SJR

5

Alaska State Legislature

Senate Majority Web: www.akrepublicans.org

Sponsor: Senator Gene Therriault
Current Version: SJR 5
Contact: Joe Balash, 465-4797

Fact Sheet for: Senate Joint Resolution 5

Short Title: REAUTHORIZE METHANE HYDRATE RESEARCH ACT

Summary:

- Requests the U.S. Congress to reauthorize the Methane Hydrate Research and Development Act to fund research and field testing under that Act.
- Requests reauthorization for five years, with appropriations of at least $70 million over that time frame.

Benefits:

- Funds research, mapping and computer simulation to determine the actual volume of gas hydrates that could be produced, and eventually lead to commercialization of Alaska's natural gas hydrates—40 to 100 trillion cubic feet of which are in place in the central portion of the North Slope in close proximity or underlying existing producing fields.
- Furthers research currently under way in the MacKenzie River delta and on Alaska's North Slope.
- Could help meet the burgeoning national demand for natural gas, predicted to increase from 59 billion cubic feet per day to 84 billion cubic feet per day by 2025.
- Could help extend the life of the proposed Alaska natural gas line, remove potential reserve risk, and provide an important supply of gas for the Lower 48.
- Could help attract project financing and potentially lower the tariff, which could in turn increase exploration and early expansion of the proposed natural gas pipeline.

Background:

- Gas hydrate is a substance composed of methane molecules trapped in cages of water molecules. Hydrates are abundant in low temperature and high pressure environments, most notably in the permafrost zones of Alaska and deep waters of the Gulf of Mexico. Gas hydrates in Alaska could total 32,000 trillions of cubic feet, and when freed, yield 164 to 180 times their volume in free gas. As of yet, however, it is not known how to harvest their energy.

Alaska State Legislature

Please enter into the record my testimony to the House Resources
committee name

Committee on SJR 5, dated 2-28-05
bill # / subject public hearing date

I oppose any effort to develop the coal and methane gas, especially in the Homer area. It will not only destroy this area but will increase the pollution of Cook Inlet and adversely affect the fisheries. I own property at Binocular Bluff along the highway that serves the City of Homer. I have attended several meetings in opposition to the development of the shallow gas wells which are related to the shallow coal seams that cover the area along the coastline of Kachemak Bay. I am aware of these shallow coal seams that exist in this area of the Bay.

As of now, the City of Homer obtains the main supply of good water at a lake high above Homer. Otherwise, the water in the low areas along Kachemak Bay is not fit for human consumption.

I was born and raised in Lima, Ohio. This is the area where Sohio discovered oil when people were drilling wells for water and also hit oil and gas. Sohio's main oil lines stretched into Texas before the larger discoveries were made in Texas and Oklahoma. Now the lines carry those oils and gases from the south to the north.

After the depression, we moved to a farm. There I witnessed the fact that the discovery of Ohio oil had a very harmful effect on the farm land by the oil wells. I could see that effect on the corn fields. Normally, the corn stalks were over 6 to 8 feet tall. However, where the oil spilled out, the corn stalks were less than a foot tall and never did produce corn of any value.

Cook Inlet does not flush itself of its glacial silt. You must reach Kachemak Bay before you can see the blue of a true ocean. This pumping of coal and methane gas at Homer would destroy the fisheries of Cook Inlet. Also, the pumps needed to suck out the methane gas are so noisy that people will no longer be able to, or much less *want* to, visit the areas of Kachemak Bay, Tutka Bay, Halibut Cove or Seldovia. The noise from the pump compressor will turn Homer into a ghost town. Even the schools will have to move up into the hills above the City of Homer in order to avoid it. We must oppose the harmful development and the added pollution which will destroy the fisheries of this still beautiful area.

Signed: Dale Bondurant *Dale Bondurant*
Testifier

Alaska Constitution Legal Defense Fund
Representing (optional)

31864 Moonshine Dr Soldotna, AK 99669
Address

(907) 262-0818
Phone number

HOUSE COMMITTEE REPC T

(9)
Date Referred to Committee: February 18, 2005 **FURTHER REFERRALS:**

Date of Committee Action: 02/28/05

The RESOURCES Commi tee considered: **SJR 5**

SENATE JOINT RESOLUTION NO. 5 **REAUTHORIZE METHANE HYDRATE RESEARCH ACT**

Urging the United States Congress to reauthorize the Methane Hydrate Research and Development Act.

Recommends it be replaced with [✓] HCS [ ] CS for SJR 5 (O+G)
For Senate Bills with new title: [ ] Technical Title [ ] New Title: HCR_______ **[✓] Same Title [ ] New Title**

[ ] attach amendments
[ ] add new referral to ___________Committee
[ ] Letter of Intent___________Committee

List of Abbrev for Depts.:
ADM
CED
COR
CRT
EED
DEC
DFG
GOV
HSS
LEG
LAW
LWF
MVA
DNR
DPS
REV
DOT
UA

NEW FISCAL NOTES
*Assigned by Chief Clerk's Office

List by Dept(s):	*FN#	Fiscal	Indet.	Zero

PREVIOUS FISCAL NOTES

List by Dept(s):	FN#	Fiscal	Indet.	Zero
DNR	1			X

Signing with recommendations	Printed Last Name	DP	DNP	NR	AM
[signature]	OLSON	✓			
Mary Kapsner	KAPSNER			✓	
[signature]	GATTO			✓	
Paul K Seaton	SEATON	✓			
[signature]	ELKINS	✓			
Albert LeDoux	LeDOUX			✓	
Harry T Crawford Jr	CRAWFORD	✓			
Chair: [signature]	KAPRAS	X			
Chair: [signature]	SAMUELS	X			

D

HOUSE COMMITTEE REPORT

2-18-05

(7)

Date Referred to Committee: February 14, 2005 **FURTHER REFERRALS: Resources**

Date of Committee Action: 2-15-05

The HOUSE SPECIAL COMMITTEE ON OIL AND GAS considered: **SJR 5**

SENATE JOINT RESOLUTION NO. 5 **REAUTHORIZE METHANE HYDRATE RESEARCH ACT**

Urging the United States Congress to reauthorize the Methane Hydrate Research and Development Act.

Recommends it be replaced with [✓] HCS or [ ] CS for SJR5 **(** O&G **)**

For Senate Bills with new title: [ ] Technical Title [ ] New Title: HCR_______ **[✓] Same Title [ ] New Title**

[ ] attach amendments
[ ] add new referral to ___________Committee
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List of Abbrev for Depts.:
ADM
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DPS
REV
DOT
UA

***NEW* FISCAL NOTES** *Assigned by Chief Clerk's Office

List by Dept(s):	*FN#	Fiscal	Indet.	Zero

***PREVIOUS* FISCAL NOTES**

List by Dept(s):	FN#	Fiscal	Indet.	Zero
DNR	1			✓

Signing with recommendations	Printed Last Name	DP (5)	DNP	NR	AM
[signature]	SAMUELS	X			
Beth Gardner	Gardner	X			
[signature]	Kohler	✓			
Mary Dahlstrom	Dahlstrom	X			
Chair: Vic Kohring	Kohring	X			
Chair:					

FISCAL NOTE

STATE OF ALASKA
2005 LEGISLATIVE SESSION

Fiscal Note Number: 1
Bill Version: SJR 5
(S) Publish Date: 2/9/05

Revision Date/Time (Note if correction):
Title: Reauthorize Methane Hydrate Research Act
Sponsor: Sen. Therriault
Requester: Senate Resources

Dept. Affected: Natural Resources
RDU: Resource Development
Component: Oil and Gas Development
Component No. 439

Expenditures/Revenues (Thousands of Dollars)

Note: Amounts do not include inflation unless otherwise noted below.

