Methane Hydrate Advisory Committee (MHAC) Meeting
Golden, Colorado
April 24–25, 2007
Meeting Minutes

Tuesday, April 24, 2007

Chairman Dendy Sloan and Designated Federal Officer (DFO) Guido DeHoratiis – Welcome and Introductions

The Methane Hydrate Advisory Committee (MHAC) meeting convened at 8:30 a.m. at the Table Mountain Inn in Golden, Colorado on Tuesday, April 24, 2007. MHAC Chairman Dendy Sloan welcomed the members and introduced Guido DeHoratiis, Director for Oil and Gas Resource Conservation in the Department of Energy (DOE). Mr. DeHoratiis notified the group that James Slutz, the DFO, was unable to attend the meeting and had delegated the position of DFO to Mr. DeHoratiis. Mr. DeHoratiis welcomed the group and thanked the members for their participation and commitment to the committee. Chairman Sloan asked the members and other attendees to introduce themselves.

After the introductions, Chairman Sloan explained that the task of the committee is to provide advice to DOE on methane hydrate. He noted that the agenda is focused on making recommendations to the *Interagency Five-Year Plan for Methane Hydrate Research and Development* and the Report to Congress as required by Section 968 of the Energy Policy Act of 2005.

Appendix A includes a list of meeting attendees and their affiliation.

The agenda is Appendix B.

The presentations and any associated questions or discussion follow.

Nader Dutta, Scientific Advisor and Chief Geoscientist, Schlumberger – Report on Visits to DOE and Congress

As suggested in the last MHAC meeting (November 2006), Edith Allison, DOE Methane Hydrate Program Manager, arranged a meeting of four representatives of the MHAC and the Deputy Secretary of Energy. While the four were in Washington, DC, they also arranged to meet with Congressional staff and the Office of Management and Budget. Chairman Sloan then introduced Nader Dutta, who presented the presentations used in the Washington meetings and summarized the outcome of the discussions. MHAC participants in the Washington, DC meetings included: Jean Whelan, Dendy Sloan, Peter Brewer, and Nader Dutta. The schedule of the March 22, 2007 meetings in Washington, DC was:

- 9:15–10:15 a.m. Joint briefing Majority and Minority staff: Senate Energy and Natural Resources;
- 10:30–11:30 a.m. Office of Management of Budget (OMB-Energy);
- 11:30 a.m.–1:00 p.m. Public Lecture: “Methane Hydrate – State of the Science” (U.S. Energy Association);
- 1:15–2:15 p.m. House Energy Appropriations staff; and

- 3:00–4:00 p.m. Deputy Secretary of Energy.

The presentations included background on methane hydrate and why they are important to U.S. energy security, discussion of the relevance of hydrate resources in the arctic and marine environments, environmental issues, international collaborative efforts, and future plans for resource development.

One of the key objectives of the meeting was to clearly convey why government involvement was essential to the success of the program. The research and development (R&D) is judged high-risk and the time period required to produce the resources is considered too far in the future to attract significant corporate private interest given the current understanding of the technology and unknown potential for ultimate recovery. It was also noted that several countries are aggressively investing in methane hydrate programs and they threaten the leadership role of the United States in developing this groundbreaking technology.

The current path forward was described in the presentations as follows:

Prepare for Long-Range: USA Needs:

1. Establish Permafrost Production Test Well
   - Within Two Years
2. Determine Marine Hydrate Viability
   - Within Five Years
3. Assess Greenhouse Gas Effect
   - The Seafloor Stability Question
4. Collaborate Internationally
   - An international joint industry project (JIP) in Gulf of Mexico

Regarding funding, it was noted that the amount of federal funding required to support the program will likely have to increase from the current level of $9 million annually up to as high as $100 million. Also the group suggested that the overall program could be run more efficiently if the budget were not zeroed out with each annual budget cycle.

The feedback received from the meetings included the following:

- There was concern about the administration appearing to support corporate welfare, particularly for the oil and gas industry who have recently posted record profits.
- Some of the congressional representatives also noted that although the budget is zeroed out annually, they do manage to appropriate the required funds each year; they cannot ignore the realities of the budgeting process.
- It was also suggested that it would be helpful if the gas hydrates initiative could identify the energy prices that would justify ongoing development of gas hydrates as is done for other competing new resource technologies.

During the discussion it was pointed out that the breakeven prices should be tied to Liquefied Natural Gas (LNG) imports which appear to be the marginal supply of natural gas for the foreseeable future. If gas hydrates can compete against LNG imports then the answer to the question is straightforward. But, the

economic analysis needs to be refined, key unknown elements being the production and distribution costs. If, for example, heat is required to produce methane hydrate safely, then this may increase the cost of production.

The importance of maintaining close contact with Congress was noted particularly during the budget cycle. These points will be addressed later in the meeting.

Ray Boswell, Gas Technology Manager, National Energy Technology Laboratory (NETL) – Update on Chevron Gulf of Mexico Gas Hydrates Joint Industry Project (JIP)

The presentation covered:

JIP members and participating organizations:

- Program objectives;
- Status of the major phases of the JIP initiative;
- Project reporting and publications;
- Status of development of new pressure coring tools;
- Planning for the 2008 drilling and coring program with a discussion of the underlying key assumptions;
- Discussion of the status of potential new JIP members;
- Involvement with academia; and
- Wrap-up focusing on long-range R&D program plans.

Some of the prior key findings of the JIP were reported as:

- Subsurface fine sediment hydrate poses a minimal drilling hazard;
- Hydrate concentration 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 physical properties of hydrate in core in a significant way; and
- Soft sediment well bore stability model developed by this project performed well.

