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1 Summary

The drilling operation is planned to start 1st July 2007 for well 15/12-18S/18A. The well is located in the Varg area, approx. 240 km from the Norwegian coast. Around 110 wells have been drilled within 50 km from the drilling location in the period 1967-2007 /19/.

As basis for planning and management of the drilling operation, identifying and implementing risk reducing measures, including oil spill contingency systems, an environmental risk analysis has been carried out. The analysis includes all relevant spill incidents and planned operational discharges. The frequency and magnitude of acute spills of crude oil, diesel, hydraulic oil and water based drilling mud has been addressed based on statistics from the oil industry and also internal records from the rig owner. Planned operational discharges have been described based on the information presented in the Discharge Permit Application /3/.

The environmental impact has been analysed using 16 parameters to describe the outcome and extent of pollution and operational discharge. These parameters include what is considered the most important environmental aspects of the spill and discharge scenarios. A classification matrix with categories from 0 to 5 has been defined as basis for the impact classification (see Table 11).

The environmental risk is expressed as a risk index which is calculated on basis of both the frequency of occurrence and the environmental impact value. The drill cuttings and jacking grease are ranked as the highest risk scenario for the drilling operation, mainly because this scenarios has higher frequencies. The spill scenarios have almost the same risk.

Major oil spills represent a risk for potential large environmental impacts, but the risk associated with such events is considered very low, and within the risk acceptance criteria of the company. In general, the environmental risk level associated with the drilling operation is considered quite low compared to other operations closer to the coast or environmentally sensitive areas. Based on the results from the risk analysis, different types of risk reducing measures has been described that will be further considered and implemented during the detailed planning phase and during the HSE management of the operation.

An oil spill contingency analysis has also been carried out to identify necessary contingency systems that must be implemented and trained before the start-up of the operation. The dimensioning oil blowout rate has been defined to 6764 Sm³/day, which has been assessed to correspond to an emulsion rate available for cleanup of 18980 m³/day. The total uptake efficiency in the period July-September is calculated to 56 %.

Based on the capacity of NOFO systems of typically 2400 Sm³/day, a blowout requires 8 NOFO systems. There may be a need for using Hi-Wax skimmers, so such skimmers should be required together with the traditional Transrec skimmer. Fastest oil drift time to the Norwegian coast is 8 days (192 hours) /22/, but response time requirements have been set equal to the requirements that presently are implemented in the NOFO Master Plan, which are 18 – 24 – 36 – 36 – 36 – 60 hours for the first 6 systems. The requirement for the two last systems is set to 80 hours.

All systems can be mobilised within response time requirements from the NOFO depots in Stavanger, Mongstad, Kristiansund and Træna. Complete NOFO systems with both traditional Transrec skimmers and Hi-Wax skimmers can also be mobilised from the regional contingency arrangements in the Jotun/Balder area.

Systems for combat actions in the coastal zone will be mobilised from NOFO, The Norwegian Coastal Administration/Coast Guard and IUA. OSRL in England may also be a source for oil contingency equipment and personnel. Totally two coastal systems are required within the

response time requirement of 8 days, but the availability of combat systems and personnel is considerably higher than this.

The response time requirements for combat and cleanup systems in environmental sensitive areas and in the tidal zone, and are set to 18 days /20/. These requirements are related to contingency area 2 (Sleipner/Varg) and are considered to be adequate for well 15/12-18S/18A.

An oil spill contingency plan that specifies requirements for notification, mobilisation, combating and normalisation will be developed /5/. The plan describes the oil spill contingency organisation, and the link to the Pertra overall emergency preparedness plan and the NOFO Master Plan.

2 Basic information

2.1 Introduction

Well 15/12-18S/18A is located approx. 5 km east from the British sector, 15 km northwest of the Varg field and 20km south of Sleipner (Figure 1). The water depth is 93 m, and the sea bottom consists mainly of fine sand.

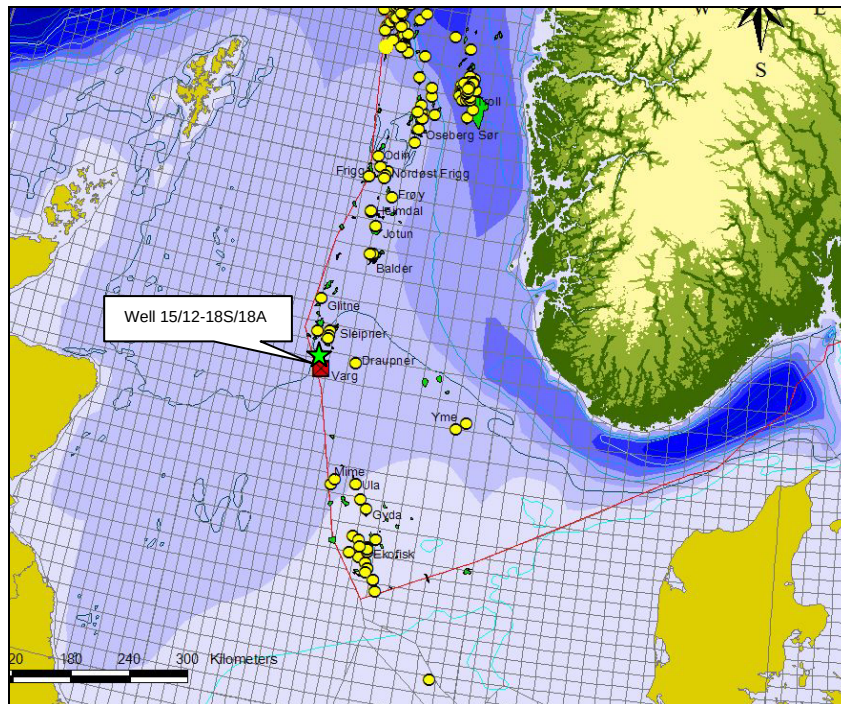


Figure 1: Location of well 15/12-18S/18A

Key information is given in Table 1.

Table 1: Key information for well 15/12-18S/18A

Position	N 58° 13' 01,4", E 01° 46' 53,9" (6 453 670 mN, 428 415 mE)
Water depth	93 m
Distance to shore	240 km
Planned start-up (spud date)	1. July 2007
Planned duration	75 days
Probable findings	48% oil (Storskrymten), 25% oil (Grytkollen)
Reservoir prospect	Selandian (Storskrymten) and Trias (Grytkollen) TD 2523 m TVD MSL (Storskrymten) TD 3212 m TVD MSL (Grytkollen)
History	Approx. 110 wells drilled earlier within 50 km of the location (1967-2007)

2.2 Abbreviations

DN	Direktoratet for naturforvaltning (www.dirnat.no) (The Directorate for Nature Management).
KyV	Kystverket (www.kystverket.no) (The Norwegian Coastal Administration).
MI	Meteorologisk Institutt (www.met.no) (The Norwegian Meteorological Institute)
MRDB®	Marine Resource Data Base (www.mrdb.no).
NOFO	Norsk oljevernforening for operatørselskap (www.nofo.no) (Norwegian Clean Seas Association for operating companies)
OLF	Oljeindustriens landsforening (www.olf.no) (Norwegian Oil Industry Association).
Ptil	Petroleumstilsynet (www.ptil.no) (Petroleum Safety Authority).
SFT	Statens forurensningstilsyn (www.sft.no) (Norwegian Pollution Control Authority).
UIA	Interkommunalt utvalg mot akutt forurensning
PSSA	Particular Sensitive Sea Areas
BOP	Blow Out Preventer
GOR	Gas/Oil Ratio
PLONOR	Pose Little or No Risk to the environment

2.3 Rules and regulations

Regulations	Section	Headwords
Framework regulations	§8 & 9	Safe and prudent operations, reduce risk
	§29-30	Establishing contingency facilities
Management regulations	§6 &16	Acceptance criteria, environmental risk
		Contingency analysis
Activity regulations	§52	Remote monitoring systems
	§53	Post-spill
	§65	Establishing contingency facilities
	§66	Contingency organisation
	§67	Contingency plan
	§69	Regional contingency systems

2.4 Policy and requirements

Pertra is establishing environmental objectives and requirements for the drilling operation that will be described in the "Project HSE Plan" /4/. This plan will also describe acceptance criteria for environmental risk and requirements for assessment of chemical usage and discharges with focus on reduction, reuse, recycling and substitution, combined with effective waste management.

2.5 Acceptance criteria for environmental risk

The Pertra acceptance criteria for operation specific environmental risk is based on the OLF recommendations as described in NORSOK Z-013 /9/ & /28/, and are comparable to the criteria used by most operators in the Norwegian oil and gas industry (Table 2).

Table 2: Environmental risk acceptance criteria for the drilling operation

Environmental damage	Operation specific acceptance criteria (per operation)
Minor (< 1 year)	$< 1,0 \times 10^{-3}$
Moderate (1-3 years)	$< 2,5 \times 10^{-4}$
Significant (3-10 years)	$< 1,0 \times 10^{-4}$
Serious (>10 years)	$< 2,5 \times 10^{-5}$

An ALARP level of 50% of the above given values has been defined.

2.6 Activity and well description

The drilling operation is planned using the jack-up rig Mærsk Giant (Figure 2). The rig will position itself by jacking down the three legs into the seabed substratum. The length of the legs is 175 m. Planned start-up is 1. July 2007, and the operation will take approx. 75 days, depending on the success during the drilling operation.



Figure 2: Mærsk Giant from Maersk Contractors Norge AS (MCN).

Well 15/12-18S/18A will have two targets, Storskrynten and Grytkollen, and will be drilled in the Selandian and Trias formation respectively (Figure 3) with potential hydrocarbon bearings in sandstones. The reservoir's thickness is approximately 40 m for Storskrynten and 100 m for Grytkollen.

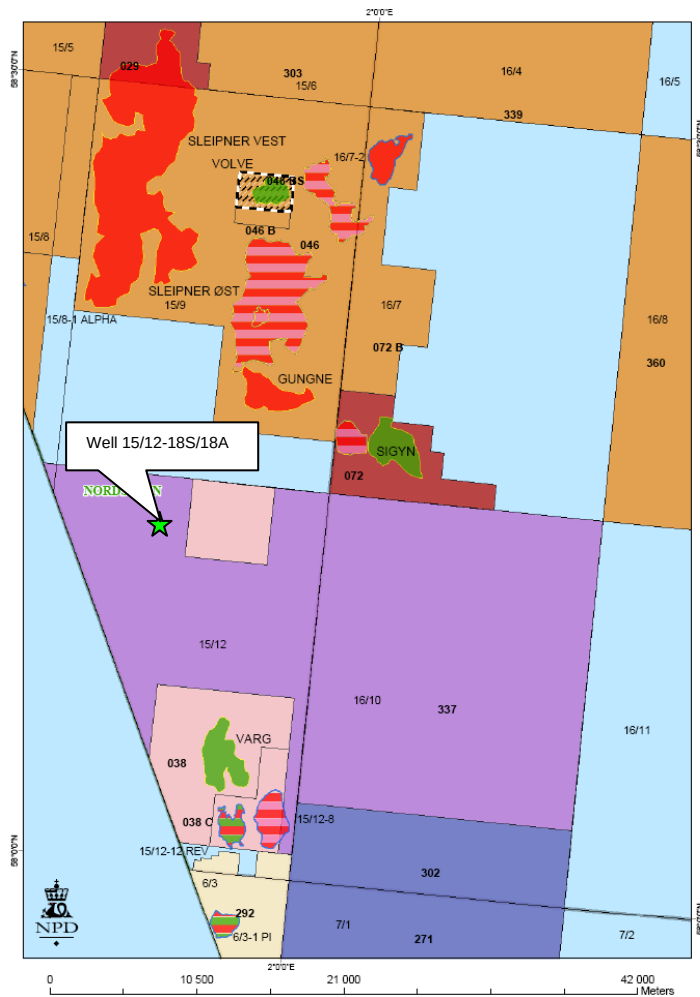


Figure 3: Location of the 15/12-18S/18A well.

The well is planned to a depth of approx. 2563 m tvd RKB (Rotary Kelly Board) for Storskrynten and 3252 m tvd RKB for Grytkollen. Water based drilling mud will be used in the upper sections, while there is a possibility that OBM will be used from 12 ¼" and down and in an eventual sidetrack.

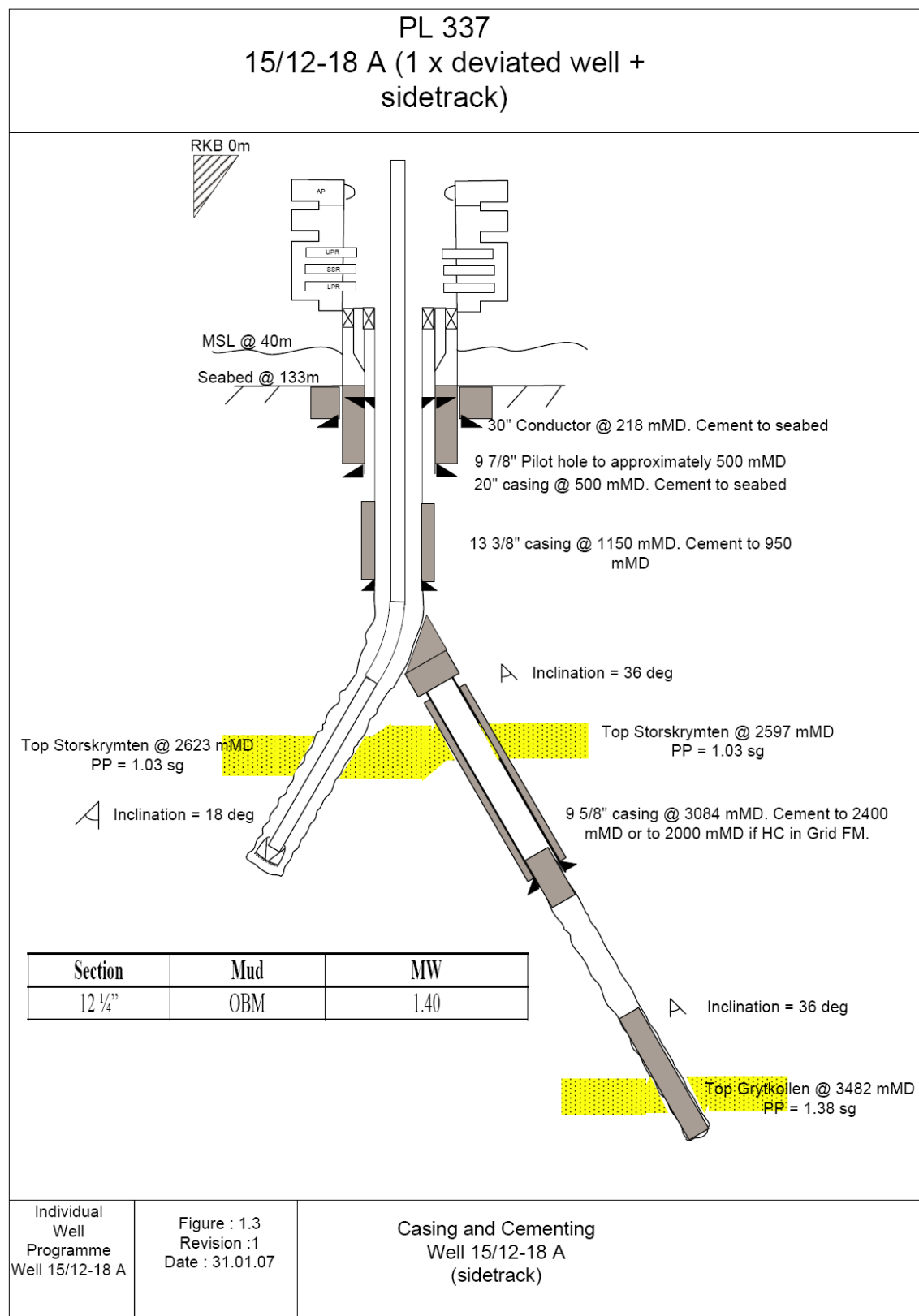


Figure 4: 15/12-18S/18A well design.

2.7 Defined situations of hazard and accident (DSHA)

Exploration drilling offshore implies a risk for acute spills to sea. Major incidents are blowouts during drilling into the reservoir zone. Minor incidents include small spills of crude oil (well releases), diesel (from the rig or from supply vessels), oil based or water based drilling mud (from the rig) or hydraulic oil (from the rig).

