CAAP Quarterly Report

Date of Report: 12/30/2025

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

Contract Number: 693JK32250008CAAP

Prime University: The University of Akron

Prepared By: Qixin Zhou, qzhou@uakron.edu, 330-972-7159

Qindan Huang, qindan.huang@marquette.edu, 414-288-6670

Hao Wang, hw261@soe.rutgers.edu, 848-445-2874

Reporting Period: 10/1/2025-12/30/2025

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 completed.

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, at The University of Akron, is working on this task this quarter. There are three subtasks in Task 2:

   Subtask 1 is the evaluation of cathodic disbondment performance in pipeline coatings. The experimental setups, testing procedures, coating samples, testing conditions, and evaluation parameters have been previously reported. This subtask is completed.

   Subtask 2 is the onset of degradation of pipeline coatings. This is the continuous immersion test for coatings without making an artificial defect on the coating surface. This test is designed to investigate the initiation of cathodic disbondment of different coatings. The same coating samples are used as in subtask 1. The applied CP potential is -2.923 V vs. SCE, and EIS is conducted weekly to monitor the change of the coating to identify the start of the coating cathodic disbondment.

   Subtask 3 is the cathodic disbondment assessment of field-aged pipeline coatings. After the mid-term review meeting, we started to study the real vintage pipeline coatings, as we were provided with some field-aged pipes. This subtask is completed.

   A manuscript is in preparation for a summary of experimental findings from Task 2.

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

   The Ph.D. student, Xingsen Yang, at Rutgers University, is working on a predictive

framework to quantify cumulative metal loss during cathodic disbondment progress. The disbondment kinetics are characterized using experimental data points of the disbonded area from Task 2 to validate the disbondment model. With this computational framework, the cumulative metal loss corresponding to experimentally tested coating under different cathodic protection levels can be quantitatively evaluated.

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

   The Ph.D. student, Brigida Zhunio Cardenas, at Marquette University, is working on this task this quarter. The Marquette team is studying three degradation models to assess the total degradation (coating disbondment along with steel corrosion). The three individual models are (1) Model 1: prediction on coating disbondment rate; (2) Model 2: prediction on steel corrosion rate; (3) Model 3: prediction on the CP level on steel under coating disbondment. Data collection from the literature review for the three models is completed. Model development using different regressions is in progress this quarter.

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

   This task will be started when Task 4 is completed.

Project Financial Activities Incurred during the Reporting Period:

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

	7/1/2025-12/30/2025
a) Summer faculty	$24,172.00
b) Graduate assistant	$18,289.56
c) Fringe benefits	$4,735.57
d) Supplies	$5,654.21
e) Travel	$802.64
f) Student tuition	$2,500.00
g) Subaward	$20,992.93
h) Indirect cost	$27,900.04
Total	**$105,046.95**

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 each other on their progress and discuss the project's work.

Dr. Qixin Zhou and Dr. Hao Wang (sub-university) have bi-weekly meetings to update each other on their progress and discuss the work of this project.

Potential Project Risks:

No potential project risks during this reporting period.

Future Project Work:

The coating cathodic disbondment in Task 2 will be continued for the continuous immersion test to understand the initiation and progress of the coating disbondment under CP conditions. A manuscript is in preparation and will be polished for submission to a journal.

The COMSOL simulation in Task 3 will continue the computational framework for metal loss prediction under different cathodic protection levels. The model will be further validated and improved with experimental results.

The three models in Task 4 will be further developed and studied using additional experimental data from the literature, as well as data specifically generated in Tasks 2 and 3.

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 the underlying metal corrosion rate under excessive cathodic protection will guide pipeline operators. As the progress of this study, the overprotection issue comes to our attention, and we plan to address this interesting phenomenon through experimental studies.