SECOND QUARTERLY PROGRESS REPORT

JANUARY – MARCH 2007

CHARACTERIZATION AND QUANTIFICATION OF THE METHANE HYDRATE RESOURCE POTENTIAL ASSOCIATED WITH THE BARROW GAS FIELDS

DOE Project Number: DE-FC26-06NT42962

Awarded to

North Slope Borough, Alaska

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DISCLAIMER

EXECUTIVE SUMMARY

Phase 1A of the Characterization and Quantification of the Methane Hydrate Resource Potential Associated with the Barrow Gas Fields Project (Project) is proceeding with the completion of work on Tasks 1, 2 and 3. Task 4, the preparation of the Phase 1A final report, is underway and is expected to be submitted by April 30, 2007.

The Research Management Plan for the Project was completed and submitted to DOE/NETL on December 14, 2006.

A Project kickoff meeting for all 2006 DOE/NETL Methane Hydrate Grant Recipients was held in Morgantown on January 9, 2007, and a presentation was made by Tom Walsh, Principal Investigator for this project.

The Technology Status Assessment was completed and submitted to DOE/NETL on March 19, 2007.

Work completed to model the gas hydrate stability zone associated with the Barrow Gas Fields includes:

- Gas samples from all three Barrow Gas Fields were gathered and analyzed for composition and isotopes.
- Well and field history files were compiled with all information on pressure, temperature and gas/fluid analysis.
- Static temperature gradients were taken on E Barrow Wells 15 and 21.
- Modeling of the gas hydrate stability zone for the NSB gas fields was underway by the University of Alaska – Fairbanks Petroleum Engineering Department.

Project update meetings were held in Barrow and at the University of Alaska – Fairbanks with participation by representatives from PRA, NETL, NSB and UAF PE Dept.

The results of this Second Quarterly Progress Report justify the approval of continuation funding for Phase 1B of the Project.

SUMMARY OF PROJECT

The North Slope Borough (NSB) has established a team to characterize and quantify the methane hydrate resource potential associated with the Barrow Gas Fields (BGF), which are owned and operated by the NSB in a permafrost region of arctic Alaska. Currently, gas from these three producing fields provides heating and electricity for Barrow, which is the economic, transportation, and administrative center of the NSB. Other commercially-operated producing oil and gas fields within the NSB include Prudhoe Bay, Milne Point, Kuparuk, Alpine and Endicott. The results of this project will enhance the understanding of the nature and occurrence of methane hydrates in the arctic environment, and specifically in the Barrow Gas Fields, and will server to evaluate the potential influence of gas hydrates on gas supply and production from producing gas fields. Findings of this project will contribute significantly to understanding the role of gas hydrate as a recharge mechanism in a producing gas field, and provide substantial commercial and social benefits for the NSB.

The characterization and quantification of methane hydrate resources in the Barrow Gas Fields (BGF) will be completed in three phases: IA, IB, and II. This approach will allow for timely evaluation and adjustment of methods and objectives as new findings are obtained. The Research Management Plan (RMP) lays the framework for all three phases; however, it will be updated before commencement of Phase II, if warranted, which will be funded in the future.

Phase 1A will determine whether the methane hydrate stability zone exists up-dip of one or more of the BGF, validating the postulate that the gas fields in question are potentially being recharged by dissociation of adjacent methane hydrates. If the results are positive, then funding will be released for Phase 1B.

In Phase 1B, the NSB will a) determine probability that the reservoir is continuous up-dip into the methane hydrate stability zone, and contained sufficient water to combine with available gas to form gas hydrate; b) determine the optimum well location for a dedicated methane hydrate well; and c) quantify reserves, expected production rates and depletion mechanisms for methane hydrate production.

The Project has been funded for $152,465 for Phase 1A to accomplish the following four tasks:

Task 1 — Develop Research Management Plan
Task 2 — Complete Technology Status Assessment
Task 3 — Develop a methane hydrate stability model
Task 4 — Prepare Phase IA Final Technical Report

The results of Phase 1A will determine whether or not funding will be requested for Phase 1B.

