Norwegian Oil Spill Contingency and Risk based Governmental Contingency planning.

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1 Abstract

The intention of my presentation is to give you a broad picture of the Norwegian Contingency system and how we carry out risk based contingency planning in SFT. During the last two years a working group from the department of Control and Emergency response has developed and tested a method which make it possible to transform very different information and knowledge about oil pollution and oil spill recovery operations, into detailed proposals for governmental oil response capacity along our coast.

2 Norwegian contingency today

2.1 Geography, weather & climate

The Norwegian economical zone is located between 56 and 82 degrees North and covers 2 million square kilometres. While the land area constitutes 324 220 square kilometres only, the total beach line - fjords and islands included - is close to 57 000 kilometres, and the population of Norway is only 4,5 million. At this northern latitude, huge variations in weather and light conditions prevail and while some parts of the country have arctic climate, mild winters with temperatures above freezing is common in mainland coastal areas. All this, in combination with extensive shipping and petroleum exploration, production and transport, represent a risk of severe environmental impact from oil and chemicals.

2.2 The Pollution Control Act

The Norwegian Pollution Control Act of 1981 chapter 6 "Acute Pollution" includes specific requirements related to contingency in cases of acute pollution. The industry and municipalities have to comply with the following obligations:

- to establish and maintain a contingency organisation and a contingency plan,
- to notify when acute pollution is identified,
- to take immediate action to limit environmental consequences,
- to assist the government in case of national emergencies.

The "polluter pays" principle is also implemented into the Act.

2.3 The national contingency system

The Pollution Control Act states that the national contingency system is divided into private (industry), municipal and governmental contingency with specific areas of responsibility. In Norway, all contingency plans and organisations are standardised and co-ordinated. Hence, in case of a major national emergency, the national contingency system will work as a single integrated response organisation.

2.3.1 The petroleum industry

Today, Norway is the world's second largest exporter of crude oil second only to Saudi Arabia. In the North Sea and Norwegian Sea, more than 3,2 million barrels of crude oil is produced daily from more than 50 floating and fixed installations. The crude oil is transported from off shore installations on shuttle tankers and through pipelines to several oil terminals on land, both in Norway and in the UK from which very large crude carriers (VLCC) embark. 10% of Norway's GNP and 36% of all export is originating from this industry. During the next decade, total investment in the petroleum industry in Norway is estimated to 8 billion £ Sterling.

About 2 500 tonnes of oil is discharged annually, of which 90% is produced water with an average oil content of 25 ppm. The remaining 10% of this annual volume originate from about 150 acute oil spills, most of which have a spilled volume of less than 1 m^3. The volume of produced water is increasing, as production wells grow older. In addition more than 150 000 tonnes of production chemicals is released annually. Such discharges require a release permit from the Norwegian authorities.

The off shore industry has to comply with contingency requirements forwarded by the Norwegian Pollution Control Authority (SFT).

2.3.2 On shore industry

In addition to the general obligations laid down in the Pollution Control Act, some 80 industrial enterprises have received individual contingency requirements from the SFT. Based on environmental risk analysis, specialised contingency is established including a contingency plan, regular training of personnel and response equipment. Typical enterprises of this category are oil terminals, refineries and chemical factories.

In addition to the industry there are more than 300 000 underground petroleum storage tanks in Norway, of which 1 % is believed to leak at any given time. New regulations aiming at quality control and the prevention of such releases came into force in 1998.

2.3.3 Sea transport

Norway is one of the most rural populated countries in the world. Small communities along the coast depend on ship as the major means of transport. Petroleum products are transported by ships between more than 400 tank facilities from which distribution is by tank lorries. In 1998 the total amount of goods transported on internal sea-lanes in Norway was 16 million tonnes, 3 vessels was totally lost, and 63 vessels were partially lost due to grounding [1]. The amount of spilled oil from vessels in 1999 comprised 223 m^3 from 101 incidents [2].

2.3.4 Land transport

In the whole of Norway, transport on rail and road containing chemicals as well as petroleum products is common. Each year about 40 accidents involving petroleum and chemical cargo take place, some causing environmental impact to rivers and soil. In 1998 14,5 million tonnes of petroleum products and 4,5 million tonnes of chemicals were transported on-road [3]. The amount of spilled oil from land transport in 1999 comprised 53,3 m^3 of petroleum products from 28 incidents and 4,2 m^3 of chemical products from 5 incidents [2].

2.4 International agreements

Norway is a member of the Bonn Agreement, Copenhagen Agreement and other international agreements concerning mutual notification and assistance in case of major environmental emergencies. Norway has also ratified the OPRC convention.

3 Models and tools

3.1 Oil drift-, trajectory- and plume models

For almost 20 years, the Norwegian Meteorological Institute (DNMI) has delivered an oil trajectory and drifting model service. Based on parameters such as location, oil quantity and oil type model results will be forwarded to the oil industry, the Norwegian Pollution Control Authority or other customers within 20 minutes. This service is operational 24h a day.