OPERATING EXPENDITURES	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Personal Services						
Travel						
Contractual						
Supplies						
Equipment						
Land & Structures						
Grants & Claims						
Miscellaneous						
TOTAL OPERATING	0.0	0.0	0.0	0.0	0.0	0.0
CAPITAL EXPENDITURES						
CHANGE IN REVENUES ( )						

FUND SOURCE (Thousands of Dollars)

1002 Federal Receipts						
1003 GF Match						
1004 GF						
1005 GF/Program Receipts						
1037 GF/Mental Health						
Other (Specify Type--Do not abbreviate)						
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0

Estimate of any current year (FY2005) cost: 0.0
Mark this box (X) if funding for this bill is included in the Governor's FY 2006 budget proposal: [ ]

POSITIONS

Full-time						
Part-time						
Temporary						

ANALYSIS: *(Attach a separate page if necessary)*

No fiscal impact anticipated with passage of this resolution.

Prepared by: Mark D. Myers, Director
Phone 269-8800
Division: Oil and Gas
Date/Time 2/4/2005
Approved by: Tom Irwin, Commissioner
Date 2/4/2005
Agency: Natural Resources

(Revised 9/23/2004 OMB)

United States Department of the Interior
U.S. Geological Survey

MEMORANDUM

January 3, 2005

TO: Bonnie Robson, Consultant to Legislative Budget & Audit, Alaska State Legislature
FR: Timothy S. Collett, U.S. Geological Survey
CC: Brenda Pierce (USGS); Robert Fisk (BLM); Robert Hunter (BPXA); Jim Clough (DGGS)
SU: Alaska North Slope Gas Hydrate Energy Research Issues.

I want to first take this opportunity to thank you for your email inquiry that dealt with gas hydrate research opportunities on the Alaska North Slope (ANS). There are two major gas hydrate projects with an ANS focus. The first is a "basin-wide" gas hydrate energy assessment project being managed by the BLM, USGS, and the DGGS. The second project is a joint industry-government effort, lead by BPXA and DOE to determine the energy resource potential and producibility of several known gas hydrate accumulations in the area of the Prudhoe Bay and Kuparuk River oil fields. In response to your request, I have compiled the following report that contains short summary overviews of both the BLM-USGS-DGGS and BPXA-DOE ANS gas hydrate energy assessment projects. I have also included a short technical review of our historical work on gas hydrates in northern Alaska. This report begins with several recommendations that address your questions about the status of the ongoing gas hydrate research efforts in Alaska and what additional work could be considered to assess the energy resource potential of gas hydrates on the ANS. Thank you again for this opportunity, please contact us if you have any other questions.

RECOMMENDATIONS:

1. The BPXA-DOE gas hydrate project is approaching a critical decision point in their ANS gas hydrate energy assessment efforts. By March of 2005, BPXA-DOE will make the decision to evolve from a mostly office exercise to an active field testing phase. It appears that both BPXA and DOE will make the decision to move ahead with a more aggressive field program, but this decision is still pending. This project could benefit from additional financial support. Letters of support to both BPXA and DOE management would also help clarify the potential importance of gas hydrate energy resource development from a State of Alaska perspective.

DEPT. OF INTERIOR MEMO

2. Activities under the Methane Hydrate Research and Development Act of 2000 are "shall cease to be effective after the end of fiscal year 2005". However, since most of the gas hydrate field production studies under the BPXA-DOE project are scheduled to start near the end of 2005 and run through 2007, it is obvious the Methane Hydrate Research and Development Act of 2000 will need to be renewed. Early indications are that there is broad support to move ahead with new government led gas hydrate research, but the future of the DOE led gas hydrate efforts beyond FY-2005 is unclear.

3. The ANS "basin-wide" gas hydrate assessment being lead by the BLM-USGS-DGGS is moving ahead on schedule with the results of the ANS gas hydrate energy assessment study to be released near the end of FY-2007. The BLM has financially supported most of the direct cost of this project since its start in FY-2003, with the USGS providing in-kind support in the form of research staff salaries. Under the stated goals and timelines, this project is adequately funded. However, both the project goals and scope associated with this effort could be modified with input from other State or Federal interest groups.

4. As summarized later in this report, the BPXA-DOE ANS gas hydrate project is designed to assess the commercial viability of gas hydrates and associated free gas resources in the Prudhoe Bay, Kuparuk River, and Milne Point field areas on the ANS. As noted above, this project has also reached a critical milestone and the future of this effort is unclear. An argument can be made that the State of Alaska and other Federal interest groups in Alaska (including BLM and the USGS) should be more involved in technical aspects of assessing the production response and characteristics of the known and inferred gas hydrate accumulations on State and Federal lands in northern Alaska. Instead of leaving the development of the technology required to produce gas from Alaskan gas hydrate accumulations to the BPXA-DOE project, it might be wise to expand this effort to include a stronger State of Alaska and Federal research component. With the inclusion of State and Federal land and resource management agencies it is likely that we will develop a more complete understanding of the energy resource potential of gas hydrates across the entire ANS.

WHAT ARE GAS HYDRATES?

Gas hydrates are naturally occurring ice-like substances composed of water and gas, in which a solid water-lattice accommodates gas molecules in a cage-like structure. Gas hydrates are widespread in permafrost regions and beneath the sea in sediment of outer continental margins. While methane, propane, and other gases can be included in the hydrate structure, methane hydrates appear to be the most common in nature. The amount of methane sequestered in gas hydrates is probably enormous, but estimates of the amounts are highly speculative. In 1995, the USGS conducted the first systematic assessment of the in-place natural gas hydrate resources of the United States. That study suggested that the amount of gas in the Nation's hydrate accumulations greatly exceeds the volume of known conventional domestic gas resources. The 1995 USGS assessment also estimated that the permafrost-associated gas hydrates on the Alaska North Slope may contain as much as 590 trillion cubic feet of in-place gas. The production history of the

Russian Messoyakha gas hydrate field, in the West Siberian Basin, demonstrates that gas hydrates are an immediate source of natural gas that can be produced by conventional methods. Gas hydrates also represent a significant drilling and production hazard. Russian, Canadian, and American researchers have described numerous problems associated with gas hydrates, including well blowouts and casing failures.

HISTORY OF GAS HYDRATE EXPLORATION IN ALASKA:

The Eileen and Tarn Gas Hydrate Accumulations. Two large gas hydrate accumulations have been identified near the Prudhoe Bay Oil Field. The volume of gas estimated within the known gas hydrates of the Prudhoe Bay-Kuparuk River infrastructure area alone may exceed 100 trillion cubic feet of in-place gas. However, it is important to note that none of the completed gas hydrate energy assessments have predicted how much gas could actually be produced from the known gas hydrate accumulations in northern Alaska.

The occurrence of gas hydrates on the North Slope of Alaska was confirmed in 1972 with data from the Northwest Eileen State-2 well located in the Prudhoe Bay Oil Field. Most of the gas hydrates near the Eileen discovery well, occur in a series of laterally continuous sandstone reservoirs; and are geographically restricted to the area overlying the western part of the Prudhoe Bay Oil Field and the eastern part of the Kuparuk River Oil Field. Three-dimensional seismic surveys in the Prudhoe Bay Oil Field indicate the presence of free-gas accumulations trapped stratigraphically downdip below several of the gas hydrate units. The volume of gas within the gas hydrates of the Prudhoe Bay-Kuparuk River area is estimated to be about 37 to 44 trillion cubic feet.

Recently, data from wells along the western margin of the Kuparuk River Field have revealed a large gas hydrate accumulation overlying the Tarn Oil Field. The Cirque-1 well, located about four miles southwest of the Tarn Oil Field, blewout in 1992 after drilling through what appears to be a free-gas interval possibly trapped below the gas hydrate stability zone. The gas-hydrate-bearing stratigraphic interval in the Tarn area appears to be the up-dip equivalent of the West Sak sands which are estimated to contain more than 20 billion barrels of in-place viscous oil and is the focus of recent development activity. Preliminary analyses of other recently completed wells along the western margin of the Kuparuk River Oil Field suggest that the "Tarn Gas Hydrate Accumulation" may be larger than the "Eileen Gas Hydrate Accumulation".

