

**Appendix J**  
**Critical Operations and Curtailment Plan**

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SHELL OFFSHORE INC.

3601 C Street, Suite 1000  
Anchorage, AK 99503

# CRITICAL OPERATIONS AND CURTAILMENT PLAN

Beaufort Sea, Alaska

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**May 2011**

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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### Reference Documents:

- 30 CFR Part 250.417 (e)
- Shell Offshore Inc. Ice Management Plan (Beaufort Sea)

## ACRONYMS & ABBREVIATIONS

API	American Petroleum Institute
BOEMRE	Bureau of Ocean Energy Management, Regulation and Enforcement
BOP	blowout preventer
CFR	Code of Federal Regulations
COCP	Critical Operations and Curtailment Plan
<i>Discoverer</i>	Motor Vessel <i>Noble Discoverer</i>
DNV	Det Norske Veritas
ft	feet (foot)
HSSE	Health, Safety, Security and Environment
HT	Hazard Time
IMO	International Maritime Organization
IMP	Ice Management Plan
<i>Kulluk</i>	conical drilling unit <i>Kulluk</i>
LMRP	lower marine riser package
m	meter(s)
MT	Move-off Time
M/V	Motor Vessel
RARs	Rig Anchor Releases
RS/FO	Regional Supervisor, Field Operations
SIWAC	Shell Ice and Weather Advisory Center
ST	Secure Time
T-Time	Total Time
USCG	U.S. Coast Guard
VMT	Vessel Management Team

## 1. **Introduction**

The primary purpose of this Critical Operations and Curtailment Plan (COCP, or plan) is to document precautionary measures to minimize the likelihood and consequence of an oil spill while drilling exploration wells in the Beaufort Sea and to protect personnel, equipment and the environment. The COCP is arranged to:

- Identify critical operations
- Identify circumstances that may cause curtailment
- Identify relationships between the COCP and the Ice Management Plan (IMP)
- Comply with all regulatory requirements.

Exploration drilling operations can be interrupted for a variety of reasons. Some factors affecting curtailment include:

- Adverse sea ice movement, weather conditions, sea states and other environmental conditions that add risk to ongoing operations.
- Time requirements for bringing support vessels to bear on a particular issue.
- Loss of ice management vessel support due to mechanical issues or as a result of temporary reassignment of vessel(s) to another area (for example, to provide rescue, supply/logistics support, etc.).
- Communications loss between vessels and/or between vessels and the shorebase.

This plan identifies certain exploration drilling activities designated as critical operations and discusses plans to delay, limit or cease these operations when hazards develop with the potential to harm personnel; damage vessels, equipment or the well; or result in a spill that could adversely impact the environment. This plan describes the decision-making process and identifies the lines of authority, responsibility and accountability for successfully handling critical operations.

A companion plan to the COCP is the IMP, which details the process for making these critical decisions with regard to ice conditions. The IMP describes ice management operations, the flow of ice information, and how minute-to-minute direction of the ice management vessels is accomplished. The “Ice Alert Procedures” contained within the IMP describe the ice alert levels, the decision process leading to their change, and the decision to return to the site. It also deals with well suspension operations, mooring system recovery, and well reentry decisions associated with ice hazards in the Beaufort Sea. No critical operation will be started, or continued if already in progress, until the time required to perform the task is properly determined under the circumstances and that time is deemed to be sufficient for safe completion of the operation.

Certain exploration drilling operations are more likely than others to generate conditions that could lead to a well control incident or other incident that could result in harm to people, assets or the environment. This is particularly the case when subsurface formations capable of flowing formation fluids into the wellbore are exposed, or when the well has encountered abnormal pressures.

This COCP in conjunction with the IMP also satisfies 30 Code of Federal Regulations (CFR) Part 250.417 (e) as required for a “floating drilling unit contingency plan for moving off location in an emergency situation.” No contingency plan can adequately cover all conceivable situations and circumstances, nor is this plan intended to be a substitute for good judgment and experience in dealing with unexpected situations.

Shell plans to use either the conical drilling unit *Kulluk* (*Kulluk*) or the drillship Motor Vessel (M/V) *Noble Discoverer* (*Discoverer*) to drill the proposed wells described in the revised Camden Bay Exploration Plan. Collectively, the *Kulluk* and/or the *Discoverer* are referred to as the “drilling vessel.”

### **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's* 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 the ice management vessels, the *Kulluk* is capable 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 CFR Part 250.417, the International Maritime Organization (IMO), the U.S. 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 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, eight-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 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 and cementing program designs 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, the *Discoverer* is comparable to the Canmar drillships used safely and successfully in exploration campaigns in the Beaufort and Chukchi Seas into the 1990s.

