Report from the IMAROS workshop in Horten, Norway 7-9 September 2021

This report summarises the workshop that was held at the Norwegian Coastal Administration in Horten from 7-9 September, 2021 as part of the IMAROS project.

IMAROS is an acronym for "**I**mproving response capacities and understanding the environmental impacts of new generation low sulphur **MAR**ine fuel **O**il **S**pills".

The workshop summarised WP 3 and initiated WP 4. The objectives for WP 4, as stated in the Grant Agreement (GA), were:

- To be able to give recommendations regarding the applicability of different response methods and equipment to the new generation of fuel oils

The agenda for the workshop is enclosed with this report (see Appendix 1).

Day-by-day summary:

Tuesday, 7 September 2021
To start off the workshop, the Norwegian Coastal Administration (NCA) informed the participants about its responsibilities and activities. Thereafter, the participants were taken on a tour of the NCA's new emergency response control room and the governmental depot. Jon-Arve Røyset of the NCA gave a short introduction about the PAME-EPPR project, a related project on low-sulphur fuel oils in the Arctic area. The workshop's planned testing program was then presented. Finally, EHS procedures were reviewed and handed out to all participants, both with regard to the Covid-19 situation and the workshop activities in the NCA's testing facilities.

Wednesday, 8 September 2021
Trials were conducted in the NCA's testing facilities. The film crew that was contracted as part of Delivery D1.4 took some footage of the trials. A few journalists were also present.

The IMAROS group had a practical day at the testing facilities in Horten to get acquainted with the facilities and to test the procedures for the trials that will be performed on the selected hybrid oils.

Before the activities in the testing facility began, risk assessments for Covid-19 and for the operations that were to take place on the premises were jointly reviewed.

Test configurations

Temperature:	Oil, water and air 15 °C
Oil type:	Raw oil from Oseberg, which had been used several times in the basin.
Amount of oil:	2000 l

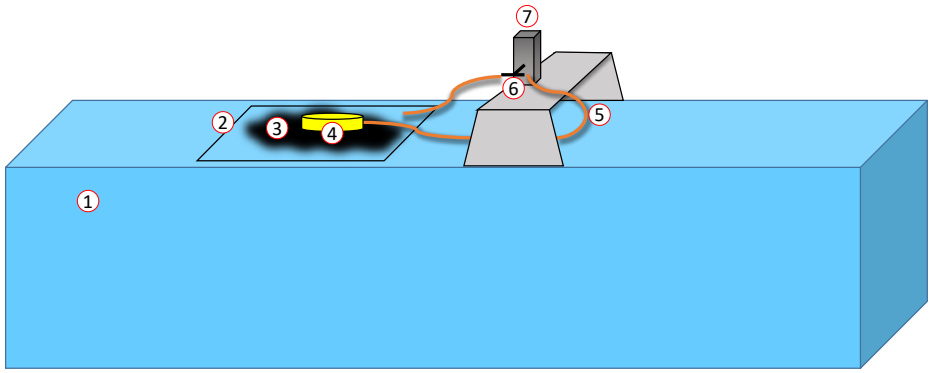
Oil thickness:	12 cm
Run time skimmer:	1 min
Settling:	5 min
Collecting tank:	1000 l
Discharge hose:	15 m

Test basin setup:

Test 1 basin:
The oil and the skimmer were placed in an enclosed area of 4x4 m within the test basin. This made it possible to obtain the desired thickness of the oil. To test skimmer capacity, the amount of oil that a skimmer can collect in a certain period of time is measured, and results expressed as m^3/hour. The trial starts with a rather thick layer of oil. In this test, an approximately 12 cm thick layer of oil was applied in the small, enclosed basin. This corresponds to a situation in which the skimmer is covered in pure oil (minimum 7.5 cm at start-up, and at least 5 cm at the end of the trial). The test also shows if the skimmer works at all. It is important that the skimmer does not come into contact with the water surface, in order to keep the oil as pure as possible. (Oil-water mixtures are not desired.)