Gas Hydrate Production. The production potential of the Eileen or Tarn gas hydrate accumulations has not been adequately tested; but it is the present focus of a DOE-BPXA led industry R&D gas hydrate research program (i.e., BPXA-DOE Gas Hydrate Resource Characterization Project). Although unverified by field testing, production models of gas hydrate-bearing reservoirs within prospects interpreted from seismic and well data in the Milne Point area suggest that sustained production rates of several million cubic feet of gas per day can be achieved. In December 2003, the Canadian Mallik 2002 Gas Hydrate Production Research Well Program partners (including the USGS and the DOE) publicly released the results of the first modern, fully integrated field study and constrained production test of a natural gas hydrate accumulation. The Mallik 2002 gas hydrate production testing and modeling effort has, for the first time, enabled rational assessment of the production response of a gas hydrate accumulation. Project-supported gas hydrate production simulations have shown that under certain geologic conditions gas can be produced from gas hydrates at rates exceeding several million cubic feet of gas per day.

A growing body of evidence suggests that a huge volume of natural gas is stored as gas hydrates in northern Alaska and that production of natural gas from gas hydrates may be technically feasible. However, numerous technical challenges must be resolved before this potential resource can be considered an economically producible reserve.

BLM-USGS-DGGS PROJECT REVIEW:

Evaluation of Alaska North Slope Gas Hydrate Energy Resources: A Cooperative Energy Resource Assessment Project
Bureau of Land Management (DOI-BLM)
United States Geological Survey (DOI-USGS)
State of Alaska Division of Geological and Geophysical Surveys (DNR-DGGS)

Gas hydrates may become an important global source of clean burning natural gas. For BLM, and the State of Alaska, gas hydrates are potentially a large untapped onshore energy resource on the North Slope of Alaska. To develop a complete regional understanding of this potential energy resource, BLM, USGS and the State of Alaska have entered into an Assistance Agreement to assess gas hydrate energy resource potential in northern Alaska. This agreement combines the resource assessment responsibilities of the USGS and the DGGS with the surface management and permitting responsibilities of the BLM. As interest in gas hydrates continue to grow, information generated from this agreement will help guide these agencies to promote responsible development of this potential arctic energy resource.

The primary objective of this project is to assess the recoverable resource potential of onshore natural gas hydrate and associated free-gas accumulations on the North Slope of Alaska. This project will assess the regional gas hydrate resource potential on both State of Alaska and Federal managed lands in northern Alaska. This project will actively collaborate with the BPXA-DOE methane hydrate research project, which is presently evaluating the energy resource potential of the known gas hydrate accumulations in and around the Prudhoe Bay and Kuparuk River oil fields.

The BLM-USGS-DGGS Alaska gas hydrate assessment project is divided into three concurrent phases over five years. Phase-I will study the known gas hydrate accumulations within and near existing development infrastructure of the Eileen and Tarn trends. Phase-II will identify and characterize undiscovered gas hydrate accumulations in NPRA, ANWR, and the other relatively sparsely drilled areas between the Canning and Colville Rivers. Phase-III will develop a comprehensive assessment of the recoverable resource potential of gas hydrates and associated free-gas accumulations in northern Alaska.

Phase-I will focus on mapping and characterizing the reservoir properties of the Eileen and Tarn gas hydrate accumulations in close association with the BP-DOE project. We may also conduct field operations to assess various gas hydrate production concepts. Test well operations could be conducted in cooperation with the ongoing BP-DOE or other joint industry research programs.

Phase-II will develop an understanding of the regional gas hydrate petroleum system with a goal to discover significant gas hydrate and associated free gas accumulations within NPRA, ANWR, and Alaska State lands between the Canning and Colville Rivers. The gas hydrate assessment techniques developed in Phase-I of this effort will be used in Phase-2 to assess available seismic and downhole well log data for the presence of gas hydrate.

Phase-III will develop a systematic geologic appraisal of the volume of gas that could be economically produced from the gas hydrates and associated free-gas accumulations on the North Slope of Alaska. The information and field test data from the first two phases of this study will be used to generate and calibrate reservoir simulations, which will be used to model various gas hydrate production scenarios. The field calibrated production simulations will be used to assess the volume of recoverable resources. This project may also include the assessment of the potential gas hydrate resources in the Canadian Mackenzie Delta.

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BPXA-DOE PROJECT REVIEW:

Resource Characterization and Quantification of Natural Gas-Hydrate and Associated Free-Gas Accumulations in the Prudhoe Bay-Kuparuk River Area on the North Slope of Alaska
BP Exploration (Alaska), Inc. (BPXA)
U.S. Department of Energy (DOE)

Under the Methane Hydrate Research and Development Act of 2000, the U.S. Department of Energy (DOE) funds laboratory and field research on both Arctic and marine gas hydrates (a copy of the 2000 Methane Hydrate R&D Act has been attached to this briefing document). Among the current Arctic studies, BP Exploration (Alaska), Inc. and the DOE have undertaken a project to characterize, quantify, and determine the commercial viability of gas hydrates and associated free gas resources in the Prudhoe Bay, Kuparuk River, and Milne Point field areas on the Alaska North Slope. Ultimately, this project could determine if gas hydrates can become a part of the Alaska North Slope gas-resource portfolio.

This cooperative project between BP Exploration (Alaska), Inc. (BPXA) and the U.S. Department of Energy (DOE) facilitates a high level of collaboration between industry, government, and university researchers. The mutually beneficial research activities would not otherwise have been independently conducted by industry. Project results will help identify technical and economic factors that must be understood for government and industry to make informed decisions regarding the resource potential of gas hydrate accumulations on the Alaska North Slope (ANS).

One of the important contributors to this effort is the U.S. Geological Survey, which has led ANS gas hydrate research for three decades. Dr. Timothy Collett of the USGS continues to promote the importance of this area to gas hydrate research and potential development. Shirish Patil of the University of Alaska Fairbanks (UAF) School of Mining and Engineering is leading reservoir and petroleum engineering research and supporting laboratory studies. Dr. Robert Casavant leads the reservoir and fluid characterization efforts at the University of Arizona (UA) with Dr. Roy Johnson and Dr. Mary Poulton.

Gas hydrates are present in many arctic regions and offshore areas around the world. In the U.S., notable deposits of gas hydrate occur in the offshore Atlantic, Gulf of Mexico (GOM), offshore Pacific, offshore Alaska, and also onshore Alaska regions beneath permafrost. Collett (1998) estimates that up to 590 TCF of in-place ANS gas resources may be trapped in clathrate hydrates. Of that total, an estimated 44 to 100 TCF of in-place gas hydrate resources may occur beneath existing ANS production infrastructure within the Eileen and Tarn trends, respectively (Collett, 1993). However, much like conventional oil and gas resources, economic production of gas from potential gas hydrate resources will require a unique combination of factors, including all of the required petroleum system components (e.g., source, trap, seal, charge, reservoir, etc.), adequate industry infrastructure, industry access to acreage, familiar production technology, and favorable economics. In addition, industry must be able to estimate ultimate recovery potential, production rates, operating costs, and potential profitability within reasonable risk limits. Currently, the most likely areas for a favorable combination of these factors are the ANS and the Gulf of Mexico.

In this project, ANS gas hydrate and associated free gas-bearing reservoirs are being studied to determine reservoir extent, stratigraphy, structure, continuity, quality, variability, and geophysical and petrophysical property distribution. The objective of Phase 1 (Oct. 2002 – Oct. 2004) is the characterization of reservoirs and fluids, leading to estimates of recoverable reserve and commercial potential, and the definition of procedures for gas hydrate drilling, data acquisition, completion, and production. If justified by prior phase results, phases 2 (Nov. 2004 – Dec. 2005) and 3 (Jan. 2006 – Dec. 2006) will integrate well, core, log, and production test data from additional wells. Ultimately, the program could lead to development of an ANS gas hydrate pilot project and determine whether or not gas hydrates can become a part of the overall ANS gas resource portfolio.

