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NORWEGIAN OIL SPILL RESPONSE TECHNOLOGY DEVELOPMENT

A status
with focus on some promising concepts in the final stages of development and field verification

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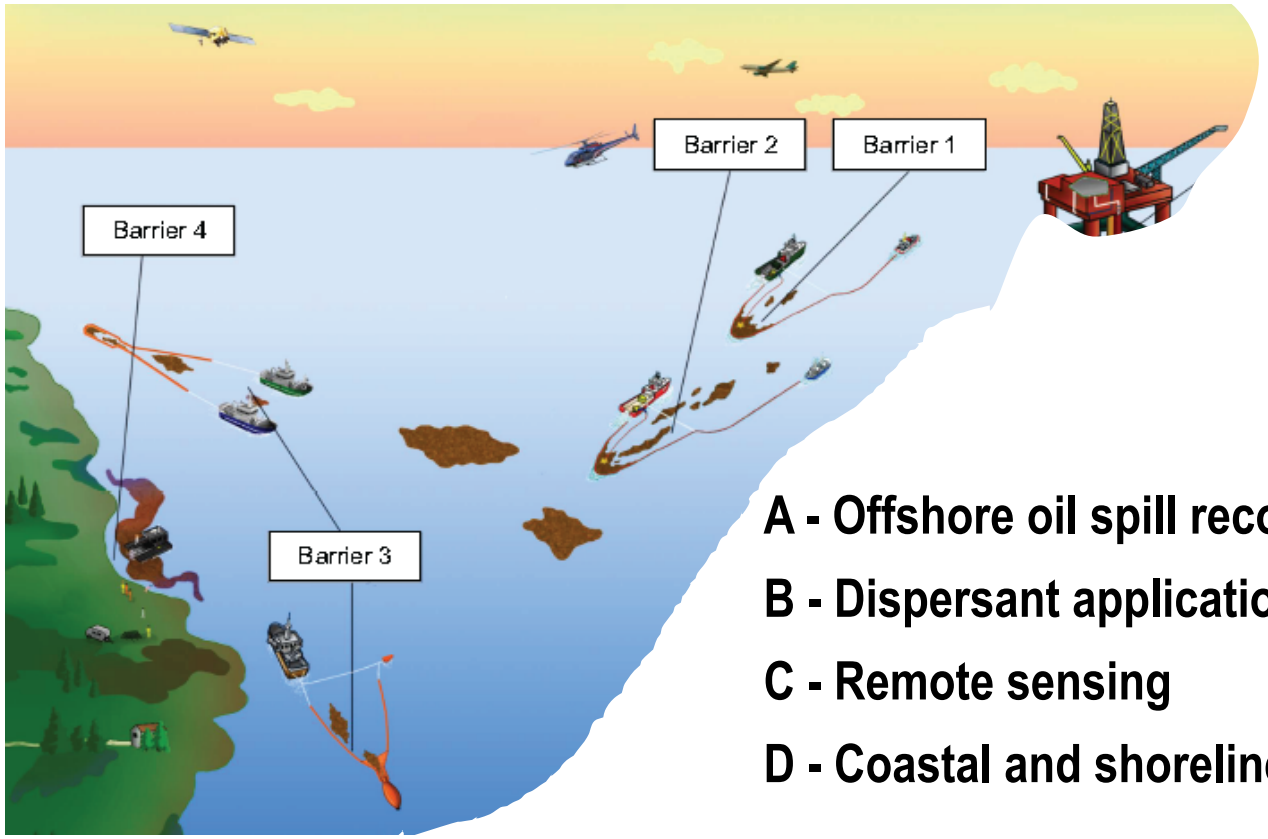
THE "OIL SPILL RESPONSE 2010"

NOFO and The Norwegian Coastal Administration initiated this technology development program in 2009, with four main topics:



A - Offshore oil spill recovery (1. pr.)

B - Dispersant application

C - Remote sensing

D - Coastal and shoreline operations

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THE "OIL SPILL RESPONSE 2010"

Motivation

- Recognizing that oil spill technology development had been insufficient for a number of years
- Increased activity on the Norwegian Continental Shelf
- New activities closer to shore
- Plans for opening new areas for exploration
- Stricter environmental regulations
- General public awareness concerning oil pollution

«Oil Spill Response 2010» projects

A: Mechanical recovery (offshore) **B: Dispersant application**
C: Remote sensing **D: Coastal and shoreline operations**

