Methane Hydrate Advisory Committee (MHAC) Meeting
Houston, TX
November 8–9, 2006
Meeting Minutes

Executive Summary

The entire committee met to provide advice on the October 2006 draft of the five year plan for methane hydrate development. A committee listing with visitors is provided in Appendix A.

On November 8 we heard reports from 1) the BP Milne Pt. hydrate project, 2) the Chevron JIP Gulf of Mexico project, 3) the Hydrates Fast Track meeting, 4) the MBARI Barkley Canyon Expedition, 5) the Indian Hydrate Expedition, and 6) the Inter-laboratory Hydrate Workshop.

The above six presentations provided six indicators of progress:

1) BP will drill at Mt. Elbert, at Milne Pt. probably in February 2007.
2) The Tiger Shark site is most likely for Phase 2 of the Gulf of Mexico Chevron JIP.
3) The Fast Track meeting reached consensus that it should be determined by 2011, whether hydrates can be a viable commercial resource.
4) Barkley Canyon deposits represent the largest ocean hydrate sweet spot found to date.
5) The 113.5-day Indian Hydrate Expedition represents one of the best exemplars of international cooperation, leveraging and advancing the US hydrate experience base in the ocean environment.
6) The inter-laboratory hydrate workshop had six summary recommendations listed in Appendix B for the way forward.

The main part of the meeting was organized to provide feedback to the Interagency Technical Coordination Team (TCT) on their October 2006 draft five-year plan, which was derived from the 20 year, long range Roadmap, approved at our last meeting in April 24-25, 2006. The TCT chair requested feedback to enable a subsequent draft, which will be considered by the committee in their next full meeting on April 24-25, 2007 in Golden, Colorado.

Rather than critique the individual projects and components in the 5-year plan, the committee elected to provide overall advice on the way forward by stating one overall goal in each of three areas: (1) permafrost-associated hydrates (2) marine hydrates, and (3) environmental hydrate concerns. The individual projects in the 5-year plan should be shaped by the program manager, using the goals and strategies detailed in Appendix C. In brief, the three area goals are:

1. Permafrost-Associated Hydrates: Perform a series of production tests to prove the viability of sustained methane disassociation from permafrost-associated hydrates under multiple production configurations. Perform these operations in a diverse set of hydrate occurrences and as soon as technically feasible.
2. Marine Associated Hydrates: In order to determine commercial viability in 5 years – develop and verify exploration models, e.g. the MMS model and the Kleinberg dyke-fracture model. In other words, identify that the resource actually exists.

3. Environmental Aspects of Hydrates: The goal is to address issues of slope stability, sensitivity to global change, and environmental impacts associated with production so that the promise of hydrates as a significant energy resource can be fulfilled.

It is clear that the permafrost hydrates state-of-the-art is in an advanced state of development, relative to marine hydrates. Permafrost hydrates are ready to go forward with production test scenarios, while marine hydrates need better remote exploration tools. Environmental concerns have moved beyond the Clathrate Gun hypothesis to a concern for physical stability - in terms of slumps and slides on the seafloor, which may be combined as a part of marine concerns.

Regarding future interactions of the committee, four items were decided.

1) We will look into the possibility of a North Slope visit for a subset of the committee.
2) We will attempt to coordinate an educational meeting with the Secretaries of Energy and Interior, coincident with a Congressional educational meeting and perhaps the awarding of the first DOE Hydrate Fellowships, for a subset of the committee.
3) Nader Dutta will summarize hydrate activities of other nations to determine what should be our next steps for international involvement.
4) The draft of the hydrate segment of the unconventional oil and gas portion of the National Petroleum Council report will be reviewed by a subset of the committee, at the discretion of the report's author, Bob Kleinberg.

We adjourned our meeting at Noon on Thursday November 9, with the chairman's expression of appreciation for the intellect and effort of the Methane Hydrate Advisory Committee members. Dr. Dutta conducted a tour of the Schlumberger Q facility after the conclusion of our meeting.

Minutes

Wednesday, November 8, 2006

Chairman Dendy Sloan and Designated Federal Officer (DFO) James Slutz – Welcome and Introductions

The MHAC meeting convened at 8:00 AM at the Marriott West Loop Hotel in Houston, TX on Wednesday November 8, 2006. MHAC Chairman Dendy Sloan welcomed the members and introduced the DFO James Slutz, Deputy Assistant Secretary (DAS) for Oil and Gas. Mr. Slutz welcomed and thanked the members for their participation and commitment to the committee. Chairman Sloan asked the members and other attendees to introduce themselves before proceeding (Appendix A contains the attendee list).

After the introductions, Chairman Sloan emphasized that the task of the committee is to provide advice to the Department of Energy (DOE) on methane hydrates. He reviewed the two-day agenda and summarized that the committee is building towards making recommendations to the *Interagency Five-Year Plan for Methane Hydrate Research and Development* as established in Section 968 of the Energy Policy Act of 2005. Additionally, the committee should consider ideas for possible meetings with the Secretary of Energy, Secretary of the Interior, and Congress.

- The committee concurred on the agenda and Chairman Sloan asked Hydrates Program Manager Edith Allison and Trudy Transtrum of DOE to review a few logistical issues.

Chairman Sloan then introduced the first presenter, Bob Hunter, of ASRC Energy Services.

Mr. Bob Hunter, ASRC Energy Services – Characterization and Appraisal of Alaska North Slope Gas Hydrate Resource Potential

Mr. Hunter's presentation was on the DOE-BP Cooperative Gas Hydrate Project on the North Slope of Alaska. He provided a project overview, information gained from the resource characterization and reservoir modeling, information on the stratigraphic test program, and preliminary conclusions.

This project has the goal of assessing the ultimately recoverable resource potential of gas hydrates and associated free-gas accumulations in northern Alaska, first focusing on the Eileen and Tarn accumulations and building up estimates based on studies of these formations. There are three phases to the project:

- Phase 1: Compile and assess existing data
- Phase 2: Assess regional reservoir modeling
- Phase 3: Acquire well data, and if approved by industry, move forward with additional data collection and a production test.

The project is currently in Phase 3, having completed the first two phases in FY 2003–FY 2005.

Mr. Hunter proceeded to describe the resource characterization and reservoir modeling performed by the project. He provided a significant amount of detailed information on the characterization and modeling efforts. The project team adapted industry-standard reservoir models to gas hydrate phase behavior. The model used was developed by the Canadian Model Group and is called CMG-STARS. The reservoir modeling effort studied pressure response variables, evaluated possible analogs, and expanded to a regional schematic model.

There are numerous uncertainties regarding gas hydrate resources, such as rates of dissociation and production, rates of associated water production, permeabilities, saturations, endothermic effects of production, and production technologies. The Stratigraphic Test Program is one way to help mitigate some of these uncertainties and is currently the main area of focus for the project. Mr. Hunter presented several slides on the stratigraphic test well plan, showing various seismic data and mapping and pictures of the test site. The Mt. Elbert-01 Data Acquisition well is scheduled to be drilled in January–February 2007. The well cost for this is approximately $5 million.

Preliminary conclusions from the project indicate that the Alaskan North Slope (ANS) gas hydrate-petroleum system has complex shallow structure and stratigraphy. Theoretical modeling results to date identified a potential resource of 33 trillion cubic feet (TCF) of gas in place in the Eileen trend, with potential recovery of 0–12 TCF. Uncalibrated model production rates indicate possible production between 0–2 million standard cubic feet per day (MMSCFD) per well and

would take decades to recover the estimated ultimately recoverable (EUR) gas resource. Mr. Hunter clarified that the regional modeling schematic showed potential production of 10 MMSCFD, but the 2 MMSCFD data is based on numerical data and is therefore a more accurate number. The purpose of the regional modeling was to show water mobility characteristics.