Interim results from this project have identified potential shallow gas hydrate prospects within reservoir sands of the Sagavanirktok formation in the Milne Point Unit (MPU) area. Areas where gas hydrate may exist in association with movable free gas or possibly movable water have the most potential for production of hydrate-sourced natural gas, based on a preliminary understanding of the geology and potential production behavior investigated within reservoir model scenarios. However, these potential prospects remain largely unproven and require confirmation, delineation, and further data acquisition to mitigate uncertainties.

The shallow gas hydrate-bearing reservoirs of the Tertiary Sagavanirktok formation are part of a complex fluvial-deltaic system complicated by structural compartmentalization within the Eileen trend. Stacked sequences of fluvial, deltaic, and nearshore marine sands are interbedded with both terrestrial and marine shales. Facies changes, intraformational unconformities, and high-angle normal faults disrupt reservoir continuity. Phase 1 work related to volumetric assessment includes detailed well-log analyses and description of reservoir facies and fluids as integrated with the 3D seismic data. In conjunction with structural analyses, the identification and mapping of net pay in discrete sand bodies improves understanding of resource quality, quantity, distribution, and continuity. This work helps refine volume estimates, reservoir models, and recovery factors, production forecasts, and economic analyses.

Interpretations of gas hydrate and associated free-gas resources within the study area correlate with gas hydrates that were originally cored and tested in the 1972 NW Eileen State #2 well and also penetrated by other wells targeting deeper reservoirs within the ANS development area. Geophysical attributes of gas hydrate occurrence are also under investigation. Seismic modeling of shallow (<950 ms) velocity fields suggests both amplitude and waveform variations may help locate gas hydrate-bearing reservoirs. Permafrost can also complicate seismic identification of gas hydrates due to its similar acoustic properties. Identification of gas hydrate prospects within the MPU 3D seismic volume are based on seismic interpretation and modeling, gas hydrate-similar waveform classes, and fault-seal geometrics integrated with well log-derived properties. Fault blocks with significant in-place volumes within identified gas hydrate-bearing reservoirs can be further delineated and/or production tested if the project proceeds into phases 2 and 3.

Understanding the nature of fluid flow and permeability is critical to assessing the productivity of gas hydrates. As part of this project, UAF has developed a new method for measuring gas-water relative permeability for laboratory synthesized gas hydrate within porous media. This work provides input to reservoir modeling and fluid flow. Although laboratory methods may differ from natural methods required to form gas hydrate, the experiment design allows gas hydrate to form in porous media over relatively long periods of time and allows measurement of effective permeability and relative permeability for different saturation values. Although some dissociation of gas hydrate occurs due to differential pressure across the core, the low temperature decreases the rate of gas dissociation. Considerable additional experimental and theoretical work remains to develop an analytical or generalized model to predict relative permeability for gas hydrate reservoir simulation. The experimental data obtained from this work will allow identification of gas hydrate stability zones, determination of flow behavior, and development of techniques for safe production of natural gas from gas hydrates.

The project team has adapted a commercial simulator (CMG-STARS) to model gas hydrate dissociation due to depressurization of an adjacent free gas accumulation in an MPU-area ANS gas hydrate prospect containing an estimated 23 BCF gas in-place. Preliminary results also demonstrate the potential of the depressurization production method by dissociation of gas hydrate adjacent to free gas. Modeling indicates that as gas is produced at rates from 8 to 25 MMscfd per well, the free gas zone depressurizes and the adjacent gas hydrate accumulation begins to release significant additional gas. Preliminary results also demonstrate the potential for depressurization of a partially-saturated gas hydrate-bearing reservoir through production of movable connate waters from a reservoir containing both gas hydrate and movable water at fractional saturations.

Work is proceeding in the areas described above as well as on a number of other tasks. Phase 1 of the project is currently scheduled for completion by November 2004. The Phase 2 progression or project termination decision is scheduled for the next quarter.

BPXA Gas Hydrate Project Manager:
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To:	**The Honorable Pete V. Domenici, Chairman** **Senate Committee on Energy & Natural Resources**
From:	**Dr. Mark D. Myers, Director, Alaska Division of Oil and Gas** **Senator Gene Therriault, Chair,** **Alaska Legislature, Legislative Budget and Audit Committee** **Representative Ralph Samuels, Vice Chair,** **Alaska Legislature, Legislative Budget and Audit Committee**
Subject:	**State of Alaska Briefing Document on Proposal to Reauthorize Methane Hydrate Research and Development Act of 2000, Public Law 103-193, 114 Stat. 234**
Date:	**January 24, 2005**

Executive Summary

Currently, 59 bcfd of natural gas is consumed daily in the United States. The Energy Information Administration estimates that domestic demand for natural gas will increase to 77 bcfd by 2015, and to 84 bcfd by 2025. If the Alaska natural gas pipeline currently envisioned is built, the 35 tcf of known Alaska reserves could satisfy 4.5 bcfd of the total domestic demand for a period of two decades. Alaska's vast gas resources are estimated to also include 250 tcf of undiscovered conventional resources, 590 tcf of onshore (100 tcf within or near existing North Slope infrastructure), and more than 32,000 tcf of offshore gas hydrates, which could supply a much greater percentage of domestic demand for generations to come, particularly if two conditions are met: 1) gas hydrates can be commercialized; and 2) the rules for access to and expansion of an Alaska natural gas pipeline encourage competition in the exploration for and development of Alaska natural gas. The latter condition is currently the subject of rule-making by the Federal Energy Regulatory Commission. However, the former—commercialization of gas hydrates—is at risk absent Congressional action in 2005. Congressional action is needed to reauthorize Pub. L. 106-193, 114 Stat. 234 (2000), the Methane Hydrate Research and Development Act, and to fund research and field testing under that Act. It is proposed that the Act be reauthorized for a period of five years, with appropriations of no less than $10 million/year in years 1-3 and $20 million/year in years 4-5.

The large quantity of hydrates that underlie the existing Kuparuk River, Milne Point, and Prudhoe Bay Fields could in itself remove all potential reserve risk from year 20-35 and beyond for an Alaska natural gas pipeline producing at 4.5 bcfd. Reducing reserve risk will have a positive effect on project financing and potentially result in a lower tariff, which in turn could lead to increased exploration and early expansion of the pipeline.

Introduction

Sharply rising U.S. consumption of natural gas coupled with increasing worldwide gas demand intensify the need to find additional sources of natural gas. An increasingly global LNG market is developing based on these growing international energy demands, and upon the enormous natural gas reserves in the Middle East and other areas of the world. Reliance on these supplies worsens the U.S. trade deficit, places the U.S. natural gas market increasingly in direct competition with other regional natural gas markets (many of which are mushrooming), exacerbates public environmental and security concerns with proposed tanker traffic and plant sitings, and increases U.S. reliance on foreign sources for energy supplies.

Undeveloped Alaska natural gas resources, both conventional and unconventional, are capable of delivering a vitally important share of U.S. gas needs. The recent rise in energy costs to what many consider to be a new long-term level has led to negotiations for building an Alaska North Slope (ANS) natural gas pipeline to ship these domestic supplies to distribution hubs serving the lower 48 states. The currently envisioned pipeline would deliver 35 tcf of proven Alaskan gas reserves from existing oil fields at a rate of 4.5 bcfd for more than two decades, supplying about 6% of the 77 bcfd of U.S. demand forecast by the EIA for 2015.

Furthermore, numerous assessments recognize that the total North Slope gas resource far exceeds just these proven reserves. Mean estimates by USGS, MMS, and the State of Alaska place at least 242 tcf of undiscovered, technically recoverable conventional gas under federal onshore and offshore areas (Table 1, AK Division of Oil and Gas, 2005) plus 590 tcf in-place of gas hydrates onshore in permafrost areas, and more than 32,000 tcf in-place of gas hydrates offshore in the Beaufort Sea (Sherwood and Craig, 2001 after Collett, 1995). Alaska's total gas hydrate endowment, including the surrounding federal waters, is estimated at over 169,000 tcf of in-place gas hydrate (Sherwood and Craig 2001 after Collett, 1995). USGS assessments estimate 40 to 100 tcf of gas in-place in shallow permafrost-associated gas hydrate reservoirs in the infrastructure-served central ANS onshore area alone (Figure 1). The Alaska North Slope is one of the most promising places in North America to determine the resource potential of gas hydrates because of existing infrastructure, which will prove vital in supporting the emerging technologies required (Johnson, 2003).