PROJECT KICKOFF MEETING

A DOE project kickoff meeting was held in Morgantown, WV on January 9, 2007. All Methane Hydrate Projects that received grants from the 2006 DOE/NETL Funding Opportunity reviewed their respective projects.

Tom Walsh, of Petrotechnical Resources of Alaska attended and made a presentation describing the purpose and benefits of the Project. The presentation is posted on the NETL website: http://www.netl.doe.gov/technologies/oil-gas/publications/Hydrates/Presentations/DOE-Kickoff-ANSB42962.pdf.

The meeting provided an opportunity for introductions of researchers and NETL staff, as well as providing an overview of some of the latest research into methane hydrates. The benefits of participation in the meeting were well-worth the trip from Anchorage to Morgantown.

TASK 1: RESEARCH MANAGEMENT PLAN

The Research Management Plan (RMP) concisely addresses the overall project, including: project goals and objectives; tasks; deliverables; schedule; costs; challenges and benefits. The final version of the RMP, with the inclusion of DOE/NETL comments was submitted on December 14, 2006, and was promptly approved by the DOE Contracting Officer's Technical Representative (COR). The RMP will be reviewed and updated as needed or requested at key decision points in the project.

TASK 2: TECHNOLOGY STATUS ASSESSMENT

The Technology Status Assessment (TSA) describes the current state of information and/or technology relevant to the proposed work, including both positive and negative aspects of each existing approach or technology. The TSA addresses the following topics:

- Current state of information or technology (Industry wide)
    - Summary of background of industry/sector
    - Technologies/Tools/Approaches/Data being used
    - Benefits and inadequacies of current state-of-the-art.
- Development Strategies
    - Why new approach is required?
    - Problems to address in the research project
- Future
    - What barriers will the research overcome and the potential impact on the exploration or ultimate production of gas hydrate, or the understanding of gas hydrate's role in the natural environment.
    - Deliverables – Tools, Methods, Instrumentation, Products, etc.
- References (relevant to the project).

The TSA focused on results of research involving hydrate accumulations in arctic environments, and specifically on the areas of detection, characterization and quantification of hydrates, and potential production technologies applicable to hydrate development on Alaska's North Slope.

Key learnings were captured from the wealth of valuable research of the Mallik Consortium, which began in 1998, and continues to produce significant results of high relevance to this project.

The Messoyakha Gas Field in West Siberia is an important analog to the Barrow Gas Fields study, in that gas production from a free gas leg at Messoyakha has been attributed to dissociation of a hydrate accumulation above the free gas pool. This depletion model may be a factor in production from the Barrow Gas Fields as well, a question that will hopefully be answered by this study.

The *Methane Hydrate Production from Alaskan Permafrost* project ("Hot Ice") was highlighted in the TSA as an important reminder of the challenges associated with the Barrow Gas Fields

study, and the importance of establishing the presence of a hydrate stability zone as a critical first step.

The ongoing *Alaska North Slope Gas Hydrate Reservoir Characterization* project has made great strides in detecting, characterizing, quantifying, and sampling in-situ methane hydrates in the Milne Point Field in Alaska's Central North Slope, and this study shares many common themes with the Barrow study.

The current study will build on previous work by the USGS and the North Slope Borough focused on the geology, petroleum systems, and hydrate potential of the Barrow Gas Fields.

The final version of the TSA, with the inclusion of DOE/NETL comments was submitted on March 19, 2007.

TASK 3: DEVELOPMENT OF A METHANE HYDRATE STABILITY MODEL

The methane hydrate stability models for the three BGF are based on the analysis of gas composition, formation water composition, and local pressure and temperature gradient of the individual fields. These parameters, along with the known phase behavior of methane gas hydrate, determine the existence and extent of the hydrate stability zone, postulated by previous researchers. The results of gas composition analysis and gas hydrate stability modeling are to be used to decide whether or not to proceed with Phase IB.

Gas Composition and Isotope Analysis

Well files and field records were researched to inventory and organize all historical gas and water analyses for the three North Slope Borough gas fields being studied.

New samples were collected from the fields for current compositional analysis and isotope characterization this winter. The samples were shipped to Isotech Labs and the compositional and isotopic analyses have been completed and incorporated in hydrate stability modeling.

