Working Document of the NPC Study:
Arctic Potential: Realizing the Promise of U.S. Arctic Oil and Gas Resources
Made Available March 27, 2015

Paper #6-11

ASSESSMENT OF RELEVANT AREAS OF CURRENT U.S. GOVERNMENT TECHNICAL RESEARCH EXPERTISE/CAPABILITIES

Prepared for the

Technology & Operations Subgroup

On March 27, 2015, the National Petroleum Council (NPC) in approving its report, *Arctic Potential: Realizing the Promise of U.S. Arctic Oil and Gas Resources*, also approved the making available of certain materials used in the study process, including detailed, specific subject matter papers prepared or used by the study's Technology & Operations Subgroup. These Topic Papers were working documents that were part of the analyses that led to development of the summary results presented in the report's Executive Summary and Chapters.

These Topic Papers represent the views and conclusions of the authors. The National Petroleum Council has not endorsed or approved the statements and conclusions contained in these documents, but approved the publication of these materials as part of the study process.

The NPC believes that these papers will be of interest to the readers of the report and will help them better understand the results. These materials are being made available in the interest of transparency.

The attached paper is one of 46 such working documents used in the study analyses. Appendix D of the final NPC report provides a complete list of the 46 Topic Papers. The full papers can be viewed and downloaded from the report section of the NPC website (www.npc.org).

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Topic Paper

(Prepared for the National Petroleum Council Study on Research to Facilitate Prudent Arctic Development)

6-11	**Assessment of Relevant Areas of Current U.S. Government Technical Research Expertise/Capabilities**
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Reviewers	**Jed Hamilton (ExxonMobil)** **Bill Maddock (BP)**
Date: October 23, 2014	**Revision:** Final

SUMMARY

The U.S. Government Arctic Research Capabilities topic paper is a summary of government research capabilities based on responses to a National Petroleum Council survey conducted in August 2014. The technology capability survey was sent to representatives of the 33 agencies and National Laboratories listed in appendix A of this paper. The capability summaries are based on submissions from 16 agencies and laboratories.

For the *Capability Survey*, 34 research areas were identified to capture the broad range of capabilities related to Arctic resource development. The survey requested government organizations identify and describe all of the capabilities applicable to their organization. In addition, to provide context to the capabilities, the survey requested information on projects that supported the identified arctic research capabilities. The paper includes the research area list (including examples), a matrix showing capabilities by organization, the capabilities summary, and the list of survey recipients.

In addition to the survey, two technology workshops were held in Washington DC and Fairbanks to obtain feedback on technology/research needs. A summary of key topics from those workshops is included.

I. INTRODUCTION

This topic paper outlines research institutions, programs and capabilities organized and primarily funded by the U.S. Government that have relevance to the Oil and Gas industry's ability to conduct exploration and production activities the U.S. Arctic. The principal objective in preparing this paper was inform members of the NPC Arctic Study Committee of past, current, and proposed Arctic research being conducted by or on behalf of the U. S. Government.

II. PUBLSIHED SUMMARIES

The following publicly available documents identify the Federal Government's Arctic research work priorities, as well as some of its recent studies:

An Evaluation of the Science Needs to Inform Decisions on Outer Continental Shelf Energy Development in the Chukchi and Beaufort Seas, Alaska, U.S. Geological Survey, Fact Sheet 2011–3048, June 2011.

Oil Spills in Arctic Waters - An Introduction and Inventory of Research Activities and USARC Recommendations, US Arctic Research Commission and the US Army Corps of Engineers Cold Regions Research and Engineering Laboratory, November 2012.

Managing for the Future in a Rapidly Changing Arctic - A Report to the President, Interagency Working Group on Coordination of Domestic Energy Development and Permitting in Alaska, March 2013.

Responding to Oil Spills in the U.S. Arctic Marine Environment – A Report in Brief, Ocean Studies Board, Polar Research Board, Marine Board, National Academy of Sciences, April 2014.

III. FINDING AREAS OF COMMON INTEREST

The Managing for the Future in a Rapidly Changing Arctic – A Report the President articulates the following priorities. Those that are directly related to science and/or research are highlighted.

- Whole-of-government coordination to improve efficiency and operational certainty;
- Direct and meaningful partnership with stakeholders;
- Science-based decision-making focused on ensuring sustainable ecosystems;
- Adaptive approaches guided by ongoing research and monitoring;
- A region-wide planning approach that looks across jurisdictional boundaries; and
- Improved understanding and consideration of the cumulative impacts of human activities in the region.

