



**Submitted to:**  
**Saint Paul Regional Water Services (SPRWS)**

**SUBJECT: RFP – Mississippi River Conduit M1 – Steel Supply  
Conduit – External Corrosion Assessment**

**Event #: 717**

**Due: November 14, 2018 – 2:00 pm**

**EN Engineering Contact:**

Phil Eggen, P.E.

Sr. Project Manager - Corrosion Engineering and Cathodic Protection Services

November 14, 2018

Saint Paul Regional Water Services  
1900 Rice St,  
St Paul, MN 55113

**RE: Bid Response – RFP – Mississippi River Conduit M1 Steel Supply Conduit  
External Corrosion Assessment  
Reference: Event #717**

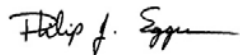
Dear SPRWS:

EN Engineering (ENE) is pleased to submit our proposal for the External Corrosion Assessment of the M1 Conduit. Our team includes professionals averaging over 30 years of design and operating experience related to pipeline systems and associated facilities for the water, liquids and gas pipeline industry.

We believe the team we have proposed is uniquely qualified to perform the services required for this important project and we are confident that our experience level will result in a safe and successful project for Saint Paul Regional Water Services (SPRWS).

If you have any questions with this proposal, please do not hesitate to call me any time at I wish to thank-you for the opportunity to provide proposal. If you have any questions, please call me at 630-473-3561.

Sincerely,



Philip J. Eggen, P.E.  
Sr. Project Manager  
Corrosion Engineering Services, Central Region  
630 473 3561 (Office)  
630 353 7777 (Fax)  
815 482 3999 (Mobile)  
[peggen@enengineering.com](mailto:peggen@enengineering.com)

## **Project Background**

St. Paul Regional Water Supply (SPRWS) is requesting proposals to evaluate the extent of external corrosion on approximately 8,500-feet of two (2) steel portions of the 60-inch Mississippi (M1) conduit and give recommendations on how to implement a cathodic protection system, with considerations given for feasibility of such systems. SPRWS is requesting that the work be completed in the following two steps:

- Task 1 – Complete an External Corrosion Direct Assessment Survey
- Task 2 – Cathodic Protection Implementation Review

EN Engineering is prepared to complete all portions of the work, with the exception of excavation activities on the conduit. ENE has performed similar assessments and is a recognized leader in the cathodic protection industry for water, gas and oil pipelines.

The ENE proposal for this work is broken down into the following tab sections:

- TAB 1 - Project Understanding, Approach and Work Plan
  - TAB 2 - Previous Work Providing Similar Services
  - TAB 3 - Organizational and Project Team Qualifications and Experience
  - TAB 4 - Cost (Separate File)
-

**TAB 1 – Project Understanding, Approach and Work Plan****1A. Project Understanding**

EN Engineering has reviewed the background reports from AECOM and Harco and is prepared to conduct an evaluation of external corrosion conditions and give cathodic protection recommendations that potentially will extend the lifespan of the M1 conduit.

During the review of the information found in the AECOM and Harco reports and the M1 plan sheets, the following items of interest were noted:

**M1 Conduit Parameters:**

The M1 conduit extends from the Mississippi River Pumping Station to the Charley Lake outlet, a distance of 7.95 miles. The majority of the M1 conduit is cast in place concrete with about 20% of the total length being steel. The steel portions of the 60-inch M1 conduit were noted on the provided plan sheets. The M1 conduit was primarily constructed in 1924, with the steel sections being of riveted and welded joint construction. The highlighted sections of steel conduit shown on the plan sheets totaled approximately 7,255 feet covering two sections. It should be noted that the 1,095 feet of pipe between Section 1 and Section 2 was replaced with Prestressed Concrete Cylinder Pipe (PCCP) in 1989/1990 due to leaks on the steel 60-inch M1 conduit.

Section 1 – From the Mississippi River Pumping Station to East of University Ave.  
Length = 4,015 feet (Sta. 2+06 to Sta. 42+21)

Section 2 – From west of Terrace Road to Tyler Street  
Length = 3,240 feet (Sta. 53+16 to Sta. 85+56)

The M1 conduit parallels the M2 conduit for its entire length. The M2 conduit is a 60-inch coated steel pipe constructed in 1958. As noted in the Harco report, these two conduits are reportedly isolated from each other, except at the Mississippi River Pumping Station.

**M1 Conduit Observations:**

There was one excavation completed by AECOM on the steel portion of the M1 conduit at station 6+85. The exposed pipe documentation at this location confirms that the M1 conduit is coated. The reported as-found coating thickness of 125 mils is four times as thick as the original specifications. The specifications for the manufacture of the riveted steel pipe call for a 1/32" thick (31-mils) Hermastic Enamel coating. The Harco report indicated that the M1 Conduit was a bare pipeline (sic – may need to be considered as electrically bare).

Even though the pipeline was originally coated with 31-mils of enamel coating (reported to be 125-mils at Test Pit 1A), it is the opinion of ENE that the effectiveness of this coating is likely to be at the end of its useful life and that the conduit is acting as electrically bare. This was confirmed with the pipe-to-soil testing completed in the excavation by AECOM. The reported pipe-to-soil reading of  $-360\text{mV}_{\text{CSE}}$  is indicative of an electrically bare pipe and is further confirmed by the Harco testing done in 1971 where the pipe-to-soil potentials for this line were between  $-460\text{ mV}_{\text{CSE}}$  and  $-130\text{ mV}_{\text{CSE}}$ .

ENE has a great appreciation for condition assessment of the SPRWS conduits completed by AECOM and their recommendations given to SPRWS. However, ENE is proposing to complete the evaluation of corrosion on the M1 conduit with an alternative approach.

**Statement Regarding Alternative Approach:**

ENE requests additional consideration during the evaluation of bids, whereby ENE is recommending an alternative action plan to extend the life of the M1 Conduit and by its close proximity location, the M2 Conduit.

This alternative approach is based on the factors presented above in relation to bare pipelines and the ability to evaluate them for active corrosion. The ECDA process that is presented in NACE SP 0502-2010 is well suited for coated pipes that are currently cathodically protected. NACE SP 0502-2010 has limited applicability to bare pipes.

Therefore, ENE is recommending a more suitable survey for bare pipelines. NACE SP 0207-2007 gives guidance on performing a "hot-spot survey" (aka cell-to-cell survey) and "side-drain survey" on a bare pipeline to evaluate areas of active corrosion. These types of surveys are more relevant than the survey types presented in the ECDA SP 0502 (CIS, ACVG/DCVG, etc.).

Due to the fact that the M1 Conduit is behaving as an electrically bare steel pipe, a large amount of Cathodic Protection Current will likely be required to protect this structure from external corrosion. There are multiple methods of providing cathodic protection, depending on the volume of active corrosion found. If limited active corrosion areas are found, then a localized approach may be warranted with galvanic anodes or close proximity impressed current linear anodes. However, if extensive active corrosion is noted, then large amounts of cathodic protection current may be needed and supplied with a rectifier and remote groundbed.

When applying the application of cathodic protection for the first time to older steel structures, consideration must also be given to the cathodic protection reaction that generates hydrogen or chlorine gas (depending on the environment) on the steel surface of



the pipeline. Where corrosion wall loss has already occurred, this gas can cause solid corrosion product caps to break free from the steel surface. As a result, the application of cathodic protection can cause an initial increase in leak rate and repairs.