Recommendations to date include continuation of the Phase 3 stratigraphic test to delineate the Mt. Elbert intra-hydrate seismic prospect, acquire static data, calibrate development models, and evaluate the data and results. Ultimately, a decision will need to be made on whether to proceed with a well test program or close out the project.

Several questions were asked and comments made during Mr. Hunter's presentation. A comment was raised that a potential recovery range of 0–12 TCF was too broad. Mr. Hunter said that much depends on the permeability and saturation of the formations and that the modeling was based on static core and log data. A follow-up question asked what would be the most likely production level from this range. Mr. Hunter replied that there were too many uncertainties to define a most likely production level, and that more data and production testing are needed to narrow the range. He noted that studies are being performed by the University of Arizona to refine volumetric data and analysis, but the stratigraphic and structural complexity of the reservoir can complicate potential production development.

A question was asked regarding what gas price is required to break even on hydrate development for this project. Mr. Hunter noted that the project performers have not worked on the economics and that it would be a resource producer's decision to proceed. It was asked what difference/variability would be seen in the production range and rates if data was inputted to the two models CMG-STARS and ToughFX. Because so little data exists, both models were fit to the small amount of data and hence, both models would give approximately the same answer.

It was asked whether there was any chance for a longer-term production facility at a similar site. Mr. Hunter replied that the project team reviewed the possibility of a short- to medium-term test, but based on data of such a test with rig on and rig off, they decided not to do a production test. However, depending upon the results of the current tests, a production test may be a follow-up activity. Regarding a potential production test, the question was asked if there are any resource limitations, notably infrastructure. There are no perceived resource limitations, but time is important for developing ice pads, ice roads, and other considerations necessary for working in an arctic environment. A long-term production test could be handled with regular production from nearby wells using industry best practices. It was suggested that this project needs to move to a production test to take advantage of all of this project's data and information.

Finally, several questions were raised relating to challenges with wireline logging and mud-chilling and core pressurization. Mr. Hunter noted that there is not expected to be any significant filtrate invasion and that oil-based mud gives more flexibility and will help improve data quality. Regarding core pressurization, the core sample is not pressurized, but wireline retrievable core can be brought to the surface very quickly, minimizing on-site data analysis so they can continuously take core samples.

Dr. Ray Boswell, National Energy Technology Laboratory – DOE/Chevron Gulf of Mexico Gas Hydrates Joint Industry Project (JIP)

Dr. Boswell presented information on the DOE/Chevron Gulf of Mexico JIP. The JIP objectives, which include several large oil and gas and industry service companies in addition to participation by various institutions, are to develop technology and data to assist in the characterization of naturally occurring gas hydrates in the deepwater Gulf of Mexico. The project is currently in Phase 2b which will evaluate/publish JIP findings through the first field test program, and improve capabilities and prepare recommendations for an additional field program. Phase 1 gathered existing data, selected drilling/coring sites, conducted pre-cruise seismic estimates and laboratory investigations, and developed new field testing equipment. Phase 2a conducted drilling/logging/coring operations. Phase 3, which is slated to begin in 2007, will conduct further drilling/logging/coring operations.

The JIP's findings to date include:

- Subsurface fine sediment hydrate poses a minimal drilling hazard
- Hydrate occurrence is linked to reservoir quality
- Limited areal influence of focused flow features
- Potential for viable remote detection and quantification of marine hydrates confirmed
- Depressurization affects critical properties in a meaningful way
- Soft sediment wellbore stability model performed well

Current activities of the project are focused on:

- Reporting on Phase 2 activities
  - 20 publicly available publications, 47 oral/poster presentations since 2001, several upcoming articles and reports, and cruise report on DOE Web site
- Development of new pressure coring tools
  - Negotiating a subcontract, reported good performance in sandy (thinly interbedded) sediments, redesigned tool that is more robust with a design due in January 2007 and field test in the fall of 2007.
  - Dr. Boswell commented that he did not know if the pressure coring tool under development was being specifically designed to improve data acquisition in sandy sediments and that the Georgia Institute of Technology (Ga. Tech) Instrumented Pressure Testing Chamber (IPTC) tool has shown the ability to analyze cores in hydrate-bearing sand.
- Testing/enhancing pressure core analysis capabilities
  - testing on the India Natural Gas Hydrate Program (NGHP) Expedition-01 (Exp-01) pressure cores and additional enhancements in conjunction with Georgia Tech
- Review of potential locations and operational plans for Phase 3 field activities
  - Have developed site selection criteria and performed initial site screening for field test
  - Alaminos Canyon Blocks 818 and 857 are potential opportunities
- Membership
  - Mexico, South Korea, and Shell have shown interest in joining

In conclusion, Dr. Boswell highlighted the educational support through the JIP, noting that 14 Ph.D. candidates, post-doctorates, and master's degree students from five universities are involved.

A question was asked whether the seven site locations evaluated were all Chevron sites and did the JIP have access to each of those sites. The sites were recommended by the Minerals Management Service (MMS) at the May meeting and the JIP did not have access to all of the sites. The JIP was more focused on geology and would worry about site lease and access later.

A concern was raised that the use of resistivity for site selection may not be as good an indicator as looking at sands in the stability zone because something other than hydrocarbons could give resistivity. There is a need for other logging data if using resistivity. An alternative method for site selection suggested was to pick a sand formation that is wet or gas-bearing and target it in an up-dip position within the hydrate stability zone. It was noted that the attempt was to find something that was not ambiguous for the site selection and that additional sites after Block 818 will be evaluated afterward.

Regarding Alaminos Canyon Block 818, it was asked whether seismic data was available to determine areal extent of Block 818. Mr. Boswell commented that this was in progress. Another comment focused on the extent of the hydrate stability zone in Block 818. The JIP program is moving forward on an evaluation of the site to determine this as well.

Additional questions were raised related to administrative and management details of the project rather than technical. It was suggested that India be invited to join the project but it was thought that India believes the participation of Reliance of India indicates India's participation. Mr. Boswell was optimistic that the 2007 drilling plan would occur. A question was asked on funding for the drilling test. Currently the House and Senate have budget marks of $12 million and $17 million respectively, for the Hydrate Program but the amount for the drilling test is dependent upon the vessel, equipment, and other criteria. It was noted that the Alaska project is not dependent upon FY 2007 funding. Dr. Boswell highlighted that in the business scope of the JIP, they have moved from safety issues regarding hydrates to hydrates as a resource and targeting hydrates in new lithology. It was suggested that this project has uncovered the best evidence of hydrates in the Gulf of Mexico and that the data set could be used in comparison tests of various models and eventually compared to an actual production test. It was noted that such a code-comparison effort was underway.

Dr. Nader Dutta, Schlumberger – Report on Fast Track Subcommittee Meeting and Discussion of Recommendations

Dr. Dutta reported on the Fast Track Subcommittee's New Orleans workshop. His presentation began by outlining the potential reasons for fast-tracking exploration and production (E&P) of gas hydrates. He presented several slides related to world oil and gas supply and demand and gross domestic product (GDP), and posed several thought-provoking questions, such as:

- Are we serious that gas hydrates are very important to solving our energy demands?
- What are we doing about it other than spending a meager amount on research and development (R&D)?

Another issue was the pace of the current Interagency Roadmap for Methane Hydrate R&D and whether it was appropriate given supply and demand issues, the state of technology, and international efforts. The objective of the workshop was to deliver a list of recommendations that provide a way forward on three action items:

- Identification and quantification of resource potential
- Increase awareness of urgency (industry, Congress, etc.)
- Way forward on fast track production tests (industry, government, etc.)

The workshop had 15 participants from industry, 7 from academia, and 9 from government. The workshop had a high level of commitment from all participants and the workshop participants also learned that Japan is planning an extended production test this winter in Canada (Mallik) and India plans a pilot production test offshore in 2008. Participants were divided into two teams: Red and Blue. Two questions quickly arose at the workshop, with disagreement on both issues between the two teams:

- Is gas supply going to be a significant problem within 5–10 years?
- Is it reasonable to expect that gas hydrates could contribute to supply in sooner than planned by the (DOE) roadmap?

