

## **NORWEGIAN OIL SPILL RESPONSE TECHNOLOGY DEVELOPMENT**

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### **ABSTRACT**

As a result of a broad announcement followed by submission of project ideas, proposals and evaluation processes, about 20 projects were offered sponsorship from the technology development program “Oil Spill Response 2010” launched in 2009 by NOFO (The Norwegian Clean Seas Association For Operating Companies) in cooperation with NCA (The Norwegian Coastal Administration).

The projects were comprised of four categories: Offshore oil spill recovery, dispersant application technology, remote sensing technology and finally coastal and shoreline operations. This paper gives a brief status of the program, with special focus on some promising and innovative concepts now in their final stages of development and field verification.

### **1. INTRODUCTION**

Recognizing that oil spill technology development had been insufficient for a number of years, the two largest responders in Norway, NOFO and The Norwegian Coastal Administration initiated the technology development program “Oil Spill Response 2010” in 2009, covering four main topics:

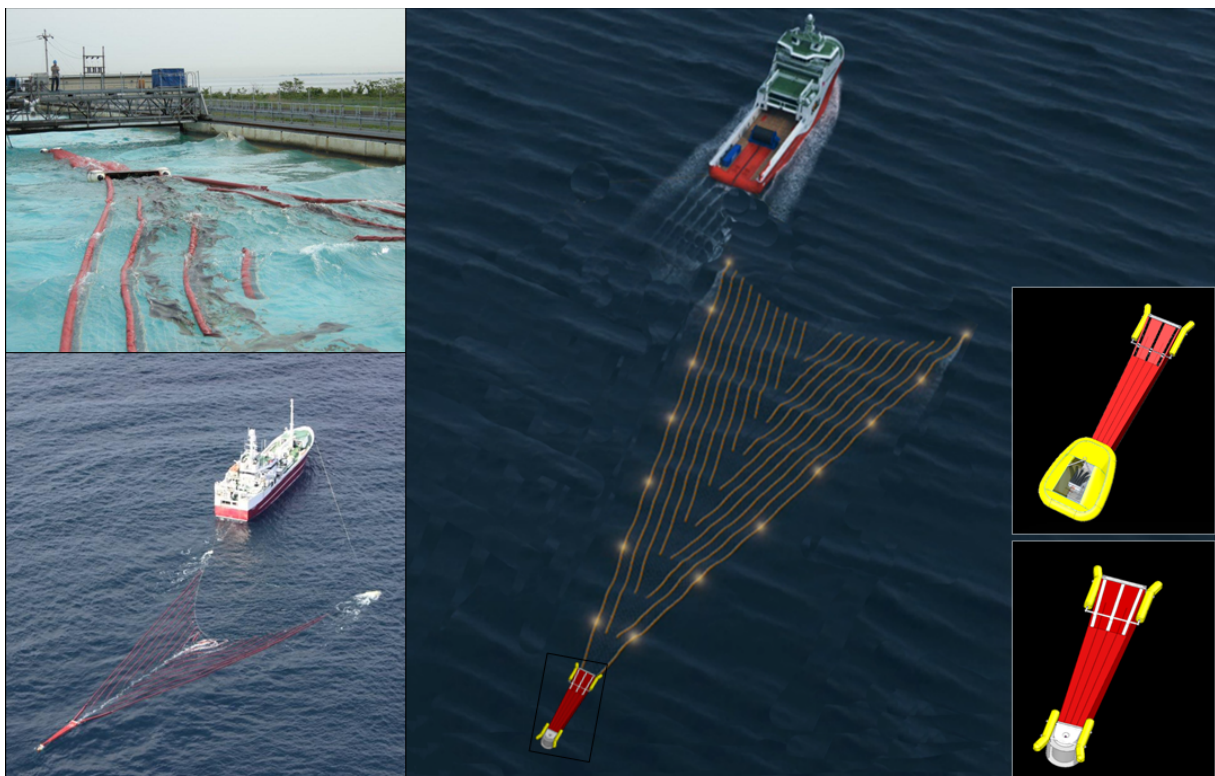
- Offshore oil spill recovery technology
- Dispersant application
- Remote sensing
- Coastal and shoreline operations

The motivation behind this initiative was increased activity on the Norwegian Continental Shelf, new activities closer to shore, plans for opening new areas for exploration, stricter environmental regulations and the general public awareness concerning oil pollution. All these factors called for accelerated development within relevant technologies involved.