A major upgrade of the model will be completed in the near future, taking into account deep water blow out (oil plumes in the water column) as well as interaction with enhanced weather forecast models.

3.2 Aerial and satellite surveillance

Since 1980, a dedicated oil pollution surveillance aircraft has been in daily operation in Norway. The on-board Side Looking Airborne Radar (SLAR), IR/UV line scanner, photo and video equipment can detect and assess oil pollution at sea. The Fairchild Merlin IIIB twin turbine propeller aircraft has all weather capabilities due to a high altitude performance (pressurised cabin) and long range. A digital image transfer system between the aircraft and the governmental operational command centres in Horten, Bergen and Tromsø is included.

Since the early 1990s, radar images from ERS and RADARSAT has been used for early warning and flight planning purposes. Each year the combined use of aircraft and satellites cover more than 10 million square kilometres of sea surface detecting more than 150 oil spills.

3.3 Oil weathering models

In Norway, a research organisation has developed an oil database containing extensive laboratory analysis of about 60 different oil types [7]. In addition, detailed crude assay data for 200 crude oils in Norway and abroad is included. Hence, the SFT has immediate access to oil weathering information (dispersion rate, evaporation rate, etc., as function of time, temperature and weather) for a wide range of crude oils. Information from such models combined with field trials is vital to risk assessment as well as contingency planning.

3.4 Environmental Risk Analysis

According to national regulations, oil spill contingency related to oil production or exploration must be established based on the following 3 steps: An environmental risk analysis (ERA), a contingency analysis and the development and implementation of a contingency plan. Among the most important criteria related to ERA, environmental damage to selected indicators (bird populations etc) lasting more than 10 years shall not occur more frequent than 1 out of 40 000 drilling operations. National standards for ERA and contingency analysis based on a Net Environmental Benefit Analysis (NEBA) approach has been in use several years.

3.5 Contingency planning tools

Recently the Norwegian Pollution Control Authority has conducted an assessment of the governmental contingency response capability based on environmental risk assessment. In this work a contingency planning simulation tool was used to assess spill scenarios at different locations.

First, environmental risk analysis (probability of oil spill & environmental impact) was established for six regions. Then a number of "most probable" scenarios were defined in each region. For each scenario a thorough description was made, including the position of the oil spill, discharge conditions, flow rate and the total amount of oil at sea. Finally, a response plan was established for each scenario.

For each of the six scenarios, the effectiveness of oil spill response was simulated. The simulations provided us with the amount of oil recovered, naturally dispersed, stranded and evaporated. After several iterations, the response resources necessary to achieve the goals in the response plan were identified given by the number mechanical oil recovery systems, response time, the number of shoreline cleanup teams etc.

The recommended level of contingency is now being compared to the present contingency level identifying the need for re-location of depots, more response equipment etc.

4 Training and exercises

A vital part of the preparedness is training and exercises. The types of courses and exercises described in this chapter are those conducted by SFT to uphold the competence of the national contingency system in Norway.

4.1 Training

The training courses are adapted to the following functions in the oil spill response organisations:

- Introduction (basic) training course
- Team leader course
- On-scene commander level course (OSC-Sea, OSC-Coast and OSC-Land)
- Management level course
- Course for governmental depot task force and technical supervisors

The basic training course is designed for all personnel involved in the contingency organisation. These courses are usually conducted by the organisation itself, preferably after a "train-the-trainer" course.

The team leader level is given a 4-day training course. The course consists of two days of lectures and two days of practical training. During the practical training one day is solely for hands-on exercises using booms and skimmers at sea and from the shoreline.

The 3-4 day on-scene commander level (OSC) focuses on operational management and tactical use of response equipment during an operation. Each course consists of lectures as well as practical training tailored to fit the needs of the various geographical response areas. (i.e. at sea, coast or on land)

The management level of an oil spill response operation is given a three-day training course consisting of one day of lectures (theory) and two days of practical training. The latter is divided into a table-top exercise to familiarise the participants with their duties, and a role-playing exercise to train their abilities during a stressful incident.

On the governmental level, there are 15 depots with their own technical supervisor and a 10 men task force. The newcomers to the task force are given a four-day introduction course by SFT in Horten, and annually the whole task force is given appropriate training at the depot.

4.2 Exercises

In Norway, exercises conducted by SFT are adapted to the needs of the municipal and the governmental contingency organisations.

Within the governmental contingency there are exercises arranged over a wide area to uphold the preparedness. Several large integrated exercises are arranged annually in which personnel and resources from the private industry, the municipalities, the government and the Coast Guard is taking part verifying that the national contingency system is operational.

On the international level a number of exercises are arranged annually based on different international obligations such as the Bonn agreement and the Nordic Copenhagen Agreement.

5. Planning based on environmental Risk analysis

We started our work with the following question:

"Taking into consideration the environmental risks from ships in Norwegian waters, is SFT's oil spill response capacity dimensioned correctly??"