Wells in the South Barrow Field that were sampled were:

- South Barrow # 11 - Structurally high in the Middle Barrow Gas Sand
- South Barrow # 10 - Mid-structure in the Middle Barrow Gas Sand
- South Barrow # 9 - Structurally low in the Middle Barrow Gas Sand

Wells in the East Barrow Field that were sampled were:

- East Barrow # 21 - Structurally high in the Middle Barrow Gas Sand
- East Barrow # 14 - Mid-structure in the Middle Barrow Gas Sand
- East Barrow # 15 - Structurally low in the Middle Barrow Gas Sand

Wells in the Walakpa Field that were sampled were:

- Walakpa # 5 - Structurally high in the Walakpa Gas Sand
- Walakpa # 10 - Mid-structure in the Walakpa Gas Sand
- Walakpa # 8 - Structurally low in the Walakpa Gas Sand

The new gas samples will be analyzed and used in the methane hydrate stability determination, as well as for comparison to historical gas analyses to see if changes in composition would suggest possible indication of methane hydrate dissociation. This work is ongoing, and the results will be included in the Phase 1A Final Technical Report.

Gas Sampling Procedure

The following procedure was used for the collection of samples of produced gas from the Walakpa Field and the East and South Pools of the Barrow Field.

1. Flow well to be sampled for minimum of 12 hours.
2. Connect the sampling tool to the flowing (annulus) side of tubing, purge IsoTube container and collect 2 samples per well.
3. Label each sample using adhesive backed labels provided, including well name, and date of collected sample.
4. Remove yellow copy of label and send to PRA.
5. Pack IsoTube gas-filled-containers with the white copy of the labels attached to the IsoTubes in the UN certified box, and ship via Evert's Air Freight to PRA in Anchorage.

Methane Hydrate Stability Zone Determination

Historical temperature gradient surveys were collected from well files and field records. These were summarized to use for definition of the methane hydrate stability zone (HSZ).

East Barrow Field HSZ Results

Static temperature gradient surveys were made in wells E Barrow #15 and #21, which had been shut-in for 7+ months and the temperature data from these wells represents the best static reservoir temperature information available.

University of Alaska Fairbanks Petroleum Engineering began using gas and water compositions in the Colorado School of Mines (CSM) methane hydrate stability model. The modeling results are sensitive to formation water salinity, and the best information available for the East pool indicates salinities in the range of 2.1-2.4% NaCl, based on analysis of samples from the Barrow Sand interval in the SB #15 and SB #17 wells.

Model results indicate that the East Barrow Field is in communication with a methane hydrate zone, as the base of the hydrate stability zone intersects the shallowest known free gas reservoir (Figure 1). This may explain why there appears to be pressure support in the reservoir, but no appreciable water production or watering out of wells, as would be expected if a water drive was providing support to the reservoir. The East Barrow Field was suspected to be a reservoir with strong aquifer support from initial material balance work, based on P/Z response (Figure 2) and the field was expected to water-out by now, having produced over 8 BSCF of gas from an original reserve estimate of 6 BSCF. Pressure support from hydrate dissociation could possibly explain the pressure response and production characteristics of this field. The other indicator that may support hydrate dissociation occurring in the East Barrow Field is the cooler temperature gradient at equivalent depths compared to the South Barrow Field. Figure 3 shows the temperature gradients for East Barrow and South Barrow Fields at equivalent subsea depths. The cooler temperatures in the East Barrow Field may be due to the endothermic cooling from the

dissociation of methane hydrates. In any case, the lower geothermal gradient at East Barrow promotes a deeper base to the methane hydrate stability zone than that in the South Barrow pool.