With respect to environmental risk, acceptance criteria, and oil spill contingency, blowouts are the dimensioning incidents. Minor incidents and planned operational discharges are included in the risk assessment in order to provide a complete risk picture for the drilling operation, and to form a basis for identifying technical and/or operational measures and best practices to reduce the overall environmental risk.

2.7.1 Blowout and well releases

Potential blowout scenarios for the drilling operation include topside blowouts, with different flow paths such as through the drill string, annulus or open hole.

Frequencies for exploration drilling with Mærsk Giant has been calculated to $2,93 \times 10^{-4}$ per drilling operation for topside blowouts and $2,05 \times 10^{-4}$ per drilling operation for well releases /12/. These frequencies are based on the frequency of blowout relevant to the rig when operating in the North Sea but excluding site-specific considerations. The analysis includes a fault-tree analysis of the frequency of topside blowouts.

Blowout releases pathways have been assessed based on statistics from the North Sea, Outer continental Shelf and Gulf of Mexico (Sintef Offshore Blowout Database). It is approx. 78% probability that a blowout will occur through annulus, approx. 11% through drillpipe, and approx. 11% through open hole. The historical probability for subsea and topside blowouts are 71% and 29% respectively /14/. In relation, degree of penetration of the reservoir, a probability distribution of 55% and 45% has been applied for drilling to only the top of the reservoir or the entire reservoir, respectively.

The probability of full blowout rates versus restricted rates is 30% and 70%, respectively. In this respect, a restricted rate refers to 5% opening of the BOP in relation to full opening rate.

The potential duration of a blowout is subject to significant uncertainty. Based on available statistics, topside blowout durations have been estimated. The maximum duration of possible blowouts is assessed to approximately 40 days /18/.

The maximum duration of well releases is 15 minutes /14/.

The blowout rates have been estimated based on model simulations carried out by Well Flow Dynamics /18/, and is based on available information about reservoir characteristics and drilling program/well design (see section 2.6).

Three blowout scenarios have been defined:

- **Scenario 1:** Blowout from Storskrymten through drillpipe to surface release (Figure 5)
- **Scenario 2:** Blowout from Storskrymten through annulus to surface release (Figure 6)
- **Scenario 3:** Blowout from Storskrymten through open hole to surface release (Figure 7)
- **Scenario 4:** Blowout from Grytkollen through drillpipe to surface (Figure 8)
- **Scenario 5:** Blowout from Grytkollen through annulus to surface (Figure 9)
- **Scenario 6:** Blowout from Grytkollen through open hole to surface (Figure 10)

Important input parameters that have been applied are listed in Table 3.

Table 3: Input data for blowout rate simulations

Parameter	Value	Unit
Oil density	852	kg/m ³
Oil viscosity	9.05	cp
Gas density	1.01	kg/m ³
Gas viscosity	0.011	cp
GOR	148	Sm ³ /Sm ³
Storskrynten		
Top reservoir	2563	m tvd rkb
Reservoir temperature	90	°C
Reservoir pressure	264	bar
	1.05	sg
Permeability	400	mD
Gross vertical reservoir thickness	40	m TVD
Net to Gross, ratio	0.85	-
Net Pay	34	m TVD
Grytkollen		
Top reservoir	3252	m tvd rkb
Reservoir temperature	125	°C
Reservoir pressure	446	bar
	1.40	sg
Permeability	100	mD
Gross vertical reservoir thickness	200	m TVD
Net to Gross, ratio	0.50	-
Net Pay	100	m TVD

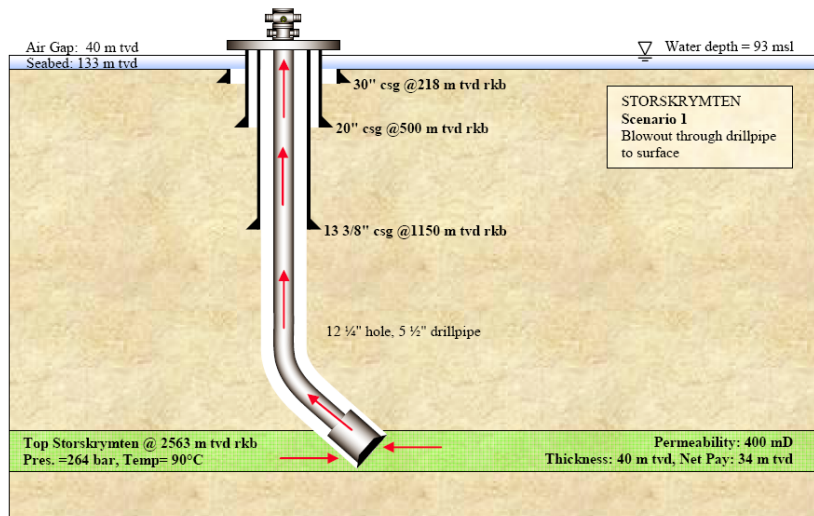


Figure 5: Illustration of Scenario 1 – blowout through drillpipe to surface from Storskrymten.

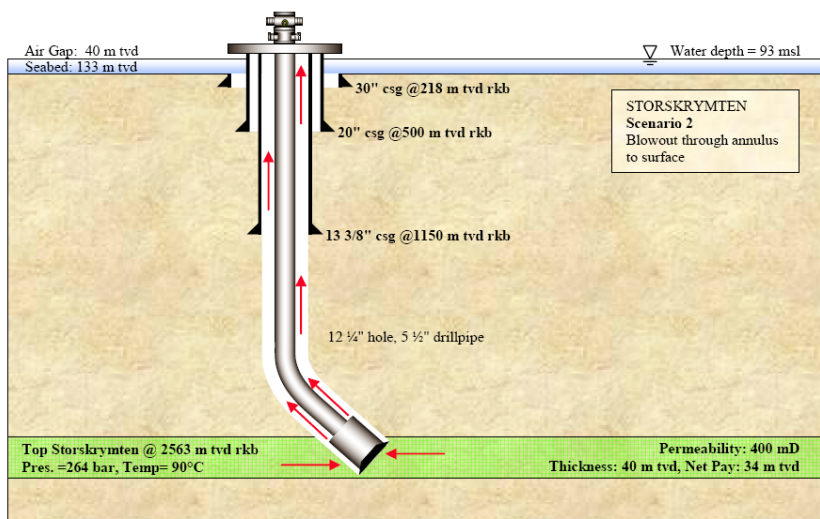


Figure 6: Illustration of Scenario 2 – blowout through annulus to surface from Storskrymten.

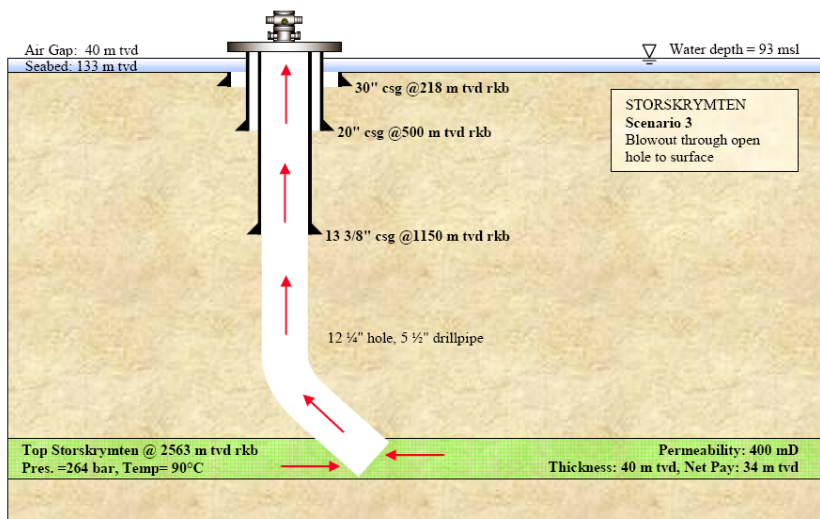


Figure 7: Illustration of Scenario 3 – blowout through open hole to surface from Storskrymten.

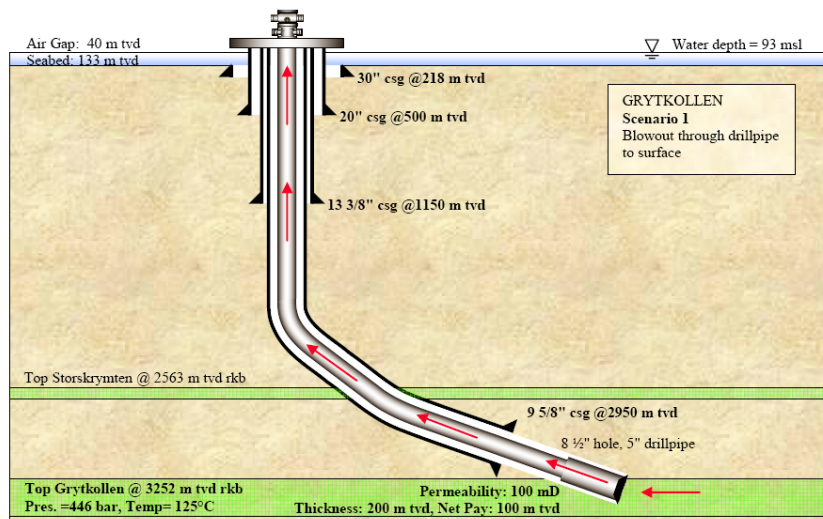


Figure 8: Illustration of Scenario 4 – blowout through drillpipe to surface from Grytkollen

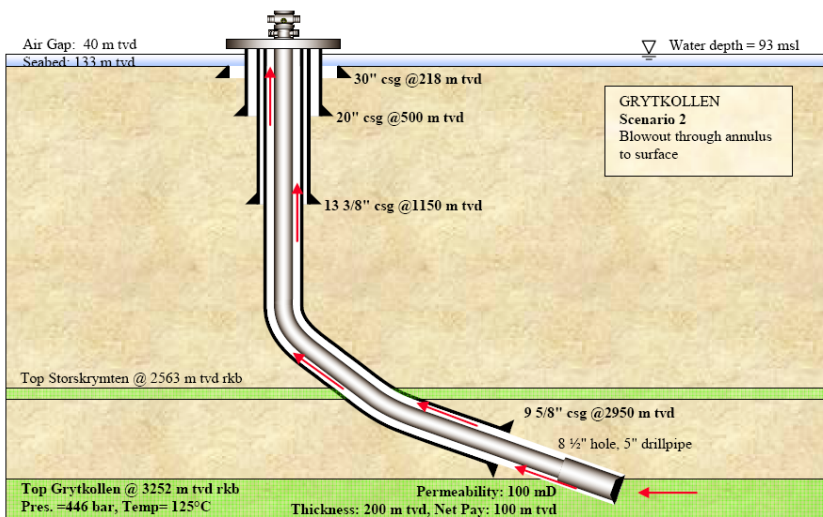


Figure 9: Illustration of Scenario 5 – blowout through annulus to surface from Grytkollen

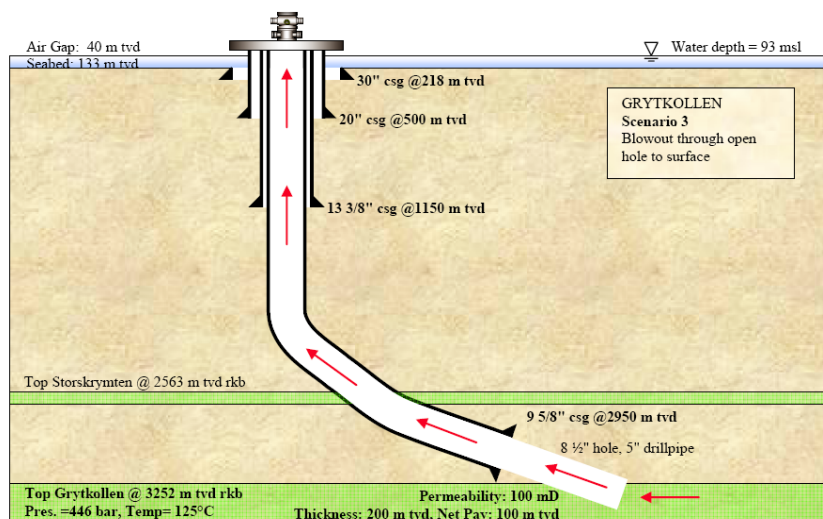


Figure 10: Illustration of Scenario 6 – blowout through open hole to surface from Grytkollen

The resulting simulated blowout rates are summarised in Table 4.

Table 4: Summary of blowout rates /18/

Scenario (flow pathway)	Penetration of reservoir (top / entire)	Opening of BOP (restrictions)	Oil blowout rate (Sm ³ /d)	Probability
1 – through drillpipe Storskrymten	Top reservoir	Open BOP	2774	1,8 %
		Restricted BOP	1583	4,2 %
	Entire reservoir	Open BOP	3690	1,5 %
		Restricted BOP	1951	3,5 %
2 – through annulus Storskrymten	Top reservoir	Open BOP	6251	12,9 %
		Restricted BOP	4351	30,0 %
	Entire reservoir	Open BOP	13978	10,5 %
		Restricted BOP	7994	24,6 %
3 – through open hole Storskrymten	Top reservoir	Open BOP	7337	1,8 %
		Restricted BOP	4871	4,2 %
	Entire reservoir	Open BOP	20090	1,5 %
		Restricted BOP	9786	3,5 %
Totals and weighted rates for seabed blowouts from Storskrymten			6764	100%
1 – through drillpipe Grytkollen	Top reservoir	Open BOP	1820	1,8 %
		Restricted BOP	1307	4,2 %
	Entire reservoir	Open BOP	4267	1,5 %
		Restricted BOP	2706	3,5 %
2 – through annulus Grytkollen	Top reservoir	Open BOP	2253	12,9 %
		Restricted BOP	1872	30,0 %
	Entire reservoir	Open BOP	7941	10,5 %
		Restricted BOP	5779	24,6 %
3 – through open hole Grytkollen	Top reservoir	Open BOP	2726	1,8 %
		Restricted BOP	2179	4,2 %
	Entire reservoir	Open BOP	17065	1,5 %
		Restricted BOP	9693	3,5 %
Totals and weighted rates for seabed blowouts from Grytkollen			4085	100%

2.7.2 Minor spills of oil and chemicals

In 2005 there were totally 147 spills of different types of oils with a total discharge of 377 m³ /10/. One discharge constituted 90% of the total spill volume (340 m³), hence 146 spills resulted in 37 m³ being discharged to sea (average value 0,25 m³ per spill). These data do not segregate between production and exploration operations.

The acute discharge of chemicals was totally 418 m³ in 2005. This is about 300 m³ less than in 2004. Totally there was reported 130 spills /10/. In 2006 there were 28 exploration wells drilled /19/.

The average spill size is estimated to 1 m³ based on the distribution of spill sizes for diesel and hydraulic oil¹.

For WBM and OBM drilling mud the spill size is estimated to 50 m³ and 1 m³, respectively.

Statistics from 109 exploration drilling operations on the Norwegian Continental Shelf in the period 2000-2005 /10/, shows that there have been

- 5 diesel spills, i.e. a frequency of 0,05
- 5 water based mud (WBM) spills, i.e. a frequency of 0,05
- 16 oil based mud (OBM) spills, i.e. a frequency of 0,15

Relevant scenarios for the drilling operation with respect to diesel, hydraulic oil, OBM and WBM, are based on these statistics, see section 2.7.4.

2.7.3 Operational discharges

Planned discharge of drilling mud

Water based drilling mud will be discharged to sea during the drilling operation, mainly during drilling of the top-hole sections in the start of the operation. The planned discharge of WBM to sea is totally approx. 1252 tons. The average density of WBM is 1.15 s.g., which implies a discharge of approx. 1089 m³. All chemicals are PLONOR, except from two which are yellow.

OBM may be used in the lowest sections and in the sidetrack. There will be no discharge of OBM to sea.

Planned discharge of drilling cuttings

In total 56 m³ (145 tons) of cuttings will be discharged to seabed from the top-hole section (36") coated with WBM, and 211 m³ (548 tons) will be discharged to sea surface from the two following sections (26" and 17,5" holes). The cuttings from the lowest sections and the sidetrack will be shipped to shore if OBM will be used.