## **2. Planned Critical Operations**

Planned critical operations are those operations that are designed to occur during the exploration drilling campaign in the Beaufort Sea. Planned critical operations include, but are not limited to:

- Drilling into a zone capable of flowing oil and/or gas
- Conducting certain operations in a well where zones capable of flowing oil and/or gas are exposed or are anticipated of becoming exposed such as:
  - Coring (whole or sidewall cores)
  - Pulling out of the hole with the drill string
  - Wireline logging in the open hole
  - Running casing, circulating and cementing
  - Continuing to drill after a well-related event (e.g., a kick)

Not all of these planned critical operations will necessarily be conducted or encountered on each well during the exploration drilling campaign. Data collection and testing requirements will vary from well to well depending on previous results from offsets and the defined exploration objectives for the new well.

### **3. Unplanned Critical Operations**

Certain operations are not planned in the normal course of drilling exploration wells, but they could be undertaken should situations arise in which they are required. If these unplanned operations are deemed to increase the risk of harm to people, assets or the environment they may be curtailed depending on the level of risk involved. Such operations could include:

- Fishing for lost items in the well
- Cutting and pulling casing/ milling casing window
- Open hole sidetracking
- Drilling into a lost circulation zone
- Perforating
- Remedial well work
- Conducting well control operations (e.g., circulating a kick out of the hole)

### **4. Other Potentially Critical Operations**

These are operations that could be considered critical depending on the well status and conditions at the time:

- Moving back over a well after an emergency evacuation
- Reentering a suspended or temporarily abandoned well
- Anchor line tensioning
- Accidental or unintentional riser disconnect
- Oil or fuel spill
- Heavy load lifting and handling during re-supply activities
- Refueling
- Shipboard fire

Should these conditions be encountered, severity and potential impact will be evaluated on a case-by-case basis and operations may be curtailed while dealing with them using safe methods and procedures. Again, good judgment is the key for dealing with such situations.

## **5. Circumstance/Conditions Requiring Curtailment**

Several situations arise under which critical operations may be terminated, limited, or not commenced. These are listed and discussed briefly below:

### **5.1 Severe Weather**

Wind and sea states can affect vessel motion (e.g., heel, pitch, roll, and heave) beyond safe operating limits and/or create conditions that make certain operations unsafe. Wind and currents can also result in ice movement that creates an unsafe condition for the vessel.

Conditions for curtailment activities will depend on the performance of the drilling vessel in the open water of the Beaufort Sea. The drilling vessel behavior will be thoroughly analyzed upon mooring on the first drill site location, and it will be reevaluated as needed during exploration drilling operations. Thresholds will be established for weather and sea conditions that will control:

- Equipment preparation to curtail operations
- Decision to cease drilling
- Hanging off drillstring or otherwise suspending the well
- Disconnecting riser
- Moving the drilling vessel off the drill site

The curtailment of critical operations as a result of severe weather is the responsibility of the Drilling Vessel Master with input provided by the Shell Drilling Foreman and the Noble Drilling Superintendent.

### **5.2 Sea Ice**

Ice conditions that impact vessel station-keeping limitations (e.g., maximum horizontal displacement off well center) or endanger the vessel hull, will lead to curtailment of critical operations. Ice Alert Level details outlined in the IMP identify timelines as well as roles and responsibilities for action before the arrival of hazardous ice and are reviewed and evaluated daily in order to determine allowable operations. If there is insufficient time to complete a critical operation, or if a routine operation becomes critical before the arrival of the ice hazard, curtailment will be required.

### **5.3 Sea Spray**

Freezing precipitation or sea spray on the vessel can quickly affect the Vertical Center of Gravity and possibly destabilize the drilling vessel. Wind exacerbates the situation by increasing ice accumulations on the windward side of the drilling vessel. Such ice loading could lead to curtailment of critical operations. The prediction of ice loading under adverse conditions is required to determine whether certain operations can begin or continue before this hazard becomes acute. Information for developing ice loading predictions is provided through the consideration of actual on-site conditions in conjunction with forecasted weather advisory information from the Shell Ice and Weather Advisory Center (SIWAC). The prediction of ice

loading is the responsibility of the Drilling Vessel Master with input provided by the drilling vessel's Ice Advisor.

