Cairn

Oil Spill Prevention and Contingency Plan
Exploration Drilling Programme 2011- Greenland

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Document Control

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2	Capricorn	ERG HSE Coordinator
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4	capricorn	Head of Assets - Greenland
5	Capricorn	In Country Representative - Greenland
6	Capricorn	MODU 1
7	Capricorn	MODU2
8	MODU Operator	Emergency Response Centre
9	BMP	Deputy Minister
10	*Oil Spill Response*	Duty Manager

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Abbreviation List

ADIOS	Automated Data Inquiry for Oil Spills
ALARP	As Low As Reasonably Practicable
AMOSC	Australian Maritime Oil Spill Centre
API	American Petroleum Institute
ASA	Applied SCience Associates
BMP	Bureau of Minerals and Petroleum
BOEMRE	Bureau of Ocean Energy Management Regulation and Enforcement
BOP	Blow Out Preventer
bopd	Barrels of oil per day
BHA	Bottom Hole Assembly
bbls	Barrels
CANDEN	Canada and Denmark Agreement
CCA	Clean Caribbean and Americas
CGP	Cairn Gated Process
CLC	Civil Liability Convention
CMP	Crisis Management Plan
CRT	Crisis Response Team
DECC	Department of Energy and Climate Change
DG	Decision Gates
OM	Duty Manager
DMI	Danish Meteorological Institute
DNV	Det Norske Veritas
DP	Dynamic Positioning
DSV	Drilling Supervisor
EC	European Commission
ECC	Emergency Coordination Centre (also referred to as ERG room)
EEl	Exclusive Economic lone
EHBS	Emergency Hydraulic Backup System
EIA	Environmental Impact Assessment
EMSA	European Maritime Safety Agency
EMG	Emergency Management Group
EMT	Emergency Management Team
ER	Emergency Response
ERC	Emergency Response Committee
ERG	Emergency Response Group
ERO	Emergency Response Officer
ERP	Emergency Response Plan
ERPr	Emergency Response Procedure
ERR	Emergency Response Room
ERRV	Emergency Rescue and Recovery Vessel
ERSC	Emergency Response Service Centre
FUR	Forward Looking Infrared Scanner
GCC	Greenland Contingency Committee
GIS	Geographic Information System
GOR	Gas Oil Ratio
GRN	Global Response Network
HE	Harsh Environment
HFO	Heavy Fuel Oil
HSE	Health Safety and Environment
HSEQ	Health Safety Environment and Quality
HSES	Health, Safety, Environment and Security
IADC	International Association of Drilling Contractors
IM	Ice Management
IMO	International Maritime Organization
IR	Infrared

IRT	Incident Response Team
ITOPF	International Tanker Owners Pollution Federation
km	Kilometre
LF	Lady Franklin
LTI	Lost Time Incident
LMRP	Lower Marine Riser Package
NCEP	National Centers for Environmental Prediction
NERI	National Environmental Research Institute
nm	Nautical Mile
NOAA	National Oceanic and Atmospheric Administration
MAH	Major Accident Hazards
MARPOL	International Convention for the Prevention of Pollution from Ships
MODU	Mobile Offshore Drilling Unit
MGO	Marine Gas Oil
MRCC	Marine Response and Coordination Centre
MSDS	Material Data Safety Sheet
MSRC	Marine Spill Response Corporation
MW	Mud Weight
MGS	Mud Gas Separator
NORSOK	Norsk Sokkels Konkuranseposisjon
NGO	Non-Governmental Organisation
OBM	Oil Based Mud
OILPOL	Oil Pollution Convention
OIM	Offshore Installation Manager
OPRC'90	Oil Prevention, Response and Cooperation Convention 1990
OSC	On Scene Commander
OSD	Offshore Safety Division
OSCP	Oil Spill Contingency ptan
OSPAR	Oslo / Paris Convention
[redacted]	
PPE	Personal Protective Equipment
ppg	pounds per gallon
PSV	Platform Supply Vessel
PVT	Pit Volume Totaliser
RAL	Royal Arctic Line
ROP	Rate of Penetration
ROV	Remove Operated Vehicle
SAR	Search and Rescue
SARa	Synthetic Aperture Radar
SEA	Strategic Environmental Assessment
SLAR	Side Looking Airborne Radar
SOPEP	Shipboard Oil Pollution Emergency Plan
rvDSS	True Vertical Depth Sub-Sea
UK	United Kingdom
UKCS	United Kingdom Continental Shelf
UNCLOS	United Nations Convention on the Law of the Sea
UNESCO	United Nations Education, Scientific and Cultural Organization
UV	Ultra Violet
UVF	Ultra Violet Fluorescence
WCE	Well Control Expert
WBM	Water Based Mud
W&DOP	Wells and Drilling Operations Policy

Associated Document List

Cairn Energy

Country Emergency Response Plan Ref: ED/GRI/CRP/ERP/10/2105
Greenland Drilling Emergency Contact list Ref: EF102062-Q1
Crisis Response Manual Ref: ED/HSE/PRO 1181
Compliance Register Ref: ED/GRL/HSE/CPL/11/2024
Waste Management Plan Ref: ED/GRL/HSE/WMP/11/2042
Well Control Bridging Document Ref: ED/GRL/DRL/BDG/11/2096
Corporate Responsibility Bridging Document Greenland Exploration Drilling Ref: ED/GRI/BRG/11/2073
Greenland Health Safety, Environment, Security and Corporate Responsibility Plan Ref: EDN/GRL/RSK/20/10/2070
Management of Change Procedures Ref: ED/GRL/HSE/MOC/10/2100
Capricorn HSE Audit Plan Ref: ED/GRL/HSE/AUD/11/2056
Health Safety Environment and Corporate Responsibility Management Plan Ref: EO GRL/RSK/20/10/2070)

C-Core 2011 Ice Condition Report for lady Franklin and Atammik Ref: R-10-Q62-007
Relief Well Plans (Napariaq, Eqqua, lady Franklin, Atammik) Ref: ED/GRI/DRI/RWP/11/2080
Relief Well Plan lady Franklin Ref: ED/GRI/DRL/RWP/11/2080/A
Marine Operations Manual Ref: ED/DRL/MOM/11/2182
Aviation Manual REF: ED/GRL/SCI/AOM/11/2010

Oil Spill Commissioning Report Phase I

Oil Spill Commissioning Report Phase"

Wells and Drilling Operations Policy' (Document No: ED/ENG/POL/10/2112)

External

- Admiral of Danish Fleet: Emergency Response Plan for National Danish Emergency Management in the combat of Pollution of the Sea by Oil and Other Harmful Substances Main Plan
- ASA project number ASA 11-002, March 2011
- ASA project number ASA 11-002: Addendum, July 2011
- Blowout (3D Oil Spill) Modeling, Baffin Bay, offshore Greenland.
- Boertmann, D., Mosbech, A., Schiedek, D. and Johansen, K. (eds) (2009) The eastern Baffin Bay. A preliminary strategic environmental impact assessment of hydrocarbon activities in the KANUMAS West area.
- Environmental Impact Assessment, Exploration Drilling Programme for Atammik Block, Offshore West Greenland March 2011 ERM Reference 0125335
- Environmental Impact Assessment, Exploration Drilling Programme for Eqqua Block, Offshore West Greenland March 2011 ERM Reference 0125335
- Environmental Impact Assessment, Exploration Drilling Programme for lady Franklin Block, Offshore West Greenland March 2011 ERM Reference 0125335
- Environmental Impact Assessment, Exploration Drilling Programme for Napariaq Block, Offshore West Greenland March 2011 ERM Reference 0125335
- Environmental Oil Spill SensitiVity Atlas for the West Greenland Coastal Zone, NERI Technical Report Ref no. 494, 2004.
- Mosbech, A (Ed) 2002: Potential Environmental Impacts of oil spills in Greenland. An assessment of Information Status and Research Needs.
- Mosbech, A., Boertmann, D. and Jespersen, M . (2007) Strategic Environmental Impact Assessment of hydrocarbon activities in the Disko West area.
- National Environmental Research Institute, Denmark. NERI Technical Report no 415

- National Environmental Research Institute, Technical Report no. 720, Aarhus University, Denmark.
- National Environmental Research Institute, University of Aarhus. 188 pp. - NERI technical resport no. 618.
- Oil Spill and Drilling Discharges Modelling at Attamic, Eqqua, Lady Franklin and Napariaq Blocks in Baffin Bay, Greenland.

Shipboard Oil Pollution Emergency Plan (CR-SOPEP) - Corcovado
Shipboard Oil Pollution Emergency Plan (LE-SOPEP) - Leiv Eiriksson

SOPEPs Field Vessels (Various)

OLF / NOFO Guide for Environmental Law Emergency Response Analysis Report 2007-0934
Maintenance Criticality Classification (CO-Pro/S17)
Temporary Equipment Program (CO-Pro 5-14)
High Risk Activity Programs (as part of Ocean Rig Safety Management System)
Permit to Work Program (CO-PRO/8-13)
Management of Change (CO-PRO 5-05,3-10,8-01,8-03)
HESQ Audits Program (CRO-PRO 8-05)
Safe Job Analysis and Assessment (CO-PRO/8-12)

Document Overview

This Oil Spill Prevention and Contingency Plan (OSCP) provides procedures and guidance for prevention, containment and response to oil spills for Capricorn Greenland Exploration 1 Limited (hereafter referred to as Capricorn, a fully owned subsidiary of Cairn Energy PLC) activities in Greenland operated assets during the 2011 drilling campaign. It is developed in accordance with *Greenland* requirements, Cairn Energy procedures and international best practice. It considers preventative, containment and response measures.

Capricorn intends to drill four exploration wells using two Mobile Offshore Drilling Units (MODU).. The proposed drill sites are located in lady Franklin, Atammik, Napariaq and Eqqua blocks. Drilling operations are scheduled to cease by the first October in Napariaq and Eqqua blocks and first December in lady Franklin and Atammik blocks. *See Operational Overview, Sedlon* 1.3.1 for more details.

This document provides information relevant to emergency response. It should be recognised that for large events initial emergency teams will modify as the event evolves and the central team and local teams will transform to more permanent project teams depending upon circumstance. This document sign-posts these elements and provides tactical information for longer-term response.

The objective of this document is to layout Capricorn activities relating to oil spill prevention and preparedness. It includes:

- Oil spill prevention measures in place within the assets and under anticipated operating conditions
- Outline well control, near well containment and capping capabilities
- Oil spill response actions, strategies and resources including
    - ⇒ Initial mobilisation of resources appropriate to deal with different oil spills
    - ⇒ Short-term management of an oil spill situation
    - ⇒ long-term strategy information for on-going project management of an oil spill

This OSCP is a 'live' document and will be maintained and updated in accordance with the actual conditions within and outside of Greenland that may impact on Capricorn's response capability. Any updates to the OSCP will be submitted to the Government of Greenland, Bureau of Minerals and Petroleum (BMP) and their auditors for further approval.

This document should be read in conjunction with the Capricorn Country Emergency Response Plan (ref ED/GRl/CRP/ERP/10/210S) and other associated documents as indicated throughout. There is no intention to repeat information captured in rig, vessel or shore or third party procedures. Reference will be made to such documentation as appropriate and summary information provided where it will enhance understanding for response personnel.

Use in an Emergency

In an oil spill refer directly to the following sections:

Section Number	Page	Information
1.6.1	67	Response Decision Flowchart
1.7	72	Response Options
2	98	Equipment Available
3.1	115	Alert procedure
3.3	119	Action Checklists

1. Prevention, Emergency Well Control and Response Strategy

1.1. Introduction

The overall strategy for control of oil consists of 3 principal elements namely:

1. Spill Prevention
   This is the most important element and most effective way of protecting the natural environment. It consists of planning; risk identification and assessment; and application of a variety of design hardware and procedural controls. Some of these controls are standard practice and others specific to this campaign. These include a dual rig drilling strategy.

2. Near Well Control
   The second line of defence is a number of options to restore control to the well.

3. Spill Response
   Three tiered oil spill response appropriate to spill size and severity. This consists of Tier 1 Local Equipment and Management Resources; Tier 2 National Equipment and Management Arrangements; and Tier 3 International Equipment and Management Arrangements.

1.2. Spill Prevention Planning

1.2.1. Planning

Risk Management is an integral part of any planning process within Capricorn, including spill prevention. It provides a framework for:

- systematic identification of the hazards, effects and impacts on people, critical equipment, the environment, assets and reputation;
- assessment of risks associated with identified hazards, effects and impacts;
- selection, evaluation and implementation of suitable control measures to eliminate, prevent, control or mitigate such risks, effects and impacts.

1.2.2. Safety Case

Safety Cases are conducted to show how and to provide assurance that a 'Duty Holder' (in this case Ocean Rig) identifies, assesses and manages the risk of Major Accident Hazards (MAHs) for an offshore installation or rig. All MAHs are assessed including among others: vessel impact; loss of structural integrity; loss of maritime integrity (loss of position); loss of process containment; fire and explosion; well; and emergency response. Duty Holders are required to demonstrate that risks are reduced to a level which is 'As Low As Reasonably Practicable' (ALARP). The Duty Holder must demonstrate competency and application of an appropriate management system.

Each rig has a certified Safety Case Assessment to UK HSE standards or an Acceptance of Compliance certificate (AoC) to Norwegian Petroleum Development standards. These are required under the approval to drill from the Government of Greenland prior to commencement of drilling.

1.2.3. Audits & Inspections

Audits and inspections of overall Capricorn activities form part of the monitoring and assurance program for the project as defined in the Health Safety Environment and Corporate Responsibility Management Plan (EO GRL/RSK/20/10/2070) and the Capricorn HSE Audit Plan (ED/GRL/HSE/AUD/11/20S6). Audits and inspections continue throughout the program and include but are not limited to rigs, vessels, supply bases, drilling approval compliance, wastes and chemicals. Weekly audits and daily inspections are conducted on rigs by Capricorn in conjunction with Ocean Rig personnel.

Ocean Rig has its own audit plan ('Ocean Rig Audit and Inspection Program 2011') which is run independently of Capricorn. In addition third party audits conducted by an independent verification organisation have been conducted in relation to Safety Case and the Ocean Rig Safety Management System prior to commencement of and during drilling.

Capricorn owned oil spill equipment has been commissioned and stored by an oil spill specialist to enable easy access and dispatch from temperature controlled store (refer to: Oil Spill Commissioning Report Phase I, Oil Spill Commissioning Report Phase 11). Details of equipment and storage arrangement are held by Capricorn by the Emergency Response Group. This OSCP has been audited by the Greenland Government.

1.3. Operational Control

This section outlines the operation conditions and controls in place to mitigate additional risk associated with these conditions.

1.3.1. Operational Overview

Capricorn plan to drill up to four exploration wells offshore West Greenland in 2011 in Eqqua, Napariaq, Lady Franklin, and Atammik blocks. The approved drilling window limits are stated in the drilling approval are:

Block	Complete before
Napariaq Eqqua	1 October 2011
Lady Franklin Atammik	1 December 2011

Table ***1*** indicates the likely well locations and these with other potential locations are displayed in *Figure* 1. The offshore operations will take place over this period using the MODU's: the *Corcovado* (drillship) and *Leiv Eiriksson* (semi submersible rig). Detailed drilling plans have been submitted to the Government of Greenland and approved as part of the drilling application process.

Table 1 Drilling Plan

Well	Block	Location	Water Depth (mTVDSS)	Distance to shore (nm)	Distance to median line (nm)	Details (subject to change)
Gamma - B	Eqqua	69.444893 N 59.967847 W	1520	103	18	Rig: *Corcovado* August to September
Delta-A	Napariaq	71.306817 N 58.6637W	293	61	65	Rig: *Leiv Eiriksson* July to September
LF7-C	Lady Franklin	64.000912 N 57.662238 W	1002 +/- 10	145	5	Rig: *Corcovado* June to August
AT7-A	Atammik	64.742519 N 55.708565 W	909	82	52	Rig: *Leiv Eiriksson* June to July; October

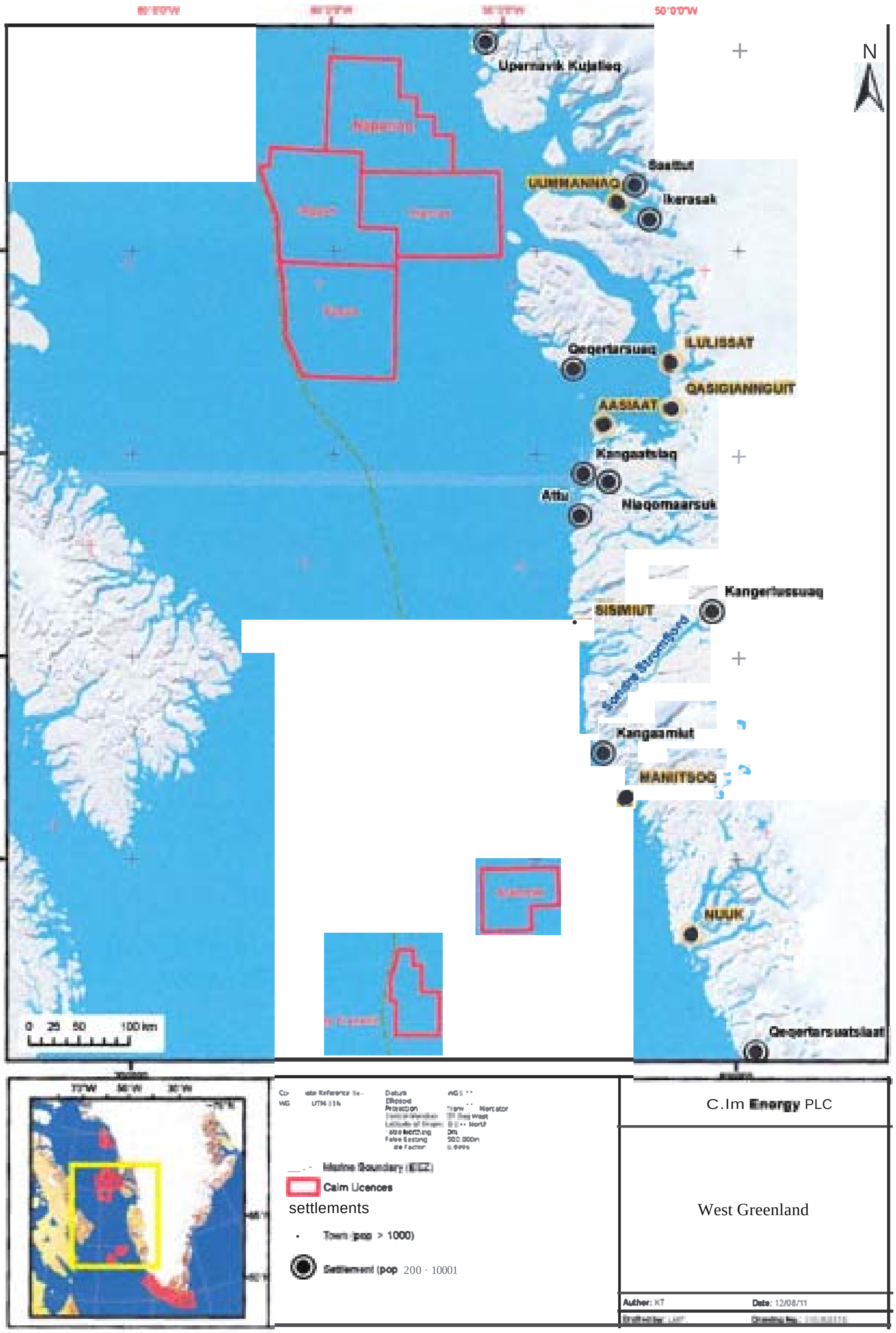

Figure 1 Locations of 2011 Well Sites

In order to support the MODU"s logistics support is required from shore. Shore bases will be operational based on the period of time rigs are to be located in the northern and southerly blocks including mobilisation and demobilisation. This will ensure full contingency support over the period of drilling activities. The usual operation logistics bases are summarised in *Table 2:*

Table 2 Loglstlcal Bases

Logistical Base	Facilities
	Onshore base, consisting of: • Material storage / laydown area • Loading and unloading facilities for vessels, including limited waste receipt transfer • Handling and transport of materials to / from other facilities • Storage of shoreline containment and recovery oil spill response equipment • Potable water / domestic water streams • Storage facility for fuel oil / diesel
	Local accommodation and ware/accommodation vessel moored in harbour that will store shoreline oil spill response equipment, can provide contingency accommodation for up to SO people and store / handle materials.
	Airport (coordinated through Air Greenland) for crew changes and SAR (SAR will be coordinated through Cougar Helicopters), providing: • Reception of flights from Kangerlussuaq • Helicopter flights to transfer offshore personnel • Storage of dispersant and helibuckets
[redacted]	Search and rescue (SAR) helicopter to be based and serviced in JIlulissat. During Eqqua/ Napariaq block drilling activities crew change helicopters to be based and serviced in Ilullisaat.
[redacted] (During ● ● activities only)	Onshore base, consisting of: • Material storage / laydown area • Loading and unloading facilities for supply boats, including limited waste receipt transfer • Handling and transport of materials to / from other facilities • Potable water / domestic water streams
	Airport (coordinated through Air Greenland), providing: • Reception of flights from Kangerlussuaq • Helicopter flights transferring offshore personnel • Storage of dispersant and helibuckets

In support of the logistical bases there are a number of vessels with defined purposes for supply, emergency response and ice management, summarised below. These vessels are subject to change throughout the drilling period, and the fleet will be expanded as required.

Table 3 Support Vessels

Vessel Name	Role
[redacted]	Ice Management (IM)
[redacted]	Emergency Response and Rescue Vessel (ERRV)
[redacted]	ERRV
[redacted]	IM
[redacted]	IM
[redacted]	IM / ERRV
[redacted]	IM / ERRV
[redacted]	IM /ERRV
[redacted]	Platform Supply Vessel (PSV)
[redacted]	PSV
[redacted]	PSV
[redacted]	Multipurpose

1.3.2. Existing Oils and Expected Oils

Oil Inventory

From an operational perspective a number of fuels and oils will be used and managed during the campaign. *Appendix* 2-0 lists the oils and their maximum anticipated volumes that are present as a result of the exploration drilling operations. No heavy oils will be present as a result of normal operations, with all in-field vessels running on marine gas oil (MGO) or other low sulphur fuel in accordance with the drilling approval.

Oil Properties

Initial exploratory drilling is an early stage in the oil and gas cycle and in the offshore Greenland exploration campaign the nature of any potential find is subject to uncertainty. This means that the exact nature of crude oil properties are not yet known. A range of oils (or gas) are possible, lighter oils such as condensate which evaporates very quickly through to heavy oils which have low mobility and do not readily evaporate.

The International Tanker Owners Pollution Federation (ITOPF) classifies oil into 4 groups based on their specific gravity. These groups of oils are represented in the following graph to ascertain the estimated average behaviour in the marine environment (temperate conditions) for each group. For the purposes of this OSCP, recommendations on oil spill response resources and strategies assume that the oil identified is of a persistent nature and will emulsify as it weathers. This is consistent with a group 3 oil. Typically crude oils will fall into group 2 or group 3.

ITOPF (2002)[1] classification of oil according to their specific graVity:

- Group 1 <0.8 (°API > 45)
- Group 2 0.8 - 0.85 (°API 35 - 45)
- Group 3 0.85 - 0.95 (°API 17.5 - 35)
- Group 4 >0.95 (°API < 17.5)

1 Source: Fate of Marine Oil Spills, ITOPF Technical Information Paper (2002)

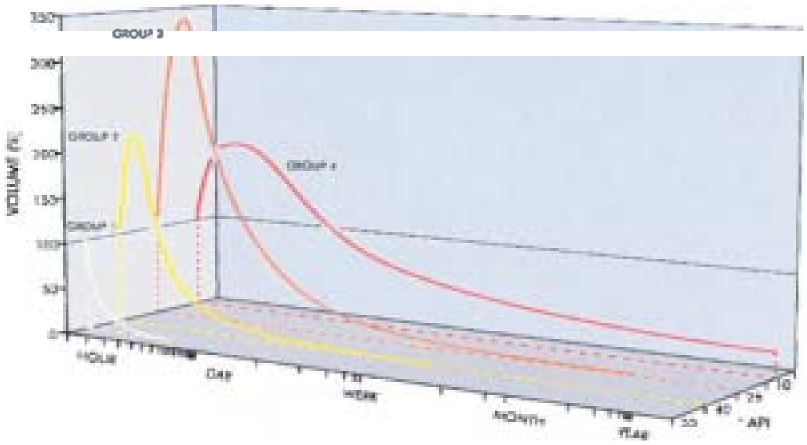

Figure 2 ITOPF Group Classification of Oil

The curves represent an estimated 'average' behaviour for each group. The behaviour of a particular crude oil may differ from the general pattern depending on its properties and environmental conditions at the time of the spill. In *Figure* 2 the volume of oil and water-In-oil emulsion remaining on the sea surface is shown as a percentage of the original spill volume (100%).

I1 drilling is successful, oil testing to ascertain its properties will be conducted once the reservoir oil can be sampled. See Oil Spill Sampling, Section 1.7.1.

The other oils that will be used in Capricorn's operations in Greenland consist of Diesel, Marine Gas Oil (MG0[2]) and utility oils, a summary of their properties and likely behaviour when spilled is discussed below.

MGO

MGO is a low viscosity distillate fuel and contains a significant proportion of light-ends which means that evaporation will be an important process contributing to the reduction in mass balance. The specific gravity of diesel is typically in the range of 0.802 - 0.844 (API 35 - 45), viscosity 4 cst/50°C and pour point -36°C. Diesel and MGO will spread rapidly on water and should evaporate within a few days upon release onto the sea surface. Evaporation can be enhanced by higher wind speeds, warmer water and air temperatures. A small percentage may also dissolve.

Utility Oils

Lubricating oils are medium to heavy oils and relatively persistent. They vary in viscosity but generally have a high capacity to take up water. Consequently, emulsification of these oils can be very rapid at sea and the resulting emulsions can be highly stable. Hydraulic oil is relatively viscous and is not easily assimilated by the environment. Umited spread and minimal loss through evaporation and natural dispersion would occur. The action of mixing energy is likely to produce a frothy emulsion.

1.3.3. Operating Conditions

This section describes the important physical and biological aspects of the west Greenlandic environment and the associated environmental and socioeconomic sensitivities. The primary operating conditions that may impact Capricorn activities are summarised below as are the environmental sensitivities of Greenland. Reference can be made to various documents to supplement this information

2 Diesel is a fuel grade of MGO

including . DMI weather and current reports; Greenland Environmental Sensitivity Atlases (see Appendix III) and the Environmental Impact Assessments for each block.

Metocean Conditions

Ice and Meteorology

During operations the meteorological conditions in the Baffin Bay area tend to be reasonably stable (see Table 4). Visibility is reduced by the occurrence of fog (and occasionally snow), with advection fog occurring most frequently in the summer months. The median wave height for the area over the over the summer period is less than one meter, while in the autumn maximum wave heights of 5 to 7 meters can occur. Significant fog can be expected in Baffin Bay beginning in May and peaking in June and July. In this peak period the percentage of time that visibility is less than 0.5 nautical miles is estimated to be 20%- 30%.

Table 4 Wind and wave data (most frequent values) In Baff1n Bay area

Month	Wind Speed *(m/s)*	Wind Direction (wind from)	Wave Height (m)	Wave Direction (current from)
June	4-5	N	0.0-0.5	SE
July	4-5	N	0.5-1.0	S
August	4-5	S	0.5-1.0	S
September	4-5	N	0.5-1.0	S/NW
October	5-6	N	1.0-1.5	NW
November	6-7	NW	1.0-1.5	N
December	6-7	NW	0.5-1.0	N

In summer, temperatures close to the sea surface will deviate little from those of the seawater, see *Table* 5. Freezing temperatures may occur over sea ice and / or within fog. In winter, very low temperatures occur over snow covered areas due to radiation cooling surface. Over open water air temperatures are normally below those of the sea surface due to advection of cold air. In the coastal zone temperatures may reach IS·C or more in summer and, under foehn[3] conditions, even in winter.

Table 5 Temperature summary in Baftin Bay for the drilling period

	sea Surface Temperature	Air Temperature
Max	S·C	4-S·C
Min	-6·C	-20·C

In the winter period a relatively deep low-pressure region (the polar convergence zone) centred between Iceland and the southern tip of Greenland forms and this largely determines the winter winds. The winds off west Greenland flow in a south easterly direction. Short-term storms, which occur mostly in autumn and winter, influence winds and waves in the area and Sea ice is normally present throughout northern West Greenland from January to May. Inside fjords, fast ice may form from October (depending on latitude), with the ice cover peaking in March. Generally freeze-up begins at the inner parts of the fjords in November or December, but ice formation can be significantly affected by

[3] foehn wind or föhn wind is a type of dry down-slope wind which occurs in the lee of a mountain range.

very low temperatures or a formed ice cover can be reduced by very strong winds in the fjords throughout the winter. large local differences are seen. Strong winds frequently occur along the shorelines, resulting in a local break up of fast ice.

Iceberg distributions within the area vary from year to year. Historic data, and that from a Capricorn sponsored field program conducted by   indicate that June and July have the highest concentration of icebergs, however monitoring and management of icebergs will be required throughout the whole program.

Icebergs originating from glaciers occur throughout the region. Iceberg density is highest in Disko Bay and Uummannaq Fjord where large and very productive glaciers are located. Ice extent varies year to year. The primary source of icebergs in the operations area is the I/Iulissat glacial system which is calving ice into Disko Bay at a rate of 35 cubic kilometres annually. *Figure* 3 shows a Google earth image of Disko Bay and the general iceberg drift around Baffin Bay and the Davis Strait.

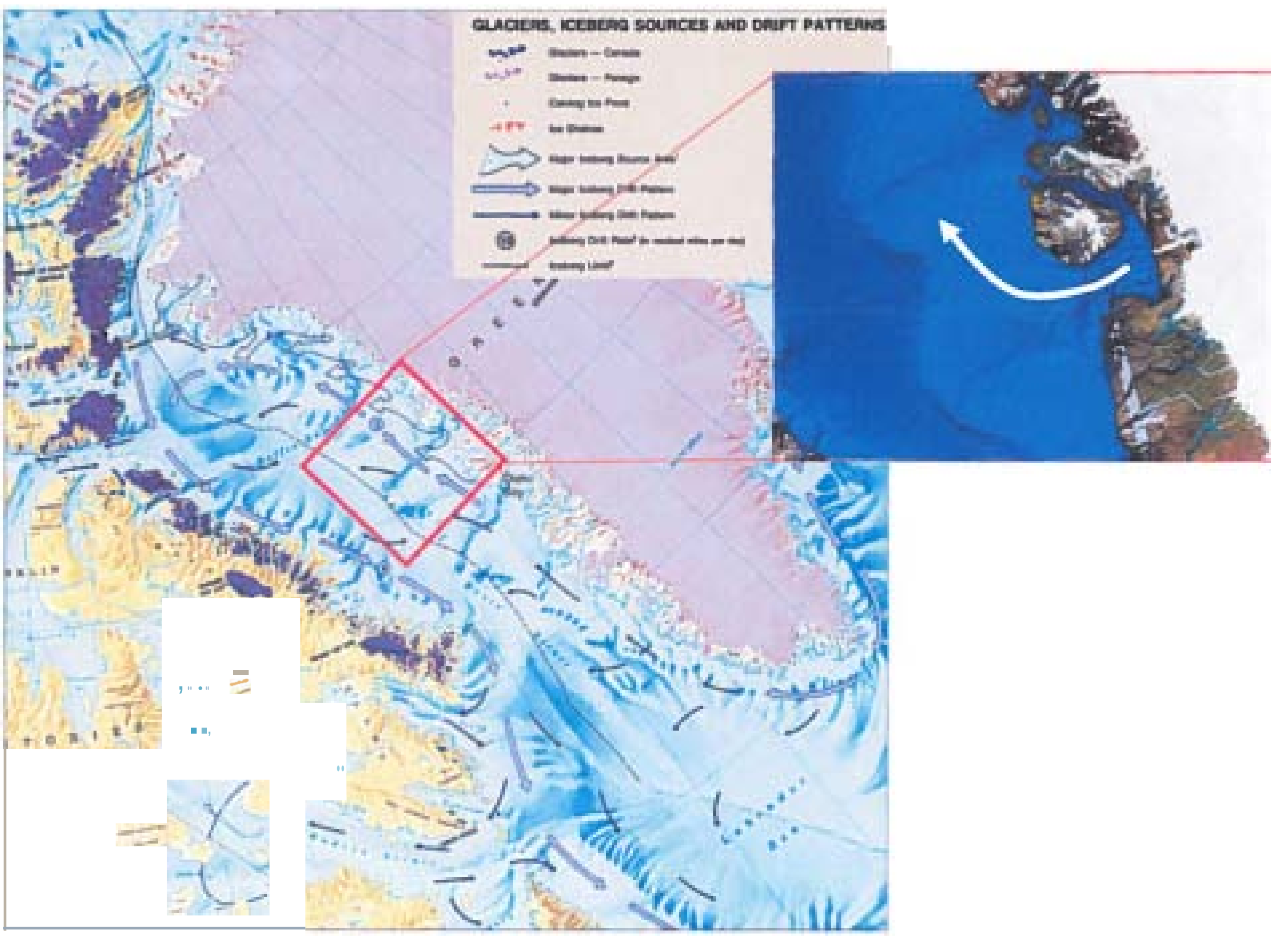

Figure 3 Dl5ko Bay and general iceberg drift pattern54

Pack ice occurs between December and May with March/April being the time that pack ice is at its maximum coverage. The rate of ice formation is directly related to the winter air temperature: The colder the winter the thicker the ice, while the extent of coverage is related to the wind patterns.

4 Direction and speed of the 50 m depth ocean current from the C-NOOFS ocean circulation model

Reoccurring northerly winds spread the pack over a greater area, while westerly winds push the pack towards the shores of the Greenland.

The area off Disko Island on the west coast of Greenland lies in the Marginal Ice Zone as it is located near the edge of the yearly pack ice coverage. As a result, pack ice encroachment is generally loose coverage (at most 4 - 6 tenths), and mostly classified as first year ice (70 cm - 150 cm) in ice small floes (20-100 m diameter). An exception is towards the end of the season when there may be the presence of thick first year ice or ratted first year ice. In addition, over the winter it is not uncommon to see ice floes classified as big or larger.

Icing of structures and substructures, and above the waterline on support vessels may occur from October to December if the air temperature drops below -3°C and the wind exceeds 17 knots. Normally, icing is generated from sea spray although freezing precipitation can also cause it. Ice management procedures and equipment have been developed for each of the Ice Management (IM) vessels.

Currents

The current regime off the west coast of Greenland is dominated by the northward flowing, relatively warm, West Greenland current, see *Figure* 4. However, within this there are complex eddies and counter currents caused by the outflow of cold water from the numerous glaciers and bottom topography. This current brings water northward along the West Greenland coast. On its way, water is diluted by run-off water from the various fjord systems. The East Greenland current component loses its momentum on the way northward and at the latitude of Fylla Bank it turns westward towards Canada where it joins the Labrador current. West of and below the Polar water of the East Greenland current, another water component is found, originating from the Irminger Sea and the North Atlantic current. This relatively warm and salty water can be traced all the way along west Greenland from Cape Farewell (south Greenland) to Thule (Avanersuaq).

Figure 4 Surface Current Patterns in the waters off West Greenland[5]

5 Brian Petrie, Bedford Institute of Oceanography, Environmental Impact Assessment, ERM, 2011

1.3.4. Operating Procedures

Capricorn applies a number of well established operating control procedures applying as best industry practice. However, given the nature of the Greenlandic environment extra operating procedures are in-place. These are outlined below.

1.3.4.1 Capricorn Procedures

Capricorn applies the Cairn Energy PLC Corporate Responsibility Management System administered through a variety of specific Capricorn Greenland Procedures these include, but are not limited to:

- Greenland Health, Safety, Environmental and Corporate Responsibility Plan (ED/GRL/RSK/20/10/2070)
- Corporate Responsibility Bridging Document Greenland Exploration Drilling (ED/GRI/BRG/Il/2073)
- Marine Operations Manual (ED/DRI/MOM/11/2182)
- Aviation Manual (ED/GRL/SCI/AOM/Il/2010)
- Well Control Bridging Document (ED/GRL/DRI/BDG/Il/2096)
- Relief Well Plans (ED/GRI/DRL/RWP/Il/2080)
- Management of Change Procedures (ED/GRL/HSE/MOC/10/2100)
- Country Emergency Response Plan (ED/GRL/CRP/ERP/10/2105)
- Oil Spill Contingency Plan (ED/GRL/RSK/29/10/2071)
- Waste Management Plan (ED/GRL/HSE/WMP/Il/2042)

These documents layout responsibilities and control measures in these specific areas. Bridging documents highlight responsibilities across the interface between Capricorn and the primary contractor Ocean Rig. Bridging documents are signed off by both parties as recognition of understanding and acceptance.

1.3.4.2 Ocean Rig Procedures

Ocean Rig has its own procedures and work instructions commensurate with their responsibilities as an operation drilling installation and in accordance with their Safety Case. These define the reqUired actions to maintain mechanisms to maintain integrity and prevent loss of containment. Ultimate control of the safety of each rig rests with the Offshore Installation Manager (OIM) who will terminate operations considered unsafe.

Accordingly there are a number of pertinent procedures which include but are not limited to:

- Maintenance Criticality Classification (CO-Pro/517)
- Temporary Equipment Program (CO-Pro 5-14)
- High Risk Activity Programs (as part of Ocean Rig Safety Management System)
- Permit to Work Program (CO-PRO/8-13)
- Management of Change (CO-PRO 5-05, 3-10, 8-01, 8-03)
- HESQ Audits Program (CRO-PRO 8-05)
- Safe Job Analysis and Assessment (CO-PRO/8-12)

1.3.4.3 Ice Management

Given the risk presented by ice in Greenland waters, this section provides a high level outline of the ice management policies and procedures required to support offshore operations. It covers operating in either anchored or dynamic positioning (DP) mode. Ice management is a routine activity in this drilling campaign in that it is considered part of normal offshore operations off the coast of Greenland. Should ice pose a direct risk to company equipment, personnel or the environment the ERG will be mobilised as per the procedures set out in the Country Emergency Response Plan (Ref: ED/GRI/CRP/ERP/10/210S). In an emergency response situation these ice management processes become an integrated part of the Capricorn emergency response system.

Four sites are planned for 2011 exploration drilling, as described in the *Operational OVerview, section* 1.3.1. Two are in Napariaq/Eqqua and one in each of the lady Franklin (IF) and Atammik blocks to the South

Depending on the rig schedule there is potentially a greater than 400 nm separation between the most northern (Napariaq) and southern rig sites (IF, Atammik). Consequently ice management operations will be conducted in regard to each rig site individually to ensure the separation distance will not pose any issues.

Icebergs

Icebergs are produced from a number of glaciers along the Greenland coast. In western Greenland, Disko Bay and areas to the north are the primary calving grounds producing icebergs of various shapes and sizes.

Sea Ice

Pack ice occurs between December and May with March/April generally being the period of maximum coverage. The area off Disko Island on the north-west coast of Greenland (Eqqua) lies in the Marginal Ice Zone - ie it is located near the edge of the yearly pack ice coverage.

As a result, pack ice encroachment is generally loose coverage (at most 4 - 6 tenths), and mostly classified as first year ice (70 cm - 150 cm) in ice small floes (20 - 100 m diameter). An exception is towards the end of the season when there may be the presence of thick first year ice or rafted first year ice.

The drilling window when drilling operations can occur has taken into account the likely timings of returning ice. It allows enough time for the drilling of a relief well from the end of operations until the time when ice normally returns.

While Multi-year ice flows can be found on the eastern side of Baffin Island, due to the current circulation no multi-year ice is present off West Greenland.

Ice Detection

Sigma Six marine radar is employed to enable early detection of icebergs in conjunction with patrol sweeps by the Ice Management (IM) vessels and the Emergency Rescue and Recovery Vessel (ERRV). The dedicated IM team on each MODU monitors both visually and by radar for any small ice that may have escaped detection by other means.

Detection activities include the following:

- Drilling Unit and all support vessels maintain a radar watch to provide close range detection of 'bergy bits' and 'growlers' (small icebergs) as well as pack ice.
- IM support vessels conduct ice reconnaissance sweeps at different radii from the drilling unit and provide this data to the onboard rig IM team to track, co-ordinate and manage any ice risks.

- Long, medium, and short-range aerial reconnaissance will be provided as required by other vessels and by air support if necessary. The results are downlinked in near real time to the Drilling Unit.
- Special helicopter reconnaissance will be conducted as and when required.

Visual Detection

Visual detection of icebergs is dependent on the observer's height above the ocean, the prevailing visibility and the size of the iceberg. Large icebergs can usually be seen on a clear day at a distance of 18 miles. But with low-lying haze around the top of the iceberg this distance is reduced to 9 - 11 miles. In light rain, drizzle or fog this is further reduced requiring extra reconnaissance sweeps by the IM vessels.

Radar Detection

Radar detection is one of the main primary methods of tracking and managing icebergs and ice. This is co-ordinated by the dedicated IM support team aboard each drilling unit. The IM Team leader in conjunction with the Offshore Installation Manager (aiM) and Drilling Supervisor (DSV) will deploy vessel and aircraft resources as required to track, move and manage any ice threats.

As required dedicated vessel sweep patterns are implemented in relation to prevailing weather conditions. This is supplemented as required by aerial reconnaissance sweeps.

Monitoring and Tracking

Once ice has been detected within the management zone, the tracking phase commences.

Monitoring and tracking will requires the iceberg's position to be updated at a period commensurate with its threat. It is preferred to have updated positions at a minimum frequency of every 3 hours. All medium and large icebergs are profiled and the above-water portion measured. This data is collated and managed by the dedicated IM team on each rig.

Equipment

The folloWing equipment is in place for ice management:

Offshore Drilling Unit Equipment

A copy of the Capricorn Ice Management Plan
This provides a detailed outline of the standards, procedures and processes to be followed for ice management on all Capricorn prospects Ref: ED/GRI/DRI/IMP/Il/2209

Marine Radar
The Drilling Unit is equipped with two marine radar systems, one in the X-Band the other in the S-Band. To provide the maximum detection coverage the antennae is mounted as high above sea level as is practical. Detection of icebergs larger than 'bergy bits' or 'growlers' can be achieved out to a maximum of 15 nautical miles under most normal sea conditions.

Environmental Instrumentation
The MODU is equipped with a variety of environmental sensors including, but not limited to:

- Current meter, which provides a continuous display of surface and/or subsurface currents.
- Anemometer, which provides a continuous display of wind speed and direction.
- Wave-rider buoy, which provides a continuous display of wave height (and possibly direction).

Ice Data Network System

Supplied by the ice management contractor, this system is capable of logging and plotting all ice data, provide plots of past, present and forecast ice drift, calculating individual iceberg status and operational ice status as defined in the ice management plan. The system has a hard copy function to ensure data integrity in case of equipment malfunction and is accessible from any PC on the network.

The system is capable of digital communications with the shore base Ice Centre via the satellite network.

Manual logs and Plotting Equipment

The MODU is equipped with various logs, plotting sheets and charts in the event of computer malfunction. All logs are in a common format designed to be relayed easily via radio in the event of a network failure.

Offshore Ice Support Vessel Equipment

A copy of the Capricorn Ice Management Plan

This provides a detailed outline of the standards, procedures and processes to be followed for ice management on all Capricorn prospects Ref: ED/GRL/DRL/IMP/Il/2209

Iceberg Tow Equipment

All dedicated ice support vessels are equipped with iceberg towing equipment. The following is a list of the minimum equipment on each ice management vessel:

1 x 80 m X 5 m Growler Tow Rope
1 x 300 m x 30 m Iceberg Net
2 Drums complete with Tow Rope
2 Drums complete with Tow Rope and Float Belt
Iceberg Measurement Camera and Software
Skid complete with power pack, crane and rope reel (21 tonnes)[6]
Iceberg net reel (6 tonnes) [6]

Satellite Imaging

Synthetic Aperture Radar (SAR) satellite images is provided from RADARSAT 1 & 2 and Envisat and others as required to supplement terrestrial observation and tracking systems.

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6 This is present on most, but not all the ice management vessels

Ice Operations Procedures

There are a series of zones around the drilling unit that dictate actions to be taken to ensure the safety of personnel, equipment, and the environment. The following describes the iceberg zones starting at the drilling unit.

Zone 1	Ice Alert	Safety Buffer - Quick Departure
Zone 2	Reaction	Orderly Departure of drilling unit from well site.
Zone 3	Ice Monitoring	Tracking and Management

Zone 1 - Ice Alert

The radius of Zone 1 is the greater of 500 meters or one-hour's ice drift from the drilling unit. If threatening ice enters this zone, the drilling unit must be capable of moving off location in the time available and in accordance with the collision avoidance procedures.

Zone 2 - Reaction

This is a variable size zone that links the approach speed of the ice with the time required for the drilling unit to suspend its current operations, make safe the well and become mobile. Zone 2 is expressed in nautical miles as:

DsxT-Time

Where:

Os = The drift speed of the approaching ice in knots.
The drift speed can be variable over a period of time. The drift assigned will be based on the observations, weather forecasts, past experience, ice computer forecast and professional judgment of Ice Specialists and supervisory personnel aboard the drilling unit.

T-Time= The Total Time required to suspend operations, secure the well and prepare the drilling unit to move off location. This time is determined and updated continually by the Senior Drilling Manager in consultation with the aiM.

Zone 3 - Ice Monitoring

This zone extends outside Zone 2. This zone has no fixed width. All ice in Zone 3 will be monitored and assessed. Any ice that is deemed to pose a risk to the operation will be managed by towing/deflecting or other management techniques.

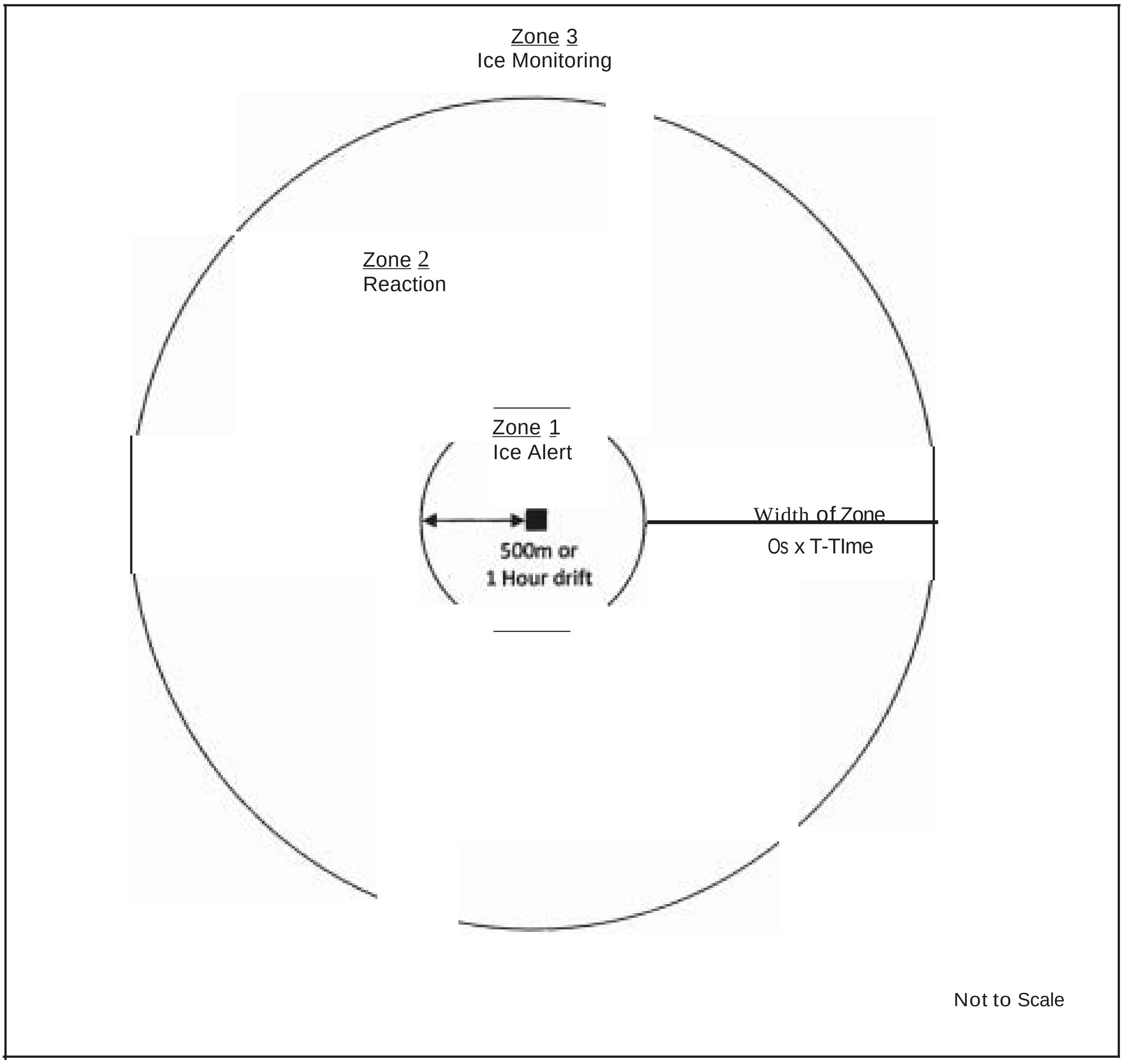


Figure 5: Ice Zone Diagram

Iceberg Characterization & Reporting Standards

Glacial ice is formed from the accumulation of snow, which has gradually changed form as it is compressed into a solid mass of large granular ice. This process produces a structure quite different from pack ice. The principal origins of the icebergs in Northern waters are the 100 tidewater glaciers of West Greenland. Between 10,000 and 15,000 icebergs are calved each year, primarily from 20 major glaciers between the Jacobshaven and Humbolt gladers. These glaciers account for 85% of the northern iceberg production. The remaining 10% come from the East Greenland glaciers and 5% from the glaciers and ice shelves of Ellesmere Island.

1. Iceberg Shape

One way to describe icebergs is by their above-water shape. One of six different shapes is assigned to an iceberg for reporting purposes. While no iceberg will fit the shape description exactly, most will generally be able to fit into one of these categories.

Tabular
Flat-topped iceberg with vertical sides. They are usually very stable and easy to tow. However, in mass they are among the largest icebergs.
Length- height ratio greater than 5:1
Shape factor for mass calculations 0.5

Pinnacle
Large central spine or pyramid, or one or more spines dominate the shape. Usually fairly easy to tow, they are one of the most picturesque types of icebergs.
Shape Factor for mass calculations 0.25

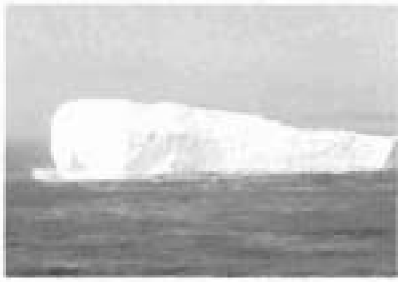
Dry-Dock
Eroded such that a large U-shaped slot is formed with twin columns or pinnacles. Slots extend into the iceberg or close to the water. They can present problems for towing depending on their size.
Shape factor for mass calculations 0.15

Wedge
As its name indicates, it has a wedge shape with one side usually at sea level. This makes it a very difficult iceberg to keep a towline attached.
Shape factor for mass calculations 0.25

Dome

Smooth rounded iceberg. Extremely difficult iceberg to tow.

Shape Factor for mass calculations 0.41

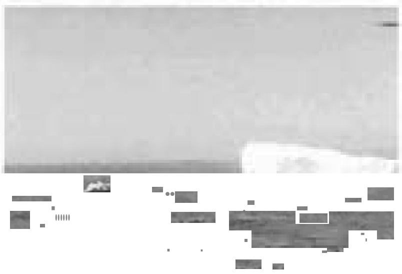


Blocky

A block-like shape, tall iceberg with vertical sides, similar to a tabular, but much higher.