The members of the DOE flagship marine methane hydrate research program (JIP) include:

- Chevron, Schlumberger, ConocoPhillips, Total, Halliburton, Reliance (India), JOGMEC (Japan), U.S. DOI – Minerals Management Service, and DOE.

Participating organizations include:

- Scripps Institute of Oceanography, U.S. Geological Survey (USGS), Naval Research Lab (NRL), Georgia Institute of Technology, Rice University, Lawrence Berkeley National Laboratory, Lamont Doherty Earth Observatory, GeoTEK, and Fugro.

The objectives of the program are to develop technology and data to assist in the characterization of naturally occurring gas hydrates in the deep waters of the Gulf of Mexico. The three major elements of the program include:

- Link seismic data to ground truth by collecting logs and cores of sediments containing hydrate;
- Develop well and sea floor stability models and the sediment properties they require; and
- Develop guidelines for drilling and operating in hydrate areas.

Although the emphasis of the initial program has been on fine grain sediments that may pose a drilling risk, in 2008 the scope will be expanded to encompass potentially productive coarse grain sands as well.

There are four major chronological phases:

Completed Activities:

Phase 1: 2001–2004

- Gathered data, selected drilling/coring sites, conducted pre-cruise seismic estimates, conducted laboratory investigations, and developed new field testing equipment.

Phase 2a: Jan 2005–April 2005

- Conducted drilling/logging/coring operations.

Ongoing Activities:

Phase 2b:

- Evaluate/publish JIP findings through first field program results; workshop conducted April 2006;
- Improve capabilities and prepare recommendations for additional field programs; and
- Site evaluation meeting held September 2006.

Probable Activities:

Phase 3: 2007–2008?

- Conduct drilling/logging/coring operations.

As regards project reporting and documentation, considerable effort had been dedicated to this activity: 7 new peer review articles have been published (total of 13) and 15 government reports have been issued. Also a total of 52 professional presentations have been provided to date including 5 since the last MHAC meeting in November 2006. Of particular note, preparations are underway for a special volume in the *Journal of Marine and Petroleum Geology* to be published in 2007. It was noted that the DOE Web site contains many of these important reference documents.

In the development of the new coring tool, efforts continue to negotiate subcontracts with Aumann and Associates. Additionally, pressure core performance in recent expeditions is being analyzed. The priority equipment needs focus on the ability to operate in high pressures, ability to mate with

Instrumented Pressure Testing Chamber (IPTC) equipment, and need for good performance in hydrate bearing sandstones.

The pressure core results from the India (NGHP) expeditions and the JIP program were then discussed, with data which suggested that the Indian expedition coring was very successful due to the use of experienced hydrate workers. However, caution was suggested in drawing conclusions from the comparisons due to the different nature of the involved operations. Although a lot of planning went into each coring operation, it was found that success still depends heavily on the skills of the people involved and ability to "learn as you go," or to utilize experienced personnel.

In planning the focus of the drilling and coring program for 2008, data was presented that supports the plan to test the Alaminos Canyon 818 and 857 sites, which are in water depths of up to 9,000 feet. The supporting data had been produced by seismic surveys and analysis prepared by WesternGECO Company. The sites feature saturations exceeding 60 percent in the hydrate stability zone, which was estimated to be in the range of 50 to 100+ feet thick based on resistivity log analysis. Although several other potential sites are still under consideration, both the Minerals Management Service (MMS) and the Lawrence Berkeley National Laboratory have both supported this site for the next phase of drilling and coring.

Recognizing the importance of international cooperation, potential new JIP membership activities were discussed as noted below:

Mexico

- Attended JIP meetings and expressed interest in joining the JIP. DOE staff will meet next month with the Mexican Department of Energy to discuss participation in this project.

South Korea

- Joined JIP recently and is currently planning a research expedition for late summer 2007.

Statoil, Shell, and ExxonMobil

- Have expressed continued interest, but no decision taken.

As a result of the project's close ties with academia, there is a high level of educational support. In total, 14 students were involved from the following schools: Rice University, San Diego State University, Georgia Institute of Technology, and Scripps Institute of Oceanography (U. Cal).

The presentation concluded by outlining the long-range plans for the project, which include:

2007–2009

- Focus on international collaborative agreements;
- Initiate regional geological / geophysical assessment in the Gulf of Mexico (GOM) incorporating advanced seismic analyses; and
- Conduct JIP Phase 3b logging, coring, and testing.

2010–2015

- Initiate/continue one or more GOM partnerships with potential to lead to an initial production test;
- Continue involvement in international programs;
- Evaluate potential for regional assessment and drilling outside the GOM; and
- Evaluate potential for recoverability in non-sandstone reservoirs.

2015–2020

- Initiate second and third followup production testing programs in the GOM; and
- Conduct drilling outside the GOM.

2020–2025

- Multi-well pilot production testing program in the GOM.

The session broke for coffee at 10:30 a.m. and reconvened at 11:00 a.m.

Joint Presentation by Joseph Wilder of the University of Akron and Brian Anderson of West Virginia University – Hydrate Simulator Comparison Study Joint Presentation.

Joseph Wilder focused on the program background and initial project objectives dealing with the more basic simulation study cases, referred to as Problems 1 through 5. Then, Brian Anderson detailed the more recent history matching experiences as a result of the BP Alaska project, collectively referred to as Problem 6. The two presentations summarized the promising accomplishments of the simulation programs to date and to share some of the significant challenges that still lay ahead.