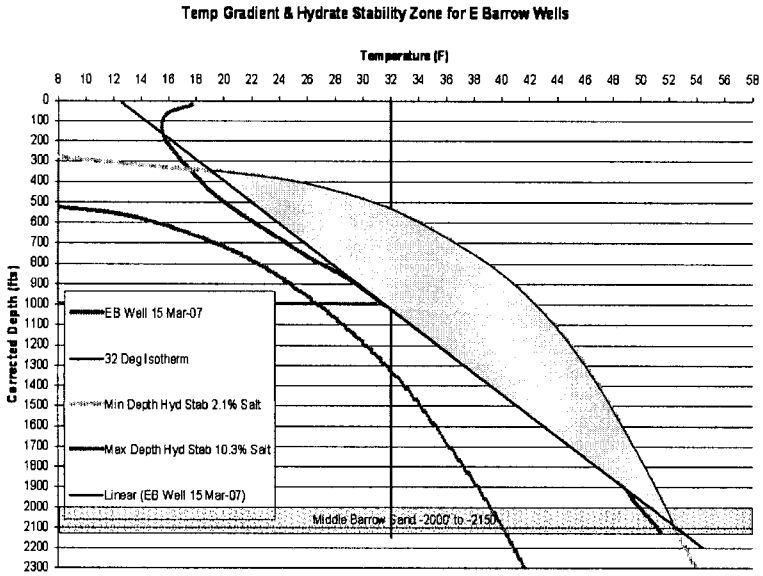


Figure 1 - East Barrow Gas Field HSZ Model

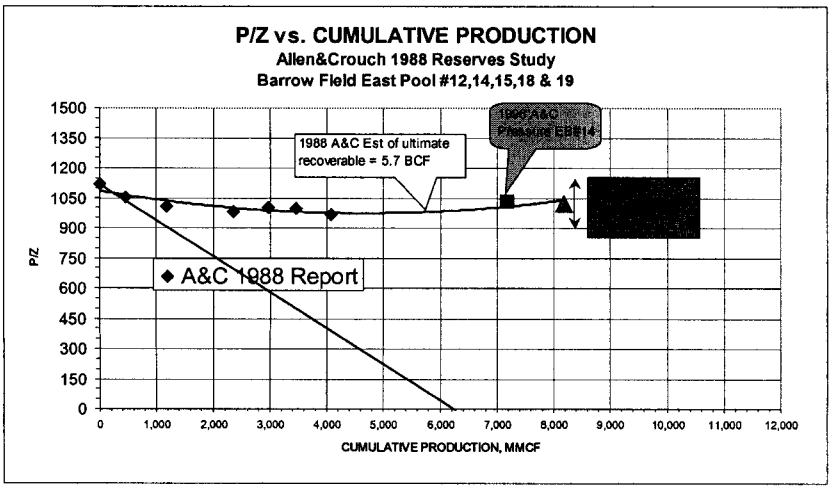


Figure 2 - East Barrow Field Material Balance

The model results for the East Barrow pool support progression to Phase 1B, do to the fact that the hydrate stability model indicates intersection between the know free gas reservoir and the base of the hydrate stability zone, and the material balance modeling indicates a strong pressure support mechanism beyond the expected volumetric gas expansion mechanism. The gas composition and formation water salinity, along with the temperature and pressure gradient information used in the modeling will be fully documented in the Final Technical Report for Phase 1B.

