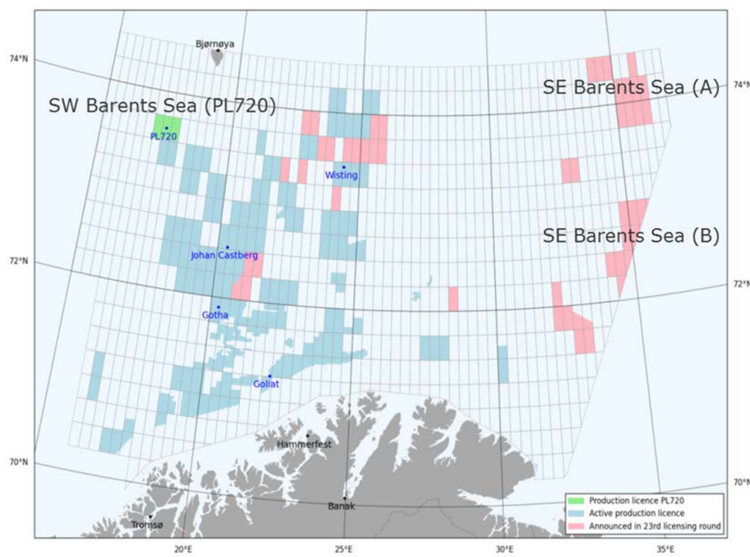
Beredskap under leting i Barentshavet

Barents Sea Exploration Collaboration (BaSEC) er et industrisamarbeid for å forberede leteoperasjoner i Barentshavet. BaSECs siktemål er å koordinere operatører og komme med anbefalinger om tiltak som kan danne grunnlag for sikker og effektiv letevirksomhet i Barentshavet. BaSEC har 16 medlemmer, alle operatører på norsk sokkel. BaSEC bygger sine rapporter på beste tilgjengelige kunnskap og på den brede erfaring disse 16 selskapene har fra operasjoner på norsk sokkel og i andre områder med tilsvarende forhold.

Et av spørsmålene som reises i forbindelse med utlysningen av de nye områdene i Barentshavet er avstanden til land og hvilken betydning for beredskapen dette kan ha under leteoperasjoner i Barentshavet.

I denne rapporten tar BaSEC for seg hvilke følger avstanden til land og andre fysiske forhold kan ha for operasjoner i områdene definert som A og B på kartet i figur 1. I tillegg er det utarbeidet en egen rapport for området benevnt PL720 i det sør-vestlige Barentshavet for å sikre at alle forhold i Barentshavet hensyntas. Konklusjonene fra denne rapporten gis til slutt i dette sammendraget.



Figur 1: Kart over lisenser i Barentshavet og hvilke områder rapportene omhandler

Formålet med rapportene er å gi områdespesifikke analyser av hva som kreves for å ha et fullgodt og effektivt beredskapssystem og identifisere mangler i forhold til gjeldendende reguleringer og industristandarder. Vurderingen skjer i forhold til et sett av definerte risikosituasjoner. Denne analysen omfatter imidlertid ikke oljevern – det spørsmålet blir analysert i sammenheng med miljørisikoanalysen (som publiseres mot slutten av april 2016). Rapporten baserer seg også på forutsetninger i andre BaSEC rapporter, slik som rapporten om fysisk miljø i Barentshavet sørøst.

Rapportens anbefalinger er et resultat av et tett samarbeid mellom BaSEC og en rekke andre aktører på sokkelen. Den bygger også videre på tidligere arbeid i regi av Norsk Olje og Gass, slik som «HSE challenges in the High North».

God beredskap er mulig hele året

Reguleringer og standarder på norsk sokkel gir for det meste funksjonelle krav. Rapporten tar utgangspunkt i at et gap i forhold til disse funksjonelle kravene oppstår når man må ha ytterligere teknologiske eller operasjonelle tiltak for å oppfylle forventningen i et funksjonelt krav. BaSEC ser at de gap som er identifisert er felles for område A og B, men at område A fordi det er lenger fra land blir gapet noe større for dette området når det kommer til evakueringstid for eksempel. Kravet til vinterisering vil være likt for begge områdene.

På grunn av avstanden til land må ressurser på feltet selv, slik som stand-by fartøy, spille en mer fremtredende rolle enn det som er vanlig i andre områder på norsk sokkel.

De fleste krav i nåværende regelverk for beredskap er vurdert kan oppfylles gjennom etablert utstyr, planer og prosedyrer. Det er identifisert 12 kategorier av krav hvor det vurderes å anbefale ytterligere tiltak for at krav og beste praksis skal være tilfredsstilte. Basert på disse funnene gis det en anbefaling om å innføre tre nye ytelseskrav som vil adressere de utfordringene som er identifisert:

- Personell skal så langt det er operativt forsvarlig bli hentet fra livbåt innen 24 timer etter denne er satt ut
- Det skal være mulig gå redde personer fra sjø innen 8 minutter etter personell i sjø er oppdaget
- Hvis helikopteret har måtte nødlande utenfor riggens sikkerhetssone (500 m) skal personer i sjø bli reddet så fort som mulig og senest innen 4 timer

BaSECs rapport om fysisk miljø dokumenterer at risiko for sjøis er lav, og risiko for isfjell er veldig lav. Likevel må denne risikoen tas høyde for og det anbefales etablering av et system for overvåking og håndtering av sjøis og isfjell.

En forutsetning for beredskapsanbefalingene er at helikopterbasen etableres på land. Dette fordi:

- Dagens helikopter kan, med noen modifikasjoner, fly til og fra område A
- En etablering av et landingspunkt midtveis mellom land og rigg er lite hensiktsmessig ettersom dette ikke vesentlig øker den operasjonelle evnen i en ulykkessituasjon. Et slikt landingspunkt introduserer derimot ytterligere risiko gjennom landing på og letting på en mobil enhet
- Helikopterbaser vil bli lokalisert på land på en hensiktsmessig måte for de ulike operasjonsområdene

I forhold til de foreslåtte endringene er det også identifiserte konkrete tiltak for å sikre at beredskapen under operasjonen er på det ønskelige nivået. Dette inkluderer forslag til utstyr, trening av personell og begrensninger i forhold til hvor og når operasjoner kan gjennomføres ombord på riggen under bestemte forhold.

Rapporten konkluderer derfor med at vinteroperasjoner er mulig utfra beredskapshensyn, men krever at operatørene gjennomfører tiltak for å vinterisere utstyr og etablerer nødvendige operasjonelle prosedyrer. Operasjoner i sommersesongen vil imidlertid ha mindre operasjonelle utfordringer, mindre behov for vinterisering og høyere regularitet.

For Barentshavet sørvest så er forholdene på noen områder annerledes enn i Barentshavet sørøst. Det er:

- Det er lavere sannsynlighet for sjøis og isfjell
- Større tilgjengelighet av utstyr og annen infrastruktur for beredskapsformål
- Basert på værdata fra Bjørnøya antas det større utfordringer knytte til tåke

Rapporten for Barentshavet sørvest gir noen få anbefalinger til operasjonelle tiltak utover de som gis for Barentshavet sørøst. Dette gjelder spesielt en anbefaling om økt meteorologisk overvåking av tåke. Et slikt tiltak vil styrke værvarslingen for området som sådan. Ellers er alle endringer i ytelseskrav foreslått for Barentshavet sørøst også gjort gjeldende for områder i sørvest med tilsvarende avstand fra land.

BASEC SSEPA BARENTS SEA 23 R AREA

Report - SSEPA Barents Sea South West

Barents Sea Exploration Collaboration

Report No.: 2015-1056, Rev. 1
Document No.: 1RI9SV4-8
Date: 2016-03-16

Project name:	BaSEC SSEPA Barents Sea 23 R area	DNV GL AS Oil & Gas
Report title:	Report - SSEPA Barents Sea South West	BDL Safety Operations
Customer:	Statoil ASA, Postboks 7200, 5020 Bergen	P.O.Box 408
Customer contact:	Anders Bergsli	4002 Stavanger
Date of issue:	2016-03-16	Norway
Project No.:	PP134928	Tel: +47 51 50 60 00
Organisation unit:	BDL Safety Operations	NO 945 748 931 MVA
Report No.:	2015-1056, Rev. 1	
Document No.:	1RI9SV4-8	

Applicable contract(s) governing the provision of this Report:

Objective:

A SSEPA for a relevant point in the Barents Sea South West Area is carried out. In agreement with BaSEC, the relevant point being addressed in this study is block PL720. This location is selected since it is found to represent typical weather conditions for the areas around Bear Island, Wisting and Hoop. The SSEPA is worked out mainly through mapping of the differences between PL720 and the South Eastern areas A and B, to check whether there are fewer or additional gaps towards performance requirements identified and evaluate the need for other or additional mitigating measures.

Prepared by:	Verified by:	Approved by:
Børre Johan Paaske Group Leader	Øyvind Roland Persson Senior Consultant	Dag Julian Ellertsen Project Sponsor
Espen Funnemark Principal Specialist		

DNV GL Distribution:

- ☐ Unrestricted distribution (internal and external)
- ☒ Unrestricted distribution within DNV GL Group
- ☐ Unrestricted distribution within DNV GL contracting party
- ☐ No distribution (confidential)

Keywords:
SSEPA, Emergency preparedness analysis, EPA, BaSEC, Barents Sea SW, PL720

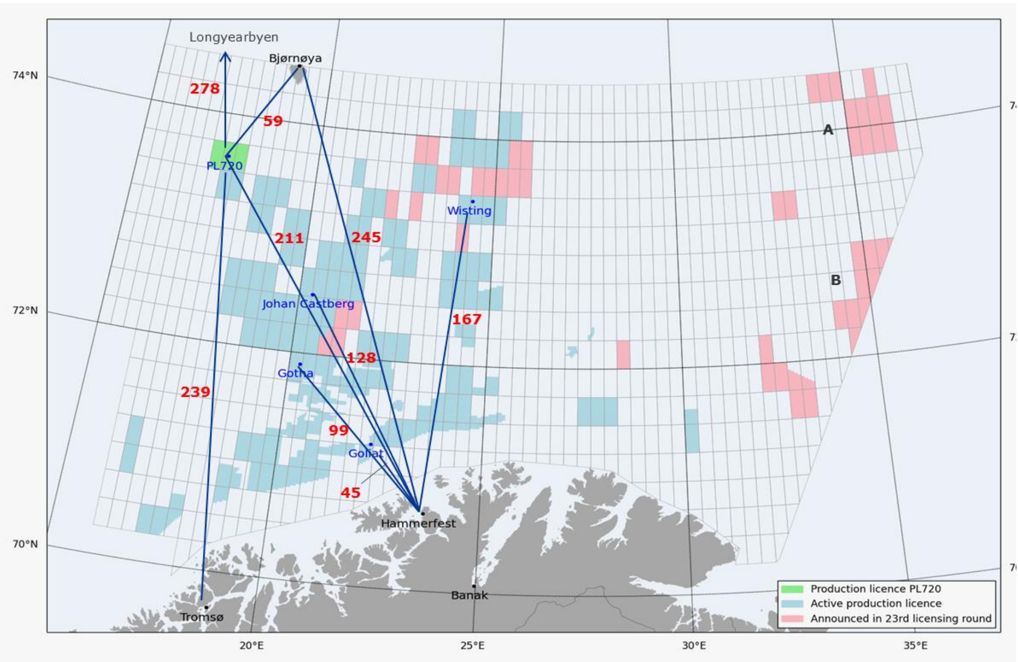
Rev. No.	Date	Reason for Issue	Prepared by	Verified by	Approved by
0	2016-01-18	First issue, Draft	FUNN/BJP	WALP	DJE
1	2016-03-16	Final	FUNN/BJP	ROLPER	DJE

Table of contents

1 EXECUTIVE SUMMARY

In relation to the BaSEC program and the upcoming 23rd licencing round (23 R), DNV GL carried out a Site Specific Emergency Preparedness (SSEPA) for two of the south eastern areas in the licencing round, areas A and B (see DNV GL report no. 2015-0606 *SSEPA Barents Sea (23 R - South East)*). The main objective of the study was to identify site specific challenges that impact the establishment of an adequate level of emergency response, identify gaps towards regulatory requirements and industry standards with respect to handling defined emergency situations, and finally to identify mitigating measures relevant for handling of the site specific challenges.

With basis in the above study, a SSEPA for a relevant location, block PL720 (73,63 N 17,50 E), in the Barents Sea South West Area is carried out. The location was selected since it is found to be representative for the longest distance from shore (mainland) for the opened areas in the South West Barents Sea. The location and some selected distances are shown in the figure below. The SSEPA was worked out through mapping of the differences between PL720 and the areas A and B. This has further been used to check whether there are deviations wrt. performance requirements. Gaps are evaluated and site specific mitigating measures are proposed. The scenario that was assessed is a harsh weather drilling rig carrying out exploration drilling in PL720 with a standby-boat close to the rig with helicopter as the primary evacuation mean.



In order to maximise the benefit of the work being carried out for the 23 R south east areas (A and B), it was focused mainly on assessing the differences between the two areas and PL720 wrt:

- DSHAs (DSHA list, descriptions/scope of each individual DSHA)
- Operational challenges

- Performance requirements and gaps
- Mitigating measures to close gaps
- Metocean conditions (wind, waves, visibility, ice, polar lows, current, snow, icing (marine/atmospheric), air and sea surface temperature, windchill, etc)
- Sailing and flight distances to shore (ships and helicopters)
- Onshore resources (AWSAR helicopters, hospitals, etc)
- Relevant onshore locations - main land Norway (Finnmark and Troms counties) and the nearby islands (Svalbard/Longyearbyen, Bear Island)
- Offshore infrastructure (other rigs and platforms, e.g. Goliat, Johan Castberg)
- Ship traffic in the area

The differences wrt metocean and ice conditions between PL720 and areas A and B is summarized below:

- Higher air/water temperatures
- Higher waves
- Higher wind speeds
- More fog
- Less icing, sea ice and ice bergs

In total twenty-three DSHAs were identified for the 23R SE areas A and B. A review of these DSHAs and corresponding challenges was made in this study to obtain the list of DSHAs and challenges being specific for the PL720 location. This work concluded that all DSHAs are relevant for PL720, but that there are slightly different challenges due to site specific factors e.g. metocean, ice, distances from shore and infrastructure. The main differences wrt challenges and emergency preparedness may be summarized as follows:

- Better access to resources/aids: Somewhat improved access to resources due to proximity to permanent installations as Goliat and possible future activities at Johan Castberg, Gotha, and Wisting. Bear Island can also be considered as temporarily base for evacuees in emergencies. SAR base at Longyearbyen will also improve the situation, but will not be included in the dimensioning of the emergency response resources.
- Hypothermia: Somewhat higher air/water temperature (on average 2-3 degrees higher) will cause less convective heat loss from water, but considering other risk factors; wind, waves, human conditional factors (age, body fat, fitness), Such a marginal temperature difference is not likely to increase time to suffer from hypothermia substantially.
- Fog challenges related to searching for missing persons: Depends mainly on occurrence of fog, and heavy snow showers and polar lows (visibility/wind). Fog probability is higher around Bear Island than in areas A/B
- Availability of onshore hospitals: In addition to Hammerfest there are hospital capacities at UNN in Tromsø and in Longyearbyen which may support operations at PL720

- Almost same mobilization and transportation times for receiving back up of relevant equipment from shore due to almost same distance(s) to shore as for area B.
- Unavailability of AWSAR due to flight conditions: Fog probability is higher around Bear Island than in areas A/B and hence higher unavailability.
- Operational limits of MOB/FRDC: Higher waves (Hs) may lead to lower availability of rescue vessels (more often beyond operational limits)
- Low air/sea temperatures will expose the FRDC/MOB crew during the operation to rescue personnel from sea: Somewhat higher water/air temperature in the area PL720 compared to areas A and B may increase time marginally before critical cold effects on crew and personnel in sea suffering from hypothermia

The study assessed further to what degree onshore facilities and relevant available rescue resources can be utilized to support the future operations at PL720 wrt escape, evacuation and rescue. The main conclusions are:

- *Hopen* is not relevant as emergency response hub due to too long distance from other infrastructure and drilling locations.
- *Bear Island* has some infrastructure today. Bear Island can be used as temporary accommodation after a dry evacuation (using helicopters), and as base for temporary accommodation of people after a precautionary down-manning. In addition Bear Island can also be used to shelter against wind and waves for life boats that are escorted by a stand by vessel. This can facilitate transfer of personnel to the stand by vessel. Bear Island is a natural reserve (except from the Station area), and hence cannot be used as a base for utility support nor pre-location of equipment for petroleum activities. For current plans and regulations regarding Bear Island, see ref. /3/ and /23/
- *SAR helicopter stationed at Longyearbyen* may go to Bear Island, re-fuel, and then go to PL720 and either back to Longyearbyen or to Hammerfest.
- *Goliat platform* has one dedicated standby vessels and a supply vessel with multi functionality including SBV role, at its disposal. In an emergency situation Goliat may release one of its vessels for support at PL720. In this situation, the vessel in Hammerfest will be mobilised to Goliat to maintain area preparedness and other activities on board. Installing equipment for helicopter re-fuelling on Goliat will also increase the operational time for SAR helicopters at the location. In addition, the extra availability of fuel combined with the rig's proximity to PL720 location will also make the helicopter flights to PL720 more efficient.
- *The Coast Guard* may act as on scene coordinator, provide support with Sea King and SAR-helicopter, re-fuelling of national SAR/Sea King. This is also relevant for area A and B, but the Coast Guard is more likely to be operating around Bear Island and Svalbard.
- *The Orion aircraft* stationed on Andøya may give assistance in Escape, Evacuation and Rescue (EER) operations

2 INTRODUCTION

2.1 SSEPA for 23 R – South East areas A and B

In relation to the BaSEC program and the upcoming 23rd licencing round (23 R), DNV GL carried out a Site Specific Emergency Preparedness (SSEPA) for two of the south eastern areas in the licencing round, areas A and B (ref. /1/). The main objective of the study was to identify site specific challenges that impact the establishment of an adequate level of emergency response, identify gaps towards regulatory requirements and industry standards with respect to handling defined emergency situations, and finally to identify mitigating measures relevant for handling of the site specific challenges.

