National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling

THE CHALLENGES OF OIL SPILL RESPONSE IN THE ARCTIC

--Draft--

Staff Working Paper No. 5

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This draft staff working paper describes some of the difficulties of spill response in the Arctic.[1] In the staff's view, response challenges in the Arctic are important for the Commission to consider in its recommendations for the future of offshore drilling. This paper provides background information regarding the status of offshore drilling in Arctic waters, identifies problems with responding to oil spills in Arctic waters, and highlights areas for further Commission inquiry with respect to Arctic drilling.

I. Background

A. The Region at Issue

The two locations of offshore drilling in the Arctic, the Beaufort Sea and the Chukchi Sea, present different drilling conditions and response issues.

The Beaufort Sea drilling sites are situated on man-made gravel islands located two to fifteen miles offshore, in water depths up to approximately 100 feet.[2] They are often linked to onshore facilities and are close to land and shoreline resources. The majority of the construction

[1] This working paper does not address all issues related to Arctic drilling in which the Commission may be interested. For example, the paper does not address the evaluation of spill impacts, the potential non-oil spill impacts of oil and gas development in the Arctic, or the role of environmental regulatory review under the National Environmental Policy Act, the Marine Mammal Protection Act, and other federal laws (or their Alaska state counterparts).

[2] BP IN ALASKA, www.bp.com/assets/bp_internet/us/bp_us_english/STAGING/local_assets/downloads/a/A02_alaska_facts_figures.pdf (last visited Sept. 15, 2010); SHELL'S BEAUFORT SEA EXPLORATORY DRILLING PROGRAM: OIL SPILL PREVENTION AND RESPONSE, http://www-static.shell.com/static/usa/downloads/about_shell/strategy/major_projects/alaska/final_shell_ospr_booklet_10-1-07.pdf (last visited Sept. 18, 2010); Ian Urbina, *BP Is Pursuing Alaska Drilling Some Call Risky*, N.Y. TIMES (June 23, 2010).

of the offshore gravel islands, however, needs to be completed during the winter ice season when an ice road exists between the site and the mainland.[3]

The locations of drilling interest in the Chukchi Sea are much further offshore and, consequently, much less accessible. This area had until recently generated less interest from industry as a result of its lack of shoreline infrastructure and the consequent heightened cost of drilling.[4] The current applications from the Shell Oil Company and StatOil are for seismic exploration and exploratory drilling at least sixty miles off the coast that would take place during the open water season from July to October.[5]

These differences in environmental conditions and drilling proposals mean that spill response in the Beaufort Sea would potentially be more straightforward than spill response in the Chukchi. The Beaufort region has more developed and proximate infrastructure, so access to a spill area might be easier. However, the Beaufort drilling sites are closer to both the sensitive shoreline and the areas traversed by bowhead whales and whale hunters.

A spill or blowout in the Chukchi Sea area would be more difficult to access, let alone contain and clean up. Although Shell has pre-positioned assets dedicated to potential spill response in the Chukchi Sea,[6] bringing any assets, both the pre-staged equipment and any additional resources brought from elsewhere, to bear on a spill in the Arctic would be more difficult than in the Gulf of Mexico. And once the winter freeze occurs, any spill would be impossible to access for purposes of response. On the other hand, any spill in the Chukchi Sea would be far from coastal resources, and oil trapped beneath sea ice would be unlikely to spread into marine ecosystems until the ice began to melt.

The Arctic areas also stand in contrast with the Gulf of Mexico in terms of the issues posed by deepwater drilling. The Deepwater Horizon containment efforts were complicated immensely by the depth of the wellhead and the high well pressures encountered at the Macondo well. Wells in both the Chukchi and the Beaufort Seas would be in far shallower water, which could make it easier to contain a blowout or riser leak. Shell asserts that well pressures in the Chukchi and Beaufort Seas would be approximately one third to one half of the pressures faced by BP at the Macondo well.[7] Finally, although wells in the Chukchi would be similar to the

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[3] J.D. Hall, *Oooguruk Project Offshore Alaska*, OFFSHORE (Aug. 1, 2008), http://www.offshore-mag.com/index/article-display/337896/articles/offshore/volume-68/issue-8/arctic-frontiers/oooguruk-project-offshore-alaska.html.

[4] CHARLES THOMAS, WALTER NORTH, TOM DOUGHTY & DAVID HITE, ALASKA NORTH SLOPE OIL AND GAS: A PROMISING FUTURE OR AN AREA IN DECLINE?, DOE/NETL (Apr. 8, 2009), http://www.netl.doe.gov/technologies/oil-gas/publications/AEO/ANS_Potential.pdf [hereinafter THOMAS ET AL., ALASKA NORTH SLOPE OIL AND GAS].

[5] Online Public Notice, State of Alaska, North Slope Borough: Shell Offshore Inc. 2010 Chukchi Sea Exploration Plan (Nov. 25, 2009), http://notes4.state.ak.us/pn/pubnotic.nsf/PNByPublActive/863634D1F5F7724089257678000615E2?OpenDocument (last visited Sept. 15, 2010).

[6] Peter K. Velez, Upstream Emergency Response Manager, Shell International Exploration and Production B.V., Presentation to Commission staff (Sept. 16, 2010).

[7] The Macondo wellhead lay below about 5,000 feet of water; the proposed exploratory wells in the Chukchi Sea would be at depth of about 150 feet. Shell believes, based on the testing it has already done, that the pressures in the Chukchi Sea would be two to three times less than they were in the Macondo well. Letter from Marvin E. Odum, President, Shell Oil Company to S. Elizabeth Birnbaum, Minerals Management Service (May 14, 2010), *available at* http://www.thearcticsounder.com/article/1020shell_letter_defends_arctic_program_in_light.

Macondo well in terms of distance from shore, the human uses of the shoreline of the Gulf Coast are much more expansive than the human uses of the North Slope Coast.[8]

The contrasts between these regions and between open water and ice conditions affect the nature of spill response and spill response planning. Many of the issues highlighted in this paper apply to both the Beaufort and the Chukchi Seas, but the different conditions should be kept in mind.

B. Industry Interest

Although interest in exploring Alaska's North Slope for oil began in the early 20th century, the region's remoteness and lack of land availability prevented serious private investment, leaving most exploration to the U.S. Navy. It was the discovery of the Prudhoe Bay and Kuparuk River fields from 1967-69 that spurred the industry to explore the Arctic region of Alaska.[9] In 1979, the government conducted a leasing sale that included state and federal waters of the Beaufort Sea, resulting in the first major venture into Arctic offshore exploration.[10]

Drilling in the Beaufort began in 1981, with a total of 20 wells drilled by 1989. Only a few of the wells were further developed, including those in the Northstar and Liberty fields. Most of the wells drilled in the Beaufort came up dry. Among the dry wells were those in the Mukluk field, which, at a cost of $120 million, are considered the most expensive dry wells ever drilled.[11] In the Chukchi, remoteness and harsh conditions continued to discourage industry activity. The first lease sale in the area was not held until 1988.

In the 1990s, industry's interest decreased in both the Chukchi and the Beaufort, in part because of the failure of Mukluk. But more recently, interest—in particular, by Shell—has begun to grow once again. Several factors have contributed to renewed oil industry interest in drilling in the Beaufort and Chukchi Seas. Improved technology has made remote locations more economically viable to explore. Additionally, the then-Minerals Management Service (MMS)[12] issued new information for the Burger field in the Chukchi Sea in advance of the lease sales held in 2008, which detailed significant untapped oil and gas resources and made the region much more attractive for exploration and investment.[13] The U.S. Geology Survey, also in 2008, released a reevaluation of Arctic potential resources, estimating that "90 billion barrels of oil, 1,669 trillion cubic feet of natural gas, and 44 billion barrels of natural gas liquids may remain to be found in the Arctic, of which approximately 84 percent is expected to occur in offshore areas."[14]

Shell estimates that there are 25 billion barrels of oil in the Alaskan Arctic, with the majority in the Chukchi Sea; the data from BOEMRE, which accounts only for oil that is economically recoverable with current technology, is 0.15 to 12 billion barrels of oil in the

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[8] Some of the shoreline and human use issues of Gulf of Mexico and the Chukchi and Beaufort Seas will be discussed in later Commission work on the potential impacts of a spill.
[9] THOMAS ET AL., ALASKA NORTH SLOPE OIL AND GAS, at 2-17 to 2-25.
[10] *Id.* at 2-26.
[11] *Id.* at 2-35.
[12] MMS is now the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE).
[13] THOMAS ET AL., ALASKA NORTH SLOPE OIL AND GAS at 2-79.
[14] Fact Sheet, U.S. Geological Survey, Circum-Arctic Resource Appraisal: Estimates of Undiscovered Oil and Gas North of the Arctic Circle (2008), *available at* http://pubs.usgs.gov/fs/2008/3049/.