The importance of reservoir simulation was most succinctly portrayed recently by the National Research Council (NRC) as they noted: “Accurate hydrate reservoir models, tested against field experience, provide an extremely cost effective alternative to field experiments in economic assessment of hydrated energy production techniques.”

The program seeks to model complex hydrate reservoir behavior in a comprehensive, reliable, and accurate manner. Achieving confidence in these multi-phase simulations is essential to being able to utilize the limited financial and human resources in the most efficient and effective manner and to yield the desired results in the shortest period of time possible.

This program aims to achieve its goals by openly exchanging vital information among the recognized leading simulation practitioners to assure that the ultimate product contains the best and latest thinking in reservoir modeling. Also, field validation of the simulation techniques is viewed as a critically important step in gaining confidence in the output. Ultimately, it is likely that hundreds of millions of dollars of investments will hinge on the results of these simulations.

There are five recognized leaders in the simulation technologies and coordinating the activities of this diverse group is challenging in itself. The most significant lessons learned were achieved not from those exercises that resulted in similar results, but rather from resolving the disparities in the simulation results.

Participants in the hydrate simulation comparisons represent the following organizations and modeling tools shown in parentheses:

- Japan Oil Engineering (MH21): Masanori Kurihara
- Lawrence Berkeley National Laboratory (TOUGH): George Moridis
- National Energy Technology Laboratory (HydrateResSim): Kelly Rose
- Pacific Northwest National Laboratory (STOMP-HYD): Mark White

Simulation Comparison Panel of experts:

- USGS: Timothy Collett
- ASRC Energy Services/BP Exploration Alaska: Robert Hunter
- Ryder Scott Company: Scott Wilson
- West Virginia University: Brian Anderson
- University of Akron: Joseph Wilder

The simulation technique seeks to model the temperature, pressure, hydrate kinetics, heat, and mass transfer phenomena within the reservoirs in 3-D spatial orientations and time. Additionally, the simulations have to deal with the four observed phases: water, ice, gas, and hydrate. Instantaneous dissociation, or production rates, and eventual recovery rates are the ultimate objectives of the simulations.

The process that is used to compare the simulations is to propose various test programs to observe the simulation results for each technique and then to compare the results and particularly to understand the differences. In all, five simulation tests were analyzed ranging from simple reservoir modeling with no hydrate to more complex production simulations. Each progressively more complex test was systematically analyzed among all participants to identify the most reliable methods and to correct any errors, incorrect simulation assumptions, or omissions observed. Agreement on each set of tests was sought prior to modeling the next more complex reservoir problem.

Using this systematic and comprehensive process, some of the key lessons learned were that some of the simulations made different assumptions that, not surprisingly, influenced the results but in unintended manners. For example, it was found that the MG21 simulation code needed to be modified to include a more accurate solubility model for methane gas dissolved in water. STOMP required reprogramming the handling of thermal effects in the presence of ice. TOUGH simulation code was modified to smooth out some of the key assumptions on specification of water/ice properties and to decrease numerical grid size in one case.

The more complex production simulations revealed significant differences between several of the techniques. It was found, for example, that MH21 and STOMP predicted gas production rates approximately double those of TOUGH. These differences are still under evaluation to understand the root causes of the disparities and to identify the most reliable and accurate simulation technique.

Testifying to the openness and commitment of the various groups, a code comparison Web site was created where all of the relevant information is posted.

Next, Brian Anderson addressed Problem Number 6, the most recent simulation comparison dealing with history matching, Mt. Elbert unit production, and Prudhoe Bay Unit (PBU) L0106. The simulations will be matched against actual physical observations gained during the recent modular dynamic test (MDT) at the Mt. Elbert site in February 2007 — particularly the observed pressure and temperature plots and flowrates. The pressure data are to be matched quantitatively while the temperatures and flow rates are to be matched more qualitatively. The temperature sensor was in a location on the MDT tool that was subject to mixed phase (gas or liquid) contact that would cause discrepancies in measured and actual temperatures. Also, during mixed phase flow, the flow rates are estimates based on probable gas and liquid fractions. These tests are the most challenging as they endeavor to simulate the actual reservoir behavior upon depressurization which models actual production conditions.

The comparison of the simulations for Problem 6 is targeted for completion by the summer of 2007. One of the more challenging problems is to understand the unexpected inflection point observed during the pressure build up following depressurization. This phenomenon may be an important factor that limits the rate at which the gas can be produced or signals the need for thermal input to maximize production rates. Once the history matching is performed, the group will agree upon a common set of variables for use in the production scenarios for the Mt. Elbert "D" zone (2023-2060 ft RKB [rotary kelly bushing]) hydrate and the PBU "C" zone (2,226-2,288 ft and 2,318-2,374 ft RKB) hydrate. The Mt. Elbert "D" hydrate was chosen over the deeper Mt. Elbert "C" (2,132-2,169 ft RKB) hydrate for production runs because the "C" hydrate has a water contact below while the "D" hydrate is bound by shale on the top and bottom.

Some of the key process variables that are being studied include:

- Simulation tests that mirrored actual 12-hour test periods;
- Bottom hole pressures in the range of 400 psi at the end of the flow test with hydrate dissociation and up to 1,500 psi at the initial packer set stages;
- Bottom hole temperatures ranged from 35–38ºF;
- Production rates were in range of 247–515 scf/day during peak flow periods;
- Gas hydrate saturation were in the range of 65–75 percent;
- Porosity in the range of 35–40 percent;
- Intrinsic permeability at 1,000 milliDarcy (mD); and
- Pore water salinity at 5 parts per thousand (ppt).

