CAAP Quarterly Report

March 27, 2023

Project Name: Determination of Potential Impact Radius for CO_2 Pipelines using Machine Learning Approach

Contract Number: 693JK32250011CAAP

Prime University: Texas A&M University

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Reporting Period: 12/27/2023 – 3/26/2023

Project Activities for Reporting Period:

The following relevant tasks in the proposal have been completed:

- Used Ansys Fluent to perform CFD simulations of CO_2 dispersion and validated the results against full-scale CO_2 release experiments, CO2PIPETRANS JIP project.
- Developed a procedure to incorporate terrain information – from CADMapper – into the CFD model using AutoCAD Architecture.
- Selected the appropriate CFD model for CO_2 dispersion after taking full consideration of their computing efficiency and acceptable accuracy.
- Conducted a literature review of CO_2 dispersion behavior including both previous experimental and simulation studies.
- Conducted a literature review to identify common CO_2 pipeline operating conditions and locations in US.

Project Financial Activities Incurred during the Reporting Period:

Based on the proposed budget, the cost is broken down into two parts:

- Efforts from the PI Dr. Wang for about 0.25 month.
- Efforts and work by graduate students, Chi-Yang Li and Jazmine Aiya D. Marquez, totally for about 3 months.

Project Activities with Cost Share Partners:

Dr. Wang's time and efforts (0.25 month) in this quarterly period are used as cost share. He devoted his time to supervise the research with the graduate students, review all paperwork, and prepare the progress report.

Project Activities with External Partners:

Dr. Wang was invited by Simon Gant (from HSE, UK) to present his research in the ADMLC webinar on "dense gas dispersion modelling in complex terrain, with a focus on CO2 pipelines" on Tuesday, March 7. The presentation was well-received by over 100 people, primarily from Europe and US.

Potential Project Risks:

For the future parametric study using Ansys Fluent, incorporating terrain information has increased the computation time. We anticipate that performing hundreds of CFD simulations in the future will require a significant amount of time. Therefore, we are searching for extra high-performance computers to expedite these simulations.

Future Project Work:

Work in next 30 days

- Draft a review paper based on the work of CO_2 dispersion behavior including both previous experimental and simulation research.
- Conduct a literature review to define the appropriate dispersion parameters for CFD simulations.
- Conduct a literature review to define the potential release scenarios of CO_2 pipelines.

Work in next 60 days

- Perform parametric studies at HPRC for all dispersion scenarios by using Ansys Fluent.

Work in next 90 days

- Construct part of the database for the PIR for CO_2 pipelines with different health consequences.

Potential Impacts to Pipeline Safety:

- Incorporating established CFD models that consider terrain effects will improve the accuracy of CO_2 dispersion predictions and allow for more accurate estimation of the PIR (Potential Impact Radius) for CO_2 pipelines, taking into account various health consequences.
- The procedure of incorporating terrain information will provide other researchers ideas for future research in the CO_2 pipeline.