Chukchi.[15] Shell acquired leases in the Beaufort during Lease Sale 195 in 2005 and in the Chukchi during Lease Sale 193 in 2008, and it has announced plans to drill in both regions. Shell's proposal for drilling exploratory wells in the Chukchi Sea envisions operations taking place from approximately July 15 to October 30. Drilling will occur from a floating drillship. If Shell begins production at some time in the future, production drilling will occur year-round, though access to the drilling operations by boat will be easier during open water season.

The shrinking Arctic ice cap is also a factor. A smaller ice cap creates longer open water seasons and increased open water areas, while diminishing risk of ice collisions.[16] The Arctic Ocean is subject to regular freezing and melting as the ice shelf that extends off the main Arctic ice cap expands in the winter and retreats in the warmer summer months. The ice seasons consist of: "open water" in the summer, "freeze up" as the ice forms through the fall, "over winter" as the solid floating ice attaches to the shelf, and "break up" as the ice melts and cracks into floes and other large pieces through the spring. As the temperatures in the Arctic increase, both the extent of ice cover overall and the length of time that ice blocks the sea decreases. Estimates vary as to how soon the Arctic Ocean will be ice-free in the summer months, but most projections place the event sometime between 2030 and 2100.[17]

C. Status of Exploration and Leasing

The Beaufort and Chukchi Seas sit in different positions with regard to where, how, and when exploration and drilling may occur. All drilling in the Arctic is on pause as of this writing. On September 3, 2010, during a trip to Alaska, Department of Interior Secretary Ken Salazar announced that the Department of the Interior will not decide whether to allow exploratory drilling for oil and gas in the Alaska Arctic outer continental shelf until the Department has completed a review of issues relating to offshore drilling activities.[18] On September 9, 2010, the state of Alaska sued the Department of the Interior in the United States District Court for the District of Alaska, contending that the announcement imposed an improper de facto moratorium and did not give the state a chance to comment or a final decision to appeal.[19] An Interior spokesperson indicated that the Department was "taking a cautious approach" and needed "additional information about spill risks and spill response capabilities."[20] The Department also

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[15] Shell Beaufort and Chukchi Sea, Program Update, Presentation to National Commission Staff, in Washington D.C. (Sept. 17, 2010); Questions and Answers: The Next Five-Year OCS Oil and Gas Leasing Program (2012-2017), http://www.doi.gov/whatwedo/energy/ocs/QA_2012-2-17.cfm.

[16] RONALD O'ROURKE, CONG. RESEARCH SERV., CHANGES IN THE ARCTIC: BACKGROUND AND ISSUES FOR CONGRESS 17 (Mar. 30, 2010).

[17] *See, e.g.*, Press Release, National Snow and Ice Data Center, Arctic Sea Ice Shatters All Previous Record Lows (Oct. 1, 2007), *available at* http://nsidc.org/news/press/2007_seaiceminimum/20071001_pressrelease.html (predicting 2030); Walter Meier, Julienne Stroeve, and Florence Fetterer, *Whither Arctic sea ice? A clear signal of decline regionally, seasonally and extending beyond the satellite record*, 46 ANNALS OF GLACIOLOGY 433 (2007): (predicting 2035-2106); Julienne Stroeve, Marika Holland, Walt Meier, Ted Scambos, and Mark Serreze, *Arctic Sea Ice Decline: Faster than Forecast*, 34 GEOPHYSICAL RESEARCH LETTERS 5 L09501 (2007) (predicting 2050-2100).

[18] Kim Murphy, *Salazar says Arctic Drilling Must Wait Until More is Known About Potential Pitfalls*, LOS ANGELES TIMES (Sept. 4, 2010), http://articles.latimes.com/2010/sep/04/news/la-artic-drilling-greenspace-sept4-m.

[19] Alaska v. Salazar, No. 3:10-cv-00205 (D. Alaska filed Sept. 9, 2010).

[20] Margaret Cronin Fisk, *Alaska Claims in Suit U.S. Government Improperly Banned Off-Coast Drilling*, BLOOMBERG (Sept. 10, 2010), http://www.bloomberg.com/news/2010-09-09/u-s-improperly-banned-drilling-off-alaska-coast-state-alleges-in-lawsuit.html.

contends that there is no moratorium in place for Alaska, but rather a period of additional review of proposed drilling plans.[21]

a. Beaufort Sea

Pioneer Natural Resources, Eni Petroleum, Shell, and BP all have interests in the Beaufort Sea. All offshore fields in the Beaufort Sea are either fully or partially based on artificial offshore islands.

Pioneer Natural Resources was the first independent company to control a producing field in the Beaufort Sea. It has been extracting oil in the Oooguruk offshore field since 2008 in partnership with Eni. The site is located on an artificial gravel island five miles offshore in four-and-a-half feet of water.[22] Italy's Eni has gradually relinquished some of its onshore leases and has instead focused on developing its near-shore Nikaitchuq field in the Beaufort Sea. Eni plans initially to produce oil through an onshore base and later to construct an offshore island and continue production from the water. The company has also teamed up with Shell to conduct seismic tests in the Harrison Bay area of the Beaufort.[23]

BP operates three offshore fields in the Beaufort Sea: Northstar, Endicott, and Liberty. All of them are constructed on man-made gravel islands in the Beaufort Sea waters. The first two fields are older operations, while Liberty was set to begin operating this summer. Liberty is of particular note because it is an ultra-extended reach well: although it will be drilled in fairly shallow water within three miles from shore on state submerged lands, the well will extend laterally for up to eight miles from the surface location of the drilling rig.[24] In light of the Gulf of Mexico oil spill, federal regulators have decided to review BP's plans before allowing BP final permission to drill at Liberty.[25]

MMS proposed additional lease sales in the Beaufort Sea in its 2010-2015 draft proposed five-year leasing program.[26] The National Oceanic and Atmospheric Administration (NOAA) commented on this plan, raising issues related to the impacts of off shore oil exploration and development on living marine resources and their habitats. It also conveyed its concern about the lack of oil spill response preparedness in the Arctic and encouraged leasing to be delayed pending additional research.[27] President Obama's March 31, 2010 announcement of a new outer-continental shelf policy cancelled planned some leases under the 2007-2012 leasing plan

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[21] Dan Joling, *Alaska rips feds over suspension of Arctic drilling*, ANCHORAGE DAILY NEWS (Sept. 10, 2010).
[22] Hall, *Oooguruk Project Offshore Alaska*.
[23] Alan Bailey, *More leases Dropped*, 15 PETROLEUM NEWS (Aug. 15, 2010), http://www.petroleumnews.com/pntruncate/109175427.shtml.
[24] Letter from Sean Parnell, Governor of Alaska, to Michael Bromwich, Director, Bureau of Ocean Energy Management, Regulation, and Enforcement 5 (Aug. 25, 2010), *available at* http://gov.alaska.gov/parnell_media/documents/govltrtoBromwich.pdf.
[25] Jim Efstathiou Jr., *BP's Liberty Oil Well in Alaska to Face New Safety Rules*, BLOOMBERG, June 24, 2010, http://www.businessweek.com/news/2010-06-24/bp-s-liberty-oil-well-in-alaska-to-face-new-safety-rules.html.
[26] MMS, Draft Proposed Outer Continental Shelf (OCS) Oil and Gas Leasing Program 2010-2015 (January 2009) [hereinafter MMS 2009 Proposal] (on file with Commission).
[27] Letter from Jane Lubchenco, Under Secretary of Commerce for Oceans and Atmosphere, to S. Elizabeth Birnbaum, Director, Minerals Management Service 5-12 (Sept. 21, 2009) [hereinafter NOAA 2009 Comments] (detailing NOAA's comments on the U.S. Department of the Interior/Minerals Management Service Draft Proposed Outer Continental Shelf Oil and Gas Leasing program for 2010-2015) (on file with Commission).

and delayed implementation of the proposed 2010-2015 plan to 2012-2017. The 2012-2017 plan is in its early stages of development, and will evaluate whether or not to lease areas in the Beaufort and the Chukchi Seas. Public meetings to determine the scope of the environmental impact statement and the areas to be considered in the five-year leasing program were scheduled for summer 2010, but were cancelled in light of the Deepwater Horizon spill.[28]

b. Chukchi Sea

The 2008 sale of Lease Area 193 in this region proved to be the most profitable in the history of Alaska offshore leasing. Companies bid a total of $2.6 billion for the available lease areas. Lease Sale 193 encompasses approximately 29.4 million acres of the Outer Continental Shelf in the Chukchi Sea. In 2008 seven companies bid for leases: ConocoPhillips, Shell Gulf of Mexico, StatoilHydro USA E&P, the Northern America Civil Recovery Arbitrage Corp, Repsol E&P USA, Eni Petroleum, and Iona Energy Company.[29]

