# Constraining Kick Signals through Advanced Multi-Phase Data

Project Number: FWP 1022409

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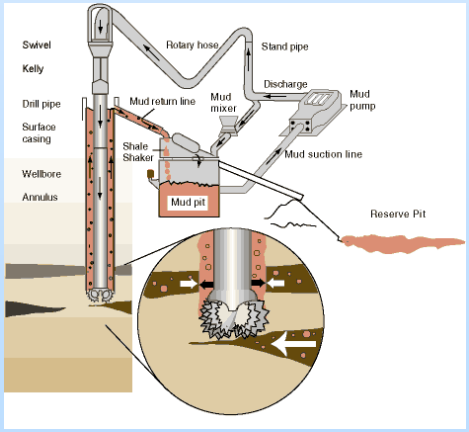
** presenter*

# Motivation and Purpose

**Unexpected formation fluid invasions into the borehole ("kicks") represent a persistent threat during the drilling process.**

Lasting ecosystem damage
Danger to public health
Detriment to local economy

## Current state-of-the art vs. This effort




Gif. Visualizing a kick[3]

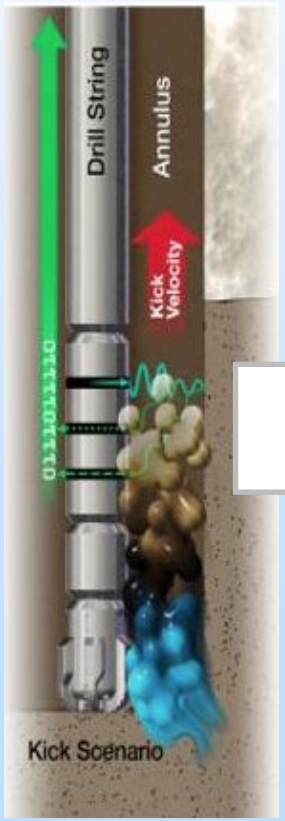
**Relies on monitoring at the surface : delayed response (hours)**

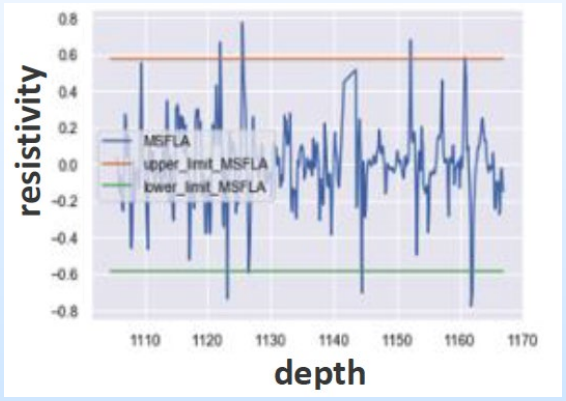

Fig. Conceptual response to kick[5]

**Using geophysical signals from LWD sensors[4]: real-time (minutes)**

# Objectives

- The objective of this project is to build a database of different type of signals resulting from a kick event (e.g., acoustic velocity/resistivity properties as a function of kick physical properties)