The session broke for lunch at 12:20 p.m. and reconvened at 1:30 p.m.

Carol Lutken, Associate Director of the Center for Marine Resources and Environmental Technology, University of Mississippi – Gulf of Mexico Gas Hydrate Research Consortium and Seafloor Observatory

The purpose of the consortium is to consolidate research efforts in providing for continuous hydrate stability zone observations on the sea bed floor of the continental slope of the northern Gulf of Mexico. Consortium members of this

multi-year effort include academia, industry, and government as led by the University of Mississippi.

The consortium is funded by MMS-Department of Interior (DOI), NETL, DOE, National Institute for Undersea Science and Technology (NIUST), National Undersea Research Program (NURP), NOAA/DOC.

The varied agencies share common interests in methane hydrate but from different perspectives: MMS: sea floor stability; DOE: potential energy resource; NOAA/NURP: global climate change implications.

Management of the consortium activities resides with the University of Mississippi and includes establishing and coordinating project priorities; coordinating research efforts; planning and hosting consortium meetings; planning scientific cruises; and writing/publishing project reports, meeting reports, cruise reports, and periodic technical and informal reports to the funding agencies.

The key objectives of the consortium include monitoring station sea floor observatory to provide continuous information from a site within the hydrate stability zone via geophysical, geochemical, and microbial monitoring.

The observatory location is MC118, approximately 150 km south of the Mississippi Gulf coast and 100 km east of the Mississippi "Canyon." The site on the continental slope is dominated by salt features (diapers, ridges, and minibasins). This site was selected because in 2002, Sassen and Roberts documented hydrate and venting at the site as well as a complex chemosynthetic community including bacterial mats, tube worms, and mussels. Importantly, it was in less than 1,000 meters water depth thus allowing for cost efficiencies; the site was unleased so that legal/contractual issues could be avoided, and MMS surveys showed an amplitude anomaly suggesting possible hydrate reservoirs. Subsequent to the site selection, the site was leased by Norsk Hydro (currently being merged within Statoil) but they have indicated continued support for the activity and sharing of pertinent geological data/information.

The site is characterized by the following analyses:

- Geophysical: autonomous underwater vehicle (AUV) swath bathymetry, side scan, chirp, and shallow source-deep receiver (SSDR);
- Geochemical vent gas, hydrate, pore fluids;
- Geological cores lithostratigraphy, biostratigraphy; and
- Microbial cores and collectors.

The data received from the analyses supports the existence and scale of the hydrate reservoir.

The analyses of the cores have indicated:

- sediments are fine grained with minor foraminiferal sand;
- < 50 cm below sea floor (BSF) with both microbes dominating methane production;
- >50cm BSF methane is thermogenic;
- Gassy sediments – vertical fluid flow along faults and fractures conducive to microbial activity;

- Litho- and biostratigraphy are typical for the GOM in “reference section” but atypical over mound; and
- Sedimentation rates typical for the GOM prevail in the reference section but are greatly reduced over the mound suggesting tectonic activity related to the mound.

Analyses of the gas content indicates that the sources of the gas is an as yet unknown existing well, suggesting a unique and new reservoir.

The goals of the observations can be summarized as:

- Geophysical: monitor physical changes in the hydrate stability zone;
- Geochemical: detect changes in geochemistry that translate to shifts of gas hydrate stability zone; and
- Microbial: determine how microbes affect the hydrate stability zone and study the structure and function of the microbial communities.

The presentation highlighted the many different types of equipment used in the observation program, how they were deployed, software and processing advances, data transmission issues, and experience to date.

Plans for 2007 include installation of a data recovery system and vertical array sensors, making connections to the integrated data/power unit (IDP), performing test runs, collecting and processing of vertical array data, and completion of the horizontal arrays. For 2008, plans include shore data transmission in near-to-real-time to enhance monitoring capability.

Edith Allison, Program Manager — Exploration, DOE – International Methane Hydrate Activities

Edith Allison presented an overview of the various international initiatives.

India

A significant highlight of the program was the Joint Oceanographic Institution for Deep Earth Sampling (JOIDES) Resolution Cruise during May–August 2006 which involved USGS and the Government of India. It featured an agreement for technical coordination where the DOE provided staff and equipment. Upcoming activities include a) continuing research to be presented at a January 2008 workshop and b) May 28–29 meeting on gas hydrates delineation and production technologies involving both the DOE and USGS participation.

The relationship with India is being strengthened through an energy working group led by the DOE featuring the development of a memorandum of understanding which is currently under legal review prior to review by India’s Ministry of Petroleum and Natural Gas. It was noted that Malcolm V. Lall is the program lead at the India Directorate General for Hydrocarbons.

Mexico

A growing relationship with Mexico regarding methane hydrate was reported and that Mexico had participated in the fall 2006 GOM JIP meeting.

Through the North American Energy Working Group, Mexico may join the GOM JIP and Canadian gas hydrate activities may also be incorporated within the scope of the program. Finally, NETL was invited to attend the American

Geophysical Union (AGU) Joint Assembly in Acapulco in May and a visit with the Mexico Department of Energy is also planned during that trip.

Japan

The DOE and Ministry of Economy, Trade, and Industry (METI) met in January 2007 and agreed to increase information exchange and research cooperation for methane hydrate. The hydrate code comparison and other related research was encouraged as a result of the meeting.

