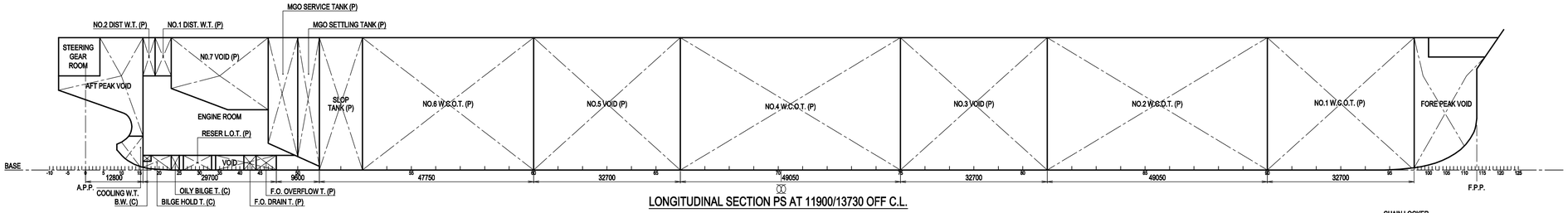
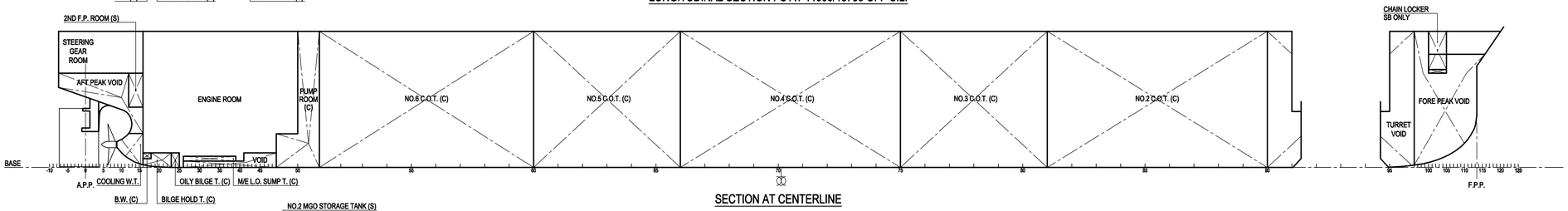
ANEXO A – CARACTERÍSTICAS DA UNIDADE DE PRODUÇÃO E DAS EMBARCAÇÕES DE APOIO

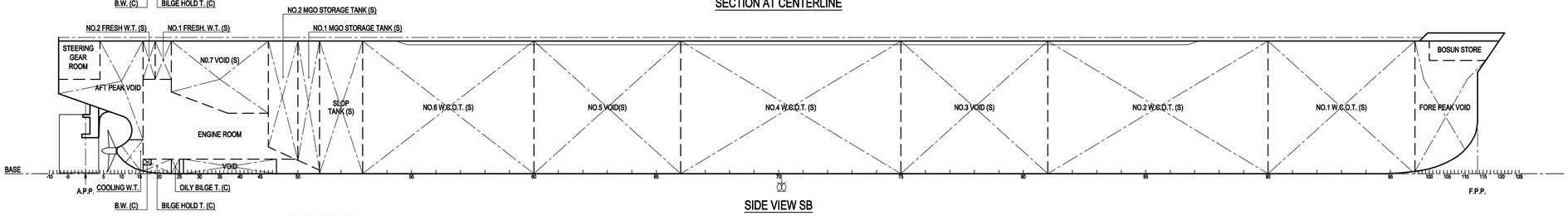
UNIDADE DE PRODUÇÃO



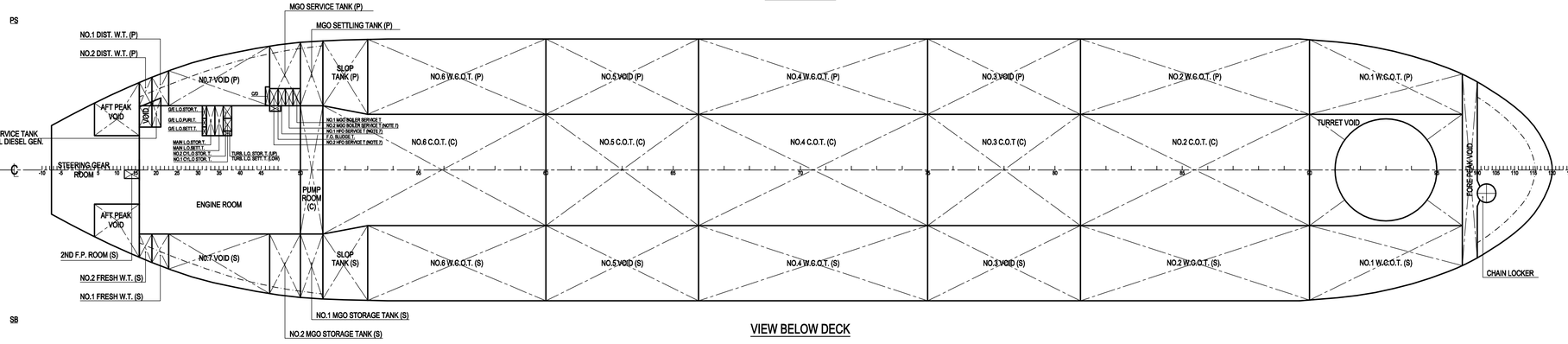
LONGITUDINAL SECTION PS AT 11900/13730 OFF C.L.



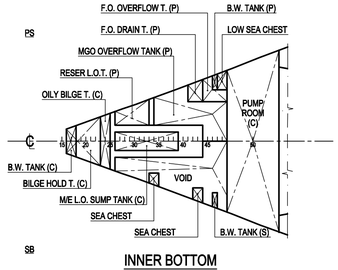
SECTION AT CENTERLINE



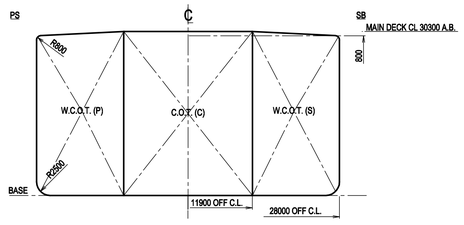
SIDE VIEW SB



VIEW BELOW DECK



INNER BOTTOM



TYPICAL CROSS SECTION

CRUDE OIL TANKS SPECIFIC DENSITY 0.949 t/m3

DESCRIPTION	VOLUME 100% m³	VOLUME 100% BBLS	WEIGHT 100% t	LCG Fwd of AP m	TCG PS:+ m	VCG Above BL m
NO2 COT (C)	35138	221011	33346	238.82	0.00	15.15
NO3 PWT (C)	23421	147311	22226	197.95	0.00	15.15
NO4 COT (C)	35083	220664	33293	157.08	0.00	15.15
NO5 COT (C)	23421	147311	22226	116.20	0.00	15.15
NO6 COT (C)	34694	218221	32925	75.67	0.00	15.16
NO1 WCOT (P)	10483	65934	9948	277.32	17.71	16.16
NO1 WCOT (S)	10483	65934	9948	277.32	-17.71	16.16
NO2 WCOT (P)	23125	145454	21946	238.49	19.76	15.09
NO2 WCOT (S)	23125	145454	21946	238.49	-19.76	15.09
NO4 WCOT (P)	23403	147203	22210	157.08	19.89	14.99
NO4 WCOT (S)	23404	147204	22210	157.08	-19.89	14.99
NO6 WCOT (P)	16955	106645	16090	81.39	19.51	15.78
NO6 WCOT (S)	16955	106646	16091	81.39	-19.51	15.78
	299690	1884990	284405	169.65	0.00	15.26

FO TANKS SPECIFIC DENSITY 0.96 t/m3

DESCRIPTION	VOLUME 100% m³	VOLUME 100% BBLS	WEIGHT 100% t	LCG Fwd of AP m	TCG PS:+ m	VCG Above BL m
FO DRAIN T.(P)	11	67	10	36.78	8.35	2.43
FO OVERFLOW T.(P)	23	147	22	40.48	8.88	2.25
FO SLUDGE T	5	30	5	41.90	13.13	8.39
NO.1 HFO SERVICE T.	43	272	42	43.30	15.56	17.22
NO.2 HFO SERVICE T.	49	306	47	41.60	15.56	17.22

MGO TANKS SPECIFIC DENSITY 0.85 t/m3

DESCRIPTION	VOLUME 100% m³	VOLUME 100% BBLS	WEIGHT 100% t	LCG Fwd of AP m	TCG PS:+ m	VCG Above BL m
NO.1 MGO STORAGE TANK (S)	1184	7447	1006	49.75	-19.25	19.66
NO.2 MGO STORAGE TANK (S)	1353	8510	1150	44.13	-19.06	21.06
MGO SETTLING TANK (P)	1184	7447	1006	49.75	19.25	19.66
MGO SERVICE TANK (P)	1176	7396	1000	44.15	19.59	21.63
MGO OVERFLOW TANK (P)	215	1351	183	36.83	5.00	1.76
NO.1 MGO BOILER SERVICE T	43	272	37	46.50	15.56	17.22
NO.2 MGO BOILER SERVICE T.	43	272	37	44.90	15.56	17.22
ESSENTIAL DESEL GEN.	24	153	21	16.44	11.17	18.66

SLOP TANKS SPECIFIC DENSITY 1.025 t/m3

DESCRIPTION	VOLUME 100% m³	VOLUME 100% BBLS	WEIGHT 100% t	LCG Fwd of AP m	TCG PS:+ m	VCG Above BL m
SLOP TANK (P)	3090	19436	3167	57.18	19.06	18.03
SLOP TANK (S)	3090	19436	3167	57.18	-19.06	18.03
	6180	38873	6335	57.18	0.00	18.03

COOLING WT.TANK SPECIFIC DENSITY 1.077 t/m3

DESCRIPTION	VOLUME 100% m³	VOLUME 100% BBLS	WEIGHT 100% t	LCG Fwd of AP m	TCG PS:+ m	VCG Above BL m
COOLING WT.	76	480	82	11.06	0.00	4.98
	76	480	82	11.06	0.00	4.98

DIST. & FRESH WATER TANKS SPECIFIC DENSITY 1.00 t/m3

DESCRIPTION	VOLUME 100% m³	VOLUME 100% BBLS	WEIGHT 100% t	LCG m	TCG m	VCG m
NO2 DIST WT (P)	122	769	122	14.20	16.41	25.91
NO2 FRESH WT (S)	122	769	122	14.20	-16.41	25.91
NO1 DIST WT (P)	200	1256	200	17.36	16.97	25.80
NO1 FRESH WT (S)	200	1256	200	17.36	-16.97	25.80
	644	4050	644	16.16	0.00	25.84

BILGE TANKS SPECIFIC DENSITY 1.00 t/m3

DESCRIPTION	VOLUME 100% m³	VOLUME 100% BBLS	WEIGHT 100% t	LCG Fwd of AP m	TCG PS:+ m	VCG Above BL m
BILGE HOLD T (C)	82	517	82	16.31	0.00	2.09
OILY BILGE T (C)	38	237	38	20.03	0.00	1.98
	144	906	140	17.48	0.00	2.06

MISCELLANEOUS TANKS SPECIFIC DENSITY 0.90 t/m3

DESCRIPTION	VOLUME 100% m³	VOLUME 100% BBLS	WEIGHT 100% t	LCG Fwd of AP m	TCG PS:+ m	VCG Above BL m
G/E PURI LO TK	3	17	3	26.75	10.07	21.83
G/E LO STOR TK	4	25	4	26.75	12.36	21.83
M/E LO SUMP T (C)	45	284	45	27.52	0.00	1.94
G/E LO SETT TK	3	17	3	26.75	8.24	21.83
MAIN LO STOR TK	57	359	57	28.10	10.53	23.49
MAIN LO STOR TK	57	359	57	28.10	10.53	23.49
TURB LO STOR TK UP	5	34	5	31.70	7.78	24.33
NO1 CYL LO STOR TK	24	154	24	31.70	12.36	23.49
NO2 CYL LO STOR TK	24	154	24	31.70	9.62	23.49
TURB LO SETT TK LOW	3	17	3	31.70	7.78	21.83
RESER L.O.T (P)	35	219	35	25.56	4.08	2.26
	260	1636	260	28.79	7.84	16.86

Status	Rev.	Description	Author	Checker	Discipline Engineer	Group Leader	Date
P	1	FIRST ISSUE	LGB	SOD	EJA	PMR	AUG.2010

NOTES

ID	DESCRIPTION
1	LONGITUDINAL CENTER OF GRAVITY (L.C.G.) IS RELATIVE TO FRAME 0.
2	TRANSVERSE CENTER OF GRAVITY (T.C.G.) IS RELATIVE TO CENTERLINE. PORTSIDE (PS) IS POSITIVE.
3	VERTICAL CENTRE OF GRAVITY (V.C.G.) IS RELATIVE TO BASELINE.
4	TANK FILLINGS OF SOME CARGO WING TANKS WILL BE LIMITED TO COMPLY WITH MARPOL REGULATIONS.
5	FINAL TANK CAPACITIES OF TANKS FOR STORAGE OF CONSUMABLES WILL BE PROVIDED IN EXECUTION PHASE OF THIS PROJECT.
6	EXISTING TANKS WHICH WILL NOT BE USED AFTER CONVERSION ARE ASSUMED VOID.
7	HFO SETTLING TANK , HFO SERVICE TANKS NO. 1 & 2 TO BE DECOMMISSIONED AFTER TRANSIT TO SITE.

REFERENCE DOCUMENTS:

1. SB81989-DNF01001 FPSO GENERAL ARRANGEMENT PLAN

MAIN DIMENSIONS

LENGTH OVERALL	: 332.00 m
LENGTH PERPENDICULAR	: 310.00 m
BREADTH MOULDED	: 56.00 m
DEPTH MOULDED	: 29.50 m
DESIGN DRAUGHT	: 19.80 m

SEE DWG.ASS'Y: Xxxxxx - XXXxxxx | TOTAL WEIGHT: N/A

E.P.M NAME: P. MARCHALOT | DATE

SINGLE BUOY MOORINGS INC
MARLY - SWITZERLAND
ENGINEERING OFFICES MONACO P.O. BOX 199

VESSEL
TANK CAPACITY
PLAN

SCALE 1:400 | DRAWING Size : A0

DRAWING Number :
SB 81989 DNV01002

EMBARCAÇÕES DE APOIO

□n□orma□□es so□re as em□ar□a□□es de a□oio, do ti□o *Anchor Handling Tug Supply Vessel* □□□T□□e *Platform Supply Vessel* □□□□□, a serem □ti□i□adas □ara ati□idades da □na□ta no □am□o de □t□anta ser□o en□aminhadas a □GM□□□□□M□ t□o □ogo ha□a de□ini□□o.

ANEXO B – FORMULÁRIOS PARA COMUNICAÇÃO DO INCIDENTE

ICS 201 – RESUMO INICIAL DO INCIDENTE

Resumo Inicial do Incidente - ICS 201 Adaptado para a □na□ta	Preparado por:	Data:	Hora:

Nome do Incidente:

Ativo: ______________ Bacia: ___________________

Coordenadas: Datum: ______

Latitude: ______________ Longitude: _________________

Tipo de Incidente:

1. ☐ Incêndio 2. ☐ Médico: 3. ☐ Vazamento:

4. ☐ Explosão 5. Nº de feridos: ______ 6. Produto: ______

7. ☐ HAZ MAT 8. Nº de fatalidades:_____ 9. Volume estimado:_____

10. ☐ Aéreo 11. Nº de desaparecidos:___ 12. Fonte controlada: SIM/NÃO

13. Se não, vazão: ___

14. ☐ Outros: ____

Descrição:

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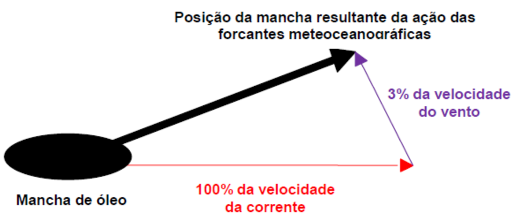
Mapa/Desenho (incluir esboço, mostrando toda a área de operações, o local/área do incidente, os resultados de sobrevoo, trajetórias, zonas costeiras impactadas, ou outros gráficos retratando o status da situação e da resposta)

Em caso de vazamento de óleo:



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Resumo Inicial do Incidente - ICS 201 Adaptado para a □na□ta	Preparado por:	Data:	Hora:
Recursos (Tipo/Nome)	Status	ETA	Tarefa

Status: S = Solicitado / ET = Em Trânsito / D = Disponível / A = Atribuído

F01 – FORMULÁRIO PARA COMUNICAÇÃO INICIAL DO INCIDENTE ÀS AUTORIDADES

Modelo de Comunicação Inicial

I - Identificação da embarcação/instalação que originou o incidente:

Nome da embarcação ou instalação:

Identificação (CNPJ, nº IMO, Código da instalação, nº da Autorização ou do Contrato de Concessão):

II - Data e hora da primeira observação:

□ia□M□s□ano: _/_/_ □ora: _:_

III - Data e hora estimadas do Incidente:

( ) □em □ondi□□es de in□ormar

□ia□M□s□ano: _/_/_ □ora: _:_

IV - Localização geográfica do incidente

□oordenadas	SIR GAS 2000	SAD 69

V - Classificação do incidente

- ☐ □is□o de dano à sa□de h□mana
- ☐ □is□o de dano ao meio am□iente
- ☐ □ano à sa□de h□mana
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- ☐ □ □orr□n□ia de □ata□idades o□ □erimentos gra□es □ara o □essoa□□r□□rio, □ara ter□eiros o□ □ara as □o□□a□□es
- ☐ □nterr□□□□o n□o □rogramada das o□era□□es □or mais de 24 (□inte e □□atro) horas

VI – Tipo de Incidente

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☐ Descarte fora de especificação de fluidos de perfuração, completação, intervenção ou cascalhos

☐ Desconexão de emergência

☐ Detonação acidental de explosivos

☐ Explosão de atmosfera explosiva

☐ Explosão mecânica

☐ Falha da barreira primária na perfuração ou intervenção em poços (kick)

☐ Falha de elemento do conjunto solidário de barreira (CSB)

☐ Falha do sistema de ancoragem

☐ Falha estrutural em instalação offshore

☐ Falha estrutural em poço

☐ Falha estrutural em sistema de coleta ou escoamento da produção

☐ Falha na demanda total ou parcial de sistema crítico de segurança operacional

☐ Falha no Blowout Preventer (BOP)

☐ Falha no riser de perfuração ou intervenção

☐ Fatalidade

☐ Ferimento com afastamento de 1 (um) a 3 (três) dias

☐ Ferimento com afastamento por mais de 3 (três) dias

☐ Ferimento grave

☐ Homem ao mar

☐ Incêndio maior

☐ Incêndio significante

☐ Interrupção não programada superior a 24 (vinte e quatro) horas decorrente de incidente operacional

☐ Parada emergencial de nível intermediário

☐ Parada emergencial de nível maior

☐ Parada emergencial de nível menor

☐ Parâmetro de monitoramento de CSB fora do limite de projeto

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VII - Substância descarregada e/ou produtos envolvidos no incidente:

Se houve derramamento de substâncias:

□o□me estimado em □□□□□□ m3.

VIII - Situação atual da descarga:

□□sem □ondi□□es de in□ormar

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VII - Breve Descrição do Incidente:

VIII - Causa provável do Incidente:

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IX - Número de feridos:

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X - Ações iniciais que foram tomadas:

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XI - Data e hora da comunicação:

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XII - Identificação do comunicante:

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XIII - Outras informações julgadas úteis:

Assinatura:

ANEXO C – INVENTÁRIO DOS RECURSOS DE RESPOSTA

□ in□ent□rio dos re□□rsos a serem dis□oni□i□□ados □e□a em□resa de res□osta a derramamento de □□eo no mar ser□ en□aminhado a □GM□□□□□M□ t□o □ogo o □ro□esso de □ontrata□□o se□a □na□i□ado.

OIL SPILL RESPONSE LIMITED

SCHEDULE 1

Charge out rates

Charge out rates as per members as detailed in the attachment hereto entitled "Scale of Fees."

SCALE OF FEES

The response hire rates for 2018 are quoted in:

GB Pounds (£) for all for all equipment, unless stated otherwise.

US Dollars ($) for our Boeing 727, Hercules and WACAF services.

Rates quoted are for oil spill response operations initiated under the terms of the Participant Member and Associate Member Agreements.

Non-members are not guaranteed a response and will be required to sign a Non-member agreement. Rates are twice as much and services differ from our Members.

	TOTAL QUANTITY	UNITED KINGDOM	SINGAPORE	BAHRAIN	FORT LAUDERDALE	INSURANCE VALUE	MEMBER DAILY STANDBY	MEMBER DAILY IN-USE
DISPERSANT APPLICATION								
Neat Sweep dispersant boom system	3	1	2			[redacted]		
Boat Spray sets for use as vessel mounted Type 3 dispersant application system	25	10	10	2	3			
Fluorometer for dispersant application analysis (Spill Response Specialist required)	8	4	3		1			
Dispersant Eductor spray system	1				1			
Dispersant transfer system (metered)	2				2			
Chemical dispersant will be charged at replacement purchase cost plus all procurement fees. Non-members will be charged a fee of £2,500 for access to dispersant stocks and an additional 15% surcharge on all invoiced costs.								
AIRCRAFT SYSTEMS								
Underslung helicopter mounted spray system (150-240 gallons) (helicopter not included) *	5	2		2	1	[redacted]		
* OSRL warrants the condition of this equipment but accepts no liability whatsoever in respect of its operation. The aircraft operator must satisfy himself of the suitability of the equipment to the aircraft and have the necessary operations manual to permit its use.								
Cargo Slave Pallet	2				2	[redacted]		
AIRCRAFT								
BOEING 727 - ALL FEES ARE IN US DOLLARS	1	1				[redacted]		
Response flights - applicable on days where flights are carried out - charged on hourly basis (excluding fuel). Subject to a minimum charge of the daily *Standby fee								
*Standby fee - applicable on days where flights are not carried out - charged on daily basis								
Training/demonstration flights - only available to Members						As incurred at direct cost		
Direct operating costs will be charged as incurred to Members including but not limited to fuel and any handling charges. Non-members will be charged an additional 15% administration fee to these direct operating costs.								
The above rates apply in respect of 'normal' response operations where the aircraft is deployed and utilised for up to a maximum of 10 days. Daily charges for non flying standby periods of greater than 10 days duration where the aircraft flies on average for less than 2 hours per day during that period will be charged at $17,000 per day and will require special consideration. Additional requirements may be placed on users in these cases. This option is only available to Members.								

continued >>

	TOTAL QUANTITY	UNITED KINGDOM	SINGAPORE	BAHRAIN	FORT LAUDERDALE	INSURANCE VALUE	MEMBER DAILY STANDBY	MEMBER DAILY IN-USE
AIRCRAFT >> continued								
HERCULES AIRCRAFT - ALL FEES ARE IN US DOLLARS	1		1			[redacted]		
Response flights - applicable on days where flights are carried out - charged on hourly basis (excluding fuel). Subject to a minimum charge of the daily *Standby fee								
*Standby fee - applicable on days where flights are not carried out - charged on daily basis								
Training/demonstration flights - only available to Members								

Direct operating costs will be charged as incurred to Members including but not limited to fuel and any handling charges. Non-members will be charged an additional 15% administration fee to these direct operating costs.

The above rates apply in respect of 'normal' response operations where the aircraft is deployed and utilised for up to a maximum of 10 days. Daily charges for non flying standby periods of greater than 10 days duration where the aircraft flies on average for less than 2 hours per day during that period will be charged at $17,000 per day and will require special consideration. Additional requirements may be placed on users in these cases. This option is only available to Members.

WEST AFRICAN DISPERSANT SERVICE - MEMBERS ONLY - NOTE ALL FEES ARE IN US DOLLARS

Embraer 110 Bandeirante aircraft	1	West Africa						
Dispersant Spraying Service						[redacted]		
Scrambling fee								
Block hour flying fee (plus any direct operating costs)								
Daily standby fee								
Dispersant replacement at cost price - delivered to site								
Aerial Surveillance service								
Scrambling fee								
Block hour flying fee (plus any direct operating costs)								
Daily standby fee								
Training flights								
Scrambling fee								
Block hour flying fee (plus any direct operating costs)								
Daily standby fee								

UKCS AERIAL SERVICES - MEMBERS ONLY

If the aircraft are placed on prepositioned Standby then there maybe a charge.
In the event of multiple response requirements, priorities will be agreed in consultation with OSRL and the operators.

Aerial Surveillance service						[redacted]		
Surveillance aircraft c/w infra red and digital video	1	1						
PA-31 Navajo - Block hour flying fee including fuel (plus any direct operating costs + 10% handling fee)	Doncaster							
Daily standby fee - Only charged if less than 1 block hour								

INSHORE BOOM ANCILLARIES

Air & water pump support box	69	31	20	14	4	[redacted]		
Boom mooring equipment (anchors, chain, and rope) are included within the boom hire packages however any losses will be recharged as consumables								
Boom Vane Small - boom deployment unit	9	3	4		1	[redacted]		
Boom Vane Medium - boom deployment unit	2	1			1			
Boom Vane (Combination)	1				1			

continued >>

	TOTAL QUANTITY	UNITED KINGDOM	SINGAPORE	BAHRAIN	FORT LAUDERDALE	INSURANCE VALUE	MEMBER DAILY STANDBY	MEMBER DAILY IN-USE
INSHORE BOOM								
Air/Skirt boom 10 metres air/skirt for coastal areas	185	89	59	37		[redacted]		
Air/Skirt boom 20 metres air/skirt for coastal areas	343	216	77	50				
Air/Skirt boom 200 metres air/skirt for coastal areas	4		4					
Beach Sealing boom 10 metres	175	42	57	54	22			
Beach Sealing boom 15 metres	78				78			
Beach Sealing boom 20 metres	158	91	36	22	9			
Troil Boom GP 750 (20 metres) (price per 20 metres)	12	8		4				
Troil Boom GP 1100 (25 metres) (price per 25 metres)	22		22					
Supermax - Rigid boom in 25 metres sections	26		26					
Sea Curtain - Foam filled in 50 metres sections	12		12					
River Boom 10" solid floatation in 10 metre sections	15				15			
River Boom 12" solid floatation in 15 metre sections	100	20			80			
Nearshore boom 18" Solid floatation in 30 metres sections	60				60			
Nearshore boom 20" Solid floatation in 15 metres sections	140				140			
Nearshore boom 24" Solid floatation in 30 metres sections	26			2	24			
INSHORE RECOVERY SKIMMERS								
Diesel driven rope mop system OM 240 Capacity 6 tph	2	1		1		[redacted]		
Diesel driven rope mop system OM 140 Capacity 3-5 tph	11	4	3	2	2			
Diesel driven rope mop system 9D Capacity 12 tph	2	2						
Cowen weir skimmer	1			1				
Komara 20k disc skimmer inc power pack	7	3		2	2			
Komara 12k disc skimmer inc power pack	7	4		2	1			
Komara 7k disc skimmer inc power pack	18	11	2	5				
Elastec combi drum skimmer inc power pack	6	2	2		2			
Elastec Magnum 100 skimmer c/w power pack	3				3			
Vikoma Minivac vacuum system	17	5	3	5	4			
Roclean Minivac vacuum system	9	5	4					
Delta Skimmer - weir skimmer inc. Spate pump. Capacity 12 tph	14		3		11			
Slickdisc MK-13 interchangeable skimmer brush / disc / weir c/w power pack	3		3					
Egmolap belt skimmer inc power system (requires working platform)	1	1						
Aquaguard RBS-20 Drum/Brush Skimmer c/w power pack	1				1			
Aquaguard RBS-5 Drum/Brush Skimmer c/w power pack	7				7			
Desmi DBDS Disc/Drum skimmer c/w power pack	3				3			
Elastec TracVac system	1				1			
Vikoma Duplex skimmer c/w power pack	1				1			
Lamor LWS 70 skimmer with brush attachment c/w power pack	3				3			
Minimax weir skimmer	5				5			
Trailerised rope mop system	4				4			
Skim Pak skimmer head	2				2			

continued >>

Q.G.E.P. KARLA VAS PSCM

	TOTAL QUANTITY	UNITED KINGDOM	SINGAPORE	BAHRAIN	FORT LAUDERDALE	INSURANCE VALUE	MEMBER DAILY STANDBY	MEMBER DAILY IN-USE
INSHORE STORAGE EQUIPMENT								
Ro-tank storage - capacity 10 m³ / 2600 US gallons	6		6			[redacted]		
Decant tank Aluminium 1300 US gallons/4T	2				2			
Fastanks - capacity 10m³ / 2400 US gallons	121	63	23	9	26			
Fastank - capacity 5m³ / 1320 US gallons	14	4		10				
Canflex floating collar tank - capacity 3000 US gallons	12				12			
Canflex floating collar tank - capacity 2000 US gallons	2				2			
Canflex floating collar tank - capacity 1000 US gallons	2				2			
Pit liner, 105000 US gallons, 398 T	3				3			
OILED WILDLIFE RESPONSE PACKAGE								
Search and Rescue	2	1	0.5	0.5		[redacted]		
Intake and triage	2	1	0.5	0.5				
Cleaning and rehabilitation	4	2	1	1				
Wildlife Rehabilitation unit	1				1			
VEHICLES (Mileage rates will be charged in addition to daily hire charge)								
6 wheel all terrain vehicle	7	4	1	2		[redacted]		
John Deere Gator Utility vehicle c/w/ cargo trailer	2				2			
Bob Cat	1				1			
MPV people carrier (£0.45/mile)	3	3						
4x4 Vehicle (£0.45/mile)	4	2		2				
17 ton truck (£1.70/mile)	1			1				
Tractor unit (£1.70/mile)	1	1						
Trailer - Arctic/Semi (£0.50/mile)	11	9	1	1				
VESSELS - without crew and approximate sizes								
2.4 metres to 2.9 metres inflatable + outboard motor	2		1	1		[redacted]		
3.1 metres to 4.2 metres inflatable + outboard motor	3		2	1				
Rigiflex Workboat + outboard motor	3	2		1				
6.2 metres semi rigid + outboard motor	1	1						
6.4 metres Carolina skiff, outboard motor and trailer	1				1			
7.5 metres semi rigid + outboard	1			1				
7.5 metres semi displacement workboat	1		1					
8.1 metres Aluminium Landing Craft	1		1					
8.2 metres semi rigid workboat	1	1						
Egmopol belt skimming barge system including propulsion for sheltered waters	1	1						

continued >>

	TOTAL QUANTITY	UNITED KINGDOM	SINGAPORE	BAHRAIN	FORT LAUDERDALE	INSURANCE VALUE	MEMBER DAILY STANDBY	MEMBER DAILY IN-USE
VESSELS - with crew and approximate sizes (These vessels are for regional use only)								
20 metres EARL oil spill response vessels (in use only)	2	1	1			[redacted]		
Minimum daily charge of eight hours will be applied. Rates will be varied to accommodate vessel duties.								
A reduced rate will be applied for extended duration operations.								
PRE LOADED EQUIPMENT								
Load 4 - Offshore Containment and Recovery (Weir Boom)	1	1				[redacted]		
Load 5 - Shoreline Containment and Recovery	1	1						
Load 6 - Offshore Containment and Recovery	1	1						
Load 7 - Egmopol Barge	1	1						
Load 8 - Shoreline Containment and Recovery	1	1				Final contents and associated costs will be determined by specific needs		
Load 9 - Shoreline Containment and Recovery	1	1						
Load Cold Weather Equipment	1	1						
ADHOC1	1	1						
ADHOC 2	1	1						
OFFSHORE BOOM								
Roboom 200 metres Bay Boom, on reel without power pack	33	13	12	4	4	[redacted]		
Hi Sprint rapid boom with reel (300 metres long without power pack)	3	1	2					
Ocean Boom 43" inflation boom in 30-metre sections	100				100			
ACTIVE BOOM SYSTEMS								
Ro-skim system, tandem, 120tph skimmer, without power pack (can be used in conjunction with additional 200m boom on reel)	4	2	2			[redacted]		
2 pump weir boom capacity (120 tph) - for use in conjunction with Roboom units excluding power systems	1	1						
Norlense Scan Trawl	3	2			1			
Noil Current Buster 2	8	2	2	1	3			
Elastec Hydro Fire Boom 150 metres - Offshore	4	3	1					
If the boom is used in fire, the boom element of the system will need to be replaced at cost.								
Elastec American Fireboom in 15-metre sections	30				30	[redacted]		
If the boom is used in fire, the boom element of the system will need to be replaced at cost.								
Heli Torch	2				2	[redacted]		

continued >>

	TOTAL QUANTITY	UNITED KINGDOM	SINGAPORE	BAHRAIN	FORT LAUDERDALE	INSURANCE VALUE	MEMBER DAILY STANDBY	MEMBER DAILY IN-USE
OFFSHORE RECOVERY SKIMMERS								
Komara 40k skimmer without power pack	8	2	2	2		[redacted]		
Desmi DS 250 skimmer without power pack	4	4						
Ro-Disc attachment for DS250	2	2						
GT 185 weir skimmer without power pack	5	4	1					
Termite weir skimmer without power pack	14	4	4	4	2			
Termite combi system brush / disc / weir without power pack	2		2					
Terminator weir skimmer (with thrusters) without power pack	2	1		1				
Terminator combi system brush / disc / weir skimmer without power pack	2		2					
Side Sweep Arms - Small Volume skimming arms without power pack	1			1				
Marflex Sweep Arms - Large Volume skimming arms without power pack	2		2					
Lamor minimax 30BC brush Skimmer c/w power pack	2				2			
Foilex Rapid Deployment System c/w power pack	2				2			
Desmi Seamop c/w transfer pump	4	1			3			
HEAVY OIL RECOVERY								
Giant Octopus skimmer	2	1	1			[redacted]		
Komara Star including power pack	6	2	2	2				
WP 130 drum skimmer without power pack	2	1	1					
Rotodrum without power pack	2	2						
Sea Devil skimmer without power pack	4	3	1					
Helix Skimmer	4	1		1	2			
Scan Trawl System	3	1	2					
High viscosity oil pump conversion kit for Foilex TDS 200	1				1			
OFFSHORE STORAGE EQUIPMENT								
Storage Barge - 25m³	24	7	9	4	4	[redacted]		
Unitor oil bag - capacity 200 m³	1			1				
Waste Containment Tank 10m³ / 2600 US Gallons	9		9					
Sea Slug -Capacity 5T	9				9			
Sea Slug -Capacity 10T	11				11			
Sea Slug -Capacity 25T	0				0			
Sea Slug -Capacity 50T	11				11			
COMMUNICATIONS EQUIPMENT								
Single VHF handset	113	90	20	3		[redacted]		
VHF Radio	10				10			
Tactical comms-mobile radio for vehicle use	3				3			
Ground to air comms	4				4			
Handheld GPS	108	71	30	5	2			
VHF Base station	6	5		1				
Mobile Base station	1				1			
VHF Base / Repeater Station	3	3						
VHF Sky masts	7	6	1					

continued >>

	TOTAL QUANTITY	UNITED KINGDOM	SINGAPORE	BAHRAIN	FORT LAUDERDALE	INSURANCE VALUE	MEMBER DAILY STANDBY	MEMBER DAILY IN-USE
COMMUNICATIONS EQUIPMENT >> continued								
Iridium satellite phone	12	4	4	1	3	[redacted]		
Inmarsat satellite phone	4				4			
Inmarsat satellite phone for marine use	1				1			
BGAN Hughes Network Systems (HNS) 9202	4	1	2	1				
BGAN Explorer 510	7	3	3	1				
Thrane and Thrane Explorer 700 BGAN	3				3			
Portable inflatable shelter	10	6	3	1				
Field Command Post (Inflatable)	2				2			
ANCILLARIES - Transfer Pumps								
Spate diephragm pump 30m³	34	12	9	3	10	[redacted]		
Desmi DOP 160 pump without power pack	10	5	3	2				
Desmi DOP 250 pump without power pack	7	5	2					
Water injection flange for DOP pump	9	3	2	4				
Peristaltic pump	9				9			
Sala roll pump c/w power pack	2				2			
Fire / washdown pump 2.5"	5				5			
Washdown pump 2"	5				5			
Trash Pump, 6" HVLP flushing system	5				5			
Shoreline Deluge / flushing System	3				3			
ANCILLARIES - Power Packs & Generators								
Generator - 1kW to 3kW	29	13	8	8		[redacted]		
Coleman Generator 3.5kW	9				9			
Diesel Generator	11	1	1	1	8			
GP10 power pack (7.4kW)	1	1						
GP30 power pack (21.9kW)	6	4		2				
Lamor 25 power pack (23kW)	8	4	4					
Haiz power pack (25kW)	6		2		4			
Multi purpose (same) power pack (50kW)	2			2				
Desmi power pack (50kW)	8	3	5					
Multi purpose power pack (50kW) Winter version air fan / lighting	3		3					
Tiger power pack (84kW)	9	6		3				
Vikoma power pack (80kW)	4	2	1	1				
Grizzly power pack (96kW)	8	4	4					
ANCILLARIES - Site Safety & Cleanup								
Hydraulic Hose reels	23	15	4	4		[redacted]		
Hydraulic pressure washers (without power pack)	13	5	3	5				
Mobile diesel drive high pressure and temperature washer for sea water use (trailer mounted)	9	4	4	1				
Diesel drive high pressure and temperature washer for sea water use (skid mounted)	2			2				
High pressure and temperature washer for freshwater use only	5				5			

continued >>

	TOTAL QUANTITY	UNITED KINGDOM	SINGAPORE	BAHRAIN	FORT LAUDERDALE	INSURANCE VALUE	MEMBER DAILY STANDBY	MEMBER DAILY IN-USE
ANCILLARIES - Site Safety & Cleanup >>continued								
Powered floodlights	4	4				[redacted]		
Pelli lights	6	2	2	2				
Plug in halogen light stands	12				12			
Prism light c/w generator	6				6			
Orimulsion Refloation Device without power pack	1	1						
Area Gas Monitor (4 channel + PID)	8	3	3	2				
Multi RAE lite	15	5	5	3	2			
Multi RAE Plus gas monitor	3	3						
Personal (4 Channel) gas monitor	54	21	19	6	8			
Gas Detection Tubes	12	3	5	2	2			
Gas Monitor (Drager Chip Measurement System (CMS)	5		5					
Air Monitor Microdust Pro	4	3	1					
OIL TRACKING								
Oil Spill Tracking Buoy - i-Sphere	1	1				[redacted]		
Oil Spill Tracking Buoy - ISMDB	2	2						
Tracking costs will be charged and the unit will be replaced at cost if used.								
Satellite imagery can be purchased for Members as and when required. The cost, type and frequency of the images will depend on the location and the particular requirements for the incident.								
Satellite Oil Detection Anomaly Report and Image						[redacted]		
Target Detection (vessel tracking) on above								
OIL SPILL MODELLING								
2D Trajectory & backtrack								[redacted]
3D Trajectory								
Day-rate charges do not include the purchase of any additional environmental data.								
PERSONNEL								
Director								[redacted]
Senior Oil Spill Response Manager (Incident Manager)								
Oil Spill Response Manager (Duty / Response Manager)								
Oil Spill Response Specialist / Responder								
Logistics Service Branch coordinator (Duty Administrator)								
OSRL uses an ICS (Incident Command Structure) during a response to provide continuous communications with the customer and to ensure efficient deployment of resources.								