Given that all reasonable estimates of the total ANS gas resource are much larger than the 35 tcf basis for the currently envisioned Alaska to Lower 48 gas pipeline, including the vast potential in the form of methane hydrates, it is essential that the federal government take steps to ensure that two conditions be fulfilled: 1) current progress in gas hydrate research and development must continue at full momentum to determine as quickly as possible whether these resources are commercially viable, and 2) the rules for access to and expansion of an Alaska North Slope gas pipeline must encourage industry competition to develop much needed additional gas, both from potential gas hydrate reservoirs and from revitalized exploration for conventional gas reserves. The Federal Energy Regulatory Commission is aware of the second condition, and is actively working to establish rules that will safeguard its ability to require capacity expansion as new reserves become available.

The economic return and risk associated with building the ANS gas pipeline depends largely on its useful lifespan, a function of both available reserves and pipeline capacity. Table 2 summarizes the relationship between project lifespan and reserves for two capacity scenarios, the 4.5 bcfd base case and a 5.6 bcfd expansion case, respectively. In the base case, project life increases from about 2 decades to more than 3 ½ decades when the available reserves increase from the 30-35 tcf of known conventional gas associated with current oil fields to 60 tcf due to the discovery of new conventional reserves or commercialization of hydrates in place beneath existing infrastructure.

The remainder of this proposal addresses meeting the former condition – federal funding in support of gas hydrate resource commercialization.

Call for Legislative Action

The Methane Hydrate Research and Development Act of 2000 (Public Law 103-193, 114 Stat. 234) was created to determine whether or not gas hydrates could become a significant source of natural gas in the future. Because this Act expires at the end of the 2005 fiscal year, immediate congressional action is needed to replace it. Governor Murkowski's proposal urges new legislation to cover the five year period 2006-2010, with total appropriations of no less than $70 million. Beginning with annual funding of $10 million to continue and expand ongoing research in 2006-2008, appropriations would increase to $20 million annually in 2009-2010 as the emphasis shifts from laboratory research and computer simulations to field testing and development pilot projects.

As stated in the proposal, the goals of the reauthorization and appropriations are threefold: 1) determine conclusively whether major gas hydrate accumulations can become a commercially producible resource, 2) grow the body of publicly available data, knowledge, and technology relevant to detailed resource assessment, exploration, and production of gas hydrates, and 3) fund a field testing program at a level adequate to remove commercial hurdles that would impede or prevent private industry from pursuing gas hydrate pilot projects. Specific steps will enable achieving each of these objectives and a careful review of the previous legislation may be required to ensure language in the reauthorization that is consistent with this legislative intent.

Conceptual Steps and Justification

The suggestions that follow are not intended to replace careful planning by those managing gas hydrate research and development programs and should not be used in constructing legislative language without broad support of those program managers. At this point, we recommend using language in the reauthorization that will ensure clear legislative intent without specifying detailed procedures for reaching these goals. In the broadest sense, activities fall into two categories: 1) developing improved assessments of both the total resource potential associated with gas hydrates and the volume of hydrate-related gas likely to become commercial over time given that pipeline capacity exists to ship it to market, and 2) developing gas hydrate production technologies, including field tests to prove up and compare alternative techniques. Both goals should be pursued beginning in year 1 with expanded desktop research and maintaining current research programs, leading to a greater emphasis on testing operations in years 4 and 5. Participation in "wells of opportunity" (i.e., industry wells targeting deeper horizons providing opportunity for data acquisition during penetration of shallow gas hydrate-bearing horizons) during years 1 through 4 merits federal funding to share or offset the costs of reservoir evaluation.

Continue technical and commercial assessments of onshore North Slope sub-permafrost gas hydrates and their associated free gas resources

Ongoing office, laboratory, and field research projects will feed directly into activities under a renewed gas hydrates act. The most successful research is likely to come from collaborative interdisciplinary teams of geologists, geophysicists, reservoir engineers, petroleum engineers, and commercial analysts representing a cross section of federal and state resource management agencies, industry, consultants, and universities. As stated in the proposal, the Alaska Department of Natural Resources, Division of Oil and Gas is also discussing with the Alaska State Legislature obtaining funding for an additional geologist dedicated to gas hydrate issues. This would facilitate the pairing of state and federal expertise and data sets, allowing for faster and more accurate collaborative resource assessments. In order for this structure to be effective, early administrative attention will be required from the participating organizations to establish the ground rules and data confidentiality requirements. Some of these ground rules and requirements which must be agreed upon early are likely to include issues such as the extent of data sharing, assessment methodologies, conditions for using proprietary data in making public resource interpretations, and specific data types and interpretive results that can be released to the public and/or shared with participating industry to support the conclusions.

Once these resource evaluation and development planning teams are in place, they should be authorized to integrate and expand upon current regional-level assessments of in-place permafrost-related gas hydrate and associated free gas resources. Some of these current assessments include the collaborative efforts underway involving the BLM, USGS, and State of Alaska. Future assessments funded by this legislation should expand upon this coordination, using consistent methodologies across federal and state lands of North Alaska. Assessment provinces should include the known hydrates in and near existing infrastructure on state lands of the central North Slope Colville-to-Canning corridor as well as more remote areas. The first remote provinces to be assessed should include state-lands foothills, the NPRA in the west, and the ANWR 1002 area in the east.

The proliferation of 3D seismic data across large areas of the North Slope over the last decade provides these research teams the opportunity to create much more reliable assessments than has ever been possible before. Access to these privately-acquired seismic surveys is restricted, but includes the state or federal agency that manages the lands in question. By assigning appropriate technical personnel in accordance with their agency's data access privileges, the research teams should be able to obtain, use, and integrate all available 3D seismic data coverage to develop a comprehensive portfolio of specific gas hydrate and associated free gas prospects. In some cases, it may be appropriate to license new or existing seismic surveys for assessment work, or even purchase the rights to release certain seismic data to the public. The portfolio should quantify the geologic risk profile and probabilistic distribution of in-place resource for each prospect using a standard petroleum systems approach. This work has been pioneered with tremendous success in the Milne Point Unit through the BPXA – DOE cooperative research study (e.g., Inks and others, 2004), where it is the basis for highly detailed gas hydrate resource estimates and production profile modeling.

Dedicated logging and/or coring of gas hydrate and sub-hydrate free gas intervals in several key wells per year should be considered beginning in year 1. The additional data obtained will improve assessments of hydrate resource beneath existing infrastructure. Office and laboratory studies should continue into years 4 and 5, when they will begin to benefit from incorporation of the results of more field-based production testing. Subsequent iterations of reservoir performance models will thus be better calibrated and will more reliably forecast production rates and ultimate recovery of untested gas hydrate reservoirs. Better production forecasting will mean better ability to convert assessments of in-place resource to estimates of technically and economically recoverable gas reserves. Ultimately, the research will develop regional depletion plans and realistic potential development programs using reserves and rate profiles to assess regional development economics. The work will extrapolate reservoir models into regionally verified resource potential, construct production rate profiles within a range of expectations, and calculate potential regional gas reserves.

A final step in the office-based research process will be to develop commercial filters to apply to in-place or technically recoverable assessment figures to screen out resources located in accumulations too small to develop profitably. Estimates of the magnitude of reserves that may eventually be shipped would be far more useful than the technically recoverable reserves figures so often cited in resource assessments.

Design and conduct field production tests and pilot development of North Slope hydrates to assess viability of producing free gas and associated methane hydrate by depressurization of the free gas leg

The dearth of factual production data is one of the most critical gaps in commercializing much needed gas hydrate resources. Many in private industry acknowledge the enormous scale of the in-place resource, but without proven production potential, are unwilling to risk large-scale investments in testing and developing these reservoirs. Given the gas supply shortage facing the nation and the likelihood that construction of a gas pipeline will begin in the near future, the national interest is best served by funding public projects to close the gap in collaboration with, but without relying exclusively upon industry.