Length-height ratio 3:1 to 5:1

Shape Factor for mass calculations 0.50



Note: All icebergs with the exception of 'bergy bits' and 'growlers' must have a shape description. The shape gives a good indication of an iceberg's tow-ability and is a factor in calculation its mass. The shape of an iceberg also has an effect on its movement, as higher "sail" icebergs are more susceptible to wind driven movement. These considerations are included in T time calculations.

2. Iceberg Size

Icebergs also will be reported by size. All icebergs will fall into one of the six size categories below.

Table 6 Iceberg Size[7]

Category	Height (m)	Length (m)	Approx. Mass (T)
Very Large	> 75	>200	<10 Million
Large	46 -75	121- 200	1 - 10 Million
Medium	16 - 45	61 - 120	100,000 - 1 Million
Small	5 -15	15 - 60	100,000
Bergy Bit	1.0 - 5	5 - 15	< 5,000
Growler	< 1.0	<5	< 100

7 CIS (2002) MANICE - Manual of Standard Procedures for Observing and Reporting Ice Conditions. Canadian Ice Service, Environment Canada. Ninth edition, April 2002

Iceberg Draft Calculation

The draft of an iceberg can be estimated from the iceberg's maximum waterline length using the following Hotzel & Miller formula[8]:

$$D = 3.781 \times L0.63$$

where D = Draft (m)

l = Length (m)

For ease of use this is displayed graphically on the following page.

Pack Ice

Operations in loose pack ice present very few problems. The larger of the small floes are broken easily using ice support vessels while the small pieces of thick or rafted ice can be treated with the same ice management techniques used for bergy bits and growlers.

Pack ice concentration is expressed in tenths of coverage and describes the mean aerial observed density of ice floes for a given area.

Table 7 Pack Ice Coverage

Coverage In IOths	Oasslficatlon	Description
1/10 and below	Open Water	A large area offreely navigable water.
1/10 - 3/10	Very open pack	An area where water predominates over ice.
4/10 - 6/10	Open pack	Areas of almost equal coverage of ice and water; floes are generally not in contact with each other.
7/10 - 8/10	Close pack	Pack composed mostly of floes in contact with each other.
9/10 - 10/10	Very close pack	little or no visible water.

Pack Ice Development

Pack ice age is classified by four stages of development. Within these are found several different types of ice. The following describes pack ice development.

New Ice

New ice is recently formed, very thin ice, usually seen after a cold calm night. New ice is composed of small ice crystals weakly frozen together. It has no measurable thickness and is dispersed as soon as any wind or sea action works on it.

New ice is composed of the ice types:

- Grease Ice: Ice crystals coagulated into a soupy layer on the surface.
- Shuga: An accumulation of white spongy ice lumps a few centimeters across
- Nilas: A thin elastic crust of ice, under 5 cm thick. It has patterns of interlocking fingers, usually dark grey in colour.

8 Hotzel, S. and Miller, J. (1985) Relationships between measured iceberg dimensions. In *Workshop On Ice Scouring*, Editor G.R. Pilkington, National Research Council of canada Technical Memorandum No.136. pp.1l4-129

Young Ice

Ice in the transition stage between new ice and white ice, 10 - 30 cm in thickness. Young ice is subdivided into grey ice and grey-white ice.

- Grey Ice: Young ice 10 - 15 cm in thickness, usually light grey in colour and elastic enough to break in a swell. Grey ice usually rafts if under pressure. Found in small floes with straight edges.
- Grey-White: Young ice 15 - 30 cm in thickness. Colour is usually light grey with traces of white around the edges. It is *too* thick to break in a swell. Grey ice will ridge under pressure. Commonly found in ice cakes along the edge of the pack or as small floes with rounded edges in the pack.

First Year Ice

Sea ice of not more than one year's growth, developing from young ice, 30cm - 150cm in thickness. Also referred to as white ice, first year ice is subdivided into three types.

- Thin First Year: First year ice 30-70 cm in thickness, white in colour with no traces of grey. Usually found as triangular shaped ice cakes or brash along the leading edge of the pack and as small floes Inside the pack.
- Medium First Year: First year ice 70-120 cm in thickness, white in colour with visible thickness above the water. Usually found as triangular shaped ice cakes of small floes along the leading edge of the pack and as small and medium floes inside the pack.
- Thick First Year: First year ice over 120 cm in thickness. Visual characteristics are similar to medium first year but the surface is usually not smooth, showing signs of extreme weathering.

Old ice

By definition sea ice that has survived at least one summer's melt. Subdivided into two types:

- Second Year Ice: Has a blue-green colour. Rafted first year ice is sometimes mistaken for old ice.
- Multi-Year Ice: Dark blue in colour and up to 3m in thickness. By late season as the pack recedes there is often a reasonable amount of rafted first year ice ahead of the main pack edge. This lee is often mistaken for Multi-year ice. However, rafted first year ice is much weaker than true multi-year ice.

1.4. Dual Rig Well Control & Relief Well Planning

<u>Ocean Rig Corcovado and lelv Elrlksson</u>

1.4.1. Exploration Project Governance:

The quality control and safety assurance of Cairn Energy's Greenland's 2011 exploration campaign well programme is of primary importance. Cairn consequently utilizes a Project Gate Process for the oversight and quality assurance of the overall Exploration Drilling Project. Capricorn is a wholly owned subsidiary of Cairn Energy and consequently implements and complies with all Cairn Energy Governance programmes, policies and standards.

The Cairn Gated Process (CGP) prOVides the overall framework for project management and principal assurance. This provides a formal documented process for systematic appraisal and decision-making forthe project to proceed from one project phase to the next. The CGP is a key pillar of the Cairn business investment process, providing a structured and integrated approach to analysis of Project options, project selection, capital efficiency, risk reduction, value optimization and asset monetisation. As such, the CGP process is applied to the planning and execution of all Drilling Projects.

The main aims of the CGP are to ensure that:

- Risks have been rigorously and regularly assessed
- Robust effective mitigation measures are fully established
- The business case is regularly reviewed and remains robust
- A conscious decision is taken to continue or stop the work process at each gate
- Risk, budget and project plans for the next stage are visible, controlled and approved prior to moving from one stage to the next
- The required definition and assurance checks have been carried out in prior stages
- A clear and robust execution strategy is fully developed and applied

The CGP has defined Decision Gates (DG) at the end of each project phase. At these gates the Gatekeeper independently assures that the defined deliverables have been produced and thereby confirm that the project is ready to move into the next stage. The DG's provide a clear framework and timeline for Management interventions, support effective early decision making and enable effective capital planning. The CGP is a six stage process as illustrated by the figure below.

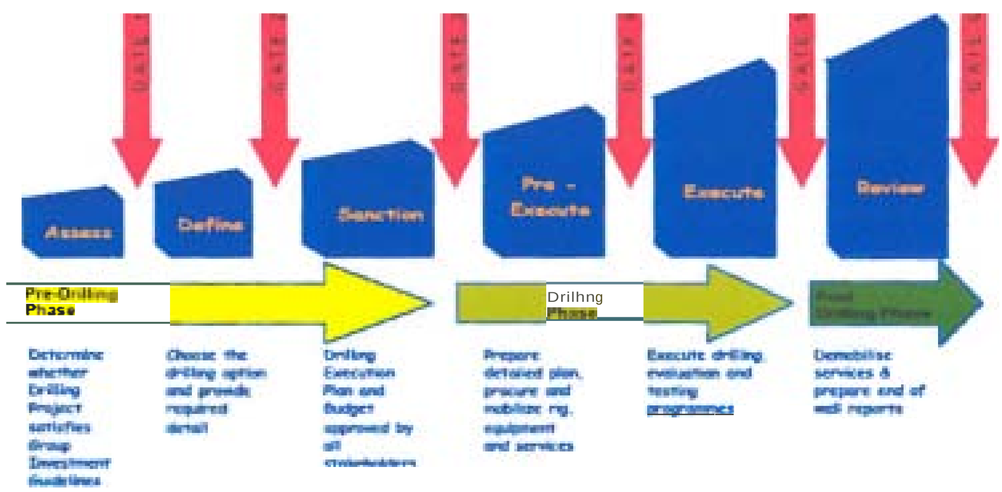


Figure 6 Cairn Gated Process

Specific deliverables and target gate passage dates are developed for each stage of the Greenland 2011 Drilling Programme. The Greenland Head of Assets is the Gatekeeper for the Exploration Drilling

Programme. Any amendments to the Project's deliverables are subject to the review and approval of the Gatekeeper and the Project Board.

Passage through each gate requires the submission by the Greenland Drilling Project Manager of a *"Gate Close-out Report",* with any requests for conditional approval of incomplete deliverables, accompanied by a detailed justification and mitigation action plan. This *"Project Gate Action Plan"* requires the review and approval of the Gatekeeper and the Project Board before the gate can be passed.

Capricorn Greenland has adopted the Cairn Energy PLC *'Wells and Drilling Operations Policy'* (Document No: ED/ENG/POL/10/2112) that provides policies for well control, and Ocean Rig's Rig Specific Operation Manuals (Documents: LE-OPM Rev 26 & CR-OPM Rev 0) *"Section 17: Well Control"* documents the Ocean Rig well control practices. All well control instructions and guidelines outlined in these documents are in accordance and compliance with Industry and recognized Operating Company Policies, American Petroleum Institute (API) rules, Government regulations, NORSOK standards and International Association of Drilling Contractors (IADC) guidelines.

The Ocean Rig well control manual provides the primary gUidance on well control practices which are complimented by the Cairn well control procedures; the primacy of each document is set out in a 'Bridging' document agreed between Cairn Energy and Ocean Rig. The process of using a 'Bridging' document is well known within industry. The provisions and contents of the well control bridging document have been reviewed and approved by senior management, in both Cairn Energy and Ocean Rig.

1.4.2. Exploration Drilling Assurance:

All Cairn Greenland Exploration wells are subject to extensive internal and external assurance reviews to ensure that risks have been effectively identified with robust prevention and mitigation procedures instituted to minimise any exposures.

Internal Drilling Engineering Design and Operations Assurance

All exploration drilling programmes are developed and reviewed through a three tier system that includes the review and sign off by a Chartered Engineer prior to approval by the Project Manager and the Head of Assets. All well designs comply with the Cairn Energy design standards and regulatory requirements.

All well design programmes undergo a HAIID review and the well design/execution process is further reviewed and assured through the internal Cairn Corporate Risk Management process. The drilling programmes and the well operational progress and exposures are also reviewed on a bi-weekly basis, in compliance with the "Project Risk Management" programme.

External Drilling Engineering Design and Operations Assurance

The overall exploration drilling programme and well engineering and operational design criteria are subject to an *"External Peer Review"* by independent industry drilling and engineering experts to assure the integrity and quality of the engineering design and operational procedures. This includes a review and assurance that the key engineering aspects of the well designs are robust and comply with industry, NORSOK and API Standards, including Casing Design, Cement Design, and Barrier Design.

The exploration programme then undergoes a Major Hazard Assessment (MHA) by DNV or alternative independent body to confirm that all major hazards have been properly Identified and addressed. Finally, the Exploration Well Programme and well designs are reviewed and approved by the BMP.

Each well design and associated programme is further assured by the independent UK Well Examiner prior to operations. As each well progresses, operational requirements are further verified by the UK Well Examiner, to ensure that the well operation is following the assured well design requirements.

Each well programme Is also individually reviewed and approved by the BMP and progress is verified on a daily basis. BMP Inspectors regularly inspect each rig to verify that the proper standards and procedures are being applied.

1.4.3. Rig Strategy

Cairn Energy adopted a dual rig strategy in October 2009 for its 2010 exploration programme. This strategy maximises the geological information attained in a single season, improves logistic efficiency and provides efficient and effective well control response capability.

Rig Selection Criteria

Environmental conditions in Greenland require the use of Harsh Environment (HE), rigs to maximise the drilling window after the pack ice retreats. In Napariaq and Eqqua, the iceberg frequency in the early portion of the drilling season creates a bias towards DP versus moored rigs, to minimise the downtime associated with iceberg management procedures and optimise safety.

Consequently Cairn Energy has elected to operate with two HE DP rigs.

Cairn Energy have engaged Ocean Rig to provide both the O.R. *"Corcovado"* drillship, and the semisubmersible *"Leiv Eiriksson"* with these capabilities, for the 2011 Exploration Drilling season.

Both rigs are certified to International Certification Standards by recognized authorities as set out in the document below. All of their equipment is built and maintained to the relevant specifications and tolerances. Only original equipment manufacturer spares are used on safety critical systems.

Separate audits of the critical systems are executed by recognized independent international experts. This includes independent subject matter expert audits of the well control system, the Ocean Rig Safety Management systems, the DP systems and the helicopter refuelling systems.

Each rig has also undergone an independent Major Hazards Assessment Audit by Det Norske Veritas (DNV) and is subject to a rolling independent audit and inspection program throughout the drilling program, in addition to its Contractor managed preventative maintenance system. Each rig is subject to BMP inspection and approval to drill. In addition there is a rolling, unannounced, independent, BMP inspection and audit programme with different Inspectors.

An independent Well Control Expert (WCE) is assigned to the field during drilling operations to conduct well control inspections and audits. In addition the WCE conducts familiarization training and oversees/assesses the effectiveness of all well control drills.

Following the tragic incident in the Gulf of Mexico, industry wide recommendations were developed. Cairn Energy reviewed and confirmed that the existing procedures and equipment fully complied with, or exceeded, the Bureau of Ocean Management (BOEMRE) recommendations.

Rig Specifications - Leiv Eiriksson

The Ocean Rig Leiv Eiriksson is designed to operate in harsh environments in water depths ranging from 280 to 2286 meters. The deck areas and variable deck load capacities prOVide significant flexibility for exploration drilling, or for subsea development projects.

Station keeping in the dynamic positioning mode is achieved by six full efficient, fixed pitch, variable speed thrusters. The DP system meets Class 3 operational requirements. The rig is designed to minimise discharges and emissions to the environment, having a no-discharge drainage system to retain all fluids, and being equipped with low noxious emission engines, for power generation.

Design Type

SSDR Leiv Eiriksson is a Semi-Submersible Bingo 9000 design.

The drilling vessel is classed according to DNV "Rules for the Classification of Mobile Offshore Units"

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1.5. Well Control

1.5.1. Well Control Governance

Capricorn operates a four tier Well Control Governance process.

Tier One; This tier covers well engineering and design assurance, risk management process, It also covers the execution assurance of "primary", "secondary" and "permanent" well barriers such as; casing and cement, mechanical and cement isolation plugs, wellheads, Bap's, casing packers, liner hangers/pack-offs DST equipment, drill-string barriers *etc*.

Tier Two; Covers the operational phase as does the subsequent tiers. It consists of primary well control such as; pore pressure evaluation and management, kick detection, finger printing, kick tolerance management, fluid management, cementing practices, Bap system testing and assurance.

Tier Three; Covers secondary well control assurance and procedures.

Tier Four; Covers tertiary well control and includes surface well control options, relief well drilling and capping options.

Similar to other offshore locations in the Arctic region, where there have been wells drilled since 1940s, drilling offshore Greenland has the additional risk of iceberg management avoidance. Consequently, all well control operations are planned with sufficient T-times and safety margins, for the drilling unit to safely secure and suspend the well, in preparation for drilling unit moving off location. These T-time procedures also include dedicated ice monitoring and management capability, throughout the entire operational period.

With a two rig stategy the second rig is available to immediately support a well control incident as required. The second drilling unit will also release all but one of its ice management vessels to the drilling unit with the well control incident, to increase the T-time for well control operations.

To provide further assurance during the operations phase, only one drilling unit is permitted to enter a new hydrocarbon zone at a time. The other drilling unit must delay entering its new hydrocarbon zone, until the first unit has confirmed it has safely accessed the zone of interest.

Cairn Energy governs drilling procedures and practices using the W&DOP. The principal elements that cover Primary Well Control operations are:

- "The drilling fluid design will ensure primary well control of the well at all times...."
- "Cement placement will be planned and performed such that the hydrostatic pressure will always be higher than the maximum formation pressure."
- "A riser margin will be maintained on all wells drilled with a riser. It is recognized, however in some deepwater well conditions, it is not practical to carry a riser margin. In such cases, the Blind Shear Rams will also be closed above the hang off rams thus maintaining the required two Well Control Barriers as required by NORSOK 0-010. The riser will be displaced back to drilling mud prior to opening the BOP's after reconnection.
- "All primary well control operations shall be carried out in accordance with the Rig Contractor's Well Control Manual and the Cairn Well Control Manual interface document."
- "All secondary well control operations shall be conducted in compliance with the Drilling Contractors Well Control Manual and the Cairn Well Control Manual interface document."

Ocean Rig's rig specific operation manuals "Section 17: Well Control" provides the basis for managing primary and secondary well control on Cairn Energy's 2011 Greenland operations and include the following agreed fundamental well control practices;

1. Flow checks may be made at any time at the sole discretion of the Ocean Rig Driller (or relief on the brake), and they are authorised to close the well in immediately without further consultation. The Ocean Rig Offshore Installation Manager (OIM), Capricorn Drilling Supervisors and Ocean Rig Toolpushers will ensure that Drillers and Assistant Drillers are fully aware of this authority.
2. Capricorn Greenland is accountable for the wells and their integrity. Ocean Rig Drilling is accountable for the integrity and operation of the wellhead connector, BOP system, riser and all other well control equipment on board the drilling units.
3. Capricorn Greenland and Ocean Rig Drilling are jointly accountable for the planning and execution of primary and secondary well control.
4. The Ocean Rig OIM, Capricorn Drilling Superintendent & Supervisors and Ocean Rig Toolpushers are responsible for planning and implementing suitable well control preparation, drills and response.
5. Ocean Rig Toolpushers and Drillers are responsible for executing well control operations as advised by the Capricorn Drilling Supervisors.
6. Tertiary well control will follow the advice and direction of the specialised well control specialists that have been engaged to provide this service. Tactically this includes:
    - a dual rig strategy to facilitate relief well drilling, in the unlikely event that it might it be required,
    - directional planning and dynamic kill simulations for relief wells
    - detailed relief well plans prepared for each of the wells in the 2011 Greenland drilling campaign
    - a well control emergency response plan

Notwithstanding the above the Ocean Rig OIM is accountable and remains the onsite commander for events within SOOm of their respective units and the OIM's order of priorities remain personnel, environment and assets.

1.5.2. Well Control Policies

Ocean Rig's Operations Manual "Section 17: Well Control" provides the basis for the management of primary and secondary well control during all Capricorn Greenland's 2011 operations. This section bridges with the Cairn policies and provides the procedures and direction for well control operations. This includes the following key principles,

The Driller is fully authorized and expected to shut the well in on his own cognisance without contacting anyone.

Kick tolerance shall be known at all times and shall be documented. In potential hydrocarbon well sections the kick tolerance level will be used to determine the appropriate level of drilling practices to be applied (Kick Alertness Levels 1-3 described later in this document).

The *"Hard Shut-In"* method is the preferred method of closing the well in as this reduces potential influx volumes.

The *"Drillers"* method is the preferred well control method for both units depending upon influx type.

The minimum requirements outlined have been reviewed and approved by independent well control experts and agreed with the Rig Contractor, Ocean Rig Drilling.

Top Hole Drilling and Design Requirements

The top hole sections of all wells drilled from floating rigs are drilled riser-less until a formation with sufficient strength to contain well bore pressures whilst drilling the next hole section has been penetrated.

The casing and wellhead equipment are designed to safely contain the maximum anticipated wellhead pressure with a gas column to surface.

Well control design considerations for each well shall accommodate loadings induced from pressure testing, stimulation and other operations.

If at any time the surface pressure that could result from a full evacuation to reservoir wellbore pressures exceed the BOP/wellhead design, the well shall be made safe, operations suspended and remedial actions implemented.

Prior to drilling any new wellbore section the OIM, Capricorn Drilling Supervisor and key rig personnel will review, discuss and document well control, T-times, emergency and contingency procedures.

After determining the leak off strength at the casing shoe a well control plan shall be developed for that hole section. This shall include;

- The pre-kick data sheet fully completed with current data
- Roles responsibilities and duty stations
- Pit level monitoring requirements and notification protocols
- Pore pressure; monitoring, management, and notification protocols
- Notification protocols and minimum acceptable timing
- Equipment hook up and utilization, including dedicated calibrated pressure gauges
- Drill-string space out and hang-off procedures, documented and displayed on the Driller's control console
- Dedicated documented well control procedures for each hole section
- Well control drills and timing
- The plan shall be documented and fully understood by all relevant personnel

The following equipment must be on the rig floor and be fully functional at all times:

- Full-opening safety valve.
- Surface installed inside BOP.
- XO's for the installation of the equipment onto any connection used in the drill, tubing or completion string currently in the hole.
- The dart if Dart Sub is included in the Bottom Hole Assembly (BHA)

Well Control Equipment, Subsea Dispersant Preparation & Minimum Stock Levels

All gas detection equipment, flow and volume sensors shall be functional and calibrated for each well section prior to drilling commencing. If the equipment does not function satisfactorily operations may only proceed with the written acknowledgement of the Drilling Project Manager.

Well capping equipment shall be airlifted to Kangerlussuaq in the event of the loss of secondary control, and the well control event moving into a significant tertiary surface control condition. This will be advised following discussions with the Regulatory authorities, the Emergency Response Group and other stakeholders.

Subsea dispersant and the associated distribution equipment for its use upstream of the tertiary well control event shall be mobilised to the rig managing the well control event. A second set of subsea dispersant/distribution equipment shall be mobilised to the second rig. This shall include the equipment to transfer the management and operation of the dispersant distribution to the ROV support ship.

Kick tolerance shall be known at all times and shall be documented using: actual leak off data; current fluid weights in the hole; casing shoe depths; the predicted pore pressures; well bore geometry; and wellbore trajectory.

Drilling operations shall be suspended if the stock levels of essential materials at the rig site fall below the following minimum levels:

- Enough weighting material and other mud chemicals to raise the weight of the active mud system by at least 2 pounds per gallon (ppg) and to maintain the rheological properties.
- A minimum barite or eqUivalent weighting material stock level of 90 MT for offshore wells or 40 MT for onshore wells provided that replenishment stocks can be supplied to the rig within 6 hours
- Sufficient loss circulation material of the correct type on site to combat lost circulation problems.
- On H_2S wells, adequate stocks of H_2S scavenger on site to treat the mud.
- Sufficient cement and additives to set two 500ft neat cement plugs in the current hole size.
- Sufficient fuel to service the rig at maximum daily usage rates for a minimum of 5 days.

A kick sheet shall be updated daily and at every change in the mud weight or BHA or if extended well sections are drilled rapidly.

Slow circulating rates are taken at least;

- Once per tour
- After a bit/nozzle change
- After a BHA change
- After mud weights have changed

Tripping, Flow Checking & Electric/Slick Line Standards

The well shall be kept full and monitored at all times, even when out of the hole. Flow checks are a minimum of 10 minutes with water based mud. A flow check shall be made:

- In the event of a drilling break.
- After any indications of down hole gains or losses.
- Prior to all trips out of the hole.
- After pulling into the previous casing shoe.
- Before the BHA enters the BOP stack.
- If trip displacement is incorrect.
- Prior to dropping a survey instrument.
- Prior to dropping a core ball.
- Prior to running the casing shoe past the previous casing shoe.

- Prior to and post cementing operations commencing
- Prior to drilling out a casing shoe to fingerprint the f1owback.

For all trips, displacements both in and out of the hole shall be monitored using the trip tank and this shall be recorded on a dedicated trip sheet.

Tripping or continued drilling with static mud losses in excess of 20 barrels/hour is only permissible following a full risk assessment, contingency planning and a documented procedure approved by the Capricorn Drilling Project Manager.

Drilling blind (i.e. without returns) is only permissible follOWing a full risk assessment, contingency planning and a documented procedure approved by the Capricorn Drilling Project Manager.

Prior to running slick or electric line in open hole, the well control procedures shall be documented and discussed with all parties and any additional equipment required will be in place (e.g. equipment to cut the line).

At all times when slick or electric line is run inside the drill string a fully open safety valve shall be installed on the top of the string.

Well Control Equipment Design Standards & Requirements

The BOP stack, wellhead and associated equipment shall be rated to contain the greatest anticipated surface pressure from the total depth of the current hole-section being drilled with the gas column to surface. The only exception to this is the annular preventers which may be of a lower rating.

All drilling units shall have two independent control systems on all BOP functions. These must be fully operational.

The working fluid volume of BOP accumulators and the BOP closing times comply with API RP 53.

The accumulator unit performance test is conducted prior to the first use of the BOP's and after repairs have been made to the accumulator system. The BOP closing times and accumulator recharge time comply with API RP 53.

Mud-gas separator, separation and blow-down capacities are known before operations commence.

The Capricorn Greenland Drilling Superintendent and Drilling Project Manager are made immediately aware of any shortfalls in the well control system, or, any well control equipment that is not in full working order.

Kick detection eqUipment are within calibration and fUlly operational at all times. These will Include the follOWing minimum requirements;

- Fully calibrated active pit volume sensors with two independent monitors
- Fully calibrated trip tank system
- A calibrated differential flow sensor
- Fluid density measurement into and out of the well
- Rate of penetration recorder
- Fully calibrated gas detection system at the header box and other high risk areas

All well control equipment is tested to the lowest of the following known criteria after the installation of any wellhead body component or prior to drilling out each casing string:

- Maximum anticipated wellhead pressure to be encountered in the hole section being drilled
- 80% of casing burst pressure
- Wellhead rated pressure
- BOP rated pressure

Additional pressure testing and full functional testing of the well control equipment shall be carried out to the pressures determined above at intervals of (and not exceeding) 14 calendar days from the date of installation. These tests shall be reported on the IADC Official Daily Drilling Report Form.

When the BOP is installed on a well, if any part of the BOP or related equipment is repaired, replaced or changed, then that part, and any other components directly affected by the repair, replacement or change, shall be tested to the well control testing criteria.

1.5.3. BOP System Pressure Testing Standards

Water or a water/glycol mix (60/40) shall be used as the test medium.

The volume of test fluid pumped and returned shall be monitored and recorded.

The opening and closing volumes of all BOP functions shall be monitored and recorded.

All tests shall include a low pressure test of 200-300 psi before proceeding to the full pressure test.

All tests shall be witnessed by the Capricorn Drilling Supervisor and recorded on a chart. The chart shall be signed by the Tool-Pusher and the Capricorn Drilling Supervisor, and a copy filed in the well file.

1.5.4. Well Control Drill Standards & Requirements

Kick detection and Shut-in drills shall be held regularly until the Capricorn Drilling Supervisor is satisfied that an acceptable industry standard has been consistently achieved. After this standard has been achieved the minimum NORSOK 0-010 requirement, well control drills will be performed as per the follOWing table:-

Type	Frequency	Objective	Comment
Shallow gas kick drill - Drilling	Once per well with crew on tour.	Response training to an shallow gas influx.	To be done prior to drilling surface hole or pilot hole .
Kick drill - Drilling	Once per week per crew.	Response training to an influx while drilling (bit on bottom).	
Kick drill - Tripping	Once per week per crew.	Response training to an influx while drilling (bit on bottom).	
Choke drill	Once per well with crew on tour.	Practice in operating the power choke with pressure in the well.	Before drilling out of the last casing set above a prospective reservoir.
H2S drill	Prior to drilling into a potential H2S zone/reservoir.	Practice in use of Respiratory equipment.	

Drills shall be documented in the officialIADC Daily Drilling Report.

Trip drill- after pulling the bit into the casing shoe when tripping out. Hold a trip drill to install the full opening safety valve, simulate closing the annular and spacing out ready to hang off, then f10wcheck for 15 minutes.

Stripping and choke drl/l - when running in to drill out casing, hold a strip drill. If possible do this at crew change so that both crews experience it. Strip in with 2-300 psi on the well, bleeding off at the choke to maintain casing pressure no less than the set pressure and no more than 100 psi greater. Circulate over the chokes and give choke operators the opportunity to adjust the choke to achieve a stated pump pressure. Make up the top drive while stripping in, to avoid having to pull back later to remove the grey valve.

Pit drill - the Toolpusher and Drilling Supervisor will periodically test each crew (including mud loggers) by transferring 10 bbls of mud into the active system while drilling. The mud loggers and other key personnel will be given prior notice of the drill. The drilling is normally stopped as soon as the Driller recognises the influx and before any BOP function is activated. Before continuing to drill, ensure that a real flow did not coincidentally start at the same time as the drill.

1.5.5. Kick Tolerance Operating Standards

Kick Alertness Level 1

Normal Well Operations (Sub Sea BOP in place, kick tolerance> 50bbls at 1.0ppg)

General Safety	
BOP Shut-in Drills	Weekly each crew
Pit/Trip Drills	Daily unless conditions do not permit
Pre shift Safety Meetings	Daily for each shift
Weather	Forecasts twice per day from one station.
T-Time	Minimum Sequence - Hang-off, Displace riser, Release IMRP Drilling
Kick Tolerance	Engineer to use LOT to calculate the Kick Tolerance at each casing shoe based on max hole depth of next interval. Calculations then updated daily or when significant changes occur to the mud weight.
Kick Detection	
Active Pit Volume	Normal
Pit Volume Totaliser (PVT) Sensitivity	5-10 bbls
Flow meter increase/decrease	Flow check for a minimum of 15 minutes
Gains	Shut in and check for pressure. If no pressure flow-check through choke. If no noticeable flow, open up well and flow-check. If in doubt, circulate bottoms up, flow-check at 75% bottoms up and route flow through choke/Mud Gas Separator (MGS). Establish PVT trends prior to drilling ahead.
Positive/Reverse Drilling Breaks	Normal trip record procedures
Hole fill records	Flow check for a minimum of 15 minutes
Mud density checks	Every 30minutes
Communications	Normal
Trip procedures	Normal tripping procedures apply. Flow check prior to POH, at the shoe and before pulling BHA through BOP.
Pressure Detection	
Pressure Trends	Report significant trends.
Gas Units	Calibrate Mud loggers gas sensors each trip. Run Calibration test on gas sensors daily. Run degasser if necessary.
Rate of penetration	Control drill if in transition zone.
Logs	As per program.
Simulated connections	As required to monitor gas trends.

Kick Alertness Level 2

Kick Tolerance >1.0ppg (25bbl kick size) while drilling in Transition and potential reservoir Zone.

General Safety	
BOP Shut-in Drills	Weekly each crew
Pit/Trip Drills	Daily unless conditions do not permit
Pre shift Safety Meetings	Daily for each shift
Weather	Forecasts twice per day from one station.
T-Time	Minimum Sequence - Hang-off, Displace riser, Release IMRP
Kick Tolerance	Drilling Engineer to use leak off test to calculate the Kick Tolerance at each casing shoe based on max hole depth of next interval. Calculations then updated daily or when significant changes occur to the mud weight.
Kick Detection	
Active Pit Volume	500 bbls (maXimum)
PVT Sensitivity	5 bbls
Flow meter increase/decrease	Flow check for a minimum of 15 minutes
Gains	Shut in and check for pressure. If no pressure flow-check through choke. If no noticeable flow, open up well and flow-check. If in doubt, circulate bottoms up, flow-check at 75% bottoms up and route flow through choke/MGS. Establish PVT trends prior to drilling ahead.
Positive/Reverse Drilling Breaks	Flow check (minimum of 15 minutes)
Hole fill records	Flow check for a minimum of 15 minutes
Mud density checks	Every 30minutes
Communications	Normal
Trip procedures	Normal tripping procedures apply- Flow check prior to POH, at the shoe and before pulling BHA through BOP.
Pressure Detection	
Pressure Trends	Report significant trends.
Gas Units	Calibrate Mud loggers gas sensors at casing points. Run Calibration test on gas sensors each shift. Check degasser response. limit maximum gas by units by adjusting rate of penetration (ROP) and/or pump rate.
Rate of penetration	Control drill if in transition zone.
logs	As required for pressure evaluation.
Simulated connections	As required to monitor gas trends.

Kick Alertness Level 3

Kick Tolerance < 1.0 ppg (25bbls kick size) while drilling in Transition and potential reservoir Zones.

General Safety	
BOP Shut-in Drills	Daily for each shift.
Pit/Trip Drills	Daily for each crew unless conditions do not permit.
Pre shift Safety Meetings	Daily for each shift. Drilling Supervisor to be present.
Barite Plug Preparation	Mix water prepared and cement unit lined up. Formulation agreed to.
Kill mud	Mix rate test required. System must be capable of increasing system weight by 1 ppg in 1 circulation. If system does not meet this criteria, kill mud will be maintained on board. Base the volume and mud weight (MW) of kill mud on increasing the drilling MW by 1 ppg in 1 circulation in conjunction with mud mixing system.
Weather	2 forecasts each day from two stations at 6 hour intervals.
T-Time	Bullhead, Hang-off, Displace riser, Release I MRP
Kick Detection	

Active Pit Volume	Minimum workable volume
PVT Sensitivity	Sensitivity 5 bbls, shut in well on any gain.
Flow meter increase	Shut-in well
Flow meter decrease	Flow check for a minimum of 15 minutes
Gains	Shut in and check for pressure. If no pressure flow-check through choke. If no noticeable flow through choke, open up well and flow-check. Circulate bottoms up, flow-check at 75% bottoms up and route flow through choke/MGS. Establish PVT trends prior to drilling ahead.
Positive/Reverse Drilling Breaks	Shut in well using "Hard shut in".
Hole fill records	Drilling Supervisor or Engineer checks procedures.
Mud density checks	Every 15minutes
Communications	Use VHF between Mud loggers and rig floor to have two means of communication.
Trip procedures	Tripping procedures for low limits to be applied apply. If heavy mud pills placed on bottom, this will be done after the wiper trip.
Pressure Detection	
Pressure Trends	Report all trends.
Gas Units	Calibrate Mud logger gas sensors at casing points. Run Calibration test on gas sensors every 6 hours. Run degasser as required. Limit maximum gas units by adjusting ROP and/or pump rate.
Rate of penetration	Do not have more than 90 feet of sample being circulated out at any time.
Logs	As reqUired for pressure monitoring.
Simulated connections	Every 15ft if increasing pore pressure is indicated. Do not have more than one dummy connection on the way out of the hole at any time. Otherwise do dummy connections once every stand.
Pressure sampling	Consider prior to drilling into transition zones or if a long section of open hole is exposed. Test formation to predetermined equivalent mud weight. Do not test to leak off.

Shallow Gas Standards & Requirements

Capricorn follow the NORSOK 0-010 guidance on shallow gas procedures.

Shallow Gas Procedures shall be agreed with the Drilling Contractor and be part of the Well Control Bridging Document.

Shallow gas kicks will not be "shut-in". The rig shall pump fluid into the wellbore at the maximum sustainable pump rate and the well shall be allowed to flow to deplete the gas pocket.

To prevent back flow through the drill-string a non-ported near bit float sub shall be run in all drill-strings, until the surface casing has been set.

Well Shut-In and Control Standards

The driller is expected and required to shut in the well as quickly as possible, on his own cognizance, without contacting anyone for permission.

The rig specific 'Hard Shut In' procedure along with space-out position is posted in the Driller's control cabin/doghouse.

The 'Hard Shut In' Method will be used for shutting in a well.

The well shall be killed with the drill-string as near to the bottom of the well as conditions dictate.

Only the annular will be used for stripping should the need arise.

If the well starts flowing when the drill string is off-bottom, the well shall be shut in and consideration given to stripping the pipe to bottom.

After completing a hydrocarbon well control operation or a drill stem test there shall be a minimum of one complete hole circulation performed to ensure unit levels of entrained gas are at safe levels. The wellbore stability shall be assured, prior to tripping the drill-string or test-string.

1.5.6. Well Control Procedures, T Times and Shallow Gas Decision Tree

The decision trees provided in *Figure* 7 and *Figure* 8 have been adopted for both Ocean Rig MODUs and by Capricorn Greenland. These are laminated and posted in the dog house on both rigs.

Due to the iceberg hazard in offshore Greenland operations T-time procedures have been developed and must be applied at all times the drilling units are operating in Greenlandic waters.

The ice threat offshore Greenland can become more intense after periods of sustained storm force winds. Consequently, the ability to safely disconnect the BOP and Riser to physically move the rig off location is a principle requirement for all operations. All Drilling Supervisors, OIMs, Toolpushers, Supervisors and Drillers must review and be fully capable of effectively developing T-times for all operations undertaken by the drilling units in all environmental conditions, this includes but is not limited to; securing the well and drill string, gas removal from BOP stack, disconnecting the IMRP, reconnecting the BOP and safely recovering the drill string.

T-time calculations are carried out for all operations with the MODUs offshore Greenland. They denote the variable exclusion perimeter for 'Threatening' ice. The DIM, Drilling Supervisor and Toolpusher assess the operational time required to safely secure the drilling unit from any ice threat that could potentially breach the T time safety perimeter. This is carried out in consultation with the dedicated ice management team aboard each of the MODUs. This includes as a minimum the time required to safely recover the drill string, secure the well, disconnect the Riser/IMRP and move the drilling unit to a secure area. The DIM, Drilling Supervisors and Toolpushers are accountable for updating the T-time(s) required to secure the well and disconnect the IMRP for every operation.

Shallow Gas Decision Tree

Every offshore Greenland well location and relief well location has a shallow gas seismic assessment or a pilot hole drilled to the depth of the 20" casing setting to preclude complications arising from shallow gas events.

Shallow gas flows will not be shut in and the shallow gas procedures for the Greenland 2011 drilling campaign are denoted in *Figure* 7. Both drilling units shall be maintained in a state of readiness for moving off location, to a pre-determined safe area whilst drilling the top hole sections of all wells, regardless of the shallows gas analysis results. This preparation shall take into account, local environmental and topographic considerations.

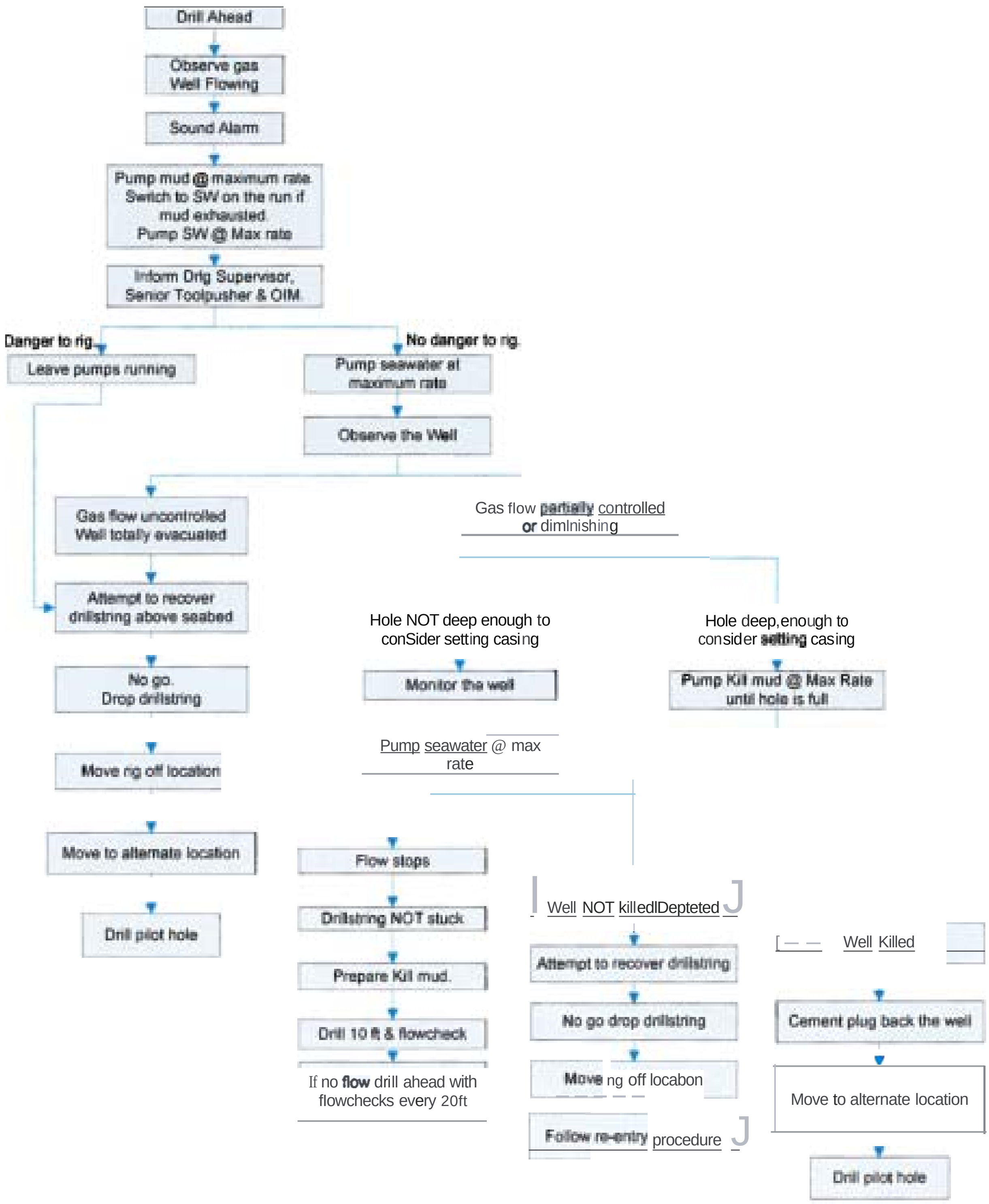


Figure 7 Shallow Gas Decision Tree

Well Shut In, Well Kill Practices and Decision Tree

- The Hard Shut-In method shall be used.
- The *"Drillers"* well control method is the preferred well control method but this shall be evaluated depending on the type of well control event, recorded data and environmental conditions. The *'Wait and Weight'* method of well control may be used after consideration of the well control event.
- No uncontrolled bleeding off pressure at the choke shall be permitted eg so as not to exceed the MAASP· unless approved by the Capricorn Drilling Supervisor and OIM.
- Rig and down-hole equipment conditions and considerations should be evaluated prior to and during all well control operations.
- Ice management resources shall be concentrated at the drilling unit with the well control event
- The other drilling unit shall secure its operations/well until the well control event has been secured

The HARD SHUT-IN METHOD shall be used as follows:

- Stop rotation.
- Raise string for annular/ram space out and to position a FOSV in the drilling stand immediately above the rotary table. (taking tide into consideration Le. a minimum of *Bm)*
- Stop pumps.
- Close annular/open choke line failsafe valves.
    - Check riser and if still flowing close lower annular and/or pipe ram
    - Confirm riser is no longer flowing using the trip tank system
    - Close diverter element and monitor returns (beware of slick joint pressure rating)
    - Be ready to avoid riser collapse i.e. open riser fill-up line if significant riser evacuation becomes evident
- Notify supervisors.
- Commence recording drill pipe and annulus pressures every 30 seconds to obtain initial pressure data. Continue to monitor the riser to detect change in fluid levels.

Prepare to Hang-Off

- Close FOSV immediately above the rotary table. Remove work stand components above. Install kill assembly. Open FOSV. (A rig specific procedure should be developed for equipment handling in this step)
- Check space out and close hang off pipe rams
- Hang off using drill string compensator and close ram locks
- Bleed off pressure between pipe rams and annular
- Check riser flow has stopped, open diverter and fill riser if required
- Open annular, flow check riser
- Resume pressure and well monitoring.

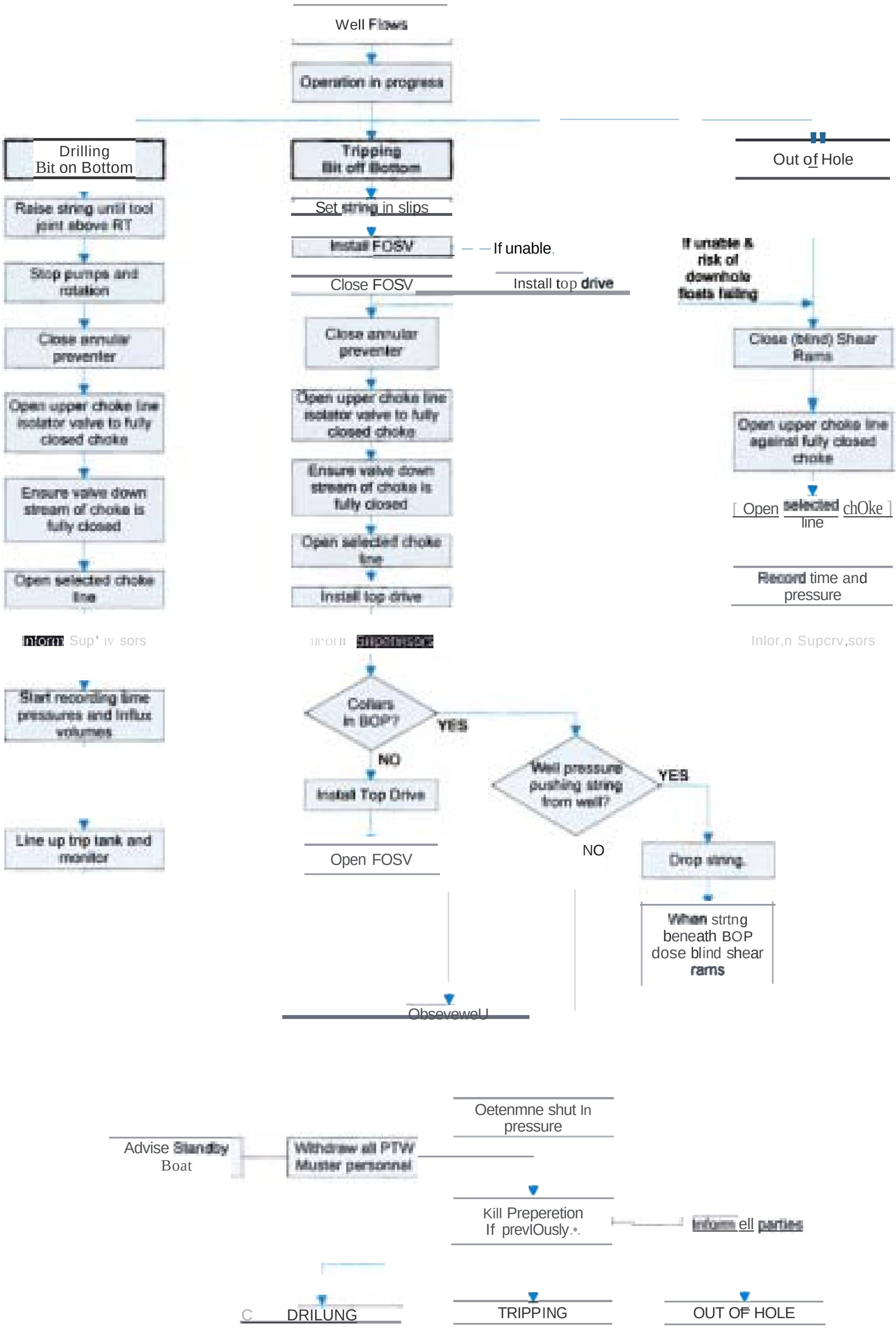


Figure 8 Shut-In and Kill Preparation Decision Tree

Subsea BOP Trapped Gas Removal Procedures

In the event of a well control operation formation gas may become trapped in the BOP cavity between the annular preventer and choke line outlet. In deeper water, this small volume of gas can be trapped at high pressure, and if brought to the surface conventionally could result in significant riser unloading, loss of hydrostatic and possibly result in riser collapse. In addition, the rate of gas unloading at surface can occur so rapidly that there is insufficient time to close the Diverter. Consequently, the potential for trapped gas will always be considered for all well control events and shall be managed as per the procedures outlined in Ocean Rig's Rig Specific Operation Manuals, Section 175.12 Removing Trapped Gas and Riser Displacement.

Tertiary Well Control Operations

Tertiary well control operations are covered by TIer Four of Cairn Energy's Well Control Governance process. This covers surface control options, which statistically have had the highest ratio of control success by a significant margin. This tier also covers well capping operations and relief well drilling operations.

Planning

All offshore Greenland wells shall have two alternate relief well locations fully identified, permitted and surveyed for shallow gas prior to operations commencing on the primary well site. All operations shall be planned in conjunction with, and be fully supported by, the Cairn Energy Oil Spill Relief Plan.

Relief well sites are evaluated to ensure the current profiles, benthic character, seabed topography and rig access plans are fully suitable for relief well operations

Surface Control Operations

Surface control operations have historically been the most successful and quickest method for regaining control of a well where both primary/secondary control methods have failed, and resulted in an uncontrolled flow. This surface intervention will be the initial and preferred method for tertiary well control in order to minimize risks to personnel and limit potential pollution impacts.

Consequently, the design of the hydraulic control system on the BOP stacks of both MODUs have been independently inspected and assured to have incorporated the BOEMRE recommendations. The hydraulic controls on both Drilling Units have been further optimized to enhance ROV control capabilities.

These BOP control enhancements also include independent ROV operation from a dynamically positioned ROV Support Vessel as well, BOP control intervention using the rigs own ROV system and a third method of BOP control intervention from the ROV system on the relief well rig. This provides triple redundancy, over and above the multiple redundancies included on the BOP stack design and the ram/valve configurations.

In parallel to the application of these multiple redundancy surface intervention methods with the ROV systems, the second rig shall be mobilised to the location to start relief well operations. This will be backed up by a third contingency, which involves the mobilisation of well capping equipment that has been designed and built to incorporate the BOEMRE recommendations.. This capping equipment will allow the diversion and collection of the uncontrolled fluids for safe disposal, minimise pollution potentials and its associated threat to the environment.

Both rigs carry an additional dunking portable surface acoustic "Command and Control Unit" set up specifically to operate on the frequency of the other rig to provide a further back-up option.

In addition to these interventions, historical records indicate that there is also the potential that the well control event could subside due to natural events, and other operations such as;

15. Natural bridging
16. Plugging of the flow path by rock debris from the well bore
17. Heavy mud displacement into the well
18. The pumping of plugging material, and/or cement down the well to kill it
19. Installation of additional well control equipment, if control was lost due to equipment failure

Relief Well Procedures and Standards

As previously described in the preceding text, Cairn Energy have a multi-tiered approach to Well Control Governance.

Each offshore Greenland well have two fully surveyed and permitted relief well sites ready for operations before the primary well is started, as per NORSOK 0-010. In the event of tertiary well control operation becoming required the ROV support vessel shall mobilise to the selected relief well site and establish the positional seabed beacons ahead of the relief well rig's arrival. This allows the relief rig to commence drilling operations immediately upon its arrival at the relief well location.

This process minimises the time line for relief well access and minimizes the impacts of the uncontrolled flow which are influenced by the timeline and other events

The prescribed well control event that results in an uncontrolled flow has been subject to a full table top drill. The drill indicated that in the severe situation of the multiple surface control system interventions failing, the primary rig unable to control the event, the ROV support ship unable to control the event and with the second rig located within audit agreed offshore Greenland that the relief well would intercept the flowing well within the prescribed time limits of the well control contingency plan (within 37 days)

The relief well in the prescribed scenario has the follOWing characteristics and requirements:

- The relief well MODU positioned at the most Southerly 2011 location and the uncontrolled flow emanating from the most Northerly 2011 drilling location
- Uncontrolled flow rates as per the prescribed OSRP rates based on regional geological analysis
- OP positional beacons pre-laid by the ROV support vessel ahead of the arrival of the relief well MODU.
- Drilling rates that reflect those achieved on the well with the uncontrolled flow
- Well designs have multiple contingent casings and redundancies
- Spare top hole equipment available on site for immediate drilling along with wellheads, casing drilling fluids and cement
- A complete set of equipment for relief well drilling is kept at the shore base
- More than four times the required amount of kill fluid is kept fully maintained in Greenland along with stocks of chemicals and cement,
- Multiple redundant supply vessels available
- Relief well design trajectories are approved by BMP prior to commencement of operations

Relief Well Drilling Unit and Schedule

Cairn Energy adopted a dual rig strategy to ensure there would be timely well intervention capability fully under its control (i.e. no other operator constraints) in the event of an uncontrolled flow from a well.