While an External Corrosion Direct Assessment (ECDA) may yield information about the coating condition of the M1 conduit, it will ultimately need Cathodic Protection to extend its useful life, regardless of the coating condition, since it is acting as a bare pipe. Another factor in this scenario is the proximity of the M2 conduit to the M1 conduit. The anticipated large amounts of current that will be needed to protect the "bare" M1 Conduit will likely have an interference effect on the nearby M2 Conduit. Although out of scope in this RFP, the M2 conduit is also likely in need of Cathodic Protection and it is ENE's recommendation to design a CP system that considers simultaneous protection of both structures – if for no other reason than to prevent stray current DC interference from occurring on the M2 Conduit.

Another factor in the application of Cathodic Protection to the M1 Conduit is the presence of PCCP tied into the steel pipeline conduit. The pre-stressed wires associated with PCCP pipe must be maintained to a specific window of recommended Cathodic Protection potential values - that are often difficult to maintain with an impressed current system operating in close proximity with high outputs. It will be important to keep the PCCP Conduit isolated from the Steel Conduit for proper Cathodic Protection levels.

### **1B. Approach**

ENE is proposing to apply the "Hot Spot Survey" and "Side-Drain Survey" as found in NACE Standard Practice (SP) 0207-2007 to assess the active areas of external corrosion of the M1 Conduit. ENE has extensive experience in applying this Standard Practice to multiple types of pipelines. The survey and data evaluation process is described in the following work plan.

The results of this survey and subsequent analysis will determine the amount of active corrosion on the pipeline and will help to decide on the recommended Cathodic Protection for the M1 Conduit. Direct Examinations of the conduit may be warranted to confirm the active corrosion areas. ENE is prepared to perform the hands on evaluation of the pipe and soil conditions found in the excavation. However, ENE does not conduct excavation activities and such work would need to be contracted by SPRWS.

**1C. Work Plan**

EN Engineering (ENE) proposes the following Work Plan:

**Task 1.A.1 – Kickoff Meeting**

1. ENE will lead an in-person kickoff meeting to meet the SPRWS personnel involved in the project and to conduct a further understanding of the elements involved in the project.

**Task 1.A.2 – Document / Data Review**

1. ENE will conduct additional in-depth review of available reports and data relevant to the M1 conduit. This review is necessary to familiarize ENE personnel with the past studies, structures to be evaluated and site peculiarities that may have an impact on the evaluation.

**Task 1.A.3 – Field Conditions Review**

Prior to deploying the survey team, a review of the field conditions will be made after the kickoff meeting and documents review activity.

**Task 1B – External Corrosion Assessment Survey**

1. ENE will deploy a three (3) person crew to the location to perform the requested surveys.
  - a. Equipment to include:
    - i. Potential survey equipment –
      1. 4 Calibrated Reference Cells
      2. 3 Calibrated Volt Meters
    - ii. ACVG/Locator - Depth of Cover equipment
    - iii. Soil Resistivity Meter and associated wiring/pin harness
    - iv. Sub-Centimeter GPS
    - v. Basic CP tools
    - vi. Watering backpack
    - vii. Current Source (portable Rectifier)
2. Upon arrival the ENE crew will:
  - a. Perform any SPRWS required safety training
  - b. Review and become familiar with the line segment
    - i. Work with SPRWS on any specific safety or field requirements
    - ii. Determine a process for daily project communication

- c. Perform Daily Quality equipment checks
  - d. Install a continuous data logger on the subject pipe segment
  - e. Locate and flag the line at 50' intervals
  - f. Perform a Depth of Cover (DOC) survey
  - g. Perform Soil Resistivity testing at every 100 feet along the M1 Conduit.
    - i. Resistivity needs to be obtained every 100 feet along the alignment so that the closest resistivity to the anodic readings found by the cell-to-cell can be considered in the selection of which locations to excavate for examination. The resistivity and delta anodic potential readings are evaluated together to get some idea of where the highest anodic current flows are. Those locations are then selected for excavation assuming that there are no underground structures that may be impacting the cell-to-cell potential data. We also need to obtain multiple depths to the bottom of the pipe so that we can see exactly what the resistivity is at pipe depth.
  - h. Perform the Hot Spot Survey (aka Cell-to-Cell Survey):
    - i. Survey readings will typically be obtained at an interval of approximately three to ten (3 to 10) feet, depending on the depth of cover of the pipeline.
    - ii. It is expected to water the locations along road crossings. ENE is not planning to drill the road crossings.
  - i. ENE will collect GPS readings during the surveys to mark above-grade features, depth readings and anodic indications.
  - j. ENE will document:
    - a. Weather conditions under which the surveys were conducted.
    - b. Findings and observations
3. Current Requirement Testing
- a. As part of the recommendations for Cathodic Protection Design, an understanding of the total amount of current required to protect the M1 (and M2) conduits is necessary. The current requirements testing will be completed in various modes that will evaluate both the M1 and M2 pipelines as individual circuits, combined circuits and an evaluation of interference between the two. Also, interference testing will be needed on the PCCP pipe that is located between the two segments of M1 conduit.
4. At completion of the surveys ENE will:
- a. Collect any flags
  - b. Coordinate with SPRWS to provide project debrief and significant observations
  - c. Demobilize



**Task 1C - Deliverables**

1. ENE will provide a report of the active corrosion findings based on the surveys conducted. The report will include the following:
  - a. Summary report of the project and findings with details
  - b. Survey notes
  - c. Excel Spreadsheet file with raw data for Hot Spot survey
  - d. Soil Resistivity data
  - e. Current Demand Testing and Interference Testing
  - f. Review and Approval per ENE ISO: 9001 Process
    - i. Final Approved Report will be by a NACE Certified CP-4 (CP Specialist).

**Task 1C – External Corrosion Direct Examinations (Not Included in this Pricing)**

If the results of the corrosion findings include recommendations to perform a direct examination of the pipeline, ENE can provide the pipe evaluation services including:

1. Soil Sampling and Testing
2. Coating Evaluation and Defect Mapping
3. Corrosion Measurements and Evaluation of Active Corrosion including pit depth measurements and ultrasonic thickness measurements.

Note – ENE does not conduct excavation activities and such work would need to be contracted by SPRW.

**Task 2.A – Cathodic Protection Implementation Review**

ENE will evaluate the results from Task 1 and develop an estimated design cost and installation costs for implementing a Cathodic Protection system for the M1 (and M2) conduits, as necessary.

## 1.D. Project Schedule and Resources

Work is proposed to commence on a date that is mutually agreeable to both ENE and SPRWS. It is anticipated the surveys will commence in Spring of 2019, with a final report by June 30, 2019. A more formal schedule is presented as follows:

Task ID	Task Name	Duration	Start	Finish	April 1-5 Week 1	April 8-12 Week 2	April 15-19 Week 3	April 22-26 Week 4	April 29-May 3 Week 5	May 6-10 Week 6	May 13-17 Week 7	May 20-24 Week 8	May 27-31 Week 9
I	Project - M1 Assessment	45 Days	04/01/19	05/31/19									
I.A.1	Kickoff Meeting	1 Day	04/01/19	04/01/19									
I.A.2	Document Review	1 Day	04/02/19	04/02/19									
I.A.3	Field Conditions Review	1 Day	04/03/19	04/03/19									
I.B.1	Field Survey Prep	10 Days	04/08/19	04/19/19									
I.B.2	DOC and Soil Resistivities	5 Days	04/22/19	04/26/19									
I.B.3	Hot-Spot Survey and Current	5 Days	04/29/19	05/03/19									
I.B.4	Current Requirements	5 Days	05/06/19	05/10/19									
1.C.1	Data Evaluation	10 Days	05/06/19	05/17/19									
1.C.2	Corrosion Report	10 Days	05/20/19	05/31/19									
2.A.1	CP Recommendations Report	5 Days	05/27/19	05/31/19									

The following Tasks would require SPRWS Meeting Hours as indicated:

Task ID	Task Name	SPRWS Meeting Hours
I	Project - M1 Assessment	
I.A.1	Kickoff Meeting	4
I.A.2	Document Review	
I.A.3	Field Conditions Review	4
I.B.1	Field Survey Prep	
I.B.2	Hot-Spot Survey	
1.B.3	Side Drain Survey	
1.C.1	Data Evaluation	
1.C.2	Corrosion Report	
1.D.1	CP Recommendations Report	4

ENE Resources and overall project hours:

Resource Title	Resource Name	Project Hours
Subject Matter Expert	Michael Szeliga	10
Subject Matter Expert	Dave Schramm	10
Sr. Project Manager	Phil Eggen	40
Sr. Project Manager	Yaofu Zhang	80
Corrosion Engineer	Adam Gervasio	160
Sr. Corrosion Technician	Greg Taylor	120
Corrosion Technician	Ryan McCarthy	120

**TAB 2 - Previous Work Providing Similar Services**

Provide at least three (3) examples of successful past projects where your company performed work of similar complexity and discipline to the services requested in this RFP.