Category	Project	Company
A	«Oil Shaver» – Novel consept for recovery	Åkrehamn Trålbøteri
A	«HISORS» – High Sea Oil Recovery System -	Frank Mohn + Desmi Roclean
A	«HISCOR» – High Speed Continuous Oil Recovery System	Vikoma
A	«Marine Oil Spill (MOS) Sweeper» - Novel concept for recovery	Maritime Development Group
A	Boom monitoring system (1)	Salford Electronic Consultants
A	Boom monitoring system (2)	Aanderaa Data Instruments
B	«BV-Spray» - Dispersant application from vessels (coastal)	ORC
B	«BV-Spray» - Offshore version	ORC
B	Automatic dispersant application nozzle control	Aptomar
C	Coherent FMCW radar for oil spill detection	ISPAS
C	Bridge console (GIS) for remote sensing data (TCMS)	Aptomar
C	«Ocean Eye» - Compact aerostat system for oil spill remote sensing	Maritime Robotics
C	Adaptive two channel digital video/data downlink (aircraft to ship)	Salford Electronic Consultants
C	Unmanned aerial system (UAS) for coastal mapping	Aranica
C	«SeaSonde» - Portable HF radar for ocean currents mapping	CodarNor
D	«Foxbarge» - working platform for shoreline operations	H. Henriksen
D	High capacity granulate application & removal system	Vacumkjempen Nord-Norge
D	«Foxtail MINI» - portable rope mop skimmer	H. Henriksen
D	«Messor» - spill kit for beach cleaning	Mercur Maritime
D	«AMV Oil Spill Fighter» - Archimedean screw vehicle (shoreline)	Team Innovation Trondheim
D	«MOSE» (Mechanical Oil Spill Equipment) – beach cleaning unit	Kaliber Industridesign

Commercially available product or service

At the Interspill 2012 Exhibition

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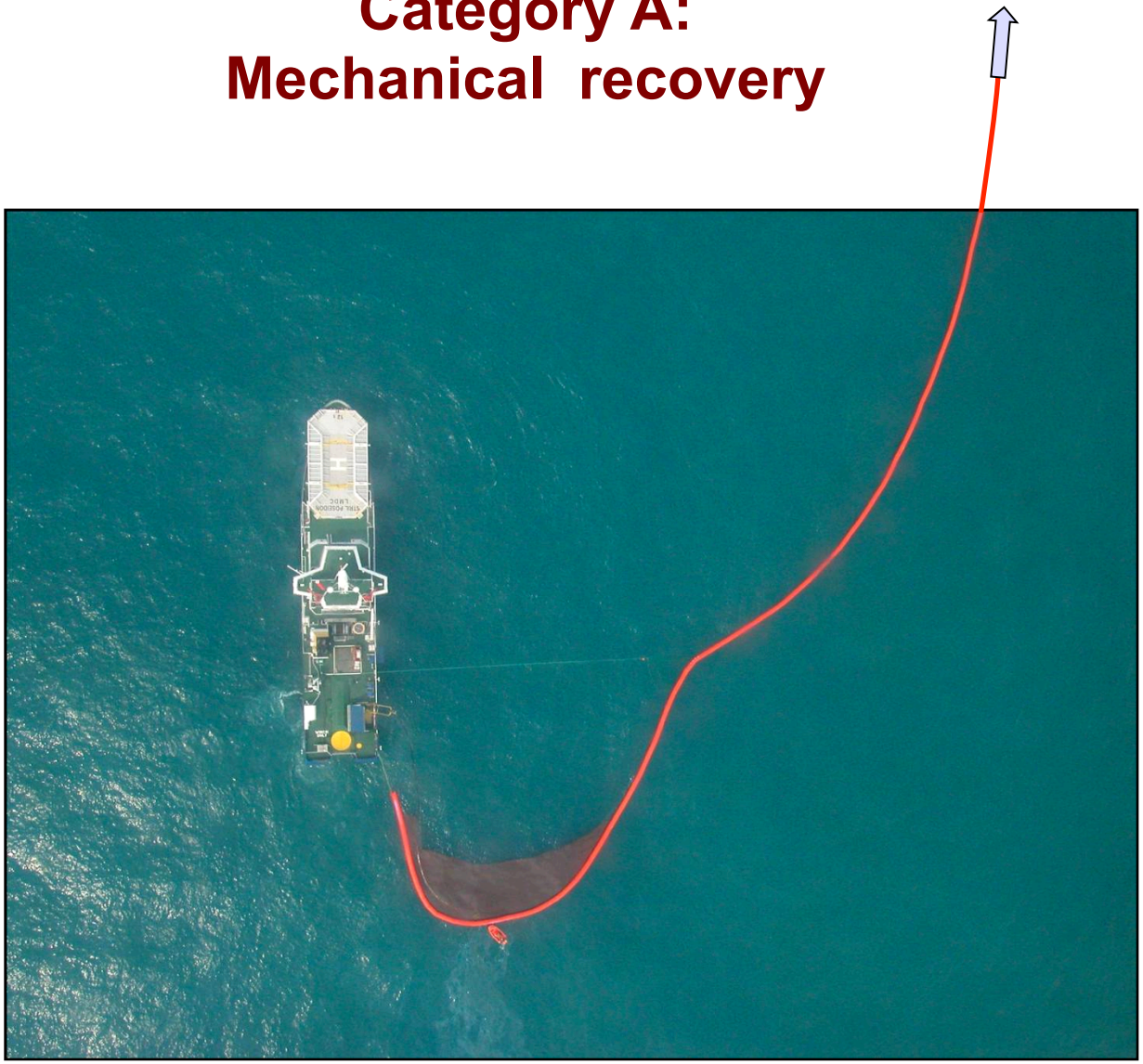
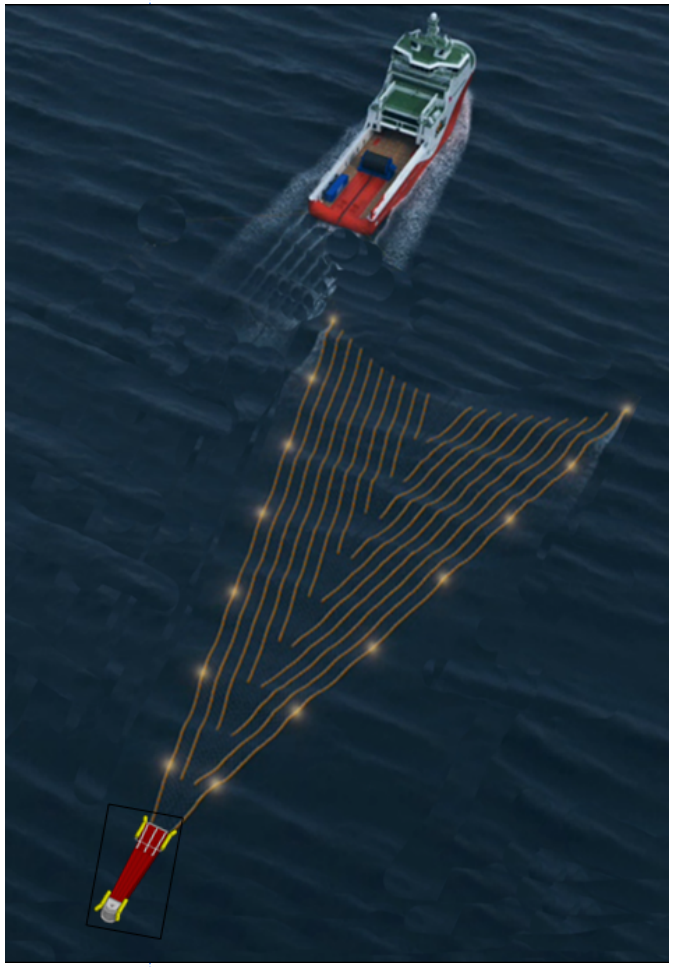
Category A:
Mechanical recovery