The Red Team's view was that gas supply is not a big problem in the near term and that many believe that the gas hydrate development plan described in the Roadmap is reasonable. The Blue Team had a different view that the United States has been lulled into a false sense of security by warmer than average temperatures and a lack of disruption from hurricanes. The decline in U.S. gas production is far steeper than predicted, there is diversion of Canadian gas for heavy oil projects, and LNG is not living up to forecasts. There was agreement between the Red and Blue Teams on the issue that an answer is needed within five years about whether marine gas hydrate is viable as a commercial resource. The workshop attendees developed a plan with five strategies and subsequent action items to move forward quickly if gas production from hydrate is needed. The five strategies are:

- Develop a plan for offshore production testing now
- Carry out production tests with foreign governments who are willing to share and cooperate — accelerate the U.S. program this way
- Expedite off-shore drilling with gas hydrate as a resource in mind
- Solicit active industry participation to develop this resource
- Increase Congressional awareness of the need for gas hydrate exploitation as a national energy security issue of no less importance than homeland security

Some final questions from the workshop were:

- Do we believe current estimates of on-shore and offshore gas hydrate resource?
- Why is it that India and Japan think that the issue is about "production and engineering" and further that India can have offshore pilot production test in 2008 but the United States needs more time? It was noted that while India may be moving ahead with an initial production test in 2008, the U.S. timeframe of 20–30 years refers to the culmination of a series of tests and exploratory campaigns designed to determine the magnitude of the nation's recoverable hydrate resource, not simply establish its recoverability

- Why is it that the largest democracy on Earth (i.e., India) can spend $37.7 million during 2006, but the wealthiest democracy (i.e., United States) can not?

A question was asked on why the United States is not involved in the Japan test with Canada. Group discussion on this question focused on the following key issues:

- For the United States to have participated, it would have required $30–40 million in funding, which far exceeds the total program funding
- Japan requested confidentiality for the project and made a business decision that it was in their interest to proceed bilaterally with Canada rather than through a consortium. Japan has information and knowledge they wish to protect. There are plans for interim publications of project information and data will be available a few years after the end of the project.
- It was noted that Japan and India have a more urgent need for energy resources, and therefore have an incentive to move forward with a different approach than the United States. However, a comment was made that it may not be in anyone's best interest to take a unilateral approach to development of gas hydrates since there is still much to learn, particularly whether gas hydrates are a viable resource.

It was suggested that there is a need for more fundamental and reliable modeling to determine the resource base. This would be helpful in convincing others of the value of the resource, including Congress. A comment was made that the fundamental issue of production lead times are not well understood.

Dr. Ray Boswell, National Energy Technology Laboratory – Update on DOE Graduate Fellowship Program

Dr. Boswell presented a brief presentation on the DOE Graduate Fellowship Program for methane hydrates. First, he cited that DOE has on-going commitment to sponsoring education efforts. Past efforts have supported 100 students at more than 30 universities and research institutions, with the major field programs acting as a major source of program support to education.

In FY 2007, there will be a newly dedicated Fellowship Program. The Program will be managed by the National Academy of Sciences (NAS) and will have four two-month open periods. The first period will be open in December 2006–January 2007. A panel of NAS members will screen applications and provide recommendations to NETL, with final selection through consultation with the interagency group members. The fellowships are open to U.S. citizens and will be for two years at the master's, PhD, or post-doctorate levels. Projects for the fellowships will be selected by merit of the proposal, mentor, university doing the work, and potential to meet program goals. Competitive stipends will be included as well as travel funds and expenses for equipment, ship time, or other expenses deemed necessary. The applicants choose the mentor and research institution. DOE has set aside $450,000 from FY 2006 funding for the Fellowships. The goal is to have four people working at any one time, typically rotating two new fellowship awardees each year, with two graduating.

A concern was raised about how to handle the issue of a two-year fellowship when many PhD students do not acquire their PhD in two years. Dr. Boswell responded that two years is a typical

time period for similar NAS fellowship programs so this appears to be fairly standard practice and should not be a concern. A question was asked as to how it was determined to select two awardees each year. These fellowships are considered prestigious and therefore the number of awardees is limited. Allowable budget requirements also need to be considered. It was also noted that there are still other projects that continue to support students. It was suggested at the April 2007 MHAC meeting that the supply and demand for the fellowships be reviewed.

A second concern was raised about whether master's students should be considered for the fellowships. It was answered that the program is also charged with supporting students who wish to join industry, and that there are likely to be qualified, non-PhD-track candidates in technical engineering programs that could benefit. This was an issue that could be evaluated further.

Dr. Edward Peltzer, Monterey Bay Aquarium Research Institute (MBARI) – MBARI Barkley Canyon Expedition August 2006

Dr. Peltzer presented findings and information from MBARI's Barkley Canyon Expedition in August 2006. He provided information on funding for the project, the research team, and a history of Barkley Canyon hydrates. The objectives of the expedition were to perform autonomous underwater vehicle (AUV) surveys and gas hydrates studies, particularly visual inspection, in-situ laser Raman spectroscopy, collect samples for post-cruise analysis, and perform in-situ dissolution and CO_2 experiments.

Dr. Peltzer provided some details on the AUV mapping survey and the remote operating vehicle (ROV) operations. He provided video highlights of the expedition to present an overview of the occurrence and formation of methane hydrates in Barkley Canyon and to illustrate the capability and operations of the ROV.

The video showed the size of the various mounds and a large exposure of hydrate which was yellowish in color due to oil-stained deposits. Underneath the yellow hydrate was white hydrate. The video showed the ROV performing various functions, including:

- Taking core from white deposit and ejecting into gas chamber
- Heating seawater to decompose hydrate. During this test, a layer of yellow oil formed at top from yellow hydrate.
- Taking samples of undisturbed hydrate and gas sample of hydrate after it is gasified
- Collecting some samples and bringing them to the surface at pressure
- Attempting to replace hydrate with liquid CO_2. The CO_2 was injected into the layer of white hydrate

Dr. Peltzer showed the results of the analyses, such as spectra of both the yellowish and white hydrate from the analyses of Keith Hester at the Colorado School of Mines. The spectra of the yellowish hydrate were much different than that of the white hydrate, with both being thermogenic with amounts of methane, ethane, and propane. However, the yellow hydrate had methane that was predominantly in small cages, similar to that for the white hydrate. The set-up of seafloor experiments and dissolution rates for the yellowish and white hydrate were also presented. The white hydrate dissolution rate was twice as fast as the yellowish hydrate.

The MBARI project concluded that:

- Laser Raman spectra is a useful tool for determining the composition of gas hydrates exposed on the seafloor
- Hydrate dissolution is a rapid process suggesting young outcrops and transient features
- ROV-based CO_2 substitution can be conducted with reasonable chances of observing a compositional change, with more results in a few months

It was suggested that the "biotic mat" may have an effect on the dissolution rate. The biotic mat may shield it from the ocean current but is using methane as an energy resource. It is expected that the mat would decrease in size in this case.

A question was raised as to how the methane hydrate formed in this area and why it is disappearing. Mr. Peltzer noted that they did not observe any gas emissions but the hydrate could be emitting intermittently. There could also be active gas venting through the hydrate but it might be very slow. He commented (I think this was Brewer talking) that it is highly unlikely that the researchers are privileged observers at a point in time and that the hydrate must be occurring somewhat frequently.