In the event of an uncontrolled flow, the drilling unit would initiate surface intervention operations whilst the second drilling unit would mobilize to the relief well location preceded by the ROV support vessel which presets the DP positioning beacons. This allows the drilling unit to start drilling immediately it arrives at the relief well location

Relief Well Timing

The total duration from the start of an uncontrolled flow to the interception and recovery of well control from the relief well depends upon a number of variables and these have been verified by the recent well control spill drill. This drill and its assumptions are further verified by another very large operator, operating in more severe offshore Arctic conditions. This operator has independently assessed and included in their Oil Spill Response Plan the follOWing offshore Arctic relief well drilling times;

"it is estimated that the duration for an 8,OOO-ft true vertical depth (TVD) relief well is approximately 16 days and the duration for a 14,OOO-ft TVD relief well would be approximately 34 days".

The anticipated maximum depth of the target zones in the 2011 Greenland Exploration programme range from 8,000ft to 13,124ft, which is within both this estimated time period and the 39 days allocated within the Cairn Energy/Capricorn well control response plan.

To ensure that sufficient time has been built into the drilling schedule to permit relief well activities to complete before the advent of ice conditions, the 2011 drilling programme contains a relief well window for each well that indicates the required time to conduct relief well operations, before the ice returns. This is updated on a weekly basis.

1.6. Oil Spill Response

This section gives assistance to response decision makers in the event of an oil spill and considers the three escalation tiers. It covers decision making tools, oil fate and behaviours, and response options.

The options presented are not mutually exclusive and will depend on the type of spill. If an uncontrolled oil spill of crude occurs, a number of response options will be applied simultaneously including mechanical containment and application, dispersant and in-situ burning[9]. The drilling window limits the possibility of any spill impacting the ice edge and strategies for prevention and emergency well control aim to minimise the possibility of impact on the environment and interaction with the ice.

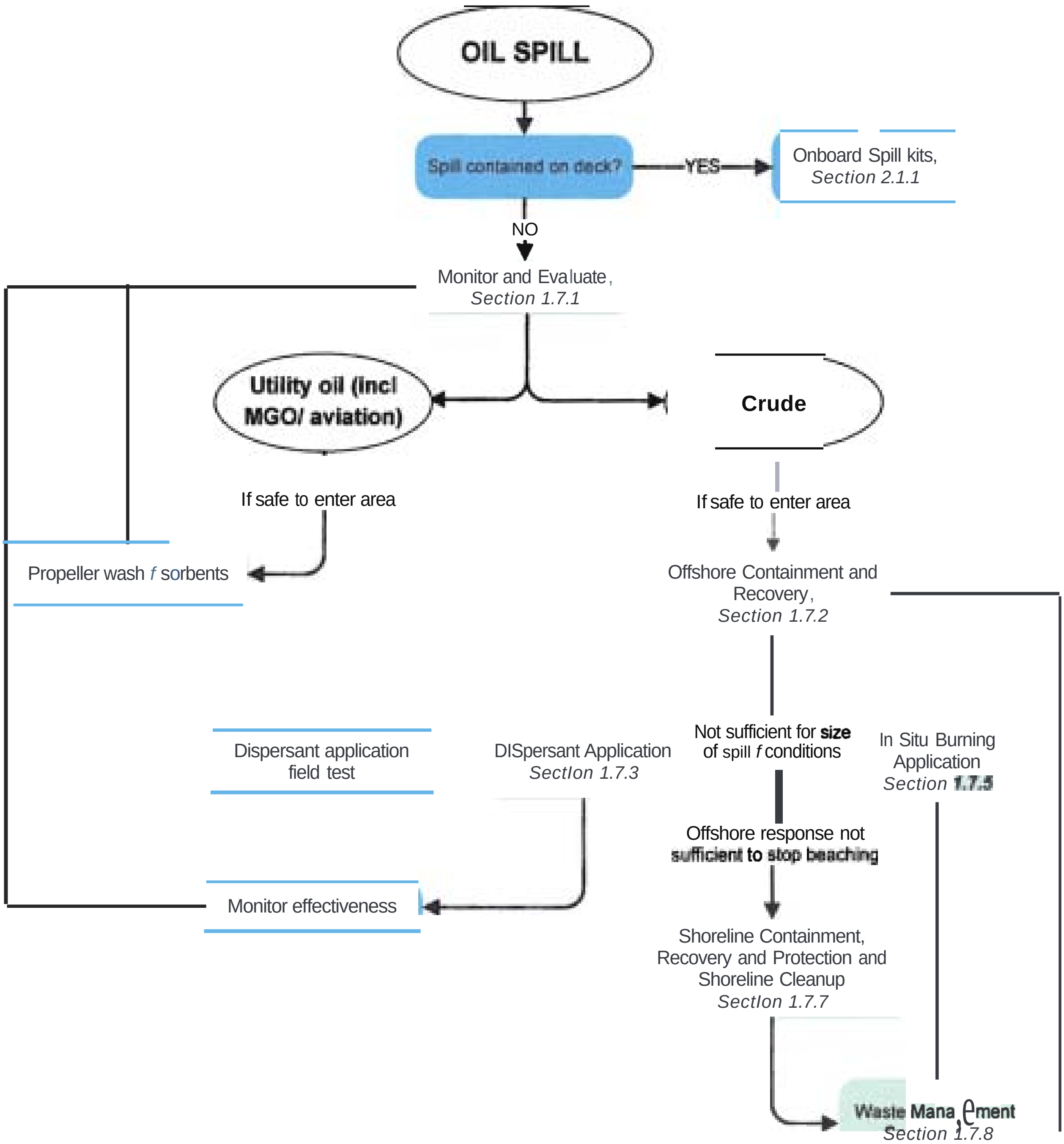
Further sections cover the tiered response and mobilisation procedures. *Section* 2 describes available resources. The *Risk Assessment, Section* 4.3 identifies oil spill scenarios that could result from Capricorn drilling operations. The majority of scenarios identified in the risk assessment pose a low impact to the environment, safety and health, public and financial aspects. The scenario with the greatest potential impact is an uncontrolled release of oil from a well control incident.

In general diesel or aviation fuel is likely to evaporate readily once spilt in the marine environment. Lubricating oils are relatively persistent in the marine environment, and as the properties of these oils vary their propensity to emulsify varies as well, see *Oil Properties, Section* 1.3.2 for further details. The crude properties for any oil produced in Greenland are not yet know as the drilling operations are explorative therefore responders will be required to apply the plan to the specific circumstances of any spill.

9 Dispersant and in-situ burning operations would only be conducted if and when appropriate permissions have been granted, but a large spill is likely to involve these strategies.

1.6.1. Response Decision Flow Chart

Following any oil spill scenario the following Response Decision Flowchart should be followed to initiate the appropriate response strategy. Response strategies have been developed based on the risk assessment, environmental and socioeconomic setting and the legal framework present in Greenland.



1.6.2. Oil Fate and Behaviour

Oil spilt from Greenland drilling operations would encounter different weathering conditions dependant on the time of year and the spill impact area.

This affects:

- Choice of most effective clean up techniques
- Safe working practices

The approved drilling window limits are stated in the drilling approval as follows:

Block	Complete before
Napariaq Eqqua	1 October 2011
lady Franklin Atammik	1 December 2011

This takes into account advancing ice and allows time for drilling relief well in the event of a well control incident. However despite the low risk of impacting ice, strategies are available for management of a spill in the event of early on-set of ice or should oil reach the ice edge, refer to *Shoreline Protection and Cleanup, Section 1..7.7.*

Comparison of Weathering of Oil in Ice versus Open Water

The following information summarises the typical fate of oil under ice and open water conditions. SINTEF (2010)[10] concludes that weathering of oil in ice is significantly slower than weathering in open water, suggesting enhanced response effectiveness and window of opportunity for dispersant and in-situ burning.

Parameter	Open water	Ice
Drifting	Combined effects of 100% current speed and direction and 3% wind speed and direction.	Ice coverage < 30%: Drifting independent of the ice and move as in open water. Ice coverage> 60-70%: Oil will mainly drift with the ice (SINTEF, 2006[11]). Surface oil trapped in broken ice will move in the same direction and speed as the broken ice. Submerged oil will move with the subsurface currents. A current of over 0.2 ms^{-1} is typically required to move oil along the underside of ice.

10 SINTEF (2010) Experimental Oil Release In Broken Ice - A Large-SCale Field Verification of Results From Laboratory Studies of Oil Weathering and Ignitability of Weathered Oil Spills

11 SINTEF (2006) Short state-of-the-art report on oil spills in ice-infested waters. Oil behaviour and response options

Spreading	Spreading dependent on oil viscosity and interfacial tension. In cold water surface tension spreading is slower than in warm water due to an increase in oil viscosity at lower temperatures. The equilibrium thickness of oil in cold waters can approach millimetres (mm) rather than micrometers (µm) typical of warmer waters.	The viscosity of an oil increases as the temperature decreases, to differing degrees dependant on oil type. Spreading in ice is dependent on ice types and ice coverage. Oil thickness increases with increasing ice coverage. If the temperature at sea is lower than oil pour point the oil will not easily spread on the water's surface.
Evaporation	Affected by surface area of slick so dependent on spreading. Evaporation is more rapid the thinner the oil film.	Increasing oil film thickness due to ice confinement reduces both the rate and degree of evaporation. Reduced evaporation due to a diffusion barrier of precipitated wax (skin) at low temperatures (SINTEF, 2006)[12] The flash point of oil will rise at a slower rate due to the reduced rate of evaporation.
Oxidation	Oxidation is promoted by sunlight and may lead to the formation of soluble products or persistent tars. Overall effect on dissipation is minor.	Oil thickness reduction causes less oxidation. Reduced sunlight slows oxidation process.
Emulsification	Oils with high asphaltene content are more likely to form stable emulsions. As light ends evaporate, an oils propensity to evaporate will increase. Wave activity increases emulsification. Emulsion stability dependant on oil type.	Emulsification usually decreases with increasing ice coverage. As temperature decreases, an oil's propensity to form a stable emulsion will increase. Presence of ice reduces wave activity. Energy caused as a result of Ice-on-ice interactions have been reported to induce emulsification (SINTEF, 2006).

Response Considerations of Oil in Ice

The nature of the ice will affect how oil is entrained (landfast, pack, broken, first or multi year) (WWF, 07[13]). The presence of structural anomalies (polynas, brine channels, keels) should be considered, as well as rate of freeze thaw.

12 SINTEF (2006) Short state-of-the-art report on oil spills in ice-infested waters. Oil behaviour and response options

13 WWF / Nuka Research and Planning Group (2007) Oil Spill Response Challenges in Arctic Waters

Ice floes will create natural barriers for oil and restrict their movement/migration across the water or ice surface. Emulsion is formed at a comparatively slower rate in ice covered water because of the affect of wave dampening.

lOw oil temperature increases viscosity. This can cause problems for response clean up strategies when the oil is to be pumped or collected. Refer to ***Offshore** Containment and Recovery Section* 1.7.2 *for more information.*

Sea ice attenuates and dampens waves. As a result the rate of natural dispersion is low. This has implications for dispersant application if there is no natural wave energy to assist in dispersing the oil. See *section 1.7.4, Dispersant Application* for more information.

If ice becomes entrained within the oil then prepare for a secondary response on thaw. If no thaw is expected, or to limit spread then recover the oil from the ice. Ice can be located by augering and recovered using ice slots. Sections of oiled ice can be cut out and allow the ice to thaw in a heated warehouse and then separating the oil from the water.

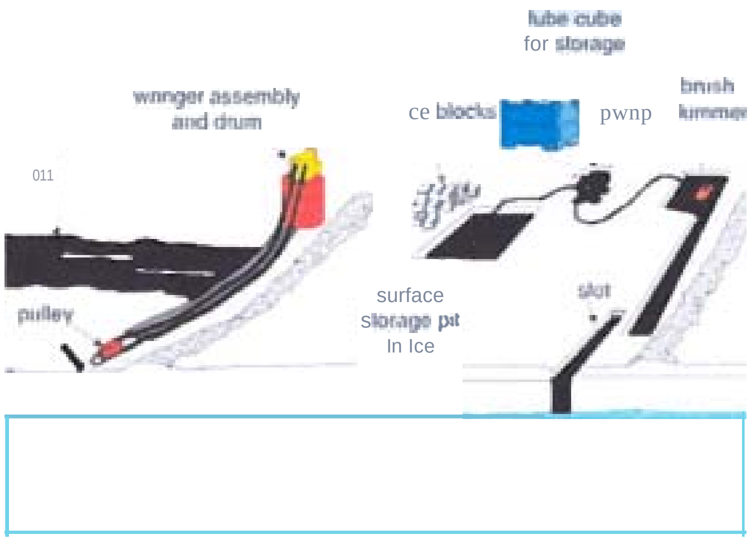


Figure 10 Techniques for Removal of Oil in Ice (Owens et al., 1998)[14]

The number of daylight hours will affect the response time. During the winter months there are very few hours of daylight which can cause serious operational complications. limited portable lights for shoreline operations are available from the stockpile in _ with supplementary lighting available as a Tier 3 resource. Vessels can be fitted with extra flood lights and it may be safe to work during hours of limited sunlight with adequate lighting and appropriate crew shifts / rest breaks. Capricorn will follow the IPIECA/OGP gUidelines for working in the extreme climates Health Aspects of Work in Extreme Climates, A Guide for Oil and Gas Industry Managers and Supervisors, 2008.

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14 Owens et ai, 1998. Field Guide for Oil Spill Response in Arctic Waters

Work/warm-up schedule for a four-hour shift (. C/kph wind)										
Air temperature °C	No noticeable wind		8lrphwind		16kph wind		24 kph wind		3Zkphwind	
	Max. work period	No. of breaks	Max. work period	No. of breaks	Max. work period	No. of breaks	Max. work period	No. of breaks	Max. work period	No. of breaks
-26to-28	115 mins.	1	115 mins.	1	75 mins.	2	S5 mins.	3	4Omins.	4
-29 to -31	115 mins.	1	75 mins.	2	5S mins.	3	40 mins.	4	3Omins.	5
-32to-34	7S mins.	2	55 mins.	3	4Omins.	4	30 mins.	5	Non-emergency work should cease	
-35 to -37	55 mins.	3	4Omins.	4	30mins.	5	Non-emergency work should cease			
-38to-39	4Omins.	4	3Omins.	5	Non-emergency work should cease					
-40 to -42	3Omins.	5	Non-emergency work should cease							
-43 and below	Non-emergency work should cease									

Figure 11 Recommended working hours to reduce exposure to cold[15]

Spills in the Arctic region can often be in remote and isolated places. Infrastructure and logistics need to be considered as a priority. Worker food supplies would need to be air freighted in so that in-country stockpiles are not depleted.

For further information on oil behaviour and response strategies in ice environments please refer to:

- Arctic Spill Response and Development Program-A Decade of Achievement (U.S. Department of the Interior Minerals Management Service 2009);
- Shell Beaufort Sea Exploratory Drilling Program Oil Spill Response in Ice (D.F.Dickens and A.A.Allen 2007)
- SINTEF Summary Report on the Joint Industry Program on Oil Spill Contingency for Arctic and Ice-Covered Waters (SINTEF Materials and Chemistry 2009).
- SL Ross Environmental Research Limited (2000). A review of the response to oil spills in various ice conditions.
- AMAP, 1998: Arctic Pollution Issues. Arctic Monitoring and Assessment Programme (AMAP), Oslo
- SL Ross Environmental Research Ltd., OF Dickins Associates LLC., Envision Planning Solutions Inc. 2010. Beaufort Sea Oil Spills State of Knowledge Review and Identification of Key Issues. Environmental Studies Research Funds Report No. 177.

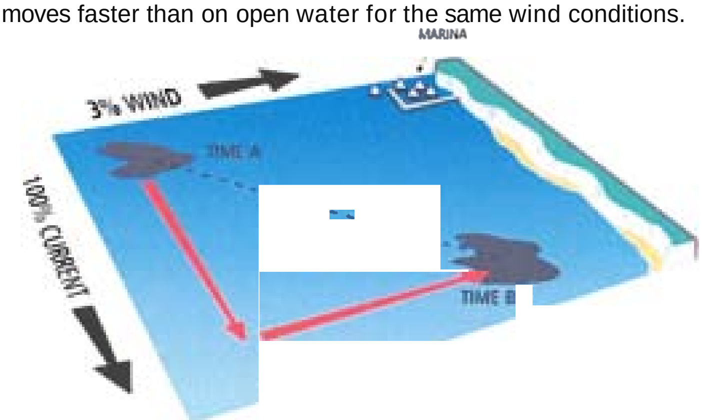
15 OGP gUidelines for working in the extreme climates Health Aspects of Work in Extreme Climates, A Guide for Oil and Gas Industry Managers and 5upervisors, 2008

1.7. Response Options

1.7.1. Monitor, Evaluate and Sample

Tier 1 Resources Available	See *Tier 1 Capability, Section* 2.J, resources includes: • Capricorn charter four helicopters (Sikorsky S92 / 561) which can be used for aerial surveillance. The search and rescue helicopters are on 24 hour call (they are available if not required for emergency personnel operations). • Further surveillance platforms include the MODU's and standby / support vessels.
Tier 2 Resources Available	Additional helicopters and fixed wing aircraft may be available from Air Greenland. These would be resourced dependant on availability and need.
Tier 3 Resources	See *Tier* 3 *Arrangements, sectian* 2.4. *Oil Spill Response* can provide: • Trained aerial surveillance personnel. • Aerial surveillance training to local personnel as requested. • Oil spill computer modelling for assessing trajectory of oil based on real time conditions. Capricorn would call on to provide a fixed wing surveillance aircraft, normally stationed in _ The aircraft has a range of equipment including Synthetic Aperture Radar (5ARa) and Forward Looking Infrared Scanner systems.

Aerial Surveillance	
Application	• Aerial surveillance provides the best option for monitoring a spill; however visual observation from sea level may be the only option initially. This will not give a reliable overall picture especially for larger oil spill events. As soon as practically possible, aerial surveillance will commence to monitor and assess the oil spill. • Aerial surveillance will be used to direct containment and recovery operations and offshore dispersant operations. It can also be used to assess and monitor the successfulness of these strategies. • Remote sensing techniques will be activated to assist with monitoring the spill.
Oil in Ice	Oil spilt in and around ice may not always be visible from the air, low light level video or cameras or 5LAR may assist the observation of oil in ice environments. See *Table* 3J *Summary afsurveillance techniques* for more information

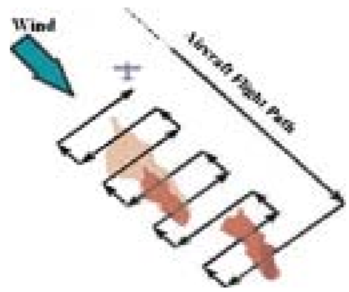
Steps to carry out aerial surveillance	
Get Organised	Before take-off: • take the following equipment: map / chart, polarising sunglasses, stopwatch, calculator, notebook, pencils, GPS (handheld with remote aerial and spare batteries), digital camera and spare batteries, and multiple surveillance reporting forms, see *Appendix 1-1* • obtain latest weather forecasts and current conditions During the flight: • start observation at an altitude of >1500ft or >450m for a good overall picture • ensure there is a good viewing window, or consider flying with door open • ensure there are good communications with the pilot
Step 1: Estimate Position	Prior to flying, obtain information on last known position of slick(s) and plot on a map. Manual plotting or oil spill modelling can provide an estimation of the slick position. Request modelling from *Oil Spill Response* using the modelling request form, *Appendix 1-F.* For manual plotting • On water oil moves at approximately 100% of current speed and direction, and 3% of wind speed and direction. For example, a current of 1 knot will move the slick 1 nm in one hour. A wind speed of 10 knots will move the oil 0.3 nm in one hour. • In broken ice oil moves in the same direction and speed as the ice. Wind effects are greater on oil in ice than on oil alone, with the result that oil in drifting ice usually moves faster than on open water for the same wind conditions. 

<table>
<tr>
<td>Step 2:Find the Spill</td>
<td>

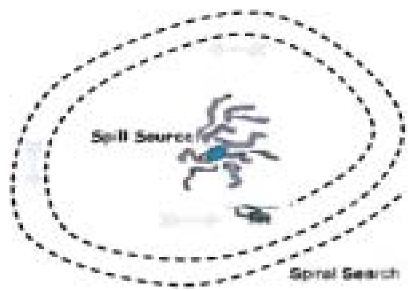
Start surveillance at high altitude (>1500 ft) for a good overall picture. Ensure there is a good viewing window. The more difficult the target is to see because of size, colour, light conditions etc., the lower the required search altitude. An altitude of 1000 - 1500 feet is the usual range for daylight over water visual searches.

A 'standard' ladder search pattern is used when it is considered that the oil spill may be anywhere in the search area to an equal probability. This is the most economical method of surveying an area. The spacing between tracks should be 6 to 10 nm.

If there is an uncertainty as to the exact location / extent of the spill, a spiral pattern can be used to investigate the area of interest. Spiral searches can be difficult operationally in a fixed wing aircraft.

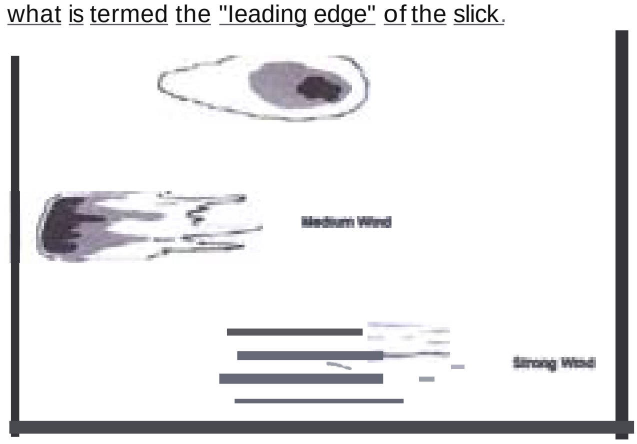


ladder search Pattern



Spiral Search Pattern

The shape and thickness distribution of fairly fresh oil spills depend on the oil properties, wind and currents. The wind spreads and elongates the spill, eventually cutting it into windrows and finally fragmenting. The thickest patches move furthest downwind to what is termed the "leading edge" of the slick.



Effect of Oil Spreading on the sea Surface

Where practical, long search legs should be aligned at 90° to the direction of the prevailing wind to increase the chances of oil detection as windrows will lie parallel to the wind direction. However haze and dazzle reflected from the sea surface can often affect their visibility. Depending on the position of the sun it may be more beneficial to fly the search pattern with a different orientation.

Breaking waves may fragment the patches so that they eventually become scattered lumps which become increasingly difficult to see. Continuous discharges will be shaped by the direction of the wind and current.

</td>
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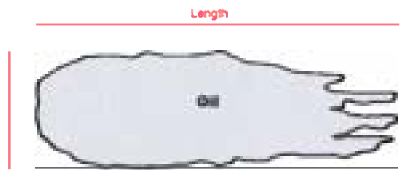
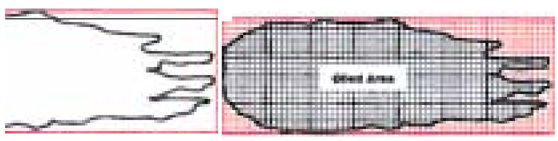
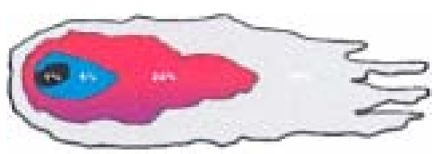
Step 3: Fly along the Spill and Measure	Fly the length and width of the slick and record the time taken and the aircraft speed (note: 1 knot = 0.5 m/second = 1.8 km/hour).  nmIng the Flight along the Length of the Slick
Step 4: Calculate Spill Area	Once the speed and times to fly the length and width are recorded, the area can then be calculated. • Example – A helicopter flying at a ground speed of 120 knots (taken from the GPS or helicopter's flight instrument) takes 260 seconds to fly along the length of the slick and 70 second to measure the width.  Length = (260 seconds x 120 knots) /3600 seconds in one hour = 8.67 nm = 16.06km Width = (70 seconds x 120 knots) /3600 seconds in one hour = 2.33nm = 4.31km Area = 16.04km (length) x 4.31km (width) = 69.13km^2
Step 5: calculate % Cover and Volume	Oiled Area The area covered with oil is calculated by placing a rectangle around a 'map' of the slick equal to the overall length and width, and calculating or estimating the percentage of the overall area covered by the oil. It can be difficult estimating the percentage of the overall area covered with oil in flight. All visual assessments should be carefully checked after landing. The use of grid overlays should be used to obtain accurate measurements of overall slick area from the recorded Imacesormap C  Overall Area and Use of Grids to estimate Coverage - in this example, estimate of oil area is 80% and clear water 20% Oiled Area = 69.13 km^2 (overall area) x 80% (oiled area) = 55.30 km^2 Oil Volume The oiled area should be sub-divided into areas that relate to a specific oil appearance following the Greenlandic Oil Appearance Colour Code. Care should be taken in the allocation of coverage to appearance, particularly the appearances that relate to higher thicknesses (Brown/Black and Dark brown/Black). It is generally considered that 90% of the oil volume will be contained within 10% of the oiled area (normally the leading edge up wind side of spill slick).  In this example, 1% of the slick is black colour, 5% blue, 24% rainbow and 70% silver.

The Greenlandic Oil Appearance Colour Code can be used to estimate minimum and maximum thickness for each identified colour, and then an estimated slick volume can be calculated.

Code	Description / Appearance	Layer Thickness (µm)	Utres per km^2
1	Silver-coloured	0.02	20
2	Grey	0.1	100
3	Rainbow	0.30	300
4	Blue	1.0	1,000
5	Blue / Brown	5.0	5,000
6	Brown / Black	15.0	15,000
7	Dark brown / Black	>25.0	> 25,000

Example Calculations:
Code 1 (Silver) = 55.3 km^2 x 70% x 0.02 **µm** = 0.77 m^3
Code 3 (Rainbow) = 55.3 km^2 x 24% x 0.3 **µm** = 3.98 m^3
Code 5 (Blue) = 55.3 km^2 x 5% x 1 **µm** = 2.77 m^3
Code 7 (Dark brown / Black) = 55.3 km^2 x 1% x 25 **µm** = 13.83 m^3
Total Volume = 0.77 + 3.98 + 2.77 + 13.83 = 21.35 m^3

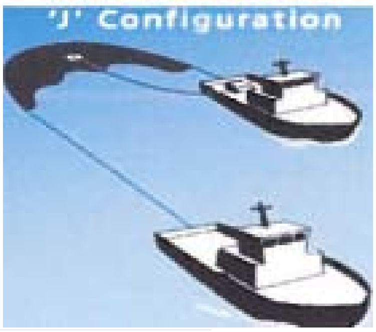
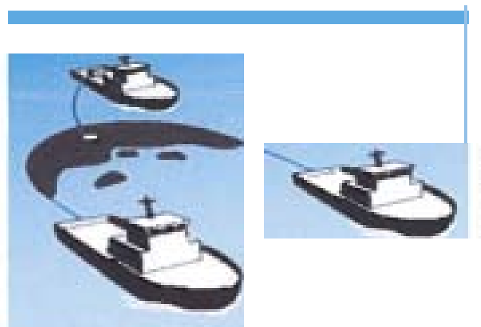
Oil Spill Sampling

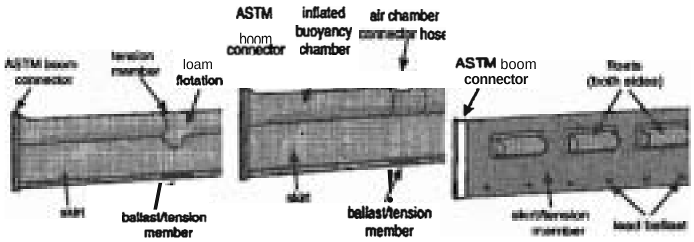
Prior to sending oil samples for analysis discussion on the analysis to be undertaken will be held with the ERG, Oil Spill Response and the GCC.

Technique for Oil Spill Sampling	
Equipment	Sampling from an oil slick itself and submission of the samples require use of correct and necessary equipment (oil sample boxes). Each oil sample box contains detailed instructions with a description of the sampling, including gathering, referencing, labelling, storage and forwarding procedure.
Frequency	For offshore spills a minimum of 1 sample per slick per day where possible.
sample Size	• Unweathered oils that are liquid and subsequently free of water -lOm!. • Oil exposed to sea surface and forming water-in-oil emulsion 'chocolate mousse' -lOm!. • Over side water discharge of lOOppm from a moving tanker or l5ppm from a fixed source is suspected - 1 litre of discharge. • If such quantities cannot be collected, sampling of any quantity should still be attempted.
Collection Methods	• Skim the oil off the surface of the water with great care, ensuring maximum oil content and minimum water. A bucket may be required to collect the sample initially. • Avoid using metal tools containing nickel/vanadium based alloys to collect the sample, as these are contained naturally within many crude oils and therefore may cause problems when analysed. • Any collection of lumpy tar / waxy pollutant should be placed directly into sample containers, with no attempt to heat or melt these samples. • Oil collected attached to floating debris, or seaweeds etc. should be placed along with the debris/ seaweeds directly in to the sampling container. • The sample containers should be sealed and labelled as soon as possible to minimise the evaporation of the oil's higher fractions.
Container sealing, Packing and Transporting	• Where possible all samples should be securely packed and sealed, using screw topped containers and fjreboard boxes to ensure safe carriage of the samples. • Sample containers should be glass with a large neck and a screw cover and a seal which would not be affected by oil, e.g. no waxed cap seals. • All sample containers should be sealed with a tamper proof seal. • Any bags should be sealed with a label, which is signed with overlap on bag and label. • Plastic / metal containers are discouraged as can react with the sample and interfere with analysis. • Samples should be stored in a refrigerator / cold room at less than 5 ·C in the dark. • When transporting the materials, dangerous goods instructions should be followed. Vermiculite should be used to surround the samples in the box for protection and to absorb any seepage. • Each sample should be clearly labelled with an identification number, date, time, location and signature of sampler, these details should also be recorded on a log form. • The 'Oil Spill Sampling Form' (see *Appendix I -J)* should NOT be put into the container with the sample but submitted separately. A copy of the form should be kept for records. • The samples and the accompanying *'Oil Spill Sampling Form', Appendix I -J* should be sent for analysis.

1.7.2. Offshore Containment and Recovery

Tier 1 Resources Available	*See Tier* 1 *Capability, Section* 2.1, equipment includes: • MODU and standby vessel onboard spill kits. • Standby vessels and offshore containment and recovery package - Hi-sprint boom, skimmer, and temporary storage.
Tier 2 Resources Available	Tier 2 offshore containment and recovery equipment is available in country through the Fire Service, contact both the Fire Service, and mobilise *Oil Spill Response* if Tier 1 resources are overwhelmed.
Tier 3 Resources Available	*Oil Spill Response* can provide offshore containment and recovery equipment and expertise, see *Tier3 Arrangements, Section 2.4*
General Considerations	• Effective offshore recovery requires trained operators, suitable equipment, well-maintained equipment, vessel logistics, aerial support, temporary storage, transportation and waste disposal. • Even in the most ideal conditions recovery rates will never be 100% and are actually more likely to be around 10 - 20%. • The faster the response, the better the recovery rate as the spill will have had less time to spread and fragment. • If ice is present on the water's surface it is likely that oil will become remobilised once there is a thaw. • Operations are unlikely to be possible in wave heights exceeding 2 m {failure of boom with oil being washed over)or in winds of more than 35 km/hr. • Vessels suitable to deploy offshore boom must have sufficient deck space to house boom reels and power packs and sufficient vessel power rating (bollard pull) to tow the boom. Typically these vessels need to have a low smooth stern without a rail. In addition vessels need sufficient deck space to allow safe crew movement. To accommodate these arrangements minimum deck sizes are: o Deck space to stow 2 x 10 ft containers safely and allow personnel movement o At least 2 m stern to deploy and inflate the boom. o Offshore boom towing vessel at least a 1.5 tonne bollard pull and 400 hp engine
Ice Considerations	• Booming may not be possible due to ice concentration - if surface ice coverage is greater than 25% - 30% booms are of little or no use (Owens, *et al., 1998).* Other research has suggested that 10% ice coverage will render booms ineffective. The extra weight from the ice will cause booms to be under increased stress so operations should be conducted carefully, always slowly working up to towing speed. • Oil may solidify on water surface in ambient temperatures below pour point making recovery using traditional means very inefficient.

Steps to carry out offshore containment and recovery	
Step 1: Direct Vessels	• Identify the thickest concentrations of oil. Aerial surveillance is the best method of directing vessels to the most concentrated area of the spill to conduct containment and recovery operations. • Sites for containment and recovery operations should be selected where the collection will reduce the likelihood of the oil impacting sensitive sites. • Ensure communication can be established between the aircraft and the vessel either directly or via the command team.
Step 2: Contain the Oil	General Considerations • Deploying containment boom will limit further spreading of the oil and concentrate the oil for recovery. • Using the appropriate supply vessels, a number of booming and recovery configurations are available, as per below, with the advantages and disadvantages listed.  + Only two vessels required - Smaller encounter than three vessel system  + Wide encounter with oil - Difficult to coordinate vessels - Wide boom apex Containment Technique • Eddies behind the booms are an indication that they are being towed too fast. Maximum speed is dependant on the amount of oil contained in the boom, boom characteristics and wave conditions. Typically a speed of 0.5 to 1.0 knots is required for effective operations. • Oil lost under the boom will appear as globules or droplets rising 2-10m behind the boom. • Sheens will often be present even when the boom is functioning well. • When towing a sectioned boom that has been joined In a 'U' configuration, an odd number of sections of boom should be used to prevent having a join in the centre of the boom from which oil can more easily escape. • To avoid sharp stress or snatching on a towed boom, lines between boom ends and the vessel should be of sufficient length. 50 m or more would be appropriate for towing a 400 m length of boom. Containment Techniques in Ice • Booming may not be possible due to ice concentration - if surface ice coverage is greater than 25% - 30% booms become of little or no use (Owens, *et al.*, 1998). • Very viscous oils or emulsions may need to be heated to pump. • Oil may solidify on water surface in ambient temperatures below pour point making recovery using traditional means very inefficient. • Oil can sometimes be contained in ice slots, boomed ice slots or in a natural

	embayment. Although the use of booms is difficult in broken ice, oil submerged below solid ice can sometimes be contained using a boomed ice slot. • Internal flotation, pressure inflatable and fence booms are the most suitable booms to use in ice and broken ice environments (Okland, 00)16. The most appropriate of these three should be selected upon the environmental conditions at the time.  Internal Flotation Pressure Inflatable Fence •

Step 3: Recover the Oil	General Considerations
	• Skimmers that are used to recover oil from the water all incorporate:
	  • an oil recovery element
	  • flotation or support
	  • pump or vacuum device to transfer recovered oil and water to a temporary storage device
	• Skimmers will need continuous maintenance by specially trained staff with a supply of spare parts
	• The effectiveness of a skimmer is determined by how qUickly it can collect the oil, and how well it minimises the water to oil ratio collected
	
	Recovery Technique
	• Recovered oil could be pumped into an inflatable storage barge or the recovery oil tank of a standby vessel.
	Wave motion reduces the effectiveness of most skimmers. In calm waters better performance can be achieved if the skimmer is suited to the viscosity of the oil in question.
	• Floating debris, both natural (e.g. sea weeds, sea grasses, trees and branches) and manmade (e.g. plastic, glass, timber) can affect a skimmers performance. Skimmers may need trash screens and regular unblocking where debris is common, such as near urban areas or the mouths of river
	
	Techniques for Ice
	• Ice can be broken by vessels and skimmers / grabs used to recover the oil from the water.
	• Brush skimmers are typically the most effective of skimming devices in a broken ice environment. Belt and rope skimmers are also suitable for oil recovery in broken ice. Large rope mops (used in the vertical plain ie suspended from the ships crane) have been used successfully. Weir skimmers can only be applied in light ice cover conditions «30%) and floes smaller than Im.
	• low temperatures can cause damage and failure due to equipment becoming brittle.

16 Okland, 2000: Recovery of Oil Spills in Marine Arctic Regions

1.7.3. Dispersant - Surface Application

Tier 1 Resources Available	See *Tier* 1. *Capability, Section* 2.1., resources include: • Offshore dispersant package -boat spray systems and dispersant aboard 4 x ERRV / reliefERRV
	See *Tier* 2 *Arrangements, Section* 2.2. resources include: • Dispersant package stored at _______________ - Simplex helibuckets and dispersant
Tier 3 Resources Available	*Oil Spill Response* can provide dispersant, aerial and vessel application systems and dispersant monitoring effectiveness equipment, see *Tier* 3 *Arrangements, Section 2.4.*
General Considerations	• In Greenland dispersant application is to be considered the secondary response strategy for crude oil spills. • Approval must be sought from the BMP prior to the application of dispersant in waters surrounding Greenland, see *Dispersant Application Approval Process, Dispersant* Application Approval Process 1..7.4. Effective Use • Dispersant should only be applied to crude and not light oils such as diesel or heavy oils such as HFO. • Dispersant effectiveness will decrease as the viscosity of oil increases. • It is unlikely that dispersant will be effective on emulsified crudes.
Ice Considerations	• The time window of opportunity for dispersant use is likely to be much longer in arctic conditions as weathering is much slower. This can make dispersant a particularly effective tool for cold climates. • High levels of ice dampen wave action. Movement is required to mix the oil and dispersant for effective application so this can lead to a reduction in effectiveness.

Steps to carry out dispersant application by vessel	
Step 1: Direct Vessels to Dispersant Application Site	• Aerial surveillance should be utilised for all dispersant application operations to direct operations and monitor the effectiveness. • The dispersant operation must be directed at the thickest portion of the slick (leading edge) and not the thinner iridescent silvery sheen areas. • Dispersant application should be considered in offshore and near shore waters to prevent oil entering environmentally sensitive inshore areas.

Step 2: Apply Dispersant

Prior to application

- A simple field dispersant effectiveness test should be conducted on board the vessel to determine effectiveness.
- Prior to wide scale application, a test spray should be conducted to ensure the dispersant will be effective in the marine environment.

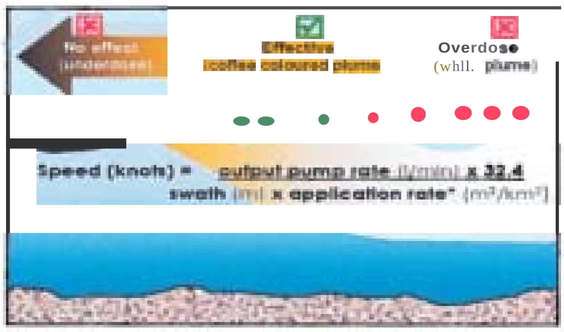
Technique

- Vessel speed should normally be between 5 and 10 knots.
- The spray arms or spray nozzle should be mounted at the bow to avoid the effect of the bow wave which can push the oil beyond the spray width. The bow wave will also provide the required mixing energy. Dispersant should be applied when steaming into the wind.
- Agitation will be required to produce the required mixing energy. In calm sea states the bow wave of the vessel should be sufficient. Applying dispersant in conditions above a Force 5 is not recommended as the turbulence will cover the oil and spray droplets will be blown away.

Application Rate

Typically the most efficient dispersant to oil ratio (DOR) is 1:20, but on fresh oils this can be a lot less (1:100).

The correct application is determined by pump rate and vessel speed (knots) as in the formula below:



DOR (Parts Dispersant : Parts Dill	•Application Rate (rn' / km') (assuming O.1mm 011 thickness)
1: 20	5
1 :40	2.5
1 :60	1.67
1: 100	1

Dispersant Dosage

(Marine Operatar's Dispersant Field Guide, 011 Spill Response 2009)

Step 3: Monitor Effectiveness	Visual Monitoring • A visual check of the spray area will indicate dispersant effectiveness. A grey / coffee colour plume indicates successful dispersion. Spraying too much dispersant will result in a cloudy white plume, too little and there will be no effect.  Illustration of effective dispersant application (left) and ineffective dispersant application (right) *(Image from ITOPF Technical Information Sheet no. 4, 2005)* Fluorometry Monitoring • Ultra-violet fluorometry (UVF) can be used to provide an estimate of the concentration of dispersed oil in the water column during the application of dispersants. This technique can be provided by *Oil Spill Response.* • Fluorometers emit light energy, different particle types re-emit energy at different wavelengths. The fluorometer is calibrated to record energy emitted by hydrocarbons. • If deployed in an area with a high level of hydrocarbons distributed through the water column, the fluorometer will show a greater reading than in an area with no or only background levels of hydrocarbons. • Typically dispersant is considered effective if the fluorometer readings demonstrate 5 times or greater the levels of natural dispersion or background readings

1.7.4. Dispersant Application Approval Process

Permission to spray dispersant must be sought from the BMP prior to any application of dispersant to an oil spill. This is a condition of the permit to drill.

Note: Dasic Slickgone NS is the approved dispersant for application in Greenland. Approval of any other dispersant must be sought on a case-by-case basis.

Dispersant use will be approved by the BMP if considered that the effects of dispersants are less harmful to the environment than if mitigation was limited to attempts at mechanical recovery or no measure at all.

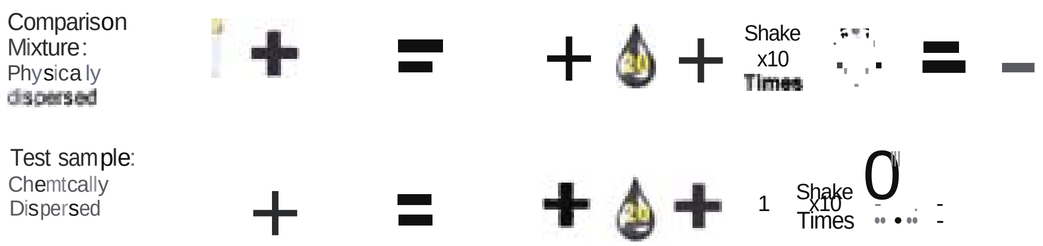
Application for the use of dispersant must contain the following as a minimum:

BMP requirement to approve dispersant application	Action to be taken by capricorn
Estimate of the volume of the spill	Assess the spill see, *Monitor, Evaluate and Sample, Section 1.7.1*
Computer based modelling defining the oil spill trajectory	Contact *Oil Spill Response* and request 0515 oil spill modelling. Complete 'Modelling Request Form' and send to *Oil Spill Response* Duty Manager, see *Appendix 1-F* If sub surface oil spill modelling is required, contact *Oil Spill Response.*
Information to assist BMP / NERI to undertake a Net Environmental Benefit (NEBA) Analysis and ascertain whether approval will be granted.	Complete the form in *Appendix 1-G*

Field Dispersant Effectiveness Test

Capricorn will arrange for dispersant effectiveness testing of oil when in a position to provide a suitable sample for laboratory analysis. If a spill occurs where the oil has not already undergone laboratory dispersant effectiveness tests, the *DSC* should instruct an Incident Response Team Member to carry out the following test:

1. Take one glass jar and fill ¾ with sea water;
2. Add 20 drops of oil to the water using the pipette, or if not available gently pour a small amount to cover the water surface to about 1 mm thickness;
3. Cap the jar and shake the oil and water mixture lightly about 10 times;
4. The oil and water should not mix very well and the droplets should rise to the surface qUickly leaving the water fairly clear. This is your comparison mixture;
5. Take the second clean jar and repeat steps 1 - 3, but also add one drop of your dispersant to the mixture before shaking. This is your test sample;
6. The oil and water should now mix to form a cloudy mixture in the jar, with very small droplets that rise to the surface very slowly (> 1hr) if left undisturbed;
7. Compare your comparison mixture with the test sample. If the dispersant is effective you should see a marked increase in water cloudiness and less surface oiling. The greater the difference the more effective the dispersant, if the two jars show similar clarity dispersant has not been effective and alternative strategies should be explored.



1.7.5. In-Situ Burning

Tier 1 Resources Available	No Tier 1 or Tier 2 fire boom is available. If sourced, then standby vessels can assist with fire boom deployment. Contact *Oil Spill Response* for resources.
Tier 3 Resources Available	*Oil Spill Response* can arrange in situ burning equipment and expertise. See *Tier 3 Arrangements, section 2.4*
General Considerations	• When mechanical recovery is unfeasible, ineffective and/or insufficient, oil burning may be considered. ARRT 2008 guidelines for Alaska will be followed[17]. • Approval must be sought from the BMP prior to commencing in situ burning activities see *In Situ Burning Application Approval Process, section 1.7.6.* • Effective in-situ burning requires trained operators, suitable and well maintained equipment, vessel logistics, aerial support and waste disposal.
Ice Considerations	• In-situ burning is identified by SINTEF as a high potential response technique suited to the arctic environment as the slow weathering of the oil means light ends are slow to evaporate allowing a longer window of opportunity for in situ burning. • Recent research (SINTEF, 2010)18 suggests that 'herders' can be effectively used to *increase* oil thickness to a level at which it can be burnt. However there are currently no commercially available tested and approved herders for use in Greenland waters. • There is evidence to suggest that oil burning is effective in 3/10ths pack ice. • The technique can be effectively employed in loose drift ice using fire booms up to about 30% ice cover. • Contaminated snow can be burned on top of solid *ice* cover if the ice has sufficient carrying capacity for personnel. The most effective way for burning oil on ice is to built a cone of oiled snow and ignite at the top of the cone using a suitable combustion promoter. Ensure melt water is contained close to the burn cone as this may contain traces of oil. Construct berms of snow around the burn cone to do this effectively (ARRT, 2008)19.
Steps to carry out in-situ burning	
Step 1: Contain the oil in appropriate site	• Follow guidance for Offshore Containment and Recovery 1.7.2. • To withstand the heat during burning, a boom which is specifically designed for heat resistance must be used. These booms are typically more rigid and are therefore more difficult to operate than ordinary booms. • No burning activities will be conducted 10 km or less from the Greenland coastline.
Step 2: Ignite the oil	Prior to ignition additional support is required. Collection activities may be conducted using two vessels but ignition requires a separate command / safety vessel and ignition vessel (this can be a FRC deployed from the command vessel). Ignition may only be conducted by trained teams.

To ignite the oil ge e e use con aine wi in an igni er o e - e igniters are available from *Oil Spill Response* and require the addition of diesel when in

17 Alaska Regional Response Team 2008 , Guidelines for In-situ Burning

18 SINTEF *2010. Field Testing of the USN Oil Herding Agent on Heidrun Crude in Loose Drift Ice*

19 Alaska Regional Response Team 2008 , Guidelines for In-situ Burning Most types of oil will burn readily, however slick thickness and emulsification have the

	most effect on ignition and burn efficiency. lighter oils are hard to ignite due to the difficulty of establishing and maintaining slick thickness. Conditions for effective burning

Oil Thickness	Minimum 1-3mm of oil is required for ignition Once the slick is ignited, combustion will be sustained so long as a minimum thickness of around Imm is maintained (ASTM, 03) Efficiency (percent of oil contained in the boom which successfully burns) increases with increased thickness
Emulsification	Less than 25% water content Efficiency and ease of ignition decrease with increasing water content
Weathering	Relatively fresh oil «2-3 days exposure) is best for ignition Once oil has been exposed for an extended period of time and becomes weathered, it is no longer amenable to ignition Weathering times vary upon crude and weather conditions
Wind	< 20 knots for ignition
Waves	Waves impact boom effectiveness and combustion by splash-over <3 ft waves is optimal
Currents	<0.75 knots relative velocity is optimal to reduce undercutting and oil entrainment beneath the boom
Ice	Burning is more efficient the thicker the oil slick is when it is ignited. Isolated floes may interfere with booming operations by filling collection areas, preventing oil build up, and damaging fire booms. Ice can build up in fire booms and preclude the effectiveness of burning.

Step 3: Maintain the burn	• In situ burns must be continually monitored to ensure that the burn does not transgress into any uncontained oil nearby and that burning is at a safe distance from any vessels personnel and combustible material.  Open water containment and burning (Arctic Waters FIeld Guide, EPPR, 1998) • Several vessels are likely to be working in close proximity for burning practices and therefore good coordination is required. • Air monitoring should be conducted whenever the burn is being conducted close to populated areas. • If at any point during the burn the conditions pose a threat to safety or public health, the burn must be extinguished.
Step 4: End the burn	• To extinguish an in situ burn, slow down so that rate of oil encounter is reduced, or release one side of the burn boom. • Collect all burn residue. Burn efficiency rate is around 90% (SINTEF, 2010)[20]. Burn residue should be recovered for floating residues involves using sorbents, large strainers, nets or hand tools. Residues which sink are difficult to recover. Suspended nets under the fire booms are the most effective option.

For further information please refer to:

[20] SINTEF, 2010. Establishing, Testing and Verification of a Laboratory Burning Cell to Measure Ignitability for In-Situ Burning of Oil Spills

- Arctic Spill Response and Development Program-A Decade of Achievement (U.S. Department of the Interior Minerals Management Service 2009)
- ARRT, 2008 In Situ Burning Guidelines for Alaska
- Emergency Prevention, Preparedness and Response (EPPR), 1998. Field Guide for Oil Spill Response in Arctic Waters
- Shell Beaufort Sea Exploratory Drilling Program Oil Spill Response in Ice (D.F.Dickens and A.A.Allen 2007)
- SINTEF, 2010. Field Testing of the USN Oil Herding Agent on Heidrun Crude in loose Drift Ice
- SINTEF, 2010. Establishing, Testing and Verification of a laboratory Burning Cell to Measure Ignitability for In-Situ Burning of Oil Spills
- SINTEF Summary Report on the Joint Industry Program on Oil Spill Contingency for Arctic and Ice-Covered Waters (SINTEF Materials and Chemistry 2009)

1.7.6. In Situ Burning Application Approval Process

Permission to burn must be sought from the BMP prior to the commencement of any in situ burning operations. This is a condition of the permit to drill.

A test burn should be conducted, with permission, prior to large scale in-situ burning operations being carried out.

The application process is:

BMP requirement to approve in-situ burning	Action to be taken by Capricorn
Estimate of the volume of the spill	Assess the spill see, *Monitor, Evoluote ond Sample, Section 1.7.2*
Computer based modelling defining the oil spill trajectory	Contact *Oil Spill Response* and request OSIS oil spill modelling. Complete 'Modelling Request Form' and send to *Oil Spill Response* Duty Manager, see *Appendix 1-F* If smoke plume modelling is reqUired, contact *Oil Spill Response*
Information to assist BMP / NERI to undertake a Net Environmental Benefit (NEBA) Analysis and ascertain whether approval will be granted.	Complete the form in *Appendix 2-H*

1.7.7. Shoreline Protection and Cleanup

Tier 1 Resources Available	See *Tier* 1. *Capability, Section* 2.1, equipment includes: • hold harbour oil spill containment and recovery equipment that would be deployed by the Fire Service for spills that may occur in harbours as a result of Capricorn operations. • A shoreline containment and recovery package stored on board [redacted]. Equipment includes boom, sorbents, skimmers, and temporary storage.
Resources Available	See *Tier* 2 *Arrangements, Section* 2.2, equipment includes: • Shoreline containment and recovery equipment stored at [redacted] Equipment, sorbents, skimmers, and temporary storage, see *Tier* 2 *Arrangements, Section 2.2.*
Tier 3 Resources Available	*Oil Spill Response* can provide shoreline containment, recovery and protection equipment and expertise, see *Tier* 3 *Arrangements, Section 2.4*
General Considerations	• A large labour force may be required to undertake shoreline cleanup. Deployment of shoreline protection will be supervised by trained Response Teams deployed to location that can assist in supervising, training and supporting local personnel such as the Fire Service and volunteers. A local workforce would be required to provide manpower, refer to *section 2.2.3.* • Surveillance and tracking activities will be critical in determining the location and extent of spilled oil. This will be important to establish areas at risk. Shoreline impact is often widely distributed as oil breaks up, spreads and fragments at sea under the influence of wind and currents. • The coastal environment in Greenland does not facilitate shoreline containment, recovery and protection due to the uneven rocky substrate that prevails in the region. • Depending on the degree of emulsification, amount of oiled debris and shoreline type, vast amounts of waste may be generated. In extreme cases, 30 times more waste could be generated than the volume of oil spilled.