To get the full benefit of this report it is recommended that it is read in context with the report for the South East areas A and B (ref. /1/).

2.2 Scope and purpose

With basis in the SSEPA for Barents Sea SE above (ref. /1/) a SSEPA for a relevant location in the Barents Sea South West Area is carried out. In agreement with BaSEC the relevant location being addressed in this study is block PL720. The location was selected since it is found to be representative for the longest distance from shore (mainland) for the opened areas in the South West Barents Sea. The PL720 location and selected distances to onshore and other offshore locations are shown in Figure 2-1 below. The PL720 field, coordinates 73,63 N 17,50 E, is located some 211 nm (390 km) NW of Hammerfest, 256 nm (473 km) NW of Banak/Lakselv, 59 nm (108 km) SE of Bear Island and 278 nm (515 km) SSW of Longyearbyen at Svalbard/Spitsbergen. The distance from the Goliat platform is approximately 155 nm (286 km).

The SSEPA is carried out through mapping of the differences between PL720 and the areas A and B, to check whether there are deviations wrt performance requirements. Gaps are evaluated and site specific mitigating measures are proposed. For a full description of the relevant Defined Situations of Hazard and Accidents (DSHAs) it is referred to the SSEPA for the SE areas A and B, see ref. /1/.

A one-day workshop was arranged where specific challenges, gaps and mitigating measures were discussed.

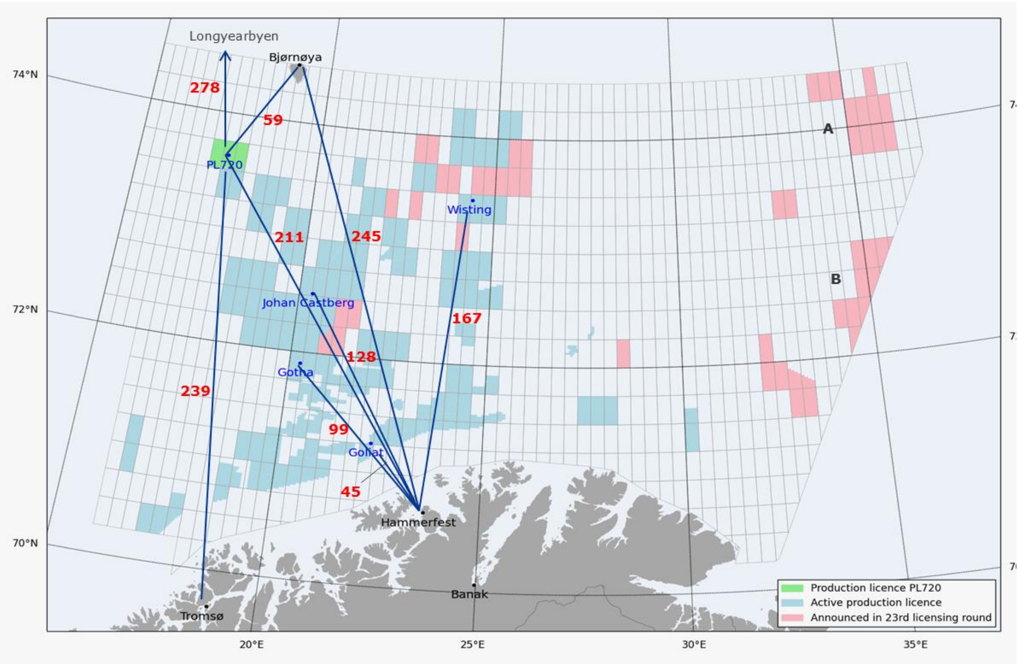


Figure 2-1: Selected distances; Hammerfest (example), Svalbard and Bear Island

3 ABBREVIATIONS

AIS	Automatic Identification System
AWOS	Automated Weather Observing System
AWSAR	All-Weather Search and Rescue
DPO	Dynamic Positioning Operator
DSHA	Defined Situations of Hazards and Accidents
EERA	Escape, Evacuation and Rescue Analysis
EPA	Emergency Preparedness Analysis
FRDC	Fast Rescue Daughter Craft
H_s	Significant wave height
IM	Ice Management
LQ	Living Quarter
MCR	Main Control Room
MOB	Man over board
NGO	Non-Governmental Organisations
NOROG	Norsk Olje og Gass
NVG	Night Vision Googles
PLB	Personnel Locator Beacon
POB	Personnel On Board
PS	Performance Standard
JRCC	Joint Rescue Coordination Centre (no: Hovedredningssentalen)
SAR	Search and Rescue
SBV	Standby Vessel
SSEPA	Site Specific Emergency Preparedness Analysis

4 METHODOLOGY

In order to maximise the benefit of the work being carried out for the 23 R south east areas (A and B), focus will be on differences between the two areas and PL720 wrt:

- DSHAs (DSHA list, descriptions/scope of each individual DSHA)
- Operational challenges
- Performance requirements and gaps
- Mitigating measures to close gaps
- Metocean conditions (wind, waves, visibility, ice, polar lows, current, snow, icing (marine/atmospheric), air and sea surface temperature, windchill, etc.)
- Sailing and flight distances to shore (ships and helicopters)
- Onshore resources (AWSAR helicopters, hospitals, etc.)
- Relevant onshore locations - main land Norway (Finnmark and Troms counties) and the nearby islands (Svalbard, Bear Island)
- Offshore infrastructure (other rigs and platforms, e.g. Goliat, Johan Castberg)
- Ship traffic in the area

The result of these assessments is to form the basis for establishing the site specific emergency preparedness in this part of the Barents Sea for possible future exploration drilling.

A workshop was organised on December 9th 2015 in order to:

- Discuss and conclude on the validity of the DSHAs and gap assessments carried out for areas A with basis in PL720 location specific conditions
- Identify and evaluate available resources for emergency response
- Identify any new mitigating measures beyond those being identified for areas A and B or changes/modifications of the same.

The list of participants is shown in Table 4-1 below.

Table 4-1: Participant list for workshop, December 9th 2015

Name	Company
Jan Vidar Markmanrud	Lundin Norway AS
Frank Berland	OIM Odfjell Drilling
Jørn Toverud	OIM Transocean
Sindre Eltvik	Transocean
Kenneth Skimmeland*	Transocean
Svein Olav Drangeid	OMV
Anders Bergsli	Statoil
Åshild T. Skjærseth	Statoil
Erik Hamremoen	Statoil
Leif Sandberg	EniNorge
Børre J. Paaske	DNVGL
Espen Funnemark	DNVGL

*): Safety delegate

5 SYSTEM DESCRIPTION

The scenario that is assessed in this report is a harsh weather drilling rig carrying out exploration drilling in PL 720 with a standby-boat close to the rig. Furthermore, helicopter is defined as the primary evacuation mean, and will be used as an evacuation means during an emergency event if it is possible to evacuate by helicopter.

There will be no drilling in hydrocarbon zones when the observable ice edge is closer than 50 km from the location. Marginal Ice Zone is defined as the transition area between the open ocean and the continuous ice cover. It consists of individual ice floes of varying sizes.

The field in question, some details/assumptions for rig and vessels and descriptions of available emergency response resources are shown in the following subchapters.

5.1 The field

The PL720 field, coordinates 73,63 N 17,50 E, is located some 211 nm (390 km) NW of Hammerfest, 256 nm (473 km) NW of Banak/Lakselv, 59 nm (108 km) SE of Bear Island and 278 nm (515 km) SSW of Longyearbyen at Svalbard/Spitsbergen. The distance from the Goliat platform is approximately 155 nm (286 km). For relevant flight operations, the estimated helicopter flight times to/from these locations to PL720 are shown in Table 5-3 together with vessel sailing times.

The coordinates of possible onshore locations are presented in Table 5-1.

Table 5-1 Coordinates for some relevant onshore/island locations

Area	Latitude	Longitude
Banak/Lakselv	70,07 N	24,97 E
Hammerfest	70,68 N	23,67 E
Tromsø	69,68 N	18,92 E
Longyearbyen	78,22 N	15,65 E
Bjørnøya (Bear Island)	74,50 N	19,03 E

Table 5-2 presents flight and sailing distances from different locations onshore to PL720. Flight distances > 300 nm is not considered feasible with existing helicopter technology. Table 5-2 shows that none of the selected locations are more than 300 nm from PL720. Distances between 200-300 nm is feasible with existing helicopter technology, but with reductions in number of passengers to reduce weight. As an example the existing Sikorsky S-92 helicopters may fly with 6-8 passengers for a distance of 265 nm, and with upgraded helicopters the number of passengers is will increase to 10. The limitations on the AWSAR helicopters will be the similar, but to a lesser degree than for transport helicopters, ref. /21/.

Table 5-2- Flight and sailing distances (nm/km) to location PL720

Area	Helicopter		Vessel	
	Nm	Km	Nm	Km
Banak/Lakselv	256	473	294	544
Hammerfest	211	390	211	390
Goliat platform	155	286	-	-
Tromsø	239	443	260	482
Longyearbyen	278	515	313	580
Bjørnøya (Bear Island)	59	108	62	114

Table 5-3 presents the expected flight and sailing times (in minutes) between the above locations and PL720. Please note that the calculated times does not consider mobilization time and that the speeds are assumed constant. In the calculations for vessels the sailing speed is assumed 15 knots.

The helicopter flight times are shown for different type of helicopters; Super Puma H-225 (Hammerfest and Goliat), Sea King (Banak, today), AW101 (Banak, future) and Super Puma AS332L1 (Longyearbyen).

Table 5-3 Helicopter flight times and sailing times (minutes) to/from PL720; one way, no mobilization time etc. included

	Helicopter				Vessel
	H-225[1]	AW101[1]	Sea King[2]	AS332L1[3]	
Banak/Lakselv	-	110	139	-	20
Hammerfest	90	90	115	101	14
Goliat platform	84	-	-	-	-
Tromsø	103	103	130	115	17
Longyearbyen	119	119	152	134	21
Bjørnøya (Bear Island)	25	25	32	28	4

1: Speed-over-ground: 140 knots (also valid for Sikorsky S-92)
2: Speed-over-ground: 110 knots
3: Super Puma Mk1; Speed-over-ground: 125 knots

5.2 Communication

Communication with rig from shore will be carried out by use of a VSAT communication terminal.

Communication with helicopter and shore will be via VHF and Iridium, and the same between helicopter and rig.

Communication between rig, SBV and helicopter and MOB/rescue boats will be via VHF.

Band with available on the location will be mapped with a satellite coverage study. It is assumed that a bandwidth of 8 Mbps is available for the rig.

5.3 Rig and vessels

Drilling rig:

No specific drilling rig is defined for the study, but some basic assumptions have been made:

- Drilling rig is assumed to be of a semi-sub configuration designed and equipment for operating in harsh conditions, with station-keeping by DP and/or anchor moored.
- It is assumed that equipment is designed according to prevailing standards.
- The rig is assumed to be designed and equipped for harsh conditions. Specific winterization requirement will be determined for each operation.
- The rig itself is intended to be relocated in accidental scenarios which are threatening the rig.
- The rig has radar that covers minimum 20 nm.
- The rig has operable and certified facilities for helicopter re-fueling
- Rig POB: 140 persons

Standby vessel:

- Radar covers min. 20 nm.
- Equipped with MOB system and possibly a fast rescue craft (FRDC).

Supply vessels:

- Example of a relevant shore base location for supporting operations at PL720 is Hammerfest.

5.4 Emergency response resources

5.4.1 Transport helicopter

The transport helicopter to be used for flights to the area must be equipped with auxiliary fuel tanks.

The transport helicopter to be used for flights to the area is assumed to have flight speed equivalent to a Super Puma H-225/Sikorsky S-92.

5.4.2 AWSAR helicopter

For the purpose of this study the cases with AWSAR helicopters have used a location onshore that reduces the distance to the locations as much as practically possible. The AWSAR will be used for emergency situations, and is assumed to have a flight speed in emergency situation of 140 knots.

The helicopter needs to be equipped with auxiliary fuel tanks, to be able to operate in the area. It is manned by rescue man, winch man, medical doctor and 2 pilots, and has a capacity to rescue 21 persons. The helicopter may take up to 4 stretchers at the same time.

Mobilisation time for SAR helicopter is 45 minutes, except during helicopter transportation it is 15 minutes. It is assumed that the doctor has the same mobilisation time as the rest of the helicopter crew.

The helicopter is assumed to meet requirements for operating all year round in the Barents Sea, and will have de-icing equipment. There is work ongoing to implement night vision googles (NVG).

5.4.3 Standby vessels

For this analysis it is assumed that the standby vessels have MOB-boat, radar available and possibly a FRDC (Fast Rescue Daughter Craft). For winter season operations or full year activities it is assumed that the SBV will have a winterization notation, with arrangements for anti-icing and de-icing, heating of spaces with important equipment etc.

5.4.4 Ice monitoring

The operation will need to include plans and systems for ice detection and monitoring in addition to a proper response to ice conditions. This will be described in the ice risk management plan which will be implemented prior to operation. Example of activities and systems are ice detection and tracking of sea ice and icebergs through satellite monitoring, air reconnaissance (fixed wing or helicopter) and forecasting of marginal ice zone, icebergs, etc.,.

5.4.5 Onshore on duty doctor

The on duty doctor has the overall responsibility for the operation. When the registered nurse offshore makes contact regarding a patient the on duty doctor takes over responsibility for medical treatment.

Together with the registered nurse they decide on further treatment. The on duty doctor is responsible for the treatment and resources until the patient arrive at the hospital.

5.5 Public resources

5.5.1 Hammerfest Hospital

Hammerfest Hospital will be used for patients being transferred to shore. In addition and if required, patients may be transferred to specialist hospitals e.g. UNN, Haukeland Hospital (for burns),etc.

5.5.2 University Hospital of Northern Norway

The rig will have extended cooperation with the University Hospital of Northern Norway (UNN) in Tromsø. It should be evaluated whether telemedicine equipment is to be installed on board the rig with assistance from UNN. Alternatively, the rig could have a permanent doctor on board.

5.5.3 Sea King, Banak

The Sea King helicopter in Banak is a national rescue resource. Mobilization is normally via the JRCC (Joint Rescue Coordination Centre) in Bodø. The operator’s emergency response organisation is dimensioned without the consideration of the national rescue resource.

The Sea King helicopter has operational limitations regarding the ability to fly directly to the locations, and will need an intermediate fuel stop on shore to reach the area. From mid-2019 the new AW101 national SAR helicopters are planned to be operational out of Banak, significantly increasing the rescue capability compared to existing Sea King helicopter.

