Minutes
Methane Hydrates Advisory Committee
La Jolla, CA
April 24-25, 2008

Thursday, April 24, 2008

1. Introduction

The Methane Hydrate Advisory Committee Meeting (MHAC) convened at 9:00 a.m. at the La Jolla Shores Hotel in La Jolla, California on Thursday, April 24, 2008.

1.1 Welcome, Introductions, and Selection of Committee Chair by Guido DeHoratiis, Acting Deputy Assistant Secretary, Office of Oil and Natural Gas

Mr. DeHoratiis kicked off the meeting by welcoming all the members to San Diego and asked everyone to introduce themselves. He then called for nominations of members to serve as committee chair. Dendy Sloan was quickly nominated and the nomination was seconded before the nominations were closed by consensus. Dr. Sloan accepted.

2. Presentations

All presentations and corresponding questions and discussion from the first day of the two-day meeting follow.

2.1 Report and Discussion of Computer Simulations and the Code Comparison by Brian Anderson, West Virginia University

Brian Anderson, an Assistant Professor in the Chemical Engineering Department of West Virginia University, gave a presentation on the Hydrate Simulator Comparison Study. The U.S. Department of Energy (DOE) along with the U.S. Geological Survey is leading a study comparing the leading hydrate reservoir simulation programs. There are six research groups that are participating in the simulations. Last year, Dr. Anderson gave a description of problems one through five. Since then, the engineers have been focusing on problems six and seven, which Dr. Anderson focused on in his presentation. He started off by giving a quick background of the code comparison and a brief description of the Mount Elbert location. He moved on to describe some of the goals of the study which are to: 1) exchange information regarding methane hydrate dissociation and physical properties enabling improvements in reservoir modeling, 2) build confidence in all the leading simulators through exchange of ideas and cross-validation of simulator results on common datasets of escalating complexity, and 3) establish a repository of methane hydrate-related experiment/production scenarios that can be used for comparison purposes.

Dr. Anderson gave a brief explanation of the first five problems, then began discussing problem six, which was history matching the Modular Formation Dynamics Tester (MDT) results with the Mt. Elbert test well. His team focused on the C2 test, pressure response, temperature response and fluid flow rates, and compared the fit parameter sets for differences.

Dr. Anderson showed that on the first pressure drawdown, the team found that there was an in situ permeability of 0.12–0.17 mD, which is extremely low. Also, they found that in the subsequent flow periods, most of the dissociated gas was left in the annular space around the MDT. Allocating this wellbore storage was necessary for reproducing pressure curves. They found that fluid segregation in this annular space plays a key role in the general shape of the recovery curves. They also found that no models explicitly can represent an open annular space. The overall fitted parameters may reflect that error. Finally, they found that formation kinetics may affect the shape of the recovery curve.

He then moved onto problem seven, which looks at 3 different production scenarios over a 50-year time scale. He showed six different models and compared the maximum gas rates for each problem.

Dr. Anderson concluded by demonstrating how all of the participating simulators show remarkable agreement, especially with gas rates and characteristic lag times. As expected, the reservoir simulators show that a warmer and deeper hydrate bed is more likely to be productive. He also noted that there is still much to be learned from coupling the log data to reservoir simulations. It is difficult to include all the complications of an actual hydrate system to the reservoir simulators. The purpose is to try to take what happens in the experimental scale up to the reservoir scale and have confidence in the scale level.

2.1.1 Discussion

Some of Dr. Anderson's slides indicated that there are zones that could be producing gas rather soon and in significant volumes. The committee members expressed a desire to see more of these types of predictions. They acknowledged that the work Dr. Anderson has done is excellent and they agree they must move in that direction. It was asked how long of a reservoir test would be needed to determine the flow characteristics of the reservoir. The response was that it depends on the reservoir. However, a 6-month production test would affect significant parts of the reservoir, which could reveal a lot more about the reservoir. Dr. Anderson was asked about modeling heterogeneous reservoirs and dipping layers. He replied by saying the group is trying to build these characteristics into the model and it makes the models more difficult to run. One model they are building is looking at the effects of a horizontal well, its location within a hydrate bearing sediment zone, and its effect on production. Further questions about the history matching study were in reference to ruling out the heterogeneity effect for the inflection point. He explained that nothing can be ruled out. The final comment revolved around showing the sensitivities of a long-term model and the assumptions made going into it. The most important assumption being made was the intrinsic permeability of the reservoir. Dr.

Anderson responded by saying the first pressure response is very important and that's where they get the relative permeability data. That was one of their big accomplishments.

The committee broke for coffee at 10:30 a.m. and reconvened at 10:45 a.m.

2.2 Report on Research for Methane Hydrate Role in Global Climate Change by Carolyn Ruppel, U.S. Geological Survey (USGS)

The next presentation was given by Carolyn Ruppel of the USGS. Her stated intent was to give everyone an update of the status of USGS hydrate activity concerning climate. She also aimed to show that gas hydrate only makes a small contribution to climate change.

Dr. Ruppel discussed hydrate climate research and federal mandates along with past efforts and critical future needs. The summary of her presentation was as follows:

- Hydrate-climate research and federal mandates
- Past efforts
    - Funded projects
    - Symposia
- MIT 2008 Workshop, Methane, Climate and the Carbon Cycle
- Current state-of-the-art technologies
- Critical future needs

She discussed the mandate for climate research put forth by the 2000 Methane Hydrate Act and the 2005 reauthorization. It is an implied mandate to assess real/potential impact of perturbations on climate system or carbon cycle. Dr. Ruppel explained that there is an inferred emphasis more on the present and future than on the deep past, although the deep past is not precluded.

Dr. Ruppel outlined some of the questions facing methane hydrate and climate change. The critical question she stressed was whether or not hydrate dissociation ever causes warming or even exacerbates warming already under way.