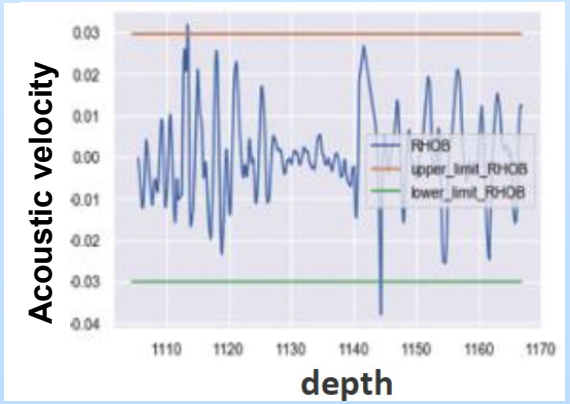
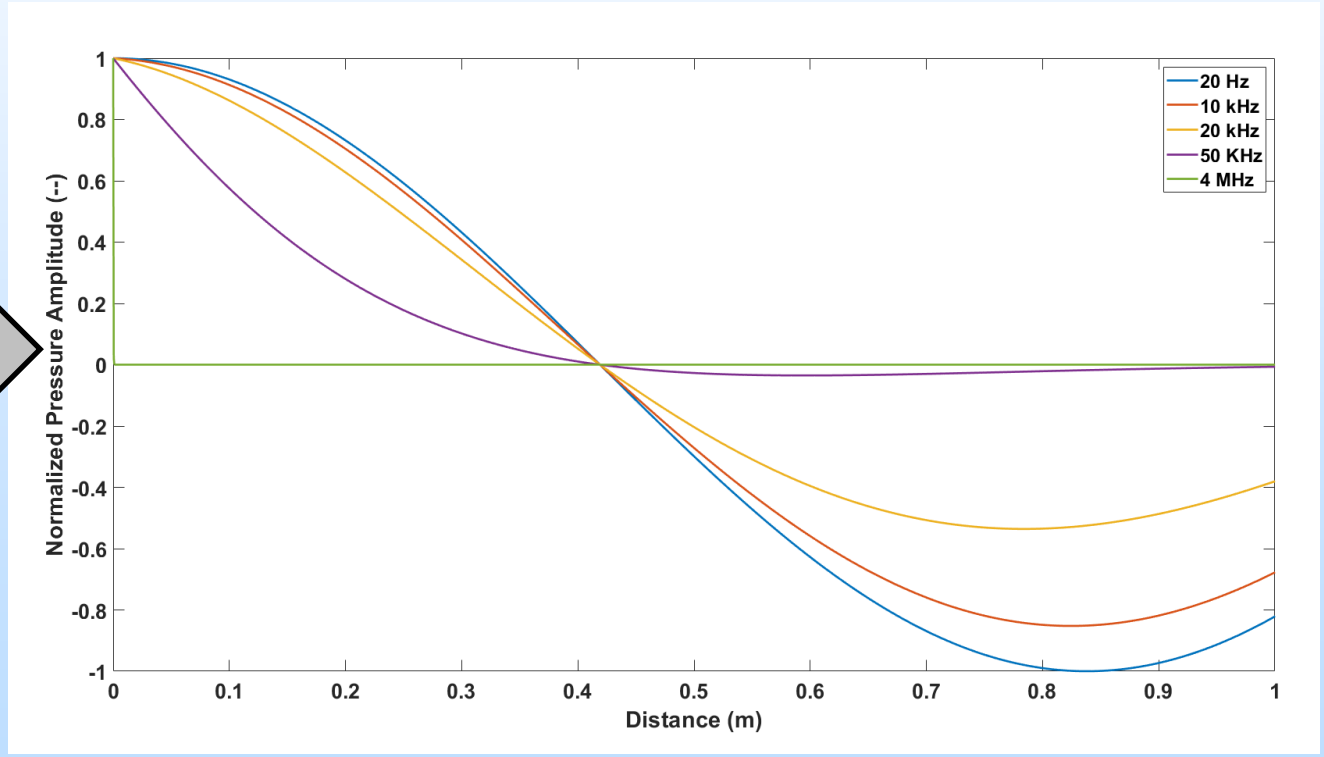




Fig. Illustration of wellbore environment[1]