Shell is the only company that has presented plans to drill in the Chukchi (after conducting seismic studies there in 2006 and 2007). It received preliminary permits to drill up to three wells during the summer of 2010. A coalition of Alaska Native and environmental groups challenged the adequacy of the environmental review of the lease sale, contending that the Final Environmental Impact Statement had not fully examined impacts on the environment and human communities. On July 21, 2010, the Federal District Court for the District of Alaska agreed, enjoined all activity under Lease Sale 193, and remanded to the BOEMRE to conduct a more thorough environmental impact analysis.[30] On August 2, 2010, the court amended its ruling and allowed non-drilling activities to continue, granting Shell and Statoil permission to conduct seismic tests in the Chukchi Sea during the remainder of the 2010 summer.[31]

Shell spent $2.1 billion for its 275 lease blocks in the Chukchi in 2008.[32] A leaseholder can have a tract for up to ten years but then must have a development plan in place or the Secretary of the Interior will cancel the non-producing lease.[33] Shell has used up three of those years on its Chukchi sites. Even if the exploratory drilling occurs in the Chukchi and is successful, Shell predicts that another ten to fifteen years would pass before production began.[34]

As with the Beaufort Sea, NOAA's comments on recent proposed lease sales in the Chukchi expressed the view that no leasing should occur in the Chukchi Sea without additional research on oil spill response.[35]

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[28] BOEMRE, Introduction—5-Year Program, http://www.boemre.gov/5-year/ (last visited Sept 17, 2010).
[29] Kristen Nelson, *Chukchi High Five*, 13 PETROLEUM NEWS (Feb. 10, 2008), http://www.petroleumnews.com/pntruncate/347813743.shtml.
[30] Native Village of Point Hope v. Salazar, 2010 WL 2943120 (D. Alaska July 21, 2010).
[31] Yereth Rosen, *Shell, Statoil get OK to do Chukchi Oil Surveys*, REUTERS (Aug. 6, 2010), http://uk.reuters.com/article/idUKN0620571620100806.
[32] Nelson, *Petroleum High Five*.
[33] 43 U.S.C. §§ 1334(c), 1337(b)(2).
[34] Shell Presentation to National Commission.
[35] NOAA 2009 Comments, at 5.

D. Overview of Applicable Regulatory Requirements Related to Spill Response[36]

a. BOEMRE and Alaska Regulations

BOEMRE and Alaska Department of Conservation regulations require an applicant for a permit to conduct offshore exploration or production to provide information regarding its response capabilities. BOEMRE requires an emergency response action plan, which identifies, among other things, a spill management team, a planned location for a spill-response operations center, and an identification of procedures to be followed in the event of a spill.[37] The plan must also include a worst-case discharge appendix.[38] In addition to information about the potential volume, trajectory, and impacted areas in a worst-case discharge spill, the appendix must include a discussion of the potential response to the worst-case discharge scenario in adverse weather conditions. This discussion requires a description of the response equipment; its type, location, and quantity; the amount of time to move the equipment to the spill; and capability, including effective daily recovery capacity. Adverse weather conditions are defined elsewhere in the regulations and "include, but are not limited to: Fog, inhospitable water and air temperatures, wind, sea ice, current, and sea states."[39]

Alaska regulators may additionally require an applicant for a permit for an exploration or production facility to "account for variations in seasonal conditions" and "provide response scenarios for a discharge of the applicable response planning standard volume under typical summer environmental conditions and typical winter environmental conditions."[40] Alaska regulations also specify how much response equipment, including boom, skimmers, and personnel, must be carried, while noting that these are minimum planning requirements, not what may be actually required to respond to a spill.

In the wake of the Deepwater Horizon disaster, Alaska is conducting an analysis of the state regulations regarding offshore drilling. Additionally, the Alaska Oil and Gas Conservation Commission[41] has put together a commission to review offshore drilling practices and ultra-extended reach wells.[42] The Commission put out a public notice on June 24, 2010, seeking public comment on the current requirements regarding well blowout prevention and well control

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[36] This section is a general introduction to spill planning in Alaska and is not meant as a comprehensive evaluation of planning requirements. Commission staff intends to provide further evaluation of spill planning requirements in general, and in the Arctic in specific, in a later working paper.

[37] 30 C.F.R. § 254.23.

[38] 33 C.F.R. § 254.21 (requiring an emergency response plan with appendices); 33 C.F.R. § 254.2 (setting out requirements for the worst-case discharge appendix).

[39] 30 C.F.R. § 254.6.

[40] ALASKA ADMIN. CODE 18 § 75.425(e)(1)(I).

[41] The Alaska Oil and Gas Conservation Commission (AOGCC) was formerly a part of the Department of Natural Resources, but is now a quasi-judicial agency within the executive branch. *See* Letter from Parnell to Bromwich (urging BOEMRE to lift the moratorium on offshore drilling in Alaska waters).

[42] The review team is made up of the AOGCC's petroleum engineer commissioner, a petroleum engineer; the chairman of the AOGCC, a geologist; and a public appointee with oil and gas experience. That Commission will also hold hearings after this Commission releases its report. "At this hearing, public testimony will be received and the Commission will examine relevant issues in light of the findings and conclusions of the National Commission." *See* Order by Daniel T. Seamount, Jr., Chair, Alaska Oil and Gas Conservation Commission, Notice of Inquiry by the State of Alaska (June 24, 2010), *available at* http://doa.alaska.gov/ogc/hear/OTH-10-16.pdf (indicating that a public hearing on the review will be noticed thirty days after this Commission issues its report).

and their possible expansion, including whether the Commission should require "operators drilling offshore or ultra-extended reach wells to demonstrate the ready capability to drill a relief well if necessary."[43] The review is focused on source control and does not appear to be investigating spill response issues. The Division of Oil and Gas, within the Department of Natural Resources, is evaluating its own rules and requirements to determine whether the existing authorities regulating petroleum are sufficient. That study may be completed as early as this September.[44]

b. Shell's Chukchi Regional Exploration Discharge Prevention and Contingency Plan

A review of Shell's Chukchi Regional Exploration Oil Discharge Prevention and Contingency Plan ("Shell C-Plan") illustrates some of the current requirements and the level of detail provided to meet them. Shell is the only company to have made a proposal for drilling in the Chukchi, so there are unfortunately no competing plans with which to compare the response plans Shell proposes. This paper's brief discussion of Shell's proposal is not meant to be comprehensive.

Because Shell's proposal is for exploratory drilling, rather than production, it is subject to different requirements than those for producing wells.[45] BOEMRE regulations require an exploratory drilling operation to calculate a worse-case discharge scenario lasting thirty days, and to provide a response plan for that scenario.[46] The worst-case discharge is the daily volume possible from an uncontrolled blowout.[47] The state regulations require an exploration facility to plan for a release of 16,500 barrels, and an additional 5,500 barrels for each of twelve days past seventy-two hours in the case of a blowout.[48] Shell's final C-Plan includes response plans for a discharge of 5,500 barrels for thirty days, for a total release of 165,000 barrels.[49]

With regard to risks from loss of well control, Shell believes that "a prudent operator can conduct a Chukchi Sea drilling program using a single drillship," which would "relocate to a safe location to initiate a relief well" in the event of a blowout.[50] Shell estimates that it could drill a relief well in as few as sixteen days or as many as thirty-four days. Shell's preferred method for containing a blowout is the use of dynamic surface control measures.[51] The plan, which Shell indicates is accepted as best available technology, is to pump fluid down the well casing and circulate the fluid at a sufficient rate to create friction, which will match or exceed the reservoir pressure and stop the flow.[52] Shell states that it would likely not be able to use a well-capping technique because of the nature of the well. It notes that "[w]ell capping is not feasible for

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[43] *Id.*
[44] Tim Bradner, *Alaska's Oil Regulators Work to Ensure the Industry is Responsible*, ALASKA J. COMMERCE (July 16, 2010), http://www.alaskajournal.com/stories/071610/oil_ao.shtml.
[45] The Macondo well was similarly in the exploratory drilling phase.
[46] 30 C.F.R. § 254.26(d).
[47] 30 C.F.R. § 254.47(b).
[48] ALASKA ADMIN. CODE 18 § 75.434.
[49] SHELL, CHUKCHI SEA REGIONAL EXPLORATION OIL DISCHARGE PREVENTION AND CONTINGENCY PLAN (Mar. 2010), *available at* http://alaska.boemre.gov/fo/ODPCPs/Shell%20Chukchi%20C-Plan%20March%202010%20Final%2005-19-10.pdf [hereinafter SHELL C-PLAN].
[50] *Id.* at 1-23
[51] *Id.* at 4-3.
[52] *Id.*

offshore wells from moored vessels with [the blowout preventer] sitting below the mudline."[53] Because of this limitation, the C-Plan asserts that Shell would immediately mobilize to drill a relief well in the event of a blowout.