1. Project Name: City of Virginia Beach Force Main Corrosion Evaluation  
Description: Performed ECDA on 140,000 linear ft of force mains throughout the city of Virginia Beach and recommended repair/rehabilitation measures. A host of ECDA techniques were incorporated into this project including: soil corrosivity surveys, stray current interference surveys, cell-to-cell surveys, current mapping and direct pipe evaluation. Pipe corrosion rates and pipe remaining service lives were estimated and calculated to recommend corresponding pipe repair / replacement priorities.  
Client Contact: Donald Piron, City of VA Beach Public Utilities, (757) 385-8478, [dpiron@vbgov.com](mailto:dpiron@vbgov.com)  
Project Team: Yaofu Zhang, David Creque, David Dawson, Michael Szeliga  
Project Cost: \$87,000
2. Project Name: DC Water 84-in Steel Pipe Condition Assessment  
Description: Performed pipe condition assessment and supervised repairs including fiberglass/carbonfiber, joint-seal, epoxy coating and welding. Reviewed and recommended pipeline rehabilitation options for this large diameter steel pipe at DC Water's Blue Plains wastewater treatment plant.  
Client Contact: Michael Nye, Delon Hampton & Associates, (202) 787-2516, [michael.nye@dcwater.com](mailto:michael.nye@dcwater.com)  
Project Team: Yaofu Zhang, David Dawson  
Project Cost: \$170,000
3. Project Name: ECDA Program for 40 NRG Power Plants  
Description: Performed external corrosion pipe condition direct assessment at 40 NRG power plants across the United States and recommended corrective measures. The evaluation closely followed the principles and process outlined in NACE RP-0502. Indirect inspection generally included surveys such as close interval potential surveys and alternating current voltage gradient survey. Direct examinations were conducted at multiple locations for each power plant. Repairs and future corrective measures were recommended in the final report.  
Client Contact: Bob Kokstein, NRG Energy, (609) 524-4648, [Bob.Kokstein@nrgenergy.com](mailto:Bob.Kokstein@nrgenergy.com)  
Project Team: Yaofu Zhang, Bruce Norred  
Project Cost: \$250,000

**TAB 3 - Organizational and Project Team Qualifications and Experience****Organizational Background:**

EN Engineering, LLC is a full-service corrosion consulting firm that has over 30 years of combined cathodic protection (CP) design experience. The ENE Corrosion Team specializes in Corrosion Engineering, Cathodic Protection and Integrity Management services. EN Engineering (ENE) is headquartered in Warrenville, Illinois with a local offices in Bloomington, MN. ENE has extensive experience working across various utilities. ENE is a multifaceted engineering company founded in 2002 with over twenty offices across the United States ([www.enengineering.com](http://www.enengineering.com)).

Our capabilities regarding corrosion control include the following;

- CP field evaluation for new structures,
- CP field evaluation for existing structures,
- CP design for pipelines, fuel lines and associated structures,
- CP design for underground storage tanks,
- CP design for aboveground storage tanks,
- CP system troubleshooting for compliance,
- AC and DC Stray current interference testing and mitigation,
- CP system surveys,
- Construction inspection for CP system installation, and
- In-house laboratory for soil sample corrosion analysis

ENE's approach to providing clients with a comprehensive CP design begins with reviewing all available documentation regarding the structures to be protected, the desired design life of the structure and a review of the structure's alignment. The field evaluation is then performed, with soil resistivities and pH measurements recorded, notation of potential corrosion causing elements such as CP systems from other pipeline operators, overhead AC power lines and nearby transit facilities that can cause stray current. The design phase starts with evaluation of the field data, design calculations to size the CP system appropriately, client design review periods and issuance of design drawings for bid and/or construction.

ENE has the capability, in terms of financial responsibility, facilities, and personnel required, to accomplish the work outlined in this request for proposal (RFP). ENE employs a talented staff of licensed Professional Engineers, Project Managers, Corrosion Technicians, and cathodic protection experts. Our staff is experienced across all types of corrosion services, including, corrosion surveys, rail-to-earth testing, stray current investigations and

measurements, cathodic protection designs, cathodic protection system monitoring and troubleshooting, coatings inspections, internal corrosion, and external corrosion.

Our engineering and field personnel are **all** certified by the National Association of Corrosion Engineers (NACE), and ENE invests heavily in continuing education, field training, and the latest equipment for our personnel.

**ENE Company Specifics:**

1. Corporate Office: EN Engineering, LLC  
28100 Torch Parkway, Suite 400  
Warrenville, IL 60555
2. Local Office: EN Engineering, LLC  
2051 Killebrew Drive, Suite 335  
Bloomington, MN 56111
3. Employees: All ENE Offices (Over 20 Total) = 1,100 Full Time Employees  
Bloomington, MN Office has 7 Full Time Employees.

**ENE Consulting Team Experience:**

The ENE Corrosion Team is part of the ENE Consulting Business Unit. The ENE Consulting Business Unit is a fully developed team of Subject Matter Experts, Project Managers, Engineers and Technicians all working to improve the Integrity of our Clients Assets. The Consulting Team is comprised of the following Teams and their focus areas described:

Consulting Team	Focus	Employees
Integrity	Integrity Metallurgy Analytics/GIS	58
Corrosion Control	Cathodic Protection Analysis and Design	35
Process Safety Management	Plant Safety	14

**ENE Project Experience:**

ENE performs pipe condition assessments on a variety of pipelines and water systems annually. These assessments range from performing all four steps of an ECDA project to performing individual portions of the ECDA process. For example, the Integrity Team performs only Preassessments for projects on a large Gas Utility System, while other



companies perform the remaining phases. Also, ENE performs all four steps by hiring the subcontractors to perform the excavations and pipe repairs.

ENE has not performed any prior work for the Saint Paul Regional Water Supply.

ENE has listed examples of experience with similar projects as listed in the Tab 2.

**NOTE:**

ENE has reviewed the Terms and Conditions associated with this RFP, and we are currently not able to submit pricing for the sub-contracting of excavation services under the current Terms and Conditions due to Limits on Liability concerns. If ENE were given the opportunity to make recommended changes to the Terms and Conditions that were more acceptable to take on the excavation tasks, ENE may be able to supply a bid to complete the excavation work through a sub-contractor.