# Accomplishments to Date [1]

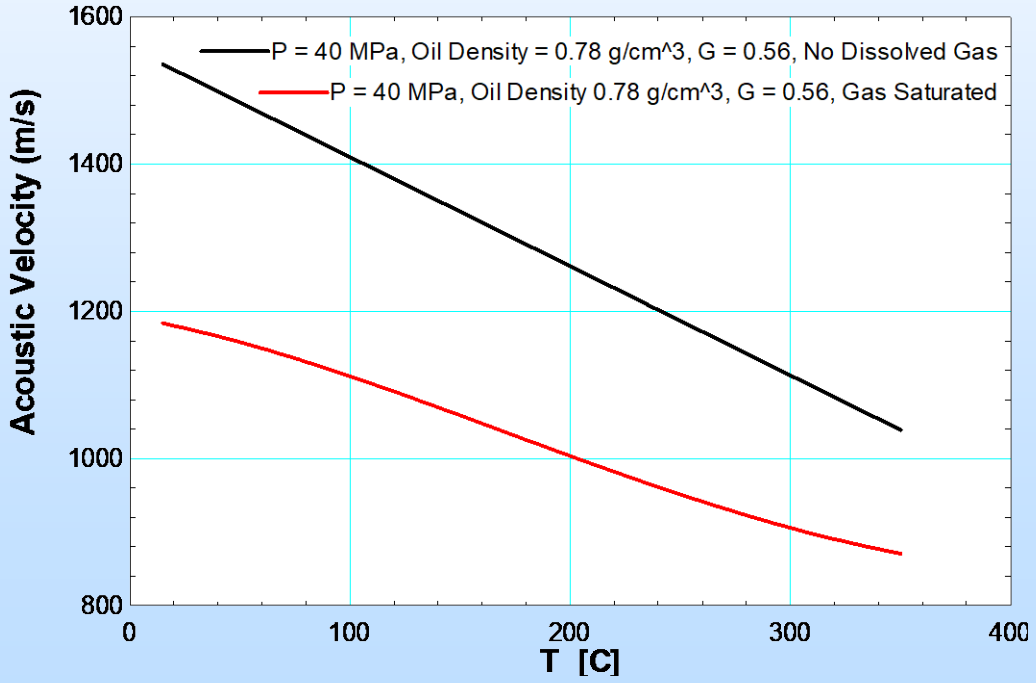
– Literature review and numerical analysis shows promising results for early kick detection via LWD and acoustic methods


Acoustic signal attenuation for a two-phase fluid between acoustic transmitter and receiver

# Accomplishments to Date [2]

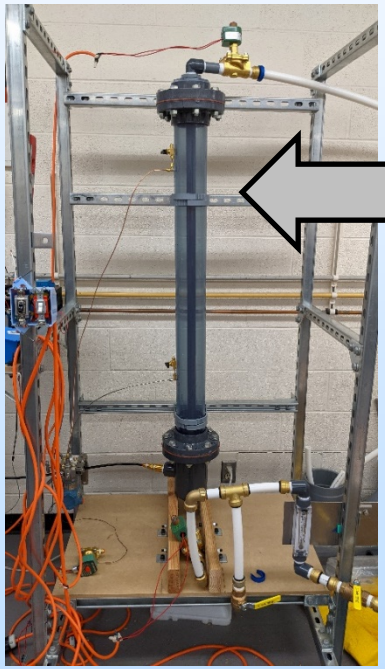
– Numerical analysis shows promising results for early kick detection even for **dissolved** gas during kick events