Since the Deepwater Horizon event, Shell has added to its plan a proposal to build a containment system similar to that built to control the Macondo well. It plans to store a containment dome and containment recovery system at a port in Alaska and to deploy it in the event of a subsea spill.[54]

The Shell C-Plan notes that, in addition to the Shell-operated response equipment and response teams, Alaska Clean Seas would be used as the primary contractor. Alaska Clean Seas is a non-profit oil spill response operator whose members are companies exploring or drilling on the North Slope or on the Outer Continental Shelf.[55] (A similar organization, the Marine Spill Response Corporation, exists for the Gulf of Mexico.) The Arctic Slope Regional Corporation also runs an additional oil spill response company. In the event of a blowout, Shell proposes to call on Wild Well Control, Inc., a well-control specialist.[56]

Shell notes that recovery of the spilled oil would be limited by the presence of ice, and the plan anticipates that during freeze-up conditions, some oil would become encapsulated by the ice. Shell states that it would monitor and track such oil, and that "response strategies and specific tactics will be modified to accommodate the challenges of working with a variety of potential ice conditions."[57] Within the context of each response strategy discussed in the plan, Shell acknowledges some of the limitations that the presence of ice creates. As discussed in greater depth below, it is likely that non-mechanical response strategies such as in situ burning would play a large role in any response.

MMS conditionally approved Shell's exploration plan (as distinguished from the C-plan) on December 7, 2009.[58] MMS found that Shell's plans for "responding to a blowout, loss or disablement to the drilling unit, or loss of or damage to support craft," complied with a regulation specific to Alaska offshore projects requiring emergency plans, and included, as required, accompanying procedures for critical operations and curtailment.[59] However, MMS required that Shell "provide documentation on the availability of suitable alternative drilling unit(s) that would be made available to Shell should it be necessary to drill a relief well."[60] Shell has identified an additional drillship that could be mobilized to begin drilling a relief well, the Kulluk drilling unit, likely to be stored at Dutch Harbor in the Aleutian Islands in southwest Alaska.[61]

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[53] *Id.*
[54] Shell, Presentation to Commission staff, in Washington D.C. (Sept. 16, 2010).
[55] ALASKA CLEAN SEAS, www.alaskacleanseas.org.
[56] SHELL C-PLAN at 1-22.
[57] *Id.* at 1-26.
[58] Letter from Jeffrey Walker, Regional Supervisor, Field Operations, MMS, to Susan Childs, Shell Offshore Inc. (Dec. 7, 2009), *available at* http://alaska.boemre.gov/ref/ProjectHistory/2009_Chukchi_Shell/2009_1207.pdf [hereinafter EP Letter] (conditionally approving Shell's 2010 exploration drilling program and noting that response to the contingency plan would follow separately).
[59] 30 C.F.R. § 250.220.
[60] EP Letter at 3.
[61] Shell, Presentation to Commission Staff, in Washington D.C. (Sept. 16, 2010).

Shell's initial C-Plan was submitted in May 2009.[62] MMS gave its conditional approval on December 18, 2009.[63] Both MMS and Alaska regulators required Shell to submit additional information on several response issues, such as where response equipment would be pre-staged, the estimated mobilization times for spill response equipment, a copy of its contract with oil spill response operators for dispersant support, and the length of time it would take Alaska Clean Seas to transport response support from Prudhoe Bay to the Chukchi sites.[64] MMS also required Shell to conduct contingency plan exercises, including a tabletop drill addressing the worst-case discharge scenario, and deployment exercises demonstrating the capacity to carry out the response activities described in the plan. Shell submitted a revised plan in March 2010.[65]

On April 6, 2010, MMS gave final unconditional approval of the Shell C-Plan, finding that the requested information had been provided. In a news interview after the Deepwater Horizon spill, BOEMRE spokesperson John Callahan said, "The Alaska Region [of BOEMRE] can confirm that it reviewed Shell's contingency plan and found it adequate for the time it was issued. However, in light of the BP oil spill in the Gulf and new requirements for the plans, we will be reviewing the adequacy of the current version of the project's spill plan."[66]

II. Challenges of Spill Response

The Arctic environment poses unique challenges for spill response. Some limitations of existing techniques are discussed below. To the extent the Shell C-Plan seeks to address these issues, Shell's proposed method of adapting to the limitations is described.

A. Adverse Weather

The presence or absence of ice is a large factor in the ability to respond to a spill, but it is not the only environmental factor affecting spill response. Temperature affects the consistency of oil and the speed at which it degrades. Winds and the resulting wave action are another factor. High energy from wind and waves can help oil to disperse naturally, but this energy also breaks up a thick slick into multiple thinner slicks, which are more difficult to address. Also, in broken ice, waves are less effective at naturally dispersing oil.[67]

Weather, including wind and wave activity, also affects responder access to an oiled area and whether recovery strategies such as boom and skimmers will work. Adverse weather conditions prevented responders from collecting oil from the wellhead, employing mechanical recovery methods, and conducting in situ burns at times during the Deepwater Horizon response. Seasonally short Arctic days and the prevalence of fog and storms also limit the amount of time

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[62] SHELL, CHUKCHI SEA REGIONAL EXPLORATION OIL DISCHARGE PREVENTION AND CONTINGENCY PLAN (May 2009), *available at* http://alaska.boemre.gov/ref/ProjectHistory/2009_Chukchi_Shell/2009_0623_Shell_cplan.pdf.
[63] Letter from Jeffrey Walker, Field Operations, MMS, to Susan Childs, Shell Offshore Inc. (Dec. 18, 2009), *available at* http://alaska.boemre.gov/ref/ProjectHistory/2009_Chukchi_Shell/2009_1218_childs.pdf (conditionally approving the Shell C-Plan).
[64] SHELL C-PLAN at 1-13.
[65] SHELL C-PLAN.
[66] Charles W. Schmidt, *Cold Hard Cache: The Arctic Drilling Controversy*, 118 ENVIRONMENTAL HEALTH PERSPECTIVES A394 (2010).
[67] MAR, INC. ET AL., EMPIRICAL WEATHERING PROPERTIES OF OIL IN ICE AND SNOW PROJECT NUMBER 1435-01-04-RP-34501 FINAL REPORT FOR U.S. DEPARTMENT OF THE INTERIOR MINERALS MANAGEMENT SERVICE ALASKA OUTER CONTINENTAL SHELF REGION (Oct. 2008), *available at* [hereinafter WEATHERING PROPERTIES].

when response is feasible. Sea state may be calmer in the Arctic than in the Gulf, as the sea ice has a muffling effect on waves. However, the water may grow turbulent over time as the summer ice melts and wave activity increases.[68]

The amount of time when responders are simply unable to work is known as the response gap, and it is based on, among other things, adverse weather conditions. A study of response capabilities in Prince William Sound attempted to quantify the response gap in that region.[69] Researchers identified when response efforts would not be possible based on their investigation of when environmental conditions would cause mechanical recovery systems to fail. For example, they concluded that response efforts would not be affected by wind speeds of less than twenty-one knots, would be impaired but possible in speeds between twenty-one and thirty knots, and would not be possible in winds of over thirty knots. They then used six years of hourly wind, sea state (a measure which includes wave height and wave period), temperature, and visibility data from two locations in Prince William Sound to evaluate the length of time that environmental conditions exceeded response operating limits.[70] They eliminated any days when the locations in the Sound were closed to tanker traffic. The study found that, considering all the environmental limitations together, response operating limits were exceeded, and response was not possible, 38% of the time. That figure rose to 65% of the time during the winter season.[71]

It does not appear that a similar comprehensive response gap analysis has been conducted for the Arctic.[72] However, the Shell C-Plan notes that temperature alone would be a significant limitation. All non-emergency work stops when temperatures reach below -45 degrees Fahrenheit. This limitation would prevent response 50% of the time in the month of January and 64% of the time in the month of March.[73]

B. Locating the Oil

One of the main challenges for oil spill responders in Arctic waters is the problem of locating oil. Oil spilled into broken ice will tend to move with the ice.[74] Oil is also more difficult to locate if it moves under ice floes or becomes encapsulated into surrounding ice. Visual observations are not an adequate means of detection, as the oil is generally hidden from view beneath the ice. In 2009, then-MMS published a report entitled "Arctic Oil Spill Response Research and Development Program: A Decade of Achievement."[75] This paper chronicles issues and advances in oil spill response in the icy Arctic environment. In the paper, MMS noted

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[68] Luc Rainville and Rebecca A. Woodgate, *Observations of internal wave generation in the seasonally ice-free Arctic*, 36 GEOPHYSICAL RESEARCH LETTERS L23604 (Dec. 2, 2009).
[69] NUKA RESEARCH AND PLANNING GROUP, LLC, REPORT TO PRINCE WILLIAM SOUND REGIONAL CITIZENS' ADVISORY COUNCIL: RESPONSE GAP ESTIMATE FOR TWO OPERATING AREAS IN PRINCE WILLIAM SOUND, ALASKA (2007).
[70] *Id.* at 41.
[71] *Id.* at 52.
[72] *See, e.g.*, *Response Gap*, OCEANS NORTH U.S., http://www.oceansnorth.org/response-gap (last visited Sept. 15, 2010) (noting the potential value of a response gap analysis).
[73] SHELL C-PLAN, at 3-20.
[74] WEATHERING PROPERTIES.
[75] U.S. DEPARTMENT OF THE INTERIOR MINERALS MANAGEMENT SERVICE, ARCTIC OIL SPILL RESPONSE RESEARCH AND DEVELOPMENT PROGRAM: A DECADE OF ACHIEVEMENT (2009), *available at* http://www.boemre.gov/tarprojectcategories/PDFs/MMSArcticResearch.pdf [hereinafter ACHIEVEMENT].

that the "ability to reliably detect and map oil trapped in, under, on, or among ice is critical to mounting [an] effective response in Arctic water."[76]

The existing method for locating oil in or under ice involves drilling holes in a grid through the ice to detect oil underneath. This method is expensive, dangerous, and not always possible based on ice conditions. MMS has conducted several research studies aimed at evaluating potential solutions to this problem. Ground penetrating radar (GPR) is the only technology viewed as having potential.[77] GPR units can be used by personnel walking on the ice or can be mounted on helicopters flying over the ice at a very low altitude.[78] According to MMS's GPR laboratory and field-testing, the technology can detect oil slicks that are at least two centimeters (approximately one inch) thick in or under one to three feet of ice when used from a helicopter and up to seven feet of ice when a hand-held unit is used.