For rates on Global Dispersant Stockpile and Subsea Well Intervention Services, please contact subseaservices@oilspillresponse.com

ANEXO D – DADOS DE SISTEMAS DE TECNOLOGIA INOVADORA

CURRENT BUSTER 6

NOFI Document no. / *Dokumentnr.:*

L650 - F - 500

NOFI Document name / *Dokumentnavn:*

NOFI Current Buster® 6 Pat.

DATASHEET (see also drawing **L650-A-102**)

B	**02.01.12**	**Updated with weigt and storage volum**			
A	**20.05.11**	**Preliminary. For information only.**	**øw**	**dn**	**dn**
Revision *Revisjon*	Date (d,m,y) *Dato (d,m,å)*	Issued for *Utgitt for*	By *Av*	Checked *Sjekket*	Approved *Godkjent*

TECHNICAL DATA

Dimensions: **Freeboard:** Separator tank: Ø 1000/800mm, guide booms: Ø 800/600mm
Length: 62,9m
Width: 4,6m
Maximum Depth during operation: Ca. 2,6m

Storage weight (dry): **Total: 2017kg.** Sweep and guide booms: 872 kg Separator: 1145 kg

Storage volume on boom reel: Min. 10m³

Front Opening(Swath): 34m

Separator tank: Gross volume 65m³, Net ca. 35m³ oil. Separation system is based on gravity separation. In large spills the oil thickness will be min. 1m.

Flotation/cross beams: 33 independent air chambers and 6 air filled cross beams with valve type MONSUN XII.2.

All external fabric : Heavy Duty PU/PVC-coated polyester, 1150g/m²,
tensile strength 7400 N/50mm, tear strength min.1900 N.

Material buoyancy chambers: Airtight PU/PVC blend coated polyester, 1150g/m²

Mooring and lifting points: 8 off, evenly distributed around the system.

Retrieval line at the stern: 4 fastening points, split link connection to the retrieval line.

Reflective markings: 50x200mm reflective pads distributed around the system. On the in and outside.

Documentation: Complete user documentation, **L650-K-610**

OPERATIONAL DATA

Area of use: Offshore and open coast up to Beaufort 5. Protected inlets, fjords, sounds and harbours in extreme weather up to wind Beaufort 7. Also any strong current exposed area with sufficient depth.

Oil types: All types from diesel to high viscosity oil, ca. 5 – 180000cPS.

Towing /operational speed: Effective collecting, concentrating and separating oil: Min. towing speed: 0,1-0,5 knots, Calm water: 5 knots, When towing directly against short period waves the max. speed gradually decrease when wave height increase.

Debris collection system: Prevents debris from entering the Pumping area.

Temporary Oil storage: The integrated non return valve enables the separator tank to be used for temporary storage of recovered oil. **HOLD** for verification.

Inflation: By backpack blower or electric/hydraulic fan through Monsun XII.2 valves

Deployment: Deployment with guidebooms or separator tank first. An area with minimum width of 5m and length of 5m is recommended in front of the boom reel. Deployment time from reel ca. 25 minutes if two fans are available.

Retrieval: The NCB6 can be retrieved with guidebooms or separator tank first. Retrieval time ca. 30 minutes.

Adjustments during operation: The system is designed for operation without any adjustments required even if the speed and oil types vary.

Skimmer Interface: Within the operational limits, the oil thickness in the separator is high with no current or vortex. Almost all types of skimmers and pumps may be used efficiently in the separator with low water content of recovered oil.

Storage: On boomreel with shaft diameter of minimum 500mm. Turntable recommended for easier retrieval.

Storage and operating temp.: -35 to +70°C (-13 to 158 °F)

□ome do □o□□mento □*Dokumentnavn*□

Current Buster□ 6 Pat. NOFI

Manual do usuário

□□de do□□mento □□ □□□*Dokumentnr.:*

L650 - M - 640

C	**05/02/2014**	**Apêndices atualizados com comentários internos**			
B	**13/12/2013**	**Apêndices adicionados para operação com um barco apenas**	**bp**	**dn**	**øw**
A	**02.04.12**	**Comentários**	**øw**	**bp**	**dn**
□e□is□o *Revisjon*	□ate □d,m,a□ *Dato (d,m,å)*	□mitido □ara *Utgitt for*	□or *Av.*	□eri□□ado *Sjekket*	□□ro□ado *Godkjent*

ÍNDICE

0 GERAL

□ste man□a□des□re□e o □so do **NOFI Current Buster® 6[Pat.].**

O NOFI Current Buster 6 (NCB6) é o produto mais recente baseado na TECNOLOGIA CURRENT BUSTER. Algumas das imagens neste manual apresentam outros sistemas do NOFI Current Buster.

Todos os te□idos s□o □□ner□□eis a danos □□ando arrastados so□re □ordas a□iadas, □on□reto □s□ero e as□a□to et□. Tais s□□er□□ies e □ordas a□iadas de□em ser □o□ertas □om □ona o□ simi□ar.

Após s o □so em □eo, o e□□i□amento de□e ser im□o o mais r□□ido □oss□e□. □er o □ro□edimento Gera□de □im□e□a □ara □arreiras de □onten□□o de □eo e te□idos de PVC/PU , do□. n° **F000-N-680** e o G□ia de □im□e□a do NOFI □□rrent □□ster,
do□. n□. **L600-N-682**.

OBSERVAÇÃO: O **NOFI Current Buster® 6 Pat.** é □ma □arreira de □onting□n□ia e n□o □oi □ro□etada □ara an□oragem □ermanente.

□□rante o arma□enamento ao ar li□re, o e□□i□amento de□e ser □o□erto □om □ma □ona □ara e□itar danos □a□sados □e□a luz so□ar. □e arma□enado em □m □ontainer e□hado, de□e□se □ro□or□ionar □enti□a□□o a□ro□riada □ara e□itar o □res□imento de mi□roorganismos.

SEGURANÇA: Qualquer manuseio da barreira de contenção e especialmente operações em alta velocidade envolvem força intensa e impõem um risco à segurança. A fim de evitar lesões pessoais, as boas práticas em operações marítimas devem ser praticadas em todas as operações. As regulamentações e práticas locais de segurança devem ser seguidas.

1 DESCRIÇÃO DO SISTEMA

Geral
O **NOFI Current Buster® 6 Pat.** é □ro□etado □ara □o□etar, se□arar e □onter o □eo derramado em □e□o□idades □□e □ariam de 0,5 a 5 n□s em □ondi□□es □im□ti□as ra□o□□eis.

□s res□tados dos testes do NOFI □□rrent □□ster 4, no tan□□e de teste □□M□□TT, indi□am qu□e o sistema □onter□ norma□mente 65% a 98% do □eo, de□endendo da □e□o□idade, do ti□o de □eo e das □ondi□□es das ondas. Gera□mente o sistema é entreg□e □om □a□os de re□o□□e e □a□os de re□□era□□o. □s g□ias da □arreira de □onten□□o (G□ide□ooms) e □arred□ra s□ee□) est□o integrados no □istema **NOFI Current Buster 6**. □ara mais in□orma□□es, □ons□te a □i□ha T□□ni□a, do□. n° **L650-F-500.**

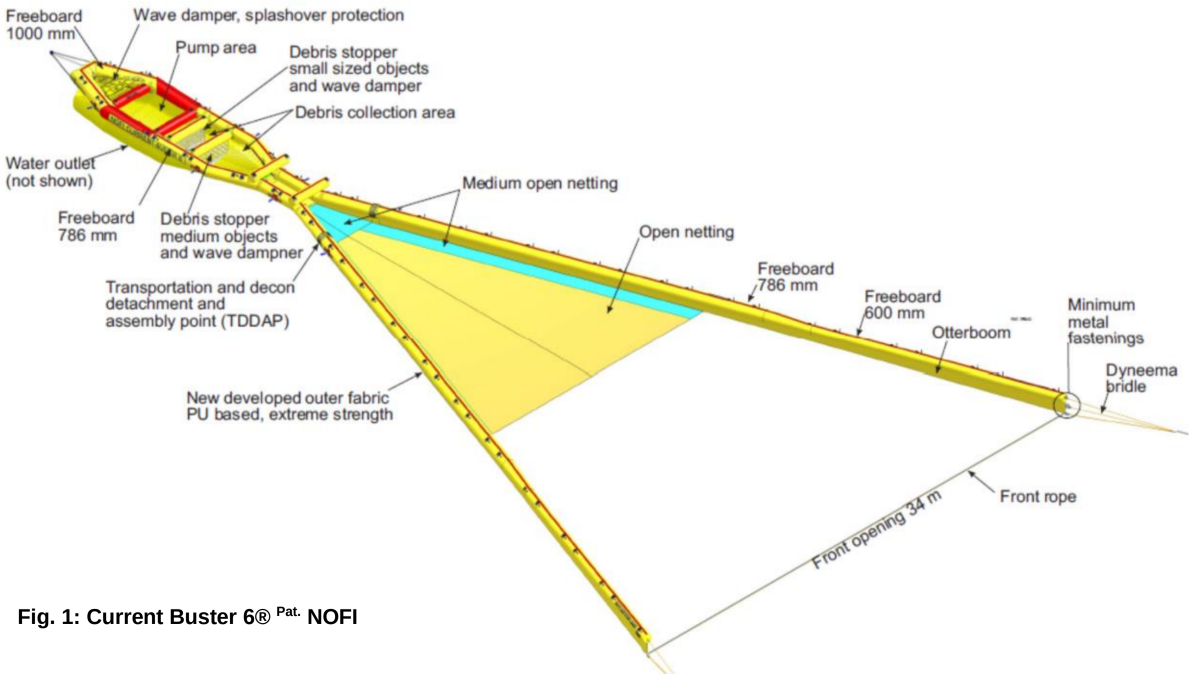


Fig. 1: Current Buster 6® [Pat.] NOFI

NOFI Current Buster 6

□ sistema **NOFI Current Buster 6** □ □orne□ido □omo □ma □nidade □om□eta e □onsiste em 5 □artes □rin□i□ais□

□. G□ia de □arreira de □onten□□o □g□ide□oom□de a□ta □e□o□idade □tter □□atente □e□erida.
□. □arred□ra
3. □rea do □o□etor
4. □is□ositi□o de □o□eta de □eo de □ana□□□ni□o
5. □e□arador e tan□□e de arma□enamento

□er desenho n□ **L650-A-104** □ara deta□hes e dimens□es.

Fig. 2: □□□□□rrent □□ster □ □ □e□o□idade de re□o□□e de 4 n□s

Guias de barreiras de contenção (guidebooms) de alta velocidade Otter [Patente Requerida]**.**

□s g□ias da □arreira de □onten□□o □g□ide□ooms□integradas da □tter s□o otimi□adas □ara o□ere□er □ma maior a□ert□ra □onta□em □om□ara□□o □s □arreiras de □onten□□o de □eo □on□en□ionais.

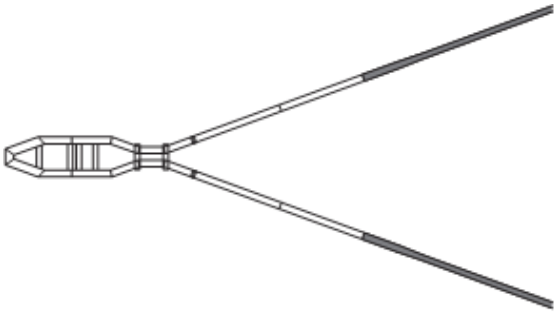


Fig. 3: G□ias de □arreiras de □onten□□o □g□ide□ooms□de a□ta □e□o□idade integradas

Varredura

□ □arred□ra integrada □ □aseada na te□no□ogia **NOFI VEE-SWEEP®** □om to□o a□erto.

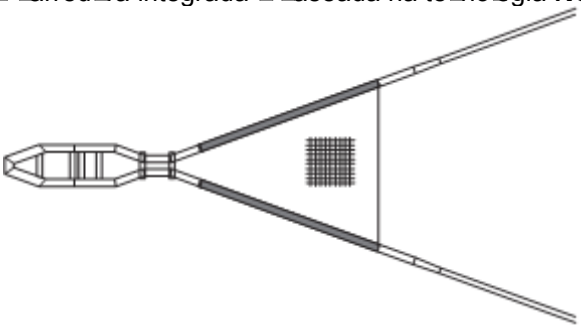


Fig. 4: □arred□ra integrada

Área do coletor

A área do coletor está localizada na parte da popa da varredura em forma de “V”. O objetivo principal da área do □o□etor □ □riar □ondi□□es ideais de □□□□o no dis□positi□o de □o□eta de □eo de □ana□□□ni□o.

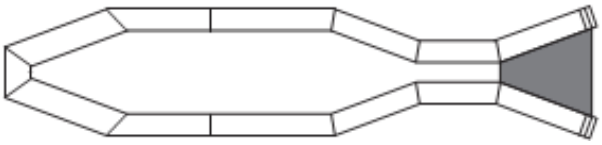


Fig. 5: □osi□□o da □rea do □o□etor

Dispositivo de coleta de óleo de canal cônico

O o□eti□o □rin□i□a□do dis□positi□o de □oleta de □leo de □ana□□□ni□o é e□e□ar a □amada s□□erior da □g□a □ontendo □leo □ara o se□arador, en□□anto drena a maior □arte da □g□a e□□edente so□ o sistema.

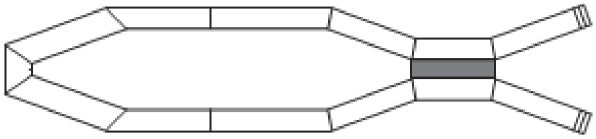


Fig. 6: □osi□□o do dis□positi□o de □oleta de □ana□□□ni□o

Separador e tanque de armazenamento

A mist□ra de □leo e □g□a qu□ entra no se□arador é se□arada □or gra□idade □de□anta□□o□. O grande □o□me do se□arador garante tem□o de se□ara□□o s□i□iente □ara □□e o □leo se□a e□eti□amente se□arado da □g□a do mar. A □g□a e□□edente é drenada atra□□s de válvu□as na □arte in□erior do se□arador. □□rante a o□era□□o, mesmo em a□tas □e□o□idades, o □leo i□a □a□mo em □ma □amada es□essa dentro do se□arador e, □onse□□entemente, as □ondi□□es ideais de □om□eamento s□o a□an□adas.

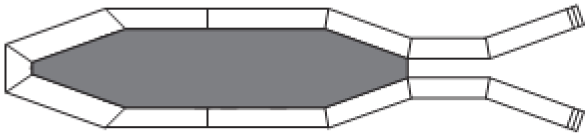


Fig. 7: □osi□□o do se□arador

Válvulas de drenagem de água

□s válvu□as de drenagem s□o distri□□das na □arte in□erior do tan□□e se□arador. A so□re□ress□o no tan□□e se□arador □a□□om qu□ as válvu□as se a□ram e dei□em sair o e□□esso de □g□a.

Fig. 8: □□□□□as de drenagem

Cabos de reboque e cabo de recuperação

□orma□mente dois □a□os de re□o□□e de 50 m e d□as □a□resteiras de 4 m s□o □orne□idos □om o sistema. A □a□resteira e o □a□o de re□o□□e □odem ser des□one□tados.

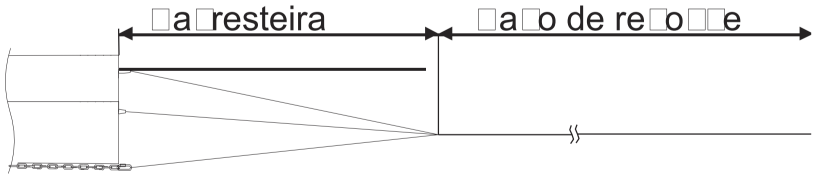


Fig.9: □a□o de re□o□□e e □a□resteira

□m □a□o de re□□□era□□o é □one□tado à □o□a do NOFI □□rrent □□ster 6. O □a□o □ode ser □one□tado o□ des□one□tado □r□□imo à □o□a do **NOFI Current Buster 6** □om □ma □one□□o r□□ida □Gan□ho□G)

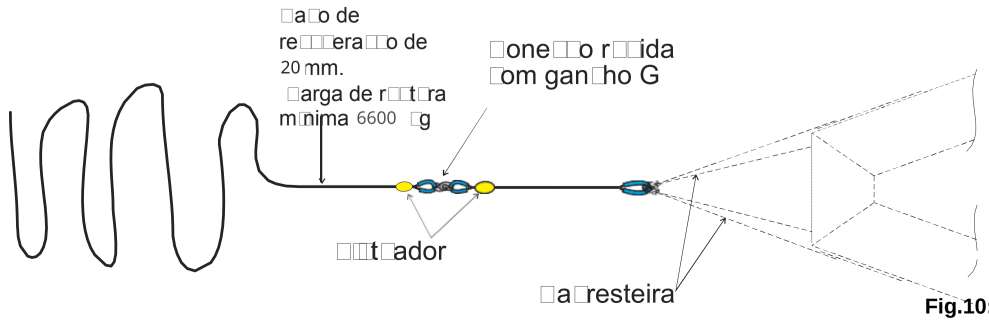


Fig.10: □a□o de re□□□era□□o

Construção

O **NOFI Current Buster 6** é □eito □omo □ma □nidade, e□□eto as □□meras trans□ersais (6 de □ada) e □ode ser di□idido em dois □ara □ins de trans□orte o□ des□ontamina□□o. O sistema □onsiste em □m te□ido e□terno □re□estimento) □□e □rotege as □□maras de ar.

Tecido externo

O te□ido e□terno é do□rado so□re as □□maras de ar e □one□tado na □arte s□□erior □or o□hais de □□□sti□o e gram□os □resos □or □ma □orda re□estida de □□□sti□o, □□e □ode ser des□one□tada d□rante a im□e□a □□ando o sistema esti□er □ontaminado.

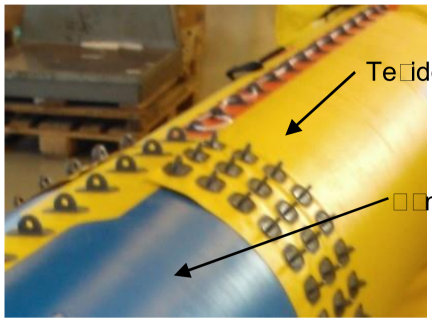


Fig. 11: Te□ido e□terno qu□ en□o□e as □□maras de ar

Todas as □n□□es de s□□orte de □arga (□ontos de an□oragem, □ontos de i□a□□o □ara as □□maras in□□□eis trans□ersais, et□.) s□o mo□imentadas □e□o te□ido e□terno

OBSERVAÇÃO: □e os gram□os □orem de□ormados □or □ress□o o□ □a□or, o □ormato origina□□oder□ ser resta□rado □om a a□□da de □ma □isto□a de ar □□ente.

Câmaras de ar

O **NOFI Current Buster 6** □oss□i dois sistemas de □□maras de ar. □m est□ □o□a□□ado nas g□ias da □arreira de □onten□□o g□ide□ooms) e o o□tro est□ no Tan□□e □e□arador. □s g□ias da □arreira de □onten□□o g□ide□ooms) s□o □om□ostas □or 18 □□maras indi□id□ais, en□□anto qu□ na □rea do se□arador as □□meras s□o □one□tadas □mas □s o□tras, □ormando □ma estr□t□ra □hamada de □str□t□ra de Flu□tua□ã□.

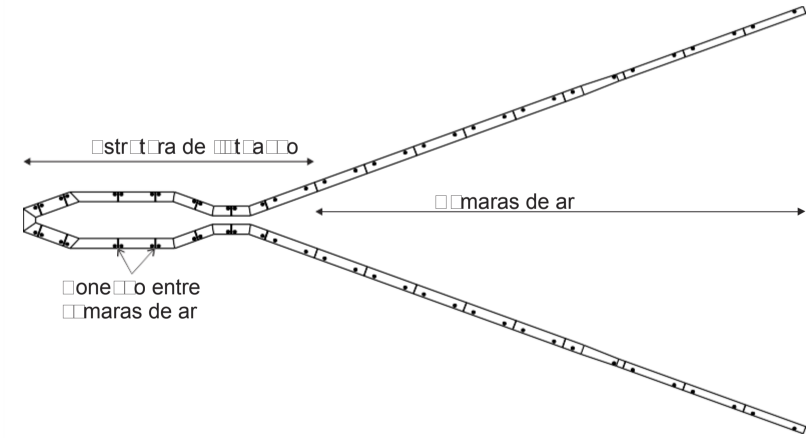


Fig. 12: □is□o gera□das □□maras de ar

Estrutura de flutuação

□ estr□t□ra de □□t□a□□o □onsiste em □5 □□maras de ar indi□id□ais □one□tadas □mas □s o□tras □ormando □ma estr□t□ra. □s □□maras de ar s□o □one□tadas □or □ma □orda □□e □assa □or o□hais so□dados nas e□tremidades de □ada □□mara de ar. □sta □orda □ode ser des□one□tada e re□one□tada □e□ □so do e□ de □orrente □om □ara□□so integrado. □sso □ □r□ti□o d□rante a □im□e□a □□□□□□ □T□M□□□□□□ □□ando o sistema est□ □ontaminado.

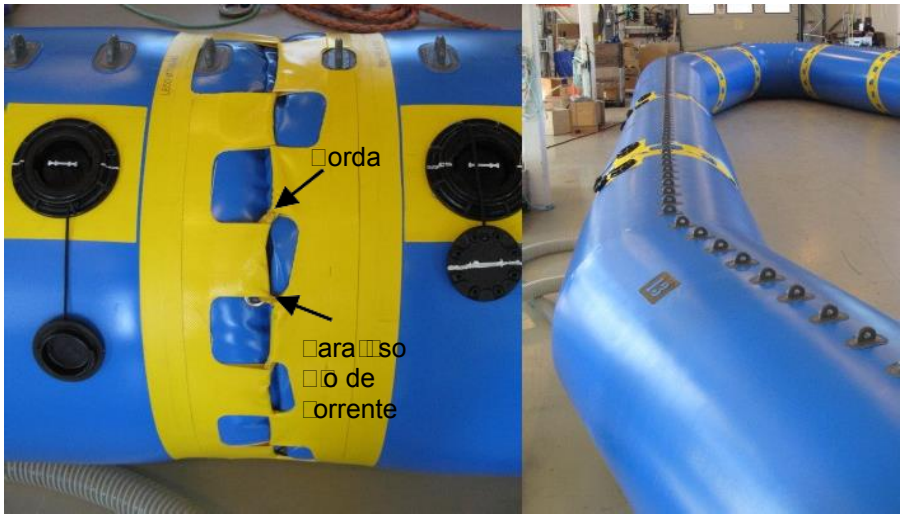


Fig. 13: □one□□o da estr□t□ra de □□t□a□□o

Câmaras transversais (Crossbeams)

□s □□maras trans□ersais (ross□eams) □reen□hidas de ar adi□ionam rigide□ à □onstr□□□o. Alé m disso, as □□maras trans□ersais □o□a i□adas na inha d' g□a no se□arador t□m □m e□eito de amorte□imento de onda, red□□indo as ondas □□e entram no se□arador. □s □□maras trans□ersais □odem ser remo□idas □ara im□e□a e et□. e s□o □osi□ionadas □orretamente □or □□digos n□m□ri□os □resentes nas □□meras trans□ersais que □orres□ondem ao □□digo no te□ido e□terno. □ □ser□ar que as □orreias de i□a□□o nas □□meras trans□ersais n° 1 e 2 s□o r□□adas □omo mostrado na ig□ra **Fig. 15**□.

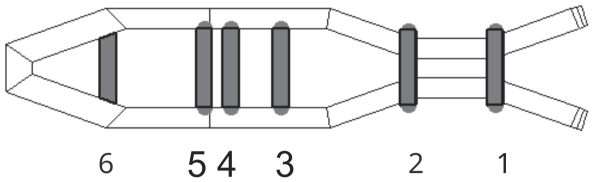


Fig. 14: □□meras trans□ersais, 6 o□□

Fig. 15: □□meras trans□ersais □om □odi□i□a□□o n□m□ri□a. □s □orreias de i□a□□o r□□adas a□i□am se a□enas □s □□meras trans□ersais 1 e 2.

Sistema de coleta de detritos e de amortecimento de ondas

□m □one□□o □om as □□meras trans□ersais n° 3 e n° 4 e□istem □ortinas □□e t□m □omo o□□eti□o im□edir a entrada de detritos na □rea de □om□eamento. □s □ortinas tam□□m at□am □omo □m sistema de amorte□imento de ondas □□e red□□em o mo□imento interno do □onte□do de □□eo e □g□a no tan□□e do se□arador.

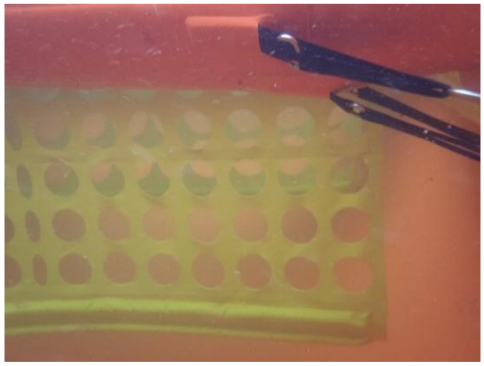


Fig. 16: □ortina na □□mera trans□ersa□n□ 4 □oto s□□a□□□ti□a.

Recurso de amortecimento de ondas e proteção contra entrada de água pela popa

O □ro□□sito do te□ido □er□□rado na □o□a do tan□□e se□arador e de arma□enamento, □er **FIG. 15**, é red□□ir a entrada de □g□a e red□□ir a ati□idade das ondas em □ondi□□es □im□ti□as ad□ersas e nas ondas. O dis□positi□o tam□□m adi□iona rigide□ao sistema.

Fig. 17: □istema de □rote□□o □ontra a entrada de □g□a□amorte□edor de ondas na □o□a.

Ponto de separação e montagem para o transporte e descontaminação (TDDAP)

□ □one□□o entre o Tan□□e □e□arador do □□ster e a g□ia da □arreira de □onten□□o e de □arred□ra integrados □ □m □onto de se□ara□□o e montagem □ara o trans□orte e des□ontamina□□o □T□□□□□. □sso in□□i □ma □one□□o entre a □arte in□erior da rede do □o□etor □saia do □o□etor.

Fig. 18: T□□□□

Dispositivo de bloqueio de óleo

□ste dis□ositi□o est□ □osi□ionado no □ina□do □ana□□□ni□o em dire□□o □ □o□a. □□rante a □o□eta e o□era□□o do □□eo, o dis□positi□o i□ar□na □osi□□o a□erta, □ermitindo □□e o □□eo entre no tan□□e se□arador. □e □or □□a□□□er moti□o o sistema □□□□□ti□er □□e ser □arado, o dis□positi□o ir□ □ara a □osi□□o □e□hada e□itando □□e o □□eo re□o□hido es□a□e.

Fig. 19: □is□positi□o na □osi□□o □e□hada

Laços de amarração

□o□e □a□os de amarra□□o □eitos em te□ido resistente e □ma mang□eira de in□□ndio re□or□ada □ontra a□ras□o est□o distri□□□dos ao □ongo do □□□□□□rrent □□ster □, □er □ig. □□.

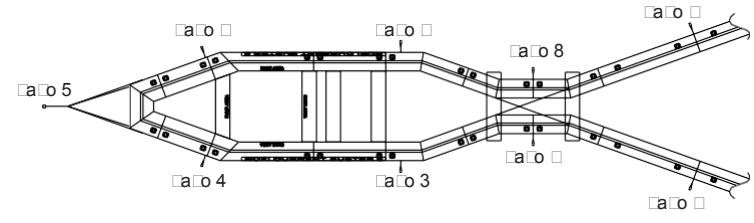


Fig. 20: □a□os de amarra□□o

□s □a□os de amarra□□o indi□ados na **Fig. 20** s□o destinados ao tra□a□ho □esado, □or e□em□o, re□o□□e, i□amento de o□tros dis□positi□os, et□.

OBSERVAÇÃO: □ □tros □oten□iais □a□os de amarra□□o o□ simi□ares **não devem** ser □sados □ara □□a□□□er i□a□□o, in□□indo o □ord□o de □e□hamento no to□o da □orda i□re o□o □ord□o na tam□a da □□□□□a. *A única exceção é a fixação de pequenos objetos, como refletores de radares ou luzes de marcação.*

Cabresteira para recolhimento

□a □o□a do se□arador, h□ □m □ma □a□resteira □eita de □orreia e □orda resitentes. □ □a□resteira □ode ser □oagada tem□orariamente □ara dentro do se□arador se ho□□er □□a□□□er □han□e de□e inter□erir □om os □ro□□sores das em□ar□a□□es □o□a i□adas ao □ado.

Válvulas

□s □□maras de ar est□o e□i□adas □om □□□□□as do ti□o Mons□n □□□. □ara en□himento e e□a□□a□□o de ar. **FIG. 28**. Todas as □□maras de ar, in□□indo as tran□ersais, est□o e□i□adas □om □ □□□□□as, □ma em □ada e□tremidade. □ara □rote□□o □ontra □ontamina□□o, a □□□□□a □oss□i □ma tam□a ros□ada □□e □ □resa □ □□□□□a □or □m □a□o.

Áreas refletivas

□s □reas re□eti□as est□o sit□adas so□ □ada válvu □a e □rea o□osta no interior do sistema. □er **fig. 21**.

Fig. 21: □reas re□eti□as

Áreas destacadas

□s sistemas NCB6 □oss□em tr□s □reas desta□adas □om te□to. □stas s□o in□orma□□es □ara na□ios □ti□it□rios e indi□am □reas na □arreira de □onten□□o □□e □odem a□etar s□a o□era□□o.

□s e□tremidades dianteiras das g□ias da □arreira de □onten□□o □oss□em te□tos tanto na □arte interna □□anto na e□terna. O te□to e□terno a□resenta o sistema a □oreste e a □om□ordo. O te□to interno, □orda dianteira, indi□a □□e h□ □ma □orda □one□tada entre as g□ias da □arreira de □onten□□o de □om□ordo e de □oreste. O in□□io da se□□o da rede é mar□ado □om te□to e □ma seta dire□iona□.

Fig. 22: □oreste

Fig. 23: □orda dianteira

Fig. 24: Seçã o de rede

Área de bombeamento

A □rea dedi□ada de 3 x 3 m □ara □om□ear e □o□etar □eo é de □or □aran□a em □ontraste □om o resto do sistema que é de cor amarela. A “Área de bombeamento” é especificado em letras pretas nas □reas □or de □aran□a.

Fig. 25: □rea de □om□eamento de 3 x 3 m no se□arador

2 ARMAZENAMENTO, LANÇAMENTO E RECUPERAÇÃO

Armazenamento

O sistema **NOFI Current Buster 6** □ode ser arma□enado em □m □ont□iner de arma□enamento □□stomi□ado, em □m □a□ete o□ em □m □arrete□□ara □arreiras de □onten□□o. O di□metro interno do □arrete□de□e ser de □e□o menos 500 mm □ara e□itar danos □s válvu□as.

Fig. 26: Current Buster 6 NOFI arma□enado em □m □arrete□□ara □arreiras de □onten□□o de 10 m³

Lançamento

O **NOFI Current Buster 6** é □ro□etado □ara □an□amento □om as g□ias da □arreira de □onten□□o o□ □om o tan□□e se□arador □rimeiro.

□e□omenda□se □ma □rea □om □arg□ra m□nima de 5m e □om□rimento de 5m à □rente do □arrete□da □arreira de □onten□□o. O tem□o de □an□amento do □arrete□é de a□ro□. 25 min□tos, □aso dois so□radores esti□erem dis□on□□eis.