**ENE Team Members:**

Resource Title	Resource Name	Qualifications	Expected Project Hours
Subject Matter Expert	Michael Szeliga	35+ Years' Experience NACE CP-4 P.E.	10
Subject Matter Expert	Dave Schramm	35+ Years' Experience NACE CP-4	10
Sr. Project Manager	Phil Eggen	15+ Years' Experience NACE CP-2 P.E.	40
Sr. Project Manager	Yaofu Zhang	7+ Years' Experience NACE CP-4 P.E.	80
Corrosion Engineer	Adam Gervasio	4+ Years' Experience NACE CP-2	160
Sr. Corrosion Technician	Greg Taylor	10+ Years' Experience NACE CP-2	120
Corrosion Technician	Ryan McCarthy	5+ Years' Experience NACE CP-1	120

*Resumes of Selected Individuals are attached for Reference.*

Key Relevance
Corrosion Control
Cathodic Protection Design
Failure Analysis
Project Management
AC Mitigation Design and Analysis

**Job Title:**

Practice Area Leader

**Years with EN Engineering:** 1**Total Years of Experience:** 35+.**Primary Office Location:**

Warrenville, IL

**Education:**

- B.S., Civil Engineering, 1977

**Professional Registration:**

- MI
- MD
- VA
- NY
- NJ
- SC
- NC
- TX

**Professional Certifications:**

- NACE – Cathodic Protection Specialist
- NACE – Corrosion Specialist

**Overview:** Mr. Szeliga has over thirty five years' experience in corrosion control engineering services. Certified by NACE International and a Registered Professional Engineer in Texas, Virginia and several other states. Project Manager for corrosion control studies, designs, failure analysis, material selection and evaluation, construction observation, and monitoring associated with stray current control, cathodic protection, coatings, and test facilities. Extensive project management experience with corrosion control for transmission and distribution pipelines, underground and above ground storage tanks, tunnels, elevated railroad structures, docks and piers, pipe type cables, elevators, tower footings, vehicles, internal building plumbing systems, and other structures. Expert in stray current interference situations associated with impressed current cathodic protection systems and mass transit systems. Has worked on cathodic protection designs, surveys, and construction; coating specifications; close interval surveys; establishment of remote monitoring programs; induced AC mitigation designs; and regulatory audits for hundreds of miles of gas distribution and transmission piping. Editor of four books for NACE International about corrosion of ductile iron piping, corrosion of prestressed concrete, corrosion in the water and wastewater industries, and stray current corrosion. Active member and frequent speaker for ASCE, and NACE International.

**Relevant Projects:****City of Baltimore Department of Public Works - Cathodic Protection and Urgent Needs Engineering Services**

Investigation of corrosion leaks in copper piping within a fountain's pump room, examination of the piping on site and within the laboratory to determine the extent and cause of the corrosion penetration, provided specific recommendations to prevent additional failures.

**Trizec Hahn Office Properties, MD**

Ultrasonic thickness evaluation of steel supply and return piping throughout a multiple story office building.

**James Posey & Associates, MD**

Corrosion evaluation of steel supply and return condenser piping inside a courthouse to identify the extent of internal and external corrosion.

**City of Baltimore Department of Public Works - Cathodic Protection and Urgent Needs Engineering Services**

Corrosion evaluation of steel and ductile iron piping inside the Vernon and Ashburton Pumping Stations.

**Charlotte Mecklenburg Utilities, Water and Sewer Mains - On-Call Corrosion Control Engineering Services**

Evaluations of soil corrosivity and stray current in water main alignments to determine corrosion control requirements; design of cathodic protection, stray current mitigation, and corrosion monitoring systems; failure analysis.

**Professional Organizations & Affiliations:**

- NACE International AGA Corrosion Control
  - Past Director
  - Past Committee Chairman - "Interference Problems Associated With Rail Transit"
  - Past Chairman - Northeast Region
  - Recipient - "Distinguished Service Award"
  - Editor - "Corrosion in the Water and Waste Water Industries"
  - Editor - "Corrosion of Ductile Iron Piping"
  - Editor - "Corrosion in Prestressed Concrete: Pipes, Piles and Decks"
  - Editor - "Stray Current Corrosion"
- Appalachian Underground Corrosion Short Course
  - Recipient – "Colonel George C. Cox Outstanding Award"
  - Lecturer
- American Society of Civil Engineers
- American Society for Testing and Materials
  - Recipient – "Certificate of Appreciation"
- American Water Works Association
  - Recipient – VA Section "Best Paper Award"

**Relevant Projects (Cont'd):****Baltimore County Department of Public Works - On-Call Corrosion Control Engineering Services**

Evaluations of soil corrosivity and stray current in water main alignments to determine corrosion control requirements; design of cathodic protection, stray current mitigation, and corrosion monitoring systems; failure analysis; periodic monitoring of cathodic protection and corrosion monitoring systems; and comprehensive corrosion evaluations of existing water mains. Cathodic protection designs and annual monitoring for elevated and at-grade water storage tanks.

**Washington Suburban Sanitary Commission (WSSC)**

Pipeline Replacement and Relocation Projects through Prime Engineering Consultants. Corrosion evaluations during the design of the Somerset Water Main Replacement, Goldsboro Road Water Main Replacement, Bladensburg Water Main Replacement, Kensington Water Main, Chillum Water Main Relocations, Montpelier Drive Water Main, Washington Grove Water Main Replacement, and several other similar projects.

**City of Baltimore Department of Public Works - Cathodic Protection and Urgent Needs Engineering Services**

Corrosion evaluations to determine remaining life and conduct life cycle cost analyses for existing water and sewer mains; cathodic protection designs for new and replacement mains; stray current evaluations; periodic monitoring of existing corrosion control systems; soil analysis and data entry in the City's GIS mapping system; and failure analysis.

**District of Columbia Water and Sewer Authority**

Washington, DC Anacostia Pump Station Replacement Project through Prime Engineering Consultant. Evaluation of corrosion control requirements and design of corrosion protection.

**U.S. Navy, Naval Facilities Engineering Command, Atlantic Division**

Through Prime Engineering Consultant, Inspection of impressed current cathodic protection systems on two elevated water storage tanks at Dahlgren, Virginia.

**Howard County Department of Public Works - Professional Services Requirements Contract for Cathodic Protection and Corrosion Control Engineering**

Evaluations of soil corrosivity and stray current in water main alignments to determine corrosion control requirements; design of cathodic protection, stray current mitigation, and corrosion monitoring systems; evaluations of atmospheric corrosion on structures; and comprehensive corrosion evaluations of existing water mains.

**City of Dallas, TX - Tawakoni Pipeline Project**

Soil corrosivity evaluation to determine corrosion control requirements for 108-inch water transmission main being bid as steel and prestressed concrete cylinder pipe.

**Professional Publications**

- "Understanding Corrosion"
- "Underground Corrosion in the Water and Waste Water Industries"
- "Corrosion Economics"
- "Corrosion Failures in the Water Industry: Case Histories"
- "The Application of Corrosion Control Methods to Large Diameter Water Mains"
- "Construction and Maintenance of Water Mains to Maximize Operating Life"
- "Corrosion Control Systems - Acceptance and Maintenance Testing"
- "The Use of Diode Micro Drainage for Stray Current Control on Distribution Water Mains"
- "Corrosion Control for Pipeline Crossings"
- "Evaluating Ductile Iron Pipe Corrosion"
- "Analysis of Ductile Iron Corrosion Data from Operating Mains"
- "An Independent Evaluation of the Effectiveness of Polyethylene Encasement as a Corrosion Control Measure for Ductile Iron Pipe"

**Relevant Projects (Cont'd):****Thames Water Puerto Rico and Dick Corporation - Evaluation and Monitoring of Corrosion Protection for the North Coast Superaqueduct**

Evaluation of 72-inch prestressed concrete water main to identify areas with active corrosion; design and implementation of "hot spot" cathodic protection at high risk locations; and periodic monitoring of the operating corrosion protection system throughout the 20 mile pipeline.