Beginning in year 1, and working in parallel with the assessment teams, engineers and geologists will be tasked with designing testing operations to begin during year 2 and continuing with the increased funding in subsequent years. Research to date has identified gas hydrate accumulations within the footprint of existing North Slope infrastructure that include a gas hydrate cap in communication with an underlying free gas column (Figures 2 and 3) as viable candidates for initial production testing. Accumulations of this description have been termed Type 1 hydrates (Moridis and Collett, 2003). Conventional completion and production of the free gas column eventually lowers reservoir pressure below the stability limit of the overlying gas hydrate zone, causing it to dissociate and release additional free gas across a broad regional contact. Because hydrates store 164 to 180 times as much methane as the same volume of free gas, their dissociation contributes large volumes of producible gas. The Messoyakha gas field in the West Siberian Basin is often cited as a producing example of a permafrost-associated gas hydrate accumulation, due to the difference between expected and actual declines in both reservoir pressure and production rate.

Feasibility studies carried out under a cooperative project between BP Exploration (Alaska) and the DOE (Howe and others, 2004) have adapted commercially available reservoir simulation software to model schematic and actual hydrate-bearing reservoirs, with more detailed versions in progress (Figure 3).

The following discussion provides an overview of the current understanding in some of the more significant modeling. Cases 1-3 of Figure 4 depict simulated production profiles of a Type 1 gas hydrate representing 15 years of production from the same 300 mD permeability reservoir, but with variations in the type and number of producing wells. The initial plateau flow rates of these three cases are operationally constrained at levels ranging from 25 to 50 million cubic feet per day (mmcfd) per well. A 50 mmcfd plateau rate can be maintained significantly longer using a single horizontal producer than with two vertical producers constrained to 25 mmcfd each. After 15 years, the simulated total flow rates are nearly the same at about 18 mmcfd, regardless of whether one, two, or three producers are involved. Additional models indicate that after the steep decline that initially follows the plateau, the very slow decline rate of later years is due to steady supply of free gas from hydrate dissociation (Figure 5). This modeling is highly encouraging, but requires validation by field testing.

Details of design activities would be determined by the actual team, but a logical workflow would presumably begin with selection of candidate prospects for field testing within areas supported by existing North Slope infrastructure. Potential locations are already available in the Milne Point Unit where collaborative studies have integrated well data and 3D seismic data to quantify both Type 1 and Type 2 (hydrate only) prospects.

Numerous questions will be addressed at the outset of the design phase, including whether to drill a dedicated research well or share one intended for deeper production. Decisions will be required regarding optimal borehole angle, the duration of test production, and facility limitations. Depending on the type of wellbore selected for the testing and pilot program, drilling or work-over and completion operations will be necessary to expose the production zone in the free gas leg. This stage, including formation evaluation, should be complete within the first month, followed by an initial well testing phase that may last several weeks or months.

At this point, it is recommended that the well be placed on long-term production test for meaningful comparison to modeled production profiles. Depending on free gas volumetrics, the difference between original reservoir pressure and the hydrate stability limit, and operational constraints on the test producer's plateau flow rate, a pilot production plan lasting more than two years may be required to monitor the effects of depressurization and consequent hydrate dissociation. Because long term production testing may yield substantial quantities of methane, it will be advantageous to plan for local use of the gas. Possibilities include fuel for testing operations or field utilities, or reinjection for pressure maintenance of other reservoirs.

Design and conduct field production tests and pilot development of North Slope hydrates to assess viability of producing directly from hydrates without free gas depressurization

A second test should be designed to assess the viability of producing directly from hydrates that have no free gas leg available for conventional completion and depressurization. A major share of potential ANS gas hydrate resources appear to be trapped within these hydrate-only areas. Potentially, such a test could be conducted in the hydrate cap of a Type 1 reservoir, in Type 2 hydrates, which are accompanied by an underlying zone of movable water in the reservoir, or in

Type 3 hydrates, which fill the entire formation (Moridis and Collett, 2003). The project team will face many of the same decisions as for the free gas/hydrate dissociation test, including site selection, type of wellbore, and duration.

The critical difference between this and a free gas production test is that steps must be taken to prevent further cooling of the reservoir around the producer that would lead to reformation of the hydrates and shut off the flow of gas. The three ways of dissociating the hydrate structure to release gas are by lowering pressure, increasing temperature, or altering reservoir chemistry. However, dissociation is an endothermic (heat consuming) reaction that lowers the temperature of the surrounding formation. So, while it may be possible initially to liberate some free gas simply by lowering reservoir pressure adjacent to the well bore, it can freeze solid again unless heat and/or chemical inhibitors are added to the formation. The optimum test for producing directly from hydrates would provide the capability of experimenting with and comparing various thermal and chemical stimulation technologies. Several processes have been proposed that warrant consideration in the design phase:

- thermal stimulation with steam huff and puff
- thermal stimulation by closed-system circulation of warm water from the surface (either artificially heated on-site or still-warm formation water separated out of production stream from deeper reservoir)
- thermal stimulation by closed-system circulation of hot waters brought directly to the reservoir from a deeper aquifer zone in the same well
- thermal stimulation by in-situ catalytic combustion, electromagnetic, or microwave sources
- inhibitor injection (e.g., methanol)
- Carbon dioxide replacement of methane in hydrate structure (McGrail and others, 2004). If this process becomes viable, it may provide synergistic carbon sequestration benefits, in addition to liberating methane.

It will be up to the test design team to identify and select the most promising of these methods for direct field comparison.

Hypothetical R&D Activity and Expenditure Timeline

Table 3 represents a broad framework for executing the suggestions outlined above. This legislative proposal is submitted in recognition of the need for funding rapid and material advances toward unlocking the potential of our gas hydrate resources. Details of research and development tasks and the proposed expenditure timeline are subject to revision by project teams.

Recommendation

An urgent need exists for the reauthorization of federal legislation appropriating funds to support gas hydrate research and development. In the face of escalating demand and uncertain supply from overseas imports, it is critical that the United States increase domestic supply and diversify its sources of natural gas to include the development of unconventional resources. Known gas hydrates overlying the already-developed oil fields of Alaska's North Slope afford a unique opportunity to meet both objectives provided they can be produced and brought to market economically. The need to better understand hydrate commerciality is all the more pressing given the inter-relationship to planning for the construction, operation, and regulation of an Alaska gas pipeline. The steps suggested here are offered as a conceptual basis for more detailed planning that will be needed to realize the intended goals of the proposed legislation.

(Figures 1-5, Tables 1-3, and References following on separate pages)

