Appendix K
Ice Management Plan
ICE MANAGEMENT PLAN
Beaufort Sea

Submitted to:
U. S. Department of the Interior
Bureau of Ocean Energy Management,
Regulation and Enforcement
Alaska OCS Region

Submitted by:
Shell Offshore Inc.
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I. INTRODUCTION

SCOPE

A Critical Operations and Curtailment Plan (COCP) will be in place for the Shell Offshore, Inc. (Shell) Camden Bay Exploration Program. As part of the COCP, this Ice Management Plan (IMP) has been developed. The description of notification of curtailment (an excerpt from the COCP) is presented in Attachment 1.

The IMP addresses the following activities:

- Vessels
- Shell Ice and Weather Advisory Center (SIWAC)
- Ice Alerts and Procedures
- Ice Management Philosophy
- Well Suspension Procedures
- Mooring System Recovery and Release
- Moving onto the Drill Site
- Training

The IMP:

- Defines Roles and Responsibilities
- Establishes Alert Levels; and
- Establishes Responses to Alert Levels.

The IMP facilitates appropriate decision-making and responses to the threat of hazardous ice and procedures set forth in the IMP prevent damage or harm to personnel, assets, or the environment.

Nothing in this document takes away the authority and accountability of the Master(s) of the vessels for the safety of their personnel and vessels and protection to the environment.

This plan is not a substitute for good judgment.

Guidance Note: This document is not intended to contain detailed procedures. Detailed procedures are contained within the vessel-specific operating manuals.
II. DEFINITIONS

A. Roles and Responsibilities

Responsibilities have been defined for key personnel in section V. In addition to the defined personnel, the following positions have a role in IMP.

<table>
<thead>
<tr>
<th>Position</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chief Officer /Second Officer</td>
<td>In addition to regular duties will assist the Ice Advisor (IA).</td>
</tr>
<tr>
<td>Officer/Third Officer</td>
<td></td>
</tr>
<tr>
<td>Shell Drilling Superintendent</td>
<td>Shell’s Drilling Superintendent is the senior Shell shore-based manager responsible for all Shell well operations offshore Alaska.</td>
</tr>
<tr>
<td>Rig Manager</td>
<td>The senior shore-based manager (Alaska). Liaising with the Shell Drilling Superintendent.</td>
</tr>
</tbody>
</table>

B. Definitions and Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>AHTS</td>
<td>Anchor Handling Tug Supply</td>
</tr>
<tr>
<td>API</td>
<td>American Petroleum Institute</td>
</tr>
<tr>
<td>BOEMRE</td>
<td>Bureau of Ocean Energy Management, Regulation and Enforcement</td>
</tr>
<tr>
<td>BOP</td>
<td>Blowout preventer</td>
</tr>
<tr>
<td>CFR</td>
<td>Code of Federal Regulations</td>
</tr>
<tr>
<td>COCP</td>
<td>Critical Operations Curtailment Plan</td>
</tr>
<tr>
<td>cm</td>
<td>Centimeter(s)</td>
</tr>
<tr>
<td>Discoverer</td>
<td>Turret-moored Drillship Motor Vessel (M/V) Noble Discoverer</td>
</tr>
<tr>
<td>DNV</td>
<td>Det Norske Veritas</td>
</tr>
<tr>
<td>ft</td>
<td>Foot/feet</td>
</tr>
<tr>
<td>FTP</td>
<td>File transfer protocol</td>
</tr>
<tr>
<td>FY</td>
<td>First-year ice. Sea ice of not more than one winter’s growth, developing from young ice; 12 inches (in.) (30 centimeters [cm]) or greater. It may be subdivided into thin FY – sometimes referred to as white ice, medium FY and thick FY.</td>
</tr>
<tr>
<td>GFS</td>
<td>Global Forecast System</td>
</tr>
<tr>
<td>GIS</td>
<td>Geographic Information System</td>
</tr>
<tr>
<td>Hazardous Ice</td>
<td>Ice, which due to its size, stage of development, concentration, set and drift is considered to be a threat to the safety of personnel, the drilling vessel and well operations. Close proximity of an ice feature regardless of its set and drift may be determined to be hazardous ice. Guidance Note: Sea state as well as visibility may influence what is categorized as hazardous ice.</td>
</tr>
<tr>
<td>HOS</td>
<td>Hang-off sub</td>
</tr>
<tr>
<td>HT</td>
<td>Hazard Time. The estimated time it will take for hazardous ice to reach the drill site.</td>
</tr>
<tr>
<td>IA</td>
<td>Ice Advisor</td>
</tr>
<tr>
<td>IMO</td>
<td>International Maritime Organization</td>
</tr>
<tr>
<td>IMP</td>
<td>Ice Management Plan</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Definition</td>
</tr>
<tr>
<td>--------------</td>
<td>------------</td>
</tr>
<tr>
<td>IMV</td>
<td>Ice management vessel. Any ice class vessel tasked with ice management duties in support of the drilling vessel. This includes the primary ice management vessel (IMV) and the ice class Anchor Handling Tug Supply (AHTS).</td>
</tr>
<tr>
<td>Kulluk</td>
<td>Conical drilling unit Kulluk</td>
</tr>
<tr>
<td>LMRP</td>
<td>Lower Marine Riser Package</td>
</tr>
<tr>
<td>m</td>
<td>Meter(s)</td>
</tr>
<tr>
<td>MODU</td>
<td>Mobile Offshore Drilling Unit</td>
</tr>
<tr>
<td>MT</td>
<td>Move-off Time. The time required to clear decks on the anchor handler recover all anchors conventionally and move off the drill site in an orderly fashion.</td>
</tr>
<tr>
<td>M/V</td>
<td>Motor Vessel</td>
</tr>
<tr>
<td>MY</td>
<td>Multi-year ice. OI which has survived at least two summers’ melt. Hummocks are smoother than on SY and the ice is almost salt-free. Where bare, this ice is usually blue in color. The melt pattern consists of large interconnecting, irregular puddles and a well developed drainage system.</td>
</tr>
<tr>
<td>NOAA</td>
<td>National Oceanic and Atmospheric Administration</td>
</tr>
<tr>
<td>Nordica</td>
<td>M/V Nordica</td>
</tr>
<tr>
<td>OI</td>
<td>Old ice. Sea ice which has survived at least one summer’s melt. Topographic features generally are smoother than FY. It may be subdivided into SY and multiyear ice.</td>
</tr>
<tr>
<td>OSR</td>
<td>Oil Spill Response</td>
</tr>
<tr>
<td>OSV</td>
<td>Offshore Supply Vessel</td>
</tr>
<tr>
<td>PIC</td>
<td>Person in Charge</td>
</tr>
<tr>
<td>RP</td>
<td>Recommended Practice</td>
</tr>
<tr>
<td>SAR</td>
<td>Synthetic Aperture Radar</td>
</tr>
<tr>
<td>Shell</td>
<td>Shell Offshore Inc.</td>
</tr>
<tr>
<td>SIWAC</td>
<td>Shell Ice and Weather Advisory Center located in Anchorage. The center develops forecasts from various sources, and disseminates same.</td>
</tr>
<tr>
<td>Support Vessels</td>
<td>Includes all vessels defined in this plan (IMV/OSR/AHTS/OSV).</td>
</tr>
<tr>
<td>SY</td>
<td>Second-year ice. OI which has survived only one summer’s melt. Thicker than FY, it stands higher out of the water. In contrast to MY, summer melting produces a regular pattern of numerous small puddles. Bare patches and puddles are usually greenish-blue.</td>
</tr>
<tr>
<td>ST</td>
<td>Secure Time. The time required to secure the well, disconnect the Lower Marine Riser Package (LMRP) from the blowout preventer (BOP), recover and secure the riser.</td>
</tr>
<tr>
<td>TD</td>
<td>Total depth</td>
</tr>
<tr>
<td>T-Time</td>
<td>Total Time. The sum of ST + MT.</td>
</tr>
<tr>
<td>U.S.</td>
<td>United States</td>
</tr>
<tr>
<td>USCG</td>
<td>United States Coast Guard</td>
</tr>
<tr>
<td>VMT</td>
<td>Vessel Management Team. This team is headed by the Drilling Vessel Master and includes the Shell Drilling Foreman, Rig Superintendent, Drilling Vessel IA and the Chief Engineer.</td>
</tr>
</tbody>
</table>
III. VESSELS COVERED BY IMP

- Motor Vessel (M/V) Noble *Discoverer* (*Discoverer*) or conical drilling unit *Kulluk* – Drilling Vessel

- *M/V Nordica* (or similar) – Primary Ice Management Vessel (IMV)

- *Hull 247* (or similar) – Ice Management and Anchor Handling

Drilling is to be executed by the *Kulluk* or *Discoverer*, but not both.