Other key international activities include the 6th International Conference on Gas Hydrates in British Columbia in July of 2008 (Chairman Sloan is on the organizing committee). Finally, the 6th International Workshop is scheduled in Bergen, Norway in May of 2008.

At the conclusion of Edith Allison's presentation, Sandy Colvine of Natural Resources Canada was invited to present a brief overview of the Mallik program underway in Canada.

The Mallik gas hydrate production research program's broad objective is to study the natural properties and distribution of gas hydrates and to measure and monitor the production of natural gas from these reservoirs.

The program is being conducted at the Mallik L-38 site, which is in the Mackenzie Delta on Richards Island. Japan and Canada have collaborated for the past 10 years and the current program is jointly funded by the governments of Canada and Japan. The Aurora Research Institute is the operator for the research program on behalf of the consortium.

A legal agreement exists between Japan and Canada which restricts the amount of information that can be shared publicly on the status of the Mallik program. The Japanese are interested in the Mallik program as they intend to use the information gained through that program in the exploration and development of the Nankai Trough, which is the primary gas hydrate resource off the Japanese coast.

A 70-day production test is planned for the winter of 2008. Canada's interest in the program is different from the U.S. program. Canada has significant domestic hydrocarbon resources, thus energy security is not a major issue in Canada. Regarding the gas hydrates program future tie-ins to the reservoirs to fill a planned Mackenzie Valley Gas Pipeline coincident with the Beaufort Gas field infrastructure are planned.

In followup discussions, it was reported that other international activities are moving forward including Chile and New Zealand as reported by the Naval Research Laboratory, and participation in a Chinese expedition in the South China Sea as reported by NETL. Additionally it was reported that Korea is planning a venture in August of 2007 and Taiwan is expected to announce plans aimed at methane hydrate exploration in the near future.

The meeting broke for coffee at 3:10 p.m.

Ray Boswell, Gas Technology Manager, NETL – Late Breaking News

The meeting reconvened at 3:30 p.m. with a discussion of the Five-Year Plan. One of the underlying assumptions is that funding would match the authorizations outlined in the Methane Hydrate Act. However, it was pointed out by some members that the actual appropriated funds were short of the original

expectations and that each year the funds were zeroed out in the Administration's proposed budgets. The latter issue was causing problems because it meant that some activities had to be curtailed while awaiting final budget resolution. Edith Allison noted that although the DOE program funding for methane hydrate research was not precisely matching the original authorization legislation, the total funds made available did essentially match the original authorizations.

Aside from the Five-Year Plan, a number of other items were covered in the presentation as noted in the sub headings below:

BP Mt Elbert Well

This project clearly demonstrated the ability to safely collect detailed data in shallow unconsolidated sediments. This is a major step forward and will be detailed later in the program. Other major achievements recorded by the program include:

- Confirmation of the ability to prospect and characterize the reservoir in standard geophysical and geochemical petroleum systems frameworks;
- Acquisition of one of the most complete gas hydrate datasets available to the science community;
- Outstanding data for model calibration and validation;
- Confirmation of gas release from natural hydrate reservoirs by depressurization;
- Proof of the efficiency of wireline coring; and
- First application of an open hole MDT, and first extended MDT with sand face temperature recording, and all of this at a cost of only $4.2MM.

New Program Documentation

- A program bibliography has been developed that features the 121 students and 40 learning institutions that have received DOE funds for over 6 years, covering the life of the program.
- A comprehensive listing of all publications and presentations has been compiled, including 233 peer reviewed reports, 63 publicly available government reports, 77 related reports, and 400 professional presentations.
- A revised interagency brochure that documents the extent and value of the interagency collaboration program including the DOE, Naval Research Laboratory (NRL), National Science Foundation (NSF), U.S. Geological Survey (USGS), DOI-MMS, and National Ocean and Atmospheric Administration (NOAA) is near completion.

National Methane Hydrates Fellowship

The application period ended in February and the first selection is being made this week. The program involved initial review with the National Academy of Sciences (NAS) and interagency review.

The first awardee will be Monica Heintz, the only candidate to score an A+ in the NAS review. Her area of study will focus on the biological control on the flux of methane from marine hydrate to the atmosphere.

The Lab Call program did not result in any projects being selected for FY 2007. The program will be reissued in FY 2008 by an interagency group including USGS, MMS, NOAA, NRL, and DOE.

Program Merit Review

This program review is scheduled for September 2007 in Denver, Colorado. In a planned 2½ day meeting, the program will review the JIP, BP, and 11 other major projects and some other selected initiatives focusing on identifying opportunities for project synergies, improvements, prioritizing ongoing projects, and identifying gaps in the portfolios.

The structure of the merit review program is designed to group projects based on the scientific disciplines rather than the resource type, which should enhance the value and efficiency of the merit review program.

Five separate review panels will involve interagency groups, members of the advisory committee and other recognized experts.

All cooperative agreements will be included in the merit review program, plus those National Lab programs that were not included in the 2006 National Lab merit review.

Later in the discussion, it was agreed that the MHAC would identify appropriate panelists and send suggested names to Ray Boswell as well as providing comments on the new structure of the program.

Final Revisions to the Five-Year Plan

The changes previously suggested by the MHAC have been incorporated in the document, including:

- revised executive summary;
- inclusion of an introductory section on program philosophy, bridging to the original roadmap document for those readers that are not familiar with that document;
- addition of several key milestones;
- de-emphasis on the performer in favor of the task;
- clearer linkages between the efforts and the goals; and
- integration of environmental efforts into all of the program elements.

