPS for each structure should be followed.

(1) A survey of the structure-to-electrolyte potential, using a standardized reference cell, should be performed. Any system failing to operate in accordance with established criteria should be optimized by adjustment.

(2) A report showing the condition of the CPSs and including any plans to repair the systems should be prepared and kept at the district for review.

(3) Any inoperable CPS should be repaired as needed.

2-3. Tests and Adjustments.

a. Tests, adjustments, and data collection. Tests should be performed in accordance with the corrosion mitigation plan. Rectifier voltages and currents should be recorded. There are no prescribed time intervals for testing new systems, but measurements should be taken and recorded monthly after initial energization or subsequent re-energization until steady-state conditions are reached. Then, based upon the judgment of the corrosion protection coordinator, tests should be performed at about 6-month intervals for a year or more, and thereafter at yearly intervals. It would be appropriate to monitor critical or strategic structures more frequently. Based upon the measurements taken, the rectifier current and voltage should be adjusted to produce either a negative polarized (cathodic) potential of at least 850 mV with the cathodic protection applied or other minimum cathodic polarization such as 100-mV polarization as described in NACE RP0169-2002 for steel and cast iron piping. This potential should be achieved over 90 percent of each face of each gate leaf. Readings should not exceed a polarized (cathodic) potential of 1200 mV at any location. Acceptance criteria for CPSs should be as defined in NACE RP0169-2002 unless otherwise noted in this manual.

b. Reports. Reports should be prepared and kept at the district. These reports should be prepared in a format similar to that shown in the miter gate sample and table in Appendix A, which presents measurements taken and data obtained. For other types of installations, the report should be modified to show similar data applicable to the respective installation. This report should be completed annually, not later than December.

c. Data. The data accumulated in these reports should be retained to provide a database for consideration of possible improvements to CPS techniques. Reports on the current corrosion deterioration status of the structures should be maintained.

CHAPTER 3

EXPERT ASSISTANCE

3-1. Background. Some USACE districts and laboratories have long been involved in planning, designing, procuring, installing, testing, operating, and maintaining various types of CPSs for navigation structures. Expertise is available to assist USACE elements in any of the above areas on a cost reimbursable basis. For further information about USACE expert assistance in the abovementioned areas, please contact the Corrosion Control and Cathodic Protection Systems Directory of Expertise (DX) at Mobile District or CECW-E at HQUSACE.

3-2. Expertise Required. District personnel who have limited experience and expertise in CPSs are encouraged to seek assistance from the Corrosion Control and Cathodic Protection Systems Directory of Expertise (DX) and/or laboratories through their Corrosion Protection Coordinator. The approval of a NACE-certified corrosion engineer is required for all new or replacement CPS designs.

3-3. Types of Assistance Available. The specific areas of assistance include initial planning, preparation and/or review of design and solicitation packages, review of design submittals, review of shop drawings or contract changes, training, and preparation of corrosion mitigation test plans. Assistance is also available, in troubleshooting, restoring, testing, and adjusting and optimizing CPSs.

3-4. Element Responsibility. USACE elements will be responsible for ensuring that all solicitations comply with current procurement policy, including consideration of the offeror's experience and qualifications. Although the procurement method selected for any given project is at the discretion of the responsible element, the intent of this manual is to provide guidance so that all contractors in cathodic protection have qualifications which, as a minimum, meet the requirements in Chapter 6.

CHAPTER 4

TESTING AND OPTIMIZING

4-1. Equipment and Personnel. Test equipment should consist of a fresh and calibrated copper-copper-sulfate reference cell, a submersible connection, cabling suitable for immersion use, and a high-impedance voltmeter capable of measuring polarized potentials with the CPS on. Sensitivity should be more than 5 meg-ohms per volt. The reference electrode should be placed in the electrolyte adjacent to and within 200 mm to the face of the gate at each test point. All tests should be supervised by an NACE-certified corrosion specialist, senior corrosion technologist, or cathodic protection specialist, a licensed corrosion engineer, or a Corps of Engineers representative assigned and qualified to do this work.