**Kulluk**

The *Kulluk* has an Arctic Class IV hull design, is capable of drilling in up to 600 feet (ft) [182.9 meters (m)] of water and is moored using a 12-point anchor system. The *Kulluk* mooring system consists of 12 Hepburn winches located on the outboard side of the main deck, Anchor wires lead off the bottom of each winch drum inboard for approximately 55 ft (16.8 m). The wire is then redirected by a sheave, down through a hawse pipe to an underwater, ice protected, swivel fairlead. The wire travels from the fairlead directly under the hull to the anchor system on the seafloor.

The *Kulluk* is designed to maintain its location in drilling mode in moving ice with thickness up to 4 ft (1.2 m) without the aid of any active ice management. With the aid of IMVs, the *Kulluk* would be able to withstand more severe ice conditions. In more open water conditions, the *Kulluk* can maintain its drilling location during storm events with wave heights up to 18 ft (5.5 m) while drilling, and can withstand wave heights of up to 40 ft (12.2 m) when not drilling and disconnected (assuming a storm duration of 24 hours).

The *Kulluk* will comply with the requirements of 30 Code of Federal Regulations (CFR) Part 250.417, the International Maritime Organization (IMO), the U.S. (United States) Coast Guard (USCG) and Det Norske Veritas (DNV). All drilling operations will be conducted under the provisions of 30 CFR 250, American Petroleum Institute (API) Recommended Practices (RP) 53, 65 Part 2 and 75, and other applicable regulations and notices, including those regarding the avoidance of potential drilling hazards and safety and pollution prevention control. Primary safety measures include: inflow detection and well control; monitoring for loss of circulation and seepage loss; and casing and cementing program designs. Primary pollution prevention measures consist of contaminated and non-contaminated drain systems, a mud drain system, and oily water processing.
**Discoverer**

The *Discoverer* is a true, self-contained drillship. The *Discoverer* is an anchored drillship with an 8-point anchored mooring system. Station keeping is accomplished using the turret-moored, 8-point anchor system. The underwater fairleads prevent ice fouling of the anchor lines. Turret mooring allows orientation of vessel’s bow into the prevailing ice drift direction to present minimum hull exposure to drifting ice. The vessel is rotated around the turret by hydraulic jacks. Rotation can be augmented by the use of the fitted bow and stern thrusters.

The hull has been reinforced for ice resistance. Ice-strengthened sponsons have been retrofitted to the ship’s hull.

The *Discoverer* is classed by DNV as a Mobile Offshore Drilling Unit (MODU) for worldwide service. It is a “1A1 Ship-Shaped Drilling Unit I” and is capable of performing drilling operations offshore Alaska. The *Discoverer* has been issued with a DNV Appendix to Class stating:

> “the structural strength and material quality of the ‘Ice Belt’ formed by the sponsons below the 8950mm A/B level, have been reviewed against the requirements for the DNV ICE-05 Additional Class Notation and found to meet those requirements (as contained in DNV Rules for Classification of Ships, Pt 5 Ch 1, July 2006) for a design temperature of -15 degrees C.”

The *Discoverer* will comply with the requirements of 30 CFR Part 250.417, the IMO, the USCG and DNV. All drilling operations will be conducted under the provisions of 30 CFR Part 250 Subpart D, API RP 53, 65 Part 2 and 75 and other applicable regulations and notices including those regarding the avoidance of potential drilling hazards and safety and pollution control. Such measures as inflow detection and well control, monitoring for loss of circulation and seepage loss, and casing design will be the primary safety measures. Primary pollution prevention measures are the contaminated and non-contaminated drain systems, the mud drain system, and the oily water processing system.

Structurally, this is comparable to Canmar drillships used safely and successfully in exploration campaigns in the Beaufort and Chukchi Seas into the 1990s.

Details on the drilling vessels are included as Attachment 2.

**Drilling Vessel Principal Dimensions**

<table>
<thead>
<tr>
<th>Dimension</th>
<th><em>Discoverer</em></th>
<th><em>Kulluk</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Length Overall</td>
<td>514 ft (156.7 m)</td>
<td>266 ft (81.0 m) diameter</td>
</tr>
<tr>
<td>Draft</td>
<td>27 ft (8.2 m)</td>
<td>41 ft (12.5 m)</td>
</tr>
<tr>
<td>Width</td>
<td>85 ft (26 m)</td>
<td>266 ft (81.0 m) diameter</td>
</tr>
</tbody>
</table>
**Ice Management Vessels**

Ice management support to the drilling vessel will be provided by the *Nordica* (or similar) and *Hull 247* (or similar). The drilling vessel will be supported by these IMVs from the beginning of the campaign until the vessel departs the area. A description of these vessels is provided in Attachment 2.

**Nordica (or similar vessel)**

The *Nordica* (or similar vessel) is designated as the primary IMV. The *Nordica* is classed by the DNV as +1A1.

Designed for the management, maintenance and service of offshore oil wells, the 380.5-ft (116-m) *Nordica* is a multipurpose vessel specialized in marine construction and icebreaking. *Nordica* is equipped with diesel-electric propulsion systems and their innovative combination of capabilities, based on extensive design and engineering work, facilitates use of these systems in arctic conditions.

**Hull 247 (or similar vessel)**

*Hull 247* is designated as the secondary IMV and anchor handler. *Hull 247* is currently in the construction phase and will be completed in March 2012. Engineered drawing and specifications are included in Attachment 2.

**Ice Management Vessel Principal Dimensions**

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Nordica</th>
<th>Hull 247</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length Overall</td>
<td>380.5 ft (116 m)</td>
<td>360.6 ft (110 m)</td>
</tr>
<tr>
<td>Draft</td>
<td>27.5 ft (8.4 m)</td>
<td>24 ft (7.3 m)</td>
</tr>
<tr>
<td>Width</td>
<td>85 ft (26 m)</td>
<td>80 ft (24.4 m)</td>
</tr>
</tbody>
</table>

**Guidance Note:** IMVs supporting the drilling vessel may be deployed to assist other vessels, as operations and ice conditions dictate. Diverting ice management resources away from the drilling vessel may require a curtailment of activities. This decision shall be made jointly by the Shell Drilling Foremen and the Master on the drilling vessel. The onshore Shell Drilling Superintendent (in consultation with the Rig Manager) will endorse the plan or set priorities if agreement cannot be reached at the field level.
IV. SHELL ICE AND WEATHER ADVISORY CENTER

SIWAC is an integrated forecasting service staffed 24/7 by industry-leading specialists under Shell contract in Anchorage, Alaska. SIWAC’s primary function is to provide current and forecast ice and weather conditions directly to field operations and planning managers during the operational season. SIWAC provides information to decision makers and field principals to help them minimize risks when operating in the presence of ice. To provide quality and accurate information, SIWAC depends on skilled forecasters, subscription and public satellite imagery, numerical models, field observations, Geographic Information System (GIS) software tools, and a robust communication network.

SIWAC ICE DATA INPUTS

Ice forecasts are developed and issued daily. The Lead Ice Analyst compiles available data from subscription, specialized, and public services in ArcMAP (GIS Software) such as:

- MDA RadarSat 2 imagery
- MODIS satellite
- Canadian Ice Services
- National Ice Center
- Contract weather services
- Field observations
- IceNav images

Data Transmission

Effective communication of SIWAC ice and weather guidance and reciprocal feedback and field observations requires a robust and capable data network. The drilling vessel and IMVs are equipped with high-speed data and voice satellite service that has been proven to perform well in the U.S. Chukchi and Beaufort Seas.

Data, including satellite imagery and observations, are relayed through a file transfer protocol (FTP) site between SIWAC and the field vessels using automated processes. This keeps both the field and forecasters continuously refreshed with the latest information. In addition, SIWAC maintains a secure website that allows direct, on demand access to all forecast reports and data products.

Additional information about SIWAC is in Attachment 3.

Ice Information Flow Chart

NOTE: The following graphic, Ice Management Communications Flow Chart, depicts the constant two-way communication that would occur between the various components of the system.
**Guidance Note:** Additional information regarding ice may be requested by the Master of the drilling vessel. Any means appropriate to the circumstances shall be used to provide this information. Where this information is to be obtained by aerial reconnaissance, the Shell Drilling Foreman will liaise with Shell Logistics to provide the appropriate resources.
V. ICE ALERT LEVELS AND PROCEDURES

These procedures define five Alert Levels that are linked to the time that hazardous ice is forecast to be at the drilling vessel location, and the time required to secure the well and move the drilling vessel off location if it becomes necessary. Roles, responsibilities and actions required are specified according to the Alert Level.

