Risk Based Oil Spill Emergency Preparedness on the Norwegian Continental Shelf

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ABSTRACT

The Norwegian Clean Seas Association for Operating Companies (NOFO) is responsible for oil spill response, planning and preparedness on behalf of the companies who are operating on the Norwegian continental shelf. The responsibility includes initial response offshore, as well as coastal protection and shoreline clean up. NOFO is working out a plan for regional oil spill preparedness to be implemented in 2001. The plan is based on risk assessment and covers planned oil production activities in the Norwegian offshore sector.

Previously, NOFOs oil spill response plan was based on Authority requirements and recognised standards. NOFO is now proposing a risk-based approach, aiming to identify the need for oil spill response in different areas of the Norwegian sector. The new approach is based on: Estimated probability of oil spill situations, dimensioning oil spill scenarios, and oil drift modelling to define arrival time to shore, coastal areas at risk, and amount of oil that may possibly reach the shore. The risk based approach is an alternative to traditional “worst case” considerations and allows implementation of more cost-effective measures.

DISCUSSION

Background

Norwegian Clean Seas Association for Operating Companies (NOFO) is an organisation responsible for preparedness in the event of major oil spills on behalf of operators on the Norwegian continental shelf. NOFO was established in 1978, and the contingency area has until now been defined as sea areas 40 nautical miles out from the coastal base line. The Norwegian authorities have stated that mechanical oil recovery close to the spill site shall be the primary combat action. At present, NOFO has 14 seagoing oil recovery units stored in depots along the coast, with response time less than 24 hours to any offshore spill location.

As a result of the Norwegian Authorities clarification of the industry's responsibility in oil spill response actions, NOFO is revising the oil spill response plan in order to include actions in coastal areas and beach clean up operations. In addition, a new risk based approach is being applied as basis for emergency preparedness requirements. The approach is founded on risk based methods and guidelines recently developed for Regional Environmental Impact Assessments (Roald, 1999; Wiklund 1999) and Environmental Risk Assessments (OLF, 2000). The revised plan shall be implemented by the summer of 2001.

The Norwegian Pollution Act states the principle that the emergency preparedness shall be in reasonable proportion to probability of acute pollution occurring and to the scope of damages and disamenities which may occur. Based on this principle, NOFO has proposed that the organisation shall be dimensioned to handle 80% of oil spills larger than 100 tons that may possibly occur during offshore oil production in Norway. In case of an extreme oil spill incident (remaining 20%), additional equipment will be brought in to the area.

In Norway, only one oil spill in this category (larger than 100 tons) has occurred during the existence of NOFO. The spilled oil (approximately 900 m^3) was efficiently recovered at the spill site in the North Sea .

Oil production activities

The first step of the risk-based approach was to gather activity prognosis from all the operating companies. The year of 2001 and 2003 were chosen as basis for the prognosis, as shown in table 1.

Table 1. Planned oil production drilling and well operations

The vast area of activities is complex with regard to the level of activities, oil and reservoir properties, distance from shore, weather conditions, etc., and was therefore divided into 10 sub areas. An example of sub areas is shown in figure 1, with registered oil production activities shown in table 2.

Figure 1: Sub areas R3-A, R3-B and R3-C in the North Sea

Table 2. Planned oil drilling and production in sub area R3-A, R3-B and R3-C

Blowout frequencies

The Norwegian regulations demand an environmental risk assessment to be carried out prior to offshore operations such as drilling and oil production. A comprehensive set of data on estimated accidental spill rates and spill duration were therefore made available from the operators. With references to the risk assessments, the environmental risk is normally related to a well blowout, and this kind of incident was therefore defined to be the dimensioning oil spill scenario. A comprehensive study of blowout frequencies was done, covering all of the sub areas as basis for the regional oil spill response plans (Wiklund, 2000).

In order to meet the criteria of handling 80% of all oil spill scenarios, dimensioning blowout scenarios were defined for each of the sub areas. The principle for the dimensioning oil spill, is that 80% of all possible oil spills larger than 100 tons, from offshore oil production operations in each sub area, will by volume be less than the defined blowout situations. Typical blowout rates (the expectation value) were chosen for different spill volume categories, and spill durations were estimated by volume divided by spill rate. Since the occurrence of sub sea blowouts are lower, and the discharge amount expectation values are higher than for topside blowouts, dimensioning blowout scenarios were defined for subsea and topside concepts as exemplified in table 3. In all of the regions, the spill rate defined for each of the sub areas, was within the range of 1500 - 7600 Sm^3 oil/day, and the discharge volume was within the range of 7000 - 68.000 Sm^3 of oil (Wiklund, 2000).

Table 3: Dimensioning oil spill situations

Offshore oil recovery performance

The seagoing equipment NOFO uses is developed in co-operation with producers and suppliers and is amongst the most effective on the market. Even though oil should be recovered close to the spill site, some oil may escape and reach the coast. In order to identify the need for equipment in coastal areas, the efficiency of oil recovery at sea is being discussed. The oil recovery performance may be reduced due to harsh weather conditions and low visibility.