Planned discharge of cementing chemicals

The planned discharge of cement is 10 tons (approx. 31 m³). PLONOR cementing chemicals that are planned discharged are Dyckerhof cement (97,1% of total discharge), Econolite which is a silicate (1,5%), calcium chloride (1,1%), EZ-FLO and SSA-1 or 2, both contains silica (both 0,1% each), Turned Spacer E+ that contains bentonite (0,04%) and Gascon 469 which also contains silica (0,003%).

Five yellow chemicals are planned discharged: NF-6, CFR-8L, Mulsol, Sem-8 and Halad-350L (0,14% altogether).

Planned discharge of rig chemicals

Rig chemicals that are planned discharged to sea are 4000 liter of the yellow rig cleaning chemical Clean Rig HP. 500 kg of the red jacking grease, Statoil Multidope, will be discharged. The planned discharge of drill pipe grease, the yellow Bestolife 3010 Ultra Special, yellow Jet Lube Seal Guard ECF and red Bestolife 2010 NM Ultra is approx. 30,25 kg, 0,55 kg and 0,5 kg respectively, and are not included in the assessment.

¹ Several hoses of hydraulic oil under high pressure are exposed to wind and spray of sea water, several locations underneath the lower rig deck with direct route to sea. Corrosion may develop rapidly on hoses that have been subjected to wear and tear and where protection material has been removed. Such an incident occurred in 2005 on the rig "Eirik Raude" (Ocean Rig) in the Barents Sea. A correspondingly scenario is probable on most drilling rigs. On "Eirik Raude" the spill was first reported to be 1,5 m³, but later investigations showed that the spill was approx. 0,9 m³.

There will be used 1500 liter hydraulic oil of the type Shell Tellus oils (T32 – 700L, T68 – 400L, T100 – 400L), and 2000 liter BOP fluid of the type Oceanic HW 443 ND, both yellow chemicals. Nothing will be discharged.

2.7.4 Summary of acute spill scenarios and operational discharges

A summary of the potential spill scenarios and operational discharges during the drilling operation is shown in Table 5.

Table 5: Summary of scenario statistics – acute spills to sea and operational discharges

Scenario no.	Description	Frequency (per operation) ²	Discharge quantity (m ³) ³	Risk Index #1 ⁴	Fraction ⁵
S 1	Subsea oil blowout through drillpipe (Storskrymten)	3,22E-05	3597	0,1	0,01 %
S 2	Subsea oil blowout through annulus (Storskrymten)	2,28E-04	83207	19,0	1,54 %
S 3	Subsea oil blowout through open hole (Storskrymten)	3,22E-05	23445	0,8	0,06 %
S 4	Subsea oil blowout through drillpipe (Grytkollen)	3,22E-05	3683	0,1	0,01 %
S 5	Subsea oil blowout through annulus (Grytkollen)	2,28E-04	46623	10,6	0,86 %
S 6	Subsea oil blowout through open hole (Grytkollen)	3,22E-05	17545	0,6	0,05 %
S 7	Oil well release (Storskrymten)	2,05E-04	70	0,0	0,001 %
S 8	Oil well release (Grytkollen)	2,05E-04	43	0,0	0,001 %
S 9	Diesel spill from rig	0,05	1	0,1	0,004 %
S 10	WBM spill from rig	0,15	1	0,2	0,01 %
S 11	OBM spill from rig	0,05	50	2,1	0,17 %
S 12	Hydraulic oil spill from rig	0,03	1	0,0	0,002 %
S 13 ⁶	Operational discharge of drilling mud	1	1089	925,7	74,86 %
S 14	Operational discharge of drill cuttings	1	266	266,5	21,55 %
S 15	Operational discharge of cement	1	10	9,7	0,79 %
S 16	Operational discharge of rig cleaning agent	1	2,20	0,6	0,05 %
S 17	Operational discharge of jacking grease	1	0,5	0,5	0,04 %

The risk index based on frequency and discharge quantity (water free) summarises as follows:

² Based on Mærsk Giant's Safety Case /12/ and the probable distribution of topside (11%) and subsea (78%) blowouts (S1-S8). S9-S12 are based on statistics from OLF and PSA in the period 2000-2005, and S13-S17 are operational discharges in accordance with the discharge application.

³ Discharge quantity = rate (m³/d) * weighted duration. For topside blowouts a weighted duration is set to 5 days. For subsea blowouts, 16 days through drillpipe/annulus and 26 days through open hole (S1-S8). S9-S12 are based on statistics from OLF, PSA and operational experiences. S13-S17 are operational discharges in accordance with the discharge application.

⁴ Risk Index (frequency x discharge quantity). S11, S13 and S16 are corrected for water content when calculating the RI

⁵ Fraction = risk index / sum of all the risk indexes

⁶ Quantities in Scenario 13-17 are discharges from the whole drilling operation, i.e. side track is included and only WBM is used.

- Blowouts and well releases (#1-8): 2,5 %
- Acute minor spills (#9-12): 0,2 %
- Operational discharges (#13-17): 97,3 %

2.8 Fluid characteristics and weathering properties

2.8.1 Crude oil

The crude oil characteristics of the potential oil in 15/12-18S/18A are evaluated to be comparable to the oils that have been found in the Varg area close by.

The density is assumed to be 852 kg/m³. The viscosity (approx. 10 cP at 13 deg C for fresh oil), is quite low and the oil forms emulsion easily. But the viscosity will, depending on i.a. wind speed, change rapidly (see Table 6 – the oil is comparable with the Varg oil), and this means that Hi-Wax skimmers should be required together with traditional oil skimmers.

As shown in Table 6, when released to sea, the evaporation rate will be in the range 21-37% after 24 hours, depending on the wind speed. After 48 hours, the evaporation rate will be in the range 25-40%. The maximum water content in an emulsion is considered to be 50% in wintertime and 60% in summertime /20/.

Table 6: Weathering data for the Varg oil /21/

Wind speed (m/s)	Varg - Summer				Varg - Winter			
	Time on sea (hours)	Water content emulsion (%)	Viscosity emulsion (cP)	Evaporated (%)	Time on sea (hours)	Water content emulsion (%)	Viscosity emulsion (cP)	Evaporated (%)
2	6	60	1000	12	6	50	4000	10
2	12	60	1500	20	12	50	5000	15
2	24	60	2000	25	24	50	6000	21
2	48	60	4000	29	48	50	8000	25
2	72	60	6000	31	72	50	10000	28
2	96	60	8000	32	96	50	11000	29
2	120	60	9000	33	120	50	13000	30
5	6	60	2000	21	6	50	5000	18
5	12	60	4000	27	12	50	7000	22
5	24	60	7000	30	24	50	9000	26
5	48	60	9000	35	48	50	12000	30
5	72	60	11000	36	72	50	16000	32
5	96	60	12000	37	96	50	17000	34
5	120	60	13000	38	120	50	18000	35
10	6	60	6000	28	6	50	8000	25
10	12	60	8000	32	12	50	10000	28
10	24	60	10000	34	24	50	12000	32
10	48	60	15000	36	48	50	15000	35
10	72	60	17000	39	72	50	20000	36
10	96	60	19000	40	96	50	25000	37
10	120	60	20000	42	120	50	30000	38
15	6	60	8000	32	6	50	10000	28
15	12	60	10000	35	12	50	15000	32
15	24	60	15000	37	24	50	20000	35
15	48	60	20000	40	48	50	30000	38
15	72	60	25000	41	72	50	30000	39
15	96	60	30000	42	96	50	35000	39
15	120	60	35000	43	120	50	40000	40

The oil drift and spreading potential during a major blowout have been assessed by DNV /22/. The probability for a blowout encountering the Norwegian coastal areas have been estimated to maximum 27%, but the remaining quantities will be small. Shortest drift time is 8 days with 11 tons of oil, maximal in one simulation is 2021 tons after 15 days, which means 28 and 5333 tons of emulsion respectively /22/. Results from calculations of encountering oil quantities from a major oil spill from well 15/12-18S/18A shows relatively low probability for arrival of more than 1 ton of oil both summer and winter within a 10x10 km square at the coast (upper left figure in Figure 11 and Figure 12). The probability for oil mass > 1000 tons is zero for both seasons.

The shortest distance to the coast is approx. 240 km.

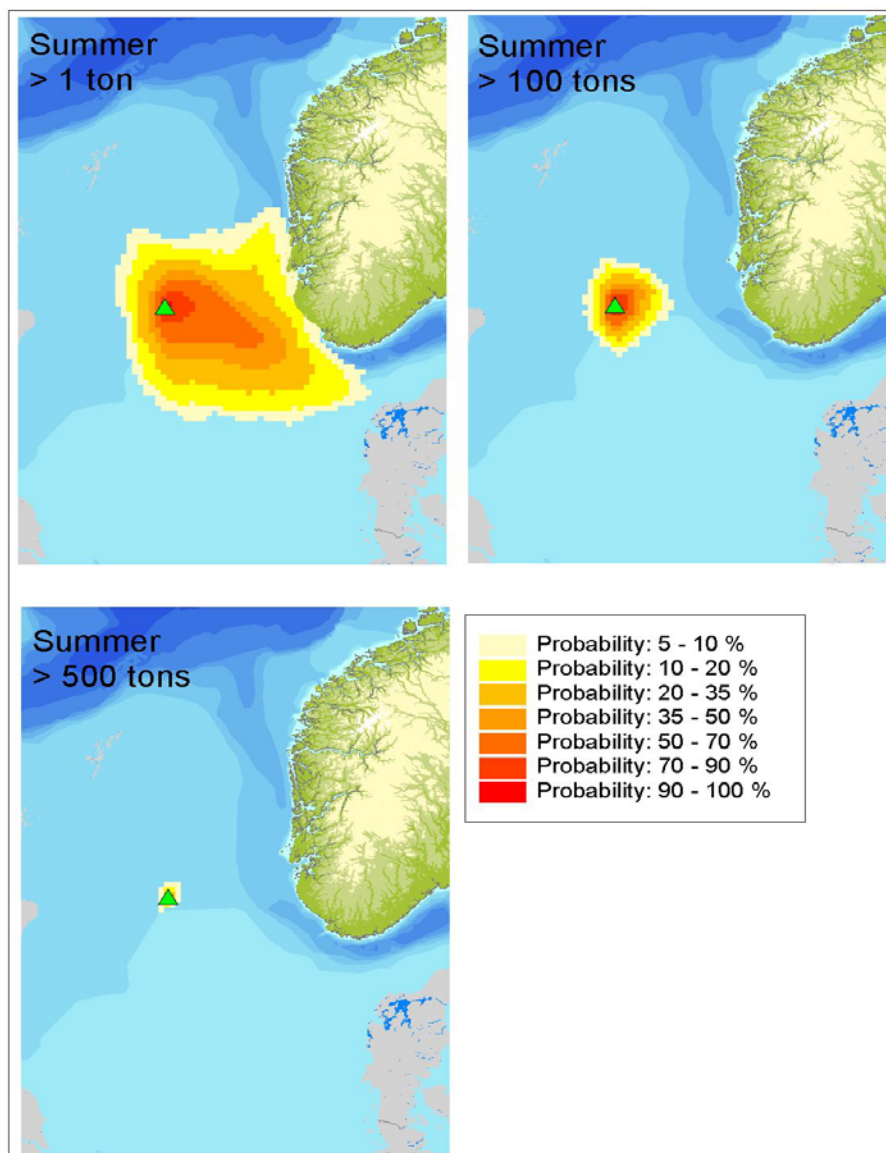


Figure 11: The influence areas for topside blowouts in summer season within 5 % hit probability for different mass intervals. The figures show hit probability for weighted durations and release rate in 10 x 10 km grid cells after 3600 simulations and not the distribution of oil after an oil release /22/.

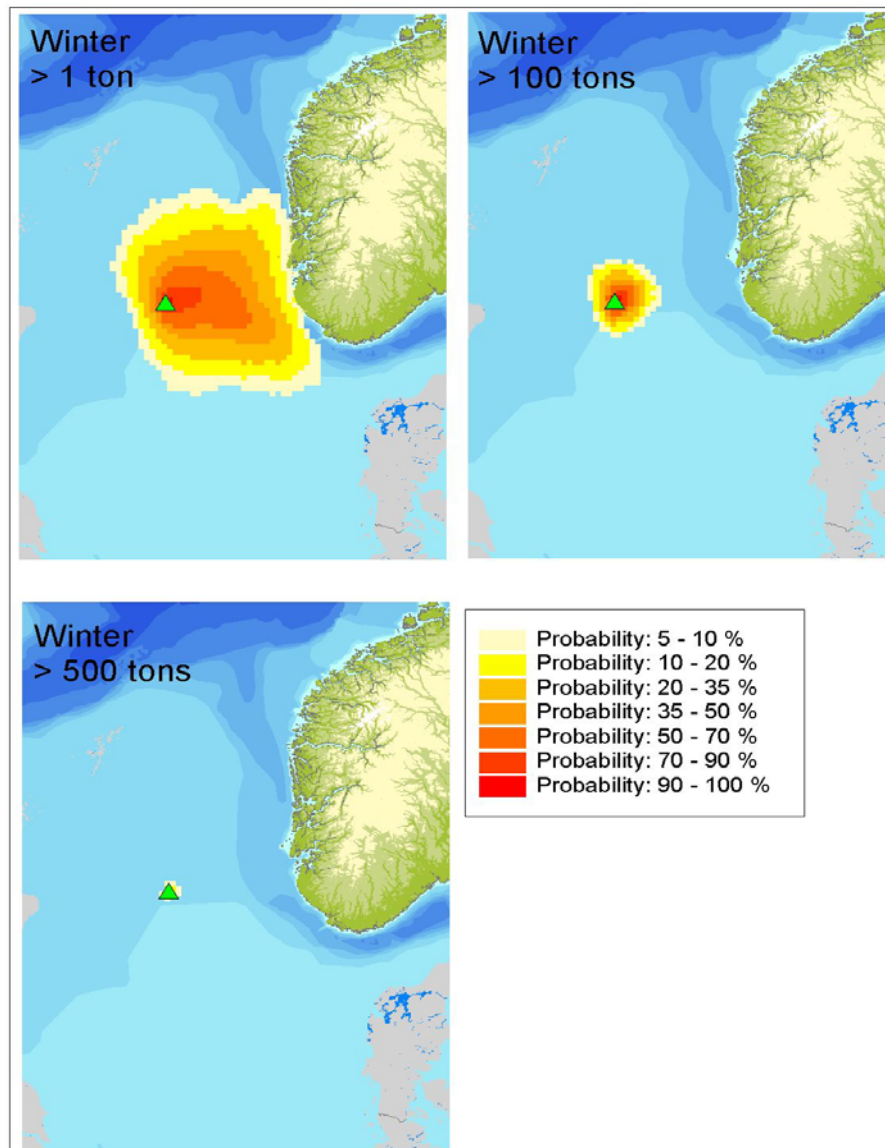


Figure 12: The influence areas for topside blowouts in winter season within 5 % hit probability for different mass intervals. The figures show hit probability for weighted durations and release rate in 10 x 10 km grid cells after 3600 simulations and not the distribution of oil after an oil release /22/.

In Figure 13 the stranding statistics for all rates and durations for topside blowouts, maximum stranded emulsion and shortest drift time to land are presented with accumulated probability. This shows that of all the rates and durations there is only 4% probability that more than 1000 tons of emulsion reaches the shore. The probability of having an emulsion of more than 5333 tons (weighted maximum emulsion) reaching the shore is 0,15 %, which correspond to a frequency of $4,2 \times 10^{-5}$ per operation.

This implies that the shore response, in the worst case, must be able to handle up to 5333 tons of emulsion over the duration of the blowout. The oil slick will be monitored using the NOFO helicopter more or less continuously. Thus there will be time enough to mobilize equipment where the oil is expected to reach the coast. It will also be possible to try to recover the oil slick on its way to the coast.

To limit the possible harm to resources on the sea in general, the NOFO equipment is available as discussed in section 5.5.