Marine Oil Spill (MOS) Sweeper



- Novel single vessel system
- Offshore prototype swath width 50 m
- Sweeper - shallow draft deflectors push surface layer towards centerline
- Behind sweeper, oil is further concentrated in closed top channel
- At rear of channel oil is recovered and transferred to the vessel
  - conventional brush skimmer
  - pump with high flow capacity (requires separation)

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Marine Oil Spill (MOS) Sweeper

Operated from offshore fishing vessel

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Marine Oil Spill (MOS) Sweeper

Marine Oil Spill (MOS) Sweeper

- 3 knots without loss of oil (OHMSETT).
- Quantitative tests OHMSETT in two weeks
- Candidate for oil-on-water exercise in June 2012

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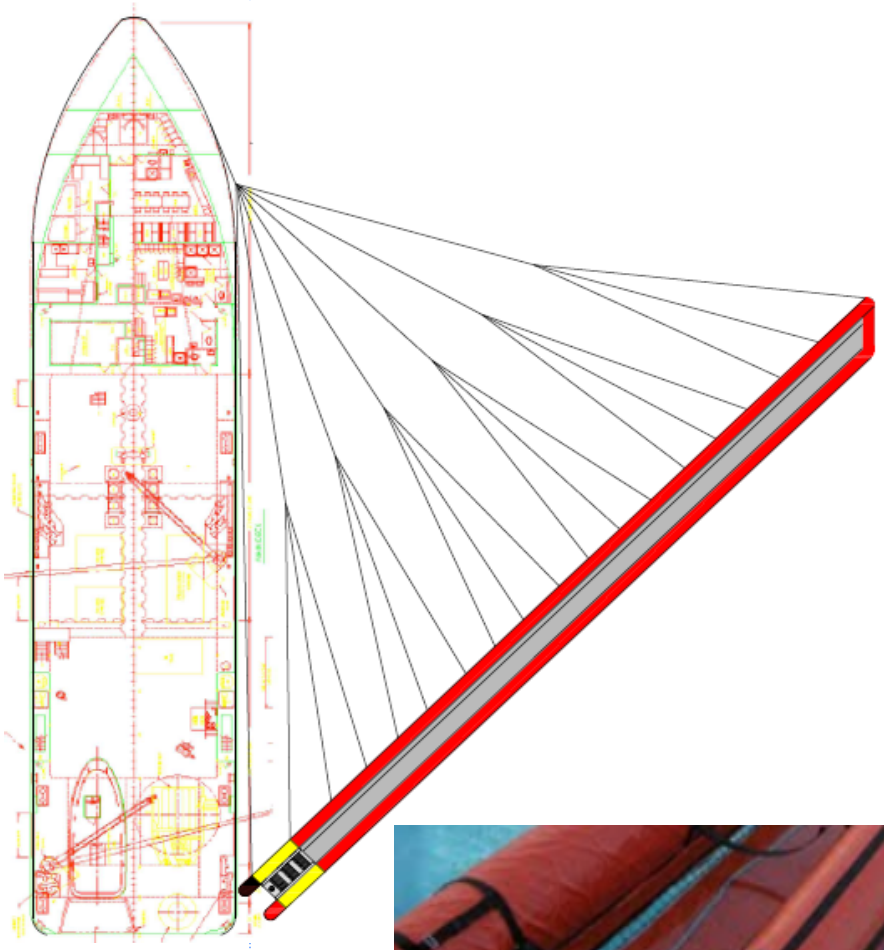
Oil Shaver



- Novel single vessel recovery concept
- Oil is collected between two parallel shallow draft pontoons.
- Formation maintained by balancing water drag and towing line forces
- Rear of system supported by hull of vessel (skimmer next to vessel, short hose)
- In Wendy Smith final at OHMSETT 2011
- Offshore demonstration from MSRC recovery vessel
- Prototype under construction for a new 44 m long vessel

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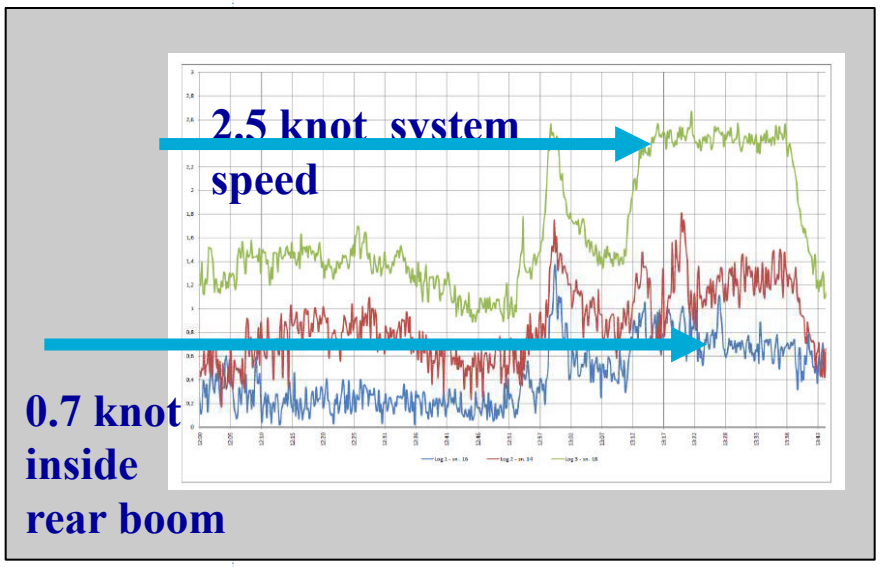
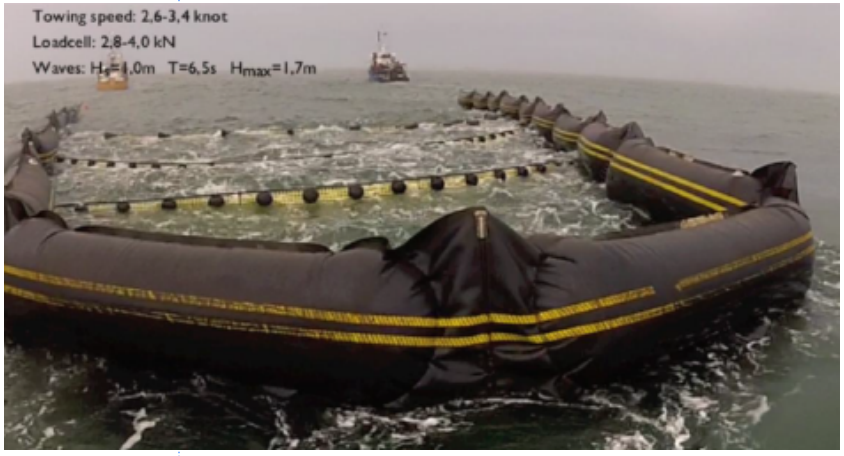
Oil Shaver