Test 2 boom:
The skimmer and the oil were placed within a boom with a current, thus simulating a boom dragged behind a vessel. The applied current was slow enough to not allow any oil to pass underneath the boom (less than 0.6 knots). The selected current was recorded. After the current was optimized, it was used throughout the entire test. At this point, the oil emulsified and looked like chocolate mousse. For the test, the same amount of oil was used as had been applied in the smaller, enclosed basin of Test 1. The skimmer was operated according to «best practise» principles. This was done by monitoring the amount of collected oil and free water, and based on the maximum time capacity set by the producers.

① Test basin with seawater
② Basin
③ Oil
④ Skimmer
⑤ Discharge hose
⑥ Tank valve
⑦ Collecting tank



In the NCA-laboratory:

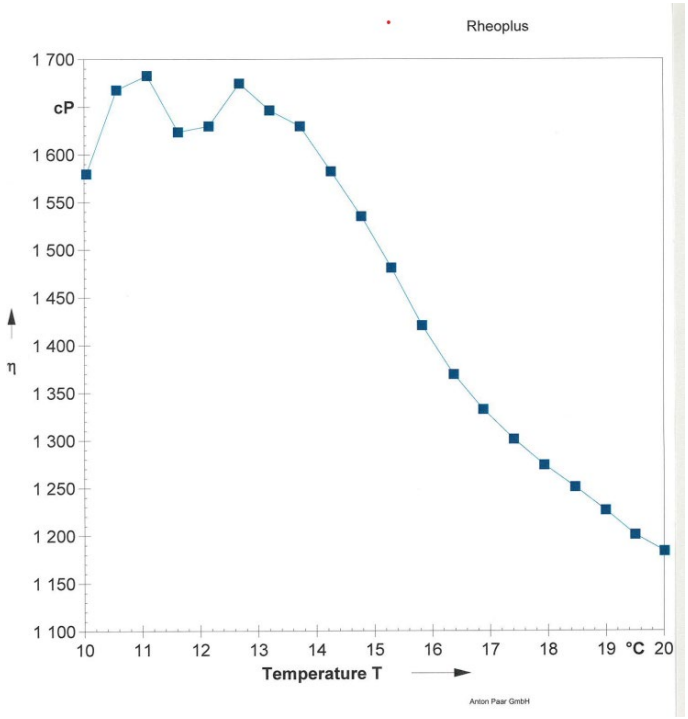
Oil samples were taken before and after the trials.

Sample results – before use of skimmer:
Density: 988.1 g/cm3
Water content: 0.3 %

Viscosity:
at 10 °C – 1960 cP
at 20 °C – 404 cP

Sample results – after testing in basin:
Density: 987.6 g/cm3
Water content: 12.5 %

Viscosity:
at 10 °C – 1560 cP
at 20 °C – 1110 cP



A «hot wash-up» held immediately after the tests gave the following conclusions:

- Some modifications will be done before testing in week 43. Water content is difficult to determine. There should be more than 15 % water, but the collection of representative samples is difficult. The measured viscosity (~1500 cP at 10 °C), should have been 5000-6000 cP.
- Adjust the skimmer higher up, to get less or no water.
- It is difficult to measure water content and viscosity of emulsions.
- Future tests should focus on test type 2 (contained in boom), but tests should be run for a longer period, and take up more of the oil.
- A larger collecting tank should be used. Suggestion: fill the recovery tank from the top, which makes it easier to take samples.
- In the first test, use the same principle as used by Cedre.
- The second test is the most valuable of the two.
- Cedre is not able to test in 'boom plus current', but agrees that this test is realistic and important.
- A light oil and a suitable skimmer were used in this test. There will be more uncertainty when it comes to the new types of oil.
- Meeting each other and networking is valuable in itself.

A list of relevant oil types for further testing is attached (Appendix 2).

Thursday, 9 September 2021
Torben Iversen from Denmark presented a summary of WP 2, and Fanny Chever from France summarised the status of the work in France. Marijke Neyts from Belgium answered questions about the fingerprint analyses that were performed earlier in the project.

