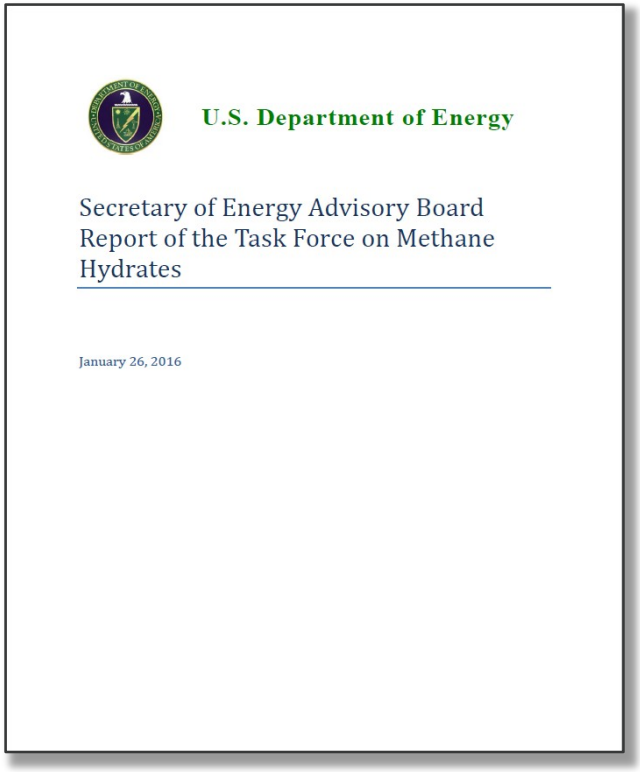
SEAB Technical Questions

MHFAC Meeting, April 4, 2017

SEAB Report

Summary

- The program has made significant contributions.
- DOE should continue funding at FY2015 levels
- R&D success will be facilitated by more stable funding and support.
- 33% of budget should remain dedicated to fundamental science– including hydrate accumulations that are not production targets
- 67% of budget for participation in international testing programs
- Work should continue to priorities issues of relevance to anticipated future industry technical priorities…


U.S. Department of Energy

Secretary of Energy Advisory Board
Report of the Task Force on Methane Hydrates

January 26, 2016

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Review of SEAB Technical Questions

NATIONAL ENERGY TECHNOLOGY LABORATORY

Heat Transfer

In what geological settings will the rate of heat transfer be sufficient to maintain hydrate dissociation?

- Warmest/closest to stability. Units with interlayered shale provide incremental heat sources.
- Thermal Conductivity measurements being refined through collaborative international studies. Sand and hydrate-bearing sand is better constrained f(por). Less clarity for mud.
- Thermal modeling of 2013 Nankai test suggests heat from outside the reservoir was not needed and sufficient heat supply from lateral flow from more distant points in the reservoir. Conductive v. convective…

How might one create a more favorable setting for assuring adequate heat transfer for producing methane from hydrates?

- "Tuning" of production rate to best match reservoir/system capacity for heat transfer. Heat can be added in the near-wellbore environment as/if needed. R&D Stage remains early.

Would the use of long horizontal wells, rather than vertical wells or hydraulic stimulation, create a larger heat-receiving sink?

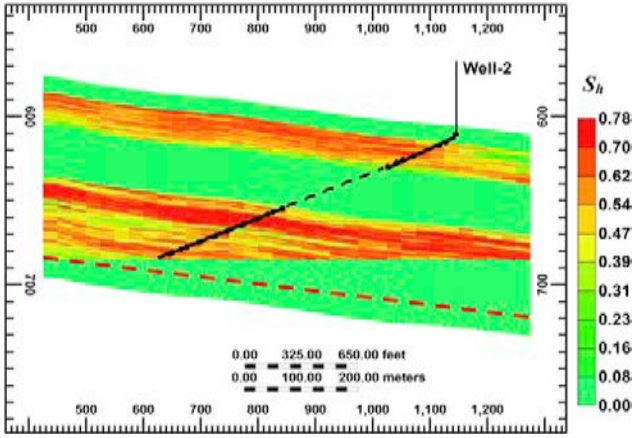
- Yes, as well as other benefits; depending on the geomechanical stability of such well designs given reservoir and "seal" geomechanics; hydraulic isolation.
- R&D Stage remains early: Initial test wells will be vertical to minimize operational risk and maximize scientific insight

