the ENERGY lab

PROGRAM FACTS

Strategic Center for Natural Gas & Oil

Arctic Energy Office

Alaska's fossil energy resources continue to play a greater role in meeting the nation's energy needs. Alaska holds several billion barrels of oil, about one-fifth of America's remaining proved oil reserves, and more than 30 trillion cubic feet of natural gas awaiting a means to reach a market.[1, 2] Undeveloped oil and natural gas resources abound as well. Alaska contains 25 to 30 billion barrels[3] of viscous or heavy oil that is largely untapped due to lack of technology, and the fact that it is largely within the existing North Slope infrastructure means it could be developed without growing the environmental footprint. NETL is continuing to invest in developing technology to safely produce natural gas from the vast methane hydrate resource located on the North Slope. As well, Alaska holds about one-half of the nation's coal deposits. The untapped energy resources of the high north make the area a key national energy asset.

There are many technological and economic challenges associated with developing Alaska's abundant fossil energy resources. NETL's Arctic Energy Office is coordinating with industry, academia, and other Government agencies to identify new technologies and methods for safely developing Alaska's fossil energy wealth while maintaining the pristine environment in which it is contained. The arctic resource projects currently being sponsored by NETL, less the methane hydrate projects, are briefly summarized in this Fact Sheet.

Environment

The Arctic Energy Office's objectives include a strong focus on environmental issues pertaining to the development of Alaska's resources. These issues are important due to the cold climate, fragile tundra, permafrost, wildlife protection, and the focus of the nation on preserving the pristine nature of Alaska.

The Arctic Energy Office works with state agencies and the University of Alaska to identify research that will address environmental issues that limit oil, gas, and coal development. For example, on Alaska's North Slope, the oil industry must travel off-road across the tundra during winter for a variety of reasons: to carry out seismic exploration, to build ice roads for exploratory drilling, to carry out construction activity, or to resupply remote oilfields. NETL's Arctic Energy Office is working with industry, academia, and state government agencies to improve access and efficiency of Arctic Transportation Networks needed to access Alaska's fossil fuel resources while maintaining the pristine environments in which they are found.

[1] Alaska Oil and Gas Report, November 2009, Alaska Department of Natural Resources, Division of Oil and Gas, Table I.1 November 2009 and "Summary: U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Proved Reserves 2009", Table 6, Nov 2010.

[2] The Alaska reserves include proven producing, proven unproducing, and some probable reserves. Using EIA values for proven reserves only, Alaska reserves are listed as 3.6 billion barrels compared to 22.3 billion barrels for total U.S. or 16%.

[3] Thomas et al, "Alaska North Slope Oil and Gas: A Promising Future or an Area in Decline? Addendum Report", U.S. DOE/NETL/Arctic Energy Office, April 2009.

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U.S. DEPARTMENT OF ENERGY

Project Summaries

- ***North Slope Decision Support for Water Resource Planning and Management***

  Ice roads and ice pads provide a cost effective means of oil and gas exploration on Alaska's North Slope with minimal impact to the sensitive underlying tundra. This project is developing tools that support stakeholders' needs while meeting regulatory requirements. Key components include information system technology, Arctic hydrology and climatology, water resources management, and decision support through modeling. The project team continues to meet with industry and regulators to incorporate modules that will make this a useful ice road planning tool. Researchers met with members of the life science National Science Foundation Data Conservancy (DC) Team at John Hopkins University to discuss adopting the NSDSS system for preserving and presenting scientific data for the global community. Data Conservancy team members will document the NSDSS project as the DC program develops a standard for national and global data research infrastructure organizations that will be used by researchers as a collaborative tool to advance science, research and learning.

  http://www.netl.doe.gov/technologies/oil-gas/Petroleum/projects/EP/ArcticResources/05683_WaterManagement.html

