CAAP Quarterly Report

Date of Report: 3/30/2024

Project Name: Performance Evaluation and Risk Assessment of Excessive Cathodic Protection on Vintage Pipeline Coatings

Contract Number: 693JK32250008CAAP

Prime University: The University of Akron

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Reporting Period: 1/1/2024-3/30/2024

Project Activities for Reporting Period:

Here are the major project activities for each task:

a) Task 1. Identification of vintage pipeline coatings and influencing factors in coating cathodic disbondment (The University of Akron and Marquette University)

Task 1 is in progress this quarter. The Ph.D. student, Yuhan Su, at The University of Akron, is working on literature reviews to understand pipeline coatings and the influencing factors in coating cathodic disbondment.

The second and third objectives of Task 1 are working on. The conditions where the vintage coating experiences cathodic disbondment and the key influencing factors on the cathodic disbondment are studied and taken into the experimental design in Task 2.

b) Task 2. Evaluation of coating cathodic disbondment considering key influencing factors through laboratory testing (The University of Akron)

One Ph.D. student, Yuhan Su, and two undergraduate students, Tanner Laughorn and Abbi Acurio, at The University of Akron, are working on this task.

Coating preparation: a liquid epoxy coating, which is a two-part system designed to protect steel pipe from the harsh effects of corrosion is used as the representative of a CP-compatible coating. 50 coating panels of this epoxy coating have been prepared in the lab for testing.

Coating cathodic disbondment testing: the cathodic disbondment of the prepared epoxy coatings is studied by applying different cathodic potentials (-0.775, -1.5, and -2.923 V vs. SCE) under different durations (3, 7, 14, 21 days). Each condition will be tested for at least three coating samples.

Coating characterization: The experimental setups for applying CP while monitoring coating disbondment behavior have been designed and used for the testing. The open circuit potential

is conducted before and after the cathodic disbondment test. Besides, electrochemical impedance spectroscopy is performed before and after the test. The local pH around the disbondment area is measured by a micro pH meter. The disbonded area of the coating surface is characterized by optical microscopy and analyzed using ImageJ software. Blisters or rust are visually inspected and recorded followed by a cathodic disbondment test.

c) Task 3. Numerical simulation of pipeline coating disbondment behavior and CP system (Rutgers University)

   Dr. Wang and his students at Rutgers University continue working on a literature review on the COMSOL model to simulate the coating disbondment behavior under CP. The Ph.D. student, Xiao Chen, is studying the initial and boundary conditions for coating disbondment modeling.

d) Task 4. Probabilistic degradation model of coated pipe wall due to excessive CP (Marquette University)

   This task just got started at Marquette University. Dr. Huang is collecting coating disbondment data from different CP conditions for the database to generate the degradation model.

e) Task 5. Determination of recoating time using reliability-based approach (Marquette University)

   Task 5 will start in the 9th quarter of this project.

Project Financial Activities Incurred during the Reporting Period:

Here is the cost breakdown list for the expenses during the reporting period:

	11/1/2023-3/31/2024
a) Full-time faculty	$5,178.41
b) Graduate assistant	$1,099.56
c) Fringe benefits	$1,785.96
d) Supplies	$3,505.83
e) Travel	$703.87
f) Indirect cost	$6,382.36
Total	**$18,655.99**

Project Activities with Cost Share Partners:

No cost-share activity during this reporting period with cost-share partners.

Project Activities with External Partners:

Dr. Qixin Zhou and Dr. Qindan Huang (sub-university) have bi-weekly meetings to update the progress of each other and discuss the work of this project. Dr. Huang is hiring graduate students to work on this project.

Dr. Qixin Zhou and Dr. Hao Wang (sub-university) have monthly meetings to update the progress of each other and discuss the work of this project. Dr. Wang has recruited a new graduate student to work on this project and the new student will start working in the next quarter.

We received another pile of vintage pipes with coating from Dr. Rafael Rodriguez through his company. Dr. Rodriguez very kindly provided us with the CP operation potentials and coating information for these pipe samples.

Potential Project Risks:

No potential project risks during this reporting period.

Future Project Work:

As a continuing understanding of the influence factors on the cathodic disbondment and cathodic disbondment conditions, the literature review in Task 1 will focus on selecting the factors and conditions that are reasonable and valuable to be tested in the lab. The conditions may need to be adjusted or further studied combing the results for experimental testing in Task 2.

The coating cathodic disbondment in Task 2 will be continued for more coating samples to repeat the same condition to generate a reliable statistical analysis. In addition, the underneath metal corrosion will be studied through Tafel testing after a long term of CP.

More liquid epoxy coating panels will be prepared in Task 2. In addition, the second type of coating, commercially prepared FBE-coating, will be in preparation in the next 90 days.

Tasks 3 and 4 at sub-universities will be in progress in the next 90 days.

Potential Impacts to Pipeline Safety:

Knowing the types of coatings that have issues with excessive cathodic protection brings attention to the pipeline industry to replace these types of coatings in vintage pipelines. Understanding coating disbondment behavior and underneath metal corrosion rate under excessive cathodic protection will provide guidance to pipeline operators.