Horizontal Wells

A later stage R&D application

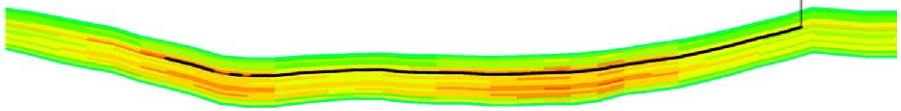
Drilling

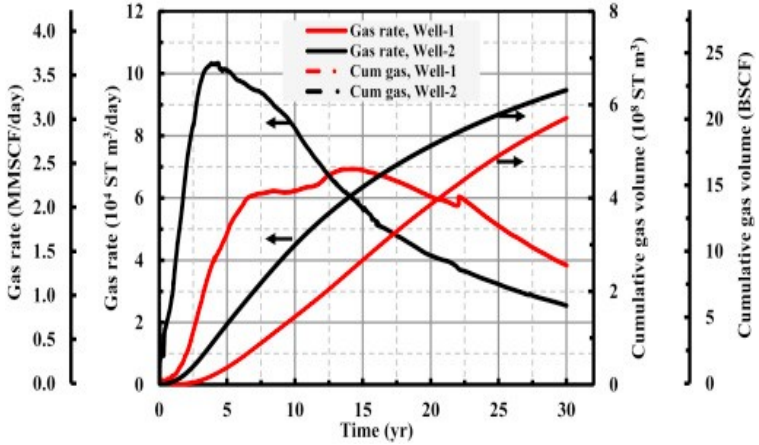
- A horizontal well was successfully drilled as part of the 2004 Nankai exploration program (Takahashi and Tsuji, 2005)



Numerical Simulation

- Class 2 and 3 reservoirs – Higher rates, reduced lag times, reduced potential for near-wellbore blockages etc.. (Moridis et al., 2008)
- Hydraulic Isolation and Bounding conditions may complicate the issue.
- Huff-n-Puff in challenging Shenhu area systems (Li et al., 2011)
- Higher rates for both inclined (Myshakin et al., 2016) and horizontal (Nandawar et al., 2016) wells in AK
- Modest benefit in marine…?
- Sand control issues will be key…





Review of SEAB Technical Questions

NATIONAL ENERGY TECHNOLOGY LABORATORY

Maintaining Formation and Well Stability

In what geologic and hydrate concentration settings should one expect geomechanical risks for formation and well stability?

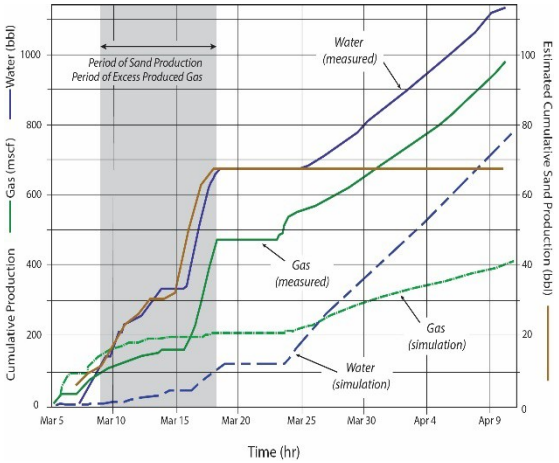
- All of them.
- Arctic hydrate has surface subsidence risk mitigated by overlying permafrost
- Deeper likely more consolidated – but also require greater pressure drawdown

How might one create more favorable well and formation integrity during the disassociation of hydrates?

- Proper site selection and characterization
- Proper well design – industry has experience with unconsolidated boreholes
- Proper well and completion design tailored to local conditions as informed by findings from multiple scientific field tests, experimental studies, and numerical simulation.

Would enhanced near-wellbore methods, such as a gravel pack, prove to be valuable?

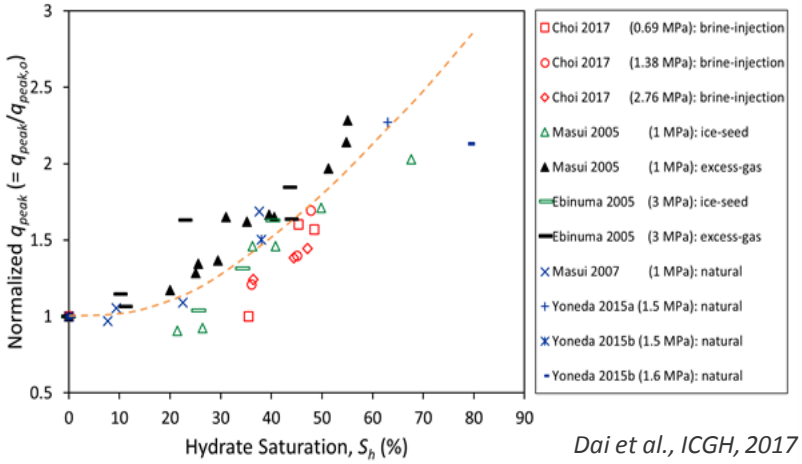
- Perhaps. All program field programs have and will involve experienced industry reservoir and completion engineering expertise and will continue to consider all options for completion design.



