**CAAP Quarterly Report**

Date of Report: 7/8/2024

Prepared for: *U.S. DOT Pipeline and Hazardous Materials Safety Administration*

Contract Number: 693JK32050008CAAP

Project Title: Effectiveness Assessment of Pipeline Cathodic Protection System Using Remote Sensing, Advanced Modeling, and Data Analytics

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For quarterly period ending: 6/30/2024

**Business and Activity Section**

# Contract Activity

The subaward to University of Akron has been issued.

The graduate student (Xiao Chen) and the postdoc (Jay Shah) are currently working on this project. A new graduate student has been recruited at Rutgers University to work on this project in fall semester 2024. Anther new graduate student is expected to be recruited at University of Akron.

# Status Update of Past Quarter Activities

The project team continued literature review on the project topic by searching the relevant publications in journals, conference proceedings, government reports, and national and international standards.

The project team started developing numerical models to simulate pipe corrosion in soil with CP protection.

# Cost Share Activity

Cost share is provided by Rutgers University and University of Akron during this quarterly period as budgeted in the proposal.

# Technical Approach

Task 1 Literature Review, Information Collection, and Refinement of Work Plan

The research team has completed literature review on CP system design principle, factors affecting CP effectiveness, and CP effectiveness assessment methods (laboratory, field, numerical modeling, data-driven). A review paper is being drafted.

Task 2 Laboratory Tests of CP Performance under Various Factors

The laboratory experiment at U. of Akron is delayed due to the student recruitment issue. The work is expected to start in fall semester 2024.

Task 3 Modelling and Simulation of CP Performance

The research team has started to develop a coupled electro-chemical-soil model for CP effectiveness assessment. The development of CP modelling includes characterization of two phenomena. One is electrochemical reactions on the pipeline steel surface, the other is chemical species transport during the electrochemical reactions. To accurately simulate CP performance, the transport of chemical species will be coupled with electrochemical reactions by constraint the reaction rate based on the concentration of species, which enables the model to take the changing environment conditions into account. Fick’s law is used to consider the concentration and the movement of chemical species, and Ohm’s law and current conversation principle are used to characterize the electrochemical reactions.

The initial model input variables will include: (1) the soil electric conductivity that is affected by moisture content; (2) oxygen diffusion in the soil; and (3) CP current level and anode type. If needed, the concentration of corrosive elements; and electrochemical reaction parameters (pH effect) will be added into model features.