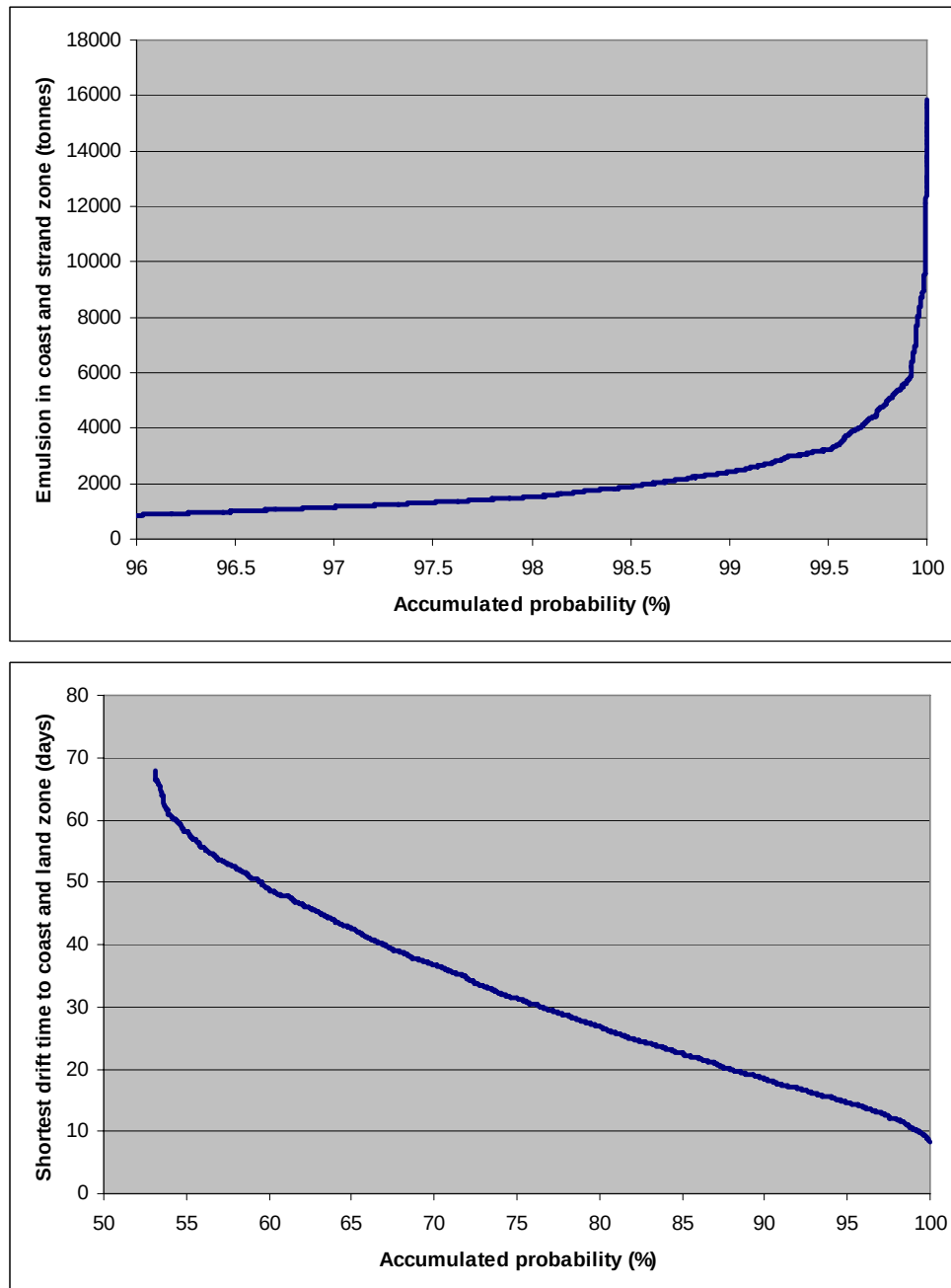


Figure 13: Statistics for maximal stranded emulsion (upper) and shortest drift time to land (lower), based on all simulations, both top side and subsea and the total combination of rates and durations /22/.

Weighted stranding statistics in predefined coast segments (see Figure 14) for both summer and winter season are presented in Table 7, such as average and maximal stranded emulsion, shortest drift time to land and probability of stranding in each segment. The probability of stranding in segment 7 in the summer is 16%, in winter 15%. One single simulation gave maximal stranded emulsion in segment 7, 1995 tons in the summer and 1905 tons in the winter.

Table 7 : Weighted statistics in predefined coast segments for summer and winter season (see Figure 14)

Coast segment	Average stranded emulsion (tons)		Maximal stranded emulsion (tons)		Shortest drift time to land (days)		Probability of stranding in coast segment (%)*	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
4	7	-	13	-	27	-	1	-
5	25	20	127	59	20	14	4	1
6	224	112	1782	660	13	9	15	11
7	220	151	1995	1905	10	9	16	15
8	248	205	1443	1009	12	8	12	15
9	149	126	613	434	13	10	5	6
10	81	72	231	221	18	11	2	2

* i.e. if no collection at sea

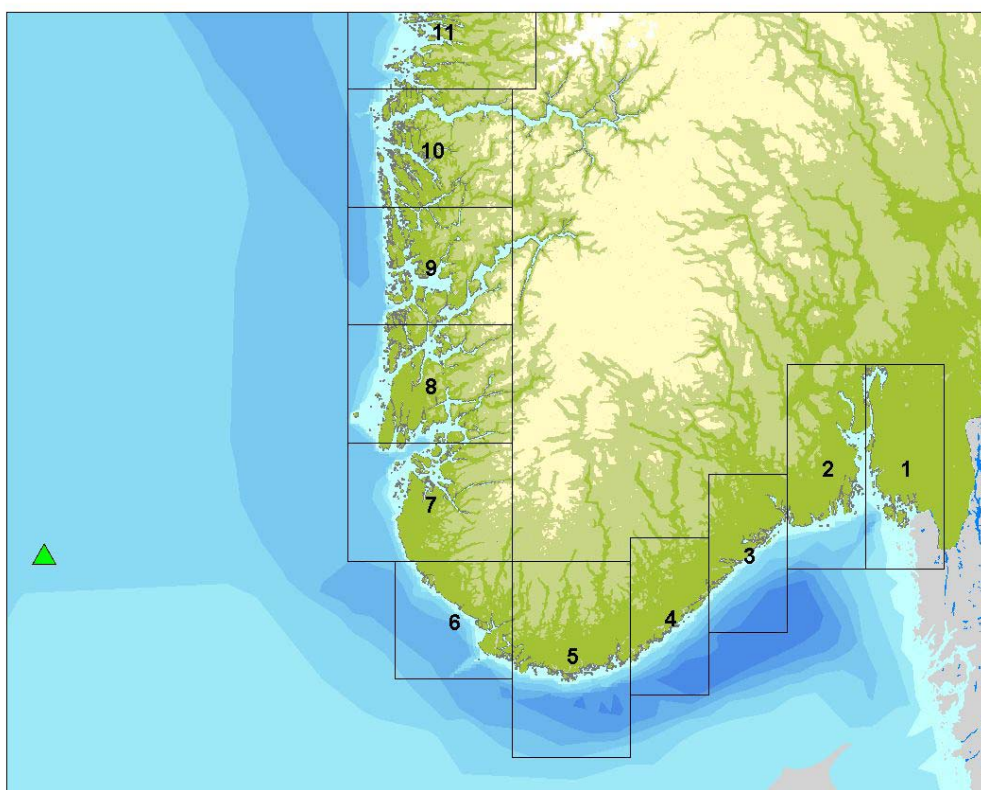


Figure 14: Coast segment distribution. The release position is marked with a green triangle /22/.

Based on available oil drift simulations, an area of influence has been determined for well 15/12-18S/18A (Figure 15).

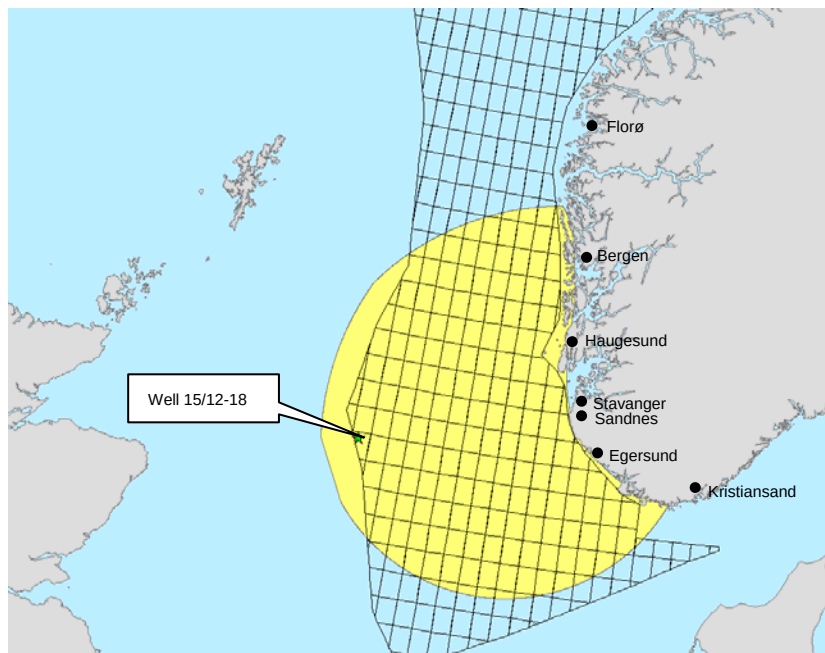


Figure 15: Area of influence (yellow area) for blowout from well 15/12-18S/18A.

The area of influence is assessed to range from Lindesnes in the south to Fedje in the north, a coastline of approx. 380 km. It should be noticed that this is a large area of influence, but this may be explained by the drilling location being located a long distance from the coastline and hence an oil spill will be exposed to varying winds and currents over a very long distance. The remaining oil quantities, however, will be rather small when encountering the beaches (max. 5333 tons of emulsion /22/).

The fraction of remaining oil in coastal areas is estimated to maximum 10-20% /22/.

The fastest drift time to coastal areas (shorelines) is estimated to 8 days /22/. And the dimensioning drift time for oil spill contingency systems have been set to 192 hours (i.e. 8 days).

2.8.2 Diesel

Diesel has a density of approx. 0,84 tons/m³, containing hydrocarbon fractions with boiling point in the range 165-360°C. Upon discharge to sea it will float on the surface and practically not disperse into water at all. However, the evaporation rate will be high, and the diesel will be almost completely evaporated within a few days. No diesel spill will reach the Norwegian coast.

A spill of 1 m³ will cover an area of maximum 2-15 km² under the assumption of a slick that forms 70% "sheen" (0,04-0,3 µm), 20% "rainbow" (0,3-5,0 µm) and 10% "metallic" (5,0-50 µm) (ref. BONN BAOAC (Bonn Agreement Oil Appearance Code) colour code 2004).

2.8.3 Hydraulic oil

The hydraulic oils being used on Mærsk Giant are Shell Tellus oils (T15, T32, T68, T100). These hydraulic oils consist of highly refined mineral oils and additives. The density is 0,87-0,88 tons/m³. The water solubility is negligible (see also 2.7.3).

If spilt, it will float on the sea surface. A spill of 1 m³ will form a slick comparable to a diesel spill.

Some components in hydraulic oils are not readily biodegradable, and may accumulate in marine organisms, but it is not toxic to marine organisms.

2.8.4 Water based mud

The discharge of WBM will occur to seabed from the first section drilled and to sea from the drilling rig. The mud is heavier than sea water, so it will sink until sufficiently diluted. It will not form any slick on the surface.

Most of the WBM components are PLONOR, except two that are yellow. Both are planned discharged to sea, Gem GP (42,3 tons) and Performatrol (43,5 tons). The discharge will occur to sea from the drilling rig. The mud is heavier than sea water, so it will sink until sufficiently diluted. It will not form any slick on the surface (see also 2.7.3).

Neither Performatrol nor Gem GP are toxic, and the biodegradability is in the range 30-69% (BOD_{28days}). The products are neither carcinogenic, contains trace metals nor have tainting properties.

2.8.5 Oil based mud

Oil-based mud is a mixture of barite, mineral oil, and chemical additives. Oil based mud might be used from 12 ¼" and down and also if a sidetrack is drilled where there is an increased likelihood for a drill pipe to stick.

Oil based mud will have a density of approx. 1,4 tons/m³. The base oil component is a mineral oil such as Clairsol NS from Halliburton, with density 0,83 tons/m³, containing hydrocarbon fractions and consists of light petroleum hydrogentreated destillates. The fluid is insoluble in water. The biodegradability of the product is good and it is not toxic to marine organisms, but it may bioaccumulate. The product has yellow environmental classification. (see also 2.7.3)

In addition to base oil, the mud will contain barite and smaller amounts of other chemicals, hereof four yellow chemicals and 11 PLONOR.

If an accidental spill of OBM occurs, a portion of the OBM will initially sink until sufficiently diluted, while the petroleum components will form a very thin slick on the surface.

2.8.6 Cementing chemicals

Discharged cementing chemicals consist mainly of PLONOR chemicals, and with only a small fraction of yellow chemicals. The yellow constituents are NF-6 which contains 60-100% rape oil and 5-10% monopropyleneglycol derivative (total discharge of 29 kg), CFR-8L which contains 30-60% sulphonated organic polymer (total discharge of 4 kg), and Halad-350L which contains 5-10% vinylsulfonatebased polymer and 5-10% substituted polyalkylene. The planned discharge of this component is 4 kg.

Either NF-6, CFR-8L or Halad-350L are toxic (LC50 >1000 mg/l), and the biodegradability is in the range 29-77% (BOD_{28days}). The products are neither carcinogenic, contains trace metals nor have tainting properties.

2.8.7 Jacking grease

Statoil Multidope contains approx. 60% grease components with red environmental classification (thickener system/synthetic ester), in addition to approx. 14% PLONOR component (Mica and calcium carbonate) and 26% yellow component (titanium dioxide). Most of the constituents are not toxic, while the grease part is moderately toxic. The bioaccumulation potential has been analysed, but the OSPAR test methods are not applicable for the heavy grease components of the products, and based on an assessment of the chemical the accumulation potential has been set to 0 (ref. CHEMS/KPD centre). The biodegradability

(BOD_{28days}) is 3% for the grease part, which forms the basis for the red classification. The product does not contain heavy metals and do not have tainting properties. (see also 2.7.3)

The jacking grease is applied on the legs during positioning of the rig (jacking up/down). The grease is discharged to sea during an extended period of time in small portions.

2.8.8 Rig washing chemicals

Cleanrig HP is a water based cleaning agent, with density approx. 1,1 tons/m³. It is clear yellow water soluble fluid, with pH 12,5-13,5. The fraction of PLONOR chemicals are 85%, while the remaining has yellow environmental classification. The yellow compounds are toxic to marine organisms (LC₅₀ <10 mg/l). However, they are readily biodegradable (BOD₂₈ 64-78%) and will not bioaccumulate in marine organisms. The consumption of rig wash chemicals will be approx. 0,5 m³/week during the drilling operation. The discharged chemical will rapidly dissolve in sea water and be diluted to non-toxic levels, causing minimal environmental effects. (see also 2.7.3)

3 Environmental description

3.1 Ambient conditions

The site is located west of the Norwegian trench, close to the UK border and halfway between the Sleipner and Varg fields at about 93 m depth.

Water masses

The area is dominated by Atlantic water masses. The direction of the currents at the drilling location is mainly from west-southwest. During summer there will be a pronounced stratification of the water masses, with a 20-40 m surface layer of water with high temperatures (14-18°C) and a colder bottom layer with somewhat colder water (around 10°C). Such stratification is not apparent in the winter season.

The temperature of the water masses at 10 m depth is typically increased from 12-14°C in July to 14-16°C in August, before it decreases again to 13-15°C in September.

Wind and waves

There are significant differences in the wind regime during the year. Statistics from the period 1995-2005 show that average wind speeds during the months July to September are 6,0-7,5 m/s (Data from Climate Diagnostic Centre (<http://www.cdc.noaa.gov/index.html>)), increasing during the period and during the winter season.

Wave statistics show that in July the wave height is above 4 m in 2% of the time, in August 3%, while in September this occurs 15% of the time (MI weather statistics database). At significant wave heights above approx. 4 m, oil spill contingency actions will be less effective (less than 15%).

Daylight

Daylight is of importance for oil spill contingency actions. The daylight period is defined as the fraction of time during the day (24h) where the sun is above 6° under the horizon. During the period July-September the fraction of daylight is 52-74% (average 62%).