#### **5.4 Unavailability of Materials, Personnel, and / or Equipment**

Curtailment of critical operations may result from any of the following developments, or combinations thereof:

- Limited availability and/or capability of critical oil containment and cleanup equipment
- Significant increase in oil spill control system response time
- A lack of trained personnel or equipment for conducting a particular critical operation
- Insufficient supply of drilling mud materials at the drill site for emergency well control purposes
- Transportation for personnel, supplies and oil spill containment and cleanup equipment not readily available
- Well control equipment, marine safety systems, fire detection, fire fighting or any other health, safety, security and environment (HSSE) critical systems that become inoperable or do not meet minimum standards
- Loss of ice support vessel(s)
- The absence of critical information and/or communications (e.g., ice data, weather forecasts, logistics)

The curtailment of critical operations due to the unavailability of materials, personnel or equipment is the responsibility of the Shell Drilling Foreman. The decision to curtail activities as a result of diverting ice management resources away from the drilling vessel shall be made jointly by the Shell Drilling Foreman and the Drilling Vessel Master. The onshore Shell Drilling Superintendent (in consultation with the Noble Rig Manager) will endorse the plan or set priorities if agreement cannot be reached at the field level.

#### **5.5 Well Control**

Critical operations, other than efforts to restore primary well control, will not be undertaken during a well control event (e.g., drilling will cease pending circulation of a kick out of the hole and adjusting mud density to prevent further kicks from entering the wellbore). The curtailment of critical operations due to a well control event is the responsibility of the Shell Drilling Foreman.

### **6. Time Requirements**

The IMP describes the color-coded alert levels associated with forecasting the arrival of a hazard (described below as Hazard Time [HT]). The IMP likewise describes how those time forecasts are used for deciding when to curtail or cease critical operations and it identifies various well

securement methods as well as the applicable roles and responsibilities of key personnel involved. The definitions below describe the time elements used in the IMP alert level chart.

## 6.1 Secure Time

Secure Time (ST) is defined as the time in hours required for rig crews to cease critical operations and to secure and temporarily abandon the well in a way that prevents leakage of hydrocarbons, regardless of how long the well will be suspended. It also includes the time it requires to disconnect the Lower Marine Riser Package (LMRP) from the Blowout Preventer (BOP) and to secure the riser and LMRP on deck.

ST varies and depends on the type of operation in progress at the time operations are suspended. For example, if the well is drilling in a zone capable of producing hydrocarbons, the time required to pull out of the hole with the drill string must be tempered by the maximum pipe speed to avoid swabbing a kick into the wellbore. It is also impacted by the method selected for suspending the well. If plugs are to be set, either mechanical or spotted cement slurries, ST will be greater than if, for example, a casing string has just been cemented and not drilled out. In the later case additional plugging may not be necessary and the drill string might simply be pulled to the surface or suspended in the wellhead and blind/shear rams subsequently closed.

As noted earlier, methods for suspending the well are detailed in the IMP. Regardless of which technique is selected, estimates of the time required to suspend the well are experienced-based and must be conservative to allow for unforeseen circumstances. The Shell Drilling Foreman, with input from the Shell Drilling Superintendent and the Shell Drilling Engineer will advise the Noble Rig Superintendent of the well suspension plan to be used. The Noble Drilling Superintendent is responsible for estimating the resulting ST and for conveying his determinations to the Drilling Vessel Master, the Shell Drilling Foreman and the rest of the Vessel Management Team (VMT).

## 6.2 Move-off Time

Move-off Time (MT) commences once the drilling riser and LMRP have been retrieved and secured, and it is defined as the time in hours required to safely store remaining items aboard the drilling vessel, recover moorings, and make the drilling vessel ready to evacuate the site.

MT, like ST, varies considerably depending on a number of circumstances including sea state, weather conditions, the type hazard involved, and the method selected for mooring recovery. Horizontal displacement of the rig from the wellbore centerline may complicate release of the LMRP. Inadequate time available for recovering anchors using conventional means may require activation of Rig Anchor Releases (RARs) or allowing anchor wires to spool off winches. These methods are also identified in “Mooring System Recovery / Release”, Section VIII of the IMP.

The Drilling Vessel Master is responsible for estimating MT. Like the ST estimate, MT will be conservatively designed to allow for uncertainties.

### 6.3 Total Time

Total Time (T-Time) is the sum of ST and MT, and it is defined as the time required, in hours, to cease operations, secure the well and be ready to move off the drill site.

### 6.4 Hazard Time

Hazard Time (HT) is the time in hours until the arrival of the hazard, regardless of type, at the drill site. The IMP outlines how the arrival of ice hazards in particular are predicted, based on observations of ice features by Ice Advisors on support vessels and on the drilling vessel, combined with ice and weather predictions provided by the SIWAC in Anchorage.