Dr. Tim Collett, United States Geological Survey (USGS) – Report on India Expedition

Dr. Collett provided a report on a recent expedition between India and the United States along the east and west coasts of India. The expedition had an overall goal of assessing the natural gas hydrate resource potential off the coast of India and also to investigate the fundamental science of the formation of natural gas hydrate in marine sediments. Dr. Collett indicated that the USGS and India government partnership started with the Mallik project in 2002. However, in December 2005, a ship "the Resolution" became available so the USGS and India quickly put together a research group. The bulk of program funding was provided by the government of India, however, the project received supplemental support from DOE-program funding to the Idaho National Engineering and Environmental Laboratory (INEEL) –$100,000; Pacific Northwest National Laboratory (PNL) – $200,000; and USGS – $50,000. More than 40 Indian scientists were on-board the ship in partnership with American and international researchers. Mr. Collett indicated that the atmosphere was very collegial among the different researchers and that a very important aspect of the project was that the crew all had extensive IODP cruise experience and therefore did not have a learning curve.

Dr. Collett outlined the various research equipment on the expedition ship, which included laboratories to conduct physical property measurements, sedimentation analysis, organic and inorganic chemistry analysis, and microbiology studies. Additionally, the ship was outfitted with numerous tools such as an advanced piston corer; extended core barrel; temperature tools; logging while drilling (LWD), measurement while drilling (MWD), and vertical seismic profile (VSP) tools; and other equipment. The expedition spent 113 operation days at 21 sites that were established during NGHP Exp-01. Of the 113 days, 19 days were spent in port, 24 days in transit, and 70 days spent on-site. The expedition recovered about 3,000 meters (M) of core with a 78.7 percent core recovery rate and 50.5 percent of the cores received under pressure.

The key scientific highlights of the expedition to date are:

- Conducted comprehensive analyses of gas-hydrate-bearing marine sediments in both passive continental margin and marine accretionary wedge settings.
- Gas hydrate discovered in numerous complex geologic settings and an unprecedented number of gas hydrate cores were recovered (2,850 meters of core were recovered).
- Delineated and sampled one of the richest marine gas hydrate accumulations yet discovered at Site 10 in Krishna-Godawari Basin, with a hydrate thickness of 120 meters.
- Discovered one of the thickest and deepest gas hydrate occurrences yet known: Site 17 in the Andaman Islands revealed gas-hydrate-bearing volcanic ash layers as deep as 600 meters below the seafloor.
- Established the existence of fully developed gas hydrate system in the Mahanadi Basin of the Bay of Bengal (Site 19).
- Demonstrated the utility of advanced logging-while-drilling operations in high-grading potential sites for later coring operations.
- A series of significant advances in IR imaging and pressure coring data acquisition and analysis techniques.

Next steps include government and industry focusing on integrated research, development, and testing of gas hydrates as a necessary pre-cursor to commercialization. Additional activities such as expanded seismic data collection and other information are needed. A conference will be held in January 2008 on the scientific results and the results will be published in August 2008.

A question was asked regarding why India was willing to share information with the United States, since Japan has taken an approach to move forward unilaterally. The response was that the Indian government is willing to admit what they do and do not know regarding hydrates in the marine environment. India does not have the hydrate research background. Japan was in the same position in 1998 and now has taken a different pathway.

It was noted that it is difficult to define mutually beneficial goals on bilateral agreements, but this project with India was a natural fit. The fact that the United States and India have a bilateral agreement helped set ground rules and open dialogue for a project such as this to occur.

Several comments were made that highlighted the approach and other benefits of this project:

- Researchers cannot assume that these are the same reservoirs as drilled in the Gulf of Mexico. The researchers approach to assume little knowledge about the resource in this area based on past efforts in the Gulf of Mexico was considered to be a good approach. Additionally, if hydrates are developed, they will not use the same regulatory structure that has been used for a long time. It was noted that not much is known about the resource but the fact that it is biogenic gas means it could be a renewable resource. Others in the group pointed out that biogenic gas is not generated at fast enough rates to be “renewable”.
- This expedition can be used as a model because the project had an experienced crew, the right tools, could sample when they wanted, and had the willingness and resources.
- It was noted that if we have funding to do one project properly or four projects half-way, it would be more beneficial to do one project. Some members relayed their experience that some cruises/projects eventually cost more that they should due to lack of experience and

other challenges. Additionally, this brought up a broader issue regarding project funding (i.e., should you spend $50 million for 10 years, or $10 million for 50 years?).

The next series of questions focused on geology, geochemistry, and geophysics integration as they relate to India and marine gas hydrates. Dr. Collett noted that the project team proceeded with the assumption that sand reservoirs are the most favorable reservoirs for future production, and still believes that is the case. However, fracture and fault systems should not be discarded or ignored. It is necessary to understand the system and put it in a geologic context. Additionally, three-dimensional (3-D) seismic is being used. A comment was made that most of the places examined in India as part of this expedition did not have much sand. Dr. Collett stated that the sand in some places was 1 – 1.5 meters thick. A follow-up question asked how the gas moved to a hydrate stability zone. This typically occurred through diffusion in water where it comes out of solution and forms a high concentration of hydrates.

The focus of the discussion shifted to what motivates countries when it comes to pursuing methane hydrates. It was noted that some countries, such as Japan, are highly motivated in developing methane hydrate resources because of national policy, priority, or the need for more energy. In the United States, some may have the viewpoint that we are not in a crisis mode regarding our natural gas situation, so development of hydrates is not a wise way to spend funds. However, Japan is highly motivated because of their energy situation and is testing technology in a marine environment which intersects with Canada's interest in the Mackenzie Delta. It was pointed out that while it is important to realize and understand a country's motivation and that it could mean they pursue development without close collaboration, it does not mean the United States should cease communication. There may be some common goals or other items which could cycle back and assist in future efforts.

A comment noted that while there is a technical level to interactions, there needs to be a framework to resolve issues, such as import-export rules to bring tools aboard ships. The political framework, such as bilateral agreements between the United States and India was helpful in creating high-level dialogue to move projects forward and the value of sharing information and participating. It was mentioned that the Asia Pacific Partnership has a methane hydrate component and could be another mechanism for international cooperation. A concern was raised that while international cooperation and participation is important due to synergies and value added by participants, a large international consortium to address everybody's issues could be too cumbersome an approach.

It was suggested that a consortium between the United States and India could be formed. It was mentioned that the United States and India are in the process of establishing a Memoranda of Understanding (MoU) for a production test. India has the motivation to develop gas hydrates to meet their energy needs; the United States has experience that could be leveraged by India at a production test where the United States could also gain valuable experience.

Some other comments and questions noted that the $36 million spent jointly on this project was probably a bargain, considering the data, information, and experience acquired. It was noted that India does not have a timetable for a production test.

Discussion of the Role of International Cooperation in the Program

The discussion of the USGS-India project led to a broader discussion of international cooperation in the DOE program. It was mentioned that a fully funded DOE component in international cooperation would be beneficial. A comment was made that there needs to be a move from technical issues to broader issues for methane hydrates development to move forward. For example, linking hydrates with climate issues such as gas venting or sequestration could be useful. It was thought that more public relations were needed on methane hydrates and that the video shown earlier by Dr. Peltzer of MBARI is an excellent opportunity to present the challenges of hydrate resource characterization and development.

A concern was raised about U.S. motivation when it comes to international cooperation. There was a concern that the United States should not be giving technology away to foreign competitors and that, from a business perspective, if you prove a resource that you do not own, it could damage your own company's business. Several comments were made that highlighted the benefits of collaborating internationally:

- Collaboration could lead to a quicker answer about how to detect hydrates and how to produce at less cost than pursuing independently.
- Other countries are putting more resources into methane hydrate development, so it is a way for the United States to leverage funding.
- Collaboration could foster stronger diplomatic relations with India or others since companies are not strongly motivated at this point to develop hydrates.
- Allows testing of technologies developed by the program that may not otherwise have occurred.
- Since hydrates are distributed throughout the world in a manner different than other resources, development of resource in places such as India, with the potential for large energy requirements in the future, could enhance the energy security of the United States.
- Methane hydrates are part of more global issues, so scientific exchange and collaboration with international partners is valuable to U.S. policy.