This document broadly addresses environmental, cultural, social, economic, and infrastructure trends, as well as issues of particular significance to Tribal governments, Alaska Native Organizations, and Municipal governments. It specifically notes that "during the coming decades, the oil and gas industry expects to develop onshore and offshore oil and gas resources in the U.S. Arctic, and that the industry seeks a future that includes:

- Improved coordination by regulatory agencies, and clear and consistent application of standards, regulations, and statutes
- Creation and maintenance of infrastructure to move oil and gas to markets, including a potential natural gas pipeline from the North Slope, subsea pipelines from the Chukchi or Beaufort Seas, shore-based facilities to support offshore operations, pumping stations, a 250-mile pipeline across the National Petroleum Reserve, and continued operation of the Trans-Alaska Pipeline System
- Management plans that consider environmental protection and cultural needs alongside resource
- extraction activities
- A balance of industrial operations with local subsistence harvest needs

While the oil and gas industry "wish list" does not identify research that is needed to facilitate oil and gas development, it points to a need to strike an equitable balance environmental and cultural concerns and resource extraction requirements. Oil and gas companies must often identify and mitigate the environmental, cultural and socioeconomic impacts of their activities pursuant to various permit application and regulatory approval processes. Such efforts, in turn, may require substantial amounts of

supporting scientific data. To the extent that the Federal government performs or funds research that provides such data, there is a convergence of interests between the oil and gas industry and the Federal government. Conversely, where the Federal government is not involved in such research, the burden of data collection often falls to the industry. This increases industry's costs and can cause schedule delays, either of which can jeopardize the economic viability of a project. More significantly, the credibility of data acquired through industry-sponsored research can be called into question by project opponents on the basis of suspected conflicts-of-interest.

Ideally, any evaluation of the impacts of a proposed action – including the incremental impacts of oil and gas activities – is performed against an established baseline or set of background conditions that is well-understood and accepted. Understanding and addressing the effects of climate change on the U.S. Arctic is a dominant theme that underlies much of the U.S. Government's Arctic research activities. This requires a very broad range of research and ongoing (past, present and future) data collection to both identify historical conditions and monitor changes to those conditions. Any scientific research and/or data collection work that the Federal government performs or sponsors which contributes information that better defines background conditions is of potential benefit to the oil and gas industry.

A number of Federal agencies have a stake in Arctic research, and are either directly engaged in research/data collection or have a need for the information resulting from such work. Examples include the National Oceanographic and Atmospheric Administration (NOAA); the U.S. Geological Survey; the Bureau of Land Management; the Bureau of Ocean Energy Management; Bureau of Safety and Environmental Enforcement; the U.S. Coast Guard; the Environmental Protection Agency; the Federal Aviation Administration; the Fish and Wildlife Service; the Marine Mammal Commission; the Maritime Administration; the National Park Service; the U.S. Navy; the U.S. Army Corps of Engineers; and the Pipeline and Hazardous Materials Administration.

In order to gain better insight into how Federal R&D efforts and capabilities might be of direct benefit to the technology needs of the oil and gas industry, the following list of 34 research areas that are considered of greatest importance to offshore exploration and production technologies was prepared.

	Research Area
1	Arctic offshore geophysical data acquisition
2	Well integrity, spill prevention and response
3	Bottom-founded structures
4	Floating structures
5	Ice management
6	Winterization
7	Low temperature materials
8	Automation and robotics
9	Subsea production equipment
10	Offtake and shipping
11	Offshore pipelines

12 Risk assessment processes

13 Technologies for associated gas

14 Airborne ice thickness

15 Satellite technology for distinguishing age and thickness of ice

16 Marine radar for detecting and classifying ice types

17 Ice drift monitoring

18 Ice drift forecasting

19 Underwater profiling of ice features

20 In situ (on ice) ice surveys

21 Arctic Personnel Safety

22 Emergency Response - evacuation, rescue

23 Oil Spill Response (OSR) - Behavior of Spilled Oil

24 OSR – Tools

25 OSR - Remote sensing and monitoring of oil

26 OSR - Toxicity of oil to Arctic organisms and natural oil biodegradation

27 OSR - Field OSR experiments and releases to test technology, procedures, and practices

28 Long duration aerial surveillance

29 Managing the ice picture (see, avoid, break and handle)

30 Arctic aviation improvement initiatives

31 Arctic Fuel Storage, Delivery and Stabilization

32 Electric Power delivery systems

33 Hi-reliability Arctic communications

34 Arctic marine asset improvement initiatives

This list was subsequently sent to a list of Federal agencies, national laboratories, and other institutions of interest with an accompanying questionnaire. Appendix A summarizes the responses to that questionnaire.

In addition to the questionnaire, two workshops were conducted. The first was held in Washington, DC on September 23, 2014 and was attended by representatives of numerous Federal agencies. Appendix B contains the Agenda and list of attendees for this workshop. The second was held in Fairbanks, Alaska on November 10-11, and was hosted by the University of Alaska at Fairbanks. The purpose in conducting the second workshop was to provide organizations and individuals based in Alaska an opportunity to attend. Appendix C contains the Agenda and list of attendees for this workshop.

The objectives of these workshops were as follows:

- Advise attending Native Alaskan representatives, academic, State and Federal Government Agencies and National Laboratories of the objectives and status of the NPC Arctic study.
- Build NPC study participants' understanding of arctic interests and capabilities of Government Agencies and National Laboratories based on the recent survey results.
- Identify potential opportunities for future R&D for priority technology extensions by Government Agencies and National Laboratories.
- Identify potential opportunities for collaboration between government and industry arctic R&D.
- Inform study team understanding of Government-led arctic R&D to develop findings and recommendations for the NPC study.

Based on the results of the first workshop, the following prioritized list of areas of potential cooperation/assistance between the oil and gas industry and Federal research institutions was developed.