HISORS



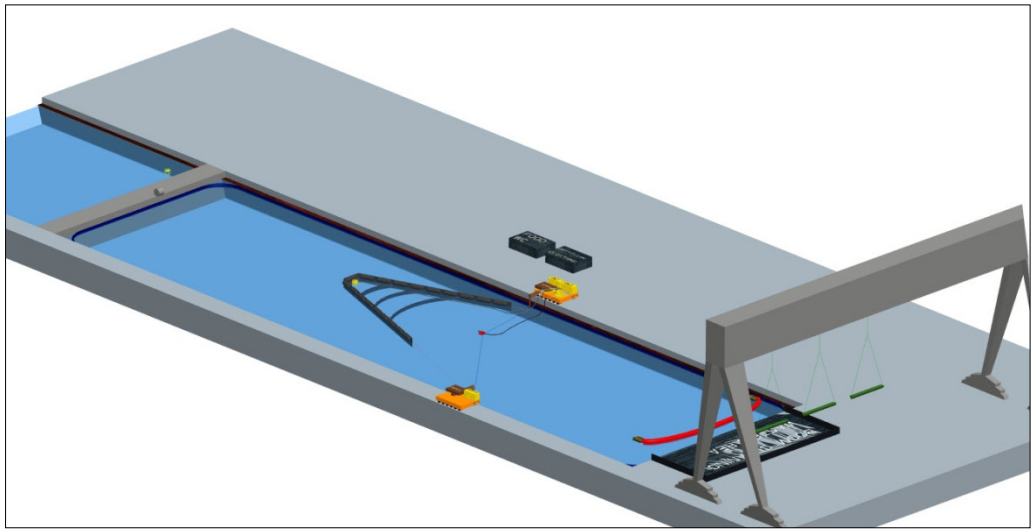
- Perforated barriers stretch the flow pattern in conventional boom systems
- Possible to increase towing speed without great loss of oil
- Offshore exercises demonstrated that operational challenges can be solved
- Motivation for sponsoring development is the possibility to increase towing speed of existing booms



HISORS

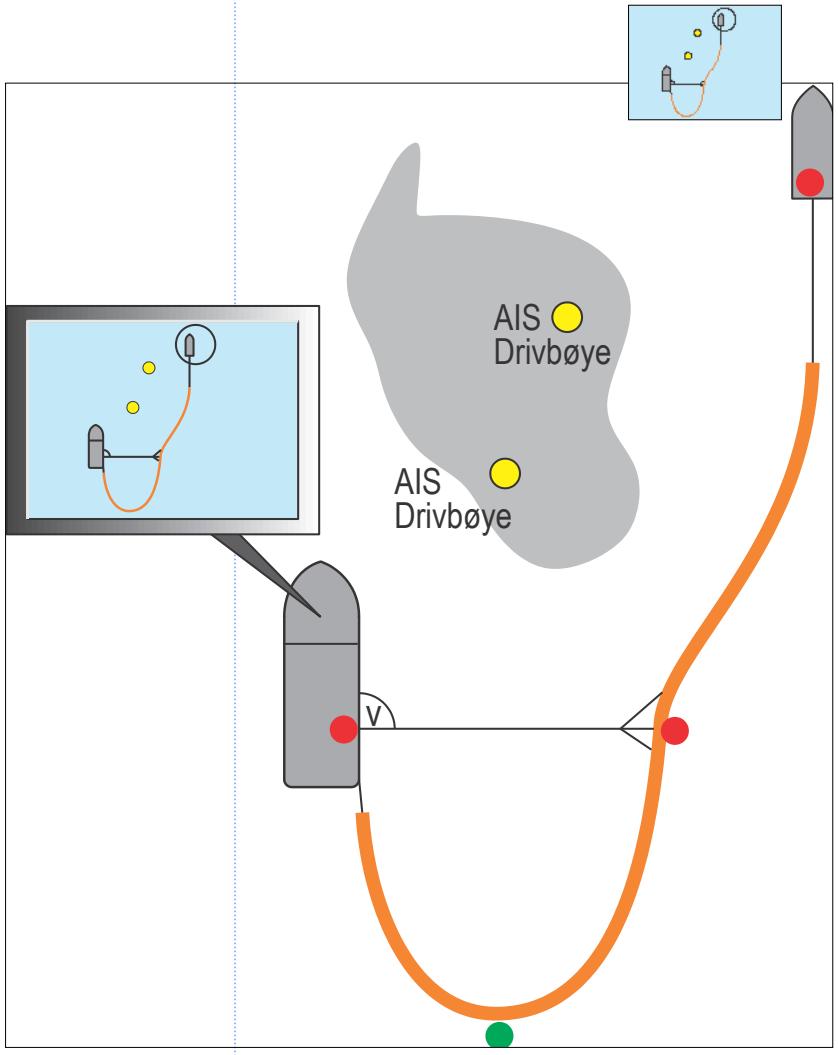
Present phase:

- **System designed and optimized through combination of**
  - **computational fluid dynamics (CFD) analysis**
  - **traditional scale model experiments in towing tank**
  - **full scale field experiments**
- **Full scale oil-on-water experiments in dry dock conducted (L315xW90xD8 m)**




TransRec150

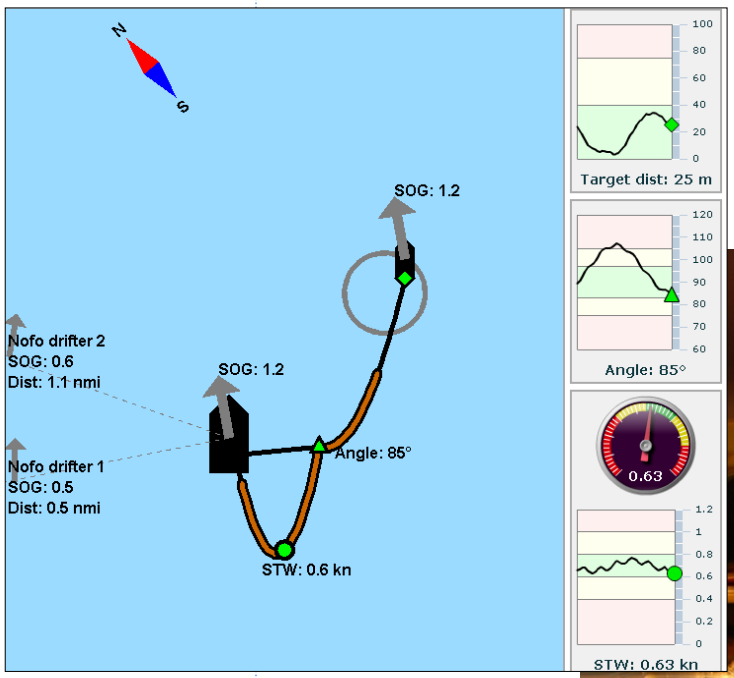
Boom monitoring system



- Objective is to ease operation of large boom systems
- To present boom information the system use
  - position from three GPS nodes (red dots)
  - AIS information from both vessels
  - Doppler log (green dot) to monitor speed through the water
- Displays on both vessels provide alarms and recommended actions when necessary
- Already proven useful during 24 hr. field trial in January far north
- AIS drifting buoys can also be shown on the same display
- Similar project for smaller systems and vessels under development

Boom monitoring system

Display on board towing vessel



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Category B:
DISPERSANT APPLICATION

BV spray – dispersant application for vessels

- The objective was to develop a large offshore system for dispersant application from vessels
- To be mobilized on an OR vessel together with mechanical recovery system
- Concept developed using standard Boom Vane
  - 20 m swath width
  - Unit later adopted as a coastal version for smaller vessels

BV spray – dispersant application for vessels

- Prototype of offshore system, swath width 50m, undergoing field trials
- Expected to be verified during oil-on-water exercise in June 2012

BV spray – dispersant application for vessels

- Average wind speed 17 m/s
- Close to max wind speed (?)

