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Characterizing Natural Gas Hydrates in the Deep Water Gulf of Mexico: Applications for Safe Exploration and Production Activities

Semi-Annual Report

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ABSTRACT

In 2000, Chevron began a project to learn how to characterize the natural gas hydrate deposits in the deepwater portions of the Gulf of Mexico. A Joint Industry Participation (JIP) group was formed in 2001, and a project partially funded by the U.S. Department of Energy (DOE) began in October 2001. The **primary objective** of this project is to develop technology and data to assist in the characterization of naturally occurring gas hydrates in the deep water Gulf of Mexico (GOM). These naturally occurring gas hydrates can cause problems relating to drilling and production of oil and gas, as well as building and operating pipelines. Other objectives of this project are to better understand how natural gas hydrates can affect seafloor stability, to gather data that can be used to study climate change, and to determine how the results of this project can be used to assess if and how gas hydrates act as a trapping mechanism for shallow oil or gas reservoirs.

During the first six months of operation, the primary activities of the JIP were to conduct and plan Workshops, which were as follows:

1. Data Collection Workshop – March 2002
2. Drilling, Coring and Core Analyses Workshop – May 2002
3. Modeling, Measurement and Sensors Workshop – May 2002

More information concerning these workshops can be found on the JIP website.

http://qpext.chevrontexaco.com/QuickPlace/wwuexpl_gashydrates/Main.nsf?OpenDatabase.

After the three workshops, the JIP Technical Teams reviewed the plans for the remainder of Phase I and Phase II of this research project.

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1.0 Introduction

In 2000, Chevron Petroleum Technology Company (Chevron) began a project to learn how to characterize the natural gas hydrate deposits in the deepwater portion of the Gulf of Mexico. ChevronTexaco is an active explorer and operator in the Gulf of Mexico, and is aware that natural gas hydrates need to be understood to operate safely in deep water. In August 2000, Chevron (now ChevronTexaco) working closely with the National Energy Technology Laboratory (NETL) of the United States Department of Energy (DOE) held a workshop in Houston, Texas, to define issues concerning the characterization of natural gas hydrate deposits. Specifically, the workshop was meant to clearly show where research, the development of new technologies, and new information sources would be of benefit to the DOE and to the oil and gas industry in defining issues and solving gas hydrate problems in deep water.

On the basis of the workshop held in August 2000, Chevron formed a Joint Industry Participation (JIP) group to write a proposal and conduct research concerning natural gas hydrate deposits in the deepwater portion of the Gulf of Mexico. The proposal was submitted to NETL on April 24, 2001, and Chevron was awarded a contract on the basis of the proposal.

The title of the project is:

"Characterizing Natural Gas Hydrates in the Deep Water Gulf of Mexico: Applications for Safe Exploration and Production Activities".

1.1 Objectives

The **primary objective** of this project is to develop technology and data to assist in the characterization of naturally occurring gas hydrates in the deep water Gulf of Mexico (GOM). These naturally occurring gas hydrates can cause problems relating to drilling and production of oil and gas, as well as building and operating pipelines. Other objectives of this project are to better understand how natural gas hydrates can affect seafloor stability, to gather data that can be used to study climate change, and to determine how the results of this project can be used to assess if and how gas hydrates act as a trapping mechanism for shallow oil or gas reservoirs.

1.2 Project Phases

The project is divided into phases. **Phase I** of the project is devoted to gathering existing data, generating new data, and writing protocols that will help the research team determine the location of existing gas hydrate deposits. During **Phase II** of the project, ChevronTexaco will drill at least 3 data collection wells to improve the technologies required to characterize gas hydrate deposits in the deep water GOM using seismic, core and logging data.

1.3 Research Participants

In 2001, Chevron (now ChevronTexaco) organized a Joint Industry Participation (JIP) group to plan and conduct the tasks necessary for accomplishing the objectives of this research project. The original members of the JIP were ChevronTexaco, Schlumberger, Phillips, Conoco, and Halliburton. During the first six months of operation, the Minerals Management Service (MMS) and TotalFinaElf, agreed to participate in the JIP and Japan National Oil Corporation was considering participating. Additional corporations and organizations are still inquiring about joining the JIP.

1.4 Research Activities

The research activities began officially on October 1, 2001; however, during the first few months, very little activity took place other than the preparation of documents within the JIP and the DOE, and the organization of Technical Teams by the JIP participants.

In December 2001, a team organization workshop was held at the offices of ChevronTexaco in Houston. Phase I of this research project has been divided into 12 Tasks. The 12 Tasks are (1) Research Management Plan, (2) Project Management and Oversight, (3) Data Collection and Organization, (4) Development of New Gas Hydrate Sensors, (5) Development of Wellbore Stability Model, (6) Seismic Modeling and Analysis, (7) Kinetics and Thermodynamics Analyses, (8) Determine Data Requirements for GeoModels, (9) Develop Drilling and Coring Test Plans, (10) Core Handling and Core Tests, (11) Review Data and Select Locations of 3 Field Test Sites, (12) Conference – Field Testing.

The JIP has formed four technical teams. The Seafloor Stability Team is responsible for planning and conducting Tasks 4, 8, and 11. The Drilling and Coring Team is responsible for

Tasks 5, 9, and 10. The Hydrates Characterization Team is responsible for Tasks 3, 6, and 7. A fourth team, called the Technology Transfer Team, is in charge of writing the technical reports and papers to describe the research and for planning Task 12.

1.5 Purpose of This Report

The purpose of this technical report is to document the activities of the JIP during October 2001 – March 2002. It is not possible to put everything into this semiannual report. However, many of the important results are included, and references to the JIP Web site are used to refer to more detailed information concerning various aspects of the project. The discussion of the work performed during October 2001 – March 2002 is organized by task and subtask for easy reference to the technical proposal and the DOE contract documents.

As mentioned above, very detailed information generated by the JIP during the time period can be found on the JIP Web site. The link to the JIP Web site is as follows:

http://qpext.chevrontexaco.com/QuickPlace/wwuexpl_gashydrates/Main.nsf?OpenDatabase

2.0 Executive Summary

Chevron (now ChevronTexaco) formed a Joint Industry Participation (JIP) group to write a proposal and conduct research concerning natural gas hydrate deposits in the deepwater portion of the Gulf of Mexico. The proposal was submitted to NETL on April 24, 2001, and Chevron was awarded a contract on the basis of the proposal.

The title of the project is

"Characterizing Natural Gas Hydrates in the Deep Water Gulf of Mexico: Applications for Safe Exploration and Production Activities".

The **primary objective** of this project is to develop technology and data to assist in the characterization of naturally occurring gas hydrates in the deep water Gulf of Mexico (GOM). **Other objectives** of this project are to better understand how natural gas hydrates can affect seafloor stability, to gather data that can be used to study climate change, and to determine how the results of this project can be used to assess if and how gas hydrates act as a trapping mechanism for shallow oil or gas reservoirs.

The project is divided into phases. **Phase I** of the project is devoted to gathering existing data, generating new data, and writing protocols that will help the research team determine the location of existing gas hydrate deposits. During **Phase II** of the project, ChevronTexaco will drill at least 3 data collection wells to improve the technologies required to characterize gas hydrate deposits in the deep water GOM using seismic, core and logging data.

A website has been developed to house the data and information that were collected in the Data Collection Workshop, as well as other items submitted during the course of this research endeavor. The link to the JIP website is as follows:

http://qpext.chevrontexaco.com/QuickPlace/wwuexpl_gashydrates/Main.nsf?OpenDatabase.

During October 2001 – March 2002, three workshops were held or planned for by the JIP. The Data Collection Workshop was the first workshop held March 14-15, 2002, and was well attended and successful in accomplishing the objectives set out by the JIP. The second and third

workshops will be held simultaneously in Houston on May 9-10, 2002. The Modeling, Measurements and Sensors Workshop was designed to find out exactly what the various engineering and geoscience modelers wanted from the JIP field data collection effort. The Drilling, Coring and Core Analysis Workshop was designed to begin the process of determining how the JIP can go about collecting the data that the modelers and scientists desire.