A rede de □arred□ra integrada □ont□m □esos e a□□ndar□. □o an□ar em □g□as rasas, a rede □ode i□ar □resa no □□ndo. □m tais □ondi□□es des□a□or□□eis, □ma □orda □ode ser amarrada em torno dos □ra□os de □arred□ra e da rede □ara e□itar que a rede a□□nde. **OBSERVAÇÃO:** □sta □orda de□e ser □ortada o□ remo□ida antes da o□era□□o.

Insuflação

A ins□□a□□o é norma□mente □eita □or □m so□rador ti□o mo□hi□a. □o□radores e□□tri□os e hidr□□i□os tam□□m □odem ser □sados. □ara e□onomi□ar tem□o, re□omenda□se o □so de dois so□radores, □m de □ada □ado, d□rante o □an□amento.

□ □□mara de ar □ □ress□ri□ada at□ o n□□e□m□□imo de □m so□rador de mo□hi□a, i.e., a□ro□imadamente □□□ m□ar.

ADVERTÊNCIA□□ □so de ar □ress□ri□ado □ara ins□□a□□o n□o □re□omendado de□ido ao □erigo de so□re□ress□o e r□□t□ra □a□sando □es□es □essoais. □e, □or □□a□□□er moti□o, □or □ti□□ado ar □ress□ri□ado sem man□metro, as seg□intes orienta□□es □odem ser seg□idas □ara a □ress□o □orreta□

□ 5□ a □□□ m□ar, □ma □essoa norma□□ode □ressionar de 5 a □□ □m □ara □ai□o □om o □oe□ho o□ de □a 4 □m □ara □ai□o □om o □o□egar na □□mara de ar, □er □otos.

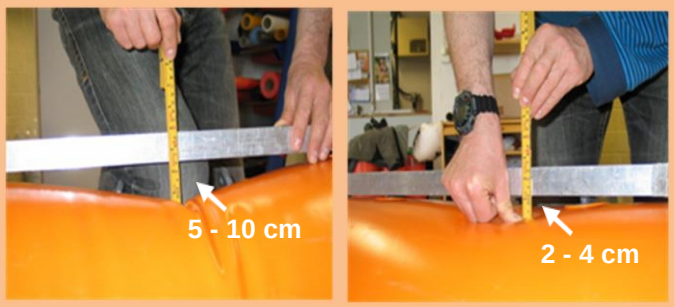


Fig. 27: Testar a so□re□ress□o □ressionando a □□mara de ar □om □m □oe□ho □es□erda□o□ □m □o□egar □direita□

□s □□□□□as Mons□n □□□ □oss□em □ma □osi□□o a□erta e □ma □e□hada. □ □ando a □ase da □□□□□a □□a□a□□ □ressionada □ara □ai□o e girada □ara a direita, a □□□□□a □tra□ada na □osi□□o a□erta □□omo □eito d□rante a re□□□era□□o□. □o girar □ara a es□□erda, a □□□□□a □ □e□hada. □inda □ □oss□□e□rea□i□ar a ins□□a□□o □om a □□□□□a na □osi□□o □e□hada, □ma □e□ □□e a □ress□o do ar □ressiona a □ase da □□□□□a a□ionada □or mo□a, □ermitindo a entrada de ar.

SEGURANÇA: □e a tam□a ros□ada n□o esti□er □one□tada, o □ꝛeo □oder□ entrar na válvu□a e, na □r□ima vɘz qu□ e□a □or a□erta, o □ꝛeo □oder□ es□irrar no rosto e nos olhos.

Tampa roscada

Base da válvula

Válvula

Fig. 28: Válvu□a Mons□n XI „2 □es□□erda) □om tam□a ros□ada □direita) a□resentada na □osi□□o a□erta. A □ase da válvu□a □□a□a) no meio da □□□□□a foi □ressionada e girada □ara a direita.

□ara o□ter □ress□o s□fi□iente nas □□maras de ar, a ins□□a□□o de□e ser rea□i□ada □om a □a□a da válvu□a na □osi□□o **fechada**. □ei□e o so□rador □n□ionar a toda □e□o□idade at□ qu□ o bocal da mang□eira de ins□□a□□o tenha sido retirado da válvu□a. A válvu□a a□ionada □or mo□a se f□cha a□tomati□amente e nenh□ma □ress□o de ar é □erdida d□rante a a□ert□ra e o f□chamento das válvu□as.

Todas as □□maras de ar □oss□em d□as válvu□as. O o□eti□o é a□i□itar a ins□□a□□o de□a□□o do **NOFI Current Buster 6 NOFI** □□ando o es□a□o □or □imitado. **Antes da insuflação, certificar que a válvula oposta está fechada.** □s válvu□as □orres□ondentes □oss□em a mesma □odi□i□a□□o de □ores.

Recolhimento

O sistema □□rrent □□ster 6 é □ro□etado □ara ser re□o□hido em am□as as dire□□es, □om se□arador o□ g□ias da □arreira de □onten□□o □rimeiro.

Recolhimento com as guias da barreira de contenção primeiro

A re□□□era□□o □om as g□ias da □arreira de □onten□□o □rimeiro n□o foi testada min□□iosamente e de□e ser rea□i□ada □om □a□te□a. □ada □s□□rio de□e desen□o□er s□a □r□□ria estrat□gia □ara essa o□era□□o.

OBSERVAÇÃO IMPORTANTE: □o re□□□erar o **NOFI Current Buster 6** □rimeiro □om as g□ias da □arreira de □onten□□o g□ide□ooms□, e□a□se a g□m tem□o at□ qu□ a g□a no se□arador se□a drenada atra□□s das válvu□as de drenagem. □sso de□e ser □eito grad□a□mente, e□antando □ent□metro a □ent□metro, sem a□i□ar m□ita or□a.

Recolhimento com o Tanque Separador primeiro

□m □a□o de re□□□era□□o de 50m é □one□tado a □a□resteira □or □m Gan□ho em G s□it□in□) (□er a **Figura 29**) O □a□o □oss□i □ma □arga de r□□t□ra m□nima de 6600 □g e é o e□□ro d□rante a re□□□era□□o. Tem□o de re□□□era□□o □a. 3□ min□tos.

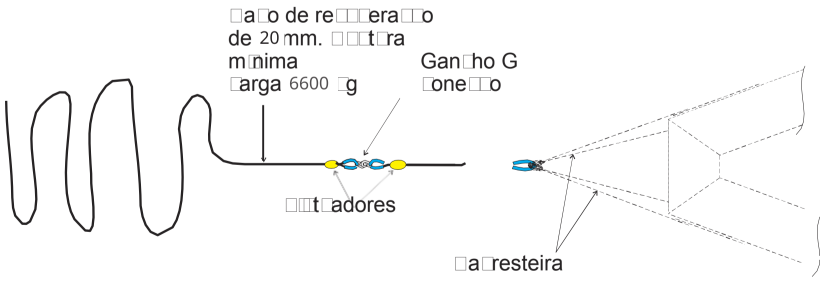


Fig. 29: □a□o de re□□□era□□o □om gan□hos em G

OBSERVAÇÃO IMPORTANTE: □a re□□□era□□o do **NOFI Current Buster 6** □e□a□se a g□m tem□o at□ □□e o se□arador se□a es□a□iado, □ma □e□ □□e a □g□a tem □□e fluir so□re o dis□siti□o de □o□□eio de □eo e atra□□s do □ana□□□ni□o e da sa□da estreita de □g□a no se□arador. □sso de□e ser □eito grad□a□mente, e□antando □ent□metro a □ent□metro, sem a□i□ar m□ita or□a. □m □ondi□□es des□a□or□□eis, □o□sas de □g□a □odem se □ormar, e□igindo inter□en□□o man□a□.

□e o sistema □or re□o□hido □ara □m □arrete□de an□amento e re□o□himento de □arreiras de □onten□□o, e□e de□er□ ser enro□ado □rmemente. □ma em□ar□a□□o o□ □m e□□□□ □ode a□dar a manter a tens□o no sistema en□□anto e□e est□ sendo re□o□hido. □o enro□ar os □a□os de re□o□□e, □erti□i□ar □□e e□es n□o i□□em □resos entre as □aredes □aterais do □arrete□da □arreira de □onten□□o e do r□□rio sistema da □arreira de □onten□□o, de□ido ao ris□o de o□str□□o dos □abos de re□o□□e.

3 OPERAÇÃO

□ sistema **NOFI Current Buster 6** □ □m □on□eito □astante no□o e este man□a□n□o des□re□e a o□era□□o idea□ □om todos os ti□os de em□ar□a□□es □e□□i□amentos o□ todos os modos de o□era□□o. □ada □s□□rio de□e desen□o□□er se□ □r□□rio □ro□edimento o□era□iona□□adr□o □aseado nas s□as □r□□rias ne□essidades.

Operação com embarcação simples
□ **NOFI Current Buster 6** □oi testado □om □m □ni□o □ar□o e □m □oom□ane. □ teste □oi rea□i□ado □om □m □oom□ane □adr□o e □ro□or□iono□ □ma □arg□ra de □arred□ra de □er□a de □8 m.

Tipo e tamanho do rebocador
□s re□o□adores de□em ser de □m ti□o □□e tenham □oa esta□i□idade dire□iona□e ser ade□□ados □ara re□o□ar o□□etos.

Dois barcos rebocando, um barco bombeando
□s **Figs 30** e **31** e□i□em o sistema sendo re□o□ado □om a a□□da de □ re□o□adores.

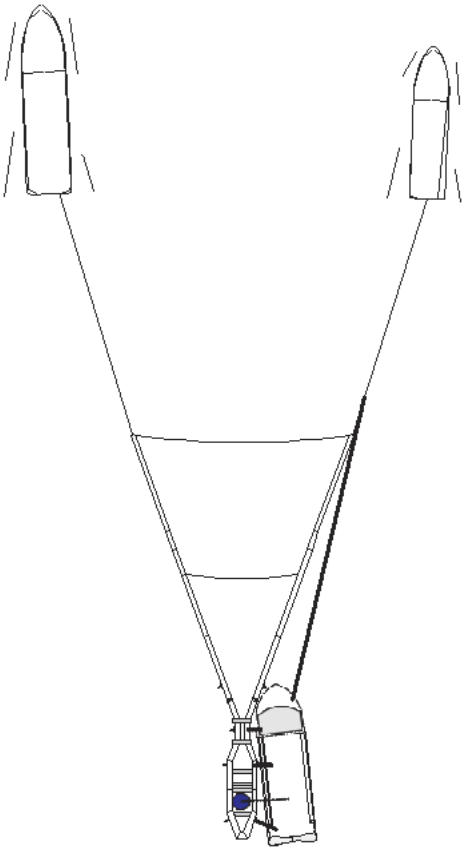


Fig. 30: □ois □ar□os re□o□ando o sistema. □ma em□ar□a□□o de □o□eta de □eo □amarrada ao □ado do se□arador ao re□o□ar.

Fig. 31: □ **NOFI Current Buster 6** em □ma □on□ig□ra□□o de dois □ar□os d□rante o teste em Troms□.

Forças de reboque
□s medi□□es rea□i□adas d□rante o teste indi□aram as □or□as de re□o□□e a□ro□imadas□

□ 3 n□s, a □or□a de re□o□□e □oi medida a a□ro□imadamente □,8 tone□adas □or em□ar□a□□o e a 5 n□s, a a□ro□imadamente 3 tone□adas □or em□ar□a□□o.

□s □a□ores se a□i□am a mo□imentos diretos □om □e□o□idade □ni□orme em mar □a□mo. □m □aso de m□dan□as re□entinas de □e□o□idade o□ dire□□o, e em mares agitados, de□e□se es□erar maiores □or□as de re□o□□e.

Enchendo o tanque separador
□ □ando o re□o□□e □ini□iado, o se□arador ser□ grad□a□mente en□hido □om □g□a. □e□omenda□se □ma □e□o□idade ini□ia□de □a. □,5 □5 n□s □ara en□her o se□arador. □ □ro□esso de en□himento demora □er□a de □□□ □5 min□tos, de□endendo da □e□o□idade de re□o□□e. □□rante este □ro□esso, a □arte in□erior do se□arador □ode □are□er inst□□e□, mas o sistema ainda ir□ □o□etar □eo. □e o re□o□□e □arar, o □astro no se□arador im□edir□ □□e o □□ndo do se□arador □□t□e. □o entanto, a□g□ma □g□a □ode es□a□ar, e □□ando o re□o□□e □artir no□amente,a□g□ns min□tos ser□o ne□ess□rios □ara atingir o n□□e norma□de en□himento.

Ajuste
Mesmo se a □e□o□idade atra□□s da □g□a e o ti□o de □□eo □ariarem, nenh□m a□□ste no sistema ser□ ne□ess□rio.

Velocidade máxima de reboque
A □e□o□idade m□□ima de re□o□□e é determinada de d□as maneiras:

1) A □e□o□idade m□□ima de □o□eta de □□eo é de 5 n□s atra□□s da □g□a. A o□era□□o a □e□o□idades maiores n□o é re□omendada. □ □ser□e □□e, nas □reas e□□ostas de □orrentes, □ma □eit□ra de GPS dar□ □ma □eit□ra errada da de □e□o□idade □ontra a □g□a.

2) □o re□o□ar diretamente □ontra ondas de □□rto □er□odo, a □e□o□idade de□e ser □imitada a 3 n□s. □aso a entrada de □g□a o□orra na □o□a, a □e□o□idade de□e ser red□□ida ainda mais, □ois o □□eo □ontido ser□ □erdido.

□orma□mente, □e□o□idades mais a□tas □odem ser □sadas ao re□o□ar □om ondas o□ a 90 gra□s em dire□□o à onda, se □om□arado a ir diretamente □s ondas. **Fig. 32**.

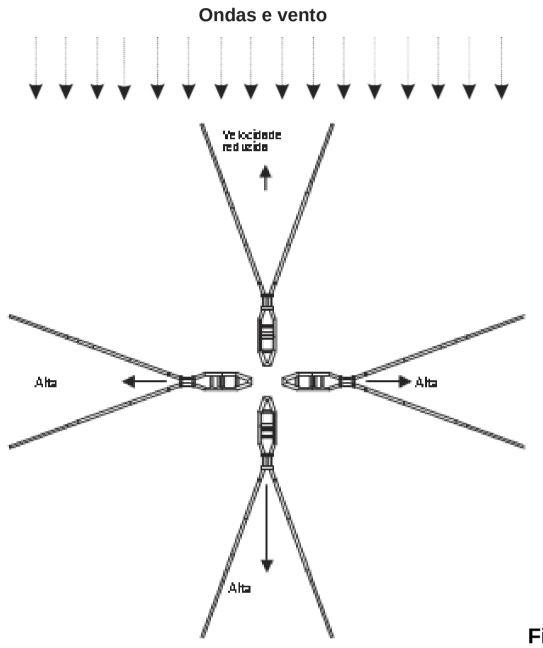


Fig. 32: □e□o□idade de re□o□□e em re□a□□o ao □ento / □ndas

Não é recomendado rebocar à ré

ADVERTÊNCIA: Nã□ □ é re□omendado re□o□ar o sistema à r□ □e□□eto d□rante a re□□□era□□o em □e□o□idades m□ito □ai□as), □ois o sistema n□o □oi □ro□etado □ara isso e ser□ dani□i□ado.

Velocidade de transporte
□e o sistema □re□isar ser trans□ortado ra□idamente de □m □o□a□□ara o□tro, de□em□se tomar a□□es □ara dimin□ir a a□ert□ra □ronta□do sistema, a □im de red□□ir a □□antidade de □g□a entrante no sistema.

□sso □ode ser □eito trans□erindo os dois □a□os de re□o□□e □ara □ma em□ar□a□□o. A □e□o□idade atra□□s da □g□a ainda de□e ser □imitada a 6 n□s.

Tipo de óleo
□s in□orma□□es dis□on□□eis a □artir de testes rea□i□ados □om □□eo indi□am qu□e o sistema □ode □idar □om a maioria dos ti□os de □□eo, de □ai□a a a□ta □is□osidade, in□□indo □□eo diese□. □□g□ns re□at□rios indi□am qu□e o sistema □ode ser e□i□iente, at□ na □o□eta de blu□e shine.

Re-insuflação de câmaras de ar
□e ho□□er □aria□□es signi□i□ati□as na tem□erat□ra □entre a noite e o dia) o□ □ongos □er□odos de o□era□□o, as □□maras de ar □odem □re□isar de no□a ins□□a□□o se □orem es□a□iadas o□ i□□arem de□ormadas. □sso □ode ser □eito □om so□radores □ort□teis.

Bombas e coletores de óleo (skimmers)

O sistema NCB6éc apaz de a□□m□ar at□ 1m de □eo no se□arador. □sso de□e ser □onsiderado ao es□o□her o ti□o de e□□i□amento a □sar. □□rios ti□os de □om□as e □o□etores de □eo (skimmers) □odem ser □sados □ara des□arregar o se□arador. A s□□er□□ie e□terna da □om□a o□ do □o□etor de□e estar i□re de □ordas a□iadas o□ □e□as girat□rias, que □odem dani□i□ar o te□ido.

□i□ar atento à □om□a e □s mang□eiras □ara que n□o o□orram danos □or a□ras□o, □or e□em□o, na □arte s□□erior da □orda i□re. □e ne□ess□rio, adi□ionar a□g□ma □rote□□o □ontra a a□ras□o, □ona et□.

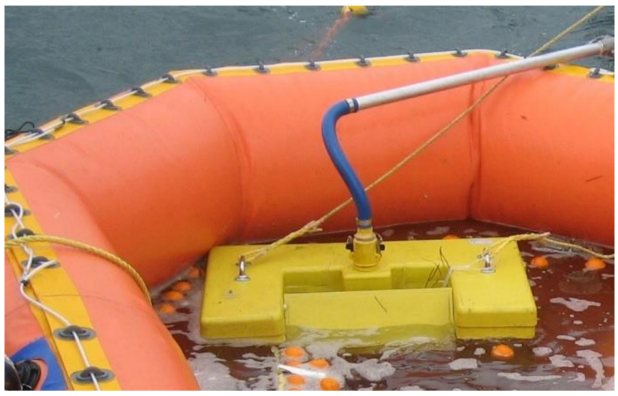


Fig. 33: □m □o□etor de □eo (skimmer) no se□arador *(Imagem do NOFI Current Buster 2)*

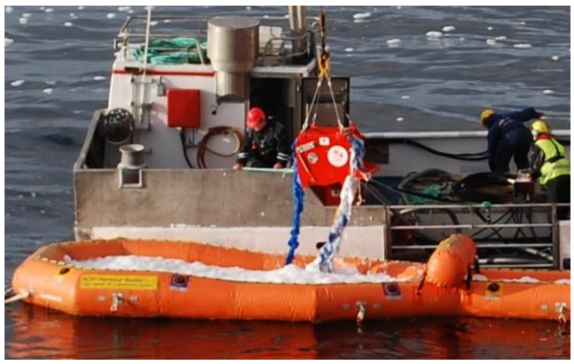


Fig. 34: □o□etor de □eo (skimmer) ti□o □orda o□eo□i□a (o□e mo□) o□erando no se□arador *(Imagem do* NOF □*Current Buster 2*)

Bombeamento e descarregamento de óleo recuperado

A em□ar□a□□o de □om□eamento □ode ser amarrada ao □ado do se□arador. A □im de e□itar danos no sistema, a em□ar□a□□o de □om□eamento de□e ter □m tamanho ra□o□□e□em re□a□□o ao **NOFI Current Buster 6** e n□o ter □ordas a□iadas o□ simi□ares □o□tadas ao sistema.

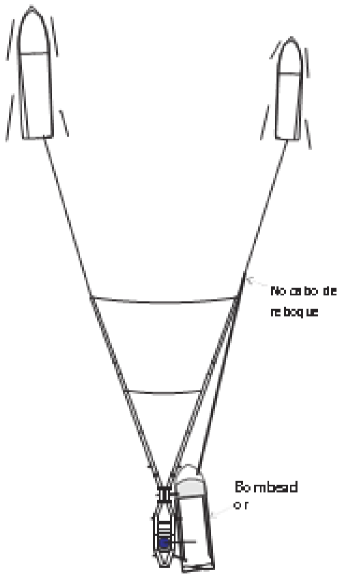


Fig. 35: □m□ar□a□□o de □om□eamento atra□ada ao □ado do se□arador com □a□os de atra□a□□o indi□ados.

Fig. 36: □a□o de atra□a□□o da □roa da em□ar□a□□o de □om□eamento at□ o □onto de □one□□o entre a □arred□ra e o □a□o de re□o□□e. *(Imagem do NOFI Current Buster 4)*

□e□endendo das em□ar□a□□es dis□on□□eis e do e□□i□amento □ti□it□rio, e□istem □□rios m□todos e estrat□gias □oss□□eis □ara o □om□eamento do **Current Buster 6**.

SEGURANÇA: Certificar que o reservatório de bombeamento não se desloque durante a operação em alta velocidade, levando o coletor de óleo (skimmer) a separar-se do separador.

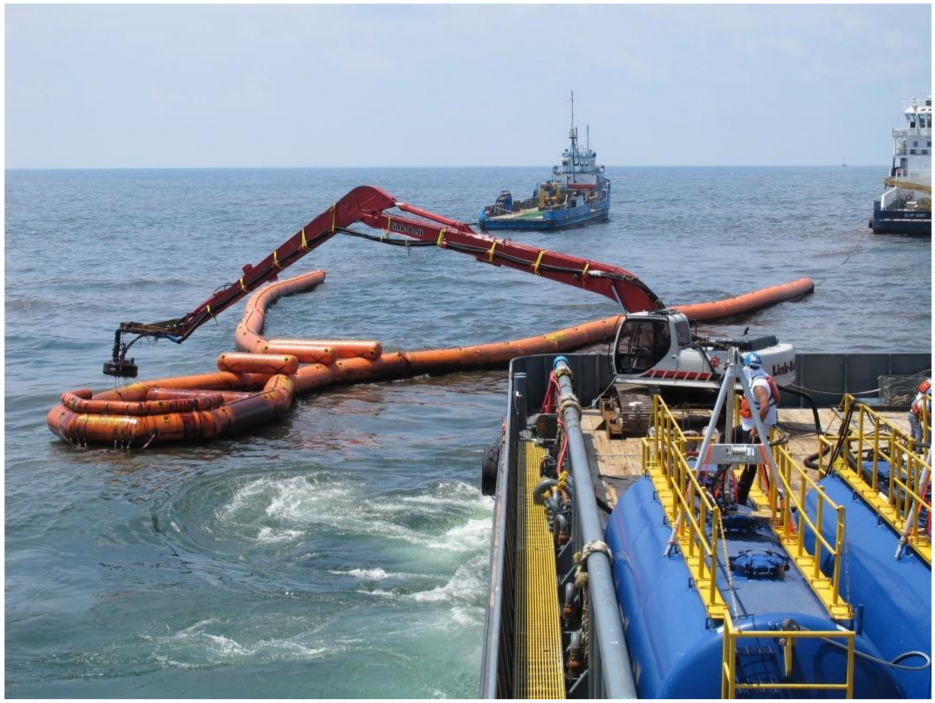


Fig.37: □s□a□adora com □om□a des□arregando □m NOFI □□rrent □□ster 8 d□rante o derramamento de Ma□ondo em 2010 .

Girando o sistema NOFI Current Buster

□e os dois re□o□adores esti□erem □em □oordenados, girar todo o sistema de □arreiras de □onten□□o se torna □ma tare□a sim□□es. □sso □ode ser □eito □om a em□ar□a□□o de □om□eamento an□orada ao □ado do se□arador.

Fig. 38: Girando o sistema em a□ta □e□o□idade de re□o□□e
(Imagem do NOFI Current Buster 4)

Remoção de detritos

Toras, detritos e o□□etos □ontiag□dos □odem entrar no sistema e □a□sar danos s□rios. □e isso o□orrer, □are a o□era□□o e remo□a os detritos.

□s a□gas □□t□antes, et□. □odem, de□ois de □m tem□o, ent□□ir a rede in□erior na □rea do □o□etor, □riar □ma o□str□□□o no t□ne□do □ana□□□ni□o o□ ent□□ir a sa□da do se□arador.

Fig. 39: □ana□□□ni□o ent□□ido □or □m □a□o

Se o entendimento redundar o desempenho a um nível inaceitável, os objetos estranhos devem ser removidos enquanto o reboque estiver parado.

Configuração de reboque

Devem-se entregar as informações a seguir aos capitães dos reboques antes do reboque.

Para manter a correta formação de reboque ao operar o **NOFI Current Buster 6** deve-se seguir as regras abaixo:

1) Um reboque deve liderar e o outro deve seguir e haver os ajustes necessários. Ainda assim, ambos os reboques são responsáveis por manter o sistema em boa formação. Concordar qual será o cabo líder. Sorteie, se necessário.
2) Os cabos de reboque devem possuir comprimentos iguais e devem ser amarrados o mais baixo possível nos reboques.
3) Ambos os reboques devem monitorar continuamente a barreira de contenção.
4) Começar a rebocar a 2,5 nós, com uma velocidade distância entre os reboques, por exemplo, 15-20 m.
5) Os reboques devem preferencialmente se movimentar mais ou menos em paralelo.
6) Os reboques devem gratificar as mudanças de velocidade e de curso.
7) Aumentar gradualmente a distância entre os reboques até que a formação correta seja alcançada. **Fig. 40**.
8) Se houver problemas contínuos com a falha de formação das barreiras de contenção, os cabos podem se aproximar.
9) Normalmente é mais fácil manter a configuração do sistema a uma velocidade acima de 2 nós.

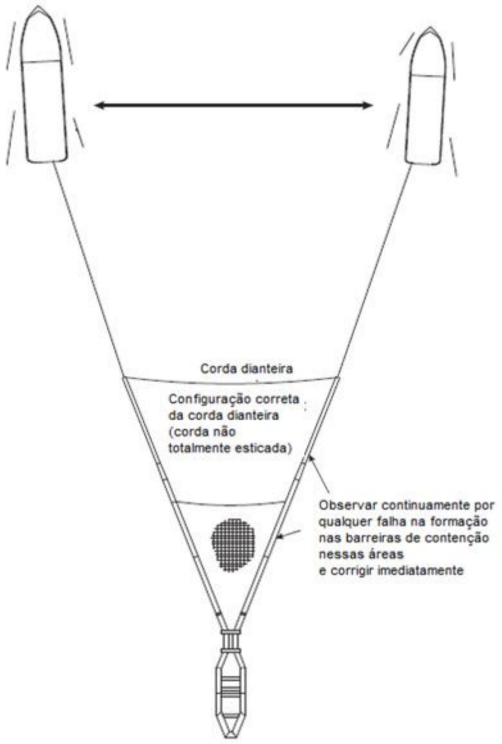


Fig. 40: Posicionamento correto dos reboques.

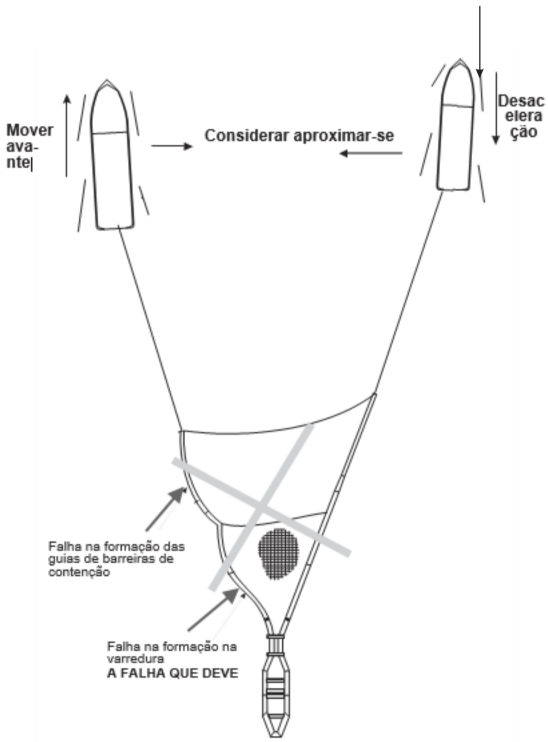


Fig. 41: Posicionamento incorreto dos reboques, causando falha de formação na guia de barreira de contenção e na arredagem.

Pequenos derramamentos

Se o derramamento de óleo for pequeno, isto é, menor que a capacidade de armazenamento do separador (aproximadamente 30-40 toneladas), pode-se usar dois cabos para rebocar o sistema e o óleo poderá ser descarregado ao final da operação de limpeza. Alternativamente, uma embarcação de pequeno porte pode escoltar o separador conforme o necessário.

<u>APÊNDICE A:</u> OPERAÇÃO DE BARCO ÚNICO COM BOOMVANE

OBSERVAÇÃO:
□ste □□ndi□e é desen□o□ido □ara os **NOFI Current Buster 2**, **4** e **6**, □sados □om o □oom□ane **padrão de 1,0 m**. □s i□stra□□es dos sistemas s□o genera□i□adas e n□o mostram ne□essariamente □ro□or□□es e deta□hes rea□istas.

Informações Gerais
O **NOFI Current Buster** □ode ser re□o□ado □om □m □ni□o □ar□o em □om□ina□□o □om □m esta□i□□ador □hamado □oom□ane. O esta□i□□ador s□□stit□i o re□o□ador no. 2 O □oom□ane é □m □rod□to □atenteado □orne□ido □e□a □□Maritim AS .

O □oom□ane ir□ □□□ar □ma das g□ias da □arreira de □onten□□o □ara □m □ado □ara que o **NOFI Current Buster** o□tenha □ma □orma□□o □om a□ert□ra □ronta□ □er **Fig. A01**.

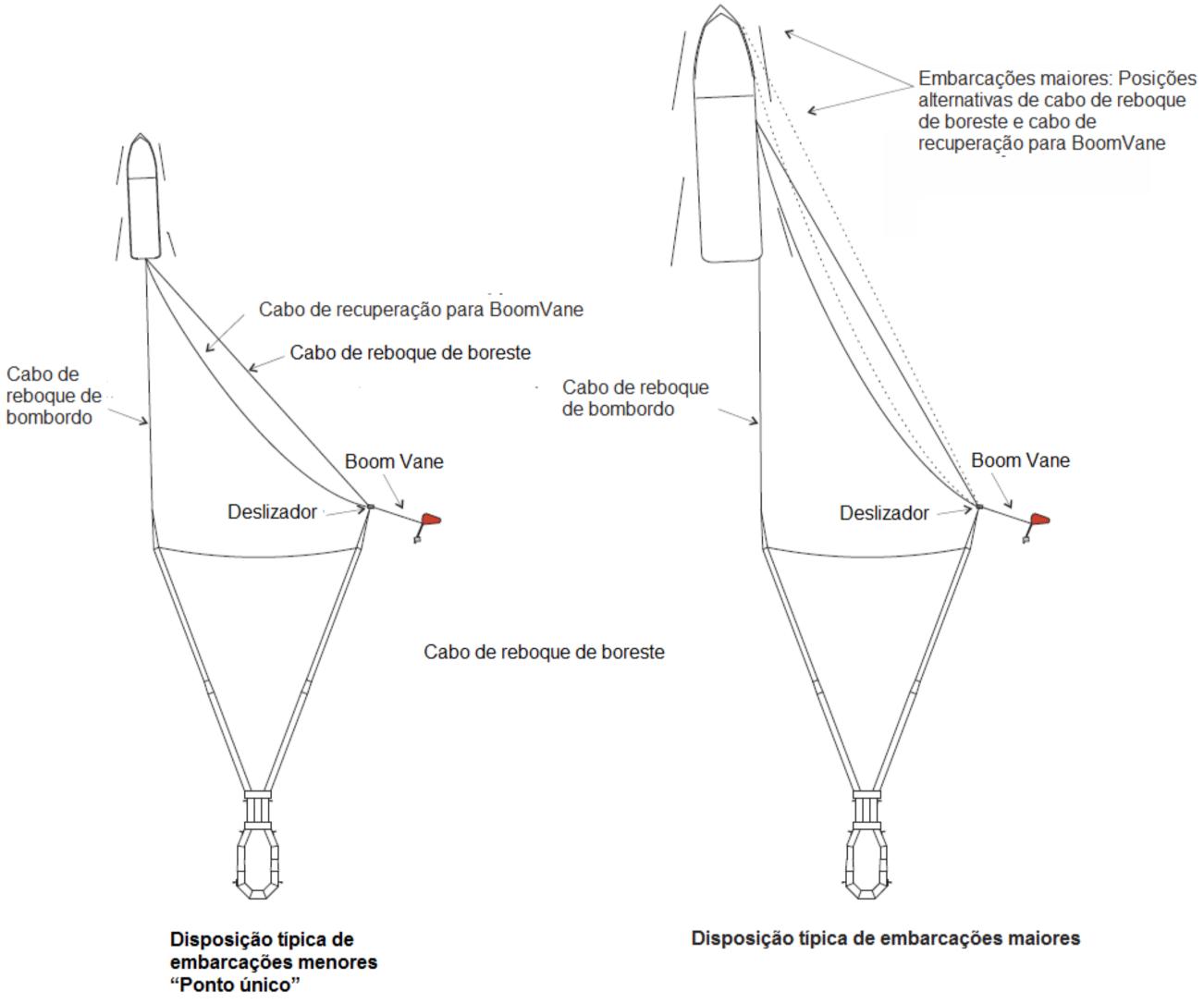


Fig. A01: □is□osi□□o de re□o□□e □ara o **NOFI Current Buster** e □oom□ane □omo sistema □ara □so a □oreste do re□o□ador.
A e□i□i□n□ia □e□o □so de □m re□o□ador e □oom□ane □ode ser me□hor do que □om o □so de dois re□o□adores. □sto □or□□e o □oom□ane □ode ser re□o□ado □erto de □raias, □ais, et□, e □or□□e as mano□ras do **NOFI Current Buster** s□o □ontro□adas □or □m □ni□o re□o□ador, e□iminando assim a ne□essidade de □oordena□□o entre d□as em□ar□a□□es.
□s em□ar□a□□es ade□□adas □ara o□era□□es □om □ar□o □ni□o norma□mente □oss□em esta□i□idade dire□iona□e / o□ □om ha□i□idades □ara mo□imentos □aterais (□or e□em□o, h□i□e / □ro□□sor □atera□) □sso o□orre □or□□e o □oom□ane ir□ pux ar □ara os □ados d□rante a o□era□□o, re□. **Fig. A01**. Alé m disso, a em□ar□a□□o de□e ser ade□□ada □ara at□ar □omo re□o□ador e ser □a□a□de re□o□ar □om □or□a de tra□□o s□i□iente (□a□ores reais medidos, □er **Fig. A02**□.

O **NOFI Current Buster** com Boom Vane pode ser equipado como um sistema a boreste ou a bombordo. Todas as descrições e ilustrações neste manual referem-se à variante de **boreste**. Para operar com o Boom Vane a bombordo, basta alternar o lado para os cabos de reboque e montar o Boom Vane alternativamente invertido em comparação às descrições e imagens apresentadas neste manual.

Forças de reboque
Todos os valores mencionados aplicam-se a um movimento direto com velocidade uniforme em mar calmo. Em caso de mudanças súbitas de velocidade ou de direção, e em mar agitado, deve-se esperar maiores forças de reboque.

