DOE Award No.: ESD12010

Quarterly Research Performance Progress Report

(Period Ending 06/30/2017)

NUMERICAL STUDIES FOR THE CHARACTERIZATION OF RECOVERABLE RESOURCES FROM METHANE HYDRATE DEPOSITS

Project Period (April 1, 2012 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

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RESEARCH PERFORMANCE PROGRESS REPORT

ACCOMPLISHMENTS:

Task 1. Project Management Plan

Status: Ongoing

A PMP was submitted for Budget Period #6 in March 2017. A revised FWP and SOPO was submitted on July 31, 2017. A revised PMP will be submitted 30 days after the beginning of the new, extended BP #6.

Task 2. Code Maintenance, Updates, and Support

Subtask 2.6:

Status: Ongoing, task expanded 7/31/2017

Development of the new STONE geomechanical code has been ongoing. New capabilities added, tested, and used in BP #6 included:

1) The ability to use 2D axisymmetric meshes to describe vertical-well problems
2) New treatment of the geomechanical mesh and coupling, allowing the flow and geomechanical simulators to use separate meshes, each optimized for the solution of the separate flow or geomechanical component of the problem.

The updated T+H and STONE (T+M) codes were used for ongoing simulations of the India NGHP Site 9 production test, and results of these simulations were presented at ICGH 9 in Denver, CO, as a conference paper and as a presentation. Additional capabilities will be developed in the proposed work scheduled in the expanded BP #6.

Publications:

Moridis, G.J., Queiruga, A.F., Reagan, M.T., "The T+H+M Code for the Analysis of Coupled Flow, Thermal, Chemical and Geomechanical Processes in Hydrate-Bearing Geologic Media," *Proc.* 9th Int. Conference on Gas Hydrates, Denver, CO, 1-3 June 2017.

Presentations:

"The T+H+M Code for the Analysis of Coupled Flow, Thermal, Chemical and Geomechanical Processes in Hydrate-Bearing Geologic Media," 9th Int. Conference on Gas Hydrates, Denver, CO, 1-3 June 2017.

Task 3. Support of DOE's Field Activities and Collaborations

Subtask 3.3: Analysis of the results of the Iġnik Sikumi field test, North Slope, Alaska

Status: Completed

One additional publication within this subtask appeared in print (previously submitted)**:**

Reagan, M.T., Moridis, G.J., Seim, K.S., "Fast Parametric Relationships for the Large-Scale Reservoir Simulation of Mixed CH4-CO2 Gas Hydrate Systems," *Computers and Geosciences*, **103**, 191-203, 2017*.*

Subtask 3.6: Detailed Analysis of the Production Potential of Hydrates Deposits Offshore India

Status: Ongoing

The latest version of the T+H and STONE codes, developed in Task 2 were used for ongoing simulations of the India NGHP Site 9 production test. In this quarter, the team completed simulations of several Site 9 production scenarios, with and without coupled geomechanics, and also examined the fate of hydrate reservoirs after the cessation of production (using the Site 9 reference case anonymously). Two conference papers and two presentations resulted from this work.

More recently, using data and geological models developed in consultation with NETL, USGS, and Indian scientists, we used the latest Meshmaker 2.0 software to generate new/updated meshes for continuing simulations of the Site 9 case and sensitivity studies. These new simulations will commence at the beginning of the next quarter (July 2017).

Publications:

Moridis, G.J., Reagan, M.T., Queiruga, A.F., "Long-Term System Behavior Following Cessation of Gas Production from Hydrate Deposits," *Proc.* 9th Int. Conference on Gas Hydrates, Denver, CO, 1-3 June 2017.

Moridis, G.J., Queiruga, A.F., Reagan, M.T., "The T+H+M Code for the Analysis of Coupled Flow, Thermal, Chemical and Geomechanical Processes in Hydrate-Bearing Geologic Media," *Proc.* 9th Int. Conference on Gas Hydrates, Denver, CO, 1-3 June 2017.

Presentations:

"Long-Term System Behavior Following Cessation of Gas Production from Hydrate Deposits," 9th Int. Conference on Gas Hydrates, Denver, CO, 1-3 June 2017.

"The T+H+M Code for the Analysis of Coupled Flow, Thermal, Chemical and Geomechanical Processes in Hydrate-Bearing Geologic Media," 9th Int. Conference on Gas Hydrates, Denver, CO, 1-3 June 2017.

Subtask 3.7: Participation in the Code Comparison Study of Coupled Flow, Thermal and Geomechanical Processes

Status: Beginning 10/2017

Task 4. Assessment of Resource Recoverability From Natural Hydrate Deposits

Subtask 4.4:

Status: Beginning 10/2017

Milestone Table

Milestone Title	Milestone Description	Planned Completion Date	Actual Completion Date	Status / Results
PMP	Maintenance and update of the Project Management Plan	April 30, 2016	Included with BP#6 SOPO 3/15/17	Will be updated 30 days after receipt of added BP #6 funding
Topical Report/Presentation	Report and presentation(s) regarding the results of the initial Subtask 3.6 simulations	June 30, 2017	Results to date presented at ICGH 9 on June 26-30, 2017.	Subtask 3.6 extended and expanded to cover a wider range of scenarios and parameters through July 2018,

PRODUCTS:

Publications:

Reagan, M.T., Moridis, G.J., Seim, K.S., "Fast Parametric Relationships for the Large-Scale Reservoir Simulation of Mixed CH4-CO2 Gas Hydrate Systems," *Computers and Geosciences*, **103**, 191-203, 2017.

Moridis, G.J., Reagan, M.T., Queiruga, A.F., "Long-Term System Behavior Following Cessation of Gas Production from Hydrate Deposits," *Proc.* 9th Int. Conference on Gas Hydrates, Denver, CO, 1-3 June 2017.

Moridis, G.J., Queiruga, A.F., Reagan, M.T., "The T+H+M Code for the Analysis of Coupled Flow, Thermal, Chemical and Geomechanical Processes in Hydrate-Bearing Geologic Media," *Proc.* 9th Int. Conference on Gas Hydrates, Denver, CO, 1-3 June 2017.

Presentations:

"Long-Term System Behavior Following Cessation of Gas Production from Hydrate Deposits," 9th Int. Conference on Gas Hydrates, Denver, CO, 1-3 June 2017.

"The T+H+M Code for the Analysis of Coupled Flow, Thermal, Chemical and Geomechanical Processes in Hydrate-Bearing Geologic Media," 9th Int. Conference on Gas Hydrates, Denver, CO, 1-3 June 2017.

CHANGES/PROBLEMS:

An updated SOPO for Budget Period #6 was submitted to NETL on July 31, 2017. This new SOPO extends Task 2.6 and Task 3.6, and also adds a new Task 3.7 to the project. A new PMP, reflecting the new tasks and extended timelines, will be submitted 30 days after initiation of the revised FWP.

SPECIAL REPORTING REQUIREMENTS:

N/A

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)
$114,708	$114,708	$350,000*	$305,402**	$1,014,708	$1,250,000*	$305,402**

* this includes the additional $150,000 to be added to the FWP for BP #6.
** this includes overlapping funds/carryover between BP #5 and BP#6.

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