Higher Priority Items

- Source control (same season relief well equivalency)
    - Application of quantitative risk assessment
    - Integration of National Energy Technology Laboratory (NETL) and industry (international collaboration opportunity)
- Oil-spill response
    - Remote sensing technology for tracking of spilled oil
    - Oil spill simulants
    - Approach to secure a field test experimental release permit through an academic agency or government
- Develop region specific population/ecosystem effects model (SYMBIOSES)
- Extended season operation in ice (ice management/all surveillance)
    - A U.S. public Synthetic Aperture Radar satellite imagery source
    - Satellite based high-resolution ice thickness measurement
    - Sea ice drift models/regional scale weather forecasting
    - Integrated technical (station keeping) and non-technical (habitat impact) extended season demonstration (acceleration opportunity)
    - Ice management/navigation simulation center
- Food security/traditional subsistence lifestyle

Medium Priority Items

- EER systems
    - Joint development of evacuation craft
- Unmanned aerial systems
    - Compact sensor development
    - Collision avoidance
    - Regulatory structure for the U.S. Arctic
- Arctic-class autonomous underwater vehicle systems
    - Launch and recovery through ice
    - Collision avoidance
    - GPS deprived navigation
    - Subsea docking, recharge, and information exchange
- Enhanced pipeline integrity assessment and leak detection
    - Application of evolving and emerging sensors

- Hi-bandwidth communications (needs further study and definition)
- Reduced manning through automation/remote operation
    - Simulation modeling of system reliability
    - Tele-presence that allow remote execution of complex procedures (linked to bandwidth)
    - Large scale demonstration facility
- Marine sound mitigation for seismic data acquisition
    - Marine vibroseis source or other
- Sustained measurement/monitoring of the ice and metocean conditions (funding issue vs. technology)
    - Ocean observing systems/cabled observatory
    - Year-round buoy platform
- Compiling existing and collecting new data to characterize current environmental conditions Technologies/methodologies to distinguish between E&P impacts and natural change
    - Ice-breakup effects on habitat
    - Detailed characterization of marine mammal use of specific areas of potential operations

Lower Priority Items

- Sensor technology for load measurements/monitoring
    - Application of evolving and emerging sensors
- Technologies that can reduce environmental impacts and generate equivalency or offset allowances for other short-term operational impacts
    - E.g., windmills that can be used to offset impacts of offshore E&P operations

The second workshop (Fairbanks) provided the following summary of key issues for consideration.

FAIRBANKS WORKSHOP SUMMARY
Breakout Session on Arctic Offshore E&P Technology and Well Integrity
Mark Moyer, Facilitator
Summary of Input from Attendees:

I. Exploration Data Acquisition

- Noise reduction would be beneficial
- Quieter energy sources other than air guns are desired
- Less invasive acoustic or other energy sources such as vibro-seismic at seafloor should be considered
- Need to study mammal response to acoustic energy
- Need methodologies to better detect marine mammals
- Wave zone seismic near shore
- Wireless communication from subsea geophones

Notes: It is recognized that seismic data is needed to safely design wells
OGP JIP is ongoing to study sound effects on marine mammals
US Navy may also have data in this area

II. Exploration Drilling Platforms

- Need better detection of ice gouging and date of gouging
- More education by Industry to the Public especially regarding the phases from exploration to production of hydrocarbons
- Suitability of jack-up rigs in the arctic (design standards)
- Ice forecasting and measurement of the open water season
- Cap and containment capability
- Reliability of blowout preventers (BOPs)

- Need an update of full scale ice load data
- Mechanical properties of sea ice

Notes: May want to engage NSF to help data subsea gouges
University of Alaska- Fairbanks is interested in dating of seafloor gouges

III. Ice Management

- Need for more ice forecasting and monitoring
- Need remote sensing for ice thickness measurement
    - Note: University of Alaska-Fairbanks is active in monitoring ice in the Arctic, including extreme ice
- Need to gather more local observations
- Need more ice breaker vessels in the US
- Need a deepwater port in Western Alaska
- Need to understand the interaction of ice management with ice dependent species and habitats (noise effects)
- Need for a rapid response vessel for emergency evacuation

IV. Arctic Well Integrity and Spill Prevention

- Reliability of BOPs
- Cap and containment
- Need to communicate differences between Deepwater Gulf of Mexico and the shallow water Arctic to stakeholders
- Explain differences in regulations (e.g., BSEE) and API Standards post-Macondo (2010)
- Inspect the totality of the offshore installation using an integrated approach (cross training of BSEE and USCG inspectors)
- Need better integration of regulations and agencies
- Same season relief well equivalent
- Extend the open water season in the Arctic
- Consider separate regulations for exploration versus production wells

V. Offshore Pipelines and Subsea Installations

- Need better data on ice gouges
    - Isotope sampling for dating
    - Repeat mapping
    - Keel depth study and measurements
    - Translation of keel geometry to gouge depth
- Pipeline materials such as corrosion resistant alloys
- Exemption to the Jones Act
- Leak detection technology
- Need for pipeline sensors to detect hazards