### Ice Alert Levels

<table>
<thead>
<tr>
<th>ALERT LEVEL</th>
<th>TIME CALCULATION</th>
<th>STATUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>(HT – T-Time) is greater than 24 hours</td>
<td>Normal operations</td>
</tr>
<tr>
<td>Blue</td>
<td>(HT – T-Time) is greater than 12 hours and less than 24 hours</td>
<td>Initiate risk assessment. Validate secure times and move times.</td>
</tr>
<tr>
<td>Yellow</td>
<td>(HT – T-Time) is greater than 6 hours and less than 12 hours</td>
<td>Limited well operations in line with COCP. Commence securing well.</td>
</tr>
<tr>
<td>Red</td>
<td>(HT – MT) is less than 6 hours</td>
<td>Well-Securing Operations Completed. Commence anchor recovery operations.</td>
</tr>
<tr>
<td>Black</td>
<td>Drill site evacuated</td>
<td>Move drilling vessel to a safe location.</td>
</tr>
</tbody>
</table>

HT = Hazard Time  
MT = Move-off Time  
T-Time = Total Time

**Guidance Note:** If T-Time becomes greater than HT at any time, well securement and drill site evacuation contingency plans will be implemented.
## Ice Alert Roles and Responsibilities

The following table summarizes roles, responsibilities and actions required for each Ice Alert Level.

<table>
<thead>
<tr>
<th>Alert</th>
<th>Drilling Vessel Master</th>
<th>Drilling Vessel IA</th>
<th>IMV IA (Shell)</th>
<th>IMV Master</th>
<th>Rig Superintendent</th>
<th>Shell Drilling Foreman</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The Drilling Vessel Master is the person in charge (PIC) of the drilling vessel. He is the final authority in regards to safety of the vessel, crew and complement. All changes of Alert level are issued by the Master. The responsibility to evacuate the drill site in response to a hazard rests with the Master. Evaluates information from SIWAC, IAs and Vessel Management Team (VMT). Establishes Ice Alert Level and directs ice management operations. Establishes MTs in conjunction with the IMV Masters. Ensure Alert Level status is broadcast to fleet and internally throughout drilling vessel at intervals dependent on Alert Level or at change of alert Level.</td>
<td>Collates and evaluates information from the SIWAC, IMV IAs and VMT. Advises Master in establishing Ice Alert Level. Correlates Secure Time (ST) with information from rig operations. Establishes HT and MT in conjunction with IMVs and drilling vessel and advises Master and VMT. Works in conjunction with IAs on IMVs to develop and establish effective ice management strategies and advises Drilling Vessel Master. Ensures current ice drift is broadcast to fleet and liaises with SIWAC.</td>
<td>The IA is Shell’s representative onboard the IMVs and is the primary contact for all communications with the Drilling Vessel Master. He advises the IMV Master in executing the ice management strategies. Works in conjunction with Master of IMVs to determine the local ice conditions and hazardous ice. Works in conjunction with Drilling Vessel IA and Master of IMVs to develop and implement effective ice management strategies. Provides feedback on effectiveness of strategy and reports any anomalies pertaining to ice.</td>
<td>The Master is the PIC of the IMVs. He is the final authority in regards to safety of the vessel, crew and complement. Evaluates advice from the SIWAC and IA (drilling vessel &amp; IMVs). Works in conjunction with IA on drilling vessel and IA of IMVs to develop and execute effective ice management strategies. Provides feedback on effectiveness of the strategy to the IA on the IMVs. Reports to IMVs IA any condition which inhibits vessel performance</td>
<td>The Rig Superintendent is the on-site supervisor responsible for all rig functions and drilling-related operations aboard the drilling vessel. Establishes ST &amp; informs VMT of ST and well conditions. Validates drilling team is aware of their duties under present Ice Alert Level. Validates well secure contingency plans</td>
<td>The Drilling Foreman is the senior on-site Shell supervisor with responsibility for overseeing drilling and well operations and for initiating spill response as the On-site Incident Commander for spills originating from the well site. Validates well ST in conjunction with the Rig Superintendent. Informs Drilling Vessel Master and Rig Superintendent regarding ongoing &amp; upcoming critical operations and curtailment plans. Communicates status of well and Ice Alert level to Shell shore-based management. Under the authority of the Shell Drilling Superintendent the Shell Drilling Foreman may raise the Ice Alert Level at any time. He may order the suspension of drilling operations, securing of the well.</td>
</tr>
<tr>
<td>Alert</td>
<td>Condition</td>
<td>VMT Comms Frequency</td>
<td>Drilling Vessel Master</td>
<td>Drilling Vessel IA</td>
<td>IMV IA (Shell)</td>
<td>IMV Master</td>
</tr>
<tr>
<td>-------</td>
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<td>----------------</td>
<td>------------</td>
</tr>
<tr>
<td>Green</td>
<td>(HT – T-Time) is greater than 24 hours</td>
<td>Every 24 hours, or more frequently as needed</td>
<td>Discharges duties as per accountabilities</td>
<td>Discharges duties as per accountabilities</td>
<td>Discharges duties as per accountabilities</td>
<td>Discharges duties as per accountabilities</td>
</tr>
<tr>
<td>Blue</td>
<td>(HT – T-Time) is greater than 12 hours and less than 24 hours</td>
<td>Every 12 hours, or more frequently as needed</td>
<td>Ensures readiness to execute contingency plans</td>
<td>Establishes Ice Management Strategies in conjunction with IMVs and IA onboard IMVs.</td>
<td>Establishes Ice Management Strategies in conjunction with IA and Drilling Vessel IA</td>
<td>Validates readiness of IMV to execute ice management strategy</td>
</tr>
<tr>
<td>Yellow</td>
<td>(HT – T-Time) is greater than 6 hours and less than 12 hours</td>
<td>Every 6 hours, or more frequently as needed</td>
<td>Directs ice management operations</td>
<td>Establishes HT &amp; advises Master &amp; VMT</td>
<td>Implements ice management strategies as directed by Drilling Vessel Master in conjunction with IMV Master</td>
<td>Provides feedback on effectiveness of strategy</td>
</tr>
<tr>
<td>Red</td>
<td>(HT – T-Time) is greater than 6 hours</td>
<td>Every hour</td>
<td>Initiates departure plans following confirmation from Rig Superintendent that lower marine riser package (LMRP) has been retrieved and secured and guide wires are released</td>
<td>Establishes and Validates MT</td>
<td>Establishes departure strategy</td>
<td>Ensures Alert Level status is broadcast to fleet and internally at 1-hour intervals or at change of Alert Level</td>
</tr>
<tr>
<td>Black</td>
<td>Drill site evacuated</td>
<td>As needed</td>
<td>Directs IMV support operations leading to safe departure from drill site to pre-agreed safe area</td>
<td>Performs preliminary reviews of ice and Drilling Vessel conditions</td>
<td>Advises IMV Master on operations leading to safe transit from drill site to pre-agreed safe area</td>
<td>Provides Master of Drilling Vessel to aid further decision making</td>
</tr>
</tbody>
</table>

Shell Offshore Inc. 12 May 2011

May 2011
VI. ICE MANAGEMENT PHILOSOPHY

An effective IMP is designed to enable execution of the exploration program, with the appropriate barriers in place to manage and mitigate against risks that are specific to exploration drilling operation in offshore Alaska (in this case, threat of ice). Additionally, the IMP identifies the “top” event caused by the failure of barriers and addresses the procedures to deal with consequences of escalation.

The “top” event, for the purpose of the IMP, is a yellow alert level that triggers the commencement of well suspension operations. This section addresses the activities associated with ice management as a barrier to the top event.

The strategy to prevent the top event is to have the following elements as effective barriers:

- proper equipment,
- skilled people,
- appropriate information, and
- work processes.

The key elements identified above are discussed herein.

**Proper Equipment**

- The IMVs will be capable IMVs, with the appropriate ice strengthening, and have been contracted to support the exploration campaign.
- IceNav: The drilling vessel and IMVs will be outfitted with IceNav Equipment (Enhanced radar imaging of ice)
- *Hull 247* (or similar vessel) is a high specification anchor handling vessel and will be the primary anchor handling vessel.
- *Nordica* (or similar vessel) designated as the primary IMV has anchor handling capability and could be used to supplement *Hull 247* if needed.

**Skilled People**

- The drilling vessel and IMVs will carry specialist IA, in addition to the regular crew complement.
- The drilling vessel and the *Nordica* (or similar vessel) will have two IAs onboard providing 24/7 coverage.
- The IAs supporting the exploration campaign will have documented experience of having performed ice management activities associated with supporting exploration activities.
- SIWAC will be staffed with world-class industry-acknowledged experts in weather, satellite and Ice Synoptic analysis.
- IMVs will have crews with ice management experience.
**Appropriate Information**

A multi-layered, systematic approach is taken to provide relevant information from SIWAC with a feedback loop from the vessels using:

- Wide Area Satellite Imagery
- High Resolution Satellite Imagery
- Meteorological Buoys
- Field Observation
- Numerical Models
- Local Radar
- Vessels are outfitted with Fit-for-Purpose Data and Communications link.