Sediments

The seabed is generally consisting of sand (96-98%) overlying very soft clay /2/ & /29/.

3.2 Cold water corals

There isn't registered any cold water corals (*Lophelia* communities) at the drilling location /24/ & /2/.

3.3 Seabirds

The vulnerability of seabirds has been thoroughly assessed /1/, /13/, /25/ & /26/. Seabirds connected to the North Sea have different levels of connection to the open sea and to coastal areas, differing between species and seasons depending on behaviour and activity.

The species that have the strongest connection to the open sea include members of several families, notably auks ("alkefugler"), gulls ("måker"), petrels ("petrell/stormfugler") and gannets ("suler"). Inshore birds include sea duck, divers, cormorants ("skarv") and terns, as well as some gull species and one auk (black guillemot = teist). These birds normally occur within sight of land, although they may move further offshore, especially in areas of shallow waters. Although some breed in substantial numbers, the North Sea is of greatest importance to most inshore species in autumn and winter. Birds that feed on inter-tidal areas such as sand and mud flats

are the most important coastal bird species. The North Sea is particularly suited to these species because of its large tidal amplitude and relatively mild climate, which prevent mud flats freezing for most of the winter. The North Sea is mainly a staging post for some species of birds on passage between breeding grounds to the north and wintering areas further south. Other species spend the winter along North Sea coasts.

Seabirds are primarily vulnerable to potential discharge of oil, predominantly from merchant shipping. Little or no direct mortality of seabirds has been attributed to exploration and production activities /25/. Due to differences in factors such as behaviour and distribution on sea, the threat from oil pollution varies between species. The individual vulnerability varies between species and seasons, and is also different for different life stages. The overall vulnerability of seabirds is given in Figure 16, and show that the area around well 15/12-18S/18A has moderate vulnerability.

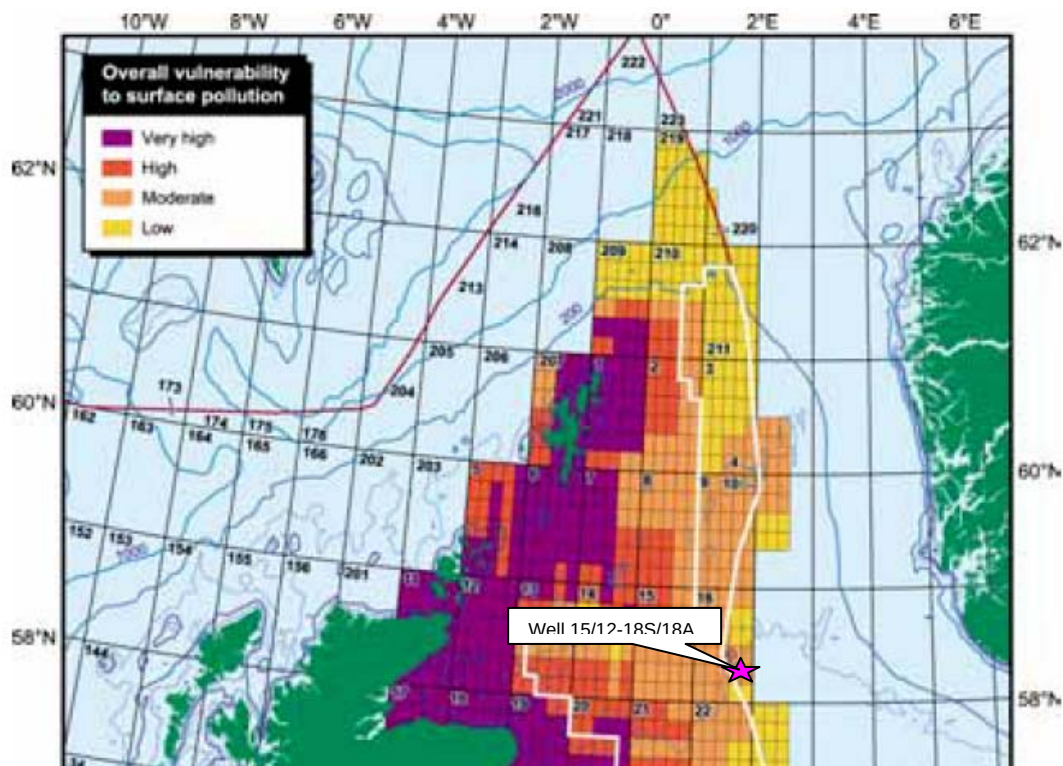


Figure 16: Overall vulnerability of seabirds to surface pollution (seasonal variability taken into account) /26/.

Norwegian coastal areas from Lindesnes to Florø are within the influence area for an oil spill from well 15/12-18S/18A. The birds normally breed in April and early May, and the moulting period is from July till October. The drilling will be conducted in late summer, and a possible oil spill could affect the moulting (Figure 17).

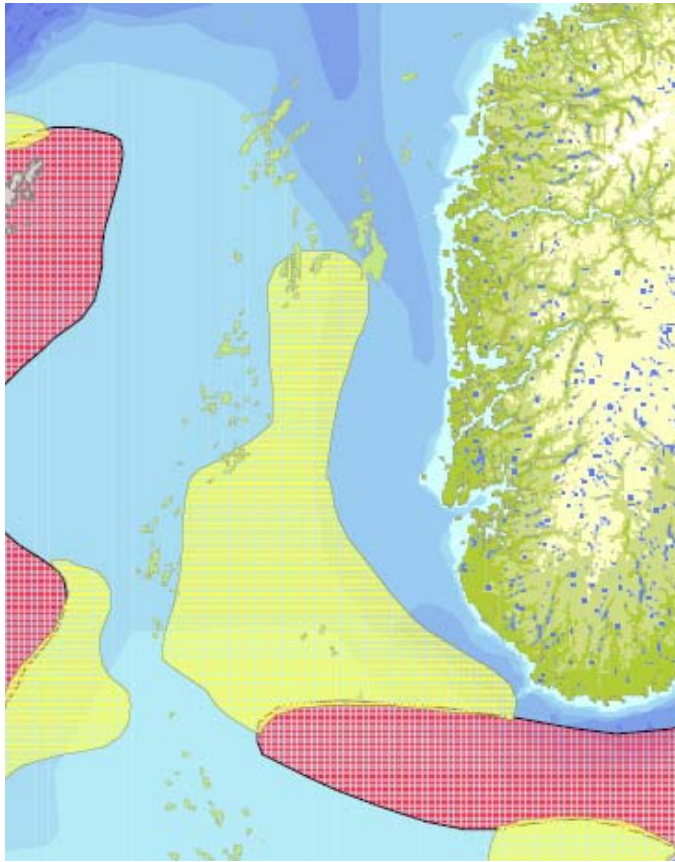


Figure 17: The most important seabird areas in the North Sea in the moulting period. Red = high vulnerability, yellow = moderate vulnerability. High vulnerability is mainly related to guillemot and auk. The red areas are the most important seabird areas at open sea in the North Sea also outside the moulting period /26/.

3.4 Sea mammals

Marine mammals are less vulnerable than seabirds to fouling by oil, but they are at risk from hydrocarbons and other chemicals that may evaporate from the surface of an oil slick at sea within the first few days. Symptoms from acute exposure to volatile hydrocarbons include irritation to the eyes and lungs, lethargy, poor coordination and difficulty with breathing. Individuals may then drown as a result of these symptoms /25/.

There are several species of whale and seals in the area of influence of the well and also sea otters in coastal areas. Common whale species are Porpoise ("nise"), Minke ("vågehval") and Killer whale ("spekkhogger").

Common seal species are Harbor seal ("steinkobbe") and Grey seal ("havert"). Harbour seal is put down in the Redlist /2/ as a vulnerable species.

Harbor seal can be found in all coastal waters in the North Sea. During the whelping and moulting period in June through August, the harbor seals spend more time ashore than during any other time of the year. Along the Norwegian coast the harbor seal is widespread, and several places along the coast of Southern Norway whelping has been registered (Figure 18). Both adults and youngsters are considered vulnerable if a possible spill from the location in the drilling period reaches the shore /25/.

The distribution of grey seal is limited to the northern part of the Atlantic Ocean. In the North Sea whelping occurs from October to January (earlier in the north), and the moulting occurs in February-March. During these periods, most parts of the population will be onshore for several weeks and the density of mammals offshore will be lower /25/. In these periods, the new-born are vulnerable to oil pollution along the coast. The distribution of grey seal along the Norwegian coast is not continuous and is most numerous between 63°N and 68°N, in addition to a concentration on Froan in the southern part of Trøndelag. Further south, whelping in Rogaland is observed. Neither adults nor youngsters are considered vulnerable with respect to oil or other spills from the location in the drilling period /25/.

Registered natal sites for grey seal and harbour seal are presented in Figure 18.

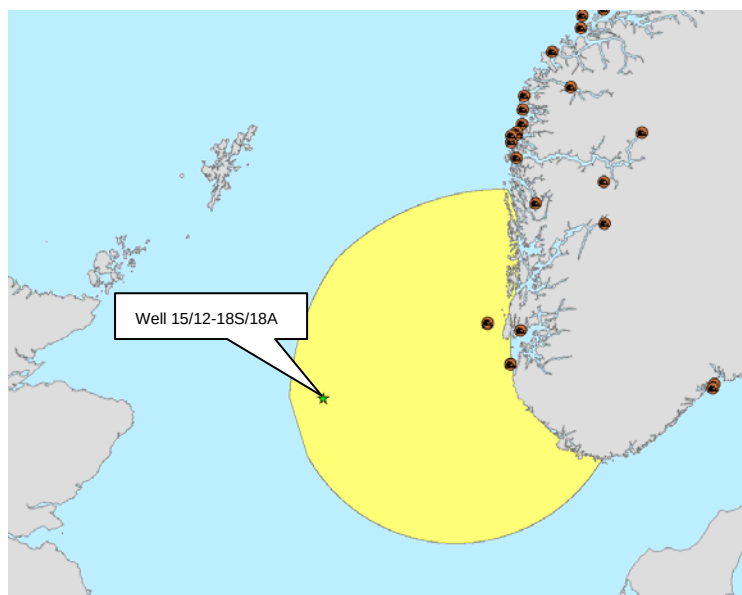


Figure 18: Registered whelping sites for harbour seal and grey seal along the coast of Southern and Western Norway /24/.

The otter have very high individual vulnerability to oil pollution and is listed on the National Redlist ("Røddlisten") as VU (vulnerable) /2/ & /26/. They are relatively rare along the coast in the influence area for an oil spill from the well, but the stocks are increasing. The risk to sea otter populations regarding pollution from the planned exploration well is considered extremely low.

3.5 Fish resources

For all species, the egg- and larval stadium is the most sensitive regarding acute oil pollution. The vulnerability is highest during and immediately after the main spawning periods in early spring when the concentrations of eggs, larva and juveniles appear to be highest. It is primarily the zone closest to the spawning areas that may have the largest potential for harmful effects to fish /14/. It is shown that on individual level there are differences in vulnerability regarding oil pollution between the different species. Saithe ("sei") is the most vulnerable, and then comes cod ("torsk"), capelin ("lode"), mackerel ("makrell) and herring ("sild"). There is however no materials that document that regular offshore activity lead to noticeably negative consequences for the fish' spawning.

Many commercially important fish species spawn and have their growth areas in the North Sea (Figure 19).

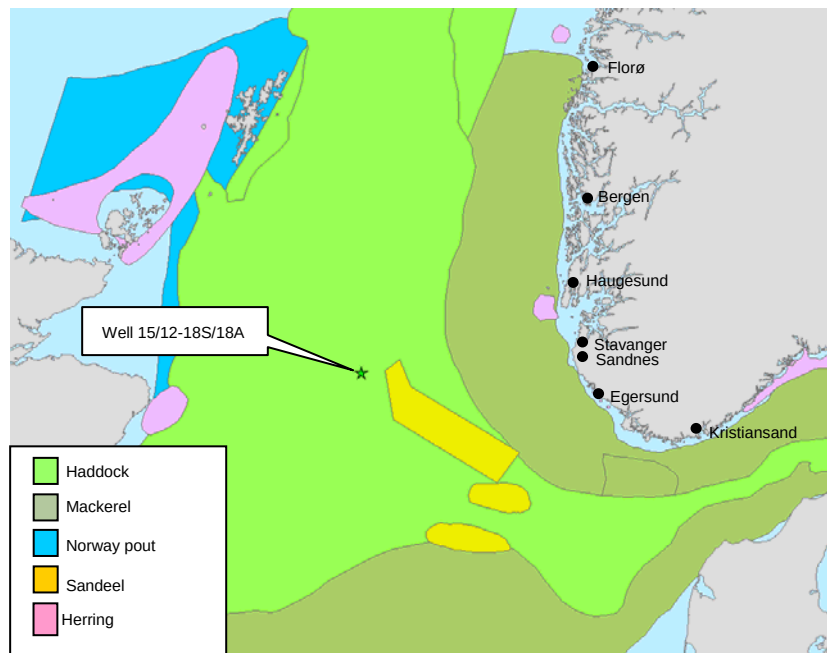


Figure 19: Spawning areas for commercial important fish species in the North Sea /24/.

The well is located within the spawning area for Norway pout ("øyepål"), mackerel, sandeel ("tobis") and haddock ("uer"). In the North Sea the spawning products are spread over larger areas and time periods than areas further north. Thus, in most cases it is expected that it is not possible to impact the species in a way that will give significant consequences to the stocks /7/.

According to the 2006-report on the stock situation, several of the important fish stocks in the North Sea still need protection and strong regulatory measures to come within safe biological limits in the near future /7/. The International Council for the Exploration of the Sea (ICES) has recommended a complete closure of the fisheries where cod is included in the catches. Saithe is one of the most important stocks in the Norwegian North Sea fishery for pelagic species. The saithe stock is inside safe biological limits, and future catches are expected to maintain at today's level.

The most important pelagic resources exploited in the North Sea are mackerel and herring. These species are mainly caught in directed purse seine fisheries. At present the herring stock is considered to be reproductive and the exploitation is sustainable. The mackerel stock is still estimated to decrease and the spawning stock is considered to be below precautionary level.

Norway pout and sandeel are the most important species in the trawl fishery for reduction to fish meal and oil. In the North Sea both stocks shows weakening reproduction ability and small spawning stocks. Because of this there is no basis for fishery of Norway pout and sandeel and it is forbidden to fish these species (ICES and Institute of Marine Research). Reopening of the fishery is considered if the 2005 stock is strong, and only if it is sure that the spawning stock in 2007 will exceed the precautionary level.

North Sea herring are harvested in a direct human consumption fishery by purse seiners and trawlers in the North Sea and in the Skagerrak. The spawning stock of North Sea herring has fluctuated throughout the last decades. Strict regulations of the by-catch and adult fisheries were implemented in the mid 1990s, and the stock size is now increasing.

3.6 Fishing activity

Fishery statistics from the area around the well shows that it was caught (based on Norwegian 2004 catch numbers) /27/:

- < 5000 tons mackerel
- < 10000 tons Atlantic herring
- < 50000 tons Saithe
- < 5000 tons shrimps
- < 5000 tons Norway pout

In the influence area:

There is quite a lot of fishing after Atlantic herring ("nordsjøsild"), Blue whiting ("kolmule"), mackerel and shrimps ("reker").

Some fishing after cod, haddock, saithe, bream ("brosme"), ling ("lange"), wolfish ("steinbit"), and close to shore edible crab.

No significant trawling and seine fisheries have been conducted close to this specific area in recent years. In these fisheries, the fishing areas will depend on both the stocks migration and regulations conducted by the authorities, both varying from year to year. As a result, these fisheries are generally considered as not affected by drilling activities.

3.7 Particular sensitive sea areas

The concept of particular sensitive sea areas (PSSA) has been developed by SFT and DN. Based on the most recent scientific data on occurrences of natural resources, the criteria developed provides a tool for identification of the areas and resources that are considered to be the most sensitive to oil pollution. Hence the PSSA data provides a prioritization of the mapping and description of resources in the previous sections.

The influence area for an oil spill from the well is generally most vulnerable during the autumn/winter season. In the spring/summer season it has been identified PSSA on regional level at the northern part of Jæren and at the west coast of Karmøy. In the autumn/winter season PSSA on a national level are identified along the coast of Vest-Agder, along and at Jæren and in the Boknafjord-area. It has not been identified any PSSAs for shoreline habitats for any season. Neither has it been identified any PSSA for fish resources. In Figure 20 the PSSAs for the whole year along the coast of southern parts of Norway are presented /20/.