Breakout Session on OSR, Logistics and Infrastructure, Safety and EER follow

Mitch Winkler, Facilitator

I. Communications

- Consider means to reinforce communications around OSR preparedness (e.g., dispersant testing, Shell 1 hour response plans, etc.)
- Consider research into use of social media for improving communications for topics such as identified above

II. Communication Technology

- Investigate opportunity to use proposed Fiber Optic Cable between North America and China for increasing local bandwidth
- Investigate Pioneer spill drill to identify lessons learned by way of communication (un)reliability

- Consider how to make better use of local community networks and their link to State and Federal Agencies during emergencies (including drills)

III. Ecology

- Consider application of NEBA like approach to develop more nuanced view of Ledyard Bay critical habitat, e.g., to enable maritime transit corridors. Investigate lessons learned from Boston regarding Right Whale and how they might provide insight

IV. OSR Preparedness

- Investigate technologies that could provide rapid updating of Subarea Plans (geographical reference, geographic response strategies, and changes in ecology/ecosystem). Driver is routine updating and changes that coastal erosion is creating. Technologies could include remote sensing, TK, and deployment (ERMA). Consider opportunities to do work in collaboration with local communities. Outcome would be improved efficiency of updating process and better plans.
- Consider research (analysis and scenario planning) to investigate frequency and types of spills (variability of hydrocarbons) from non-oil and gas related maritime activity. Consider how climate change might impact. Identify how current capability addresses and where gaps exist. Consider use results to suggest enhancements to USCG and Navy mission

V. OSR tools

- Consider research to identify waste disposal sites (OSR waste) that meet operator, State, and local community requirements.
- Consider research into enhanced incineration methods with focus on air emissions
- Consider research to identify enhanced methods for assessing dispersant effectiveness considering air (manned and unmanned aircraft, satellites) and water based (AUV) detection methods.

Breakout Session on Ice Measurement & Characterization

Rick Elliott, Facilitator

Synthetic Aperture Radar (SAR) Issues:

I. Reliance on satellites – Most of the data has to come from a SAR-equipped satellite

- There is no U.S. Government-owned or U.S. satellite that can provide the SAR information needed to manage ice for oil and gas E&P purposes
- Consequently, the industry relies on non-U.S. assets for SAR services/data
- This is probably adequate for most of the industry's purposes
- It is not an ideal arrangement when timely data is needed for oil spill response or other emergencies

II. Proprietary nature of SAR Data

- Reliance on private, non-U.S. satellites results in there being a considerable number more restrictions on the use and dissemination of data
- The University of Alaska receives SAR data and provides it to its sponsors
    - It has a "mixed bag" of funding sources, and it is not free to provide data to those who are not paying for it
    - This is not conducive to sharing of information for research purposes
    - Data acquisition costs can be a substantial barrier to researchers
- A central repository of SAR ice data would be helpful

III. Should there be a U.S. Government-owned or sponsored SAR satellite?

- NASA would presumably provide such a satellite
    - There is some concern that NASA might focus too much on research needs
    - Dual or multiple use of data is desirable
- A government-owned or sponsored satellite could have multiple sponsors/funding sources
    - NOAA
    - Coast Guard

    - Industry
    - Defense
        - DMSP (Defense Meteorological Satellite Program) – control and maintenance of the satellites was transferred to NOAA in 1998 to reduce costs
        - DOD's current needs are unclear
- What would the appropriate limits of the data from a government satellite be?

IV. SAR Data time lag

- Not an issue for data collected at UAF Fairbanks
- Information is available to key users such as Shell in minutes
- People interface/procedures take more time than actual data processing
    - This is probably unavoidable

V. Drift Monitoring and Forecasting Issues

- The computer models are simple and adequate, for the most part
    - Models do not account for interactions between ice and surface topography, which would offer an improvement
- Models are generally not useful for real-time operational needs (information needed for a forecast period of days to weeks)
    - Quality and/or availability of real time data can be poor/inadequate
    - There have been some improvements in data availability
    - Currents data is inadequate; currents can change quickly

VI. Non-Satellite Issues

- There is a need for a greater capability to collect and integrate data from multiple sources
- Importance of local knowledge from local ice experts becoming part of the broader body of knowledge
    - Particularly desirable to have local ice knowledge available in real-time during emergencies
- There should be greater use of marine radars for both real-time ice management purposes and research

VII. Navigation

- Is anyone enforcing polar code requirements with respect to vessel ice capabilities?
- The AIS vessel tracking system is mandatory for vessels over 90 ft in length (Arctic Information System)
    - Originally developed as a collision avoidance tool
    - Continuously transmits vessels' position, **identity**, **speed and course**, along with other relevant information, to all other AIS equipped vessels within range
    - Also offers port authorities AIS database includes some vessel information – this does not necessarily include a vessel's Polar Code ice classification
- General vessel traffic may not have adequate access to timely ice data
    - Shell's ice charts are proprietary
    - Quantity/type/sources of ice information available in ERMA (see following page) is unclear

Arctic ERMA – from NOAA Website

As Arctic sea ice continues to contract and thin, energy exploration and transportation activities will be increasing in the region, escalating the risk of oil spills and accidents. In anticipation, NOAA and interagency partners are actively preparing for these possible emergencies.