A **Fig. A02** apresenta as forças de reboque medidas em relação à velocidade através da água para os **NOFI Current Buster 2** e **4**. Os valores são valores médios que apresentam forças de reboque totais para reboque do **NOFI Current Buster** com **BoomVane padrão de 1,0 m**.

Força de reboque para operações do NOFI Current Buster e BoomVane padrão de 1,0 m barco único

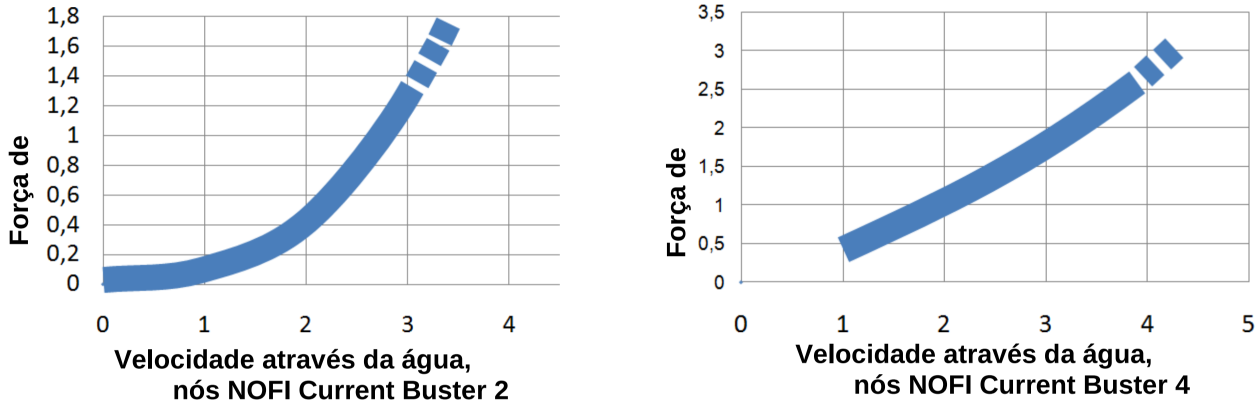


Fig. A02: Força de reboque para operações de barco único com **NOFI Current Buster** e Boom Vane padrão de 1,0 m

Para **NOFI Current Buster 2**: À velocidade de 2 nós, a força de reboque é de aprox. 1,4 toneladas e a 3 nós, de aproximadamente 1,3 toneladas.

Para **NOFI Current Buster 4**: À velocidade de 2 nós, a força de reboque é de aprox. 1,1 toneladas e a 4 nós, de aproximadamente 2,7 toneladas.

Adicionalmente, para o **NOFI Current Buster 6**: Os medições durante o teste indicaram que na faixa de velocidade de 2 nós a 5 nós, pode-se esperar forças de reboque na área de 1 a 5 toneladas.

Onde amarrar as cabos de reboque no rebocador
As experiências de um número considerável de testes e derramamentos de óleo com diferentes embarcações de reboque indicam que muitas vezes é mais difícil manobrar o sistema quando os dois cabos de reboque estão amarrados no mesmo local do navio (método “Reboque de ponto único”). Ver **Fig. A01** para um exemplo de “Reboque de Ponto Único” com ponto de atracação na popa. Se a embarcação tiver estabilidade direcional suficiente, o ponto de atracação pode ser colocado na lateral da embarcação, e não na popa.

No entanto, dependendo das instalações a bordo do rebocador, outras configurações podem ser mais desejáveis. As considerações sobre a capacidade de manobra da embarcação devem ser enfatizadas, e acima de tudo, a segurança da tripulação e da embarcação.

Disposição de reboque para o NOFI Current Buster e o BoomVane

O **NOFI Current Buster** é entregue pelo fornecedor como um sistema para uso com **dois** barcos. O sistema é entregue montado e pronto com dois conjuntos de passeiras conectadas a cabos de reboque.

Para operações de barco único, a experiência de uso prático resultou em um método doravante referido como NOFI Drop-back. O NOFI Drop-back será descrito posteriormente, neste capítulo.

O BoomVane de 1,0 m padrão

□ara deta□hes so□re o □oom□ane, □ons□lte a do□□menta□□o □orne□ida □e□o □orne□edor. □m g□ia de montagem sim□i□i□ado □ara o □oom□ane est□ ane□ado □omo **Apêndice B** neste man□a□do □s□□rio.

Fig. A03: □ □oom□ane □adr□o □om des□i□ador de □,□m, □ montado. □ a□t□ra □de a□ro□ □,□m mais o o□ha□de i□amento.

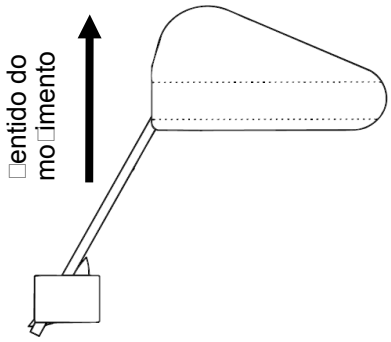


Fig. A04: □oom□ane □on□g□rado □ara □so □omo □m sistema □atera□de □oreste, □isto de □ima.

O sistema Drop-back

A disposição para o sistema NOFI Drop-back inclui a cabresteira e o bloco do BoomVane, além de, entre outras coisas, engates rápidos (Ganchos G), cabo prolongador e um deslizador (mosquetão), ver □ig □□5 e □ig. □□□. Para uma visão geral do sistema NOFI Drop-back, ver □ig. □□□.

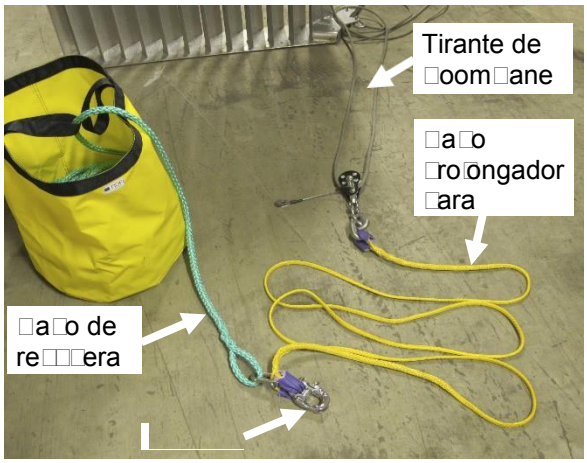
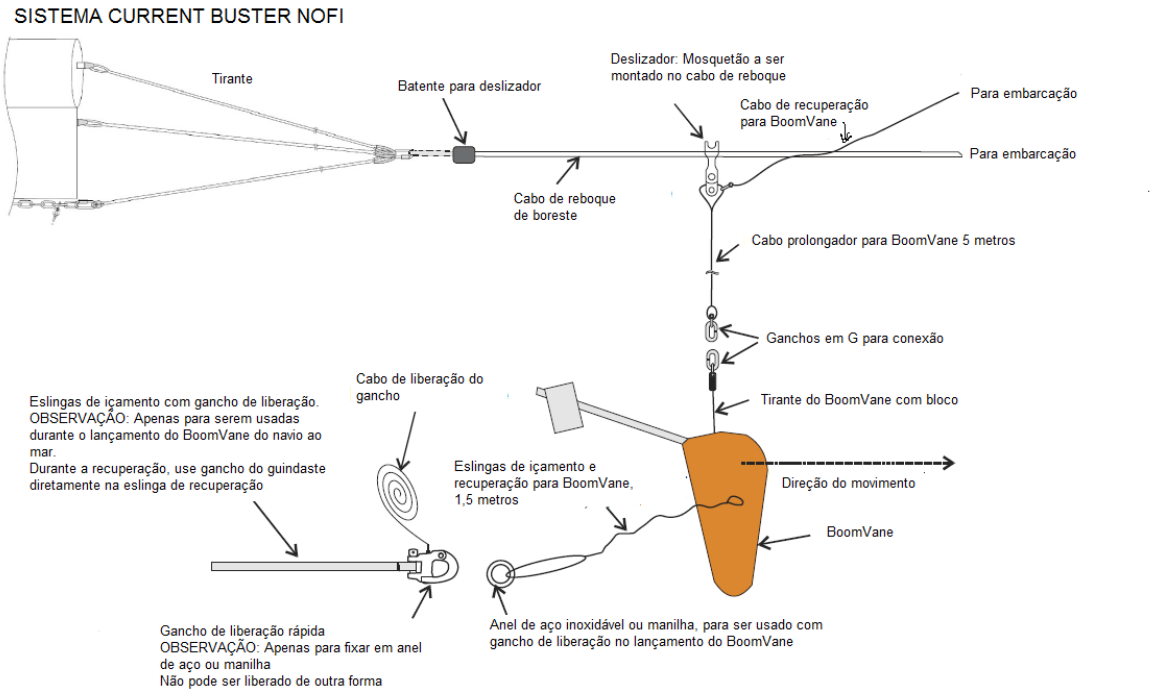


Fig. A05: □a□o □ro□ongador □ara □oom□ane □om des□i□ador □mos□□et□o□no □iso e □a□os de re□□□era□□o □ara □oom□ane na □o□sa.

Fig. A06: □is□a□i□a□□o deta□hada do tirante do □oom□ane □om □o□o e gan□ho G

OBSERVAÇÃO: □on□g□ra□□o do sistema de □oreste a□resentada. □ □on□g□ra□□o de □om□ordo ser□ in□ertida □atera□mente.



Fi □oreste □mostrado.

□ara o□ter instr□□es gerais so□re o □an□amento e re□o□himento do **NOFI Current Buster**, □er o □a□t□o □ □□rma□enamento, □an□amento e □e□o□himento.

Lançamento do BoomVane na água

□ □oom□ane de□e ser □an□ado □om □e□o□idade □enta a□ante de a□ro□imadamente □,5 n□s. □es□one□tar o □oom□ane do e□□i□amento de man□seio imediatamente a□□s o □ontato □om o mar, □ois o □oom□ane se a□astar□ do □ado da em□ar□a□□o. Manter □ma □igeira tens□o nos □a□os de re□□era□□o □g□ns □□i□os de □or□a□ ao so□tar grad□a□mente a □orda. □er **Fig. A08** e **Fig. A09**. □sso garantir□ □□e o □oom□ane □ontin□e sendo □□□ado na dire□□o □orreta. Manter □ma □igeira tens□o at□ o □oom□ane □arar no □atente.

ADVERTÊNCIA: □e a es□inga de i□amento □om gan□ho de i□era□□o esti□er sendo □sada □ara □an□ar o □oom□ane, de□e□se dar es□e□ia□aten□□o ao gan□ho de i□era□□o r□□ida e ao res□e□ti□o □a□o de i□era□□o, e□e□□tando, □or e□em□o, □ma □n□ise de □eg□ran□a do Tra□a□ho es□e□ia□mente □ara esta tare□a.

ADVERTÊNCIA: □ □an□amento do □oom□ane de□e ser e□e□□tado □om □□idado □ara e□itar □s□es, □or e□em□o, □essoas □resas entre □a□os de re□o□□e e e□□i□amentos o□ em□ar□a□□es.

□e ne□ess□rio, a□□star o □om□rimento dos □a□os de re□o□□e □ara o□ter a □orma□□o □orreta do re□o□□e, re□ **Fig A01**. □er tam□□m□
Apêndice D, **Fig. D02**.

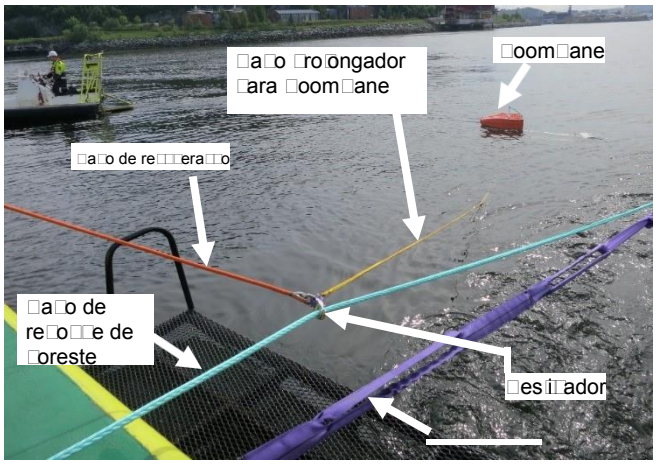


Fig. A08: □oom□ane des□□ando ao □ongo do □a□o de re□o□□e.

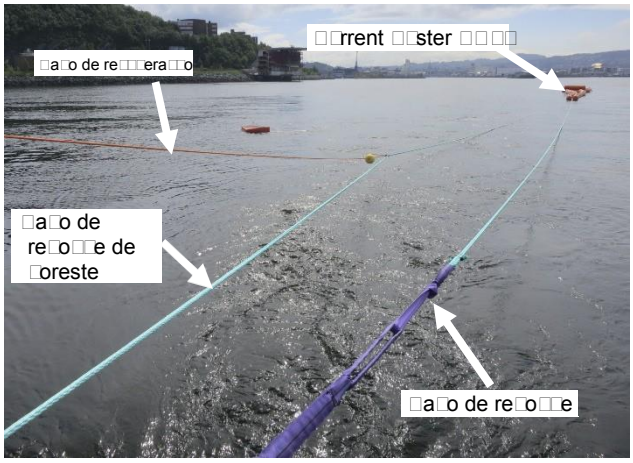


Fig. A09: □oom□ane des□□ando ao □ongo do □a□o de re□o□□e.

Manobrando o NOFI Current Buster com o BoomVane

□s □imita□□es re□ati□as □ □e□□idade de re□o□□e em re□a□□o ao □ento e □s ondas s□o as mesmas ao re□o□ar □om o □oom□ane □omo ao re□o□ar □om dois □ar□os.

□o m□dar de dire□□o, de□e□se estar □iente do seg□inte□

Girar a bombordo:
□o girar a □om□ordo, o □oom□ane e a g□ia da □arreira de □onten□□o □tter de □oreste atingir□o □ma □e□□idade mais a□ta do □□e a em□ar□a□□o de re□o□□e, de□ido a □m maior raio de giro. □ode ser □anta□oso red□□ir a □e□□idade de re□o□□e ao girar □ara manter a □or□a de re□o□□e □ai□a.

Curva a boreste:
□o girar a □oreste, o □oom□ane e a g□ia da □arreira de □onten□□o □tter de □oreste ganhar□o □ma □e□□idade menor do □□e a em□ar□a□□o de re□o□□e.

□m am□os os □asos e se a □□r□a □or □e□hada, o **NOFI Current Buster** □ode o□ter tem□orariamente □ma □orma□□o menos □□e idea□. □er a **Fig. A10** □ara □m e□em□□. □□ando a dire□□o do re□o□□e □ retomada, o **NOFI Current Buster** □o□ta □ □orma□□o norma□.

Fig. A10: Girar a □om□ordo. □ g□ia de □arreira de □onten□□o de □om□ordo □tter se do□ra □m □o□□o en□□anto o giro est□ em andamento.

□ e□i□n□ia de □o□eta de □□eo □ode ser red□□ida d□rante as o□era□□es de giro. □ □□eo □ontido no tan□□e se□arador □arma□enamento n□o ser□ a□etado □e□a o□era□□o de giro.

□ara manter □ma □oa □orma□□o ao □ongo do giro, o □om□rimento dos □a□os de re□o□□e □ode ser a□□stado e a □e□□idade do re□o□□e a□□stada en□□anto a □□r□a est□ em □rogresso. □sto □ress□□□e □□e o na□io de re□o□□e est□ e□□i□ado □om □a□restante, g□in□ho o□ seme□hante, e □□e o □a□o de re□o□□e n□o i□□e e□□osto ao desgaste o□ □a□ras□o, □a□sando o a□□e□imento do □a□o.

Fig. A11: □om a a□da de □m g□in□ho, o □om□rimento de □m dos □a□os de re□o□□e é a□stado □ara qu□ o **NOFI Current Buster** mantenha □ma □oa □orma□□o d□rante a □□r□a.

Recolhimento do equipamento

□ □ando o sistema ti□er qu□ ser re□□□erado, o □oom□ane □ode ser i□ado a □ordo no□amente □om a a□da do o□ha□de i□amento na □arte s□□erior do □□t□ador do □oom□ane, e retirado do **NOFI Current Buster** atra□□s dos gan□hos em □orma de G.

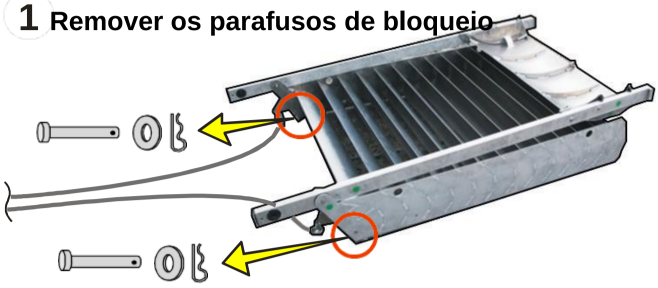
□n□identa□mente, a o□era□□o de re□□□era□□o do sistema NOFI □□rrent □□ster é e□e□□tada da mesma maneira □□e na o□era□□o rea□i□ada □om dois na□ios re□o□adores.

APÊNDICE B: GUIA DE MONTAGEM SIMPLIFICADA do BOOMVANE

OBSERVAÇÃO: O □oom□ane é □m □rod□to □atenteado da ORC AB , □□□□ia. □ara o□ter instr□□es □om□etas, □ons□te as in□orma□□es do □orne□edor. □m □□a□□er □aso de dis□re□□n□ia entre este g□ia de montagem e as in□orma□□es do □orne□edor, as in□orma□□es do □orne□edor de□em □re□a□e□er.

□s i□□stra□□es mostram a montagem do □oom□ane □omo sistema de **boreste** □ara □so □om **NOFI Current Buster**.

1 Remover os parafusos de bloqueio

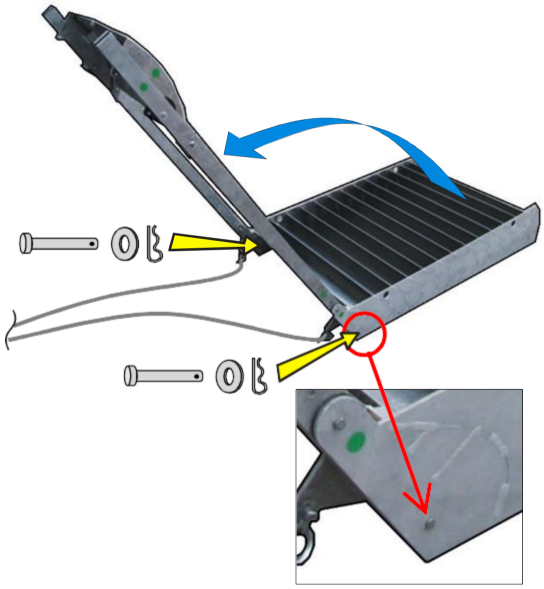


Dica: □ara sistema de **boreste** as mar□a□□es em **vermelho** de□em □oin□idir.

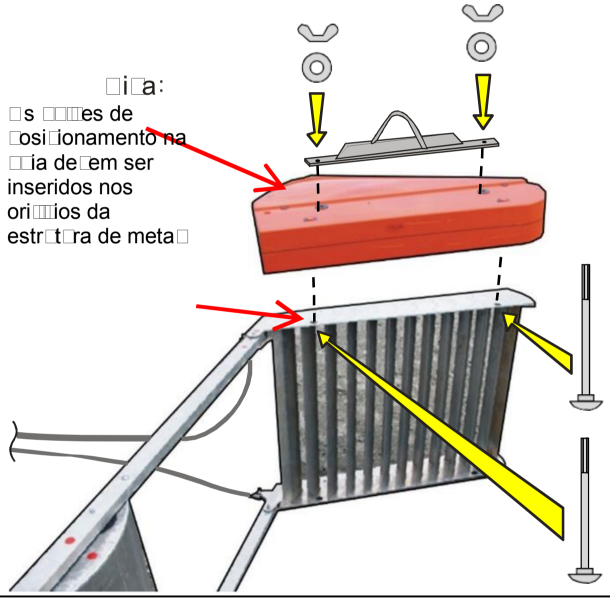
□ara sistema de □om□ordo as mar□a□□es em **verde** de□em □oin□idir.

□em□re □eri□i□ar se h□ desgaste o□ danos antes de □sar!

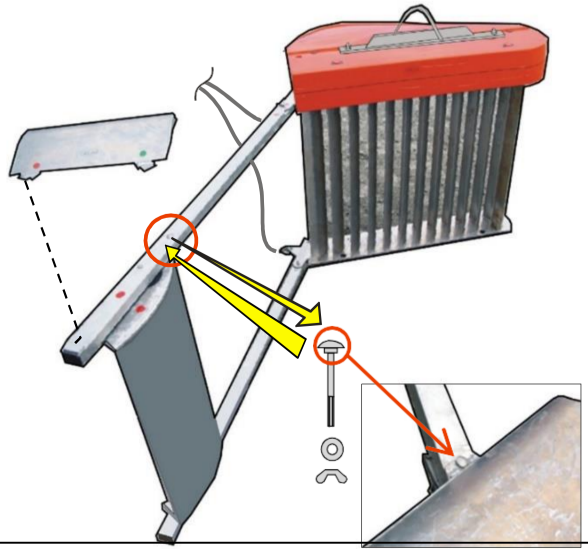
2 Bloquear o braço estabilizador na posição



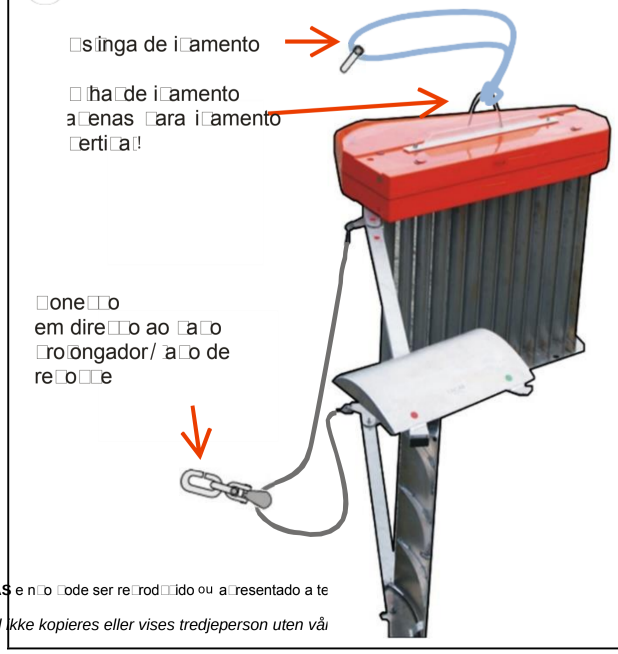
3 prender o flutuador e o olhal de içamento



4 Anexar a asa estabilizadora



5 BoomVane montado



<u>APÊNDICE C:</u> LANÇAMENTO E RECOLHIMENTO DO NOFI CURRENT BUSTER® PAT. COM BOOMVANE

OBSERVAÇÃO: □sta des□ri□□o □oi desen□o□□ida □ara os **NOFI Current Buster 2, 4 e 6**, □sados □om o □oom□ane **padrão de 1,0 m**.

OBSERVAÇÃO: □s i□□stra□□es dos sistemas s□o genera□i□adas e n□o mostram ne□essariamente □ro□or□□es e deta□hes rea□istas.

NB! □ssa des□ri□□o □orne□e a□enas di□as ao □s□□rio e n□o □ □m do□□mento □om□eto □om instr□□□es ao □s□□rio. □ara garantir o □so □orreto, □ im□ortante est□dar a do□□menta□□o □om□eta do □s□□rio men□ionada no □a□e□a□ho desta □o□ha.

NB! □ man□seio de e□□i□amentos de □arreira de □onten□□o em gera□, e es□e□ia□mente em a□tas □e□o□idades, im□i□a em ris□o. □ara e□itar □es□es, todo o man□seio de□e ser rea□i□ado de a□ordo □om as □oas □r□ti□as em o□era□□es mar□timas.

LANÇAMENTO:

- □osi□ionar o □arrete□de □an□amento e re□o□himento de □arreiras de □onten□□o □□a□et □ em□a□agem □ontendo o **NOFI Current Buster** □ara □□e o sistema □ossa ser □an□ado □rimeiro □om as g□ias de □arreiras de □onten□□o g□ide□ooms□□tter

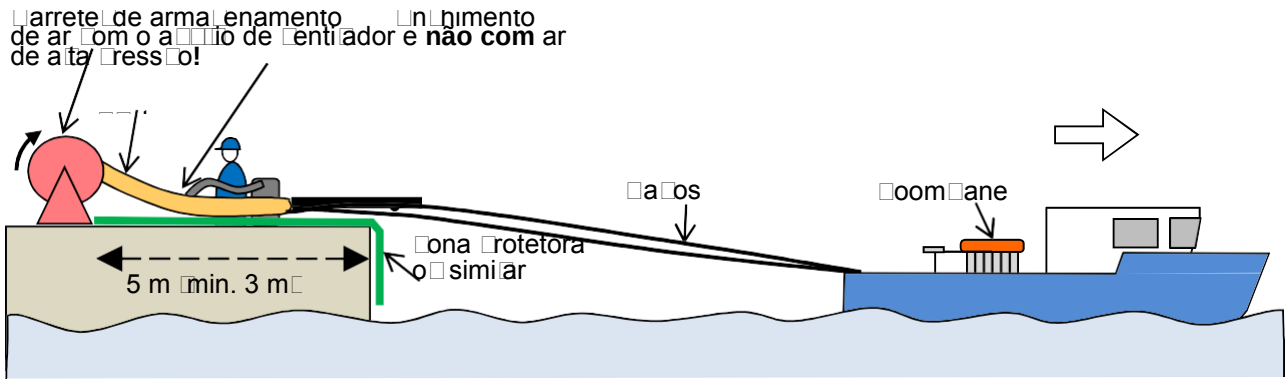


Fig. C01

RECUPERA

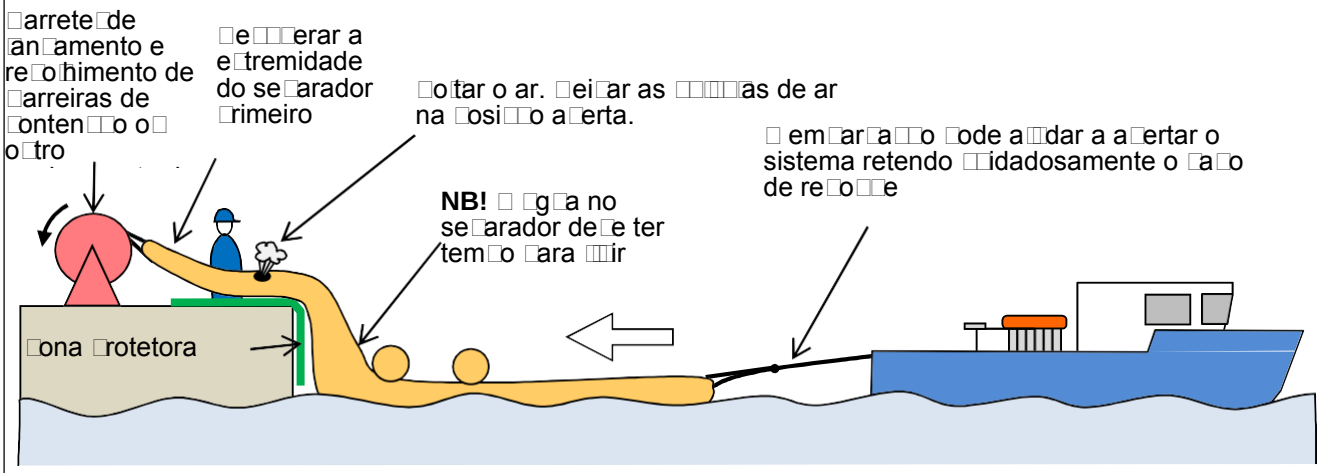


Fig. C02

<u>APÊNDICE D:</u> COMO REBOCAR/MANOBRAR O CURRENT BUSTER® PAT. NOFI COM BOOMVANE

OBSERVAÇÃO: □sta des□ri□□o □oi desen□o□ida □ara os **Current Buster 2, 4 e 6 NOFI**, □sados □om o □oom□ane **padrão de 1,0 m**.

OBSERVAÇÃO: □s i□stra□□es dos sistemas s□o genera□i□adas e n□o mostram ne□essariamente □ro□or□□es e deta□hes rea□istas.

NB! □ssa des□ri□□o □orne□e a□enas di□as ao □s□□rio e n□o □ □m do□□mento □om□eto □om instr□□□es ao □s□□rio. □ara garantir o □so □orreto, □im□ortante est□dar a do□□menta□□o □om□eta do □s□□rio men□ionada no □a□e□a□ho desta □o□ha.

NB! □ man□seio de e□□i□amentos de □arreira de □onten□□o em gera□,□e es□e□ia□mente em a□tas □e□o□idades, im□i□a em ris□o. □ara e□itar □es□es, todo o man□seio de□e ser rea□i□ado de a□ordo □om as □oas □r□ti□as em o□era□□es mar□timas.

LANÇAR O BOOMVANE

- □e□o□idade □enta □ □ante □a□ro□. □,5 n□s□
- □an□ar o □oom□ane □m□o o□g□indaste □□eso a□ro□. □□ □g□
- □eter os □a□os de re□□□era□□o □ara o □oom□ane d□rante o □an□amento

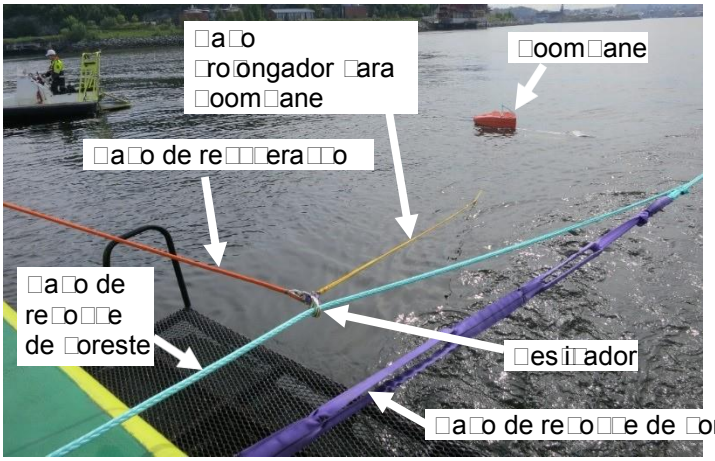


Fig. D01 □an□ando o □oom□ane

ENCONTRAR A FORMAÇÃO CORRETA DE REBOQUE

- Manter a □e□o□idade a□ro□imada de □,5 n□s, e so□tar o □a□o de re□□□era□□o □ara o □oom□ane, mantendo □ma □e□e tens□o, at□ o □oom□ane □arar no □atente.
- □e ne□ess□rio, a□□star o □om□rimento dos □a□os de re□o□□e □ara o□ter □ma □orma□□o □orreta do re□o□□e.

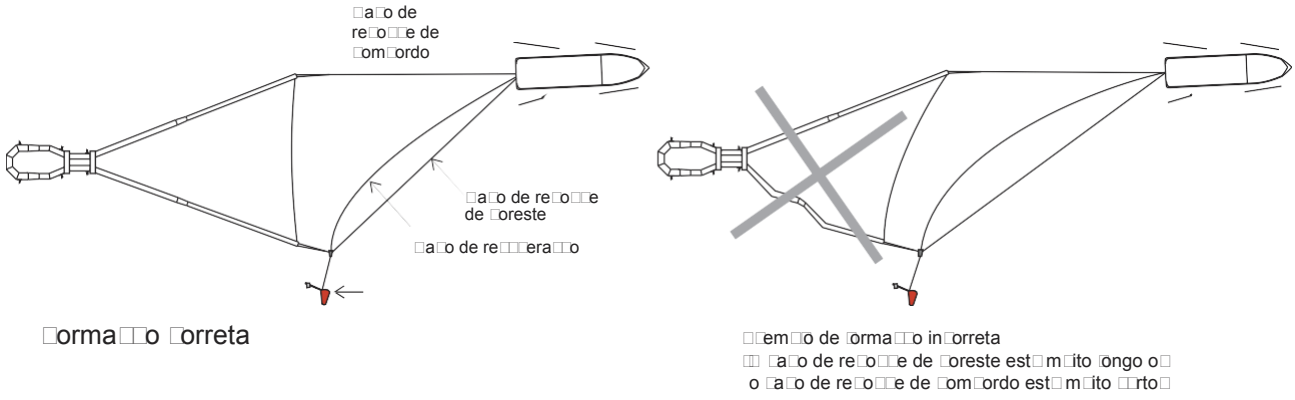


Fig. D02 □□em□□os de □orma□□es de re□o□□e □orreta e

ORIENTAÇÕES GERAIS SOBRE O REBOQUE E A COLETA DE ÓLEO

- □erti□ar de □□e ha□a □ma □oa □is□o do e□□i□amento da □osi□□o de dire□□o
- □ni□iar a o□era□□o de re□o□□e em □ai□a □e□o□idade, a□ro□imadamente □n□ e manter em □e□o□idade □enta at□ □□e o □oom□ane se mo□a □orretamente a □ante.
- □ □ser□ar □omo o sistema reage aos mo□imentos da em□ar□a□□o. □rati□ar m□dan□as dire□ionais e de □e□o□idade.
- □e□o□idade d□rante o en□himento ini□ia□do se□arador do sistema□□,5 a 3,5 n□s. □ se□arador ir□ en□her grad□a□mente d□rante □□a □5 min□tos. □ sistema □ode □o□etar □□eo d□rante o a□aste□imento.
- □e□o□idade d□rante a □o□eta de □eo□□,5 □4,5 n□s de□endendo do sistema **Current Buster NOFI** e das □ondi□□es das ondas e do □ento.
- □□rante a □□r□a, o □oom□ane atingir□ □ma □e□o□idade menor o□ maior □□e a do re□o□ador, de□endendo da dire□□o, e o **Current Buster NOFI** □ode □hegar a □ma □orma□□o menos idea□. □e ne□ess□rio, red□□ir a □e□o□idade de re□o□□e d□rante as o□era□□es de giro.
- □as □aradas d□rante o re□o□□e, o □□eo □□t□ar□ □ara a □rente do sistema e □oder□ se □erder. □m a□an□o □ento e□itar□ a □erda de □□eo.