There are a couple of reasons for asking this question. The main reason is that SFTs oil spill emergency response organisation has not been changed very much since it was established in the late seventies. The today's structure of SFTs oil spill emergency response organisation has been a result of many compromises. The organisations should in a reasonable way give same protection to all parts of the coastline and our depots should not be located too far from airports and deep water harbours. The distance between the depots should not differ too much.

The location of our equipment depots and the types and numbers of oil spill recovery equipment were not decided on the basis of systematic risk assessments. But I would like to stress that there is no reason to believe that there is a great miss-match between SFT oil recovery capacity today and the environmental risks from the oil spills SFT has to react against. The point is that we do not have a precise picture of whether the location of equipment depots and the numbers and types of equipment are optimal with regards to SFTs responsibilities.

Today, both private companies and municipalities do their contingency planning on the basis of risk assessments. There is no reason why SFT should not do the same.

5.1 Survey of our method

1) Use of dimensioning oil spill scenarios.

   Basically, we wanted to compare SFT's existing level of oil spill preparedness with the level of preparedness SFT would have to establish against a certain number of realistic, but imaginary oil spills from ships in Norwegian waters. The idea is that these imaginary oil spills shall be used as dimensioning oil spills which SFT's contingency planning shall be based on. These dimensioning oil spills will in the following be called oil spills scenarios.

- They represent realistic oil spill situations, situations which SFT has the responsibility to react against.
- They are supposed to threaten our most sensitive environmental areas along the coast
- They are supposed to take place when the potential for environmental damage is largest
- And , the level of oil spill recovery capacity which needs to be established against the dimensioning oil spills, should also be sufficient against the most common oil spills from ships which happen in Norwegian waters.

2) Simulation of oil spill operations
   We have simulated oil spill operations against the oil spill scenarios

   A governmental oil spill response capacity along the coast has been proposed based on the results from the simulated oil spill operations.

3) The need for changes
   We asses the need for changes in the SFTs oil spill emergency organisation.

   -number of depots
   –the location of the depots
   –types and number of equipment

5.2 Use of the method

First I will give an overview over how we use oil spill scenarios in our contingency planning:

1) Location of the oil spill scenario by the help of oil drift model
2) Selection of oil weathering properties and weather conditions
3) Requirement for effectiveness of oil spill response
4) Analysis of the oil spill response

But how many oil spill scenario do we need, where are they supposed to be located and in which season are they supposed to happened?

*Based on environmental and administrative criteria we divided the coastline in 6 geographic regions.

*The regions were ranked in accordance to their relative environmental sensitivity with regards to oil spills winter and summer and the region's relative probability for oil spills fromships

*We made the following decision: We would locate a dimensioning oil spill scenario in regions where we during a year would have the following combination of damage class and probability: moderate/moderate, low/high, moderate/high and high/high. For each region you will have such a combination in the summer or winter time. Based on this risk matrix we therefore decided that an oil spill scenario should take place in each region.

*We decided that the oil spill scenarios was supposed to take place in the season when the environmental risk in the region is largest.

*For each region we described a realistic oil spill scenario based on ship traffic patterns and statistical information about ships involved in accidents. Each scenario is characterised by the type of ship involved, time of the year when the spill take place, wave- and wind conditions at the time of the spill, oil type involved, discharge rates, amount of discharges.

*By means of oil drift models, we calculated the exact position of the oil spill scenario if the oil was to threaten the most environmentally sensitive areas in the regions.

*As I have already mentioned, the governmental level of oil spill recovery capacity shall reflect the threats or environmental risks from oil spills from ships in Norwegian waters.

*How could we calculate or figure out the response capacity which is needed to copy with the environmental risks from oil spills from ships in each region. To solve this problem, we defined certain environmental objectives for the simulated oil spill operations. The environmental objectives describe what level of protection we want the oil spill operation to give.

"We have decided that the main intention of the simulated oil spill operations should be:

<u>The sea operation</u>

Avoid or reduce the possibility of contact between highly environmental sensitive areas and the drifting oil.

Avoid remobilization of stranded oil

No free floating oil on the sea surface 3 weeks after the spill had occurred.

<u>The beach cleaning operation</u>

The most important locations of seabirds, protection areas and recreational areas are to be sufficiently cleaned within a fixed date to avoid any harm or problems connected with normal use of the areas."

5.3 Results from simulated oil spill operations

The simulation of the oil spill operations against the dimensioning oil spill scenarios was carried out by the help of a simulation model. The model calculates the effects of applying different types of measures against the oil spills scenarios. The model takes into account the assumed efficiency of the applied measures, the weathering of the oil and the weather during the oil spill scenarios. The model also calculated the distribution of the oil spill between the sea surface, water column, evaporation and stranded oil.

The simulated oil spill operation was divided into three phases:

1) Collection or removal of oil from the sea surface in open waters
2) Collection of free floating oil near the beach
3) Collection of oil stranded on the beach.

*To reach our environmental objectives for each simulated oil spill operation we had to apply sufficient with resources in open sea, near shoreline and on the beach.