As a result, NOAA and its partners have developed an Environmental Response Management Application (ERMA®) for the Arctic region. ERMA is a web-based GIS tool that assists both emergency responders and environmental resource managers in dealing with incidents that may harm the environment.

ERMA integrates and synthesizes data—some of which happens in real time—into a single interactive map, providing a quick visualization of the situation and improving communication and coordination among responders and environmental stakeholders.

- ERMA brings together all of the available information needed for an effective emergency response in the Arctic's distinctive conditions, such as the extent and concentration of sea ice, locations of ports and pipelines, and vulnerable environmental resources.
- In developing this project for the Arctic, NOAA has received valuable support from the Department of the Interior's Bureau of Safety and Environmental Enforcement (BSEE). This partnership with BSEE has improved access to key environmental, commercial, and industrial data sources throughout lease areas in the Arctic. NOAA is also working with Indigenous communities to share information on how ERMA can best support an emergency response and protect the unique lifestyle and resources of the region.

Arctic ERMA is also a pilot project supporting the efforts of the Arctic Council's Emergency Prevention, Preparedness, and Response Working Group. Arctic ERMA is a partnership among NOAA's Office of Response and Restoration

Breakout Session on Ecology and Human Environment

Jim Slutz, Facilitator

The breakout session was divided between the topics of ecology and human environment. To begin the discussion, Michael Macrander provided a summary of the key Ecology themes identified by the study team.

I. Breakout Discussion on Ecology Technology and Research Needs

- Ecology Review key topics/themes
  - Understanding and documentation of current (baseline) conditions
  - Marine sound and impacts on biological resources
  - Ecological fate and effects of energy related discharges
  - Interactions between ice dependent species and O&G operations
  - Population and habitat changes of biological resources re: climate
  - Arctic fate and effects of oil spills and response measures
  - Range and efficacy of mitigation measures
  - Methods of assessment and forecasting of cumulative impacts
  - Ecosystem characteristics during winter periods of the year
  - Habitat restoration and rehabilitation
  - Air quality impacts on ecological resources
  - Integration of traditional and local knowledge
- The participants identified several over-arching frameworks that would be useful in considering ecology related science or technology.
  - Pro-active conservation planning
  - Systems approach to understanding ecosystems and planning research needs and development
  - Use of traditional knowledge as an important input to research planning and to policy actions
- Following are three specific areas identified which are recommended for further research:
  - Base-line data must be collected on a consistent and continuous basis
  - Greater research on the effectiveness and impact of mitigation requirements is needed to understand what works, this should include minor as well as major mitigation plans
  - Walrus platforms as an alternative to diminished ice flows
- The participants also identified that past policy decisions have resulted in unintended consequences and these decisions/actions could be enhanced through better science.

- Habitat protection areas should be designed to protecting the necessary area, but not be overly large that cause adverse impact to other uses, without benefit to the protected species
- Example provided was the overly broad protection of Point Lay, which inhibits local inhabitants from participating in commercial activities.

II. Breakout Discussion on Human Environment Technology and Research Needs

To begin the human environment discussion, Michael Macrander provided an overview of the human environment themes identified by the study team.

- Human Environment Review key topics/themes
  - Identification of subsistence practices and interactions with O&G activities
  - Incorporation of Traditional Knowledge
  - Sustainability of human environment relationships in relation to climate change and energy exploration and development
  - Impacts of climate change on human relationship to the environment
  - Food security – changing patterns of contamination and disease
  - Arctic fate and effects of oil spills – the human environment interface
  - Impacts of O&G activity on the distribution and availability of subsistence resources
- Participants identified three high level operating principles/questions:
  - Traditional knowledge is an important source of information, but it should be two-way communication
  - When is information sufficient to make a decision?
  - Effective communication of risk will be an important aspect of communicating across the broad range of interested individuals and organizations
- Areas which would be useful for research to better understand the Human environment in the Arctic
  - Social science research may be an area that is not adequately addressed in research plans, since most research focuses on physical sciences and technology
  - Understanding workforce development needs and opportunities to develop small businesses to support resource development could be an opportunity for greater arctic community engagement. An example was shared that Canada has been very active in the area.
  - Questions were raised about the Coast Guard's capability – is the capability sufficient to support development and also support local arctic communities.
  - Corporate social responsibility as a possible area for additional research to measure effectiveness and support the development of performance measures.
  - An example of effective and useful research in the area of human environment was the work that has been done on subsistence mapping.

