CAAP Quarterly Report

04/01/2024

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: 01/01/2024-03/31/2024

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, PI's 10% academic year and corresponding fringe benefit, 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:

- Non-intrusive pipeline survey techniques (CIPS, DCVG, PCM, ACVG)
- Hidden dangers of cathodic protection
- Criteria for cathodic protection
- Dynamic stray current analysis
- Design of impressed current cathodic protection
- AC interference mechanisms and mitigation strategies

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

- 1.07 M most recent inspection records for 5 pipelines have been aggregated into a single database table to create a base pipeline table holding 463 K External Corrosion anomalies and 157 K different pipeline joints.
- A unique identification system has been developed to identify external corrosion features and the type of external corrosion across 5 different pipelines with different inspection formats across all historically available inspections (unique identifiers, type: clusters, child feature, single metal loss)
- A level 2 API 1163 assessment at 95% Confidence and ILI-Field Outlier Analysis has been performed on the latest inspection run for most pipelines with considerations around ILI tool error and field tool error. The sensitivity of the field measurement method, wall thickness, field corrosion morphology, heat affected zone interactions have been assessed on these results.
- gSSURGO integration of all relevant soil properties using dominant soil layers, and weighted average soil layers at the exact depth of cover of the pipeline.
- The distance between the pipeline joints and foreign pipelines and transmission power lines have been provided. Relevant foreign pipelines and transmission power lines were provided by our external partners, and they have been mapped to our dataset.
- It was found that no electrical rails are within 1 km of the pipelines studied using Open Street Map, thus removing them from this study. Open Street Map data on rails (non-electric), roads, waterways, building and land use have also been connected to our dataset for any proxy relationships with corrosion.
- Field soil resistivity measurements have been compared against other open-source estimations to understand the quality of open-source soil resistivity in comparison to field results. Distributions have been created to demonstrate the variability in soil resistivity accuracy. Overall, they do not demonstrate sufficient accuracy for deterministic modelling.
- Most of all historical Cathodic Protection data on the relevant pipelines have been mapped geospatially to relevant pipeline joints for:
    - Test Station Measurements
    - Bond Measurements
    - Rectifier Facility Measurements
    - Decoupler Measurements

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 collect relevant data on the 5 transmission pipelines. The data will be further analyzed and prepared for corrosion growth modeling. We will also see possible additional pipelines that are close to electrical railway systems.

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.