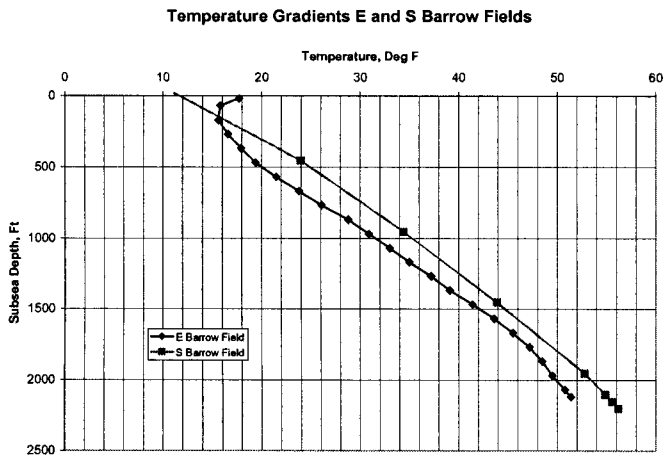


Figure 3 - Temperature Gradients for East and South Barrow Fields

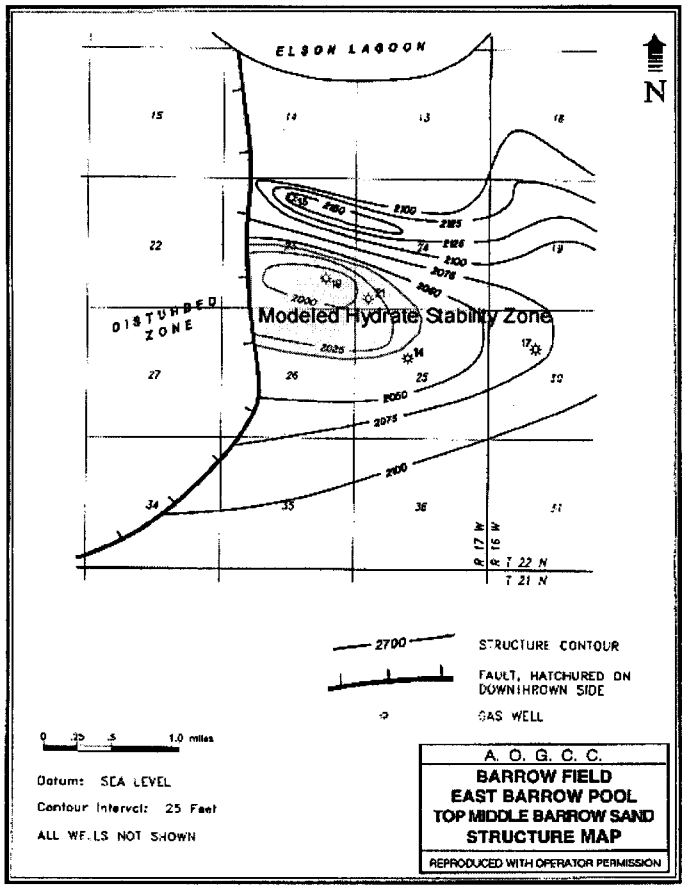


Figure 4 - Modeled most likely hydrate stability zone depth in East Barrow Field

Walakpa Field HSZ Results

Analysis of the pressure, temperature, gas and fluid data for the Walakpa Field similarly support the presence of a hydrate stability zone which is potentially in communication with the free gas reservoir in this field. The base of the modeled hydrate stability zone at Walakpa (Figure 5) coincides with the shallowest well penetration of the free-gas sand, and Phase 1B emphasis in the Walakpa area will be on extension of the reservoir sands updip into the hydrate stability zone.

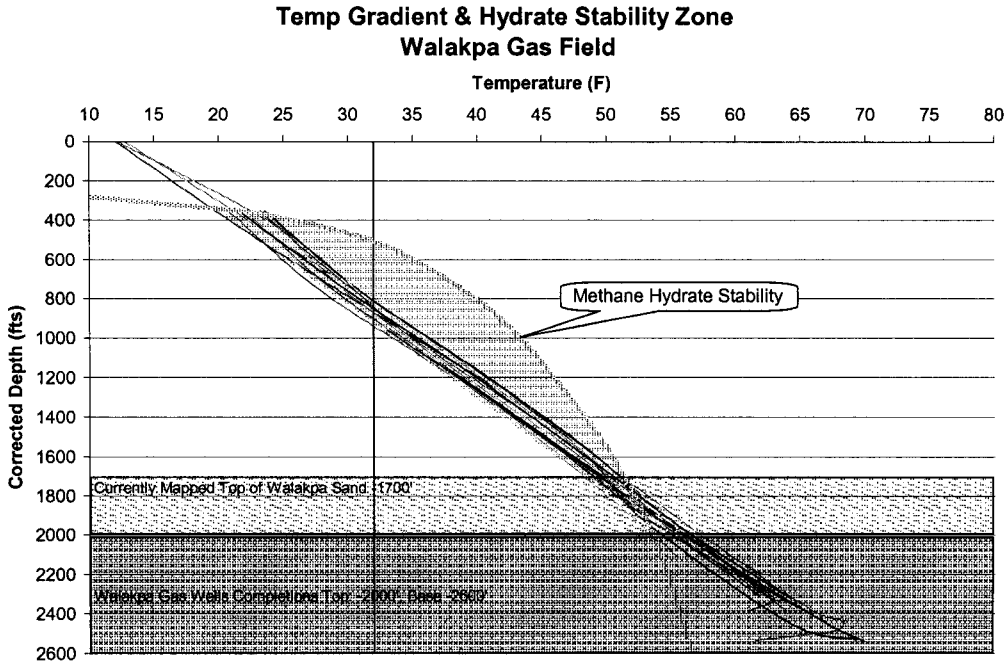
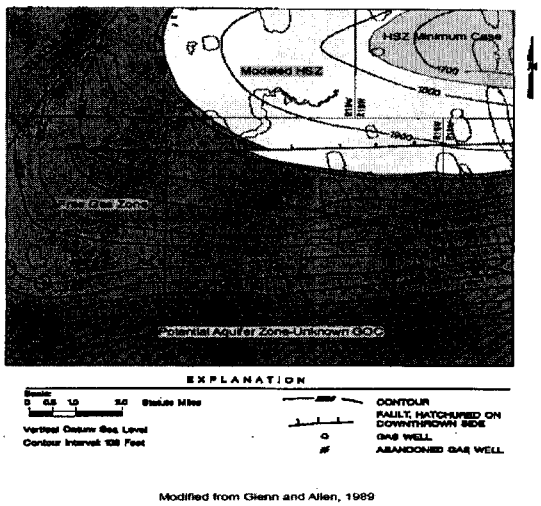