5.5.4 Svalbard

The emergency preparedness and response system for the Svalbard area is managed by the Governor of Svalbard (Sysselmannen). Local authorities have the overall responsibility for planning and assessment related to rescue scenarios on and offshore at Svalbard. Their authority and rescue plan is limited by the 12 nm economic line. Sysselmannen will use the JRCC for Northern Norway to lead any large emergency situations offshore of Svalbard. In the following, the offshore emergency response resources and appliances at Svalbard is summarized:

- Rescue resources and lifesaving appliances located in Longyearbyen:
    - “Polarsyssel” emergency preparedness vessel on 6 months yearly contract (May to October) for the Governor of Svalbard. The vessel is equipped with lifesaving appliances for 42 persons in addition to large transport capacity. Helicopter logistics is enhanced by Helicopter In-Flight Refueling (HIFIR) and helipad capacity for large helicopters (Super Puma). When operational crew is on standby and can respond immediately
    - 2 SAR helicopters (AS332L1) at Longyearbyen are equipped with paramedic and doctor, with a 60 minute maximum mobilization time
    - For transport of personnel one Dornier DO-228 with capacity of 19 persons and 120 kg cargo, or a total of 2.3 tons cargo, is available. Tests have been carried out to prove that the aircraft is suitable for the Arctic Survival Kit (SKAD). No stand by for the crew and unknown mobilization time. To be operational for cargo drop it will include a cargo door exchange
    - Local hospital with capacity for 1 severe injury and 5 beds, all medical personnel on standby, and telemedicine equipment is available

- In addition, the industry and airport has site specific emergency preparedness plans, but the equipment is not intended for long distance deployment
- Arctic Survival Kit (SKAD) is owned and maintained by the local red cross consisting of:
  - Emergency response unit (Survival Kit Air Droppable) is owned by the local red cross and will be able to support 240 persons through 30 bags consisting of 4 dual sleeping bags, water, food and heating blanket for 8 persons, mobiliseringstid < 2 hours
  - Tents with heating for 150 persons, response time < 6 hours
  - Field-hospital unit includes 1 surgical unit, 4 tents with capacity for hosting 25 persons, medical personnel must be transported from mainland, mobiliseringstid < 24 hours
- Transport capacity at Svalbard outside of Longyearbyen:
  - In Barentsburg at the Russian helicopter base Kaap Heer, located 30 km west of Longyearbyen there is one MI-8 transport helicopter. This helicopter has no specific SAR capability and no standby for transport or search operations is required. Capacity for the distance between Bear Island and Svalbard is not known.

5.5.5 The Coast Guard

The Coast Guard ("Ytre Kystvakt Nord") has 7 vessels ("Nordkapp" and "Barentshav" classes) at its disposal of which four are carrying a helicopter. All but one may provide SAR service. The coast guard is regularly present in the Barents Sea and will in the coming years again be fully equipped with helicopter capability as the NH-90 helicopters are phased inn and operational.

5.6 Bear Island area and facilities

The Meteorological station, located at the northern tip of the island, is owned by Statsbygg and MET Norway is renting the facilities. The location of the station with the protective zones is shown in Figure 5-1 below together with supporting pictures in Figure 5-2. The station has been in operation for about 100 years. The station area (15000 m^2) is excepted from the protection regulations (ref. /3/). A summary of the station area and facilities is given below. :

- Heated facilities (2500 m^2)
- Tractors and snow mobiles
- Quay with hydraulic crane (only for smaller vessels/ships)
- Boat and raft for loading/unloading vessels/ships (highly weather dependent. Coast Guard and SAR helicopter assist if transport problems occur)
- Hangar made ready for housing Sea King helicopter
- Two helipads

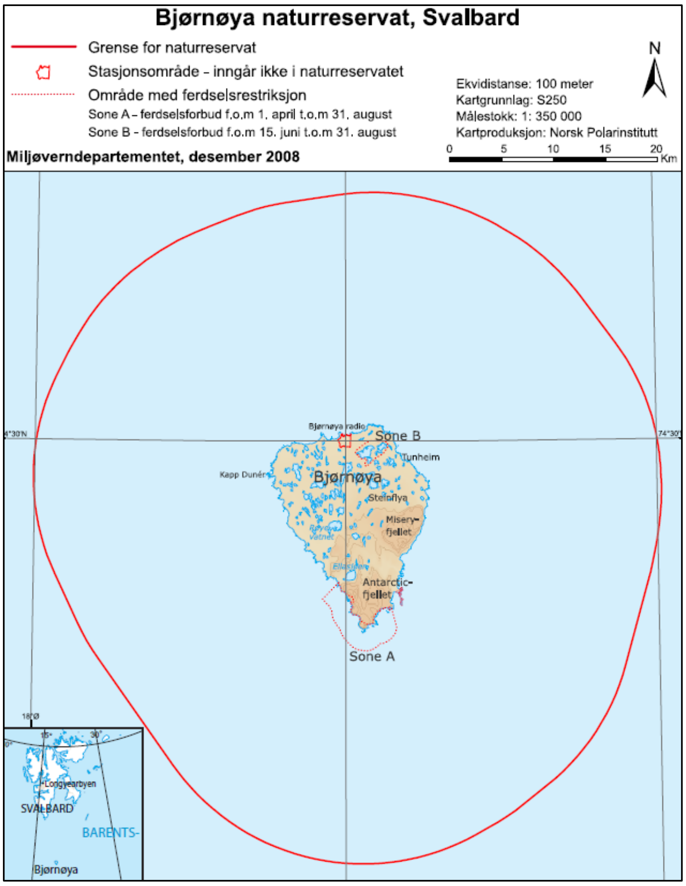


Figure 5-1 Bear Island nature reserve. Source: Protection regulations, ref. /3/.

Figure 5-2 Collage from the Meteorological station. Source: MET.

5.7 Metocean and sea ice data

In phase 1 metocean and sea ice data was obtained for the areas A and B. Relevant data for PL720 has been obtained from the same material which is summarized below. For comparison, the corresponding data for A and B is shown.

Table 5-4 Summary of metocean and sea ice data for PL720 and SE areas A&B

	PL720	SE areas A&B (ref. /1/)
Waves - extreme Hs ($p=10^{-2}$/year)	15.5 m	13.5 m
Extreme wind 10 m AMSL ($p=10^{-1}$/year)	29.5 m/s *(10^{-2}/year value: 32 m/s)*	28.5
Extreme min. temp (1 hr duration, $p=10^{-2}$/year)	-26°C	-36°C
Extreme min. temp (24 hr duration, $p=10^{-2}$/year)	-24°C	-34°C
Mean annual #days with moderate icing	15	30
Fog (visibility)	Measurements at Bjørnøya indicates that fog is expected 25% of the time during the summer months, However this is considered to be a conservative estimate for the PL720 location	-
Polar lows	Frequency of polar lows as for the Apollo/Atlantis area, but not as frequent as for the Snøhvit area	-
Sea temperature	Higher sea temperature is expected for PL720 area compared to A&B	-
Sea ice and ice bergs	Occurrence of sea ice and ice bergs similar as for area A, however considered to be somewhat lower.	-

In summary, the table shows that in PL720 it is expected the following compared to areas A&B:

- Higher air/water temperatures
- Higher waves
- Higher wind speeds
- More fog
- Less icing, sea ice and sea bergs
- Almost same frequency of polar lows

5.8 Assessment of infrastructure and onshore locations

Hopen is not relevant as emergency response hub due to lack of infrastructure and too long distance from other infrastructure and drilling locations.

Bear Island has some infrastructure today. Bear Island can be used as temporary accommodation after a dry evacuation (helicopter), and as base for temporary accommodation of people after a precautionary down-manning. Fog may cause challenging flight operations and current landing conditions will be continuously evaluated by the rescue. Ports can only be used with light crafts. There is a weather and research station with 12 persons on the north cape of the island.

All areas except from the meteorological station are located in a nature reserve and the area is regulated in accordance with the Svalbard treaty. It is recommended that the station will be visited wrt possible use for future emergency evacuation purposes.

The landing base has the capacity for one helicopter. However, additional helicopters may land in an emergency situation. One should map possible locations for giving shelter for wind (lifeboats, SBVs and rigs, water depth and currents around Bear Island. Current plans and regulations regarding Bear Island are found in ref. /3/ and /23/

SAR Longyearbyen may go to Bear Island, re-fuel, and then go to PL720 and either back to Longyearbyen or to Hammerfest.

One should inform Longyearbyen and Bear Island (through Sysselmannen) about plans to use Bear Island and Longyearbyen in emergency situations.

Goliat: The two installation specific vessels, speed 16 knots, one located at Goliat and one in transit to and from Hammerfest. In an emergency situation and the operations at Goliat allows for it SBV can be released for support at PL720. In this situation, the vessel in Hammerfest will be mobilized to Goliat to maintain helicopter transport and other activities onboard. Further, Goliat may be used to drop personnel arriving from PL720, but this requires re-fuelling capacity to be installed at Goliat. There is space available on Goliat for a re-fuelling system. Goliat is an additional hub to Bear Island for pre-cautionary evacuation and emergency dry evacuation.

Coast guard: May act as on scene coordinator, provide support to Sea King and SAR-helicopter re-fuelling of national SAR/SeaKing, in addition to its SAR helicopter capability (NH-90).

Fishing vessels may be used to escort life boats to safe haven. Fishing vessels will have a duty to rescue evacuees from sea. Formal agreements exist with NOFO to mobilize tugs offshore within 24 hrs to support for oil spill response. It should be investigated if this agreement could be extended to support for other scenarios, such as escorting life boats to safe haven.

In extreme situations **Longyearbyen Hospital** may be utilized if approaching Norwegian mainland are challenging due to weather conditions

An area emergency response vessel with landing facility for SAR-helicopter can be located with an optimal position towards simultaneous drilling operations in the area. The vessel with helicopter deck is to be used for supporting down-manning and for re-fuel. However, the workshop concluded that a better solution is to optimize the use of the dedicated SBV, and utilize the capacity of the three SAR helicopters available (Hammerfest, Longyearbyen, Banak). Due to safety and regularity issues it is not recommended to have a SAR-helicopter concept with landing base on a SBV vessel.

Orion aircraft on Andøya is relevant for both PL720 and the areas A and B. This aircraft is mainly for search operations.

6 DEFINED SITUATIONS OF HAZARD AND ACCIDENT (DSHA)

In the recent study for the 23R SE area and locations A and B (ref. /1/), 23 DSHAs were identified. For each DSHA a detailed description was given together with specific challenges related to future exploration drilling in the areas. The descriptions and challenges are found in Appendix A of this report.

A review of the DSHAs and challenges has been made in this study to obtain the list of DSHAs and challenges being specific for the PL720 location. This work concluded that all DSHAs are relevant for PL720, and that there are slightly different challenges due to site specific factors. The main differences between locations A&B and PL720 are summarized in the table below.

Differences in weather conditions and infrastructural factors may require a different approach to emergency preparedness and risk reducing measures during planning and execution.

Table 6-1 Main differences compared to South East area (locations A/B)

#	DSHA name	Differences
0	General DSHA	Limited access to resources/aids: • Better access to resources/aids due to proximity to permanent installations as Goliat and possible future activities at Johan Castberg, Gotha, and Wisting. Especially if shore base is possible at Bear Island. SAR base at LYR will also improve situation Hypothermia: • Somewhat higher air/water temperature (on average 2-3 deg higher) will cause less convective heat loss from water, but considering other risk factors; wind, waves, human conditional factors (age, body fat, fitness). Such a marginal temperature difference is not likely to increase time to suffer from hypothermia substantially Search for missing persons: • Depends mainly on occurrence of fog, and heavy snow showers and polar lows (visibility/wind). Fog probability is higher around Bear Island than in areas A/B Availability of onshore hospitals: • In addition to Hammerfest there are hospital capacities at UNN (Tromsø) and Longyearbyen. Kirkenes not relevant for operations at PL720
1	Shallow gas blowout	• Unknown reservoirs also at PL720, but to a lesser extent since more wells have been drilled in the area • Probability of experiencing scenarios where well needs to be abandoned during ice season, is considered lower than for A/B due to shorter ice season. However, this will not impact the planning of the emergency preparedness
2	Well kick	• As for DSHA 1
3	Subsea blowout	• As for DSHA 1
4	Topside blowout and uncontrolled releases of hydrocarbons	• As for DSHA 1
5	HC release in well test area	• None
6	Toxic gas release	• Unknown reservoirs also at PL720, but to a lesser extent since more wells have been drilled in the area

#	DSHA name	Differences
		• Almost same mobilization and transportation times for receiving back up of relevant equipment from shore due to almost same distance(s) to shore. However, significantly shorter time if future base at Bear Island
7	Fire in accommodation	• None
8	Fire/explosion in the machinery spaces/fire in utility areas	• None
9	Helicopter accident on installation (at helideck area)	Fire water/foam may freeze when flushed onto the helideck in low temperatures • Somewhat higher minimum temperatures at PL720 compared to areas A/B
10a	Helicopter accident into the sea within safety zone	• Operational limits of MOB/FRDC: Higher waves (Hs) may lead to lower availability of vessels (more often beyond operational limits). This will also put restrictions on transport helicopter flights when MOB/FRDC cannot be launched. • Low air/sea temperatures will expose the FRDC/MOB crew during the operation to rescue personnel from sea: Somewhat higher water/air temperature may increase time marginally before suffering from hypothermia (see above) • Rescue from sea within 120 mins: same situation as for A/B due to long flight times from onshore bases (except from Bear Island)
10b	Helicopter accident into the sea “en route”	• Helicopter base for PL720 operations will be Hammerfest
11a	Ship and other objects on collision course	• Higher fishing activity around PL720 than for A/B. However, this does not impact the planning of the emergency preparedness
11b	Sea ice and ice berg threats	• Shorter ice season • Lower probability of ice/icebergs
12	Structural failure	• None
13	Loss of position	• Lower probability of ice/icebergs causes lower probability of loss of / damage to mooring/anchors
14	Loss of stability	• As for DSHA 13
*15**	*Loss of control in transit*	N/A
16	Evacuation and rescue	• Flight and sailing times in the same order of magnitude as to area B (except from Bear Island) • Positive effect of SAR base at LYR even though 278 nm from PL720. • Fog probability is higher around Bear Island than in areas A/B and hence possibility for helicopter to land on the rig may be reduced • The reduced availability of the AWSAR helicopters (unless base at Bear Island) will make the overall evacuation and rescue concept more dependent on the resources present on the field; SBV, basket and means for wet evacuation: More fog, wind and waves at PL720 affect SBV operational capabilities, though marginally • There are weather limitations for using MOB boats, FRDC and AWSAR. Weather conditions may marginally reduce the availability of these resources for rescuing personnel from lifeboats • For personnel ending up in the sea after an

#	DSHA name	Differences
		evacuation, drowning and hypothermia was identified as the main challenges. Hypothermia can occur due to late rescue of personnel if helicopter and MOB/FRDC is unavailable: Hypothermia: See above
17	Occupational accidents/acute illness	• Almost same transport distances to hospital, but a possible emergency hospital facilities at Bear Island will improve the situation
18	Man overboard situations	• None
19	Fire/explosion in mud treatment areas	• None
20	Security threats	• None

*): DSHA 15 is not part of scope for this study

Note: Extreme weather situations are covered in each DSHA. Extreme weather can be a factor that reduces the possibility to meet defined performance requirements, and the SSEPA have focused on how to mitigate or compensate this (low temperature, visibility, extreme icing, polar lows/rapidly increasing wind and reduced visibility) with additional measures. If extreme weather situations are not handled properly they can develop into an emergency situation and a DSHA. For each operation it should be considered if there is a need to treat extreme weather situations as a defined emergency situation, and to specify the actual weather condition that requires an emergency response. Loss of power/blackout on the installation is also considered as a challenge that can lead to a DSHA (e.g. loss of position if thruster power is lost due to blackout), in addition to loss of winterization. Such events are included in the DSHAs.

7 GAP ASSESSMENT

In ref. /1/ a *gap assessment* was carried out where the identified site specific challenges were assessed wrt compliance with performance requirements from regulations and standards. Areas where there is considered to be a gap between the required performance and the available level of performance were identified. In addition, the challenges for which there were not established any performance requirements covering the site specific challenges, or where performance requirements are inadequate or not specific, were identified. The assessment included gaps towards the following standards and requirements:

- PSA Activities and Facilities regulations (ref. /13/ and /14/)
- NOROG Guideline 064 Etablering av områdeberedskap (ref. /6/)
- NOROG Guideline 016 Medisinsk beredskap (ref. /7/)
- NOROG Guideline 096 Mann over bord beredskap[1] (ref. /8/)
- ISO 19906 Arctic Offshore (to the extent that this is applicable to mobile offshore units) (ref. /9/)
- Internal requirements for BaSEC companies; GDF Suez (ref. /10/), Lundin (ref. /11/), OMV (ref. /12/), and Statoil (ref. /5/).