## 2. PROJECTS IN FINAL STAGES OF DEVELOPMENT

In this section we describe the status of projects that are still active; they all have the potential to become important elements of future spill response technology.

### 2.1. “Marine Oil Spill (MOS) Sweeper” – multi barrier recovery system

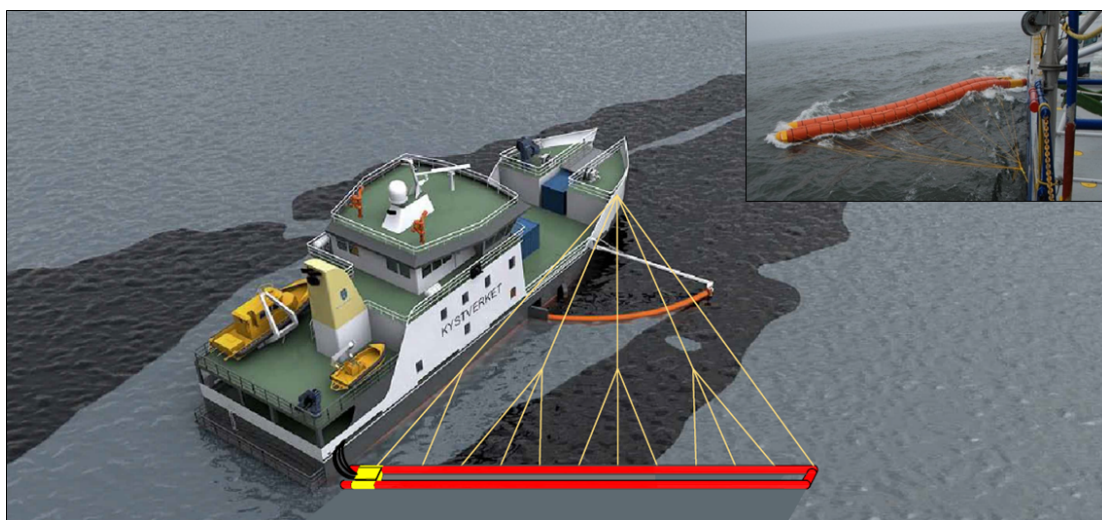


*Figure 1. MOS Sweeper, a novel multi barrier mechanical system with two alternative oil recovery devices (right) transferring collected oil to the vessel. Small photos (left) are from OHMSETT testing and trials with an offshore fishing vessel.*

This is a single vessel system utilizing a paravane to spread the sweeper. It consists of a series of shallow deflectors that push surface oil and water towards the centerline, see figure. At the rear of the sweeper the oil is further concentrated in a so-called reduction channel that prevents splash over from an open surface, where after the oil is recovered and transferred to the vessel through a flexible hose. Training exercises with the system by use of offshore fishing vessels have gained valuable experience, and at the same time demonstrated the similarity with operation of active fishing gears. The swath width of the offshore prototype is 50 m. Based on testing at OHMSETT the system seems to work satisfactorily in at least 3 knots speed through the water without significant loss of oil. This recovery system is a candidate for the NOFO oil-on-water exercise in the North Sea planned in June 2012.

One of the recovery devices is a conventional brush skimmer while the other device includes a pump with a high flow capacity that requires a first stage separation system to enable offloading of free water prior to storage. One such separation system has been identified, the search for another one is on-going.