4-2. Optimizing System. Data collected during the test should be reviewed, and any necessary adjustments should be made. The system should be properly optimized by adjusting the rectifier until 90 percent of the potentials fall within the range of polarized (cathodic) potential of between negative 850 mV and negative 1200 mV, or 100-mV polarization according to NACE RP0169-2002. A report on test results should be prepared and retained at the district. Research and development work on low-cost remote monitoring systems has been performed recently to increase reliability, extend service life, minimize maintenance requirements, and automate CPS testing, evaluation, and diagnostic procedures in order to reduce CPS life-cycle costs (Van Blaricum et al. 2001). For further information about CPS remote monitoring systems, contact the Corrosion Control and Cathodic Protection Systems DX at Mobile District or CECW-E at HQUSACE.

CHAPTER 5

SYSTEM SELECTION

5-1. Corrosion Protection. Corrosion occurs on all metallic structures that are not adequately protected. The cost of replacing a structure which may have been destroyed or weakened due to excessive corrosion is substantial but avoidable, and means should be taken to consistently prevent or mitigate this added cost through cathodic protection. In addition to preparing and applying protective coatings to the surface of a structure, corrosion protection can be provided by applying a protective electric current to the structure surface which is immersed and in contact with an electrolyte. In the presence of certain other metals contacting the electrolyte near the structure, this technique transforms the structure into a cathodic electrode. A properly selected and designed cathodic protection system can prevent surface corrosion of the structure, or drastically reduce the rate at which it occurs.

5-2. Types of CPSs.

a. Sacrificial CPS. This type of system helps reduce surface corrosion of a metallic structure immersed in an electrolyte by coupling a less noble metal with the structure. Sacrificial CPSs work through the sacrifice of an anodic metal, i.e., one that has a negative electrochemical potential relative to the protected ferrous structure, to prevent deterioration of the structure through corrosion. Sacrificial anodes for fresh water applications typically are composed of zinc- or magnesium-based alloys. In the past, installation of sacrificial anodes has often been done on an ad hoc basis, relying largely on the installer's individual knowledge and experience. However, recent research on sacrificial anode materials has provided an improved engineering basis for designing civil works applications of these systems.

b. Impressed current CPS. This type of system uses direct current applied to an anode system from an external power source to drive the structure surface to an electrical state that is cathodic in relation to other metals in the electrolyte. A number of impressed current anode materials and geometries are used. Materials include mixed metal oxides, precious metals (e.g., platinum-clad titanium, niobium), and high-silicon chrome-bearing cast iron. The most common geometries are slab or button anodes, rods, and strings. Any anode mounted on the structure must be isolated with a dielectric shield to assure effective current distribution.

5-3. CPS Selection. When selecting which type of system to use, the designer should consider the size of the structure to be protected and past project experience in operating and maintaining both types of systems. Early in the selection process, if practical, it is useful to perform a current requirement test to help define the total amount of electrical current needed to protect the structure (see PROSPECT Corrosion Control course handbook [009, 2003-01 et seq]). For large structures with significant expanses of bare or poorly coated metal, where the total current requirement tends to be very high, a properly maintained impressed current system can provide

10 to 30 years of effective corrosion protection. Where current requirements are lower and the structure's protective coatings are well maintained, sacrificial anode systems can be very effective. Improved modern coating systems and maintenance practices today allow for a wider use of sacrificial CPSs on large civil works structures than was the case in the past. For both types of systems, preliminary design estimations and comparisons of costs, current output, and overall design life should give an adequate indication of which system is preferable for the specific application. Other factors such as future maintenance needs, reliability, accessibility, and impact on operations may also warrant consideration.

a. Basis for selecting an impressed current system.

(1) Can be designed for a wider range of voltage and current applications.

(2) Higher total capacity (i.e., ampere-years) can be obtained from each installation.

(3) One installation can protect an extensive area of the surface of a metallic structure.

(4) Voltage and current can be varied to meet changing conditions, providing operational flexibility that is very useful to increase protection of the surface coating.

(5) Current requirement can be read and monitored easily at the rectifier.

(6) System can be designed to protect bare or poorly coated surfaces of metallic structures.

b. Basis for not selecting an impressed current system.