Furthermore, cross-cutting WP3 /WP 4 activities and plans for further testing were discussed. The key points from this session were:

- It is important that the tests include a wide variety of skimmers and oil types. Oils should have varying physical-chemical properties, especially pour point.
- The number of skimmers depends on the number of different oils to be tested, as well as on the thickness of the oils during testing.
- Will oils emulsify if they are repeatedly reused? According to assessments in Norway, it is acceptable to reuse the same oil multiple times as long as the layer of oil is at least 20 cm thick. However, this needs to be verified by taking samples before each run.
- France uses thin layers of oil, and runs their tests on pure oil that has not been previously used.
- It is important to coordinate reporting, to ensure that the results of the tests that summarise the experiences from WP 4 are comparable.
- Detailed testing plans and procedures need to be prepared. The test procedures will be distributed to everyone in the group.
- It was suggested to increase the duration of the skimmer tests (to about 24 hours?), to see if this affects oil properties and thus oil uptake.
- The parameters that are analysed in WP 4 are density, water content and viscosity. Cedre performs the analyses themselves. In Norway, samples will be taken in NCA's laboratories, but samples will also be sent to SINTEF. The data presented in the Norwegian report will be based on the analyses performed by an external laboratory.

- The results from WP 3 and from the meso-scale flume tests with Wakashio oil were presented. The results from the Wakashio oil flume tests performed by SINTEF and Cedre are very similar. The oil was tested in 15 °C and in cold water (2 °C and 5 °C, respectively). Being able to verify that the results from flume tests in Norway and France were so similar was extremely valuable.
- Since there is considerable variation between oils, it will be difficult to draw any conclusions regarding the skimmers. Although it is desirable to test ULSFO and VLSFO, the main objective is that tested oils have considerable variations of physical-chemical properties, such as pour point.
- One challenge is that there are discrepancies between the submitted analysis reports and the actual analysis data for the corresponding batch. All large samples must be fully re-analysed. The analyses from WP 3 were reviewed, but cannot be used as initially intended. The analyses in WP 3 provide a basis for additional input to national modelling databases. However, the further processing of data for such databases is not part of the IMAROS budget. This work has to be done nationally.
- There is some uncertainty regarding the toxicity of hybrid oils, due to the possible high contents of aromatics. However, this cannot be confirmed or disproved by BE oil analysis.

A separate CPT meeting was held, and minutes from this meeting are available.

Furthermore, a summary of proposed skimmers for further testing is provided in a separate note, see Appendix 3.

Proposed skimmers for tests at CEDRE:

Skimmer 1: Elastec TDS 118,

Used by land/shore recovery organisation (which one?) in France. Available at CEDRE,

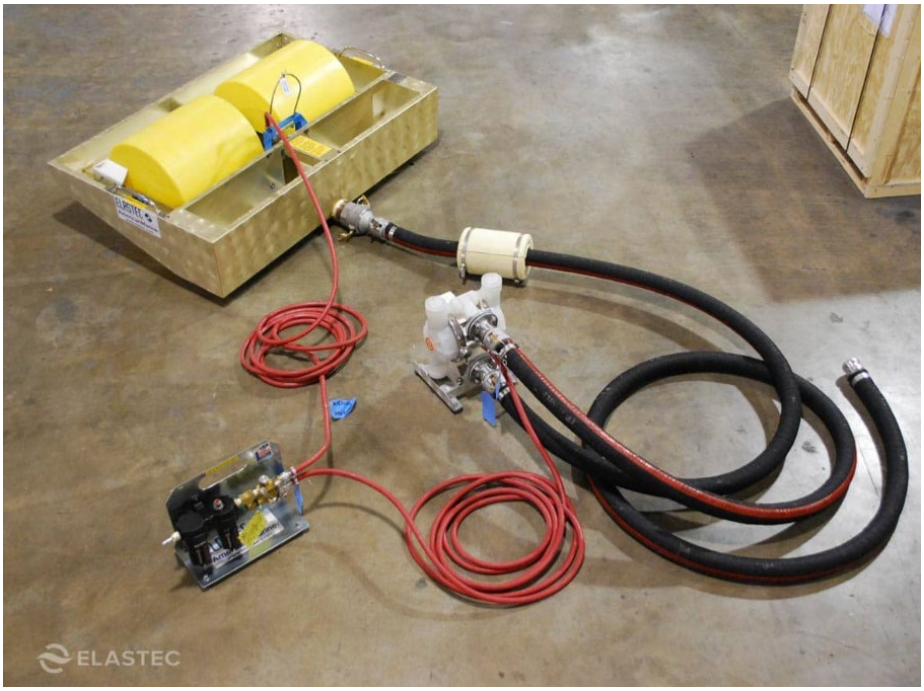
TDS 118, Grooved drum type skimmer, oleophilic based;