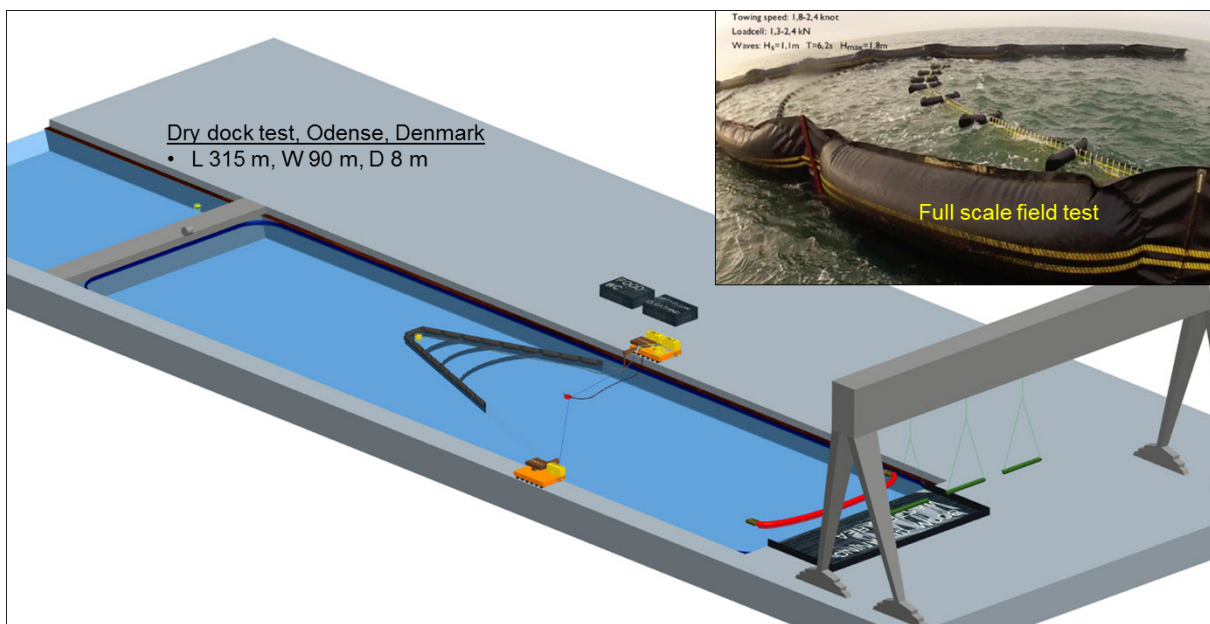
## **2.2. “Oil Shaver” – single vessel recovery system**



*Figure 2. Oil Shaver is a novel concept for oil recovery, under construction for evaluation on board a new NCA spill response vessel to be outfitted with built in sweeping arms.*

The Oil Shaver is a novel single vessel recovery concept. Oil is collected and concentrated between two parallel shallow draft pontoons. The formation of the system is maintained by balancing the water drag and the forces from a set of towing lines, the rear of the system being supported by the hull of the vessel. With this mode of operation the transfer hose will be very short, and the skimmer can be visually inspected from the deck of the vessel. The concept did qualify for the Wendy Smith competition final at OHMSETT in 2011. Later it was demonstrated on board an MSRC recovery vessel in offshore conditions. A prototype for a 44 m long vessel is under construction, and this prototype will probably be equipped with a standard type skimmer for oil recovery.

### 2.3. “HISORS” – High speed oil recovery system



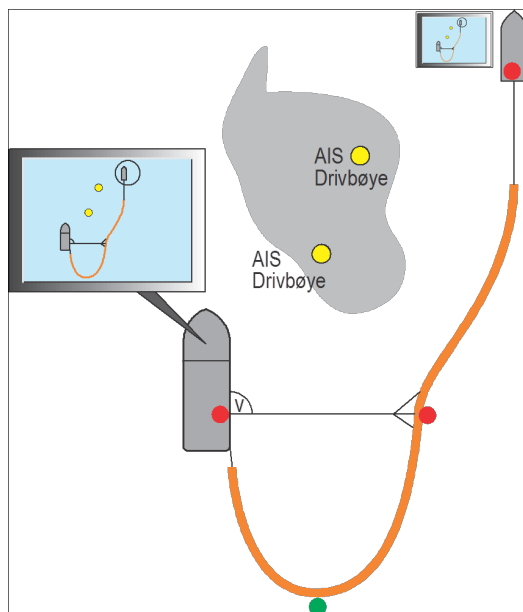
*Figure 3. Perforated booms ahead of a conventional boom can increase towing speed significantly without major loss of oil.*

The HISORS concept introduces several perforated barriers to stretch the flow pattern inside a traditional boom system. This well-known principle makes it possible to significantly increase the towing speed of a conventional boom without great loss of oil. Designed and optimized through a combination of computational fluid

dynamics (CFD) analysis, traditional scale model experiments in a towing tank and full scale field experiments, the best values of various parameters have been identified. Full scale oil-on-water experiments in a large dry dock in Denmark are in progress.