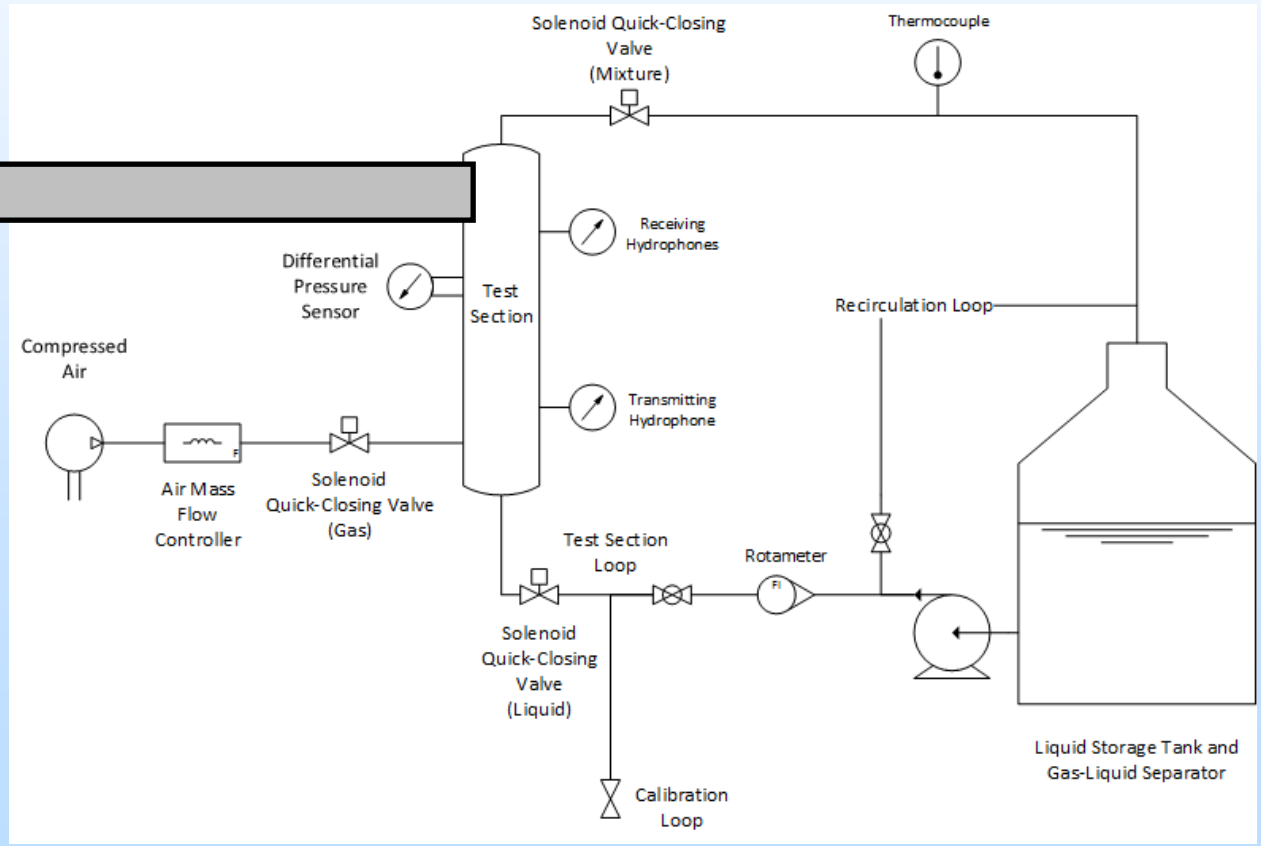




Acoustic velocity change as a function of **dissolved** methane in oil-based mud

# Accomplishments to Date [3]

– Flow loop design and assembly to experimentally investigate the acoustic properties in gas-liquid flow in vertical annulus configurations



