Quarterly Report – Public Page

Date of Report: 8th Quarterly Report-September 8, 2020
Contract Number: DTPH5617RA000002
Prepared for: Government Agency: DOT PHMSA
Project Title: Cost Benefit Analysis of Deploying or Retrofitting External Based Leak Detection Sensors
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For quarterly period ending: August 31st, 2020

1: Items Completed During this Quarterly Period:

Item #	***Task #***	***Activity/Deliverable***	***Title***	***Federal Cost***	***Cost Share***
14	6	Develop and document CBA framework demonstration	Summary of the CBA framework demonstration (to be incorporated into the eighth quarterly report)	42,439	0
15	7	Prepare draft of the final report	Draft of the final document	24,730	0
16	7	Eighth quarterly progress report	Eighth quarterly progress report	2,912	0

2: Items Not-Completed During this Quarterly Period:
None; the project is on time.

3: Project Financial Tracking During this Quarterly Period:
Quarterly accounting of projected, actual and cumulative invoices is provided in Figure 1 below. Note that the projected invoice amounts listed in Figure 1 reflect the modified deliverable milestone schedule per the schedule extension.

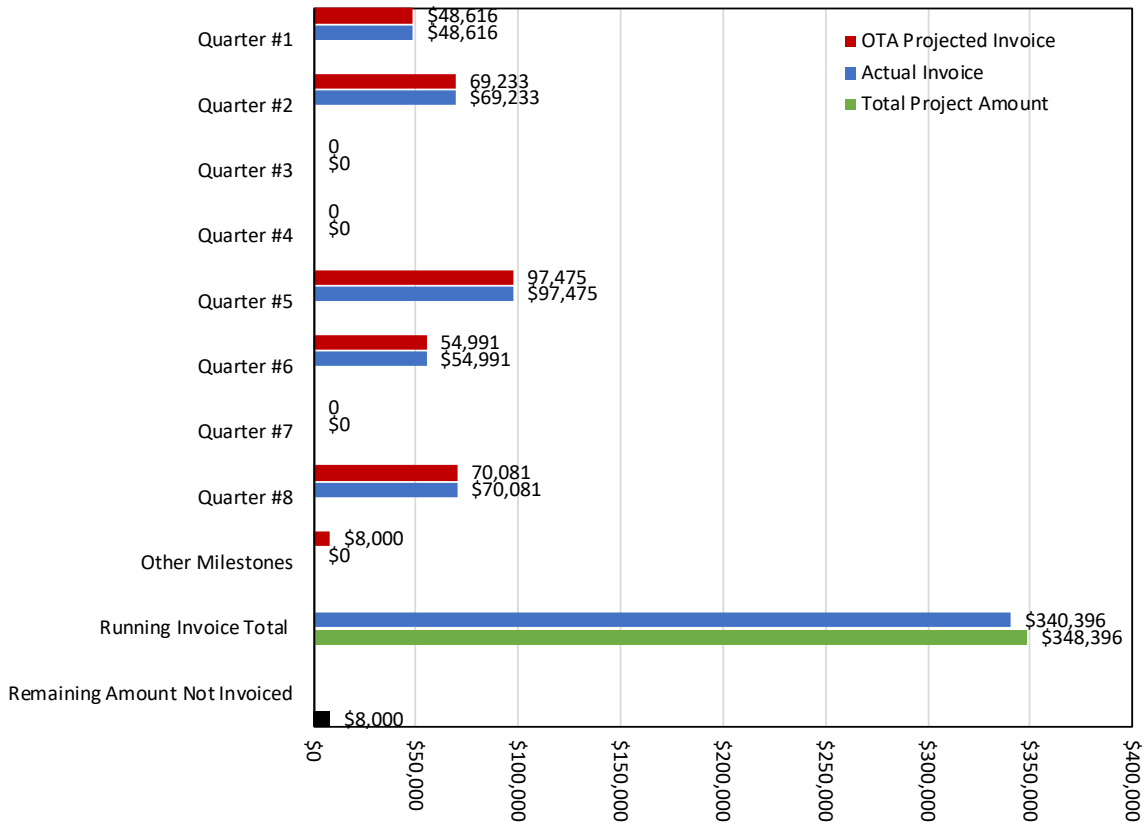

Figure 1: Quarterly Payable Milestones/Invoices – *DTPH5617RA000002*

4: Project Technical Status –

Active tasks in the eighth quarter (Q8) include Tasks 6 and 7. Progress related to these tasks achieved during Q8 is summarized as follows:

Task 6

Task 6 consisted of developing and documenting a CBA Framework demonstration. The objective of the exercise is to demonstrate and illustrate the application of the External Leak Detection Cost-benefit Analysis Framework developed in this project. The demonstration exercise is documented in an appendix to the main report. Below is a brief summary of the process followed in the demonstration appendix.

In the demonstration exercise, a hypothetical cost-benefit analysis (CBA) was performed to evaluate and compare three external leak detection (ELD) systems for possible implementation on a hypothetical new-construction pipeline (i.e. the "demonstration pipeline").

The selection of the demonstration pipeline was guided by two primary considerations: to provide a clear and practical demonstration of selected key aspects of the CBA

Framework, and to make the findings of the demonstration exercise as broadly applicable as possible.