Thus, the three workshops were designed to (1) inventory the data currently available on naturally occurring gas hydrates in the deep water Gulf of Mexico, (2) determine what additional data need to be collected for the modelers and scientists, and (3) determine how to collect the data.

2.1 The Data Collection Workshop

The Data Collection Workshop was held in March 2002 to determine what data are available concerning natural gas hydrate deposits in the deep water Gulf of Mexico. The specific goals of the Data Collection Workshop were as follows:

1) To develop an understanding of the safety issues involved in drilling and operating in marine sediments containing naturally occurring hydrates through case histories;

2) To determine what is known and what needs to be known for accurate detection and seismic interpretation of hydrate bearing sediment zones using seismic, geochemical, well logging, well testing and drilling data;

3) To determine what is known and what needs to be known about the physical, thermo-chemical, and biogeochemical properties of hydrate bearing sediments to accurately evaluate and model sediment stability;

4) To assimilate data on naturally occurring hydrates in the Gulf of Mexico;

5) To gather all data in the literature, as well as from public and private sources that pertain to naturally occurring hydrates in deep water Gulf of Mexico;

6) To develop a preliminary format and content for a database to be used by the JIP to store collected data and to select drilling sites in Phase II of the project; and

7) To identify individuals and institutions that can assist in obtaining the necessary data and technology to meet the needs of the JIP.

The Data Collection Workshop began with a general session to familiarize the attendees with the NETL/DOE Gas Hydrates research program and the JIP plans for research into the properties of naturally occurring gas hydrates in the deep water Gulf of Mexico. **Brad Tomer** (DOE/NETL) provided an overview of the DOE gas hydrates research program. To help attendees focus on what was needed from the workshop, **Emrys Jones** (ChevronTexaco) gave an overview of the JIP and its goals. **Mike Smith** (MMS) discussed current deepwater operations in the GOM and what is known about naturally occurring gas hydrates in the region. **Charles Paull** (Monterey Bay Aquarium Research Institute) discussed his past experiences in obtaining deepwater core samples containing gas hydrates. **Bob Hardage** (Bureau of Economic Geology) discussed using 4-component (4C) ocean-bottom-cable seismic data to characterize seabed hydrate reservoirs and their mechanical properties. **Dendy Sloan** (Colorado School of Mines) provided an overview of what is known regarding the physical properties of gas hydrates and the importance of having accurate fundamental data to understand the phase behavior of naturally occurring hydrates. **Dick Plumb** (Schlumberger) discussed the subject of modeling for designing systems used when drilling and producing wells through zones that contain naturally occurring gas hydrate deposits.

These seven keynote presentations set the stage for an excellent workshop. Presentation materials from the general session are posted separately on the JIP website at the following address:

https://qpext.chevrontexaco.com/QuickPlace/wwuexpl_gashydrates/Main.nsf/h_4CE8EB048234FE2388256B5E0043A3EE/CEDF97717E17E4EE86256B8A0072AFF3/?OpenDocument

After the general session, the workshop was divided into three (3) breakout groups on the basis of the attendee's specialties and preferences. The three breakout groups were as follows:

- Group A – Pre-Drilling Hydrate Detection Methods
- Group B – Properties of Naturally Occurring Gas Hydrates

- Group C – Drilling in and Modeling of Naturally Occurring Gas Hydrates

Again, the purpose of these breakout groups was to identify the existing data and knowledge in the public domain that could be used by the JIP to accomplish its goals, and what gaps in data or technology need to be worked on by the JIP. The results from the three breakout groups can be found in the DOE Topical Report entitled

"Results from the (1) Data Collection Workshop, (2) Modeling Workshop and (3) Drilling and Coring Methods Workshop as part of the Joint Industry Participation (JIP) Project to Characterize Natural Gas Hydrates in the Deep Water Gulf of Mexico"

2.2 Drilling, Coring and Core Analysis Workshop

This workshop will focus on the current state of the art with respect to planning for taking cores, safety issues, core sampling and preservation and core analysis. The objective of this workshop is to determine what is currently known regarding coring in hydrates and what major gaps in technology need to be filled. The three breakout sessions that will be conducted as part of this workshop are as follows:

- Session D1 – Drilling and Coring Well Plan and Safety Issues
- Session D2 – Core Sampling and Core Preservation
- Session D3 – Core Analysis

Details of this workshop can be found both on the JIP website and in the DOE Workshop report cited above.

2.3 Modeling, Measurements and Sensor Workshop

The workshop on Modeling, Measurements and Sensors will focus on the current state of the art with respect to the stability of hydrate sediments, data required to improve modeling, the impact of local seafloor instabilities and the use and role of seismic and reservoir modeling to improve our understanding of hydrates. The objective of the workshop is to determine what is currently known in these areas and what the major gaps or unknowns are. Three breakout sessions planned as part of this workshop are as follows:

- Session M1 – Wellbore Stability
- Session M2 – Modeling Seafloor Instability
- Session M3 – Seismic Attributes and Verification of Seismic Analysis

2.4 Tasks and Subtasks

On the basis of the Technical Proposal and the ChevronTexaco – DOE Contract, the following tasks and subtasks have been identified for this research project. This semiannual report uses the tasks and subtasks as a way of reporting the progress during October 2001 – March 2002 on Phase I of the project. **Table 2.1** presents these tasks and subtasks.

Table 2.1 - Task and Subtask List

PHASE I: Data Collection, Analyses and Protocol Development
Task 1.0 -- Research Management Plan (Completed)
Task 2.0 -- Project Management and Oversight
Task 3.0 -- Data Collection and Organization ✓ Subtask 3.1 -- Data Committee ✓ Subtask 3.2 -- Workshop Attendance/Participation ✓ Subtask 3.3 -- Conduct Data Collection and Case Histories Workshop ✓ Subtask 3.4 -- Identify Data Platform ✓ Subtask 3.5 -- Data Protocol Subtask 3.6 -- Gulf of Mexico Natural Gas Hydrate Database
Task 4.0 -- Development of New Gas Hydrate Sensors ✓ Subtask 4.1 -- MWD Sensors for Gas Hydrates Subtask 4.2 -- Gas Hydrate Disassociation Sensor Subtask 4.3 -- Gas Hydrate Formation Sensor Subtask 4.4 -- Tech Transfer/Sensor Specifications
Task 5.0 -- Develop Wellbore Stability Model Subtask 5.1 -- Wellbore Stability Model Evaluation Subtask 5.2 -- Prototype Wellbore Stability Model Subtask 5.3 -- Wellbore Stability Model Evaluation/Tests Subtask 5.4 -- Wellbore Stability Model Validation
✓ Completed

Task 6.0 -- Seismic Modeling and Analysis Subtask 6.1 -- Identify and Obtain Existing 2D and 3D Seismic Data Subtask 6.2 -- Theoretical Seismic Modeling Subtask 6.3 -- Protocol Development for Seismic Data Subtask 6.4 -- Specify Seismic Data Laboratory Tests Subtask 6.5 -- Seismic/Petrophysical Laboratory Tests
Task 7.0 -- Kinetics and Thermodynamics Analyses ✓ Subtask 7.1 -- Literature Analysis of Hydrate Kinetic/Thermodynamic Properties Subtask 7.2 -- Gas Hydrate Kinetic/Thermodynamic Data Analysis Subtask 7.3 -- Laboratory Test Specifications - Kinetic/Thermodynamic Data Subtask 7.4 -- Laboratory Test Specifications - Chemical/Physical Properties Subtask 7.5 -- Laboratory Testing - Kinetic/Thermodynamic Data Subtask 7.6 -- Laboratory Testing - Chemical/Physical Properties
Task 8.0 -- Determine Data Requirements for GeoModels
✓ Subtask 8.1 -- Geoscience/Reservoir Modeling Committee Subtask 8.2 -- Geoscience/Reservoir Modeling Workshop Planning Subtask 8.3 -- Geoscience/Reservoir Modeling Workshop Subtask 8.4 -- Geoscience/Reservoir Modeling White Paper Subtask 8.5-- Data Collection Requirements for Future Phases
Task 9.0 -- Develop Drilling and Coring Test Plans Subtask 9.1 -- Drilling/Coring Committee Subtask 9.2 -- Drilling/Coring Modeling Workshop Planning Subtask 9.3 -- Drilling/Coring Modeling Workshop Subtask 9.4 -- Current Drilling Practices in Hydrates Areas Subtask 9.5 -- Scenarios for Drilling and Coring Gas Hydrates in Deep Water Subtask 9.6 -- Cost/Risk Analysis Subtask 9.7 -- Drilling/Coring Guidelines and Protocols
Task 10.0 -- Core Handling and Core Tests Subtask 10.1 -- Core Sample Information Subtask 10.2 -- Core Sample Protocols
Task 11.0 -- Review Data and Select Locations of 3 Field Test Sites Subtask 11.1 -- Field Test Sites - Short List Subtask 11.2 -- Comprehensive Database Evaluation Subtask 11.3 -- Additional Data Analysis Subtask 11.4 -- Field Test Sites Selection - 3 Sites Subtask 11.5 -- Prioritize Field Test Sites - 3 Sites
Task 12.0 -- Conference – Field Testing
✓ Completed