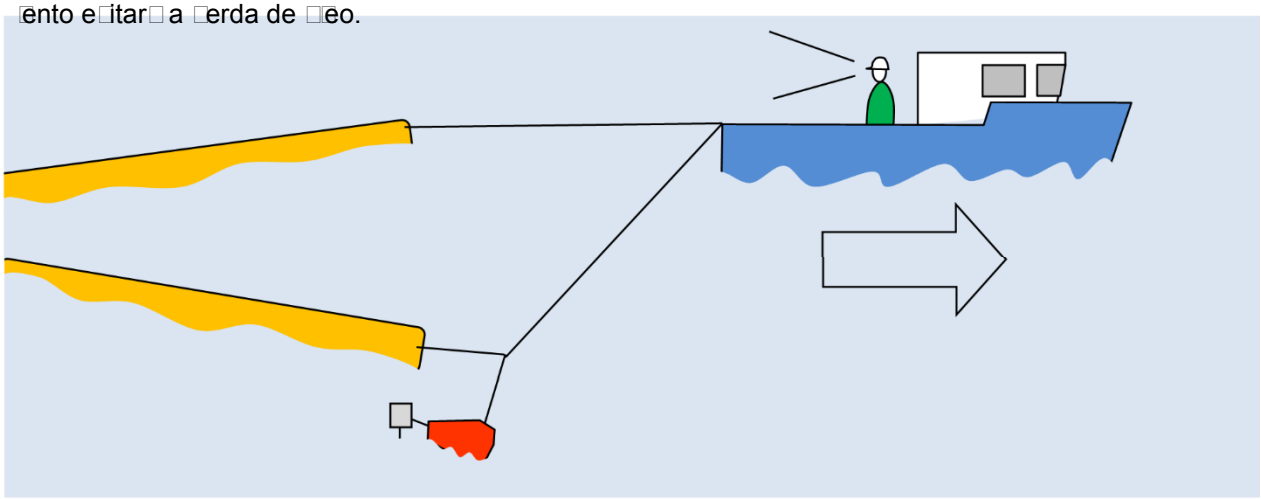


Fig. D03

ONDAS E VENTO

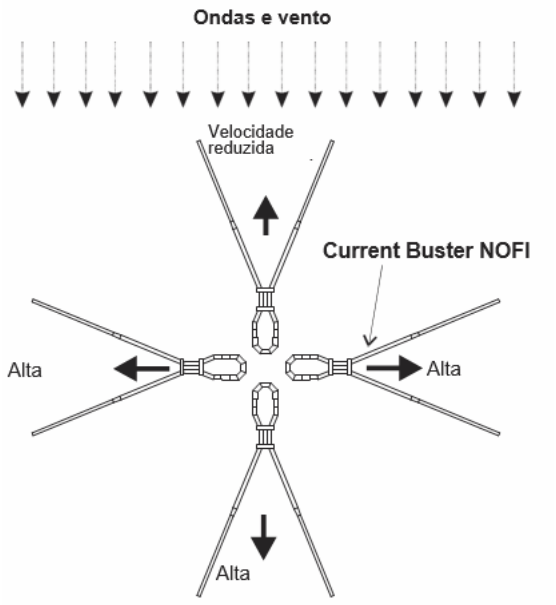
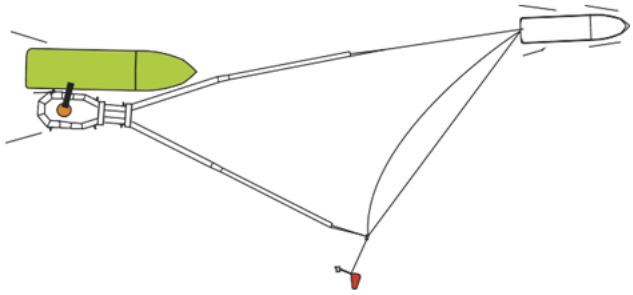


Fig. D04 Ondas e vento

COLETA DE ÓLEO (SKIMMING)

- A embarcação de coleta de óleo pode atracar ao lado do **Current Buster NOFI** e, eventualmente, dependendo da embarcação de reboque e do sistema **Current Buster NOFI**, também ao rebocador
- A velocidade constante à frente garante boas condições para a coleta de óleo (skimming).



High Capacity Advancing Oil Recovery System Performance Testing at Ohmsett for the Wendy Schmidt Oil Cleanup X CHALLENGE

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MAR Incorporated/ Ohmsett Test Facility
Atlantic Highlands, NJ, USA
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Abstract

Ohmsett - The National Oil Spill Response Research & Renewable Energy Test Facility was selected as the test venue for the $1.4 Million Wendy Schmidt Oil Cleanup X CHALLENGE. The competition was designed to inspire a new generation of innovative solutions for recovering spilled oil from the seawater's surface.

Ten finalists, selected from more than 350 entries from around the world, demonstrated oil cleanup systems during rigorous testing where they each had 10 days to demonstrate their individual technology in the Ohmsett test tank. In this head-to-head competition, a $1 Million Grand Prize was awarded to the team that demonstrated the ability to recover oil from the water's surface at the highest oil recovery rate (ORR) at oil recovery efficiency (ORE) of more than 70%.

This was the largest oil recovery test ever conducted at Ohmsett. This paper discusses the test setup and methodology used during the high capacity advancing oil recovery system performance testing at Ohmsett.

1 Introduction

The X PRIZE Foundation, a non-profit organization, selected Ohmsett as the test venue for the $1.4 Million Wendy Schmidt Oil Cleanup X CHALLENGE. This challenge, the Foundation's sixth major competition, was designed to inspire a new generation of innovative solutions for recovering spilled oil from the seawater's surface.

The $1 Million Grand Prize would go to the team with the highest oil recovery rate (ORR) provided the ORR was greater than 9500 liters per minute (L/min) (2500 gallons per minute (gpm)) and the system's recovery efficiency (RE) was greater than 70%. To put this in perspective, prior to the competition the largest capacity skimmer ever tested at Ohmsett achieved an ORR of approximately 3,400 L/min (900 gpm).

The X PRIZE committee determined that the competition should enable contestants to possibly recover 11356.2 L/min (3,000 gal min) of oil or greater. The advancing speed range was decided to be between one and four knots. To enable the contests to encounter that much oil, an 18.3 m (60 ft) swath width was chosen with a minimum tow speed of one knot. Based on the 18.3 m (60 ft) width at one knot tow speed, the required slick thickness was 25 mm (1 in), which equated to 11356.2 L/min (3000 gpm). This allowed contestants to choose a narrower swath width with higher speeds to encounter 11356.2 L/min (3,000 gal min) or greater. Later, the X PRIZE committee decided to reduce capacity to 9500 L/min (2500 gal) to meet performance goals.

Testing was conducted by Ohmsett staff with competition oversight by impartial judges provided by X PRIZE. The judges included personnel from industry and government agencies with oil spill response experience. To guarantee fairness, a judge was present whenever a team was on-site.

The competition took place from July through September 2011. Each team was given ten days at Ohmsett to demonstrate their system, including three full days of testing in the test basin. To ensure that the last team that tested did not have the advantage of additional development time, all team equipment had to be en route to Ohmsett by the same date. Tools and spare parts were required to be in the main shipment and additional parts and/or tools were not allowed to be brought to the facility at a later date.

2 Test Apparatus

2.1 Test Area

Ohmsett's test basin is 203 m long x 20 m wide (667 ft x 65 ft) with three moveable bridges that span the width of the tank. The bridges, mounted on rails that run the length of the tank, can travel at speeds up to 3.1 m/s (6 knots). For this competition, each team's oil recovery system was rigged between the Main Bridge and the Auxiliary Bridge. The team's ancillary equipment, such as hydraulic power units and control stands, were mounted on the Main and/or Auxiliary Bridge.

At the south end of the basin is a wave generator and at the north end is a wave attenuating beach system. Allowing for the wave-generating equipment, beaches, and acceleration and deceleration zones, the teams had approximately a 122-m (400-ft) long test area to operate their system under steady state conditions. The test tank is shown in Figure 1.

Figure 1 Ohmsett Test Tank with a 25 mm (1 inch) oil layer

2.2 Test Oil

Hydrocal 300 was used as the test oil because its properties would remain consistent over the course of testing. The nominal viscosity of Hydrocal is 200 cP at 20.0°C, with specific

gravity of 0.903, and interfacial tension of 20.6 dynes per cm at 25.5°C. The Hydrocal was dyed red for better visibility.

2.3 Slick Thickness

To achieve the nominal slick thickness of 25-mm (1-inch) for the oil recovery systems to encounter the required 102,000 L (27,000 gal), oil was dispensed on the surface of the tank. A VisiScreen device was used to measure and document the slick thicknesses at multiple locations in the test basin prior to each test.

2.4 Oil Distribution and Sampling

76,000 L (20,000 gal) calibrated frac tanks were used to store the 303,000 L (80,000 gal) of test oil. As test oil was transferred from the frac tanks to the test basin, the oil levels in the frac tanks were carefully measured to ensure the proper amount of oil was transferred to create the 25-mm thick (1-inch) slick. As oil was dispensed into the test tank, samples were obtained and analyzed to confirm initial oil properties. Multiple oil surface samples were obtained and analyzed for initial properties prior to each official test.

2.5 Oil Recovery

Two banks of four-cell calibrated recovery tanks, located on Ohmsett's Auxiliary Bridge, were used during the test (Figure 2). Each of the eight recovery tanks had a capacity of approximately 2,300 L (600 gal) and for sounding purposes, equates to 1.8 L/mm (11.8 gal/in). Fluid depth was measured with a 1.2 m (4 ft) aluminum ruler, and readings were accurate to within 3 mm (1/8 in).

Figure 2 Recovery Tanks on the Auxiliary Bridge

The skimmer's discharge line was connected to Ohmsett's manifold system via a 254-mm (10-inch) flange. A wye downstream of the flange split the flow into two 254-mm (10-inch) pipes, and recovered fluid traveled 4.5 m (15 ft) vertically up to a 203-mm (8-inch) 3-way valve located at each recovery tank. Each manually operated 3-way valve either diverted flow to bypass mode or to collect mode. As each skimmer was allowed to reach to steady state conditions, fluid flow was diverted to bypass mode where the fluid traveled through the manifold and returned to the basin surface. Once the timed collection period started, flow was diverted to the recovery tanks. Prior to test end, flow was redirected to bypass and the collection period ended.

The volume of oil recovered was determined in the following manner. At test end, fluid soundings of each recovery tank cell were obtained to determine total volume of fluid recovered. Following a 30-minute period in which gravity separation took place, free water was decanted from the bottom of each recovery tank cell. A second set of fluid soundings were obtained from which the gross oil volume was calculated. The remaining fluid was stirred and a representative sample was obtained and sent to Ohmsett's on-site lab for water content analysis per ASTM D-1796 (ASTM, 2011). After deducting the free and entrained water from the total fluid recovered, the volume of (pure) oil recovered was determined. Valves located at the bottom of each recovery tank cell allowed for visual decanting of free water.

3 Test Procedure

This was an advancing skimmer test and the methodology was developed based on guidelines from ASTM's F-2709, *Standard Test Method for Determining Nameplate Recovery Rate of Stationary Oil Skimmer Systems* (ASTM 2008a) and ASTM F-631, *Standard Guide for Collecting Skimmer Performance Data in Controlled Environments* (ASTM, 2008b).

3.1 Preliminary Tests

The ASTM F-2709 standard suggests a minimum measurement period of 30 seconds (ASTM, 2008a). The minimum 30 second test period would be waived only if the system filled all eight recovery tanks (18,000 L (4800 gallons)) within 30 seconds. Other applicable data collection, measurement and sampling techniques were integrated into the protocol based on ASTM standards.

Prior to official testing, each manufacturer was allowed one day of practice runs to adjust equipment settings and operational speeds to optimize their system and determine the best tow speeds for calm and wave conditions.

3.2 Performance Tests

The measurement period for each test began when:

- The skimmer system was at its proper tow speed;
- The skimming system was adjusted to its optimum setting;
- The oil recovery and discharge flow appeared to be at steady state;
- The team signaled they were ready to begin the measurement period.

When the above conditions were met, the 3-way valve on each bank of recovery tanks was swung to divert the flow from bypass mode to collect mode and timing started.

The test could end in three possible ways: typically the team leader signaled to end the test period; the tanks were full; or the end of the test distance was reached. At test end flow was

redirected to bypass mode and timing ceased. All measurements were taken and the skimmer system was repositioned to start the next test.

3.3 . **Calculation of Performance Measurements/Oil Recovery Rate and Oil Recovery Efficiency**

The two performance measurements are:

Oil Recovery Rate (ORR): Total volume of oil recovered per unit time.

$$ORR = \frac{V_{oil}}{t} \qquad (1)$$

Where: ORR = Oil Recovery Rate, L/min (gpm)
V_{oil} = Volume of oil recovered, L (gal) (decanted and lab corrected)
t = Elapsed time of recovery, minutes

and: Recovery Efficiency (RE): The ratio of the volume of oil recovered to the volume of total fluid recovered.

$$RE = \frac{V_{oil}}{V_{total\ fluid}} \times 100 \qquad (2)$$

Where: RE = Recovery Efficiency, %
$V_{total\ fluid}$ = Volume of total fluid (water and oil) recovered

WENDY SCHMIDT OIL CLEANUP X CHALLENGE

11 October 2011

Dear Dag,

Congratulations to you and NOFI for completing your testing at Ohmsett during the Wendy Schmidt Oil Cleanup X CHALLENGE this past summer. All of us, including Judge Gene Johnson as well as the personnel at the Ohmsett facility, were pleased to see your system operating in the test basin in pursuit of this X CHALLENGE. Your team spirit and camaraderie were appreciated by all.

In this binder, you will find your team's test results, associated data, pictures, and video from Ohmsett.

Below, we have included a summary of your team's mean Oil Recovery Rate (ORR) and mean Oil Recovery Efficiency (ORE) as calculated by the Judging Panel and the X PRIZE Foundation in accordance with the Competition Guidelines and Field Testing Procedures. In addition, we have provided a summary of which of your Official Test Runs were used to compute your official score in the competition.

Combined MEAN ORR	Combined MEAN ORE	CALM MEAN ORR	CALM MEAN ORE	Run 1 CALM Ohmsett #83			Run 2 CALM Ohmsett #84		
				ORR	% from mean	ORE	ORR	% from mean	ORE
2712	83.0	2958	91.9	2865	3.1%	90.1	2553	N/A	71.1
				Run 3 CALM Ohmsett #85			Run 4 CALM Ohmsett #90		
				ORR	% from mean	ORE	ORR	% from mean	ORE
				2860	3.3%	91	3149	6.5%	94.7
		WAVE MEAN ORR	WAVE MEAN ORE	Run 1 WAVE Ohmsett #86			Run 2 WAVE Ohmsett #87		
				ORR	% from mean	ORE	ORR	% from mean	ORE
		2466	74.0	2573	4.3%	78.5	2419	1.9%	72.3
				Run 3 WAVE Ohmsett #88			Run 4 WAVE Ohmsett #89		
				ORR	% from mean	ORE	ORR	% from mean	ORE
				2399	N/A	72.2	2406	2.4%	71.3

= Official Test Run used for calculation

= Official Test Run not used for calculation

xxx = individual test run results meet or exceed competition criteria

xxx = individual test run results less than competition criteria

Again, congratulations for completing this enormous effort and we wish you all the best in your future endeavors!

Sincerely,

The Wendy Schmidt Oil Cleanup X CHALLENGE Team and the X PRIZE Foundation


WENDY SCHMIDT
OIL CLEANUP
CHALLENGE
Dated October 11, 2011
NOFI
$ 300,000.00
Three Hundred Thousand 00/100
Dollars


CHALLENGE
OIL CLEANUP

SISTEMA X150

ELASTEC

PRODUCT DESCRIPTION

ELASTEC X150 Skimmer Launching System

0SYSTLA150

Customized for

aLBriggs Defesa Ambiental S/A

The Elastec X150 Skimmer is now available with a fully integrated Launching System. The system is a seamless, all-in-one oil collection and skimming system that recovers high volumes of oil in stationary and advancing modes - from zero to three knots, from a single vessel.

The centerpiece of the new system is the X150 skimmer, the first commercial model developed incorporating Elastec's patented grooved disc technology that won the XPRIZE Foundation's Wendy Schmidt Oil Cleanup X CHALLENGE.

The self-contained launching system is wirelessly remote controlled and includes the launcher, the X150 skimmer, boom and reel, BoomVane™ and power unit. Hydraulic and discharge hoses are built into the sweep boom, eliminating external umbilical. The complete system fits into a 20ft high cube container for rapid global shipment.

The launching system is easily operated, it does all the heavy lifting by hydraulically telescoping the X150 skimmer from the stern of the vessel, hoisting and winching it into the ocean. All the system components are stored within the robust steel frame which fits into a 20ft container for storage and shipping.

Launching System Specification - 4BASEDE022C

Dimensions:	
Length Stored:	19ft 3 inch / 5.867 m
Width:	7ft 6 inch / 2.286 m
Height:	8ft 2 inch / 2.489 m
Weight (full system)	15,740 lb / 7,139.5 kg
Max Lifting Capacity:	4,000 lb / 1,814 kg

Wireless remote control

Integrated Hydraulic Power Pack;

Water cooled diesel engine with 12 Volt Electric Start and dual variable displacement hydraulic pumps. An option to attach the auxiliary control panel to an outside hpu is available to assist with extra pump capacity.

Engine:	48hp / 36kW @ 2800 rpm water cooled diesel engine with 12v electric start (net continuous 38.5hp)
Fuel Capacity:	28 gals / 106 litres
Fuel consumption:	2.823 gallon per hour (2800 rpm)
Hydraulic tank:	30 gallons / 113 litres.
Max Hydraulic output (tandem pump):	
Front pump:	20.7 gpm 3500 psi
Rear pump:	13.3 gpm 3000 psi

Hydraulic tank with strainer, sight, temperature gauge and cover plate and spin on return filter, spark arrestor (incorporated in the muffler).

X150 Grooved Disc Skimmer - 0SKIMUN153

The X150 skimmer is a workhorse in recovering extreme volumes of oil. It has a verified nameplate oil recovery rate (ORR) of 660 gallons of oil per minute (150 cubic metres per hour) and an oil recovery efficiency (ORE: oil-to-water collection rate) of 87.6%.

Encounter Rate – The X150 can be towed through water at speeds higher than towing conventional booms which means more oil is encountered for a given sweeping width.

Containment – Elastec's patent-pending design features a unique oil retention hull that retains the oil and expels water.

Recovery – Elastec's patented grooved discs are an evolution of the well-proven grooved drum design. The discs are exclusive to Elastec. They have one of the highest verified oil recovery rates (ORR) in the industry.* This is achieved through a larger surface area that traps the oil, allowing the discs to run faster than conventional smooth discs.

Tested speed - Stationary, Advancing 1-3 knots

Advancing results;

Oil Recovery Rate (Calm)	646 gpm / 146.8 cu.m per hour *
Recovery Efficiency	87.6%
Oil Recovery Rate (Wave)	551 gpm / 125 cu.m per hour
Recovery Efficiency	89.7%
Max Oil Recovery Rate	671.9 gpm / 152.7 cu.m per hour
Max Recovery Efficiency	95.3%
Max Throughput Efficiency	91.8%

Independent testing of the Elastec X150 skimmer, in advancing and stationery modes, was conducted at Ohmsett in May, 2012. Award-winning results from the XPRIZE Foundation's Wendy Schmidt Oil Cleanup X CHALLENGE were replicated at Ohmsett in the scalable, commercial X150 model.

*Nameplate capacity of the Elastec X150 skimmer has been recognized by the US Coast Guard.

Skimmer Specifications - 0SKIMUN153

Disc Nameplate capacity:	660 gpm / 150 cu.m per hour
Number of discs:	2 x 5 high speed Grooved Discs (10 discs total)
Boom connection / towing:	Pad eyes mounted inside the hull
Operational mode:	Advancing up to 3 knots
Dimensions (LxWxH):	108 x 59 x 55 inches / 2.74 x 1.50 x 1.4m
Weight:	1,341 lbs / 608kg
Construction:	Painted marine grade aluminum
Handling:	Fork pockets, lifting points.
Draft:	32 inches / 0.82m (operating)
Recovered oil pump:	High capacity salvage pump
Recovered oil pump capacity:	1,541 gpm @ 40 psi / 350 cu/m hour @ 3 bar
Pump casing:	Seawater resistant aluminum
Discharge connection:	6 inch / 150 mm with Camlock coupling.
Pump diameter:	490 mm
Debris management:	Included
Hydraulic hose:	60 m / 180 ft hydraulic hose set, rated to requirement.
Operational Mode:	Stationary and advancing from 0 to 4 knots.

The same system can be supplied with two variations of Recovery Capacity:

	180 m^3/h	200 m^3/h
Disc Nameplate capacity:	790 gpm / 180 cu.m per hour	880 gpm / 200 cu.m per hour
Weight:	1,383 lbs / 627kg	1,424 lbs / 646kg

Oil Boom Specifications - 01430150

Included with the system is Sweep boom with 200ft / 60 m of rugged air-inflatable oil boom, that incorporates the hydraulic and discharge hoses. This single point inflation boom chambers are fitted with foam panels that act as reserve buoyancy and integrated netting assists in retaining the sweep configuration. The boom is deployed from the remote controlled boom reel that incorporates an air blower. The boom chambers are fitted with foam panels that act as reserve buoyancy, integrated netting assists in retaining the sweep configuration.

Freeboard:	18 in / 46 cm
Draft:	10 in / 25 cm
Length:	200 ft / 60 m single inflatable chamber
Sweep Opening:	147 ft / 45 m
Bottom Tension:	½ in / 12 mm galvanized chain

Net for retaining sweep shape.
50 ft / 15 m hydraulic hoses (between power pack and sweep boom)
150 ft / 46 m discharge hose (from sweep boom)

Chamber fitted with foam panels that act as reserve buoyancy in the event of a puncture.

Elastec 1m BoomVane™ - 0VANEST10000

The setup comes with our 1m BoomVane™ enabling the skimmer with sweep boom to be towed by a single vessel. The BoomVane™ is powered by the water flowing past as the vessel advances, held by a single tow line it swings out and away from the vessel, towing the oil boom. The BoomVane™ is stable and self-trimming in all sweep speeds and is insensitive to wave action.

ELASTEC

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OIL TRAWL

QUALITY APPROVED		
Edition	Valid from	Revision date
5	2015	08.12.2015
Signature	HS	

NorLense

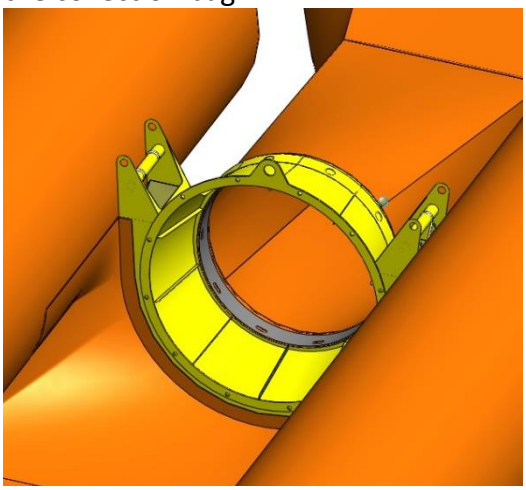
USERS MANUAL OIL TRAWL
NO-T-1000-S DAMEN

Table of content

GENERAL DESCRIPTION

NorLense **NO-T-1000-S** is a coast and offshore high speed oil spill containment system, designed for a significant wave height up to 2,5 m. The Oil Trawl is stored on a hydraulically driven winch, which simplifies and makes it safer to deploy and retrieve the Oil Trawl. Operated from land only one person is required to execute this operation. Operated from a ship, NorLense recommend two persons.

The Oil Trawl system consists of two 25 meters long oil boom arms with a diameter of 1000 mm and a skirt depth of 1200 mm narrowed in at the aft to a narrow area where a splitter is located. This splitter separates the uppermost layer of the surface, where the spilled oil is, from the rest of the water. The oil/water mixture is led into a collecting bag where the oil separates from the water by natural gravity, and the separated water is led out of the bag through an opening at the bottom. This collection bag is connected to the trawl by means of a specially designed “drop-coupling” with a female part on the trawl and the male part on the collection bag.



Drop coupling in yellow.

The Oil Trawl has automatic inflation of the freeboard when deployed. This is achieved by pre inflating a series of flotation elements located inside the freeboard. The flotation elements are interconnected with air hoses between the elements and a Y-piece hose at the aft end and both arms fills through one filling point. The air pressure required to make this work is 6 – 8 bar.
During deployment, these flotation elements will expand and the boom arms will inflate automatically during the time it takes to leave the storage drum until they hit the water. This makes deployment very fast and little resource demanding. One man does this job in less than 20 minutes.

The freeboard has no stiff longitudinal elements, this giving the trawl exceptional sea following properties, ensuring good oil recovery even under bad weather conditions.

The collection bag connects to the trawl by means of a “drop coupling”. A male part mounted at the forward end of the collection bag is dropped into the female part which is mounted at the aft end of the trawl itself and behind the splitter. The drop coupling can be connected and disconnected very easily.

The collection bag has a patented solution inside, making it possible to fill the bag with a layer of oil emulsion up to one meter without risking that the oil flows back into the trawl when towing stops.
The bag has a net storage volume of oil/emulsion of 10 m3.

The trawl on board the FCS 5005 vessels will be deployed over the stern.

Warning. The Oil Trawl must be retrieved over the top of the winch. Always!

CERTIFICATION

NorLense is certified according to ISO 9001:2015, ISO 14001:2015 and Achilles standards. The environmental and quality management systems are used as control tools in such way that NorLense is competitive in the market. NorLense is an environment-conscious company. ISO is an international organization for standardization. ISO 9001:2008 sets out the criteria for a quality management system. The standard is based on a number of quality management principles including a strong customer focus, the motivation and implication of top management, the process approach and continuous improvements. Internal audits are also a vital part.
In addition to being ISO certified, NorLense is Achilles certified. Achilles is a leading global provider of integrated supplier management and supply chain solutions. This contributes to reduce risks, costs and time, spent on procurement activities.

ENVIRONMENT

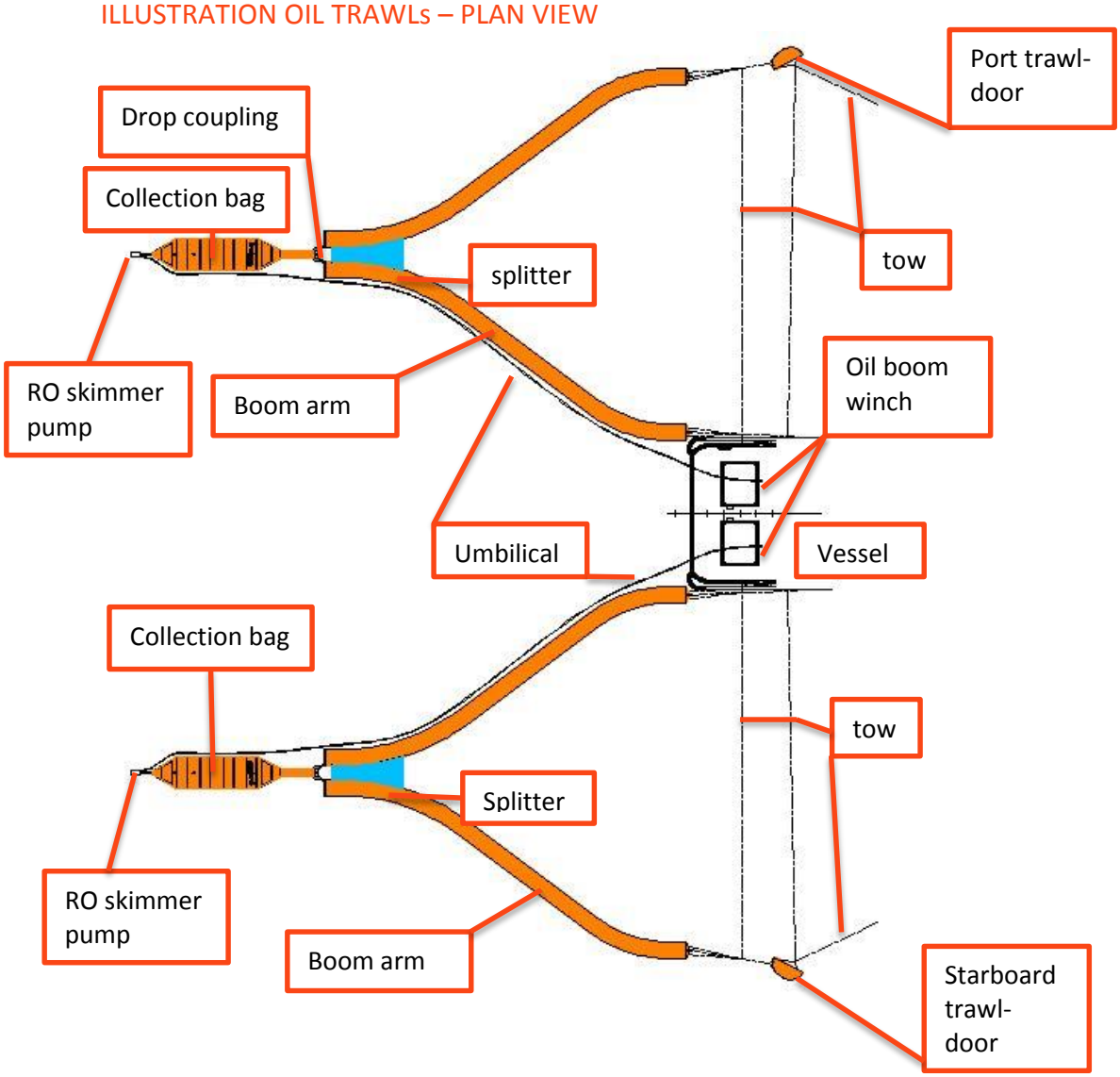
NorLense is certified according to ISO 14001 and NorLense have high standards for the environmental impact of our activities both externally and internally.
According to ISO 14001 NorLense are monitoring and controlling the aspects that may have a substantial environmental impact. Wrecked/defect oil booms are recycled as much as possible. The remains are classified as substantial environmental aspect under the ISO requirements, and NorLense treat this as special-category waste to the recycling station. Wrecked/defect oil booms can be returned to NorLense. If not, it is recommended to handle this to an approved recycling station as special category waste, so this can be correctly treated in relation to the environment.
Please contact NorLense for complementary information.

TECHNICAL SPECIFICATION

OIL TRAWL	NO-T-1000-S
	OPERATIONAL DATA
Wave height maximum	5,0 m
Wave height significant	2,5 m
Wind normal	18 m/s
Wind maximum	22 m/s
Towing speed maximum During recovery	<2 m/s (<4 knot)
Towing force minimum	20 kN
Towing force maximum	82 kN
	PHYSICAL DATA
Diameter freeboard	1000 mm
Length boom arms	25 m
Trawl opening	20 m
Skirt depth	1200mm
Ballast/main tension member	13x81 mm Galvanized steel chain
Weigth ballast	2,7 kg/m
Breaking strength chain	162 kN
Storage volume Trawl	10 m^3
Buoyancy/weigth ratio	39/1
Weigth boom arms	22 kg/m
	MATERIALS
Freeboard, skirt and splitter	1250 g/m^2 PVC-coated PE-fabric
Collection bag	1250 g/m^2 PVC/TPU-coated PE-fabric
Ballast/main tension member	Galvanized steel
Colour	Orange

Hydraulic oil system pressure	200 bar
Hydraulic oil brand / type	Mobil DTE 10 exel 46
Air system pressure	8 bar max
Weights:	
Winch complete with boom/oil bag/pump/hoses	2400kg
Empty winch	900kg

ILLUSTRATION OIL TRAWLs – PLAN VIEW



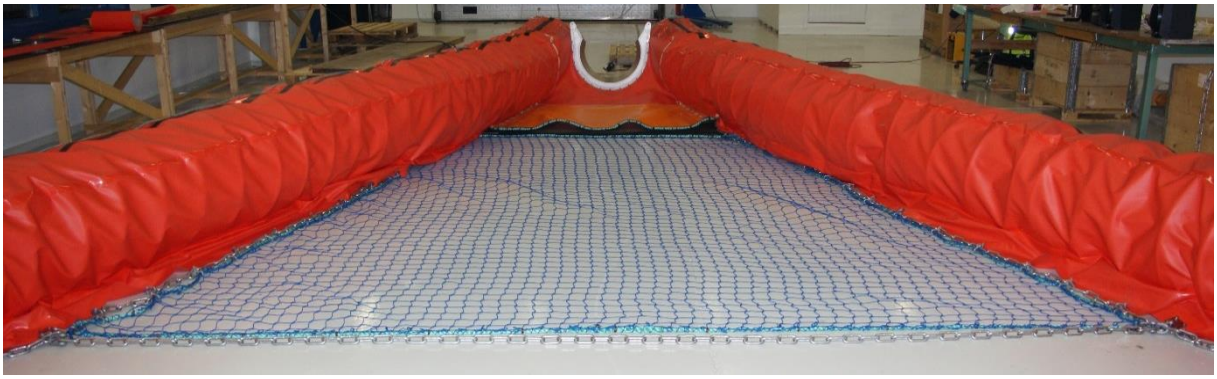
SPESIFICATION FABRIC

The boom is made from oil resistant pvc-coated PE-fabric. The base fabric is a 2x2 Panama PE –fabric coated with pvc on both sides.

Fabric	NO-T-1000-S
Weight	1250 g/m²
Coating	PVC
Breaking strength N/5cm	4000
Tear strength in N	500
Adhesion N/5cm	130
Cold resistance	-35 °C
Heat resistance	+70 °C Limited period of time
Colour	Orange
Skirt	1250 g/m²
Ballast chain	13 x 81 mm galvanized chain

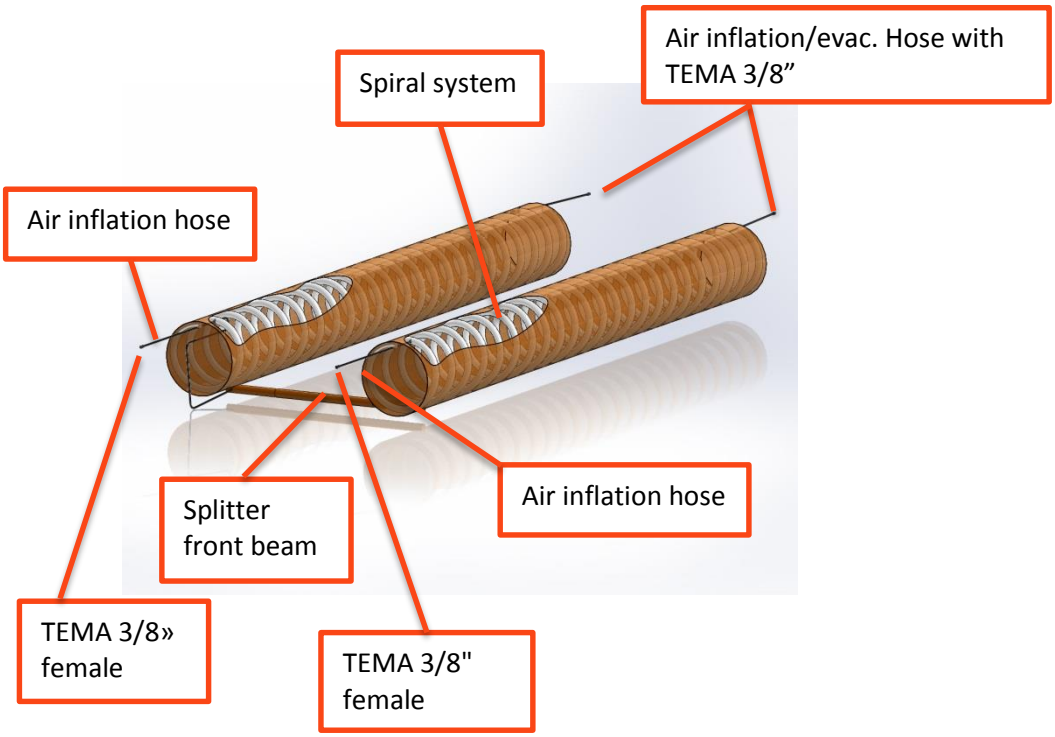
SPLITTER

At the aft end of the trawl arms, two horizontal net pieces are mounted. The purpose of these nets are to reduce turbulence and contribute to the separation process. The splitter is located behind these net pieces. The purpose of the splitter is to separate the uppermost layer where the oil is, from the rest of the water before entering the drop coupling area. Leading the oil/water mix into the collection bag and the rest of the water away from the drop coupling and the collection bag.