Though GPR represents an advance over the drilling method, many factors limit its usefulness. MMS's field test report acknowledges that "[d]etection of oil under ice through multi-year ice or rafted/ridged first-year ice might be difficult or impossible."[79] Other types of rough or pocketed ice will pose similar difficulties. Additionally, though oil slicks may tend to be thicker in the Arctic environment than in other places as a result of the cold temperatures, the oil is still likely to spread out, making the ability to detect only slicks that are more than two centimeters thick a serious limitation. Though researchers indicate that the technology has promise, the responder may still need to start out with a basic sense of where the oil is in order for GPR to be of use.

The Shell C-Plan acknowledges that tracking a spill through ice might be necessary. Shell indicates that it could track the oil with drift buoys, radar reflectors, flags, GPR, and laser fluorosensors.[80] In the section on planning for a release in winter pack ice, the Shell C-Plan states that "[p]romising results of tests with Ground Penetrating Radar and other remote-sensing systems could lead to the development and refinement of detection and tracking techniques for oil that is trapped deep within a thick ice layer." The C-Plan goes on to predict that such trapped oil could be dealt with through a "leave in place" strategy, discussed below.[81] It does not appear that MMS had any comment on this aspect of the plan when the agency approved the C-Plan.[82]

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[76] *Id*. at 11.
[77] *Id.*
[78] DF DICKENS ASSOCIATES LTD., SINTEF, THE UNIVERSITY CENTRE AT SVALBARD, BOISE STATE UNIVERSITY, 2006 SVALBARD EXPERIMENTAL SPILL TO STUDY SPILL DETECTION AND OIL BEHAVIOR IN ICE: SUMMARY FIELD REPORT (Apr. 12, 2006), http://www.boemre.gov/tarprojects/569/SummaryFieldReport.pdf [hereinafter "SVALBARD 2006"].
[79] Svalbard 2006.
[80] SHELL C-PLAN, at 1-27.
[81] *Id*. at 3-27.
[82] *See* MINERALS MANAGEMENT SERVICE OFFICE OF PUBLIC AFFAIRS, QUESTIONS AND ANSWERS ON SHELL'S OCS CHUKCHI SEA EXPLORATION PLAN, *available at* http://www.boemre.gov/ooc/PDFs/CHUKCHI_SEA_QA1209.pdf (last visited Sept. 15, 2010); Press Release, Minerals Management Service, Salazar Conditionally Approves Shell's Exploration Plan for Certain Chukchi Sea Leases (Dec. 7, 2009), http://www.boemre.gov/ooc/press/2009/press1207.htm (last visited Sept. 15, 2010).

C. Mechanical Recovery Technology

In addition to acting as a barrier to detection, ice also poses a physical barrier to mechanical containment and response efforts. Boom and skimmers, which are often deployed in tandem as part of early response efforts, are not very effective in broken ice conditions.[83] For any mechanical recovery technology to work, it needs to "encounter" the oil, which means that the oil needs to be grouped together in a thick enough slick for the recovery system to separate the oil at the surface from the water.

Boom is difficult to deploy through broken ice. MMS notes that boom is "of little to no use in large moving ice floes or in ice concentrations greater than 30%."[84] Boom for use in the Arctic also must be made of a durable material that can withstand impacts from pieces of ice.

Skimmers can become clogged with ice and slush, and they need to be positioned between ice floes, which may not always be possible. Additionally, a skimming vessel will break up ice floes, moving the natural ice barrier and letting the oil spread out, thus making it harder to skim.[85] The oil that is skimmed will still likely contain pieces of ice. Although some advances in the material used to make skimmers, such as the development of grooved skimming drums, have improved skimmer efficiency in ice conditions, overall skimming potential is limited by the presence of ice.[86]

If the ice cover is too great, and mechanical recovery is not possible, it may be necessary to let the oil become incorporated into the ice and deal with it when the ice melts.[87] MMS notes: "For high ice concentrations of 8/10 or more, most of the spilled oil (especially from a subsea blowout) will become immobilized or encapsulated within the ice . . . . Oil encapsulated within the ice is isolated from any weathering processes (evaporation, dispersion, emulsification). The fresh condition of the oil when exposed (e.g. through ice management or natural melt processes) enhances the potential for in situ burning." This strategy effectively requires responders to leave oil in place but somehow track it, so that they can attempt to remove it once it is freed from the ice but before it re-enters the marine environment. This is sometimes referred to as "mining" of oil.[88] In the interim, the oil is unlikely to degrade, making it more susceptible to burning but less likely to be reduced in amount by natural processes.

This "leave-in-place" strategy does not appear to have been used during an actual spill, though it is the subject of research. The Shell C-Plan indicates that this strategy might be used for a spill in early winter. The plan predicts that "[t]ypically, within a day or two, new ice would completely surround the oil, encapsulating, immobilizing and preserving the condition of the oil.

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[83] Of course, boom and skimmer technology can be of only limited use in spills in non-Arctic waters as well. The oil recovery from boom-and-skimmer efforts as part of the Deepwater Horizon response only constituted 3% of the total amount of oil recovered. JANE LUBCHENCO ET AL., DEEPWATER HORIZON OIL BUDGET: WHAT HAPPENED TO THE OIL? (Aug. 4, 2010), http://www.deepwaterhorizonresponse.com/posted/2931/Oil_Budget_description_8_3_FINAL.844091.pdf.

[84] ACHIEVEMENT at 15.

[85] Hans V. Jensen & Joseph V. Mullin, *MORICE—new technology for mechanical oil recovery in ice infested waters*, 47 MARINE POLLUTION BULLETIN 453 (2003).

[86] Victoria Broje and Arturo A. Keller, *Improved Mechanical Oil Spill Recovery Using an Optimized Geometry for the Skimmer Surface*, 40 ENVIRON. SCI. TECHNOL. 7914 (Oct. 26, 2006).

[87] ACHIEVEMENT at 15.

[88] SHELL C-PLAN, at 3-27

The ice-encapsulated oil can be marked and tracked for removal when the ice is safe to work on, or the oil could be tracked until spring. At that time the oil would become exposed at the surface through brine-channel migration or through surface melt down to the small entrapped oil droplets."[89]

The behavior of oil in ice is an important topic of research.[90] According to researchers, the accepted view is that oil becomes encapsulated as ice forms around it. As the ice begins to melt, the oil is transported through the ice to the surface of the ice through brine channels, which are paths through the ice where salt is very concentrated.[91] However, newer research calls this assumption about transportation up to the surface into question, and there remain unknowns about the role of brine channels as a pathway for marine exposure to oil. Questions remain about whether oil may be pulled into the brine channels and, rather than moving to the surface of the ice, move down through the ice and into the water column.[92]

The Shell C-Plan comments on the difficulties of using mechanical response technologies in icy conditions. The plan notes that even low concentration of individual ice floes "can obstruct containment or deflection boom, prevent oil from accumulating in large pools, and block the flow of oil toward a recovery device."[93] Shell explains that, though it will modify mechanical response tactics to suit the Arctic environment, as ice concentrations increase, non-mechanical tools such as in situ burning and dispersants (both discussed below) will become more practical.[94]

D. In Situ Burning

In situ burning is another response technique that was used in the Deepwater Horizon response and would be used in any Arctic oil spill response. This strategy requires gathering the oil either with fireproof boom or between natural ice berms. It also requires that the oil not be overly weathered. Burning is an important strategy in the Arctic, where there is less risk of having a fire spread out of control. Additionally, there is potentially less concern about the negative air quality impacts of burning as there are lower concentrations of people and wildlife that could be affected. Moreover, oil mixed with some ice, snow, or slush can still burn.