*To find the optimal distribution of resources between the open sea operation, the near shore operations and the on shore operations, we first had to decide what would be a reasonable number of oil spill response systems applied in open sea in each scenario. Here, we based our judgement on knowledge of the existing SFTs resources supplied with supposed available resources from private companies, municipalities and international oil spill emergency response organisations, i.e the Swedish Coast Guard.

*The model calculates the amount of oil removed from the sea surface by applying a certain amount of oil spill removal systems. The model also calculates the amounts of oil which has been stranded. Based on knowledge of how much oil that has been stranded, we can calculate the need for resources to collect the free floating oil near shore and the oil which has been stranded.
To calculate the efficiency of the different oil spill response systems and beach cleaning groups used in the simulation, we had to correlate for significant wave heights, light conditions, operational troubles, type of shores, type of oils.

*Based on the simulations we have calculated the oil spill response capacity which is necessary to obtain the environmental objectives set for each simulated oil spill operation.

”Scenario Runde: Resources needed if the environmental action objectives are to be achieved”

System	Response time (h)
Ocean going	12
Ocean going	20
Coast	14
Coast	21
Coast	6
4 Fjord systems	48
Dispersing system	6
Beach cleaning: 11 groups	96

5.4 Proposal for the governmental preparedness against oil spill from ships in each region

*Based on the calculated response capacity against the scenarios, we have proposed a governmental response capacity for each region. The proposed response capacity for the whole region is of the same magnitude as the response capacity against the dimensioning oil spill scenario for the region. The proposed governmental response capacity (number of systems and their response time) in the region will consist of SFT’s oil recovery systems supplied with available systems from private, local and international oil spill response emergency organisations.

*In relation to the magnitude of environmental risk from ships in the region, this level of preparedness is assumed to be acceptable. Remember that the dimensioning oil spill scenarios represents realistic oil spill situations and that they are supposed to threaten our most sensitive environmental areas along the coast. The oil spill response capacity which needs to be established against the dimensioning oil spills, should therefore also be sufficient against the most common oil spills from ships in the regions.

“Proposed response capacity in each region

Example: Region Nordvestlandet

Based on the scenario Runde

Systems	***Response time (h), sensitive areas: Stadt –Hustavika***	***Response time(h) Rest of the area***
Ocean going	*12*	*18*
Ocean going	*20*	*30*
Coast	*14*	*21*
Coast	*21*	*32*
Coast	*6*	*9*
4 Fjord systems	*96*	*96*
Dispersing system	*6*	*6*
Beach cleaning		
11 beach cleaning groups à 30 persons ~330 persons	*96*	*96*
support , ca. 100 persons	*96*	*96*
Emergency loading capacity	*48*	*48*
Airborne surveillance of the oil spill	*6*	*6*

The mechanical recovery systems must be able to collect different types of oil (marine diesel – heavy fuel)”

To carry out this type of analysis, you need knowledge and information about:

- probabilities for oil spill from ships in your waters
- environmental sensitive areas along the coast
- traffic patterns in your waters
- the weathering of oils in your waters
- oil drift in your waters
- the efficiency of different types of response equipment
- experiences from real oil spill operations
- use of “oil spill models”

6. Conclusion

In this paper I have tried to give a description of how the Norwegian contingency system is organised today, and some of the future challenges that has to be addressed by the authorities. Furthermore the use of models and tools both for contingency planning is described. Explaining how an environmental risk analysis and an oil spill contingency assessment related to governmental oil spill preparedness have been conducted. As a result specific contingency needs have been identified for regions covering all Norwegian waters, including Svalbard. A contingency level has been specified for each geographical region based on dimensioning scenarios (oil spill from ships) and national objectives. Each contingency level is characterised by response time requirements as well as specific requirements towards oil recovery systems, chemical dispersing systems, emergency offloading systems, remote sensing and surveillance, beach cleaning capabilities and human resources.

7. References

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This do not belong to the lecture.

Biography

Jan Nerland is a Master Mariner. He sailed on different ships, tankers, dry cargo and cruiseliners until he joined The Norwegian Pollution Control Authority. Where he now has the position as Senior Adviser. He has taken part in most oil spills in Norway since the BRAVO blow out in the North Sea in the late seventies, and has been observer and adviser on several big spills around the world. During the Gulf War he was on a special assignment in Saudi Arabia in connection with the large oil spill there. He has worked for IMO(the International Maritime Organization in London) as Adviser on Marine Pollution, responsible for South East Asia and the Pacific

