CAAP Quarterly Report

06/24/2024

Project Name: A Novel Reliability-Based Approach for Assessing Pipeline Cathodic Protection (CP) Systems in External Corrosion Management

Contract Number: 693JK32350002CAAP

Prime University: Marquette University

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Reporting Period: 04/01/2024-06/24/2024

Project Activities for Reporting Period:

The research team has been working on Task 1 (literature review) and Task 2 (data collection).

Project Financial Activities Incurred during the Reporting Period:

The financial charges include the professional service from inferModel, graduate student stipend, tuition and corresponding fringe benefit, and indirect cost.

Project Activities with Cost Share Partners:

Cost share has been charged as planned.

Project Activities with External Partners:

Several meetings were held with our external partner to discuss the data collected. Weekly meetings were also held between Marquette research team and Project Contractor, inferModel, to discuss the preliminary analysis on the pipeline dataset.

In terms of literature review, the following topics have been reviewed:

- Fundamentals of corrosion mathematics and electricity
- Fundamentals of pipe and cable locating
- Fundamentals of corrosion
- Introduction to cathodic protection
- Electrical isolation
- Introduction to pipeline coatings
- Rectifier fundamentals
- Cathodic protection measurement basics

In terms of data analysis, the following summarizes the high-level activities conducted in the past quarter:

- A data dictionary with over 800 relevant engineering variables was developed and correlating all Cathodic Protection attributes (that we received so far) to the pipelines in this study was done.
- Detailed repair matching was performed at the feature and the pipe joint level using several available sources with field NDE information and repair history.
- Geospatial haversine approximations were performed to determine the bearing angle between power lines or foreign pipelines to the relevant pipelines used in this study.
- External corrosion Box to Box (B2B) matching integration on all historical MFL-A inspections of 5 pipelines has also been finalized, as well as the development of a novel approach to identify significant growth incorporating tool error uncertainty.
- The benefits and drawbacks of B2B matching have been quantified through visual examination, similarly situations at which B2B is most reliable have been quantified.
- Historical pipeline joint statistics on external corrosion have also been captured temporarily across multiple inspections per pipelines to provide a macro-view on corrosion growth including historical changes to the number of features, the density per meter, the equivalent radius, the percentage of surface area lost, and maximum external corrosion depth.
- The historical pressure data for 24 pump stations have been obtained, and a MOP Extreme Value Analysis has been performed to determine realistic MOP estimations that can be used pipeline reliability analysis of external corrosion.

There were several conversations among the research team, industry partners, and Technical Advisory Panel regarding the data collection of pipelines close to electrical rails. Here are some conclusions:

- Currently, there is a lack of field data for pipelines close to electrical rails. Electrical rails generate non-stationary DC interference, requiring continuous monitoring and input variables from electrical railway systems; the current field monitoring data for such system is not mature to be used for the data analysis;
- The DC interference will be studied from two ways: one is from Task 3 (Lab testing and modeling), the other one is from Task 4 (Defect growth modeling) using the field data that contains the DC interference from foreign pipelines.
- We will explore the possibility of using field data reported in the literature to understand the impact of DC interference due to electrical rails on CP performance.

Potential Project Risks:

So far no risk has been identified.

Future Project Work:

In the next quarter, we will continue Task 1 literature review and working closely with our external partner to update them regarding our data analysis on the 5 transmission pipelines. The data will be further analyzed and prepared for corrosion growth modeling.

Potential Impacts to Pipeline Safety:

At the current phase, the project provides a better understanding of the usage limitation of CP survey data, and the needs in the existing defect analysis frameworks.