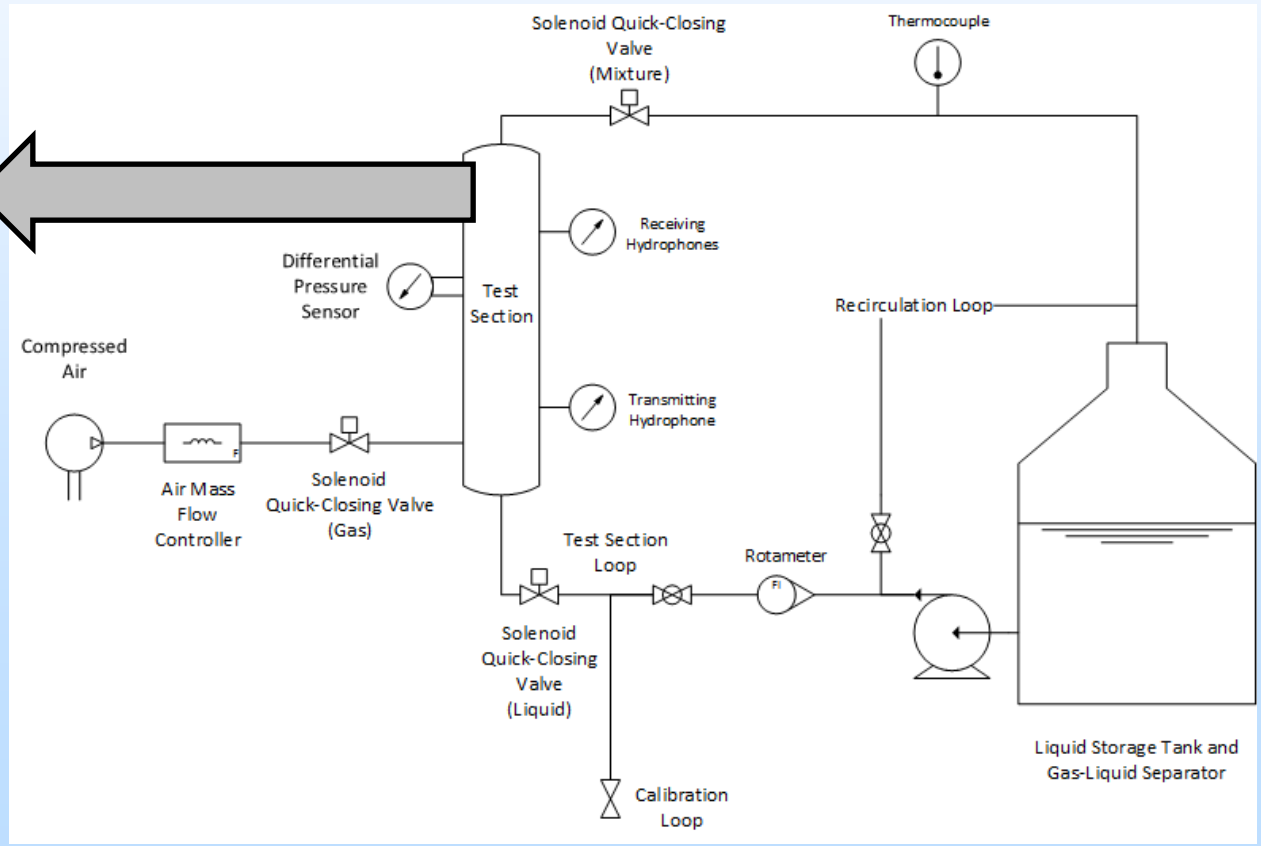


# Lessons Learned

- Field LWD/MWD data is extremely difficult to get
- LWD/MWD renting tools to be tested in the lab are cost prohibitive at the moment
- Proprietary information about the LWD tools and raw measuring data is challenging to obtain
- Closer collaboration to a LWD/MWD tool provider would be ideal to enhance further analysis comparison between lab and filed/LWD data
- A proposed unsupervised ML technique is difficult to develop (available logging data or DAS data not as useful as anticipated)

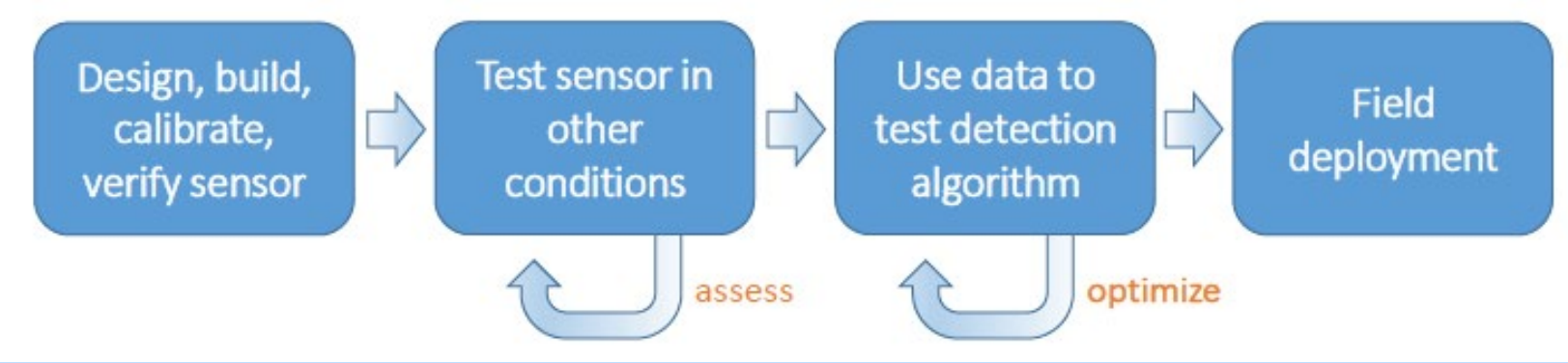
# Synergy Opportunities

– OSU low cost flow loop could be potentially used for other kick detection methods at lab scale



# Project Summary

- Literature review on early-kick detection methods shows an absence of data on acoustic properties for method development
- Numerical analysis show promising results for early-kick detection via LWD and acoustic methods
- This project will run experimental tests with flow loop, acquire data and develop an technique to use acoustic measurements for early kick detection via LWD tools