Some of the state-of-the-art climate issues she discussed included:

- Past climate change events with inferred hydrate connection
- Current methane sources/sinks
- Near-future of methane emissions
- Numerical modeling
- Critical knowledge gaps

Dr. Ruppel next discussed evidence that about 600 million years ago gas hydrate may have dissociated in response to climate change. There is evidence to show that event was preceded by a global glaciation event which some refer to as "snowball earth." However, it abruptly ended due to massive volcanism. There were extreme greenhouse conditions

when CO_2 was absorbed by the oceans to create "cap carbonates." Cap carbonates can be linked to hydrate degassing.

The Paleocene–Eocene Thermal Maximum (PETM) is a good period to study in order to understand the climate/hydrate link. Higher resolution records have clarified that hydrate dissociation lagged atmospheric warming and that the warming began rapidly and was short-lived.

Dr. Ruppel went on to discuss the Late Quarternary Period and its temperature changes. She showed several core records to demonstrate the ice volume during periods of differing temperatures.

Dr. Ruppel talked about the connection between climate change and submarine slides, a topic which has been around for some time. Submarine slides are known to be spatially associated with hydrate areas and temporally associated with sea level changes; however, the latter does not have a big impact on the hydrate stability zone.

Dr. Ruppel next discussed a model of methane emissions and showed a summary map of the measurements. She also reviewed what happens with marine hydrate dissociation. She next spent time discussing permafrost hydrate, which is widely viewed as being the most susceptible to likely climate change scenarios.

After discussing the great improvements of numerical modeling in the past several years, she talked about hydrate zone modeling, climate modeling, and coupled climate-ocean modeling. These modeling techniques have become more sophisticated in recent years.

Dr. Ruppel wrapped up her presentation by discussing the challenges and critical problems. Some of the technical challenges include:

- Discriminating hydrate methane from other methane in field studies
- Total integrated flux at one vertical location
- Upscaling: point to local to regional to global
- Scaling: short to longer-term to interannual to millennial
- Episodicity of emissions
- "Efficiencies" of methane transfer between different parts of Earth Systems

2.2.1 Discussion

The discussion of Dr. Ruppel's presentation began with an observation that from a past Intergovernmental Panel on Climate Change (IPCC) report that looked 100 years ahead, methane hydrate was completely left out as a potential energy source. This is a concern for the committee members because it means IPCC's financial models are incomplete. Methane hydrate's impact on global warming was also discussed. One thing Dr. Ruppel stressed was that the key impact to the environment is not from the methane itself — it is what happens to the methane when it hits the atmosphere. It is oxidized and increases the

long-term CO_2 burden. If there is a pulsed release of methane, the more significant impact comes from the CO_2.

The discussion continued with a question about the lack of correlation to the sea level curves. A member wanted to know if there was any work done on the paleoseismicity and the tectonic setting. Dr. Ruppel confirmed that they have been working on that for some time now. She went on to explain how some of the slides are clearly seismic oriented. The seismic triggers are fairly important. Moving on, the members then discussed the fluxes of emissions into the atmosphere. It is *guessed* that methane hydrate accounts for two to three percent of all carbon emissions. Keep in mind, all gas in the system doesn't escape into the atmosphere; some of it is held back by geology. The big question is whether or not methane hydrate will even contribute in the future.

The committee members feel that methane hydrate is a small player. There hasn't been any serious work done on hydrate so reliable numbers are not available. It would help if they had the number from the Arctic, for example. Next, the committee looked at whether or not there is evidence that dissociation caused failure in the Holocene era or earlier. Dr. Ruppel explained that is very difficult to prove. The slides are very hard to study; they need more dating information. It was determined that the near-future is more important than the geologic past. What needs to be answered is whether or not methane hydrate is contributing now. There was also a discussion about funding. The issue surrounded what to do with the information if the funding was received. Lastly, a member wanted to know if the submerged shelf of the permafrost system is most susceptible and if so, why that was so. The Arctic Ocean is expected to see dramatic changes in temperature and it has been shown that we're already seeing some degassing from those offshore hydrates. The issue in the Arctic is that the water temperatures are 10° to 12° warmer than the seafloor surface on the shelf, which has been flooded for the last 110,000 years. There is already a large disequilibrium in the system.

2.3 Report on MMS Assessment of Offshore Methane Hydrate Resource by Matt Frye, Minerals Management Service (MMS)

Mr. Frye of MMS reported on the assessment of in-place gas hydrate in the Gulf of Mexico's (GOM) Outer Continental Shelf. His presentation consisted of background and a description of the project goals, description of MMS's jurisdiction, the regional geology of the Gulf of Mexico, the model methodology, and the GOM in-place results. Mr. Frye began by reminding everyone that the last comprehensive gas hydrate assessment performed in the United States was in 1995. He started his speech by giving a history of MMS involvement in gas hydrate study and chronological summary of their milestones. Some of the model specifications include a study area of approximately 450,000 km2 and 202,079 model cells (each cell 2.32 km2 [5000' x 5000']). The outputs of the model are GIS-ready and easily mappable. It was programmed in FORTRAN version 90 (Compiled as v. GOM3.38)

The focus of the presentation was on the modern day deepwater GOM. He showed the results of their resource assessment by displaying numerous slides of basin maps, water

depth charts, basement salt maps, surficial seismic anomalies, and the model cell structure. He then went on to describe the two different charge models: Generation and Migration. Three modules (container, concentration, and integration) were also discussed before moving on to the U.S. GOM in-place results: mean in-place methane hydrate is 21,444 TCF, and the in-place resource in sandstones is 6,717 TCF.

The conclusions of the presentation show that in-place results are reflective of GOM geology and complex geometries. They found that the model methodology and structure provides a high degree of spatial resolution and that the disaggregated mass balance approach allows for component modification as new data and information becomes available.

Mr. Frye described the path forward by stating that they want to infill areas with new seismic and saturation data. They also plan to develop a thermogenic gas model and a technically recoverable model. Finally, they want to refine methods and inputs for other Outer Continental Shelf (OCS) margins and run a modified model through the technically recoverable analysis.