**Newport News Waterworks, VA - On-Call Corrosion Control Engineering Services**

Soil studies in high failure areas, design of cathodic protection and corrosion monitoring systems for new transmission mains, periodic evaluations of operating corrosion control systems.

**Anne Arundel County Department of Public Works - Ductile Iron Pipe Study**

Corrosion evaluations of 10 in-service ductile iron force mains. Soil analysis, stray current evaluations, and corrosion potential surveys to identify locations for test pit inspections. Test pit inspections including visual examinations, ultrasonic wall thickness measurements, and corrosion pitting and graphitic corrosion analyses to estimate the probability of additional failures and remaining life of the mains.

**Frederick County, MD - New Design Water Transmission System**

Through Prime Engineering Consultant, soil and stray current evaluations to determine corrosion control requirements for new pipelines, design of corrosion control systems, and technical assistance during the construction of the systems.

**City of Corpus Christi, TX - Surveys and Designs of Corrosion Protection**

Mary Rhodes Memorial, Padre Island, Leopard Street, and Southside Phases 7 and 8 water mains.

**Washington Gas - Springfield, VA**

Evaluation of overall corrosion program including corrosion control standards and procedures for level of compliance with relevant regulations as well as the minimization of risks associated with corrosion failures of natural gas piping.

**South Jersey Gas Company - Folsom, NJ**

Cathodic protection survey of more than 1,000 cathodic protection test points on gas distribution system. Corrosion control records review and organization of spreadsheets for data management.

**Llewellyn Village Apartments - Copper Piping Evaluation, VA**

Investigated copper water piping failures that occurred within the buildings. Evaluation of removed segments of piping and water samples for characteristics that contribute to corrosion activity, provided recommendations for piping replacements and water chemistry adjustments.

**Relevant Projects (Cont'd):****Maryland Correctional Institute - Evaluation of Copper Water Piping and Fittings**

Evaluated the copper water plumbing system throughout the building, evaluated water samples for characteristics that promote corrosion, tested for dissimilar metal corrosion couplings and stray current, determined the cause of the failures, and provided recommendations for repairs and replacements.

**Baltimore Marriott Waterfront Hotel**

Evaluation of building copper and galvanized steel plumbing systems to determine the cause of the piping and valve failures, evaluation of water samples for corrosivity, and provided recommendations to prevent corrosion failures in the future.

**Carroll County Bureau of Utilities - Corrosion Evaluation of Copper Water Piping**

Evaluated failed segments of copper water piping, determined the cause of the failures and provided specific recommendations for corrective action.

**Lake Village Townhome Apartments - Copper Piping Evaluation, MD**

Evaluation of failed copper water piping, testing of soil and water samples for characteristics that contribute to corrosion activity, determined the cause of the failures, and provided specific recommendations for water treatment adjustments to prevent future failures.

**Chasney & Company, Inc. - Heater Towel Rack Evaluation, MD**

Evaluation of a corrosion penetration of a brass and chrome towel rack this is heated with circulating water. The towel rack was evaluated internally and externally for corrosion and extent of corrosion, a water sample was evaluated for characteristics that promote corrosion, and provided specific recommendations to prevent internal and external corrosion in the future.

**City of Baltimore Department of Public Works - Cathodic Protection and Urgent Needs Engineering Services**

Investigation of pinhole corrosion leaks in copper plumbing and provided a detailed evaluation of the causes of pinhole leaks as well as specific recommendations for tracking future failures, informing customers, and water chemistry adjustments to prevent internal corrosion of the copper piping.

**Knollwood Retirement Home - Chilled Water Piping Evaluation, MD**

Evaluation of steel chilled water piping failures that occurred throughout the building, determination of the cause of the failures, and specific recommendations for action to be taken to prevent additional failures.



Key Relevance
<b>SME - Cathodic Protection Design – Underground and Submerged Structures</b>
<b>SME – Cathodic Protection of Underground Storage Well and Gathering Systems</b>
<b>SME – HVDC and Pipeline Conflicts (Stray Current)</b>
<b>SME - Corrosion Control Field Assessments</b>
<b>SME - Cathodic Protection Trouble Shooting</b>
<b>SME - AC Mitigation Design and Analysis</b>
<b>SME -Atmospheric Corrosion Inspection</b>
<b>SME -Internal Corrosion</b>
<b>SME – Wall Loss Assessment (Corrosion)</b>
<b>SME – Coating Selection and Condition Assessment</b>
<b>Operator Qualification Program Management and Assessment</b>
<b>Corrosion Education and Training</b>

**Job Title:**

Vice-President

**Years with EN Engineering:**

17+

**Total Years of Experience:**

38

**Primary Office Location:**

Warrenville, IL, USA

**Education:**B.S., Iowa State University,  
Ames, Iowa

**Overview:** Mr. Schramm has over thirty-eight (38) years of extensive experience in the direct and practical application of corrosion control methods, cathodic protection assessment and design, and system integrity management and field services.

Direct experience with external, internal, and atmospheric corrosion control on natural gas and liquid transmission and distribution pipeline systems, underground natural gas storage, under-ground storage tanks, above-grade storage tanks, power plant structures, condenser/chiller/heat exchange equipment, production and injection/withdrawal wells, lead sheath cable, underground electric cable, water transmission systems, and fresh-water marine structures

Responsible for the technical performance, quality, and operation of the service offering that provides:

- Corrosion engineering analysis and design
- Cathodic protection monitoring and assessment
- Process control and measurement
- Correlation of internal “smart” tool to indirect inspection survey data
- Cathodic protection design, installation and maintenance
- AC safety and AC corrosion assessment, modeling, and mitigative design
- Computerized close interval potential survey
- Direct current and alternating current voltage gradient survey
- Stray DC interference and telluric current monitoring, measurement, and mitigation
- Coating selection and inspection
- Material selection, specification and procurement
- Technical specification and procedure
- OQ qualification and training
- Corrosion related field failure, wall loss assessment, and remaining strength evaluation
- Indirect and direct inspection program support
- Field installation oversight and inspection
- Project management and commission services
- Operational support including:
  - Leak detection
  - Purge operations
  - Watch and protect and rights-of-way inspection
  - Locating
  - High Consequence Assessment and Class Survey

**Professional Certifications:**

- NACE Institute No. 3178 Certified Cathodic Protection Specialist
- NACE Institute No. 3178 Certified Corrosion Technologist

**Professional Organizations & Affiliations:****NACE International Institute (NII)**

- Member, Public Policy and Outreach Committee (PPOC)
- Past Chair, Certification (2017-2019)
- Board of Directors – (2012-2016)
- Chairman, Certification Committee (2012-2016)
- Audit Committee (Board) 2015-2016)

**NACE International (NACE)**

- Professional Activities Director (PDAC) (Board) (2011 to 2014)
- Audit Committee (Board) (2011 to 2014)
- Professional Activities (PDAC) Chair (2011 to 2014)
- Professional Activities (PDAC) Vice-Chair (2008 to 2011)
- Certification Committee Chair (2003 to 2006)
- Certification Committee Vice-Chair (2000 to 2002)
- T-10A-11: Gas Distribution Industry Corrosion Problems Chair (1997 to 2001)
- T-10A-11: Gas Distribution Industry Corrosion Problems Vice-Chair (1995 to 1997)
- SME Department of Defense (DoD) Panel on Training and Certification
- CP Interference Course Development Task Group: Cathodic Protection Interference (2006)
- Cathodic Protection Sub-Committee: Cathodic Protection Technologist (2004)

**EN Engineering Program Support:**

- ENE Health, Safety, and Environmental Committee – member
- OSHA Safety Training Programs
  - Development and documentation of program safety documents.
  - Initial creation and training of Level 0 OSHA training presentations (PowerPoint)
- Vision Accounting and Project Documentation:
  - Part of management team charged with the development of project management and project set-up (2014/2015) Vision EWMS project.
  - Developed IN proposal documentation and procedures under Opportunity section of Vision
  - Automation of reports and training of Vision to departmental Project Managers
  - EMWS Super User
- Operator Qualification and Safety Records
  - Administrator for ISNETWORLD software and NCCER program audit and oversight.
  - Initial development and submittal of safety programs for RAV review
  - Initial support for Client response and safety program update.
  - Set-up and established support for Veriforce OQ programs.
- ISO 9001: 2000 Certification
  - Part of team tasked with the initial development and completion of ISO 9001 policy and procedures within EN Engineering; leading to, ISO9001: 2000 certification for the corporate office.