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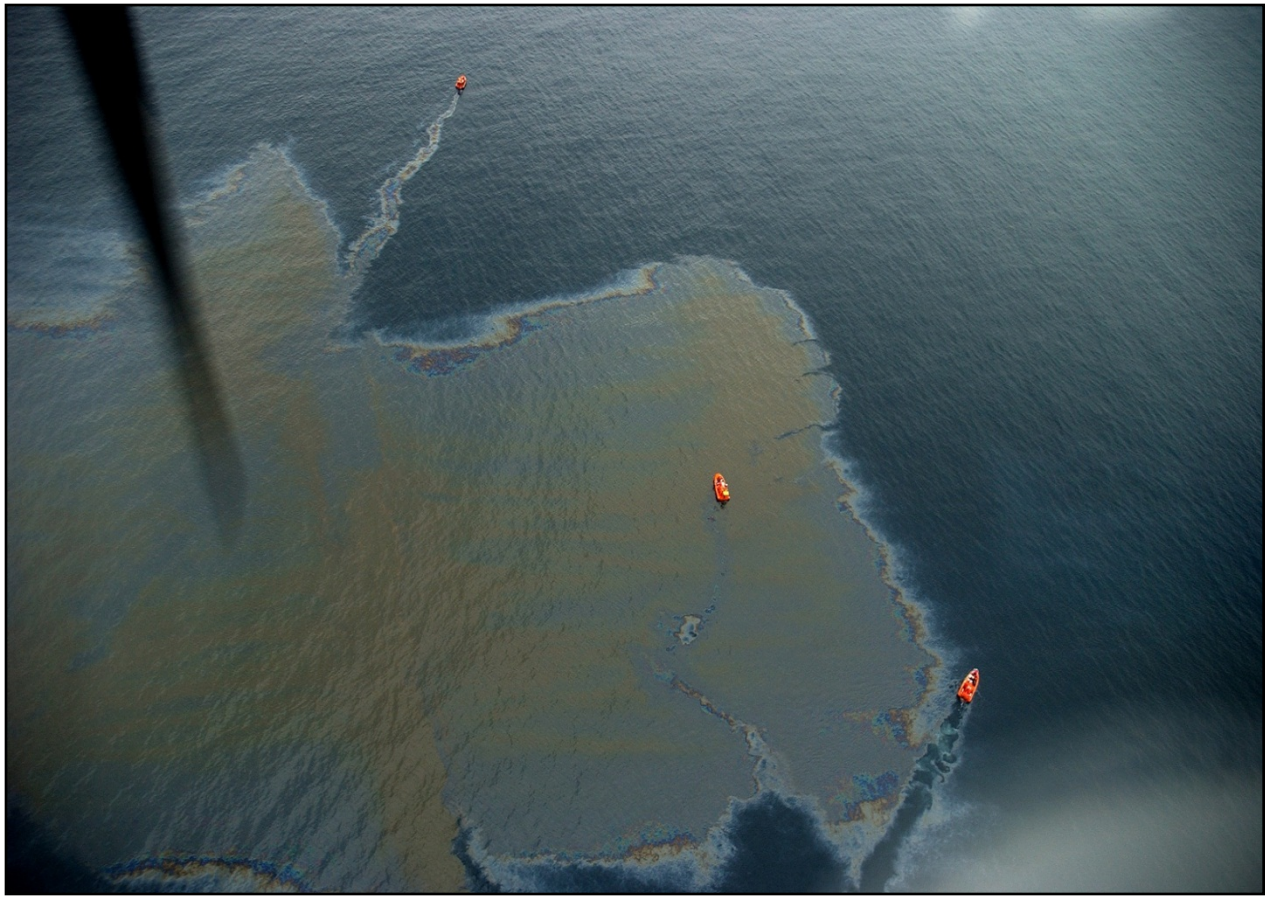
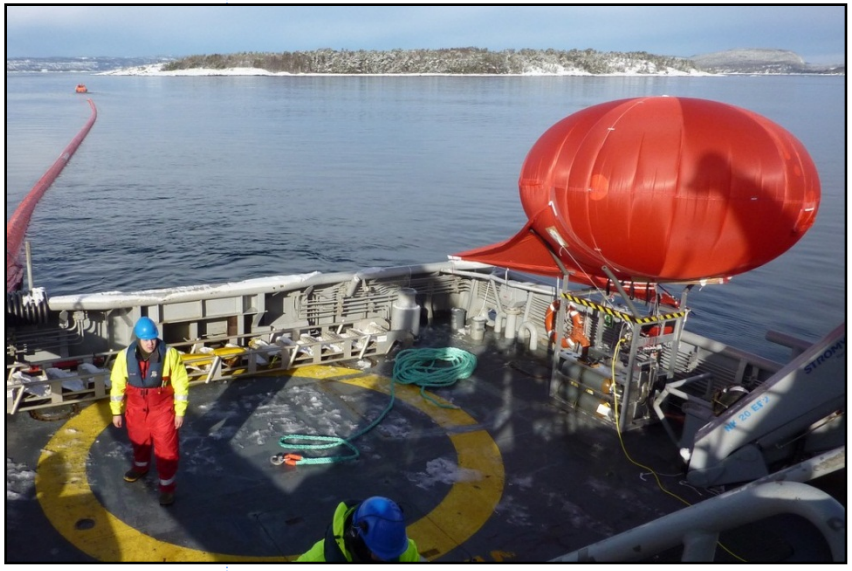
Category C:
REMOTE SENSING



