External Quarterly Report

Date of Report: 7th Quarterly Report -June 30th, 2025

Contract Number: 693JK32310012POTA

Prepared for: DOT PHMSA

Project Title: A Framework for Improving Geohazard Monitoring, Data Integration, and Information Fusion at Scale

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For quarterly period ending: June 30th, 2025.

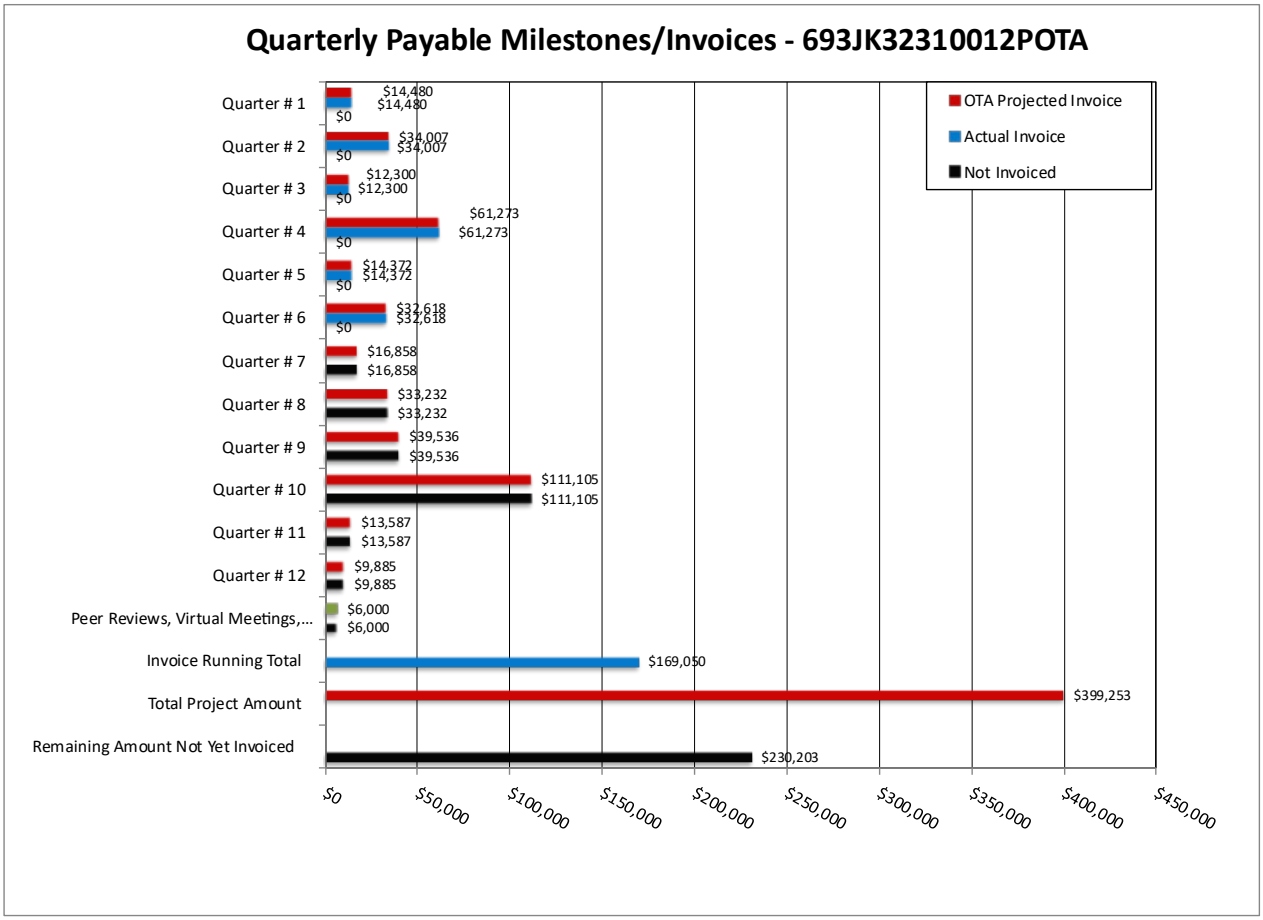
1: Items Completed During this Quarterly Period:

Item #	***Task #***	***Activity/Deliverable***	***Title***	***Federal Cost***	***Cost Share***
17	2	Generalized Framework and Use-case Development	Interim Report: Engineering requirements for modular and networked software system	14,466.00	37,773.00
18	11	7th Quarterly Status Report	Submit 7th quarterly report	2,392.00	1,471

2: Items Not Completed During this Quarterly Period:

None

3: Project Financial Tracking During this Quarterly Period:



4: Project Technical Status

- The project is on schedule and on budget.
- There are no late deliverables.
- There is a single deliverable due this quarter. It is presented in Appendix 1. Interim Report: Engineering Requirements for Modular and Networked Software SystemInterim report - Inventory models, methods, and datasets used to address a geohazard use case. The introduction material is presented below:

Throughout this project we have characterized how geohazard management requires a unique suite of technical capabilities to understand and get ahead of geohazards that vary over space and time over thousands of miles pipeline networks.

We discussed the importance of geohashing, its ability to normalize, manage, and index spatial observations and data efficiently and its ability to enable effective geo-joins and retrieval of those observations. This approach makes data addressable, well described, and useful at the most fundamental granular level.

However, what should happen to that information downstream? How should it be organized and architected to deliver the kinds of risk assessment solutions geohazards require? What kinds of computational structures, schemas and data models should be used?

Once data and models are normalized and addressable, the real opportunity lies in connecting data and models together into a network of microservices which can deliver two disrupting capabilities:

1. To learn from one another as environmental conditions change, and
2. To be easily improved, revised, and replaced with better data and models as they are developed.

This paper explores the application of modular and networked solutions for geohazard management as well as the engineering considerations that enable a modular and networked architecture.

The overarching vision is to enable pipeline operators to predict the state of assets at any location, in real-time, at scale, accounting for and informed by the distinct environmental that change along the pipeline network.

Addressing data through geohashing is the first step to describe **what** is happening through space, time, and across locations with similar conditions. **Networking models and data** together makes it possible for operators to observe, define, and exploit the relationships between agents, and answer deeper questions like:

- **How** are measured observations impacting the pipeline?
- **How** have interventions made an impact in diffusing the threat?

- **How** can operators predict risk across complex, dynamic, changing conditions and at scale?
- **Why** do we see risk here and not there?

End of Report