# Appendix

# Benefit to the Program

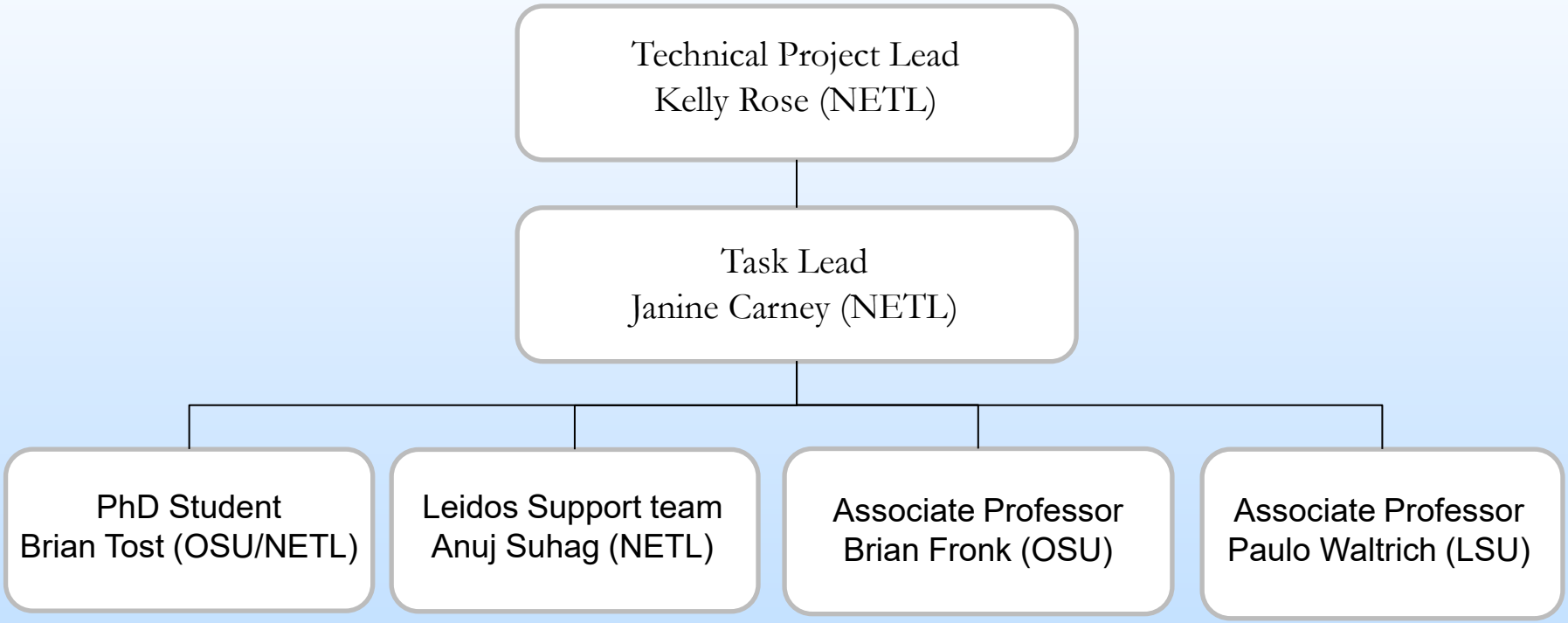
- This project aims to Reduce risks to the environment by developing an method of early-kick detection which can ultimately prevent oil spills

# Project Overview

## Goals and Objectives

- This project aims to Reduce risks to the environment
- NETL's Offshore research is focused on innovating solutions to challenges associated with geohazard prediction, subsurface uncertainty reduction, and addressing oil and gas infrastructure integrity and optimization for new and existing infrastructure systems
- DOE's mission is to provide clean & affordable energy security
- Supports the Department of Energy (DOE) Fossil Energy's (FE's) primary mission to ensure the nation can continue to rely on traditional domestic resources of energy while reducing the footprint of and potential deleterious impacts from these efforts

# Organization Chart



# Gantt Chart

| | Time (years) | | | |
|---|---|---|---|---|
| **Major Tasks** | **2018** | **2019** | **2020** | **2021** |
| Development of an in-house multi-phase fluid flow modeling capability | | | | |
| Critical review of the DFM and its capabilities | | | | |
| Development of a kick algorithm based on NETL's patented approach | | | | |
| Literature on signal processing methods | | | | |
| Flow loop desing and assembly | | | | |
| Experiment Design and Data Collection | | | | |
| Sensitivity Analysis | | | | |
| Algorithm Development | | | | |

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