**Industry Participation:**

- API 1161 – Task Group on Operator Qualification, Pipeline Segment – Resolution of Appreciation for contributions to the Task Group
- OSHA 510 Certified “Occupational Safety & Health Standards for the Construction Industry”
- Quality Awareness Training (Nicor Gas- 1993)
- Basic Corrosion Course (NACE- 1983)
- 
- TWIC (Transportation Workers Identification Credential)
- Clockspring Trainer/Installer Certified (2002)
- Administration Training: Assessor Training (Nicor Gas-1994)
- Goodall Rectifier School: Goodall Electric, Inc. (1982 –
- Managing Cultural Diversity (Coleman Management Consultants (1994)
- Control, West Virginia, University (1985)
- Corrosion Prevention by Cathodic Protection (NACE– 1983)
- Effective Business Communication (IWCC – 1990)
- Appalachian Underground Course: Advanced Corrosion

**Relevant Projects****Tallgrass Development**

Provide subject matter expertise (SME) related to conflict between proposed HVDC system and large diameter, high pressure natural gas pipeline in the State of Illinois.

**Whiting Petroleum Corporation**

Provide professional subject matter expertise (SME) of a test installation of nine (9) deep anode cathodic protection systems installed to provide protection to directionally drilled production wellhead systems in the State of North Dakota. Data review and professional opinion of deep anode design, cement log, and cathodic protection profile (CPP) tool run data. Project deliverables included a professional opinion report and a technical presentation on results.

**Valero Energy Corporation**

SME project direction for AC Threat Assessment on 150-mile pipeline as an “active” high level management approach to evaluate both present “threat area” and future AC “threat” risk. Project included the gathering of AC voltages on the pipeline and soil resistivity at intervals not exceeding 1000-ft. AC Threat calculation, research and inclusion of historic data obtained from other sources (DFOS), generation of plots and graphs, scenario or sensitivity analysis, report, observations and recommendations.

**Southern Star Gas Central**

SME project support for 20-inch diameter natural gas pipeline damaged by 12kV AC power line arc near Joplin, Missouri including assessment of condition, documentation of event, wall loss discovery, assessment and written report, and Client support with regulatory oversight and questions

**Exxon Mobil Refinery**

SME technical project support assessment of condition (cathodic protection systems), annual survey, remediation, and recommendation.

**Professional Organizations & Affiliations:**

- Cathodic Protection Training and Certification Program Task Group: Cathodic Protection Level 1 (2000) and Cathodic Protection Level 2 (2000)
- Chicago Section Membership Chairman (1986-1987)
- Cathodic Protection Task Group: Cathodic Protection Training Program (1999 – 2000)
- Chicago Section – Special Events Chairman (1985-1986)
- Chicago Section – Membership
- Chicago Regional Committee on Underground Corrosion (CRCUC) Chair and Vice-Chair
- Michigan Electrolysis Committee Chair and Vice-Chair

**National Center for Construction Education and Research (NCCER)**

- Administrator
- Certified Master Trainer (2010)
- Certified Administrator (2010)
- Certified Craft Trainer/Evaluator: Core Curricula, Gas Pipeline Operations, Liquid Pipeline Control Center Operations, Liquid Pipeline Field Operations, Pipeline Core, Pipeline Corrosion Control, Pipeline Electrical and Instrumentation (E&I), Pipeline Maintenance, Pipeline Mechanical, Specialty Craft

**Veriforce**

- Administrator
- Authorized Evaluator

**Midwest Energy Association (MEA)**

- Administrator

**The Society for Protective Coatings (SSPC)**

- Member

**United States Gypsum**

Develop, perform training, assessment and evaluation for operator qualification of Client employee resources, assess natural gas pipeline system and plant facilities, and develop initial pipeline normal operation system drawing format.

**United States Gypsum**

SME level support for isolation flange failure in Washington, PA including: assessment of condition, purge out of product, oversight of repairs, purge in of product, and restoration of service.

**Corrosion Control Operations**

Managed and directed the Corrosion Control Service Group for Nicor Technologies and Nicor Gas providing corrosion control consulting services to distribution and transmission pipelines, municipal and utility organizations, and commercial and industrial customers. Responsible for the performance of all operating corrosion control programs (internal, external and atmospheric) on the Nicor Gas pipeline system including specification, performance and day-to-day operation. As a member of the Nicor Gas welding and joining, system integrity, and code committee operating task groups provided technical expertise in pipeline integrity, research and testing, corrosion control and cathodic protection issues. Having responsibility for the due diligence corrosion control and cathodic protection evaluations on acquisition projects in Argentina and Tennessee. Developed risk, quality, and integrity management programs related to corrosion control and cathodic protection operations. Location: IL

**Corrosion Control Services**

Directed and coordinated the Nicor Gas corrosion control programs for distribution, transmission, and storage facilities. Directly supervision responsibility for the completion of annual corrosion control and corrosion control activities that included annual reading programs, close interval survey, stray current interference, and impressed current rectifier system replacement.

**Research Services**

Managed and directed the research lab for Nicor Gas and was responsible for day-to-day operation, quality performance, testing, recommendation and approval, including the performance and analysis ASTM and ANSI test standards and methods. Directly responsible for the purge routine process for all large-diameter high- pressure pipelines. Conducted, analyzed and developed corrosion control action and recommendation for all wall loss and field failure events. Locations: IL

**Expert Witness Testimony:**

- South Dakota Public Utility Commission - Testimony
  - Keystone Pipeline, October 2007- Corrosion and Protective Coating Sections and Related Code
  - Keystone XL, September 2009 – Corrosion and Protective Coating Sections and Related Code
  - Keystone XL, March-July-September, 2015 – Corrosion Protective Coating Sections and Related Code
- State of Iowa Utilities Board
  - 2002, Testimony related to AC Interference, assessment, and mitigation as it relates to: proposed pipeline construction beneath overhead AC transmission systems, Iowa.
- Illinois Commerce Commission
  - 2015, Expert Witness Testimony related to impact of proposed HVDC system on large diameter, high-pressure natural gas pipeline system in Illinois.

**Technical Presentations:**

- AGA/SPE Underground Storage Operators Workshop, Detroit, MI. May 1-2, 2018 “Downhole Corrosion and Cathodic Protection
- NACE International, January-2018 Northern Plains Corrosion Control Short Course, Omaha, Nebraska – Speaker and presentation on AC Interference
- 30<sup>th</sup>. Annual Corrosion Control Seminar, Great Bend Kansas, April 2017 “AC Interference”
- Northern Plains Corrosion Short Course, January, 2017 “AC Interference”

**Lakehead Pipeline Company**

Directed the completion of all annual cathodic protection reading programs, close interval survey, stray current interference, impressed current rectifier system replacement, and field failure investigations for the Lakehead Pipe Line Company over a six (6) year period on facilities that include pipeline, compression, substation, and storage facilities. Locations: ND, MN, WI, IL, MI, NY.