PHASE II: Initial Field Tests and Analyses
Tentative tasks are presented for the Phase II activities. The tasks are provided to describe the generally anticipated work scope. Work will not proceed into Phase II until a continuation application (technical and cost) is submitted and approved by DOE/NETL.
Task 1.0 -- Research Management Plan
Task 2.0 -- Project Management and Oversight
Task 3.0 -- Validation of New Gas Hydrate Sensors
Task 4.0 -- Validation of the Wellbore Stability Model
Task 5.0 -- Core and Well Log Data Collection - Area A
Task 6.0 -- Data Analysis - Area A
Task 7.0 -- Update Models, Plans and Protocols
Task 8.0 -- Integrate New and Old Seismic Data in Test Areas
Task 9.0 – Conference - Information Transfer

3.0 Technical Teams

This research project is managed by ChevronTexaco, whose Program Manager is Dr. Emrys Jones. Dr. Jones is assisted by an Executive Board. The Executive Board has the power to control the direction of the research and suggest contractors and subcontractors for various portions of this research effort.

Reporting to the Executive Board are four technical teams. Each of these teams has a Team Leader and participants from the other JIP member companies. Member companies pay for the time and expenses of their employees as part of the cost sharing for this project. Time and expenses required in excess of the agreed contributions for each company may be paid for by the project. These funds will come from the portion of funds allocated for each task of the project. Ten of the tasks associated with Phase I of this project will be managed by the various technical teams.

The JIP has formed the following four technical teams.

- The Seafloor Stability Team is responsible for conducting Tasks 4, 8, and 11.
- The Drilling and Coring Team is responsible for Tasks 5, 9, and 10.
- The Hydrates Characterization Team is responsible for Tasks 3, 6, and 7.
- A fourth team, called the Technology Transfer Team, is in charge of writing the technical reports and papers to describe the research, and for planning Task 12.

The primary activities of the technical teams during October 2001 – March 2002 were to plan and conduct workshops. After the workshops, the technical teams will prepare Cost, Time and Resource (CTRs) estimates for all of the tasks and subtasks listed above.

3.1 Executive Board

The Executive Board assists the ChevronTexaco Program Manager with determining which tasks are accomplished, and how the contracts and subcontracts are handled within this research project. The Executive Board consists of one person from every company participating in this

joint industry project. During October 2001 – March 2002, the Executive Board consisted of the following individuals.

- Craig Lewis — ChevronTexaco, Chairman
- Steve Holditch — Schlumberger
- Lewis Norman — Halliburton
- Dave Peters — Conoco
- William Parish — Phillips
- Jess Hunt — Minerals Management Service
- Pierre Montaud — TotalFinaElf

The Executive Board has met five times between September 2001 and March 2002. **Table 3.1** shows when the Board met and the essence of the topics at the meetings.

Table 3.1 - Record of Executive Board Meetings

Number	Date	Topics
1	9/10/01	• JIP organizational issues – waiting on DOE announcement before publicizing the contract and project
2	11/5/01	• Technical team organizational issues – lining up personnel from each JIP member to do the work on the technical teams • Discussed other companies that we would like to join the JIP
3	12/10/01	• Technical team launch meeting • Discussed work of the teams • Status of the JIP and the DOE Contract
4	2/5/02	• Technical team progress • Status of the data collection workshop planning • Status of JIP membership
5	3/18/02	• Review the results from the data collection workshop • Discuss how we will issue RFPs and guidelines for selecting contractors for specific projects • Get technical teams working on CTRs for all tasks using the input from the data collection workshop

3.2 Hydrates Characterization Team

During October 2001 – March 2002, the Hydrates Characterization Team consisted of the following individuals.

• Jesse Hunt	MMS
• Siva Subramanian	ChevronTexaco
• Bill Parrish, Team Leader	Phillips
• Steve Primeau	Conoco
• P. Montaud	TotalFinaElf
• Rick Coffin	NRL
• Peter Eick	Conoco
• Nader Dutta	WesternGeco
• Mike Curtis	Halliburton
• Bill Hottman	Halliburton
• Tim Collett	USGS
• Lecia Muller	WesternGeco

The Gas Hydrates Characterization Team Charter is presented in **Table 3.2**.

Table 3.2 – Gas Hydrates Characterization Team Charter

Team Purposes	Links to Organization's Context
1. Develop database that can be used to collect and store data on natural gas hydrates in the Gulf of Mexico. 2. Develop forward seismic models, which find and characterize the response of gas hydrates. 3. Develop methods of geochemical analysis in the variation of hydrate content. 4. Apply experiments to understand and predict the geologic, geochemical, and biogeochemical controls on the occurrence and stability of gas hydrates.	1. Provide a database that teams can use to store all data. 2. Development geological parameter protocols for team's data use.

Process to Be Used	Success Measures and Progress Measures
All work from the team will be conducted with a spirit of cooperation in mutual respect. 1. Equal division of the work load. 2. Timely response to program correspondence. 3. Delegate alternate team member for travel/absence. 4. All final decisions attempted by team consensus. 5. Decisions set by company vote.	1. The ability to identify and predict gas hydrate presence, content and absence. 2. Provide hydrate presence and content probability analyses. 3. Ability to predict hydrate properties – physical, chemical, mechanical. 4. Data transfer to technology development.
Boundaries of the Team's Work	**Resource Availability/Constraints**
Meeting set time line and defined goals for the hydrate project task list.	1. *Time* 2. *Funding*
Key Milestones	**Team Member Time Commitments**
1. Completion of workshop (Q2). 2. Operating and populated database (Q3). 3. Complete field site geologic and geochemical analyses (Q5). 4. Complete seismic data analysis (Q6). 5. Laboratory work complete (Q6).	1. Anticipated commitment of team members will be 20% time contribution. 2. Monthly, one day team meetings.

The following meetings were held by the Gas Hydrates Characterization Team.

Table 3.3 – Meetings held by the Gas Hydrates Characterization Team

Number	Date	Topics
1	12/10/01	• Technical team launch meeting • Discussed work of the teams • Status of the JIP and the DOE Contract
2	1/22/02	• Technical team organizational issues – lining up personnel from each JIP member to do the work on the technical teams • Established tentative plan for Characterization workshop
3	2/15/02	• Establish hotel and arrangements for workshop • Establish speakers and agenda • Work on facilitators and progress plan
4	3/14-15/02	• First Workshop meeting for collection of the known information • 6 breakout sessions and final report written from meeting

3.3 Drilling and Coring Team

During this time period, the Drilling and Coring Team consisted of the following individuals.

- Jim Schumacher — ChevronTexaco
- Jacques Bourque — Schlumberger
- Gary Weaver — Halliburton
- Ben Bloys, Team Leader — ChevronTexaco
- G. Leon Holloway — Conoco
- Terry Cook — Phillips
- Larry Williamson — NRL MMS
- Carole Fleming — ChevronTexaco
- Brian Jonasson — ODP
- Terry Shawchuk — Orion

The Drilling and Coring Team Charter is given in **Table 3.4**.