**Work Processes**

A systematic approach for risk mitigation is adopted by developing effective work processes.

- Development of effective ice management strategies based on available information (global and local)
- Deployment of assets to deliver strategy
  - Threat sectors identified
  - Assess manageability of ice feature
  - Appropriate management of ice feature (breaking/deflecting)
  - Primary IMV deployed at an effective perimeter to reduce floes to manageable size in advance of HT
- Scheduled VMT meetings (frequency dictated by Alert levels)
- Planning/Coordination meetings with specific focus on Ice Alert Levels
VII. WELL SUSPENSION PROCEDURES.

Effectiveness of the IMP depends on accurately establishing HT, ST and MT. Secure Time is time taken to secure the well, disconnect and retrieve the LMRP.

As part of securing the well, well suspension procedures will be established. These procedures will supplement the detailed well securing procedures that will be contained within the Rig Operations Procedures and will be specific to securing the well in response to the threat of hazardous ice.

Return to the drill site following exit due to the threat of hazardous ice is covered in Section IX.

Examples of well suspension options and procedures are presented in Attachment 4.

A. Well Suspension Options

Securing and suspending the well can be accomplished by several means. The base case is to suspend the well by plugging, (mechanical or cement). The chosen option or combination thereof will be dependent upon well conditions, environmental conditions, and (or) equipment limitations. Shell will employ the most effective suspension procedure under the specific circumstances at the time.

Relevant information associated with well suspension will be documented in the daily drilling reports. The BOEMRE field representative will be apprised, and relevant records will be submitted to BOEMRE.

Potential well suspension options are listed in the following table.
<table>
<thead>
<tr>
<th>Time Required / Preference</th>
<th>Mechanical Plugging</th>
<th>Drillpipe Hang-off</th>
<th>Pull Out of Hole</th>
<th>Shearing Drill Pipe</th>
<th>Dropping String</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requires most time. Is the base case procedure for securement.</td>
<td>Requires most time. Is the base case procedure for securement.</td>
<td>Less time than plugging</td>
<td>Potentially less time depending upon position in hole.</td>
<td>Least amount of time; Stuck pipe contingency</td>
<td>Comparable to shearing drillpipe. Contingency to cope with mechanical hoisting failure</td>
</tr>
</tbody>
</table>

| Provides Wellbore Isolation | Yes | Yes (blind/shears closed) | Yes (blind/shears closed) | Yes (blind/shears closed) | Yes (blind/shears closed) |

| Hang-off Sub (HOS) Required | No | Yes (Emergency Drill Pipe Hang-off Tool) | No | No | No |

| Packers / Bridge Plug Required | Yes | No | No | No | No |

| Potential to Leave String in Hole | Yes, if suspended below packer. | Yes | No | Yes, but access to pump through sheared string is questionable. | String in hole but requires fishing trip and overshot to circulate |

| Remarks | Mechanical plugs are preferred method in cased hole. | In this case no downhole plugging has been assumed. | This method is acceptable in situations where casing has been run and cemented, but not drilled out yet. Pipe can be pulled and blind/shears closed without further containment. | Contingency for stuck pipe situation | Contingency to cope with mechanical hoisting failure |

| Advantages | Provides complete wellbore isolation. Equipment readily available. | Provides wellbore isolation via blind/shear rams. Equipment readily available. Can be done in a timely manner. Leaves kill string in place for potential well control requirements. | Requires less time in situations where casing has been run but not drilled out, or if already out of the hole as noted above, for logging or changing BHA. | Quickest way to secure the well and prepare for move-off | Next to shearing, quickest way to prepare rig for move-off. Also leaves the top of the string in the hole undamaged and ready for recovery or circulating via overshot and packoff |

| Disadvantages | Takes longer. Packers require additional tripping. Cementing requires mixing / pumping time and introduces potential for contamination. | No downhole wellbore isolation. | Not a preferred method with open hole conditions because no pipe is left in the hole for potential well control methods. No downhole wellbore isolation. | Potential to leave a deformed pipe profile complicating fishing and circulating operations | No downhole isolation is accomplished. Requires fishing trip to reestablish downhole circulation |
VIII. MOORING SYSTEM RELEASE/RECOVERY

A. Conditions Present to Initiate Mooring System Release and Recovery

This section addresses mooring system release and recovery if ice conditions have triggered an Ice Alert Level of yellow and escalated to a red. The following discussion assumes the well has been secured and all recoverable well-related equipment has been retrieved.

B. Release Options

Mooring system release/recovery can be accomplished by several means. The base case is to recover moorings in the conventional manner. The selection of a specific release option and the execution of the procedures rest with the Drilling Vessel Master who informs the VMT. Potential options are listed in the table below.

### Mooring System Release/Recovery

<table>
<thead>
<tr>
<th></th>
<th>Conventional Anchor Retrieval</th>
<th>Rig Anchor Release (RAR)</th>
<th>Running off Wires</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time Required / Preference</td>
<td>Requires most time. Is the base case procedure for retrieval</td>
<td>Less time than conventional recovery</td>
<td>Contingency plan if RARs fail to activate.</td>
</tr>
<tr>
<td>Advantages</td>
<td>System is intact. Ready for redeployment</td>
<td>Reduced MT</td>
<td>None</td>
</tr>
</tbody>
</table>

IX. MOVING ONTO OR RETURNING TO THE DRILL SITE

The authority to move on to or return to the drill site will be issued by the Shell Drilling Superintendent with the concurrence of the Rig Manager. Relevant regulatory authorities will be notified in accordance with the requirements.

Upon authorization, the final decision to move on to or return to the drill site is dependent upon the Drilling Vessel Master and the VMT who are able to assess the various parameters properly with input from the IMV Masters and IA to determine the practicality of the decision.
X. TRAINING

All personnel will be made aware of their roles and responsibilities within this IMP through a training session on each vessel. This training will include a table-top exercise, which will be executed prior to beginning operations to provide exposure to and test communications and procedures of the COCP and the IMP. Participants at the table-top exercise will include:

- Shell and Drilling leadership
- Rig Crews (both Drilling and Marine Operations staff)
- Oil Spill Response (OSR) representative
- SIWAC representatives
- BOEMRE operations representatives
- IMVs
- IAs
- Alaska Logistics (Marine and Aviation) Representatives

Observations from the table-top exercise will be documented.
XI. ATTACHMENTS
Attachment 1 – Extract from Critical Operations Curtailment Plan

Per Section 10 of the COCP:

Notification of the decision for curtailments requiring the rig to disconnect from the well and depart location will be made as soon as practical, but not to interfere with the safety of the crew, environment, or vessel. This notification will be made either verbally to a representative on site or by telephone to a BOEMRE representative on duty; the notification may also be made in written form through the use of fax or email.

All operations curtailment decisions will be documented on the Shell Daily Operations Report. This information will be conveyed to BOEMRE on a weekly basis via the Well Activity Report and at the end of the well operations as part of the End of Operations Report.

The following flow chart depicts notifications in the event of curtailment.
Curtailment Notification Flow Chart (Attachment 1 continued)
Attachment 2 - Vessel Descriptions
**Kulluk Specifications**

**Kulluk**

**BeauDrill**

Kulluk is the first floating drilling vessel designed and constructed for extended season drilling operations in deep Arctic waters.

An improvement on the floating drillship concept, Kulluk is a conically shaped, ice strengthened floating drilling unit with a 24-faceted double-walled hull.

**Key Features**

- Unique, purpose-built conical Arctic Class IV hull design
- Operating water depth 60 to 600 ft (18.3 to 183 m), drilling depth up to 20,000 ft (6096 m)
- Electrically driven Varco topdrive drilling system
- 24 ft (7.3 m) diameter glory hole bit capable of drilling and setting a steel caisson 4 ft (1.2 m) into the seabed for ice scur protection
- Partially enclosed derrick
- 18½ in (476 mm), 10,000 & 15,000 psi (69 & 103 MPa) BOP stacks
- High-performance 12 point mooring system

![Diagram of Kulluk](image-url)
**Classification**

The unit has been designated as Arctic Class IV (by the Canadian Coast Guard) under Canadian Arctic Shipping Pollution Prevention Regulations, and as Ice Class 1AA by the American Bureau of Shipping.

