Oil Spill Response

- recommendation for further development

BACKGROUND

Considerable technological development has occurred since the beginning of petroleum activity on the Norwegian continental shelf. Thanks to strict environmental requirements and the development of new solutions, present offshore petroleum activity has high environmental standards. Technological development is needs driven. New solutions are generated when needed through research and development because more stringent regulations and complex expansions require technology that has not existed before. The oil and gas activity will however continue to expand into new waters and near the coast, resulting in new and even tougher challenges for the oil spill contingency and response systems.

In the period 1977-1984, the Norwegian public sector in cooperation with the oil and gas industry invested relatively heavy in technology development for oil spill countermeasures. After 1985 public sector investment in oil spill technology in Norway has however been missing. As a result, we are in roughly the same technological situation as we were 20 years ago. To prepare for expansion into near coast- and areas with more difficult climatic conditions, considerably larger investments are needed in the coming years.

Technology is improved through knowledge-based development. Oil spill contingency and response can be improved through new and innovative technological solutions, better knowledge and increased insight into issues related to oil spill contingency and response.. Consideration must be given to operations near the coast and in northern waters where the challenges are different than those we have operated under so far. Greater focus on these topics creates the potential for international cooperation, for value creation and industrial development in the north and for a safe development of the northern areas.

Better technology will result in less damage to the environment, reduce the cost of accidents and make the suppliers of technology and knowledge more competitive in the market.

CHALLENGES

The offshore petroleum activity has been increasing dramatically for many years without a corresponding increase in the number or volume of spills. The largest oil spill on the Norwegian continental shelf occurred during the Bravo platform blowout in 1977 (20,000 tonnes). The most recent large-scale spill from Norwegian petroleum activity occurred at Statfjord in December 2007 (4,400 tonnes). Damage to the coastal zone from petroleum activity has been avoided until now, but we face new challenges from the rise in activity in near-coast waters.

So far oil spills from shipping along the coast have caused the greatest damage in Norwegian waters. Since 1980, a total of 11 major spills from ships have occurred along the Norwegian coast (Table 1).

Offshore (crude oil, tonnes)			Vessels (fuel oil, tonnes)			
Year	Name	Volume	Year	Name	Location	Volume
1977	Ekofisk	20000	1981	Deifovos	Heleglandskysten	1000
1992	Statfjord	1000	1989	Mercantile Marica	Sognesjøen	340
2003	Draugen	750	1990	Azalea	Haugesund	330
2005	Norne	400	1991	Sonata	Ålesund	200
2006	Draugen	100	1992	Arisan, Runde	Runde	150
2007	Statfjord	4400	1997	Leros Strength	Karmøy	150
2008	Statfjord	70	2000	Green Ålesund	Haugesund	100
			2004	Rocknes	Bergen	560
			2007	Server	Fedje	520
			2009	Full City	Langesund	1200

Table 1 – The largest oil spills in Norway related to offshore petroleum activity and shipping accidents.

Some defining features of preparedness development include:

- Offshore: : Large-scale operations with many vessels. The effectiveness of operations in bad weather is limited, particularly with significant wave heights above 3 m. The oil's properties change quickly, which affect the choice of response measures. It is difficult to conduct operations in the dark and under situations with poor visibility, and there is insufficient knowledge about oil dispersion. Low temperatures and icing affect the preparedness equipment, and logistics present a challenge in many areas as well.
- Near the coast: A rapid response is needed to prevent spilled oil from reaching land. Accidents often occur in the vicinity of vulnerable natural resources or commercial interests. Heavy bunker oil is difficult to handle. Strong currents make it difficult to use traditional preparedness equipment, and there are often logistical challenges associated with transporting resources and personnel into and out of the area quickly.
- Beaches: Large variations in beach type require a variety of solutions. A vulnerable environment can be damaged by large and heavy machinery and personnel traffic in the area. A wrong decision can cause more damage, and there is a danger that the oil will spread into new areas. Resources that are both vulnerable and commercially important represent a conflict of interest. Cleanup operations produce large amounts of waste, and efforts by volunteers pose an organizational and management challenge.
- Arctic/ice-covered areas: : Large variations in ice conditions require many different solutions. The oil is often spread in small amounts among the ice floes, and traditional seagoing equipment is not always useful. Response time is less critical due to a slower rate of weathering. Many small, easy solutions can work just as well as a few large ones. To date, there is a lack of remote sensing solution that is effective for use with oil spills in ice-covered areas. Low temperatures are a challenge for both personnel and equipment. The Arctic is a vulnerable environment with few species and a short food chain.