Table 3.4 – Drilling and Coring Team Charter

Team Leader, Members, and Sponsor (if appropriate)	
Team leader: Ben Bloys, ChevronTexaco Assistant Team Leader: Jacques Bourque, Schlumberger	
Team Purposes	**Links to Organization's Context**
1. Hold workshop for GOM drilling and coring related to hydrates. 2. Evaluate and or develop wellbore stability models that can deal with hydrates in shallow subsea sediments. 3. Drilling safety guidelines. 4. Coring protocols and equipment guidelines. 5. Core sampling and preservation guidelines. 6. Core analysis protocols.	1. Provide data and protocols to enable maximum safety and data value on test wells. 2. Document best practices for rest of industry.
Process to Be Used	**Success Measures and Progress Measures**
All work from the team will be conducted with a spirit of cooperation in mutual respect. 1. Equal division of the work load. 2. E-mail, conference calls, etc. 3. Timely response to program correspondence. 4. Delegate alternate team member for travel/absence. 5. All final decisions attempted by team consensus. 6. Decisions set by company vote.	1. Meet deadlines. 2. Good participation in workshop. 3. Protocols for safe drilling in hydrate areas of GOM. 4. Good core recovery and good core data for models and measurements.

Boundaries of the Team's Work	Resource Availability/Constraints
Meeting set time line and defined goals for the hydrate project task list.	1. *Time* 2. *Funding*
Key Milestones	**Team Member Time Commitments**
1. Completion of workshop (Q2, '02). 2. Core sampling, preservation and testing protocols (Q4, '02). 3. Drilling and coring guidelines and protocols (Q1, 03).	1. Anticipated commitment of team members will be 10-20% time contribution. 2. 0.5-1.0 day team meetings monthly or bi-monthly.

The following meetings were held by the Drilling and Coring Team. Details of the meeting results can be found on the JIP website.

Table 3.5 – Record of Drilling and Coring Team Meetings

Number	Date	Topics
1	9/10/01	• JIP organizational issues – waiting on DOE announcement before publicizing the contract and project
2	11/5/01	• Technical team organizational issues – lining up personnel from each JIP member to do the work on the technical teams • Discussed other companies that we would like to join the JIP
3	12/10/01	• Technical team launch meeting • Discussed work of the teams • Status of the JIP and the DOE Contract
4	1/22/01	• Technical team progress • Data collection workshop planning • Status of JIP membership

3.4 Seafloor Stability Team

During this time period, the Seafloor Stability Team consisted of the following individuals.

- Jen-hwa Chen ChevronTexaco

- Jeff Mueller — Conoco
- John Matson — Halliburton
- Michael A. Smith, Team Leader — MMS
- Bob Kleinberg — Schlumberger
- Jorge Manrique — Schlumberger

The Seafloor Stability Team Charter is given in **Table 3.6**.

Table 3.6 – Seafloor Stability Team Charter

Team Leader, Members, and Sponsor (if appropriate)	
Team leader: Mike Smith, MMS Assistant Team Leader: Jen-hwa Chen, ChevronTexaco	
Team Purposes	**Links to Organization's Context**
1. Characterize gas hydrates in the deep water GOM so the industry can assess potential safety hazards associated with drilling and production operations. 2. Develop numerical geomodel data requirement 3. Development sensor specification 4. Work with other teams to coordinate site selection. process	1. Prioritizing data measurement for test well program
Process to Be Used	**Success Measures and Progress Measures**
• E-mail • Conference calls • Consensus, if not simple majority	• Good participation in workshops • Meet milestone
Boundaries of the Team's Work	**Resource Availability/Constraints**
• Exclude creating geomodel • Exclude actual design of sensors • Does not include assessment of long-term seafloor stability. Identify modeling	• Facilitator for workshop • Logistic support for workshop Team members in geomodeling community

techniques and data required.	
Key Milestones	**Team Member Time Commitments**
• Workshop by 2nd quarter 2002 • White paper on geomodel data requirement by 3rd quarter 2002 • Specification on sensor 11/2002	• One day meeting per month • 8 hours per month • Attendance at workshops

The following meetings were held by the Seafloor Stability Team. Details of the meetings can be found on the JIP website.

Table 3.7 – Record of Seafloor Stability Team Meetings

Number	Date	Topic
1	12/10/01	• Technical team launch meeting • Draft team charter • Review status of JIP and DOE contract
2	1/17/02	• Define team member role and responsibilities • Prepare for first (data collection) workshop • Develop plan for Modeling workshop in May
3	2/20/02	• Decisions on Modeling workshop dates, format, agenda and facilities • Core and site selection criteria
4	3/14-15/02	• Data collection workshop
5	3/20/02	• Review lessons learned from first workshop • Adjust plan for Modeling workshop

4.0 Phase I – Tasks for Data Collection, Analyses and Protocol Development

4.1 Task 1.0 – Research Management Plan (Completed)

ChevronTexaco developed a work plan and supporting narrative that concisely addressed the overall project as set forth in the Technical Proposal and DOE Contract. The Research Management Plan (the Plan) provides a concise summary of the technical objectives and the technical approach for each Task and, where appropriate, each Subtask. The Plan provides detailed schedules and planned expenditures for each Task using graphs and tables as needed. The Plan contains all major milestones and decision points. The Plan was submitted to DOE on January 31, 2002. **Table 4.1** presents the milestones and decision points that were part of the Plan.

Table 4.1 – Milestones for Phases I and II

	Year	Timing	Milestone
Phase I	2001	Q4	Technical Teams formed and staffed
	2002	Q1	Hold a data and case histories workshop
	2002	Q2	Construct data and case histories database
	2002	Q3	Meet with industry to discuss specifications on gas hydrates sensors
	2003	Q1	Develop prototype wellbore stability model
	2003	Q1	Publish laboratory test results on kinetic, physical, and chemical properties of cores saturated with gas hydrate
	2002	Q2	Conduct geomodeling workshop
	2002	Q1	Conduct drilling and coring workshop
	2002	Q4	Develop protocols and plans for data collection wells
	2002	Q2	Develop protocols for core handling and testing
	2002	Q4	Select and prioritize sites for data collection wells
	2003	Q1	Hold 2-day conference to review Phase I results and solicit input and interest for data collection wells
	2003	Q1	Final report on Phase I

	Year	Timing	Milestone
Phase II	2003	Q2	Meet with service companies to review new sensor design
	2004	Q4	Produce and distribute protocols for new gas hydrate sensors
	2004	Q1	Publish and distribute wellbore stability model
	2004	Q1	Drill Well A1
	2004	Q1	Drill Well A2
	2004	Q1	Drill Well A3
	2004	Q4	Hold 2-day conference to present results from data collection wells
	2005	Q1	Final report on Phase II

4.2 Task 2.0 – Project Management and Oversight

Dr. Emrys Jones was appointed Project Manager by ChevronTexaco to manage the JIP and the DOE Contract. The work has been delegated to Technical Teams and to Contractors. Dr. Jones manages the day-to-day operation of the project and reports verbally and by written report on the progress of the project to the DOE, as required. The original organization chart for this project is given in **Fig. 4.1**.