2.3.1 Discussion

The discussion of Mr. Frye's presentation began with the notion that there are a few areas in the GOM where you get a bottom simulating reflector (BSR). One issue Mr. Frye made clear was that MMS has limited resources since their large number of lease sales has everyone focused on conventional resources. The next comment made was in regards to the assumptions made from the migration model described earlier. Mr. Frye explained that they retained about 25 percent of the gas that was generated, which is higher than normal. Another member posed the question as to why there are so few BSRs in GOM if there is so much hydrate. There isn't a direct answer to that, but one reason may be that there probably isn't gas hydrate everywhere they projected in the basin. Mr. Frye mentioned in his talk that there are 4,700 seeps and one member inquired about their relation to large hydrate accumulations. Mr. Frye says the seeps are often found on the margins of the basins, although they do see some thermogenic gas components seeping out those features. By and large, they are located on the rims of the basins and the scientists think the active flux that is feeding those systems will also help shape the distribution from the gas they have modeled. Next, there was concern from a member whose company had found suspected gas hydrates in only 3 or 4 or over 250 GOM wells. The apparent disagreement with the model may be explained by the fact that MMS does not allow wells to be drilled in obvious hydrate-bearing areas. Also, a number of the logging runs aren't necessarily done in the upper part of the section from the seafloor down, so hydrates may not be detected.

2.4 Report on Chevron Joint Industry Project (JIP) (Emrys Jones)

Emrys Jones gave a presentation on the DOE/Chevron Gulf of Mexico Gas Hydrate JIP. The aim of this project is to develop technology and data to assist in the characterization of naturally occurring gas hydrate in the deepwater Gulf of Mexico.

Dr. Jones explained that the membership of JIP is slowly expanding and gaining more international participation. Objectives of the JIP are:

- Link seismic data to ground truth by collecting logs and cores of sediments containing hydrates
- Develop well and sea floor stability models and the sediment properties they require and provide guidelines for drilling and operating in hydrate areas.
- FOCUS 2005 Field program: Gas hydrate in two distinct fine-grained sediment settings
- FOCUS 2008–2010 Field programs: coarse-grained sediments

Dr. Jones gave a brief overview of the project status and its three phases. JIP Project Status is as follows:

- Phase 1: Complete (9/2001–12/2004)
  - Select sites/pre-cruise seismic estimates
  - Conduct laboratory investigations
  - Develop new field testing equipment
- Phase 2a: Complete (1/2005–4/2005)
  - Conduct drilling/logging/coring operations
- Phase 2b: Complete (9/2007)
  - Evaluate/publish Phase 2a findings
  - Improve sampling/analysis capabilities
- Phase 3: Started (10/2007–2010)
  - Plan and conduct drilling/logging/coring operations through one or more field programs
  - Analyze data and prepare final volume

After laying out the administrative aspect of his talk, Dr. Jones spent some time discussing seismic data and seismic analysis of three potential drilling locations in the GOM. The three locations are: Alamedas Canyon, Green Canyon, and Walker Ridge, which are leasing areas in the GOM. What the JIP is trying to accomplish is to find out if the current techniques and data sets that they have for petroleum exploration are suitable to use for analyzing the location of gas hydrate. The reason is that they don't want to have to go out and reshoot all the seismic data that they have. They want to be able to use the data that they have currently. The JIP's interest in gas hydrate is twofold: 1) it represents a hazard to their operations, and 2) it represents a long-term potential resource. In general, the purpose of the JIP is to conduct drilling operations and analyze the data that they collect from those operations in the GOM.

2.4.1 Discussion

A comment was raised about the possibility of the absence of BSR due to the absence of trapped free gas below. Dr. Jones confirmed that to have a BSR, you need to have at least some percentage of free gas. Another possible reason the BSR doesn't show up is that

you could be in an area with a lot of heat fluxes. BSRs seem to pop up when you have stable sediments. According to another member's experience, BSRs show up more often in older sediments. There was also discussion of the new pressure core and if the intention was to use that continuously through to the hydrate stability zone. Dr. Jones confirmed that was partially the case. He said they would use it through the target zone. He explained that it commonly takes two hours to run an application. With the $20,000 an hour rig expense, it would be too much for them to core continuously. Just to clarify, there will be no coring in this next leg (June, July, and August, 2008). A final comment surrounded the issue of why the seismic inversion shows there's hydrate when they were sure there were none. A member wanted to know if there was going to be data in the future to help explain why that is. Dr. Jones doesn't think so. Also, it was noted from an attendee that inversion should not be trusted and should only be used as a guide.

The committee broke for coffee and snacks at 3:15 p.m. and reconvened at 3:30 p.m.

2.5 Report on BP Arctic Project (Scott Digert, and Ray Boswell)

Before the report on the BP Arctic Project, Sandy Colvine of Natural Resources Canada volunteered to give an informal update of their arctic project. Dr. Colvine started off by giving a brief background of gas hydrate in the North Slope and an overview of their site. He said for a single point, and because of over 20 years of research, it is probably the best studied and documented site in the world for gas hydrate. In 2002, five countries got together to better investigate Mackenzie Delta methane hydrate deposits by drilling, coring and short-term production testing, including thermal stimulation.

He then discussed the results of their last two winter operations. The second year, even with a constrained budget, there was gas flow achieved by depressurization with some wellbore heating for a period of six and a half days. The actual flow rates haven't been officially announced by the jointly managed program, but he noted that it's safe to say their Japanese colleagues are happier with this year's operation over last year's and are probably more agreeable to getting the results out quickly. It was also noted that they have a legal agreement with Japan, not a memorandum of understanding (MOU).

Scott Digert of BP Exploration (Alaska) Inc. started the presentation by explaining that it was an update of a talk they gave in Golden, CO at last year's meeting. Mr. Digert handled all the slides that showed why they did it and Dr. Boswell's job was to show what they found and what they actually did.