Burning in the Arctic, however, is not without difficulty. In order to stage the fire-proof boom, vessels must be able to can access the area and boom must be pre-staged for quick deployment. Oil is more difficult to ignite at lower temperatures. Chemical "herders" may be required to gather and thicken the oil, but no commercially-produced herders are currently approved for use in Arctic waters.[95] Oil that enters the water column before hitting the surface, such as from a subsea pipe leak or blowout, will be more likely to become emulsified and spread

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[89] *Id.* at 3-26.
[90] *See, e.g.*, WEATHERING PROPERTIES; PROGRESS REPORT, OIL IN ICE: TRANSPORT, FATE, AND POTENTIAL EXPOSURE (Progress Report for the Period Oct. 15, 2008 to Apr. 15, 2009) , *available at* http://www.crrc.unh.edu/progress_reports/sintef/04_2009/index.htm.
[91] WEATHERING PROPERTIES.
[92] Amy Merten, NOAA Office of Response and Restoration, Coastal Response Research Center, "NOAA's Increased Preparedness for Arctic Response," Presentation at the National Ice Center Symposium (June 11, 2009).
[93] SHELL C-PLAN, at 1-27.
[94] *Id.* at 1-27-1.28.
[95] WORLD WILDLIFE FUND, NOT SO FAST: SOME PROGRESS IN SPILL RESPONSE BUT US STILL ILL-PREPARED FOR ARCTIC OFFSHORE DEVELOPMENT (2009) (reviewing and critiquing MMS's "Decade of Achievement" report).

out once it reaches the surface and will therefore be harder to burn. Because of the propensity of oil to spread, in situ burning is a technique that will work best with a rapid response.

As with all response techniques, the efficiency of in situ burning will vary widely. Efficiency rates of 90% were achieved in an experiment in Norway that simulated a tanker spill,[96] but a 1998 well blowout study estimated only 3.4-6.4% efficiency in fall freeze-up conditions on open water.[97]

The Shell C-Plan takes a positive view of in situ burning, asserting that "the consensus of research" is that it is an "effective technique with removal rates of 85 to 95 percent in most situations."[98] The C-Plan describes difficulties associated with ice, but also suggests that ice may assist burning by containing the oil, dampening wave action, and reducing the propensity of the oil to spread out in a thin layer.[99] Shell does not estimate the percentage of days that wind and wave conditions would likely prevent in situ burning.

E. Chemical Countermeasures

Dispersants were used extensively in the Deepwater Horizon response and are often a critical component of oil spill response. However, their potential Arctic use is limited by uncertainty over their effectiveness and toxicity in that environment.

Dispersant effectiveness depends on the properties of the oil, the amount of weathering that has taken place, and the energy available to mix the dispersants into the oil. Aerial spraying can occur even during broken ice or bad weather conditions, but mixing might be reduced. Application by boat can increase mixing as the vessel churns up the water, but requires a boat capable of traveling in the ice and appropriate weather. Once the oil is encapsulated into or emulsified with the water, dispersants are unlikely to be effective. A 2001 study commissioned by the Prince William Sound Regional Citizens' Advisory Council found that dispersants were less than 10% effective when applied to Alaska North Slope crude oil spilled on water at the temperature and salinity common in the estuaries and marine waters of Alaska.[100] The study found that temperature had a strong effect on the behavior of the oil, which in turn affected dispersant effectiveness. However, an MMS/ExxonMobil-sponsored project, based on testing at Ohmsett, the National Oil Spill Response Test Facility in New Jersey, concluded that dispersants could be effective in cold water.[101] This study estimated dispersant effectiveness at a range of

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[96] Svalbard 2006.
[97] SL ROSS ENVIRONMENTAL RESEARCH, D.F. DICKINS AND ASSOCIATES, VAUDREY AND ASSOCIATES, EVALUATION OF CLEANUP CAPABILITIES FOR LARGE BLOWOUT SPILLS IN THE ALASKAN BEAUFORT SEA DURING PERIODS OF BROKEN ICE (June 1998), *available at* http://www.boemre.gov/tarprojects/297/297AA.pdf.
[98] SHELL C-PLAN, at 3-24, 3-32 to 3-33.
[99] *Id.* at 3-25.
[100] ADAM MOLES, LARRY HOLLAND, AND JEFFREY SHORT, THE EFFECTIVENESS OF COREXIT 9527 AND 9500 IN DISPERSING FRESH, WEATHERED, AND EMULSION OF ALASKA NORTH SLOPE CRUDE OIL UNDER SUBARCTIC CONDITIONS (April 2001), *available at* http://www.pwsrcac.org/docs/d0001400.pdf.
[101] SL ROSS ENVIRONMENTAL RESEARCH, DISPERSANT EFFECTIVENESS TESTING IN COLD WATER (August 2002) *available at* http://www.boemre.gov/tarprojects/450/450mmsExCold.pdf.

82% to 99%. More research is needed regarding dispersant effectiveness in situations involving ice cover, heavy wind conditions, and weathered oils.[102]

Concerns about dispersant toxicity in the Arctic are similar to concerns about dispersant toxicity generally. One Arctic-specific issue is the speed of biodegradation of dispersed oil. Dispersants break down oil into smaller droplets, which may then be more easily biodegraded by oil-consuming bacteria.[103] Oil-consuming bacteria are present in Arctic waters, but they may break down dispersed oil more slowly than in warmer waters.[104] As a result, dispersed oil may be present in the ecosystem for a longer period of time. Moreover, concerns about the long-term fate and effects of dispersed oil in the Arctic are potentially magnified because of the lack of baseline data about the environment.

The Alaska Regional Contingency plan sets out dispersant guidelines.[105] Within the Alaska plan, the North Slope subarea contingency plan sets out the decision-making process for the use of dispersants: "Any decision regarding the use of dispersants and/or *in situ* burning in the North Slope Subarea will be made by the [Federal and State On-Scene Coordinators] in consultation with the Alaska Regional Response Team" and should also involve the North Slope Borough.[106] The plan includes specific dispersant guidelines for Alaska.[107] The Federal On-Scene Coordinator must "examine conventional response alternatives, such as containment and cleanup, for comparison to dispersant application" and may consider dispersant use only "when an effective conventional response is not feasible or not totally adequate in containing/controlling the spill."[108]

Shell's dispersant plan for Chukchi exploration is to store 25,000 gallons of Corexit 9500 in Anchorage and pre-stage another 1,300 gallons with Alaska Clean Seas on the North Slope.[109] The Shell C-Plan contends that "[d]ispersant use is a rational approach to mitigate environmental impacts from spills when sea states or other factors limit or negate conventional countermeasures."[110] The plan suggests that, because mechanical recovery and in situ burning opportunities might be limited, dispersants are a valuable option.[111] However, the plan also notes the potential limitations on dispersant effectiveness. It recognizes that because the properties of the oil in the reservoir are unknown, on-site testing would be a condition of dispersant use. The plan also notes that, to be effective, dispersants must be applied to fresh crude before it has an opportunity to emulsify or weather, and that dispersants are less effective

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[102] *See, e.g.*, PRINCE WILLIAM SOUND OIL SPILL RESPONSE INSTITUTE, ADVANCING OIL SPILL RESPONSE IN ICE-COVERED WATERS 4 (2003), *available at* http://www.pws-osri.org/publications/OilIce_final.pdf (identifying research needs to improve response abilities in icy environments)

[103] There is dispute within the scientific literature about whether dispersants promote biodegradation of oil. For more information, see the draft staff working paper on dispersants.

[104] *See* WORLD WILDLIFE FUND, OIL SPILL RESPONSE CHALLENGES IN ARCTIC WATERS 7 (2007).

[105] ALASKA REGIONAL RESPONSE TEAM, UNIFIED PLAN, ANNEX F: CHEMICAL COUNTERMEASURES F-11 (1999), *available at* http://www.akrrt.org/UnifiedPlan/F-Annex.pdf [hereinafter ANNEX F].

[106] ALASKA REGIONAL RESPONSE TEAM, UNIFIED PLAN, NORTH SLOPE SUBAREA CONTINGENCY PLAN, RESPONSE SECTION, A-22 (1999), *available at* http://www.akrrt.org/NSplan/nstoc.shtml.

[107] ANNEX F.

[108] *Id.* at F-2.

[109] SHELL C-PLAN, at 3-40.

[110] *Id*. at 3-37.

[111] *Id*. at 3-38.

on colder, more viscous oil. Finally, Shell states that it would try to avoid applying dispersant on or near sea birds or marine mammals.[112]

F. Bioremediation and Natural Processes

Oil will degrade in the water over time as it is consumed by bacteria. Bioremediation is "the act of adding materials to contaminated environments to cause an acceleration of the natural biodegradation processes."[113] The National Contingency Plan, which governs oil spill response, specifies that "bioremediation agents" are "microbiological cultures, enzyme additives, or nutrient additives that are deliberately introduced into an oil discharge and that will significantly increase the rate of biodegradation to mitigate the effects of the discharge."[114] Bioremediation may be a potential response strategy in the Arctic, where the temperature and weather conditions otherwise slow the natural biodegradation process.