Other hazards (e.g. severe weather and sea spray) are predicted using a variety of sources including, but not limited to, the support vessel Ice Advisors and the SIWAC as well as the on-site routine observations of the Marine Mammal Observers who also report on environmental conditions as they regard sea state, weather and spray ice conditions aboard and in proximity to the drilling vessel. The potential for an earlier-than-forecasted arrival of a given hazard at the well site should be anticipated. Observation and reporting frequency from all sources must increase as HT decreases to ensure that appropriate measures are being employed to protect people, assets, and the environment.

## 7. Curtailment Decision Process

The decision process and the roles and responsibilities for dealing with ice hazards are addressed in the IMP. The decision processes for dealing with emergencies in general are in the drilling vessel operations procedures which are kept on the drilling vessel for reference. In every case, the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) will be included in the process and will be kept informed of all operations, alerts, and decisions through verbal communications and written reports.

### 7.1 Key Personnel

The following on-site personnel have significant roles in determining when and how curtailment of critical operations will be undertaken:

- Drilling Vessel Master
- Shell Drilling Foreman
- Noble Drilling Superintendent
- Noble Chief Engineer
- Ice Advisors

Together, the key personnel identified above make up the VMT. This VMT ensures that all input from the various data sources are considered in making a decision to curtail operations. Determining critical operations and their curtailment in the face of approaching hazards rests

primarily with the Shell Drilling Foreman with inputs from the rest of the VMT and the Shell Drilling Engineers, Shell Drilling Superintendent, and Well Delivery Manager.