Department for Control and Emergency Response

sft: Oil Spill Contingency

Norwegian Oil Spill Contingency and Risk Based Governmental Contingency Planning

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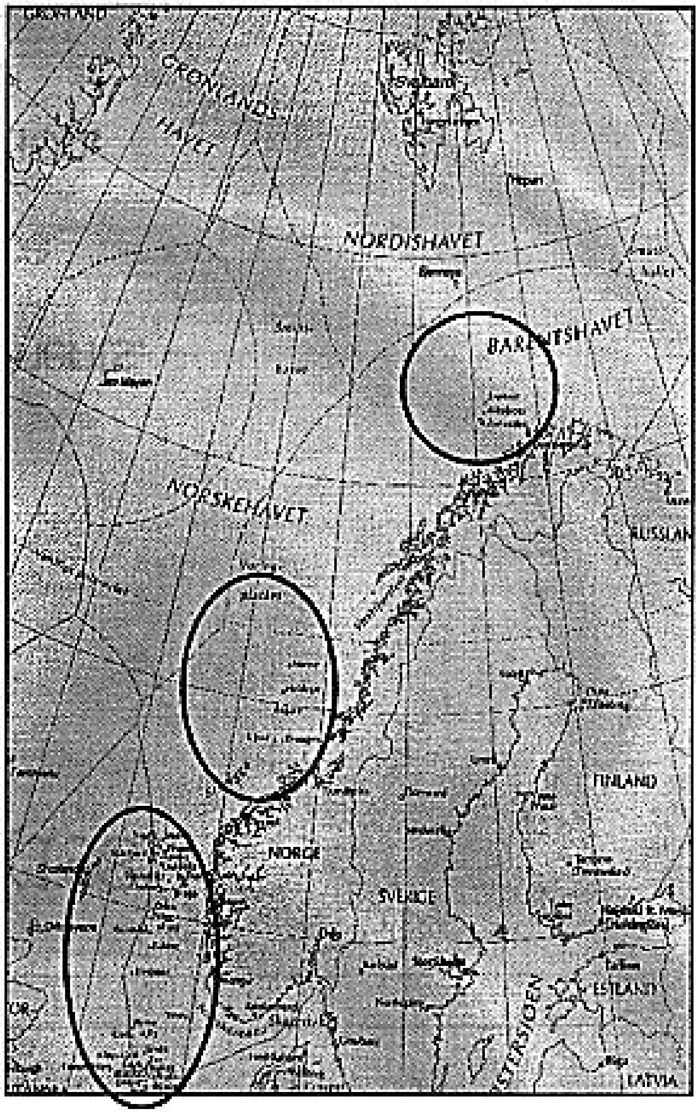
Norway - facts & figures

- Geographical features:
  - Shortest distance North - South: 1752 km
  - Coastline: approx. 80 000 km
  - Climatic variations form arctic in the north to coastal in the south.
- Shipping industry:
  - 7th largest fleet, approx. 33 mill DWT, (approx. 4,4% of total world fleet, 1999).
- Petroleum industry:
  - Daily production rate: approx. 3 mill. bbl.
  - Approx. 90 % is exported.
  - Worlds 2nd largest exporting country.
  - Three main areas.