**Specifications**

- **Owner:** Beaudril Limited
- **Flag:** Canadian
- **Rig Type:** Conical Drilling Unit (CDU)
- **Delivered:** 1983
- **Rig Design:** Earl & Wright - Lavalin
- **Built By:** Mitsubishi Engineering and Shipbuilding, Japan

**Dimensions**

- Diameter at main deck: 266 ft (81.0 m)
- Diameter at pump deck: 196 ft (59.7 m)
- Full Depth: 61 ft (18.5 m)

**Operations**

- **Draft**
  - (max. operating): 41 ft (12.5 m)
  - (min. operating): 33 ft (10.0 m)
- **Light Ship**
  - Draft (light ship): 20 ft (6.0 m)
- **Displacement:**
  - Maximum: 19,300 tons (17,510 tonnes)
  - Operating: 20,000 tons (6,996 m³)
- **Water Depth:**
  - 60 to 600 ft (18.3 to 183 m)

**Variable Load**

- 7,717 tons (7,000 tonnes)

**Storage Capacities**

- Barre & cement bulk: 21,471 cf (600 m³)
- Liquid mud: 2,665 bbl (414 m³)
- Drill water: 4,277 bbl (672 m³)
- Fuel: 10,685 bbl (1,603 m³)
- Potable water: 1,961 bbl (312 m³)
- Ballast: 35,528 bbl (5,712 m³)
- Pipe & casing (pipe deck): 1,543 tons (1,430 tonnes)
- Briar: 2,010 bbl (320 m³)

**Operational Limits**

Stationkeeping Conditions

Kuluk was built to operate in the ice-infested waters of the Arctic offshore. The unit was developed to extend the drilling season available to more conventional floating vessels by enabling operations to be carried out through spring breakup conditions, the summer months, and well into the early winter period.

Kuluk was designed to maintain location in a drilling mode in moving first-year ice of 4 ft (1.2 m) thickness. With ice management support provided by Beaudril's Arctic Class IV icebreakers, the unit can maintain location in more severe conditions as shown below.

In terms of Kuluk's open water performance, the drilling unit was designed to maintain location in storm conditions associated with maximum wave heights of 18 ft (5.5 m) while drilling and 40 ft (12.2 m) while disconnected (assumed storm duration of 24 hrs).

If ice or open water storm conditions become more severe than those indicated, the unit's mooring system, which incorporates acoustic release devices, is disconnected from the anchors and the unit moves off location.
Ice Management Plan

Ice Mana
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Shell Of

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shore Inc.

27
Beaufort Sea, Alaska

May 2011

Ice Management Plan

Ice Mana

Shell Of

egment Plan
shore Inc.

27
Beaufort Sea, Alaska

May 2011

Equipment

Drilling Equipment

Derrick

16 ft (4.48 m) Dree dynamic with a
40 ft x 40 ft (12.2 m x 12.2 m) base,
rated at 1,400,000 lb (623 000 daN)
with 14 lines

Racking platform has capacity to hold
23,340 ft (7,115 m) of 5 in (127 mm)
drill pipe plus bottom hole assembly

Drawworks

Ideco E-3000 electric drawworks
complete with sand reel, Elmag
model 7838 Baylor auxiliary brake,
spacing and breakout catheads and
three GE model 752 motors each rated
at 1,000 hp (746 kW) continuous

Travelling Block

McKissack model 666, 650 ton (590
tonne) capacity with 7 sheaves grooved
for 1 in (43.1 mm) drilling line

Swivel

Ideco TL-500, 500 ton (454 tonne)
capacity

Drill Pipe

20,000 lb (9,096 kg); 5 in (127 mm),
19.5 lb/ft (29 kg/m) with 4½ IF
connections

Top Drive

Varco TDS-3 with one GE model 752
motor rated at 1,000 hp (746 kW)
continuous and a 500 ton (454 tonne)
hosting capacity

Rotary Table

Ideco LR-495, 49.5 in (1.27 mm)
driven by one GE model 752 motor,
rated at 1,000 hp (746 kW) continuous,
coupled to a two speed transmission

Drill String Compensator

NL Shaffer 18½ in (476 mm) compensating
capacity or a 1,000,000 lb
(444 800 daN) locked capacity

Tensioner System

4 x 80,000 lb (35.9 ton) Western Gear
ramp tensioner, 48 ft (14.6 m)
wireline travel with 1½ in (44.5 mm)
wire rope

6 x 16,000 lb (7 100 daN) Western Gear
guide/pod tensioners, 40 ft
(12.2 m) wireline travel with ¾ in
(19.11 mm) wire rope

Mud Pumps

2 x Ideco T1600 triplex, each driven by
two GE model 752 motors rated at
1,000 hp (746 kW) continuous

Cementing Unit

Dowell owned R717 twin triplex
powered by two GE model 752 motors
each rated at 1,000 hp (744 kW)
continuous, with 7,500 psi (52 MPa)
and 10,500 psi (73 MPa) fluid ends

Big Floor Pipe Handling System

Varco Iron Roughneck model IR-2000
Range: 2½ to 8 in (73 to 203 mm)

Mud Logging Room

Designed to accommodate
equipment from any of the major
mud logging companies. This room is
an integral part of the rig and contains
complete lab facilities

Testing Equipment

Complete testing system with a 10,000
BOPD (1 900 m³/day) capacity
consisting of: data header, choke
manifold steam heater, 3 phase
safety valve surge tank, water degasser,
transfer pumps, and flare booms

Mud Conditioning Equipment

4 x ThuleUnited VSM-128 shale
shakers
1 x Brand SR-3 desander
1 x Brand SE-24 desilter
1 x ThuleVSM-200 mud cleaner
1 x Wagner Sigma-100 centrifuge
1 x Sharpes DM 60 000 centrifuge
2 x Burgess Magna-Vac vacuum
degassers
2 x Alfa-Laval AX30 mud coolers

Subsea Equipment

BOP System
1 x NL Shaffer 18¼ in (476 mm),
10,000 psi (69 MPa) BOP stack with
annular, ram type preventers, and
Vetco H-3 E-4 connector
1 x NL Shaffer 18¼ in (476 mm),
15,000 psi (103 MPa) BOF stack with
annular rated at 10,000 psi (69 MPa),
4 ram type preventers, and Vetco
H-4 E-1 connector

Lower Marine Riser Packages
2 x 19/16 in (476 mm) with: 10,000 psi
(69 MPa) Shaffer annular, 25 ft
(762 mm) Marine Riser System
3 x hydraulic pin connectors; 2 x 36 in
(914 mm) Cameron and 1 x 30 in
(762 mm) Drill-Quip

1 x Regan 28 in (711 mm) CR-1
pressure compensated lower ball joint
30 in (762 mm) riser consisting of 1 in
(25.4 mm) wall casing with Hunting
Lynx 52S connectors
1 x Regan 28 in (711 mm) telescoping
riser joint with 2 in (13.7 m) stroke
1 x Regan 28 in (711 mm) DR-1 upper
ball joint
1 x Regan KFDS 28 in (711 mm)
diverter
21 ¾ in (549 mm) Marine Riser
21 ¾ in (549 mm) Cameron RCK riser
with 10,000 psi (69 MPa) choke and
kill lines
2 x Cameron telescoping riser joints,
1 x 40 ft (12.2 m), and 1 x 50 ft
(15.2 m) stroke
1 x Regan 24 in (610 mm) DR-1 upper
ball joint
1 x Regan KFDS 24 in (610 mm)
diverter

Glory Hole Bit
1 x Brown Tornado, 24 ft (7.3 m)
diameter hydraulically operated with
a lift and discharge. Capable of drilling
a glory hole 40 ft (12.2 m) into the
seafloor for ice scour protection

Power Generation
Prime Movers:
3 x Electro-Motive Diesel rated at
2,817 hp (2 100 kW) each

Emergency Power:
1 x GM Detroit diesel rated 873 hp
(651 kW)

Cranes
3 x Liebherr, BOS 65/850, rated at 72
ton (65 tonnes) at 30 ft (9.1 m)

Safety Equipment
4 x Whittaker 54-person survival craft;
two on port, two on starboard
1 x Hurricane Model 700-D emergency
rescue boat
2 x RFD inflatable escape slides

Helideck
Capacity for Sikorsky S-92 or similar
with fueling station

Accommodation
Bunks for 108 people, recreation
room, sauna, gallery with seating for
36, offices, and hospital
The Kulluk's mooring system consists of twelve Hepburn winches located on the outboard side of the main deck. Anchor wires lead off the bottom of each winch drum inboard for approximately 55 ft (17 m). The wire is then redirected by a sheave, down through a hawse pipe to an underwater, ice protected, swivel fairlead. The wire travels from the fairlead directly under the hull to the anchor system on the seafloor.

**Specification:**

**Anchor Winch**
12 x Hepburn single-drum winches with a 287 ton (263 tonne) operating tension

**Mooring Wires and Anchors**

**Anchors:**
- Various sizes & quantities of anchors are available for use. Exact anchor configuration to be provided once location and seafloor conditions are specified.

**Wire ropes:**
- Each winch drum has capacity for 3,763 ft (1,147 m) of 3/4 in (88.9 mm), 573 ton (520 tonne) breaking strength wireline.