Appendices

A Summary of Questionnaire Responses

B Washington, DC Workshop Agenda and Attendees

C Fairbanks, Alaska Workshop Agenda and Attendees

Appendix A

Research Category	Argonne National Laboratory	Bureau of Ocean Energy Management Alaska OCS Region	Bureau of Safety and Environmental Enforcement (BSEE) Alaska Region (TAP)	Bureau of Safety and Environmental Enforcement (BSEE) Oil Spill Response Division	Lawrence Berkeley National Laboratory	Los Alamos National Laboratory	NASA	National Energy Technology Laboratory (NETL)	National Renewable Energy Laboratory (NREL)	Naval Research Lab	Office of Naval Research: Ocean Battlespace Dept.	Oil Spill Recovery Institute	Pacific Northwest National Laboratory	Sandia National Laboratory	Savannah River National Laboratory	United States Geological Survey
Arctic offshore geophysical data acquisition		X			X	X	X						X		X	
Well integrity, spill prevention and response						X		X					X			
Bottom-founded structures			X					X			X		X			
Floating structures								X								
Ice management		X	X		X	X					X	X		X		
Winterization												X				
Low temperature materials			X					X					X			
Automation and robotics		X		X							X	X	X			
Subsea production equipment																
Offtake and shipping																
Offshore pipelines			X					X					X			
Risk assessment processes	X	X			X	X		X				X	X	X		
Technologies for associated gas					X			X					X			
Airborne ice thickness							X	X		X	X					
Satellite technology for distinguishing age and thickness of ice						X	X	X								
Marine radar for detecting and classifying ice types											X			X		
Ice drift monitoring		X	X			X	X	X			X					
Ice drift forecasting						X	X				X			X		
Underwater profiling of ice features			X	X							X					
In situ (on ice) ice surveys		X			X							X				
Arctic Personnel Safety															X	
Emergency Response - evacuation, rescue								X								
Oil Spill Response (OSR) - Behavior of Spilled Oil	X	X			X	X	X	X				X	X			
OSR - Tools		X		X				X				X			X	
OSR - Remote sensing and monitoring of oil	X	X		X			X	X				X	X			
OSR - Toxicity of oil to Arctic organisms and natural oil biodegradation		X			X							X	X		X	
OSR - Field OSR experiments and releases to test technology, procedures, and practices		X		X	X											
Long duration aerial surveillance		X					X							X		
Managing the ice picture (see, avoid, break and handle)						X										
Arctic aviation improvement initiatives		X														
Arctic Fuel Storage, Delivery and Stabilization																
Electric Power delivery systems								X	X				X	X		
Hi-reliability Arctic communications																
Arctic marine asset improvement initiatives																

Appendix B

NATIONAL PETROLEUM COUNCIL

An Oil and Natural Gas Advisory Committee to the Secretary of Energy

National Petroleum Council (NPC) Workshop:

U.S. Government Arctic R&D Assessment For the NPC Arctic Research Study

Agenda

8:00-8:30	Arrival and coffee	
8:30-8:45	Call to Order, Safety	Jan Mares, RFF
	NPC Overview	Marshall Nichols, NPC
8:45-9:15	NPC Arctic study overview	Doug Hoyt, Assist. Chair NPC Arctic Study Coordinating Subcommittee
9:15-10:15	Panel: NPC Study Technology Chapter	Bill Maddock, BP, Moderator
	• Offshore E&P Technology	Jed Hamilton, ExxonMobil
	• Characterization of the Ice Environment	Jim Bruce, Chevron
	• Safety-Logistics	Peter Velez, Shell
	• Arctic Ecology and Human Environment	Russell Tait, ExxonMobil
10:15-10:30	Coffee break	
10:30-11:30	Panel: Government Technology Leaders	Jim Slutz, NPC, Moderator
	• National Academies	Amanda Staudt, NAS
	• U.S. Navy	Rear Admiral Jonathon White
	• National Lab	Charlie Brandt, PNNL
	• National Energy Technology Laboratory	Jared Ciferno, NETL (invited)
11:30-12:00	Identify workshop tasks and breakout groups	Bill Maddock
12:00-12:30pm	Lunch in Breakout Group (pick up box lunch)	
12:30-3:00pm	Breakout Group Sessions and Facilitators:	
	• Offshore E&P Technology	Mitch Winkler, Shell
	• Characterization and Measurement of the Ice Environment	Rob Raye, Shell
	• Safety – Logistics	Peter Noble, Noble Assoc.
	• Arctic Ecology and Human Environment	Tim Nedwed, ExxonMobil
3:00-3:15pm	Coffee Break	
3:15-4:15pm	Report out by work groups	Group Facilitators
4:15-4:45pm	Actions and workshop reporting/Wrap-up	Jed Hamilton

Workshop: U.S. Government Arctic R&D Assessment
For the NPC Arctic Research Study
Attendance list

Name	Title	Organization
James Bond	Director, Shared Technology	America Bureau of Shipping
Charlie Brandt	Division Director, Coastal Sciences	Pacific Northwest National Laboratory
Dr. John Brozena	Head Marine Physic Branch	Naval Research Laboratory
Jim Bruce	Arctic Offshore Engineering Advisor	Chevron
Scott Carr	Arctic Research Coordinator	Bureau of Safety and Environmental Enforcement
Jared Ciferno	Director, Strategic Center for Natural Gas & Oil	Department of Energy, National Energy Technology Laboratory
Joseph V. Cordaro	Advisory Engineer	Savannah River National Laboratory
Dr. Venkat Dasari	Staff Member	Los Alamos National Laboratory
Dr. Elizabeth Eide	Director, Board on Earth Sciences and Resources	The National Academies
Rick Elliot	Director, Division of Advanced Supply and Facilities	Department of Energy
Dale Farmer		ExxonMobil
Dr. John Farrell	Executive Director	US Arctic Research Commission
Wyche Ford	Project Director	Fluor Alaska
Dr. Victor Garas	Engineering Associate	ExxonMobil