Ice Considerations	• A program to track oiled ice would be required for oils that occur among pack ice or for open water spills that reach the pack ice edge or persist through freeze-up in protected inshore waters. This program is being developed and until completion oil under ice would be tracked using current data. This data will provide an estimated position that will then be verified by using augers to pinpoint oil. • Where oil is washed onto exposed ice surfaces, the oil is unlikely to adhere except in cold temperatures when the air, water and oil surface temperatures are below O°e. • If ice is present on the waters surface it is likely that oil will become remobilised once there is a thaw. • During ice conditions the response may be limited to monitoring the spill with recovery operations resuming once the thaw is complete. • During freeze-up, oil present on the shore or stranded on the shore-zone ice during a period of freezing temperatures can become covered and encapsulated within the ice. • In broken ice, without a landfast ice cover, oil may reach the shore and be stranded on the substrate in between the ice floes. If this substrate can be safely reached from land the shoreline cleanup will be carried out. If access is only safely possible by vessel then the position will be recorded and the ice coverage monitored. Shoreline cleanup will then take place on ice thaw. • The drilling window when drilling operations can occur has taken into account the likely timings of returning ice. It allows enough time for the drilling of a relief well from the end of operations until the time when ice normally returns.

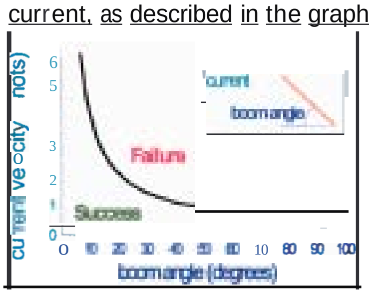
<table>
<tr><th colspan="2">Steps to carry out shoreline protection and cleanup</th></tr>
<tr><td>Step 1:
Prioritise Shoreline for Protection</td><td>

- Areas that should be protected include environmental and socioeconomic sensitivities refer to *Oil Spill Sensitivity, section* 4.2.4 with consideration of the time of the year (e.g. no birds are present at breeding colonies in the winter).
- Protective booming is generally feasible across small bays, inlets, and river mouths with currents <Iknot and breaking waves <1.5ft (O.5m), and on straight coastline areas to protect specific sites, where breaking waves <1.5ft (O.5m).

</td></tr>
<tr><td>Step 2:
Protect Sensitive Shorelines</td><td>

General Techniques

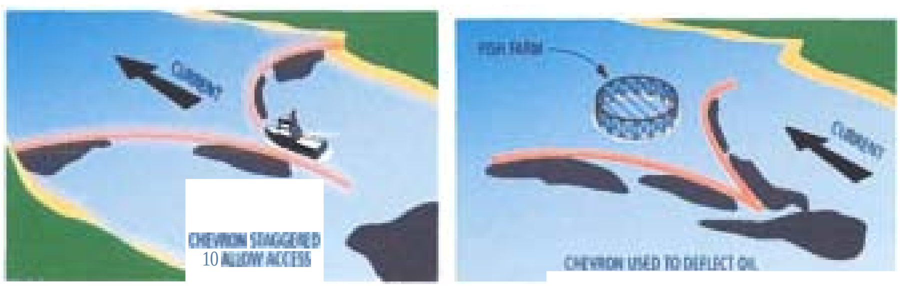
- Where possible, protective booms should be deployed at an angle to the approaching slick to divert oil away from any sensitive area, for example bird breeding grounds.
- When wave amplitude exceeds 1.Sft (O.Sm) or currents exceed 3 knots protective booms should be moved to calmer waters if possible as boom are likely to fail.
- Booming will be ineffective if the current speed at right angles to the face of the boom (due to water current or speed of towing vessels) exceeds 0.75 knots. Entrainment failure can be reduced by reducing the boom at an angle to the current, as described in the graph below.



Booming Angle against Current Speed

Cascade Booming for Shoreline Protection

- A cascade booming system, as shown above, can be deployed where a long length of boom is required or when deploying boom in difficult sea conditions, see cascade booming below.
- For inlets, chevron boom formations can be used to protect sensitivities and to deflect oil to recovery locations, see below:



Chevron Booming as a Protection Strategy

</td></tr>
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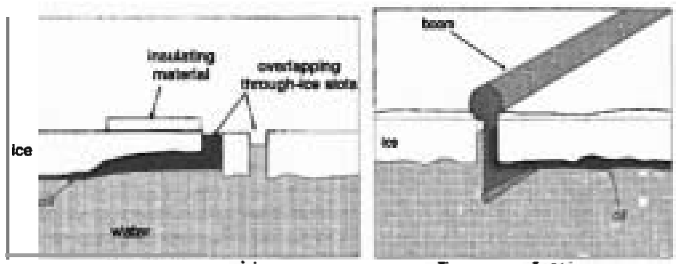
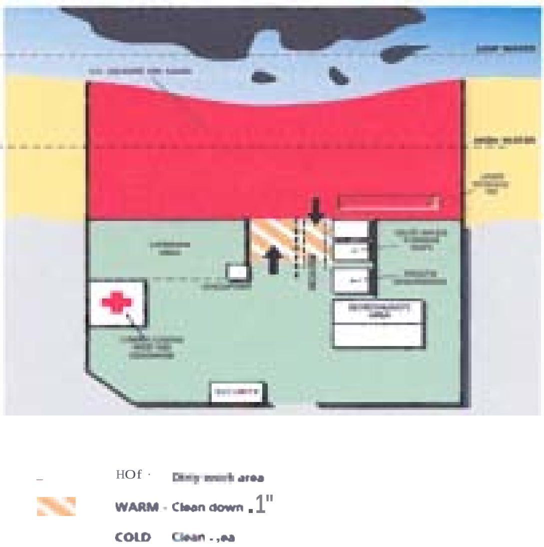
<table>
<tr><td></td><td>Techniques In Ice</td></tr>
<tr><td>Step 2
continued</td><td>• Booming may not be possible due to ice concentration - if surface ice coverage is greater than 25% - 30% booms become of little or no use (Owens, et 01,1998)21.
• Stability of the ice close to the ice/water border may be weak. Personnel should wear harnesses for safety. Constructing diversion booms in broken ice may be impractical unless working using a small vessel.
• Berms can be created on the ice surface to prevent oil spreading further. Berms can be constructed using snow and loose/broken ice. Once in place they should be covered with a plastic sheet to prevent the oil soaking Into the berm and causing additional contamination.
• Excavated structures can be used to collect oil spilled on solid ice cover. Trenches can also contain booms which are frozen in place to create a barrier for oil migration.
• For oil spilt beneath the ice, subsurface slots can be used to divert and contain the oil. In addition, during periods of ice freeze, pockets can be created by placing a insulating material on the ice surface which minimises ice growth below. A pocket will form which will contain any oil trapped under the ice. Oil can then be recovered from slots created in parallel to the pocket.


• Ice Slots to Recover Oil Under Ice[21]</td></tr>
</table>

[21] Emergency Prevention, Preparedness and Response (EPPR), 1998.Field Guide for Oil Spill Response in Arctic Waters 1998. Environment Canada.

Step 3: Prepare the Site for Cleaning	If possible prepare the shoreline for the arrival of oil. Remove any vegetation, floating and stranded debris etc which could become oiled. This reduces oiled waste. • Prepare the shoreline for site cleanup operations. Designate three working zones for the oil spill cleanup site: • Hot Zone: Where all the work is carried out, and temporary storage of collected oil. Under no circumstances should any personnel, public, media or visitors enter this area without full PPE or without permission from the Shoreline Supervisor. Any personnel or equipment leaving this zone must do so only through the warm zone. • Warm Zone: This area is designed to stop any further contamination of oil free areas. It is a transition zone for which all personnel and equipment should pass through to enter either the COLD ZONE or the HOT ZONE. It should be used as the clean down area before leaving the HOT ZONE. Any oiled or segregated waste can be loaded into suitable vehicles for removal in this zone. • Cold Zone: The area where all other operations are carried out (not clean up operations), such as first aid, ICC, shelter, refreshments for workforce, rest areas, toilets, communications, equipment laydown area and security. 

Step 4: Clean Oiled Shoreline	General Considerations • The purpose of shoreline cleanup should be to produce a net environmental benefit. Cleanup techniques can be damaging and in some circumstances oiled shorelines are best left to recovery naturally. • In many areas, fjords, bays and other inshore areas may also be somewhat protected from the extensive contamination by the flushing action of tidal currents and the natural outflow of streams and rivers. As a result, much of the shoreline may not require a widespread active cleaning effort unless it is heavily contaminated. • Where active shoreline clean-up is required, priorities for restoration can be established based on both the environmental sensitivity and oil persistence factors. Preference should be given to *in situ* cleaning techniques such as in-place washing of rocky shores, use of shoreline cleaning agents, in-situ burning and bioremediation. Use of these techniques will minimise the amount of oily material collected and subsequent hauling requirements. Ice Considerations • During ice conditions the response may be limited to monitoring the spill with recovery operations resuming once the thaw is complete. • Natural recovery is the preferred option on exposed coasts. Natural recovery may not be appropriate immediately prior to freeze-up, as the oil would be covered and incorporated into the ice, and potentially be remobilized during the next thaw. • Physical washing can be practical and efficient but shore-fast ice edges often are steep, so washing from a vessel or barge is preferable if water depths allow. The oil should be contained by booms or sorbents and collected by skimmers or sorbents. • Where there is access, response options on frozen shorelines include the cutting of troughs into which the oil may be corralled to enhance collection efficiency. • The drilling window when drilling operations can occur has taken into account the likely timings of returning ice. It allows enough time for the drilling of a relief well from the end of operations until the time when ice normally returns. Techniques In general, heavily contaminated areas should be cleaned first so that bulk oil is not remobilized impacting other areas: • Stage 1: Removal of heavy contamination and floating oil. • Stage 2: Clean up of moderate contamination, stranded oil and oiled beached materials. • Stage 3: Clean up of lightly contaminated shorelines and removal of oily stains. Appropriate techniques to use will depend on the characteristics of both the area oiled and of the oil, but include: • Natural recovery • low or high pressure ambient or warm water flushing • Manual cleanup • Mechanical removal, e.g. graders, scrapers, vacuum systems • Sediment relocation • Absorbents • Washing In the stage of final cleanup the endpoint should be determined for each oiled site. Endpoints should be realistic and obtainable for the spill conditions.

1.7.8. Waste Management

Capricorn's daily waste management practises are described in the Waste Management Plan (ED/GRI/HSE/WMP/10/2094). Capricorn will extend this plan and its principles to management of waste arising from any oil spill.

legal Requirement

The waste producer, as defined in Article l(l)(b) of Directive 2006/12/EC has a legal duty to ensure that waste oil and contaminated material produced as a result of an oil spill incident is handled, transported and disposed of in an appropriate manner. Capricorn, as waste producer, will utilise a registered waste contractor to handle all waste generated as a result of an oil spill incident.

Where capacity exists, waste will be transferred in suitable UN-approved containers and transported to the municipal incinerator with energy recovery in Greenland for disposal. If disposal in Greenland is not possible, waste will be transported to Denmark by a registered waste carrier in accordance with the International Maritime Dangerous Goods Code (IMDG), Regulation (Ee) No. 1013/2006 and Regulation (Ee) No. 308/2009 for disposal at specialist treatment facilities.

Waste Volumes

Oil spill response operations have the potential to generate liquid and solid wastes. The types and quantities of waste material largely depends on the amount of oil that reaches the shoreline and on the specific cleanup methods employed.

Capricorn support vessels involved in drilling operations have oily waste storage available for immediate offshore recovery as stated in *Appendix 2-0*.

If required, Capricorn will charter a tanker suitable to transfer waste to Denmark, the tanker or tankers chartered will vary dependent upon the capacity required. This vessel will be chartered through Capricorn will liaise with in-country logistics as coasters may be more suitable in shallow draft locations.

Waste Types

Waste from an oil spill response operation includes:

- recovered oily wastes
- non-oily materials generated from the operational and supporting activities
- materials contaminated with solvents, dispersants and fuels, gray water and unoiled wastes.

The types and volumes of waste generated by response activities are determined by the response objectives set during the spill management.

Table 8 identifies the likely types of waste from each response strategy.

Table 8 Type of Waste related to Response Strategies

Technique	Effect on Waste Stream	Type of Waste
At-sea Response Options	Recovery operations will potentially give rise to a large quantity of waste oil and water for treatment. The type of oil spilled will have an effect on the resultant waste; in particular viscous and waxy oils will entrain debris and can create large volumes of waste. They can also present severe handling difficulties.	• Oiled equipment / vessels / PPE • Recovered oil / oily water • Oiled vegetation • Oiled sorbent materials • Oiled flotsam and jetsam • Animal carcasses
Dispersant Application	Waste concentrations are minimal as the oil is dispersed in the water column and allowed to biodegrade naturally.	• No hydrocarbon waste is generated • PPE • Empty dispersant drums / considerations
Shoreline Cleanup	The type of oil spilled will often have an effect on the amount of oily waste generated. Waste segregation and minimisation techniques are critical to ensure an efficient operation. These should be established at the initial recovery site and maintained right through to the final disposal site. Waste sites should be managed in such a way as to prevent secondary pollution.	• Oiled equipment/vessels / PPE • Animal carcasses • Recovered oil / oily water • Oiled vegetation • Oiled sorbent materials • Oiled beach material: • Oiled flotsam and jetsam / debris

Waste Handling and Storage

Waste minimisation will be given a high priority when responding to a pollution incident. The segregation of wastes into different waste streams is key to ensuring they can then be disposed of in an appropriate manner.

Waste generation ideally involves immediate classification, segregation, packaging and labelling at source. All packaging or containers should be labelled with information such as type of material, location (waste generation site), date and description of the type of material (sand, PPE, debris).

Waste management in remote areas is challenging. The primary method of transportation in Greenland will be by sea as there are few roads and overland access areas. Intermediate transfers by helicopter or all-terrain vehicles may support the consolidation of the waste materials but are not suitable for large volume waste management.

2. Oil Spill Response Resources Available to Greenland Operations

The following Tier 1 capability and Tier 2 and 3 arrangements layout the oil spill response resources that are available to Capricorn.

2.1. Tier 1 Capability

2.1.1. MODU's

Tier 1 resources on board the MODU's consist of spill kits for mitigating minor deck spills. Nine 'type 1' kits are on board the *Leiv Eiriksson,* and seven on the *Corcovado,* each containing:

Sorbent pads (numerous, assorted sizes)	Sorbent booms	Shovels
Personal Protective Clothing (PPE)	Plastic bags	Buckets

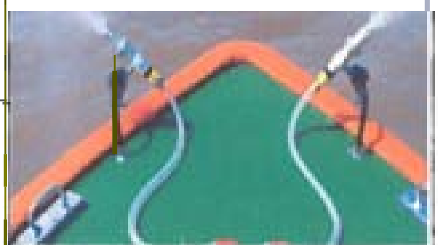
The *Corcovado* has an additional 15 kits containing assorted sorbents on board. On board locations of spill kits are shown in *Appendix 2-5*.

2.1.2. Offshore equipment

The primary offshore response vessels are the two emergency rescue and recovery vessels (ERRVs), • [redacted]. The backup ERRVs, have supplementary equipment loaded onto them to provide coverage during *Esvagt* crew changes.

Table 9 lists the equipment available.

Table 9 Standby Vessel Tier 1 Oil Spill Response Equipment

Resource	Location	Description	Number in total, not per vessel	Image
Offshore Containment Boom	[redacted]	250 m Hi-sprint boom with powered reels	2	
	[redacted]	200m Ro-Boom 1300 1 power pack per vessel	3	
Offshore Recovery	[redacted]	Helix (brush head) offshore skimmers with power packs	2	
	[redacted]	Walosep offshore wier skimmer (to be used with same power packs as boom)	2	
Dispersant Package	[redacted]	Boatspray system with Afedo nozzles	3	
	[redacted]	Vessel mounted spray arms with in-built fire system pump	1 set	
	[redacted]	Dasic Slickgone NS Dispersant. See *Appendix 2·k* for MSDS	16,000 litres (4,000 per vessel)	

2.1.3. Shoreline equipment

A shoreline response package Is placed on the ware/accommodation vessel, the _ This package consists of the equipment listed in Table 10 below. Container numbers are listed in *Appendix 2-r.* When the rigs separate to drill in both northern and southern blocks, an additional shoreline package will be mobilised from _ stocks and placed on the second ware/accommodation vessel. This will provide 3 separate stocks of shoreline equipment with Tier 1 resources in and Tier 2 resources in _ resulting in faster deployment to sensitive areas than a single stockpile provides.

Table 10 Shoreline Oil Spill Response Resources - *Toisa Vigilant*

Resource	Amount
Rope Mop	2
Komara 12 Skimmer	12
Power vac units	12
Spate pump with delta heads	2
Fastank	4 x 2000 gallon
Sea sentinel boom	20x20m
Shore guardian boom	6x20m
Fence boom	8x2Sm
Anchor system	30
Honda water pump	2
Air fans	4
Boom ancillary box	2
Clean up consumables (rakes and shovels)	20
Clean up consumables (20 buckets and 100 bin bags)	20
Absorbent boom bale	6
Absorbent pad pack	6
PPE	2S sets

2.1.4. Aerial Surveillance

Aerial surveillance will be provided by helicopters involved in Capricorn exploration drilling operations, or fixed wing aircraft. Sikorsky S-92 helicopters, operated by Cougar, will be based and serviced at . for the whole 2011 drilling period. During drilling activities, they will also be based in _____ - The fixed wing aircrafts will operate between [redacted] _ and are operated by Air Greenland. See *Table **14*** for aircraft specifications.

2.2. Tier 2 Arrangements

2.2.1. Equipment owned by Capricorn

There are no Tier 2 oil spill response providers in Greenland. Tier 1 resources will be supplemented by the Tier 2 resources in Table 11, which are stored at During Eqqua and Napariaq drilling activities, a proportion of these stocks will be positioned on the for faster deployment to central and northern Greenlandic areas.

Table 11 Tier 2 011 Spill Response Equipment Stockpile

Resource	Unit	Description	Image
Shoreline Response Package	28	Ropemop Skimmers	
	28	Komara 12 oleophillic disc skimmer	
	28	Mini Vacuum systems	
	28	Spate pumps with delta heads	
	20 28	Fastanks: 2000 gallon capacity 1500 gallon capacity	
	5600 m	Sea Sentinel boom	
	2680 m	Shore Guardian boom	
	2800 m	Fence boom	Shoreline boom
	90	Absorbent boom bales	
	90	Absorbent pad packs	
	150	Anchor systems	
	2	Boom ancillary box	
	375	PPE sets (hard hats, cold weather overalls, thermal wellingtons, gloves, etc)	
	300	Shovels	Fastank - temporary storage
	300	Rakes	
	300	Buckets	
	150	1 tonne bags	
	15,000	Bin bags	
Dispersant Package	5	Helibuckets (Simplex) Initially all based in [redacted], they will be split between [redacted] and [redacted] activities	
	32,000 litres	Dasic Slickgone NS Dispersant (see *Appendix 2·k* for MSDS). 8,000 litres will be held at [redacted] 8,000 litres in Aasiaat (during [redacted] • and activities) and 16,000 litres at [redacted]	

2.2.2. Regional Fire Station Resources

The Fire & Rescue services hold both offshore and shoreline equipment and a request for assistance would be undertaken during an oil spill.

Greenland consists of four municipalities who have their own respective Fire & Rescue services. The Fire Departments are spread over 17 cities and more than 60 smaller settlements. There are over 850 fire fighters in Greenland, 466 of which are based in cities. In a spill a request for assistance would be undertaken. Those based in cities would be easier to mobilise due to logistics. City-based personnel numbers are listed in *Table 1.3*.

Harbour Equipment

[redacted] have the following shoreline oil spill response equipment available for use in [redacted] and other important centres stockpile a similar range of equipment.

Table 12 Fire Station Oil Spill Response Resources

Resource	Unit	Description
Transfer pump and hose	1	10 m, 8.5 cm diameter hose
Sea sentinel boom	6	Air inflation skirted boom
Disc skimmer and hydraulic pump	1	*12 tonnes/hr* pump rate
Hose	1	15 m, 5.2 cm diameter, camlock and storz coupling
2.5kw generator	1	Diesel powered electric generators.
Air compressor	1	Hand held
Temporary storage	1	Capable of storing up to O.S m^3, further temporary storage may be sourced.

Coastal Equipment

Some Fire & Rescue departments have the capability of handling smaller coastline oil spills as they have boom / skimmer equipment. Deployment vessels would need to be sourced, refer to *Locol Greenlandic Resource Mobilisation 2.2.3.*

Stated below is the subdivision of the Departments in the cities and their oil spill material. The boom is of various size, some is short skirt river Ro-boom ideal for deflection booming in the fiords. Some is up to 1.5 m which is ideal for coastal and offshore containment and recovery.

Table 13 City Fire & Rescue service Equipment

[redacted]	[redacted]	Fire Fighters	Oil spill equipment
[redacted]	[redacted]	25	None
	[redacted]	27	None
	[redacted]	27	None
	[redacted]	31	200 meter boom, 2 oil skimmers
	[redacted]	27	200 meter boom, 1 oil skimmer
	[redacted]	27	200 meter boom, 1 oil skimmer
	[redacted]	27	200 meter boom, 1 oil skimmer
	[redacted]	25	None
[redacted]	[redacted]	31	200 meter boom, 1 oil skimmer
	[redacted]	29	200 meter boom, 1 oil skimmer
[redacted]	[redacted]	32	520 meter boom, 2 oil skimmers
	[redacted]	27	200 meter boom, 2 oil skimmers
	[redacted]	27	200 meter boom, 1 oil skimmer
		25	None
[redacted]	[redacted]	29	360 meter boom, 2 oil skimmers
	[redacted]	2S	200 meter boom, 1 oil skimmer
	[redacted]	25	200 meter boom; 1 oil skimmer
[redacted]		466	

2.2.3. Local Greenlandic Resource Mobilisation

A shoreline response would require the mobilisation of local support, both for vessels and personnel. Shallow draft vessels would be required to assist in deploying shoreline protection boom and moving personnel to different coastal areas for protection or possibly shoreline cleanup activities.

The instruction to mobilise support would be issued from the ERG, and at the same time the ERG would request assistance from the BMP ERC to mobilise support from Greenlandic services. The process to mobilise local support would be run initially from the Capricorn in country logistics team, moving to the in country operations team once the in-country Tier 3 structure has been set up.

To mobilise personnel, the in-country logistics team will issue requests to the municipalities who have the structure and knowledge to enable community communication. The main point of contact with the municipalities lies with _ who are a • based organisation that facilitate cooperation between all four municipalities of Greenland: . local personnel availability was tested during one of Capricorn's emergency exercises held in 2011 which was based on a large oil spill scenario. Within hours ofthe exercise commencing, _ had organised a list showing availability for approximately 400 people for oil spill response duties on request. Due to exercise timings, this did not include input from all municipalities.

Vessels would be sourced from several different areas. Capricorn holds contact lists for Harbour Master, local charter and logistics services which will be contacted by the in-country logistics team should local vessel mobilisation be required. This process has been tested and snapshot vessel availability confirmed.

In a large incident a local call-in facility for grievances, complaints and offers of support would be set up. This facility was tested during one of the 2011 emergency exercises and were able to provide this facility.

local mobilisation will require a support structure. PPE is held in ________ _ Food and additional supplies would be flown in by aircraft charter and moved by vessel or helicopter to the appropriate areas. During a 2011 emergency exercise a test was run to secure accommodation and within hours accommodation for over 350 people had been secured in [redacted] with more accommodation available after a week. Capricorn chartered vessels can also provide accommodation.

2.3. Mobilisation Logistics for In-Country Equipment

Tier 2 shoreline response equipment is held centrally at _ airport in a temperature controlled hangar in order to enable rapid deployment by sea or air. Tier 3 equipment arriving by air will also be brought into _ .

By5ea

A vessel with crane will steam towards _ airport, travelling the approximate 90 nm up [redacted] From the airport storage hangar at the equipment will be transferred by flat bed truck to the loading jetty at the top of Søndre Strømfjord, a distance of approximately 15 km. local logistics staff working at _ airport have been familiarised with the warehouse layout and equipment organisation as part of the equipment commissioning procedures.

The jetty at has a crane and loading barges to shuttle equipment out to a craned vessel such as the _ . This vessel will transport the equipment down and offload it onto smaller vessels for deployment.

Approximate vessel transit times for the operational area are provided in Figure 12.

By Air

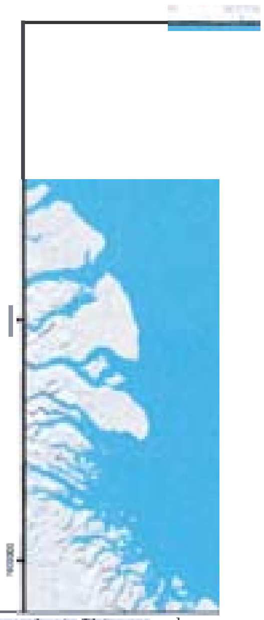
Equipment can be transferred as an under slung load from the helicopters or onboard fixed wing aircraft, see Table 14 for aircraft specifications. Tier 2 oil spill response equipment may require re-packaging to be transported by fixed wing aircraft or helicopter. Helicopter cargo nets will be provided by [redacted]

Air Greenland has helicopters and pilots trained in the use of underslung loads based at _ Airport. On the knowledge that their assistance will be required they will be contacted to see what resources can be used.

For planning purposes use the aircraft specifications in the table below. The exact capabilities of each aircraft will be discussed with Cougar Aviation or Air Greenland during an incident.

Table 14 Aircraft Specifications

No/type of capricorn Chartered aircraft		Operated by; and from	External payload (maximum)	Range (maxfuel)	Speed
Sikorsky 5-92/ 561	4	cougar; . [redacted]	3,000 kg / 6,613 lb (with 1 hr flying time)	1,389 km	250 km/hr (typical cruise)
De Havilland Dash 7	2	Air Greenland; [redacted]	4,500 kg (9,920lbs) Configured as a passenger plane for normal operations, must be converted to cargo carrying for eqUipment transportation. Cargo door dimensions: height - 1.78 m, width - 2.31 m	1,931km	397km/hr



Approximate Distances and nmes to WOrldnl **Locations**

From	To	Dlstlnml	Dlst (kml	at 12kts
Auiaat	Kanlertussuaq	277	514	23h06m
AlSiaat	Nuuk	295	546	1d00h33m
Aaslaat	Delta	204	377	16h59m
Aula. t	Gamma	185	342	15h 24m
Aasiaat	At.mmik	271	SOl	22h33m
Aaslaat	Lady Franklon	328	608	27h21m
Nuuk	Aasiaat	295	546	1dOOh33m
Nuuk	Kanlertussuaq	230	427	19h 12m
Nuuk	Lady Frankl̈n	162	300	13h 30m
Nuuk	Atamml k	120	222	09h58m
Nuuk	Gamma	408	755	1d09h57m
Nuuk	Delta	481	890	ld 16h03m
Delta	Lady Franklin	451	836	ld 13h 36m
Delta	Atammik	406	752	1d09h51m
Delta	Gamma	122	225	lOh08m
Gamma	Lady Franklin	348	644	Id04h 57m
Gamma	Atammlk	315	583	Id02h ISm
Nuuk	Narsarsuaq	340	630	ld04h 20m
Aberdeen	Peterhead	23	43	01h5Sm
Peterhead	Esberg	355	657	IdOSh 35m
Peterhead	Nuuk	1n4	3193	5d 23h4Om
Pete'head	Aaslaat	2025	3750	7d00h45m
Kanlertussuaq	Søndre Strømfjord moUth	89	165	07h25m
Kangerlussuaq	Della	433	802	36hOSm
Kangerlussuaq	Gamma	346	641	28h49m
Kangerlussuaq	Alammlk	181	335	15hOSm
Kangerlussuaq	Lad Frankl̈n	249	461	2Oh45m

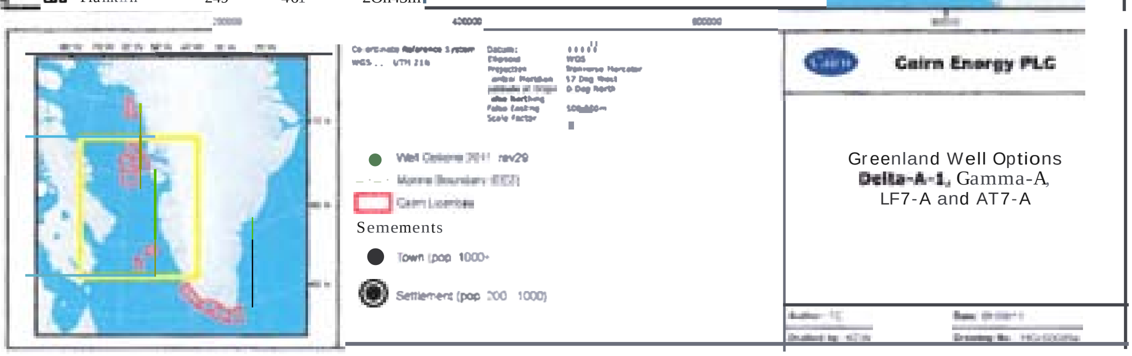


Figure 12 Working Locations and Approximate Transit Times

2.4. Tier 3 Arrangements

Oil Spill Response is the Tier 3 oil spill response contractor for Capricorn and operates on a 365 days / 24 hours basis, with the nearest main response base located in _ . On notification / mobilisation during an incident, the *Oil Spill Response* Duty Manager can offer over the phone advice and guidance on response techniques prior to *Oil Spill Response* personnel and equipment joining the response in Greenland.

Notification or Mobilisation

Oil Spill Response

Contact *Oil Spill Response* and ask for the Duty Manager

[redacted]

Cairn employees with the authorisation to mobilise *Oil Spill Response are listed in Appendix 1-E*

Notification and Mobilisation Forms can be found in *Appendices C and D.*

Tier 3 resources supplement and extend all other oil spill resources with equipment, personnel and expertise. A full inventory of equipment is located in the current *Oil Spill Response* Yearbook or accessed at www.oilspillresponse.com. Table 15 lists a snapshot of the equipment available; note that Capricorn would be entitled to 50% of the stock of the containment and recovery equipment listed in the event of a Tier 3 incident.

Table 15 Tier 3 Resources

Resource	Description
Technical Advisor *(free of charge for first 48 hrs once on site)*	Expert oil spill technical advice and support within the ERG or IRT, mobilised from [redacted]
Oil Spill Response Team	1 x Team Manager; 1 x Field Operations Manager; 1 x Duty Administrator; 11 x Spill Response Specialists; 1 x Spill Response Specialist with specific responsibility for undertaking specialist task (such as fluorometry)
Aerial Surveillance and Remote Sensing	Aerial Surveillance *Oil Spill Response* can provide trained Aerial Observers and training for in country personnel as required
	Remote sensing Aircraft with SLAR / SARa / FUR / IR / UV remote sensing capability can be sourced through *Oil Spill Response* or in the first instance. *section* 2.5.1 outlines the logistics of this service and *Appendix I-m* provides more information on the surveillance capability. Satellite observation can be requested by the Admiral Danish Fleet in Denmark (as an EU coastal member state) through the European Maritime Safety Agency (EMSA) satellite service. A request will be made to the Admiral Danish Fleet through Greenland Command; Capricorn will liaise with Greenland Command to obtain this service. For remote sensing descriptions see, *Monitor Evaluate and Sample, Section 1.7.1*

Oil Spill Response aerial dispersant application	• Dispersant (various types available), see *Tier 3 Dispersant Resources, Section 2.4.1* • Hercules and Aerial Dispersant Delivery System (ADDS) • Hercules and Nimbus Dispersant Delivery System • Fluorometry dispersant effectiveness monitoring equipment • For timeframes of mobilisation / transport to site of Tier 3 equipment refer to *Tier 3 Logistics, Section 0*. 
Oil Spill Response offshore containment and recovery equipment	• 6,500 m offshore boom stockpile with ancillaries • ~32 offshore skimmers and ancillaries; • Temporary storage • For timeframes for mobilisation and transport to site of Tier 3 equipment refer to *Tab/e9.* 
Oil Spill Response in-situ burning equipment	• 2 x Elastec hydrofire boom (2 based in _ 2 i n ___ -+ 2 additional training boom) 
Oil Spill Response shoreline containment and recovery equipment	• 15,410 m shoreline boom stockpile with ancillaries • ~117 shoreline skimmers and ancillaries; • Temporary storage • For timeframes for mobilisation and transport to site of Tier 3 equipment refer to *Tab/e9*. 
Global Response Network (GRN)	*Oil Spill Response* may request resources for an ongoing Tier 3 response from the GRN. The Global Response Network is a collaboration of seven major oil industry funded spill response organisations whose mission is to harness cooperation and maximise the effectiveness of oil spill response services worldwide. Equipment held by GRN members other than *Oil Spill Response* includes over: • 16,000 m offshore boom • 82,0000 m shoreline boom • 300 skimmers or integrated oilbooms • 370 pumps • 370 temporary storage tanks or barges

2.4.1. Tier 3 Dispersant Resources

The following table Identifies the location of Dasic Slickgone NS stockpiles available to Capricorn. Dasic Slickgone NS is the approved dispersant for application in Greenland. Other dispersant types could be mobilised but approval of any other dispersant type must be sought through the BMP to be considered on a case by case basis.

Table 16 Dispersant Resources

Source		Location	Volume[22] in litres
Industry	Capricorn	[redacted] ([redacted] vessels; [redacted] airports)	48,000
Oil Spill Response and the GRN	*Oil Spill Response*	[redacted] / [redacted] 1	255,000 This will be increased throughout 2011 to 500,000, 300,000 of which will be held in the UK
	[redacted] through the Global Response Network (GRN) Dispersant Sharing Agreement t-_through *Oil Spill Response*_-+-	[redacted]	150,000 could be provided from a 500,000 stock held
Potentlal[a] other resources	[redacted] mobilised through *Oil Spill Response*	[redacted]	216,000 (access would be to a portion of this stock)
	Further governmental resources	[redacted]	600,000 (access would be to a proportion of this stock)
Mutual Aid Agreements[24]	Canden	[redacted]	
	Copenhagen Agreement	[redacted]	

Further dispersant would be available from the Dasic. For planning purposes the following information is provided by on how quickly dispersant could be manufactured (this could be affected if there are several suppliers placing very large raw material orders at the same time):

- Dasic try to keep the raw materials for 100 m^3 of dispersant in stock at any point in time for additional orders
- Dasic require 2-3 weeks to manufacture this 100 m^3 dispersant and supply in IBC's (assuming normal supply times for IBC's)
- Dasic require 2-3 weeks to increase manufacturing capacity, from which point they will be able to manufacture 50 m^3 Dasic Slickgone NS from this point on

[22] Note - all dispersant volumes not held by Capricorn are approximate and subject to change. Request confirmation of volumes from *Oil Spill Response* at time required.

[23] Potential resources cannot be guaranteed. However based on current indications, access to these stocks is probable and should be confirmed if required.

[24] Activation of mutual aid agreements should be discussed between the Greenland Government, Danish Government and involved parties as more resources are reqUired.

2.5. Mobilisation Logistics for International Equipment

2.5.1•• aerial surveillance

If SAR capability is required this can be provided by • and exact logistical requirements confirmed dependant on conditions on the day. The surveillance aircraft is on 24 hour call (ie from request to wheels up will take 24 hours as this allows a call back period if already mobilised for another task). The aircraft would be mobilised from _ to Greenland, with a flight time of approximately 10 hours.

Operational flight time for the aircraft is 5 hours in total so allowing for 1 hour transit each way from the airport in Greenland to the rig area leaves 3 hours on-station time for the surveillance activities. It is possible to conduct 2 flights per/day within the crews duty time.

2.5.2. Tier 3 Logistics - Oil Spill Response

The following table provides an estimation of likely response times for mobilisation of Tier 3 resources to Greenland or Canada from *Oil Spill Response.* Times are dependent upon a number of criteria including aircraft charter availability, weather and availability of flight crews. *Oil Spill Response* can provide accurate timescales at the time required.

Table 17 Tier 3 Logistics

Tier 3 Operations based from Greenland, initially mobilising from UK						
Operation	Mobilisation (hrs)	Transit	urnaround	To site	Total	Comments
Tier 3 aerial dispersant application based from _ (2xflight crew)	6	6	2	1	15	There would be a necessity to refuel in Keflavik (Iceland) or alternate
Tier 3 aerial dispersant application based from _ (Ixflight crew)	6	6	12	1	25	A period of a 12 hr rest time will be required by the flight crew if only one crew are available
Dispersant re-supply by airto _	6 to 18	6	N/A	N/A	12 to 24	Payload and mobilisation time is dependent upon aircraft availability
Tier 3 offshore equipment to _ and vessel to site	6 to 18	6	24	15 to 36	51 to 84	Payload and mobilisation time is dependent upon aircraft availability Offshore equipment will be mobilised by barge from Kangerlussuaq and transferred to the Standby Vessels

Tler 3 Operations based from Canada, initially mobilising from UK							
Operation	Mobilisation (hrs)	Transit (hrs)	Turnaround (hrs)	To site (hrs)	Total (hrs)	Comments
Tler 3 aerial dispersant application based from " _ (2xflight crew)	6	11	2	2	21	
Tier 3 aerial dispersant application based from " _ (lxflight crew)	6	11	12	2	31	A period of a 12 hr rest time will be required by the flight crew if only one crew are available
Dispersant re-supply by air to "	6 -18	<11	N/A	N/A	17 - 29	Payload and mobilisation time is dependent upon aircraft availability
Tler 3 offshore equipment to Iqaluit and vessel to site	6 -18	<11	2	56 (based on 12 kn speed)	75 - 87	Payload and mobilisation time is dependent upon aircraft availability Offshore equipment will be mobilised by working barge from _ _ to Standby Vessel based offshore

2.5.3. ISB Boom Mobilisation Procedure

Note: loading times are based on 1 or 2 ISB booms (with all ancillaries) only. A full bespoke package including other equipment would take longer to load and may exceed 10.5 tonnes in which case a refuelling stop would be required.

Action	Tlme (hours)	Response Assumptions
Call out *Oil Spill Response,* load boom and transport to airport Recall Hercules and arrange crew with sufficient flying hours	6	Using _ airport - _ would be quicker but may not be available during a night time call out
Airplane load and flight to [redacted]	6	No time delay in obtaining permission to land; no fog or other weather issues causing flight delays
Unload, transfer to vessel at [redacted]	2	Flat bed truck available and waiting, no customs issues, and a clear loading jetty
Steaming time to mouth of ___ [redacted]	7.5	Based on steaming speed: 12 kn and that a vessel is within 5.5 hours steaming time of and can be immediately directed - if all releasable vessels are in the permit blocks then this time will be increased. If evacuation support is required this will take priority over equipment movement.

2.5.4. *Oil Spill Response* Mobilisation Procedure

The following procedure will be followed to mobilise *Oil Spill Response.*

OILSPILL)

Notify *Oil Spill Response* prior to Tier 1 *1*2 resources becoming ovelWhelmed,
Call the Duty Manager (OM) - , faxlemall *Oil Spill Response* Notification Form, *AppendixC*

↓

Liaise with *Oil Spill Response* OM, assess if a Technical Advisor is required

Mobilise *Oil Spill Response* if Tler 1 *I* 2 resources are likely to be overwhelmed, faxlemail Oil Spill Response Mobilisation Form, Appendix 0

↓

Prepare for the arrival of *Oil Spill Response* personnel and eqUipment, see Role of Cairn in supporting *Oil Spill Response, Section 2.3.4*

Maintain contact with *Oil Spill Response* Duty Manager

Oil Spill Response Actions

OM will operate from the Operations Control Room, Southampton, UK.
The DM will:

- Offer advice and support,
- Discuss the option of sending a Technical Advisor to Caim (free of charge for first 48 hrs on site),
- Begin preparatory mobilisation procedures,
- Liaise with Cairn on potential flight clearance issues, dispersant requirements, logistics,
- Notify the 1hr team and Aircraft Contractor.

↓

The OM will:

- Confirm the mobilisation with the authorisation authority,
- Mobilise nominated personnel, Tier 3 dispersant application eqUipment, aircraft and other equipment as necessary,
- Mobilise dispersant stocks as required,
- Liaise with Cairn regarding flight clearances.

Oil *Spill Response* personnel and equipment mobilise to Caim oil spill incident in Greenland

Figure 13 *Oil Spill Response* Mobilisation Procedure

2.5.5. Role of Capricorn in Supporting *Oil Spill Response*

In the event of an *Oil Spill Response* mobilisation, Capricorn would be required to assist *Oil Spill Response* in logistical support. *Oil Spill Response* has vast experience of responding to oil spills and can assist with customs documentation, information on the types of vehicles and boats required, and the number of personnel needed, but they will ultimately rely on Capricorn to ensure that in-country requirements are met.

The following figure shows the tasks involved in moving equipment from the *Oil Spill Response* base to the scene of the incident and then to deploy these resources to mitigate the effects of the incident.

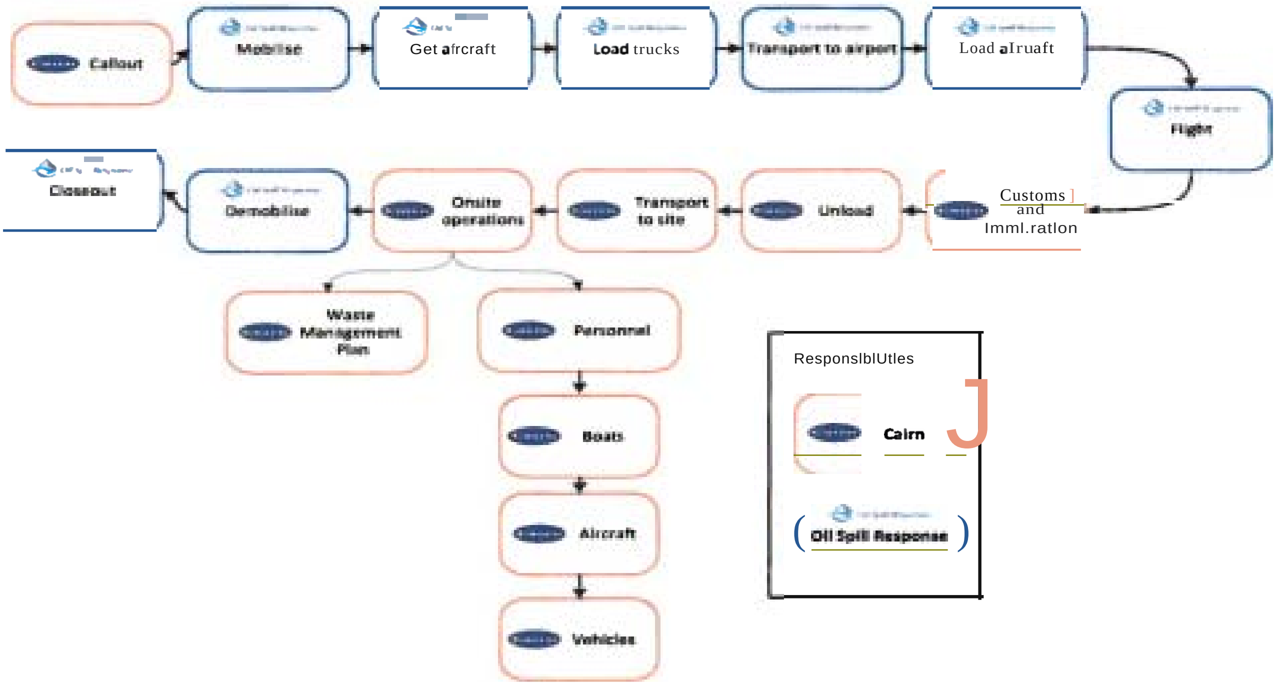


Figure 14 Responsibilities of Capricorn and *Oil Spill Response* In the Mobilisation of Resources

Oil Spill Response works continually to improve their response but needs the continued support of Capricorn in the event of an incident to ensure the chain is not broken. Once *Oil Spill Response* has been mobilised, Capricorn will assist in a variety of ways:

Table 18 Responsibilities of Capricorn and *Oil Spill Response* in the Mobilisation of Resources

Action	Assistance Required
Flight	• Liaise directly with the *Oil Spill Response* Duty Manager (OM) to see if assistance is required with obtaining over-flight clearances and landing rights • Meet the flight (equipment will normally be accompanied by a Response Specialist)
Customs and Immigration	• Liaise directly with the *Oil Spill Response* OM to explain required documentation for Greenland Customs and Immigration • Arrange emergency clearance for customs / immigration / visas
Unloading	• At the airport Capricorn to provide: o Ground handling equipment o Hi-loader o Forklifts (low mast for unloading Hercules L-382 aircraft) o Local agents to carry out aircraft unloading • Transport to Site. Capricorn will arrange and to assist with: o Trucks for transport o Loading of equipment onto transport o Provision of secure storage o Control and tracking of equipment
On Site Operations	• *Oil Spill Response* will provide: o Technical expertise and services o Daily reports on activities and costs o Management of own personnel and decisions on duration of duty periods • Capricorn will be expected to arrange: o Food, accommodation and transport for *Oil Spill Response* personnel
Demobilisation	• *Oil Spill Response* will liaise with capricorn to plan demobilisation: o In use / standby decision o Onsite cleaning o Return freight by air or sea

3. Action Plan

3.1. Alert Procedure

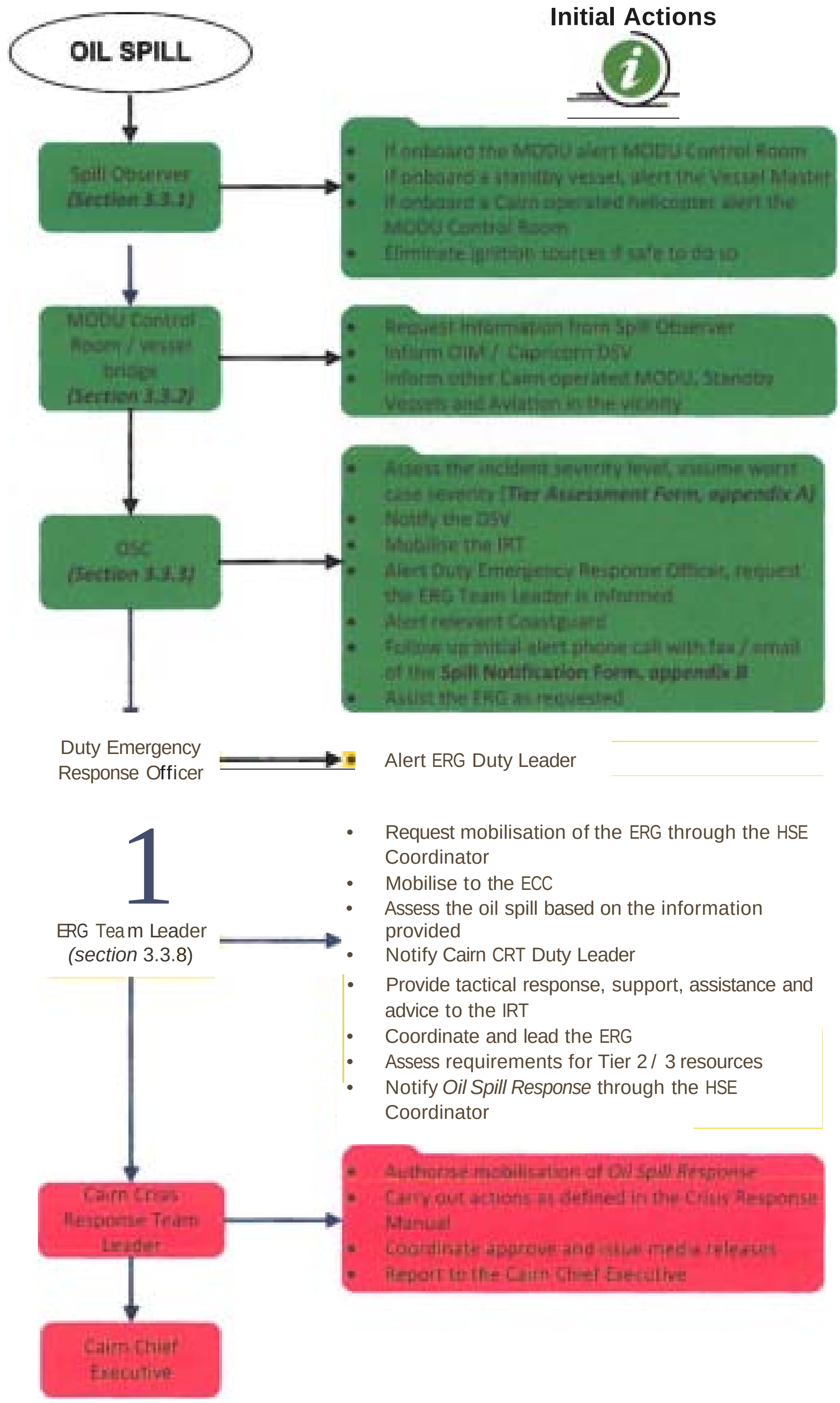


Figure 15 Alert Procedure

3.2. Oil Spill Response Organisation

Management of oil spill response by Capricorn depends on a tiered organisation, with defined responsibilities and reporting lines. See also the Country Emergency Response Plan (ref: ED/GRL/CRP/ERP/IO/210S).

3.2.1. local Incident Response Team (IRT)

The Local IRT carries out in-field actions and will be formed according to local procedure on the rig or vessel.

Responsibilities
Provide the operational response in-field to deal with any incidents and emergency situations which may occur at the location.

Team members
The IRT will be led by the On Scene Commander (DSC). The DSC may be the Offshore Installation Manager (OIM) of the MODU, the Vessel Master of the vessel associated with the incident, or an alternative appropriate person as designated by the DIM or the Emergency Response Group (ERG) Leader.
Standby vessel, rig and aerial support personnel will form the team.

Communications
If a spill from the rig occurs, the DIM will notify the Capricorn Drilling Supervisor (DSV). The DSV will immediately notify the Duty Emergency Response Officer who will inform the ERG Team leader, as described in the Country Emergency Response Plan. The DIM will notify Greenland Command. If a spill from a vessel occurs the Vessel Master will notify the Duty Emergency Response Officer directly.

Additional support and resources are requested by the IRT through the ERG as required.

3.2.2. Duty Emergency Response Officer

The duty Emergency Response Officer (ERO) provides a dedicated emergency notification service manned permanently throughout the campaign. The duty ERO relays the initial available information regarding any emergency situation to the ERG Team Leader as described in the Country Emergency Response Plan.

3.2.3. Capricorn Emergency Response Group (ERG)

The Capricorn ERG is the tactical response team which supports the IRT by mobilising appropriate tiers of response. The Capricorn ERG is responsible for providing all emergency logistlcal, medical support requested by the DIM of the Rig or Vessel Master and for providing the onshore reception and ongoing treatment and repatriation of personnel evacuated from the operational area. In addition the Capricorn ERG is responsible for coordinating all oil spill response actions in the event of any oil spill which may occur as a result of Capricorn activities.

Responsibilities

- Tactically support, assist and advise the IRT in response to any incident or emergency situation
- Provide Cairn's Crisis Response Team (CRT) with pertinent information
- Obtain approval from CRT for implementation of specific oil spill response activities
- Provide support, advice and off location assistance

- Confirm notification of the Coastal State and MRCC, for details see *Section 3.5*
- Confirm notification of employees, affected vessels and MODU company's Emergency Management Team
- Notify and liaise with the Cairn CRT Duty Leader
- Provide and coordinate specialist support including Tier 3 oil spill contractor
- Coordinate recovery from the incident
- Draft media releases. Pass to CRT for approval

Team members are listed below and are on call 24 hours a day ready to respond to any incident. If an incident occurs that requires long term, ongoing management then this team will modify in terms of personnel, structure and roles as the situation develops.