During previous offshore exercises it has been demonstrated that the operational difficulties related to moving a skimmer over the perforated barriers all the way to the boom apex can be solved. The main motivation for NOFO and NCA to sponsor this kind of development is the possibility to increase the towing speed of existing conventional oil booms during favorable weather conditions.

## 2.4. Boom monitoring system



*Figure 4. Boom monitoring system with Doppler log for conventional booms.*

To improve and ease the operation of the large offshore systems, a boom monitoring system is under development. The system utilizes position data from three GPS nodes (red dots), AIS information from both vessels, and a Doppler log (green dot) to monitor the boom speed, brace line angle and relative positioning of the vessels. With displays on both vessels providing alarms and recommended actions when parameters are outside acceptable range, the system already has proven very useful, especially for long lasting operations in darkness or reduced visibility. AIS drifting buoys can also be shown on the same display. A similar project for smaller systems and vessels is currently underway.



## 2.5. “BV Spray” - Dispersant application by use of paravane

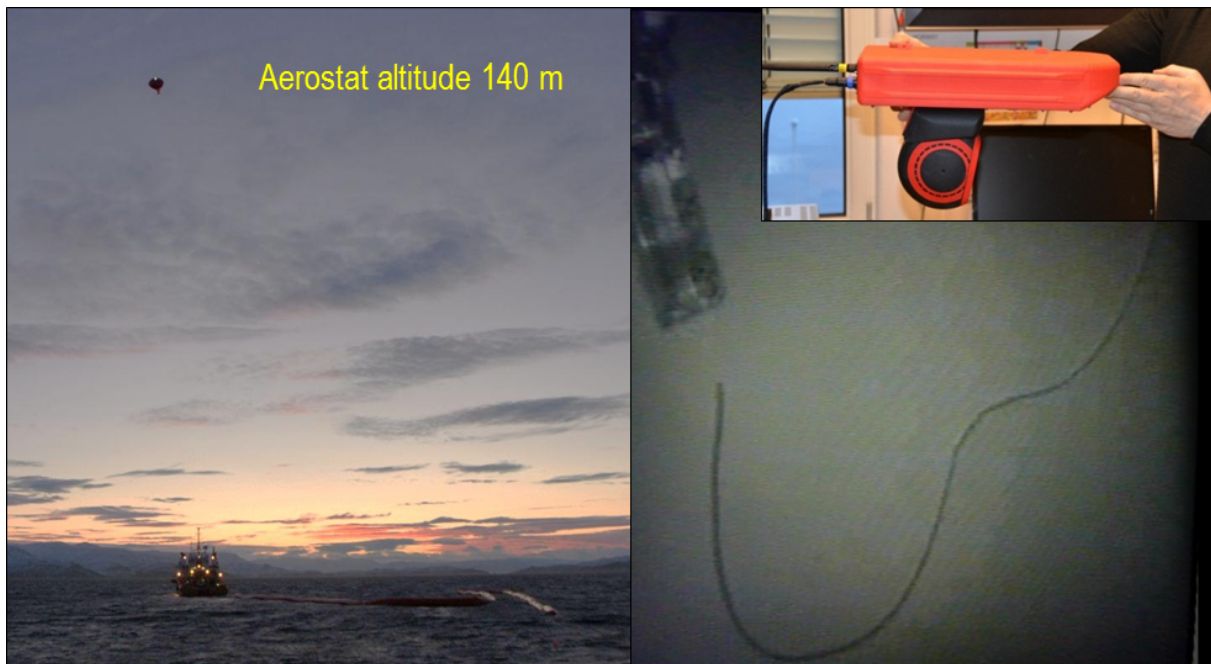


*Figure 5. Dispersant application system using paravane, coastal version with 20 m swath width (upper left) and offshore version with 50 m swath width.*

The objective of this project was to develop a large offshore system for dispersant application using a paravane to provide the swath width as well as supporting a flexible hose with spray nozzles. The concept was developed using a standard ORC Boom Vane providing a 20 m swath width. This unit was later adopted as a coastal version for smaller vessels.