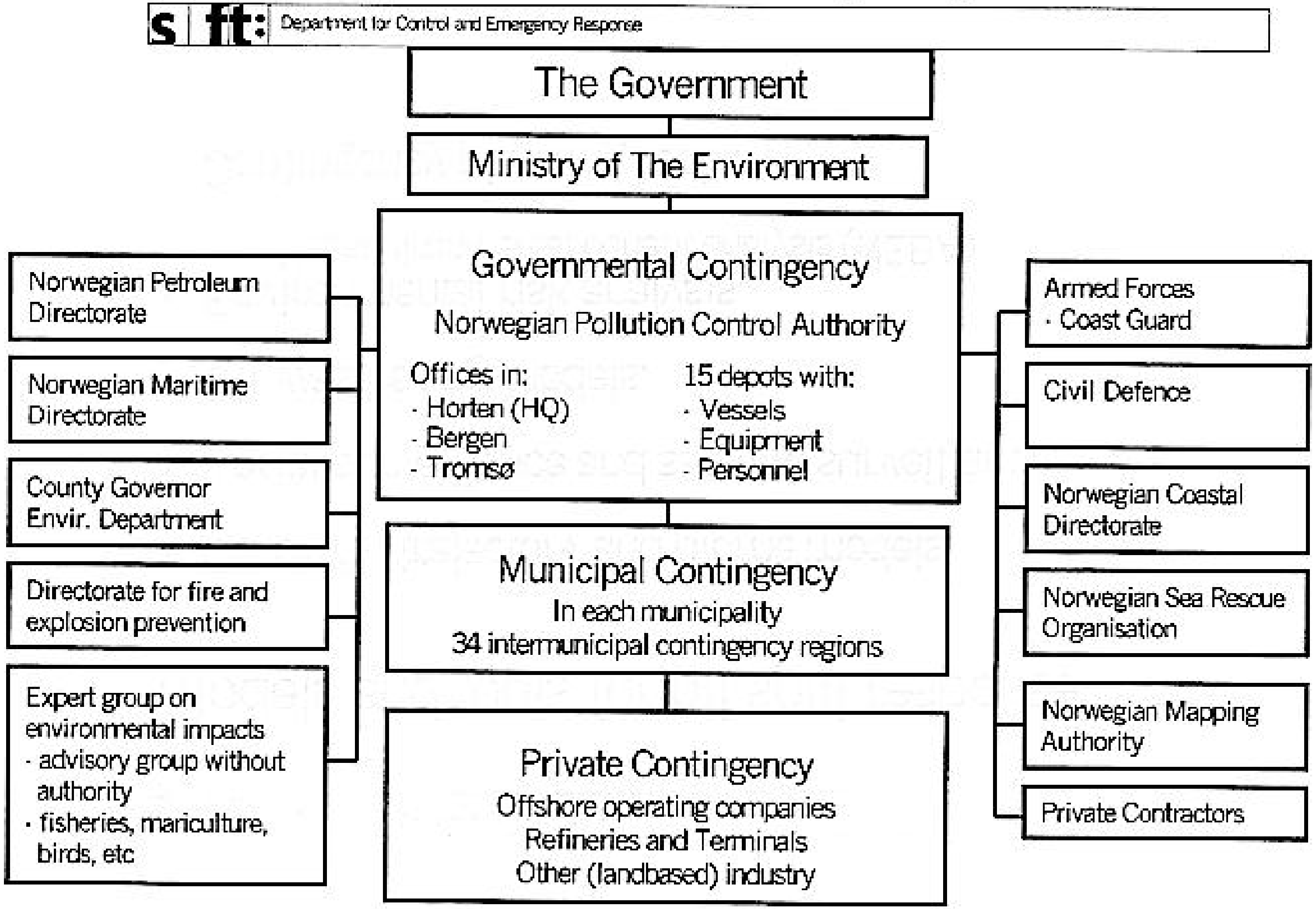


The Pollution Control Act (1981)

Main principles - acute pollution:

- "Polluter pays"- principle.
- Obligation to notify.
- Contingency planning requirements.
- Obligation to provide assistance.
- Obligation to provide information.

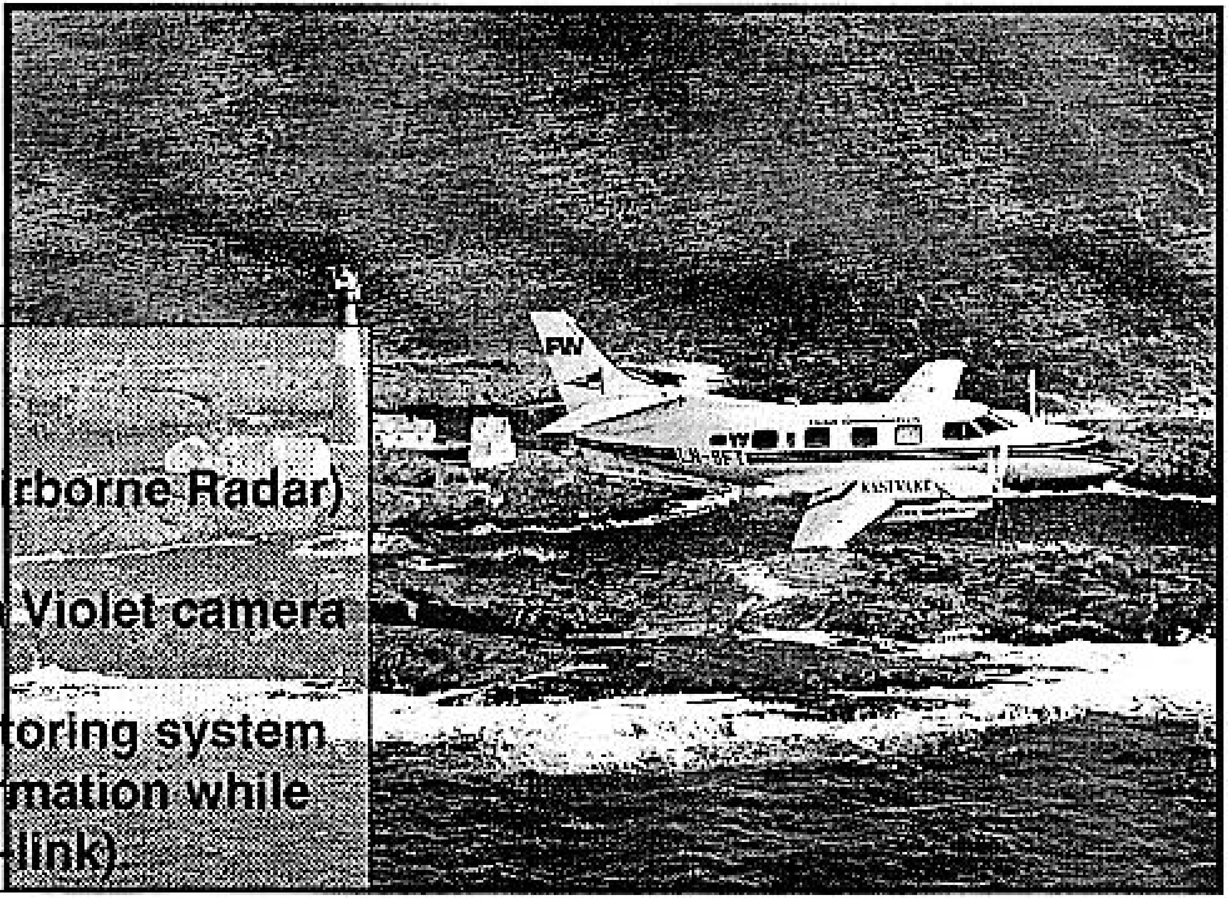
Norwegian Contingency



Models and tools for oil spill response

- Oil drift-, trajectory and plume models.
- Aerial surveillance and satellite surveillance.
- Oil weathering models.
- Environmental risk analysis.
  - Net environmental benefit analysis (NEBA)
- Contingency planning tools.