Name	Title	Organization
Deborah Glickson	Senior Program Officer	The National Academy of Sciences/National Research Council
Nalini Gromley	Petroleum Engineer, Emerging Technologies Branch	Bureau of Safety and Environmental Enforcement
John Guy	Deputy Executive Director	National Petroleum Council
Amy Halloran	Manager, Geophysics and Atmospheric Sciences	Sandia National Laboratory
Jed M. Hammilton	Sr. Arctic Consultant	ExxonMobil
Commander J.D. Horne	Commander	Navy Warfare Development Command
Douglas Hoyt	EMDC Engineering Manager/CSC Alternate Chair	ExxonMobil
Dr. Martin Jeffries	Arctic Science Advisor & Program Officer	Office of Naval Research
Shannon Jenkins	U.S. Coast Guard Research, Development Program Office	U.S. Coast Guard
Nancy Johnson	Director, Environmental Science and Policy Analysis Office of Oil and Natural Gas	Department of Energy, Office of Fossil Energy
David Kennedy	Arctic Senior Advisor to the Undersecretary	National Oceanic and Atmospheric Administration
Dr. John R. Krummel	Director, Environmental Science Division	Argonne National Laboratory
Lt. Trisha Kutkiewicz	Flag Aide to OPNAV N2/N6E	U.S. Navy
Roy Long	Ultra-Deepwater Technology Manager Strategic Center for Natural Gas & Oil	Department of Energy/NETL/SCNGO
Bill Maddock	Arctic Engineering and Technology	BP

Name	Title	Organization
Jan Mares	Senior Policy Advisor	Resources for the Future
Elena Melchert	Division Director, Oil and Gas Research Office of Fossil Energy	Department of Energy, Office of Fossil Energy
Mark Myres	Vice Chancellor for Research	University of Alaska Fairbanks
David M. Moore	Chief - Oil Spill Response Division	Bureau of Safety and Environmental Enforcement
George Moridis	Head, Hydrocarbon Resource Program	Lawrence Berkeley National Laboratory
Mark C. Moyer	Drilling Technical Manager	ExxonMobil
Candace Nachman	Fishery Biologist	National Oceanic and Atmospheric Administration, Fisheries Service
Tim Nedwed		ExxonMobil
Marshall W. Nichols	Executive Director	National Petroleum Council
Peter Noble	President and Senior Advisor	Nobel Associates LLC
David Ott	Alaska Infrastructure Manager	Shell
Rajesh J. Pawar	Program Manager	Los Alamos National Laboratory
Ron J. Piret	Arctic Affairs Officer	U.S. Navy
Jim Poplin	Pt. Thompson Project Technical Advisor	ExxonMobil
Robert Raye	Ocean Science Advisor	Shell
Will Riddell-McKay	Librarian	National Petroleum Council

Name	Title	Organization
Sam Rizzo	Office of International Programs	Bureau of Safety and Environmental Enforcement
RDML David Score	Director, Office of Marine and Aviation Operations & NOAA Corps	National Oceanic and Atmospheric Administration /Office of Marine and Aviation Operations
Dr. James M. Shuler	Manager, DOE Packaging Certification Program	Department of Energy
Lt. Joshua Slater	Flag Aide to Read Admiral Score, NOAA	National Oceanic and Atmospheric Administration, Office of Marine and Aviation Operations
Jim A. Slutz	Consultant	National Petroleum Council
Robert Smith		Department of Energy, Office of Fossil Energy
Dr. Amanda Staudt	Director, Board on Atmospheric Sciences and Climate	The National Academies
Russell Tait		ExxonMobil
Geir Utskot	Arctic Manager	Schlumberger
Peter Velez	President	Peter Velez Engineering LLC
Dave Westerholm	Director, Office of Response and Restoration	National Oceanic and Atmospheric Administration
RDML Jonathan White	Oceanographer of the Navy	U.S. Navy
Dr. Dee Williams	Studies Chief	Bureau of Ocean Energy Management
Mitch Winkler	Arctic Technology Program Manager	Shell

Appendix C

National Petroleum Council

An Oil and Natural Gas Advisory Committee to the Secretary of Energy

Technology Engagement Workshop
For the NPC Arctic Research Study

November 11, 2014
University of Alaska – Fairbanks
Butrovitch building, Room # 109
910 Yukon Drive
Fairbanks Alaska

