**CAAP Quarterly Report**

**04/04/2023**

*Project Name: Development of Compatibility Assessment Model for Existing Pipelines for Handling Hydrogen-Containing Natural Gas*

*Contract Number: 693JK32250004CAAP*

*Prime University:*

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*Reporting Period: 12/30/2022 – 03/29/2023*

## Project Activities for Reporting Period:

During this reporting period, the project team developed an experimental database of hydrogen embrittlement of steel (Task 1) and modified experimental facilities to perform the planned research studies on various pipeline steel grades (Task 2.1). In addition, the data cleaning and reconciliation task (Task 1.2) has been completed. As part of developing a master database for pipeline materials' hydrogen embrittlement (HE), experimental data sets related to hydrogen diffusivity and solubility, area reduction, maximum elongation, fracture toughness, and fatigue resistance have been gathered. Data analytic techniques are then applied to resolve missing data issues by imputation or removal. Data from various sources, including handbooks and relevant standards, is used for cases with missing metal composition and mechanical characteristics such as yield stress, ultimate strength, and hardness.

Currently, experimental facilities are being modified (Task 2.1). We hired a new technician after losing our research equipment specialist in January. Apart from the autoclaves, all major setup components have been installed, and we are waiting for the autoclaves to be delivered. Due to recent backlogs, the vendor (High Pressure Equipment Co.) indicated that the autoclave manufacturing would be delayed. The completion of this task is therefore expected to be delayed. We have ordered an additional autoclave to conduct tests in parallel to avoid delays in subsequent tasks (Tasks 2.2 to 2.4). The addition of the autoclave not only ensures the project stays on schedule, but it also minimizes any future schedule disruption caused by equipment failure.

## Project Financial Activities Incurred during the Reporting Period:

Table 1 presents expenses during the reporting period in each budget category.

**Table 1: Quarterly expense breakdown**

| Budget Category | DOT-PHMSA | OU Cost Share | Total |
|---|---|---|---|
| Salaries and Wages | $19,200 | $10,490 | $29,690 |
| Fringe Benefits | $1,498 | $3,609 | $5,107 |
| Equipment | $13,606 | | $13,606 |
| Travel | | | |
| Materials and Supplies | $1,249 | | $1,249 |
| Tuition | $9,684 | | $9,684 |
| Indirect Costs | $12,071 | $7,754 | $19,825 |
| **Total** | **$57,308** | **$21,853** | **$79,161** |

## Project Activities with Cost Share Partners:

The PI and Co-PI of the project participated in various research and development activities as part of the cost share, including supervising research assistants and technical personnel, conducting research on hydrogen embrittlement, and developing designs and specifications for experimental setups.

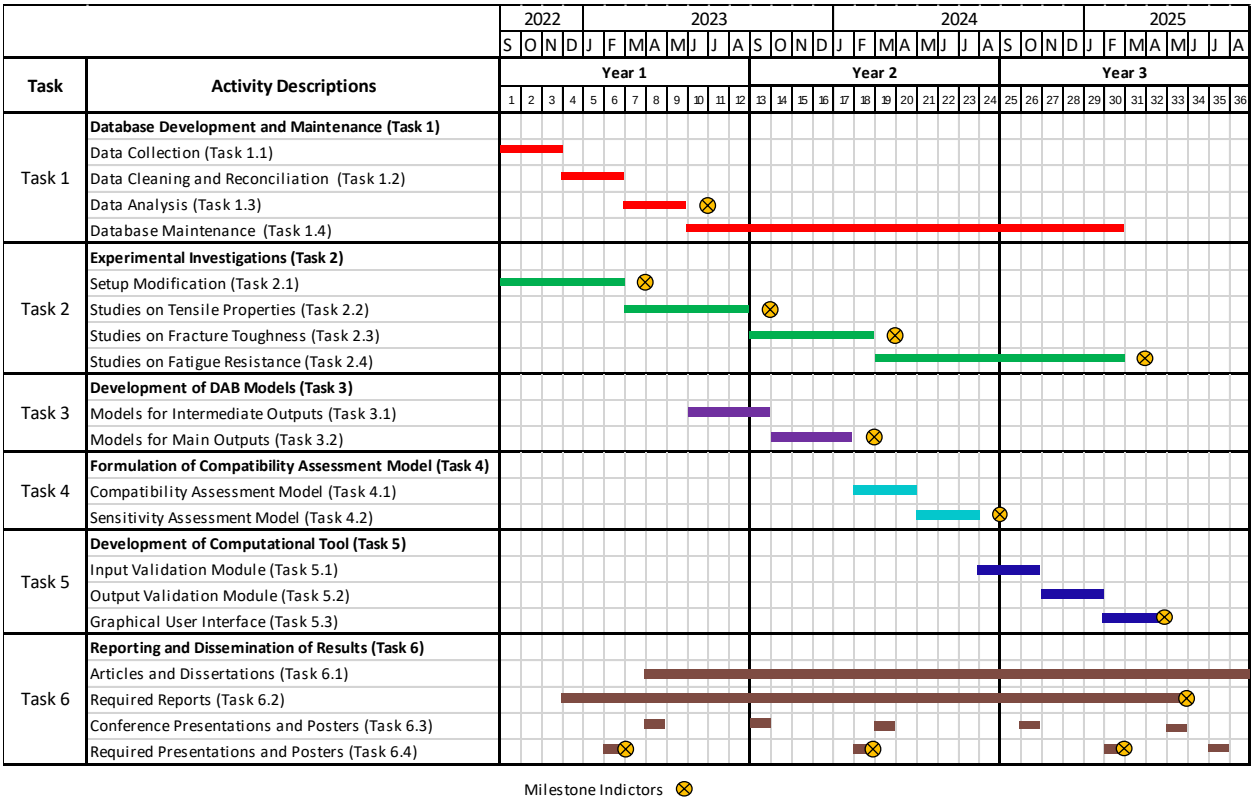
## Project Activities with External Partners:

Not applicable.

## Potential Project Risks:

There will be a 3-month delay in modifying experimental facilities (Task 2.1). However, the delay will not have a significant effect on the overall project schedule since experimental studies (Tasks 2.2 and 3.2) will be conducted in parallel instead of sequentially (Table 2).

**Table 2: Project schedule**




## Future Project Work:

In the coming months, we will receive the autoclaves and complete the modification of the experimental setup (Task 2.1). Also, the tensile and CT specimens required for the experimental investigations will be manufactured. Furthermore, hydrogen embrittlement data collected and cleaned in Tasks 1.1 and 1.2 will be analyzed to explore hidden patterns and relationships (Task 1.3). The analysis is performed through data processing, including observation, exploration, organization, and transformation. This task seeks out patterns and regularities in existing data.

**Potential Impacts to Pipeline Safety:**

The experimental database developed at the project's current phase can be used to model pipeline fatigue resistance and forecast the level of degradation occurring if hydrogen is transported in existing pipelines. The predictions help establish an operating envelope for safe hydrogen transportation in the existing natural gas pipeline networks.