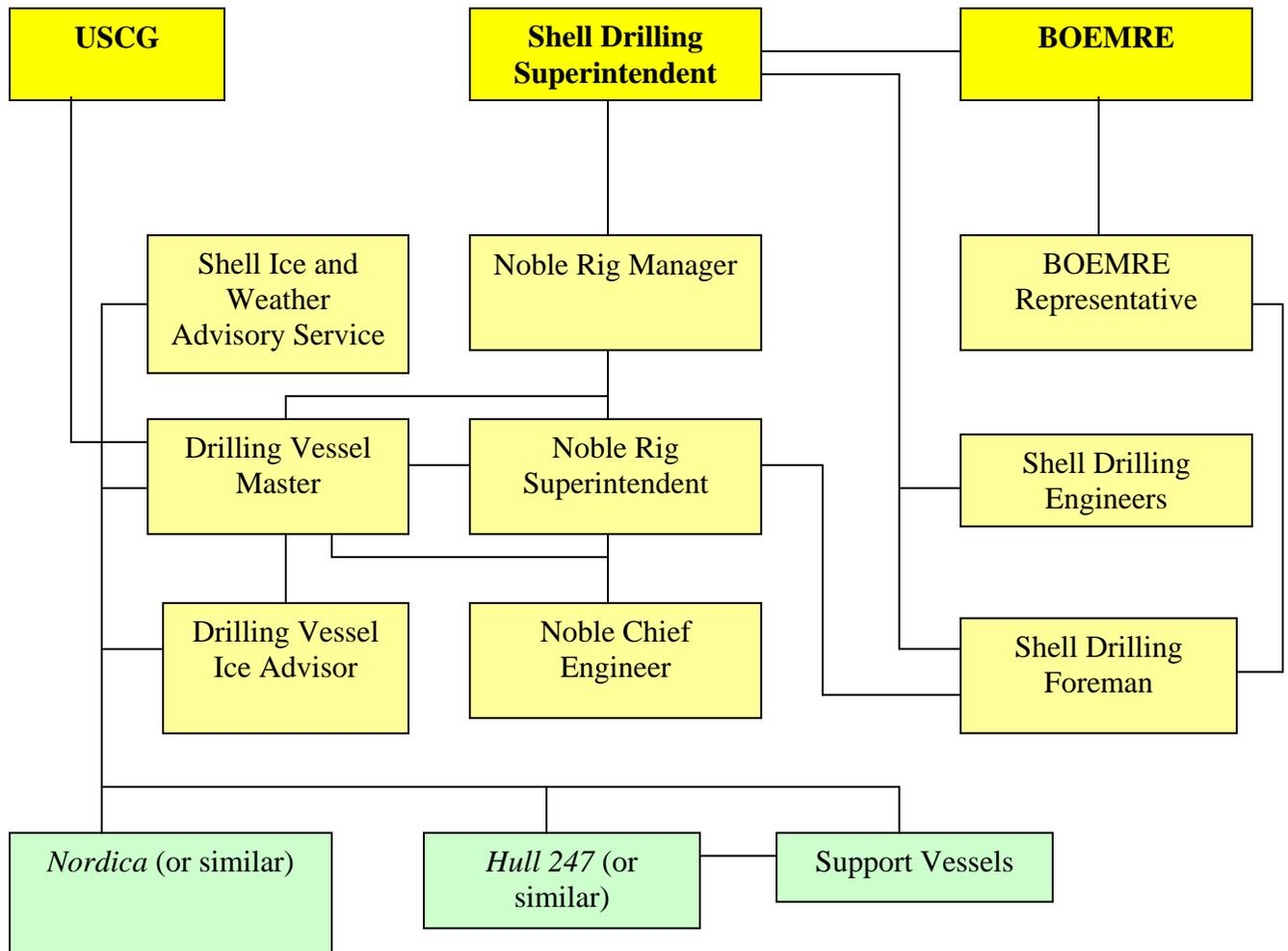
## 7.2 Curtailment Decision Protocol

The curtailment decision protocol is described below, and covers steps to be taken from the time a hazard is recognized until ultimately, the drilling vessel is ready to depart location should the situation require.

- Upon identifying that a hazard exists which may require curtailment, the Drilling Vessel Master will notify the Shell Drilling Foreman. The Shell Drilling Foreman, with the concurrence of the Shell Drilling Superintendent and Shell Drilling Engineer, will determine what operations will be curtailed based on hazard type, severity and projected arrival time. This decision will incorporate input from the VMT and will have the concurrence of the Drilling Vessel Master.
- If the well needs to be suspended, a suspension procedure will be selected by the Shell Drilling Foreman and the Shell Drilling Engineer and approved by the Shell Drilling Superintendent.
- The Shell Drilling Superintendent will submit the proposed suspension plan and ST details to the BOEMRE Regional Supervisor, Field Operations (RS/FO) for approval.
- The Shell Drilling Foreman will advise the Noble Drilling Superintendent of the suspension procedure chosen, and the Noble Drilling Superintendent will estimate ST. The ST calculation will then be distributed to the Shell Drilling Foreman and the VMT as well as applicable shore support parties.
- The move-off procedure and estimated time required will be determined by the Drilling Vessel Master. An estimate of Move-off Time (MT) will be provided to the Shell Drilling Foreman and the rest of the VMT as well as applicable shore support parties.
- When the alert level described in the IMP reaches yellow status, well suspension procedures will be performed and the drilling vessel made ready to move off location as conditions require. The Drilling Vessel Master will ultimately make the decision to move the vessel to a safe location until the hazard has passed.
- The decision to execute an emergency well suspension due to an unanticipated acute hazard (e.g., well control incident, shipboard fire) and the procedure selected to do so will be made by the Drilling Foreman (e.g., drop drill string, cut the drill pipe). Once the well is suspended, the Drilling Vessel Master will make the drilling vessel ready to move if necessary. The Well Delivery Manager, the Shell Drilling Superintendent and the BOEMRE RS/FO will be notified as soon as practicable after the drilling vessel has been made safe.
- The Shell Drilling Superintendent with the concurrence of the Shell Drilling Foreman and the Drilling Vessel Master will make the decision to move back onto the well and resume operations when it is safe to do so.

**8. Organization and Reporting Chart**

Notification of the decision for curtailments to Shell and USCG and BOEMRE agency representatives will be made as soon as practical, but in a manner that does not interfere with the safety of the crew, environment, or vessel. All operations curtailment decisions will be documented on the Shell Daily Operations Report and conveyed to the on-site BOEMRE representative as they develop. Operations curtailment decisions will also be formally 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 chart illustrates the lines of communication in the field and from the field to the shorebase.



**9. Training**

All personnel will be made aware of their roles and responsibilities described within this COCP and the IMP through a training program to be taught before the vessel is on site. All persons with a key position in the COCP will be provided a copy of this document, and training will be provided by Shell prior to deployment. This training will include a table-top exercise that will be carried out prior to initiating operations in the Beaufort Sea.

Anticipated participants will be:

- Shell and drilling vessel leadership (both Drilling and Marine Operations staff)
- Oil Spill Response representative
- Ice Information Center representatives
- BOEMRE
- Ice Advisors, Ice Observers and Ice Pilots
- Anchor Handlers

If necessary, this document will be updated and reissued, incorporating the lessons learned from the table-top exercise.

**Reference Documents:**

- CFR 30 Part 250.417(e)
- Shell Offshore Inc. IMP (Beaufort Sea)

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