Note that the gap assessment was performed on an informative basis, as some of the standards above are not mandatory for the drilling operations in Area A and B.

The regulations and standards mostly give functional requirements. Hence, gaps were considered to arise where site specific challenges require additional technological or operational measures to fulfil the expectations in the defined performance requirements. Wherever possible, quantification of the efficiency of the emergency response, in terms of response time and capacity, has been used in the gap assessment.

A similar gap assessment has not been carried out for PL720 in this study since it was considered that the identified gaps for A&B are relevant for this area as well and hence no additional gaps were expected. However, specific measures for closing gaps in addition to those proposed for A&B, are identified, ref. chapter 8.

[1] Please note that NOROG 096 Guideline has been withdrawn and replaced by 064 (area preparedness) and 088 (permit to work). As these standards do not specify the manning of MOB team, the reference to 096 is still used.

8 MITIGATING MEASURES

Table 8-1 below is taken from ref. /1/ showing the mitigation measures being proposed to close the identified main gaps for areas A and B. The table was edited during the workshop on December 9, 2015. The table was updated to cover PL720 which is found in the rightmost column. As can be seen, most of the proposed measures for areas A and B are also valid and relevant for operations in PL720.

Table 8-1 Mitigation measures and recommendations

Requirement	Site specific issue to be mitigated to meet requirement	Mitigation measures for area A and B	Measures, comments and recommendations

Requirement to keep rig safety system operational at all times (PSA; Facilities Regulations §8, ref. /15/)	• Cold environment effect on safety systems reduce their functionality or availability
	
	This requirement is challenged by the environmental conditions at the locations at the site, such as low temperatures, polar lows, troughs, marine icing and reduced visibility (fog, snow fall). This gap will be mitigated by a combination of technical measures for winterization of safety systems and operational measures included in the winterization manual. Planning operations to the summer season will reduce the impact from polar lows, marine icing and low temperatures significantly.
		Technical
		• Winterization gap assessment according to season of operation to be carried out.
		• Winterization of safety barriers/safety systems (technology or operational measures, consider season of operation).
		• Winterization gap assessment of SBV and PSV, according to season of operation and use in emergency situations. Requirements should be adapted to specifications for the rig.
		• AWOS installed on the rig, with direct data reporting to METNO (including visibility and ceiling/cloud height measurement)
		Operational
		• Seasonal operations according to rig specification.
		• Winterization manuals and operations
		• Winterization manual; ensure lifeboats are operational in relevant weather conditions, remove snow/ice.
		• Adapt activity level onboard according to operating conditions/environmental conditions and status on safety- and EER systems
		• Relocate rig out of the area in case approaching critical environmental conditions (e.g. extreme weather).
		• Operational limitations (environmental conditions) for EER equipment to be defined, and procedures for precautionary measures (activity control, down manning due to extreme weather) when EER system cannot be operated.
		• Training of weather forecast contractor
			• AWOS installed on the rig, with direct data reporting to METNO (including visibility and ceiling/cloud height measurement).
			  o Recommend to streamline process of procuring and installing AWOS on the rigs.
			  o Agree with METNO how weather data shall be received, processed and stored.
			  o Use weather observations from rigs to improve fog forecasts (expectation and duration).
			• (Fog reduces search capability – evaluate use of personnel trackers and search systems as a compensating measure; see below).
			• **General recommendation:** Perform inspections/audits of life saving equipment and lifeboats on the rig, PSVs and SBVs with respect to use at the location. Also relevant for area A and B.

Requirement to safely abandon well (PSA; Activities regulations §88, ref. /14/ and Facilities Regulations §48, ref. /15/)	• Well control problems during sea ice season, which can last for several months If well control problems occur prior to or during the winter season, the rig will need to move off location if sea ice is approaching. The rig can return when the sea	**Technical** • Two independent mechanical plugs and cement, for which equipment should be available at all times on the rig or SBV • Equipment for temporarily abandon well available within mobilization times identified in ice risk management plan. • If well has to be left for longer period during sea ice without isolation by plugs; monitor BOP integrity with ROV/ice breaker.	PL720: Shorter ice season than for area A. Similar measures as for area A/B, probability for scenario where well needs to be abandoned during ice season is considered lower than for A/B due to shorter ice season. **General recommendation:** Consider benefits for operators to share storage of critical equipment on- or offshore.

Requirement	Site specific issue to be mitigated to meet requirement	Mitigation measures for area A and B	Measures, comments and recommendations
	ice has drifted off location. Safe abandonment of the well will need to reflect the timelines for approaching sea ice, and the length of the period for which sea ice can be on the location	**Operational** • Ice risk management plan to reflect procedures and time requirement for temporarily abandoning well (ice drift pattern, response times).	
Requirement to implement well control measures (PSA; Activities Regulations §85-86, ref. /14/)	a) Long supply routes for critical equipment b) Install capping stack in water depth for location A and B c) Drill relief well during winter season, and in shallow water	**a) Technical** • Ensure sufficient mud supply according to well conditions and logistical supply times. Need rigs with sufficient deck/storage capacity. **b) Technical** • Evaluation of available capping stack technology, including installation, for water depths relevant for area A and B. • Evaluation of logistics and mobilization plan for capping stack installation in area A and B. **c) Technical** • DP rigs should be considered for drilling relief wells in shallow reservoirs. **c) Operational** • Obtain an overview of rigs being available for relief well drilling (so that 12 days requirement can be achieved, type of rigs, plan for utilization of available rigs, should include plan to contract harsh environment/all year rig for Barents Sea operations). Include ice breakers/ice management vessels, and ice classed drilling rig in the relief well drilling plan.	**a) General comment:** BaSEC rig group is considering how well design can be optimized. Uncertainty in reservoir conditions should be communicated to drilling operator in order to make relevant plans for mitigating measures, such as possible scenarios for excessive loss of mud. Bear Island is not considered relevant for storage due to lack of deep water port and limitations on use for petroleum activity. **b)** Water depth at PL720 is 300-500m. As for area A&B and other parts of NCS there is a need for a capping stack installation plan. **c)** Same as for area A/B.
Requirement to evacuate personnel to safe area (PSA; Activities regulations	• Remoteness and few other vessels and installations in area. • AWSAR long response time and reduced capacity due to long	**New performance requirement: Target should be to rescue personnel from lifeboats within 24 hrs after lifeboats have been launched.** **Technical** • Move off location or use crane transfer basket for	**Slightly higher sea state than area A/B:** As for A/B, SBV and helicopter crew to conduct on site specific/relevant training.

Requirement	Site specific issue to be mitigated to meet requirement	Mitigation measures for area A and B	Measures, comments and recommendations
§77, ref. /14/): Requirement for rescue of personnel in sea after evacuation (NOROG Guideline 064) – not mandatory in areas without area emergency response.	distance from shore. • Low temperature; reduced survival time in sea after evacuation. • NOROG requirement is met for conventional and free fall in weather conditions where MOB/FRDC can be launched. Requirement is not met with AWSAR. The remote location and with few vessels and installations in the area require more attention to how to bring personnel to a safe location after evacuation, and for protection against hypothermia until they are rescued. Rescue methods need to cover both rescuing from the lifeboats and from the sea. As for A&B the time and capacity requirement for rescue of personnel from the sea after an evacuation as defined in NOROG Guideline 064 is not met if the SBV cannot launch its MOB boat or FRDC.	personnel or bridge type connection to SBV to avoid use of lifeboats. • 50% backup survival suits certified for Barents sea conditions stored at all mustering/lifeboat stations. • PLB (AIS/121.5 VHF) for entire crew • AIS/121.5 VHF tracker on SBV • Hand held AIS/121.5 tracker in MOB-boat. Verify that the tracker can be used in an open MOB-boat. • Transfer of personnel from lifeboat to stand by vessel: Preferred method is to pick up from sea by SBV MOB boat or hoisting to helicopter from lifeboat or sea. *Comment: Higher waves and more wind in PL720 could make SBV less available* **Operational** • SBVs required to have documented plans for rescue of personnel from lifeboats. • SBV training requirements for rescue of personnel from sea and lifeboat. • Training of SBV personnel on site. • SBV MOB crew; required to have two MOB crews and also exchange of personnel/additional team for prolonged periods of work outdoor. • Training of helicopter crew for rescue from lifeboats • SBV may be used to escort/tow lifeboats towards shore, to reduce flight distance for helicopter from shore.	Training of lifeboat crew for pick up/rescue operations to SBV. **Fog:** Increased presence of fog is not considered as a significant difference with respect to helicopter pick-up from sea/lifeboat. Consider to install emergency beacon on the lifeboats to enhance search capability. This should be seen in combination with the personnel AIS transponders on the survival suit. **Recommendation**: Work group to assess the optimum search and tracking system for personnel and lifeboats, in addition to quality and availability of survival suits. **Recommendation:** install re-fuelling capacity on Goliat to reduce flight times. Bear Island and Goliat can be used as evacuation hubs for temporary accommodation of evacuees. Helicopters in Longyearbyen and Banak will be available, but is not included in the dimensioning. Additional measures available but not dimensioned for: Utilise resources at Goliat (SBV), Svalbard (SAR helicopter) and Coast Guard (vessel and SAR helicopter) *Comment (remoteness/infrastructure): More activity at PL720 – better situation, more vessels/rigs available to assist in evacuation, this is however not accounted for: Coast Guard (vessel and NH90 helicopter), SAR helicopter at Longyearbyen, SBV/helicopter at Goliat and vessels in general.* *Comment (temperatures): Somewhat higher sea/air temperatures in PL720, but still low and time to reach hypothermia may not be significantly lower*

Requirement	Site specific issue to be mitigated to meet requirement	Mitigation measures for area A and B	Measures, comments and recommendations
Requirement for safe transport (PSA; Activities regulations §17, ref. /14/).	• Helicopter accidents outside the rig safety zone/en route • Remoteness and few other vessels and installations in area. AWSAR long response time and reduced capacity due to long distance from shore. • Lower water temperature reduces time to reach hypothermia. • Challenging search conditions; darkness and reduced visibility. • New performance requirement need to be established. • Requirement to pick up before hypothermia within 120 minutes is not met, ref. NOROG 064, still the requirement is not specified in NOROG 064 The remote location and with few vessels and installations in the area require more attention to how rescue personnel after a helicopter accident outside the rig safety zone. .	**New performance requirement: *Persons in the sea following helicopter ditch outside the safety zone: The helicopter passengers and crew shall be picked up from sea as soon as possible but at latest within 4 hrs *.*** (Survival suits certified according to NS-EN ISO 15027 / NOROG 094 for use in Barents Sea are documented to protect against hypothermia for 6 hours). This is an important premise for complying with the time requirement of 4 hours **Technical** • New temporary helicopter base onshore, located to reduce helicopter flight time. • PLB (AIS/121.5 VHF) on survival suits • Additional thermal clothing required ("vams" or similar) and to be defined as mandatory PPE. • Night Vision Goggles (NVG) available for SAR-crew. • AWSAR helicopters must be AWSAR-equipped with the latest safety / localization equipment (e.g. AIS tracking) • AWSAR helicopter to bring along drop kit to release to personnel in sea. • National SAR (Banak and Hammerfest) will be additional resources, Banak SAR will be upgraded from 2019 with increased capacity and reach (however not included in dimensioning). **Operational** • Limit passenger flights transport flights during day light, if possible (facilitates emergency ditch, not relevant for SAR operation). • The AWSAR helicopters to be operational during all passenger flights to meet the 4hrs requirement. PL720	**-Measures proposed for A/B also relevant for PL720** **-Proposed new performance requirement also valid for PL720** • Helicopter base onshore (Hammerfest), located to reduce helicopter flight time. Additional measures available but not dimensioned for: Utilise SAR helicopter at Longyearbyen and Coast Guard's vessels and lynx helicopters *Comment: : Increased probability of fog at PL720 may marginally reduce SAR/AWSAR helicopter availability compared to Barents Sea SE areas A and B* **): The intention is to clarify that the operator has a responsibility for safe transport to and from the offshore installation, both inside and outside the safety zone. The proposed 4 hour criterion is equivalent to the requirement for rescue inside the safety zone, but with an extended time requirement. The requirement reflects implementation of additional mitigating measures proposed from the study. It should be noted that the survival suits to be applied are certified to protect against hypothermia for up to 6 hours in Barents Sea conditions*
Requirement for safe and efficient rescue of man over board (PSA;	• Low water and air temperature reduces time for getting hypothermia. • Rescue/launch of MOB-boat: Hydraulic systems in	**New performance requirement proposed: *In man over board situations, personnel shall be rescued from the sea within 8 minutes after man over board is detected **.***	**-Measures proposed for A/B also relevant for PL720** **-Proposed new performance requirement also valid for PL720** **Recommendation:** Work group to consider proper work

Requirement	Site specific issue to be mitigated to meet requirement	Mitigation measures for area A and B	Measures, comments and recommendations
Activities regulations 41, ref. /14/): Personnel performing work above sea shall be picked up from sea before hypothermia.	outdoor areas in low temperatures. • Icing on MOB-boat and connection hook for lifting boat to vessel/rig. • Visual contact can be challenging in darkness/fog/snow/reduced visibility Low water temperature and reduced visibility is found to require additional measures to ensure that personnel who fall overboard can be rescued safely and efficiently	**Technical** • Personnel tracking system on people working above sea (other system than PLB on survival suits) • Use of protective work suit for work above sea **Operational** • Establish best practice for launching and pick up of MOB boats. Relevant training of SBV MOB crew on site, in realistic conditions. • Training requirements for MOB personnel. Training of MOB personnel on site.	suit for work above sea (also relevant for area A/B). **Recommendation:** Evaluate experience with use of ISPAS (tracking of oil spill) radar and how this can be used for personnel tracking *Comment: Increased probability of fog at PL720 may prove it to be somewhat more difficult to spot/detect persons in the sea. Safe Job Analysis and restrictions for work above sea should ensure that the person in the sea can be detected* **): *Survival in case of a man over board accident strongly depends on how quickly a person can be rescued from the sea. The low water temperature and possible low visibility at location A and B further underlines the need for immediate response in case a person falls over board. The work group considered that the SBV and rig to have a level of preparedness that relatively easy will meet a 24/7 time requirement to rescue a person from the sea within 8 minutes after alert of the accident, and the requirement is therefore not limited to periods where work above sea is ongoing.*
Requirement for SBV to perform emergency response efforts according to defined requirements **(Statoil internal emergency response requirement, WR1156, ref. /6/):**	• Extended use of SBV for Medevac, down manning, lifting with crane transfer basket for personnel, MOB-operations, rescue from sea after helicopter accident.	**Technical** • Equipment onboard SBV to meet additional requirements for Medevac, down manning and rescue after evacuation. **Operational** • On-site training for SBV personnel on rescue operations and down manning, where relevant, and also focus on cooperation with AWSAR-helicopter and rig crew. • Challenging to cover all operations for one single SBV vessel. Evaluate the need for more than one vessel on site.	**Measures proposed for A/B also relevant for PL720.**

Requirement	**Site specific issue to be mitigated to meet requirement**	**Mitigation measures for area A and B**	**Measures, comments and recommendations**
Requirement for hospital and emergency hospital to provide prudent first aid and medical treatment (PSA; Facilities regulations §59-60, ref. /15/) The hospital and emergency hospital shall be equipped such that it can provide prudent first aid and medical treatment.	• Longer response time for AWSAR due to distance from shore, and AWSAR not available due to flight conditions may increase need for sustained medical treatment on rig and in helicopter.	**Technical** • Medical equipment onboard need to reflect possibility for unavailability of the helicopter, or longer time for transport to shore. • Telemedicine (specification for area A and B due to remoteness/flight times to be given by the BaSEC Health and working environment group) **Operational** • Two medics offshore (one additional on the rig), with training for cold climate and remote operations). • Medical doctor, preferably anesthetic doctor onboard AWSAR-helicopter.	**Measures proposed for A/B also relevant for PL720** Medical doctor in helicopter can be replaced with existing specialized SAR nurse in Hammerfest, due to Hammerfest being a permanent SAR base with closeness to UNN, Hammerfest hospital and National SAR. For A/B/PL720: Telemedicine requires an agreement with medical resources onshore (hospitals, telemedicine centers) in addition to the actual technical equipment onboard the rigs.
Requirement to handle defined emergency situations (PSA; Activities regulations, §73, ref. /14/) **NOROG 064 Guideline (ref. /7/): Medical evacuation within 180 minutes**	• Longer response times or helicopter not available or able to land on rig due to flight conditions (reduced visibility). • Helicopter deck unavailable due crash on helideck. Medical evacuation, both due to occupational accidents, acute illnesses and major accidents (i.e. helicopter accident on installation) will have longer response times The performance requirement in the NOROG 064 guideline for Medevac	As for regulation PSA; Facilities regulations §59-60 above, but in addition: **Technical** • New helicopter base onshore, located to reduce helicopter flight time To enable Medevac if helicopter cannot land on rig: due to reduced visibility • Crane transfer basket to be used for transfer of stretchers, Medic and injured persons to SBV in case helicopter cannot land due to fog/weather change. • SBV need to have dedicated landing area for crane transfer basket for personnel. • Higher waves and more wind in the area must be accounted for in SBV design and operations	**Measures proposed for A/B also relevant for PL720** **Recommendation**: Agree with BaSEC Health and Working-environment group on how to specify required medical treatment onboard the rig and plans for medevac, to give optimum solution for saving lives. The 180 minutes medevac requirement cannot be achieved, although a SAR-helicopter shall be available 24H with specialized SAR-nurse. **Additional measures available at PL720, but not dimensioned for:** • Utilise helicopter resources from Coast Guard, Longyearbyen and Goliat • Use Longyearbyen as alternative medevac • SBV to drop off personnel at Goliat *Comment: Less favorable visibility conditions may in PL720*

