Date of Report: *6th Quarterly Report- March 25th, 2025*

Contract Number: *693JK323RA0001*

Prepared for: *PHMSA, Government Agency: DOT*

Project Title: *Dual Purpose PIG for Cleaning and Internal Integrity Assessment for Hazardous Liquid Pipelines*

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1.1. Team Project Activity 1: Task 2: Development of the Attachment Set for Transferring the Cleaning Pigs into Dual-purpose Pigs

In the previous report (Q5), the major updates for the Task 2 included 1) the development of Version 2 of the attachment, along with functionality testing; 2) Pressurized water tests on both attachments; and 3) A new housing design for Version 3. Results indicated that both Version 1 and Version 2 attachments successfully met the requirements outlined in the proposal, demonstrating the ability to capture video inside pipelines clearly. Building on this success, in this reporting period, the research team continued optimizing the design and developing additional models to support research progress and potential technology transfer. Therefore, a trial Version 3 housing with dual cameras has been fabricated to enable more detailed image capture when needed. Version 4, designed to navigate small bending radii, has also been successfully fabricated. Meanwhile, Version 5 is currently under design.

1.2. Team Project Activity 2: Task 4: Development of a Digital Twin-Enabled Pipeline Integrity Assessment Framework

The previous research stage (Team Project Activity 2: Task 3) has successfully developed a deep learning-based computer vision approach to automatically and efficiently identify corrosion and crack regions from internal pipeline inspection videos. In this quarter, A digital twin-based analytical framework was developed and successfully used to create a virtual representation of corrosion identified by a learning-based computer vision model from experimentally captured video. This approach enables the simulation of material degradation processes and helps quantify the pipeline's residual strength. The risk of failure is assessed through probabilistic analysis, allowing for more precise predictions of pipeline lifespan and optimized maintenance planning.

1.3. Team Project Activity 3: Task 4: User-friendly Software Development for the Dual-purpose Pig and Economic Analysis

1.3.1. Development of the User-friendly Software (Task 4.1)

In the previous report (Q5), significant progress was made in software development, including the creation of key components such as the homepage, login page, and video list page. That report also provided a detailed page-by-page breakdown of the existing Graphical User Interface (GUI) design. This report outlines recent enhancements aimed at improving usability, data visualization, and overall system functionality across multiple pages and interfaces. In addition, several new features have been integrated into the user interface software.

1.4. Team Project Activity 4: Task 5 Validating Feasibility through Field Testing and Final Report

The research team has been actively communicating with the facility to arrange field testing. The liquid test loop offers customizable pipeline configurations, including piggable pipelines specifically designed for inspection purposes.

2. Project Schedule –

After thorough evaluation of the project progress and careful review of the items listed in section 2 of this report, we confirm that the project is currently on time, aligning with our projected timeline and milestones. However, due to the uncertainty of the loop testing schedule for the field test, it is expected that there may be a delay in Task 5.1 Field Testing. We would appreciate a consideration of potential 6 or 9 months no-cost extension of the project to ensure that we can include the field testing to validate the developed technologies in this project.