At present, Norway is one of a few countries, which allows release of oil for test and training purposes. NOFO has executed about 20 tests of mechanical oil recovery at sea during the last 15 years. Results from the tests are shown in figure 2.

Figure 2. Effectiveness of oil recovery (%) related to significant wave height (m). The red line shows the theoretical effectiveness.

In order to optimise an oil recovery operation, the effort should be concentrated on the thickest parts of an oil slick. With reference to NOFOs contingency plan, remote sensing shall be executed by helicopter equipped with infra red camera, a colour video camera, and a down link system to transfer pictures to the on scene commander's vessel. In addition, NOFO has an aerostat with the same camera equipment. With the remote sensing systems in place, the effectiveness of a recovery operation will be significantly improved. This is especially true in darkness, and NOFO has suggested that an efficiency of 60-70% may be obtained with the camera systems, compared to daylight.

Based on the above figure and historical data on weather conditions and darkness, the mean effectiveness of an oil recovery operation offshore has been estimated to about 70 % during summer and 30-50 % during winter.

Oil drift modelling

Oil drift modelling is an integrated part of an environmental risk assessment, and an extensive set of modelling results has been obtained for the offshore oil activities. As part of the regional oil spill response plans, modelling results will be provided for each sub area, based on the defined blowout situations and the assumed effectiveness of oil recovery. The spill location and oil properties shall be representative for the sub area. The oil drift modelling will be done during autumn 2000, as soon as the Norwegian authorities have agreed on the choice of spill situations and the expected effectiveness of oil recovery. The results will then be used to calculate the number of oil recovery units needed to protect the coast, the minimum response time, as well as any other equipment needed to carry out an effective operation.

CONCLUSIONS

Oil spill preparedness should be reasonably proportioned to the environmental risk, and risk assessment should therefore be an active tool to design cost effective measures, as opposed to conventional “worst case” considerations. NOFO has proposed that the organisation shall be dimensioned to handle 80% of all oil spills larger than 100 tons, related to offshore oil production. Consequently, a risk-based approach has been developed to establish emergency preparedness requirements specific for different areas. The approach allows design of more effective measures by focusing on the characteristics of an area, including reservoir and oil properties, weather conditions, probabilities for major oil spills and probabilities for oil reaching the shore.

BIOGRAPHY

Jon Oddvar Rødal is the Director of Operations in NOFO. Mr. Rødal has worked with NOFO since 1984, and his main responsibilities are to make and maintain oil spill contingency plans, educate oil spill response personnel, participate in developing equipment, oil spill combat tactics and methods for collecting spilt oil.

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Figures and tables:

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Table 1. Planned oil production drilling and well operations

Concept	Year	Oil production wells to be drilled	Oil producing wells	Work over operations	Wire line operations
Sub surface	2001	50	175	51	76
Platform	2001	58	530	119	484
Sub surface	2003	8	193	46	86
Platform	2003	57	595	119	533

