NATIONAL ENERGY TECHNOLOGY LABORATORY
OIL & GAS

DOE Award No.: FWP 65213

Quarterly Research Performance Progress Report

(Period Ending 12/31/2017)

Kinetic Parameters for the Exchange of Hydrate Formers

Project Period (07/01/2013 to open)

Submitted by:
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Signature

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U.S. DEPARTMENT OF ENERGY | NATIONAL ENERGY TECHNOLOGY LABORATORY

Office of Fossil Energy

RESEARCH PERFORMANCE PROGRESS REPORT

DISCLAIMER

ACCOMPLISHMENTS:

BP5-Task 13.0 Nitrogen Injection (KIGAM-funded, Separate, Coordinated PNNL Project #68908)

A progress report was submitted to the KIGAM client that documented a verification problem for coupled thermo-hydro-geomechanics, executed with the STOMP-HYDT-KE simulator with the PNNL developed GeoMech module. The geomechanical capabilities in STOMP-HYDT-KE were partially developed during the KIGAM funded project, entitled "Geomechanics Implementation for the STOMP-HYDT-KE Simulator," but not verified against analytical solutions. Before investigating the injection of nitrogen into natural gas hydrate bearing reservoirs, we sought to validate the geomechanics module, called GEOMech, against simple thermo-hydro-geomechanical problems with analytical solutions. One such problem is the Terzaghi Poroelastic Deformation problem (Verruijt, 2013). This one-dimensional deformation problem involves the compaction of fluid filled rock under a constant vertical stress.

Verruijt, A. 2013. "Arnold Verruijt. 2013. "Theory and Problems of Poroelasticity." Delft University of Technology, Delft, Netherlands.

BP5-Task 14.0 Geomechanics Implementation and Verification

This task is closely linked with the BP5-Task 13.0, as geomechanical modeling capabilities are required to complete the nitrogen injection simulations. Accomplishments reported for BP5-Task 13.0 equally during this quarter equally apply to this task.

BP5-Task 15.0 International Hydrate Code Comparison

The 2nd International Gas Hydrate Code Comparison Study had its inaugural teleconference in early November 2017. The study comprises 49 participants, representing 24 teams, from 5 countries (i.e., United States, United Kingdom, Germany, Korea, Japan, and China). A workspace within the NETL EDX system has been created for the study, and accounts have been granted for requesting participants. Three study teleconferences have been held:

- Teleconference #1: November 9, 2017
    - Introductions

    - NETL's Energy Data eXchange (EDX)
    - Code Description Presentation Series
    - Initial Benchmark Problems
        - Hydrate dissociation via depressurization from 1st IGHCCS problem set
        - Terzaghi's poroelastic deformation problem

- Teleconference #2: December 7, 2017
    - T+H Code Description Overview, Matt Reagan (LBNL)
    - STONE Code Description Overview, Alejandro Queiruga (LBNL)
    - T+M and T+F Code Description Overviews, Jihoon Kim (Texas A&M University)
    - HydrateBiot Code Description Overview, Yilong Yuan (Jilin University)
    - Coupled Hydromechanical Benchmark Problem, Mark White (PNNL)

- Teleconference #3: January 11, 2018
    - A THCM Code for Methane Hydrate Reservoirs - Numerical Implementation and Benchmarks, Shubhangi Gupta (GEOMAR Kiel)
    - CODE_BRIGHT-HYDRATE Code Description Overview, Marcelo Sánchez (Texas A&M University)
    - Coupled Hydromechanical Benchmark Problem, Mark White (Pacific Northwest National Laboratory)

The study teleconferences were principally focused on code descriptions and establishing initial benchmark problems. All teleconferences were recorded and those recordings were posted on the NETL EDX system, along with the slide decks from the presentations. A logo for the study was created based on the infamous burning gas hydrate photo taken by

MILESTONES:

Milestone Title	Milestone Description	Planned Completion Date	Actual Completion Date	Status / Results
Nitrogen Injection (KIGAM-funded, Separate, Coordinated PNNL Project #68908)	Conduct a series of numerical simulations using its STOMP-HYDT-KE simulator to assess the feasibility of the nitrogen injection technology for production natural gas.	6/30/2018		Not started
Geomechanics Implementation and Verification	Develop algorithms for its STOMP-HYDT-KE simulator for computing the geomechanical properties as a function of hydrate saturation.	3/31/2018		Not started

IGHCCS2: Problem Definition	Initial Problem Set Drafted and Participants Identified for the 2nd International Hydrate Code Comparison Study.	9/30/2017		Three working teleconferences held, focused on code descriptions. Two initial benchmark problems were identified.
IGHCCS2: Problem Issue	Initial Problem Set Issued for the 2nd International Hydrate Code Comparison Study.	12/31/2017		Not started
IGHCCS2: Problem Submission	Initial Problem Set Submission for the 2nd International Hydrate Code Comparison Study.	6/30/2018		Not started

PRODUCTS:

No publications nor presentations were released this quarter.

IMPACT:

No significant impacts occurred this quarter.

CHANGES/PROBLEMS:

The IGHCCS2 started later than anticipated, but the study current has about 49 participants from three continents, indicating strong interest in the project.

SPECIAL REPORTING REQUIREMENTS:

No special reporting requirements occurred during this quarter.

BUDGETARY INFORMATION:

Actual Cost (this quarter)	Actual Cost (cumulative for BP)	Funds available (for the BP)	Balance of unspent funds (for the BP)	Actual Cost (cumulative for the full FWP)	Funds available (for the full FWP)	Balance of unspent funds (for the full FWP)
$9,671	$12,496	$100,000	$87,504	$249,516	$370,000	$120,484

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