From web site: “Due to its shallow draft and light weight, the TDS118 is ideal for cleanup in creeks, rivers and lakes.”

TDS118 Oil Skimmer Specifications

Recovery Rate*	90 gpm / 20 m^3h (Grooved Drum)
Weight	83 lb / 37.6 kg
Dimensions	53 x 41 x 18 inch / 1.33 x 1.02 x 0.46 m
Application	Industrial, Inland, Harbor

*Tested at Ohmsett test facility according to ASTM F2709. Nameplate capacity verified by the U.S. Coast Guard.



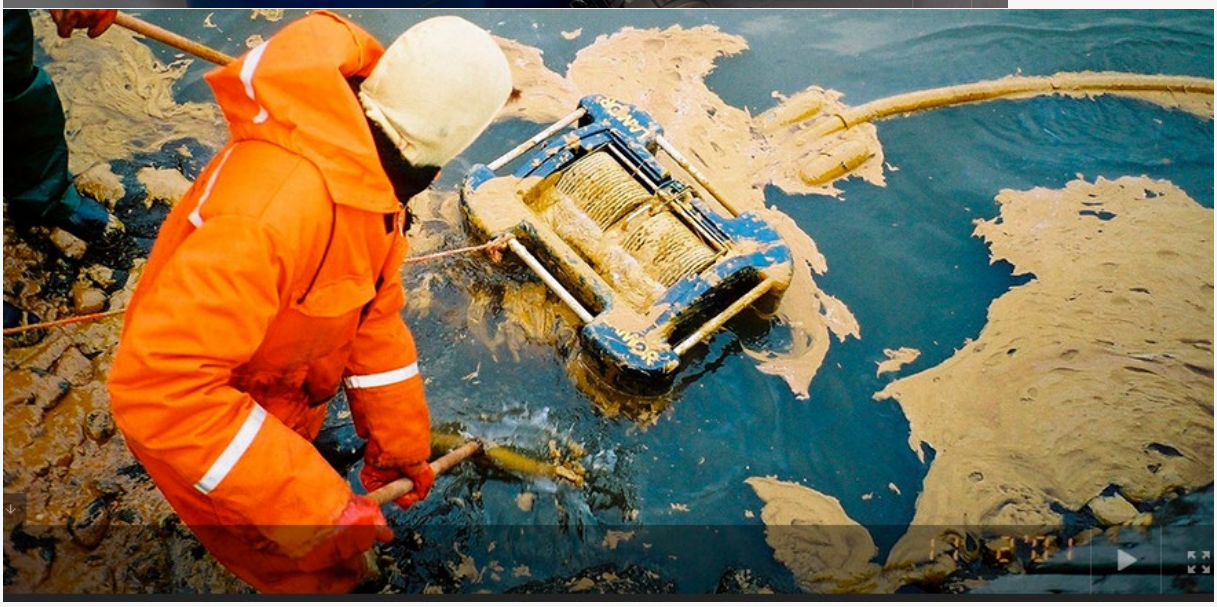
Skimmer 2: Lamor Minimax 12:

Used by the French Navy. The French Navy will make it available to CEDRE. The skimmer is also used by the Swedish Coast Guard. (KBV)

From Web-site: The Minimax 12 is a light, portable oleophilic brush skimmer, designed to recover oil from shorelines, harbors, rivers and lakes. The skimmer has proven its efficiency in continuous recovery operations in hundreds of oil spills worldwide, in all climatic conditions and varying types of spilled oils.