Team members

- ERG Duty Leader
- Operations and Technical Co-ordinator
- Logistics Co-ordinator
- Human Resources (HR) Coordinator
- Health, Safety and Environment (HSE) Co-ordinator
- Country Representative (based in-country, not at Cairn Head Office)
- External Communications Coordinator
- Recorder
- Other key specialists, dependent on incident type

Communications

The ERG is notified of an emergency by the IRT through the Duty Emergency Response Officer.
The ERG Duty Leader will notify the Crisis Response Team (CRT) Leader.

Location

The ERG will be based at the Emergency Coordination Centre (ECC) at [redacted]

- The ECC is a fully maintained facility with all necessary communication tools essential for an effective emergency response.

3.2.4. Capricorn Crisis Response Team

Responsibilities

- Provide strategic response assistance, support and advice to the ERG
- Approve the tactical response being undertaken by the ERG
- Approve mobilisation of Tier 3 oil spill response contractor
- Carry out actions as defined in Cairn's Crisis Response Manual (Ref: ED/HSE/PRO 1181)
- Manage issues pertaining to the reputation and the continued commercial wellbeing of the Company.

Team Members

- CRT Leader (24 hour call)
- Corporate Affairs (24 hour call)
- Other representatives (not on 24 hour call) will be mobilised as considered necessary by the CRT Leader.

Communications

The ERG Team Leader will notify the CRT Duty Leader of the incident. The CRT Duty Leader will take the decision to call out the CRT. The Chief Executive will be notified by the CRT Duty Leader.

Location

The CRT is established at the [redacted]

3.2.5. MOOU Company Emergency Management Team

For an emergency response related to safety of the rig and its personnel, onshore support shall be undertaken by the MODU Company. See *section* 3.5.6 for details.

3.3. Action Checklists

Action Checklists have been compiled for key members of the IRT and ERG. These checklists act as a quick reference for the key actions that should be taken by these key individuals during the initial stage of a response.

3.3.1. Spill Observer

<table>
<tr><td colspan="2">Spill Observer: Observes and reports the spill</td><td>✓</td></tr>
<tr><td colspan="3">Reports to: Dependent upon location of spill observer:
• Onboard MODU - MODU Control Room and OSC
• Onboard Vessel - Vessel Master
• Onboard Helicopter - MODU Control Room (via the Hell-Ops / Radio Operator)</td></tr>
<tr><td rowspan="6">Initial Action</td><td>ENSURE SAFETY IS A PRIORITY</td><td></td></tr>
<tr><td>Raise the alarm</td><td></td></tr>
<tr><td>Inform the MODU Control Room ! DIM ! Vessel Master of the incident and provide as much information as possible; injuries, hazards, location, quantity spilt, oil type, cause of spill, etc</td><td></td></tr>
<tr><td>Remain up-wind of the oil spill</td><td></td></tr>
<tr><td>If trained and safe to do so, take reasonable actions to stop the source of the spill</td><td></td></tr>
<tr><td>If unsafe to remain at spill site, leave and instruct other personnel to evacuate the hazardous area</td><td></td></tr>
<tr><td rowspan="4">Further Actions</td><td>If safe to do so, continue monitoring the spill, keeping the Control Room! OSC informed until the IRT arrives</td><td></td></tr>
<tr><td>Update the JRT when they arrive</td><td></td></tr>
<tr><td>Be prepared to direct the IRT to the spill</td><td></td></tr>
<tr><td>If safe to do so, if trained and if required, assist the IRT</td><td></td></tr>
<tr><td rowspan="2">Final Actions</td><td>After the emergency, take part in the debriefing</td><td></td></tr>
<tr><td>Provide recommendations based on observations made during the response</td><td></td></tr>
</table>

3.3.2. MODU Control Room

<table>
<tr><td colspan="2">MODU: Control Room Alerts the DSC</td><td>✓</td></tr>
<tr><td colspan="3">Reports to: DSC</td></tr>
<tr><td rowspan="5">Initial Actions</td><td>Alert the OIM and request his! her attendance in the MODU Control Room</td><td></td></tr>
<tr><td>Start and maintain personal log</td><td></td></tr>
<tr><td>Receive as much information as possible from the Spill Observer, including injuries, hazards, location, quantity spilt, oil type, cause of spill, etc</td><td></td></tr>
<tr><td>Inform the OIM of the incident and pass on as much information as possible</td><td></td></tr>
<tr><td>Inform other Cairn operated MODU! Standby Vessels in the vicinity and aviation service provider</td><td></td></tr>
<tr><td rowspan="3">Further Actions</td><td>If safe to do so, request the Spill Observer continues to monitor the spill until the IRT arrives</td><td></td></tr>
<tr><td>Be prepared to direct the IRT to the spill</td><td></td></tr>
<tr><td>Assist the OSC with all requests</td><td></td></tr>
<tr><td rowspan="2">Final Actions</td><td>After the emergency, take part in the debriefing</td><td></td></tr>
<tr><td>Provide recommendations based on observations made during the response</td><td></td></tr>
</table>

3.3.3. On Scene Commander (DSC)

DSC: Coordinates the tactical offshore oil spill response activities		✔
Reports to: Capricorn ERG		
Initial Action	ENSURE SAFETY IS A PRIORITY	
	On notification of the incident attend the MODU Control Room or Vessel Bridge	
	Order and supervise the shutdown of any and all operations necessary to isolate the source of the incident	
	Order the muster / evacuation of personnel as necessary	
	Alert the DSV	
	Alert the relevant Coastguard authorities	
	Follow up alert with the fax / email of the *Spill Notification Form, Appendix 1.-C*	
	Mobilise the IRT, brief the team of the situation. Ensure risk assessment is carried out prior to IRT entering working area	
	Assess the spill and confirm the spill Tier level categorisation with the Standby Vessel Master and IRT *Tier Assessment Form, Appendix 1.-A*	
	Coordinate the IRT offshore resources as required by the ERG	
	Obtain authorisation from ERG Duty leader prior to any dispersant spraying activities being carried out	
	Maintain dated, timed log of events	
Further Actions	Ensure communication is established with the ERG via the DSV. Maintain close communication with the DSV	
	Act on instructions from the ERG	
	Conduct incident briefings with personnel working in the MODU Control Room or onboard the Vessel and establish when further briefings will be provided to theIRT	
	Maintain overall management of the tactical spill response, liaising closely with the IRT	
	Assess the efficiency of oil spill response measures as appropriate	
	Beware of all hazards and accident situations in designated field of operations	
	Ensure the site of the incident onboard the MODU or Vessel is cordoned off for later investigation and safeguarding of evidence	
	Standby to assist with any further oil spill response actions	
Final Actions	Assist with the decision to close out the incident	
	Resume normal operations as and when safe to do so	
	Organise the IRT response debrief after the incident	
	Collect all offshore Personal logs by personnel involved with the incident	
	Provide Personal logs to the Operations and Technical Co-ordinator	

3.3.4. Standby Vessel Master

SBV Master: Leads the practical response to an oil spill. In the event that the oil spill originates from the vessel undertakes the role of OSC, see OSC Action Checklist, *Section* 3.3.3		✔
Reports to: OSC		
Initial Action	ENSURE SAFETY IS A PRIORITY.	
	Move to, and stay, upwind of any spill	
	Respond immediately to any oil spill notification	
	Assume OSC role or establish communications with the OSC as appropriate	
	Alert IRT (vessel crew), provide an initial brief to the IRT	
	Act on instructions from the OSC	
	Collect PPE and safety equipment	
	Ensure the appropriate MSDS for the substance spilt is available	
	Maintain dated, timed log of events	
Further Actions	Coordinate with other standby vessels in the vicinity or assisting with emergency operations	
	Be aware of danger / exclusion zones and the areas where entry is forbidden for people / boats / helicopters	
	Know what actions to take if someone is injured (i.e. first aid, medivac, etc)	
	Oversee the deployment of this equipment as instructed by the OSC	
	Ensure work is undertaken within the designated site safety zones to prevent the spread of oil into 'clean' areas	
	Instruct the sampling of the oil spill as requested, *Monitor, Evaluate and Sample, Section 1.7.1*	
Final Actions	Provide Personal Log and issue to OSC and ERG leader	
	Attend debrief of the incident	
	Recover, clean and maintain all equipment after use	
	Report any damage of response equipment to the OSC	

3.3.5. Incident Response Team Member

IRT Member: Consist mainly of support vessel personnel (for offshore operations), engage in the practical response to an oil spill		✓
Reports to: Standby Vessel Master		
Initial Action	ENSURE SAFETY IS A PRIORITY.	
	Respond immediately to any oil spill notification; follow the instructions from the OSC	
	Collect PPE and safety equipment	
	Collect communications equipment, ensure this and Personal Protective Equipment (PPE) are in good working order	
	Receive an initial briefing from the OSC or designate	
	Make yourself and those around you aware of hazards in the working environment. For example, gases, explosive vapour, fire risk and dangers when using response equipment or chemicals	
Further Actions	Assume there is a fire or explosive risk until proven otherwise	
	Know what actions to take if someone is injured (i.e. first aid)	
	Deploy oil spill response equipment as instructed by the OSC / Vessel Master	
	Observe the correct safety procedures for work, handling containment and recovery equipment and / or dispersant spraying equipment	
	~~Know the locations and tasks of others on site and ensure that they are aware of~~ your location and task	
	Work within the designated site safety zones to prevent the spread of oil into 'clean' areas	
	Sample the oil spilt as requested, *Monitor, Evaluate and Sample, Section 1.7.1*	
	Regularly reassess safety hazards to yourself and to other team members	
Final Actions	Collate Personal Log and issue to OSC	
	Attend debrief of the incident	
	Recover and clean equipment and if necessary repair all equipment after use	
	Report any damage of response equipment to the *DSC*	

N.B. For shoreline response refer to the *Site Response Pion* as applicable for the response, *Appendix 1-E.*

3.3.6. Capricorn Drilling Supervisor (DSV)

DSV: Initially alerts and maintains communications with the ERG		✔
Reports to: ERG Team Leader		
Initial Action	On notification of the incident report to the MODU Control Room	
	Alert Duty Emergency Response Officer	
	Follow up alert with the fax / email of the *Spill Notification Form, Appendix 1-8*	
	Initiate communications with the ERG Team Leader	
	If ERG team assembled, maintain communication with the Operations and Technical Co-ordinator	
	Maintain close communication with the OSC	
	Assist with the spill Tier level categorization, *Tier Assessment Form, Appendix I-A*	
	Maintain dated, timed log of events	
Further Actions	Act on instructions from the ERG Team Leader	
	Attend incident briefings as necessary	
	Assist the OSC as necessary	
	Assist with the determination of the efficiency of oil spill response measures as appropriate	
	Standby to assist with any further oil spill response actions	
Final Actions	Attend debrief of the incident	
	Resume normal operations as and when safe to do so	
	Provide Personal logs to the Operations and Technical Co-ordinator, copying the OSC	

3.3.7. Capricorn In-Country Representative

In-Country Representative: Initially alerts and maintains communications with the ERG		✔
Reports to: ERG Team Leader		
Initial Action	On notification of the incident mobilise to BMP Emergency Response Centre	
	Notify the Country Regulator of the incident and maintain communication	
	Initiate communications with the ERG Team Leader	
	Maintain communications with the HSE Co-ordinator	
	Initiate communication with the BMP ERC Leader as requested by the ERG Team Leader	
	Maintain dated, timed log of events	
Further Actions	Act on instructions from the ERG Team Leader	
	Act as the Capricorn representative within the BMP Emergency Response Committee (ERe)	
	Feedback the ERG activities that are being undertaken to the BMP Emergency Response Committee	
	Arrange for in country logistics as requested by the ERG Logistics Coordinator	
	Pass media statements received from CRT to BMP Emergency Response Committee Team Leader	
	Attend incident briefings as necessary	
	Standby to assist with any further oil spill response actions	
Final Actions	Attend debrief of the incident	
	Resume normal operations as and when safe to do so	
	Provide Personal Log to the ERG Team Leader	

3.3.8. ERG Team leader

ERG Team leader: Coordinates the ERG's response to the 011 spill, assisting the IRT with support and advice. Decides upon the tactical response. Responsible for gaining approval to use dispersant and deployment of tier 2 and approval for tier 3		✔
Reports to: CRT Team Leader		
Initial Actions	Initiate contact with OSC and establish: • initial spill incident and assistance required • initial response actions taken on site	
	Instruct the HSE Coordinator to mobilise the ERG as required	
	Carry out actions as defined in the Emergency Response Plan	
	Report to the Emergency Coordination Centre (ECC). Confirm all ECC systems are operational Check the incident status boards and initiate information capture if not yet started	
	Undertake an initial briefing with the ERG, informing them of the incident	
	Maintain dated, timed log of events	
	Notify the Crisis Response Team (CRT) leader that the Country Emergency Response Team has been mobilised	
	Review information obtained from the IRT, establish key facts and confirm correct initial actions have been taken	
	Identify and establish contact with the Emergency Response Teams of any Contractors who may have responsibility for the incident location. Co-ordinate Contractor and Cairn ERG actions	
	Make contact with BMP ERC via the HSE Co-ordinator and Capricorn Country Representative	
	With input from ERG members, set out a tactical plan of action: • establish severity and spill Tier level (see *Appendix I-A)* • identify actions • agree ERG action parties	
	Instruct the HSE Co-ordinator to notify *Oil Spill Response* and make them aware of the situation including Tier level	
	Identify tactical issues	
	As required, seek specialist expertise and support from experts (for example in oil spill response, aviation, drilling, engineering, IT, etc)	
	Confirm that support personnel are briefed and aware of what action needs to be taken, e.g. switchboard, reception, etc	
	Obtain authorisation from CRT leader for activation of *Oil Spill Response* if required, see *Tier 3 Arrangements, Section 2.4 and Mobilisation Form, Appendix 1-0*	

Further Actions	Provide regular updates to the Cairn CRT Leader
	Confirm external communications have been initiated: • Greenland authorities via BMP ERC Leader • Media statements prepared and sent to Corporate Affairs • Contact numbers issued for Relative Response and Media • Relative Response is mobilised and briefed • Reception and switchboard issued with statement and contact numbers • Company employees brief issued
	Initiate timeouts when deemed necessary. During a timeout pass on concise information, ensure information is understood, what is required and how to achieve objectives
	Define the ERG objectives and response priorities. Communicate objectives to OSC and support OSC in achieving them.
	Assess overall effectiveness of inddent response (planning, resources, and execution)
	Monitor and evaluate the effectiveness of response operations, re-assess response options as necessary
	Ensure status board are maintained and updated
	Work with the Operations and Technical Coordinator to determine the impact of the incident upon business continuity, in particular with reference to any shutdown operations
	Identify the need for and mobilise additional support personnel, consider the implementation of rotation for ERG members
	Identify and obtain authorisation for extraordinary expenditure
	Confirm that interfaces with external bodies are being managed effectively
Final Actions	Monitor activity and reduce or stand down the ERG
	Organise a debriefing of the incident response
	Oversee preparation of the recovery plan
	Complete Personal Log
	Collect logs from ERG including Capricorn Country Representative
	Attend incident review meeting

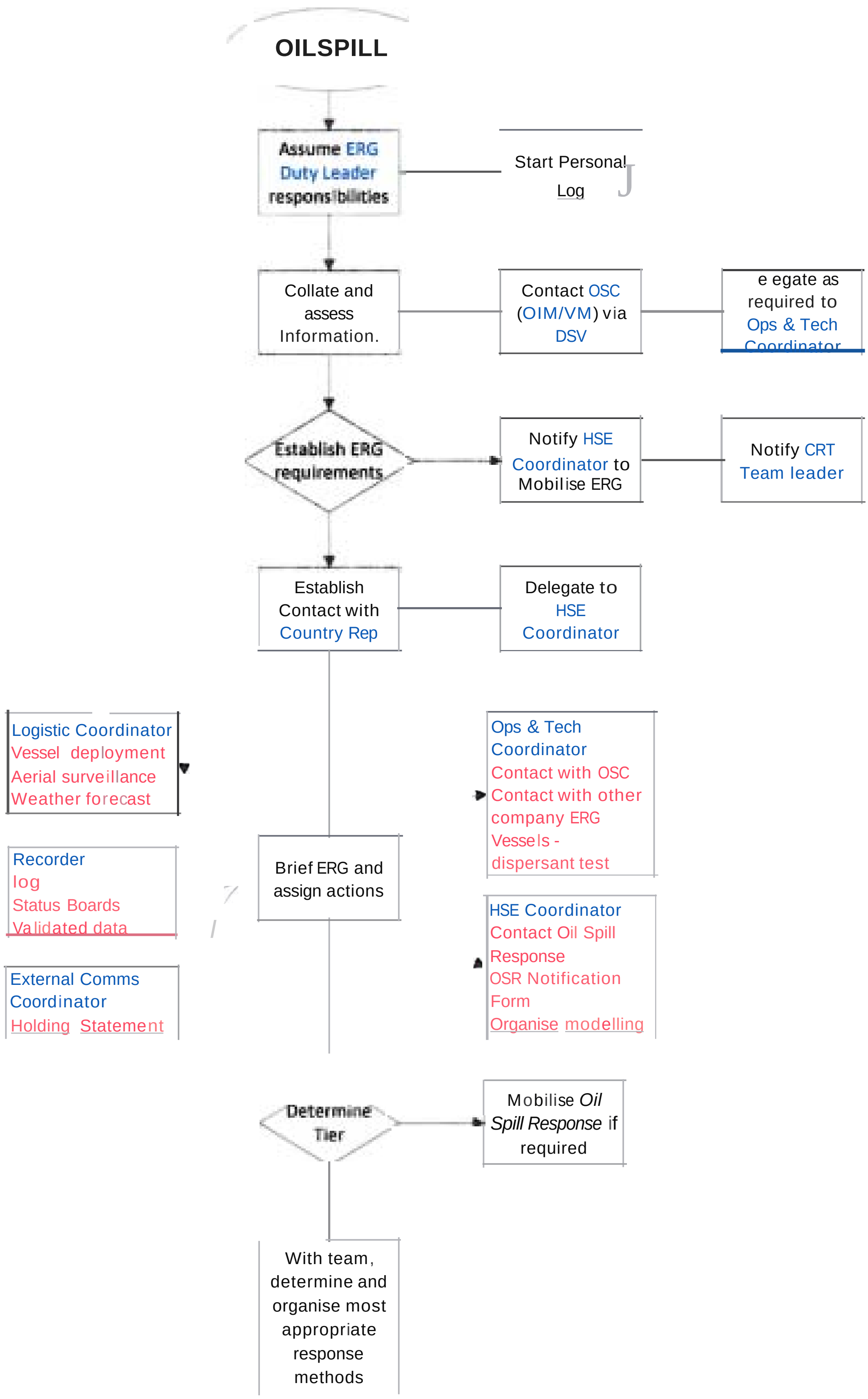


Figure 16 ERG Duty Leader Initial Actions Flowchart

3.3.9. Health, Safety and Environment (HSE) Coordinator

HSE Coordinator: Responsible for ensuring that all activities in the response to the 011 spill are carried out in a safe manner, minimising risk to personnel, the public and environment.		
Reports to: ERG Team Leader		
Initial Actions	If directed by the ERG Team Leader, activate the call out of the ERG and support personnel in accordance with the ERG duty list	
	Report to the ECC room	
	Carry out actions as defined in the Emergency Response Plan	
	Attend initial briefing by ERG Team Leader, log arrival on the ERG Board in the ECC	
	Check Status Boards for the latest information Update status boards (delegate as appropriate)	
	Call the Country Representative. Ensure he/she has notified the BMP ERC Team Leader. Maintain contact with the Country Representative as the response is implemented • Advise on the situation and actions that are being taken • Request assistance if required • Identify information to notify to Government and regulatory authorities	
	Notify Oil Spill Response using Notification Form, *AppendiX I·C*	
	Request oil spill modelling as appropriate using Modelling Request Form, *Appendix I ·F*	
	Assist with establishing the severity of the incident and the support reqUired	
	Brief the ERG Team leader of the potential HSE implications of the spill	
	Maintain dated, timed log of events. Keep a record of incoming and outgoing calls	
Further Actions	Update status of response to the Country Representative	
	Assist with the development of a response action plan based on the initial spill assessment	
	Assess and advise the ERG Team Leader of damage and potential damage to environmental and sensitive areas which may be affected by the incident: • Assess the spill trajectory • Establish the environmental impact • Advise on actions that should be taken to minimise the effect of the spill • Confirm the appropriate action is being taken at the spill site • Mobilise *Oil Spill Response* if authorised by the CRT Team leader, *Append/x 1-0* • Coordinate the deployment of oil spill response equipment with the logistics Coordinator	
	Ensure all operations are undertaken within the requirements of applicable legislation.	
	Develop the site clean-up and waste disposal plan, see *Waste Management, Section* 1.7.5.	
	Arrange for offshore oil samples to be collected and sent for analysis, *Monitor, El/aluate and Sample, section 1.7.1*.	
	If dispersants are considered, obtain regulatory authorisation; see *Dispersant Application Approl/al Process section* 1.7.4, Dispersant Approval Form, *Appendix 1-G*	
	Provide regular updates to BMP Emergency Response Committee	
	Arrange for additional oil spill specialist support as reqUired.	
	Attend briefings and timeouts.	
Final Actions	Complete and hand Personal log to Recorder.	
	Attend incident review meeting.	
	Provide support for incident investigation analysis as required.	

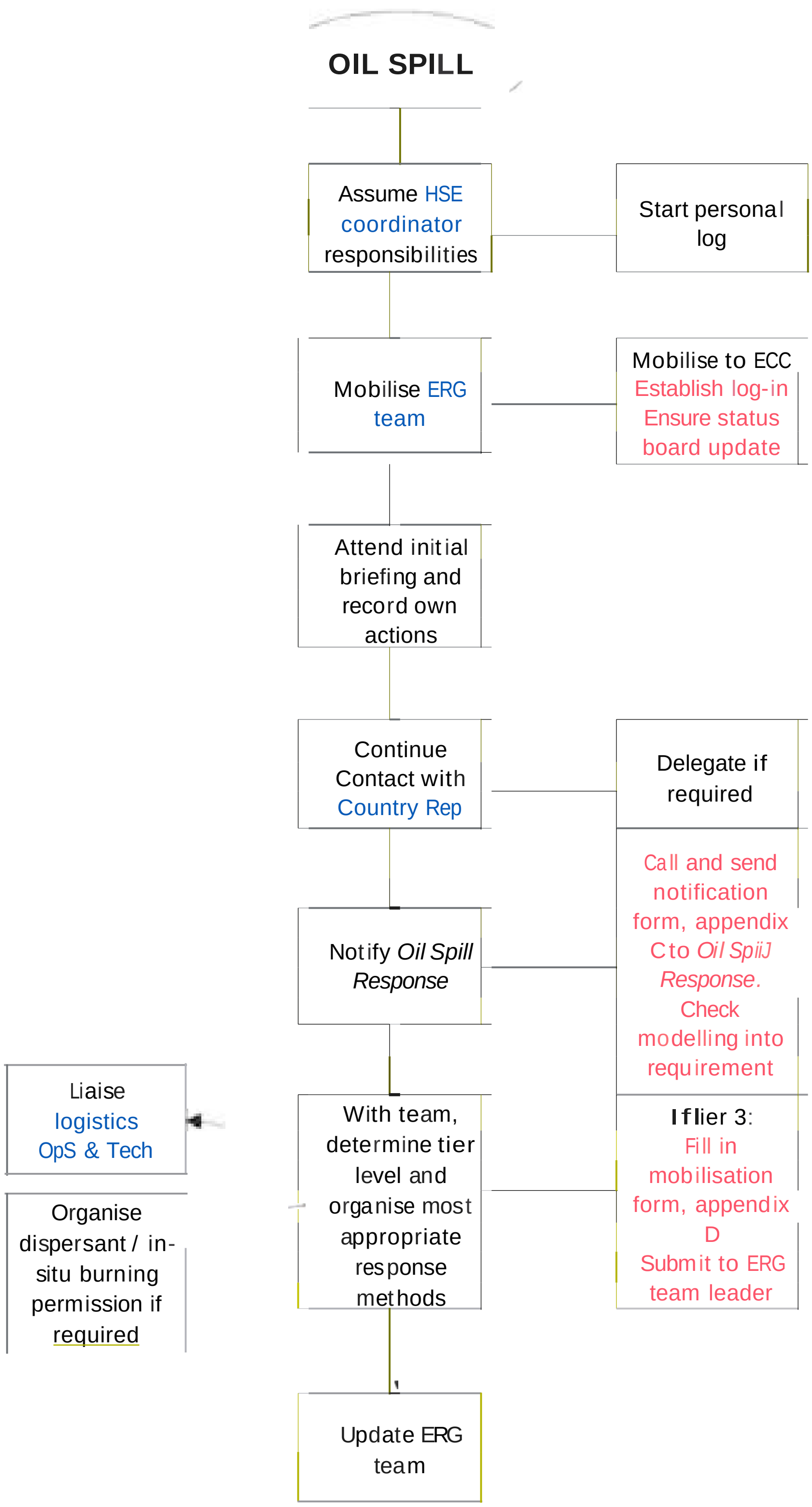


Figure 17 HSE Coordinator Initial Actions Flowchart

3.3.10. Operations and Technical Coordinator

Operations and TechnIcal Coordinator: ProvIde strategic direction and support to the ERG Team Leader. Responsible for receiving information through the IRT Team Leader on the status of the IRT operations and providing guidance on the continued response strategy.		✓
Reports to: ERG Team Leader		
Initial ActIon	On notification of the incident report to the ECC room	
	Carry out actions as defined in the Emergency Response Plan	
	Obtain briefing by ERG Team Leader	
	Check Status Boards for the latest information, Log arrival on the ERG Board	
	Establish and maintain communication with the DSV on site Request an update on the situation Identify the support and assistance reqUired	
	Establish communication with the MODU operator Emergency Management Team	
	Provide technical/engineering input	
	Determine and activate technical personnel needed	
	Maintain dated, timed log of events. Keep a record of incoming and outgoing calls	
Further Actions	Keep a record of incoming and outgoing calls on Log Sheets	
	Keep the ERG briefed on the current situation with the IRT and their support requirements	
	Ensure all written documentation is forwarded to the ERG Recorder and confirm all appropriate information is recorded on the status boards	
	Assist the ERG Team Leader with an analysis of the incident potential	
	Ensure all required technical/engineering information and drawings required for incident management and issues communication are available	
	Advise on required actions to assure technical integrity in the proposed strategies and action plans	
	Provide engineering / technical support related to the incident as required by the ERG Team Leader to enable asset recovery and business continuity	
	Maintain a daily functional Action Plan for the Technical Coordination Group	
	Identify, facilitate contact with and activate any specialist technical support	
	Advise the Logistics Coordinator of changes to resource requirements	
	Advise when source of oil spill has been secured / stopped	
	Attend briefings and timeouts	
Final Actions	Complete and hand in Personal Log to Recorder	
	Obtain personal Logs from DSV and OSC at site of spill and give to Recorder for safe keeping	
	Attend incident debrief	
	Provide support for incident investigation analysis as required	

3.3.11. Logistics Coordinator

Logistics Coordinator: Responsible for obtaining personnel, equipment, materials and supplies needed to mount and sustain emergency response operations and for providing services necessary to ensure that emergency response operations are carried out in a safe and efficient manner.		✔
Reports to: ERG Team Leader		
Initial Action	On notification of the incident report to the ECC	
	Carry out actions as defined in the Emergency Response Plan	
	Obtain briefing by ERG Team leader	
	Check Status Boards for the latest information, log arrival on the ERG Board in the ECC	
	Place aerial surveillance helicopters and support vessels on standby	
	Confirm the initial Incident severity classification, with the ERG Team leader	
	Advise on the response equipment available, *Section 2*	
	Ensure early availability of MSDS Sheets	
	Advise and coordinate the ERG on alllogistical requirements	
	liaise with the HR Coordinator to coordinate actions and requirements for Evacuees: • Coordinate transportation of casualties to hospitals • Reception • Hospitalisation • Emergency accommodation • Transfer to shore • Repatriation • Med-rescue or Medevac	
	Maintain dated, timed log of events. Keep a record of incoming and outgoing calls	
Further Actions	Keep a record of all incoming and outgoing calls on Log Sheets	
	Establish a system for recording and tracking all equipment	
	Establish a refuelling and maintenance schedule for equipment being use	
	Establish necessary backup systems that can be used to support personnel affected by the incident and those in the response teams	
	Coordinate Search and Rescue activities	
	Request aircraft and observer for aerial surveillance activities or equipment transportation see *Monitor, Evaluate and Sample, Section 1..7.1.* and *Tier 2 Arrangements, Section 2.2*	
	Ensure all written documentation is forwarded to the ERG Recorder	
	Establish contact with in-country logistics and ensure additional oil spill equipment is mobilised as required by ERG /OSC	
	Assist the HSE Coordinator with the development of the site clean up and waste disposal plan, see *Waste Management, Section 1..7.5*	
	Assist with the mobilisation of Tier 3 response from *Oil Spill Response* as required	
	Obtain data related with weather, wind, tide, current information, relay information to HSE Coordinator for onward transmission to *Oil Spill Response* for oil spill modelling	
	Assimilate data (Aviation/Marine) to update oil spill modelling outputs (spill tracking and modelling)	
	Ensure alllogistical support is provided, e.g. transport and support facilities for all response activities. Prepare for the potential arrival of Tler 3 equipment and personnel	
	Attend briefings and timeouts	
Final Actions	Complete and hand in Personal Log to Recorder	
	Attend incident review meeting	
	Provide support for incident investigation. Analysis as required	

3.3.12. Human Resources (HR) Coordinator

HR Coordinator: Responsible for all human resources matters relating to the oil spill incident.		✓
Reports to: ERG Team Leader		
Initial Action	On notification of the incident report to the ECC and log arrival	
	Carry out actions as defined in the Emergency Response Plan	
	Obtain briefing by ERG Team Leader	
	Check Status Boards for the latest information	
	Record all key information about personnel at the emergency site, update status boards as required	
	Mobilise the Relative Response Team if required	
	Maintain dated, timed log of events. Keep a record of incoming and outgoing calls	
	Keep a record of all incoming and outgoing calls on Log Sheets	
	Obtain personnel records for all personnel at the incident site: • Next of kin information • Employer information • Nationality • Pass information to relative response as required • Identify the number of persons on board and advise the Logistics Coordinator	
Further Actions	Identify and mobilise support personnel as required to assist with: • Tracking evacuated personnel movements • Relative response • Evacuee reception • Emergency accommodation • Medical/casualty disposal and support • Casualty evacuation • Hospital reception arrangements • Next of kin notification • Fatality response and liaison with the Police	
	Notify contractor HR departments and liaise with them over their personnel support	
	Mobilise and brief Reception and Switchboard Duty personnel	
	Implement office security procedures	
	Advise the ERG Team Leader on the HR strategy that should be adopted	
	Advise the External Communication Coordinator of Relative Response contact number	
	Maintain communication with the Relative Response Supervisor	
	Maintain up to date movement and status list of all personnel evacuated from site	
	Ensure enquiry telephone numbers have been released and inform the Reception, Switchboard when and where to divert calls	
	Ensure casualties being evacuated from site are being tracked	
	Ensure the procedure for removal of fatalities is being followed	
	Consider and arrange for the provision of translators	
	Attend briefings and timeouts	
Final Actions	Complete and hand in Personal Log to Recorder	
	Attend incident review meeting	
	Provide support for incident investigation. Analysis as required	

3.3.13. External Communications Coordinator

External Communications Coordinator: Responsible for gathering accurate information about the Incident or emergency situation from within the ERG and prepare the information in a format to be submitted to Cairn Corporate Affairs representative for consideration for release to the media.		✔
Reports to: ERG Team Leader		
Initial Action	On notification of the incident report to the ECC and log arrival	
	Carry out actions as defined in the Emergency Response Plan	
	Obtain briefing by ERG Team Leader	
	Check Status Boards for the latest information	
	Maintain dated, timed log of events. Keep a record of incoming and outgoing calls	
	Prepare accurate media reports for approval by ERG Leader and submission to CRT Corporate Affairs Co-ordinator	
	Inform Corporate Affairs Co-ordinator that ERG mobilised	
Further Actions	Gather detailed information about the incident or emergency situation: • Prepare a Media Holding Statement for release within 60 minutes • Consult the Media Greenland Crisis Communication Response Plan • Include Relative Response contact details • Include Media Response contact details	
	Confirm accuracy of the Holding Statement with the ERG Team Leader	
	Send ERG Leader approved media statements to CRT Corporate Affairs Duty Person	
	If instructed by Corporate Affairs, mobilise the Media Response Team	
	Insert Media Response and Relative Response numbers into Media Statements	
	Update the Corporate Affairs Coordinator regularly	
	Continue to prepare and submit updated media statements	
Final Actions	Complete and hand in Personal Log and copies of all media statements to Recorder	
	Attend incident review meeting.	
	Provide support for incident investigation analysis as required.	

3.3.14. Recorder

Recorder: Responsible for maintaining an accurate written record of all the Information and actions carried out by the ERG within the ECC.		✓
Reports to: ERG Team Leader		
Initial Action	On notification of the incident report to the ECC and log arrival	
	Carry out actions as defined in the Emergency Response Plan	
	Obtain briefing by ERG Team Leader	
	Check and update Status Boards for the latest information	
	Activate the Recorder PC	
	Maintain a dated and timed record of ERG information, actions and communications	
Further Actions	Commence a time record for key information about the incident including: • Record the ERG members present • Record the latest status on the Status Board • Record actions to be taken	
	As requested by the ERG Team Leader: • Display relevant sections of the Log on an electronic smart board • Search e-windows for relevant data and display on the smart board	
	Record briefings and timeouts	
Final Actions	Record / file all ERG Personal Logs and documentation pertaining to the incident	
	Attend incident review meeting	
	Provide support for incident investigation analysis as required	

3.4. Greenland Emergency Organisation and Communications

3.4.1. Contact Directory

A list of all Capricorn Greenland contacts are contained in the *Greenland Drilling Emergency Cantact List* (Cairn document ref: EFI02062-01). Controlled copies are printed and circulated to specified parties

3.4.2. Tier 1 and 2 Greenland Emergency Organisational Structure

Figure 18 outlines the communications and relationships that will be activated in an oil spill emergency, regardless of Tier level. If a long term Tier 3 response is required then this structure will expand over time. *Appendix 2-1* identifies the positions and functionality of a TIer 3 oil spill command structure for a response to an oil spill in the 'project' (i.e. post emergency response) stage.

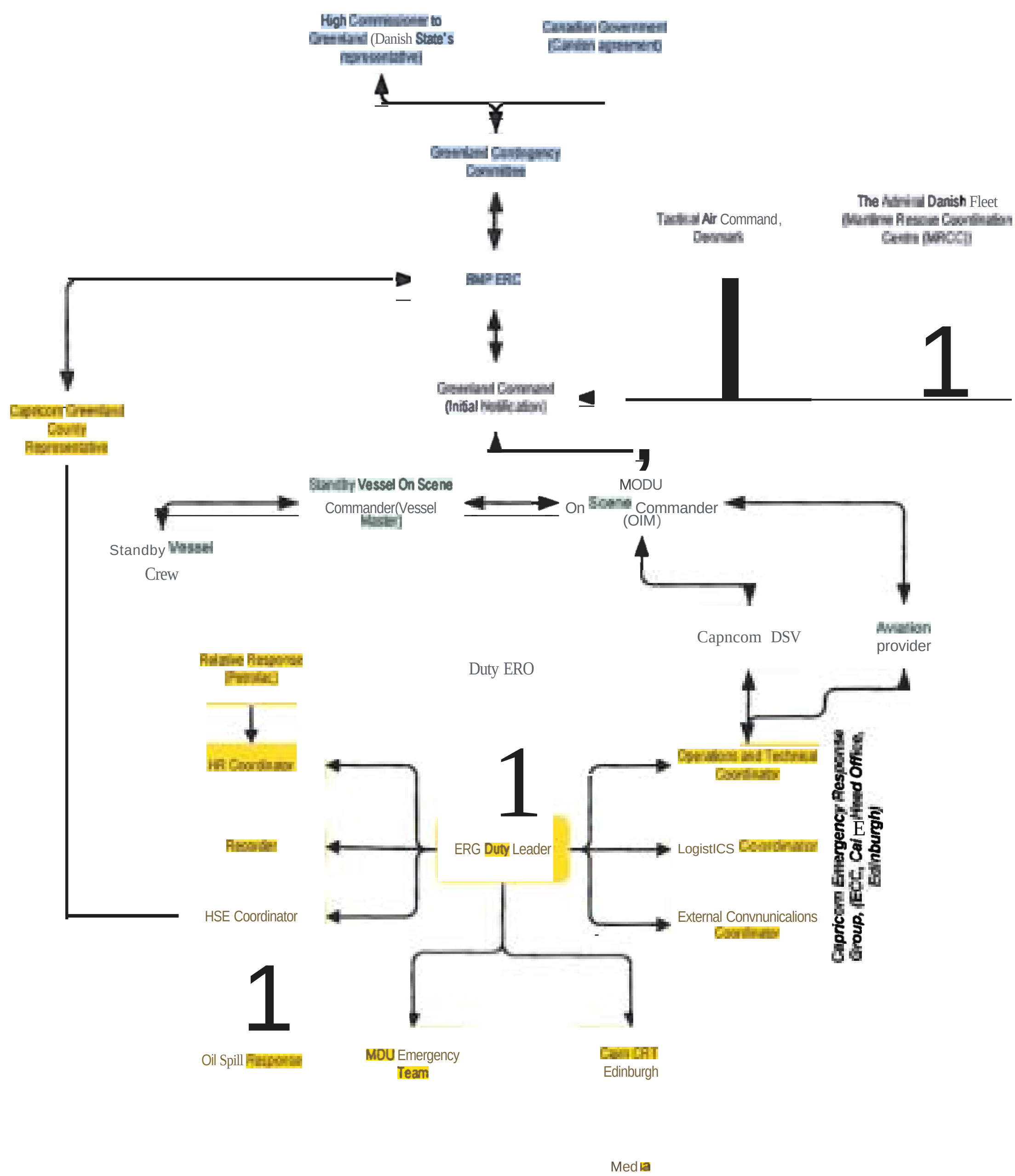


Figure 18 Greenland Emergency Response Organisational Structure

3.5. Roles and Responsibilities of Key Greenland Stakeholders

3.5.1. Capricorn

As the license holder, Capricorn is responsible for responding to an oil spill caused by its operations in Greenlandic waters.

The DSC will notify Greenland Command of an oil spill (see Figure 18). The ERG will notify the BMP via the Greenland In-Country Representative.

3.5.2. Bureau of Minerals and Petroleum (BMP)

The BMP have responsibility to supervise the response to an oil spill being implemented by Capricorn and approve original and revised DSCP's.

During an incident the BMP will maintain communication with the Greenland In-Country Representative and the Capricorn ERG via the BMP Emergency Response Committee (ERe).

The BMP ERC is the in-country Emergency Response Team. The BMP ERC will be mobilised at the request of Greenland Command in response an escalating spill event. The following organisations and authorities will be mobilised to form the BMP ERG.

- Bureau of Minerals and Petroleum
- National Environmental Research Institute (NERI)
- Greenland Command
- Police Department Representatives
- Fire Department Representatives
- Local Authorities
- Health Authority
- Media Representative

The BMP ERG will be mobilised to the Emergency Response Room based in Nuuk. The Cairn Country Representative will also mobilise here and be the primary contact between the Cairn ERG and the BMP ERe. Further Cairn staff may mobilise to this BMP ERC as the incident severity escalates.

3.5.3. Greenland Command

Greenland Command is the Coastguard Authority within Greenland. Their role is to save lives and warn vessels of an incident. Following notification of an incident by the DIM or Vessel Master, Greenland Command will notify the BMP Emergency Response Committee (ERe) Team Leader. They maintain a representative on the BMP ERe.

Greenland Command has jurisdiction and responsibility to oversee the combat of pollution at sea outside of 3 nautical miles from the Greenlandic coast, to the end of the Greenland Exclusive Economic Zone (EEZ). As per the drilling permit it is not the responsibility of Greenland Command to lead or coordinate an oil spill response where the oil spill is caused as a result of Capricorn's operations.

3.5.4. Greenland Government

The Greenland Government is responsible for all liaisons with the Canadian and Danish Governments to firstly notify them of the incident and co-operate in an escalated pollution response strategy. This cooperation between governments draws on the *Canden Agreement* (Canada-Denmark) and

Copenhagen Agreement (Denmark, Finland, Iceland, Norway and Sweden) which describe arrangements for interactions between each party in such circumstances.

3.5.5. Greenland Contingency Committee (GCe)

The Greenland Contingency Committee (GCC) is made up of a Chairman and representatives from the Police, Health Ministry, High Commission, Danish Marine Authority and the Bureau of Minerals and Petroleum (BMP). The Chairman of the BMP Emergency Response Committee is responsible for reporting emergency information to the GCC.

3.5.6. MODU Company Emergency Management Team

Each Drilling Rig has its own Emergency Response Procedure (ERPr) and Oil Spill Response Procedure which identify the operational and environmental emergency situations which they could experience. The ERPr and SOPEP detail the emergency response organisation, headed by the Offshore Installation Manager (aiM), and the procedures and actions required in order to address all identified emergency situations. The aiM is overall responsible for managing the response to any emergency situation which may occur on the Rig or within the 500 meter safety zone around the Rig. In the event of any emergency situation the aiM is required to notify the Owners of the Rig and the Capricorn Emergency Response Group immediately via the emergency contact system.

In order to support the aiM on the Rig there are emergency support organisations provided by the Rigs Owner, Ocean Rig, and Capricorn.

In Ocean Rig the Emergency Management Group (EMG), based in Stavanger, is on call at all times 24 hours per day and is responsible for providing the aiM with support and guidance for all Rig based all emergency situations. The Ocean Rig EMG is responsible for communicating and liaising with the Capricorn ERG in the event of any emergency associated with the Rigs.

3.5.7. Vessel Company Emergency Management Teams

Each Vessel has its own Emergency Response Procedure (ERPr) and Oil spill Response Procedure which identify the operational and environmental emergency situations which the vessel could experience. The ERPr details the emergency response organisation, headed by the Vessel Master, and the procedures and actions required in order to address all emergency situations. The Vessel Master is overall responsible for managing the response to any emergency situation which may occur on the vessel. In any emergency situation the Master is reqUired to notify the Vessel Owner and the Capricorn Emergency Response Group immediately via the emergency contact system.

In order to support the Master on a Vessel there are emergency support organisations provided by the Vessel Owner and Capricorn.

4. OSCP Background Information

4.1. Introduction

This section includes:

- An overview of the oil spill legislative and regulatory framework
- A risk assessment of Capricorn operations
- A summary of the oil spill modelling conducted

4.2. Legislative and Regulatory Framework

Capricorn complies with the following international and national legislation and statutory requirements applicable to offshore petroleum activities and oil spill planning in Greenland.

4.2.1. International Conventions

Greenland is a signatory to following international conventions through Denmark:

- International Convention for the Prevention of Pollution of the Sea (OILPOL 1954)
- International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC '90)
- MARPOL 73/78 (and all pertinent Annexes)
- Civil Liability Convention for oil pollution damage (CLe) 1992 and Fund 1992
- United Nations Convention on the Law of the Sea (UNCLOS 1982)

International Convention for the Prevention of Pollution of the Sea (OILPOL 1954)

This Convention considers the control of oily water discharges from general shipping and oil tankers. It also introduced the term 'nearest land from the baseline', from which the territorial sea of the territory in question is established in accordance with the *Geneva Convention on the Territorial Sea and the Contiguous Zone*.

International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC '90)

The OPRC convention provides an international framework for co-operation in combating and responding to major incidents or threats of oil pollution. The convention strives to:

- prevent marine pollution by oil, in accordance with the precautionary principle
- advance the adoption of adequate response measures in the event that oil pollution does occur
- provide for mutual assistance and co-operation between States for these aims

The Parties adhering to the OPRC'90 convention are required to establish measures for dealing with pollution incidents, either nationally or at a regional and global level, in co-operation with other countries. The convention calls for the establishment of stockpiles of oil spill response equipment, for the conduct of oil spill response exercises, and for the development of detailed plans for dealing with pollution incidents. Parties must require that ships, offshore units and seaports under their jurisdiction have oil pollution emergency plans.

Recognising the importance of international co-operation in combating the dangers of marine oil pollution, the convention encourages all parties to enter into bilateral and regional response agreements to prepare for, and respond to, oil spills. The convention establishes a voluntary mechanism for Parties to provide technical assistance in the form of equipment and training to other Parties that request such assistance.

International Convention for the Prevention of Pollution from Ships (MARPOL 73/78)

MARPOL 73/78 is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes. It is a combination of two treaties adopted in 1973 and 1978 and includes subsequent amendments.

The Convention includes regulations aimed at preventing and minimising pollution from ships, both from accidental pollution and from routine operations. Under Regulation 26, Annex 1 of MARPOL 73/78, any field support vessels and installations (i.e. drilling rigs) must have a Shipboard Oil Pollution Emergency Plan (SOPEP) approved by a classification society or flag state.

The SOPEP must include:

- Procedures for reporting oil pollution incidents;
- List of authorities and persons to be contacted in the in the event of an incident;
- Detailed description of immediate action to be taken to reduce or control discharge of oil following an incident;
- Procedures and point of contact for co-ordinating spill response actions with national and local authorities.

Initial actions following a spill will be taken in accordance with the approved SOPEP. In the event of a spill from a vessel or unanchored MODU, the Vessel Master or MODU OIM is responsible for statutory reporting and implementing the SOPEP. Once the MODU is on station this OSCP and the Cairn Emergency Response Plan (ERP) will take precedence over the SOPEP.

MARPOL 73/78 also provides guidelines for reporting pollution incidents to the authorities and outlines standard reporting procedures. However, Greenland has developed national gUidelines which must be used when reporting an oil spill incident.

Civil Uabillty Convention for oil pollution damage (CLC) 1992 and Fund 1992

Greenland is a signatory to CLC 1992 and Fund 1992 providing a higher level of compensation. The CLC 1992 deals with compensation for damages from spills of persistent crude and fuel oil from tankers. It does not cover oil spills from offshore installations.

The United Nations Convention on the Law of the Sea (1982)

The United Nations Convention on the Law of the Sea (1982) also referred to as the Law of the Sea Convention or the Law of the Sea treaty, is the international agreement that defines the rights and responsibilities of nations in their use of the world's oceans, establishing gUidelines for businesses, the environment, and the management of marine resources. UNCLOS came into force in 1982.

4.2.2. Regional Framework

Convention on the Protection of the Marine Environment of North-East Atlantic (OSPAR 1992)

The OSPAR convention requires that the Parties 'shall take all possible steps to prevent and eliminate pollution and shall take the necessary measures to protect the maritime area against the adverse effects of human activities so as to safeguard human health and to conserve marine ecosystems and, when practicable, restore marine areas which have been adversely affected.' The Parties will co-operate especially in the work of the International Maritime Organization (IMO), to tackle threats to the marine environment from shipping through promoting better waste reception facilities and their more effective use including harmonised arrangements to remove economic, administrative or organisational incentives for ships not to use port waste reception facilities.

The Copenhagen Agreement (Nordic Agreement)

The 1971 Copenhagen Agreement (revised in 1993) between Denmark (including Greenland and Faroe islands), Finland (Aland islands), Iceland, Norway and Sweden, addresses marine oil pollution. The Parties agree to cooperate on surveillance, investigations, reporting, securing of evidence, combating and assistance in combating, as well as general exchange of information in order to protect the marine environment from pollution by oil or other hazardous substances.

CANDEN Agreement

The 1983 Agreement aims at developing further bilateral cooperation in respect of the protection of the marine environment of the waters lying between Canada and Greenland and of its living resources, particularly with respect to preparedness measures as a contingency against pollution incidents resulting from offshore hydrocarbon exploration or exploitation and from shipping activities that may affect the marine environment of these waters.

4.2.3. National Legislation

Environmental Protection Act

The purpose of the Act is to contribute to safeguarding nature and the environment, thus enabling a sustainable social development in respect of human conditions of life and for the conservation of flora and fauna. The Act applies to all activities which by emission of solid, liquid or gaseous substances are likely to harm health or the environment. The objectives of the Act are:

- to prevent and combat pollution of air, water, soil and subSOil, and nuisances caused by vibration and noise
- to provide for regulations based on hygienic considerations which are significant to human and the environment
- to reduce the use and wastage of raw materials and other resources
- to promote the use of cleaner technology
- to promote recycling and reduce problems in connection with waste disposal

Act on the Protection of the Marine Environment

The Act aims to prevent and reduce pollution of the environment, in particular the marine environment, from ships, aircraft, floating and fixed platforms by solid, liquid, gaseous or other substances which may:

- cause hazards to human health

- harm living resources and marine life
- cause hindrance to legitimate uses of the sea
- reduce amenities

National Plans

The Admiral Danish Fleet 'Emergency Response Plan for National Danish Emergency Management in the Combat of Pollution of the Sea by Oil and Other Harmful Substances' (2004) establishes the framework for the implementation of a speedy and effective response. The Plan defines responsibilities in Greenland as follows:

The area from the base line to 3 nautical miles.

- In accordance with Royal Order no. 1035 of 22 October 2004, "Order on the entry into force in Greenland of the Danish Act on the Protection of the Marine Environment " and "Greenland's Hjemmestyre's (Home-Rule - national administration) emergency management plan relating to operational deployments in combating oil pollution in Greenland's ports and coastal areas" of May 1993, Greenland's Hjemmestyre has responsibility for fighting pollution from the base line out as far as 3 nautical miles from the coast. The head of Greenland Command (CH GLK) looks after the marine environmental interests of Danish Defence in relation to Greenland's Hjemmestyre.

The area from 3 nautical miles as far as 200 nautical miles

- In accordance with Royal Order no. 1035 of 22 October 2004, responsibility for tackling pollution by oil or other harmful substances in Greenland's waters beyond three nautical miles from the base line to 200 nautical miles from the base line, the dividing line between Greenland/Canada and Greenland/Iceland, respectively, lies with Greenland Command. Greenland's requests for assistance are to be issued via Greenland Command to Admiral Danish Fleet.

The 'Emergency Response Plan for Combating of Pollution of the Sea by Oil and other Harmful Substances in the Waters off Greenland' is issued by the Greenland Command Marine Section under the Marine Environment Act. The plan defines:

- Greenland's policy for dealing with pollution at sea
- The roles and jurisdiction of the Greenland's statutory and non-statutory organisations who have responsibility and involvement in dealing with spilt hydrocarbons at sea and along the shoreline
- The circumstances under which Greenland Command deploys Greenland's national assets to respond to a marine pollution incident including the role of the High Commissioner for Greenland, when he is representing the Danish State.

Waste Management

There are a number of laws which deal with various aspects of waste management. The Greenland Government will coordinate the activities in relation to the life cycle of waste, i.e. from generation to disposal under the Environmental Protection Act and the EC Regulation No 532/2000. The shipment of wastes is covered under the Danish Statutory Order No 799 and EC Regulation No 1013/2006.

4.2.4. Oil Spill Sensitivity

A large sensitivity mapping project was completed by the National Environmental Research Institute (NERI) for the Ministry of the Environment of Denmark. The maps on the following pages contain information from an update issued July 2011. The most recent information is maintained in the Geographic Information System (GIS) portal maintained by Capricorn and available to the Emergency Response Group (ERG) in case of a need to use during an oil spill response.

Two aims of this sensitivity mapping project were to develop a GIS based environmental planning tool for coastal zone management, and to develop a management tool for use in planning and implementing an oil spill response.

To derive the sensitivities the coast was divided into separate areas. A sensitivity ranking system was developed for the assessment of marine oil spills and each segment was classified based on the fate and impact of oil on the eco-system and on human activities.

Full details of the ranking system and methodology used can be found within the Environmental Oil Spill Sensitivity Atlas for the West Greenland Coastal Zone, NERI Technical Reports. These reports are appended as Appendix III of this document.