Aerial surveillance



Fairchild - Merlin
- **SLAR**
  (Side Looking Airborne Radar)
- **IR/UV**
  (Infra Red / Ultra Violet camera
- **Video/ Photo**
- **GIS based monitoring system**
- **Transfer of information while airborne (phone-link).**

Training Programme Outline

Standard Training Programme
Based on the Municipalities, the Coast Guard's and other Governmental Authorities training requirements within acute pollution.

Special Training Programme
Based on requests by foreign aid organisations, the private industry or foreign authorities/ organisations.

Standard Training Programme - Oil Spill Response

Administrators and Senior Managers
Corresponding to IMO Model, Level 3

On-Scene Commander/Supervisor
Corresponding to IMO Model, Level 2

Shoreline Supervisor

First Responder
Corresponding to IMO Model, Level 1

Train the Trainer
Corresponding to IMO Model

Analysis of oil spills from vessels

The question:

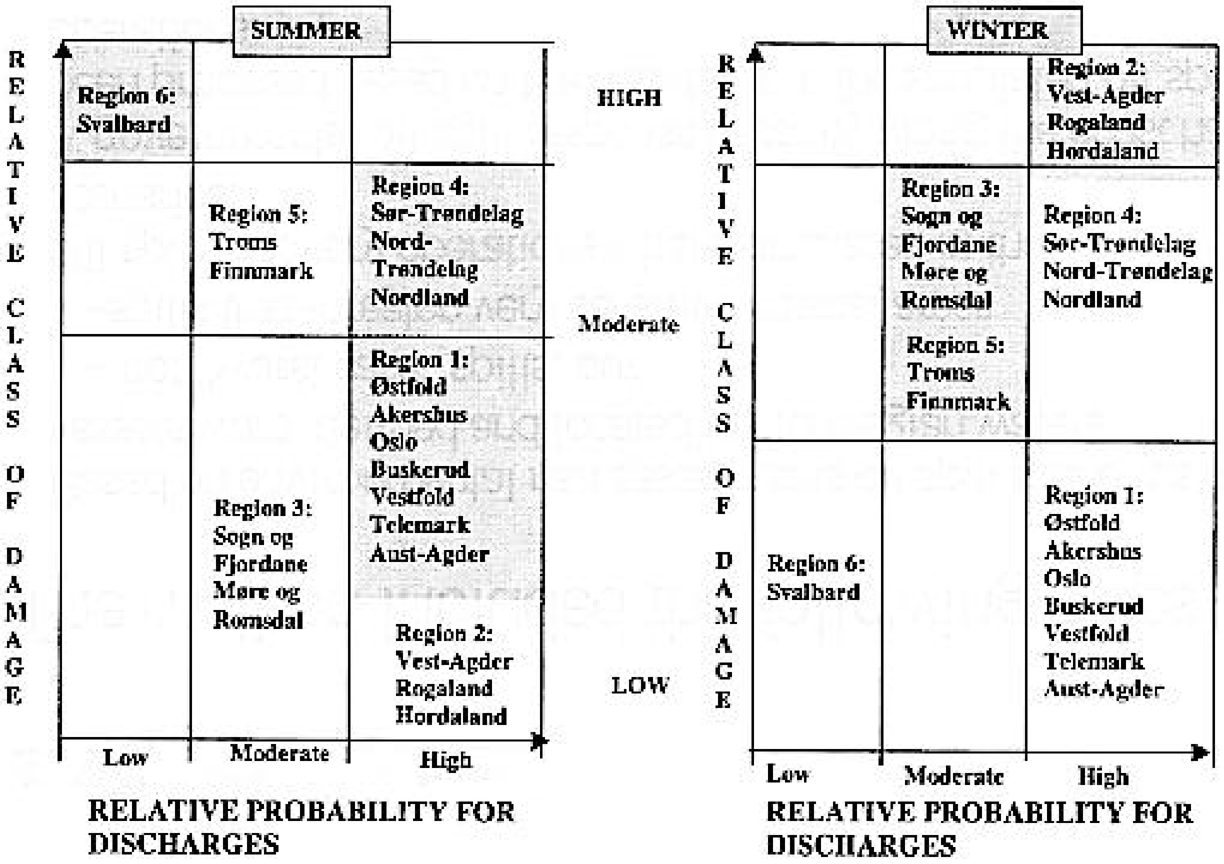
Taking into consideration the environmental risks from vessels in Norwegian waters, is SFT's oil spill response capacity correctly dimensioned?