**Anchor Release:**
- Each anchor wire contains a remote acoustic release (RAR) unit.

For more information about Kulluk, contact the Kulluk Contact Manager, Beaufort Oilfield (606) 852-6300.
**Discoverer Specifications**

<table>
<thead>
<tr>
<th>DISCOVERER SPECIFICATIONS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>TYPE-DESIGN</td>
<td>Drillship - Sonat Offshore Drilling Discoverer Class</td>
</tr>
<tr>
<td>SHAPE</td>
<td>Monohull with sponsons added for ice-resistance</td>
</tr>
<tr>
<td>SHIP BUILDERS &amp; YEAR</td>
<td>Namura Zonshno Shipyard, Osaka, Japan - hull number 355</td>
</tr>
<tr>
<td>YEAR OF HULL CONSTRUCTION</td>
<td>1965</td>
</tr>
<tr>
<td>YEAR OF CONVERSION</td>
<td>1976</td>
</tr>
<tr>
<td>DATE OF LAST DRY-DOCKING</td>
<td>2010</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DISCOVERER DIMENSIONS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>LENGTH</td>
<td>514 ft</td>
</tr>
<tr>
<td>LENGTH BETWEEN PERPINDICULARS (LBP)</td>
<td>486 ft</td>
</tr>
<tr>
<td>WIDTH</td>
<td>85 ft</td>
</tr>
<tr>
<td>MAXIMUM (MAX) HEIGHT (ABOVE KEEL)</td>
<td>274 ft</td>
</tr>
<tr>
<td>HEIGHT OF DERRICK ABOVE RIG FLOOR</td>
<td>175 ft</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DISCOVERER MOORING EQUIPMENT</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Anchor pattern symmetric 8 points system. The unit is fitted with Sonat Offshore Drilling patented roller turret mooring system giving the unit the ability to maintain favorable heading without an interruption of the drilling operations</td>
<td></td>
</tr>
<tr>
<td>ANCHORS</td>
<td>Stevpris New Generation 7,000 kilograms (kg) each (ea) 15,400 pounds (lb) ea</td>
</tr>
<tr>
<td>ANCHOR LINES</td>
<td>Chain Wire Combination</td>
</tr>
<tr>
<td>SIZE/GRADE</td>
<td>2.75-in. wire 3-in. ORQ Chain</td>
</tr>
<tr>
<td>LENGTH</td>
<td>2,750 ft (838 m) wire + 1,150 ft (351 m) chain (useable) per anchor</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DISCOVERER OPERATING WATER DEPTH</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>MAX WATER DEPTH</td>
<td>1,000 ft (305 m) with present equipment (can be outfitted to 2,500 ft [762 m])</td>
</tr>
<tr>
<td>MAX DRILLING DEPTH</td>
<td>20,000 ft</td>
</tr>
</tbody>
</table>

[Shell Offshore Inc. 31 May 2011]
### Table 1.c-2 Discoverer Specifications (continued)

<table>
<thead>
<tr>
<th>Specification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DRAW WORKS</strong></td>
<td>EMSCO E-2,100 - 1,600 horsepower (hp)</td>
</tr>
<tr>
<td><strong>ROTARY</strong></td>
<td>National C-495 with 49 ½-in. opening</td>
</tr>
<tr>
<td><strong>MUD PUMPS</strong></td>
<td>2 ea. Continental Emsco Model FB-1600 Triplex Mud Pumps</td>
</tr>
<tr>
<td><strong>DERRICK</strong></td>
<td>Pyramid 170 ft. with 1,300,000 lb nominal capacity</td>
</tr>
<tr>
<td><strong>PIPE RACKING</strong></td>
<td>BJ 3-arm system</td>
</tr>
<tr>
<td><strong>DRILL STING COMPENSATOR</strong></td>
<td>Shaffer 400,000 lb with 18-ft (5.5 m) stroke</td>
</tr>
<tr>
<td><strong>RISE TENSIONS</strong></td>
<td>8 ea. 80,000 lb Shaffer 50-ft (15.2 m) stroke tensioners</td>
</tr>
<tr>
<td><strong>CROWN BLOCK</strong></td>
<td>Pyramid with 9 ea. 60-in. (1.5 m) diameter sheaves rated at 1,330,000 lb</td>
</tr>
<tr>
<td><strong>TRAVELING BLOCK</strong></td>
<td>Continental - Emsco RA60-6</td>
</tr>
<tr>
<td><strong>BLOWOUT PREVENTOR (BOP)</strong></td>
<td>Cameron Type U 18 ¾-in. (48 cm) x 10,000 pounds per square in. (psi)</td>
</tr>
<tr>
<td><strong>RISE</strong></td>
<td>Cameron RCK type, 21-in. (53 cm)</td>
</tr>
<tr>
<td><strong>TOP DRIVE</strong></td>
<td>Varco TDS-3S, with GE-752 motor, 500 ton</td>
</tr>
<tr>
<td><strong>BOP HANDLING</strong></td>
<td>Hydraulic skid based system, drill floor</td>
</tr>
<tr>
<td><strong>DISCOVERER DISPLACEMENT</strong></td>
<td></td>
</tr>
<tr>
<td><strong>FULL LOAD</strong></td>
<td>20,253 metric tons (mt)</td>
</tr>
<tr>
<td><strong>DRILLING</strong></td>
<td>18,780 mt (Drilling, max load, deep hole, deep water)</td>
</tr>
<tr>
<td><strong>DISCOVERER DRAUGHT</strong></td>
<td></td>
</tr>
<tr>
<td><strong>DRAFT AT LOAD LINE</strong></td>
<td>27 ft 8.20 m</td>
</tr>
<tr>
<td><strong>TRANSIT</strong></td>
<td>27 ft (fully loaded, operating, departure) 8.20 m</td>
</tr>
<tr>
<td><strong>DRILLING</strong></td>
<td>25.16 ft 7.67 m</td>
</tr>
<tr>
<td><strong>DISCOVERER HELIDECK</strong></td>
<td></td>
</tr>
<tr>
<td><strong>MAXIMUM HELICOPTER SIZE</strong></td>
<td>Sikorsky 92N</td>
</tr>
<tr>
<td><strong>FUEL STORAGE</strong></td>
<td>2 ea. 720-gallon tanks</td>
</tr>
<tr>
<td><strong>DISCOVERER ACCOMODATIONS</strong></td>
<td></td>
</tr>
<tr>
<td><strong>NUMBER OF BEDS</strong></td>
<td>140</td>
</tr>
<tr>
<td><strong>SEWAGE TREATMENT UNIT</strong></td>
<td>Hamworthy ST-10</td>
</tr>
<tr>
<td><strong>DISCOVERER PROPULSION EQUIPMENT</strong></td>
<td></td>
</tr>
<tr>
<td><strong>PROPELLER</strong></td>
<td>1 ea 15 ft 7-in. (4.8 m) diameter, fixed blade</td>
</tr>
<tr>
<td><strong>PROPULSION DRIVE UNIT</strong></td>
<td>Marine Diesel, 6 cylinder, 2 cycle, Crosshead type</td>
</tr>
<tr>
<td><strong>HORSEPOWER</strong></td>
<td>7,200 hp @ 135 revolutions per minute (RPM)</td>
</tr>
<tr>
<td><strong>TRANSIT SPEED</strong></td>
<td>8 knots</td>
</tr>
<tr>
<td><strong>GENERAL STORAGE CAPACITIES</strong></td>
<td></td>
</tr>
<tr>
<td><strong>SACK STORAGE AREA</strong></td>
<td>934 cubic meters (m³)</td>
</tr>
<tr>
<td><strong>BULK STORAGE</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Bentonite / Barite</strong></td>
<td>180 m³ - 4 tanks</td>
</tr>
<tr>
<td><strong>Bulk Cement</strong></td>
<td>180 m³ - 4 tanks</td>
</tr>
<tr>
<td><strong>LIQUID MUD</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Active</strong></td>
<td>1,200 barrels (bbl)</td>
</tr>
<tr>
<td><strong>Reserve</strong></td>
<td>1,200 bbl</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>2,400 bbl</td>
</tr>
<tr>
<td><strong>POTABLE WATER</strong></td>
<td>1,670 bbl / 265.5 m³ (aft peak can be used as add. pot water tank)</td>
</tr>
<tr>
<td><strong>DRILL WATER</strong></td>
<td>5,798 bbl / 921.7 m³</td>
</tr>
<tr>
<td><strong>FUEL OIL</strong></td>
<td>6,497 bbl / 1,033 m³</td>
</tr>
</tbody>
</table>

¹ Sponsors designed and constructed to meet requirements of Det Norske Veritas (DNV) Additional Class Notation ICE-05.
**Nordica Specifications**

**Powerful, high-tech, multipurpose vessels for global underwater oil field construction**

Designed for the management, maintenance and service of offshore oil wells, the 97-metre Botnica is a multipurpose vessel specialised in marine construction and cebreaking, as are the 116-metre vessels Fennica and Nordica. They are equipped with diesel-electric propulsion systems and their innovative combination of capabilities, based on extensive design and engineering work, facilitates their use in both arctic and tropical conditions. All three of these multipurpose vessels are highly advanced, powerful and extremely well designed and built.