(1) First costs for design, acquisition, and installation are high.

(2) Installation is complex due to the need for an external power supply, cabling, and numerous electrical connections.

(3) Maintenance costs can be high.

(4) System can create stray currents that may potentially corrode other nearby ferrous structures.

(5) If an excessive amount of current output is used, hydrogen gas may form between the substrate and coating, causing paint blistering or possible hydrogen-embrittlement of high-strength steel.

c. Basis for selecting a sacrificial anode system.

(1) External power source is not required.

(2) Installation is less complex since an external power source, including rectifier, is not required.

(3) System works very well when electrolyte resistivity is low, surfaces are well coated, structure is easily accessible, and significant deterioration of the coating is not expected within 5 to 10 years.

(4) System is easier to install on moving complex structures such as tainter valves where routing of cables from an impressed current system could present a problem.

d. Basis for not selecting a sacrificial anode system.

(1) Current output per anode is low and may not be sufficient to protect large structures with significant expanses of uncoated or poorly coated bare metal.

(2) System generally cannot be economically justified where large surface areas of a poorly coated metallic structure require protection.

(3) Anode replacement expenses and/or the number of anodes required can be high compared with impressed current systems for structures with high current requirements.

(4) Current output cannot easily be adapted to seasonal changes in water resistivity or to unexpected changes in coating coverage caused by weathering, routine wear, or impact damage due to debris, ice, or aquatic vessels.

(5) Due to the buildup of algae, silt, or other deposits on sacrificial anodes, current output to the structure may be reduced.

(6) Monitoring system operation in accordance with NACE criteria is labor-intensive and inconvenient because it requires that structure-to-electrolyte potential measurements be taken in the field.

CHAPTER 6

SYSTEM DESIGN, CONSTRUCTION, OPERATION, MAINTENANCE, AND RESTORATION

6-1. Design. For existing structures, a current requirement test should be made to accurately assess the overall system design. The designer should become familiar with the availability and suitability of types of commercially manufactured anodes which would satisfy the system requirements for cathodic protection. Chapter 5 provides guidance for selecting impressed current and sacrificial (i.e., galvanic) anode systems. The designer should become familiar with manufacturer recommendations for use and product performance claims. CPSs should be designed to attain and maintain a level of protection of the structure as defined in the section "Criteria and Other Considerations for Cathodic Protection" in NACE RP0169-2002. In order to achieve this level of protection, design calculations must be made to determine the number and types of anodes required. Examples of calculations can be found in Appendix B of this manual for impressed current cathodic protection design; in ETL 1110-9-10 for impressed current CPSs using ceramic anodes; and in MIL-HDBK-1004/10, "Electrical Engineering Cathodic Protection," which was developed from evaluations, surveys, and design practices of the Naval Facilities Engineering Command, other government agencies, and the private sector. Appendix C of this manual provides engineering formulae and reference tables for use in designing sacrificial CPSs for civil works applications, and Appendices D, E, and F present detailed examples of sacrificial anode CPS design for different types and sizes of structures using various anode geometries. MIL-HDBK-1004/10 can be a useful tool for design calculations in conjunction with the criteria that follow. These calculations must take into consideration the total area of the structure to be protected, the resistivity of the electrolyte, the present condition of the protective coatings on the structure, the predicted deterioration of these coatings due to physical damage, the normal paint change of state over a 20-year period, and the environment to which the structure will be subjected. The design of CPSs should be accomplished under the supervision of a NACE-certified corrosion specialist, a cathodic protection specialist, or a professional engineer licensed in corrosion engineering.

a. Criteria. Design of civil works hydraulic structures shall conform to NACE RP0169-2002, paragraph 6.2.2 inclusive, "Steel and Cast Iron Piping." Those criteria are specifically included here by reference.

b. Guide specification. Unified Facilities Guide Specification UFGS-13113A, "Cathodic Protection Systems (Impressed Current) for Lock Miter Gates," should be used in preparing contract documents for procurement of CPSs. This specification, in addition to providing the technical requirements for various items of equipment for the CPS, addresses methods for protection from ice and various debris of the string anodes and the electrical leads to the button and string anodes. This specification is based upon the use of impressed current systems, which are normally used on hydraulic structures having large areas requiring corrosion protection.