*Available oil recovery vessels
*Number and location of equipment depots
*Training (level of preparedness)
*Manpower and endurance
*Type and amount of equipment

The method included the following steps

- Based on environmental risk assessments oil spill scenarios from vessels were defined and located in Norwegian waters
  - not "worst case" spills, but
  - spills that threaten very sensitive coastal areas
- Oil spill recovery operations where simulated in the oil spill scenarios.
- A governmental oil spill response capacity along the coast has been proposed based on the results from the simulated oil spill operations.
- The need for changes in SFTs oil spill respone organisation has been assessed:
  - number and location of equipment depots
  - types and amount of equipment

Risk matrix summer and winter



Oil spill scenario –Example: Oslofjord

Region no./name (counties)	Accident	Oil type	Amount discharged/ discharge rates	Time/ season	Very important environmental resources in the area
Nr.1: Skagerrak (Østfold, Akershus, Oslo, Buskerud, Vestfold, Telemark and Aust-Agder)	*Discharges from grounded tanker:* Tanker, size about 126400 dwt loaded with 137000 m3 crude runs aground in the outer Oslofjord en route to the Slagentangen oil refinery. The grounding results in rupture of three cargo tanks. Amount of fuel: 1500 tons of bunker C and 80 tons of marine diesel.	Crude from the Balder oilfield Balder Bunker C	During the two first hours after the grounding: Discharge of 15000 tons of crude oil. Discharge of 300 tons of bunker C. After two hours the leakage stops due to the water pressure.	June	The area of Hvaler. Important areas for seabirds like auks, lesser black back and eider duck. Very important recreational areas for large groups of the population.

Environmental objectives for the response

The main objective for the simulated oil spill operations are:

<u>The at-sea operation</u>

- Avoid or reduce the possibility of contact between highly environmental sensitive areas and the drifting oil.
- Avoid remobilization of stranded oil.
- No free floating oil on the sea surface 3 weeks after the spill had occurred.

<u>The beach cleaning operation</u>

- The most important locations of seabirds, protection areas and recreational areas are to be sufficiently cleaned within a fixed date d ate to avoid any harm or problems connected with normal use of the areas.

The " Breaking point" theory

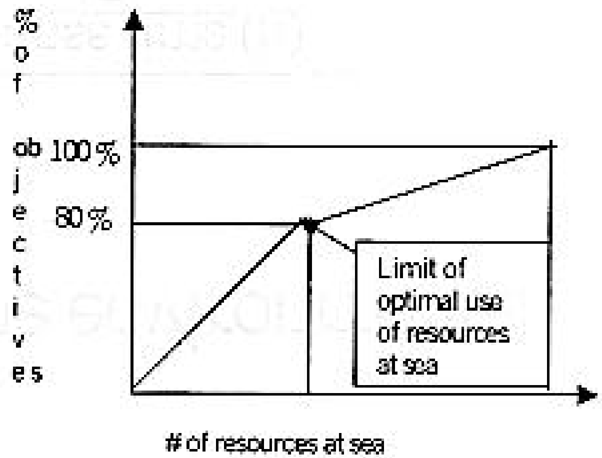
How many heavy oil removal systems will it be reasonable to use in open waters?

The "breaking" point:

The addition of more systems to the operation does not improve substantially the achievement of the environmental objectives,

or

the addition of more systems means unrealistic costs.



Resources needed to meet the environmental response objectives

System	Response time (h)
Ocean going	12
Ocean going	20
Coast	14
Coast	21
Coast	6
4 Fjord systems	48
Dispersing system	6
Beach cleaning(11 groups)	96

Proposed response capacity in a region

Resources	Response time (h), sensitive areas: Stadt –Hustavika	Response time(h) Rest of the area
Recovery systems:		
Oceangoing	12	18
Oceangoing	20	30
Coast	14	21
Coast	21	32
Coast	6	9
4 Fjord systems	96	96
Dispersing system	6	6
Beach cleaning:		
11 beach cleaning groups à 30 persons ~330 persons	96	96
support , ca. 100 persons	96	96
Emergency offloading capacity	48	48
Airborne surveillance of the oil spill	6	6

Conclusions

- This type of analysis is dependent on knowledge and information about:
  - traffic patterns, probabilities for oil spills from ships and environmental sensitive areas along the coast
  - the weathering of oils, oil drift, efficiency of different types of equipment and use of oil spill models
  - experiences from real oil spill operations
- If applied within in hours after the spill has occurred the use of dispersants may in many cases reduce the amount of oil drifting ashore.
- The emergency off-loading capacity should be strengthened.
- It may be necessary to strengthen the beach cleaning capacity. Important question: Is there an acceptable ratio between the number of heavy (ocean) and mid-sized (coastal) booms and skimmers and the ocean and coastal going recovery vessels?