It was suggested that while some countries, such as Japan, may be taking a more unilateral position to methane hydrates development, they probably do not know all the answers to overcome the issues surrounding development, so it would still be beneficial to continue to hold discussions because political changes may alter the situation. For example, the political change in Japan resulted in new program managers which led to their decision not to coordinate on the next phase of the Mallik project.

A question was asked as to where Russia stood on methane hydrate development. It was noted that the official position is that Russia has so many conventional gas resources that hydrates are currently not a potential production option. However, Russia is expanding into areas overlaid with hydrates so they are starting to look at characterization of hydrate as a predictable resource. It was noted that Russia will not spend any funds on drilling a well, and that their political climate at the moment does not make it practical to pursue any opportunities. However, there could be cost benefits because of their structure.

Chairman Dendy Sloan, Colorado School of Mines – Report on the Inter-laboratory Meeting

Chairman Dendy Sloan provided a summary of the Inter-laboratory Hydrate Meeting which was held September 19–20, 2006 in Golden, CO. The meeting drew 47 attendees from national laboratories, USGS, universities, and private laboratories. The focus was on energy production and how to use the scarce amount of resources available to avoid duplication of efforts. Six plenary addresses were used to set the stage for the discussion:

- From the field: needs including sampling and geophysical logging
- Material property needs for models of extraction
- Hydrate-sediment geomechanics and what do we need to know
- A review of the fast-tracking hydrate meeting and the science needs and applications
- Hydrates in sediment systems and synthesis, standards, and property needs
- Hydrates in Barkley Canyon

Six major recommendations from the meeting were:

- Develop sample testing/preservation standards and comparisons between laboratories
- Test rock-physics theories and measure hydrate-sediments properties aligned with energy recovery
- Develop accurate logging model for remote detection of hydrates in porous media
- Refine core preservation and measurement methods at situ conditions
- Continue the model code comparison activity
- Verify the models via long-term field tests and meso-scale tests

Five sub-recommendations for the laboratories were:

- Optimize natural specimen preservation
- Describe hydrate-sediment interactions
- Develop method comparisons
- Needs such as heat capacity, permeability, and capillary effects
- Identify data gaps with a focus on methane (not mixture) hydrates in sediments

Three sub-recommendations for the field were:

- Logging needs such as resistivity logging and account for anisotropy
- Pressure coring is a critical issue
- Next generation cores

Five sub-recommendations for models were:

- Continue code comparison activity to identify the most reliable code that can be used by industry
- Meso-scale production simulations
- Pursue expanded sample ranges
- Address code efficiency and user accessibility
- There is a need for a production test of 6–12 months

Chairman Sloan asked those who attended the inter-laboratory meeting to make any additional comments to expand upon his presentation. Some of these comments were:

- One or two laboratories are doing synthesis of sediments because they have such a heterogeneous mixture
- Anisotropy is important because the properties in the layer of rock will not be the same vertically as horizontally and there is a need to account for this
- Incremental improvements on coring devices are necessary but we will need to rethink how we are doing coring and what is really needed to collect and analyze the core in 5-10 years. A concern was raised if anyone really trusts the information from the current core sampling methods because slight errors could have big implications.
- Difficult to transport pressure coring samples around the country because of greater security due to terrorism threats.
- DOE is actively implementing findings that came out of this effort by placing more emphasis in geomechanics, devices, and key parameters for measurement.

A series of follow-up questions and comments covered a variety of topics. One comment encouraged collaboration with international institutes. Other comments focused on technical issues dealing with samples and cores. One person commented their project is focusing on synthetic samples and depressurization and that if successful, will provide a better understanding of hydrates in the dissolved phase. A post-doctoral project is investigating the advantage to a system that would bring samples up to the seafloor and measure in-situ at the bottom of the watercolumn.

Dr. Ray Boswell, NETL – Introduction of Draft Five-Year Plan

Dr. Boswell made a presentation on the *Draft Interagency Five-Year Plan for Methane Hydrates Research and Development*. He noted that the MHAC has the responsibility to develop a report to Congress on the five-year plan. The five-year plan is set within the context of the Interagency Roadmap which has a timeline of 20 years. The five-year plan sets 74 specific near-term milestones for on-going activities, describes new initiatives that should be started in the near term, helps align activities with collaborating agencies, and communicates near-term plans to a broader community.

Current program activities and planning assumptions were presented. The planning assumptions assume that funding is consistent with authorized levels, reflects the desire to continue an approach to seek alignment between federal and private goals and recognition of the need to pursue alternative means to achieve the goals, and DOE's role in using the Methane Hydrates R&D Act to achieve the Act's goals.

Dr. Boswell highlighted the long-range 2015 and 2025 goals of the program and the structure of the five-year plan. The remainder of the presentation focused on the key milestones for the major issues in the plan, which are: data management, assessment/characterization, production technologies, exploration technologies, field analysis tools, simulation, geological/environmental processes, international, education/training, management, and outreach. The challenge is to

determine if the milestones for these activities keep the program on track to accomplish the goals of the Methane Hydrates R&D Act.

Following Dr. Boswell's presentation, discussion ensued on the five-year plan. One general comment was that this version of the five-year plan appeared more aggressive than past versions but it may lack focus. There was concern about whether any hydrate would be produced within five years. It was noted that the five-year plan and 20-year roadmap push the program forward and offer points for correction along the way. Others had concern that the plan diversifies a program that is too thin on resources.

Since the five-year plan builds upon and supports the 20-year roadmap document, some discussion focused on the goals and milestones of the 20-year roadmap since it influences the five-year plan. Dr. Boswell commented that the planning process started with formulation of the long-term goal and linking it to the milestones. Some members liked the timeline aspect and Gantt charts shown in the 20-year roadmap and thought it was very useful and suggested inclusion of some way to cross-organize the milestones on a timeline in the five-year plan. There was some concern raised that the 2025 milestone/goal of demonstrating technical recoverability could be earlier, given the fact that India and Japan are already pursuing production tests. It was noted that the plan's focus is on U.S. resources and that the 2025 date relates to assessment of the U.S. marine resource of hydrates. Another concern was that some of the 74 milestones in the five-year plan may be redundant and that we may get answers from projects conducted by India if we wait. This was thought to be true for generic technological questions, but the purpose is to prove U.S. resources, so there are unique aspects. It was suggested that those milestones or technologies that are considered high priority be coded or highlighted in the plan.

There was also some discussion on the technical components of the plan. Some thought that exploration needed more emphasis and should be stated clearly upfront in the plan. Another comment was that the resource could be underestimated because there is not a good correlation between standard tools. There was also some concern regarding sands selected as a primary focal point but there is also hydrate in other forms such as shales. It was suggested that focus should be on producing on-shore resource such as those in the Arctic where more proven technologies are available, and continue to research marine resources. It was suggested that as many exploration models should be tested as possible to find several valid models and rule out some possibilities. Another suggestion was to add market-based incentives to the plan to motivate those who have access to hydrate resources to produce them. Additional questions on the plan focused on terminology, specifically what is defined as a resource, occurrence, or reserve. It was thought that the terms may be causing confusion.

At this point, Chairman Sloan suggested that those who have not had a chance to review the plan do so that evening prior to the next day's meeting. His plan for the next day was to have the committee break into three groups based on the breakout in the 20-year roadmap (i.e., arctic resource, marine resource, and environmental) and develop comments. Others commented that the committee's role is to review the plan and identify if anything is not included, ensure dates are appropriate, determine which actions should receive higher priority, and re-assess the goals for 2015 and 2025 and their appropriateness. It was suggested that the plan be viewed as a

starting point and that the committee also review the fast-track meeting recommendations and consider them. Chairman Sloan announced that the meeting would start at 8:00 AM the next day in Salons A&B and adjourned the meeting at 5:10 PM.