It was acknowledged that some comments were more difficult to incorporate, including prioritization of efforts, acceleration of efforts, reconciliation to expected budgets, and contingencies for desired future budgets.

An active discussion followed, focusing on editing comments and document release procedures. It was decided that the best way to document the plan was to include it as an appendix in the soon-to-be-released report. Chairman Sloan asked that all MHAC members read both the Five-Year Plan and the report to Congress that evening and be prepared to contribute to the finalization of those documents the following day.

The meeting adjourned at 4:45 p.m.

Wednesday, April 25, 2007

Chairman Sloan reconvened the meeting at 8:30 a.m.

Joint Presentation by Scott Digert, Resource Manager, Milne Point Unit, BP and Robert Hunter, Gas Hydrate Project Manager, Arctic Slope Regional Corporation (ASRC) Energy Services — Gas Hydrate Resource Potential/Alaska North Slope Update

The meeting reconvened with opening comments on the BP–Alaska Mt Elbert Test Program by Scott Digert, who noted that were it not for the active involvement and funding from the DOE Methane Hydrate Program and the MHAC, the test program in Alaska would never have taken place. Chairman Sloan thanked BP and Mr. Digert for hosting MHAC members (Brewer, Charter and Sloan) to visit the Mt. Elbert wellsite on February 14–15, 2007.

It was BP's view that although methane hydrate had significant and promising potential, the current prospects for that venture could not effectively compete with the alternative internal corporate financing demands. Although BP senior management did not have any significant expectations as a result of the program, they were pleased with the outcome of the program to date and proud of their contribution to the overall effort. BP also gained valuable information about the response and impact of hydrate in a production environment that will be useful in future ventures. As a cautionary note, irrespective of the positive outcome of the test program, methane hydrate is still considered an unproven resource by BP.

Scott Digert then introduced Bob Hunter who presented the details of the 2007 DOE-BP Alaska gas hydrate stratigraphic test program. This information had only recently been presented for the first time in a public venue at the American Association of Petroleum Geologists (AAPG) annual meeting in San Diego two weeks prior and at the American Association of Drilling Engineers (AADE) meeting in Anchorage the week before.

The presentation highlighted many of the "firsts" recorded by the 2007 Alaska North Slope Stratigraphic Test Program:

- First significant Alaska North Slope (ANS) gas hydrate bearing core (430', 100' gas hydrate-bearing);
- First ANS open hole multi-day data acquisition program in gas hydrate section;
- First in world open-hole dual packer MDT (Modular Dynamic Testing (wireline production testing)) program in gas hydrate bearing sections;
- First ANS MDT sampling of both gas and water in gas hydrate-bearing section; and
- First in world sand face temperature data tracking cooling and warming events during flow and shut-in periods during MDT testing.

The active participants in the successful test program which included industry, government, and academia were identified and it was noted that the total cost of the program was approximately $4.2MM. This cost estimate was considered to be very reasonable largely due to the heavy reliance on the significant infrastructure already in place in the Prudhoe Bay region.

The test focused on two hydrate zones interpreted from BP's 3D seismic data in the Milne Point Unit in the northwestern portion of the Eileen gas hydrate trend at a depth of 2,000 to 3,000 feet. This is one of several interpreted gas hydrate prospects in the Milne area that is 100 percent owned by BP. Earlier reservoir characterization and modeling studies estimate 33–44 Tcf of gas is in place of which 0–12 Tcf may be recoverable. The low range of this estimate is most probable, which reflects the fact that methane hydrate production technology does not yet exist. This potential resource compares to 28 Tcf (Alaska Department of Natural Resources estimate) of recoverable conventional gas reserves within the adjacent Prudhoe Bay area fields.

The collaborative research approach and dedicated external team was directly responsible for the success of the program. This approach had been utilized since the inception of the program which dated back to 2002. Earlier phase project studies focused on characterization and modeling of the reservoirs and resource potential. This led to schematic regional modeling in 2005 followed by planning and executing the recently completed stratigraphic test well data acquisition, including core, logs, and MDT wireline testing earlier this year. The next phase under consideration would include acquiring additional well data and production testing. Strict reliance on a gate decision making process has been and continues to be used as a fundamental element of the successful planning process.

The Mt. Elbert prospect is characterized as a fault bounded structural closure. Drilling, which took place between February 3 and 19, validated the initial seismic interpretations. The test acquired 430 ft of core, achieved extensive wireline logging, and featured the first gas hydrate open-hole dual-packer modular dynamic testing including flowing and shut in pressure and temperature data collection. Data analysis is underway and will be finalized by year end. Gas hydrate was found in two distinct zones and saturations were as high as 75 percent. The Nuclear Magnetic Resonance, NMR logs indicated low mobile connate water saturation, which may signal the need for thermal and/or chemical enhancement for future potential production test programs.

One of the keys to the stratigraphic test program related to the deployment of an oil-based chilled mud drilling fluid, which aided in not only maintaining the stability of the gas hydrate cores, but was also instrumental in assuring borehole stability during extensive open hole data acquisition.

The gas hydrate confirmed in zones C and D combine to a total thickness of 100 feet. The test also featured 2½ days coring for 23 wireline cores totaling 430 feet of core, with 85 percent recovery, and 261 subsamples. The onsite handling and subsampling procedures for the cores were detailed and accomplished by a team of BP, ASRC Energy, USGS, DOE, and Oregon State University scientists. The geophysical well logging included gamma ray lithology, resistivity, neutron and density porosity, acoustic porosity, magnetic resonance imaging and Electromagnetic Propagation (EPT) data.