The outline of the presentation was as follows:

- Project Overview
- Resource Characterization
- Stratigraphic Test Results
- Conclusions / Future Plans

Mr. Digert gave a thorough explanation of gas hydrate stratigraphic test "firsts" for the Milne Point Unit (MPU). He then showed a map to describe where the study area is located and also where there are several gas "trends" located in the area. This is a collaborative research approach with the following objectives:

- Jointly assess gas hydrate resource potential
- Maintain focus with dedicated external team
- Use Alaska North Slope (ANS) as natural laboratory
- Require clear decision gates between phases
- Acquire data to improve resource assessment
- Mutually agree to project goals / decisions

The main goal is to assess resource potential in 3 phases:

1. Characterization and modeling
2. Schematic regional modeling

3a. Acquire stratigraphic test well data core, logs, & modular dynamics testing (MDT) wireline testing

3b. Acquire additional well data long-term production test (gravel pad)

Ray Boswell of NETL next discussed how they chose the site and what they found once they were there. He started his portion of the presentation by showing the characterization of the resources. This section of the presentation involved mostly describing where known gas hydrate accumulations are located and more specifically the Milne Point hydrate accumulation and its prospects.

The site they chose to conduct the stratigraphic test at was Mt. Elbert. This site was chosen because it was a place where there were two prospects and it was very consistent in terms of seismic responses.

He then went on to show the test results:

Prediction

- Prospect within undrilled, 3-way fault-bounded trap
- Seismic attributes estimate reservoir thickness and saturation for Zones C & D
  - Upper "D" sand: 46' thick with 68 percent Gas Hydrate Saturation
  - Lower "C" sand: 70' thick with 85 percent Gas Hydrate Saturation
- Thickest previous total gas hydrate seen in MPU wells ~20 ft.

Results

- Validated seismic methods
- Extensive open-hole logs
- 430' core, 261 subsamples
- 100' gas hydrate-bearing
- Comprehensive OH MDT

The next portion of his presentation progressed through the downhole data acquisition and the logging program results. He also showed the Mt. Elbert – 01 log data summary. Everything was as expected. When comparing the prediction to the actual, the C zone was remarkably accurate. The D zone was overestimated, but it was still very good. As a package, it gives their team great confidence in their ability to assess gas hydrate from seismic. So this confirmation of the pre-drill technique was one of the big outcomes of the program.

Next, he talked about the coring and the sampling. The decision to use chilled, oil based mud was a risky decision by BP, but it paid off. The team also used the wireline coring system with 85 percent core recovery. There was gas hydrate confirmed in both primary target zones (C and D sands), with approximately 100' of gas hydrate. He also showed photos and gave credit to members of their team analyzing cores. The cores were sent to Lawrence Berkeley National Laboratory (LBNL), where they were CAT scanned and sent to other labs. They also reviewed petrophysical and pore-water analysis on the cores.

The MDT serves several purposes: it tests the reservoir response to fluid withdrawal and pressure reduction, it gives an indication of reservoir quality and performance, and it conducts tests at four locations, two per pay zone. This produces critical data for reservoir simulation calibration and potential production test. The key results of the MDT at Mt. Elbert were as follows:

- Confirmation of gas release via depressurization
- Clear indication that depressurization alone may not be sufficient in select (T) settings
- Confirmation of mobile water phase
    - Sgh = 65%; 25% = Swirr
    - Sgh = 75%; 10% = Swirr
- Determination of intrinsic K
    - 0.12 – 0.17 mD
- Reformation kinetics may be important
- Detailed reservoir heterogeneity may control productivity

Mr. Digert gave a summary of the gas hydrate well at Mt. Elbert. The well demonstrated a safe collection of data in shallow, unconsolidated, gas hydrate-bearing sediments. It was a good hole which equals outstanding core recovery and log suite. It is a confirmed hydrate reservoir in close conformance to pre-drill predictions. Finally, they acquired and analyzed a complete and integrated dataset for approximately $5.0 million.

The road ahead for this project will entail refining/demonstrating exploration methodology for Arctic hydrate, refining ANS hydrate resource description, and conducting a long-term, scientific production test. The team wants to do this so they can better understand the natural condition of gas hydrate, improve models and understanding of productivity, leverage data into a more effective pursuit of marine resource issues, understand ANS gas hydrate resources, and understand gas hydrate impact on other North Slope resources.

Dr. Boswell subsequently talked about the goal of the project from the beginning - to do a long-term production test. Something that would really advance their understanding of the deliverability of methane from gas hydrate reservoirs. He then went on to discuss parameters for a successful production test in 2009 and 2010 for project phase 3b and some of the 2008 activities for the test project phase 3a.

2.5.1 Discussion

The first comment from the members was in regards to the well program. They wanted to know how the logs looked in permafrost. Their team only ran logging while drilling (LWD) on the North Slope. LWD is very inexpensive, which is the advantage of being on the North Slope. It was noted that Anadarko actually has fantastic well log data and cores of permafrost. Next, the members wanted to know if they drilled a horizontal well, what they would learn as they cut through all the different zones. They thought it would be hard to tell what they were seeing. Mr. Digert explained that's why they decided to cut a vertical well. After that, the issue was the timeline and budget for phase 3b. It was decided that the earliest they can drill is about February 2010 since the winter of 2009 rig schedule is booked. As for the costs, they have escalated dramatically over the last 2 to 3 years. The cost-sharing will remain at 20 percent for BP. One member wanted to know if the Mallik well was horizontal or vertical. Dr. Boswell confirmed it was vertical. The discussion was closed with applause from the chairman for the program (DOE, BP, and USGS), the work performed, and the accomplishments made.

2.6 Discussion of DOE Strategy and Plans for Field Tests

During the final session of the day, the chairman called for discussion about the DOE strategy and future plans for field test.

The discussion was kicked off with a remark by a member stressing the importance of getting industry more actively involved in gas hydrate. The oil industry by and large is hanging back. It was decided that the committee needs to maintain flexibility and keep multiple options. They also need to be sharper about what they want up front, before they get to the testing phase. The committee feels it is important that people realize the importance of gas hydrate. They need funding because they are on the verge of something big.