Figure 5 - Walakpa Field Modeled Hydrate Stability Zone



Modified from Glenn and Allen, 1989

Figure 6 - Modeled most likely hydrate stability zone depth in Walakpa Field

South Barrow Field HSZ Results

Results of the hydrate stability modeling for the South pool indicate that the HSZ is significantly above the known gas sand shallowest penetration, and it is not clear that the sands extend up-dip enough to intersect the HSZ. This question will be addressed in Phase 1B by mapping the reservoir sands in more detail.

TECHNOLOGY TRANSFER

- Tom Walsh of PRA presented an overview of the Project at the January 9, 2007 2006 DOE/NETL Funding Opportunity Projects Kick-off Meeting in Morgantown, WV.
- A data CD was compiled and distributed that contained gas and fluid compositional analysis, field production, pressure and temperature data and previous technical studies and well files for the three NSB Gas Fields. The CD was distributed to NSB, UAF and NETL.
- With DOE/NETL made a visit to Barrow to review project and collect well and field information.
    - Met with NSB Dept. of Public Works and Presented findings of E Barrow being a colder reservoir than S Barrow, which suggests the probability of hydrate stability.
    - Took field tour and met with Glenn Sheehan of Barrow National Science Laboratory.
    - Had meeting with Richard Glenn and reviewed his previous DOE Walakpa hydrate project and status of current Project.
- Had a meeting at UAF with PE Head and researcher. PRA and NETL attended.
- Tom Walsh of PRA wrote an article on project for publication in DOE/NETL "Fire in Ice" publication. Additional information will be added to the draft article to cover findings of Phase 1A, and the article is to be published in the next issue of the journal

CONCLUSION

The Technology Status Assessment was completed during the quarter.

Gas sample collection and analysis were completed and comparison to historic gas analyses is under way. Initial analysis of compositions and isotopes has not shown conclusive evidence of whether or not there is methane hydrate dissociation.

Static temperature surveys were taken in E Barrow Field Well #'s 15 and 21, which confirmed early temperature profiles that E Barrow Field's reservoir is cooler than South Barrow Field at equivalent depths.

All of the compositional data and the temperature gradient data collected from previous work and acquired for this study were used to model the methane hydrate stability for the three fields. The stability modeling shows strong support for the presence of a HSZ very close to or intersecting know gas sands in the East Barrow Field and Walakpa Field, and an HSZ above the known reservoir in the South Barrow Field.

The results of this modeling support the recommendation to proceed to Phase 1B of the project.

