

Quarterly Report – Public Page

Date of Report: *5th Quarterly Report – December 31, 2020*
Contract Number: *693JK31910005POTA*
Prepared for: *DOT PHMSA and OTD*
Project Title: *Procedures for Selecting Locating and Excavation Technologies*
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For quarterly period ending *December 31, 2020*

1: Items Completed During this Quarterly Period

Task 5- Database Development and Web-Based Program: The incidents databases from NTSB and PHMSA records and the development of the web-based program are complete.

Task 8- Project Management: Submitted the 5th Quarterly Report.

2: Items Not-Completed During this Quarterly Period

Task 6- Predictive Data Analysis and Visualization: continue working on the analysis of the effect of site characteristics and excavation practices on the probability of excavation damage. The distributions of the various incident parameters are obtained from the database results in Task 5. These parameters are implemented in a Bayesian network approach for the evaluation of the probabilities of failures. Completion of this task is due next quarter.

3: Project Technical Status

- This task investigated NTSB and PHMSA Incident data and reports for natural gas distribution, transmission, and hazardous liquid pipelines. These records were stored in an SQL database in Azure cloud server for access and analysis. A web-based data management program was developed for searching, processing, and displaying records of these incidents. The relationships and distributions of the incidents' parameters were investigated using a reporting tool in Microsoft Power BI to customize data display and run queries. Further analysis of this data is currently performed in Task 6 (Predictive Data Analysis and Visualization) using statistical and Bayesian Network analysis. This work aimed at reconciling root causes and other factors affecting excavation damage in distribution and transmission pipeline segments.
- The review of incidents data included tabulating NTSB reports and reconciling the different reporting fields of all PHMSA incident records from 1970 the 2019. the tabulation of the datasets in these records included the following:
 - a) National Transportation Safety Board (NTSB) investigation reports and recommendations from 1969 to 2019
 - b) Gas Distribution (GD) from PHMSA incidents records from 1970 to 2019

c) Gas Transmission and Gathering (GT&G) from PHMSA records from 1970 to 2019

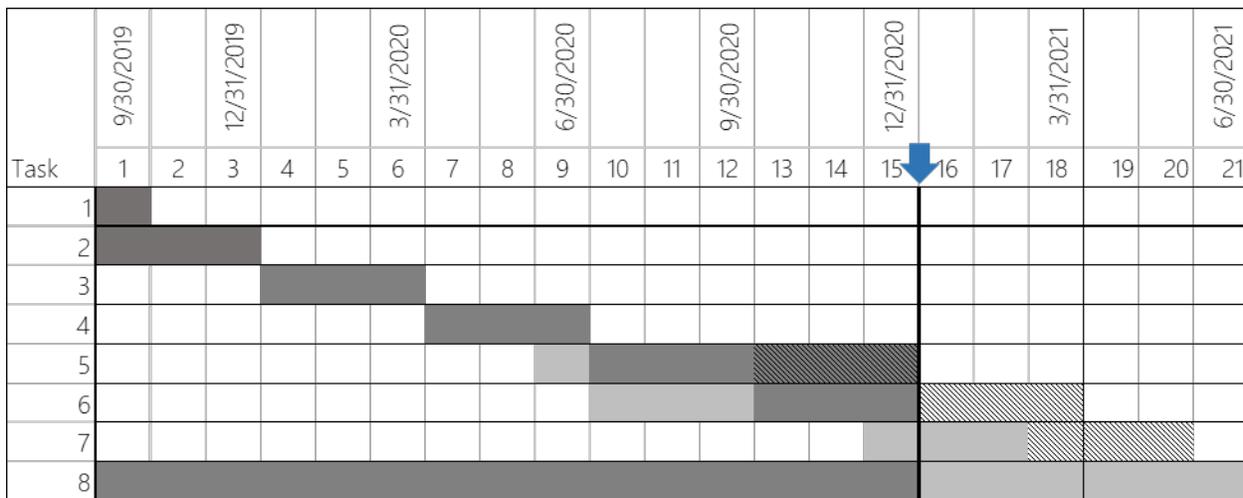
d) Hazardous Liquids (HL) incidents from the PHMSA records from 1968 to 2019.

- The web-based program ‘Pipeline Incidents Database’ was developed to provide a search engine for the incidents’ databases in an Azure cloud server platform. Several interactive search forms are set for the users to search and retrieve data. Although the project focuses on excavation damage, the database was developed for all NTSB and PHMSA incident records which include all types of pipelines threats. This allows the program to be used in other root-cause investigations other than excavation damage.
- Work of Task 6 includes analysis of the effect of site characteristics and excavation practices on the probability of excavation damage. The distributions of the various site and excavation parameters are obtained from the database results and analysis in Task 5. These parameters are implemented in a Bayesian network approach for the evaluation of the probabilities of failures.

Bayesian analysis is a framework for calculating conditional probabilities based on given input parametrical distributions. The analysis begins with a "prior distributions" which are based on the assessment of the relative likelihoods of parameters or the results of field observations. The likelihood of observed distributions is then calculated as a function of the parameters values to obtain an overall possible probability.

4: Project Schedule

The following figure shows the project schedule and progress as of the end of this quarter. Work in Task 6 is extending to the next quarter (ending on 03/31/2021) to complete the analysis of the excavation damage incidents.



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