Offshore Sensitivities

In general, coastal areas tend to have higher oil spill sensitivity than offshore areas. As can be seen, the sensitivity of different areas fluctuates with differing seasons. Therefore any response priorities must be identified not just with consideration to location, but to the seasonal cycle of the species that occur within that region. The sensitivity maps in the following pages show an overview to the offshore areas but in an oil spill more detailed information would be reviewed by the ERG. This detailed information includes species population distributions and shoreline sensitivities on a much smaller scale to those illustrated here. Summer data *(Figure* 19) illustrates that extreme sensitivity areas exist in the coastal areas of south Disko Bay; in and either side of the fjords culminating at Nuuk, the coastal area just to the north of Napariaq and Pltu, and the coastal areas on the south Greenland coast.

Autumn data *(Figure 20)* illustrates that extreme sensitivity areas spread through the coastal areas to approximately 300 nm south of Disko Bay; in and to the south of the fjords culminating at Nuuk; just east of Pitu and to the very north of the study area.

Winter data *(Figure* 21) illustrates that extreme sensitivity areas exist throughout most of the coastal areas from the southern tip of Greenland to Nuuk; the coastal areas to the north and south of Disko Island and the coastal area just to the north of Napariaq.

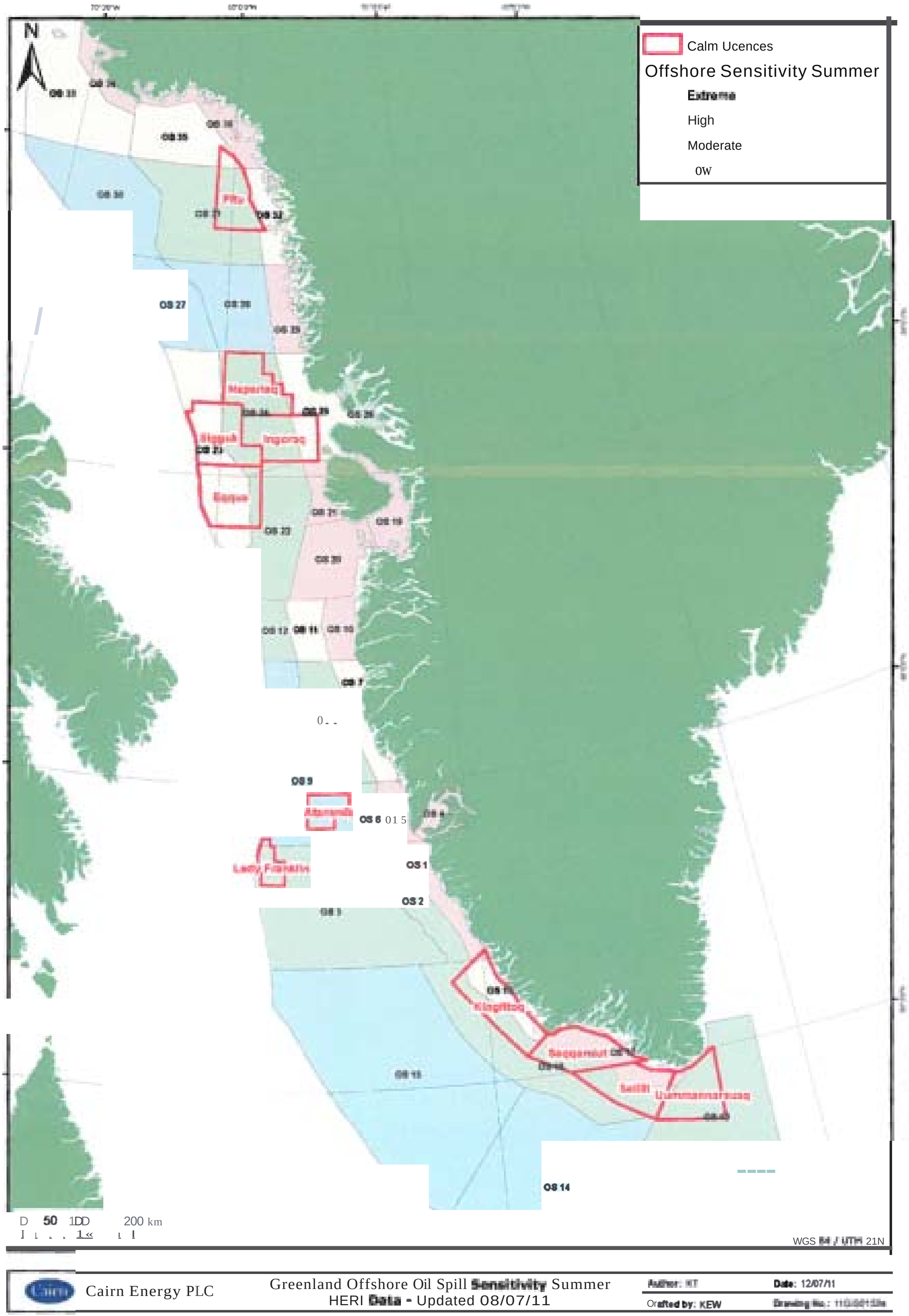


Figure 19 Offshore sensitivities - Summer

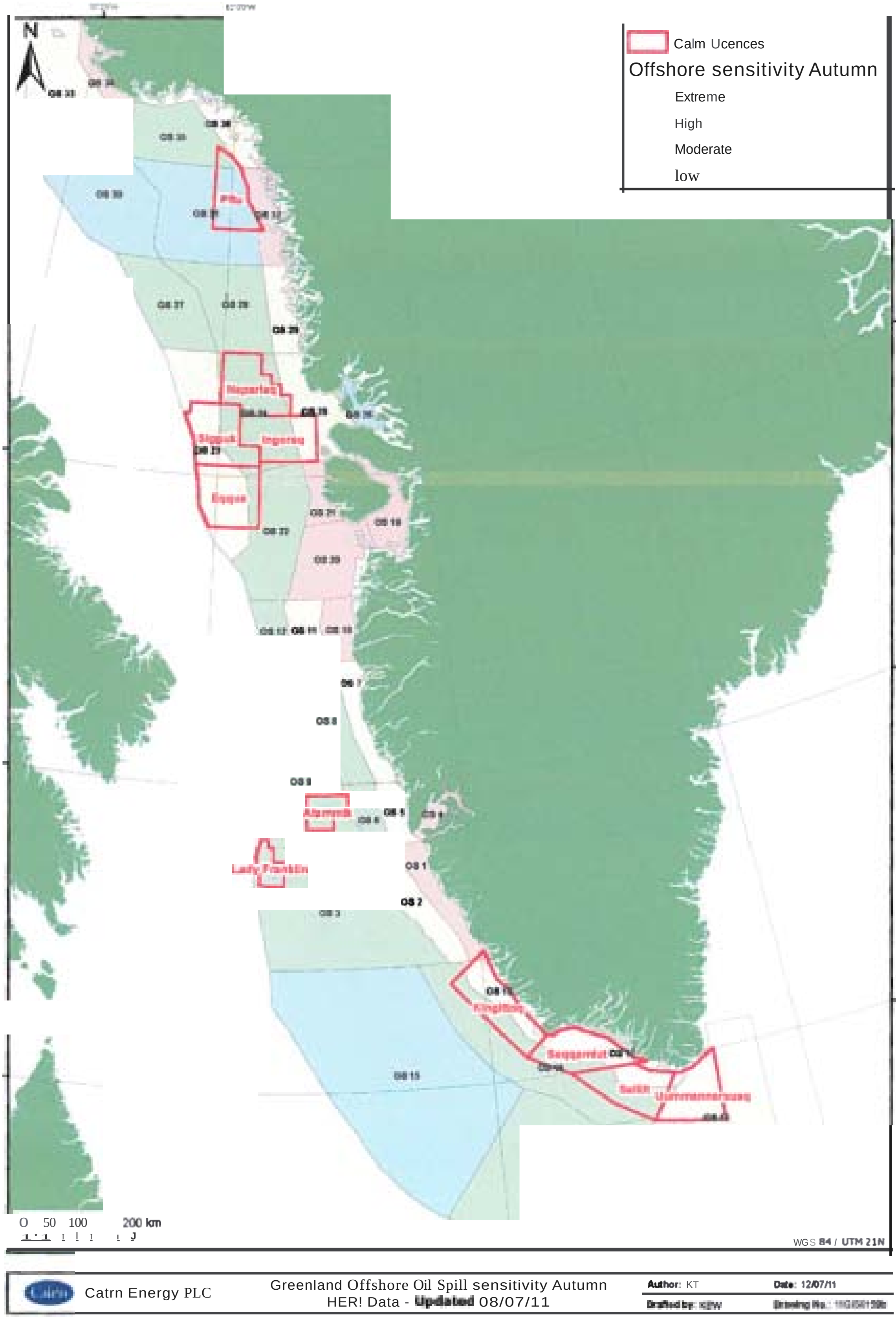


Figure 20 Offshore sensitivities - Autumn

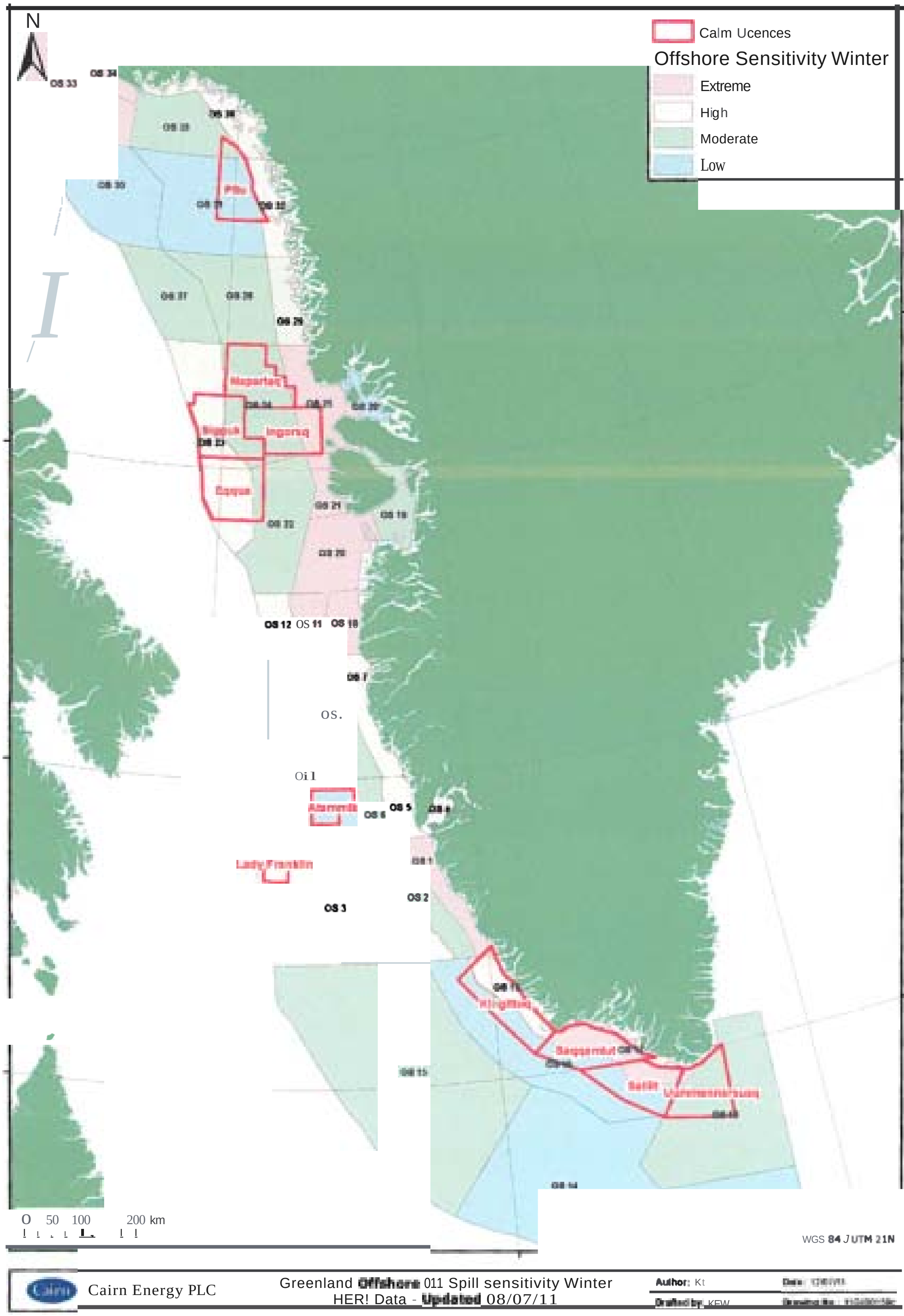


Figure 21 Offshore Sensitivities – Winter

Sensitive Species

The offshore oil spill sensitivity maps on the preceding pages are an indication of the seasonal oil spill sensitivity of the West Greenland areas. If an oil spill were to occur they would be used in conjunction with *real* time information, such as the ice edge position at the time of spill and the distribution of certain species at that particular time. Important species to be considered are briefly mentioned below. More information on species distribution can be found in the Environmental Impact Assessments for the project, and the full sensitivity reports appended in Annex III. Capricorn holds a copy of the shape *files* identifying species distribution and these are available to the ERG to overlay with spill trajectory information to identify protection priorities in the event of a spill.

Fish

Fish can take up oil components into their tissues after exposure to oil in water, food or sediment. Toxicity to fish is related to the total aromatic hydrocarbon concentration, with fish eggs and larvae generally being more sensitive than adult fish. Sensitivity has been found to be variable by species. In open seas toxic concentration will *seldom* be high enough to cause mortality. Adult salmon and cod have been observed to avoid oil[2S].

Fish are highly important in Greenland for both commercial and subsistence fishing, and as a prey item for other species. Capelin and lumpsucker, important commercial and subsistence species, spawn in or just below the intertidal zone so would be at high risk in an oil spill that reached the coast. The spawning period for these species ends in June so is unlikely to be affected by an oil spill due to the drilling period.

Invertebrates

Physical smothering of invertebrates with oil prevents respiration, reduces mobility, and creates excess weight and shearing forces on mobile species. Ultimately these factors can lead to invertebrate death. Some species such as muscles can survive short term smothering by oil as they close up their shells during low tide but will still be smothered by thick oil. Mobile invertebrates may survive by seeking deeper water.

There are over 2000 Greenlandic invertebrate species. Crustaceans are the most abundant and copepods and krill are the dominant and important species in the Greenland marine ecosystem[26]. Northern shrimp and snow crab are economically important.

Spilt oil reaching coastal Greenlandic areas is likely to cause a reduction in diversity and increase in opportunistic species. Rates of recovery in the Arctic may be slower due to slow growth rates and short reproductive seasons[26].

Marine Mammals

Marine mammals are generally less sensitive to oiling than many other organisms (Boertmann *et 01.,* 2009)[27]. Whales and adult seals are less vulnerable as they rely on blubber rather than fur for insulation. Seal pups are more vulnerable as they rely on their fur for insulation. Marine mammals

2S Ernst et al 189 / Serigstat 1992, cited in Mosbech et al 2002 NERI report 415
26 Mosbech et al 2002: Potential environmental impacts of oil spills in Greenland. NERI report 415
27 NERI report 720: The eastern Baffin Bay. A preliminary strategic environmental impact assessment of hydrocarbon activities in the KANUMAS West area

residing in open water will probably avoid heavily affected areas (Mosbech *et 01.,2007)28.* If a spill was to encroach under or within ice then populations that use the cracks and leads in ice may be affected; as marine mammals may be forced to surface in an oiled area, where there is a risk of inhaling oil vapours[28]. Individuals of narwhal may be affected and long term impacts on narwhal populations from inhaling oil vapours is unknown and could be significant[28].

Populations of polar bear are unlikely to be significantly affected due to their dispersed distribution, but individuals have been found to be highly sensitive to oiling[29]. Oiling can reduce fur insulation and ingested oil from grooming can be toxic.

Marine mammals may be affected through the food chain and particularly exposed are those that feed on benthic fauna, especially walrus and bearded seal, which feed in shallow waters where toxic concentrations of oil can reach the seafloor (Boertmann *et al., 2009)27.*

Birds

Birds are vulnerable to oil spills through both direct ingestion of the oil and through oil soaked plumage reducing insulation and buoyancy which can cause hypothermia, starvation and drowning. Birds which rest and dive from the sea surface, such as auks, seaducks, cormorants and divers, are most exposed to floating oil.

A high proportion of the breeding adult Atlantic puffins and razorbills from important breeding colonies in the outer Disko Bay are likely to be exposed to oil during a spill that reached the area, as are other alcids (black gUillemot, little auk) (Mosbech *et al., 2007)28.*

Other breeding populations such as fulmar, Iceland gull, kittiwake, great cormorant and arctic tern are likely to be impacted to a lower degree than Atlantic puffin and razorbill. A high mortality among the great cormorants would be expected, but this population has a high recovery potential. Moulting common eiders, moulting harlequin ducks and thick-billed murre would be at risk if oil reached their colonies. King eider moulting areas on the west coast of Disko Island and important wintering area on Store Hellefiskebanke and the adjacent coast are highly vulnerable to oil spills and a large spill is likely to significantly deplete populations (Mosbech *et 01.,2007)28.*

Greenland has 11 sites in the Ramsar list of Wetlands of International Importance, 8 of these to the west of Greenland. Their position is illustrated in *Figure* 22 and GIS files are available to the ERG in case they are required for protection prioritisation activities during an oil spill response. *Qinnguata Morroo-Kuussuoq* is the closest site to the licence area and covers a total area of 6,480 ha. This site was designated because it is an important moulting area for king eiders. BirdUfe International has also designated a number of Important Bird Areas (IBAs) in western Greenland.

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28 NERI report 618: Strategic Environmental Impact Assessment of hydrocarbon activities in the Disko West area

29 St Aubin 1990, cited in Mosbech et al 2002: NERI report 415

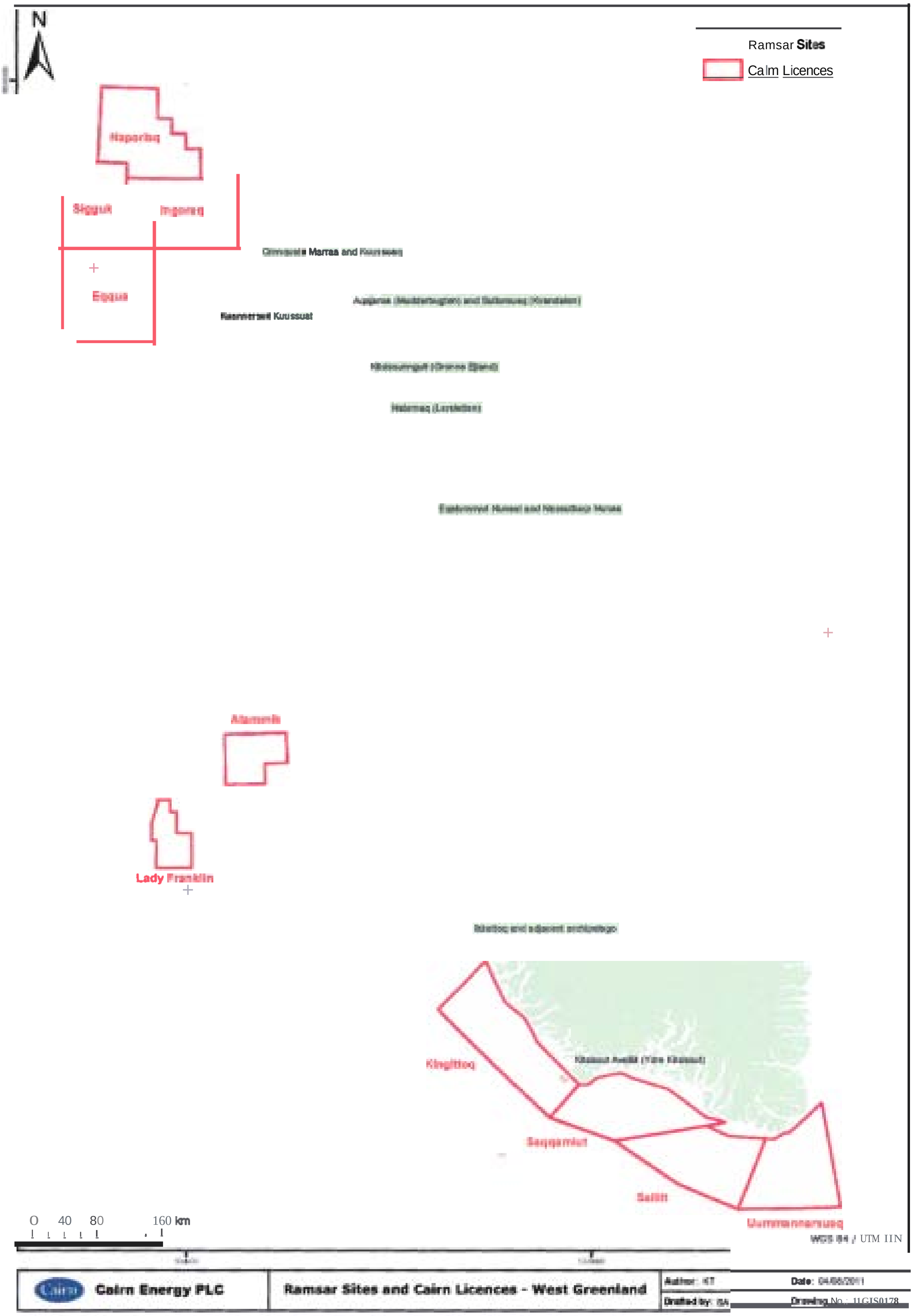


Figure 22 Western Greenland Ramsar Sites

4.3. Oil Spill Risk Assessment

Potential oil spill scenarios have been identified from the information in the Operational Overview, *Section* 1.3.1, and historic data, *Section 4.3.1*.

Understanding the overall oil spill risk requires these scenarios to be defined in terms of the likelihood of occurrence and potential consequences. The likelihood of each scenario has been estimates using a qualitative methodology based on industry data and experience. The potential consequence has been predicted based on the sensitivities at risk as described in *section 4.2.4*.

Those scenarios deemed to be worse case have been modelled to gain an understanding of spill trajectory. The overall oil spill risk profile has been illustrated on a risk assessment matrix which allows the overall trend to be seen. The risk assessment process has been undertaken in line with the Cairn Group's HSE risk management process, (HSE, Security and CSR Risk Management, Report Number EDHSEPR002 1241/Rev4/September 2002).

4.3.1. Historical Spill Data

There are no Greenlandic or global oil spill databases for exploration activities; however the UK Government has compiled comprehensive statistics from oil spills reported on drilling operations in the North Sea over a 25 year period.

The types and quantities of hydrocarbons spilt from mobile drilling units on the United Kingdom Continental Shelf (UKCS) between 1984 and 2002 are shown in Figure 23. The type of oil spill from MODUs have been OBM, base oil, diesel oil, crude oil, lube oils, hydraulic oil and aviation fluid.

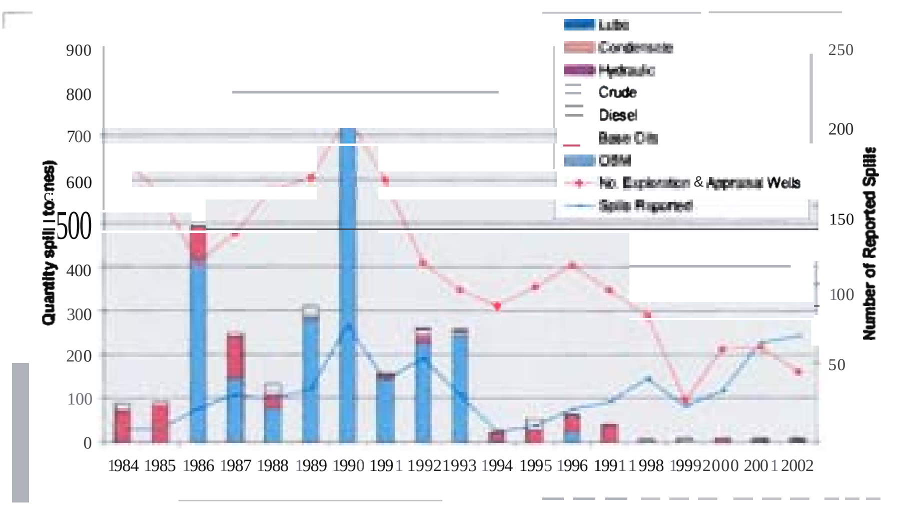


Figure 23 Hydrocarbons Spilt from Exploration and Appraisal Drilling 1984-2002

The data shows that in the earlier years of the database, the greatest quantity of oil spilt was OBM and base oil. The decline in OBM and base oil spills has been through use of containment systems and increased awareness of the effects of OBM and base oil spills on the seabed as well as legislative changes in oil-on-cuttings discharges (UKOOA, 2006). Capricorn will only be using water based muds (WBM) in their drilling operations offshore Greenland.

Volumes from spills of aviation fluid, lube and hydraulic oil from MODUs are negligible. lube and hydraulic oils are stored onboard in tanks or sealed drums, thus posing a minimal spillage risk. Spills of diesel oil and crude oil have occurred throughout the period and may be expected to occur at any time. There is no trend in their frequency of occurrence.

Large spills may occur from well control problems such as well control incidents or well kicks. Literature available provides a range of well control incident frequencies used in oil spill risk assessments. This range is partly due to differences in the definition of well control incident (e.g. exclusion of shallow gas events), and to difficulties in comparing risk units. However the only significant well control incidents on the UKCS to date have been from West Vanguard (1985) and Ocean Odyssey (1988). There have been no well control incidents on the UKCS which resulted in oil pollution.

The UK Health and Safety Executive's Offshore Safety Division (OSD) records well kicks. These involve an unexpected but controlled flow of formation fluids into the wellbore and include "serious" kicks. These are defined as those kicks that posed a safety hazard to personnel on the installation or have the potential to cause a significant safety hazard. Between 1988 and 1998, 52 serious kicks have been recorded from 3,668 UKCS wells (an occurrence rate of 1.4%), none of which resulted in oil pollution to the sea (SEA2, 2001).

Site Specific Factors

- The wells are to be drilled using water based muds
- Drilling related large and medium sized spills are considered extremely unlikely due to the controls in place and historical industry data

4.3.2. Risk Assessment for Greenland Drilling Operations 2011

Statistically the most common spills that occur are small operational type spillages, for example those occurring during routine maintenance operations and fuel transfers. However, in terms of assessing risks to the environment, it is also important to consider those spills that have a low probability of occurring, but a high potential impact such as well control incidents.

The potential oil spill scenarios for the exploration drilling activities and associated operations are summarised in *Table* 21. In practice, due to precautions such as training, operating procedures and engineered solutions, potential spills are likely to be small, with larger spills being extremely unlikely.

The scenarios and spill volumes presented here are indicative only. Not every eventuality can be accounted for however; these represent a broad cross section of possible oil spill scenarios. The qualitative ratings for 'likelihood' and 'consequence' are defined in *Table* 19 and *Table* 20 and have been taken from Cairn Group's risk management process (HSE, Security and CSR Risk Management, Report Number EDHSEPR002 1241!Rev4!September 2002).

Table 19 Likelihood Ranking

Ukellhood	Reference	Description	Frequency Description
Almost Certain	A	Consequence expected to occur in most circumstances	High frequency of occurrence - occurs more than once per month
Likely	B	Consequence will probably occur in most circumstances	Regular frequency. Event likely to occur at least once per year
Possible	C	Consequence should occur at some time	Occurs once every 1- 10 years
Unlikely	D	Consequence could occur at some time	Unlikely to occur during life of operations - Occurs once every 10 - 100 years
Rare	E	Consequence may occur under exceptional circumstances	Highly unlikely to occur **during** life of the operation. Occurs less than once every 100 years

Table 20 Consequence Severity Ranking (Site Level)

	Company Level (3-7)	Low	Minor	Moderate	Major	**Critical**
Business Level (2-6)	Low	Minor	Moderate	Major	Critical	
Site Level (1-5)	Minor	Moderate	Major	Critical		
Level 1	Level 2	Level 3	level 4	levelS	level 6	Level 7
Injury and disease						
Low level short-term subjective inconvenience or symptoms. No measurable physical effects. No medical treatment.	Objective but reversible disability/impairment and/or medical treatment injuries requiring hospitalisation.	Moderate irreversible disability or impairment «30%) to one or more persons.	Single fatality and/or severe irreversible disability or impairment (>30%) to one or more persons.	Short or long term health effects leading to multiple fatalities, or significant irreversible human health effects to >50 persons.	Short or long health effects leading to >50 fatalities, or very serious Irreversible human health effects to >500 persons.	Short or long health effects leading to >500 fatalities, or very severe irreversible human health effects to >5,000 persons.
Environmental effects						
No lasting effect. Low-level impacts on biological or physical environment. Limited damage to minimal area of low significance.	Minor effects on biological or physical environment. Minor short-medium term damage to small area of limited significance.	Moderate effects on biological or physical environment but not affecting ecosystem function. Moderate short-medium term widespread impacts (e.g. oil spill causing impacts on shoreline).	Serious environmental effects with some impairment of ecosystem function (e.g. displacement ota species). Relatively widespread medium-long term impacts.	Very serious environmental effects with impairment of ecosystem function. Long term, widespread effects on significant environment (e.g. unique habitat, National Park).	Significant impact on highly valued species, habitat, or ecosystem to the point of eradication.	Eradication or very significant effects on highly valued species/ habitat, especially endangered species. Long term destruction of highly valued land/ecosystem (e.g.: World Heritage Area).
Sodall cultural heritage						
Low-level social or cultural impacts. Low-level repairable damage to commonplace structures.	Minor medium-term social impacts on local population. Minor damage to structures/ items of some significance. Minor infringement of cultural heritage. Mostly repairable.	Ongoing social issues. Permanent damage to structures/ items of cultural significance. or significant infringement of cultural heritage/ sacred locations.	On-going serious social issues. Significant damage to structures/ items of cultural significance, or significant infringement and disregard of cultural heritage.	Very serious widespread social impacts. Irreparable damage to highly valued structures/items/ locations of cultural significance. Highly offensive infringements of cultural heritage.	Irreparable damage to highly valued structures/items/ locations of cultural significance or sacred value. Destabilisation and breakdown of social order In **a** community.	Destruction of multiple very highly valued and significant cultural heritages (e.g.: National Parks and monuments). Destruction of social fabric of communities.

	Comoany Level (3-7)	Low	Minor	Moderate	Malor	Critical
Business Level (2-6)	Low	Minor	Moderate	Major	Critical	
Site Level (1-5) Low	Minor	Moderate	Major	Critical		
Level 1	Level 2	Level 3	Level 4	levelS	Level 6	Level 7
Community laovernment / media / reputation						
Public concern restricted to local complaints. Ongoing scrutiny/ attention from regulator.	Minor, adverse local public or media attention and complaints. Significant hardship from regulator. Reputation is adversely affected with a small number of site focussed people.	Attention from media and/or heightened concern by local community. Criticism by NGOs. Significant difficulties in gaining approvals. Environment credentials moderately affected.	Significant adverse national media/ public/ NGO attention. May lose licence to operate or not gain approval. Environment! management credentials are significantly tarnished.	Serious public or media outcry (international coverage). Damaging NGO campaign. Ucence to operate threatened. Reputation severely tarnished. Share price may be affected.	International multi-NGO and media condemnation. Several licences to operate revoked. Banned from operating in a few countries.	Shareholder revolt. Product boycotts, mass demonstrations. International media/NGO campaign. Multiple licences to operate revoked. Banned from operating in multiple countries.
Legal						
Low-level legal issue. On-the-spot fine. Technical non-compliance. Prosecution unlikely.	Minor legal issues, non-compliances and breaches of regulation. Minor prosecution or litigation possible.	Serious breach of regulation with investigation or report to authority with prosecution and/or moderate fine possible.	Major breach of regulation with potential major fine and/or investigation and prosecution by authority. Major litigation.	Investigation by authority with significant prosecution and fines. Very serious litigation, including class actions.	Very significant fines and prosecutions. Multiple litigation, including significant class actions.	Very significant legal actions e.g.: legal closures of operations.
OperatlonalImpact (safety, health environment related incidents)						
Easily addressed or rectified by immediate corrective action. No loss of production. No damage to equipment.	Minor or superficial damage to equipment and/or facility. No loss of production.	Moderate damage to equipment and/or facility. Loss of production <one week.	Major damage to facility requiring significant corrective/ preventative action. Loss of production <six months.	Future operations at site seriously affected. Urgent corrective/remedial action. Loss of production >six months.	Future operations untenable and remedial actions, demolition, total loss of production.	Future operations untenable, neighbouring businesses similarly affected and total production loss.
Total estimated cost (inclusive of all safety, health and environment related costs e.g. potential clean up, corrective actions, fines, liabilities.						

Table 21 determines the potential oil spill scenarios from Capricorn's operations offshore Greenland.

Table 21 Offshore Oil Spill Scenarios

Ref	Scenario	Oil Type	Volume	Likelihood	Consequence	Comments
1	Minor operational or maintenance spills	UtiJityoil, diesel	<1m^3	B	1	Spill unlikely to have a significant impact due to size, and it would be easily mitigated. Release may not even come into contact with the marine environment if spilled on deck
2	Minor diesel spills during fuel transfer operations, offshore or in harbour	MGO	<1 m^3	C	1	MGO likely to naturally dissipate readily
3	Major spills during fuel transfer operations. Full flow release of diesel due to rupture of transfer hose, offshore or in harbour	MGO	<7m^3	C	1	MGO spill likely to naturally dissipate, but likely to spread over a large area. Exact volume depends on shut down times. Publicity and public interest Increased as a result of a spill in the harbour
4	Complete loss of maximum diesel inventory offshore, from the Corcovado	MGO	7500m^3	E	3	MGO spill likely to naturally dissipate. The largest potential release is loss of the entire inventory which is unlikely
5	Support Vessel with largest fuel tank, *Olympic Poseidon,* diesel tank rupture, offshore	MGO	1270 m^3	E	3	MGO spill likely to naturally dissipate. The largest potential release is loss of the entire inventory which is unlikely
6	Support Vessel with largest fuel tank, *Olympic Poseidon,* diesel tank rupture, nearshore	MGO	1270 m^3	E	4	MGO spill likely to naturally dissipate. The largest potential release is loss of the entire inventory which is unlikely. Increased environmental impact and therefore public interest as a result of location
7	Well control Incident, with maximum anticipated uncontrolled flow rate	Crude	794.9 m^3 /day (5,000 bbls/day)	E	5	well control incident follOWing a kick from the top 3m of an overpressured oil reservoir nearTD, see well control incident Scenario details below
8	Loss of aviation fuel from the *Leiv Erikkson,* MODU with max capacity of aviation fuel onboard	Aviation fuel	7.5 m^3	D	1	This is the maximum possible inventory and it is unlikely the entire inventory will be lost (maximum per tank = 2.5 m^3). Aviation fuel will evaporate readily
9	Drop out from burner when well testing	Crude	<0.5 m^3	B	1	Only a risk if well testing occurring. Given the location, there is no chance of the oil reaching shore
10	Water causing flare to splutter when well testing	Crude	I-5m^3	C	2	Only a risk if well testing occurring. Given the location, there is no chance of the oil reaching shore
11	Flare goes out when well testing due to equipment failure	Crude	5-10 m^3	D	3	Well will be shut-in to stop flow

Well Control Incident Scenarios

Possible rates were estimated for the 2011 campaign by Capricorn's Drilling Engineers:

Estimation of Well Control Incident Rate for 2011 Greenland Drilling Campaign

- This scenario assumes a well control incident following a kick from the top 3 m of an overpressurised oil reservoir near TO.
- Initially total BOP failure is assumed but the drilling unit and riser are assumed to remain intact.
- The oil is assumed to be light with a minimum flowing gradient close to the static gradient with no wellbore restrictions.
- It is assumed that the BOP Is re-activated remotely and the well is killed from the surface within 37 days.
- The average oil rate from the previous nine Greenland offshore wells is zero - rates must be estimated without analogues.
- Based on the previous Greenland wells, formation permeability is assumed to be relatively low.
- Rate is estimated using a radial flow equation, ignoring skin and partial penetration effects[30].
- Oata[30] indicates 91% of well control incidents were controlled within one month, and less than 7% required relief wells.

Parameter	Definition	Field units		Metric Units	
		Assumptions			
WD_{min}	Minimum water depth	820	*feet*	250	m
WD_{min}	Maximum water depth	4921	*feet*	1500	m
Dmin	Minimum reservoir depth	7874	ft TVD SS	2400	m TVD SS
D_{max}	Maximum well depth	15420	ft TVD SS	4700	m TVD SS
PP_{max}	Maximum design pore pressure EMW	14	ppg	1.68	SG
Yomln	Minimum oil flowing gradient	0.3	psi/ft	0.69	SG
D	Worst case blowout depth	15092	ft TVD SS	4600	m TVD SS
		Calculated Values			
Prma•	Worst case maximum reservoir pressure	10987	psia	75752	kPa
Pwfmln	Worst case minimum bottom hole pressure	4528	psia	31216	kPa

30 Volume 2 Report of Task Group One - Worst Case Scenario. A report prepared on behalf of the canadian Petroleum Association for the Beaufort Sea Steering Committee, April 1991.

Inflow rate into the wellbore can be estimated using the following radial inflow equation (in metric units):

$$\frac{(P_R - P_{wf})}{1866\,\mu_o B_o \left[\ln\left(.472\,\frac{r_e}{r_w}\right)\right]}$$

Parameter	Definition	Field units		Metric Units	
		Assumptions			
PR	volumetric average reservoir pressure	11000	psia	75842	kPa
P_w	flowing bottom hole pressure	5000	psia	34474	kPa
k_o	effective oil permeability	25	mD	2S	mD
h	net pay	10	feet	3.0	m
μ_o	live oil viscosity at reservoir conditions	0.2	cP	0.2	mPa.s
8_0	oil formation volume factor	1.2	rb/ stb	1.2	rm^3/ sm^3
r_e	drainage radius	10000	feet	3048	m
rill	wellbore drainage radius	0.6	feet	0.18	m
		Calculated Values			
qo	oil rate	4858	bbl/day	772	m^3/day
		Assumptions			
$Q_{m..}$	Worst case averace oil rate	5000	bbl/day	795	mJ/day
T_{max}	Worst case duration	37	days	37	days

Fuel Transfer Operations

Nearshore interaction is expected to be limited to supply boats entering near to [redacted] or _ harbour to transfer waste materials ashore or to take on fuel from designated refuelling barges, water or materials to support the operations. Potable water and fuel (marine fuel oil, diesel) will be re-supplied by the Arctic Base Supply, with the re-supply of specialist materials and consumables required for the drilling operation (not available in Greenland) being undertaken from the UK directly to the MODUs or into _____ _

Oil Spill Risk Assessment Matrix and Summary

The risk assessment matrix,
Table 22, shows the overall risk profile for Capricorn's drilling operations. The matrix shows that there are no extreme risk operations primarily as a result of Capricorn implementing various preventive measures to ensure the oil risk is as low as reasonably practicable. The only oil spill scenarios that present a high consequence are well control incidents, and a large release of diesel from a support vessel tank rupture nearshore (the diesel spill haVing a high consequence due to close proximity to the shoreline). This well control incident high consequence rating results from the potential large scale impact, persistency in the environment, and potential shoreline impact; despite the low probability of such events actually occurring.

- The vertical axis represents increasing consequences (Severity Levels 1 to 5) in terms of environmental damage.
- The horizontal axis represents increasing likelihood (Levels A to E) of occurrence.
- Boxes in the matrix represent levels of risk; low, medium and high, increasing from the bottom left to the top right corners of the matrix. These are categorised as yellow, green, purple and red areas to illustrate the increasing level of risk.

Table 22 Risk Ranking Matrix

Likelihood or Frequency	Ref.	Consequence Severity				
		Low	**Minor**	**Moderate**	**Major**	**Critical**
		1	**2**	**3**	**4**	**5**
Almost Certain	A					
Likely	B	1, 9				
Possible	C	2, 3	10			
Unlikely	O	8		11		
Rare	E			4, 5	6	7

Key

Low Moderate Extreme

Mitigating Measures

As with all oil spill handling operations, there is an inherent risk that oil may be spilled. Capricorn takes various preventive measures to both reduce the likelihood of a release and reduce impact should a release take place. These are documented in the Compliance Register (document reference EO/GRL/HSE/CPL/ll/2024)

4.3.3. Maintaining Oil Spill Preparedness

Training

The required level of training for the specific roles carried out during an oil spill response incident is given in the training matrix, see *Table* 23. The matrix details response team job title/role and the appropriate international standard level of the course individuals will undertake.

Table 23 Oil Spill Training Matrix

Role / Position	International Maritime Organisation (IMO) Level 3	International Maritime Organisation (IMO) Level 2	Awareness Course / exercises
Emergency Response Group			
ERG Team Leader	✓		✓
Logistics Coordinator		✓	✓
Operations and Technical Coordinator		✓	✓
HSE Coordinator	✓	or ✓	✓
Finance Coordinator			✓
HR Coordinator			✓
External Affairs Coordinator			✓
Recorder			✓
Incident Response Team			
OSC	✓	or ✓	✓
Capricorn DSV	✓	or ✓	✓
Cairn In-Country Representative			
Vessel Master(s)		✓	✓
Vessel Crew			✓

The details on the content of the courses are prOVided in *Table* 24. The courses are recognised by the IMO.

Table 24 IMO Model Training Course Information

IMO Course Level	Content and Issues
Level 3 Senior Managers and Administrators	Overview of roles and responsibilities of senior personnel in the management of incidents, cause and effect of oil spills, response policy and strategies, contingency planning, crisis management, public affairs and media relations, administration and finance and liability and compensation.
Level 2 Supervisors, On-Scene Commanders and Responders	Detailed training in oil spill behaviour, fate and effects, spill assessment, operations planning, containment, protection and recovery, dispersant use, shoreline cleanup, site safety, storage and disposal of waste, record keeping, command and control management, communications and information, liability and compensation, response termination and post incident review / briefing.
Level 1 First Responder	Training on practical aspects of oil properties, response techniques, health and safety, boom and skimmer deployment, dispersant application, use of sorbents, shoreline cleanup, debris / waste handling and disposal and wildlife casualties.

Exercises

Oil spill response exercises are undertaken to ensure all emergency response personnel are clear on their functions and responsibilities. Realistic exercises support the measurement of emergency response preparedness. The various exercise components may be practised separately to minimise disruption to normal operations. As well as improving people's skills and maintaining their awareness, exercises provide an opportunity to assess equipment, familiarise personnel with their roles and measure performance, obtain feedback from participants and give a clear message about the company's commitment to oil spill preparedness and response. An overview of the different types of exercises recommended is provided in *Table* 25 overleaf.

Table 25 Overview of Exerdses

Exercise	Description	Frequency
Notification	• Practice of the procedures to alert and call out the emergency management teams • Conducted over the telephone or radio, depending on the source of initial oil spill report • Test communications systems, availability of personnel, travel options and ability to transmit information qUickly and accurately Duration: 1 hours, held at any time of the day or night	Communications test once a month
Tabletop	• Simulated oil spill incident to test teamwork, decision-making and procedures • Planning of a realistic scenario, clearly defined objectives for participants, exercise inputs, and a well briefed team in control of the running and debriefing of the exercise. Duration: 2-8 hours	Every 6 months
Equipment Deployment	• Designed to give personnel a chance to become familiar with equipment • Test / evaluation of the capability of equipment, personnel or functional teams within the wider oil spill response; • Verification of availability of oil spill response equipment and its working order • l evel of difficulty can be varied by increasing the pace of the simulation or by increasing the complexity of the decision-making and co-ordination needs	When eqUipment loaded onto vessels, catch up sessions with alternate crew throughout 2011

Records

The Emergency Response Exercise and Training Plan is developed, as a spread sheet, at the beginning of each drilling season. This Plan identifies the planned emergency response, including oil spill response, training, drills and exercises for the coming season. The Plan incorporates the drills and exercises stipulated in the BMP "Approval to Drill" Licence.

This Emergency Response Exercise and Training Plan lists all the planned emergency response exercises and drills, shows the names of all persons who make up the Emergency Response Duty Lists, records the dates when the training, drill or exercise is carried out and records the names of Emergency Response Duty Persons who participated.

A master copy of the Emergency Response Exercise and Training Plan is maintained by HSEQ Department during the drilling season. A record of this plan is archived by the Cairn Energy HR Department.

4.3.4. Oil Spill Modelling

This section contains a summary of the oil spill modelling conducted. For full results and a complete explanation of the hydrodynamic data used in the modelling, please refer to the ASA reports *Oil Spill and Drilling Discharges Modelling,* at *Attamik, Eqqua, Lady Franklin, and Napariaq Blocks In Baffin Bay, Greenland (ASA rel: 2011-002 ERM-Greenland 2011);* and *Additional Blowout (3D Oil SpilJ) Modelling, Baffin Bay, offshore Greenland (ASA rel: 2011-002 ERM-Greenland 2011 (Addendum Report).*

Modelling background

Oil spill modelling has been conducted by Applied Science Associates (ASA) to predict where impact may occur for specific scenarios identified in the risk assessment.

The model program used was OILMAP, developed by Applied Science Associates, an oil spill model that predicts the movement of oil on the water surface and the distribution of oil in the environment.

The OILMAP/Deep model was developed as an enhanced version of the ASA's OILMAP modelling system. It allows prediction of the effects of deep-water well control incidents. This model predicts the effects of deep-water well control incidents, solVing the equations for the conservation of water mass, momentum, buoyancy, and gas mass using integral plume theory.

Modelling Umltations

All modelling results are to be used for guidance purposes only. Response decisions should not be based solely on modelling results. As with any other model, results are dependent on the quality of the environmental parameters (hydrodynamic databases) and scenario inputs used. All the modelling results are illustrative only and assume that no response Intervention has been undertaken. A separate estimate of oil spill clean-up volumes is provided in *section* 4.4. In an oil spill, further trajectory modelling representative of the conditions at the time would be undertaken.

Model Types

Stochastic and trajectory modelling has been conducted. These types of modelling consider movement of oil on the water surface. In addition, 3D subsurface well control incident modelling has been conducted to characterise the trajectory and fate of the plume mixture (oil, gas and water) from the wellhead as it ascends through the water column.

Stochastic models	predict probable behaviour of potential oil spills under historical meteorological and oceanographic conditions. Used in contingency planning to examine probability of oiling (surface and shoreline);
Deterministic models	are used to predict the movement of oil on the sea surface, based on a specific set of meteorological and oceanographic conditions. It predicts the fate and effects of oil spilled on the water and the time it takes for oil to beach. Generally used in response scenarios with known metocean conditions;
3D models	look at both the near field (describing the oil/gas plume generated by the well control incident) and far field (long term transport and weathering of released hydrocarbons) analysis.

Modelling Parameters

A high resolution metocean dataset from the Danish Meteorological Institute (DMI) was used to describe environmental conditions of the area. This dataset consists of wind and surface current data generated from records of hindcast model outputs for an area covering Baffin Bay, Davis Strait and part of the Labrador Sea. For the 3D models, HYCOM 3D model outputs were provided in the form of vertical current profiles at each of the well sites.

Wind data was obtained from DMI, derived from instantaneous daily values during June to October, 2005 to 2009. In general the wind observed increases with southerly latitude. The average instantaneous wind varied by block from 9.9 knots (Napariaq) to 12.6 (Attamik) and the maximum recorded value from 32 knots (Eqqua) to 49 knots (Attamik). At all wind locations, the dominant wind directions are from the SE and NW. October tends to have the highest wind speeds. Generally, August tends to have the weakest average winds.

Regional currents for the study area were from a model hindcast analysis from DMI based on data from 2004 to 2009. The monthly average currents shows that between the Napariaq / Eqqua and Lady Franklin / Atammik blocks there is a general trend toward the north in June, and the south in October. At the well sites the average current velocities are slightly stronger in October than in June. The surface currents within Baffin Bay are complex and variable. Daily instantaneous values were used for the modelling.

Medium crude oil was used for modelling purposes to predict a spill from the reservoir as potential reservoir characteristics are not known, see *Table* 26 for the properties of the oils modelled. As the subsurface modelling is conducted by a slightly different system where more specific oil properties are required then a different crude was selected, matched to ensure it would emulsify under the right conditions and had a similar density to the previous one used. Once an oil sample can be obtained then this will be sent for analysis and further spill modelling conducted.

Table 26 Propertles of Modelled Olis

Oil type	Density (g/cm^3)	Viscosity (cP)	Surface Tension (dyne/ cm)	Max. water content
Medium crude - surface models	0.8373	33.0	30	70%
Medium crude - subsurface	0.873	29	13.4	90%
Marine Diesel	0.8690	1.15	20	0%

4.3.5. 011 Spill Scenarios

Well Contra/Incidents

All of the well control incident scenarios assumed medium crude was released at a continuous rate of 5000 bbl/day for 37 days as this is the estimated time to drill a relief well. Simulations lasted for 60 days to allow the modelling of oil fate post the 37 days shut off. For each site listed in the operational overview, *section* 1.3.1, a well control incident model has been run at or very close to the site. For Gamma B (Eqqua) and LF7-C (Lady Franklln), additional subsurface well control incident scenarios have been run.

Table 27 Well control incident Positions

Block	Site	Modelled Site
Napariaq	Delta A	Delta B
Eqqua	Gamma B	Gamma B
Atammik	AT7-A	AT-7A
Lady Franklin	LF7-C	LF-6A

Diesel spills

Each vessel spill scenario assumed 2500 m^3 marine diesel was spilled over 1 hour. Simulatlons lasted for 21 days. The location of each diesel spill site was chosen as the midpoint between the modelled well location and the harbour in the Greenland coast serving the well site.

Table 28 Diesel Spill Positions

Block	Port Location	latitude (N)	Longitude (W)
Napariaq	[redacted]	70.04198	55.58685
Eqqua	[redacted]	69.11803	56.35696
Atammik	[redacted]	64.04079	54.70623
Lady Franklin	[redacted]	64.42542	53.72701

4.3.6. Selected Stochastic Model Results

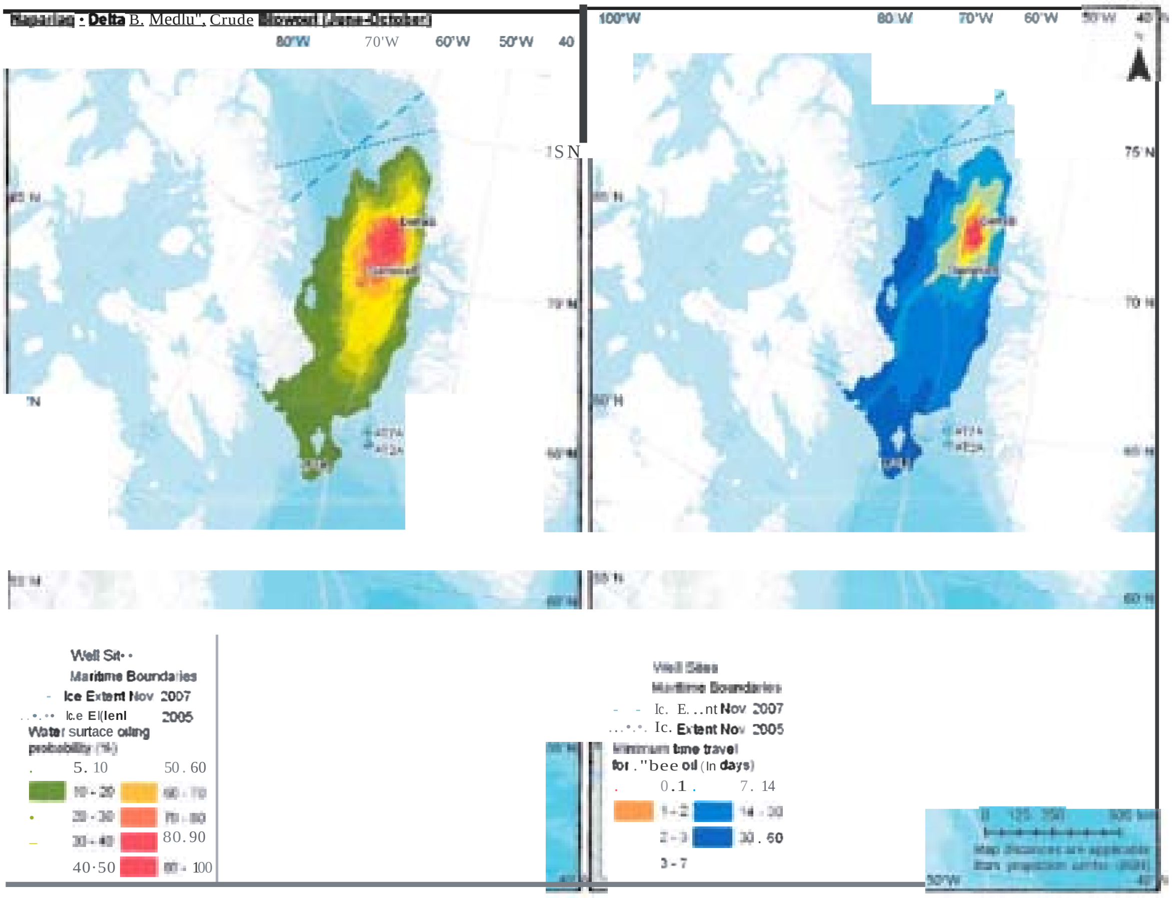


Figure 24 Napariaq Delta B - 5,000 bbl/day Modelling Results

Figure 24 shows the predicted probability and associated minimum time of travel resulting from a 37-day release of 5,000 barrels/day of medium crude oil at the Napariaq Block, tracked for 60 days from the first release of oil. The stochastic footprint covers a large area within Baffin Bay and the Davis Straight. The minimum time to shore is 13 days and average time to shore is 37.5 days.