- ***Using Artificial Barriers (Snow Fences) to Augment Fresh Water Supply***

  Current Arctic energy production is situated in a "Polar Desert." Total annual precipitation averages a mere 6"–10". With water available only 12 weeks of the year, difficulties with storing and distributing water in Arctic conditions, and high operating costs, water is a precious resource. This project evaluates the use of snow management with snow fences to augment lake water supplies. Finding an optimum location for creating snow drifts could increase the probability that this captured snow will effectively recharge a lake through most of the summer. Snow depths at the site were measured with sensors during the 2010/2011 winter and are currently being analyzed. Pretreatment water balance analysis for 2009 indicated that the majority of water loss was due to evaporation from the lake surface with only half of the water loss being replaced through summer rainfall. The cumulative rainfall in 2010 was below average and equaled only half the rainfall total for 2009. Water balance calculations indicate there is additional inflow into the man-made lake. The Alaska Dept. of Transportation has contacted the project performer, University of Alaska Fairbanks, and expressed interest in creating vegetation snow fences along highways based on the results of this project.

  http://www.netl.doe.gov/technologies/oil-gas/Petroleum/projects/EP/ArcticResources/05684ArcticLakes.html

- ***Alaska North Slope Oil and Gas Transportation Support System (Arctic Transportation Networks)***

  A majority of oil and gas development and exploration on the North Slope takes place in winter when the tundra surface is stable (i.e. frozen). This project uses scientific understanding to develop a set of tools useful to industry and management such as providing the ability to forecast environmental conditions so that management agencies can respond to snow cover and soil temperature audits more effectively and industry can plan the significant mobilization efforts which take place every transportation season. This project is responsible for establishing eight data collection stations on the North Slope which can help in the modeling efforts leading to forecast. The project team also collaborates with other environmental networks in the hope of establishing a standard for data collection in order to be able to extend findings from this project to other regions such as the Brooks Range Foothills, an area of interest for gas exploration. So far, soil temperature modeling methods have been developed and tested, soil strength studies have been completed, and a snow measurement methods manual has been created with the hope that the regulators, industry, and researchers will adopt a common method for data collection. Further, the

Trans Alaska Pipeline System (TAPS)

Oil production from known resources as well as new discoveries is essential for keeping the Trans Alaska Pipeline System (TAPS) operating both technically and economically. Current production rates are about 600,000 barrels per day, down from a maximum of over 2 million barrels per day in 1988. The mechanical lower operating limit of TAPS is about 300,000 barrels per day. The economic limit of TAPS will depend on world oil prices and operating costs, but as oil production rates continue to decline, the tariffs can be expected to increase, affecting the economic viability of all North Slope production. With currently producing and identified development, the TAPS minimum flow rate could be reached as early as 2045 and strand over a billion barrels of oil currently booked as reserves (economically producible). Maintaining the viability of the TAPS pipeline is essential for maintaining access to undiscovered North Slope resources but will require access in a timely manner to the most promising areas for exploration and development (e.g., unexplored areas of the National Petroleum Reserve Alaska, and the Alaskan Outer Continental Shelf).

recent development and deployment of a new "smart phone" application enabling regulators to immediately report snow and soil conditions while still in the field has been utilized for the winter of 2010/2011, eliminating two days from the historical time lag between measurements and reporting, a significant savings in time when the industry has only about 100 days to complete a season's worth of work.

http://www.netl.doe.gov/technologies/oil-gas/Petroleum/projects/EP/ArcticResources/01240_NStransportation.html

- ***Fluid and Rock Property Controls on Production and Seismic Monitoring Alaska Heavy Oils***

  The Ugnu formation on Alaska's North Slope contains highly viscous, biodegraded oils. Because of their cold temperatures and low flow rates, standard production methods are ineffective. Seismic responses from pre-production of the reservoir could be used to illuminate the local geology, which could assist in designing well trajectories that would enhance productivity. The rocks containing the fluids have porosities, permeabilities, connectivity, and mineral contents that vary over short distances; and the heterogeneity of the system is a prime factor in sweep efficiency. In addition to variability of the rock matrix, the heavy oil can have varying resin and asphaltene content further complicating recovery. This study is attempting to characterize the reservoir fluid and rock properties by using seismic data to develop a geophysical monitoring program that can potentially be used to enhance heavy oil recovery. A large number of experiments have been completed to date, including molecular beam mass spectroscopy, optical and scanning electron microscopy, x-ray CAT scans, and laboratory seismic measurements. This work is expected to improve seismic resolution through permafrost and the ability to evaluate heavy oil reservoirs. Successful completion of the project will result in the capability to monitor, over time, the progress of a heavy oil recovery process by seismic measurements.