Thursday, November 9, 2006

Discussion of Five-Year Plan

MHAC Chairman Dendy Sloan re-convened the meeting on Thursday, November 9 at 8:03 AM and noted that DFO James Slutz delegated authority of the DFO to Edith Allison, Hydrate Program Manager. He continued by making a brief presentation stating that the focus of the meeting will be the five-year plan. He encouraged the MHAC members to think about what are the end goals for the nation in dealing with hydrates. He outlined the following tasks for the rest of the meeting:

- Hear the National Petroleum Council (NPC) report on oil and gas
- Attempt to frame the five-year plan to answer the fast track sub-committee questions "Will hydrates be a viable commercial resource and how can hydrates as environmental concern be addressed?"
- Set dates for future meetings

He encouraged the members to consider how they would manage the program when developing their comments and recommendations and to also consider international collaboration.

Prior to the discussion of the five-year plan, a question was raised concerning the designation of committee members as Special Government Employees and their ability to make recommendations and statements regarding the plan. Acting DFO Edith Allison noted that there are two kinds of participants — a representative and a Special Government Employee. The difference is that Special Government Employees must have full financial disclosure. She mentioned that committee members are free to discuss topics of interest and are encouraged to do so, but they cannot make formal recommendations on their own projects. A basic rule of thumb is that committee members should not take advantage of their position to provide themselves a financial advantage. Providing information on their specific projects is encouraged but they should not make recommendations that could impact their projects' financial situation.

Chairman Sloan continued his presentation by asking whether hydrates can be a viable resource. For permafrost hydrates, the answer appears to be "yes," and is contingent upon pipeline availability and defining a proven way to produce the resource. For the marine resource, it potentially has more than two orders of magnitude reserves greater than the permafrost but requires a reliable exploration tool to assess the concentrations of the hydrates. The third issue highlighted was environmental concerns and potential problems posed by hydrates such as slumps and slides. Additionally, the fact that hydrates are composed of methane which poses global warming considerations since it has a global warming potential 21 times higher than carbon dioxide.

Chairman Sloan concluded the presentation by identifying the three groups and the leaders for each group for today's discussion:

1. Permafrost – Bob Swenson
2. Marine – Nader Dutta
3. Environment – Peter Brewer

The tasks for the groups are to define the overall goals and how those goals shape the work of the program over the next five years being proposed in section 4 of the five-year plan. Chairman Sloan asked members to participate in a group that interests them and asked that they report back in one hour.

Discussion Group Outputs

Prior to the reports from the discussion groups, acting DFO Edith Allison relinquished the DFO duties to DAS James Slutz. The discussion groups first reported on the overall goal for each of their groups:

Goals

- The permafrost group suggested that the name be changed to "permafrost associated hydrates." The overarching goal is to test multiple production scenarios under multiple hydrate occurrence conditions as quickly as technically feasible.
- The overarching goal for the marine group is to determine in five years whether marine gas hydrate is viable as a commercial resource and develop and verify exploration models such as MMS and dike-fracture model (viability to identify resource that it actually exists).

The environmental group had the viewpoint that it was difficult to develop one overarching goal for environmental aspects because of the situation's complexity. The group had spent more time on issues affecting the marine environment, such as new diagnostic tools, stability of hydrates on continental slopes, and greenhouse gas emissions. It was suggested that the environmental group could couple together with the marine group.

The environmental group proposed a series of suggestions. First, the group suggested that the section 4.7, Introduction needs to be re-written. Secondly, how hydrates fit into established work groups such as the Intergovernmental Panel on Climate Change (IPCC) needs to be considered because some of these work groups may emphasize restricting fossil fuel use. The MHAC may determine that hydrates are a viable resource and this information will feed back into these other working groups. Another suggestion was to extract information from arctic studies to understand the environmental implications. A specific suggestion was to replace all bullets in section 4.7 except the last three which should be placed in an appendix. Since physical stability is much less known and production is the focus of the plan, a clearer picture of the environmental issues is required. Some suggested overarching goals for the environmental group were: 1) to understand significant environmental hazards of marine hydrates in next five years; and 2) learn about environmental implications from work being done about geohazards, stability, and reservoir dynamics.

Strategies

The permafrost group suggested the following strategies:

- Encourage industry participation through incentives, show how this research program could be beneficial to industry, educate, and clarify confidentiality and legal rules. It was noted that lack of industry participation does not negate doing work but could limit facilities access and other important benefits to the program.
- Look at other unconventional resources, such as coalbed methane, as analogies that could help methane hydrates research
- A full suite of data should be gathered at any hydrate production facility or test
- Answer the question whether permafrost production should take a significant amount of the near-term funding
- Encourage a stand-alone facility in consult with industry to test multiple different scenarios
- Maximize wells of opportunity
- Foster more communication amongst different researchers — how much information is transferred that can be used by all different researchers? For example, was there an opportunity for further analysis from the India cruise?
- Need to consider whether many short cheap tests are better than one big, expensive test
- Go/no-go aspect of arctic test relative to a marine test; should the marine test be independent of success of arctic test? If the production test fails in the Arctic, this does not necessarily mean that it will fail in marine environments. It was noted that failure of production in the Arctic does not necessarily rule out the Arctic either, but could have programmatic implications such as slower or less funding. There is some expectation that the first four or five tests in the Arctic may be failures and therefore not much emphasis should be put on the first test. It is more important to say that this is research and that the knowledge base is moving forward and that is why there is a government role. This resource is far from commercial and is in the research phase. The arctic test is a singular test and should not be perceived as "the" test; it is an iterative process. It was suggested that there should not be too significant amount of money spent in the Arctic. Regarding the independence of the marine and Arctic, it was asked if the five-year plan needs to have a decision tree which shows there is not a clear linkage between the two resource environments.

The marine group was complementary of the comprehensive plan developed by the team and liked the suggested data management approach in the plan. However, they thought that the plan needs more focus, particularly to answer whether the milestones are achievable in five years. The group recommended the following strategies:

- Develop exploration models
- Emphasize the MMS model but do not ignore dike-fracture model or other models; these models may be inter-related and that makes it difficult to study one at the exclusion of another
- DOE should work closely with MMS to continue to identify areas of interest (MMS model is a good start, but needs to begin identifying sites; need detailed geologic framework for sites of interest using tools available). Need a program of 10–30 wells in GOM if you are serious. Need to show that it is widespread.
- Integration with other tools is needed; thermal data, etc. — ground truth to calibrate
- Use LWD and then follow up with detailed assessment to holes of interest
- Need to go beyond Alaminos Canyon 818 because this activity does not provide all the information about the marine environment

- Emphasize the Gulf of Mexico in the five-year plan as opposed to the Atlantic and Pacific Oceans
- Expanded JIP in the United States might include something similar to the Indian program; JIP-type program may involve more industry participation and access to more funding
- Need to prioritize the budget — should plan include recommendations on prioritization?
- Important to ensure that projects are funded continuously because industry is hesitant to participate otherwise
- Look to other oceanic sites that can be explored with future research
- Modeling efforts should be broadened beyond sand in Gulf of Mexico
- Include the overall, long-range goal in the opening sentence of the document and state that the five-year goal is for the Gulf of Mexico
- Include discussion of international collaboration and that India data can potentially help take the United States beyond the Gulf of Mexico
- Encourage MMS to proceed with the sand model and do more beyond sand; this requires additional time and resources so it might be beneficial to work with industry in other areas beyond the Gulf of Mexico
- A follow-up action item was to determine whether MMS is using Q-data

The environmental group recommended the following strategies:

- Examine the "tipping point" issues of hydrates in climate; the IPCC panel is a primary vehicle for getting knowledge into a public forum; there is a gap in what we know about hydrates and what is being communicated; there is a need to make these connections; three working groups in the IPCC, one of which is carbon sequestration, provide one of many opportunities.
- Effort should be made to extract environmental implications from Arctic projects and place in broader context
- Marine hot spots — ancient hydrate accumulations — and ways to observe, measure, and put them in broader context would provide greater environmental insight and can help address some of the uncertainties on why some of these are occurring and where they are. It was suggested to invest in two sites for study within the next five years.