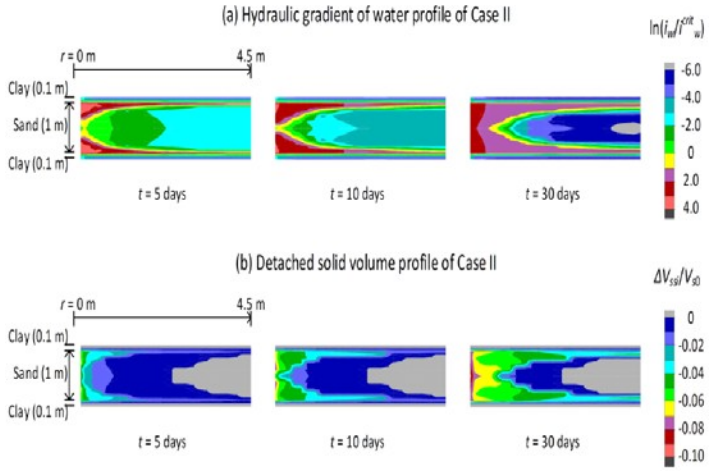
Ongoing Studies

Strength, Subsidence, Sand Production

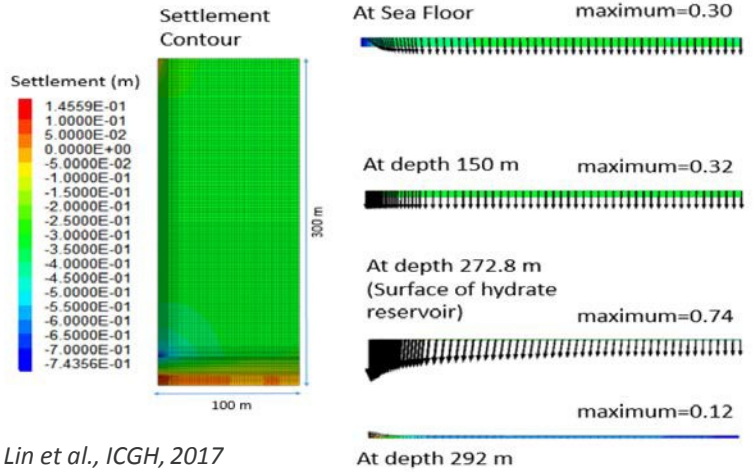
- Modeling is accessing log and core data from NGHP-02
- Modeling is assessing case of relatively shallow (sub-sea) interlayered sand, in deepwater with extensive P drawdown



Dai et al., ICGH, 2017



Uchida et al., ICGH, 2017



Lin et al., ICGH, 2017

Review of SEAB Technical Questions

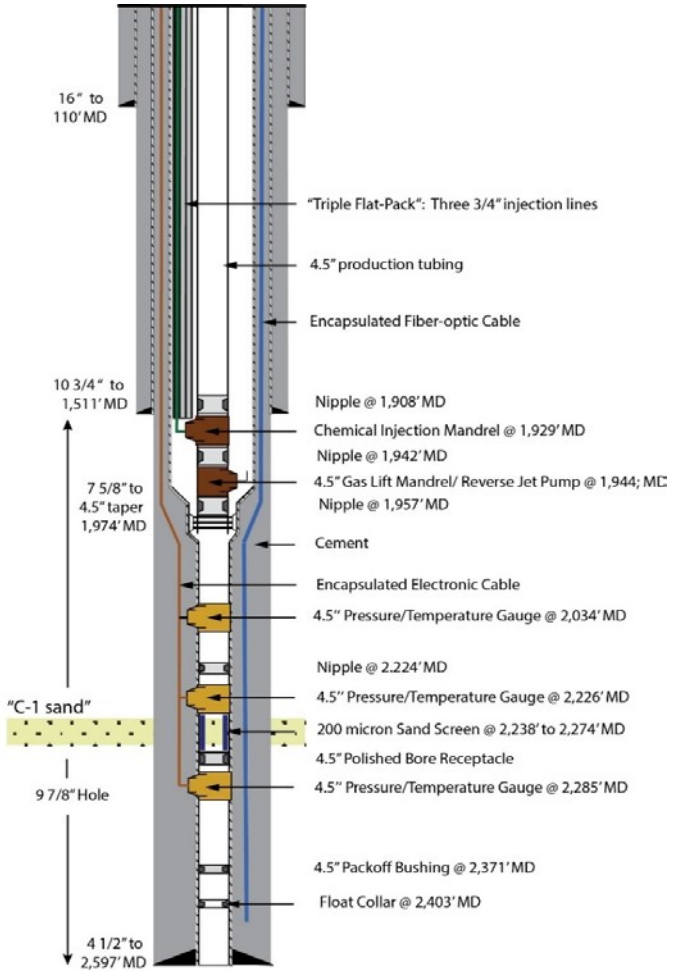
Assuring Continuity of Methane Release and Production

How might one assure the continuity of methane release and prevent hydrates from reforming near the wellbore should the well need to be shut-in or becomes shut-in due to formation collapse or other reasons?

- Hydrate will reform both near and in the wellbore during any shut-in.
- Focus on means to minimize shut-ins, limit their duration, and rapidly mitigate their impact via pre-set systems.
- The 2012 Ignik Sikumi well had these systems in place (a triple-flat-pack of injection lines to the upper completion)

Should a hybrid system involving heated glycol or other methods be a part of the field test production process?

- Yes; a glycol injection system was installed and utilized in the Ignik Sikumi test.
- Similar intervention/maintenance capabilities will be part of all future tests.



Boswell et al., 2016