Fabric splitter	NO-T-1000-S
Weight	1250 g/m²
Coating	PVC
Breaking strength N/5 cm	4000
Tear strength N	500
Adhesion N/5 cm	130
Cold resistance	-35 °C
Heat resistance	+70 °C Limited period of time!
Colour	Orange
Net $_{coarse}$	155 mm mesh x 4 mm tread
Net $_{fine}$	11 mm mesh x 2 mm tread

SPIRALS



Inside the boom, flotation elements with expansion hoses are mounted and inflated through an air inflation hose. This hose runs through the whole length of each boom and is connected to the flotation elements. Inside the flotation elements a special woven hose is mounted as a spiral and act as distention elements. The spirals are pre inflated and this gives the Oil Trawl its automatic inflation properties.
Before retrieving the Oil Trawl these spirals must be emptied. This is done by inserting the vent plugs at the front some time before retrieval is started. When no air vents out of these plugs, they must be removed before spooling the boom on to the reel. When the aft end of the boom is reachable from the ship, the vent plug is inserted into the quick connection on the air hose, and the rest of the air is drained out of the booms.

Spirals	NO-T-1000-S 35 m
Spiral, distention element	Diameter 43 mm
Burst pressure	> 38 Bar
Working pressure	6-8 Bar
Cold resistance	-30 °C
Heat resistance	+70 °C Limited time!
Oil resistant	Yes

AIR INFLATION SYSTEM

The trawl arms have an air inflation system, which has to be pressurized before deployment can take place. The air quick connectors are located 2 at the front of the boom, and 1 at the aft end of the boom, close to the quick drop coupling. Air from the quick connector at the aft end is distributed into both boom arms via a Y-coupling.

CHAIN/BALLAST

The skirt has a galvanized chain mounted as ballast. The chain is also the main tension member in the construction.

Chain / Ballast	NO-T-1000-S
Material	Galvanized steel
Dimension	13 x 81 mm
Breaking strength	162 kN
Weight	2,7 kg/m

DROP COUPLING

The collection bag connects to the trawl by means of a “drop coupling”. A male part mounted at the forward end of the collection bag is dropped into the female part, mounted at the aft end of the trawl itself and behind the splitter. This can be connected and disconnected very easily and without having to deploy a small craft.

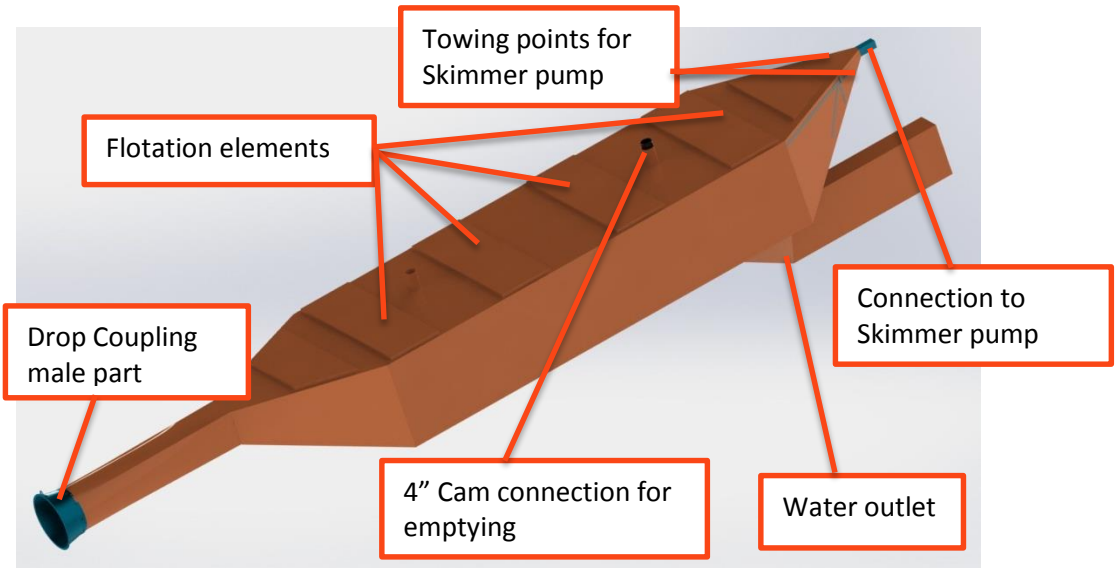
Drop Coupling	
Material	ANSI 316
Weight total	21 kg
Weight female part	12,5 kg
Weight male part	8,5 kg
Colour	Grey

COLLECTION BAG

After the water and the oil has passed the splitter, it enters the drop coupling and is led into the collection bag. Natural gravitation separates the oil and water mixture and leaves you with clean emulsion inside the bag as the water is led out of the bag through an opening at the bottom of the bag.
The collection bag has a patented solution inside, making it possible to fill the bag with a layer of oil emulsion up to one meter without risking that the oil flows back into the trawl when towing stops.
The bag has a net storage volume of oil/emulsion of 10 m^3.

Fabric	
Weight	1250 g/m^2
Coating	PVC/TPU
Breaking strength N/5cm	6500
Tear strength N	1100
Adhesion N/5 cm	160
Cold resistance	-35 °C
Heat resistance	+70 °C Limited time!
Colour	Orange

Bag	10 m^3		
Length	10 m		
With	2 m		
Depth	1 m		
Weight	100 Kg		

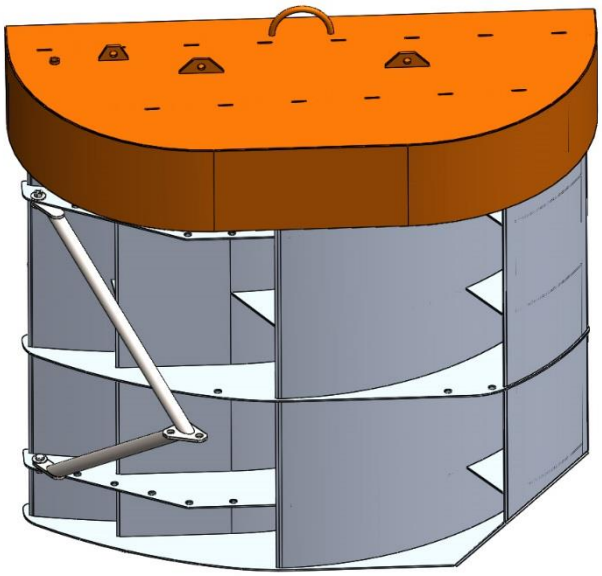


NB! The bag must not be lifted using the towing points!

REFLEX

As a standard, the Oil Trawl is delivered with a horizontal reflex at both sides of the ends and at the middle of the freeboard. More reflexes can be mounted according to customer requirements.

TRAWLDOOR TD MARINE



TD Trawl Door is a tool making it possible to tow the trawl system with only one vessel. The Trawl Door act as a rudder and pulls the outer boom away from the vessel, as far as the towing line, which is between the trawl door and the vessel, is allowed to go. At the front side, the painter line is connected, coming from the front side of the vessel, which tow the trawl door and the outer boom.
A light can be installed on the trawl door. The doors are marked SB and BB respectively. It is made from aluminum and withstands rugged use. The construction and choice of material simplifies maintenance. The trawl door can be delivered for both starboard and port use of the trawl.

OPERATION OF NO-T-1000-S

Prior to deployment, air supply to both spiral systems must be pre-charged before deployment. Air supply from air compressor must be on for at least 10-15 minutes until a pressure of 8 bar has been established. The compressed air will pressurize the spiral systems in both boom arms from outer- to inner end.

Attach flotation buoys to the connection point between the towline and the bridle. The reason for this is to prevent that shackles and G-hooks attached sink and could be tangled in the propeller. The same for the hydraulic hoses and the cargo hose.

When the trawl is correctly pre-charged and deployment starts and, the boom arms will expand and to circular shape as they leave the winch. During this process, the boom will fill itself with atmospheric air through an opening at the top of the freeboard.

Between the two booms outer end there a distance rope is installed for keeping the opening in correct position. In the center of this rope a splitlink is attached. This splilink is connected to a towrope connected to the drum pipe. This rope is used for safe deployment and retrieving of the system.

During operation, it is very important that the system has an even V-formation. Recommended length on towlines in open sea is approx. 55 m. This will be adjusted when the system is installed onboard and the tow ropes will be marked.

The trawl system is designed to recover oil in towing speed up to 5 knot through water, but the ideal speed is between 2-3 knots.

DEPLOYMENT

It is very important to have a good communication between the operators so that towing forces are as even as possible.

MAXIMUM SPEED DURING DEPLOYMENT SHOULD NOT EXCEED 2 KNOTS!

STEP BY STEP DEPLOYMENT

1. Remove cover from winch.

2. The trawl has one filling point located at the stern of the vessel. This filling point is divided by a Y-connector. Towards the booms there are two TEMA $^{3}/_{8}$" male quick connection, and the filling point has a TEMA ½'' male quick connection. Prepare towlines, bag and Trawl door. As previously mentioned pre-charging of the trawl takes 10-15 minutes.

3. Attach the sea anchor to the ropes at the aft end of the pump.

4. Unwind the bag so that the drop coupling for the bag is free. Check that the strap on top of the drop coupling secured correctly.

5. (Connect the male bag coupling to the female coupling between the guide arms. Because of the unique design, it will lock automatically. System is now ready for deployment.) **On your product, this is pre attached.**

6. Throw the sea anchor overboard. Vessel moves forward with about 1 knot. During deployment, check that the oil collection bag keeps a straight line behind the system. Continue to deploy until outer end of the bridles are free from the winch. Stop. Connect Trawl door and towlines. Connect hydraulic hoses from trawl to winch and cargo hose to tank connection. Continue deployment until tow forces are transferred to the towlines.



7. Deploy Trawl door and adjust system to correct position. The Trawl is now operational.
8. Stop HPU.

IMPORTANT! Protect fabric and equipment from sharp edges!

PROCEDURE DURING OIL RECOVERY OF OIL EMULSIONS WITH DIFFERENT VISCOSITIES

To determine what oil emulsion viscosity is when an oil recovery operation is in progress is not an easy task without taking samples of the emulsion and test it.
Thereby it is also a difficult task to determine what viscosity the emulsion inside the bag has. The only way to have a meaning about this is to have a “Weathering property scheme” for the oil in question where the boat is operating. Or, for several oils if the boat is covering more than one oilfield.

Water-in-oil (w/o) emulsions are generally more viscous than the parent crude oil, this is illustrated in Figure 3.2.

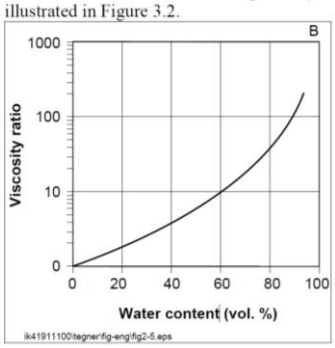
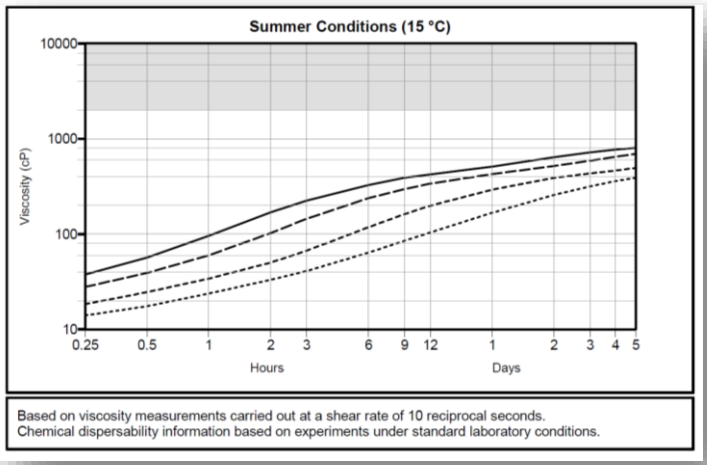


Figure 3.2 An example of the viscosity ratio as a function of increasing water content Mackay et al., 1980).

The example show how viscosity changes as water content in the oil change.



This example show how viscosity change depending on the amount of time the oil stays on the surface. This has to do with how much water is mixed into the oil forming the emulsion.

Different viscosity will to some extent influence on pumping from the bag, as the pump deliver more m^3/h at low viscosity than on high viscosity.
For training with the system, pure seawater is pumped and requires less pressure and flow than a real situation will. See table below.

As a guidance to pumping different viscosities the following settings for the control valve can be used:
The hydraulic system onboard must be adjusted to the skimmer pump that requires 235bar.
The maximum limit for the flow control valve is **235bar.**

PUMPING OIL AT 50.000 cST:

1. It takes approx. 20min to empty the 10m^3 oil bag when the oil is 50.000 cSt
2. When the oil bag is full with oil, the bag lift because of the difference in gravity on the two media, oil and seawater. The top will lift and become shaped as an arc. See image 1
3. Ensure that the flow control valve is on **235 bar**.
4. Start FRAMO R/O-pump and start water injection system at the same time. This procedure pumps the oil from the bag to the vessels tanks. Flow approx. 8m^3/h.

PUMPING OIL AT 35.000 cST:

1. I take approx. 17min to empty the 10m^3 oil bag when the oil is 35.000 cSt
2. When the oil bag is full with oil, the bag lift because of the difference in gravity on the two media, oil and seawater. The top will lift and become shaped as an arc. See image 1
3. Ensure that the flow control valve is on **235 bar.**
4. Start FRAMO R/O-pump and start water injection system at the same time. This procedure pumps the oil from the bag to the vessels tanks. Flow approx. 10m^3/h.

PUMPING OIL AT 25.000 cST:

1. It takes approx. 12min to empty the 10m^3 oil bag when the oil is 25.000 cSt
2. When the oil bag is full with oil, the bag lift because of the difference in gravity on the two media, oil and seawater. The top will lift and become shaped as an arc. See image 1
3. Ensure that the flow control valve is on **212 bar**.
4. Start FRAMO R/O-pump and start water injection system at the same time. This procedure pumps the oil from the bag to the vessels tanks. Flow approx. 15m^3/h.

IMAGE 1 – Bag filled with oil. Top of bag shaped as an arc.

PUMPING OIL AT 7.500 cST:

1. It takes approx. 10min to empty the 10m^3 oil bag when the oil is 7.500 cSt
2. When the oil bag is full with oil, the bag lift because of the difference in gravity on the two media, oil and seawater. The top will lift and become shaped as an arc. See image 1
3. Ensure that the flow control valve is on **165 bar.**
4. Start FRAMO R/O-pump and start water injection system at the same time. This procedure pumps the oil from the bag to the vessels tanks. Flow approx. 50m^3/h.

PUMPING OIL AT 4.500 cST:

1. It takes approx. 8min to empty the 10m^3 oil bag when the oil is 4.500 cSt
2. When the oil bag is full with oil, the bag lift because of the difference in gravity on the two media, oil and seawater. The top will lift and become shaped as an arc. See image 1
3. Ensure that the flow control valve is on **140 bar**.
4. Start FRAMO R/O-pump and start water injection system at the same time. This procedure pumps the oil from the bag to the vessels tanks. Flow approx. 80m^3/h.

PUMPING SEA WATER DURING EXERCISES

1. It takes approx. 10min with towing to fill the oil bag with seawater.
2. When the oil bag is full with seawater. The bag will now float at same height as sea level See image 2
3. Ensure that the flow control valve is on **100 bar.**
4. Start FRAMO R/O-pump. This procedure pumps the seawater from the bag to the vessel, from the vessel and overboard.

IMAGE 2 – Bag filled with seawater. Top of bag at sea level.

RETRIEVAL

Start the power pack. Slow speed to less than 1 knot through water. The center of the distance rope is always connected to the retrieval line on the winch during operation and towing of the Trawl. The Trawl is to be retrieved by this line and not the towlines. Start retrieval. When Trawl door is retrieved, disconnect, and store it. Locate the two air hoses in front on the guide booms. Insert male pipe into the female quick connectors on both lines. Evacuate air from both air hoses connected to the spiral system (this will take from 5-10 minutes). When the airflow stops from the ventilation pipes, disconnect them from the TEMA female quick connector on the hose ends. **This is important!** The Boom is now ready to be retrieved.

Continue retrieval until the outermost ends of the trawl arms is on deck. Insert ventilation pipes into the TEMA female connector; evacuate air from both air hoses. When the airflow stops, disconnect ventilation pipes and connect the Y-coupling to the spiral system. Continue retrieval. Mount the cover.

MAINTENANCE

The Oil Trawl should always be stored under a tarpaulin protecting the PVC/TPU-fabric against direct sunlight.

The Oil Trawl itself requires a minimum of maintenance, but there are some tests that ought to be done at regular basis to make sure the Oil Trawl operates properly the day it is required. All TEMA couplings on the boom shall be sprayed with WD 40 or similar product according to the maintenance form. Maintenance form and control scheme shall be used for periodical control.

An air tightness test should be run on a regular basis testing the spiral and the air filling system. This test can be done the following way without deploying the trawl:

1. Start filling Oil Trawl in the usual way; fill in 10-15 min. Air source should deliver approximately 8 bar.
2. Disconnect the air supply, and connect a manometer in order to read the pressure in the inflation system.
3. When the pressure is 8 bar, the first filling is finished.

The pressure inside the air supply system will now drop to some extent. This does not necessarily indicate a leakage, but can occur because of expansion of the spiral wound onto the drum. Refill the spiral system until the pressure reaches 8 bar.

After this second filling a drop in pressure during a period of 1/2 hour shall not exceed 0,5 bar. If so, this indicates a leakage in the system and necessary steps should be taken to locate and repair this leakage.

Detection of a leakage in the air supply system is done the following way:

The Oil Trawl is deployed in accordance to normal procedures. During deployment, one man visually inspects the Oil Trawl as it is deployed from the winch. If a leakage is observed, the area where the leakage is observed must be marked on the boom before further unwinding is done, this in order to open the Oil Trawl at the right point when retrieved.
If no leakage is heard or seen during deployment, the Oil Trawl has to be stretched out in its full length. Leave the air for the spiral supply system on after the oil trawl is fully deployed and listen well along trawl arms. When all damages are observed, just open the freeboard and repair the damage immediately.

INSPECTION OF OIL TRAWL

A visual control of the Oil Trawl exterior shall be accomplished every year. It is particularly important to inspect the Oil Trawl concerning mechanical tear or damage on the PVC-fabric. It is important that holes in the freeboard are repaired.

All snap links and couplings on hoses should be inspected at least once a year.
The Oil Trawl is to be opened at 2 or 3 randomly selected places and the spiral and air supply hose are to be inspected.

If any parts of the Oil Trawl have to be repaired or replaced with equipment from the spare parts, new material has to be ordered from NorLense AS in order to replace used material.

WASHING

If the Oil Trawl has been in contact with oil, it must be washed so that all remaining oil residues are removed.
Alkaline washing fluids which contain a mixture of several tensides, phosphates, silicates and 4,5% Potassium hydroxide mixed with 10 parts of water is the strongest concentration most commonly used.
Remark, however, that using washing fluids, containing the elements mentioned above, always requires thorough rinsing, using a lot of water.

NOTE: Water temperature shall not exceed 40 °C / 104 °F

Using an alkaline washing fluid mixed with water has a very little extracting effect on the softening agents in the PVC-fabric. Nevertheless, such fluids shall not be in contact with the PVC-coated fabric for a longer period of time. The material will then absorb smaller amounts of fluid which will not be rinsed away afterwards, and the PVC-material will stiffen.

High pressure rinsing of the fabric must be done with care. Do not hold the nozzle to close to the fabric. The best way is using lots of water at low pressure, from fire pump or similar source.

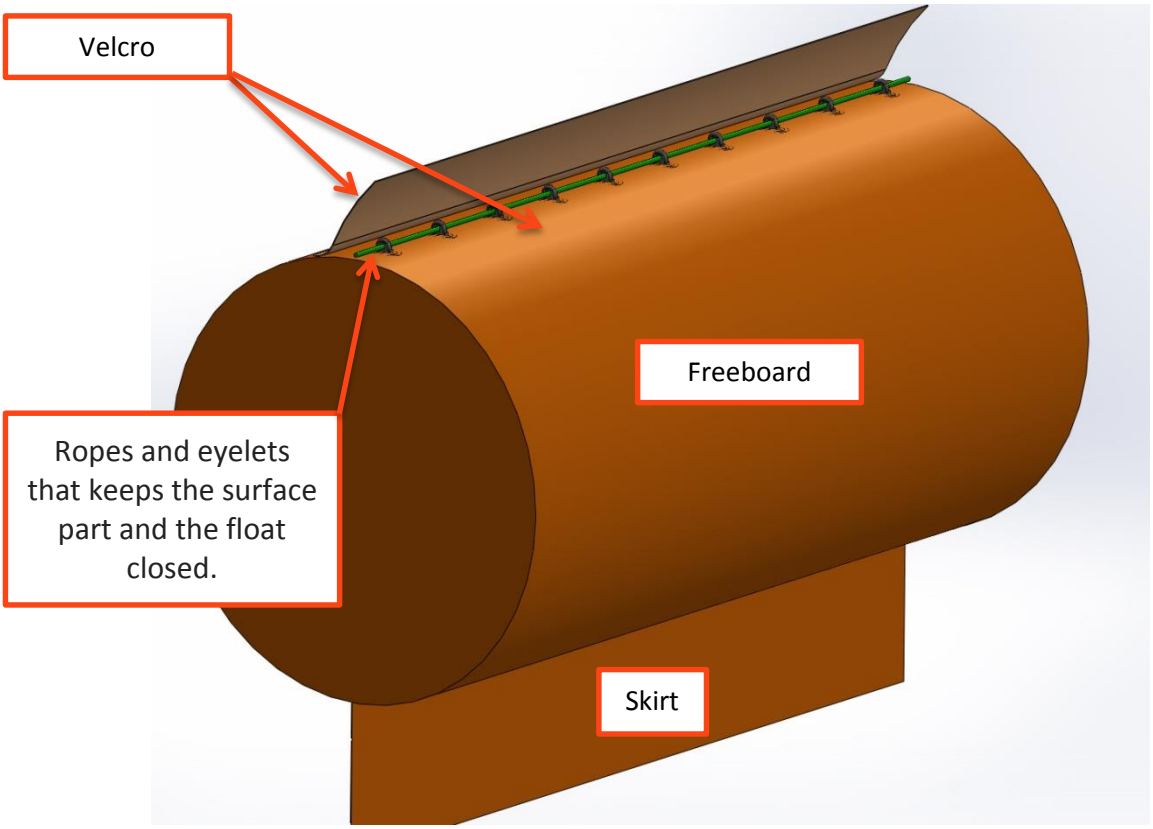
After cleaning, the boom shall be rinsed with seawater. This will prevent water remainders to rot inside the boom during storage. Always use salt water when cleaning. Fresh water contains algae that miscolour the fabric and also leaves a distinct smell.

First cleaning is normally done when the oil trawl is aft of the transom. Fine and final cleaning is normally done onshore.

HOW TO OPEN UP THE TRAWL ARMS

Under normal conditions, oil will not come oil into the freeboard. It is recommended that this is checked when the trawl has been in contact with oil. If there is oil inside, the boom must be opened and cleaned thoroughly.

Oil booms manufactured by NorLense have a closing system on top of the freeboard part. The freeboard consists of an outer layer with double closing flips on the top on one side, and a single flip on the other part. The closing flips are connected together using male eyelets on one side, reinforced holes on the second flip, and a rope locking these two flips together. See illustration.



To get access to the inside of the freeboard the following steps must be done:

1. Open Velcro and fold back the loose flip. Pull the rope, which is led through the eyelets, out of the eyelets. Be careful when doing so as pulling to hard or to fast may burn and damage the hole in the eyelet. Now the surface part is open.

2. Fold the fabrics apart. Now is the spiral available for inspection and cleaning. The freeboard is manufactured so that it can be folded out completely when all ropes are removed and the air system is removed. This makes cleaning the inside easier

MAINTENANCE FORM, PERIODIC SCHEDULE

COMPONENT	After use/ exercise	Every 2 weeks	Every 3 months	Every 6 months	Every 9 months	Annually
Oil Trawl in general	Vc + Cw		Pc	Vc		Cw
Hydraulic and air couplings between power pack and reel		Vc + Gr				
Oil Trawl reel	Gr + Vc			Gr + Vc		
Towing rope, bridles and buoys	Vc + Ma					
Training						

LETTER CODE	DESCRIPTION	ACTION	REFERENCE
Cp	Change of parts	If damaged or malfunctioning	Spare part list, boom page 30 User manual, reel
Vc	Visual control	Check for damage during deployment/retrieval of boom, hoses, tow lines and buoy. Check for malfunctioning/rust on valves and connectors.	Contact NorLense
Cw	Cleaning/washing	Follow Washing instructions	User manual, page 22
Gr	Grease	Grease nipples and clamps on reel when turned fully to port and starboard. Spray and test couplings.	Maintenance manual, reel User manual boom, page 21
T	Tighten	Hydraulic couplings and bolts on reel.	Maintenance manual reel
Ma	Maintenance	Follow Maintenance instructions.	User manual, page Contact NorLense for new spares
Oh	Overhaul	When errors, leaks or similar.	Contact NorLense
Pc	Pre-charging Oil Trawl (no deployment necessary)	Follow our Maintenance instructions.	User manual, page 21
Tr	Training	According to ship planning	

CONTROL SCHEME, PERIODIC

COMPONENT	LETTER CODE	DATE	COMMENT	DATE/SIGN.

STORAGE OF OIL TRAWL

Normal life expectancy of oil booms is approx. 10 years depending on use and handling of the equipment. This assuming all instructions are followed up correctly.

Before storage of the boom over a period of time it is important that it is clean inside and outside. If the boom only has been used during exercise and is dirty, is it enough to flush it with sea water before retrieving on winch. If the boom has been in contact with oil or other pollutions, it has to be thoroughly washed with fresh water and soap. Remember to flush with seawater afterwards! **Notice our washing instructions on page 22.**

When the boom is clean it **shall** be stored in an airy place and be protected from direct sunlight. Temperature shall not exceed +50 °C/-30 °C (+122°F/-22°F) during storage period.

- If the temperature exceeds +50 °C (+122°F) during storage, this will degrade the quality of the materials the boom system is made of. This reduces the life expectancy of the product.
- If the temperature falls below -30°C (-22°F) during storage, direct use of the boom without preheating it, can damage or weaken the components. The boom shall if possible, be preheated before use at extremely low temperatures. This is normally done by blowing hot air under the tarpaulin that cover the winch and boom. When temperatures are below zero degrees Celsius, always drain the air system for condensation and add ethylene glycol to prevent glaciation that could damage the air system. Ask NorLense for instructions for this.

NOTE: The OIL TRAWL is suitable for storage temperatures between +50 °C / -30 °C (+122°F/-22°F). If temperature is higher than + 50°C over a periode of time, this can affect the pvc-coated fabric and other parts in the boom.

FIELD REPAIR

Together with our products a spare part kit is delivered to do first hand and smaller repairs. In this box the required parts and tools are stored. See spare part list for your product on page 30.

The booms are produced in PVC or a PVC/TPU-coated Polyester fabric. PVC and PVC/TPU coated fabrics has the property that the coating melts when exposed to high temperatures. In the spare part box you will find a hand held hot air welding machine, a pressure roll for applying pressure on the weld, and some extra fabric that matches the product delivered.

The advantage of welding is that this is not depending on room temperature to make a repair. If the welding is done properly, the product will have the same strength as when newly made.

HOT AIR WELDING, STEP BY STEP

Step 1:
Open the repair kit box and take out the necessary equipment: Scissor, fabric, pressure roll and hot air welding machine.
Some rags and acetone are needed to clean the surface to be welded, and a brass wire brush to clean the nozzle of the welding machine when necessary.
The acetone you will not find in the repair kit due to shipping regulations.

Step 2:

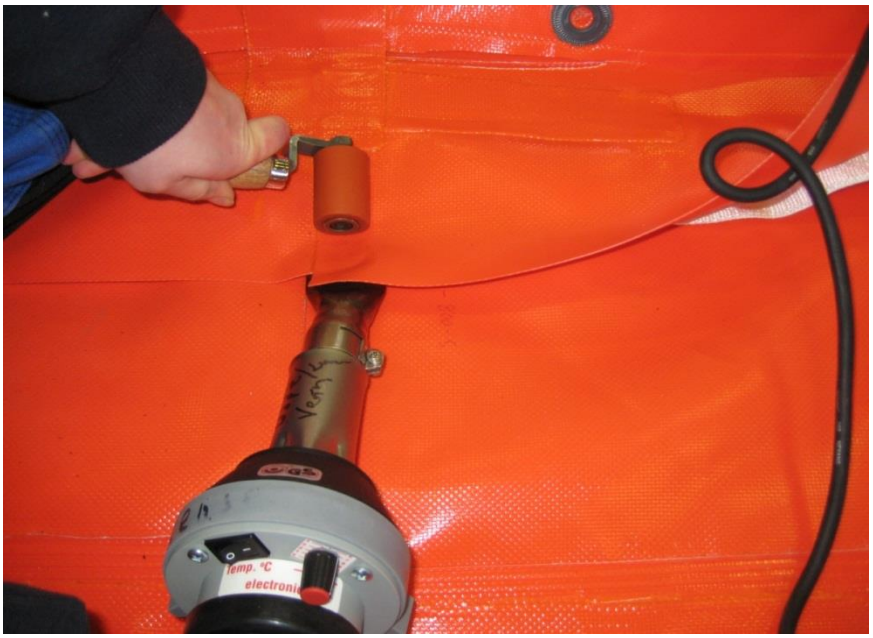
1. Wash and degrease the damaged area with cloth and Acetone.
2. The damaged area has to lie as flat as possible on a hard and even surface for easy and good welding.
3. Start the welding machine and set the thermostat to 7-8.
4. Wait a few seconds for it to obtain the right temperature.

Step 3:

1. Cut a proper piece of fabric. The new fabric has to cover and exceed the damaged area at least 40mm in every direction.
2. Centre the fabric on the damage, and put the pressure roll on top to hold it still.
3. Insert the nozzle of the welding machine between the two pieces of fabric.
4. When white smoke appears, start rolling as you slowly move the welding machine in the required direction.
5. After welding a few centimeters, lift top fabric to check. The layers shall have blended perfectly, and when torn apart one of the fabrics shall appear white without coating. Test on sample.

NOTE: It is of importance to find the right temperature and speed for good welding**. Practice on forehand!**

As visible on the pictures, there are several ways to hold the hot air welder and the pressure roll. When withdrawing the nozzle from the weld, too much sot on the nozzle means that the weld is no good. Brush the nozzle when it's turning black.



It is possible to weld both lengthwise and crosswise. Use method most suitable for the repair in question.

REPAIR KIT BOX CONTENTS

Article No.	Description	Quantity
700.400.001	Box	1 pc
700.000.231	Heytex fabric 1250 g/m² PVC	2,5 m²
700.000.070	Rope, 11m	2 pc
710.100.084	PVC-eyelets	10 pc
500.450.235	PVC-TIR Strap	11 m
200.200.202	Hot air welder, 220 V 50-60 Hz	1 pc
200.200.201	Pressure roll, 45 mm	1 pc
200.300.040	Knife, stainless steel	1 pc
200.200.056	Tape, pvc 38 mm	1 pc
200.300.041	Scissor	1 pc
200.350.111	Pressure gauge, complete	1pc
700.101.275	Enamel paint for reel, 1/3 box	1pc

CUSTOMISATION

NOTES

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To whom it may concern

Stronstad, 09nd of July 2021

NorLense Oil Trawl
RE – Recovery Efficiency

NorLense Oi Trawl

NorLense Oil Trawl **NO-T-1000-S** is an offshore high-speed oil spill recovery and containment system, designed for a significant wave height up to 2,5 m (maximum 5 m). The Oil Trawl is stored on a hydraulically driven winch, which simplifies and makes it safer to deploy and retrieve the Oil Trawl. It is designed to be deployed and towed by a single vessel and can be operated by only one person (single man operation).

The Oil Trawl system consists of two 30 meters long oil boom arms with a diameter of 1000 mm and a skirt depth of 500 mm narrowed in at the aft to a narrow area where a splitter is located. This splitter separates the uppermost layer of the surface, where the spilled oil is, from the rest of the water. The oil/water mixture is led into a collecting bag where the oil separates from the water by natural gravity, and the separated water is led out of the bag through an opening at the bottom. This collection bag is connected to the trawl by the means of a flexible coupling that can be disconnected.

The Oil Trawl has automatic inflation of the freeboard when deployed. This is achieved by pre inflating a series of flotation elements located inside the freeboard. The flotation elements are interconnected with air hoses between the elements and a Y-piece hose at the aft end and both arms fills through one filling point. The air pressure required to make this work is 6 – 8 bar.

During deployment, these flotation elements will expand and the boom arms will inflate automatically during the time it takes to leave the storage drum until they hit the water. This makes deployment very fast and little resource demanding. One man does this job in less than 20 minutes.

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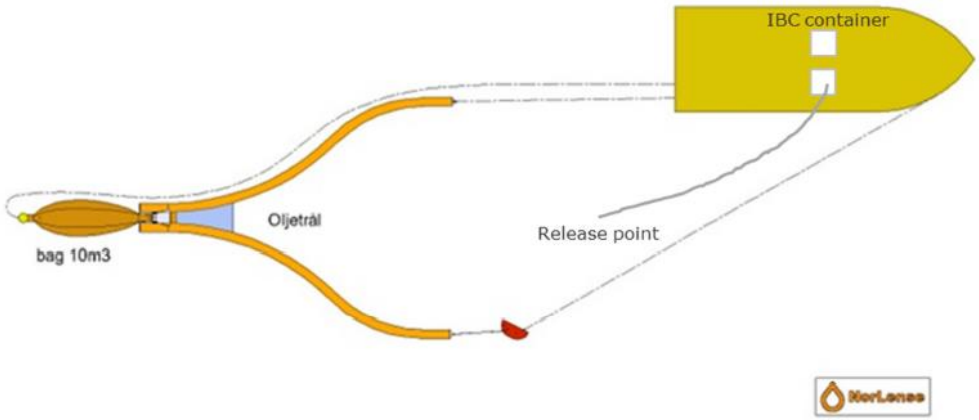

Figure 1: Schematic drawing of oil trawl operation (DNV-GL).

The freeboard has no stiff longitudinal elements, this giving the trawl exceptional sea following properties, ensuring good oil recovery even under bad weather conditions. The collection bag connects to the trawl by means of a flexible coupling integrated in the trawl and the bag.

The collection bag has a patented solution inside, making it possible to fill the bag with a layer of oil emulsion up to one meter without risking that the oil flows back into the trawl when towing stops. The bag has a net storage volume of oil/emulsion of 10 m3. Maximum towing speed is **5 knots**. The Oil Trawl can capture and contain oil viscosity from **1 – 1 000 000 cP**.

The system is designed for numerous of exercises and incidents. The simplicity of deploying, towing and retrieving the system enhances safety for operator significantly. There is no need for any crew to be in contact with the system when it comes out of and goes back to the storage reel. User's Manual can be found in **Attachment I**.

Figure 2: Oil trawl being operated by the Norwegian Coast Guard in an exercise.

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Throughput Efficiency [%]:

As defined in ERSP calculator User Manual (2016), from **BSEE** (Bureau of Safety and Environmental Enforcement), "**Throughput Efficiency (TE)** is the percentage of oil/emulsion taken onboard, out of the total volume of oil/emulsion encountered. It is a measure of the effectiveness of the containment component of the skimming system and its ability to prevent entrainment or loss of the oil encountered."