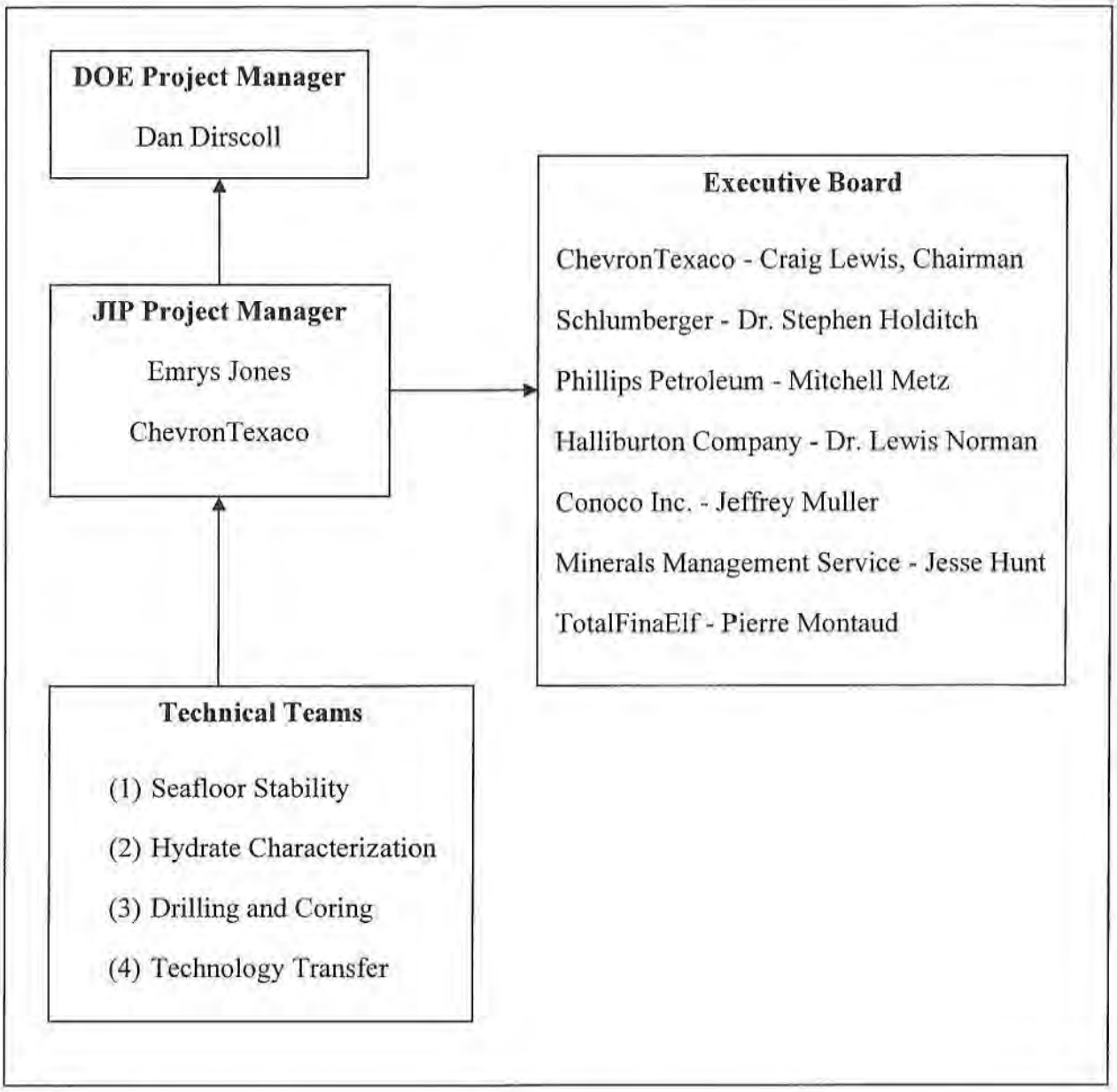

Fig. 4.1 - Organization Chart for "Characterizing Natural Gas Hydrates in the Deep Water Gulf of Mexico"

4.3 Task 3.0 – Data Collection and Organization

A committee was formed to plan a data and case histories workshop. The committee solicited interest from the oil and gas, scientific, and academic communities to participate in the data and case histories workshop. The committee organized and held a workshop in March 2002 to collect data and case histories on the successes, failures, and lessons learned from field

operations where hydrates may have been encountered in drilling, production, or pipeline installation and operation. After the workshop, we collected the information and made it available to the public on the JIP website.

4.3.1 Subtask 3.1 – Data Committee (Completed)

During January 2002, the Gas Hydrates Characterization Team planned the workshop for compiling data and case histories concerning operations in the deep water Gulf of Mexico, as it relates to gas hydrates on or near the seafloor. The Team defined objectives for the workshop and prepared a very detailed agenda. The Team worked hard to solicit keynote speakers and presenters for the breakout sessions.

4.3.2 Subtask 3.2 – Workshop Attendance (Completed)

The Hydrates Characterization Team solicited interest from the oil and gas, scientific, and academic communities to participate in the data and case histories workshop. Using email lists from the DOE, and personal communication, the Team contacted oil and gas operators who have interest in deepwater prospects in all parts of the world, service companies, national research laboratories, private research institutes, certain consulting organizations, government organizations, and academic communities and solicited interest in participating in a data and case histories workshop.

4.3.3 Subtask 3.3 – Conduct Data Collection Workshop (Completed)

A workshop to collect data and case histories on the successes, failures, and lessons learned from field operations where hydrates may have been encountered in drilling, production, or pipeline installation and operation was held in Houston in March 2002. The main purpose of the workshop was to collect data and case history information. We obtained information that documents where the gas hydrates are located (at least based on then current information), how many wells have been drilled through areas that could possibly contain gas hydrates, various drilling problems encountered that could possibly be attributed to gas hydrates, and other pertinent information in the deep water GOM.

The purpose of the data collection task was to obtain the information required (and available) to select the sites for collecting cores and well log data, and to actually plan and conduct the

remaining tasks in this research project. The data collection task also highlighted for us what additional data are required (that currently do not exist) to properly conduct this research project.

A detailed DOE report was written to capture the information generated at the Data Collection Workshop.

4.3.4 Subtask 3.4 – Identify Data Platform (Completed)

The JIP, following the recommendations of the Project Manager and the Hydrates Characterization Team, decided to use a third party program, "QuickPlace", as the platform for collecting and disseminating the information obtained in the data and case histories workshop, as well as all other information generated by the JIP. The JIP website can be accessed using the following web address.

http://qpext.chevrontexaco.com/QuickPlace/wwuexpl_gashydrates/Main.nsf?OpenDatabase.

4.3.5 Subtask 3.5 – Data Protocol (Completed)

The Hydrates Characterization Team, working with ChevronTexaco, developed the protocols needed for collecting, storing, and disseminating data on natural gas hydrates in the Gulf of Mexico. Essentially, the QuickPlace website tools of ChevronTexaco have been used to store data using software such as Microsoft Word and Excel.

4.3.6 Subtask 3.6 – Build Gulf of Mexico Gas Hydrates Database

The database of information concerning natural gas hydrates in the deep water Gulf of Mexico has been constructed. JIP members have access to all of the information. Most but not all of the information is available to anyone. In time, all of the data will essentially be available to anyone. The database is a central repository for all data that will be generated and/or obtained during the remainder of this research project. The database can be accessed using the following web address.

http://qpext.chevrontexaco.com/QuickPlace/wwuexpl_gashydrates/Main.nsf?OpenDatabase.

4.4 Task 4 – Development of New Gas Hydrates Sensors

The Seafloor Stability Team is in the process of determining the feasibility of developing MWD sensors for gas hydrates. The team is developing specifications for feasible sensors. The team plans to meet with service companies, national laboratories and other groups to discuss these specifications.

4.4.1 Subtask 4.1 – MWD Sensors for Gas Hydrates (Completed)

The Seafloor Stability Team has looked into the feasibility of developing MWD sensors for gas hydrates. At the Modeling, Measurements and Sensor Workshop held in Houston in March 2002, a portion of the workshop dealt with sensors. Dr. Robert Kleinberg made a keynote presentation and a breakout session was devoted entirely to discussing existing sensors and the need for new sensors.

4.4.2 Subtask 4.2 – Gas Hydrate Disassociation Sensor

Gas hydrates found in the formation near the seafloor may begin to disassociate into gas and water as the pressure and temperature change during drilling or producing conditions. The exact values of pressure and temperature when disassociation occurs are a complicated issue and depend on a number of parameters. The Seafloor Stability Team has been discussing what occurs when gas hydrates begin to disassociate, what can be measured, and will be developing specifications for a sensor(s) that can help us determine when gas hydrates begin to disassociate.

4.4.3 Subtask 4.3 – Gas Hydrate Formation Sensor

Gas hydrates will form as gas and water are mixed under certain pressure and temperature conditions. The formation of gas hydrates is a very complicated issue, one that depends on many parameters. However, as gas hydrates form, chemical and physical reactions occur that could possibly be detected by sensors. The Seafloor Stability Team has been discussing what occurs when gas hydrates form, what can be measured, and will be developing specifications for a sensor(s) that can help us determine when gas hydrates form.