  http://www.netl.doe.gov/technologies/oil-gas/Petroleum/projects/EP/ArcticResources/05663_AlaskaHeavyOil.html

Alaska's Unconventional Oil Resource:

- The Alaska heavy oil resource is large, on the order of 45 billion barrels of original oil in place.
- The West Sak pool in the Kuparuk River Field is believed to contain between 15 and 20 billion barrels of oil (BBO) with variable oil gravity from 10 to 22°API.
- West Sak development is restricted to a core area of about 2 BBO of which only 1.2 BBO is considered to be economical to develop.
- The Schrader Bluff pool in the Milne Point Field is believed to contain between 15 and 20 BBO of 17°API oil.
- Schrader Bluff development is restricted to a core area of about 2 BBO of which only 1.3 BBO is considered to be economical to develop.
- Other heavy oil producing formations on Alaska's North Slope are the Ugnu, Tabasco, Orion, and Polaris.

Ice road north of the ConocoPhillips Alpine Facility (M. Lilly, 2008).

- ***Chemical Methods for Ugnu Viscous Oils, DE-NT0006556***

  The North Slope of Alaska has about 20 billion barrels of viscous oil in the Ugnu, West Sak and Shrader Bluff reservoirs. These reservoirs overlie the already producing reservoirs of Kuparuk and Milne Point, but exist below the permafrost. The proximity of these reservoirs to the permafrost requires the use of non-thermal oil recovery methods which do not risk melting the permafrost and the subsidence of unconsolidated sand. The objective of this work is to develop efficient chemical recovery methods for extracting the viscous oil. The methodologies evaluated include the injection of brine at different salinities followed by an alkaline-surfactant (AS), alkaline-surfactant-polymer (ASP) or polymer formulation, in order to introduce and or generate surface active agents that reduce interfacial tension between the brine and oil. Core floods have been conducted with AS emulsions and 10,000 cp oil, and with ASP microemulsions and 330 cp oil. It was found that the oil recovery of the AS formulation was in the range of 50–75%, and that the ASP formulation recovered virtually 100% of the residual oil. A secondary polymer flood was conducted in the same core, where about 90% of the 330 cp oil was recovered. Recent experiments with AS formulations and 10,000 cp oil in a quarter 5-spot sand pack test bed have shown a brine flood recovery of 33–35%, with an additional 18–24% recovery obtained through the injection of the AS solution.

  http://www.netl.doe.gov/technologies/oil-gas/Petroleum/projects/EP/ArcticResources/06556_UgnuViscousOil.html

- ***Producing Light Oil from a Frozen Reservoir: Reservoir and Fluid Characterization of Umiat Field, National Petroleum Reserve, Alaska***

  The Umiat field contains an estimated 1.2 billion barrels of oil and 84 bcf of gas in a shallow, frozen reservoir. This unconventional reservoir is thought typical of many light oil accumulations scattered across the Arctic. The question of how to produce oil from such low pressure matrices of rock, ice and oil remains unresolved. This project was designed to develop a robust reservoir model to evaluate the use of modern drilling and production methods for Umiat and similar permafrost reservoirs without the use of steam or other fluids that may melt and disrupt the frozen reservoir matrix. Umiat core samples have indicated that natural fractures which might allow for subsurface oil movement are not abundant. Thus, fieldwork to understand the reservoir geology was conducted in 2010, where results indicated that exploiting the anisotropic permeability of the reservoir could prove more promising. A small >50 year old oil sample from the Umiat field was also analyzed and used as a basis for creating a larger quantity of comparable "Umiat" oil for further testing. An experimental apparatus was also constructed, where preliminary results indicate that a significant reduction in the relative permeability of oil in the presence of ice may be observed. Lastly, the research team is developing a reservoir simulation model to evaluate the effectiveness of the various drilling and production strategies being proposed, such as cold gas injection.

  http://www.netl.doe.gov/technologies/oil-gas/Petroleum/projects/Arctic_Energy/5641_FrozenReservoirs.html

Trans Alaska Pipeline Traversing the Brooks Range