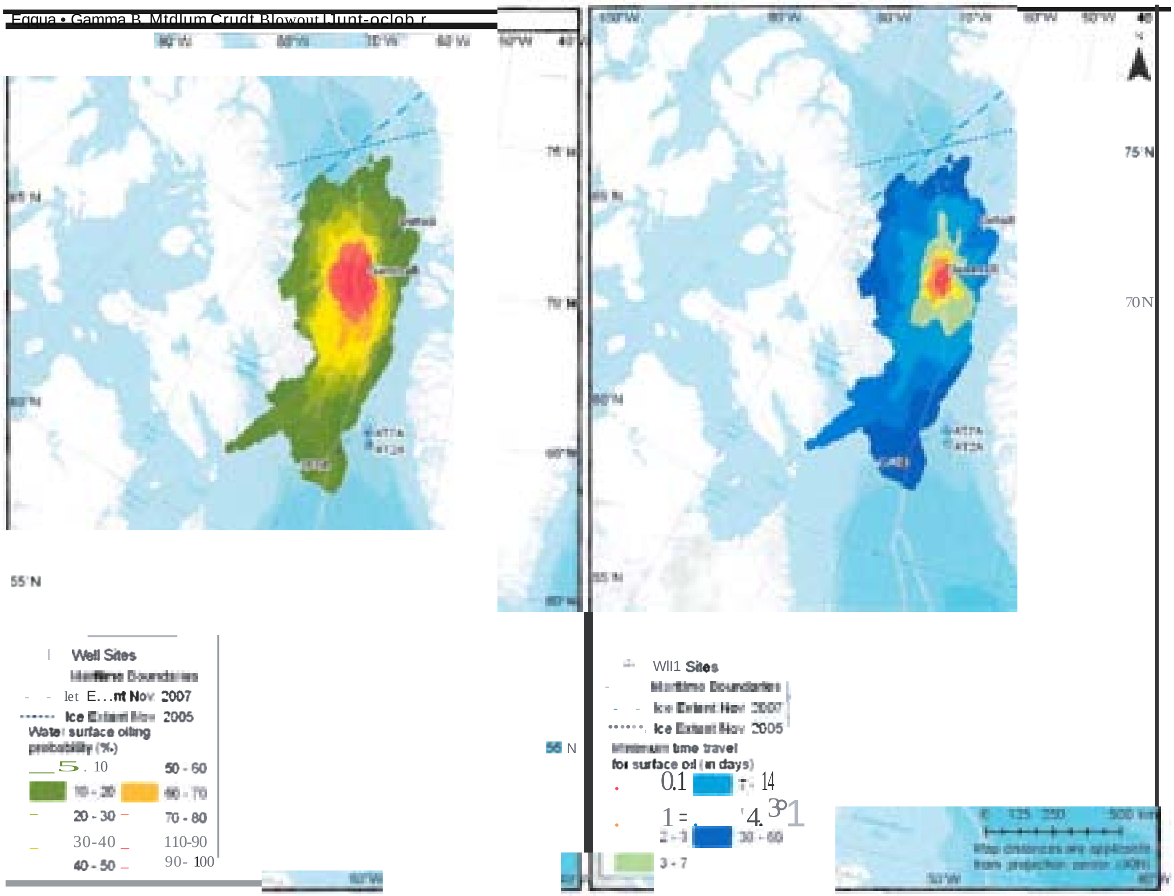


FIgure 25 Eqqua Gamma B - 5,000 bbl/dav Modelling Results

Figure 25 shows the predicted probability and associated minimum time of travel resulting from a 37-day release of 5,000 barrels/day of medium crude oil at the Eqqua Block, tracked for 60 days from the first release of oil. The stochastic footprint has a large extent across Baffin Bay similar to the Napariaq model. The minimum time for oil to reach shore is 12 days and the average time is 39 days.

The highest surface oiling probabilities occur directly to the north, west, and south of the well location, and are pushed away from the east due to local hydrodynamic forcings. A large section of Baffin Island's eastern coastline experiences shoreline oiling probabilities in excess of 10%.

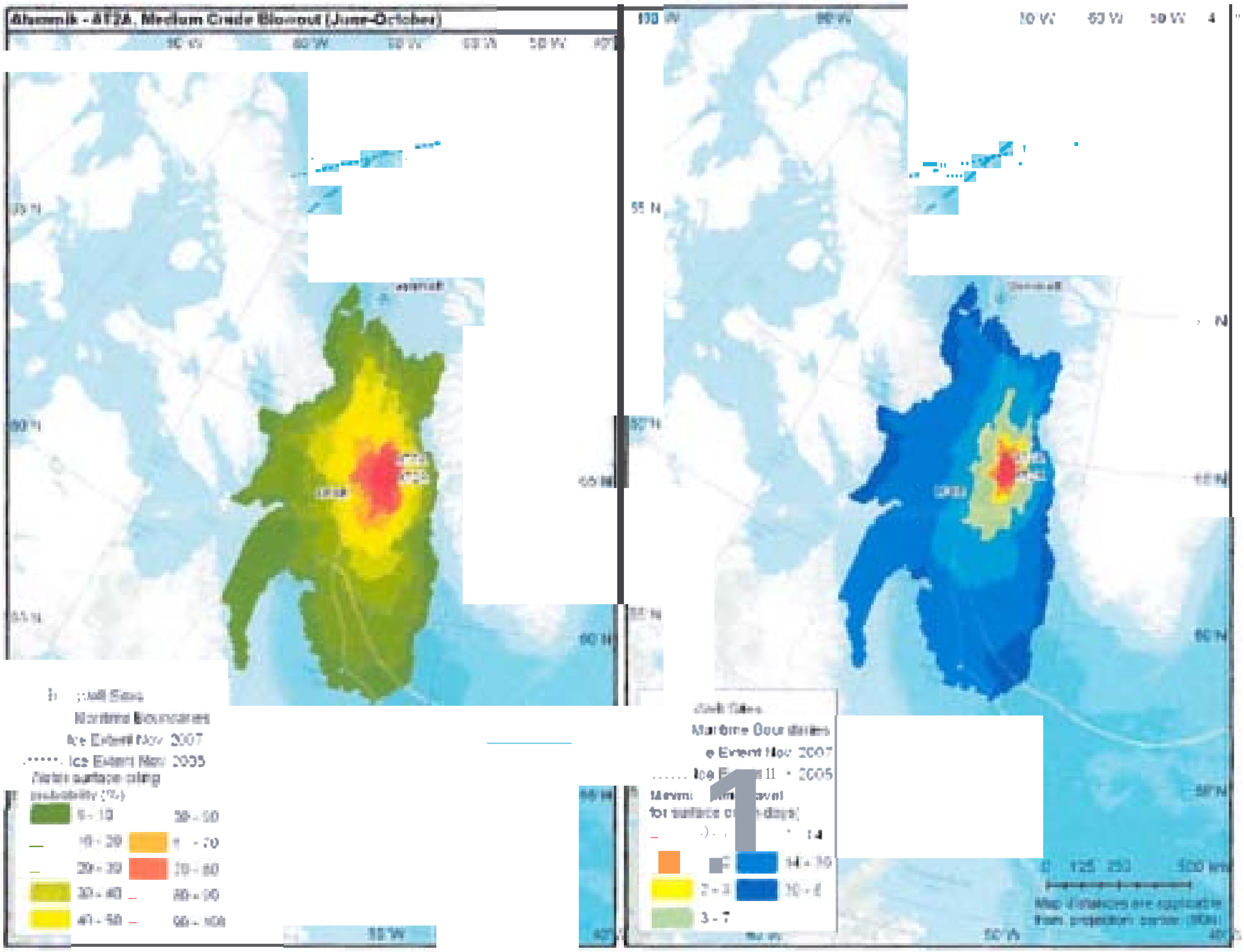


Figure 26 Atammik - AT2A - 5,000 bbl/day Modelling Results

Figure 26 shows the model-predicted footprint of probability and associated minimum time of travel resulting from a 37-day release of 5,000 barrels/day of medium crude oil at the Atammik Block, well AT-2A, tracked for 60 days from the first release of oil. The stochastic footprint has a coverage extending from Baffin Bay south into the Labrador Sea. Minimum and average time for the oil to reach shore is just above 18.5 and 40.5 days, respectively.

The highest surface oiling probabilities occur to the south of the well location due to the prevailing winds, which are strongest from the north-northwest. Although high probabilities of oil occur south of the well, the oil arrives at the shoreline faster toward the northeast at the Greenland coast, with oil hitting the coast at this location within 14 to 30 days. This scenario does not result in oil reaching the 2005 or 2007 ice extent lines due to the southern location of the well

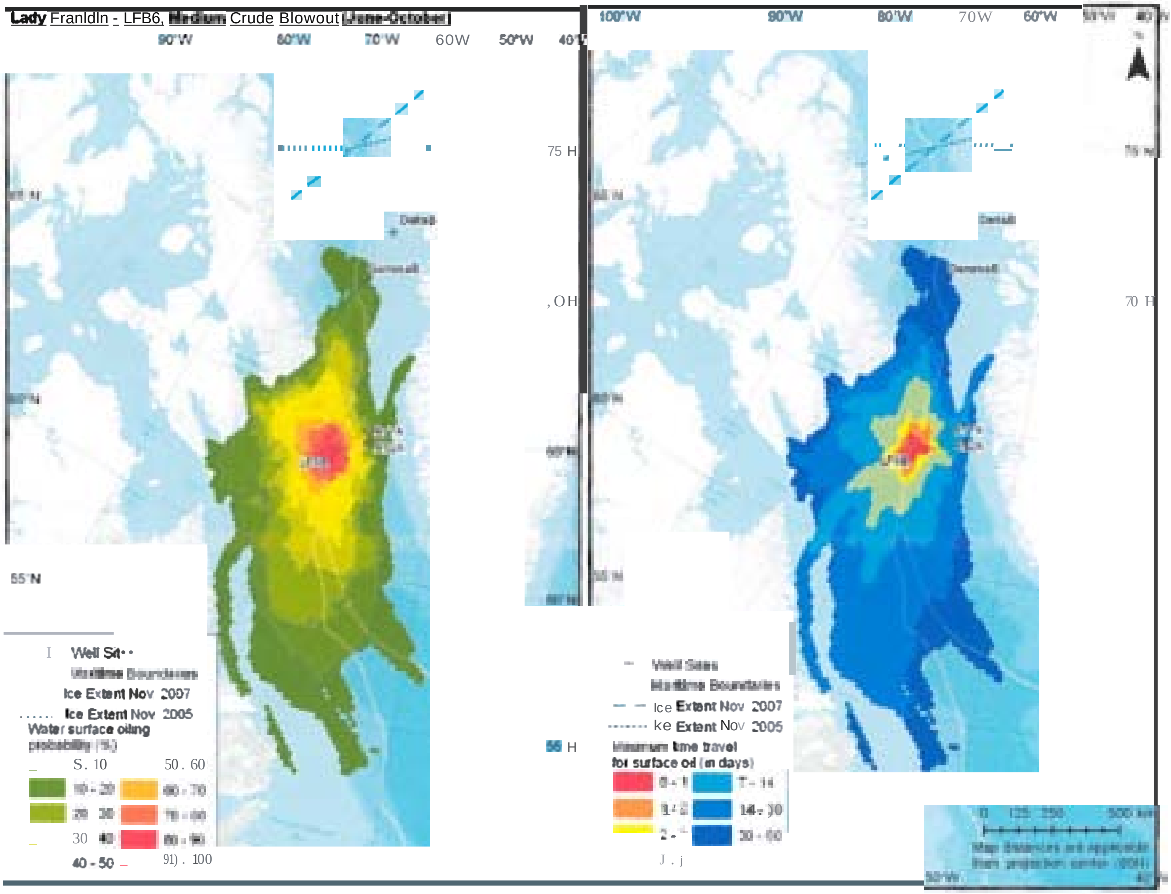


Figure 27 Lady Franklln LFB6· 5,000 bbl/day Modelling Results

Figure 27 shows the predicted probability and associated minimum time of travel resulting from a 37-day release of 5,000 barrels/day of medium crude oil at the Lady Franklin Block, tracked for 60 days from the first release of oil. The stochastic footprint extends south into the Labrador Sea and north above the Eqqua block. Minimum time to shore is just less than 17 days, while average time to shore is 39 days.

The highest probabilities of surface oiling occur directly south and west of the spill location, driven away from the northeast due to local winds and hydrodynamics. Only a small section of shoreline on Greenland has a predicted risk of oiling, although the probabilities of oiling are low.

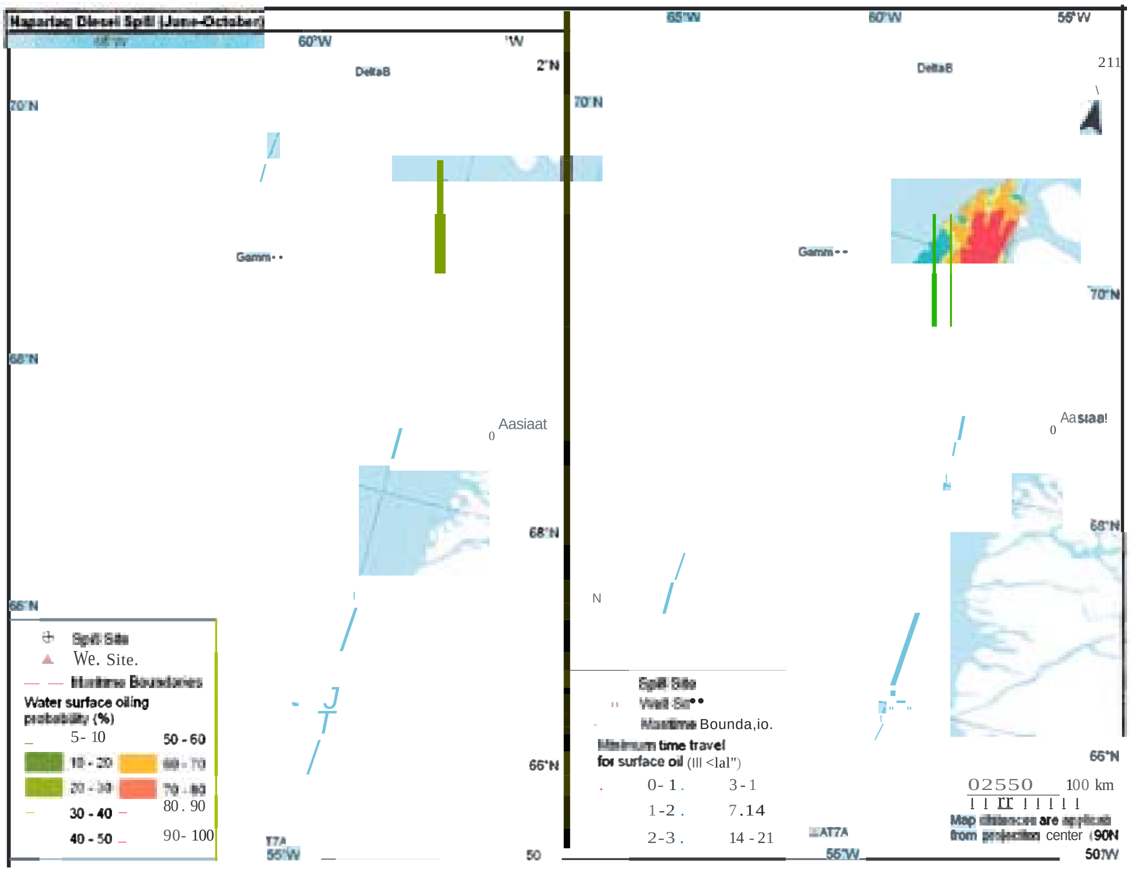


Figure 28 Napariaq Diesel Spill Modelling Results

Figure 28 shows the model-predicted footprint of probability and associated minimum time of travel resulting from an instantaneous release of 2,500 m^3 of diesel, spilled from a vessel midway between the Napariaq block and the port of Aasiaat. This is the only diesel model that showed any probability of oil reaching the shoreline and so are the only results displayed here. The stochastic footprint to the 5% probability contour extends south by 120 km and north by 80 km_The highest probabilities of surface oiling occur directly at the spill site, with areas further away from the spill site progressively having lower risk of oiling. The area associated with 50% or greater probability of surface oiling extends at maximum 10 km from the release location.

The largest observed probability of oiling from a vessel spill between Napariaq and Aasiaat is 18%. However, only a small section of shoreline located to the NNE of the spill location has greater than a 5% probability of oiling_The minimum time for oil to reach shore is 36 hours, while average time to shore is over 8 days.

4.3.7.30 Modelling results

The first step of the well control incident modelling is to characterise the trajectory and fate of the plume mixture from the wellhead as it ascends through the water.

In both models, the velocity of the plume decreases quickly away from the discharge point as it entrains heavier ambient seawater. This initial jet momentum is replaced with gas buoyancy. As the plume continues to rise and entrains more ambient seawater, the velocity gradually decreases, approaching zero at approximately 80 m above the wellhead at LF-7C and nearly 120 m at Gamma-B. From here, gas and oil droplets will ascend to the water surface much more slowly, under free rise velocities determined by Stokes law.

The plume radius tend to increase linearly until approximately 90% of the termination height has been reached, at which point the plume widens more quickly. The plume reaches a maximum radius of about 30 m for both the Gamma Band LF-7C well control incident scenarios.

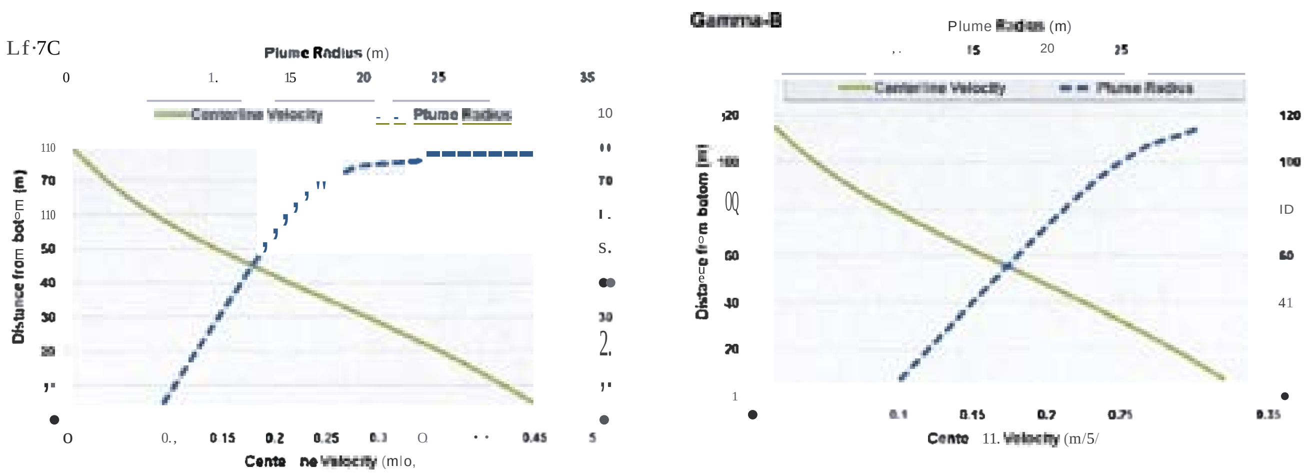


Figure 29 Subsurface Modelling Results - Plume Radius and Velocity

Near-field modelling also characterise oil droplet size distribution generated by the well control incident. Size dictates how long the oil droplet will remain suspended in the water column. Large droplets will reach the surface faster, potentially generating a floating oil slick that will drift much faster due to surface winds and currents; small droplets will remain in water column longer and be subjected to the subsurface advection-diffusion transport. As the oil is transported by subsurface currents away from the well site, natural dispersion of the oil droplets qUickly reduces aromatic and hydrocarbon component concentrations in the water column.

The table blow displays the 011 droplet sizes for the two wells modelled.

Table 29 Subsurface Modelling Results - Droplet Size

Well	MInimum Volume (microns)	Peak Volume (microns)	Maximum Volume (mIcrons)	Averaged time to reach surface (hours)
Gamma-B	500	4000	10000	3.5
LF-7C	493	2958	9863	2.8

For each of the scenarios, stochastic and trajectory modelling was conducted. The trajectory scenarios were the conditions that brought about the longest shoreline oiling in the stochastic analysis. The results are displayed in Figure 30 below.

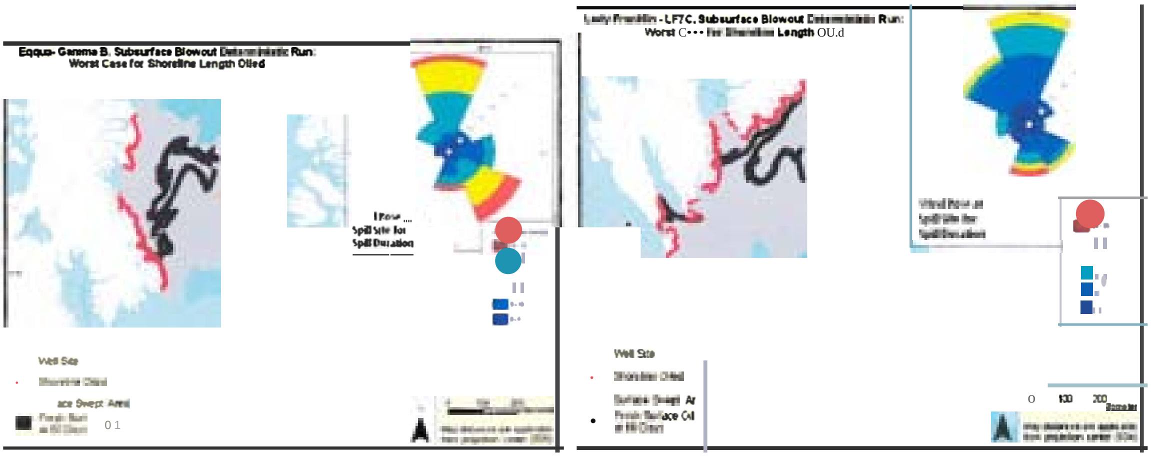


Figure 30 Subsurface Modelling Results - Greatest Shoreline Oiling Trajectory

In addition, the mass balance of oil for each of the trajectory scenarios was calculated. This shows oil on the water surface, evaporated, in the water column, ashore, and decayed as a function of the relative percentage of oil spilled with time. Results are displayed in Figure 31 below.

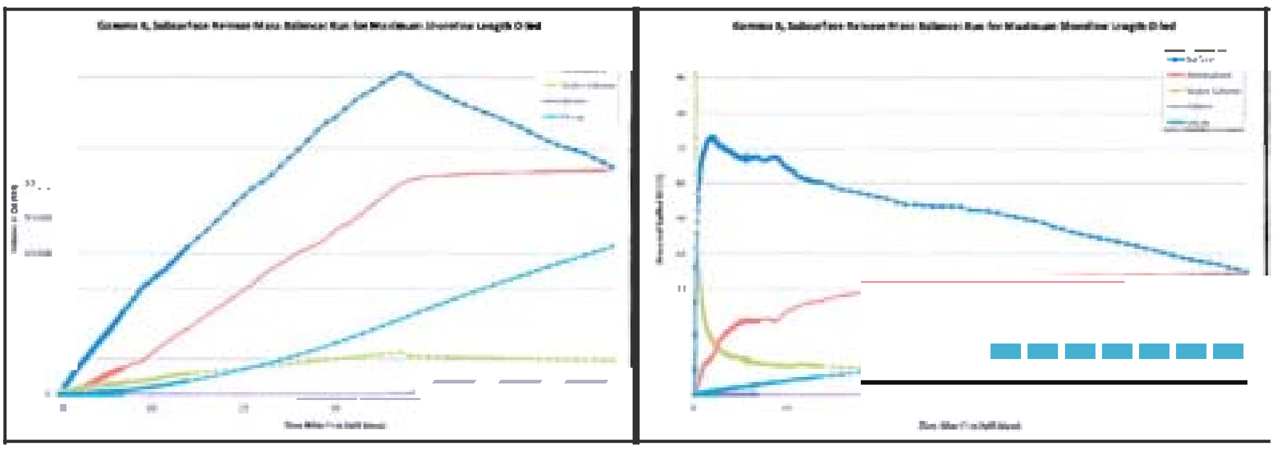


Figure 31 Subsurface Modelling Results - Mass Balance

4.3.8. Greenland Campaign Modelling

Weekly modelling process

Throughout the drilling period, weekly models are run in OSIS by *Oil Spill Response.* These are run for each well in being drilled and are based on the well control incident scenario as previously outlined. The weather data used is from the most recent available from the OMI forecast, and is specific to rig position. The most recent ice edge predictions are incorporated and overlaid with the spill trajectory results. These models are recorded on Capricorn systems and are forwarded to the BMP.

OMI modelling

OMI provides marine oil spill forecasts using an oil drift model. The development of the OMI model is a multi-year project to improve oil spill modelling in the region by improving the metrological data held. The model calculates drift and spreading of oil due to wind and current. It includes a number of weathering processes, so that the oil composition develops over time.

In order to provide a stable service, OMI maintains an input data archive that is kept up-to-date on a routine basis (4 times a day).

- OMI runs an atmospheric model HIRLAM to produce a 60 hour wind forecast.
- OMI runs a 3-dimensional ocean model BSHcmod to produce a 60 hour current forecast.
- Wind and current data from the above are stored on 15 min interval. The data archive extends 72 hours back in time and 60 hours forward in time, relative to the latest analysis (00, 06, 12 or 18 utc)

The oil drift calculations are made on demand based on the archived dataset.

Modelled scenarios should be used as an indication only and real time oil spill modelling will be requested for more accurate results in the event of an oil spill.

4.4. Estimated Spilt Oil Surface Clean up Capacity

The figures below are based on the well control incident scenario release of 5000 barrels a day (see *section* 4.3 Oil Spill Risk Assessment for an explanation of this volume). If a well control incident occurred on the seabed it would take time for the oil to reach the surface. Subsurface modelling conducted (refer to *section* 4.3.7 for results) suggests that the larger droplets would reach the surface rapidly, in under an hour. For the purposes of this clean up capacity calculation it is assumed that the volume of oil is in steady state so the varying time of the droplets to reach the surface is discounted.

As the drilling is explorative, oil properties have not been determined so there is a lack of knowledge of how the oil encountered will weather, affecting evaporation and emulsification and therefore the volume of product to be recovered. From the subsurface release modelling conducted[31], it is predicted that the proportion of oil on the surface would initially be approximately 75% of that released, decreasing to approximately 50% at the end of the release period at day 37 as a steady state of natural dispersion and evaporation reduces the amount of oil. As cleanup strategy would be to target spilt oil rapidly, the evaporation rates will be lower than those seen for heavily weathered oil. Therefore taking a value of 70% of the oil ending up on the sea surface, systems must be effective to handle 3500 barrels of oil a day (non-emulsified volume).

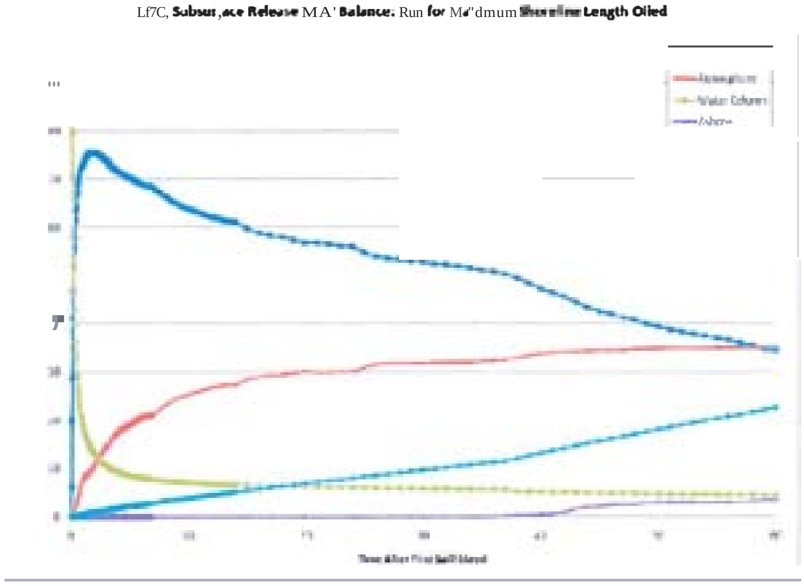


Figure 32 Mass balance for subsurface release [31]

Emulsification would increase this volume. Emulsification increases with time and varies hugely by oil type, increasing the volume of oil by 0 to several hundred percent. Based on the medium crude used in the oil spill modelling the maximum water content is 70%[32]. Cleanup strategy would be to target oil quickly before emulsification took place so assuming an average water content of 20%, the oil volume requiring clean up is 4375 barrels /day, or 696 m^3/day.

Each clean up strategy is now considered with estimated oil volume recovered. Shoreline protection and collection and shoreline clean-up are not included in these estimates as although significant resources are available in these areas, the cleanup priority is to stop oil reaching shoreline areas to minimise environmental impact.

31 ASA 2011, Report ASA 11-002: Addendum: Blowout (3D Oil Spill) Modeling, Baffin Bay, offshore Greenland
32 ASA 2011, report ASA 11-002: Oil Spill and Drilling Discharges Modeling, at Attamik, Eqqua, Lady Franklin, and Napariaq Blocks In Baffin Bay, Greenland

Containment and Recovery

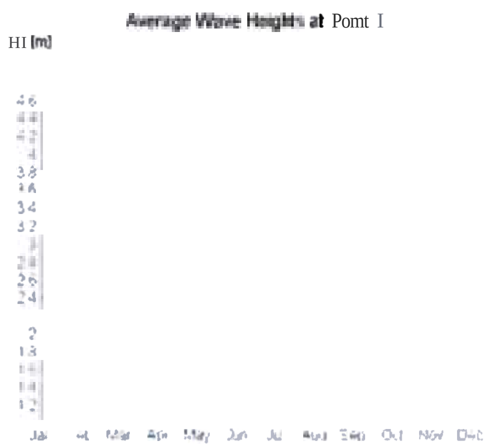
System efficiency for boom and skimmer operations has been calculated based on a method from NOFOs regression analysis[33], adapted for daytime operations only:

$$System\ Efficiency = 87 - (9.80 * Hs)$$

Where: Hs = Significant wave height

Based on oil in water exercises, it is assumed that there is a minimum loss of 20%, meaning that the maximum system efficiency is 80%. In periods when significant wave height is over 4 m the assumption is made that system efficiency is 0%. However in rough weather conditions, spill response is assisted in that oil at sea is more rapidly dispersed and evaporated by natural processes.

Wave heights in eastern Baffin Bay are small[34] so Napariaq and Eqqua experience smaller average wave heights than Lady Franklin and Attamik. The average wave height in the region of Lady Frankin and Attamik has therefore been used to calculate skimmer efficiency as this is a more cautious approach. In the data below, point one is located at 57.50° W, 64.5° N and point five at 54.0° W, 64.0° N. The average significant wave height over the period from June to December is taken to correspond with the drilling and relief well contingency periods and is calculated from the data below to be 1.8 m, equating to a skimmer efficiency of 69%.



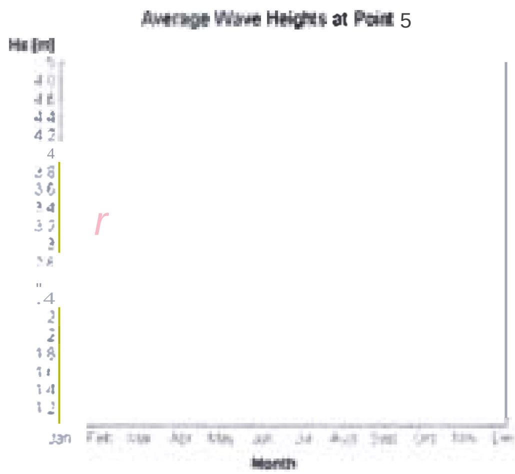


Figure 33 Mean Monthly Value of Significant Wave Height[35]

The skimmers on the ERRV's have a recovery rate of 45 m^3/hr so relating the efficiency calculated above we can expect 31 m^3/hr to be recovered. Typical skimmer oil to water recovery ratios are 30:70[36] so oil only recovery is 9.4 m^3/hr.

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33 OIF / NOFO Guide for Environmental law Emergency Response Analysis Report 2007-0934

34 DMI, 1998; Valeur et *al.,* 1996, cited in ERM 2011: EnvironmentalImpaet Assessment, Exploration Drilling Programme for Napariaq, Offshore West Greenland

35 DMI, 2004 cited in ERM 2011: EnvironmentalImpaet Assessment, Exploration Drilling Programme for Napariaq, Offshore West Greenland

36 011 Spill Response Field Manual, Exxon Mobil, 2005. This is based on average skimmer efficiency. Using the oleophillic brush attachments which are on each ERRV, the oil/water efficiency rates would be improved.

This calculation assumes that there is sufficient oil contained within and being fed into the boom for the skimmer to constantly be recovering spilled oil. Depending on the containment and recovery operation direction this mayor may not be the case. By directing containment and recovery vessels to the thickest oil close to the source then constant recovery is possible. However spill strategy will involve targeting patches of oil that may reach sensitive areas such as the ice edge, and collection volumes may therefore be less to achieve the target strategy. For this reason a further factor of skimmer recovery operations being run for 50% of the working time is applied.

Therefore 94 m^3/day is estimated to be recovered by containment and recovery systems, based on 2 separate containment and recovery teams running a 10 hour day. Two containment and recovery teams would be operational based on normal operating vessel resources; however in a large spill additional vessels and equipment would be mobilised to the spill site so the number of teams could be increased. Recovery rates can also be increased by increasing working hours to include night time conditions, following adequate safety assessments.

Dispersant

There are two means by which Capricorn would look to use dispersant operations at the surface - from vessel and aerial spray systems. 4 vessel spray systems are available in-field but although coverage is maintained with the rig at all times the exact number able to commence operations immediately will be dependent on crew changes, rig distance, and being granted appropriate authorisation to spray. Under normal operations, 2 spray systems could be available immediately. Extensive field trials in the UK indicate that an effective treatment rate for dispersant is approximately 1 part dispersant to 20-30 parts of oil so 25 is used in the estimates below.

Assuming:

- 2 spray systems available
- spray rate is 0.5 m^3 dispersant per hour
- spray swath width is 20 m
- efficiency of spray is 80%
- dispersant to oil ratio is 25
- dispersant effectiveness is 72%[37]
- oil thickness is O.lmm
- spraying continues for 8 hours per day (2 hours allowed for repositioning and effectiveness testing)

Then the resultant oil dispersed per day by the vessel operations is 115 m^3/day

Aerial spraying capability would be provided by the Hercules mobilised from *Oil Spill Response*

Assuming:

- 15 m^3 per sortie
- efficiency of spray is 80%
- dispersant to oil ratio is 25
- dispersant effectiveness is 72%[37]
- each sortie lasts 2.5 hours
- 3 sorties per day are possible

Then the aerial dispersant spraying operations will disperse 648 m^3/day (4076 bbl/day).

---

37 Based on the average effectiveness for Dasic Slickgone NS tests on 4 different oils, from SINTEF, 2007 Effects of Time of the Effectiveness of Dispersants

More boat spray systems and aerial dispersant capability could be sourced in a large spill to increase dispersant capacity although as noted earlier the limiting factor could be dispersant supply as production of Dasic Slickgone NS is unlikely to exceed 50 m^3/day. However this capacity could be increased by using alternative types of dispersant, if approved by the BMP. In addition much higher dispersant to oil ratios than 25 have been found to be effective and would be tested on the actual oil spilt in a large spill.

In-Situ Burning

In-situ burning equipment would be available through mobilisation from *Oil Spill Response.* The folloWing calculation is assuming a single burn team as initially Capricorn would need to use in-field vessels to carry out the operation. In-situ burning would be carried out following approval from the BMP. The folloWing calculation assumes a 4 hour burn is maintained, to allow for time to reposition and collect enough oil to start a burning operation.

Assuming

- 150 m length in-situ burning boom
- 20% of the boomed area contains oil thick enough to maintain a burn
- 3.5 mm/min burn rate[38]
- Burn efficiency is 90%[39]
- 4 hour burn is maintained
- Single burn team working

Then the in-situ burning operations will burn 541 m^3/day (3233 bbl/day). This volume could be increased by increasing the number of in-situ burning teams, and if the conditions allow, maintaining longer burns.

In Total

Between dispersant, containment and recovery and in-situ burning operations under all assumptions listed, an estimated 1398 m^3/day (8793 bbl/day) surface oil could be effectively responded to based on in-field or rapidly available resources. This capacity could be increased by increasing teams and resources in field. This value exceeds the estimated requirement based on the well control incident scenario.

38 Based on unemulsified crude on water Buist, l. 2000. In situ burning of oil spills in lee and snow. Alaska Clean Seas, International Oil and Ice workshop 2000, Anchorage and Prudehoe Bay

39 SINTEF, 2010. Establishing, Testing and Verification of a Laboratory Burning Cell to Measure Ignitability for In-Situ Burning of Oil Spills

4.5. Summary

The Capricorn Drilling OSCP details the operational scope, environmental and socioeconomic setting, legal framework, oil spill modelling and risk assessment taking into account the potential fate of a marine hydrocarbon release from within the field.

The risk assessment identified oil spill scenarios that could result from Capricorn drilling operations. The majority of scenarios identified in the risk assessment pose a low impact to the environment, safety and health, public and financial aspects. The scenario with the greatest potential impact is a continued release of oil from a well control incident, *Risk Assessment, Section 4.3.*

Capricorn has TIer 1 and 2 resources in place to implement all the recommended strategies in both offshore and shoreline equipment packages, see *Oil Spill Response Resources, section 2.*

In the event that an oil spill escalates to a Tier 3 incident (ie once Tier 1 and 2 resources are overwhelmed), arrangements are in place to mobilise the Tier 3 contractor, *Oil Spill Response.* Their resources include aerial surveillance, containment and recovery, shoreline protection, shoreline recovery, in-situ burning and dispersant application.

Appendix I: Forms

A. Tier Assessment Form

The ERG Team Leader must use the table below to assign an appropriate tier level to the incident. Always assume worse case if unsure.

Spill severity depends on the potential consequences for people, assets, the environment and reputation. Cairn has adopted an industry standard tiered preparedness and response system for assessing the severity of oil spills.

The purpose of Tier levels is to quickly establish the correct level of response needed. By identifying the Tier, the *DSC* and ERG Team Leader can mobilise the appropriate resources to combat the spill.

FOR UNCONTROLLED WELL CONTROL INCIDENTS GO IMMEDIATELY TO TIER 3

Tier 1

Incident giving rise to a localised release that can be controlled with the resources available on-site, see Tier 1 Capability, *Section* 2.1. The *DSC* will manage the incident and keep the ERG Team Leader informed.

O Spill occurs within immediate site proximity O Able to respond to the spill immediately	O Spill can be easily managed using oil spill response resources available offshore O Source of spill has been stopped

Tier 2

Incident in which national ... control the spill. See Tier 2 ... port outside the geographical area are required to ... ection 2.2 for details of Capricorn's Tier 2 resources.

O Possible continuous release O Tier 1 resources overwhelmed, requiring additional regional resources	O Not able to respond to the spill immediately O Potential impact to sensitive areas and / or local communities O Local/national media attention

Tier 3

Incident for which assistance is required from national and international resources. Bilateral agreements will be mobilised. Capricorn will request assistance from their Tier 3 service provider, see *Tier 3 Arrangements, Section 2.4.*

O Uncontrolled well blowout O Significant or increasing continuous release O Major spill beyond site vicinity O Tier 1 and Tier 2 resources overwhelmed, requiring international Tier 3 resources to be mobilised	O Spill has crossed international maritime boundaries O Significant impact to sensitive areas and / or local communities O International media attention

Table 30 TIer Assessment

B. Spill Notification Form

OSC to use to notify Greenland Command DSV to use to notify Duty Emergency Response Officer

Location:	Date:	Time:

*Tier 1 Cl *Tier 2 Cl *Tier 3 Cl *tick whichever is applicable.

1. Spill Observer: .
2. Material Spilled: ..
3. Apparent Source / Cause: ..
4. Time and Date Spill Occurred: hrs / ./ ..
5. location of Spill: lat: long: ..
6. Is Spill Continuing: Yes / No
7. If Yes, Estimated Rate Of Release: ....(m^3/kilolitres per day) (bbl per day)
8. Volume of Discharge: a) estimated m^3/kil0litres bbl
   b) known m^3/kilolitres bbl
9. Size of Spill: (plot on chart) .
10. Rate and Direction of Slick Movement: ..

II. Oil Slick Type: Continuous Wind rosé .

Appearance on Water: .

12. Estimated Average Thickness: ..
13. Samples/Photographs Taken: Where located: ..
14. Identity/Position of Vessels in Area: .

Current Meteorological Data

15. Temperature: Air oC
16. Wind: Speed Knots. Direction ..
17. Precipitation: .
18. Visibility: ..
19. Forecast: .

Current Oceanographic Data

20. Temperature: Air DC Sea DC ..
21. Tide State: ..
22. Currents: Speed Knots, ms^{-1} Direction .
23. Sea State: 1 2 3 4 5 6+ .
24. Average Wave Height: Metres Period Seconds
25. Remarks: .

Prepared By:	Phone:
CompanylAgency:	Fax:
Position:	Mobile:
Signature:	Date:

C. Oil Spill Response Notification Form

COMPLETE BOTH PAGES (Page 1 of 2)

Oil Spill Response

WARNING! Ensure telephone contact has been established with the Duty Manager before using e-mail and fax communications.

HSE Co-ordinator to complete and forward to *Oil Spill Response,* Southampton

To	Duty Manager, Oil Spill Response Southampton		
[redacted] Emergency Fax		Emergency Fax	[redacted]
[redacted] Telephone		Telephone	[redacted]
Email	dutymanagers@oilspillresponse.com		

Section 1 Obligatory Information Required - Please Complete All Details

Name of person in charge	
Position	
Company	
Contact telephone number	
Contact Mobile number	
Contact fax number	
E-mail address	

Section 2 Spill Details

Location of spill	
Description of slick (size, direction, appearance)	
Latitude / longitude	
Situation (cross box)	❑ Land ❑ River ❑ Estuary ❑ Coastal ❑ Offshore ❑ Port
Date and time of spill	❑ GMT ❑ Local
Source of spill	
Quantity (if known)	❑ Cross box if estimate
Spill status (cross box)	❑ On-going ❑ Controlled ❑ Unknown
Action taken so far	
Product name	
Viscosity	
API/SG	
Pour point	
Asphaltene	

Section 3 Weather

Wind speed and direction	
Sea state	
Sea temperature	
Tides	
Forecast	

COMPLETE BOTH PAGES (Page 2 of 2)

Oil Spill Response

Section 4	Additional Information Required Please Complete Details If Known
Resources at risk	
Clean-up resources	
On-site / Ordered	
Nearest airport (if known)	
Runway length	
Handling facilities	
Customs	
Handling agent	

Section 5	Vessel availability
Equipment deployed	
Recovered oil storage	

Section 6	Equipment logistics
Transport	
Secure storage	
Port of embarkation	
Location of command centre	
Other designated contacts	

Section 7	Special requirements of Country
Security	
Visa	
Medical advice	
Vaccinations	
Others (specify)	

Section 8	Climate Information

Section 9	Other Information

D. 011 Spill Response Mobilisation Form

Mobilisation Authorisation Form

WARNING! Ensure telephone contact has been established with the Duty Manager before using e-mail and fax communications.

Must be completed by authorised signatory - see Appendix 1-E to the Oil Spill Contingency Plan

To		Duty Manager					
[redacted]	Emergency Fax	[redacted]		[redacted]	Emergency Fax	[redacted]	
[redacted]	Telephone	[redacted]		[redacted]	Telephone	[redacted]	
Email		dutymanagers@oilspillresponse.com					

Authoriser's Details	
Subject	Mobilisation of *all SpJll Response*
Date	
Name	
Company	
Position	
Contact Telephone Number	
Contact Mobile Number	
Contact Email Address	
Incident Name	
Invoice Address	

I, authorise the activation of *011 SpJll Response* and its resources in connection with the above incident under the terms of the Agreement in place between above stated Company and Oil Spill Response Limited.

Signature:	

If *Oil SpJll Response* personnel are to work under another party's direction please complete details below:

Additional Details
Name
Company
Position
Contact Telephone Number
Contact Mobile Number
Contact Email Address

E. Cairn Employees with the Ability to Mobilise *Oil Spill Response*

The following employees have the authority to mobilise *Oil Spill Response*. One of the employees named below must be a signatory on the Mobilisation Authorisation Form, ***Appendix 1-D***.

- [redacted]
- [redacted]

- [redacted]
- [redacted]
- [redacted]

- [redacted]
- [redacted]
- [redacted]

If this list requires update then please contact:

[redacted]
Membership Executive
Oil Spill Response Limited
[redacted]

F. Oil Spill Modelling Request Form

Oil Spill Response Oil Spill Model Request Form

Complete and send to *Oil Spill Response*

[redacted]

For the Attention of:				
Date/Time:				
From:	Name			
	Organisation/Company			
	Tel Number			
	Fax Number			
	Email Address			
Spl/I Release:	Date			
	Start TIme			GMT/I ocal TIme
	latitude PLEASE MAKE FORMAT CLEAR			
	longitude PLEASE MAKE FORMAT CLEAR			
Release Rate:	Instantaneous Release (Le. Total Amount) PLEASE STATE UNITS			
	OR Continuous Release PLEASE STATE UNITS	Per Hour	For Hours/Days	Total Amount to be Released
Oil Type: PLEASE STATE UNITS	Oil Name			
	APt			
	Specific Gravity			
	Pour Point			
	Wax Content			
	Sulphur Content			
Wind Data:	Date!Time of Wind Data			
	Wind Direction (wind direction given from)			
	Wind Speed PLEASE STATE UNITS			
Sea Temperature:				·C/"F
Air Temperature:				·C/"F
Other Information:				

G. Dispersant Application Approval Form

Application for use of dispersants during an oil spill

Name of Applicant (e.g., company):	E-mail:
Contact person(s):	Phone:

Complete forms and, together with requested attachments, submit to Bureau of Minerals and Petroleum.

[redacted]

1. Date and local time for start of spill						
2. Position of spill Longitude/latitude, indication of locality/place name:	N			E		
3. Distance to land and water depth	Distance to land (km)			Water depth (m)		
4. Description of the oil spill source (Name of vessel/ship, installation, etc.)						
5. Description of the oil spill (Oil type, surface / sub sea, presence of gasses)						
6. Has the oil spill been stopped?	No		Yes		Hrs	
7. Estimated quantity of 011 spilled (m^3) Mark or state quantity:	< 10	10 - 100	I00-Soo	Soo-Ioo0	10oo-Sooo	>SOOO
8. Estimated surface area of 011 slick (km^2) Total area of sea surface covered by the oil slick.	km		xkm =		km^2	
9. Estimated thickness of oil slick	Sheen 0.04-0.30 µm	Rainbow 0.30-5.0µm	Metallic 5.0-50 µm	Discontinuous true oil colour 50-200 µm	Continuous true oil colour > 200 µm	
10. Weather conditions Presently: 24 hrs forecast:	Temp. (ºC) Sea | Air	Wind Speed (m/s)	Direction	In-/decreasing	Wave height	
11. Forecasted location of oil slick at the time of planned dispersants application, i.e., time for arrival of dispersant equipment	N	E		Hrs		
	Attach latest oil slick trajectory-modelling forecast					
12. Visibility and light conditions	Cloud base (m)	Horizontal visibility (m)		Hours of daylight From hrs	To hrs	
13. Ice conditions Degree of coverage (%).	No ice	Open water with ice floes	Ice floes / broken ice	Consolidated / Fast ice		

14. Description of dispersants application Only dispersants product(s), preapproved for the contingency plan, can be used.	Method Name of dispersant (trademark)
	Amount dispersant/oil slick surface area
	Estimated lotal amount

15. Forecasted mixing of dispersed oil in the water column Information on dilution efficiency / vertical mixing; the depth of the expected oil concentrations in the water column and trajectory of the dispersed oil for performing the NEBA (Form 2). Attach modelled vertical mixing of dispersed oil in water column together with modelled oil slick trajectory

16. Identification of dispersant application equipment and effectiveness monitor	Dispersant application equipment incl. dispersant spotter
	Dispersant effectiveness monitor

Net Environmental Benefit Analysis (NEBA)

Application of dispersants will in total make the spilled oil cause less harm to the environment than no response or mechanical measures? Result from NEBA, Form 2.	Yes No

Operational conditions

The operational conditions to accomplish a dispersant application operation are met? Result from evaluation of oil and operational conditions by the oil spill response team.	Yes No

Attachments

1. NEBA (Form 2)	
2. Operational conditions	
3. latest forecast oil slick trajectory modelling	
4. Modelled vertical mixing of dispersed oil	

Recommendation

	Yes	Yes, with certain limitations	No	Further information needed
Initiation of a dispersant application operation is recommended				
Comments				

Signatures

Date and **time**

Dale and time

Form 2: Net Environmental Benefit Analysis

Evaluation of the total potential environmental benefit from the application of dispersants during an oil spill assuming operational conditions are met. Information and explanations for pts 1-5 follow in Annex 1.