4.4.4 Subtask 4.4 – Sensor Specification and Technology Transfer

The Seafloor Stability Team will be writing a White Paper that will address all the issues concerning existing sensors and required sensor development to measure the properties of gas

hydrate deposits in situ. After the White Paper has been completed, the JIP will conduct a series of meetings with any service company and/or research organization that would like to receive the information. The plan would be for the companies or organizations to take the information in the White Paper and then develop the required sensors using their own research dollars. The JIP does not plan to fund any sensor development during this research project.

4.5 Task 5 – Develop Wellbore Stability Model

Wellbore stability models are in common use in the oil and gas industry. These models are used routinely to design slanted, horizontal and multilateral wells. Wellbore models can also be used to determine if sand control measures are required and to assist engineers in designing stimulation treatments. The data for these wellbore stability models have been measured in both the laboratory using core samples and in the field using wire line conveyed tools. For conventional formations, wellbore stability models are very reliable.

However, we are not aware of the use of wellbore nor seafloor stability models that have been developed and tested to investigate the stability of wellbores that penetrate formations containing gas hydrates. Our initial work will be to find out what models have been developed and if they have been modified to handle the problem for a wellbore penetrating a formation containing gas hydrates. If there is a model, we need to know if the model has been tested against laboratory measurements of rock strength and modulus of a rock containing gas hydrates.

4.5.1 Subtask 5.1 – Wellbore Stability Model Evaluation

Wellbore stability models are in common use in the oil and gas industry. These models are used routinely to design slanted, horizontal and multilateral wells. Wellbore models can also be used to determine if sand control measures are required and to assist engineers in designing stimulation treatments. The data for these wellbore stability models have been measured in both the laboratory using core samples and in the field using wire line conveyed tools. For conventional formations, wellbore stability models are very reliable.

However, we are not aware of the use of wellbore nor seafloor stability models that have been developed and tested to investigate the stability of wellbores that penetrate formations containing gas hydrates.

Subtask 5.2 – Prototype Wellbore Stability Model

If the feasibility study concludes that it is feasible to build a wellbore stability model, we will put out a request for proposal to determine the best organization for building a prototype wellbore stability model. We will specify the requirements of the prototype and try to leverage existing technology. A sub-contract will be let and supervised to build the wellbore stability model.

4.5.2 Subtask 5.3 – Wellbore Stability Model Testing

It is highly unlikely that sufficient laboratory data are available that can be used to validate the prototype wellbore stability model. As such, we will prepare specifications concerning the data we require from laboratory tests to verify the accuracy and calibrate the wellbore stability model. Once the specifications and data requirements have been decided upon, we will write a request for proposal and entertain proposals from interested organizations that wish to conduct the required laboratory tests. A sub-contract will then be awarded and supervised to obtain the data we will require to calibrate and verify the wellbore stability model.

4.5.3 Subtask 5.4 – Wellbore Stability Model Validation

As the laboratory work is being conducted, the data generated will be supplied to the sub-contractor who is building the wellbore stability model. The data will be used to both calibrate and validate the model, as well as to guide the future laboratory experiments.

4.6 Task 6 – Seismic Modeling and Analysis

An important part of this research project will be to investigate the best ways to shoot, record, process and analyze seismic data to characterize the gas hydrates that are located in the deep water GOM. The data will be used to select sites for data collection in later phases of this project. During Phase I, we will be soliciting existing seismic data in the deep water GOM. We will search public records, and will contact both operating companies and services companies to gauge interest in donating data to the research team in the areas of interest. A team of geoscientists will research the public and private records to determine the areas of interest for this research project.

4.6.1 Subtask 6.1 – Identify and Obtain Existing 2D and 3D Seismic Data

During this research project, the JIP will determine the best ways to shoot, record, process and analyze seismic data to characterize the gas hydrates that are located in the deep water GOM. These protocols will be used to select sites for data collection in Phases II and III of this project. The technical team reviewed the data required and contacted data suppliers for interest and donations to the program.

4.6.2 Subtask 6.2 – Theoretical Seismic Modeling

Virtually all seismic data shot in the deep water GOM has been optimized to find oil and gas formations deep below the mud line. Since gas hydrate deposits are located at or near the seafloor, it is likely that the seismic data that we will obtain will not have been optimized to image the seafloor and the potential gas hydrate zones that lie beneath the seafloor. We plan to engage a group of geophysicists to conduct theoretical seismic modeling to determine the shooting and recording parameters necessary to accurately image the naturally occurring gas hydrate deposits.

4.6.3 Subtask 6.3 – Protocol Development for Seismic Data

Once the geophysical modeling has been concluded, the scientists can prepare protocols that can be used in future research to shoot, record, process and analyze seismic data to better image the gas hydrate zones in the deep water GOM. As we proceed into Phases II and III of this project, we can discuss the protocols with various seismic and/or operating companies who will be shooting seismic in our areas of interest. Ideally, we can obtain either 2D or 3D seismic data shot using the protocols developed during this portion of our research.

4.6.4 Subtask 6.4 – Specify Seismic Data Laboratory Tests

To calibrate seismic data and to improve analyses procedures, it is useful to have information concerning sonic travel times (both P wave and S wave) through any sediment that affects the interpretation of the seismic data. In our case, we would like to have laboratory data concerning how gas hydrate saturation in cores affects the acoustic properties of the core. To prepare for running the required laboratory tests, specifications for the laboratory tests will be used to acquire proposals from various laboratories for conducting the tests.

4.6.5 Subtask 6.5 – Seismic and Petrophysical Laboratory Tests

A request for proposal for conducting laboratory tests to generate data to help interpret the seismic and petrophysical properties of cores containing natural gas hydrates will be prepared. We will then accept proposals and select a laboratory to conduct the necessary laboratory work. We envision that the results of this laboratory work will be valuable in both the interpretation of seismic data, as well as in the development and analyses of wire line and MWD measurements.

4.7 Task 7 – Kinetics and Thermodynamics Analyses

It is clear that more information concerning the kinetic and thermodynamic properties of naturally occurring gas hydrates will be required by the modeling community. We plan to conduct laboratory tests to generate the much needed data.

4.7.1 Subtask 7.1 – Literature Review of Hydrate Kinetic and Thermodynamic Properties (Completed)

Over the years, scientific data has been generated and published concerning both the kinetic and thermodynamic properties of gas hydrates. However, it is not clear how much data exist concerning how gas hydrates in porous media affect the properties of the porous media. As such, we have conducted a thorough investigation of what information lies in the published literature. We have searched journals in all possible disciplines and will look into Master Theses and Ph.D. Dissertations at various universities. The results of our literature search are posted on the JIP website at the following address.

http://qpext.chevrontexaco.com/QuickPlace/wwuexpl_gashydrates/Main.nsf?OpenDatabase.

4.7.2 Subtask 7.2 – Gas Hydrate Kinetic and Thermodynamic Data Analysis

Eventually, models must be developed to allow engineers and geoscientists to analyze the present conditions in a natural gas hydrate deposit, and to predict the future behavior of the gas hydrates and pressures and temperatures change, or chemicals are injected. We need geologic, reservoir and geomechanical models concerning the behavior of formations containing natural gas hydrates. These models will need data – specifically, kinetic, thermodynamic and physical data measured in the laboratory in order to function properly. To design such tests, we will hold a Workshop with Geoscience and Reservoir modelers in May 2002, to find out what data they

require for their models. The results from that workshop will be posted on the JIP website and presented in detail in a DOE report. The JIP will be using the results of that workshop to design the laboratory tests, and to plan our field data collection efforts in Phase II of this project. Our goal is to provide all the data required for existing and future models of natural gas hydrate deposits.

4.7.3 Subtask 7.3 – Specifications for Kinetic and Thermodynamic Laboratory Tests

Once we know what kinetic and thermodynamic data are required by the geoscience and engineering models, we can specify the laboratory tests and the desired results from such tests. We are soliciting input from various laboratories concerning the feasibility of generating the required data in a reasonable amount of time.

4.7.4 Subtask 7.4 – Specifications for Chemical and Physical Property Tests

We will also need to determine what physical and chemical data are required from laboratory measurements by the geoscientists and engineers who will be building and using the models. We can then specify the laboratory tests and the required results from the tests. Again, we are soliciting input from several laboratories concerning the feasibility of running the tests and obtaining the desired results.