Responders have used bioremediation techniques in the cleanup of a number of major oil spills.[115] For example, one day after the June 8, 1990 spill from the *Mega Borg* off the coast of Texas, the federal on-scene coordinator authorized the use of a bioremediation product on the open-sea oil slick.[116] It was unclear how effective the product was, and this response highlighted the difficulties of open-sea application.[117] Responders applied bioremediation materials—including nutrients, fertilizer, and exogenous bacteria—to the shoreline after the *Amoco Cadiz* wrecked off the coast of France.[118] The approaching tourist season, however, prevented more extensive use in the area.[119]

The most prominent experimentation with onshore bioremediation occurred after the *Exxon Valdez* spill.[120] The level of endogenous oil-metabolizing bacteria had already increased on the Alaska shoreline. Responders decided to promote growth of these endogenous bacteria by adding nutrients and fertilizer to the shoreline of Prince William Sound, instead of seeding the shoreline with exogenous bacteria.[121] This technique was considered successful.[122] As with the *Amoco Cadiz* response, bioremediation in the *Exxon Valdez* response involved shoreline use, rather than use in open water.

There are concerns that low temperatures and the variable salinity in the Arctic will decrease the potential of bioremediation. Research done in Norway, however, suggests that

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[112] *Id*. at 3-42.
[113] Richard P.J. Swannell et al., *Field Evaluations of Marine Oil Spill Bioremediation*, 60 MICROBIOLOGICAL REV. 342, 342 (1996) (internal quotations omitted).
[114] 40 C.F.R. § 300.5.
[115] Swannel, at 351-52.
[116] *Id.* at 351.
[117] *Id.*; *see also id.* at 358 ("[T]here is little convincing evidence to suggest that bioremediation is effective at sea. This is partly due to the logistical difficulties involved in conducting controlled open-sea trials. Further research is required to derive an effective bioremediation strategy at sea.") (internal citations omitted).
[118] *Id.*
[119] *Id.*
[120] *Id.* at 352.
[121] *See id.*; P.H. Pritchard et al., *Oil Spill Bioremediation: Experiences, Lessons and Results from the Exxon Valdez Oil Spill in Alaska*, 3 BIODEGRADATION 315 (1992).
[122] Pritchard at 315.

microbial communities located in ice can begin to break down oil.[123] A patent issued in 2001 registers an improved method of administering bacteria to an open-water spill, and a pending patent application filed by a German group discloses a technique specifically aimed at bioremediating open water Arctic spills.[124]

The regulatory framework governing bioremediation processes is complicated. The NCP treats bioremediation products similarly to dispersants, with a product schedule and authorization requirements.[125] Twenty-four products are listed on the product schedule. The North Slope Subarea Area Contingency Plan also discusses bioremediation products, and contains a general protocol for testing products listed on the NCP schedule for use in Alaskan waters.[126] These products are not preapproved for any use. A later staff working paper will provide a more detailed discussion of research on bioremediation.

III. Geographic and Cultural Issues

A. Response Posture and Readiness

As noted above, the Beaufort and Chukchi Seas are different in terms of response needs. This section focuses mainly on response in the Chukchi, where the distance from shore and lack of infrastructure make access, let alone response, difficult. Some of these concerns do apply to the Beaufort as well.

Coast Guard officials have noted over the past few years that they are ill-prepared to respond to a major spill in the Arctic.[127] In addition to the response limitations detailed above, the Coast Guard lacks ice-class vehicles capable of responding to a spill under Arctic conditions. The Coast Guard has three polar icebreakers: the *Polar Star*, the *Polar Sea*, and the *Healy*. Both the *Polar Star* and the *Polar Sea* are currently non-operational, and both have exceeded their intended 30-year service lives.[128]

The *Polar Sea*, originally commissioned in 1978, was returned to service in 2006 following a rehabilitation project intended to extend the vessel's service life to 2014.[129] In June of this year the Coast Guard announced that the *Polar Sea* would cease operations until January 2011 due to "an unexpected engine casualty," the cause of which is still under investigation.[130] Another rehabilitation project, budgeted at $60 million and intended to extend the life of the

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[123] SINTEF, Oil Biodegradation in Arctic Ice, http://www.sintef.no/Home/Materials-and-Chemistry/Marine-Environmental-Technology/Projects-and-News/Oil-biodegradation-in-Arctic-ice/. SINTEF is studying a number of techniques for combating oil spills in ice covered water. *See* SINTEF, JIP Oil in Ice, http://www.sintef.no/Projectweb/JIP-Oil-In-Ice/.
[124] U.S. Patent No. 6,267,888 (issued July 31, 2001); U.S. Patent Application Publication No. US2010/0051541 A1.
[125] 40 C.F.R. § 300 Subpart J.
[126] ANNEX F at F-85.
[127] *See, e.g.*, Captain J.J. Fisher, "Policy & Cooperation in the Arctic," Presentation at Capitol Hill Ocean Week, (June 10, 2010), *available at* http://nmsfocean.org/CHOW-2010-agenda; "Oil Spill Response in the U.S. Arctic: A U.S. Coast Guard Perspective," Presentation at the Environmental Law Institute (Mar. 11, 2010), *available at* http://www.eli.org/program_areas/ocean_arctic_spill.cfm.
[128] RONALD O'ROURKE, CONGRESSIONAL RESEARCH SERVICE, COAST GUARD POLAR ICEBREAKER MODERNIZATION: BACKGROUND, ISSUES, AND OPTIONS FOR CONGRESS 1 (July 2, 2010).
[129] *Id.* at 3.
[130] *Id.* at 4.

Polar Star by seven to ten years, began in 2006.[131] It is expected to be completed in 2013. The most recent Coast Guard estimates suggest that the work required to further extend the lives of the *Polar Sea* and the *Polar Star* would cost about $400 million per vessel (in 2008 dollars), and the cost of replacement ships would be between $800-925 million.[132] The same report predicts that it would take eight to ten years to build the new ships.

The Coast Guard procured the third ship, the *Healy*, in the 1990s, and commissioned it in 2000. The *Healy* was supposed to complement the *Polar Sea* and the *Polar Star* with its greater research support capabilities. It has less icebreaking capability than the other ships.

The funding for operations and maintenance on all of these vessels has come through the National Science Foundation's budget since FY2006, because of the ships' increasing research functions.[133] Should a major drilling program begin offshore in the Chukchi Sea, additional operational polar icebreakers would be required to reach a rig or a spill in icy conditions. Decisions regarding whether to repair the current vessels or to acquire additional ice-class vessels are currently in the hands of Congress and subject to the budgeting process.

Distance is another major hurdle, even in open water and good weather conditions. Though the Coast Guard has a presence on the North Slope, the nearest Coast Guard operations base to the Chukchi region is on Kodiak Island, which is approximately 1,000 miles from the leasing sites. In Northern Alaska, the Coast Guard has only forward operating locations, not fully staffed and equipped bases. No infrastructure presently exists along the Chukchi. If drilling moves forward, some of this infrastructure would naturally be created by industry, but in a seasonal drilling environment it is unclear how much permanent development can be expected.

In the Beaufort Sea, response capability is increased by proximity to the city of Barrow and the shoreline. However, Barrow is still a small community of less than 5,000 people.[134] Wainwright, the second-largest town in the North Slope Borough and on the Chukchi Sea coast, had a population of about 550 at the time of the 2000 census.[135] A major spill would require bringing in responders, but it would be difficult for this region to support a large influx of response personnel. The nature of the sea also complicates the staging of operations. The sea is too shallow at Wainwright to support a full dock, and there is only a boat ramp from which to launch smaller vessels. The nearest dock capable of supporting large vessels is at Prudhoe Bay in the Beaufort Sea.

Shell's plan for exploratory drilling in the Chukchi involves a small flotilla of ships available to assist with response efforts. The Shell C-Plan asserts that an oil spill response vessel will be positioned so that it could arrive at a spill site within one hour.[136] It also anticipates that a larger transport vessel will be able to arrive within 24 hours and would be able to store 287,100 barrels of oil or oily water, which is the worst-case planning discharge amount. Additional

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[131] *Id.*
[132] *Id.* at 10-11.
[133] *Id.* at 7.
[134] U.S. Census Bureau, Population for the 15 Largest County Equivalents and Incorporated Places in Alaska: 1990 and 2000, *available at* http://www.census.gov/census2000/pdf/ak_tab_6.PDF.
[135] U.S. Census Bureau, Fact Sheet, Wainwright city, Alaska, *available at* http://factfinder.census.gov/home/saff/main.html?_lang=en (search for Wainwright, AK).
[136] SHELL C-PLAN at 1-19, 1-25.

personnel and resources, according to the plan, will be mobilized through the contractor Alaska Clean Seas, which has personnel stationed on the North Slope in Prudhoe Bay and along the Beaufort Sea. They have an advisor on Chukchi exploration issues but do not appear to have any response personnel stationed west of Barrow at present.[137] According to the C-Plan, equipment will be pre-staged at Wainwright, where there is a small airport and a boat ramp from which to deploy the equipment to the spill.