Agenda

8:00-8:30am	Arrival and coffee	
8:30-10:00am	Opening	
	• Call to Order, Safety	Mark Myers, University of Alaska
	• NPC Overview	John Guy, NPC
	• NPC Arctic study overview	Doug Hoyt
	• Study Technology Overview	Jed Hamilton
10:00-10:15am	Coffee break	
10:15-11:15am	Panel: NPC Study Technology Chapters	Bill Maddock
	• Offshore E&P Technology	Jed Hamilton
	• Characterization of the Ice Environment	Jim Bruce
	• Safety and Emergency Response	Peter Velez
	• Logistics and Infrastructure	Wyche Ford
	• Arctic Ecology and Human Environment	Michael Maccrander
10:30-11:45am	Panel: Technology Leaders	Jim Slutz, NPC, Moderator
	• University of Alaska	Mark Myers
	• North Slope Science Initiative	John Payne
	• Native Corp. or Local Gov.	Richard Glenn
	• National Lab (NETL)	Jared Ciferno
11:45-12:00pm	Identify workshop tasks and breakout groups	Bill Maddock
12:00-12:45pm	Lunch	
12:45-3:00pm	Breakout Group Sessions and Facilitators:	
	• Offshore E&P Technology	Mitch Winkler, Shell
	• Characterization and Measurement of the Ice Environment	Rick Elliott
	• Safety, Emergency Response - and Logistics	Mark Moyer
	• Arctic Ecology and Human Environment	John Payne
3:00-3:15pm	Coffee Break	
3:15-4:15pm	Report out by work groups	Bill Maddock Group Facilitators
4:15-4:45pm	Actions and workshop reporting/Wrap-up	Jed Hamilton

Technology Engagement Workshop for the NPC Arctic Research Study
Attendance List

Name	Title	Organization
Ashley Adamczak	Environmental Program Specialist	State of Alaska: Dept. of Environmental Conservation
Jacob Adams	Chief Administrative Officer	North Slope Borough
Nils Andreassen	Executive Director	Institute of the North
Marty Awalin	President/CEO	Cully Corporation
Waska Awalin Jn.	Project Manager	Beluga Construction, LLC
Betsy B. Baker	Professor	University of Washington School of Law, Alaska Programs
Price Brower	Chairman	Ukpeagvik Inupiat Corporation
Jim Bruce	Arctic Offshore Engineering Advisor	Chevron
William Scott Carr	Acting Arctic Research Coordinator	Bureau of Safety and Environmental Enforcement
Jared Ciferno	Director, Strategic Center for Natural Gas & Oil	DOE, National Energy Technology Laboratory
Bud Cribley	Alaska State Director	Bureau of Land Management
David Dickins		Chevron
George Edwardson	ICAS Vice-President	Inupiat Community of the Arctic Slope
Hajo Eicken	Professor of Geophysics	University of Alaska Fairbanks, Geophysical Institute
Rick Elliott	Director	Dept. of Energy
Wyche Ford	Senior Project Director	Fluor
Jessica Garron	Senior Science Consultant, ASF	University of Alaska Fairbanks, Geographic Information Network of Alaska
Richard Glenn	Executive Vice President Lands and Natural Gas	Arctic Slope Regional Corporation

Name	Title	Organization
John Guy	Deputy Executive Director	National Petroleum Council
Jed Hamilton	Sr. Arctic Consultant	Exxon
Thomas Heinrichs	GINA Director	University of Alaska Fairbanks, Geographic Information Network of Alaska
Kevin Hillmer	Environmental Governance PhD Candidate	University of Alaska Fairbanks
Larry Hinzman	Director, Intl. Arctic Research Center and Professor	University of Alaska Fairbanks
Doug Hoyt	Engineering Manager	ExxonMobil
Teresa Imm	General Manager	Arctic Inupiat Offshore
Bill Ingersoll	Chief of the Plans Section, Office of Leasing and Plans	Bureau of Ocean Energy Management
Ken Johns	COO	Cully Corporation
David W. Johnston	Regional Supervisor	Bureau of Ocean Energy Management
Nettie La Belle-Hamer	Associate Vice Chancellor for Research and ASF Director	University of Alaska Fairbanks, Alaska Satellite Facility
Steve Hartman	BLM Fairbanks District Manager	BLM
Charles C. Lampe	Vice President Kaklovik Inupiat Corp.	AIO
Doreen Lampe	ICAS Executive Director	Inupiat Community of the Arctic Slope
Mary Beth Leigh	Associate Professor	University of Alaska Fairbanks, Institute of Arctic Biology
Michael Maccrander		Shell
Bill Maddock	Arctic Engineering and Technology	BP
Patrick Mekiana	Director	Arctic Inupiat Offshore LCC
Mark C. Moyer	Drilling Technical Manager	ExxonMobil

Name	Title	Organization
Mark Myers	Vice Chancellor for Research	University of Alaska Fairbanks
John Payne	Executive Director	U.S. Department of the Interior
Drue Pearce	Senior Policy Advisor	Crowell & Moring
Lori Polasek	Research Scientist	Alaska Sea Life Center
Jim Poplin	Technical Interface	ExxonMobil
Kristin Ryan	Spill Prevention and Response Director	State of Alaska, Department of Environmental Conservation
Courtney Sanborn	Special Projects Coordinator	University of Alaska Fairbanks
Silke Schiewer	Professor	University of Alaska Fairbanks
William Schnabel	Director, Water and Environmental Research Center	University of Alaska Fairbanks
Brent Sheets	Research Manager	Alaska Center for Energy and Power
Jim Slutz	Consultant	National Petroleum Council
Bert Stedman	Senator	Alaska Legislature
Betty Swan	Project Manager	Cully Corporation
Richard Ungarook	Secretary	Ukpeagivik Inupiat Corporation
Peter Velez	President	Peter Velez Engineering LLC
Skip Walker	Professor	University of Alaska Fairbanks, Institute of Arctic Biology
Mitch Winkler	Manager, Arctic Technology	Shell