The committee feels they have gotten to a real point with truly proven concepts and they have to do their best to communicate that fact. Just listening to reports doesn't help if they don't effectively communicate. An active discussion followed with recommendations on improving committee effectiveness. Some key points that were made included: not underestimating industry's buy-in, telling the big story of the Mallik well and the MMS assessment, and approaching Congress successfully for appropriations. Some members feel people just don't understand why with all the oil and gas data available to use, gas hydrate still is not seen as a viable resource.

The committee's Federal representative made comments in regards to the new administration coming into office and the changes it will bring along with its transition team. The committee feels this is going to be an important time and they can possibly influence the budget. The consensus was that they need to make contacts on the transition team and let them know the importance of hydrate. Also, someone at the meeting might know the new administration's science advisor. They need to keep close track of that — it could potentially be a big opening. They need to let the government know why they need the funding. Two possible avenues include: visit D.C. to talk to the transition team and create a slick, short document to show gas hydrate benefits.

An assignment handed down by the chairman of the committee was for everyone to think about how to put plans together to assemble a national program.

3. Day 1 Wrap-up and Adjournment

The first day of the committee meeting was adjourned at approximately 5:15 p.m. by Chairman Dendy Sloan. Miriam Kastner provided directions for everyone in the room to attend the Scripps Aquarium reception and walking tour at the Scripps Institute of Oceanography.

Friday, April 25, 2008

4. Re-convening of the Meeting

The second day of the meeting was called to order at 8:30 a.m. by Chairman Sloan. He began with welcoming remarks and a thank you to Miriam Kastner for being such a gracious host at Scripps last evening. The chairman also made quick reminders about submitting receipts and travel reimbursement procedures.

5. Presentations

All presentations and corresponding questions and discussion from members or any other attendees from the second day of the meeting are in the following section.

5.1 Update on DOE Projects (Ray Boswell)

The first presentation of the day was given by Ray Boswell of NETL and was an update on the DOE program in gas hydrate research and development (R&D). He began the discussion by briefly explaining what has been going on in the interagency program, which they take very seriously. He next showed the budget profile and where the money goes in a given year. He also explained that the funding has been going up lately, but has been trailing the authorizations significantly. Essentially, about two-thirds of their money goes to cooperative agreements with private industry, academia, and others. The breakdown of funding is as follows:

- 65 percent: Cooperative Agreements
  - Two "flagship" field projects with BP and Chevron JIP
  - 11 supporting projects selected in FY2005 and FY2006
  - One earmarked project (7 percent)
  - Solicitations currently open
- 25 percent: Program-directed work (NETL In-house, National Labs, Interagency Agreements)
  - Field program support
  - Numerical simulation
  - Specialized lab studies
  - International collaboration
- 10 percent: Programmatic Initiatives
  - Fellowship Program
  - Merit Reviews
  - Outreach

Next, Dr. Boswell described the program R&D priorities. They are basically an interagency consensus on what needs to be done. Some of the priorities are:

- Better understand controls on gas hydrate occurrence
- Better understand key remaining properties of hydrate-sediment mixtures
- Understand causes, fluxes, and fates of methane between GH systems, the ocean, and the atmosphere
- Create a validated numerical simulation capability
- Develop a validated exploration capability
- Conduct a series of multi-well marine exploration expeditions
- Conduct a series of long-term production tests leading to viable production technology
- Integrate environmental monitoring into the field programs

He then went on to discuss some of the other projects that he did not discuss previously. He talked about the Alaska North Slope project at Barrow gas field and NETL's effort to expand their portfolio of opportunities for testing on the North Slope. He also gave a brief overview of the Gulf of Mexico Seafloor Monitoring Station project which is being led by the University of Mississippi. Finally, he explained that the other cooperative agreements are focused on marine gas hydrate exploration/assessment technologies.

Dr. Boswell next touched quickly on three projects they have with universities studying fundamental gas hydrate systems. They are with Georgia Tech/Oak Ridge National Laboratory, the University of Texas, and Rice University. In terms of their program-directed work, NETL has various interagency agreements with the USGS, Naval Research Laboratory (NRL), MMS, and the National Institute of Standards and Technology (NIST). They are also doing a lot of work with the national labs as well as in-house and onsite which he has been more involved with.

After briefly describing the work to address the hydrate in the global environment, he moved on to explain the list in everyone's handout booklet to show how they have been incorporating external scientific input. Lastly, he brushed on the educational opportunities and the fellowship program which they now have three students working on. He encouraged all committee members to not only read NETL's hydrate Web site and *Fire in the Ice* newsletter, but to periodically send in updates on their work.

5.1.1 Discussion

The discussion began with a clarification that ASRC is the operator in the Barrow project. Also, a member wanted to know what impacts and changes were made as a result of the peer reviews in September. It was answered that one project was terminated and there were a lot of tweaks made to the other projects. Dr. Boswell made a point to say that the University of Mississippi project focus is driven by peer reviews. The committee felt that broader research is needed and they need to advance the science as an underpinning to the whole effort. There were questions brought forth about the applications for new graduate and post-doctoral fellowships. Dr. Boswell explained that the number of applications has been going down, but they are still adding about one per year, which is appropriate at the current funding levels. Expansion would be possible if the budget was larger.

5.2 Update on International Activities (Kelly Rose)

The next presenter was Kelly Rose of NETL. She gave an update on their international methane hydrate activities. She showed the growing amount of countries that are interested in gas hydrate and different areas worldwide where there has been gas hydrate activity. Ms. Rose talked about the enormous amount of organic carbon to exist in gas hydrate compared to all other resources. She explained how the form that the gas hydrate takes is extremely variable. She also showed the distribution of the huge amount of in-place resources.