Technical Specifications:

Length; 835 mm / 33 in
Width: 665 mm / 26 in
Height: 357 mm / 14 in
Weight: 28 kg
Capacity: 45.4m3/h / 200 gpm
Free water collected: <5%
Hydraulic flow (skimmer):1-3l/min / 0.3-0.8 gpm
Hydraulic pressure: 60-100 bar / 870-1450 psi



Alternative: Lamor Minimax 30

Do any of you have that skimmer available; it seems like an even better alternative;

The LMM 30 is a stiff-brush conveyor belt-type oil skimmer designed to recover oil and contaminated debris in fast flowing rivers, oil ponds, harbors or as an advancing side sweep skimmer. Surface water, oil and debris are drawn into the skimmer with a water suction propeller forcing oil to the brush system.

The brush conveyor recovers all oil types but is particularly effective on weathered oils, crude, high viscosity bunker oil, emulsions, and high concentrations of oily debris, while collecting almost no free water. Oil and oily debris are separated, lifted, and delivered into a debris basket and collection sump. This skimmer has a recovery efficiency of 95%.

The patented V-Brush belt combines high oil recovery capacity with low free water pick-up. It has an oil recovery rate of 30m³/hr. That said, capacity tests, conducted by Bureau Veritas, certified a recovery rate of 53.1m³/h.

Length, mm	2400
Width, mm	1720
Height, mm	1400
Weight, kg	180
Weight, with pump, kg	230*
Certified capacity, m³/h	53.1*
Free water content	<5%
Hydraulic flow (skimmer only), l/min	10-15
Hydraulic pressure, bar	60-150
Power requirement, kW	4

* Related to pump selection

Proposed skimmers for tests at the NCA, Horten

Skimmer 1: Desmi Terminator, Belt skimmer

Used by the NCA, Norway, and commonly used “world-wide”.

This skimmer also covers the principle from the “new prototype” suggested by Desmi, which seems to be a modified version of the one used by the NCA

From website: highlighted the problems of recovering very viscous oils at sea. To respond to this challenge DESMI has developed a line of belt skimmers.
The BELT skimmer is a special attachment to the TERMINATOR skimmer that enables the recovery of highly viscous oils that do not flow well into a conventional weir. The BELT skimmer is able to operate in either direction (depending on the oil type) - to pull in and discharge the oil into the hopper, where the vertical screw pump is housed.

Skimmer 2: KLK 602

Used by the NCA, Norway, (the one used in the test basin during the workshop in week 36)

Drum/shovel principle

602 TWIN DRUM

"Two skimmers in one"

KLK-602 TWIN DRUM handle oils of most viscosities, from heavy crude to light oils.
TWIN DRUM has been specially designed to operate with **heavy crude oils** both at sea and in ports, at temperatures down to **freezingpoint.**

KLK-602 TWIN DRUM operates well in rough sea without taking in unwanted water.
TWIN DRUM handles most types of debris, ropes, wood, sea-grass, birds etc. without difficulty.

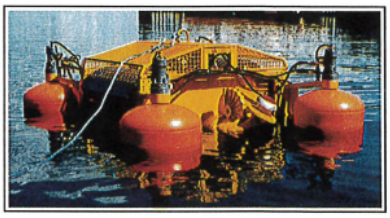
The **two drums** collect oil from opposite directions which **doubles the capacity** rate.

For minimum storage space and for rapid and effective maintenance the **pontoons** may easily be **removed.**

Model 602 works with a built-in pump for maximum lifting capacity.

KLK-602 TWIN DRUM is a high-quality product, manufactured of first-class materials, chosen to withstand very corrosive environments.

KLK-602 TWIN DRUM is designed to meet the requirements for service availability and ease of maintenance.