**Portal Pipeline Company**

Supervised and completed the annual cathodic protection reading program for the Portal Pipe Line Company including pipeline, gathering and wellhead systems. Location: ND

**Alyeska Pipeline Service Company**

In-state direction, supervision and related to the process of conducting, analyzing and performing telluric based close interval surveys for the Trans-Alaska Pipeline System (TAPS) over a four (4) year period. Direct responsible for the performance, provision, data quality, data analysis and report recommendations. Location: AK

**Desert Generation and Transmission Company**

Supervised, conducted and performed the design and testing services for the Deseret Generation and Transmission Company. Planned and performed a wide variety of duties involving the evaluation, design, and installation of cathodic protection systems to inhibit corrosion on pipelines, tanks, and similar underground and submerged structures including electrical continuity and protection of concrete steel cylinder pipe. Locations: UT

**Mobil Oil**

Conducted and analyzed all underground facilities for the potential application of cathodic protection for the Mobil-Joliet Refinery. Operational and performance responsibilities related to installation of new and existing cathodic protection systems: design, redesign, and installation of impressed current systems for tank bottoms. Location: IL



**Technical Presentations:**

- NACE Eastern Area Conference, October, 2016 “AC Interference”
- Whiting Petroleum Corporation September 2015 presentation on Cathodic Protection of Wellhead Structures
- NACE International – Rocky Mountain Section Meeting, September 2015 presentation on AC Interference and Mitigation.
- Columbia Gas, Virginia – Technical presentation on AC Interference and Mitigation and CIS/ACVG/DCVG Data Interpretation, September, 2015
- Baltimore Gas and Electric (BGE), September, 2015 – Technical Presentation on
- Baltimore-Washington Corrosion Committee (BWCC) – Technical Presentation on AC Interference and Mitigation- May, 2015
- PG&E – February, 2015 Technical Presentation on AC Interference and Mitigation
- NACE International, January-2015 Northern Plains Corrosion Control Short Course, Omaha, Nebraska – Speaker and presentation on AC interference and Mitigation and case examples
- USG – January, 2015 – Technical Presentation on Plant Audit Inspections
- NACE San Antonio Section Meeting, May-2014 – Speaker and presentation on AC interference and mitigation and case examples
- NACE International, January-2014 Plains Short Course (Omaha), Nebraska – Speaker and presentation on AC interference and Mitigation and case example
- NACE Wisconsin Short Course, September, 2013 – Cathodic Protection Design and Practical
- NACE Wisconsin Short Course, September, 2013 – Casings: Design and Regulations
- NACE International, August – 2013 Central Area Conference, Little Rock – Speaker and presentation on AC interference and Mitigation and case example.

**Montana Power**

Conducted, analyzed and performed close interval and leak detection surveys on large diameter - high pressure – natural gas transmission pipelines owned and operated by Montana Power near Helena, Montana. Location: MT

**Northern Natural Gas**

Conducted, analyzed and performed close interval surveys on large diameter - high pressure – natural gas transmission pipelines owned and operated by Northern Natural Gas (NNG) in the Upper Peninsula of Michigan. Location: MI

**Mountain Bell Telephone**

Supervised, conducted, analyzed and performed the corrosion control and cathodic protection analysis of the Mountain Bell Telephone lead sheath cable running between Evanston and Cheyenne. Locations: WY

**Coffeen Power Plant**

Supervised, conducted, analyzed, designed and installed cathodic protection systems for the Coffeen Power Plant Facilities operated by the Central Illinois Light Company (CILCO). Location: IL

**LaGrange Hospital**

Designed, analyzed and supervised the installation of galvanic anode systems designed to protect the interior water box of condenser/chiller units operated by the LaGrange Hospital. Location: IL

**Union 76**

Supervised, conducted and analyzed the cathodic protection systems installed on over 250 underground gasoline and waste oil storage tanks systems owned and operated by Union 76. Locations: IL, KY, IN

**Technical Presentations:**

- Northern Natural Gas (NNG) Spring Corrosion Round Table – 2013: AC Interference and Mitigation Training (Minneapolis, Des Moines, El Paso)
- NACE Eastern Area Conference, October, 2016 “AC Interference”
- Whiting Petroleum Corporation September 2015 presentation on Cathodic Protection of Wellhead Structures
- NACE International – Rocky Mountain Section Meeting, September 2015 presentation on AC Interference and Mitigation.
- Columbia Gas, Virginia – Technical presentation on AC Interference and Mitigation and CIS/ACVG/DCVG Data Interpretation, September, 2015
- Baltimore Gas and Electric (BGE), September, 2015 – Technical Presentation on
- Baltimore-Washington Corrosion Committee (BWCC) – Technical Presentation on AC Interference and Mitigation- May, 2015
- PG&E – February, 2015 Technical Presentation on AC Interference and Mitigation
- NACE International, January-2015 Northern Plains Corrosion Control Short Course, Omaha, Nebraska – Speaker and presentation on AC interference and Mitigation and case examples
- USG – January, 2015 – Technical Presentation on Plant Audit Inspections
- Northern Natural Gas (NNG) Spring Corrosion Round Table – 2013: CIS/ECDA Defect and Interpretation
- AGA/SPE, March 2012 – Identification and Prevention of Corrosion in Gas Storage Gathering Facilities
- NACE Wisconsin Section – Annual Short Course – 2013: Speaker and presentation on Cathodic Protection Design and Practical's and Casings: Design and Regulations
- NACE Wisconsin Section – 2012: Speaker and presentation on AC interference and Mitigation and a case example related to a 12-inch and 20-inch pipeline system.

**O'Hare Airport**

Designed and supervised the installation of galvanic anode protection systems for aviation fuel pipelines related to jet-way expansions. Responsible for the cathodic protection assessment, design, and mitigation on jet-way expansions of the G & H terminals as well as field supervision on the United Airlines terminal 1 construction project. Locations: IL

**City of Viburnum**

Designed and supervised the installation of down-hole impressed current systems for the City of Viburnum including the protection of water well casing, column and bowls. Location: MO

**Technical Presentations:**

- 51<sup>st</sup>. Annual Underground Corrosion Short Course: Speaker and presentation on AC issues on Pipelines presented under the System Integrity section, Purdue University, 2012
- 51<sup>st</sup>. Annual Underground Corrosion Short Course: Pipeline Casing Presentation, 2012
- 51<sup>st</sup>. Annual Underground Corrosion Short Course: Station Assessment Procedures, 2012
- EPRI/Southwest Research: June 2010, Copper Grounding Presentation
- China International Oil and Gas Pipeline Conference, Langfang, Hebei, China, November-2009: Safety and Operability Assessment Report and HAZOP Study Report (PetroChina),
- China International Oil and Gas Pipeline Conference, Langfang, Hebei, China, November-2009: ECDA Implementation Case Study – Pipeline Integrity and Corrosion Control Technology
- NACE International, March 1991 – The Development and Conversion to an “On-line” Corrosion Control Records System on a Mainframe Computer, Corrosion 91, Paper Number 346, NACE International.

Key Relevance
Corrosion Control Field Assessments
Cathodic Protection Design
Cathodic Protection Troubleshooting
Risk Assessment and Prioritization

**Job Title:**  
Sr. Project Manager  
Corrosion

**Years with EN Engineering:** 7

**Total Years of Experience:** 7+

**Primary Office Location:**  
Columbia, MD

**Education:**

- M.S., Environmental Engineering, Virginia Tech, 2010

**Professional Registration:**

- MD
- CA
- TX

**Professional Certifications:**

- NACE – Certified Cathodic Protection Specialist CP 4

**Overview:** Yaofu possess over 7 years' experience with conducting cathodic protection system monitory surveys, structure-to-earth potential surveys, soil resistivity surveys, in-situ pH testing, electrical continuity verification, electrical isolation testing, close-interval and cell-to-cell potential surveys, stray current evaluation surveys, induced AC interference evaluations and pipe sample analysis. His experience includes designing CP systems for major cities and utilities around the country as well as creating maps and graphs, using GIS software and related equipment; conducting research to locate and obtain existing databases, providing recommendations, training and support as needed. Yaofu has managed large scale projects for major cities and municipalities around the country, including Tarrant Regional Water District, City of Virginia Beach, Lavaca-Navidad River Authority, Baltimore County, and District of Columbia Water and Sewer Authority, and lastly is a Project Management Fundamentals Graduate from Georgetown University, in addition to his M.S. Environmental Engineering Degree from Virginia Tech.