Requirement	Site specific issue to be mitigated to meet requirement	Mitigation measures for area A and B	Measures, comments and recommendations
	to hospital within 180 minutes: A&B: Requirement not met PL720 (example): If AWSAR base in Banak with hospital facilities in Hammerfest/ Tromsø/ Longyearbyen, the requirement is exceeded with 1-2 hours	**Operational** • First aid resources at SBV vessel need to be adapted to its importance in the rescue strategy (strengthened with one Medic from the rig or medic stationed on SBV). • Training of SBV personnel, and cooperation with SBV and Rig. • Training of rig crew (crane operator, deck crew, and medic) in use of crane transfer basket for personnel. • Weather limitations for use of crane transfer basket for personnel (wind, wave, visibility) must be established. • Basket must be certified for personnel transfer	*compared to A&B may cause more often landing problems* *Comment: More wind and waves and reduced visibility in PL720 compared to A&B may increase unavailability of use of transfer basket*
Requirement to monitor safety zone and outside zone for threats (PSA; Management regulations, §57, ref. /16/):	• The potential for approaching sea ice and ice bergs require additional measures for monitoring the area around the rig, and to define appropriate response actions.	**Technical** • Ice detection and monitoring system. Required resources defined based on specification from ice risk management plan. Evaluate use of measures on rig, SBV and use of fixed wing/helicopters for detection and monitoring. It is recommended to use local competence on forecasting services. • Awaiting results from CIRFA project on ice surveillance methods. **Operational** • Establish ice risk management plan, detection and monitoring, identify hazards and establish response procedures. • Sea ice and ice berg competence available	**Measures proposed for A/B also relevant for PL720** *Comment: Same measures even if PL720 will experience lower probability of ice/icebergs* **Recommendation:** Consider use of ATON ("artificial reef") to reduce possibility of ship collisions.

Requirement	Site specific issue to be mitigated to meet requirement	Mitigation measures for area A and B	Measures, comments and recommendations
Requirement to ensure safety of MOB personnel before initiating rescue operation (IMO SOLAS, Chapter 3, §17.1 – ref. /17/) **Requirement to not expose personnel to unnecessary danger during rescue and combat (Statoil internal requirement WR1156, , ref. /6/):**	• Rescue personnel will be exposed to harsh conditions during rescue and combat operation outdoor and combat and rescue operations may require extended periods of outdoor work.	**Technical** • PPE/Clothing for low temperatures for emergency response organization, in particular MOB crews. **Operational** • Additional MOB-crews mobilized if operations are extended. • Robust team sizes and considering need for additional crews/crew change. • On-site training in cold climate emergency operations	**Measures proposed for A/B also relevant for PL720** *Comment: Same measures even if the WCI for PL720 may prove to be lower* **Comment:** FRDC gives better protection, but conventional MOB boat may be more efficient for swift rescue operation. Phase 2I of BaSEC SSEPA will evaluate best practice, and discuss crew size.
Requirement to pick up entire helicopter crew within 120 minutes for helicopter accident within rig safety zone (NOROG 064 Guideline, ref. /7/): The NOROG 064 guideline puts a requirement to pick up a full helicopter (max 21 persons) from sea in case of a	• The requirement is met with MOB boat or FRDC as recue resources. **<u>A&B:</u>** If MOB boat or FRDC cannot be launched and AWSAR is the main resource this requirement is not met for Area A. The requirement can be achieved with AWSAR for area B with reduced number of people in the helicopter (max 10 persons,). **<u>PL720:</u>** Requirement is met if either 1) SBV launches MOB boat	**Technical** • New helicopter base onshore, located to reduce helicopter flight time • PLB (AIS/121.5 VHF) on survival suits • Additional thermal clothing required ("vams" or similar) and to be defined as mandatory PPE. • Night Vision Goggles (NVG) available for SAR-crew. • AWSAR helicopters must be AWSAR-equipped with the latest safety / localization equipment (e.g. AIS tracking) • AWSAR helicopter to bring along drop kit to release to personnel in sea. • National SAR (Banak and Hammerfest) will be additional resource. Banak to be upgraded from 2019 with increased capacity and reach (however not included in dimensioning). • Winterization of MOB boat; icing on hook and	**Measures proposed for A/B also relevant for PL720** **Comment:** With conventional lifeboats 25% of POB shall be rescued within 120 min. This scenario will be dimensioning, unless a specific risk assessment is done for lifeboat evacuation. **Recommendation:** Consider use of freefall lifeboats for distances from shore where 25% of POB cannot be rescued within 120 minutes (NOROG)

Requirement	Site specific issue to be mitigated to meet requirement	Mitigation measures for area A and B	Measures, comments and recommendations
helicopter ditch <u>inside</u> the rig safety zone. Not mandatory	/ FRDC and assuming 3 min rescue time per person. or 2) AWSAR at Hammerfest with reduced number of people in the helicopter (max 10 persons)	need for "de-icing" if rescue equipment prior to helicopter landing. Cranes, winches and hydraulic equipment forming a part of the rescue system must also be winterized and tested prior to helicopter landings. **Operational** • Area A: No transport helicopter flights if MOB/FRDC cannot be launched. • Area B: Reduce helicopter capacity to 8 passengers if MOB/FRDC cannot be launched • Procedures need to be in place to ensure the standby vessel alerts if wave height increases above requirement, and flights have to be stopped. • Limit passenger flights transport flights during day light, if possible (facilitates rescue after emergency ditch, not relevant for AWSAR operation). • AWSAR-helicopters to be operational during all passenger flights to meet the 120 mins requirement	

9 CONCLUSIONS AND RECOMMENDATIONS

The study has shown that the main differences between PL720 and the South East areas A and B when considering escape, evacuation and rescue in emergency situations arising from accidents related to possible future exploration drilling operations at PL720 are related to metocean and ice conditions, infrastructure and available resources onshore. Even though wind, sea conditions and visibility may prove to be somewhat less favourable in PL720, it may be concluded that the emergency preparedness situation in total is better at PL720 compared to areas A and B. The study has shown that the DSHAs that were identified for areas A and B are the same that could be experienced at PL720. Furthermore, most of the proposed measures identified for A and B are also valid and relevant for operations at PL720.

In the SSEPA for the areas A and B (ref. /1/) a number of actions and recommendations were given which are relevant for PL720 operations as well. However, in this study additional recommendations were identified which are summarized in the table below. It should be noted that some of these recommendations are relevant for areas A and B as well.

Table 9-1 Summary of actions and recommendations

No.	Action / recommendation
1	Define specific requirements to the type of safety equipment to be on board the SBVs. This should be followed up by performing inspections/audits of the equipment with respect to use at the location.
2	Consider benefits for operators to share storage of critical equipment on- or offshore.
3	Increased presence of fog is not considered as a significant difference with respect to helicopter pick-up from sea/lifeboat, but it should be considered to install emergency beacon on the lifeboats to enhance search capability. This should be seen in combination with the personnel AIS transponders on the survival suit. Recommendation: BaSEC work group is to assess the optimum search and tracking system for personnel and lifeboats, in addition to quality and availability of survival suits.
4	Install re-fuelling capacity on Goliat to reduce flight times and increase operational time at the location.
5	Assess and evaluate whether Bear Island and Goliat may be used as evacuation hubs.
6	BaSEC work group is to consider proper work suit for work above sea
7	Evaluate experience with use of ISPAS (tracking of oil spill) radar and how this can be used for personnel tracking
8	Agree with BaSEC Health and Working-environment group on how to specify required medical treatment onboard the rig and plans for medevac, to give optimum solution for saving lives. The 180 minutes medevac requirement cannot be achieved, although a SAR-helicopter shall be available 24H with specialized SAR-nurse.
9	Consider use of ATON ("artificial reef") to reduce possibility of ship collisions.
10	It should be checked whether there are formal restrictions on the use of Bear Island for emergency response purposes. It is recommended that the station should be visited wrt

No.	Action / recommendation
	possible use for future emergency evacuation purposes
11	Fishing vessels may be used to escort life boats to safe haven. Fishing vessels will have a duty to rescue evacuees from sea. Formal agreements exist with NOFO to mobilize tugs offshore within 24 hrs to support for oil spill response. Hence, it should be investigated if this agreement could be extended to support for other scenarios, such as escorting life boats to safe haven

10 REFERENCES

/1/ SSEPA Barents Sea (23 R - South East). DNV GL report no. 2015-0606, Rev. 1 (Final). 03. December 2015

/2/ DNV GL, Transocean Spitsbergen Emergency preparedness analysis, Report No: 2015-3051, Rev: 0, Document No: 1GK5UDD-10, March 2015

/3/ Vernebestemmelser Bjørnøya: http://faktaark.naturbase.no/Vern?id=VV00002569

/4/ Lloyd's Register Consulting, Risk analysis of marine operations involving dynamic positioning, 2014

/5/ Statoil ASA, Barentsseismikk gir nye perspektiver, news and media, October 2014, Link: http://www.statoil.com/no/NewsAndMedia/News/2014/Pages/02Oct_Barents_seismic.aspx

/6/ Statoil ASA, WR1156 - Beredskap på norsk sokkel, Statoil egenoperert innretning

/7/ Norsk olje og gass, GL064 Anbefalte retningslinjer for etablering av områdeberedskap, 2012

/8/ Norsk olje og gass, GL016 ANBEFALTE RETNINGSLINJER FOR MEDISINSKFAGLIG BEREDSKAP VED AKTIVITETER PÅ NORSK KONTINENTALSOKKEL, rev. 4, 2012

/9/ Norsk olje og gass, GL096 Anbefalte retningslinjer for mann over bord beredskap, 1. Januar 2005

/10/ International Standards, ISO 19906 Petroleum and natural gas industries - Arctic offshore structures, 2010

/11/ GDF Suez, Emergency preparedness Assessment PL607 Byrkje, 7218/8-1, 2013

/12/ Lundin Norway AS, Site Specific Risk and Emergency Preparedness Analysis PL 609, P609-LUN-S-RA-3009, 2015

/13/ Acona/OMV, SITE SPECIFIC EMERGENCY PREPAREDNESS ANALYSIS FOR WISTING MAIN – PL537, 600324, 2014

/14/ PSA, REGULATIONS RELATING TO CONDUCTING PETROLEUM ACTIVITIES (THE ACTIVITIES REGULATIONS)

/15/ PSA, REGULATIONS RELATING TO DESIGN AND OUTFITTING OF FACILITIES, ETC. IN THE PETROLEUM ACTIVITIES (THE FACILITIES REGULATIONS), 16 December 2014

/16/ PSA, REGULATIONS RELATING TO MANAGEMENT AND THE DUTY TO PROVIDE INFORMATION IN THE PETROLEUM ACTIVITIES AND AT CERTAIN ONSHORE FACILITIES (THE MANAGEMENT REGULATIONS), 16 December 2014

/17/ International Convention for the Safety of Life at Sea (SOLAS), Chapter III

/18/ Statoil, Leteboring Hoop – Erfaringer/lessons learned, møte med Petroleumstilsynet 13. august 2014.

/19/ Statoil, Site specific emergency response assessment – Metocean and ice in the Barents Sea East, PowerPoint 26.05.2015

/20/ NOROG - HMS-utfordinger i nordområdene; Arktiske værfenomener – Regiondirektør Helge Tangen, Værvarslinga for Nord-Norge, 24-25. Mars 2014.

/21/ Statoil/Erik Hamremoen, Barents Sea Helicopter Logistics and SAR, BaSEC workshop 28.05.2015

/22/ Gangway access to Offshore Facilities – Walk to Work – Industry Guidance; DNV GL UK 2015

/23/ Forvaltningsplan Bjørnøya: http://www.sysselmannen.no/Documents/Sysselmannen_dok/Trykksaker/Bj%C3%B8rn%C3%B8ya_NR_forvaltningsplan_MsrrQ.pdf

Field Code Changed

APPENDIX A
Defined Situations of Hazard and Accident (DSHA) for 23R South East Area locations A & B – Descriptions and challenges

The content of this appendix is copied from ref. /1/:

The defined situations of hazard and accident (DSHA) used in this assessment were initially based on the situations used for a generic EPA for a semi-submersible drilling rig updated in 2015 (ref. /2/). Based on discussions in workshop 1 the generic DSHA-list was updated to include two site specific DSHAs:

10b: Helicopter accident into the sea “en route”

11b: Sea ice and ice berg threats

Both these DSHAs require performance requirements and emergency response measures that differ from the generic DSHAs for 10a *Helicopter accident* into the sea within safety zone, and 11a *Ship and other objects on collision course*.

#	DSHA name
0	General DSHA
1	Shallow gas blowout
2	Well kick
3	Subsea blowout
4	Topside blowout and uncontrolled releases of hydrocarbons
5	HC release in well test area
6	Toxic gas release
7	Fire in accommodation
8	Fire/explosion in the machinery spaces/fire in utility areas
9	Helicopter accident on installation (at helideck area)
10a	Helicopter accident into the sea within safety zone
10b	Helicopter accident into the sea “en route”
11a	Ship and other objects on collision course
11b	Sea ice and ice berg threats
12	Structural failure
13	Loss of position
14	Loss of stability
*15**	*Loss of control in transit*
16	Evacuation and rescue
17	Occupational accidents/acute illness
18	Man overboard situations
19	Fire/explosion in mud treatment areas
20	Security threats

*): DSHA 15 is not part of scope for this study

An evaluation of each DSHA is described in the following sections.

In the following a summary of the most important preconditions and site specific challenges related to each DSHA are given.

DSHA 0: General site specific challenges

This DSHA is included for identifying all general challenges applicable for all DSHAs. The following table summarizes challenges which are relevant for all DSHAs. The implication of the different challenges has been discussed for each DSHA specifically in following sections.

The Joint Rescue Coordination Centre (JRCC) in Bodø will normally be leading and coordinating the use of rescue resources in an large scale emergency response situation. With respect to communication with the resources at the location A or B they will do this directly via satellite communication, or via a local coordinator (Coast Guard, Orion or Rescue helicopter).

For the purpose of capacity of the satellite communication the limitation of bandwidth in the area is managed by prioritizing the different consumers of the bandwidth according to their criticality. Telemedicine will have priority. Bandwidth (Mbps) applied for operations in the area has been from 4 Mbps which has been experienced to less than what has been practically required, and up to 8-12 Mbps where 8 Mbps has shown to be sufficient, ref. /18/.