Button anodes are normally used on the skin plate side of the gate, with rod or string anodes installed in the compartment areas of the gate; however, button anodes may also be used in the compartment areas if practical from an installation standpoint.

c. Zebra mussel guidance. In areas with potential for zebra mussel infestations, the CPS components may be at risk of failure or disruption. Design considerations in preventing these infestations should be included. For control strategies, refer to Zebra Mussel Research Technical Note ZMR-3-05, compiled by the Zebra Mussel Research Program at Waterways Experiment Station, Vicksburg, MS.

6-2. Construction. Installation of a CPS by a construction contractor should be accomplished under the supervision of an NACE-certified corrosion specialist, senior corrosion technologist, or cathodic protection specialist or a licensed corrosion engineer.

a. Services of corrosion engineer. The construction contractor should be required to obtain the services of a licensed corrosion engineer to supervise the installation and testing of the CPS. The term "corrosion engineer" refers to a person who has knowledge of the physical sciences and the principles of engineering and mathematics, acquired by professional education and related practical experience, and who is qualified to engage in the practice of corrosion control on metallic structures. Such person may be a licensed professional corrosion engineer or may be certified as being qualified by NACE International if such licensing or certification includes suitable cathodic protection experience.

b. Workmanship. All material and equipment shall be installed in accordance with the requirements of the specifications and as recommended by the corrosion engineer and approved by the Contracting Officer. The installation, including testing, should be performed by an organization that has had at least 3 years experience in this type of work.

6-3. Operation and Maintenance. The reliability and effectiveness of any CPS depend upon the manner in which it is operated and maintained, as well as its proper design and installation.

a. Performance testing prior to acceptance. The primary purpose for testing of a CPS is to determine if it has been optimized in accordance with and effectively meets design criteria (typically RP0169-2002). A system that does not meet these criteria will not adequately protect the structure against corrosion.

b. Operations and maintenance manual. An operations and maintenance manual should be provided for each CPS installed. This manual should provide instructions for testing and optimizing the system and should specify test equipment required. Copies of the structure-to-electrolyte potential measurements, obtained by the contractor at the time of acceptance of the system by the Government, should be included for reference. Blank data sheets should be provided for Government test personnel to record data obtained in future periodic testing of the CPS.

c. Troubleshooting guide. A troubleshooting guide should be provided for use with the CPS. This guide should address possible symptoms associated with failure of various items of equipment of the system. Recommendations and possible solutions should also be included. If a problem cannot be resolved by the corrosion protection coordinator, then it is recommended that the designer seek the assistance addressed in Chapter 3 of this manual.

6-4. Restoration. Existing inoperable CPSs should be restored whenever possible and feasible. Restoration of a CPS should be part of the corrosion mitigation plan and should include, but not be limited to, the following:

a. A list of materials and cost.

b. An assessment of impact protection and consideration of the need for additional impact protection devices.

c. A survey indicating the status and functional condition of rectifiers, anodes, terminal cabinets, anode system cables, and impact devices.

d. A copy of the latest structure-to-reference-cell potential readings.

CHAPTER 7

TRAINING AND SERVICES

7-1. Training. Training should be provided for project designers, inspectors, and operation and maintenance personnel who are responsible for CPSs in use at projects. Corrosion protection coordinators should arrange with District Training Coordinators for this training. The training should include both cathodic protection in general terms and report preparation. A PROSPECT course on corrosion control is offered annually for district personnel. The course provides the required CPS training on design and testing.

7-2. Services. Services are available on a cost-reimbursable basis from the Corrosion Control and Cathodic Protection Systems DX at Mobile District, or the Engineer Research and Development Center – Construction Engineering Research Laboratory at Champaign, IL, to assist districts in matters related to corrosion control and cathodic protection. Services are also available for design, restoration, construction, operation and maintenance, and optimization adjustments of CPSs. Services inquiries may be referred to CECW-E at HQUSACE.