4.7.5 Subtask 7.5 – Laboratory Testing for Kinetic and Thermodynamic Properties

An RFP will be generated to run the desired kinetic and thermodynamic tests using cores containing natural gas hydrates. The best proposal will be selected and the winning organization will be sub-contracted to conduct the laboratory work.

4.7.6 Subtask 7.6 – Laboratory Testing for Chemical and Physical Properties

An RFP will be generated to run the desired physical and chemical tests using cores containing natural gas hydrates. The best proposal will be selected and the winning organization will be sub-contracted to conduct the laboratory work.

4.8 Task 8 – Determine Data Requirements for GeoModels

The Seafloor Stability Team took on the tasks of planning and soliciting interest in a geoscience/reservoir modeling workshop. A workshop on Modeling, Measurements and Sensors

is planned for May 2002 for geoscientists and reservoir engineers to determine data requirements for state of the art models. The results of the workshop will be recorded in a DOE report and will also be included in a White Paper on data requirements for models. This information will be used to provide input on data collection planning for Phase II, and any possible Phase III of this project.

4.8.1 Subtask 8.1 – Form Geoscience/Reservoir Modeling Committee (Completed)

To analyze existing data concerning naturally occurring gas hydrate deposits, and to predict the behavior of these deposits as things change, geoscientists and reservoir engineers need to use models. In the case of formations with gas hydrates in the pore space, we need to learn both how to properly model this system and what data are required to improve accuracy. The JIP conducted planning for the Modeling, Measurements, and Sensors Workshop which will be held in May 2002 to solicit input from the modeling community.

4.8.2 Subtask 8.2 – Plan a Geoscience/Reservoir Modeling Workshop

The Seafloor Stability Team took on the task of planning a workshop to allow professionals who do geoscience and/or reservoir modeling to discuss the issues surrounding data needs and data collection methods for the models. The team met several times to set the agenda, identify likely participants, solicit interest, solicit keynote speakers, and finalize the plans for the workshop. Again, the purpose of the workshop is to get together those geoscientists and engineers who are the experts in modeling of sediments containing natural gas hydrates, and let them tell the JIP what data they need to run their models. The workshop also is being designed to obtain information on measurement techniques and sensors needed to better measure the properties of naturally occurring gas hydrates.

4.8.3 Subtask 8.3 – Conduct a Geoscience/Reservoir Modeling Workshop

This workshop is planned for May 2002. The results from the workshop will affect the planning for the remainder of this research project. The workshop was designed to simulate discussion and ideas concerning the data requirements for all modelers, the measurement techniques that will provide the best data, and the need for new and better sensors for making measurements. From this workshop, the JIP intends to learn the data requirements most needed from the participants, and the relative importance of each data item or data set. The JIP will use the

output from the workshop to prioritize the data we can collect in our field work. The results from the workshop will be documented in detail. A workshop report will be available on the JIP website, and a DOE report on the workshop will be written and submitted to the DOE.

4.8.4 Subtask 8.4 – Write a Geoscience/Reservoir Modeling White Paper

The results from the Modeling, Measurements, and Sensors Workshop will be documented and placed on the JIP website. In addition, a DOE report on this and the other two workshops will be written and submitted to the DOE. However, to guide data collection in Phase II of this project, the Seafloor Stability Team will prepare a White Paper on the data required by geoscientists and engineers who develop and use models to understand the behavior of sediments containing gas hydrates. The White Paper will use the results of the workshop, and provide a guide for the JIP as it makes plans to gather data in both the laboratory and the field.

4.8.5 Subtask 8.5 – Develop Data Collection Requirements for Phase II

As we develop data collection plans for Phase II of this project, the White Paper and the results from the Modeling, Measurements and Sensors Workshop will provide valuable input into the planning process. The Seafloor Stability Team will be instrumental in the planning processes, so that we are assured of maximizing our efforts at collecting data that will be useful to the modeling community.

4.9 Task 9 – Develop Drilling and Coring Test Plans

We formed a committee on drilling and coring practices in gas hydrates and this committee planned and solicited interest in a drilling and coring workshop. The workshop on drilling and coring practices in deepwater gas hydrates is planned for May 2002. The results of the workshop will be included in a DOE report and will be used to document current drilling practices when drilling in areas where hydrates are known to or thought to exist. The workshop will also help us to develop scenarios for drilling and coring gas hydrates in deep water, and to determine costs and risks of the various scenarios. Finally, we plan to develop guidelines and issue protocols to be used when drilling or coring through natural gas hydrates, then prepare detailed plans for drilling and coring gas hydrates in deep water.

4.9.1 Subtask 9.1 – Form a Drilling and Coring Committee (Completed)

Currently, we do not know the best way to drill through or core through formations containing natural gas hydrates. Several methods have been discussed and costs have been estimated, but substantial progress is required to meet the objectives of this research project while keeping the research budget reasonable. As such, the Drilling and Coring Team was charged with organizing and conducting a workshop concerning drilling and coring practices through formations containing gas hydrates in deep water.

4.9.2 Subtask 9.2 – Plan a Drilling and Coring Workshop

The Drilling and Coring Team met several times to plan the Drilling, Coring and Core Analyses Workshop, to set the agenda, identify likely participants, solicit interest, and find keynote speakers. The purpose of the workshop is to get the drilling community together to discuss the important issues and help develop plans that can be used in Phase II of this project.

4.9.3 Subtask 9.3 – Conduct a Drilling and Coring Workshop

The Drilling, Coring and Core Analyses Workshop is being planned for May 2002. The results of the workshop will be instrumental in organizing the remaining tasks in Phase I, and for planning Phase II. The workshop will be organized to allow participants to discuss the state of the art in drilling and coring practices in deep water, and how those practices are affected by the presence of natural gas hydrates. Safety issues will also be thoroughly discussed and documented. In addition, time will be spent looking at relevant drilling and coring issues from the Mallik project and other projects of interest. The results from the Drilling, Coring and Core Analyses Workshop will be documented in detail on both the JIP website and in the DOE report.

4.9.4 Subtask 9.4 – Publish a White Paper Documenting Current Practices

In addition to the workshop report on the JIP website and the DOE report documenting the results from the workshop, the Drilling and Coring Team will be preparing a White Paper concerning how to best drill and core through formations containing natural gas hydrates. The importance of this task cannot be overstated. Safety is the primary concern in all deepwater operations. This White Paper will prove to be extremely beneficial to all parties associated with this research project.

4.9.5 Subtask 9.5 – Develop Scenarios for Drilling and Coring Gas Hydrates

One expected result from the Drilling and Coring Workshop is the discussion of scenarios concerning how we can best drill through and core formations containing gas hydrates. These discussions will help the Drilling and Coring Team prepare plans for drilling and coring wells during Phase II of this project. In addition to the workshop, members of the Drilling and Coring Team have been reviewing data and specifications for several vessels that could be used in Phase II of the project.

4.9.6 Subtask 9.6 – Conduct a Cost/Risk Analyses on the Various Scenarios

All feasible scenarios concerning how the JIP can drill and core wells during Phase II of this project will be defined and analyzed to determine the costs and risks associated with each scenario.

4.9.7 Subtask 9.7 – Develop Drilling and Coring Protocols for Gas Hydrates

From the workshop and other meetings held by the Drilling and Coring Team, the team will recommend a likely scenario for drilling and coring natural gas hydrates in deep water, that will lead to a logical field data collection process in Phase II of this project. Once the drilling and coring protocols and procedures are approved by the MMS, they will be documented and put out to industry for comments.

4.10 Task 10 – Core Handling and Core Tests

We have conducted a detailed literature search to determine what information is required from tests of cores containing gas hydrates. We are in the process of preparing protocols for coring, core handling, core preservation, core transport, and core testing for cores containing natural gas hydrates. Much of the information the JIP needs will be presented and recorded in the Drilling and Coring Workshop in May 2002, which will be documented in a DOE Report.