Table 10-1 Summary of general site specific challenges

Phase	Remoteness	Metocean (wind, waves, fog, polar lows, icing)	Sea ice Ice bergs	Communication	Other
Alert	• Unstable/limited broadband satellite coverage	• Icing of antennas, radars and outdoor PA speakers • Uncertain weather forecasts • Mustering in outdoor areas • Disturbance in satellite communication	• Insufficient ice surveillance system • Uncertain ice charts	• Limited availability for transfer of video/pictures to/from scene. • Helicopter communication • Technical requirements for antennas • Several parties involved – ensure common situation understanding.	• Lack of common standards, procedures and guide lines • Alert to Russian authorities • Routines for managing safety related information for new challenges (e.g ice risk). • Competence and organization wrt. information transfer. • Process/routines for requiring assistance from Police.
Danger Limitation	• Flight safety • Limited access to resources/aids	• Hypothermia • Winterization of consequence limiting barriers (firewater, gas detectors etc.) • Prolonged outdoor operations in cold climate to handle DSHA	• Availability of vessels for operations in ice(class) • Move off location in time	• Telemedicine ; unclear specifications	• Medical Competence offshore; competence and capacity • Training for response in cold climate • Training personnel for handling hypothermia • Medevac with personnel basket

Phase	Remoteness	Metocean (wind, waves, fog, polar lows, icing)	Sea ice Ice bergs	Communication	Other
Rescue	• Response time external resources (AWSAR helicopter and vessels) • Range/capacity limitations for helicopters • Flight safety • Forward storage of emergency response equipment. • Adapt work operations according to availability of helicopter.	• Response time • Search for missing persons • Pick-up time more critical • MOB rescue in cold climate • Hypothermia • Availability of vessels to operate in icing conditions • Darkness • Personnel transportation device/capsule training on use of FRDC (daughter craft) – qualification of SBV for the "stand by" operation. • Type of rescue equipment • Electrical lights on board rig and SBV • Personnel experience and training	• Availability of vessels for operations in ice (class) • Use of MOB boat in ice covered waters or when ice bergs are present	• Limited communication capabilities; availability for transfer of video/pictures to/from scene.	• Lack of common standards, procedures and guidelines • Capacity on hospitals • Cooperation with Russian authorities • Russian military activity close to the border • Requirement for Medical competence on SBV • Training personnel for transportation with basket • Competence of MOB boat responsible
Evacuation	• Response/capacity for dry evacuation • Rescue from life boats	• Survival in low temperature in lifeboat/raft • Icing of wet evacuation means • Darkness • Personnel basket as emans of evacuation • Mustering location outdoor/indoor according to weather conditions.	• No wet evacuation in sea ice conditions	-	• Lack of common standards, procedures and guide lines • Standby vessel. • 2nd line response; reception of personnel onshore (hotel, media contacts, accommodation). Coordinate resources onshore. Coordinate with public rescue resources.
Normalization	• Response time/availability for external resources	• Delay	• Delay	-	-

DSHA 1: Shallow gas blowout

Shallow gas blowouts occur as a result of hitting a pocket of gas during top hole drilling. Top hole drilling is performed without the use of a marine riser and with a non-return valve in the drill string. As a consequence of this a shallow gas blowout may occur subsea.

The site specific challenges are evaluated to be the same for Area A and Area B for this DSHA. One challenge is that the reservoirs are unknown and not explored earlier, which creates more uncertainty with respect to performance of the drilling operation and well characteristics. The reservoirs in the regions for Area A and Area B are expected to be shallow and have a short pilot section, which gives a limited margin before reservoir is reached and therefore shorter detection and response times in case a gas pocket is hit.

If the rig is moored and a shallow gas blowout occurs an external vessel may not be available in the area to tow the rig away from location (if rig does not have sufficient propulsion to move off location by itself).

It is not expected to be any seasonal variation for Area A and Area B related to shallow gas blowouts.

DSHA 2: Well kick

During drilling, it is possible that the pore pressure is higher than estimated or that the pressure in the well is lower than expected. If the pore pressure is higher than the well pressure, reservoir fluid will flow in. This is lighter than drilling mud, and as it partly fills the annulus, it will reduce the average density there, so that the static pressure at the bottom of the well drops. Then the reservoir fluid will flow in more quickly and the density of the fluid in the annulus will decrease even more. This is called a “kick” and may quickly come out of control. Well release occurs if oil or gas flows from the well from some point were flow was not intended and the flow was stopped by use of the barrier system that is available on the well at the time the incident starts. Loss of well control occurs if one of the well control safety barriers fails.

Well kick can occur due to inadequate geological data, inappropriate drilling practices, equipment failure, failure/loss of DP, mud characteristics, formation pressure.

The site specific challenges are evaluated to be the same for Area A and Area B for this DSHA and are mainly linked to the possibility of hitting hydrates.

Some of the reservoirs in Area A and Area B are expected to be shallow, with a short distance from the reservoir to the well head. This means that less mud will be used, giving shorter response times to detect a situation with loss of well control.

To control well kick additional supplies from shore of mud, chemicals etc. may be required if too much mud is lost in the formation. The remote location will increase the supply delivery times from shore, compared to other locations on the NCS. Additional mud stored on the rig or vessels may compensate for this, in addition to availability on the shore bases closest to the two locations.

It is not expected to be any seasonal variation for Area A and Area B related to well kick.

DSHA 3: Subsea blowout

A blowout is the uncontrolled release of hydrocarbons from a well after all pressure control systems and barriers have failed. For subsea blowouts the hydrocarbons are released to the sea due to failure in the subsea systems. The release of a blowout cannot be controlled by the predefined well barriers. Releases may occur from various locations below the sea level.

Subsea blowout can occur due to inadequate geological data, inappropriate drilling practices, equipment failure, failure/loss of DP, mud characteristics, formation pressure.

Identified challenges related to blowout for Area A and Area B are unknown reservoirs – still this is not "Barents sea specific", and approaching sea ice or ice bergs that require a disconnect and move off. Sea ice or ice bergs may ultimately impact marine riser/drill string causing release of well fluids. There will be no drilling in hydrocarbon zones when the observable ice edge is closer than 50 km from the location. Ice impact on the drill string may be due to a failure in the ice surveillance and ice management system and failure to isolate well and move off in time, since the overall strategy is to shut down operations and move off location if ice is detected within the defined ice risk zones.

Area A has experienced sea ice in 20 of the last 41 years. Since area B is more south, the occurrence of sea ice in that area will hence be somewhat lower. The frequency of having an ice berg ice inside the rig safety zone (500m radius) for area A is about 1 per 500 year, ref. /19/.

Sea ice and small ice bergs may damage the drill string; this includes small pieces of ice which can have high impact load on the drill string in harsh weather. Ice management includes marginal ice zone monitoring by satellite and forecasting provided by an Ice Surveillance Contractor. Further action should be taken to prevent ice from impacting the blowout scenario. This includes to establishing: criteria for when the rig has to move off location; a system for marginal ice zone surveillance and alert; and, criteria for how close to the marginal ice zone the rig may operate.

Closing the BOP will normally be used to regain control of a well kick and stop the blowout. If the BOP fails to close on signal from the rig, it may be closed via other measures e.g. acoustic signal, or "hot stab" function where an ROV uses a hydraulic coupling directly on the BOP to close it. This will require specific equipment available on the rig, in addition to back-up from shore. If the operation cannot be done from the rig itself, additional vessels and equipment will need to be brought from shore. Transport time from shore will be longer than for other locations on the NCS.

If a well kick cannot be controlled by closing the BOP, a subsea blowout may be controlled by e.g. installing a capping stack and/or drilling a relief well, use of kill mud, etc. The remote location will increase the logistical challenges and response time for mobilizing a rig for drilling a relief well. The NORSOK requirement is to start relief well drilling 12 days after the decision is made wrt the operation. In addition to the transport logistics, the relatively shallow water at the location is considered to be a challenge for installing the capping stack. Installing the capping stack may be facilitated with standardized subsea equipment that interfaces with the capping stack. Vessels with specific equipment and capabilities will be required for both these operations, and also potentially for operations during winter season.

Area A and Area B are located in an area of the Barents Sea where there are no other permanent installations and normally few other drilling rigs. Identification of other rigs that will operate in the same area when drilling at Area A and Area B will be a benefit in this context. Rigs mobilized for relief well drilling may need to meet requirements for all year operations in Barents Sea conditions. It may be considered to use two different rigs for relief well drilling; one to start up the drilling and then a fully winterized rig to take over if required due to the seasonal challenges changing along the operation.

The probability for ice impact will be higher during the season when the ice edge moves closer to the two locations, typically from October to April/May.

DSHA 4: Topside blowout

A blowout is the uncontrolled release of hydrocarbons from a well after all barriers have failed. The release of a blowout cannot be controlled by the predefined well barriers. Releases may occur from various locations including on the drill floor, in mud treatment areas and from the mud gas separator.

Topside blowouts can occur due to inadequate geological data, inappropriate drilling practices, equipment failure, failure/loss of DP, mud characteristics, and formation pressure. The consequences are likely to be personnel injuries, release to sea, or fire and/or explosion.

The site specific challenges for this DSHA are similar to the ones already mentioned for DSHA 1, DSHA 2, and DSHA 3. The ignition probability for gas clouds originating from a topside blowout may increase due to more winterization by electrical heating, increasing the amount of potential ignition sources on the rig.

DSHA 5: HC release in well test area

During well testing, hydrocarbons are produced to the rig and although the equipment itself does not contain a large inventory. However, if well isolation fails following a release, the whole reservoir would be available to fuel the event. Leaks may occur from the pipe work, flanges or other equipment as for any section of hydrocarbon containing process equipment.

Site specific challenges for this DSHA are the same for Area A and Area B. During the dark season it can be difficult to visually detect a leak and at the same time it will prove difficult to visually detect whether HC is spilled to the sea. However, there are detectors which will detect a leak and most likely it will be possible for personnel to hear it as well.

Another challenge is that the well test equipment has to be designed to be used in atmospheric icing conditions and low air temperatures, and hence it is required that there are specified cold climate requirements and winterization manuals for well test equipment.

DSHA 6: Toxic gas release

A blowout or well release may contain hydrogen sulphide (H_2S) which is a flammable and extremely toxic gas. On the rig, H_2S is hazardous to workers and may also causes sulphide-stress-corrosion cracking of materials. It is assumed that all the drilling equipment intended to be used in the well is H_2S resistant.

For Area A and Area B, no new toxic gases are expected to be introduced. There is also low probability of H_2S on the fields. Identified site specific challenges are:

- Unknown subsurface/reservoirs (not Barents Sea specific).
- Enclosed rigs cannot ventilate gas as good as open rigs, and the toxic gas will be trapped inside.
- Longer mobilization time for receiving back up H_2S kit from shore.
- Muster personnel outdoor due to H_2S indication in cold climate. It may be possible to muster at the helideck since it is elevated, but indoor mustering in cold climate is preferred. During the

winter months or in low air temperatures it may be challenging to muster personnel outside for longer periods.

DSHA 7: Fire in accommodation

There are especially three areas that are considered to be the most likely source of accommodation fires:

- **Cabin Fire** - Cabins contain combustible material and use of electrical equipment may result in ignition. Site specific challenges for Area A and Area B are increased use of electrical heating in the accommodations due to the cold air temperatures.
- **Galley Fire** - Cooking presents a potential fire hazard and a galley fire could ultimately destroy the galley. Smoke from the fire may spread throughout the accommodation. The probability of such fires to spread is low and hence there is minimal potential for galley fires to develop into major accidents.
- **Laundry Fire** - Drying overalls with residual oil traces present a fire risk, as does accumulation of lint in the dryer exhausts. A laundry fire is unlikely to spread beyond the compartment since the combustible inventory is limited and the construction is fire-rated, however the accommodation could become smoke logged.

It has been identified (ref. DSHA 16 below) that for some rigs there is lower quality of the survival suits stored at the life boat stations than the personal survival suits stored in the cabins. The survival suits stored at the lifeboat stations is designed according to SOLAS while the personal survival suits are adapted to conditions in the Barents Sea and certified according to NS EN ISO 15027. A fire in the accommodation can hence prevent personnel from bringing their personal survival suit from the cabins. It should therefore be considered to also provide survival suits at the lifeboat stations that are adapted to conditions in the Barents Sea.

If a fire occurs in the accommodation module, it has to be decided whether mustering should be at the lifeboat stations or at alternative mustering areas indoors. Alternative indoor mustering is required if accommodation is unavailable for a longer period. The cold climate forces alternative muster areas to be equipped for stay during extended periods for down manning with helicopter or other means.

The effect of the seasonal variations for this DSHA is the same as for DSHA 6 wrt mustering of personnel outdoors. No differences between area A and B are identified.

DSHA 8: Fire/explosion in the machinery spaces/fire in utility areas

Generator room fires may be initiated with a fractured fuel line or any leak from the fuel system getting into contact with a hot surface such as an exhaust manifold. Oily rags left close to or in contact with hot machinery surfaces can also initiate small fires in machinery spaces.

Site specific challenges for Area A and Area B are similar. For both places there will be an increased storage of helifuel and other substances on board the rig which may increase the duration and extent of a fire in the utility areas. Furthermore the high heating demand in low temperatures may increase the possibility for overheating of the boilers at the rig, but this is assessed to have a limited effect.

It is not identified any seasonal variations, or differences between Area A and Area B for this DSHA.

The workgroup commented that external support for firefighting cannot be expected due to the remote locations, implying that the rig's own firefighting personnel will have to be engaged in fire fighting for a longer period and the rig will need to handle the situation with own resources.

DSHA 9: Helicopter accident on installation (at helideck area)

The DSHA covers helicopter accident on the rig during landing or take-off that might lead to fatalities/injuries, damage to structure and assets, fire/explosion on helideck or fire/explosion on the rig. Possible scenarios with respect to helicopter crashes are heavy landing or crash onto the helideck, with potential for a subsequent fire; crash into the control room/bridge due to overshooting the helideck, with potential for impairment of the upper LQ due to the resulting fire; crash onto other areas of the rig.

For operations in Area A and Area B it is may be more flights compared to when drilling on other parts of the NCS, since each flight will have less passengers due to the length of the flights. As an example Statoil/Transocean operated with a maximum of 13 persons in the helicopter for transport to the Hoop area, compared to the full capacity of 21 persons.

A site specific challenge identified for Area A and Area B is that the fire water/foam may freeze when flushed onto the helideck in low temperatures. This should be checked when onsite and compensating measures should be implemented if necessary. Fire water in low temperature can also be a hazard for personnel, causing hypothermia, if they are not rescued to warm areas.

It is required that all floating rigs have helideck netting to prevent helicopter and personnel to slide. The rigs should also consider winterizing access and escaping ways, and removing snow/ice to avoid slips and falls. This is normally part of the winterization manuals for the rigs.

If the helideck is unavailable to due fog/reduced visibility or due to the crashed helicopter, on may need to transfer injured personnel from the dedicated hoisting area on the rig to the SBV by use of basket. The injured personnel can then be hoisted from the SBV to the helicopter.

DSHA 10: Helicopter accident into the sea

This DSHA is normally limited to helicopter accidents into the sea within the rig safety zone. Inside the rig safety zone the rig's 1st line emergency response resources and the SBV will be mobilized to rescue personnel in sea, and provide first aid.

In the NOROG 064 guideline there are no specific requirements for response to helicopter accidents outside the rig safety zone. It has been generally concluded for operations on the NCS that the availability of AWSAR helicopter resources has been sufficient to meet the time requirement for rescue of personnel from sea requirement also for accidents outside the rig safety zone. For the locations A and B considered in this SSEPA this will be different due to the remoteness and longer flight/response times for the AWSAR helicopters.

In this perspective it was decided by the workgroup to split this DSHA into helicopter accidents into the sea inside (10a) and outside (10b) the safety zone.

DSHA 10a: Helicopter accident into the sea within the safety zone

If a helicopter ditches into sea inside the 500 m safety zone of the rig, personnel on board shall perform emergency procedures. The helicopter may capsize and/or sink and personnel being able to escape from the overturned helicopter will be left in the sea. Personnel will be able to survive in their survival suits for some hours, depending on type of survival suit, personal condition and sea temperature.

The challenges for Area A and Area B are identified to be similar, but the response time from shore will be lower for Area B due to the shorter distance. The challenges which were identified are:

- Reduced availability of AWSAR and MOB/FRDC due to bad weather. The AWSAR may be unavailable due to flight conditions, leaving the MOB/FRDC as the only means of rescuing personnel from the sea. If wave height exceeds the operational limit for the MOB/FRDC these cannot be launched, and then AWSAR will be the mean to rescue personnel from sea. Longer flight times reduce the capability for the AWSAR to rescue personnel within the 120 minutes requirement. This will put limitations on number of persons the transport helicopter can have on board when MOB/FRDC cannot be launched. Alternatively one may halt all transport flights if wave height is above limit for launching of MOB/FRDC.
- Difficult to localize personnel in fog/snow/reduced visibility, but helicopter passenger survival suits do have VHF tracking (AIS) and homing capability (121,5 Mhz).
- Low air/sea temperatures will expose the FRDC/MOB crew during the operation to rescue personnel from sea.
- Winterization of MOB boat; icing on hook and need for “de-icing” if rescue equipment prior to helicopter landing. Cranes, winches and hydraulic equipment forming a part of the rescue system must also be winterized and tested prior to helicopter landings.
- This DSHA is affected by seasonal variations in air and sea temperature, and is more challenging during the cold season. Area A is more remote than area B, and hence is more affected with respect to the response time and availability of the AWSAR.
- There are large variations in the training and competence of the SBV crew, and how efficient they respond to emergency situations. It will be needed to state clearly the requirements to the SBV in their emergency response role, and requirements related to training.
- Heavy fog impairs visibility and in particular limits the possibility to take off and land, and is more present during the summer months. Other weather conditions that may cause poor flight conditions are atmospheric icing, polar lows, strong winds and heavy snowfall. All these conditions are more present during the autumn and winter months, typically from October to March/April. Reduced visibility due to lack of daylight varies with season.