The **TE** of a skimming system can be specified using the results of testing done under ASTM F631-99 as per Paragraphs 3.1.13 and 13.2.22 (as the average value of TE in all individual tests performed).

The system has shown an average **throughput efficiency of 82%** when testing in Ohmsett, Nem Jersey. The detailed information and certification can be verified in **Attachment II – Ohmsett – Performance efficiency test Oil trawl**.

It has also been tested by NorLense and verified by DNV-GL (**Attachment III**).

RE – Recovery Efficiency

As defined in ERSP calculator User Manual (2016), from **BSEE** (Bureau of Safety and Environmental Enforcement), "**Recovery Efficiency** is a measure of the amount of oil/emulsion recovered compared to the total fluids recovered, expressed as a percentage. ASTM F1780-97 explains that a skimmer will recover free water along with the recovered oil, and that the amount of free water recovered is a measure of the efficiency of the skimmer system." In other words: How much of the originally emulsion of oil was recovered without the addition of free water.

According to ASTM International, the ASTM F2709-08 test method "defines a method and measurement criteria to quantify the nameplate recovery rate (capacity) of a stationary skimmer system in ideal conditions. If a determination of a skimmer's capabilities in realistic conditions (that is, advancing or waves) is required, testing should be performed according to Guide F 631 or equivalent". . RE as defined in the F 631-99 includes emulsions in estimating the amount of the oil slick recovered and can be calculated as described next:

$$RE = \frac{V_{oil}}{V_{total\ fluid}} \times 100 \qquad \textbf{Equation (1)}$$

As analogy, is possible to deduce that the percentage of water recovered per unit of measure, which can be calculated as described next:

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Water Recovered per unit of measure (WR) = $\frac{V_{water}}{V_{total\ fluid}} \times 100$

Equation (2)

Before going any further, is very important to clarify what is being considered was "**water**" in the equation (2) above.

BS&W

According to the Oil Field Glossary, from **Schlumberger**, BS&W is an "abbreviation for basic sediment and water. It includes free water, sediment, and emulsion and is measured as a volume percentage of the production stream".

Thus, the volume of water that is considered in equation (2) includes not only free water, but also emulsion.

Keeping that in mind, it is possible to attest that the sum of percentages of the originally oil (**Recovery Efficiency**) and free water plus emulsion recovered (water recovered per unit of measure) should be equal to 100%, reaching the equation described bellow:

RE + WR = 100%

RE = 100% - WR **Equation (3)**

This logical memorial of formulas were the one used to calculate the Recovery Efficiency of Oil Trawl during the tests presented in this document.

Ohmsett Tests – Recovery Efficiency Results

Tests in Ohmsett in 2013 were done with 2 different types of oil emulsion:

Sundex 790 with a viscosity of **8000 cP**.

Hydrocal 300 with a viscosity of **200 – 300 cP**.

A total of **38 tests** were done with the oil trawl in the test tank during the test period in calm and sinusoidal wave conditions and with a range of towing speed varying from 1.5 to 3.0 knots.

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The average water content in the spilled oil was 8,5% for the **Sundex 790** samples. Six samples were taken before release into the test tank: (10% + 10% + 8% + 9% + 7% + 7%)/6 = 8,5% (**Attachment IV: Main Bridge Pretest Oil Analysis**).

After 17 runs; **Attachment V**, column 1, test #4-20, in the test tank with **Sundex 790**, the water content and respective **WR** and **RE**, calculated by the **equations (2) and (3)**, can be found next (data can found in **Attachment VI**).

Type of Oil	Average of water before the tests (%)	Samples	Tube #	Water after the tests (%)	WR (%)	RE (%)
Sundex 790	8,5	551-06	5	27	18,5	81,5
Sundex 790	8,5	551-06	4	26	17,5	82,5
Sundex 790	8,5	551-08	9	25	16,5	83,5
Sundex 790	8,5	551-12	8	25	16,5	83,5
Sundex 790	8,5	551-29	8	25	16,5	83,5
Sundex 790	8,5	551-29	9	25	16,5	83,5
Sundex 790	8,5	551-07	6	24	15,5	84,5
Sundex 790	8,5	551-07	7	24	15,5	84,5
Sundex 790	8,5	551-08	8	24	15,5	84,5
Sundex 790	8,5	551-12	9	24	15,5	84,5
Sundex 790	8,5	551-26	7	24	15,5	84,5
Sundex 790	8,5	551-14	9	23	14,5	85,5
Sundex 790	8,5	551-26	6	23	14,5	85,5
Sundex 790	8,5	551-27	8	23	14,5	85,5
Sundex 790	8,5	551-36	1	23	14,5	85,5
Sundex 790	8,5	551-40	23	23	14,5	85,5
Sundex 790	8,5	551-09	3	22	13,5	86,5
Sundex 790	8,5	551-36	3	22	13,5	86,5
Sundex 790	8,5	551-37	5	22	13,5	86,5
Sundex 790	8,5	551-09	1	21	12,5	87,5
Sundex 790	8,5	551-14	8	21	12,5	87,5
Sundex 790	8,5	551-24A	3	21	12,5	87,5
Sundex 790	8,5	551-27	9	21	12,5	87,5
Sundex 790	8,5	551-37	4	21	12,5	87,5
Sundex 790	8,5	551-43	21	21	12,5	87,5
Sundex 790	8,5	551-49	21	21	12,5	87,5
Sundex 790	8,5	551-50	21	21	12,5	87,5
Sundex 790	8,5	551-50	21	21	12,5	87,5
Sundex 790	8,5	551-01	6	20	11,5	88,5
Sundex 790	8,5	551-01	7	20	11,5	88,5
Sundex 790	8,5	551-04	4	20	11,5	88,5
Sundex 790	8,5	551-04	5	20	11,5	88,5
Sundex 790	8,5	551-05	1	20	11,5	88,5

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Type of Oil	Average of water before the tests (%)	Samples	Tube #	Water after the tests (%)	WR (%)	RE (%)
Sundex 790	8,5	551-05	3	20	11,5	88,5
Sundex 790	8,5	551-13	6	20	11,5	88,5
Sundex 790	8,5	551-25	4	20	11,5	88,5
Sundex 790	8,5	551-25	5	20	11,5	88,5
Sundex 790	8,5	551-25A	4	20	11,5	88,5
Sundex 790	8,5	551-28	1	20	11,5	88,5
Sundex 790	8,5	551-28	3	20	11,5	88,5
Sundex 790	8,5	551-32	4	20	11,5	88,5
Sundex 790	8,5	551-33	4	20	11,5	88,5
Sundex 790	8,5	551-35	8	20	11,5	88,5
Sundex 790	8,5	551-38	20	20	11,5	88,5
Sundex 790	8,5	551-40	20	20	11,5	88,5
Sundex 790	8,5	551-42	20	20	11,5	88,5
Sundex 790	8,5	551-03	1	19	10,5	89,5
Sundex 790	8,5	551-11	6	19	10,5	89,5
Sundex 790	8,5	551-13	7	19	10,5	89,5
Sundex 790	8,5	551-24A	1	19	10,5	89,5
Sundex 790	8,5	551-25A	5	19	10,5	89,5
Sundex 790	8,5	551-39	19	19	10,5	89,5
Sundex 790	8,5	551-42	19	19	10,5	89,5
Sundex 790	8,5	551-43	19	19	10,5	89,5
Sundex 790	8,5	551-49	19	19	10,5	89,5
Sundex 790	8,5	551-10	4	18	9,5	90,5
Sundex 790	8,5	551-11	7	18	9,5	90,5
Sundex 790	8,5	551-33	5	18	9,5	90,5
Sundex 790	8,5	551-34	6	18	9,5	90,5
Sundex 790	8,5	551-35	9	18	9,5	90,5
Sundex 790	8,5	551-38	18	18	9,5	90,5
Sundex 790	8,5	551-41	18	18	9,5	90,5
Sundex 790	8,5	551-41	18	18	9,5	90,5
Sundex 790	8,5	551-46	18	18	9,5	90,5
Sundex 790	8,5	551-03	3	17	8,5	91,5
Sundex 790	8,5	551-15	3	17	8,5	91,5
Sundex 790	8,5	551-24	1	17	8,5	91,5
Sundex 790	8,5	551-24	3	17	8,5	91,5
Sundex 790	8,5	551-34	7	17	8,5	91,5
Sundex 790	8,5	551-39	17	17	8,5	91,5
Sundex 790	8,5	551-46	17	17	8,5	91,5
Sundex 790	8,5	551-02	9	16	7,5	92,5
Sundex 790	8,5	551-10	5	16	7,5	92,5
Sundex 790	8,5	551-15	1	16	7,5	92,5

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Type of Oil	Average of water before the tests (%)	Samples	Tube #	Water after the tests (%)	WR (%)	RE (%)
Sundex 790	8,5	551-17	7	16	7,5	92,5
Sundex 790	8,5	551-18	8	16	7,5	92,5
Sundex 790	8,5	551-18	9	16	7,5	92,5
Sundex 790	8,5	551-20	3	16	7,5	92,5
Sundex 790	8,5	551-21	4	16	7,5	92,5
Sundex 790	8,5	551-21	5	16	7,5	92,5
Sundex 790	8,5	551-48	16	16	7,5	92,5
Sundex 790	8,5	551-48	16	16	7,5	92,5
Sundex 790	8,5	551-02	8	15	6,5	93,5
Sundex 790	8,5	551-16	4	15	6,5	93,5
Sundex 790	8,5	551-16	5	15	6,5	93,5
Sundex 790	8,5	551-17	6	15	6,5	93,5
Sundex 790	8,5	551-31	1	15	6,5	93,5
Sundex 790	8,5	551-31	3	15	6,5	93,5
Sundex 790	8,5	552-32	5	15	6,5	93,5
Sundex 790	8,5	551-45	15	15	6,5	93,5
Sundex 790	8,5	551-45	15	15	6,5	93,5
Sundex 790	8,5	551-20	1	14	5,5	94,5
Sundex 790	8,5	551-30	6	14	5,5	94,5
Sundex 790	8,5	551-47	14	14	5,5	94,5
Sundex 790	8,5	551-44	13	13	4,5	95,5
Sundex 790	8,5	551-44	13	13	4,5	95,5
Sundex 790	8,5	551-47	13	13	4,5	95,5
Sundex 790	8,5	551-30	7	12	3,5	96,5
					RE minimum:	**81,50**
					RE average	**89,53**

The average water content in the spilled oil was 1,70% for the **Hydrocal 300** samples. Four samples were taken before release into the test tank: (1,8% + 1,5% + 1,5% + 2%)/4 = 1,70% (**Attachment IV: Main Bridge Pretest Oil Analysis**).

After 18 test runs in the tank with **Hydrocal 300** the water content and respective **WR** and **RE**, calculated by the **equations (2) and (3)**, can be found next (data can found in **Attachment VI**).

Type of Oil	Average of water before the tests (%)	Samples	Tube #	Water after the tests (%)	WR (%)	RE (%)
Hydrocal 300	1,7	551-117	1	37	35,3	64,7
Hydrocal 300	1,7	551-117	3	37	35,3	64,7

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Type of Oil	Average of water before the tests (%)	Samples	Tube #	Water after the tests (%)	WR (%)	RE (%)
Hydrocal 300	1,7	551-115	3	33	31,3	68,7
Hydrocal 300	1,7	551-115	1	30	28,3	71,7
Hydrocal 300	1,7	551-116	6	28	26,3	73,7
Hydrocal 300	1,7	551-116	7	28	26,3	73,7
Hydrocal 300	1,7	551-70	3	25	23,3	76,7
Hydrocal 300	1,7	551-71	4	25	23,3	76,7
Hydrocal 300	1,7	551-71	5	25	23,3	76,7
Hydrocal 300	1,7	551-70	1	24	22,3	77,7
Hydrocal 300	1,7	551-69	8	23	21,3	78,7
Hydrocal 300	1,7	551-54	1	22	20,3	79,7
Hydrocal 300	1,7	551-65	14	22	20,3	79,7
Hydrocal 300	1,7	551-54	3	21	19,3	80,7
Hydrocal 300	1,7	551-67	5	21	19,3	80,7
Hydrocal 300	1,7	551-68	7	21	19,3	80,7
Hydrocal 300	1,7	551-65	15	20	18,3	81,7
Hydrocal 300	1,7	551-67	4	20	18,3	81,7
Hydrocal 300	1,7	551-69	9	20	18,3	81,7
Hydrocal 300	1,7	552-72	11	20	18,3	81,7
Hydrocal 300	1,7	552-72	12	20	18,3	81,7
Hydrocal 300	1,7	551-50A	1	19	17,3	82,7
Hydrocal 300	1,7	551-50A	3	19	17,3	82,7
Hydrocal 300	1,7	551-52	6	19	17,3	82,7
Hydrocal 300	1,7	551-52	7	19	17,3	82,7
Hydrocal 300	1,7	551-68	6	19	17,3	82,7
Hydrocal 300	1,7	551TB53-58	5	19	17,3	82,7
Hydrocal 300	1,7	551-51	4	18	16,3	83,7
Hydrocal 300	1,7	551-51	5	18	16,3	83,7
Hydrocal 300	1,7	551-53	8	18	16,3	83,7
Hydrocal 300	1,7	551-64	11	18	16,3	83,7
Hydrocal 300	1,7	551-64	12	18	16,3	83,7
Hydrocal 300	1,7	551TB59-64	11	18	16,3	83,7
Hydrocal 300	1,7	551TB59-64	12	18	16,3	83,7
Hydrocal 300	1,7	551-53	9	17	15,3	84,7
Hydrocal 300	1,7	551-66	1	17	15,3	84,7
Hydrocal 300	1,7	551-66	3	17	15,3	84,7
Hydrocal 300	1,7	551-73	14	17	15,3	84,7
Hydrocal 300	1,7	551-77	3	17	15,3	84,7

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Type of Oil	Average of water before the tests (%)	Samples	Tube #	Water after the tests (%)	WR (%)	RE (%)
Hydrocal 300	1,7	551-59	15	16	14,3	85,7
Hydrocal 300	1,7	551-74	7	16	14,3	85,7
Hydrocal 300	1,7	551-77	1	16	14,3	85,7
Hydrocal 300	1,7	551TB53-58	4	16	14,3	85,7
Hydrocal 300	1,7	551-59	14	15	13,3	86,7
Hydrocal 300	1,7	551-60	1	15	13,3	86,7
Hydrocal 300	1,7	551-62	6	15	13,3	86,7
Hydrocal 300	1,7	551-62	7	15	13,3	86,7
Hydrocal 300	1,7	551-63	8	15	13,3	86,7
Hydrocal 300	1,7	551-73	15	15	13,3	86,7
Hydrocal 300	1,7	551-76	8	15	13,3	86,7
Hydrocal 300	1,7	551-76	9	15	13,3	86,7
Hydrocal 300	1,7	551-55	4	14	12,3	87,7
Hydrocal 300	1,7	551-55	5	14	12,3	87,7
Hydrocal 300	1,7	551-60	3	14	12,3	87,7
Hydrocal 300	1,7	551-113	6	14	12,3	87,7
Hydrocal 300	1,7	551-113	7	14	12,3	87,7
Hydrocal 300	1,7	551-61	4	13	11,3	88,7
Hydrocal 300	1,7	551-61	5	13	11,3	88,7
Hydrocal 300	1,7	551-74	6	13	11,3	88,7
Hydrocal 300	1,7	551-58	12	12	10,3	89,7
Hydrocal 300	1,7	551-63	9	12	10,3	89,7
Hydrocal 300	1,7	551-112	4	12	10,3	89,7
Hydrocal 300	1,7	551-114	8	12	10,3	89,7
Hydrocal 300	1,7	551-114	9	12	10,3	89,7
Hydrocal 300	1,7	551-58	11	11	9,3	90,7
Hydrocal 300	1,7	551TB65-76	14	11	9,3	90,7
Hydrocal 300	1,7	551TB65-76	15	11	9,3	90,7
Hydrocal 300	1,7	551-112	5	11	9,3	90,7
Hydrocal 300	1,7	551-97	7	7	5,3	94,7
Hydrocal 300	1,7	551-95	5	6	4,3	95,7
Hydrocal 300	1,7	551-96	1	6	4,3	95,7
Hydrocal 300	1,7	551-96	3	6	4,3	95,7
Hydrocal 300	1,7	551-97	6	6	4,3	95,7
Hydrocal 300	1,7	551-95	4	5,5	3,8	96,2
Hydrocal 300	1,7	551-57	8	5	3,3	96,7
Hydrocal 300	1,7	551-57	9	5	3,3	96,7

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Type of Oil	Average of water before the tests (%)	Samples	Tube #	Water after the tests (%)	WR (%)	RE (%)
Hydrocal 300	1,7	551-92	7	5	3,3	96,7
Hydrocal 300	1,7	551-93	9	5	3,3	96,7
Hydrocal 300	1,7	551-93	8	4,5	2,8	97,2
Hydrocal 300	1,7	551-119	14	4,5	2,8	97,2
Hydrocal 300	1,7	551-119	15	4,5	2,8	97,2
Hydrocal 300	1,7	551-92	6	4	2,3	97,7
Hydrocal 300	1,7	551-118	11	3,5	1,8	98,2
Hydrocal 300	1,7	551-118	12	3,5	1,8	98,2
Hydrocal 300	1,7	551-56	6	3,2	1,5	98,5
Hydrocal 300	1,7	551-56	7	3,2	1,5	98,5
Hydrocal 300	1,7	551-94	3	3	1,3	98,7
Hydrocal 300	1,7	551-94	1	2,5	0,8	99,2
					RE minimum:	**64,70**
					RE average:	**86,51**

Tests performed with the equipment at the OHMSETT (2013) indicated percentages for system **Recovery Efficiency** ranging from 64,7% (minimum) to 99,2% (maximum) for Hydrocal 300 and ranging from 81,50% (minimum) to 96,50% (maximum) for Sundex 790. The respective averages are 86,51% for Hydrocal 300 and 89,53% for Sundex 790.

For the purpose of defining the standard **Recovery Efficiency** for oil trawl system, only the average and minimum values were considered to calculate **RE.** The intention was to define a very conservative value.

Thus, average RE minimum and RE average for the two different tests for the NorLense Oil Trawl:

RE minimum: (81,50 + 64,70)/2 = **73,10%**

RE average: (89,53 + 86,51)/2 = **88,02%**

Areal Coverage Rate (ACR)

As defined in ERSP calculator User Manual (2016), from **BSEE** (Bureau of Safety and Environmental Enforcement), "**Areal Coverage Rate** is the rate at which the skimming

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system *sweeps the oil slick* in units of square meters per second. It is a function of Speed and Swath".

ACR = Swath x System speed **Equation (4)**

Encounter Rate (ER)

As defined in ERSP calculator User Manual (2016), from **BSEE** (Bureau of Safety and Environmental Enforcement), "**Encounter Rate** is the rate at which oil/emulsion is encountered by the skimming system and is a function of the oil slick Thickness, the Speed of the skimming system, and the Swath".

ER = ACR x oil slick thickness **Equation (5)**

Oil Trawl system openness measurement is about 30 m. In the case of Conventional Settings, this measurement is calculated from the extent of the boom. Thus, considering the "U" formation as a semicircle, and its perimeter as the total length of the boom (200 m), the diameter (corresponding to the system opening measurement) would be equivalent to 127 m. As the formation is asymmetric, 5% of this value was discounted, resulting in 120 m of opening.

In order to allow the calculation of the **ACR** value (required for oil enclosure capacity analysis), Table next shows the Opening and Speed values for each containment and recovery system.

System	Swath	Resulting Speed
Conventional System	120	1 knot – 0,514 m/s
Oil Trawl	30	5 knots – 2,572 m/s

Thus, the following maximum **ER** values are obtained:

Conventional System

$$ER = 120\ x\ 0{,}514\ x\ oil\ slick\ thickness$$
$$\boldsymbol{ER = 61{,}68\ x\ oil\ slick\ thickness}$$

Oil Trawl

$$ER = 30\ x\ 2{,}572\ x\ oil\ slick\ thickness$$
$$\boldsymbol{ER = 77{,}16\ x\ oil\ slick\ thickness}$$

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Based on the above values, the Encounter Rate (ER) results showed that the Oil Trawl Configuration has about **25% more oil enclosure capacity** than the Conventional Configuration, utilizing a 200 m containment boom and the and the maximum swepping speeds.

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Managing Director

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Attachment II

EXECUTIVE SUMMARY

Ohmsett
Oil Spill Response Research & Renewable Energy Facility

EVALUATION of the NORLENSE AS PROTOTYPE OILTRAWL SYSTEM

During the weeks of 5/28/2013 and 6/3/2013 Norlense AS, a Norwegian based company performed efficiency testing of their updated advancing oiltrawl system. During previous testing in June 2012, ideas were generated to improve the system performance and for scalability for testing within the Ohmsett test basin. The primary objective of these test were to quantify the recovery throughput efficiency values of the system while encountering a consistent slick thickness at varying speeds in calm and wave conditions.

The Norlense Oil Trawl is designed as a fast water system and is primarily designed to recover patches and thin oil slicks over large areas. The oil trawl is a passive system and now includes elongating boom legs. This is a new design that allows air to escape from vents when compressed for example between two ship hulls preventing damage and will then re-expand to provide its original buoyancy. The collection bag conical coupling design allows for rapid interchangeability and internal baffle prevents loss of collected product when not advancing. The system collects at 1 to 10 m3 /hour and has a capacity of 10 cubic meters.

Each test was performed by accelerating the oiltrawl to the test speed in which it encountered a consistent slick thickness of approximately 5.8mm. Oil distribution was started and ended such that the system encountered the slick at test speed. Oil distribution was performed such that the system encountered 100% of the oil slick. Each test was comprised of two passes in the test basin. At the conclusion of the two passes, oil which escaped the system was collected from the surface into the Ohmsett recovery tanks and quantified. Efficiency values were determined by using the known volume distributed minus volume lost/vol dist = %eff.

The first 7 tests (14 passes) were performed using Sundex 790 (nominal viscosity 8000cps) and were performed at speeds of 1.5 to 3.0 knots in both calm and sinusoidal wave conditions. An additional series of 9 tests were performed using Hydrocal 300 oil (nominal viscosity 200cps) at speeds of 1.5 to 3.0 knots in both calm and sin wave conditions. Tests, also included runs in which double and triple distribution rates were encountered to quantify the effects on throughput efficiency.

The test results and calculations are provided within the data spreadsheet. Reviewing the data – it appears that within the range of test parameters tested, there were minimal detrimental effects to performance yielding throughput efficiency values of approximately 70% and greater. For all tests, including both oil types and surface conditions, the average throughput efficiency is 82.2%. The range of parameters only affected the performance +/- 10% from the average with a minimum T.E. of 69.2% at 3 knots with Hydrocal test oil to a maximum T.E. of 92% when encountering Sundex 790 at 2.0 knots.

Ohmsett Test Director

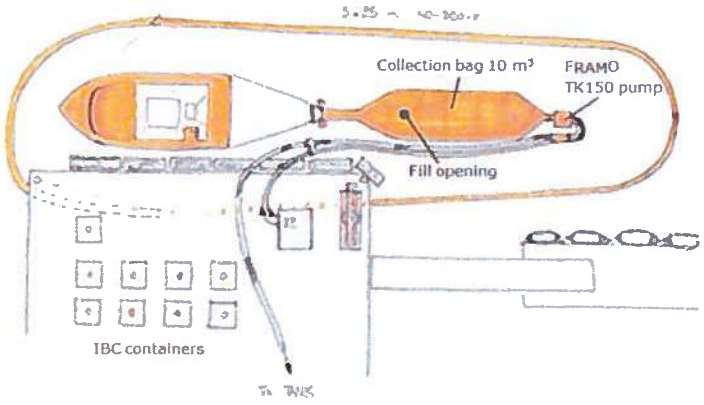
Dave DeVitis P.E.

DNV·GL

LETTER OF COMPLIANCE

Statement number 1IG7A1H-15

Owner:	NorLense AS
Name of system:	Collection back NO-T-600-S/10 with an integrated FRAMO TK 150 pump
Location:	Fiskebøl, Norway
Description:	Third party witnessing of a performance test of the collection back NO-T-600-S/10 with an integrated FRAMO TK 150 pump
Main test procedure:	Emptying of the collection bag NO-T-600-S/10 by use of a FRAMO TK 150 pump. The collection bag was moored behind a current inducing tug boat. 7635 liters of soyoil emulsion were filled into the collection bag und recovered by pumping with a Framo TK150 pump. A schematic drawing of the test set-up is shown below.



Verification method: Witnessing by DNV GL representative

This is to state that:

That the above mentioned systems have been tested as described above and in DNV GL's test report. DNV GL has verified that the test has been performed according to the test set-up and that the test parameters have been logged in a correct manner.

Validity: This statement is valid on the date of issue.

Reference documents: DNV GL test report, number 1IG7A1H-14

Place: Harstad Date: 20.10.2014

Anne Wenke	Stein Thorbjørnsen	DNV GL stamp
Senior Consultant	Head of Section	

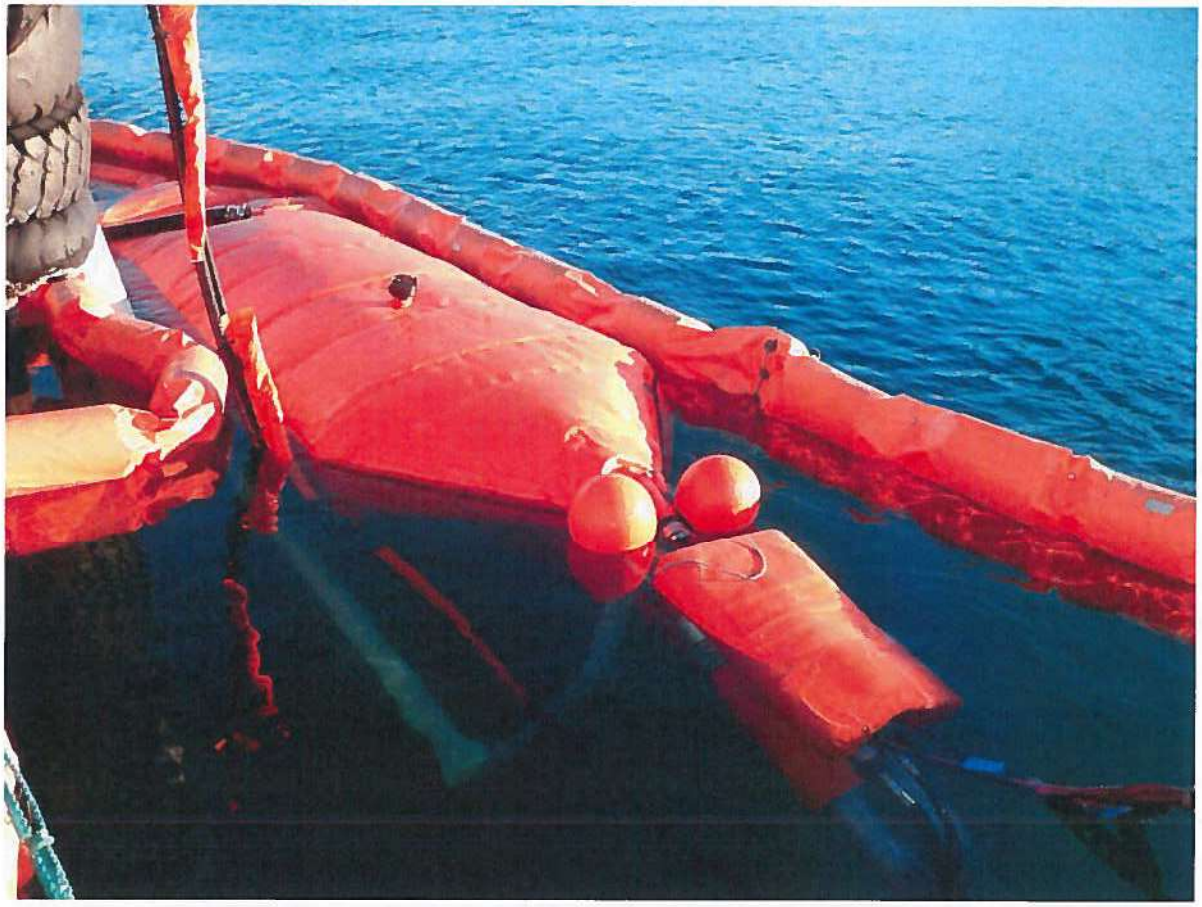
DNV·GL

NORLENSE OILTRAWL NO-T-600-S/NO-T-1000-S 10 M3 COLLECTION BAG WITH INTEGRATED FRAMO TK150 PUMP

Performance test report

NorLense AS

Report No.: 2, Rev.
Document No.: 1IG7A1H-14
Date: 2014-10-20



Project name:	Norlense Oiltrawl NO-T-600-S/NO-T-1000-S 10 m3 collection bag with integrated Framo TK150 pump	DNV GL AS DNV GL Oil & Gas BDL Environmental Risk Management P.O.Box 300 1322 Høvik Norway Tel: +47 67 57 99 00 NO 945 748 931 MVA
Report title:	Performance test report	
Customer:	NorLense AS, Fiskebøl 8317 STRØNSTAD Norway	
Contact person:	Hugo Svendsen	
Date of issue:	2014-10-20	
Project No.:	PP113700	
Organisation unit:	OENNO629	
Report No.:	2, Rev.	
Document No.:	1IG7A1H-14	

Task and objective:

NorLense AS is specialised in the production of oil spill equipment. A test with soyoil-emulsion as testmedium was performed to test the emptying NorLense's Oiltrawl collection bag NO-T-600-S/10 with a Framo TK150 pump.

Prepared by:	Verified by:	Approved by:
Anne Wenke Senior Consultant	Hans Petter Dahlslett Principal Consultant	Stein Thorbjørnsen Head of Section
[Name] [title]	[Name] [title]	
[Name] [title]	[Name] [title]	

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Keywords:
[Keywords]

Reference to part of this report which may lead to misinterpretation is not permissible.

Rev. No.	Date	Reason for Issue	Prepared by	Verified by	Approved by
0	2014-10-20	First issue, signed and verified	Anne Wenke	Hans Petter Dahlslett	Stein Thorbjørnsen

Table of contents

1 INTRODUCTION

NorLense AS is a company located in Fiskebøl on Lofoten, Norway which is specialised in the production of oil spill response equipment. NorLense's Oiltrawl, is a fast current boom system with a single point inflation boom and a collection/storage bag at its end. The bag has the function to separate oil from water. The bag can either be disconnected from the boom for emptying or it can be connected via a pump/hose system to a tank storage vessel.

NorLense AS designed a field test with the purpose to document the functionality of the collection bag NO-T-6000-S/NO-T-1000-S (10 m^3) used in combination with a FRAMO TK150 pump. Soyoil-emulsion was used as a testmedium.

DNV GL was contacted by NorLense AS to perform a 3rd party witnessing of this test.

The test took place at NorLense's facility in Fiskebøl on the 15th of October 2014.

2 TEST METHODOLOGY

2.1 Tested equipment

The following equipment was tested (Figure 1):

- **Collection bag NO-T-600-S/NO-T-1000-S (10 m^3)**

  Length: 11 m

  Storage volume 10 m^3

  Weight: 100 kg

- **FRAMO portable pump TK 150**

Figure 1 Collection bag NO-T-600-S/NO-T-1000-S (10 m^3) (left) and TK 150 pump from Framo (right).

Figure 2 IBC container with soyoil-emulsion (left) and drainage of free water at the bottom of the tank before testing (right).

2.2 Test medium

In total 7635 liters of soyoil-emulsion (78% water content*) were used as testmedium. The soyoil-emulsion was stored in 10 IBC-containers. Prior to the testing free water was released from the tanks (Figure 2).

Table 1 List of IBC-container and amount of testmedium after release of free water.

IBC-container Nr.	Amount emulsion (liter)
1	570
2	550
4	665
5	950
6	870
7	815
9	845
10	805
12	815
13	750
Sum	7635

**Water content not verified by DNV GL as measurements were performed in a separate laboratory*

2.3 Test set-up

Figure 3 shows a schematic drawing of the test set-up. The collection bag was placed in the water in the harbour at Fiskebøl and moored behind a small tug boat. The tug boat was used to generate current into the bag opening. A Framo TK150 pump was installed at the rear end of the bag, with a hose leading to a settling tank (12 x 2.36 m). The area was secured with a harbour boom NO-350-F.

The soyoil-emulsion was pumped with a Vogelsang pump into the bag via a fill opening on the front top.

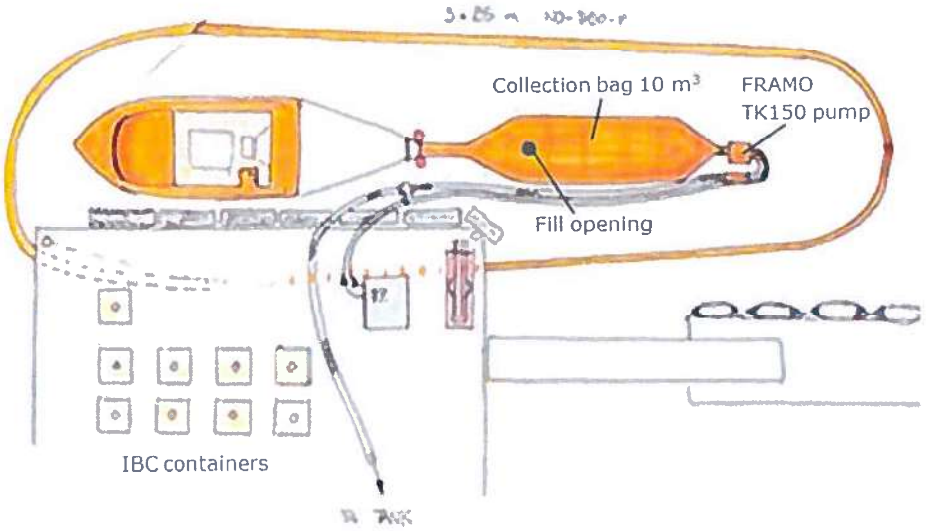


Figure 3 Schematic drawing of the test set-up (Source: NorLense AS).

2.4 Test procedure

The test went according to plan. 7635 liters of soyoil emulsion were filled into the collection bag with a pump/hose system. This equals ~76 % of the bags theoretically storage volume. The pump and hose system was additionally flushed with water to ensure no remaining soyoil in the system.

The current flow generated form the tug boat was measured to be 0.447 m/s (~2 knots). The inlet was 100% submerged. After the collection bag was filled, the emulsion was left inside the bag for 1 hour with only small traces of soyoil leaking from the lower water outlet (Figure 4).

The collection bag was emptied using a FRAMO TK150 pump via a 46 meter long 5" cargo hose with a total lifting height of 6 m. The soyoil emulsion was transferred into a settling tank (Figure 5).

The measured pump rate was ~3.8 m^3/h. Samples were taken periodically to assess the amount of free water. Within the first 75 minutes only soyoil emulsion was pumped with no associated water with a recovered volume of 4.8 m^3. After that associated oil and water was recovered for 27 minutes and the pump rate increased at this stage to ~ 40 m^3/hour. This resulted in a recovered soyoil-water volume of 17.8 m^3.