Budget Justification

The North Slope Borough Department of Public Works will work with Petrotechnical Resources of Alaska, the Arctic Slope Consulting Group and the University of Alaska, Fairbanks on a two-phase research program to better understand the nature and occurrence of methane hydrates in the Barrow Gas Fields and to evaluate the potential influence of gas hydrates on gas supply and production. The budget for this project is as follows:

Personnel	$ 11,067.20
Fringe Benefits	$ 5,090.91
Travel	$ 4,145.00
Contractual	$ 632,371.16
Total Direct Costs	$ 652,674.27
NSB Share 20%	$ 130,535.00
Total Federal Funds 80%	$ 522,139.27
Indirect Costs 21% on Federal funds only	$ 109,649.25
Total Costs	**$ 762,323.52**

The North Slope Borough will be providing a 20 % cost share to this program. The North Slope Borough budget includes:

Position	Hourly Rate	number of hours	Total	46% Benefits
Fuel Division Manager	$ 52.59	120	$ 6,310.80	$ 2,902.97
Office Specialist	$ 25.85	184	$ 4,756.40	$ 2,187.94
			$ 11,067.20	$ 5,090.91

TRAVEL	
Hydrates Conference	$ 1,370.00
Final Project Presentation	$ 2,775.00
Total	**$ 4,145.00**

Travel Detail:

Purpose	**Barrow to:**	**Airfare**	**Lodging**	**Vehicle**	**Per Diem**	**Nights**	**Lodging Per Diem**	**Number travelers**	**Trip Total**
State of Alaska Hydrates Conference - KG	Anchorage	$ 730.00	$ 80.00	$ 35.00	$ 45.00	4	$ 640.00	1	$ 1,370.00
Final Project Presentation - KG	W Virginia	$1,500.00	$ 150.00	$ 60.00	$ 45.00	5	$1,275.00	1	$ 2,775.00
									$ 4,145.00

The North Slope Borough will also share in $110,232 in the contractual line item. This expense will be paid for the ASCG contract and part of the PRA contract. The budget detail for the contractual line item is as follows:

Contract	
Petrotechnical Resources of Alaska	$ 485,000.00
Arctic Slope Consulting Group	$ 49,871.16
University of Alaska-Fairbanks	$ 97,500.00
TOTAL	**$ 632,371.16**

Budget detail for Petrotechnical Resources of Alaska

Professional Services			
	Hourly Rate	Hours	Technical Cost
Project Lead	$ 150.00	752	$ 112,800.00
Geophysicist	$ 150.00	232	$ 34,800.00
Geologist	$ 150.00	600	$ 90,000.00
Petrophysicist	$ 150.00	72	$ 10,800.00
Petroleum Engineer	$ 150.00	920	$ 138,000.00
Reservoir Engineer	$ 150.00	200	$ 30,000.00
Total Technical Cost			**$ 416,400.00**
Expenses			
Document Costs for Research Management Plan			$ 300.00
Document Costs for Revised Research Management Plan			$ 300.00
Document Costs for Technology Status Assessment			$ 300.00
Document Costs for Revised Technology Status Assessment			$ 300.00
Document Costs for Methane Stability Model Report			$ 300.00
Reprocessing of 2D Seismic			$ 30,000.00
Document Costs for Mapping Report			$ 300.00
Document Costs for Optimum Well Location Report			$ 300.00
Document Costs for Production Prediction Report			$ 300.00
Reproduction Costs for Peer Review			$ 300.00
Document Costs for 4 Quarterly Project Reports			$ 1,600.00
Document Costs for Final Project Report			$ 1,000.00
Reproduction Costs for Technical Presentation			$ 300.00
			$ 35,600.00

TRAVEL	
Review Mapping of Fields	$ 3,900.00
Select Well Locations & Review Methane Reservoir Simulator	$ 3,900.00
Review Optimum Well Location	$ 5,200.00
Annual NETL Conference	$ 10,000.00
Final Project Presentation	$ 10,000.00
	$ 33,000.00