Planning: Possible Meetings w/Secretaries of Energy and Interior and Congress, Topics for April 24-25, 2007 Meeting in Golden, CO

Chairman Sloan continued the meeting by focusing on planning of future meetings. The MHAC is scheduled to meet again on April 24–25, 2007 in Golden, CO. He suggested that it might be useful to have a subset of the committee visit the permafrost project in the Arctic and another subset meet with the Secretary of Energy on hydrates. He emphasized that there is a need to educate politicians on hydrates. The suggestion of the Arctic visit was put on hold, however, because the project is currently restricted to scientists working on the project and high-ranking DOE officials and accommodations are limited. A suggestion was made that the meeting with the Secretary of Energy could potentially take place if there is a public event announcing the methane hydrate fellowship awardees in February 2007. A subset of the committee could attend this event.

Another suggestion was to raise the profile of U.S. activities. It was mentioned that international collaborators may have an interest and that there could be some benefits of additional information exchange, with possible attendance by international participants at the MHAC meetings. However, some cautioned that you need to understand the motivation of each country and their areas of emphasis. It was also suggested that if you meet with international participants, you need to be clear on what your goals are for the meeting. A meeting similar to one sponsored by DOE in Denver several years ago was suggested. The general feeling among the committee was that there is a need to inform the international community of our activities. Nader Dutta was to lead the international focus of the MHAC to complement the DOE program in this area.

Mr. Rod Nelson, Schlumberger – Report on the NPC Global Oil and Gas Study

Mr. Rod Nelson provided a summary report on the NPC Global Oil and Gas Study. The study will be submitted to the Secretary of Energy in June 2007 and will address three key questions:

- What does the future hold for global oil and natural gas supply?
- Can incremental oil and gas supplies be brought on-line, on time, and at a reasonable price to meet future demand without jeopardizing economic growth?
- What oil and gas supply strategies and/or demand-side strategies does the Council recommend the United States pursue to ensure greater economic stability and prosperity?

The study will gather and analyze public and aggregated proprietary data. It is not a "grassroots" forecast but rather looks at what information is available and attempts to understand differences of models. Input is being solicited from a broad range of interested parties and emphasis is on long-term conditions (timeframe is 2030) rather than near-term volatility of oil and gas prices. The study group has asked a number of countries to participate or provide information for the study.

The study's approach involves a number of parallel tasks and engages and includes a cross-section of resources. The study is composed of four task groups: geopolitics and policy, supply, demand, and technology. Cross-cutting sub-groups are within each task group. Each sub-group includes a core group of approximately 10–15 people with a mix from large oil companies, independent oil companies, universities, and non-governmental organizations. Currently, the study is at the stage where most of these subgroups have a rough draft for circulation by the end of November for integration into a draft report in December.

The methane hydrates component of the study was limited to 10 pages and leaned heavily on the interagency 20-year roadmap and other public information. Nothing in the report will be surprising to the members of the MHAC because the methane hydrate section was drafted for an audience that knows little about hydrates. The report includes two resource streams — arctic and marine — which have two different levels of knowledge. The arctic resource is somewhat well-known and production testing is recommended. The marine resource is a different situation with unclear resource and reservoir geometry.

The review process for the methane hydrate section involved sending the first draft to five people, some of which are members of the committee. There was some discussion on how other members of the MHAC could comment and make suggestions on the methane hydrates section. Ultimately, it was decided that the author of the NPC section on gas hydrates would have the option to submit the report to any MHAC member at this meeting to review. It was noted that the deadline for the draft report was December 1, 2006, so that it might be difficult to obtain comments from the MHAC by that timetable. Several members of the MHAC had reviewed the NPC report and Chairman Sloan stated that the NPC report findings were consistent with the direction of the MHAC. It was mentioned that the NPC report should not be quoted or cited until it is published and should be treated as confidential.

Wrap-up and Adjournment

Chairman Sloan opened the floor for any additional items for discussion. One discussion topic was the potential for meetings with the Department of Interior and Congress. Edith Allison offered to speak with USGS about taking the MHAC request to the Department of Interior. She stated that DOE's Congressional Affairs could help organize meetings with the House Science Committee and the Senate Energy and Resources Committee. DFO James Slutz suggested that companies be cautious in their role as members of the MHAC, particularly if they are representing their company. He suggested that he and Edith Allison will ensure that the MHAC gets the appropriate opportunity to educate members of Congress. It was suggested that efforts should be coordinated so that the same information and message is being delivered.

A final suggestion was to continue with the current format for future meetings. Chairman Sloan thanked the attendees for coming and adjourned the meeting at 12:03 PM.

E. Dendy Sloan, Chairman

James Slutz, Designated Federal Officer

Appendix A: Attendee List

Wednesday, November 8, 2006
Dr. Peter Brewer, MHAC member, MBARI
Mr. Richard Charter, MHAC member, Resources Legacy Fund
Dr. Nader Dutta, MHAC member, Schlumberger
Mr. Arthur Johnson, MHAC member, Hydrate Energy International
Mr. Emrys Jones, MHAC member, Chevron
Ms. Kimberly Juenger, MHAC member, World Energy Systems
Dr. Miriam Kastner, MHAC member, Scripps Institute of Oceanography
Dr. Devinder Mahajan, MHAC member, Brookhaven National Laboratory
Dr. Stephen Masutani, MHAC member, Hawaii Natural Energy Institute
Dr. E. Dendy Sloan, MHAC Chair, Colorado School of Mines
Mr. Robert Swenson, MHAC member, Alaska Department of Natural Resources
Dr. Jean Whelan, MHAC member, Woods Hole Oceanographic Institution
Mr. Scott Wilson, MHAC member, Ryder Scott Company
Dr. Robert Woolsey, MHAC member, University of Mississippi
James Slutz, Designated Federal Officer, Department of Energy
Edith Allison, Department of Energy
Trudy Transtrum, Department of Energy
Ray Boswell, National Energy Technology Lab
Kelly Rose, National Energy Technology Lab
Bilal Haq, National Science Foundation
Tim Collett, US Geological Survey
Joe Gettrust, Naval Research Laboratory
James Howard, ConocoPhillips
Sandy Colvine, Natural Resources Canada
Deborah Hutchinson, US Geological Survey
Robert Hunter, ASRC Energy Services
Robert Kleinberg, Schlumberger
Bob Langston, Consultant
Beth Maclean, Bureau of Land Management
Robert Miller, ConocoPhillips
Tamara Neukam, Bureau of Land Management
Edward Peltzer, Monterey Bay Aquarium Research Institute
Pulak Ray, Minerals Management Service

Thursday, November 9, 2006
Dr. Peter Brewer
Mr. Richard Charter
Dr. Nader Dutta
Mr. Arthur Johnson
Mr. Emrys Jones
Ms. Kimberly Juenger
Dr. Miriam Kastner
Dr. Stephen Masutani

Dr. E. Dendy Sloan
Mr. Robert Swenson
Dr. Jean Whelan
Mr. Scott Wilson
Dr. Robert Woolsey
Edith Allison
James Slutz
Trudy Transtrum
Ray Boswell
Tim Collett
Joe Gettrust
James Howard
Sandy Colvine
Deborah Hutchinson
Robert Hunter
Robert Kleinberg
Bob Langston
Rod Nelson, Schlumberger
Edward Peltzer

Appendix B:

Inter-Laboratory Hydrate Meeting Summary

Colorado School of Mines, Golden, Colorado
September 19-20, 2006

Our meeting focused on energy production from hydrates, with the recognition that there should be less emphasis on assessment and climate modeling due to limited resources. The NETL manager indicated that other areas such as climate change were still on the table, but acceptable proposals had not been obtained. We had 30 attendees from laboratories of all kinds (academics, national labs, and industrial labs) across the nation (attendees listed in appendix), in addition to 17 Colorado School of Mines students.