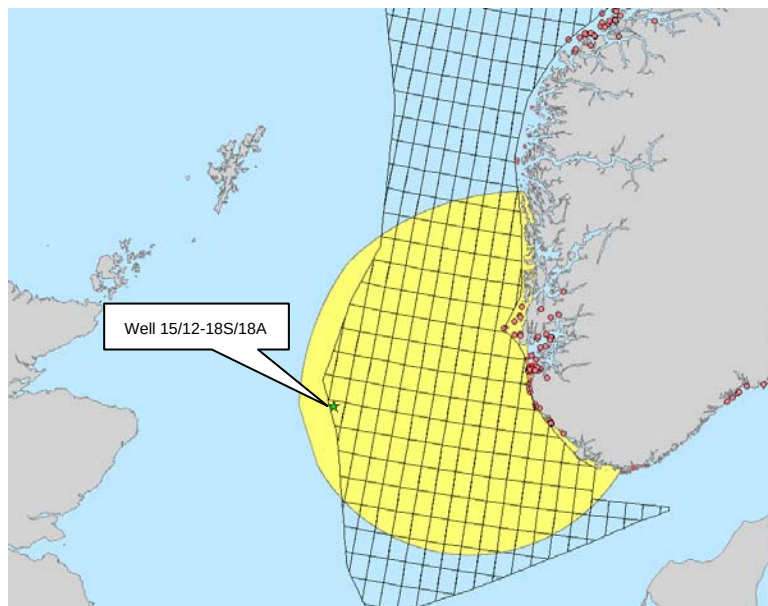


Figure 20: Area of influence (yellow) and PSSAs (red spots) (whole year) /25/.

The NOFO Master Plan describes important areas along the coast (“example areas”) which partly is a reflection of the PSSAs (Figure 21). The areas contain high occurrences of environmentally prioritised locations and resources and are important for designing oil spill contingency systems.

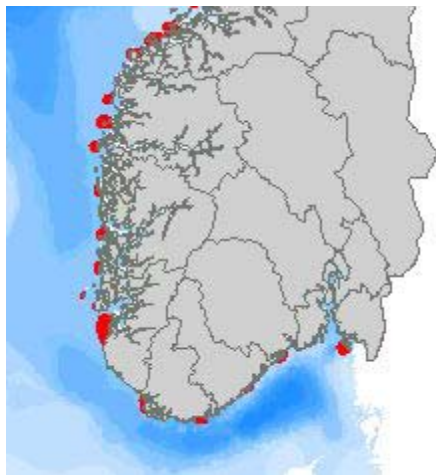


Figure 21: Important coastal areas /20/ (<http://planverk.nofo.no/eksempomr.htm>)

3.8 Recreational areas

The coastal areas of Norway, and particularly in the southern parts, are widely used for recreational and outdoor activities. Oil pollution will almost in any circumstances cause extensive inconvenience to a large number of people, particularly in the spring (partly), summer and autumn (partly) months. In winter the inconvenience will be less, depending on the extent and duration of oil pollution.

Particularly valuable areas for recreational activities are listed as “secured” (“sikrede”) areas. More than 140 such areas in the outer coastal zone are identified within the influence area for the drilling operation. Lista and the beaches of Jæren (“Jærestrendene”) are particularly important recreational areas.

3.9 Background pollution

The background pollution level must be described as basis for assessment of potential effects of oil spills or other discharges (ref. the Management Regulations §16).

A comprehensive quality status report describes the pollution status and input to the North Sea and Skagerrak area /11/. Inputs of heavy metals occur both from rivers (e.g. 36-64 tons/year cadmium and approx. 1000 tons/year lead) and from the atmosphere (e.g. 15 tons/year cadmium and approx 1500 tons/year lead).

The “natural” background levels (BRC) and ecotoxicological assessment criteria ⁷ (EAC) in sea water of some priority heavy metals are:

	BRC	EAC	Factor above EAC
• Cadmium (Cd)	8 – 25 ng/l	0,01 – 0,1 ng/l	50 – 2500 x
• Mercury (Hg)	0,2 – 0,5 ng/l	0,005 – 0,05 ng/l	2 – 100 x
• Lead (Pb)	10 – 20 ng/l	0,5 – 5 ng/l	1 – 40 x
• Copper (Cu)	50 – 360 ng/l	0,005 – 0,05 ng/l	1000 – 72000 x

For both cadmium and copper, the levels are alarming high. However, it has not been reported negative effects on marine organisms in the open waters of the North Sea. Other pollutants, such as polychlorinated biphenyls (PCB) that are persistent and bioaccumulate, can be found in all biota in the North Sea, but the levels are not as alarming high as in arctic areas. Because of the prohibition to use PCB, the levels are generally being reduced.

Other synthetic pollutants (such as dioxins, furans, hexachlorbenzene, pesticides) mainly represent a problem in some coastal and fjord areas.

PAH (polyaromatic hydrocarbons) are discharged to the North Sea from offshore installations, oil spills and ship transport. The ranges of background/reference concentrations (BRC) and Ecotoxicological assessment criteria of PAHs in the surface sediments for the northern North Sea and Skagerrak, has been reported by OSPAR /11/:

	BRC	EAC	Factor above EAC
• Benzo(a)pyrene	8,8 – 112 µg/kg dw	0,1 – 1 µg/kg dw	9 – 1120 x
• Fluoranthene	14 – 160 µg/kg dw	0,5 – 5 µg/kg dw	3 – 320 x
• Benzo(b+k)fluoranthene	46 – 434 µg/kg dw	-	-
• Pyrene	11 – 128 µg/kg dw	0,05 – 0,5 µg/kg dw	22 – 2560 x

PAH have very low water solubility and will tend to bind to particulate material and sediment in fall-out areas such as the Norwegian trench. The levels of PAH in sea water are either at the EAC level or lower.

Although the levels of PAH are high, the risk of negative effects on marine organisms are reasonable low due to the fact that most organisms have well-developed enzymatic or other means for metabolism and excretion of PAH compounds.

Other sources of discharge of petroleum hydrocarbons are riverine inputs from the countries surrounding the North Sea and also produced water discharges from offshore installations.

⁷ EAC is defined as the concentration level of a substance above which concern is indicated.

The nearest discharge sources for produced water are from the installations Varg and Sleipner. The total amount of produced water discharged from the fields Varg and Sleipner in 2005 was 0,5 million m³, constituting approx. 0,3 % of the total discharge in the Norwegian sector /10/. These produced water discharges may affect the areas around the drilling location. However, calculations of Environmental Impact Factor (EIF) for these installations for the 2005 discharges show a very low EIF. Based on these results it is concluded that the produced water discharge from Varg and Sleipner will not affect the resources in the influence areas of the drilling locations.

The overall conclusion is that the vulnerability of marine organisms in the water column is not affected of background/reference concentrations of natural and man-made pollutants. With respect to discharges that contain persistent substances that may bioaccumulate and that mainly will end up in marine sediments, it is reasons to believe that the background concentrations may be affecting the vulnerability of sediment organisms. This aspect is therefore relevant to consider with respect to operational discharges of drilling cuttings which mainly will deposit on the sea bottom.

4 Environmental risk analysis

4.1 Impact assessment

When petroleum hydrocarbons are discharged to sea, a number of weathering processes will start, such as evaporation, downmixing, dilution, emulsification. The rate of the processes depends particularly on oil characteristics and weather conditions. Eventually, relatively stable oil-in-water emulsions will form, with 60-80% water content. Usually, such an emulsion slick will be distributed on the sea with approx. 90% of the oil quantity on 10% of the slick area. After some time on the sea surface, downmixing rates will be very slow.

The environmental effects of oil are numerous, and depend on the combination of oil type and quantity, weather conditions, and the presence of vulnerable resources. The potential effects of oil in Norwegian offshore/onshore areas have been assessed during a large number of studies and assessments. An important basis is the "Regionale Konsekvensutredning for Nordsjøen" (Regional Impact Assessment for the North Sea, /12/ & /26/), but also the oil spill impact review by SFT /15/.

Important factors for assessment of environmental impact of spills and operational discharges are:

1. **Recovery time**; estimated time from discharge to the environment (biological resources) are recovered (comparable to pre-spill situation taking into account natural variation).
2. Number of environmental and economical **resources affected**: seabirds, sea mammals, fish, phytoplankton, zooplankton, shoreline habitats (littoral zone and beaches), coral reefs, seabed fauna and sediments, fisheries, aquaculture, tourism, water resources, ports and marinas, other industrial activity.
3. **Ecological/conservation value/interest** of affected resources.
4. The **size** of affected areas in open sea and in the coastal zone.
5. The **degradability** of the pollution (biological and/or mechanical/chemical) indicates the duration of potential effects.
6. The **quantity** of pollution on shorelines.
7. The size of **areas with harmful concentrations** of pollution in water masses (e.g. oil concentrations above 30-50 µg/l).
8. The size of **areas on the sea bed** with harmful concentrations or amounts of pollution (e.g. persistent substances that can bioaccumulate).
9. **Transfer** of effects to other parts of the ecosystems or new generations, e.g. bioaccumulation of pollutants with potential harmful effects on reproduction on survival, particular in relation to key species in the ecosystem.
10. The significance for **fisheries** expressed as number affected vessels in combination with level of importance of the fisheries (local, regional etc).
11. The significance for aquaculture expressed as the number of affected fish/shellfish farms affected.
12. The significance for the **recreational/outdoor** life expressed as the "value" of affected areas based on whether they are secured as recreational areas ("sikrede friluftsområder").
13. The significance for **ports and marinas** expressed as the number of vessels/boats potentially affected (effects such as cleaning of vessels).
14. Additional **workload** in the company related to investigations, correspondence and communication with authorities, follow-up and planning of mitigation and restoration measures.
15. The effect on the company **reputation** caused by the incident or planned operational discharges. Pre-planning and risk reducing measures, and contingency measures as well as management and follow-up of incidents may affect the company's reputation among authorities and the public in general.
16. **Economic costs** in relation to spill combat and mitigation, fines and compensation, investigations and research activities etc.

Classification and weighting of the impact parameters are shown in the Impact Matrix (Table 11 in appendix).

The impact matrix has been used for assessment of the 17 spill and operational discharge scenarios and the results from the impact classification are shown in Table 11 and Figure 22. The average impact values (AIV) in Figure 22 is calculated by multiplying each impact value (for the 16 impact parameters) with its weighting factor (the sum of all weighting factors is 100%), and then summarising the values:

$$AIV = \sum_{i=1}^{16} (\text{impactvalue})_i \times (\text{weightingfactor})$$

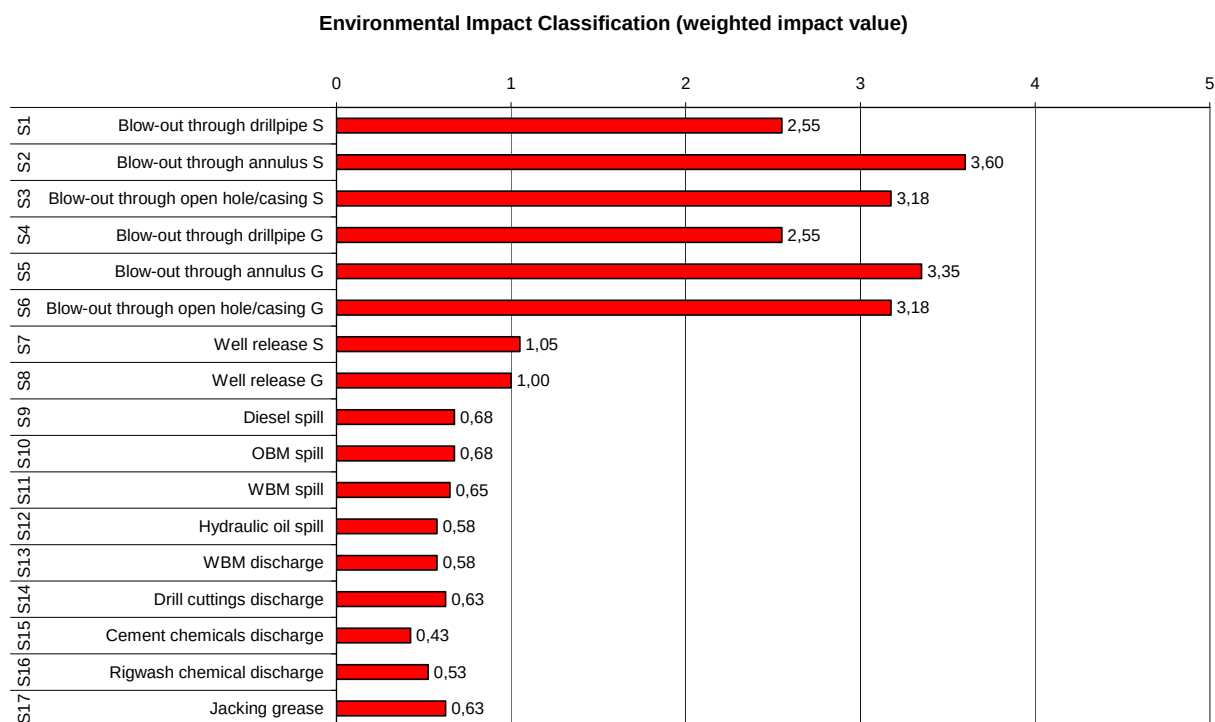


Figure 22: Results from the impact classification for acute spills and operational discharges.

The blowout scenarios (S1-S6) are the most serious incidents with respect to potential environmental impact. A topside blowout through annulus will cause the largest impacts, because of a larger discharge quantity. Well releases (S7-S8) will not cause serious environmental impact.

Among the minor spill incidents, the diesel (S9) and hydraulic oil (S10) spills are considered to cause equal impact (both 1 m³ spills).

The operational discharges generally cause insignificant environmental effects. Although large differences in discharge quantities, the operational discharges are considered to be associated with the same consequence levels.

4.2 Activity specific environmental risk

The environmental risk expressed on basis of recovery has been considered for all the scenarios, but only the blowout scenarios may cause significant effects on a population or

community level and hence are relevant to consider with respect to environmental risk acceptance criteria.

Using the risk ranking method for the blowout scenarios, a classification of 2 and 3, corresponding to minor (<1 year) and moderate (1-3 years) consequences based on the parameter recovery time is used. Supportive information for the classification (bird distribution used) has been gathered from the Environmental Risk Analysis for Alvheim /30/, which is presumed to be comparable with respect to oil type and spill scenarios. And since well 15/12-18S/18A lies further away from shore than Alvheim, so using the same parameters (birds) would be a conservative approach when analysing the environmental risk.

The average impact classification for the chosen risk indicators was moderate (1-3 years). The average probability distribution in the summer season were 30% (<1 year), 46% (1-3 years), 19% (3-10 years) and 4% (>10 years). The average hit probability was 12% in the spring/summer season for topside blowouts.

Combined with the blowout frequencies, see S1 to S6 in Table 5, the resulting total impact frequencies have been calculated to $1,10 \times 10^{-5}$, $1,69 \times 10^{-5}$, $6,94 \times 10^{-6}$ and $1,53 \times 10^{-6}$, which are 1,1%, 6,8%, 6,9% and 6,1% of the acceptable risk, respectively (see illustration in Figure 23). This illustrates that the risk level is well below the Pertra risk acceptance criteria, and also below the ALARP level (as low as reasonable practicable), which is set to 50% of the acceptance criterias.