KLK -602 TWIN DRUM

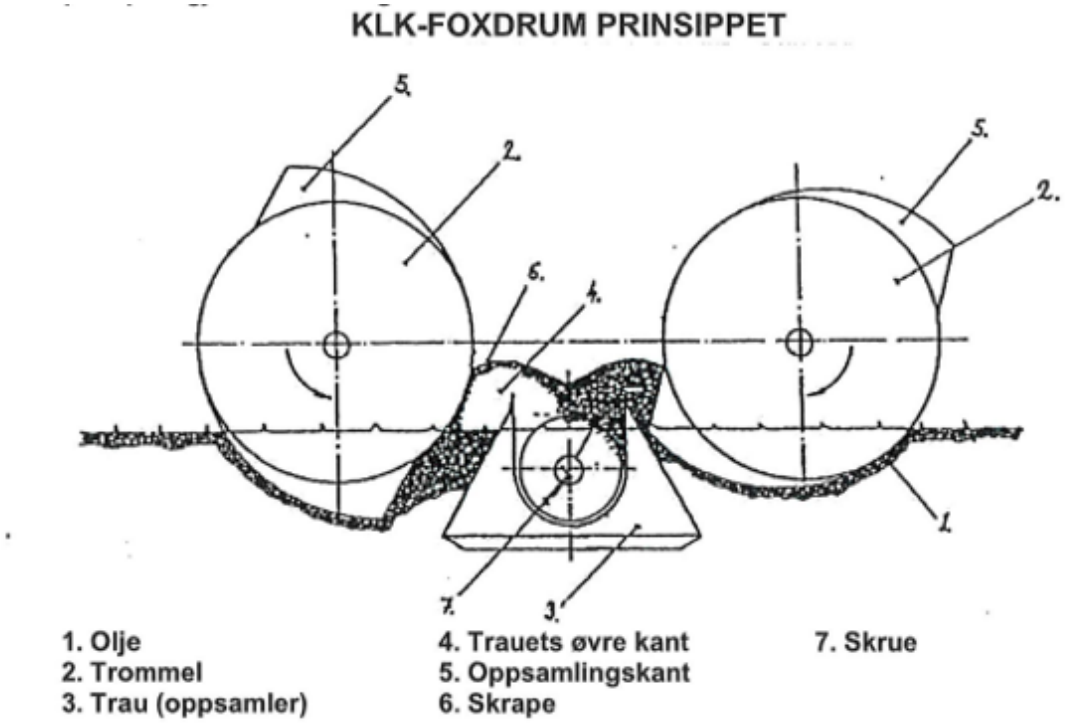
Technical Specification

Dimensions:	
L x W x H	1900 x 1900 x 1300 mm (75 x 75 x 51 in)
With pontoons:	2400 x 2400 x 1300 mm (95 x 95 x 51 in)
Draught:	400 mm (16 in)
Weight:	360 kg (800 lbs)
With pontoons:	410 kg (911 lbs)
Skimmer frame:	Aluminium
Shipping volume:	3.5 m³
Hydraulic motors:	DANFOSS
Screw Pump:	DESMI DS-250
Hydraulic Couplings:	TEMA (or customers choise)
Capacity:	90 m³/h
Oil separation:	95-98%
Hydraulic Power:	30 kW

KLK AB reserves the right to change specifications without prior notice.

1.1 The KLK FoxDrum system

The KLK FoxDrum 602 uses a very simple method for collecting oil from the water surface. The system consists of a collection unit that is placed in the oil spill. The pontoons ensure that the skimmer is kept at the correct height in the water (each pontoon can be adjusted individually). The two drums rotate in opposite directions and ‘scoop’ up the oil from the water’s surface. Each drum is also fitted with a scraper that scrapes the oil off the drum and into the skimmer sump. A special screw forces the separated oil into the pump. Finally, the oil is pumped through a hose to a collection reservoir.



1. Oil
2. Drum
3. Sump (oil collection)
4. Upper sump edge
5. Upper oil collection level
6. Scraper
7. Screw

1.2 Drum rotation speed

The drum rotation speed can be adjusted infinitely. When collecting heavy oils, such as Bunker C, the skimmer is operated at low drum rotation speeds. For lighter oil types, higher speeds are used. The drum rotation speed should also be adapted to the thickness of the oil layer, and also depends on whether or not the presence of free water in the collected oil can be accepted. If some free water can be accepted, the skimmer should be operated at high drum rotation speeds to ensure maximum oil uptake capacity. However, the drums should not rotate so fast that the oil spill breaks up. Maximum oil uptake capacity can be achieved by positioning the skimmer in those areas within the boom where there is the most oil. Typical drum rotation speeds are 5-20 rpm.