**Unique technology for demanding conditions**

These vessels are ideal for offshore operations. The working decks are about 1,000 m², making it exceptionally large and level for ships of this length. The deck was designed for fast equipment changes. Depending on the ship, such equipment may range from simple deckcranes to a 160-tonne pedestal active heave compensated crane, or from deepwater installation equipment to pipe-laying systems, underwater machinery control or the towing and installation of large pipelines.

With their 15,300 kW power output and 230-tonne bollard pull, the Nordica and the Fennica are ideal for seabed ploughing and towing, and they are also fully equipped for anchor-handling operations. The ships’ main engine and generator solution makes it possible to perform heavy duty maintenance tasks without affecting their operating ability.

Both the Fennica and the Nordica are also equipped with a stern roller.

**Accurate, safe and highly suitable**

The Botnica’s moon pool and the large size of its working deck make this ship highly suitable for a variety of offshore operations. Different types of special tools and structures can be installed on the working deck. The attributes of the Botnica, a class 3 DP ship, are in keeping with the strict rules and stipulations demanded in oil well management, as well as the requirements on oil fields set by the Norwegian Maritime Directorate.

The multipurpose icebreakers are equipped with Kongsberg Simrad’s Dynamic Positioning (DP) system, which has five independent control units operating their main propellers and three bow thrusters. Even in a sector in which ocean vessels equipped with DP systems are normal, these vessels have performed their tasks exceptionally well in terms of manoeuvrability and accuracy. Their unusual asymmetrical, spacious navigation bridge was designed with an eye to the requirements placed on the ship’s multiple applications, both on the open sea and in icebreaking and towing operations.

The vessels have a separate deck for the clients’ use, with cabins and offices and a separate data network. The high-quality facilities accommodate a total of 45-48 guests, depending on the ship.
**Finnica**

**Dimensions**
- Length: 116.00 m
- Beam: 24.0 m
- Draught: 8.40 m max.
- Built: 1994
- Max. speed: 16 knots

**Class**

**Dynes**
- Simrad ADP 710

**Accommodation**
- 62 persons
- 24 cabins for cabin use (47 persons)

**Deck**
- Working deck area 900 m²
- Anchor handling/towing winch
- Aquamaster TAW 300/3000 E

**Machinery**
- Main engines
  - 2 x Wärtsilä Diesel, Vasa 14V 32, each 6600 kW
  - 2 x Wärtsilä Diesel, Vasa 12V 32, each 4500 kW
- Generators
  - ABB Rivorbom Drive
  - 2 x HSG 1120 MPB, power 8.314 kW, Volt: 6.3 kV, speed: 750 rpm
  - 2 x HSG 700 LR8, power: 6.225 kVA, Volt: 6.3 kV, speed: 750 rpm
- Propellers
  - 2 x HSSOL 18/1654, output: 7.500 kW each, ABB Stromberg Drive
  - 2 x Aquamaster-Rauma US ARC 1, 7500 kW each, FP propellers, variable RPM
  - Bow thrusters
    - 3 x Brunvoll IV-80 FTC-2250, VP propellers: 1100 kW each

**Bollard pull**
- 234 tons

**Crane(s) [optional]**
- 60 tons/38 metre jib
- 15 tons

**Navigation Equipment**
- Robertson ECDIS Navigation System
- Doppler speed log
- Loran C
- GPS
- Fiber optic gyro
- Differential GPS Gyo
- Navintra Ecdis
- Direction finder
- Echo sounder
- Facsimile recorder

**Communications Equipment**
- SATCOM TRP 84000 MF/HF 558, including all GMSS requirements
- 1 x Watch receiver
- 1 x AEC VHF. Helicopter communication
- 6 x VHF
- 1 x Navtex receiver
- 1 x Inmarsat B satellite comm. system
- 1 x UHF walkie-talkie
- 3 x VHF walkie-talkie
- 2 x Freefloat EPIRB, 121,5 and 406 MHz
- 2 x Distress transponders, 96 Hz
- Call signal: OJA

**Nordica**

**Dimensions**
- Length: 116.00 m
- Beam: 24.00 m
- Draught: 8.40 m max.
- Built: 1994
- Max. speed: 16 knots

**Class**

**Dynes**
- Simrad ADP 02

**Accommodation**
- 62 persons
- 24 cabins for client use (47 persons)

**Deck**
- Working deck area 900 m²
- Anchor handling/towing winch
- Aquamaster AW 3000/3000 E

**Machinery**
- Main engines
  - 2 x Wärtsilä Diesel, Vasa 16 V 32, each 6000 kW
  - 2 x Wärtsilä Diesel, Vasa 12 V 32, each 4500 kW
- Generators
  - ABB Stromberg Drive
  - 2 x HSG 1120 MPB, power 8.314 kW, Volt: 6.3 kV, speed: 750 rpm
  - 2 x HSG 700 LR8, power: 6.225 kVA, Volt: 6.3 kV, speed: 750 rpm
- Propellers
  - 2 x HSSOL 18/1654, output: 7.500 kW each, ABB Stromberg Drive
  - 2 x Aquamaster-Rauma US ARC 1, 7500 kW each, FP propellers, variable RPM
  - Bow thrusters
    - 3 x Brunvoll IV-80 FTC-2250, VP propellers: 1100 kW each

**Bollard pull**
- 234 tons

**Main crane [optional]**
- Lifting capacity: 160 t/m
- Boom length: 30.73 m

**Winch**
- Active Heave Compensated
- Constant Tension

**Heave amplitude**
- + 3.5 m double part
- + 7 m single part

**Operating depth**
- 500 m – 160 T (double part)
- 1000 m – 80 T (single part)

**AUX winch**
- 10 T, 33 m

**Tugger winches**
- 2 x 4 T Constant ’tension’

**A-frame [optional]**
- 120 tons

**Navigation Equipment**
- Navintra ECDIS Navigation System
- Doppler speed log
- Loran C
- GPS
- Fiber optic gyro
- Differential GPS Gyo
- Direction finder
- Echo sounder
- Facsimile recorder

**Communications Equipment**
- SATCOM TRP 84000 MF/HF 558, including all GMSS requirements
- 1 x Watch receiver
- 1 x AEC VHF. Helicopter communication
- 6 x VHF
- 1 x Navtex receiver
- 1 x Inmarsat B satellite comm. system
- VSAT online satellite comm. system
- 1 x UHF walkie-talkie
- 3 x VHF walkie-talkie
- 2 x Freefloat EPIRB, 121.5 and 406 MHz
- 2 x Distress transponders, 96 Hz
- Call signal: OJA

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- Brygga Næringsenteret
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- Phone +47 3701 2240, fax +47 3701 2842
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- www.gdv.no

Shell Offshore Inc. 34 May 2011
HULL 347 Specifications
Attachment 3 – Shell Ice and Weather Advisory Center

Operational Support Overview

Safe and efficient offshore operations in the Arctic are contingent upon quality and timely ice and weather forecasts. Using state-of-the-art satellite technology, large areas of the Beaufort and Chukchi Seas are monitored remotely by the SIWAC to track and forecast movement of ice and make estimates of ice type and concentration.

Synthetic Aperture Radar (SAR) instruments on board the RADARSAT 2 satellite are contracted to acquire necessary images of sea ice over areas of interest several times per week. These images are transmitted to ground stations, processed, and made available for analysis within hours of acquisition. Interpretation of the ice edge and features are performed by experienced specialists using powerful mapping software to produce ice charts that are considerably more detailed than those available from national ice centers. These charts are then distributed to operational personnel and planning managers.

Knowing the location and composition of the ice at any given moment is a valuable tool. However, it is important to forecast how the ice may change over time. A complementary component of ice forecasting is quality weather information. Weather conditions in the Arctic are among the most severe on the planet and can change dramatically over a short time. The National Weather Service does not provide measurements and forecasts that sufficiently resolve the conditions over small areas or short time spans in the Arctic offshore. Therefore, dedicated meteorologists with Arctic forecasting experience are employed full time to produce accurate snapshots of the current conditions and reliable forecasts of weather conditions into the future.

Using the Global Forecast System (GFS) numerical weather model as a starting point, the meteorologists produce a high resolution grid in proprietary modeling software of weather parameters, such as atmospheric pressure, wind speed, and wave height that have been corrected based on local observations and weather instrumentation from Shell’s vessels at sea, meteorological buoys, and coastal weather stations. The result is a model that accurately reflects current and forecast weather conditions over short distances in the Beaufort and Chukchi Seas, making marine operations and vessel transits safer and more responsible. Without this innovative forecast effort, weather products from other sources tend to describe the average or general conditions that one could expect over large areas, such as the entire U.S. Beaufort Sea, which results in reports of local conditions rarely matching what is forecast for the specific areas of operations.