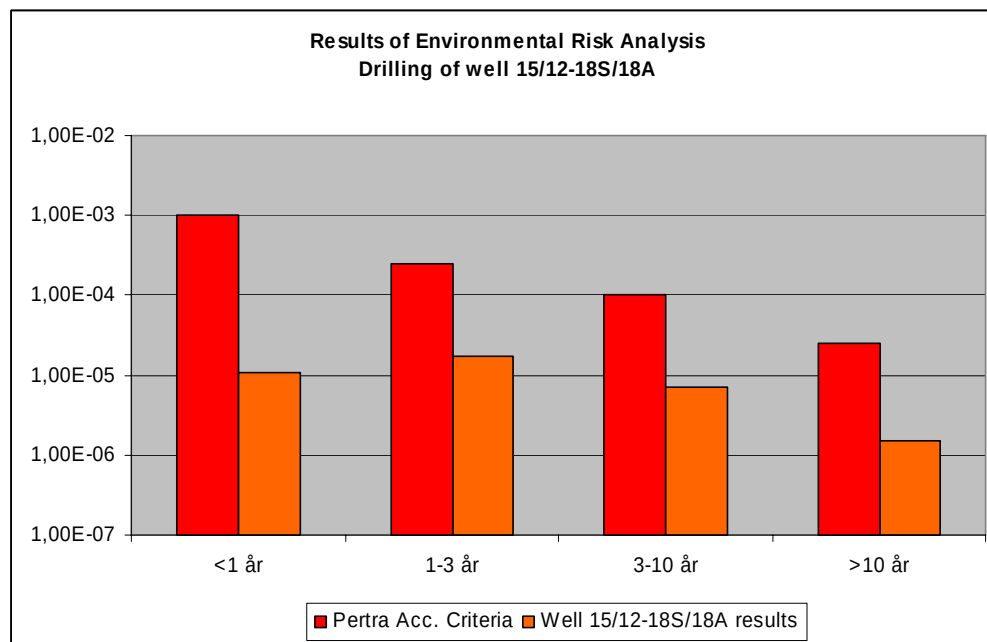


Figure 23: Total impact frequencies compared with PERTRA's acceptance criteria.

In addition to the evaluation of environmental impact based on recovery time, the environmental risk has been assessed and ranked for identified spill and operational discharge scenarios based on totally 16 impact parameters (see Table 11).

The Environmental Risk Index is calculated by dividing the Impact value (AIV) with the logarithmic value of the Frequency of occurrence value (F), raised by 2^8 . The results are shown in Figure 24.

⁸ Environmental Risk = $(AIV / \log \text{ frequency})^2$. AIV is given in Figure 22 and the frequencies in Table 5.

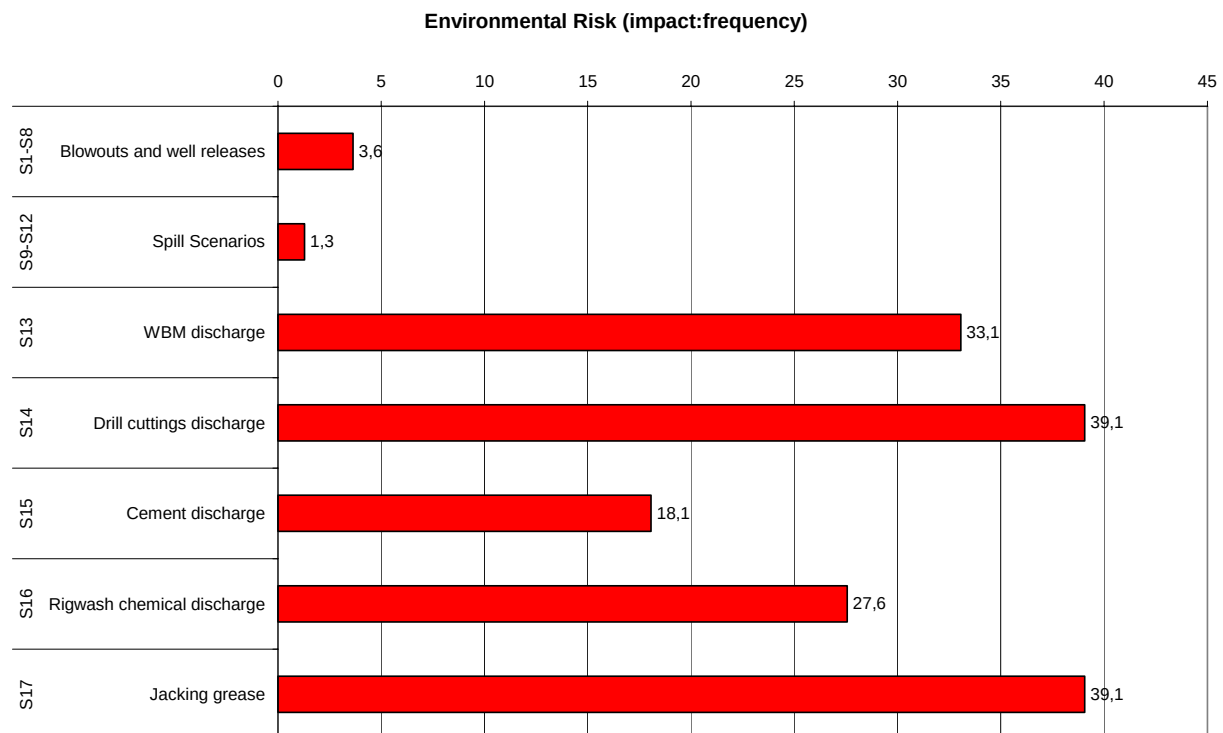


Figure 24: Ranking of environmental risk for 17 spill and operational discharge scenarios (the six blowout scenarios and two well release scenarios have been summarised, and also the four spill scenarios) for exploration well 15/12-18S/18A based on the Environmental Risk (Frequency of occurrence/Impact classification).

Compared to the impact classification (Figure 22), this provides a completely different picture. The drill cuttings and jacking grease are ranked as the highest risk scenario for the drilling operation, mainly because these scenarios have higher frequencies. The spill scenarios have negligible risk. The overall picture is a very low environmental risk level for the drilling operation.

4.3 Regional environmental risk

In the part of the North Sea where the drilling location is, there is a very high activity level with many producing fields, drilling operations, pipelines and ship transport, both in the Norwegian and UK sector. It is considered not to be appropriate to assess the contribution to the environmental risk from the drilling operations to the whole activity level in the area. The contribution from the drilling operations will be marginal and only covers a limited time period.

4.4 The effect of risk reducing measures

During the detailed planning phase and the subsequent management of the drilling operation, risk reducing measures will be identified and implemented based on the results of the environmental risk analysis. Risk reducing measures may be either probability reducing or impact reducing.

In the following sections it is indicated which types of measures that are relevant and that are being considered:

- **Use of jacking grease:** Jacking grease is classified as environmentally red substance. It will be substituted when an alternative yellow chemical is on the market.

- **Use of rig wash detergent:** The procedures and operational logistics for use of the rig wash detergent Cleanrig HP on the drilling rig will be audited and verified. The HSE Plan addresses activities to ensure minimal use of chemicals during the drilling operation.
- **Major oil spills:** Such incidents represent a low environmental risk for the drilling operation because of the low probability and low environmental sensitivity in the area. This is addressed in a separate oil spill contingency analysis (section 5). Solutions and the organisational aspects and procedures will be described in an oil spill contingency plan /5/ which will be linked to the NOFO Master Plan /20/.
- **OBM spills:** Procedures for transport and handling of both new and used oil based drilling mud are established, with requirements for inspection and closing of all drains that could result in OBM being routed to sea. Handling of OBM will be audited and verified if decided to be used.

Pertra will arrange pre-spud meetings where results from analysis and plans will be communicated to operational staff. Pertra will emphasize the importance of transferring theory into action through learning and discussions. The company will during the operational phase ensure that these issues are followed up in staff meetings and through planned verification activities.

5 Oil spill contingency analysis

5.1 Introduction

If an acute oil spill occurs, established oil spill contingency plans will come into force. Pertra has together with NOFO established a contingency system that covers the field, open sea, the coastal zone and shorelines. The contingency system covers successive phases of a combat action:

- Alerting/notifying
- Mobilising
- Combating
- Restoring
- Monitoring
- Normalisation.

The NOFO Master Plan /21/ forms the basis for the contingency system. Drilling operations are covered by the plan, but the results from a contingency analysis may identify other or more stringent requirements.

5.2 Combating strategies

Oil spill to sea will be combated with available methods that cause less environmental damage. The combat strategy is primarily based on mechanical cleanup close to the source. Factors that affect the choice of strategy are discharge conditions, weather conditions, oil characteristics and spreading/weathering conditions, and the presence of vulnerable environmental resources.

To ensure appropriate choice of combating strategy, it is important to monitor or predict the transport and fate of the oil.

The philosophy in the combat strategy is to establish several barriers between the source of spill and environmental sensitive resources. The contingency analysis covers all these barriers and analyse requirements that must be set to each of the barriers:

- Barrier 1: Combating in open sea (field systems and NOFO systems)
- Barrier 2: Combating in the coastal zone (NOFO/coastal systems)
- Barrier 3: Protection of environmental priority areas (coastal systems)
- Barrier 4: Combating in the tidal zone
- Barrier 5: Beach cleaning

For each of the barriers it will be considered systems for remote monitoring and post-spill investigations.

The use of chemical dispersants has not been considered as an adequate combating strategy during the planned drilling operation. One reason for this is that the oil type characteristics are not known in detail. But NOFO approved a dispersant policy in April 2006 allowing spreading dispersants by boat and an agreement is established with OSRL in UK for using their Hercules plane to spread dispersant.

The result of the contingency analysis will result in performance standards for barriers and systems for remote monitoring and post-spill investigations, including response time requirements.

5.3 Equipment, capabilities and effectiveness

Resources (equipment, personnel and vessels) are primarily available from NOFO, The Norwegian Coastal Administration and IUA ("Interkommunalt utvalg mot akutt forurensning").

NOFO's Master Plan contains a database over location and available equipment for oil spill combat in Norway (http://planverk.nofo.no/OV_ress.htm). The NOFO depots in Stavanger and Mongstad are the primary sources for offshore actions. There are presently 8 traditional systems at these depots, and in addition 4 Hi-wax systems (Table 8), with in total 3200 m Ro-Boom offshore booms.

Table 8: Equipment at NOFO depots

Depot	Equipment	Type	No.	Capacity	Unit
NOFO Stavanger	Framo Transrec 150	Overflow skimmer	2	350	m ³ /h
NOFO Stavanger	Roboom 3500	Offshore boom	2	400	m
NOFO Mongstad	Framo Transrec 150	Overflow skimmer	6	350	m ³ /h
NOFO Mongstad	Framo Hi-Wax	Drum skimmer	4	160	m ³ /h
NOFO Mongstad	Roboom 3500	Offshore boom	6	400	m
NOFO Mongstad	BP 100 WD	Dispersant	30	1	tonne
NOFO Kristiansund	Framo Transrec 150	Overflow skimmer	3	350	m ³ /h
NOFO Kristiansund	Framo Hi-Wax	Drum skimmer	2	160	m ³ /h
NOFO Kristiansund	Roboom 3500	Offshore boom	3	400	m
NOFO Træna	Framo Transrec 150	Overflow skimmer	3	350	m ³ /h
NOFO Træna	Framo Hi-Wax	Drum skimmer	3	160	m ³ /h
NOFO Træna	Roboom 3500	Offshore boom	3	400	m

Two of the systems at NOFO Mongstad are normally located at Troll/Oseberg and Jotun/Balder, both locations with both overflow and drum skimmer available. The response time from Jotun/Balder to well 15/12-18S/18A is in the order 3-4 hours.

The uptake capacity of the NOFO systems is documented at the NOFO Master Plan website (<http://planverk.nofo.no/kapasite.htm>). For Transrec 150 a capacity of 2400 m³ oil/day emulsion is defined, and for Hi-Wax skimmers the capacity is set to 1900 m³/day and FoxTail 8-14 is set to 800 m³/day. The efficiency of mechanical uptake in relation to wave height and light conditions are given in the NOFO Master Plan (http://planverk.nofo.no/mek_eff.htm). The values used in the analysis are shown in Table 9.

Table 9: Uptake efficiency of NOFO systems in relation to wave height

Significant wave height, Hs (m)	Uptake efficiency (absolute efficiency)	Proportion of time in July-September
0 – 0,5 m	85 %	3 %
0,5 – 1,5 m	75 %	27 %
1,5 – 2,5 m	65 %	38 %
2,5 – 4 m	55 %	25 %
> 4 m	0-45%	7 %

The total uptake efficiency based on these values is estimated to 64%.

Relevant depots at The Norwegian Coastal Administration (Kystverket) are located in Stavanger, Bergen, Florø and Solund.

In total, The Norwegian Coastal Administration resources include (approx. numbers):

- 9000 m oil booms for use in sheltered areas.
- 22000 m oil booms for use in coastal waters.

- 10000 m oil booms for use in offshore areas.
- 100 devices (skimmers, pumps etc) for uptake of oil from sea.
- Personal clothing and equipment for 1000 persons.
- Equipment for beach cleanup (including light, vessels etc).

The uptake capacity of The Norwegian Coastal Administration (Kystvakta - KyV) systems is documented at the NOFO Master Plan website (<http://planverk.nofo.no/kapasite.htm>). For Transrec 250 a capacity of 1200 m³ oil/day emulsion is defined. For FoxTail 8-14 and 4-9 the capacity is set to 800 and 300 m³/day, respectively.

Totally 8 vessels are available from Coast guard for oil combat actions.

Relevant IUA depots are located in Stavanger, Haugesund and Bergen. The uptake capacity of the IUA systems is documented at the NOFO Master Plan website (<http://planverk.nofo.no/kapasite.htm>). For coastal systems, the uptake capacity is set to maximum 120 m³/day oil emulsion.

Oil combat systems can also be mobilised from OSRL in Southampton (England). This company has an agreement with NOFO and can provide both equipment and personnel for combat actions in coastal and shoreline areas. The equipment includes approx. 3000 m coastal booms and more than 10000 m port booms.

5.4 Personnel safety

The personnel safety is given the highest priority during combating actions. Guidelines for establishing safety measures for personnel is described in the NOFO Master Plan – Attachment 2 – HSE routines (http://planverk.nofo.no/Vedlegg_2_15.htm).

5.5 Barrier 1 – combat actions in open waters

The dimensioning oil blowout is set to 6764 Sm³/day (Storskrynten), ref. Table 4.

In order to calculate a dimensioning uptake rate for oil emulsion on sea, the following parameters has been assumed:

- Dissipation rate: 1% per hour (natural down-mixing/dispersion rate).
- Evaporation rate: 20% in 24 hours.
- Water content in emulsion: 60% (maximum).

This provides a dimensioning oil combat discharge rate of 10629 m³/day. The uptake capacity of NOFO systems are 2400 m³/day. The weather and daylight specific uptake efficiency in the period July-September is estimated to 56%. The parameters and specifics for the uptake efficiency estimate are given below:

- Relative uptake efficiency in relation to significant wave height in Feb-Mar: 64%.
- Night efficiency relative to daylight: 65%.
- Proportion of daylight in July-September: 62%.

Total uptake efficiency = $(0,64 \times ((0,62 \times 1,0) + (0,38 \times 0,65))) = 0,56$.

Combining the uptake efficiency with the calculated rate of oil at sea of 10629 m³/day, provides an estimate total uptake capacity of $(10629 \text{ m}^3/\text{day} \times (1/0,56)) = 18980 \text{ m}^3/\text{day}$. This implies a requirement of minimum 8 systems (capacity 2400 m³ oil/day) for blowouts within the requirements for response time. Hi-Wax skimmers (1900 m³ oil/day) should be required

together with the traditional skimmers, because under certain wind and wave conditions, the oil will get thick and hard to handle with the traditional skimmers.

The regional contingency analysis describes 3 systems for region 2B (Varg) and 6 system for the region as a whole. This is because the amounts of emulsions are smaller than for this well, and it is also believed that dissipation rate is not taken into consideration in these calculations. In conclusion, for well 24/9-8 it is necessary to demonstrate the mobilisation of minimum 2 extra NOFO systems within the response time requirement.

The response time requirement is conservatively based on the fastest drift time to shore or environmental sensitive areas. For well 15/12-18S/18A, the fastest drift time is 8 days (192 hours), based on a distance to shore of approx. 240 km /22/. Since this is longer response time than what is defined in the NOFO Master Plan for region 2, it is decided to use the established requirements for the well for the 6 first systems.

The response time requirements for 6 systems in region 2 are already implemented in the NOFO Master Plan:

- 1 system within 18 hours - from Stavanger
- 1 system within 24 hours - from Mongstad
- 1 system within 36 hours - from Kristiansund, Stavanger or Mongstad
- 1 system within 36 hours - from Kristiansund, Stavanger or Mongstad
- 1 system within 36 hours - from Kristiansund, Stavanger or Mongstad
- 1 system within 60 hours - from Træna.