Environmental groups have criticized this plan, asserting that the estimated response times are unrealistic. Pew Environment's U.S. Arctic program is currently drafting a report on oil spill response in the Arctic, which will include a response scenario analysis for the Chukchi Sea. This report will be peer-reviewed and should be available by the end of October 2010.[138]

B. Subsistence Resource Use

Subsistence resource uses provide an important background to any discussion of offshore drilling in the Arctic. Inupiat Eskimos are the dominant population in Alaska's Arctic region and have practiced subsistence hunting and fishing for thousands of years. For most residents of the North Slope, a subsistence-based lifestyle is an economic necessity. The cost of living is high as a result of transportation costs for goods and services. While jobs are available in oil extraction facilities in the Prudhoe Bay area, the per-capita income does not correspond to the high cost of living.[139] The Inupiat are forced to supplement their diet through subsistence hunting and fishing since the harsh weather makes agriculture impossible.[140] Walruses, seals, and caribou make up part of the Inupiat diet, but the bowhead whale is of particular importance due to its size and food potential.

Bowhead whales can reach 60 feet in length and weigh more than 120,000 pounds. They migrate from Russian to Canadian waters and back through the Chukchi and Beaufort Seas. They are the most important subsistence animal for the coastal communities of northwest and northern Alaska.[141] Of the 74 percent of North Slope Borough households that responded to a 1998 survey, nearly 69 percent of Inupiat families reported that the bowhead whale makes up more than half of their subsistence food diet.[142]

Whale hunting and the customs surrounding it are also an important part of the cultural heritage of the Inupiat. A 1986 study estimated that 70 percent of the population of Wainwright, Alaska directly participates in preparing and preserving a whale that has been caught. No other communal activity involves as high a level of participation.[143]

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[137] *See* Alaska Clean Seas, Yearbook 30-41 (2009), *available at* http://www.alaskacleanseas.org/adobefiles/2010%20Yearbook_web.pdf (listing personnel and office locations)
[138] Email to National Commission Staff from Marilyn Heiman, U.S. Arctic Program, Pew Environment Group, received Sept. 15, 2010.
[139] COMMITTEE ON THE CUMULATIVE ENVIRONMENTAL EFFECTS OF OIL AND GAS ACTIVITIES ON ALASKA'S NORTH SLOPE, NATIONAL RESEARCH COUNCIL, CUMULATIVE ENVIRONMENTAL EFFECTS OF OIL AND GAS ACTIVITIES ON ALASKA'S NORTH SLOPE 20 (2003) [hereinafter CUMULATIVE ENVIRONMENTAL EFFECTS].
[140] *Id.* at 132.
[141] ALASKA DEPARTMENT OF FISH & GAME, BOWHEAD WHALE (2008), http://www.adfg.state.ak.us/pubs/notebook/marine/bowhead.php.
[142] CUMULATIVE ENVIRONMENTAL EFFECTS at 135.
[143] *Id.*

Many coastal Inupiat are strongly opposed to offshore drilling, largely because it can interfere with the migratory patterns and well-being of the bowhead whale. Much of this opposition relates to concerns over seismic activities, which can drive the whales off their normal migratory path.[144] Oil spills present another hazard. In case of a spill, whales may pass through the oil, exposing their bodies to harmful hydrocarbons. No research has studied the toxic effects of inhaled or ingested oil on bowhead whales, but scientists believe the consequences would be similar to those for polar bears and seals, which are both seriously affected by oiling.[145] While no major oil spill has occurred in the Beaufort Sea, concerns about the potentially calamitous effects of a spill on the bowhead whale population are a major factor in any evaluation of offshore drilling.

IV. Areas for Commission Inquiry

The areas for Commission inquiry suggested by this draft are all topics that can and should be discussed by panelists at the hearing on September 27, 2010. Staff recommends that the Commission ask the panelists to address these issues.

Shell's exploratory drilling C-Plan is currently the only formal industry proposal for contingency planning and oil spill response in the Arctic. While Shell's plan acknowledges many of the challenges of spill response in the Arctic, questions remain as to whether its solutions to those challenges are realistic. For its final report, the Commission may want to consider the forthcoming analysis conducted by the Pew Environmental group in evaluating the Shell plan and the requirements for Arctic response plans generally.

The Commission may also want to consider the regulatory standards to which the C-Plan is keyed. The regulations set out requirements for spill response planning, such as the volume for the worst-case discharge scenario and the proximity to the well of spill response equipment. The Shell plan appears to go beyond these standards, but other drillers may not. Environmental groups have criticized the current response planning standards as inadequate because they allow an applicant to underestimate the risk of, and do not require sufficient response capacity in the event of, a worst-case discharge. Bills in both the House and Senate attempt to respond to these concerns by requiring response plans to include a more comprehensive risk analysis, greater detail about response capability, and specific information on measures to be used in case of a loss of well control.[146] The Commission, after further review of the regulations and an evaluation of the action Congress is considering, may wish to recommend amending the regulations.

The Commission may also want to consider the resources brought to bear to review contingency plans. The Shell C-plan process, where MMS did request further information in

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[144] *See* NATIONAL MARINE FISHERIES SERVICE, ENDANGERED SPECIES ACT—SECTION 7 CONSULTATION, BIOLOGICAL OPINION 13 (2002) (noting that, with reference to the construction and operation of the Liberty Oil production island in the Beaufort Sea, that bowhead whales will defect from their normal migratory paths at distances of up to 35 miles from seismic operations). Changes in migratory patterns will have a significant effect on Inupiat hunting: hunters must follow the whales into riskier waters, making the hunting trip longer and more dangerous. Further, the hunters may not be able to transport the carcass to the shore before it begins deteriorating, thus jeopardizing the whale's food potential.

[145] CUMULATIVE ENVIRONMENTAL EFFECTS at 103.

[146] *See* The Consolidated Land, Energy, and Aquatic Resources Act of 2009, H.R. 3534, 111th Cong. (2009); Outer Continental Shelf Reform Act of 2010, S. 3516, 111th Cong. (2010).

support of the plan, shows that at least some review of the plan took place. The Commission may wish to consider whether the new BOEMRE possesses the expertise, resources, and appropriate incentives to review spill response plans, and whether other agencies should play a role in such review. For example, EPA and NOAA may possess scientific expertise relevant to the evaluation of Arctic response plans, and the Coast Guard may possess relevant operational expertise. EPA and NOAA are currently involved in the environmental review process, but could play a larger role in the spill response planning process. Proposed Congressional actions would require the lead agency reviewing the response plan, such as BOEMRE, to obtain the written concurrence of other agencies that have a significant responsibility to remove, mitigate damage from, or prevent or reduce a substantial threat of the worst-case discharge of oil. The Commission may wish to consider this and other mechanisms to incorporate consultation with other agencies into spill response planning.

It is unclear the extent to which and the speed at which the Coast Guard, the oil spill response contractors, and industry could mobilize response equipment and personnel in the event of a spill in the Chukchi Sea. Because the Coast Guard has an admitted lack of response capacity in the Arctic, immediate responsibility would fall on industry and their oil spill response contactors. Shell, at least, accepts this responsibility. One of the questions for the Commission is whether increased Coast Guard capacity should be a prerequisite for offshore activity or whether the government is comfortable with accepting responsible parties (and private contractors) as primary spill responders—especially in light of widespread public concern about BP's role as the responsible party in the Deepwater Horizon response.

The Commission may also wish to consider encouraging research in two areas. First, further research is needed on the dynamics of the Arctic marine ecosystem and the ways in which marine mammals use sea and shoreline resources. Second, further information is required on the effectiveness of common response methods and whether they can be modified for the Arctic environment. The use of dispersants, bioremediation, and more advanced GPR technology should be investigated to improve response capacity. A response gap analysis, such as the analysis conducted in Prince William Sound, may be a useful tool to identify which response mechanisms should be prioritized.

The United States Geological Service is presently evaluating the state of scientific knowledge about the Arctic and will identify specific areas for research. DOI directed this analysis on April 13, 2010 (a week before the Deepwater Horizon explosion).[147] Potential mechanisms for funding oil spill response research in general, and in the Arctic specifically, will be discussed in a later working paper.

Another question the Commission may consider is the role of the local Inupiat community in setting up response infrastructure and assisting with response efforts. The Prince William Sound Regional Citizens' Advisory Council, established after *Exxon Valdez*, has been suggested as a model for incorporating local communities into spill planning and spill response. The Commission may wish to recommend that a similar council be created in the North Slope communities and be funded by industry engaging in offshore activities.

[147] Press release, Department of Interior, Secretary Salazar Unveils Arctic Studies Initiative that will Inform Oil and Gas decisions for Beaufort and Chukchi Seas (April 13, 2010).