Ocean Eye - Compakt aerostat system



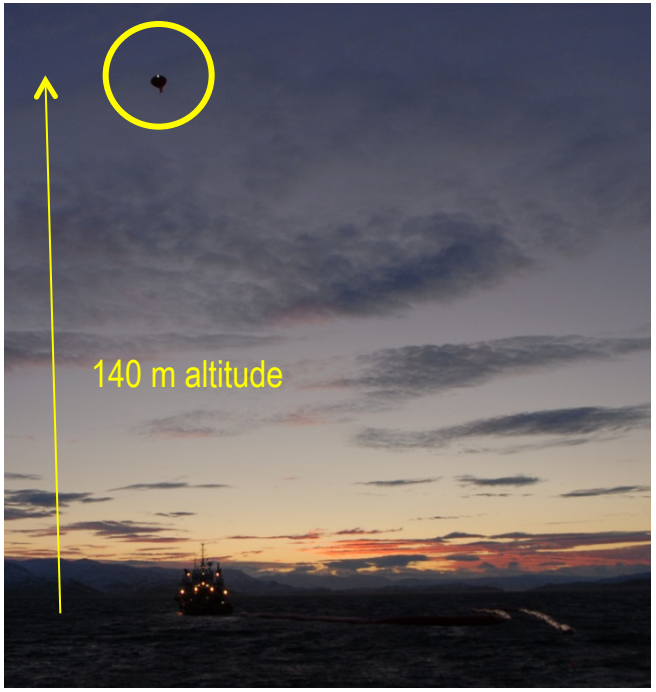
- Ground unit with small footprint
- Payload capacity 3 kg, consists of
  - battery, data link, emergency deflation system, strobe light, AIS repeater, HD video camera, uncooled IR sensor
- Typical altitude 150 m
- Imagery from sensors transferred by radio link to ground unit and to stand alone control unit typically located in wheelhouse
- Other vessels within LOS can receive live imagery if they have a receiver unit
- First production version is for 2-year pilot service (Interspill exhibition)
- Concept to be further developed
- Aerostat systems have significant potential both offshore and in coastal waters, providing continuous local area situation overview

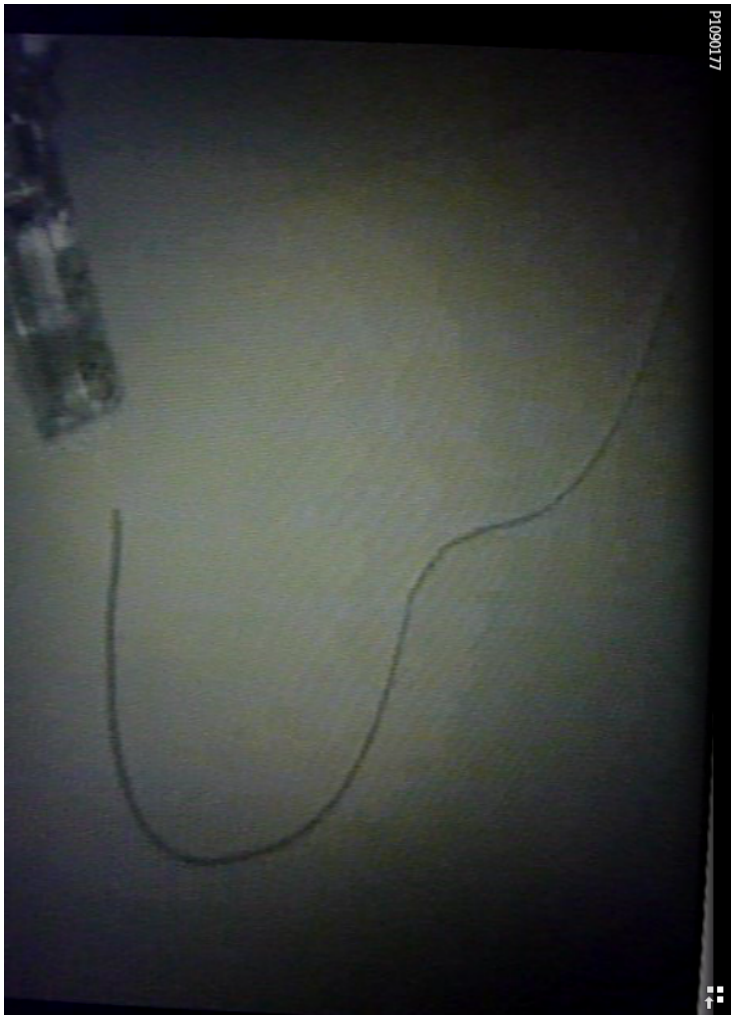
Compakt aerostat system

- Can be operated from smaller vessels

Ocean Eye - Compakt aerostat system

From 24 hr. field trial in January far north





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CONCLUDING REMARKS

- Significant technology improvements have already been achieved
  - from development of novel concepts
  - from modifications of existing technology.
- We expect that projects presently in the final stage of development will be part of future oil spill response technology that will make oil spill response more effective 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.