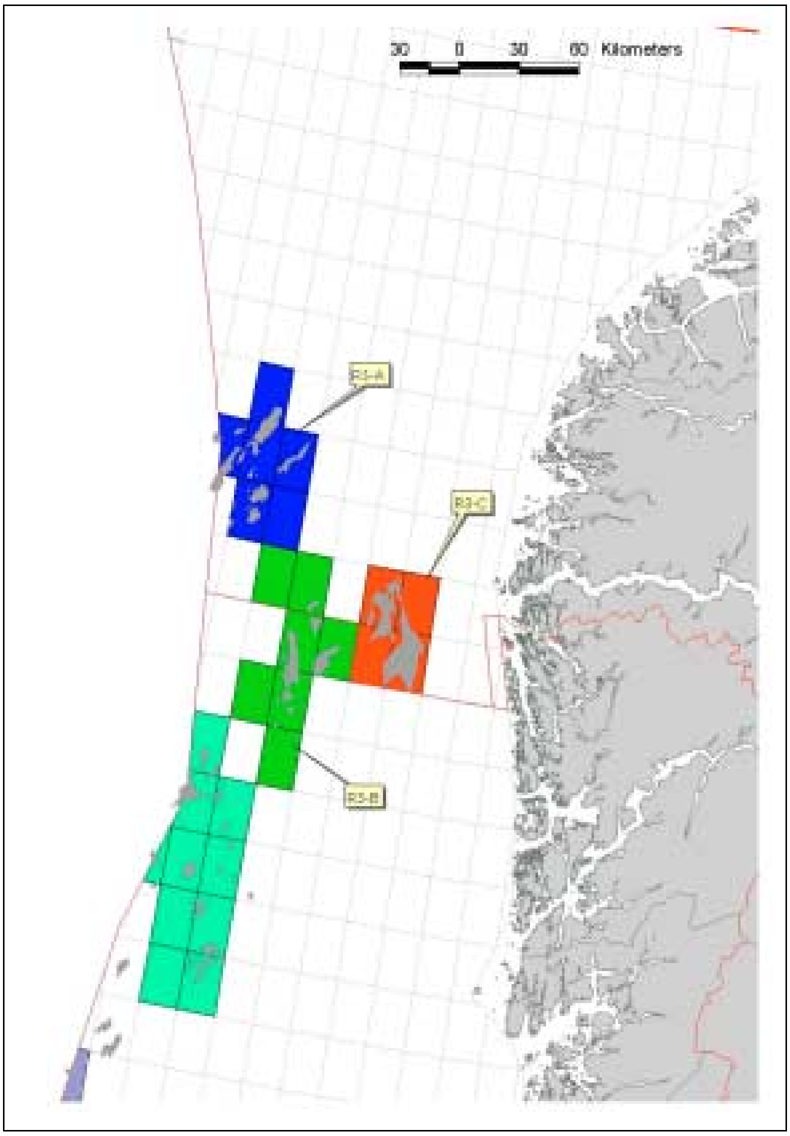

Figure 1. Sub areas R3-A, R3-B and R3-C in the North Sea

Table 2. Planned oil drilling and production in sub area R3-A, R3-B and R3-C

Year	Sub area	Well concept	Oil production wells to be drilled	Oil producing wells
2001	R3-A	Sub sea	12	43
		Topside	21	201
	R3-B	Sub sea	3	8
		Topside	19	86
	R3-C	Sub sea	17	67
2003	R3-A	Sub sea	5	25
		Topside	24	206
	R3-B	Sub sea	0	11
		Topside	8	98
	R3-C	Sub sea	0	87

Table 3: Dimensioning oil spill scenarios

Year	Sub-area	Well Concept	80 % of oil spills are less than…		
			Volume (Sm^3)	Duration (days)	Spill Rate (Sm^3/day)
2001	R3-A	Topside	20000	6	3300
		Sub sea	26000	9	2900
	R3-B	Topside	25000	6	3900
		Sub sea	35000	9	4000
	R3-C	Topside	18000	6	3300
		Sub sea	16000	9	1800
2003	R3-A	Topside	20000	6	3200
		Sub sea	27000	9	3000
	R3-B	Topside	22000	6	3700
		Sub sea	37000	10	3700
	R3-C	Topside	9000	6	1500
		Sub sea	16000	11	1500

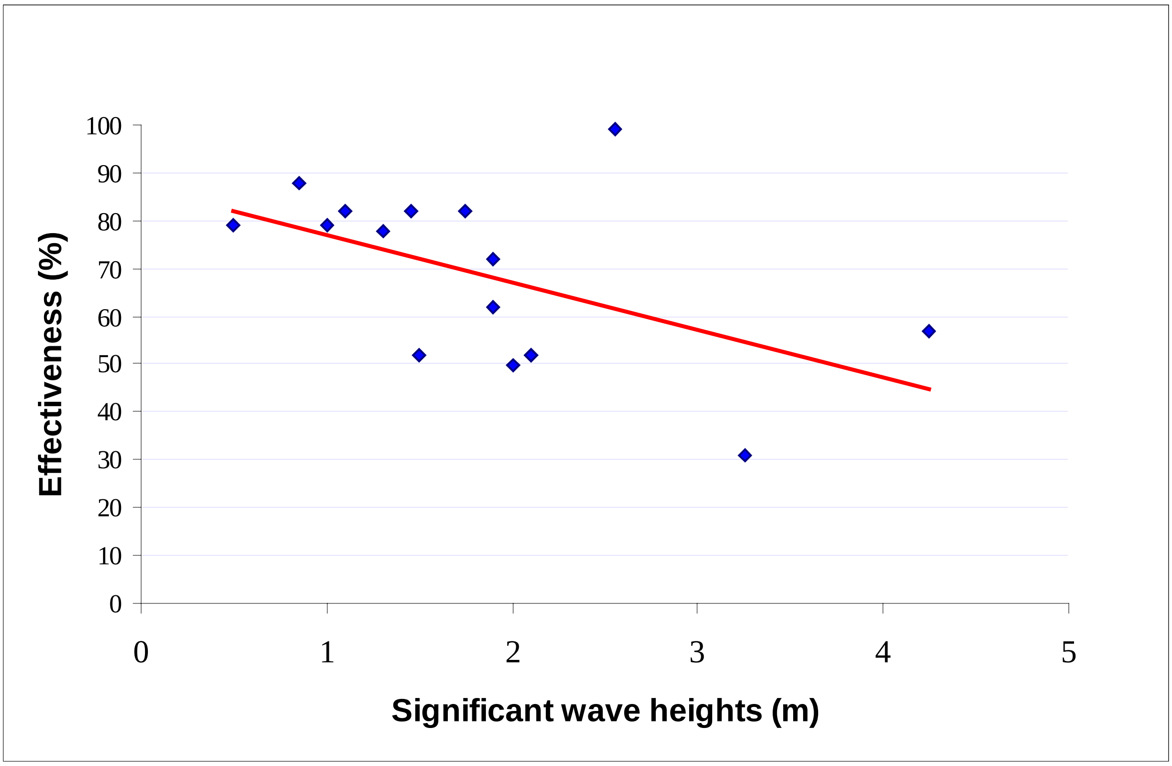

Figure 2. Effectiveness of oil recovery (%) related to significant wave height (m). The red line shows resulting effectiveness, as applied in further assessments.