At the conclusion of our meeting it was reiterated that two things were clear: (1) there is no unambiguous way to detect hydrates remotely, and (2) there is no proven way to produce seafloor hydrates, which contain the large hydrate majority. Perhaps these two problems should be the drivers for much of the future research.

There were six summary recommendations from our study groups of laboratory, field and model work:

1. Develop sample testing/preservation standards, and comparisons between laboratories concentrating on methane hydrates in sediments, rather than hydrated gas mixtures.
2. Test rock physics-based theories and measure hydrate-sediments properties most aligned with energy recovery – especially geo-mechanical properties, relative permeability, and capillary pressure.
3. Develop an accurate logging model for remote detection of hydrates in porous media.
4. Refine methods for preservation and measurement of cores at situ conditions.
5. Continue the model code comparison activity.
6. Verify the models via long-term field tests and meso-scale tests.

The above six summary recommendations are detailed more completely in the full minutes of this meeting report, which are available from E.D. Sloan (esloan@mines.edu) upon request.

Appendix C

Overall Hydrate Goals and Strategies to Shape the Five-Year Plan in Three Areas: (I) Permafrost Associated Hydrates, (II) Marine Hydrates, and (III) Environmental Concerns

I. Permafrost-Associated Hydrates

The overall goal is to perform a series of production tests to prove the viability of sustained methane disassociation from permafrost-associated hydrates under multiple production configurations. Perform these operations in a diverse set of hydrate occurrences and as soon as technically feasible.

A strategy for permafrost-associated hydrates should include:

1. Strongly encouraged industry participation. This is a very important aspect of any operation on the North Slope as there will be significant cost savings to the program and invaluable operational knowledge captured in such a partnership. However, it is also very important that it is made clear that industry participation is not *necessary* to complete the program. Progress on such a nationally important issue should not be dictated by a private corporation's global agenda. The resource belongs to the public, which deems the government responsible for assuring its timely assessment for the greater good of the people.

2. Study analogies in non-conventional resource development to ascertain possible pitfalls and roadblocks that can be avoided. For example, the recent boom in Coal Bed Methane (CBM) production was not achieved without many years of difficult and challenging roadblocks.

3. Prioritize the allocation of funds within the overall hydrates program to ensure that the limited available capital is being applied to projects that will answer the most critical questions. This is true especially when a given project result could dictate a significant change in program course.

4. Consider a long term "testing facility" that could be the focus of numerous production experiments from one location. The development of this type of location should not negate the pursuit of "wells of opportunity" however.

5. Foster communication between the stakeholders in hydrates research to ensure all reasonable chances to gain additional data are pursued. For example, the production engineers would have thought a MDT test in one of the recent marine core-holes could have provided significant data at minimal extra cost.

II. Marine Hydrates

The goal of marine hydrate work is to answer, within 5 years, whether marine gas hydrate is viable as a commercial resource. To achieve the overall goal as stated above, we should know how much gas hydrate we have and whether it is recoverable to the extent that it could be a viable commercial resource. There are two aspects to address: Exploration and Production. The strategy discussed below is aimed at addressing both issues.

A strategy for Marine Hydrates should include:

1. ***Develop and verify viable exploration models for Marine Hydrates in the Gulf of Mexico, including but not limited to the MMS model for sand fairways. This may include alternate models such as the dyke-fracture model, pore filled model or any other (as yet unknown) model realizing that some of these models may be interrelated.***
    a. ***DOE should work closely with MMS and ensure that the current MMS exploration model is extended to the entire Gulf of Mexico utilizing not only the conventional seismic data but also the Q-Marine data wherever available for reliability in mapping hydrate resource. This will lead to detailed geologic framework for sites of interest for Gas Hydrate drilling with resource estimation as the objective (see below). Further, MMS should be encouraged to present the findings at an another meeting***
    b. ***Some of the viable exploration models must be tested by a consorted exploration drilling campaign in the Gulf of Mexico which may involve drilling ~ 20 – 30 wells such as in the India and Japan campaigns. Thus, it may be necessary to either expand the scope of work of the current JIP or establish an expanded – JIP' that include a broader participation of domestic and international collaborators. An immediate testing of the current MMS model should be carried out in the JIP Phase – II drilling scheduled for 2007 / 2008. In this test, we recommend using a variety of tools such as OBC, CSEM, thermal data etc, for assessing the uncertainty in the prediction of the quantity of gas hydrates.***

2. ***Develop and implement a plan for various production testing scenarios in the Gulf of Mexico involving academic institutions and industry. The data obtained from JIP-Phase II drilling could be used to test various "what-if" scenarios and reservoir simulation algorithms.***

3. ***Accelerate collaboration with the International Community such as India, Korea, and Mexico to fast track exploration and production tests and thus enhance our knowledge base in other oceanic sites, other than the Gulf of Mexico, that might be viable sites for marine gas hydrates.***

    a. ***Be pro-active in soliciting participation of the international community in JIP-type programs (current as well as future "enhanced JIP programs").***
    b. ***Participate in the upcoming 2008-production test to be carried out by India and use the data set, if possible, for fast track production testing scenarios.***
    c. ***Hold international workshops and conferences to propagate a culture of knowledge sharing using the resources of the international community and the technology of the United States.***

4. ***Increase awareness in the Industry and the US Congress of the importance of gas hydrates as a possible viable energy source that should be explored and exploited. This will entail that:***

a. ***The MHAC suggests that US Congress consider that the funding for hydrates research to DOE be consistent, without variation on a year-to-year basis, so all parties (researchers, e.g.) have the assurance of a continuing effort***
b. ***Encourage and notify operators to collect and share shallow data. Further, request that all operators release all shallow data already collected to address issues, if any with environmental consequences of exploration and production drilling***

III. Environmental Concerns

The overall goal is to rapidly advance knowledge of the role of methane hydrates in the environment so that issues of slope stability, sensitivity to global change, and environmental impacts associated with production are known - well enough that the promise of hydrates as a significant energy resource can be fulfilled.

The following strategies should be employed to achieve the above Environmental goal:

1. Investigate by a combination of novel lab and field experiments, and associated modeling, the effect of hydrates and dissociated gas on the mechanical stability of unconsolidated marine sediments on continental margins.

2. Investigate the fluxes of methane from the Arctic regions, and particularly sources from methane hydrates, so as to place production of hydrates as an energy resource within the context of uncontrolled background releases from on-going environmental change.

3. Re-examine the relationship between climate changes in earth history and today so that the tipping point associated with the hydrate phase boundary is placed within a well-recognized context. The topic of hydrate stability and global change was highlighted in the previous report of the MHAC to Congress, and thus a clear message of progress and assured knowledge is our professional duty.

4. Develop new exploration and experimental techniques for locating and assessing sea floor exposures of methane hydrates. These are being found around the world with increasing frequency as exploration of the sea floor progresses. They offer critically important windows and experimental opportunities for studying lifetime, stability, and physical forcing, and they are conduits to the vastly larger buried hydrate resources.

5. Link the MHAC skills and knowledge of hydrates to IPCC concerns over climate change so that an accurate account is given, with possible direct representation. Plans for development of the hydrate energy resource and its combustion to fossil fuel CO_2, knowledge of possible direct methane leakage to the atmosphere and ocean, the insights from studying sea floor exposures,

and possible combination of CO_2 injection - CH_4 hydrate exchange as a sequestration strategy are all directly related to IPCC concerns.