Skimmer 3; Option 1 Foxtail 2-6

Used by the NCA, Norway, and by the Swedish Coast Guard. Also suggested by Jelena (KBV)

Vertical adhesion band skimmer (rope mop skimmer)

From Web;

Heavy and light oils are collected from the water surface by the Foxtail rope skimmer's endless high-performance adhesion bands (mops). These fibrillated polypropylene bands collect (adhere) oil when moving through the water. The oil is squeezed out of the Foxtail rope skimmer inside the machine with special rollers.

Oil collected in the vertical adhesion band (VAB) is then pumped onboard/ashore into the collection tank. The Foxtail rope skimmers are lightweight and can be hung from a single wire (crane or other fixture). Larger models are provided with bumpers for motor protection.

Model	VAB 1-6	VAB 2-6
Capacity	$3m^3/h$	$9m^3/h$
Weight empty skimmer	33kg	125kg
Weight operating skimmer	50kg	220kg
Outside dimensions (L x W x H)	0.7 x 0.5 x 0.8m	0.9 x 0.7 x 0.8m
No of Foxmops	1	2
Length of Foxmops	10m	10m
Foxmop size	6	6
Transfer pump capacity	x	15
Total system weight w/container	x	454kg

Skimmer 3; Option 2 XXX

Other suggestions: Please give your suggestion

Thursday 9. September

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Country	Supplier	Oil Type	Sulphur	Density(15)	Viscosity(50)	Pour Point
Malta	Valetta Bunker	VLSFO	0,47	947	250	+3 (+18)
Sweden	Stena Oil	VLSFO	0,46	936	184	+24
Spain	Repsol	VLSFO	0,48	953	245	-18 (-9) ?
SWE/NL	Shell	ULSFO	<0,1	?	60-100?	20-30

– Clean, safe and efficient seaways

KYSTVERKET
NORWEGIAN COASTAL ADMINISTRATION

Tuesday. 7. September

09.00-09.30	Log in (coffee and fruit)	
09:30- 10.00	Welcome / Presentation of NCA	Hans-Petter Mortensholm
10:00 - 10:30	Agenda – participants introduction	Kathrine Idås / All
10:30-11.00	HSE – Risk analyses	Bente Søndersrød
11.00-12:00	Visiting Operation Center/Depot	Stig Nordaas
		Bjørn R. Frost
12.00-13:30	Lunch (mails,calls and small-talk)	All
13.30-14.15	PAME – EPPR project	Jon Arve Røyset NCA
14.15-15:15	Presentation of test-program	Bjørn Ronny Frost, Ingvild Alstad Frogner, Giedre Agurkyte
15.15-16:15	Visiting testfacilities	Kathrine Idås
19:00	Dinner at Eiken Pensjonat	

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Wednesday 8. September

09:00 – 10:30	Log in (coffee and fruit)	
	Today’s agenda	Kathrine Idås
	Presentation film team	Stang Media
	HSE – repetition, demonstration	Bente øndersrød
10:30 – 12:00	Testing	All
12:00 – 13:00	Lunch	
13:00 - 16:00	Testing	All
16:00 – 16:30	“Hot wash up”	All
19:00	Dinner at Fishland restaurant	

KYSTVERKET
NORWEGIAN COASTAL ADMINISTRATION

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Thursday 9. September

09:00 – 09:30	Log in (coffee and fruit)	
09:30 – 10.00	Status project	Kathrine Idås
10:00 - 11.00	Torbens' 15 minutes: summing up WP2	Torben Iversen
	Fannys' 40 minutes: summing up WP3	
	Status: Shoreline, dispersion, in situ, flume-testing	Fanny Chever
	10 questions about analyses	Marijke Neyts
11:00 – 11:15	Break (coffee and tea)	
11:15 – 12:30	Discussing cross-cutting WP3/WP4	All
12:30 – 13:30	Lunch	
13:30 - 15:15	Discussing continue / further plans for testing	All
15:15 – 15:30	Break (coffee and tea)	
15:30 – 17:00	CPT-meeting	
19:00	Dinner at Sjømilitære samfunn	

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