4.10.1 Subtask 10.1 – Core Sample Information

During Phase II of this project, we will be cutting cores in formations potentially containing natural gas hydrates. To prioritize how the core is handled, preserved, transported and distributed, the Drilling and Coring Team have been working to determine the exact core tests that will be required, and how much core will be required to conduct those tests.

To design core sampling and core presentation work plans, the JIP must develop a flow chart that clearly enumerates what measurements will be needed, where, when and by what process they will be obtained. Only after knowing exactly how much core is needed, where the core is needed and for what purposes the core will be used can the JIP come up with a realistic plan to preserve and transport that core. Several gas hydrate coring projects, Mallik 2L-38, ODP Leg 204 BPS Arctic Project, and Anadarko's Arctic Project, have just been completed or will be conducted soon. The JIP should watch these projects very closely and apply all best practices.

4.10.2 Subtask 10.2 – Core Sample Protocols

It is likely that the results from the Drilling and Coring Workshop will clearly show that protocols already exist in the Ocean Drilling Program and other programs, such as the Mallik project, concerning how to core, handle, preserve and transport cores containing natural gas hydrates. The JIP plans to use existing protocols as much as feasible during Phase II of the project. We will combine the ODP protocols with information we obtain elsewhere and will prepare comprehensive plans that will be used in Phase I of this project for core handling, preservation and transportation.

Westport Technology Center will prepare a report for the DOE, under a separate contract, covering all aspects of core handling, preservation, and transportation. A meeting is planned for the May 2002 workshop. The Drilling Team and others will meet with Westport personnel to discuss the details of this task and to transfer responsibility for accomplishing it to Westport.

4.11 Task 11 – Select Locations for 3 Field Tests

Using the database we have created, and all available information from the three workshops we have held, we have developed a short list for potential field test sites. As we progress through Phase I of this project, we will be collecting as much data as possible concerning the location of gas hydrate deposits in the deep water GOM.

4.11.1 Subtask 11.1 – Develop Short List of Field Test Sites

During Task 3 of this project, the JIP held a Data Collection Workshop and developed a website to store information concerning gas hydrate deposits in the deep water GOM. The information

obtained during the workshop has been combined with published data and knowledge held within the JIP participants to develop a short list for potential field test sites.

4.11.2 Subtask 11.2 – Comprehensive Database Evaluation

Once several sites have been selected for potential field test sites, we will thoroughly evaluate the data in the database to evaluate each site. If possible, we will obtain additional data from service companies, operating companies, academia and government organizations to assist our evaluation of the most promising sites.

4.11.3 Subtask 11.3 – Additional Data Analysis

As the JIP continues to evaluate the data and determine the best sites for field tests, it will become evident that we are missing certain data items or data sets that could be of benefit to our analyses. We will use this knowledge to help us plan the data collection programs for future field tests. It is important to not only collect accurate data, but we must also know and prioritize our data collection efforts to be of maximum benefit to the geoscientists and engineers who will be using the data.

4.11.4 Subtask 11.4 – Selection of 3 Field Test Sites

Using all available information, we need to select three sites for conducting field tests during this project. Site selection will be critical to our success and should be based upon costs, risks and the ability of our project to succeed. Obviously, the operators of the sites selected will need to be contacted and included in our planning processes.

4.11.5 Subtask 11.5 – Prioritize Field Test Sites

Since only a limited number of test sites will be drilled in Phase II, it will be necessary to prioritize the field test sites in order of preference. We will be conducting a pilot test during Phase II so we can test our protocols, our methodology and our technology. It is important that the best site be chosen to maximize our chances of success. Costs, risks and the quality of the technical information must all be evaluated to prioritize the field test sites.

4.12 Task 12 – Document Results and Conduct Conference on Field Test Plans

Annual and topical research reports will be written to document this project. We plan to hold a 2-day conference to solicit input from industry on the plans for conducting field tests. In addition, technical papers will be written and presented at various technical meetings as warranted. The reports that will be written during Phase I of this project are given in **Table 4.2**.

Table 4.2 – Reports to be Written During Phase I

	Subtask	Title	Due Date
1	3.3	Results from the Data Collection Workshop, the Drilling and Coring Workshop, and the Modeling, Measurements and Sensors Workshop.	Nov. 2002
2		Semi-Annual Report, October 2001 – March 2002	Jan. 2003
3		Semi-Annual Report, April – September 2002	Jan. 2003
4	6.3	Protocols for Seismic Data and Acquisition and Processing	TBD
5	8.4	Geoscience/Reservoir Modeling White Paper	TBD
6	9.4	Current Drilling Practices White Paper	TBD
7	12.0	Results from the Field Testing Workshop	TBD
8		Final Report for Phase I	Dec. 2003

5.0 Phase II – Initial Core and Well Log Collection and Analyses

Phase II of this project will commence early in 2003.

5.1 Task 1 – Research Management Plan

We will develop a work plan and supporting narrative that concisely addresses Phase II of the project as set forth in the Technical Proposal and DOE Contract. The Research Management Plan (the Plan) will provide a concise summary of the technical objectives and the technical approach for each Task and, where appropriate, each Subtask. The Plan will provide detailed schedules and planned expenditures for each Task using graphs and tables as needed. The Plan will contain all major milestones and decision points.

5.2 Task 2 – Project Management and Oversight

A Project Manager will be appointed by ChevronTexaco to manage Phase II of the project for the JIP. The Project Manager will supervise the technical committees and the contractors and will handle the day-to-day operation of the project. The Project Manager will report verbally and in writing to the DOE as needed.

5.3 Task 3 – Validation of New Gas Hydrate Sensors

We will meet with all interested parties to discuss the new sensors that are being developed (assuming that someone has taken on this task). Once the prototype sensors are ready, we will plan to test the sensors in our data wells and to produce and distribute protocols for using the new sensors.

5.4 Task 4 – Validation of the Wellbore Stability Model

The well bore stability model will be revised using laboratory data and will be validated using all available information. Changes or improvements will be made and the model will be distributed for use by organizations that are drilling wells in the deep water GOM.

5.5 Task 5 – Core and Well Log Data Collection – Area A

Using our best area selected during Phase I, we plan to drill twin wells in the most favorable location for gas hydrates in Area A. Well A-1 will be drilled without well control and will gather drilling, MWD and open hole logging information. Well A-2 will be drilled with well

control and will gather drilling, MWD, core and open hole logging information. The wells will be surveyed and the core will be sent to laboratories for analyses. We will then drill Well A-3 in the least favorable location for gas hydrates in Area A, and obtain appropriate core, logging and drilling data. These drilling plans may be modified to accomplish currently undefined scientific objectives and drill ship availability and cost.

5.6 Task 6 – Data Analysis – Area A

We will conduct appropriate laboratory tests of cores from Wells A-2 and A-3 to generate data to assist in the interpretation of the seismic data, the petrophysical properties, the sedimentology, the distribution of the hydrates in the cores, and the chemical and physical properties of the cores. We will also analyze data from the MWD and open hole geophysical logs from Wells A-1, A-2, and A-3. Finally, we plan to integrate log, core and seismic data from all three wells.

5.7 Task 7 – Update Models, Plans and Protocols

Using all of the new data from Area A, we will update all theoretical models, as well as all protocols concerning drilling, coring, and seismic operations. These protocols and models can be used to update plans for drilling future data collection wells.

5.8 Task 8 – Integrate New and Old Seismic Data in Test Analyses

The results of the previous data collection and lab analysis effort may indicate changes to or improvements in the type and method on seismic data needed for natural gas hydrate collection. Based on these results, we will determine the need for and collect additional seismic data in the test areas and integrate these new data into our existing database.

5.9 Task 9 – Conference and Information Transfer

We plan to write topical and annual reports, plus a final report and appropriate technical papers to document the work we will do during this project. We will also hold a 2-day technical conference to present all information to industry and solicit opinions and interest in continuing with Phase III.

5.10 Phase III – Comprehensive Core and Well Log Data Collection and Analyses (2005-2006)

Phase III is not included in this research project. If Phase II is successful and all parties agree to continue this research, Phase III will be a continuation of Phase II in more gas hydrate sites in the deep water GOM. If all parties agree to proceed with Phase III, a detailed technical and cost proposal will be prepared and presented.