**Relevant Projects:**

**Washington Metropolitan Area Transit Authority (WMATA)** Extensive WMATA work included testing of track resistance and other stray current issues. Has assisted in the hands on field portion of the WMATA personnel Basic Corrosion training program for the past 3 years.

**Tarrant Regional Water District**

Surveyed 140 miles of water transmission line (proposed) for corrosion control concerns.

**DC WATER - District of Columbia Water and Sewer Authority**

Performing pipe condition assessment for 1300 miles of DC WATER pipelines by reviewing and expanding existing assets database; analyzing risks, prioritizing pipe rehabilitation, and designing and monitoring CP systems.

**Washington Suburban Sanitary Commission**

Cathodic Protection System Evaluation. Visited the 113 test stations for physical appearance evaluation, "pipe-to-soil" potential surveys, anode current outputs tests, electrical insulation tests, and current requirement measurements.

**City of Virginia Beach**

Force Main Evaluation. Through Prime Engineering Firm, measured in-situ soil resistivity and pH; evaluated stray current interference and pipeline electrical continuity; and performed cell-to-cell potential survey.

**Washington Gas**

Chalk Point Transmission Line Evaluation. Performed "Close Interval Survey" and monitored induced AC interference.

**Baltimore County Department of Public Works**

Water Storage Tank Impressed Current Cathodic Protection System Evaluation. Evaluated the performance of impressed current CP systems on fourteen (14) water storage tanks within Baltimore County.

**Baltimore City Department of Public Works**

Performed failure inspection on a section of excavated 10" cast iron water main by evaluating graphitization and pitting; measured pipe depth with ultrasonic instrument.

**District of Columbia Water and Sewer**

Inventorize Cathodic Protection Systems using GIS System, reviewed documents and metadata such as; as-built drawings and extract information of the cathodic protection (CP) systems for the water infrastructure of DC Water. The cathodic protection system information was then imported into maps/graphs, using GIS software and related equipment. The data included in the GIS map included the locations and types of cathodic protection test stations and various surveying readings. The survey readings can then be incorporated into a map for better visual presentation and better understanding of the status of cathodic protection systems. The final deliverable included a GIS layer with cathodic protection systems and historical surveying readings collected from these CP systems.



Key Relevance
Project Management
Cathodic Protection Design
Corrosion Control Field Assessments
Cathodic Protection Trouble Shooting
AC Mitigation Design and Analysis
Atmospheric Corrosion Inspection

**Job Title:**

Sr. Project Manager  
Corrosion Engineering

**Years with EN Engineering: 3**

**Total Years of Experience: 22**

**Primary Office Location:**  
Warrenville, IL, USA

**Education:**

- B.S., Civil Engineering, North Dakota State University, Fargo, North Dakota
- M.B.A., Business, DePaul University, Chicago, IL.

**Professional Registration:**

- Civil Engineer, IL

**Professional Certifications:**

- NACE International – Cathodic Protection Technician (CP Level 2), #33330
- Transportation Worker Identification Credential (TWIC)

**Overview:** Mr. Eggen is an experienced engineer and project manager with over twenty (20) years of engineering experience, with over fifteen (15) years in the planning, design, installation and operation of natural gas pipelines. He has lead teams in the areas of cathodic protection, pipeline integrity management, geographic information systems (GIS) and general pipeline maintenance and design activities. Prior to joining EN Engineering, he worked for Nicor Gas, a Southern Gas Company. Areas of Direct Industry Experience Include:

- Project Management – Budgets, Schedules, Communications.
- Cathodic Protection Design, Installation and Maintenance
- AC Corrosion – Threat Assessment, Analysis and Mitigation
- Review of internal “smart” tool data (ILI tools) for remediation options
- Coating selection and inspection
- Material selection, specification and procurement
- Technical specifications and procedures
- Operational support including:
  - High consequence area (HCA) assessment and class surveys
  - Integrity management plan writing and review
  - Threat analysis and risk ranking
  - Cathodic protection design review and recommendations

**Relevant Projects:**

**Corrosion Control and Design Services**

Manager of Corrosion Control and Design for the Nicor Gas Distribution, Transmission and Storage assets. Also responsible for the Corrosion Control of AGL Resources Storage assets post-merger with Nicor Gas. Major responsibilities included: Code Compliance Assurance, Cathodic Protection Design Review, Oversight of Corrosion Database, Technical Reference for Project Designs, Updating/Creating Corrosion Related Construction Specifications and participating in Records Audits. Location: IL

**Integrity Management Services**

Project Manager for the implementation of the Nicor Gas Transmission Integrity Management Program. Responsibilities included Integrity Management Plan writing, program metrics tracking, DA and ILI contractor selection, maintaining data integrity and review of pipeline assessment inspection results. Transmission Integrity data was managed and validated in the GIS system and risk modeling was updated and analyzed for baseline assessments. Led the Nicor Gas corporate team through multiple state commission audits of the Integrity Management Program. Locations: IL

**Geographic Information System (GIS) Experience**

Project Manager for the implementation of a corporate GIS for Nicor Gas. Efforts included the oversight of database design, conversion vendor selection, conversion project management, budget management, back office systems management, end user interface design for office and field users. Location: IL

**Professional Organizations & Affiliations:**

- NACE International Member #301138
- American Society of Civil Engineers (ASCE) Member

**Relevant Projects (Cont'd):**

**Interference Analysis**

Project Manager and Engineer for a cross country pipeline experiencing stray current interference from a nearby, parallel pipeline system. Field surveys and data analysis resulted in the installation of IR-Free coupons to determine true pipe potentials and develop a monitoring plan. Location: MO

**CP System Gap Analysis**

Reviewed records, procedures and assessed existing CP components for a major midwestern metropolitan water utility transmission system. Results of the gap analysis included a report that summarized CP infrastructure upgrades, recommended a system wide data gathering effort with improved CP procedures and an improved data management system. Location: MN

**PCCP Water System Analysis and Design**

Project Manager for a close-interval-survey (CIS) and interference study on a 60" PCCP water system. Results of the survey were analyzed and a design was implemented to improve the pipe potentials to recommended levels for a PCCP pipe system. Work also included the implementation of the bidding process for contractor selection. Location: IL

**Tunnel Pipe Assessment and CP Design**

Project Manager for the condition assessment and CP design for a 24" natural gas pipeline in a tunnel under a river. Assessments included corrosion and dent analysis after coating removal. CP design included a linear anode system, reference cells and coating recommendations. Location: Illinois.

**Station Piping CP Design**

Project Manager for the design and details of multiple compressor and regulating stations for gas and liquids pipelines. Designs included deep well, traditional and linear anodes. Details include groundbeds, rectifiers, isolation and monitoring systems. Location: Various.

**Project Management**

Project Manager for various customers involving Cathodic Protection Design Services:

- Enbridge Pipeline Co.
- Northern Natural Gas Co.
- Kinder Morgan
- Kern River Gas Transportation Co.
- Blue Racer Midstream
- Pioneer Seed (DuPont)