DSHA 10b: Helicopter accident into the sea “en route”

If a helicopter ditches into the sea when en route to the rig, personnel on board the helicopter will normally evacuate into the sea or/and into the helicopter rafts. On the NCS it is the responsibility of the national resources to cater for the emergency response and rescue outside the installation’s 500m safety zone. The operators do also have responsibility for safe transport to/from the rig, normally handled by use of the SAR helicopter supporting the rig(s).

The helicopter may capsize and/or sink and personnel being able to escape from the overturned helicopter will be left in the sea. Personnel will be able to survive in their survival suits for some hours, depending on type of survival suit, personal condition and sea temperature. It is assumed that all personnel have survival suits designed and certified for use in Barents Sea conditions.

The helicopter VHF communication with shore/rig will be a limiting factor due to the nature of VHF signals, this with the result that the helicopter will be out of VHF range for part of the flight. This normally for when the rig is outside approximately 150 nm from shore. This is mitigated by use of Iridium satellite phone and tracking. The tracking is done by active monitoring by the helicopter operator. The VHF transmitter/receiver antenna on the rig needs to have an optimum position and the effect of the VHF set needs to be high.

The site specific challenges for 10a are also relevant for 10b. The seasonal variations are as for DSHA 10a.

DSHA 11: Ship and other objects on collision course, including sea ice and ice bergs

This DSHA does traditionally cover both ships and other objects on collision course. Sea ice and ice bergs may also be categorised as “drifting objects”, but since these objects represent hazards with specific measures to prevent and mitigate the DSHA is split into DSHA 11a “Ship and other objects on collision course”, and DSHA 11b “Sea ice and ice berg threats”.

DSHA 11a: Ship and other objects on collision course

Typical collision scenarios are collision with passing vessel (supply vessels, fishing vessel), collision with other rigs/vessels due to power blackout, positioning failure or collision with other drifting object.

The maritime surveillance is reduced compared to the North Sea, and will be more reliant on the radar mounted on the SBV or the rig to detect ships or objects on collision course. As an example, Statoil Maritime Control Central will in the North Sea in many cases give pre-warning to installations about vessels on possible collision course 60 minutes prior to estimated time of collision. This is different from the fact that most rigs use the NOROG 064 Guideline related to detection of vessel on collision course within 50 minutes prior to a possible collision. This may give reduce the time available to establish correct response, in particular since there will be less time available to decide whether a vessel is on collision course or not.

Offshore activities and exploration drilling is a new activity in this part of the Barents Sea, and the importance of the 500m safety zone around the rig may not be clearly understood, and lead to vessels operating closer to the installation than what is normal practice. An important action to avoid ship collisions is to establish contact and communication with approaching vessels. However, language problems may reduce the quality of such communication. In the workshop is was commented that the AIS coverage was reduced for some areas of the Barents Sea, and this may lead to more difficulties in identifying which ship is approaching, and to establish necessary communication.

The majority of the ship traffic in Area A and B is fishing activity with e.g. large trawlers. Figure provides a plot of fishing vessel activity in August 2012, based on available AIS data. Area A and B have experienced crossings of oil tankers going the Northern Sea Route north of Novaja Semlja, and this is a seasonal a activity reflecting when the NSR may be open for passage, ref. Figure. The tanker traffic may increase in the future, however this is uncertain. In additions some special vessels (ice breakers, seismic vessels, research vessels) that follow the border towards Russian economic zone, close to area C and D.

The ship traffic is generally much lower in this area than in the North Sea. The majority of the ship activity in the area is fishing vessels. These vessels are more challenging to detect early with radar compared to e.g. larger tankers. The fishing vessels in the area are mostly of the size 1000 - 5000 GT according to AIS data for 2012.

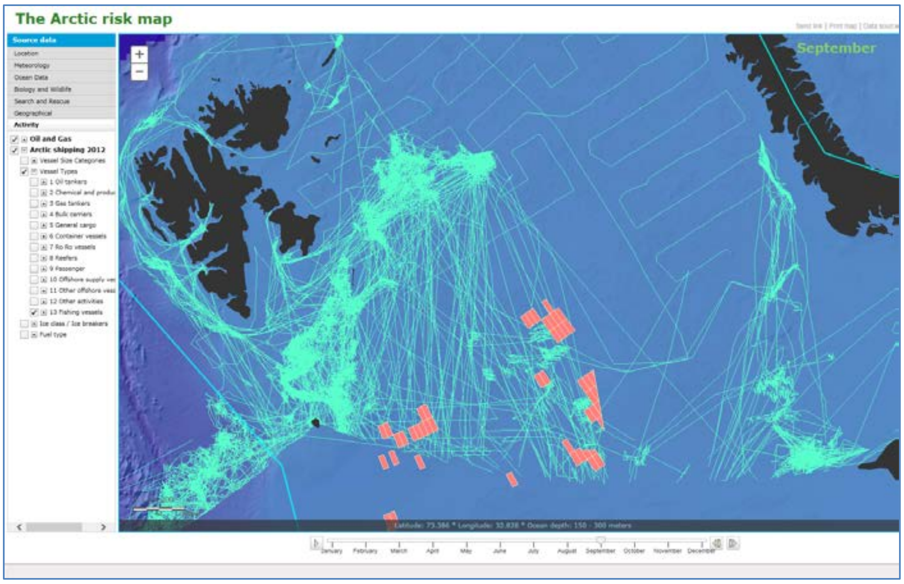


Figure: AIS data showing fishing vessels for September 2012 from DNV GL's Arctic Risk Map.

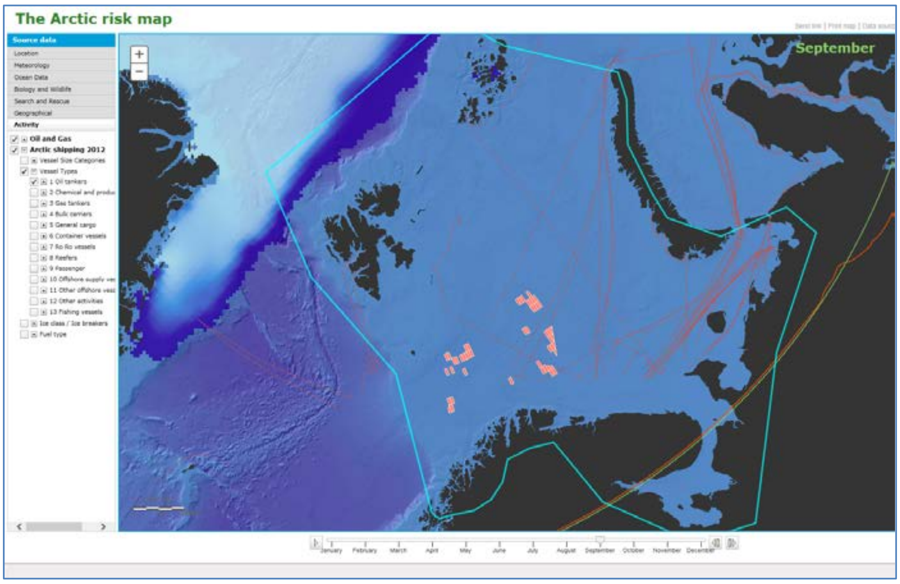


Figure: AIS data for Oil tankers, September 2012 from DNV GL's Arctic Risk Map.

The vessel traffic is, in general, lower in the South-eastern Barents Sea compared to the other areas on the NCS. In addition, the border to Russia is close, especially for Area B. It was discussed during the workshop that there can be a blind zone on the Russian side of the border which may pose difficulties to having control over the ship traffic in the area.

BaSEC members with experiences from operations in the Barents Sea say that some of the drilling rigs have used large standby vessels and supply vessels. If collision occurs between the rig and one of these vessels, the design loads on the rig might be exceeded.

DSHA 11b: Sea ice and ice berg threats

For locations A and B sea ice or icebergs will represent site specific collision scenarios, with a higher probability for this in area A than for area B.

The major challenge being identified for Area A is sea ice or ice bergs with the potential to cause collisons The annual probability of an ice berg being within a 500 m radius from a random point in the area is estimated to 1 per 500 years, and sea ice has been present in 20 of the last 41 years. The last year sea ice was observed in area A was in 2003/2004, ref. /19/.

Figure and Figure shows the average extension of the sea ice (> 10% sea ice concentration) on April and September 2011, respectively.

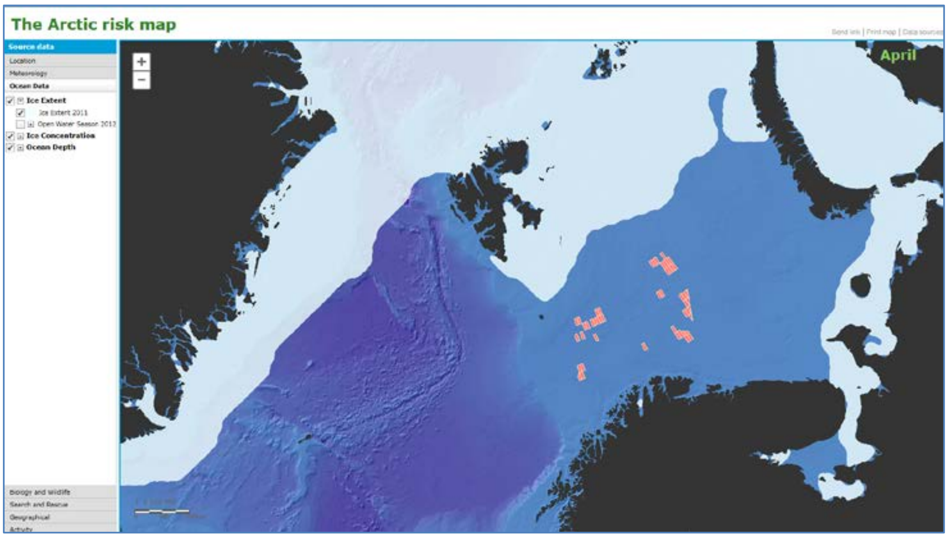


Figure: Example – average extension of sea ice (> 10% ice concentration) in April 2011, from DNV GL's Arctic Risk Map.

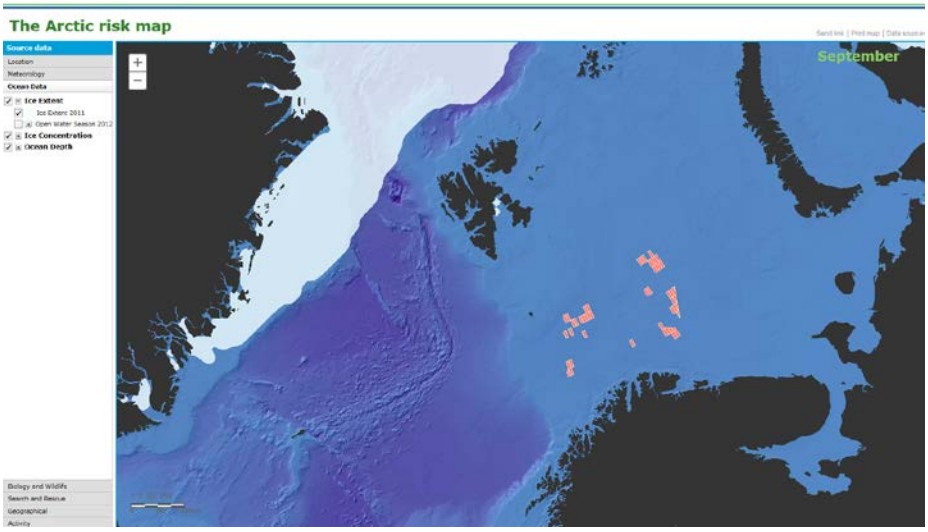


Figure: Example – average extension of sea ice (> 10% ice concentration) in September 2011, from DNV GL's Arctic Risk Map.

The main principle to handle ice threats is to implement an ice surveillance and detection system, and ultimately move the rig off location if sea ice/ice bergs is present within a defined radius. The actions on board in response to different ice threats need to be determined by an ice risk assessment. The SBV, or other dedicated vessel(s), may be used to manage approaching sea ice/ice berg to reduce the probability of collision. Collisions with sea ice/ice bergs are a result of ice objects not being detected, failure of ice management operations or failure of the rig to move off location. In particular small icebergs (growlers, bergy bits) will be difficult to detect on radar and with satellite, and can therefore go undetected until impact with the rig. The probability of presence of ice bergs is high when the sea ice is approaching as it drifts along with the sea ice, but ice bergs may also appear independent of the drifting sea ice.

It is assumed that the rigs applied for operations in the area are not designed for operations in sea ice conditions, and will therefore move off location if sea ice or ice bergs are approaching. Dynamically positioned rigs will have a benefit compared to anchor moored rigs in this sense, as the anchor moored rigs will have limited ability to move off location (typically 100 m) without emergency disconnect of anchors. In addition the current life boats are not designed to be used in sea ice conditions, which also require the rig to avoid sea ice conditions.

If the drilling rig decides to disconnect from the well due to sea ice is approaching, the well may need to be abandoned for several weeks if the ice remains in the area. The well needs to be left in a *safe condition for this prolonged period,* meaning that no reservoir fluids or drilling mud shall be released after it is abandoned.

Operational experience from East Coast of Canada demonstrates that insufficient ice surveillance system has led to undetected relatively large icebergs in close proximity to a drilling rig, triggering shutdown and disconnection (July 2015).

DSHA 12: Structural failure

Structural failure is defined as the loss of ability of the rig's primary structure to carry the imposed design loads and/or extreme environmental loads. Two incidents of semi-submersible capsize due to structural failure have occurred: the *Transocean 3* in 1974 and the *Alexander Kielland* in 1980.

Possible causes of structural failure include:

- Corrosion
- Fatigue
- Construction/ design errors
- Improper loading or placement
- Ship collision
- Ice bergs and ice loads
- Rough weather
- Unsecured anchors on bolster

The site specific challenges for Area A and Area B discussed for DSHAs 11a and 11b are considered to be relevant also for DSHA 12.

In addition, extremely low temperatures may cause brittle failure of materials, but this may be mitigated by operational measures e.g. to move away of the area in this situation. The 100 year minimum temperature in Area A is about -34^{o}C (ref. /19/).

When carrying out e.g. lifting operations, unexpected change in weather conditions (polar lows, wind, wave, visibility) it will not be sufficient time to secure crane and load which may lead to swinging/falling load accidents. In the workshop it was considered that such incidents will be avoided by following normal operational measures for securing crane and load. However it was stated that clear limitations on allowable activities has be established with respect to foreseeable changes in weather conditions. About 13 polar lows can be expected for the entire Norwegian part of the Barents Sea, per winter, ref. /20/.

DSHA 13: Loss of position

Loss of position implies that the rig deviates from the specified location when the red limit is crossed; this limit is specified with an exact angle.

DP operated rig

Loss of position on DP is in this analysis defined as critical loss of position, where recovery of position by DP operator has not been achieved, i.e. the red limit has been passed.