Hence, 6 systems can be mobilised well within the fastest drift time to shore of 192 hours. Based on the fact that NOFO has totally 14 systems available at 5 bases along the coast, it is concluded that a mobilisation and response requirement for combating actions in open sea – barrier 1 – is met also for the remaining systems, and is set to 80 hours. Hence, well before the oil potential reaches the shore.

Complete NOFO systems with both traditional Transrec skimmers and Hi-Wax skimmers can also be mobilised from the regional contingency arrangements in the Jotun/Balder area that is located 3-4 hours sailing time from the well.

5.6 Barrier 2 – combat actions in coastal areas

The dimensioning of systems in the coastal zone is performed on basis of oil drift simulations and estimations of arrival quantities /22/. Topside discharge is dimensioning since there will be no subsea discharges (Table 10).

Table 10: Oil pollution statistics for the coastal zone

Discharge location	Maximum quantity of stranded oil emulsion	Maximum rate of stranding
Sea surface	6259 m ³	1691 m ³ /day

The uptake capacity of coastal systems from the Coast Guard (Kystvakta) is set to 920 m³/day based on an assumption of KyV systems distributed with 30% offshore booms (1200 m³/day) and 70% coastal booms (800 m³/day). The dimensioning rates specified in **Error! Reference source not found.**10 therefore implies a requirement for minimum 2 systems from KyV (Transrec 250 or Foxtail 8-14) within the requirements for response time for blowouts. For coastal systems the requirement in the NOFO Master Plan for Region 2B is 20 days in the summer season (12 days in the winter season).

5.7 Barrier 3 – combat actions at environmental priority areas

Protection of environmental priority areas (NOFO example areas), primarily locations with MOB priority A and B, will be carried out using systems from KyV/Coast Guard and IUA. A typical system unit will consist of a Coast Guard vessel with 200-300m offshore/coastal oil boom and Framo Transrec 250 skimmer, and a tow boat. Also NOFO Transrec systems may be mobilised for actions in these areas.

The systems will be directed to locations in the coastal zone based on monitoring and drift simulations of oil slicks, weather conditions and information of priority locations from NOFO oil spill contingency maps. It may further be necessary to gather information from people acquainted with the area.

A potential blowout from well 15/12-18S/18A entering the Norwegian coast may be widely distributed and affect a very large distance of the coast with quite small amounts at any given site. The oil drift simulations for a topside blowout show that there is 10-20% probability for arrival of more than 1 ton of oil in a 10x10 km area. Hence the quantity of oil at a specific location at the coast will be very low, and well within the uptake capacity of a coastal system from KyV/IUA of up to 120 m³/day. The important matter is how many locations that will be affected at the same time, requiring a number of systems to be directed to different locations. This will be evaluated during the monitoring of oil slick movement during the oil combat action period. Requirements should therefore be set for minimum 3 coastal systems to be mobilised.

The agreements and system availability for actions in coastal and priority areas that are established in the NOFO Master Plan, is therefore sufficient to comply with the oil spill contingency requirements for the wells. The response time requirement for combat actions and protection of priority resources in the coastal zone is set to 18 days in the NOFO Master Plan.

5.8 Barrier 4 – combat actions in the tidal zone

Simulations of oil spill scenarios that show maximum quantities of stranding oil are prepared by DNV /22/. The response time requirements for combat and cleanup systems in contingency area 2 (Sleipner/Varg) is considered to be adequate for well 15/12-18S/18A, and are set to 18 days /20/.

In the tidal zone barrier, both wind and currents will have considerable impact on the possibilities for combat actions. In the NOFO Master Plan for region 2 it is presupposed that combat actions will be carried out simultaneously at three locations, during a period of 10 days. In the summer season the dimensioning number of systems has been set to 2. Systems will be provided from The Norwegian Coastal Administration or IUA.

5.9 Barrier 5 – Beach cleanup

Oil drift simulations show that the largest quantities of oil probably will arrive in outer parts of Hordaland. The oil will be widely distributed, and it is assumed that the oil pollution will cover 5% of the affected area/coastline. Based on this, it must be set requirements for beach cleanup actions on minimum 65 km beach during a period of 30 days, and this will require in total 22 beach cleanup teams (ref. NOFO Regional Contingency Analysis for region 2 - http://planverk.nofo.no/beredskapsbehov_r2.htm).

5.10 Systems for remote monitoring

Systems for remote monitoring implies technologies and routines to ensure that oil slicks on sea can be detected and monitored independent of visibility, light and weather conditions, including mapping of position, area and oil quantity (ref. The Activity Regulations §52). Such systems shall cover both open sea and coastal areas.

Relevant systems for remote monitoring are:

- **Visual observation from vessels and helicopters:**
Available systems are vessels on the field, helicopters and aeroplane (LN-SFT). Existing systems are considered sufficient, and no specific requirements are set to detection time. All upset or hazard situations during the drilling operation will be detected immediately.
- **Helicopter with IR/Downlink systems** (part of NOFOs systems):
NOFO have agreements with Helicopter Service for mobilisation of helicopters with several technologies for remote monitoring, including common video camera and FLIR (Forward Looking Infrared camera) suitable for use in bad light conditions. The NOFO oil spill contingency vessels have equipment for immediate downloading of observation data. Response time requirements for helicopters are set to 24 hours.
- **Aerostat and aeroplane** with SLAR/IR/UV (part of NOFOs systems):
Surveillance aeroplane from KyV (LN-SFT) has common video camera and still photo camera, and SLAR type radar (Side-looking airborne radar). The observation area is within 40 km to each side of the aeroplane flight line. The aeroplane is a useful supplement to other monitoring systems. No specific response time requirements are set as there is no specific formal agreement between NOFO and KyV for the mobilisation of the plane.
- **Satellite images.**
- **Weather reports** from Meteorological Institute (met.no), and onsite weather observations:
Routines are established for receiving weather forecast reports from met.no, in addition to onsite observational data. There has also been established a website service with direct access to weather forecasts for the North Sea area (<http://metoc.met.no:8080/metoc/menu.jsp>). The weather forecast from met.no is also used directly in the oil drift simulations for prediction of transport and fate of oil slicks.
- **Oil drift simulations** at met.no (part of NOFOs Master Plan):
The results from the simulations shall be submitted within 30 minutes after the order is received. The simulations are carried out on basis of the provided oil properties and weather forecast for the relevant period. New oil drift simulations are ordered if the circumstances changes or new information is available.
- In addition there will be established **operational routines for monitoring** of the nearby sea surface to detect oil spill (includes both the rig crew and the stand-by boat). And we have routines for checking the helicopter supplier.

5.11 Post-spill investigations

Post-spill investigations include chemical and biological mapping of the extent and the effects of an oil spill. The results are used both during the combat and restoration phase. Authority requirements for post-spill investigations are given in the Activity Regulations §53. SFT has also published guidelines for accomplishment of such investigations /16/ and /17/.

NOFO has an agreement with SINTEF for carrying out post-spill investigations according to the SFT guidelines. The mobilisation time requirement is set to 48-72 hours.

5.12 Performance requirements

Based on the assessments in the above sections, a set of performance standards have been identified for defined barriers and contingency systems. These performance standards form the basis for development of the Oil Spill Contingency Plan /5/ containing specific Action Plans and necessary agreements.

Performance requirements – Barrier 1 – Open sea (field / NOFO contingency systems)	
Uptake capacity requirements	18980 m ³ oil-in-water emulsion per day
System requirements	8 Transrec 150 NOFO systems if topside blowout
Equipment – primary	NOFO Transrec 150 and 400 m NO-1200 oilbooms.
Equipment – secondary	NOFO Hi-Wax systems shall be available.
Response time system 1	18 hours (Stavanger).
Response time system 2	24 hours (Mongstad).
Response time system 3-4-5	36 hours (Stavanger, Mongstad or Kristiansund).
Response time system 6	60 hours (Træna).
Response time system 7-8	80 hours (Stavanger, Mongstad or Kristiansund).
Thin oil films	NOFO strategy for double oil boom systems shall be available.
Thick oil capabilities	Hi-Wax drum skimmers shall be available within the response time requirements.
Operational weather conditions	The oil recovery equipments shall be able to operate effectively in minimum 2,5 m significant wave height and ocean currents up to 1,5 knots.
Darkness and reduced visibility	Equipment for operation in darkness and reduced visibility (e.g mist) shall be available. This includes IR camera and FLIR down-link. The response time requirement for this equipment is 18 hours.
Prioritised environmental resources	Priority to combat actions close to source.

Performance requirements – Barrier 2 – Coastal zone (KyV/Coast guard, secondary NOFO)	
Uptake capacity (emulsion)	1691 m ³ oil-in-water emulsion per day
System requirements	2 Transrec 250 KyV or Foxtail 8-14 systems. The average uptake capacity must be minimum 920 m ³ emulsion per day.
Equipment – primary	KyV oil skimmers (Transrec or Foxtail), NO80N or NOFI 800S offshore oil booms
Equipment – secondary	NOFO Transrec skimmers and Ro-Boom oil booms. Alternatively KyV Expandi, NOFI or Sea Serpent coastal oil booms.
Response time system 1, 2, 3, 4	8 days
Thin oil films	It will be focused on using Foxtail and/or double lenses
Darkness and reduced visibility	Operations in darkness or reduced visibility must be considered with respect to safety.
Prioritised environmental resources	High priority resources in PSSAs or NOFO “example areas”. Priority settings based on the MOB classification system.

Performance requirements – Barrier 3 – Environmental priority areas (KyV/Coast guard and IUA)	
Uptake capacity	Minimum 3 coastal systems with a capacity of up to 120 m ³ /day.
System requirements	Transrec or Foxtail oil skimmers from KyV or Oil Mop skimmers from IUA. KyV Expandi, NOFI or Sea Serpent coastal oil booms, or NOFI, NOAS or Expandi coastal oil booms from IUA.
Equipment – primary	Equipment from KyV/Coast Guard and IUA.
Equipment – secondary	Equipment from OSRL.
Response time system 1, 2, 3	18 days (based on requirements in the NOFO Master Plan).
Darkness and reduced visibility	Operations in darkness or reduced visibility must be considered with respect to safety.
Prioritised environmental resources	To be based on the MOB classification system. Highest priority to MOB A and B locations.

Performance requirements – Barrier 4 – Tidal zone (KyV/SFT, IUA)	
Uptake capacity	Minimum 4 coastal systems with a capacity of up to 120 m ³ /day.
System requirements	Transrec or Foxtail oil skimmers from KyV or Oil Mop skimmers from IUA. KyV Expandi, NOFI or Sea Serpent coastal oil booms, or NOFI, NOAS or Expandi coastal oil booms from IUA.
Equipment – primary	IUA and KyV/Coast Guard equipment and personnel mobilized from the whole country.
Equipment – secondary	OSRL (Southampton, England).
Response time	18 days (based on requirements in the NOFO Master Plan).

Performance requirements – Barrier 5 – Beach cleanup (IUA)	
Beach cleanup teams	Minimum 22.
Response time – beach cleanup	18 days (based on requirements in the NOFO Master Plan).
Darkness and reduced visibility	Operations in darkness or reduced visibility must be considered with respect to safety.
Restoration / normalisation	Cleanup of beaches shall be accomplished within 30 days after free floating oil slicks have been recovered.

Performance requirements – Systems for remote monitoring (NOFO, KyV, MI)	
Visual observation from rig and vessels	Immediate notification to the platform manager (OIM).
Helicopter	Shall be mobilized within 24 hours (Helicopter Service). The helicopter shall have systems for remote monitoring including common video camera and IR camera (FLIR).
Aerostat	No requirements are set to the use of aerostat (NOFO). May be a supplement to other remote monitoring systems. To be evaluated by the action leadership.
Surveillance aeroplane	It is required to have access to a surveillance aeroplane such as LN-SFT, but no specific requirements are set to response time or monitoring capabilities. The technologies available must include common video camera, still picture camera and radar (SLAR).
Satellite images	May be used during an action. No specific requirements.
Weather observations	Updated weather forecast shall be available on a regular basis during an action.
Oil drift simulations	Oil drift simulations from MI shall be ordered if the oil spill is above approx. 100 m ³ . Information about the spill shall be submitted on standard scheme by fax to MI. The results shall be available 30 minutes after the order has been received.

Performance requirements – Post-spill investigations (Sintef, other scientific institutions)	
Chemical and biological investigations	Equipment and personnel for sampling and analyses shall be mobilized within 48-72 hours according to NOFO agreement with SINTEF.

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7 Appendix – Environmental impact classification

Table 11: Impact matrix and classification of environmental impacts of scenarios for exploration drilling 15/12-18S/18A

No.	Impact category	0	1	2	3	4	5	Weighting Factors	Scenario																
									1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	Recovery time (year)	Not detect.	< 1 month	< 1 year	1- 3 year	3-10 year	> 10 year	15 %	1	3	2	1	2	2	0	0	0	0	0	0	1	1	0	0	0
2	Number of resources	None	1-2	< 5	< 10	< 15	> 15	5 %	2	4	3	2	4	3	1	1	1	1	1	1	2	2	1	1	1
3	Conservation Value of affected resources / areas	None	Local	Regional	County	National	International	5 %	4	5	5	4	5	5	2	2	2	2	1	2	2	1	1	1	1
4	Size of affected area on sea surface (km ²)	< 0,1	< 0,5	< 5	< 50	< 150	> 150	5 %	5	5	5	5	5	5	2	2	0	0	2	0	4	3	2	0	0
5	Fluid degradability (weathering properties)	-	Very fast (hours)	Fast (days)	Moderate (weeks)	Slow (months)	Very slow (mnts-years)	10 %	4	5	5	4	5	5	3	3	2	2	4	1	0	0	0	3	4
6	Shoreline quantity (tons)	<1	<10	<100	<1000	<5000	>5000	5 %	3	5	4	3	4	4	0	0	0	0	0	0	0	0	0	0	0
7	Area with harmful water concentrations (km ²)	< 0,1	< 0,5	< 5	< 50	< 150	> 150	5 %	3	5	4	3	5	4	1	1	0	0	0	0	0	0	0	0	0
8	Area with harmful sediment conc./amounts	None	< 0,1 km ²	< 0,15	< 0,3	< 0,6	> 0,6	5%	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
9	Transfer of effects (to new generations etc)	None	No	-	Uncertain	-	Yes	10 %	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	0	0
10	Importance for fisheries	None affected	Locally, few vessels	Locally, many vessels	Regionally, few vessels	Regionally, many vessels	Nationally	5 %	1	2	2	1	2	2	0	0	0	0	0	0	0	1	0	0	0
11	Importance for aquaculture	None affected	<5 farms affected	5-10 farms	10-20 farms	20-50 farms	>50 farms affected	5 %	4	5	5	4	5	5	0	0	0	0	0	0	0	0	0	0	0
12	Importance for outdoor life (secured areas level)	None affected	1-2 secured areas aff.	3-5	6-10	11-20	>20	5 %	1	4	2	1	3	2	0	0	0	0	0	0	0	0	0	0	0
13	Importance for harbours and marinas (boats)	None affected	Only few boats aff.	Many boats, locally	Many boats, communicip.	Many boats, regionally	Many boats, county level	2,5 %	0	2	1	0	2	1	0	0	0	0	0	0	0	0	0	0	0
14	Additional adm.effort/work in the company	Insignificant	Little extra work, short duration	Moderate extra work, short dur.	Moderate extra work, long dur.	Considerable extra work, short dur.	Considerable extra work, long dur.	2,5 %	4	4	4	4	4	4	2	2	1	1	2	1	1	1	1	1	1
15	Company reputation	No effect	Small effect	Moderate effect	Considerable, short duration	Considerable, long duration	Serious effect	10 %	4	4	4	4	4	4	2	2	2	2	1	2	1	1	1	1	1
16	Economic costs, mill. NOK	< 0,05	< 0,5	< 2,5	< 5	< 10	>10 mill. NOK	5 %	5	5	5	5	5	5	2	1	0	0	0	0	0	0	0	0	0
AIV = (impact value) x (weighting factor) Most of the impact values are based on professional judgements, except parameter 4,6,7,8,11,12 and 16, which are based on facts/calculations									2,55	3,60	3,18	2,55	3,35	3,18	1,05	1,00	0,68	0,68	0,65	0,58	0,58	0,63	0,43	0,53	0,63