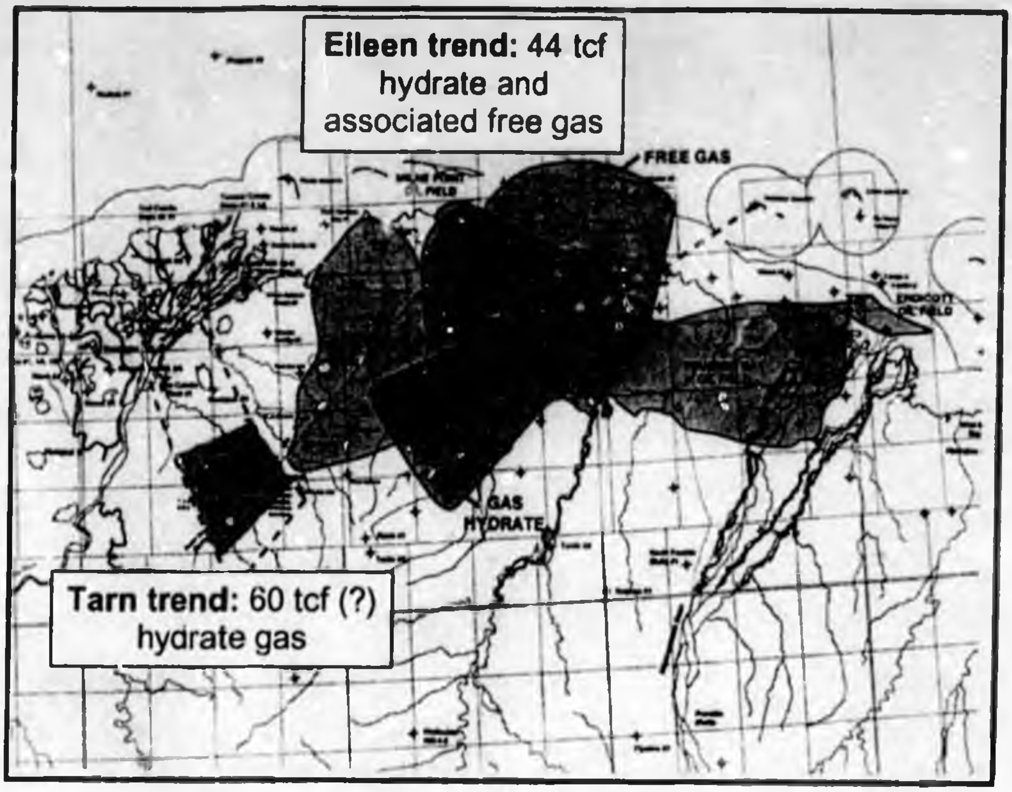

Figure 1. Known gas hydrate accumulations (blue) and hydrate-associated free gas accumulations (orange) in the vicinity of the major North Slope oil fields (green). The USGS estimates up to 100 tcf in place of hydrate in the Eileen and Tarn trends combined. From T.S. Collett, 10/01 and Hunter and Collett, (2004).

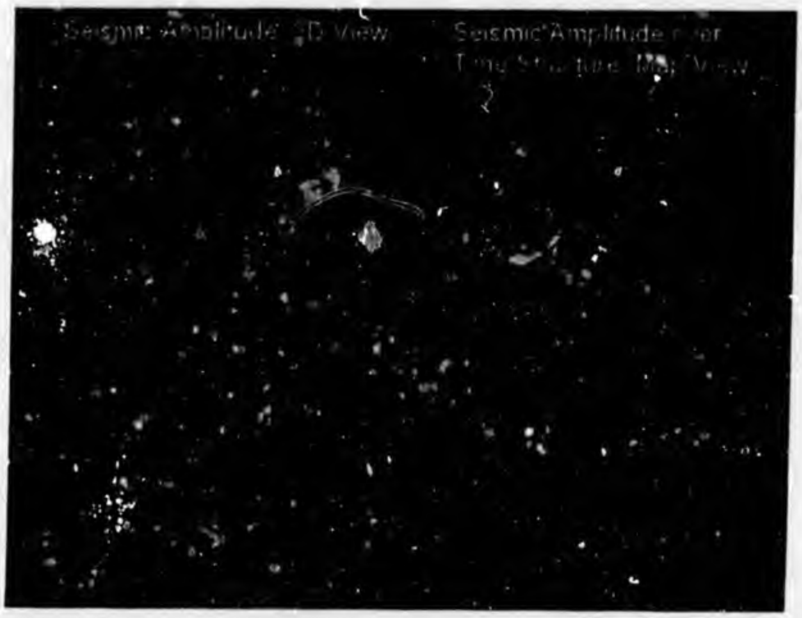

Figure 2. Seismic amplitude of a gas hydrate prospect within the Milne Point Unit in 3-dimensional view (left) and in map view with time structure (right). Warmer shades in shallowest corner of the fault-bounded reservoir compartment are interpreted to be gas hydrates, consistent with the estimated depth of the hydrate stability zone. From Hunter (2004).

Figure 3. Milne Point Unit reservoir model showing gas hydrate cap (orange) overlying free gas (green) and a single vertical producing well. From Howe and others (2004).

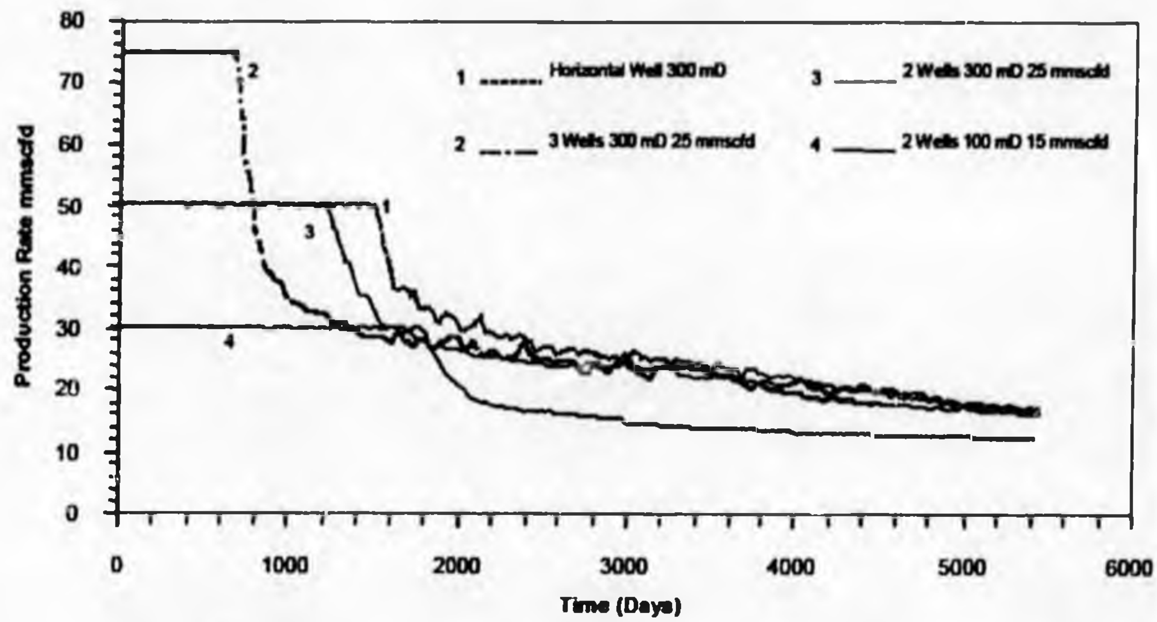

Figure 4. Gas production profile from a schematic reservoir. Cases 1, 2, and 3 compare offtake profile from the same reservoir using one horizontal, three vertical, and two vertical wells, respectively. Note extended plateau for one horizontal compared to two vertical wells, and that total flow in all scenarios is virtually the same after 15 years. Case 4 represents a lower permeability reservoir. Originally from Howe and others (2004) cited by Hunter (2004)