The climax of the test program was the MDT tests. In all, four tests were conducted, two in each hydrate zone, and included testing reservoir response to gas/fluid production and pressure reduction. This information is indicative of reservoir quality and is an important predictor of production performance and production test design. Extensive and repeatable flow and pressure transient data were obtained from the MDT tests. The test program collected sandface

temperature data, tracked cooling, and warming events during flow and buildup periods, obtained four gas samples and one pre-hydrate dissociation water sample, and observed rapid cooling and potential freezing of pre-water during gas hydrate dissociation/gas flow. During the tests with pressure drawdown below gas hydrate stability pressures, a choked porous media response was observed, which may be indicative of reformation of hydrate and or ice.

Despite the many promising observations gained during the test, many gas hydrate resource uncertainties remain, including permeabilities and saturations during initial and dissociating conditions; rates of gas and water production; endothermic effects during dissociation; and unresolved production technologies.

Future recommendations include continued evaluation of the Phase 3a stratigraphic test data and results which may lead to revised data acquisition, a long-term arctic test program, evaluation of marine resources, or possible research closeout. As noted earlier, a full report is expected by year end.

Discussions focused a) on the impact of the high saturation range in the test program and whether lower saturations might not produce better results, b) the importance of highlighting the positive lessons learned in drilling of hydrate zones safely, and c) the plan for issuing the final results.

At the conclusion of the presentation the MHAC group commended the hard work and dedication of the project team, which resulted in the exceptional results of the Alaska North Slope Stratigraphic Test Program.

Finalization of the Report to Congress

Chairman Sloan took the floor to introduce the next conference agenda item, Finalization of the Report to Congress document. He reiterated the primary issues that had been tabled at the prior day's session:

1. Insertion of the Five-Year Plan document as an appendix to the Report to Congress.
2. Streamlining of the executive summary to be more hard hitting and pointed and less technically focused.
3. Reconsideration of some sections of the second draft version.

To achieve this objective, Chairman Sloan organized the MHAC into three four-person groups with two additional groups comprising the other non-MHAC attendees.

Prior to breakout, Chairman Sloan invited Nader Dutta to describe his recommendations in proposing an alternative fast track plan. Some of the committee members believed that the current plan was too limited in its perspective. Some were of the opinion that in light of the recent significant progress in methane hydrate technological developments, it was appropriate to adjust the prior plan into a more aggressive accelerated plan with significantly higher investments approaching $100MM annually.

Chairman Sloan invited other MHAC members to comment. It was noted that many of the features of the suggested accelerated program were actually captured in the Five-Year Plan and that no major changes were needed. Several MHAC members agreed with that assessment. It was further suggested that a paragraph be added making that point and that the appendix should include an outline of the major elements of an accelerated plan and what might be achieved

from such a change. Others suggested that the content was reasonable but that the executive summary should de-emphasize the scientific rigor and detail. Tone of the document should be more positive and less confrontational regarding past and current funding limitations. Rather, it should focus on positive accomplishments and the potential for future developments. To achieve this objective, the executive summary should very briefly suggest two cases: a base case funding level and an accelerated funding program with a very brief description of the related deliverables from each path, thereby appropriately leaving the funding decision in the hands of Congress.

The meeting broke into separate discussion groups at 10:05 a.m. with instructions that each group is to bring forward its recommendations by 10:30 a.m.

At 10:30 a.m. the meeting reconvened and each group presented their recommendations which included:

- Modify the executive summary to be more positive, leaving open the possibility of an accelerated program.
- With all of the changes contemplated, the document should undergo a professional editorial review to polish the presentation and ensure consistent wording/style throughout the document as opposed to a collection of disparate ideas and concepts.
- Acknowledging the importance of carbon sequestration, the document should highlight the synergies between methane hydrate production and the potential for sequestration. It was felt that this was an important concept and should not be omitted in the final document.
- Meeting participants believed that the level of scientific detail was excessive (e.g., the discussion of the methane hydrate geometries was best left for the appendix).

The groups representing the other attendees suggested the following recommendations:

- Streamline the major points to emphasize the importance of the resource base, mention the environmental issues involved in the arctic program and that the U.S. needs to take a more leadership role focusing on safety, greenhouse gas (GHG) emissions impacts, production sea floor stability. Highlight the expense and budget issues but also note the real manpower resource limitations.
- Also, it was felt that the program should be more open to exploring methane hydrate occurrences in fine grain sands similar to the India expeditions in addition to the current focus on coarse grain formations.
- The last suggestion was the report to Congress should identify four major points: the national significance of the methane hydrate program as it relates to energy security and financial impact, a summary of key questions that need to be answered, the accomplishments to date, and what could be achieved in the future programs given a base case and accelerated funding scenario.

Further discussion revolved around the concern that the environmental issues are treated as an afterthought in the main document and it was suggested that

an environmental assessment should be an integral part at the outset of each new project. It was also suggested that the funding plan should identify some level of uncertainty and the possibility of new and unexpected requirements testifying to the fact that this is a new area and not "business as usual." It should be made clear that the methane hydrate program is still in its infancy.

Other points presented prior to closing included:

- The DOE Web site should be a repository for all project data so that it is made available to all scientific communities as they individually move forward on their own initiatives.
- The importance of international initiatives should remain a high priority as the U.S. program has high visibility in the international community and growing with time (e.g., new initiatives in Chile, New Zealand, and China etc.).
- Chairman Sloan promised to have the next draft released by the end of April and suggested that the final release date be established as June 1 after final editorial review.