Under these conditions there is a need for tools ensuring that:

- There will be a satisfactory oil spill solution for every situation and area
- We can have knowledge of events in connection with every response operation and situation
- The person responsible will have adequate decision-support tools for selecting the correct strategy and method for every situation
- The authorities and those responsible for the pollution will have the proper tools to assess every situation (before, during and after)
- The general public and interest groups will be given sufficient information in every situation
- The goal to minimize the damage resulting from oil spills in every situation is achieved

DEVELOPMENT NEEDS

A complete preparedness solution must cover all the situations we operate under. This means that the toolbox must contain many different solutions that do not exist to date. There is a need to develop new solutions in the areas of:

- Monitoring and decision-support systems
- Maritime operations – including new vessels
- Traditional oil spill contingency and response
- Health, safety and environment related to the operations
- Risk and risk management

In addition to this, new possibilities in the area of materials and information technology should be exploited to generate new, innovative solutions.

Information technology – monitoring and decision-support systems

In connection with the Norwegian Government's High North strategy, an initiative has been undertaken to establish a cohesive monitoring and warning system for the northernmost seas (Barents Watch). The system will link existing components of Norwegian monitoring and warning into one integrated system.

Barents Watch will constitute a common platform for all relevant background information in connection with disasters in the area. Along with mathematical models, simulation tools and data sources, this will enhance the potential for rapid, correct decision-making during an accident. The system can link the Norwegian Coast Guard, the Norwegian Coastal Administration and the Joint Rescue Coordination Centre to give those involved a true picture of the actual situation. The system will also be available for use by local municipalities and preparedness groups so that the proper measures can be coordinated in the best way. Barents Watch will also give the central authorities the best possible overview of events as a basis for decision-making and information to the media.

Maritime operations and vessels

The monitoring of shipping traffic in coastal areas makes possible the early identification of ships that pose an environmental risk. Early intervention by providing emergency tows for ships with propulsion difficulties or emergency barges for ships with hull damage can prevent or reduce the size of oil spills. Today's response vessels are multifunctional and designed to carry out various tasks such as fishery control, border control, monitoring of shipping traffic, oil spill preparedness, emergency tows and the like. These tasks place various demands on the vessels, and a design that seeks to satisfy many demands will usually end up with solutions that are not optimal for critical operations under difficult weather conditions. As a result, there is a great need to study new vessel concepts that can cover various tasks such as:

- Establishment and implementation of emergency tows
- Emergency barging of cargo or bunker oil
- Management of oil booms
- Oil spill response operations in the near coast area

When designing new vessels, emphasis must be placed on security for the personnel, development of effective operational procedures and the training of key personnel (both simulator based and in the field.)

New Materials

A technique that can be used to collect or contain oil spills involves the use of various natural absorbents such as bark, moss and wool which have relatively good absorption capacity. Very little R&D underlies these solutions. The use of modern materials technology, for instance nanowire membranes, can develop new absorption agents which are tailor made for oil uptake and which are adapted to different purposes and various oil qualities. In the same way, modern materials technology can be used in oil boom and skimmer technology as well as in other areas of technical oil spill contingency and response.

Oil spill technology

Currently we have four traditional techniques for dealing with marine oil spills: 1) mechanical recovery, 2) chemical dispersion, 3) biological decomposition and 4) the burning of oil on the surface. Norwegian oil spill contingency and response is based on the first three techniques, while the burning of oil on the surface is a useful method in ice-covered waters.

Mechanical oil spill technology. Today's mechanical oil spill response is based largely on containing the oil with a boom and using skimmers to pump the oil over to a suitable vessel. There is great potential for the development of new technology in this area. The use of modern materials technology and experience from the fishery sector will lead to the development of booms that contain the oil better, as well as more effective skimmers. The development of new simulation programmes and better laboratories will reduce the costs of testing the new technology. In the Arctic and ice-covered waters, smaller and more flexible units have a potential. In open seas, booms with built-in skimmers will simplify operations and increase effectiveness. For beach zone preparedness, the goal must be to replace lengthy, labour-intensive operations with technical solutions.

Chemical dispersion. The purpose of utilizing dispersants is to remove oil from the surface in order to protect vulnerable resources found on the surface and in the beach zone. Through new and revised regulations, the Norwegian authorities allow for the use of chemical agents both at sea and in the beach zone during oil spill response operations. This places great demands on and presents challenges to technology and operational strategies and requires good knowledge about the environmental impacts.

By applying new knowledge about polymer chemicals and nanotechnology, as well as knowledge from processing- and chemical techniques, methods and products can be developed which are more effective and more environment-friendly than the methods used today. This includes dispersants, products that solidify the oil for easier collection, various techniques for emulsification and emulsion breaking, as well as the addition of components to oil that cause formation of gel, thus making it easier to handle. There is also great potential for the further development of application technology as well as decision support tools in order to maximize the chemical response to oil pollution.