The next part of her discussion touched on the four major international field programs and the DOE-International collaboration. She then talked about the India expedition describing the objectives, laboratories, and timeline and let everyone know there are DVDs available from US Geological Survey showing the preliminary results. After discussing the results of the India expedition, she moved on to highlighting the 3 basins around India and the 10 sites that were drilled, cored, and wireline logged. They found the majority of the hydrate in all the accumulations was disseminated within clay. They found there were not very many permeable reservoirs. She also described that in the Krishna-Godavari (KG) Basin there was evidence of an extremely high fluid flux and they even encountered possible paleo-chemosynthetic communities.

Ms. Rose next talked about the Andaman Forearc basin, which was formed from subduction of the Indian Plate beneath the Southeast Asian Plate. This basin was found to be a much different geologic environment. The area's primary sediment source is marine calcareous and siliceous oozes. There were also mafic to felsic ash-falls & volcanoclastic

beds (cm thicknesses), which are ash layers that represent volcanic activity from the Miocene to present. They saw a strong correlation between where they found the hydrate and where they found the ash beds.

The next basin discussed was the Mahanadi Basin. The results were based on advanced geophysical/geological analysis. They were actually prospecting for channels when they discovered it. The site was widely expected to contain hydrate-bearing sandstones. Instead, they encountered fine-grained, clayey sediments like those found in the KG Basin.

Ms. Rose then moved on to the Chinese expedition that ran from April 21, 2007 to June 12, 2007 in the South China Sea. She gave an overview of the study participants, the sites they explored, the water depths, and showed the collection of data and samples. Their main goal there was to improve their understanding of the nature and controls on hydrate occurrences in the South China Sea. She described in detail the shipboard program and gave an in-depth overview of the preliminary results. Finally, she talked about the future activities that were going to take place and what researched they performed when the ship returned back to shore.

She spoke briefly about the UBGH-1 Gas Hydrate Expedition that ran from September to November of 2007. This Korean expedition was conducted in the Ulleung Basin in the East Sea. She talked about the study participants, how the sites were selected, how many cores where taken, and the analysis that was done. One thing Ms. Rose noted was that all three sites they selected were hydrate-bearing sites. She laid out the coring summary, a summary of the shipboard samples, and described the shipboard core analyses.

To wrap up, Ms. Rose discussed one slide on the U.S. National R&D Program. She explained how USGS has been working with international entities for quite some time. Just last week DOE signed an agreement with the South Korean government for future research and collaboration in the hydrate sciences.

5.2.1 Discussion

The first issue discussed was the fact that there is still a sense in a lot of parts of the world that the BSR is the “holy grail.” The committee discussed how they can get past that perception and push home the idea that the petroleum system is a better predictor of methane hydrate occurrence. Ms. Rose thinks the community is trying to publish material and speak out about the need for that. Next, the members discussed how DOE can play a role in learning from others and how to broaden what they already have learned. They agreed NETL and others are in a unique position to bring everyone together. Committee members then asked Ms. Rose if she had a favorite site that looked producible. She felt that all the sites showed promise, but the Koreans probably showed the most promise of finding a producible reservoir since they recovered a lot of sand. Future expeditions were also discussed and it was noted that India is the only known country currently planning a program.

5.3 Update on International Activities (Edie Allison)

The last presentation of the segment was given by Edie Allison of DOE. She discussed the ongoing DOE Methane Hydrate Program international activities. Ms. Allison gave a brief overview and limited her comments on the international activities to growing activities that have really focused on potentially productive hydrate sites. Some of the current multi-national work that has been going on includes: bilateral agreements for R&D cooperation with India, Japan, and Korea; DOE funding support for multi-national conferences; informal R&D cooperation on projects; and other government agencies such as USGS becoming involved in international cooperative projects.

She next went on to explain some of the reasons why DOE has bilateral agreements: they inform political leaders of the benefits of methane hydrate R&D, they may help managers justify budget increases, they encourage scientists to form informal collaborations, and they are necessary for co-funding projects or sending funds to another country. Ms. Allison explained the bilateral agreements DOE has or is planning with Japan (pending), South Korea, and India. She also gave an overview of the U.S-Canada cooperation before moving on to the future plans.

Lastly, she discussed the requirements for all pending agreements. First, they must develop a work plan. Then, they move on to the coordination and approval of participating scientists and organizations. The next step is the additional formal agreements. Finally, the members of the methane hydrate scientific community are encouraged to provide recommendations.

5.3.1 Discussion

Following Ms. Allison's presentation, a discussion centered on the extent that the bilateral agreements provide ammunition for getting attention. They are extremely valuable. When an international agreement is proposed, there is general pushback by DOE because they usually have more agreements than they can handle. DOE has recommended for several years that the gas hydrate program be eliminated, which hinders bilateral agreements which imply future funding. However, this constraint was overwhelmed by the recognition that hydrate research is important. Ms. Allison believes the high level DOE officials finally have a raised awareness of the program and have recognized it as valuable.

5.4 Report and Discussion on National Research Council (NRC) Assessment and 2009 Report to Congress (Edie Allison)

Edie Allison next gave an introduction to the National Research Council's (NRC) assessment of the DOE program, which will produce a report to Congress in 2009. In 2004 and 2005, the NRC did an assessment of the gas hydrate program that was directed by the Methane Hydrate Research and Development Act of 2000. It is a standard procedure for programs authorized by the House Science Committee. DOE feels that after the five-year authorization Congress gave, they want to know how the program is

doing in time to reauthorize. NRC was asked to: 1) conduct a study of the progress made under the methane hydrate R&D program, 2) make recommendations for future methane hydrate R&D needs, and 3) submit a report with findings and recommendations to Congress by September 30, 2009.

Another major change is that the Board on Earth Sciences and Resources will be leading the study. NRC is ready to form a study board and all advisory committee members present were encouraged to recommend people who might serve on the board. Even though no government employees may serve, international representation is accepted and encouraged. The contact for that is Elizabeth Eide at 202-334-2392 and recommendations should be sent to her very quickly.