Meeting Wrap-up / Residual Items

The final item on the planned agenda was to discuss plans for the next MHAC meeting. After considerable discussion, it was agreed that the next meeting should be April 24–25, 2008 in San Diego after the AAPG conference in San Antonio earlier that week. It was agreed that although the firm requirement for the meeting can not be identified at this time, there are sufficient possible issues that will likely evolve over the next 12 months. These will require the attention of the MHAC including assessing the impacts of the next phases of the GOM JIP and Alaskan activities and the need for planning a follow-up meeting with congressional representatives.

It was noted that next February the budget process starts anew and that scheduling congressional meetings in the March timeframe assures the opportunity for the MHAC to table pertinent issues with Congress.

MHAC Member Term Limits

A discussion of term limits concluded that the MHAC had an adequate level of turnover in light of the fact that there were only three members that have been active since 2001 and that most had less than two years service.

Also related to the matter of term limits, Edith Allison noted that the MHAC charter is due for renewal in 2010 due to the sunset clause provisions in EPACT 2005. On a related matter, it was also suggested that the DOE adopt a more proactive involvement with the NRC in connection with its required assessment of the program that is due to Congress before September 2009.

Merit Review Program

One last item involved a follow-up item on the Merit Review Program from the prior day. Dr. Boswell had requested recommendations for reviewers. In response, it was agreed that the following people would provide feedback within one month:

- Geophysics-related projects: Nader Dutta;

- Experimental programs: Dendy Sloan;
- Geochemistry-related projects: Jean Whelan;
- Major program management items: Art Johnson; and
- Numerical Analyses: Scott Wilson.

Feedback is to include suggestions on the structure of the merit review programs in addition to specific names of potential panelists.

The meeting was adjourned at 11:45 a.m.

Appendix A.

Methane Hydrate Advisory Committee Meeting Attendee List

Attendee	Organization
Warren Agena	USGS
Edith Allison	U.S. Department of Energy
Brian Anderson	West Virginia University
Mike Batzle	Colorado School of Mines
Ray Boswell	National Energy Technology Laboratory
Richard Charter	Resources Legacy Fund Foundation
Rick Coffin	Naval Research Laboratory
Sandy Colvine	Natural Resources Canada
Guido DeHoratiis	U.S. Department of Energy
Scott Digert	BP
Fred Digert	March Resources
Donna Digert	March Resources
Nader Dutta	Schlumberger
Bob Fisk	Bureau of Land Management
James Howard	ConocoPhillips
Robert Hunter	ASRC Energy Services
Arthur Johnson	Hydrate Energy International
Emrys Jones	Chevron
Kimberly Juenger	World Energy Systems
Robert Kleinberg	Schlumberger
Carolyn Koh	Colorado School of Mines
Mauri Lappinen	Technology & Management Services, Inc.
Carol Lutken	University of Mississippi
Divinder Mahajan	Brookhaven Science Associates
Stephen Masutani	Hawaii Natural Energy Institute
Tom McGee	University of Mississippi
Manika Prasad	Colorado School of Mines
Kelly Rose	National Energy Technology Laboratory
E. Dendy Sloan (MHAC Chairman)	Colorado School of Mines
Robert Swenson	Alaska Department of Natural Resources
Collin Timm	Colorado School of Mines
Trudy Transtrum	U.S. Department of Energy
Matt Walsh	Colorado School of Mines
Jean Whelan	Woods Hole Oceanographic Institution
Joe Wilder	University of Akron
Scott Wilson	Ryder Scott Company
Robert Woolsey	University of Mississippi

Appendix B.

Agenda
Methane Hydrate Advisory Committee Meeting
Table Mountain Inn, Golden, Colorado
April 24–25, 2007

Tuesday, April, 24, 2007

7:30 a.m.	Registration and Continental Breakfast
8:30 a.m.	Welcome and Introductions (Dendy Sloan and Guido DeHoratiis)
9:00 a.m.	Report on visits to Department of Energy and Congress (Dendy Sloan and others)
9:45 a.m.	Update on Chevron JIP (Ray Boswell)
10:30 a.m.	Break
11:00 a.m.	Report and discussion – Code Comparison for methane hydrate simulators (Brian Anderson and Joe Wilder)
Noon	Working Lunch
1:15 p.m.	Report and discussion – University of Mississippi sea floor observatory (Carol Lutken)
2:15 p.m.	Report and discussion – international activities (Edie Allison and others)
3:00 p.m.	Break
3:30 p.m.	Report and discussion – Breaking news from DOE research (Ray Boswell)
4:00 p.m.	Final critique of 5-year plan and 2007 Report to Congress
5:30 p.m.	Adjourn for the day
6:30 p.m.	Optional group dinner

Wednesday, April 25, 2007

7:30 a.m.	Registration and Continental Breakfast
8:30 a.m.	Report on BP Alaska Project (Bob Hunter and Scott Digert)
9:30 a.m.	Preparation of 2007 Report to Congress
10:15 a.m.	Break
10:30 a.m.	Continue preparation of 2007 Report to Congress

11:00 a.m.	Environmental, Fast-track, and International Subcommittee discussions
12:00 p.m.	Wrap up – action items
12:30 p.m.	Lunch
1:30-3:00 p.m.	Optional tour of Colorado School of Mines methane hydrate laboratory

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E. Dendy Sloan
Chairman, Methane Hydrate Advisory Committee

Guido DeHoratiis
Designated Federal Officer, Methane Hydrate Advisory Committee