Biological decomposition. The biological degradation of oil is one of the most important processes for removing oil from polluted waters, bottom sediment and the beach substrate. This is a slow, natural process, and methods which can stimulate this process will help to accelerate the speed of degradation. By using new methods and new knowledge, today's products can be improved and their effects can be documented so that biological decomposition can become an integral part of the contingency response. A targeted development of technology for the biological degradation of oil, especially for oil on beaches, may hold great potential. There are also products than can be added which utilize UV/visible light as an energy source to aid in this type of bio-chemical decomposition.

In situ burning. TToday, in situ burning is utilized as a method in ice-covered waters. There is however still uncertainty associated with the practical use of the method and to the safety related to this type of technique. Burning is highly effective in cases when the method can be employed, but much work remains to be done in developing this into an effective operative tool. Everything from technology for ignition, via fireproof booms, clothing and security equipment for preparedness personnel, to regulations for the use of burning as a response method needs further development

Health, safety and environment

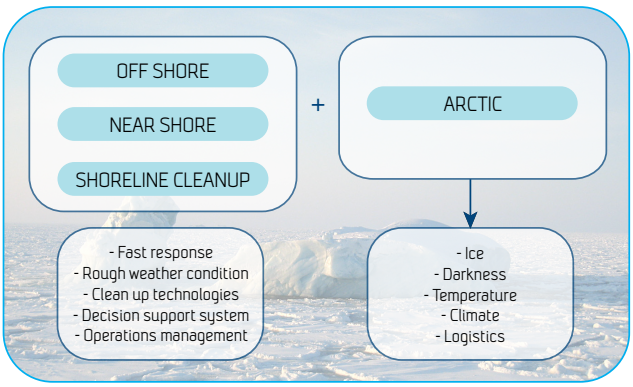
Health, safety and environment are the cornerstone of all operations. IPIECA, the oil industry's own organization, points out the need for development and common guidelines for operations of this nature. Some of the keywords in this context are: leadership and safety during operations – including management of volunteers, risk analysis to ensure that preparedness personnel operate under a safe framework and working conditions, chemical safety related to the oil spill – the danger of health effects, working environment and safety during response operations, personal security equipment and work tools, as well as safety and logistics in the response area (water, hygiene, sanitation, etc.)

Risk and risk management

Parallel with developing new oil spill technology, knowledge about risk and risk management should also be expanded. There is considerable knowledge and experience to build on from the risk management area/field, where focus has been placed on developing human, technological and organizational barriers to prevent major accidents and accidents involving personal injury. We expect large-scale technological and organizational changes, which increase the need to develop tools which make it possible to discover negative safety trends at an early stage and to implement countermeasures.

KNOWLEDGE-BASED DEVELOPMENT

Knowledge-based development carried out in cooperation between the R&D environments and Norwegian and international industry and authorities yields good solutions. The further development of the oil spill technology must therefore make more extensive use of innovative solutions in cooperation between the R&D-organisations, the industry and the authorities. The development of solutions in one area (eg.



Coastal) can be transferred to other areas (eg Arctic). This is important for the supplier industry which is dependent on a market, and this should be the basis for the development of new concepts. Utilizing the resources found within SINTEF and other R&D organisations in the form of systematic testing of new concepts in the laboratory, model studies as part of development work, simulator training and courses for operations management and personnel involved in preparedness operations will promote faster and better development of the next generation oil spill technology.

A development programme, next generation oil spill contingency and response, should be broad-based so that the development of new technical solutions is ensured in a wide range of areas. The challenge in further developing the oil spill technology is not related to lack of new and good ideas but rather to financing. To gain the active involvement of industry, it is necessary to ensure that the process leads to commercial solutions that can be used in several markets and in several types of scenarios.

RECOMMENDATIONS

Our specific recommendations for the period 2010-2020 are:

- Competence building. - Establish larger, publicly supported competence-building programmes in oil spill technology and related activities (such as the effects on marine life). NOK 350 million. (NOK:US$ = 5,7:1)
- Industrial development projects. Establish an escalation plan for public co-financing of industrial development projects on oil spill technology. NOK 500 million.
- Industrialization. Develop effective instruments for industrializing new oil spill technology, including full-scale testing of pilots. NOK 400 million
- Concept development, new vessels. – Establish a fleet of oil spill vessels with specialized equipment. Concept development to take place in the period 2010-2015. NOK 200 million
- Enhanced research infrastructure. Strengthen research infrastructure in this area, total NOK 250 million

A framework should be established for cooperation between the public and private sector, also leading to international cooperation. The various instruments are linked and should be managed as parts of a greater whole with regard to planning, follow up and evaluation.

SINTEF

www.sintef.com

Postal address:
SINTEF, box 4760 Sluppen, NO-7465 Trondheim, Norway
Tel: +47 73 59 30 00*, Fax: +47 73 59 33 50