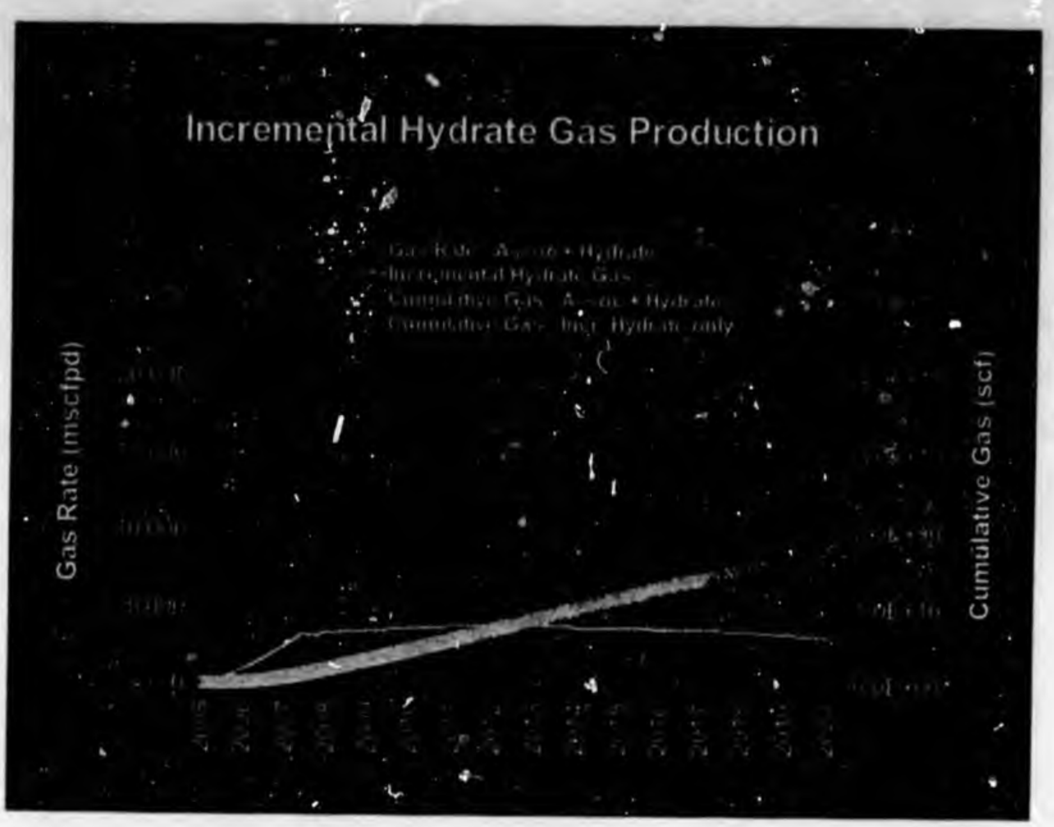

Figure 5. Graph showing modeled contribution of hydrates to total production for the reservoir model in Figure 3 (not the schematic reservoir represented in Figure 4). Production of original free gas constitutes all of the initial production; reservoir depressurization results in dissociation of overlying hydrates into free gas. In this particular simulation, dissociated hydrate gas accounts for nearly all production beyond the fifth year, and continues at a nearly constant rate for the next decade.

Table 1. Mean value, total natural gas reserve and resource base for Alaska assessment areas.

All Values Trillions of Cubic Feet (TCF)
Alaska Division of Oil and Gas (01/12/05)

BASIN	KNOWN RESERVES	RISKED UNDISCOVERED CONVENTIONALLY RECOVERABLE RESOURCE	*RISKED UNDISCOVERED CONVENTIONALLY RECOVERABLE DEEP GAS RESOURCE* [2]	GAS HYDRATES IN PLACE RESOURCE [6]	COALBED METHANE IN PLACE RESOURCE	BASIN TOTAL
NORTH ALASKA (onshore)	35.000 [1]	141.700 [8]	*17.700* [2]	590.000 [6]	800.000 [7]	1,566.700
NORTH ALASKA (Beaufort shelf)[2]	0.000	32.070	*N/A*	32,325.000 [3]	N/A	32,357.070
NORTH ALASKA (Chukchi shelf)[2]	0.000	60.110	*N/A*	50.000 [3]	N/A	110.110
CENTRAL ALASKA [4]	0.000	2.760	*N/A*	N/A	N/A	2.760
YUKON FLATS[9]	0.000	5.460	*N/A*	N/A	N/A	5.460
KANDIK [5]	0.000	0.116	*N/A*		N/A	0.116
NENANA/TANANA	0.000	N/A	*N/A*	N/A	N/A	N/A
COPPER RIVER	0.000	N/A	*N/A*	N/A	N/A	N/A
TOTAL BY GAS TYPE	**35.000** [1]	**242.216**	***17.700*** [2]	**32,965.000**	**800.000** [7]	**34,042.216**

After Craig, J., and Sherwood, K.,Prospects for development of Alaska natural gas: a review as of January 2001, Minerals Management Service, Alaska Region, tbl. 9, p. 76.
Modified to include only North and Central Alaska basins and updated to include new information as footnoted.
N/A = Not Assessed

[1] Current estimate of known "stranded" recoverable North Slope conventional gas reserves in Prudhoe Bay, Point Thomson and smaller fields.
[2] *Subcategory of and included in "Undiscovered Technically Recoverable Conventional Reserves". Represents Basin Deep or Basin Centered component > 15,000' depth.*
[3] Craig and Sherwood arbitrarily split offshore hydrate resource estimates between Beaufort and Chukchi Sea shelves. Total North Alaska offshore gas hydrate potential remains 32,375 tcf.
[4] 1995 National Assessment of United States Oil and Gas Resources, U.S. Geological Survey, Open File Report , Digital Data Series-30, pub. 1995. For all central Alaska basins except the Kandik Basin. Other basins not evaluated individually.
[4,5] Geological Survey of Canada estimated mean undiscovered gas in place ~ 0.489 - 0.800 TCF. Alaska component estimated as 0.116 Tcf.
[6] Collett, personal communication, 11/26/04.
[7] Barker, C.E., Clough, J.G., Roberts, S.B., and Fisk, R., Coalbed methane in Northern Alaska, potential resources for rural use and added supply for the proposed trans-Alaska gas pipeline, AAPG-SPEM Joint Technical Conference, Anchorage, AK, May 2002.
[8] Includes nonassociated and associated gas. State and Native lands are estimated to be approximately 60 TCF and are included in this total.
[9] Oil and Gas Assessment of Yukon Flats, East-Central Alaska, 2004, USGS Fact Sheet 2004-3121, December 2004.

Table 2. Useful life of an Alaskan gas pipeline given variations in reserves and capacity.

	Reserves, TCF	Project Life (Years) Pipeline Capacity BCF/Day (4.5)	(5.6)
Known Resources	33	20.1	16.1
	36	21.9	17.6
↕	40	24.4	19.6
	60	36.5	29.4
Undiscovered Resources	100	61.5	48.9
	150	91.3	73.4

Table 3. Methane Hydrate Research, Development and Field Operations – Authorization Budget

	2006	2007	2008	2009	2010	Total Spending
North Slope Studies						
Seismic data processing and/or acquisition	4.00	2.00	-	-	-	**6.00**
Regional resource assessments	0.50	0.75	1.00	1.00	0.50	**3.75**
Prospect definition studies	1.00	1.00	1.00	0.75	0.50	**4.25**
Data Acquisition (wells of opportunity)						
Logs (3 ea, 2006 - 2009)	0.36	0.36	0.36	0.36	-	**1.44**
Core (1, for thermal studies)		0.50	0.50	-	-	**1.00**
Thermal stimulation research	0.50	0.50	0.50	1.00	1.00	**3.50**
Carbon dioxide replacement research	0.50	0.50	0.50	0.50	0.50	**2.50**
Test designs/site selection/planning/permittting/LL items	0.50	0.75	0.75	0.25	-	**2.25**
	7.36	**6.36**	**4.61**	**3.86**	**2.50**	**24.69**
North Slope Field Operations						
Test production of NS Hydrates from underlying free gas zone	-	3.00	4.56	4.56	2.00	**14.12**
Test direct production of NS Hydrates	-	-	-	6.38	5.48	**11.86**
	-	**3.00**	**4.56**	**10.94**	**7.48**	**25.98**
Total North Slope Spending	**7.36**	**9.36**	**9.17**	**14.80**	**9.98**	**50.67**
Gulf Coast and Other L-48 Studies	**2.64**	**0.64**	**0.83**	**5.21**	**10.02**	**19.34**
Total Spending	**10.00**	**10.00**	**10.00**	**20.00**	**20.00**	**70.00**

Average daily fully-loaded rig cost:	$35,000/day	45 days, RU, D&C, rig test = $1.575 million
Production testing costs:	$12,500/day	15,000 /day for direct production test (includes thermal costs)
Incremental shallow logging costs:	$120,000/well	

Test production of NS Hydrates from underlying free gas zone: - operations start mid-2007, w/ 45 days of rig work, prior to long-term production testing

Test direct production of NS Hydrates: - operations start early-2009, w/ 45 days of rig work, prior to long-term production testing

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