The three following candidate, hypothetical ELD technologies were identified for evaluation in the demonstration exercise:

- Distributed Acoustic Sensing (DAS);
- Vapor Sensing Tubes (VST); and
- Distributed Temperature Sensing (DTS)

The candidate ELD technologies are representative of commercial ELD systems that are typically installed on existing pipelines. The listed technologies are well established, and many pipeline operating companies are reasonably familiar with them. Further, they are believed to adequately capture the possible range of performance capabilities of existing commercial systems in terms of response time and detection threshold.

A number of potential deployment configurations were identified for each of the candidate ELD technologies. Scores based on the relative deployability and relative performance were then assigned to each of the identified deployment configurations. It was decided to carry forward the three deployment configurations with the highest overall scores for each of the candidate ELD technology vendors following a process that is consistent with the guidance provided in the CBA Framework. These deployment configurations, referred to as the preferred deployment configurations, are listed as follows:

- DAS - On Pipe
- VST - On Pipe
- DTS- On Pipe
- DAS - Near Field
- VST - Near Field
- DTS - Near Field
- DAS - Far Field
- VST - Far Field
- DTS - Far Field

The “On Pipe” configurations are located on the pipeline’s outer surface at the 12 o’clock position. The “Near Field” configurations are located along the bottom of the trench in the so-called shadow region of the pipeline (i.e. the area defined as being within the shadow that would be cast on the trench floor if a light were shone on the pipe from directly above). Finally, the “Far Field” configurations are located at the intersection of the trench floor and the trench wall. The DAS and DTS sensors are assumed to be deployed in conduit, whereas the VST sensor is not. The preferred deployment

configurations were carried forward throughout the remainder of the demonstration exercise and were a key component of the sensitivity analysis.

Consistent with the guidance provided in the CBA Framework, costs associated with each of the preferred deployment configurations were arranged into two main categories: initial costs and reoccurring costs. Initial costs (i.e. procurement and installation costs) and reoccurring costs (i.e. operation and maintenance costs) for each of the preferred deployment configurations were determined through a combination of TAP guidance, discussions with representative ELD technology vendors and available public domain literature.

The overall benefit associated with each of the preferred deployment configurations was assumed to comprise predominantly of environmental protection enhancements. More specifically, it was assumed that the overall benefit is based wholly on the expected reduction in release volume that would result from ELD implementation. This is because the demonstration pipeline is assumed to transport crude oil. Given the relatively low life safety risks associated with the transport of crude oil, especially compared to natural gas, life safety benefits are assumed not to be significant and are therefore not considered in the benefit characterization exercise. Further, the candidate ELD systems are assumed not to have any encroachment detection capabilities. Therefore, break prevention is assumed to be minimal.

The environmental protection benefits were calculated using a hybrid approach that is consistent with the guidance provided in the CBA Framework. This approach was selected because the demonstration pipeline is a new-construction pipeline and, therefore, it was assumed that there is no ILI data from which to leverage a full probabilistic analysis. While a deterministic analysis was possible, it was assumed not to provide the required degree of accuracy and granularity, and it was, therefore, not pursued. In the adopted hybrid approach, the baseline release volume, the reduced release volume and the failure rate were calculated by averaging the results from repeated deterministic calculations over a large number of random realizations from the baseline release volume distribution and other random variables.

The costs and monetized benefits were temporally distributed throughout the pipeline's operational life span and converted into present-day equivalent values using a nominal social discount rate of 3%. A single variable test was then carried out to identify input parameters with the greatest impact on the adopted evaluation metrics. These parameters were flagged, and additional consideration was given in order to minimize the associated uncertainty associated with them to the extent possible. Then, Net present Value (NPV) and Benefit Cost Ratio (BCR) values were calculated for each of the preferred deployment configurations in both HCA and non-HCA locations. It was shown that the candidate ELD systems, when deployed in HCA locations, are generally cost effective, whereas they are not cost effective when deployed in non-HCA locations.

Because there was found to be sufficient separation between the highest and second highest NPVs, and also because ELD is assumed to be deployed along a fixed length

rather than over a fixed budget, the selection of a preferred alternative was based on NPV alone. However, for expanded ELD deployment on other sections of the demonstration pipeline, including on non-HCA sections, it may be more appropriate to fix the ELD budget rather than the deployment length. In these cases, it would be more appropriate to select the preferred alternative based on BCR rather than NPV. This is because alternatives with high BCR scores are expected to be more scalable when deployment length is not constrained.

The results presented in this demonstration are primarily intended to demonstrate the CBA process as described in the CBA Framework. The final ELD technology rankings (based on the calculated NPVs and BCR values) should not be interpreted to suggest that one ELD technology type is superior to that of the other. Rather, the results should be interpreted to suggest that, given the information available, and with reference to the specific conditions that pertain to the demonstration pipeline, one ELD technology, installed in the described preferred deployment configuration, is indicated as being more cost effective under the stated assumptions.

Task 7

Work performed under Task 7 during Q8 primarily consisted of preparing the draft final report and the Q8 quarterly report.

5: Project Schedule –

There are no anticipated schedule delays to report. The project is on time.