5.4.1 Discussion

It was noted by one committee member that some of the prior participants of the Board on Earth Sciences and Resources were not particularly up to speed on the issue of gas hydrate. Also briefly discussed were the NRC's stringent policies regarding membership.

The committee broke for coffee at 10:00 a.m. and reconvened at 10:15 a.m.

5.5 Discussion and Preparation of Recommendations to DOE

The discussion and recommendations portion of the meeting was opened with Chairman Dendy Sloan asking the committee members to think about what they can do to drive the program forward. One member wanted to point out three things the program needs to be successful: 1) a strong leadership team with experience and expertise that can credibly represent the program, 2) effective cooperative and partnerships focused on key issues with the goal of achieving important milestones in a timely manner, and 3) adequate funding to realize scientific advancements necessary to allow the resource potential to be fully explored. One member feels DOE has done a great job with numbers one and two, but number three is not sufficient.

The committee also feels they need to identify what the important issues are. The way forward, which is very important, is to make people understand what the key issues are. People must also understand that the MHAC committee and the knowledge they possess is very important. The institutional knowledge within this committee also needs to be kept together.

DOE has come out with a roadmap that outlines their goals. It was decided that it might be worth the committee's time to revisit the goals and timeline in that document. They should back out of this and say what they need to accomplish. They need to be able to translate the issues to the layperson. The next recommendation dealt with the issue that there is value added to the government by having production tests. The suggestion is that the committee should advance that with the new administration's transition team. To do that, it must be kept away from controversies such as ANWR or the catfight over the gas

line in Alaska. They should describe the production test as the next logical step and make it clear for industry.

The next discussion focused on the reauthorization and if there was a role for the committee to play in the way it is reauthorized. No one has come to the committee yet about reauthorization, but DOE will keep everyone informed. It would also help for the committee to have authorization language in place.

There was a question about the reluctance of DOE to fund the oil and gas program in recent years. It has been an issue since early in this administration. Basically, it is because they are trying to reduce discretionary spending. The current administration found up to 150 programs the President doesn't support. Oil and gas was included as was methane hydrate, which is lumped in with oil and gas. The administration has threatened to zero out the budget every year, but funds are always added. That makes it very tough to plan ahead. Another question in line with the budget was raised about whether DOE would see a continuing resolution (CR) this year. There is a good chance there will be a longer-term CR passed, but Congress doesn't want any problems in this election year.

The effort that DOE has put forth to do the bilateral agreements internationally was applauded and should be encouraged. Also, a member recommended possibly funding programs under the Department. At a minimum, the members should write up documents describing accomplishments that contribute to the bilateral agreement. That would help to support those programs.

Next, there was a discussion as to what the MHAC could do to help DOE to make the issue more important. The best thing to do would be to focus on the transition team. The idea of contacting the lead energy person for the three current leading presidential candidates was discussed, but it was thought that the committee members might be spreading themselves too thin. The issue of gas hydrate awareness was raised again. The committee felt most people have heard of other alternatives, but not hydrate. One way to achieve outreach is to push for documentaries, etc. of energy futures, in this case methane hydrate. The committee had two concerns: 1) the U.S. government might be thinking that other countries might be able to do all the work to make hydrate a useable resource, and 2) people will say that using methane hydrate as a resource will attract conflict from the global warming camp.

There has been a lot of internal questioning the last couple of weeks. It is feared that some integrated oil and gas companies have little interest in hydrate. It is thought that some of those executives still say that hydrate as a resource is 30 years out. Their geologists have knowledge of hydrate, but the managers need to show a return on their investment today so they are not concerned with hydrate right now. There was discussion of comments made by managers from some integrated oil and gas companies and they all thought it was too far out to be too concerned with. In general, the committee feels that they would be amiss if the U.S. didn't focus on methane hydrate. It has huge potential resources, it is clean, and it will help with global warming. These issues need to be brought back to forefront.

6. Meeting Wrap-up, Action Items, and Adjournment

Once the discussion and preparation of recommendations for DOE were complete, the action items the committee needed to take were discussed. Since the committee possesses a wealth of information, they decided to pen a briefing paper on methane hydrate. It was decided it could be a document or a PowerPoint file, but it should not be more than one page. It will need to be very concise. An action item for the committee was to start putting together some bullet points stressing the importance of the program. Someone will have to volunteer to pull it all together. The committee decided they will need to get together in the fall via teleconference to discuss the topic. DOE officials mentioned that to present a report at a public meeting, they need five weeks to approve the meeting and get the information into the Federal Register. The presentation will need to be really well done and the case needs be made on the very first page. A committee member has proposed to make a start to the document immediately and pass it around to the other members for editing. It will be in the form of a bulleted list. The committee feels it needs to be a scare piece to get attention. It should demonstrate how the future of energy is a really huge problem and how it will affect national security. It was determined that what the public knows about methane hydrate is usually wrong. Getting good information out to the public in a creative way is crucial. There was a small concern over authorization language, but DOE will address that and get back to the committee.

The committee commissioned Amos Nur, to investigate the possibility of a hydrate documentary to educate the general public about hydrates. This documentary might have a theme of "Energy Security is Homeland Security," and consider Steve Masutani's CO2 sequestration experience with bringing such ideas to the public.

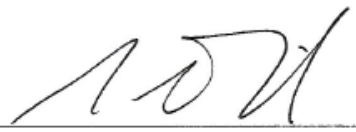
Art Johnson, Kelly Rose, and Miriam Kastner each volunteered to compose a PowerPoint seminar which any MHAC member might present to the general public.

The members next discussed having another meeting in the fall. They discussed potentially setting up a net-meeting or teleconference in September. Until then, they can fine tune the issues over e-mail. The chairman asked all members to work on the bulleted list and research available times they can meet in the fall.

Another member brought forth the issue of having distinguished lecturers. Many programs do that and have success. It would be good to possibly use two fellows. One could discuss global climate change and the other could discuss the geological aspect of methane hydrate.

At the conclusion of the action items segment of the meeting, Chairman Sloan called for adjournment at approximately 11:30 a.m.