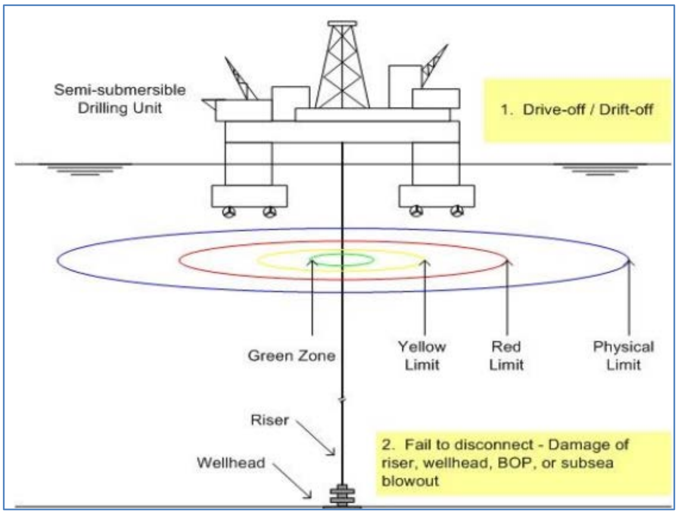


Figure: DP drilling operation, limits are not to scale, ref. /4/

Large excursions imply that the rig deviates from the specified location more than what is operationally tolerable. Possible failure modes are leading to loss of position are:

- Drive-off (abnormal thrusters force driving the vessel away from the target)
- Drift-off (insufficient thrusters force resulting in a drifting vessel
- Force-off (loss of position scenario due to extreme environmental forces). This is especially relevant for operations in new areas.

Moored rig

For moored rigs breakage of anchor lines can occur. If two or more anchors break, the result may be that the rig loses its position. Generally, mooring failures on a semi-submersible is not necessarily considered as a major hazard, unless disconnection from well fails and causes a blowout or collision with an adjacent structure or vessel is possible. Although considered possible, no collision events have occurred in the North Sea as the result of mooring line failure on semi-submersibles.

The site specific challenges identified for both DP operated and moored rigs are the same for Area A and Area B. The identified challenges are the following:

- Satellite to DP system not available/unstable, this can be due to reduced satellite coverage and that antennas are placed in a temporary shadow on the rig.
- GPS satellite coverage in high latitudes - GPS satellites have an inclination of 55 degrees, Russian GLONAS has slightly higher inclination, and European Galileo is planned to include polar orbiting satellites (not operational yet). The challenge with an orbital inclination of 55 degrees is that the coverage gets more limited the further north one goes. Even in Kristiansand (58 degrees north) one has only GPS satellites in the south / southeast / southwest, giving limited triangulation / geometry and thus gradually poorer precision the further north you are.
  The fact that the satellites gradually come lower on the horizon will also mean that the signal

must pass through thicker layers of ionosphere can disrupt the electromagnetic signal. It is not certain how much this affects the precision. Experience from drilling campaigns at similar latitudes in the Barents Sea, this is not considered as a challenge

- Icing on GPS position transponders, impairing position indication/instruments/systems.

For DP rigs, rapid worsening of weather conditions may cause the DP system to misinterpret/override indications and DPO needs some time to understand and respond to the situation. DP system will need to be to be tuned to local patterns of changes in weather, and settings and logics are to be reflected in DPO training.

Examples of possible causes of anchor line breakages on moored rigs are:

- Wrong weather forecasts
    - less certain at high latitudes
    - unexpected high motions (role, heave) on the rig
- Ice berg impact on anchor chains (only relevant for Area A)
- Brittle fractions in anchor chains in extreme low temperatures

Normally, during the summer months icing will not occur and neither will sea ice or icebergs appear, but the other challenges mentioned will not be influenced by the seasons.

In April 2015 offshore East Coast of Canada, a rig had to make a rapid shutdown and disconnection due to big heave motions. The magnitude of the waves had not been forecasted and hence not being prepared for.

DSHA 14: Loss of stability

The most frequent accidental events that could lead to loss of stability are collisions, fire/explosions and extreme weather. Wrong weight distribution causing a larger angle of heel may also, conservatively, lead to impairment of the supporting structure. A stability failure may occur due to one or a combination of the following events:

- Ballast system failure (Due to human error or malfunction of equipment, ballast water can flow uncontrolled between tanks and/ or from sea to tank)
- Sea water leak in double bottom
- Collision - covered by DSHA 11
- Load displacement
- Structural failure - covered by DSHA 12
- Fluid/bulk operation failure
- Blowouts (subsea, topside or shallow gas) – covered by DSHA 1, DSHA 3, DSHA 4

Site specific challenges for Area A and Area B, are:

- Freezing of ballast system. Some rigs have heating in the ballast systems, while others have the ballast system below the water line and hence will never reach sub-zero air temperatures. For rigs having the ballast systems above the water line it should be ensured that it is winterized with heat tracing.
- Fire water/deluge in freezing conditions. The foam contains water and therefore deluge may freeze at low temperatures when flushed onto the rig. Heat from a fire will most likely prevent the deluge from freezing, but it may still be a problem if it is used for other purposes. Technical data for foam should therefore be checked and measures implemented if necessary to prevent foam from freezing.
- Heavy marine icing and snow. Checking the need for removal of ice and snow should be included in the daily checklists for the area responsible and more specifically, ice which could pose a threat as dropped object should be included in these checklists.
- Unexpected change in weather – deck loads that are not secured may be displaced and thereby causing the centre of gravity of the rig to change. In addition, deck loads may be larger than normal due to longer supply routes (logistics).
- Collision with iceberg or sea ice (more relevant for Area A than B).
- SBVs operating during the periods with marine icing, typically October to April, will need to have de-ice capabilities.

DSHA 15: Loss of control in transit

Loss of control in transit includes all the situations that can occur during the transit to the drilling location. These situations may for instance be loss of stability, loss of desired transport direction (machinery failure) or towline failures.

These events are not part of the scope for this analysis and are therefore not discussed any further.

DSHA 16: Evacuation and rescue

Evacuation is listed as a separate DSHA in this analysis since this is relevant for most of the other specific DSHAs. In addition, this DSHA is introduced due to specific challenges and potential hazardous events being imposed by evacuation of the rig. The main means of evacuation are:

- Helicopter (dry evacuation)
- Lifeboats (wet evacuation)
- Escape chute / life rafts (wet evacuation)
- Directly to sea (wet evacuation)

Dry evacuation with helicopter is the primary means of evacuation. If the situation makes it impossible for the helicopter to land (dry evacuation), or the time required for helicopter evacuation is not sufficient, wet evacuation will be considered.

Site specific challenges (using lifeboats and/or rafts) for Area A and B, are:

Dry evacuation and down manning/precautionary evacuation

- Evacuation using helicopter is challenging due to the long distances to/from shore implying long flight and sailing times, which in turn reduces the rescue capacity within given timelines specified in existing NOROG 064 guideline. Distances from shore exceeding 300 nm is considered to be outside the limit with the flight/helicopter technology that is available today. This implies that new a new SAR base closer to location A and B has to be established, to ensure shortest possible flight distance. It should also be considered to start helicopter evacuation earlier than usual or to fly personnel to other installations in the area if such are present.
- Availability of helicopter to land on the rig may be reduced due to reduced visibility due to fog (summer), polar lows and heavy snowfall (autumn/winter). Heavy atmospheric icing or freezing conditions can also be a challenge. Strong winds will be a similar challenge as for other parts of the NCS.
- There is little/no infrastructure in the area. Neither no binding agreements on co-operation with other rigs in the area exists. Hence, the total availability of evacuation infrastructure is less compared to other parts of the NCS.
- Rescue operations on location A and B will be time consuming. Manning the helicopter base with two crews per helicopter, enables the helicopters to be operational for longer periods with less limitation on required rest for the crew members. The extra helicopter crew will be stationed onshore, thus crew changes will take place there.

Crane transfer basket/capsule for personnel to SBV may be used as an alternative to dry evacuation with helicopter. It must be ensured that sufficient training in use of this solution is given, and that this training is initiated as early as possible.

In emergency situations the SBV can give shelter for all personnel on board the rig. Reduced visibility due to heavy snow or fog may complicate transfer with basket to SBV. Bridge connection from the SBV to the rig may be a solution, but this requires specially designed SBVs, and modifications on the rig (bridge landing area, POB control systems linked to the bridge etc.). Such solutions should be further evaluated for use in the Barents Sea. A recent JIP on Walk to Work has developed industry guidance to assist offshore facility operators in achieving safe and efficient personnel transport to/from their facilities via a gangway system on a floating structure, ref. /22/.

If available, the Sea King at Banak may be scrambled by the Joint Rescue Coordination Centre. However this and other national resources need to be included as available resources, but not as basis for the

The reduced availability of the AWSAR helicopters will make the overall evacuation and rescue concept more dependent on the resources present on the field; SBV, basket and means for wet evacuation. This has to be reflected in the overall dimensioning and training of the emergency response organization, including each individual crew member on board the rig.

Wet evacuation

For wet evacuation the following site specific challenges are identified:

1) Icing: Icing on launch equipment and lifeboats/chutes/rafts prior to launching. It is assumed that the lifeboats, life rafts and MOB boats with launching arrangements are kept free from ice and snow, making this equipment fully accessible and operable independent of weather conditions.

2) Visibility of drop zone: Snow and fog may be a challenge with regard to clearing the drop zone before dropping life boats.

3) Sea ice: No means of wet evacuation are approved for operation in sea ice conditions. The rig has to move off location if sea ice enters the area since evacuation in sea ice conditions is not relevant.

4) Rescue from the sea: Water temperature is not expected to change the requirement of rescuing 5-25% POB within 120 min, as the survival suits being certified for cold climate according to NS EN ISO 15027 have sufficient insulating capacity, ref. NOROG 064 Guideline. It is assumed that personnel are wearing survival suits. It is however recommended that minimum 50% (70) survival suits are of the type certified for use in cold climate (Sea Air Barents), not only those stored in the LQ cabins and lifeboat stations of “non-cold climate” type. Furthermore, the lifeboat stability due to icing after launching is challenging. The potential of marine icing on lifeboats and whether this may impact the stability of the lifeboats needs to be investigated further. It is discussed whether sea water washing over the lifeboats will avoid icing or not.

5) Rescue of personnel from lifeboats. Personnel are normally considered safe when successfully evacuated with lifeboats. However, for location A and B the long distance to shore in combination with no other infrastructure offshore will require special attention to rescuing personnel from the lifeboats to a safe location. Icing on hull, hatches and other external equipment of lifeboats will build up over time. Safe and efficient transfer from lifeboats to a safe location, such as an SBV, will be an important risk reducing measure for the evacuation concept.

   Personnel may be brought to a safe location in three ways:

   a. Transfer to supply vessel directly from lifeboat

   b. Towing to shore

   c. Hoisting to AWSAR, and transfer to stand by vessel or transfer to shore.

There are weather limitations for using MOB boats, FRDC and AWSAR. Weather conditions may reduce the availability of these resources for rescuing personnel from lifeboats. Due to distance to shore and sea conditions, towing to shore is not preferred. It should be considered to use an SBV suited for picking up lifeboats from the sea enabling recovery of personnel faster and more efficiently from the lifeboats. For personnel ending up in the sea after an evacuation, hypothermia was identified as the main challenge. Hypothermia can occur due to late rescue of personnel if helicopter and MOB/FRDC is unavailable. Calculations show that the requirement (ref. NOROG 064 Guideline) for rescue from the sea is not met with use of AWSAR in case of wet evacuation for Area A, while for Area B with limitations on the number of passengers on board the helicopter the NOROG 064 Guideline requirement will be met. It should therefore be considered to always have an SBV with FRDC on board to be able to rescue personnel in harsh weather conditions. Further, the personal survival suits available in the LQ have been modified to suit conditions in the Barents Sea, but the survival suits at the lifeboat stations are as mentioned only regular ship suits as specified in SOLAS. It should therefore be included in procedures that personnel always bring their survival suit from the cabin if possible during an evacuation. Furthermore it should be considered to provide minimum 50% (70) survival suits adapted to the Barents Sea also at the lifeboat stations.

The environmental conditions in Area A and Area B during the winter months have high impact on the evacuation and rescue of personnel. Many of the above mentioned challenges, e.g. sea ice, icing, etc., will initially not be relevant during the summer months. Even though the summer months are usually milder, an evacuation and rescue situation may prove critical due to remoteness. Note that there may be annual variations with milder winters and cold/snow may be experienced during the summer.

DSHA 17: Occupational accidents/acute illness

This DSHA includes occupational accidents (accidents with no potential to cause fatalities outside the immediate area of the incident) and acute illnesses (food and potable water contamination and events independent of work and rig conditions, e.g. heart attack, cardiac arrest, and stroke). Occupational accidents or acute illnesses related to operations in Area A and area B, may be caused by:

- Falling ice from heights (challenging to remove ice on structures and equipment)
- Ice causing slippery surfaces/gangways/stairs/ladders
- Ice accumulation on containers lifted from supply vessel (ice falls off)
- Hypothermia
- Cold/frost bite/freezing of extremities
- Low temperatures / darkness having impact on personnel both physically and psychologically

The following specific challenges for Area A and B were identified in the workshop:

- AWSAR not available for landing on the rig due to difficult/unacceptable flight conditions (e.g. reduced visibility, strong and unfavourable winds, etc.)
- Longer transport times to hospital. Due to the distance to e.g. Hammerfest, Tromsø or Kirkenes, the time for transportation to hospital may be longer than elsewhere in Norway, and exceeding the 180 minutes' guideline of bringing personnel to hospital. To compensate for this it is important to facilitate the use of telemedicine on the rig/hospital as early as possible and to utilise all new/modern medical technology in training. Further, it must be ensured that there is competence offshore to conduct treatment initiated through telemedicine and that training includes connecting to doctor on duty when solutions for telemedicine are used. The registered nurses need to be certified/re-certified wrt competence and experience within anaesthesia and sufficient acute and pre-hospital training. Adequate training should be given both to the first aiders and the registered nurses. It can also be considered to have more defined health requirements for personnel working at the most remote locations, to reduce the possibility for acute illnesses.
- Longer time to evacuate personnel in case of epidemics. Need to have plans for how to treat and isolate personnel with epidemics offshore
- Risk for not being able to pick up patients with helicopter at the rig due to flight conditions, in particular reduced visibility.

Operations and work tasks on the rig with an increased risk potential should be avoided if the AWSAR helicopter is available during the planned work period to perform medevac.

In the summer months the temperatures are normally higher and with less rough weather, and hence the risk for occupational accidents and acute illnesses is lower than during the winter months. However, it should be noted that there may be annual variations with milder winters and cold/snow during the summer.

DSHA 18: Man overboard situations

This DSHA covers primarily incidents where personnel working over the sea accidentally fall into the sea. Other personnel may fall into the sea caused by external influence such as wind and missing/damaged structure (e.g. missing grating or railings).

The site specific challenges are already covered by DSHA 10a *Helicopter accident into the sea within the safety zone* above.

DSHA 19: Fire / explosion in mud treatment areas

When drilling mud sometimes carries combustible gas from the well and up onto the rig. This may lead to the formation of an ignitable cloud if not ventilated sufficiently. In other situations oil based mud is used when drilling and vapour from the mud may be formed leading to ignitable gas clouds if not ventilated. Overheating of rotating equipment and/or hot work in areas with oil based mud may also cause a fire or an explosion.

Other possible scenarios for this DSHA are

- Flammable gas can be released from the shale shakers,
- Fire/explosion in the mud pit area due to build-up of gaseous atmosphere in the mud tank when oil is present in the mud;
- Fire/explosion on the drill floor due to release from mud return system and/or hazardous drains.

The site specific challenges are covered by DSHA 8 *Fire/explosion in the machinery spaces/fire in utility areas* above.

DSHA 20: Security threats

Security threats are situations with unauthorized access to rig or safety zone, or interference with the operations. This may be threats and criminal acts against the installation and operations. Further, security risk may also be an issue at supply/helicopter bases such as airports and ports onshore. Plans have to be implemented, and personnel have to be trained to handle such situations. Finally, there should be requirements to harbour and heliport operators to establish proper security measures.

The major site specific challenge related to security is the increased focus from NGOs (non-governmental organizations). These groups usually put great focus on oil and gas activity in the Barents Sea. Plans should be prepared and people trained to handle such situations. It will be required to clarify the juridical status of the safety zone prior to start-up of operations, in addition to procedure for how to engage police authority on the rig.

Exploration drilling in location A and B will represent a new activity in an area close to the maritime separation line towards the Russian economic zone, and may attract interest from parties that not have direct relations to the exploration activity.

Experience from the Statoil Hoop/Apollo/Atlantis campaign, Shells campaign in the Chuckchi Sea and towards seismic vessels heading towards the northeast Greenland demonstrates that it should be expected high attention and possible interference from NGOs for the future exploration drilling activities in the area.

About DNV GL

Driven by our purpose of safeguarding life, property and the environment, DNV GL enables organizations to advance the safety and sustainability of their business. We provide classification and technical assurance along with software and independent expert advisory services to the maritime, oil and gas, and energy industries. We also provide certification services to customers across a wide range of industries. Operating in more than 100 countries, our 16,000 professionals are dedicated to helping our customers make the world safer, smarter and greener.