A prototype of the offshore system with swath width 50 m is undergoing field trials this winter, and is expected to be verified during an oil-on-water exercise in June 2012. In case of an oil spill response operation, the intension is that this type of offshore application system will be mobilized on board OR vessels together with a mechanical recovery system, making it possible to choose either response method even after arrival at the spill site.

## 2.6. “Ocean Eye” - Compact aerostat system for oil spill remote sensing



*Figure 6. Compact aerostat system during 24 hour field experiment. Night time low sensitivity IR imagery and sensor package (right).*

The Ocean Eye compact aerostat system has a ground unit with a footprint the size of a Euro-pallet, which makes it possible to operate it even from small workboats. The payload capacity is approximately 3 kg, and the payload currently consists of a battery, data link, emergency deflation system, strobe light, AIS transponder, a high definition video camera and an uncooled IR sensor. Imagery from the sensors is transferred by radio link to the ground unit and to the stand alone control unit that typically will be located in the wheelhouse of the vessel. Other vessels within line of sight may also receive the live imagery on their own receiver units. The first production version is currently under construction for a 2-year pilot service, and the aerostat concept will be further developed through the pilot phase and as part of a parallel project addressing use of autonomous surface vehicles. NOFO and NCA believe aerostat systems have a significant remote sensing potential both offshore and in coastal waters, providing continuous local area situation awareness and overview.

### 3. OTHER “OIL SPILL RESPONSE 2010” PROJECTS

This section gives a tabulated summary of other projects within “Oil Spill Response 2010”, some already resulted in commercially available products or services.

*Table 1. Remote sensing*

Project	Description
Adaptive two channel digital video/data downlink	The analogue downlink for transfer of information from aircraft to vessel has been upgraded to a two-way digital data link (commercial product).
Coherent FMCW (frequency modulated continuous wave) radar for oil spill detection	Development of a new 10+ GHz oil detection radar has been initiated. This could potentially detect oil as a substance, not by wave dampening.
Portable SeaSonde high frequency radar for surface current mapping	Pilot product ready for market, delivering ocean current data enhancing oil drift model services.
Bridge console for displaying remote sensing data (TCMS – tactical collaboration management system)	Real time system receiving information from sensors on board various platforms, providing a synthesis or common operating picture (COP) of a spill site (product commercially available).
Unmanned aerial system (UAS) for coastal mapping (weight 30 kg)	Pilot service available shortly, providing mosaic of vertical still photos and/or IR imagery of coastlines.



*Table 2. Coastal and shoreline operations*

Project	Description
High capacity granulate application & recovery system	Concept based on a modified vacuum truck with long hoses, operated from landing craft with crane, reach more than 20 m (pilot service ready)
MESSOR - spill kit for beach cleaning	Further development of existing unit for beach cleaning (commercially available)
Foxtail mini, lightweight rope mop skimmer	Gasoline engine with clutch is driving the wringer mechanism (product available)
Work platform for shoreline operations	60 m <sup>2</sup> flat work deck, payload 8 tons. Stored and transported as 40' container.
Archimedean screw vehicle for shoreline operations	Intended as a tractor for transfer between water and beaches. The prototype is facing technical challenges, outcome uncertain.
MOSE (Mechanical Oil Spill Equipment) – beach cleaning unit	Rotating disk with brushes for kneading sorbents into oil, application and recovery of sorbents through integrated pipe and flexible hose.

#### **4. CONCLUDING REMARKS**

Significant improvements have already been achieved from development of novel concepts as well as from modifications of existing technology. Projects presently in the final stage of development are expected to become part of future oil spill response technology that will make it possible to combat marine oil spills more effectively both in bad weather, in strong currents, and in darkness/reduced visibility. Technology development through broad announcements combined with financial sponsorship, high degree of project involvement and commitments from major responders has been a very positive experience. The same approach will be used for future spill response initiatives.