E. Dendy Sloan
Chairman, Methane Hydrate Advisory Committee



Guido DeHoratiis
Designated Federal Officer, Methane Hydrate Advisory Committee

Appendix A: Meeting Attendees

Methane Hydrate Advisory Committee Meeting			
Pre-Registrant List - April 24, 2008			
Last Name	**First Name**	**Organization**	**Signature**
Allison	Edie	U.S. Department of Energy	
Anderson	Brian	West Virginia University	
Boswell	Ray	National Energy Technology Laboratory	
Brewer	Peter	Monterey Bay Aquarium Research Institute	
Charter	Richard	National OCS Coalition	
Coffin	Rick	Naval Research Laboratory	
Collett	Tim	U.S. Geological Survey	
Colvine	Sandy	Natural Resources Canada	
DeHoratiis	Guido	U.S. Department of Energy	
Dellagiarino	George	Minerals Management Service	
Digert	Scott	BP Exploration (Alaska) Inc.	
Frye	Matt	Minerals Management Service	
Goldberg	David	Columbia University (LDEO)	
Haq	Bil	National Science Foundation	
Johnson	Arthur	Hydrate Energy International	
Jones	Emrys	Chevron	
Kastner	Miriam	Scripps Institute of Oceanography	
Kohanowich	Karen	NOAA	
Masutani	Stephen	University of Hawaii (HNEI)	
Matey	Robert	Technology & Management Services, Inc.	
Miller	Robert T.	ConocoPhillips	
Nur	Amos	Stanford University	
Rose	Kelly	National Energy Technology Laboratory	
Ruppel	Carolyn	U.S. Geological Survey	
Shipp	Craig	Shell International E&P	
Sloan	E. Dendy	Colorado School of Mines	

Swenson	Robert	Alaska Department of Natural Resources	
Transtrum	Trudy	U.S. Department of Energy	
Trehu	Anne	Oregon State University	
Whelan	Jean	Woods Hole Oceanographic Institution	
Wilder	Joe	University of Akron	

Constable Steven SIO

Weitemeyer Karen SIO

Wilson Peter SIO

Charter Richard

Michael Tryon SIO

Kevin Brown SIO

Methane Hydrate Advisory Committee Meeting			
Pre-Registrant List - April 25, 2008			
Last Name	**First Name**	**Organization**	**Signature**
Allison	Edie	U.S. Department of Energy	
Anderson	Brian	West Virginia University	
Boswell	Ray	National Energy Technology Laboratory	
Brewer	Peter	Monterey Bay Aquarium Research Institute	
Charter	Richard	National OCS Coalition	
Coffin	Rick	Naval Research Laboratory	
Collett	Tim	U.S. Geological Survey	
Colvine	Sandy	Natural Resources Canada	
DeHoratiis	Guido	U.S. Department of Energy	
Dellagiarino	George	Minerals Management Service	
Digert	Scott	BP Exploration (Alaska) Inc.	
Frye	Matt	Minerals Management Service	
Goldberg	David	Columbia University (LDEO)	
Haq	Bil	National Science Foundation	
Johnson	Arthur	Hydrate Energy International	
Jones	Emrys	Chevron	
Kastner	Miriam	Scripps Institute of Oceanography	
Kohanowich	Karen	NOAA	
Masutani	Stephen	University of Hawaii (HNEI)	
Matey	Robert	Technology & Management Services, Inc.	
Miller	Robert T.	ConocoPhillips	
Nur	Amos	Stanford University	
Rose	Kelly	National Energy Technology Laboratory	
Ruppel	Carolyn	U.S. Geological Survey	
Shipp	Craig	Shell International E&P	
Sloan	E. Dendy	Colorado School of Mines	

Swenson	Robert	Alaska Department of Natural Resources	
Transtrum	Trudy	U.S. Department of Energy	
Trehu	Anne	Oregon State University	
Whelan	Jean	Woods Hole Oceanographic Institution	
Wilder	Joe	University of Akron	

CONSTABLE Steven S.I.O

Appendix B: Agenda

Agenda
Methane Hydrate Advisory Committee Meeting
La Jolla Shores Hotel, La Jolla, California
April 24–25, 2008

Thursday, April, 24, 2008

7:30 a.m.	Breakfast for Those Attending the Ethics Briefing
8:00 a.m.	Ethics Briefing for Special Government Employees
8:30 a.m.	Registration and Continental Breakfast
9:00 a.m.	Welcome, Introductions and Selection of Committee Chair (Guido DeHoratiis)
9:30 a.m.	Report and Discussion of Computer Simulations and the Code Comparison (Brian Anderson)
10:30 a.m.	Break
10:45 a.m.	Report on Research for Methane Hydrate Role in Global Climate Change (Carolyn Ruppel)
11:45 a.m.	Discussion of Methane Hydrate Program Role in Global Climate Change Research
12:15 p.m.	Working Lunch
1:15 p.m.	Report on MMS Assessment of Offshore Methane Hydrate Resource (Matt Frye)
2:15 p.m.	Report on Chevron JIP (Emrys Jones)
3:15 p.m.	Break
3:30 p.m.	Report on BP Arctic Project (Scott Digert and Ray Boswell)
4:30 p.m.	Discussion of DOE Strategy and Plans for Field Tests
5:30 p.m.	Adjourn for the day
6:30–8:00 p.m.	Reception at Scripps Aquarium

Methane Hydrate Advisory Committee Meeting
La Jolla Shores Hotel, La Jolla, California
Friday, April 25, 2008

8:00 a.m.	Registration and Continental Breakfast
8:30 a.m.	Update on DOE Projects (Ray Boswell) and International Activities (Edie Allison and Kelly Rose)
9:45 a.m.	Report and Discussion on National Research Council Assessment and 2009 Report to Congress (Edie Allison)
10:00 a.m.	Break
10:15 a.m.	Discussion and Preparation of Recommendations to DOE
12:00 p.m.	Wrap up - Action Items - Adjourn