The wind vectors, a set of points indicating the speed and direction of the wind distributed over the Beaufort and Chukchi Seas, and other output from the weather model are applied to the ice charts in the mapping software. This allows the ice analyst to assess the effect of wind and weather systems on the future movement and development of the ice.
Attachment 4 – Well suspension Options and Contingencies

In all the following well suspension scenarios, the assumption is that a determination has been made by the Shell Drilling Superintendent, the Shell Drilling Foreman, the Drilling Superintendent, the Drilling Vessel Master and the VMT that a hazard exists and the well should be suspended. The Shell Drilling Foreman and the Drilling Superintendent in conjunction with the Shell Drilling Engineer and the Shell Drilling Superintendent will have analyzed the trip time, borehole stability, well control issues, operational parameters, depth of hole, and time available to decide upon the contingency steps most appropriate for well securement, and a detailed procedure will have been worked up. The Shell Drilling Foreman then presents the procedure to the BOEMRE Field Representative aboard the drilling vessel for comment and concurrence.

Well Suspension Scenario 1 – Mechanical Plugging

1. After determining that the well should be suspended under the assumptions described above, the Shell Drilling Foreman orders the Drilling Superintendent to stop all normal drilling operations and to commence circulating the hole.

2. The driller completes circulating at minimum a full “bottoms up.”

3. The drilling assembly is pulled out of the hole and a mechanical packer suitable to the last casing or liner size is made up on the bottom of the drill string.

4. The packer is tripped in the hole, set approximately 200 ft above the last casing or liner shoe depth and pressure tested.

5. Depending on actual water depth, sufficient pipe is pulled to enable having the end of the string 200 ft above the top of the packer when hung off in the wellhead via the hang-off sub (HOS).

6. A full-opening safety valve and an inside blowout preventer (BOP) are made up in the top of the drill pipe, and one additional joint is added above these valves. The HOS is installed in the top of this joint. (The full opening safety valve is left in the open position.)

7. The HOS assembly is run in the hole on drill pipe to land the HOS in the wellhead bowl.

8. The proper hydraulic fluid volume to actuate the BOP stack is confirmed by the Subsea Engineer and the system operating pressure is checked. Pipe rams in the BOP are closed on the HOS profile. The drill pipe is backed out from the HOS and the landing string is pulled from the riser. The blind/shear rams are closed and locked above the HOS. BOP failsafe valves are all left in the closed position.

9. The master bushings are removed and the riser spider is installed.

10. The diverter handling tool is made up and the diverter assembly is laid down.

11. The riser landing joint is made up into the slip joint inner barrel. The slip joint inner barrel is collapsed and the inner barrel is locked.

12. BOP stack functions are blocked, and the LMRP connector is unlocked.
13. The LMRP is pulled off the top of the BOP with the block motion compensator and riser tensioners.

14. Once the Shell Drilling Foreman has ascertained that the LMRP is released from the BOP, he advises the Drilling Vessel Master that he is free to initiate (or continue) mooring recovery and departure procedures.

15. The drill crew and Subsea Engineer pull the landing joint to surface. The landing joint, slip joint and riser are then layed down and the LMRP is secured on deck.

16. The Drilling Vessel Master confirms with the IA that the Ice Alert Level has reached “red” status (ice hazard is due to arrive within 6 hours of completing anticipated mooring recovery time). The Drilling Vessel Master advises the Drilling Superintendent to have the Subsea Engineer shear guidelines loose from the top of the BOP guideposts and to retrieve the lines to surface.

17. The drill floor and moonpool area are cleared and inspected in preparation for mobilizing the drilling vessel.

18. All decisions and supporting facts are recorded on the Daily Report and issued to the BOEMRE, SIWAC, and the normal distribution list.

**Well Suspension Scenario 2 – Drillpipe Hang-off**

1. After determining that the well should be suspended, the Shell Drilling Foreman orders the Drilling Superintendent to stop all normal drilling operations and to commence circulating the hole.

2. The driller completes circulating at minimum a full “bottoms up.”

3. A pill of heavy, kill-weight drilling mud is mixed and spotted at total depth (TD), then the rig pulls the bottomhole assembly back into the casing such that the bit will be at least 200 ft above the shoe when the pipe has been hung off on the BOP rams.

4. After pulling the proper distance into the casing, a full-opening safety valve and an inside BOP are made up in the top of the drillpipe. (The full opening safety valve is left in the open position.) One additional joint of drillpipe is added above these valves and all connections made up properly.

5. Drill pipe is added to the top of the single, but the connection at the hang-off point is not fully tightened.

6. The drill string is lowered back into the well with the loose connection positioned just above a pipe ram.

7. The proper hydraulic fluid volume to actuate the BOP stack is confirmed by the Drilling Superintendent and the system operating pressure is checked. Pipe rams in the BOP just below the loose drill pipe connection are closed. The drill string is lowered until all string weight is resting on the closed pipe ram. The loose connection is backed off and the remaining drill pipe is pulled from the riser. The blind/shear rams are closed and locked above the backed off drill pipe. BOP failsafe valves are all left in the closed position.

8. Proceed with steps 9 through 18 as indicated in Scenario 1 above.
**Well Suspension Scenario 3 – Pull Out of Hole:**

It is assumed the wellbore is isolated from the formation (i.e., a casing string has been run and cemented, but not yet drilled out). A drilling assembly has been run in the hole to the top of cement.

1. After determining that the well should be suspended, the Shell Drilling Foreman orders the Drilling Superintendent to pull out of the hole.
2. After pulling out of the hole, the proper hydraulic fluid volume to actuate the BOP stack is confirmed by the Drilling Superintendent and the system operating pressure is checked.
3. The blind/shear rams are closed and locked. BOP fail-safe valves are left in the closed position.
4. Proceed with steps 9 through 18 as indicated in scenarios 1 and 2 above.

**Well Suspension Scenario 4 – Shearing Drill Pipe**

It is assumed the drill string is stuck and unable to be pulled from the hole.

1. After determining that the well should be suspended, the Shell Drilling Foreman orders the Drilling Superintendent to circulate at minimum a full “bottoms up” (assuming circulation is possible).
2. While circulating, the Drilling Superintendent and the Toolpusher calculate the location of the drill string tool joints below the rotary.
3. Once circulation is completed the proper hydraulic fluid volume to actuate the BOP stack is confirmed by the Drilling Superintendent and the system operating pressure is checked.
4. Pipe rams are closed under the nearest connection.
5. The drill string is slacked down until all string weight is resting on the closed ram or the string weight has been transferred to the point at which pipe is stuck.
6. The blind/shear rams are closed, shearing the drill string above the hang-off point. The blind/shear rams are locked closed. BOP fail-safe valves are left in the closed position.
7. The cut section of drill string is pulled to surface.
8. Proceed with steps 9 through 18 as indicated in scenarios 1 and 2 above.

**Well Suspension Scenario 5 – Dropping String**

It is assumed that there has been a failure to the rig’s hoisting capability; for example, failure of the drawworks to be able to pick up or position the string by lifting, and an approaching hazard has been identified. (Dropping the string is normally associated with being unable to shear the pipe across the shear rams, whether it is in the form of drill collars or heavywall casing, etc., and comes into play more often with a dynamically positioned vessel in a “drive off” situation.) Under most all circumstances with encroaching ice (barring mechanical failure), there is
adequate time to trip drill collars out of the hole if across the stack or to install a crossover and run casing past the stack on drill pipe and then utilize a conventional hang-off tool.)

1. After determining that the well should be suspended and the string dropped because of a mechanical failure, the Shell Drilling Foreman orders the Drilling Superintendent to circulate at minimum a full bottoms up (if circulation is possible).

2. Once circulation is completed the proper hydraulic fluid volume to actuate the BOP annulars is confirmed by the Drilling Superintendent and the system operating pressure is checked.

3. Operating pressure for both annulars is increased to maximum, and both annulars are closed.

4. The string is slacked down until all string weight is supported by the closed annular elements.

5. Elevators are unlatched.

6. Opening pressure is applied to the annulars, releasing their hold upon the string and allowing it to fall downhole.

7. The blind/shear rams are closed and locked. BOP failsafe valves are left in the closed position.

8. At this point, the BOP stack functions are blocked, and the LMRP connector is unlocked. The LMRP is pulled off the top of the BOP with the riser tensioners alone, allowing it to clear the BOP sufficiently to enable moving off location.

9. Note that in this circumstance the LMRP is left hanging until the hoisting capabilities of the rig have been restored. Movement off location will thus have to take water depth into consideration and clearance between the bottom of the LMRP and the seabed.

10. Once hoisting capabilities have been restored, proceed beginning with step 9 in the scenarios above to get the diverter and slip joint layed down and the LMRP secured on deck.