Travel Budget Detail PRA

Purpose	Anchorage to:	Airfare	Lodging	Vehicle	Per Diem	Number of Nights	Lodging/Per Diem Total	Number travelers	Trip Total
Review Mapping of Fields	Barrow	$ 730.00	$ 100.00	$ 50.00	$40.00	3	$ 570.00	3	$ 3,900.00
Select Well Locations & Review Methane Reservoir Simulator	Barrow	$ 730.00	$ 100.00	$ 50.00	$40.00	3	$ 570.00	3	$ 3,900.00
Review Optimum Well Location	Barrow	$ 730.00	$ 100.00	$ 50.00	$40.00	3	$ 570.00	4	$ 5,200.00
Annual NETL Conference	W VA	$1,000.00	$ 150.00	$ 60.00	$90.00	5	$1,500.00	4	$ 10,000.00
Final Project Presentation	W VA	$1,000.00	$ 150.00	$ 60.00	$90.00	5	$1,500.00	4	$ 10,000.00
									$ 33,000.00

Budget detail for Arctic Slope Consulting Group

Arctic Slope Consulting Group			
Professional Services	$ 36,236.16		
Travel	$ 13,635.00		
TOTAL	**$ 49,871.16**		
Professional Services			
	Hourly Rate	Hours	Technical Cost
Consultant	$ 83.88	432	$ 36,236.16

Travel for ASCG

Review Research Management Plan	$ 1,315.00
Review Technology Status Assessment	$ 1,315.00
Review Methane Stability Model	$ 1,315.00
Review Mapping of Fields	$ 1,315.00
Select Well Locations & Review Methane Reservoir Simulator	$ 1,315.00
Attend State of Alaska Hydrates Conference	$ 1,510.00
Annual NETL Conference	$ 2,775.00
Final Project Presentation	$ 2,775.00
Total	**$ 13,635.00**

Detailed Travel Budget ASCG

Purpose	Barrow to:	Airfare	Lodging	Vehicle	Per Diem	Nights	Lodging/Per Diem Total	Number travelers	Trip Total
Review Research Management Plan	Anchorage	$ 730.00	$ 100.00	$ 50.00	$45.00	3	$ 585.00	1	$ 1,315.00
Review Technology Status Assessment	Anchorage	$ 730.00	$ 100.00	$ 50.00	$45.00	3	$ 585.00	1	$ 1,315.00
Review Methane Stability Model	Anchorage	$ 730.00	$ 100.00	$ 50.00	$45.00	3	$ 585.00	1	$ 1,315.00
Review Mapping of Fields	Anchorage	$ 730.00	$ 100.00	$ 50.00	$45.00	3	$ 585.00	1	$ 1,315.00
Select Well Locations & Review Methane Reservoir Simulator	Anchorage	$ 730.00	$ 100.00	$ 50.00	$45.00	3	$ 585.00	1	$ 1,315.00
Attend State of Alaska Hydrates Conference	Anchorage	$ 730.00	$ 100.00	$ 50.00	$45.00	4	$ 780.00	1	$ 1,510.00
Annual NETL Conference	W VA	$1,500.00	$ 150.00	$ 60.00	$45.00	5	$1,275.00	1	$ 2,775.00
Final Project Presentation	W VA	$1,500.00	$ 150.00	$ 60.00	$45.00	5	$1,275.00	1	$ 2,775.00
									$13,635.00

Detailed Budget for University of Alaska Fairbanks

UAF			
Professional Services	$ 90,000.00		
Travel	$ 7,500.00		
TOTAL	**$ 97,500.00**		
Professional Services			
	Hourly Rate	number of hours	Technical Cost
U of A PE Professors	$ 138.89	648	$ 90,000.00

Travel: UAF

Review Research Management Plan	$ 3,300.00
Review Technology Status Assessment	$ 4,200.00
Total	**$ 7,500.00**

Detailed Travel for UAF

Purpose	**Fairbanks to:**	**Airfare**	**Lodging**	**Vehicle**	**Per Diem**	**Nights**	**Lodging/Per Diem Total**	**Number travelers**	**Trip Total**
Review Research Management Plan	Anchorage	$ 500.00	$ 100.00	$ 50.00	$50.00	3	$ 600.00	3	$ 3,300.00
Review Technology Status Assessment	W VA	$1,230.00	$ 150.00	$ 50.00	$90.00	3	$ 870.00	2	$ 4,200.00
									$ 7,500.00