Net Environmental Benefit Analysis (NEBA): Application of dispersants will in total make the spilled oil cause less harm to the environment than no response or mechanical measures? Pt 1- 5.	Yes No
Operational conditions: The operational conditions to accomplish a dispersant application operation are met? Result of evaluation performed by the oil spill response team.	Yes No

Criteria for evaluation:	SCore
Positive net environmental benefit	A
Semi-positive net environmental benefit Further evaluation / information needed	B
Negative net environmental benefit	C

Criteria to be evaluated in NEBA:		Score	Comments
1. Expected life time of oil on sea w/o use of dispersants	A: > 24 hours B: < 24 hours C: < 3 hours		
2. Oil dispersible	A: Oil is dispersible within possible time for operation B: Reduced dispersibility of oil within possible time for operation C: The application of dispersants cannot be performed within the operational window		
3. Sensitive elements in potential oil spill trajectory	A: Seabird congregation, or sensitive shorelines - not important pelagic spawning area or season. B: Seabird congregations and / or sensitive shorelines and important concentrations of pelagic eggs / larvae C: Important pelagic spawning area and season - seabird rare or absent		
4. Sea depth and distance to land	A: Depth> 50 m and distance to land> 10 km B_1: Depth> 50 m and distance to land < 10 km B_2: The criteria in A and B_I is not met, but specific conditions justify use of dispersants (seabirds, wind / currents direction) C: The criteria in A, B_1 and B_2 are not met		
5. Possible stranding of dispersant treated oil	A: Stranding of treated oil can be prevented B_1: Stranding of treated oil can be significantly reduced B_2: Stranding of treated oil on exposed / semi-exposed coast C: Stranding of treated oil on sheltered coast / sandy beach		

Additional comments:

Annex 1. Information and explanations

1. Evaluation of the lifetime of the oil slick on the sea surface

If it is expected that the oil will evaporate or naturally disperse within 3 hours, application of dispersants will not be relevant (C). If it is assessed to be within 24 hours, application of dispersants may be considered if drift of the oil slick may be to environmental sensitive areas (B). If type and amount of oil indicate a longer lifetime on sea surface than 24 hours, dispersant application is relevant (A).

2. Assessment of the dispersIbility of 011 within the operational window

The weathering degree of the oil is crucial to its ability to chemical dispersal. The type of oil and the weather conditions determine the time frame for weathering and hence the operational window for dispersants application, therefore the success of the application depends on whether the oil is dispersible within the possible time window for the operation (A), or if the dispersibility of the oil may be reduced (B), or whether the oil is not dispersible within the possible time window for operation (C).

3. Evaluation of oil harming natural resources against the benefit of dispersants application

The Environmental Oil Spill Sensitivity Atlas of Greenland (http://www.dmu.dk/en/arctic/oil/sensitivity+atlasl)) will serve as background information in identifying particular environmental sensitive areas, which may be located in the modelled trajectory of the oil slick in the relevant season. The atlas also provides information on logistics and countermeasures.

The atlas consists of five parts (pdf-files) covering the following areas:

- South Greenland region sso·62°N
- West Greenland region 62°-6soN
- West Greenland region 6So·noN
- West Greenland region 72°-75°N
- West Greenland region 7s°·77°N (will be published by NERI in 2011)

If there are seabird congregations or prioritised shorelines in the oil slick trajectory and no identified spawning area, application of dispersants will be appropriate (A). If seabirds and / or sensitive shorelines and pelagic spawning products are present at the same time in the oil spill trajectory, it has to be assessed by experts which organisms need most protection at the season in question (B). In a pelagic spawning area and no seabird congregations are present, dispersants should not be used (C).

4. Evaluation of the dilution effect of the potential sea area

The benefit of chemical dispersal of the oil spill depends on the sea area's dilution capacity. In open seas the chemically dispersed oil will quickly be diluted below toxic levels. Due to gaps in knowledge on the Arctic environment precautions have been taken in use of dispersants, which thus has been restricted to deep waters and offshore.

Therefore dispersants can be used if depth> SO m and distance to land> 10 km (A). If depth> SO m and distance to land < 10 km dispersant application can be considered, and even if these criteria are not met, but specific conditions may justify the dispersants use (sea birds, wind / currents direction), dispersant application may still be considered (B). If none of the above criteria are met use of dispersant should not be considered (C).

5. Evaluation of the risk of 011 / treated oil to strand including sedimentation in shallow waters

With reference to the marine communities along the shorelines stranding of oil should be prevented. As toxicity of chemically treated oil is enhanced compared to the oil itself, the dilution of the dispersed oil offshore is important.

Therefore, when using dispersants it should lead to prevention of oil/treated oil to strand including sedimentation in shallow waters (A). If the oil / treated oil stranding can be significantly reduced or strands on exposed / semi-exposed coast, application of dispersants may be considered (B). However, use of dispersants is not appropriate if risk of stranding of oil / treated oil on sheltered coast / sandy beach (C).

References

European Maritime Safety Agency (EMSA). 2006. Applicability of Oil Spill Dispersants. Part I. Overview. 91 pp.

Kystverket, Norway. 2009. Krontrollskjema for bruk av dispergeringsmidler på sjø. 1 p.; Beslutningsskjema for bruk av dispergeringsmidler incl. Veiledning. 13 pp.

National Environmental Research Institute, Denmark. 2010. Anvendelse af dispergeringsmidler i forbindelse med et akut oliespild ved Capricorns olieboringer i Vestgrønland 2010. Memo. 14 pp. *(being updated)*

Regional Environmental Emergency Team, Canada. 2003. Evaluation procedure of a request to use dispersants during an oil spill. 22 pp.

H. In Situ Burning Approval Form

Application for use of *in situ* burning during an oil spill

Form 1

Name of Applicant (e.g., company):	E-mail:
Contact person(s):	Phone:

Complete forms and, together with requested attachments, submit to Bureau of Minerals and Petroleum.
[redacted]bmpemergency@bm . I

1. Date and local time for start of spill						
2. Position of spill longitude/latitude, indication of locality/place name:	N			E		
3. Distance to land and water depth	Distance to land (km)			Water depth (m)		
3a. Distance to land < 10 km Assess if modelled smoke plume trajectory is necessary with regard to weather conditions	YES Attach modelled smoke plume trajectory			NO		
4. Description of the oil spill source (Name of vessel/ship, installation, etc.)						
S. Description of the oil spill (Oil type, surface / subsea, presence of gasses)						
6. Has the oil spill been stopped?	No		Yes		Hrs	
7. Estimated quantity of oil spilled (m^3) Mark or state quantity:	< 10	10-100	100-500	500-1000	1000-5000	>5000
8. Estimated surface area of 011 slick (km^z) Total area of sea surface covered by the oil slick.	km x km=					
9. Estimated thickness of oil slick	Sheen 0.04-0.30 µm	Rainbow 0.30-5.0 µm	Metallic 5.0-50 µm	Discontinuous true oil colour 50·200 µm	Continuous true oil colour> 200 µm	
10. Weather conditions Presently: 24 hrs forecast:	Temp. (°C) Sea Air	Wind Speed (m/s)	Direction	In·/decreasing	Wave height	
11. Forecasted location of 011 slick at the time of planned *in situ* burning operation, i.e., time for arrival of *in situ* burning equipment	N		E		Hrs	
	Attach latest oil slick trajectory-modelling forecast					
10. Visibility and light conditions	Cloud base (ml		Horizontal visibility (m)		Hours of daylight From hrs To hrs	
11. Ice conditions Degree of coverage (%).	No ice	Open water with ice floes	Ice floes / broken ice		Consolidated / Fast ice	

12. Description of *in situ* burning technique	Method
	Ignition
	Fire booms: trademark, resistance time, amount (m)
	Estimated burning time
	Attach latest smoke trajectory-modelling forecast

Net Environmental Benefit Analysis (NEBA)

An *in situ* burning operation will in total make the spilled oil cause less harm to the environment than no response or mechanical measures? Result from NEBA, Form 2.	Yes No

Operational conditions

The operational conditions to accomplish an *in situ* burning operation are met? Result from evaluation of oil and operational conditions by the oil spill response team.	Yes No

Attachments

1. NEBA (Form 2)	
2. Operational conditions	
2. Latest forecast oil slick trajectory modelling	
3. Latest forecast smoke trajectory modelling	

Recommendation

	Yes	Yes, with certain limitations	No	Further Information needed
Initiation of an *in situ* operation is recommended				
Comments				

Signatures

______________________ Date and time ______________________ Date and time

Form 2: Net Environmental Benefit Analysis

Evaluation of the total potential environmental benefit from the *in* situ burning (ISB) operation during an oil spill presuming operational conditions are met. For explanation of pt. 1-5, please consult Annex 1.

Net Environmental Benefit Analysis (NEBA): *In situ* burning operation will in total make the spilled oil cause less harm to the environment than no response or mechanical measures? Pt 1- 5.	Yes No
Operational conditions: The operational conditions to accomplish a dispersant application operation are met? Result of evaluation performed by the oil spill response team.	Yes No

Criteria for evaluation:	SCore
Positive net environmental benefit	A
Semi-positive net environmental benefit Further evaluation / information needed	B
Negative net environmental benefit	C

Criteria to be evaluated in NEBA:		Score	Comments
1. Expected life time of oil on sea without ISB	A: > 24 hours B: < 24 hours C: < 3 hours		
2. Oil ignitable and burnable	A: Oil is ignitable and burnable within possible time for operation B: Reduced ignitability and combustibility of oil within possible time for operation C: The operation cannot be performed within the operational window		
3. Distance to land and wind direction	A: Distance to land> 10 km B_1: Distance to land < 10 km - but offshore wind B_2: Distance to land < 10 km - but seabirds aggregations or sensitive shoreline in oil slick trajectory and no populated land in wind direction C: The criteria in A, B_1 and 8_2 are not met		

Additional information		Description
4. Collection of residues / residual oil *Collection equipment*	The *in situ* burning operation includes collection of residues / residual oil, i.e., equipment for this part of the operation must be available. Please describe the equipment available	
5. Collection of residues / residual oil *Collection plan*	Please describe the plan for collection of residuals / residual oil	
6. Storage and disposal of residues / residual oil	Please describe the facilities available for storage and disposal and state how these are appropriate for handling burning residues / residual oil	

Additional comments:

Annex 1. Information and explanations for Form 2:

1. Evaluation of the lifetime of the 011 slick on the sea surface

If it is expected that the oil will evaporate or naturally disperse within 3 hours, application of dispersants will not be relevant (C). If it is assessed to be within 24 hours, application of dispersants may be considered if drift of the oil slick may be to environmental sensitive areas (B). If type and amount of oil indicate a longer lifetime on sea surface than 24 hours, dispersant application is relevant (A).

2. Evaluation of ignitablllty and burnabillty of 011 within the operational window

The weathering degree of the oil is crucial to its ability to ignite and burn. The type of oil and weather conditions determine the time frame for weathering and hence the operational window for the *in situ* burning operation, therefore the success of the operation depends on if the oil is ignitable and burnable within possible time for opertion (A), or if these parameters of oil may be reduced (B), or if the oil is not ignitable and burnable within possible time for operation (C).

3. Evaluation of air pollution against the benefit of an in *situ* burning operation

During an *in* situ burning operation the emissions of particles to the air is of primary concern. The safety limit is defined as the level of fine particulate matter ($PM_{2.5}$) being below 65 **µg** m^{-3} on an hour mean. In Alaska the safe distance is set to 3 nautical miles (5.5 km) from the burn. This safety distance is based on computer model predictions of particulate matter in a smoke plume, and where the $PM_{2.5}$ limit value is reached at the greatest downwind distance.

The Environmental Oil Spill Sensitivity Atlas of Greenland (http://www.dmu.dk/en/arcticloil/sensitivity+atlasl)) will serve as background information in identifying particular environmental sensitive areas, which may be located in the modelled trajectory of the oil slick in the relevant season. The atlas also provides information on populated land, logistics and countermeasures.

The atlas consists of five parts (pdf-files) covering the following areas:

- South Greenland region S8°-62°N
- West Greenland region 62°-68°N
- West Greenland region 68°-n °N
- West Greenland region nO-7SoN
- West Greenland region 7So-noN (will be published by NERI in 2011)

Due to gaps in knowledge on the Arctic environment and fast weather changes, precautions have been taken in use of in *situ* burning as a countermeasure leading to a safety zone of 10 km.

Therefore, if the operation has a distance to land> 10 km it has a sufficient safety distance (A). *In situ burning* may also be considered if the distance to land < 10 km - but the wind is offshore (B_1); if there are seabird congregations or prioritised shorelines in the oil slick trajectory and no populated land in wind direction (B_2). *In situ* burning cannot be considered if distance to land < 10 km, no specific conditions justify the use of in *situ* burning (seabirds, sensitive shoreline in oil slick trajectory) or wind direction is towards populated land (C).

4-6. Collection of 011 residues / residual oil

As oil residues / residual oil may contain higher concentrations of PAHs and, in case of residual oil, be more adhesive compared to none-burned oil, collection of the residues Iresidual oil from the *in situ* burning operation is important. When residues cool down they often sink, but also heated oil, which has not been efficiently burned, may sink. This residual oil is tar like, Le., very sticky and adhesive.

Therefore, an *in* situ burning operation must include collection as well as storage and disposal of residues / residual oil. Descriptions of available equipment and plan for collection as well as storage / disposal facilities for this part of the operation are requested.

References

Alaska Regional Response Team. 2008. In Situ Burning Guidelines for Alaska. 65 pp.

National Environmental Research Institute, Denmark. 2010. Anvendelse af afbrænding af olie på åbent hav til bekæmpelse af akut oliespild *(In-situ* burning, ISB). Memo. 6 pp. *(being updated)*

Regional Environmental Emergency Team, Canada. 2003. Evaluation procedure of a request to use the *in situ* burning technique during an oil spill. 19 pp.

I. Aerial Surveillance Report Form

INCIDENT NAME

DATE AND n ME — Day — Month — Year

TYPE OF AIRCRAFT

AERIAL SURVEILLANCE REPORT No.

TAKEOFF liME (LT)

LANDING liME (LT)

AIRCRAFT COMPANY

OBSERVER

ASSISTANT OBSERVER

PHOTOS 0

USE OF GPS 0

VIDEO 0

SHORT DESCRIPIION OF ROUTE

WEATHER

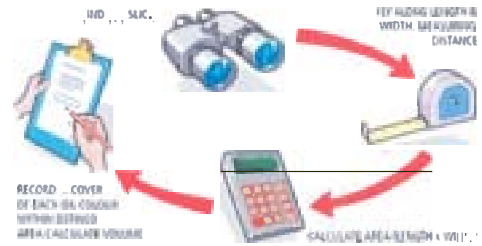
WIND DIRECTION

WIND SPEED

SEA STATE

WEATHER 0 SUNNY 0 CLOUDY 0 RAINY

Aerial Surveillance Step by Step



Step 1: Find the Spil

Ladder Search / Spiral Search

Step 2: Fly **along** the Spill and Measure

Example: Length " (260 seconds x 120 knots) *13600* seconds ,n one hour " B.67 nm = 16.04km

Width " (70 seconds x 120 knots) / 3600 seconds 'n one hour " 2.33nm = 4.31km

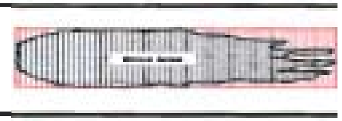
Area " 16.04km (length) x 4.31km (w,dth) " 69.13km'

(note: 1 knot " 0.5m/second " 1.B kmfhour)

Step 3: Spill Area Calculation

Overall Area and Use of Grids to estimate Coverage - in this example. **estimate** of **oil** area Is **80%** and dear water **20%**

Example: Oiled Area " 69.13 km' (overall area) x **80%** (oiled area) " 55.30 km'



Step 4: **%** Cover and Volume Calculation

In this example. **1%** of the slick Is black colour, **5%** blue, 24% rainbow and **70%** silver.

OBSERVAn ONS													
TIME	POSITION		DIMENSIONS		OIL APPEARANCE / COVERAGE **(%)**							VOLUME	SUCK MOVEMENT
Local	latitude (N)	Longitude (W)	Length (m)	Width (m)	1 (silver coloured)	2 (grey)	**3** (rainbow)	4 (blue)	5 (blue / brown)	6 (brown *1* blackl	7 (dark brown/ black)	m' / km'	Direction
Estimated litres / km for each colour code (see *section* ***1.7.1*** for more information)					20	100	300	1100	5000	15000	>25000		
COMMENTS / REMARKS													

J. 011 Spill Sampling Form

Oil Spill Sampling Form This form is to be completed by the person (s) taking the samples, ensuring to complete the sample container label and sign	
ID Number - VY/MM/DD - with initials of person taking sample	
Sample description, viscosity, colour and contaminants	
location of samples -lat /long	
Date and time of sample collection	
Purpose for which sample was taken	
If known, suspected source	
Were dispersants used	
Name, address, email address, telephone and company of person taking sample and any witness	
Air and sea temperature	
Description of the oil spill, distribution and consistency	
Original to be kept with sample - keep a copy of the form with the Capricorn DSV	

Appendix 11: Further Information

k. MSDS for Dasic: Slickgone NS

Dasic 5lickgone N5 is the approved dispersant for use in Greenland.

CASIe INTERNATIONAL LTD

SAFETY DATA SHEET

Page 1 of 3

Slickgone NS

Revision 4
Revision date 25-Aug-2010

[redacted]

Product name

Description

Company

elephone

Fax

Emergency telephone number

2 HAZARDS [redacted] TION

The product is classified as non hazardous. May cause [illegible] ing of the skin. May cause irritation to eyes.

3 [redacted] RMATION ON INGREDIENTS

Hazardous ingredients

	Conc	CAS	EINECS	Symbols/Risk phrases
Kerosine - sulphur free - distillates hydrotreated light	50- ...%	64 42...7-6	265-...-8	Xn
Sodium dioctylsulphosuccinate				Xi R38 ...

4. FIRST AID MEASURES [redacted]

Skin contact	Remove contamin ed clothing W · ith water. Seek medical [illegible] n if irritation or symptoms persist. Wash contaminated clothing before reuse.
Eye contact	se imm with plenty of w for 6 minutes holding the eyelids open. Contact . es should be removed. Seek medical on
Inhalation	Move the exposed person to sh air. Seek attention if irritation or symptoms persist.
Ingestion	DO NO [illegible] inse mouth thoroughly. Drink 1 to 2 glasses of water. Seek medical attention.
General information	tial for aspiration if swallowed.

5 [redacted] MEASURES

Extinguishing media	Alcohol [illegible] rbon oxide. CO2. Dry chemical. Do NOT use water jet. Cool fire exposed containers with waters.
Fire hazards	Burning produces irritating, toxic and obnoxious fumes.
Protective equipment	case of fire and/or explosion do not breathe f Self-contained bre sus

Slickg e

Revision 4
Revision date 25-Aug-2010

6. ACCIDENTAL RELEASE MEASURES

Personal utions	Wear suitable protective equipment. See section 8 for further information.
Environment l precautions	Prevent further spillage if safe. Do not allow product to enter drains. Do not flush into surface water. Do not let product contaminate subsoil. Advise local authorities if large spills cannot be contained.
Clean up methods	Absorb with inert, absorbent material. Transfer to suitable, l belled containers for disposal. Contact a licensed waste disposal company. Cl spillage area thoroughly with plenty of water.

7. HANDLING AND [redacted]

Handling	Wear protective clo ing. See section 8 for er ion.
Storage	Keep out of the reach of c i . Avoid contact wi strong oxid g agents. Keep in a cool, dry, well ventilated area.
Suitable packaging	Store in original container.
Specific use	Obtain special instructions from the supplier.

[redacted] S / PERSONAL PROTECTION

Exposure limits

Kerosine - unburless - distillates (petroleum), hydrotreated light	WEL 8-Hr 111ppm N L 15 r [illegible]	WEL 8H [illegible] 1000 WEL 15 [illegible] mg/m3

Engineeri measures	Ensure adequate ventilation of the working area.
Respiratory protection	Not normally required. Wear suitable respiratory equipment when necessary. For s ort periods of work a combination of charcoal filter and particulate filter is s le.
Hand protection	Chemical resistant gloves (PVC)
Eye protection	Approved safety goggles. Provide eye wash station.
Protective equipment	Apron (Plastic or rubber) Rubber boots.

9. PHYSICAL AND CHEMICAL PROPERTIES

Description	Viscous liquid.
Colour	Bro
Odour	Mild.
Boi in!J point	192"C
Flash point	
Rel .ve density	0.87
Water solubility	slightly ible in w
Viscosity	Flow IOO cup (ISO 2431) .40

10. ST ITY AND REACTIVITY

Stability	conditions.
Conditions to avoid	B ing produces irritating, toxic a oxious fumes.
rials to avoid	Strong oxidising agents.

lickgone

Revision 4
Revision date 25-Aug-2010

11. TOXICOLOGICAL INFORMATION

Acute toxicity	Ingestion may cause nausea and vomiting.
Corrosivity	May cause irritation to eyes. May cause degreasing of the skin. Potential for aspiration if swallo
Repeated or prolonged exposure	Repeated or prolonged exposure may cause dermatitis.
Mutagenic effects	No utagenic effects reported
Carcinogenic effects	No carcinogenic effects reported.
Reproductive toxicity	No teratogenic effects reported.

12. ECO IN

Bioaccumulation	Does not bioaccumulate.

13. DISPOSAL C TIONS

General information	Dispose of as special waste in compliance with local and national regulations.
Disposal of packaging	Dispose of in compliance with all local and national regulations.

14.[redacted]ORT INFORMATION

Further information	The product is not classified as dangerous for carriage.

116. REGULATORY INFORMATION

16. OTHER TION

Text of risk p rases in Section 3.	R36 - Irritating to eyes. R38 • Irritating to skin. R65 • Harmful: may cause lung ge if swallowed.

I. Tier 3 Emergency Organisational Structure

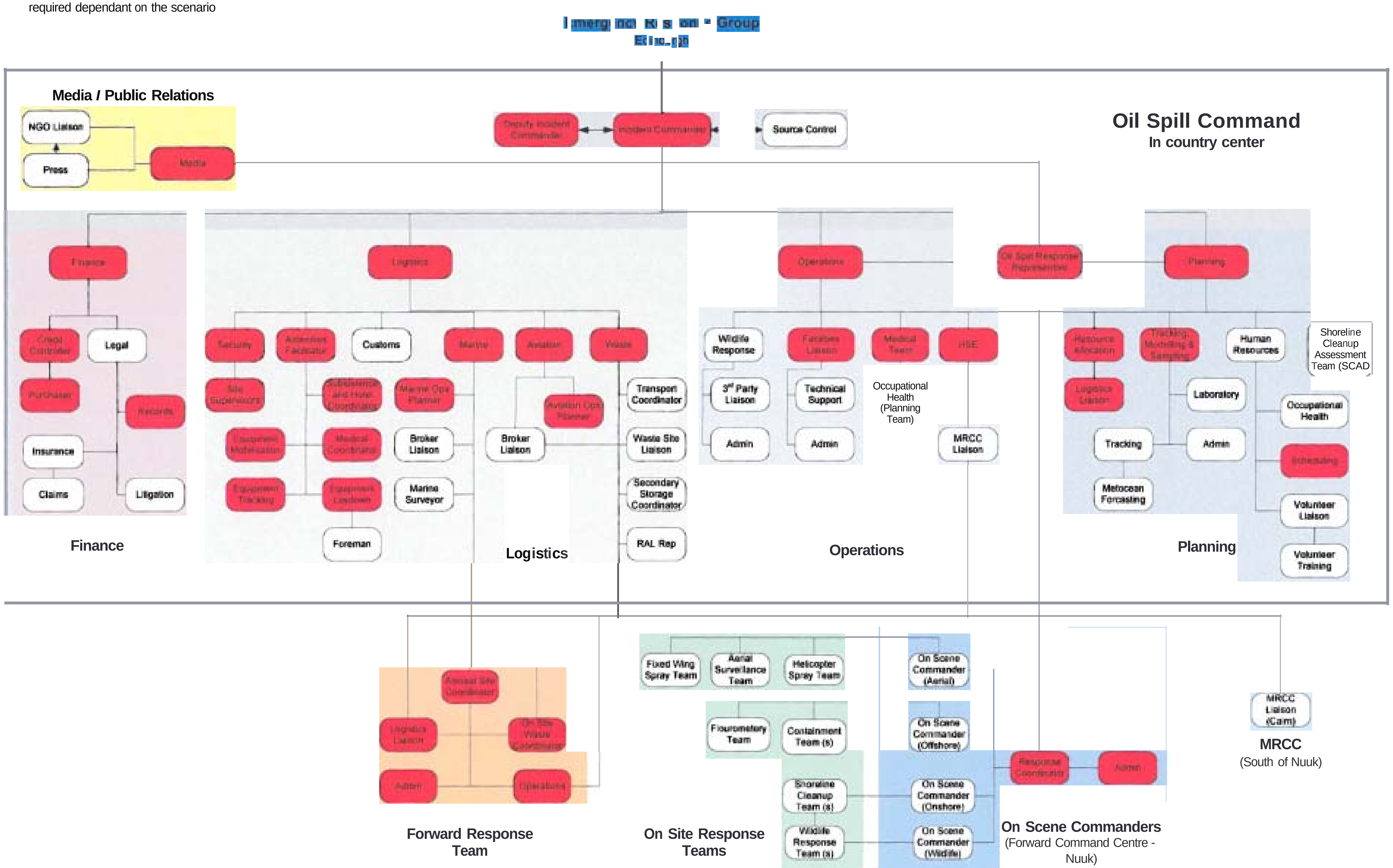
In the event that a Tier 3 response is required the initial in-country structure will be expanded to realise a longer-term Tier 3 response. The following organogram identifies the positions and functionality of a full Tier 3 oil spill command structure for a response to an oil spill in the 'project' (i.e. post emergency response) stage. If a large scale incident were to occur, a smaller team of key personnel in country initially whilst all necessary facilities were secured.

Department	Position	Role	Reports To	Interacts With
Capricorn Energy	Incident Commander	Supervises the tactical response operations in the field. Provides the focus point for Capricorn in country operations and maintains communications with the ERG throughout the response operation.	Emergency Response Group	Country Representative, Operations Manager, logistics Manager, Planning Manager, Finance Manager, Media /Public Relations, Oil Spill Response Representative
	Deputy Incident Commander	Assists the incident commander in all aspects of the incident response operation	Incident Commander, ERG	Country Representative, Operations Manager, logistics Manager, Planning Manager, Finance Manager, Media /Public Relations, Oil Spill Response Representative
Tier 3 Contractor	*Oil Spill Response* Representative	Provides technical advice on all aspects of the spill response operation	Incident Commander	Operations Manager, Planning Manager
Media/Public Relations (In country)	Media/Public Relations Manager	Provides a focal point for all media relations dealing with the response operation. Develops and releases information about the incident to the news media as well as other appropriate agencies and organisations	Incident Commander	NGO liaison, Members of the Press
Regional Response Teams	Regional Response Team	Establishes command and control over the tactical response at an incident scene	Response Coordinator	logistics liaison, Administration Team, On-Site Waste Coordinator, Operations Department
Operations Department (in country)	Operations Manager	Coordinates the Operation Teams response to the incident, assisting the 'RT with support and advice	ERG via the Incident Commander	HSE Department, Medical Team, Facilities liaison Wildlife Response, Response Team Coordinator, Oil Spill Response Representative
	Facilities liaison	Responsible for providing adequate facilities to support the conduct of the response operation. These Include Command Centre facilities, IT technical and communication support.	Operations Manager	Resource Allocation Team, Technical Support Team, Administration Teams
	HSE Coordinator	Responsible for ensuring that all activities in the response operation are carried out in accordance with HSE legislation	Operations Manager	All Departments Coastguard liaison
	Medical Team	Responsible for dealing with medical issues arising from the response operation	Operations Manager	All Departments, Occupational Health Teams, Coastguard liaison
	Wildlife Response	Responsible for dealing with wildlife impact issues that arise from the response operation	Operations Manager	3rd Party liaisons, Administration Teams
Planning Department (in-country)	Planning Manager	Responsible for the collection, evaluation, dissemination and use of information about the development of the incident and the use of resources. Coordinates the Planning Teams response to the incident, assists the IRT with support and advice	ERG via the Incident Commander	Resource Allocation Team, Tracking and Sampling Team, Human Resources, SCAT Teams, Oil Spill Response Representative
	Resource Allocation Team	Identifies and obtains resources required to support the response operation	Planning Manager	logistics Department
	Tracking and Sampling Team	Support the response operation with access to sampling and tracking resources	Planning Manager	Administration Team, Sampling laboratories, Spill Tracking and Modelling Providers, Metocean Forecasters
	Human Resources Department	Support the response operation in all Human Resources and scheduling matters	Planning Manager	Resource Allocation Team, Scheduling Department, Medical Team (Occupational Health), Volunteer liaison Team, Volunteer Training Team
	Shoreline Cleanup Assessment Team (SCAT)	Assessment of the need for shoreline cleanup, selection of the most appropriate cleanup method, determination of priorities	Planning Manager	Resource Allocation Team, l ogistics Department
Logistics Department (In-country)	l ogistics Manager	Communicates and coordinates between the logistics Teams in response to the incident, assists the IRT with support and advice	ERG via the Incident Commander	Security Team, Amenities Facilitator, Marine Department, Aviation Department, Waste Management Team, Customs Team
	Security Team	Provides practical and at the scene tactical response security services regarding security issues in relation to the response operation	logistics Manager	Site Supervisors

Department	Position	Role	Reports To	Interacts With
	Amenities Facilitator	Responsible for ordering, receiving, servicing and storing all supplies for the incident including personnel, non-expendable equipment and supplies	logistics Manager	Subsistence and Accommodation Coordinator, Medical Coordinator, Equipment Mobilisation, Equipment Tracking, Equipment l ay-down Areas Site Foremen
	Marine Department	Responsible for organising marine operations and providing logistical support to incident vessels.	logistics Manager	Resource Allocation Team, Marine Operations Planner, Marine Broker liaison, Marine Surveyor, Response Coordinator, Aasiaat Response Team, IIlullsat Response Team
	Aviation Department	Responsible for organising *air* operations and providing logistical support to incident aircraft.	logistics Manager	Resource Allocation Team, Aviation Operations Planner, Aircraft Broker liaison
	Waste Management Team	Implement the Waste Management Plan and oversee the waste streams, waste segregation, collection procedures, storage sites and disposal sites.	logistics Manager	Resource Allocation Team, Transportation Coordinator, Waste Site liaison, Secondary Storage Coordinator, RAI Rep, Aasiaat Response Team, IIlulisat Response Team
	Customs Team	Provides advice and for all customs matters relating to the response operation	logistics Manager	Resource Allocation Team, Planning Department
Finance Department (In-country)	Finance Manager	Responsible for managing and supervising all financial aspects of the response operation including; accounting, invoice processing, contracts, cost control, insurance coordination and financial reporting to the ERG	ERG (Aberdeen) via the Incident Commander	Credit Controller, Purchasing Department, legal Department
	Credit Controller	Provides accounting and cost control functions for the response operation	Finance Manager	Purchasing Department
	legal Department	Responsible for prOViding advice regarding legal issues associated with the response operation	Finance Manager	Records Team, litigation Team, Insurance Departments, Claims Team
Coastguard	Coastguard liaison (Capricorn)	Provides a link to the Coastguard in regard to all aspects of the response operation	Operations Manager	HSE Coordinator
Regional Response Teams	Regional Response Team	Establishes command and control over the tactical response at an incident scene	Response Coordinator	logistics liaison, Administration Team, On-Site Waste Coordinator, Operations Department
Response Teams (In-country)	Response Coordinator	Coordinates the on-scene Response Teams tactical response to the incident, assisting the ERT with support and advice	Operations and Planning Managers	On Scene Commanders for Offshore, Onshore, Aerial or Wildlife Response (as dictated by the response operation), Regional Response Teams, Administration Teams
	Offshore On Scene Commander	leads the practical response operation to an offshore incident	Response Coordinator	Flourometery Team, Containment and Recovery Teams
	Onshore On Scene Commander	leads the practical response operation to an onshore incident	Response Coordinator	Shoreline Cleanup Teams
	Aerial On Scene Commander	leads the practical aerial response operation to an oil spill incident	Response Coordinator	Helicopter and Fixed Wing Spray Teams, Aerial Surveillance Team
	Wildlife On Scene Commander	leads the practical wildlife response operation to an oil spill incident	Response Coordinator	Wildlife Response Teams

Notes:

- All positions shown in red are required to be filled 24 hours a day
- Positions shown are 'main players' additional support may be required dependant on the scenario



m. Summary of Different Remote Sensing Techniques and Effectiveness

Remote Sensing
Remote sensing is a possible complementary method of observation to observation by the human eye. A number of different sensing systems are able to *detect* and map the presence of hydrocarbons on the sea surface in certain conditions. This observation method has the following advantages over visual observation: • Detection can be carried out from a distance (SLAR: 15 to 20 nautical miles on each side); • Spills can be accurately plotted on charts/maps; • Imagery from sensors can be recorded; • Visualisation is possible outside of the visible spectrum.

Table 31 Summary of surveillance techniques

Remote sensing equipment	sensing means	Range	Layer thickness detected	Effectiveness
Side-looking Airborne Radar (SLAR)	Detects dampening by wind and oil of capillary waves generated by the wind.	During reconnaissance flights (from 1,500 to 4,000 feet), SLAR can detect oil 15 to 20 NM away, on either side of the plane, except in a "blind spot" directly under the plane, which is equal in width to the altitude of the plane. This gap can be covered by an infrared scanner.	Over 3 to 5 µm (to produce a dampening effect on capillary waves)	• Can be used day and night and through fog or clouds; • limited to wind speeds in the range 1.5-6 m/s; • Penetrates the cloud layer. • Cannot detect oil in calm (0 to 1 on the Beaufort scale), or very rough (over 7 or 8 on the Beaufort scale) conditions. • The results must always be confirmed by visual observation and/or IR-UV scanning. • Can detect oil in up to 3/10 ice floe coverage. Cannot detect oil on ice surface or under snow.
Infrared line Scanner (IR)	Detects thermal radiation with a wavelength in the band of 8 to 12 µm.	Zone scanned is twice the plane altitude. Compensates for the "blind spot" of the SLAR. In practice, scanning should be carried out at 1,500 feet and 160 knots, allowing a width of ~ 1,000 m.	Over 10 µm. Slicks appear black or white on the screen depending on thickness and temperature.	• Effectiveness is dependent upon surface heating and can only be used up to a few hours after sunset.

Ultra Violet Line Scanner (UV)	Detects the ultraviolet component of light from the sun reflected by oily liquids.	Zone scanned is equal to twice the altitude of the plane. Com-pensates for the SLAR "blind spot". In practice, scanning should be carried out at 1,500 feet and 160 knots, allowing a width of approximately 1,000 m.	From **1 µm**	• Cannot distinguish between different thicknesses; • Effectiveness is dependent upon reflected sunlight; • Cannot be used at night. • Can detect oil in up to 3/10 ice floe coverage. Cannot detect oil on ice surface or under snow.
Microwave Radiometer	Similar to IR Line Scanner. Has the advantage of measuring the thickness, and therefore volume, of slicks detected.		From 100 **µm**	• Calibration necessary to determine volumes; • For thick slicks and emulsions, the surface area of the slick can be calculated, but the thickness must be determined using other methods, such as by ships involved in response operations.
Forward-Looking Infrared Scanner (FUR)	Detects thermal radiation with a wavelength in the band of 8 to **12 µm.**	Depends on the altitude of the plane and the field of view selected by the operator, as well as the hygrometry.	From code 2 or 3, see Oil Appearance Code	• FUR detects zones of different temperatures, cannot be used as a principal pollution research sensor. • Recordings complementary method to visual observation. • Can detect oil in up to 9/10 ice floe coverage. • Can detect oil on ice surface but not buried under snow.
EMSA Satellite Service (Can only be mobilised through Denmark)	Side Aperture Radar, detects the roughness of a target surface. An oil slick smoothes the water surface and reduces radar backscatter to the sensor.	Dependent upon satellite footprint generally has a large field of view.	Cannot determine spill thickness or volume	• Only effective at moderate wind speeds in the range of 2-12 m/so • Takes time to alter orbit to collect images. • Grease ice can be mistaken for oil spills. • Long revisiting time. • Can be used day and night and under all weather conditions. • Can detect oil in up to 3/10 ice floe coverage. Cannot detect oil on ice surface or under snow.

n. • Technical Specification for Oil Spill Surveillance Activities

[redacted] owns and operates a fleet of multi-mission maritime patrol aircraft that are contracted by government and private industry to conduct a wide variety of missions including pollution detection and oil spill response.

The primary role of the response aircraft is to map the extent of the oil coverage and task the surface clean-up vessels to the thicker sections of the spill. Aircrews are trained to interpret thickness by the observable colours reflected by the spill. Based on the total coverage and thickness of different areas the onboard mission management system can calculate the total amount of oil within the spill.

The radar system onboard fixed-wing reconnaissance Aircraft is the multi-mode ELTA Systems EL/M2022A(V)3. The EL/M-2022A{V}3 is an, X-Band, pulse compression search radar that is capable of detecting very small targets in open ocean conditions.

The EL/M2022A(V)3 is a very effective radar for the detection, classification and mapping of targets of interest including but not limited to:

- Icebergs and pack ice
- Pollution such as oil spills
- Vessels and fishing gear
- Marine life

The most compelling feature of the EL/M2022A(V)3 are its imaging capabilities of surface features such as oil spills.

The SAR capability of the EL/M2022A(V)3 enhances pollution monitoring and oil spill detection providing more accurate information in both oil quantity and its spatial distribution over the ocean's surface. The ELM 2022A(V3) can enhance pollution monitoring with its 360 degree search capability combined with its SAR imaging capability to prOVide both initial target detection and accurate information in both oil quantity and its spatial distribution over the ocean's surface. SAR is useful particularly for searching large areas and observing ocean areas at night and under cloudy weather conditions or inclement weather.

o. Oil Inventory

The table below lists oils and their maximum volumes that are present as a result of the exploration drilling operations being carried out by Capricorn. Details are subject to change and will be updated throughout the drilling period. Waste storage capacities are noted in the additional information. This space is available for temporary storage of waste oil/water in a spill.

Table 32 Oil Inventory

MODU	Oil type	Max Capacity (m^3)	Additional Information
Leiv Eiriksson	Fuel oil (MGO)	4631	
	Base oil	406	
	Aviation fuel	7.5	
Corcovado	Fuel oil (MGO)	7500	
	Base oil	476	
	Aviation fuel	7.5	
support Vessels	**Oil type**	**Max Capacity (m^3)**	**Additional Information**
[redacted] Ice Management (IM)	Fuel oil (MGO)	850	
[redacted] Emergency Response and Rescue Vessel (ERRV)	Fuel oil (MGO)	180	Oil recovery 10 m^3
[redacted] ERRV	Fuel oil (MGO)	486	Oil recovery 500 m^3
[redacted] IM	Fuel oil (MGO)	607	
[redacted] IM	Fuel oil (MGO)	607	
[redacted] IM / ERRV	Fuel oil (MGO)	1000	Oil recovery 1206 m^3
[redacted] IM / ERRV	Fuel oil (MGO)	930	Oil recovery[40] 2270 m^3
[redacted] IM / ERRV	Fuel oil (MGO)	1050	Oil recovery 2270 m^3
[redacted] Platform Supply Vessel (PSV)	Fuel oil (MGO)	1095	
[redacted] PSV	Fuel oil (MGO)	965	
[redacted] PSV	Fuel oil (MGO)	1070	
[redacted] Multipurpose	Fuel oil (MGO)	940	

40 ORO capacity on *Siem* anchor handlers is provided in two of the multipurpose tanks of size 973.4 m^3 and 1296.5 m^3.

p. Example Site Response Plan Template

Site Response Plan

THIS SITE RESPONSE PLAN IS INTENDED TO PROVIDE STAFF WITH A COMPREHENSIVE GUIDE TO All CONSIDERATIONS IN INCIDENT SITE SAFEIY MANAGEMENT.

Incident Name	
Project Code	
Site location	
Site Assessors	
Date and TIme of Initial Assessment	

section 1	Site Attendance Register
section 2	Site Safety and Health Plan Flow Chart
Section 3	Gas Monitoring Records
Section 4	Site Safety and Health Plan
section 5	Site Survey

TO BE COMPLETED BY THE **SITE** SUPERVISOR (S/S) ON THIS **SITE**						
	DEPARTING S/S			INCOMING S/S		
	PRINT NAME	SIGNATURE	DATE	PRINT NAME	SIGNATURE	DATE
HANDOVER 1						
HANDOVER2						
HANDOVER3						
HANDOVER4						

SECTION 1 - 7 DAY SITE ATTENDANCE REGISTER									
ANYONE WHO ATTENDS THE SITE MUST HAVE A SAFETY BRIEFING									
	NAME	DATE							OTHER RELEVANT INFO
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									

When arriving onsite, the response team should have a minimum 200m exclusion zone before turning on the gas monitor. Monitor to be switched on 20 minutes prior to being taken on site. Gas monitors should be held at chest level. Upon approaching site, readings should be taken every 50m and recorded. In the event of any alarm sounding start moving backwards from site. Wait 15 minutes before moving in again. If no alarms sound upon reaching site it's safe for personnel to enter and work. Readings should then be taken every 30 minutes throughout the working day.

		Calibration Date

Alarm	O_2	LEL	H_2S	CO	VOC	Benzene
1	19.5%	10%	5ppm	25 ppm	50ppm	0.5 ppm
2	23.5%	20%	10ppm	200 ppm	150 ppm	0.5 ppm

Time	Oxygen	% LEL	H_2S	CO	VOC		Signed
Initial reading (200m point)							
Subsequent readings every 50m							
Readings taken every 30 minutes							

Applies to site					
Date				Time	
Produet(s)		MSDS on site?		Yes	No
Site characterisation	Tick all relevant boxes				
Area	D Ocean	DBay	U River	D Salt marsh	D Mudflats
D Inland	D Pipeline	D Mountainous	D Refinery	D Tank Farm	D Bunded Area
D Docks	DShoreline	DSandy	D Rocky	IDOiffs	DOther

Notes (Note High and low water times if applicable)

Use	D Commercial	D Industrial	D Farming	D Public	D Government
D Recreational	DOther				

Notes

Weather	Dice/frost	DSnow	DRain	Wind Speed .... knots		Wind Direction	
D Wind chill	D Fog/mist	DSun	D Other (specify)	Cloud Cover	DHigh	O IOw	Temp............ºC

Notes

Site Type	%	Site Access		Load Bearing		
Cliffs		D	Metalled road	D	Firm	will support any vehicle
Bedrock		D	Track	D	Good	4 wheel drive
Boulders (>10 cm)		D	Pathway	D	Soft	tracked vehicles
Pebbles (1-10 cm)		D	Steps	D	Very soft	will not support vehicles
Gravel (2mm - 1cm)		D	Slipway	Access/site Information.		
Sandy		D	Car park			
Mud		D	Boat			
Man-made		D	Other			
Marsh/mangrove						
Other:						

O Bird handling	O Fire, explosion, in-situ burn	O Slips, trips and falls
O Boat safety	O Heat stress	O Steam and hot water
O Chemical hazards	O Helicopter operations	O Tides
O Cold stress	O Motor vehicles	O Trenches, excavations
O Electrical hazards	O Overhead/buried utilities	O UV radiation
O Fatigue	O Work near water	O Visibility
O Inclement weather	O Dangerous animals	O Other (specify)

Notes

D Foot protection	DCoveralls	O Ear protection	O Hand protection
O Head protection	O Impervious suits	O Eye protection	O Personal flotation
O Cold Weather Clothing	O Personal Air Monitors	DSCBA	O Respirators
O Survival suit	O Other (specify)		

Notes

O Sanitation	O First Aid	I O Decontamination
O Security	O Shelter	I O Other (specify)

Notes

Site alerting

SOMETHING RECOGNISABLE

MUSTER POINTS, ROLES AND RESPONSIBILITIES ETe

Doctor	

D capricorn staff	D Contractors (Trained)	DContractor (untrained)
D Volunteers (Trained)	D Volunteers (Untrained)	D Other (specify)

NOTE· Shaded areas require manual handling training, use guideline document to record the basic field training,

Notes (Record the manual handling hazards identified and remedial action)

D Diesel Driven Power Pack	D Small Skimmer	D Air Innation Pump/Water Pump
O Pressure Washer	D Large diesel pump	D Product Uplift Skimmers
D Other (Specify)	If you tick any of the above hearing protection Is required, consider If single or double protection Is necessary	

Notes PPE required?

D Platforms	D ladders	D Tanker walkways
D Scaffolding	D Cliffs/ledges	D Others specify J

Notes

D Gantry cranes	D Mobile cranes	D Tower cranes	DForklifts	DOther (specify)

Notes

D Storage Tanks	DSilos	D Enclosed Drains
D Sewers	O Open Topped Chambers	O Vats
D Ductwork	D Unventilated or poorly ventilated rooms	O Beaches restricted by headland and tide
O Bunds	O Excavations	D Other (specify)

If any of the shaded areas are ticked please contact your Team Leader for advice.

Notes (ensure that entry and exit points are clearly defined on the sketch or picture of the site)

D Open flame work	DWelding	D Other (specify)

Notes

SE•• [•

SKETCH MAP OF AREA (Plan view and shore proflle/s)

SECTION 5 • • •CO • • ON REPORT

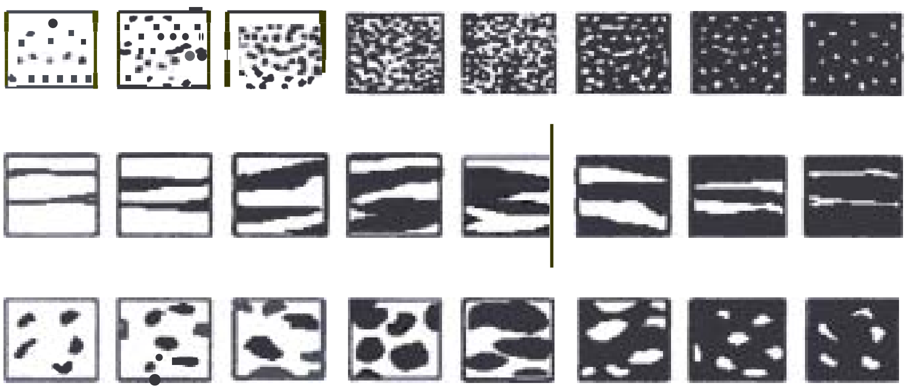
0	**A,** B. **C, etc. oiling zones**	POINTS TO REMEMBER	KEY
0	**Boom anchor** points	0 **Key landmarks**	
0	Ukely disposal sites	Access points	
0	**Backshore features**	**North arrow**	
0	**Access restrictions**	**% Cover**	
0	Position HII **tide**	**Slope**	
0	Photo locations	0 **Scale**	
0	**Oil** distribution	0 Pits	
Site:		Date:	Initials:

SURFACE OILING (see key below and visual aid)

1 Band	2 Area		3 Dist.	4 Thickness					5 Character							6 Zone		
	length m	Width m	%	1	2	3	4	5	F	M	T	C	R	P	D	US	MS	LS
A				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

1 Band	Delineated on sketch map. Use identifiers A, B, C etc. Bands to be chosen to have fairly even oil distribution and thickness
2 Area	I ength and width of the *oiled area* at each zone. If multiple bands of oil across shore, width represents the sum of them
3 D1strib utlon	The % of the surface within an area covered by oil. *(see visual estimatian chart below)*
4 Thickness	Average or dominant oil thickness within an area 1 Pooled Oil >*Icm* thick 2 Cover Imm - I cm thick 3 Coat O.I mm -Imm thick (can be scratched off rock with fingernail) 4 Stain < O.Imm thick (cannot be scratched off easily) 5 Film -Transparent or translucent film or sheen
5 Character	Visual state of oil F Fresh un-weathered, low viscosity M Mousse/ Emulsified T Tar balls or patties Balls < I Ocm; Patties > IOcm C Tar coat/weathered coat or cover R Surface residue/non-cohesive, oiled surface sediments P Asphalt pavement cohesive mix of oil and sediment D Debris seaweed, rubbish etc.
6 Zone	Refers to height on shoreline US Upper Shore MS Middle Shore LS I ower Shore

Visual estimation of surface oil cover



10% 20% 30% 40% 60% 70% 80% 90%

q. Conversion Table

Volume		
1 Barrel (US)	= 42 Gallons (US)	= 159 Litres
1 Barrel (Imp)	= 45.1 Gallons (Imp)	= 205 Litres
1 Gallon	= 1.2 Gallons (US)	= 4.546 Litres
1 Cubic Meter	= 1000 Litres	= 6.29 Barrels
1 litre	= 0.22 Gallons (Imp)	= 0.03531 Cubic Feet
1 Cubic Yard	= 0.765 Cubic Meters	
1 Cubic Foot	= 0.0283 Cubic Meters	
1 Cubic Decimetre	= 0.001 Cubic Meters	= 1 Litter
1 Tonne (metric)	= approx 7.5 Barrels (US)	= 262 Gallons (Imp)
Area		
1 Acre	= 0.405 Hectares	= 4050 Square Meters
1 Hectare	= 10,OOOSquare Meters	= 2.471 Acres
1 Square Kilometre	= 100 Hectares	= 247 Acres
1 Square Meter	= 1.196 Square Yards	
1 Square Yard	= 0.836 Square Meters	= 9 Square Feet
1 Square Foot	= 0.093 Square Meters	
1 Square Mile	= 2.59 Square Kilometres	= 640 Acres
Length / Distance		
1 Kilometre	= 0.54 Nautical Miles	=0.622 Miles
1 Nautical Mile	= 1.852 Kilometres	= 1.151 Miles
1 Mile	= 1.609 Kilometres	= 1760 Yards
1 Meter	= 1.094 Yards	= 3.282 Feet
1 Yard	= 0.914 Meters	
1 Foot	= 0.305 Meters	
1rnch	= 25.4 Millimetres	
Speed		
1 Knot	= 1.85 km/hour	= 0.51 Meters / second
1 Meter/ Second	= 3.6 km/hour	= 1.94 Knots
Mass		
1 Tonne (metric)	= 1000 Kilograms	=0.984 Tons
1 Ton (Imp)	= 20 Hundredweight	=1016.05 Kg
1 Hundredweight	=50.8 Kilograms	=112 Pounds (lbs)
1 Kilogram	=2.205 Pounds (lbs)	=(1 Litre of water)
1 Gramm	= 0.035 Ounces	
Flow[41]		
1 Cubic Meter / Hour	= 16.7 Litres / Minute	= 3.671 Gallons / Minute
1 Litre / Second	=2.119 Cubic Feet / Minute	=13.21 Gallons / Minute
1 Cubic Foot / Minute	= 0.1039 Gallons / Second	=0.472 Litres / Second
1 Gallon / Minute	= 0.0631 Litres / Second	
1 Barrel/Hour	=2.65 Litres / Second	= 0.5825 Gallons / Minute
1 Gallon (US)/ Acre	=11.224 Litres / Hectares	
Pressure		
1 Psi	=0.069 Bar	= 6901 Pascal
1 Bar	=100,000 Pascal	=14.49 Psi
1 Bar	=30 Feet of Water	
Engine Power		
1 Horsepower	=0.7457 Kilowatts	
Temperature	of to °C deduct 32, multiply by 5, divide by 9. °C to of multiply by 9, divide by 5, add 32.	

41 Where not specified Gallons are Imperial

	0	10	20	30	40	50	60	70	80	90	100
	32	50	68	86	104	122	140	158	176	194	212

r. location of Hired Equipment

The following table identifies the container numbers and location of hired oil spill response equipment, the shoreline equipment has been highlighted.

Container	Size	Contents	In-field Location
Information Removed	10'	250m Hi-sprint system	Information Removed
	10'	2S0m Hi-sprint system	
	10'	GT185 skimmer	
	10'	4 x IBC dispersant & spray system	
	10'	4 x IBC dispersant & spray system	
	10'	4 x IBC dispersant & spray system	
	10'	4 x IBC dispersant	
	10'	GT185 skimmer	
	10'	200m Ra-Boom 1300	
	20'	2 x 200m Ra-Boom 1300	
	10'	Walosep skimmer	
	10'	Walosep skimmer	
	20'	8x Komara skimmers	
	20'	4 x Power vacs; 2 Komara skimmers	
	20'	2 x Power vacs; 2 Komara skimmers; 2 Rope mops; 4 fastank	
	20'	2 x Helibuckets	
	20'	boom: 400m sea sentinel; 120m shore guardian; 200m fence; ancillaries	
	20'	6x power vac	
	20'	8 x IBC dispersant	
	20'	3 x Helibuckets	

S. Locations of MODU spill kits

leiv Eriksson

[redacted]

Corcovado

[redacted]

Appendix III: Environmental 011 Spill sensitivity Atlas, NERI Technical Reports (Supplied as a separate volume)