After the test the water content in the soyoil emulsion had -according to NorLense AS- increased to 82 % and the viscosity was measured to be 58.300 cSt at a shear of 0.5 sek^{-1} and a temperature of 11 °C.*

** not verified by DNV GL as measurements were performed in a laboratory after the test.*

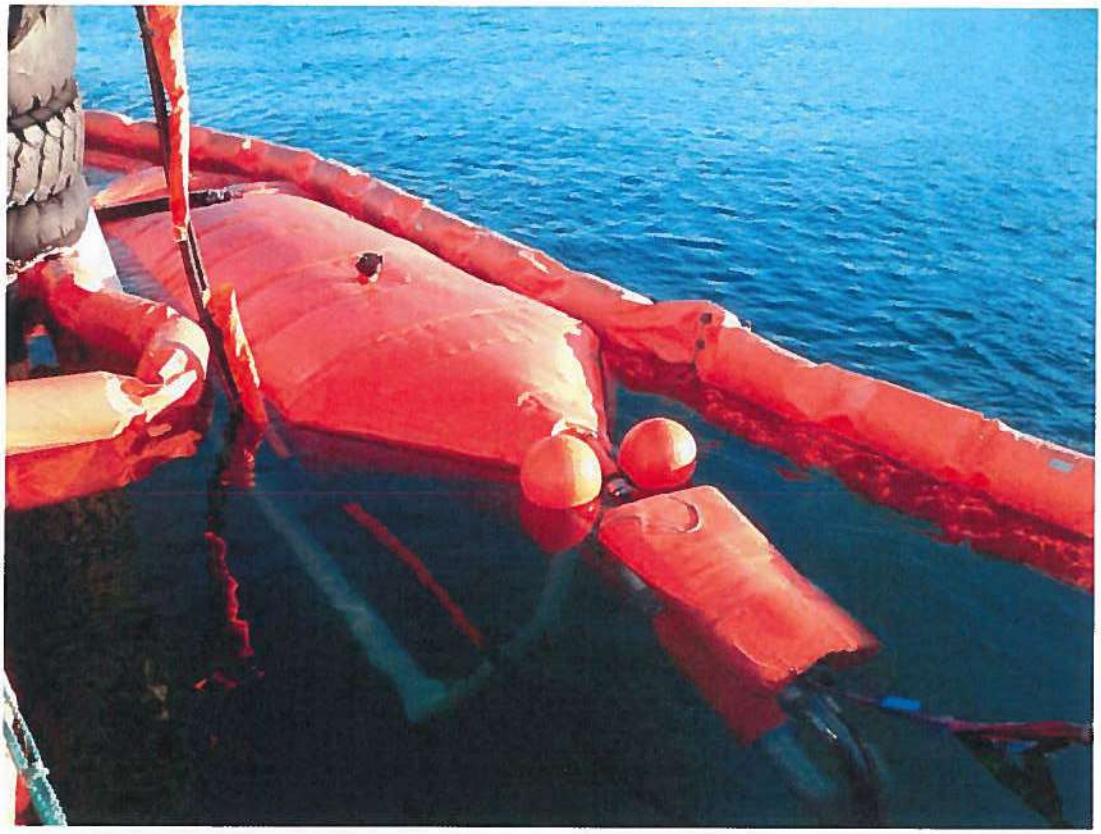


Figure 4 Collection bag NO-T-600-S/NO-T-1000-S 10 m^3.

Figure 5 Recovery of pure soyoil emulsion (left) and soyoil emulsion with associated water (right) into the settling tank.

2.5 Test conditions

Test conditions in Fiskebøl on the 15.10.2014 between 10:00 and 14:00 were as follows (source www.yr.no):

Air temperature: 4 °C

Sea temperature: 9 °C

Wind: 3.5 m/s

Waves: no waves

According to Norlense , the power pack was run on reduced speed and a pressure of 120 bar during the test which reduces the pumping rate by approx. 50 %. Appendix A shows a performance diagram from the Framo TK150 pump.

3 RESULTS

DNV GL witnessed that the testing of emptying the collection bag NO-T-600-S/10 with a FRAMO TK 150 pump went according to plan. Additional to this report, a Letter of Compliance (statement No. 1IG7A1H-12) has been issued to NorLense AS.

4 APPENDIX A

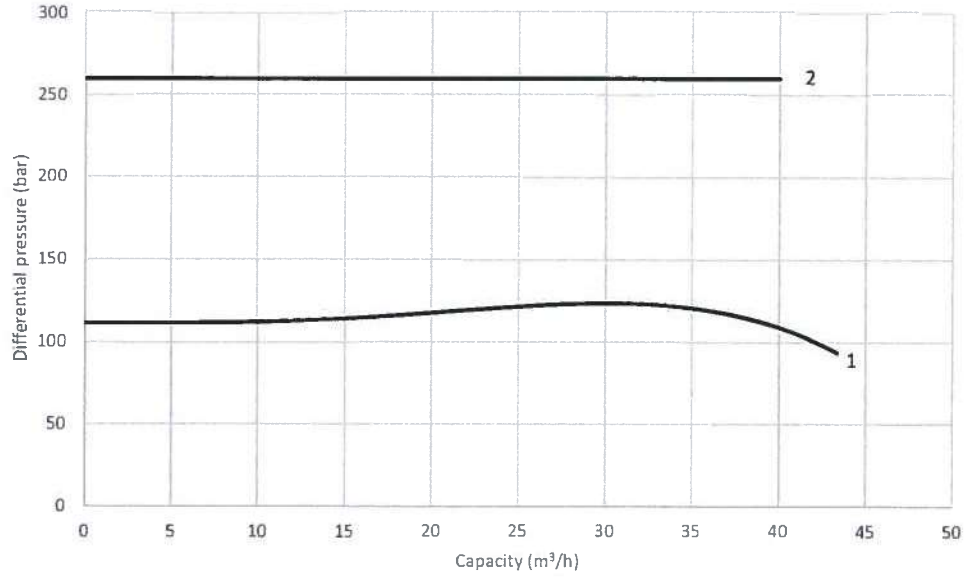
FRAMO

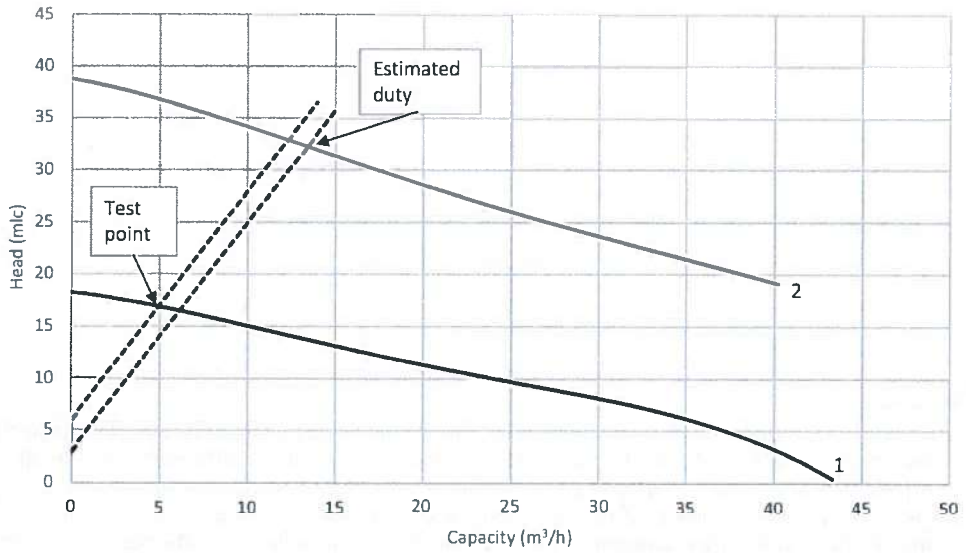
PERFORMANCE DIAGRAM
FRAMO PUMP TK150

Date/Sign.: 17.10.2014/EHo
Rev.: -
Page: 1

Driver: A2FM56
Impeller diameter: 224 (mm)
Comment: *Calculated values*

No.	Viscosity [cSt]	Specific gravity [kg/dm^3]	Pressure [bar]	Speed [rpm]
1	40 000	1	120	1715
2	40 000	1	260	2500





Performance diagram of the Framo TK150 pump provided by NorLense to this report.

About DNV GL

Driven by our purpose of safeguarding life, property and the environment, DNV GL enables organizations to advance the safety and sustainability of their business. We provide classification and technical assurance along with software and independent expert advisory services to the maritime, oil and gas, and energy industries. We also provide certification services to customers across a wide range of industries. Operating in more than 100 countries, our 16,000 professionals are dedicated to helping our customers make the world safer, smarter and greener.

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MAIN BRIDGE PRETEST OIL ANALYSIS

				BS&W		
Sample Description:	Sample #:	Date:	Tube #:	Water:	Solids:	SUM:(%)
PRE TEST 1 SUNDEX790	MB551-01	5/30/13	1	10	0	20
			3	10	0	
PRE TEST 10 SUNDEX790	MB551-02	5/30/13	4	8	0	17
			5	9	0	
PRE TEST 21 SUNDEX790	MB551-03	6/4/13	6	7	0	14
			7	7	0	
PRE TEST 24 HYDROCAL	MB551-04	6/4/13	8	1.8	0	3.3
			9	1.5	0	
PRE TEST 33 HYDROCAL	MB551-05	6/6/13	1	1.5	0	3.5
			3	2	0	
AFTER TEST 38 HYDROCAL	MB551-06	6/6/13	4	1.3	0	2.6
			5	1.3	0	

51/6 = 8.5%

6.8/4 = 1.7%

						Bucket = .39gal/inch								
						Tank (21,22,23,24)= 1.72gal/inch + 2.5 gal in cone								
Test#	Tow Speed knots	Test Oil	Surface Condition	Lost Oil collected into	Initial Depth (inches)	Final Depth (inches)	Volume (gal)	Initial Water Content	Sample BS&W	Volume Lost (actual oil)	Volume distributed (gross)	Volume Encountered (actual oil)	Volume Recovered	Throughput Efficiency
4 & 5	1.5	Sundex 790	Calm	B1	11 .2	10.5	4.1	0.20	0.40	12.8	57.0	45.6	32.8	71.9
				B2	11.4	11	4.3		0.31					
				B3	11.3	10.8	4.2		0.36					
				B4	11.6	11.1	4.3		0.40					
				B5	12.8	9	3.5		0.40					
6& 7	1.5	Sundex 790	Wave 10cpm 12inch stroke		ABORTED									
8 & 9	2.0	Sundex 790	Calm	B10	12	11	4.3	0.20	0.39	14.2	65.0	52	37.8	72.7
				B11	10.3	9	3.5		0.39					
				B12	10.5	8	3.1		0.30					
				B13	11.5	8.1	3.2		0.31					
				B14	11.3	8.3	3.2		0.32					
				B15	8.5	4	1.6		0.30			volume in bag (measured)		
				B16	12	6.8	2.7		0.32					
5/29/13 Bag Collection	From Tests 4-9		plus 2.5 gal for cone	T24	32.3	31.3	56.3		0.30	Volume Lost (Total)	Total Recovered in Bag	Total -Bag and Lost	Total Distributed	
				T23	32.8	30.5	55.0		0.29	27.0	80.1	107.1	97.6	
				B17	10.5	6.8	2.7		0.37					
12 & 13	2.0	Sundex 790	Wave 10cpm 12inch stroke	B18	11.6	7	2.7	0.17	0.40	3.9	60.0	49.8	45.9	92.1
				B19	12.5	6.75	2.6	0.17	0.39					
				B20	12.4	2	0.8	0.17	0.47					
				B21	3.6	1.25	0.5	0.17	0.44					
14 & 15	3.0	Sundex 790	Calm	T21	17.5	11.8	22.8	0.17	0.50	11.4	71.0	58.93	47.5	80.7

						Bucket = .39gal/inch								
						Tank (21,22,23,24)= 1.72gal/inch + 2.5 gal in cone								
Test#	Tow Speed knots	Test Oil	Surface Condition	Lost Oil collected into	Initial Depth (inches)	Final Depth (inches)	Volume (gal)	Initial Water Content	Sample BS&W	Volume Lost (actual oil)	Volume distributed (gross)	Volume Encountered (actual oil)	Volume Recovered	Throughput Efficiency
5/30/13 Bag Collection	From Tests 11-15			T22	32.75	27.5	49.8		0.35	Volume Lost (Total)	Total Recovered in Bag	Total -Bag and Lost	Total Distributed	
				T23	33	26.1	47.4		0.26	15.3	109.3	124.60	108.7	
				T24	32.6	30	54.1		0.30					
				B22	12.8	9.5	3.7		0.38					
				B23	11.00	6.50	2.5		0.35					
17 & 18	3.0	Sundex 790	Wave 10cpm 12inch stroke	T24	7.60	6.50	13.68	0.17	0.38	8.48	65.00	53.95	45.47	84.28
19	2.0	Sundex 790	Calm	B24	12.00	11.25	4.39	0.17	0.45	6.26	71.00	58.93	52.67	89.37
double distribution				B25	12.75	12.00	4.68		0.41					
				B26	12.60	11.75	4.58		0.36					
				B27	13.25	11.00	4.29		0.43					
20	2.0	Sundex 790	Wave 10cpm 12inch stroke	B28	12.25	11.00	4.29	0.17	0.36	6.85	56.00	46.48	39.63	85.27
double distribution				B29	12.75	11.10	4.33		0.39					
				B30	7.75	6.25	2.44		0.40					
5/31/13 Bag Collection	From Tests 17-20			T22	32.80	32.80	56.42		0.26	Volume Lost (Total)	Total Recovered in Bag	Total -Bag and Lost	Total Distributed	
				T23	32.60	32.60	56.07		0.30	21.59	122.78	144.38	159.36	
				T21	32.00	31.60	54.35		0.35					
				B31	13.00	11.38	4.44		0.27					
				B32	13.80	12.13	4.73		0.32					
21 & 22	1.5	Hydrocal 300	Calm	B33	12.50	7.25	2.83	0.03	0.38	9.44	76.00	73.72	64.28	87.20
				B34	12.75	9.00	3.51		0.36					
				B35	13.00	11.75	4.58		0.38					

						Bucket = .39gal/inch								
						Tank (21,22,23,24)= 1.72gal/inch + 2.5 gal in cone								
Test#	Tow Speed knots	Test Oil	Surface Condition	Lost Oil collected into	Initial Depth (inches)	Final Depth (inches)	Volume (gal)	Initial Water Content	Sample BS&W	Volume Lost (actual oil)	Volume distributed (gross)	Volume Encountered (actual oil)	Volume Recovered	Throughput Efficiency
				B36	11.38	10.25	4.00		0.35					
23 & 24	1.5	Hydrocal 300	Wave 10cpm 12inch stroke	T24	13.50	13.50	25.72		0.28	18.52	77.00	77.00	58.48	75.95
6/3/13 Bag Collection	From Tests 21-24			T21		27.50	49.80		0.23	Volume Lost (Total)	Total Recovered in Bag	Total -Bag and Lost	Total Distributed	
				T22		31.87	57.32		0.10	27.96	149.08	177.04	150.72	
				T23		31.75	57.11		0.06					
				B37		6.38	2.49		0.31					
				B38		6.25	2.44		0.29					
				B39		7.00	2.73		0.26					
25 & 26	2.0	Hydrocal 300	Calm	B40		9.50	3.71	0.03	0.30	9.04	94.00	90.90	81.86	90.06
				B41		12.25	4.78		0.32					
				B42		11.88	4.63		0.42					
				B43		1.88	0.73		0.34					
27 & 28	2.0	Hydrocal 300	Wave 10cpm 12inch stroke	B44		11.88	4.63	0.03	0.41	13.75	82.00	79.29	65.54	82.66
				B45		12.00	4.68		0.40					
				B46		12.25	4.78		0.43					
				B47		11.50	4.49		0.49					
				B48		12.50	4.88		0.50					
				B49		3.25	1.27		0.40					
29 & 30	3.0	Hydrocal 300	Calm	B50		11.25	4.39	0.03	0.32	26.04	87.00	84.39	58.35	69.15
				B51		11.88	4.63		0.30					
				B52		11.75	4.58		0.33					
				Tank		13.50	25.72		0.35					

						Bucket = .39gal/inch								
						Tank (21,22,23,24)= 1.72gal/inch + 2.5 gal in cone								
Test#	Tow Speed knots	Test Oil	Surface Condition	Lost Oil collected into	Initial Depth (inches)	Final Depth (inches)	Volume (gal)	Initial Water Content	Sample BS&W	Volume Lost (actual oil)	Volume distributed (gross)	Volume Encountered (actual oil)	Volume Recovered	Throughput Efficiency
31 & 32	3.0	Hydrocal 300	Wave 10cpm 12inch stroke	Tank		14.75	27.87	0.03	0.36	17.84	87.00	84.39	66.55	78.86
6/4/13 Bag Collection	From Tests 25-32			T21		30.50	54.96		0.12	Volume Lost (Total)	Total Recovered in Bag	Total -Bag and Lost	Total Distributed	
				T22		31.75	57.11		0.12	66.66	178.81	245.47	338.97	
				T23		31.75	57.11		0.06					
				T24		32.00	14.98		0.09					
				Tank(highbay)		21.75	10.98		0.22					
				B77		11.00	4.29		0.13					
33 & 34	2.0	Hydrocal 300	Calm	T21		11.63	22.50	0.03	0.23	17.33	126.00	122.22	104.89	85.82
	DOUBLE DISTRIBUTION 58 gpm													
35 & 36	2.5	Hydrocal 300	Calm	T22		9.25	18.41	0.03	0.28	13.26	86.00	83.42	70.16	84.11
	DOUBLE DISTRIBUTION 58 gpm													
37 & 38	2.0	Hydrocal 300	Calm	T23		17.25	32.17	0.03	0.24	24.45	176.00	170.72	146.27	85.68
	TRIPLE DISTRIBUTION 87 gpm													

Attachment VI

MAR INCORPORATED

6/20/13

NorLense AS
Fiskebøl
8729 Strønstad
Norway
Tel: +47 761 18 1 83
Email: hugo@norlense.no

ATTENTION: Hugo Svendsen, R&D Manager

REFERENCE: BSEE Contract E13PD00040, MAR/OHMSETT Task Order F-551

SUBJECT: Transmittal of Deliverable Documentation from the Evaluation of NorLense AS Prototype Oiltrawl System at Ohmsett

ENCLOSURE: (1) Data Binder (Qty 2)

Dear Mr. Svendsen,

MAR, Incorporated hereby submits deliverable documentation in fulfillment of the referenced contract Task Order conducted at Ohmsett 5/28/13 – 6/7/13. Enclosed you will find two (2) copies of the Data Binder containing; 1) Ohmsett Statement of Work, 2) Executive Summary, 3)Data/Result Summary, 4) Test Plan/Setup, 5) Daily Test Logs, 6) Oil/Water Laboratory Analyses, 7) Photo/Video Logs, 8) two (2) DVD-R's of video documentation and one (1) photo DVD-R .

Should you have any questions, feel free to contact David DeVitis at (732) 866-7287 ddevitis@ohmsettnj.com or myself at (732) 866-7286 scunneff@ohmsettnj.com.

Sincerely,

Susan Cunneff
OHMSETT FACILITY

Thomas Coolbaugh
Digitally signed by Thomas Coolbaugh
Date: 2021.07.07 09:27:09 -04'00'

Ohmsett
Oil Spill Response Research

cc: L. Medley, BSEE COR
M.L. Pence, MAR Contracts
W. Schmidt, MAR/Ohmsett

Task Order 551

AS Prototype Oiltrawl System

Test & Evaluation

2013

NorLense

Thomas Coolbaugh

Digitally signed by Thomas Coolbaugh
Date: 2021.07.07 09:30:04 -04'00'

May 28th – June 7th

NorLense

Ohmsett

MAR INCORPORATED

296T-551 NORLENSE

Recovered Oil Analysis: Bottom Solids & Water

				BS&W		
Sample Description:	**Sample #:**	**Date:**	**Tube #:**	**Water:**	**Solids:**	**SUM:(%)**
TEST 4&5 (BUCKET 1) SUNDEX 790	**551-01**	5/30/13	6	20	0	40
			7	20	0	
TEST 4&5 (BUCKET 2) SUNDEX 790	**551-02**	5/30/13	8	15	0	31
			9	16	0	
TEST 4&5 (BUCKET 3) SUNDEX 790	**551-03**	5/30/13	1	19	0	36
			3	17	0	
TEST 4&5 (BUCKET 4) SUNDEX 790	**551-04**	5/30/13	4	20	0	40
			5	20	0	
TEST 4&5 (BUCKET 4) SUNDEX 790 DUPLICATE SAMPLE	**551-05**	5/30/13	1	20	0	40
			3	20	0	
TEST 4&5 (BUCKET 5) SUNDEX 790	**551-06**	5/30/13	4	26	0	53
			5	27	0	
TEST 6&7 (BUCKET 6) SUNDEX 790	**551-07**	5/30/13	6	24	0	48
			7	24	0	
TEST 6&7 (BUCKET 7) SUNDEX 790	**551-08**	5/30/13	8	24	0	49
			9	25	0	
TEST 6&7 (BUCKET 8) SUNDEX 790	**551-09**	5/31/13	1	21	0	43
			3	22	0	
TEST 6&7 (BUCKET 9) SUNDEX 790	**551-10**	5/31/13	4	18	0	34
			5	16	0	
TEST 6&7 (TANK 21) SUNDEX 790	**551-11**	5/30/13	6	19	0	37
			7	18	0	
TEST 6&7 (TANK 22) SUNDEX 790	**551-12**	5/30/13	8	25	0	49
			9	24	0	

500/24 20.8%

Attachment VI

296T-551 NORLENSE

Recovered Oil Analysis: Bottom Solids & Water

				BS&W		
Sample Description:	**Sample #:**	**Date:**	**Tube #:**	**Water:**	**Solids:**	**SUM:(%)**
TEST 8&9(BUCKET 10) SUNDEX 790	**551-13**	5/31/13	6	20	0	39
			7	19	0	
TEST 8&9(BUCKET 11) SUNDEX 790	**551-14**	5/31/13	8	21	0	44
			9	23	0	
TEST 8&9(BUCKET 11) SUNDEX 790 DUPLICATE SAMPLE	**551-15**	5/31/13	1	16	0	33
			3	17	0	
TEST 8&9(BUCKET 12) SUNDEX 790	**551-16**	5/31/13	4	15	0	30
			5	15	0	
TEST 8&9(BUCKET 13) SUNDEX 790	**551-17**	5/31/13	6	15	0	31
			7	16	0	
TEST 8&9(BUCKET 14) SUNDEX 790	**551-18**	5/31/13	8	16	0	32
			9	16	0	
TEST 8&9(BUCKET 15) SUNDEX 790	**551-20**	5/31/13	1	14	0	30
			3	16	0	
TEST 8&9(BUCKET 16) SUNDEX 790	**551-21**	5/31/13	4	16	0	32
			5	16	0	
TEST 8&9(TANK24) SUNDEX 790	**551-24**	5/31/13	1	17	0	34
			3	17	0	
TEST 8&9(TANK 23) SUNDEX 790 DUPLICATE SAMPLE	**551-25**	5/31/13	4	20	0	40
			5	20	0	
TEST 12&13 (BUCKET17) SUNDEX790	**551-24A**	6/3/13	1	19	0	40
			3	21	0	
TEST 12&13 (BUCKET17) SUNDEX790	**551-25A**	6/3/13	4	20	0	39
			5	19	0	

424/24 = 17.6%

296T-551 NORLENSE

Recovered Oil Analysis: Bottom Solids & Water

				BS&W		
Sample Description:	**Sample #:**	**Date:**	**Tube #:**	**Water:**	**Solids:**	**SUM:(%)**
TEST 12&13 (BUCKET20) SUNDEX790	**551-26**	6/3/13	6	23	0	47
			7	24	0	
TEST 12&13 (BUCKET21) SUNDEX790	**551-27**	6/3/13	8	23	0	44
			9	21	0	
TEST 12&13 (BUCKET21) SUNDEX790 DUPE	**551-28**	6/3/13	1	20	0	40
			3	20	0	
TEST 14&15 (TANK21) SUNDEX790	**551-29**	5/31/13	8	25	0	50
			9	25	0	
TEST 11-15 (TANK 23) SUNDEX790	**551-30**	5/31/13	6	14	0	26
			7	12	0	
TEST 11-15 (TANK 23) SUNDEX 790	**551-31**	5/31/13	1	15	0	30
			3	15	0	
TEST 11-15(TANK 22) SUNDEX 790	**551-32**	5/31/13	4	20	0	35
			5	15	0	
TEST 11-15(BUCKET 22) SUNDEX 790	**551-33**	6/3/13	4	20	0	38
			5	18	0	
TEST 11-15 (BUCKET23) SUNDEX790	**551-34**	6/3/13	6	18	0	35
			7	17	0	
TEST 17&18(TANK 24) SUNDEX 790	**551-35**	6/3/13	8	20	0	38
			9	18	0	
TEST 19 (BUCKET24) SUNDEX790	**551-36**	6/4/13	1	23	0	45
			3	22	0	
TEST 19 (BUCKET25) SUNDEX790	**551-37**	6/4/13	4	21	0	43
			5	22	0	

$47\frac{1}{24} = 19.6\%$

296T-551 NORLENSE

Recovered Oil Analysis: Bottom Solids & Water

				BS&W		
Sample Description:	**Sample #:**	**Date:**	**Tube #:**	**Water:**	**Solids:**	**SUM:(%)**
TEST 19 (BUCKET25) SUNDEX790 DUPLICATE SAMPLE	**551-38**	6/4/13	6	20	0	38
			7	18	0	
TEST 19 (BUCKET26) SUNDEX790	**551-39**	6/4/13	8	19	0	36
			9	17	0	
TEST 19 (BUCKET27) SUNDEX790 DUPE	**551-40**	6/4/13	1	23	0	43
			3	20	0	
TEST 20 (BUCKET 28) SUNDEX790	**551-41**	6/4/13	4	18	0	36
			5	18	0	
TEST 20 (BUCKET 29) SUNDEX790	**551-42**	6/4/13	1	19	0	39
			3	20	0	
TEST 20 (BUCKET 30) SUNDEX 790	**551-43**	6/4/13	4	21	0	40
			5	19	0	
TEST 17-20(TANK 23) SUNDEX 790	**551-44**	6/4/13	6	13	0	26
			7	13	0	
TEST 17-20(TANK 22) SUNDEX 790	**551-45**	6/4/13	8	15	0	30
			9	15	0	
TEST 17-20 (TANK 21) SUNDEX790	**551-46**	6/4/13	1	18	0	35
			3	17	0	
TEST 17-20 (BUCKET31) SUNDEX790	**551-47**	6/4/13	4	13	0	27
			5	14	0	
TEST 17-20 (BUCKET31) SUNDEX790	**551-48**	6/4/13	6	16	0	32
			7	16	0	
TEST 17-20 (BUCKET32) SUNDEX790	**551-49**	6/4/13	8	21	0	40
			9	19	0	

422/24 = 17.6%

296T-551 NORLENSE

Recovered Oil Analysis: Bottom Solids & Water

Sample Description:	Sample #:	Date:	Tube #:	BS&W Water:	BS&W Solids:	BS&W SUM:(%)
TEST 8&9 (BUCKET11) SUNDEX790 DUPLICATE SAMPLE	551-50	6/4/13	1	21	0	42
			3	21	0	
TEST 21&22 (BUCKET33) HYDROCAL	551-50A	6/5/13	1	19	0	38
			3	19	0	
TEST 21&22 (BUCKET34) HYDROCAL	551-51	6/5/13	4	18	0	36
			5	18	0	
TEST 21&22 (BUCKET35) HYDROCAL	551-52	6/5/13	6	19	0	38
			7	19	0	
TEST 21&22 (BUCKET36) HYDROCAL	551-53	6/5/13	8	18	0	35
			9	17	0	
TEST21&22(BUCKET36) HYDROCAL DUPLICATE SAMPLE	551-54	6/5/13	1	22	0	43
			3	21	0	
TEST 23&24(TANK 24) HYDROCAL	551-55	6/5/13	4	14	0	28
			5	14	0	
TEST 21-24(TANK 23) HYDROCAL	551-56	6/5/13	6	3.2	0	6.4
			7	3.2	0	
TEST 21-24 (TANK 22) HYDROCAL	551-57	6/5/13	8	5	0	10
			9	5	0	
TEST 21-24 (TANK 21) HYDROCAL	551-58	6/5/13	11	11	0	23
			12	12	0	
TEST 21-24 (BUCKET37) HYDROCAL	551-59	6/5/13	14	15	0	31
			15	16	0	
TEST 21-24 (BUCKET38) HYDROCAL	551-60	6/5/13	1	15	0	29
			3	14	0	

Glenrowan with 18.32%

= 21%

317/22 = 14.4%

3.3 + 3.5 + 2.6 / 6 = 16%

296T-551 NORLENSE

Recovered Oil Analysis: Bottom Solids & Water

				BS&W		
Sample Description:	**Sample #:**	**Date:**	**Tube #:**	**Water:**	**Solids:**	**SUM:(%)**
TEST21-24(BUCKET39) HYDROCAL	**551-61**	6/5/13	4	13	0	26
			5	13	0	
TEST 25&26 (BUCKET40) HYDROCAL	**551-62**	6/5/13	6	15	0	30
			7	15	0	
TEST 25&26 (BUCKET41) HYDROCAL	**551-63**	6/5/13	8	15	0	27
			9	12	0	
TEST25&26(BUCKET41) HYDROCAL DUPLICATE SAMPLE	**551-64**	6/5/13	11	18	0	36
			12	18	0	
TEST 25&26 (BUCKET42) HYDROCAL	**551-65**	6/5/13	14	22	0	42
			15	20	0	
TEST25&26 (BUCKET43) HYDROCAL	**551-66**	6/5/13	1	17	0	34
			3	17	0	
TEST 27&28 (BUCKET44) HYDROCAL	**551-67**	6/5/13	4	20	0	41
			5	21	0	
TEST 27&28 (BUCKET45) HYDROCAL	**551-68**	6/5/13	6	19	0	40
			7	21	0	
TEST 27&28 (BUCKET46) HYDROCAL	**551-69**	6/5/13	8	23	0	43
			9	20	0	
TEST 27&28 (BUCKET47) HYDROCAL	**551-70**	6/5/13	1	24	0	49
			3	25	0	
TEST27&28 (BUCKET48) HYDROCAL	**551-71**	6/5/13	4	25	0	50
			5	25	0	
TEST 27&28 (BUCKET49) HYDROCAL	**551-72**	6/5/13	11	20	0	40
			12	20	0	

458/24 = 19%

296T-551 NORLENSE

Recovered Oil Analysis: Bottom Solids & Water

				BS&W		
Sample Description:	**Sample #:**	**Date:**	**Tube #:**	**Water:**	**Solids:**	**SUM:(%)**
TEST29&30(BUCKET50) HYDROCAL	**551-73**	6/5/13	14	17	0	32
			15	15	0	
TEST29&30(BUCKET50) HYDROCAL DUPLICATE SAMPLE	**551-74**	6/5/13	6	13	0	29
			7	16	0	
TEST 29&30 (BUCKET51) HYDROCAL	**551-76**	6/5/13	8	15	0	30
			9	15	0	
TEST29&30 (BUCKET52) HYDROCAL	**551-77**	6/5/13	1	16	0	33
			3	17	0	
TEST 29&30 (BUCKET53-58) HYDROCAL	**551TB53-58**	6/5/13	4	16	0	35
			5	19	0	
TEST31&32 (BUCKET59-64) HYDROCAL	**551TB59-64**	6/5/13	11	18	0	36
			12	18	0	
TEST 25-32 (BUCKET65-76) HYDROCAL	**551TB65-76**	6/5/13	14	11	0	22
			15	11	0	
TEST 25-32 (TANK24) HYDROCAL	**551-92**	6/5/13	6	4	0	.9
			7	5	0	
TEST 25-32 (TANK 24) HYDROCAL DUPLICATE SAMPLE	**551-93**	6/5/13	8	4.5	0	9.5
			9	5	0	
TEST 25-32 (TANK 23) HYDROCAL	**551-94**	6/5/13	1	2.5	0	5.5
			3	3	0	
TEST 25-32 (TANK 22) HYDROCAL	**551-95**	6/5/13	4	5.5	0	11.5
			5	6	0	
TEST 25-32 (TANK 21) HYDROCAL	**551-96**	6/6/13	1	6	0	12
			3	6	0	

264.5/24 = 11%

296T-551 NORLENSE

Recovered Oil Analysis: Bottom Solids & Water

				BS&W		
Sample Description:	**Sample #:**	**Date:**	**Tube #:**	**Water:**	**Solids:**	**SUM:(%)**
TEST25-32 (BUCKET77) HYDROCAL	**551-97**	6/6/13	6	6	0	13
			7	7	0	
TEST33&34 (BUCKET78-82) HYDROCAL	**551-112**	6/6/13	4	12	0	23
			5	11	0	
TEST 35&36 (TANK 22) HYDROCAL	**551-113**	6/6/13	6	14	0	28
			7	14	0	
TEST37&38 (TANK 23) HYDROCAL	**551-114**	6/6/13	8	12	0	24
			9	12	0	
TEST 33-38 (TANK 24 BOTTOM) HYDROCAL	**551-115**	6/6/13	1	30	0	63
			3	33	0	
TEST33-38 (TANK 23 BOTTOM) HYDROCAL	**551-116**	6/6/13	6	28	0	56
			7	28	0	
TEST 33-38 (TANK 22 BOTTOM) HYDROCAL	**551-117**	6/6/13	1	37	0	74
			3	37	0	
TEST 33-38 (AUX TANK1) HYDROCAL	**551-118**	6/6/13	11	3.5	0	7
			12	3.5	0	
TEST 33-38 (AUX TANK2) HYDROCAL	**551-119**	6/6/13	14	4.5	0	9
			15	4.5	0	
TEST 33-38 (TANK 24 TOP) HYDROCAL	**551-120**	6/6/13	4	0.6	0	0.9
			5	0.3	0	
TEST 33-38 (TANK 23 TOP) HYDROCAL	**551-121**	6/6/13	8	0.8	0	1
			9	0.2	0	
TEST 33-38 (TANK 22 TOP) HYDROCAL	**551-122**	6/6/13	4	1	0	1.3
			5	0.3	0	

300/24 = 12.5%

Smitt 14.2%

296T-551 NORLENSE

Recovered Oil Analysis: Bottom Solids & Water

Sample Description:	Sample #:	Date:	Tube #:	BS&W Water:	BS&W Solids:	BS&W SUM:(%)
TEST 8&9 (TANK 24) SUNDEX 790	551-22	5/30/13	1	15	0	30
			3	15	0	
TEST 8&9 (TANK 23) SUNDEX 790	551-23	5/30/13	4	13	0	29
			5	16	0	
						14.75%

SPEED SWEEP

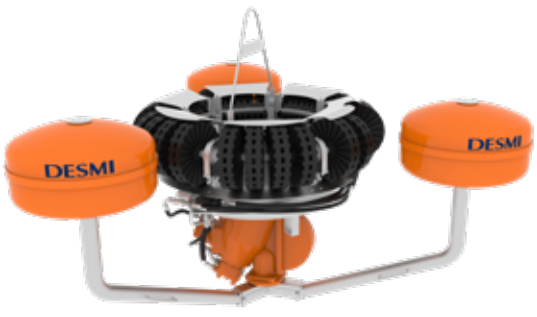
Ultimate Speed-Sweep Systems

Proven Oil Spill Technology

PROVEN TECHNOLOGY

DESMI

See more on containerised solutions on page 15



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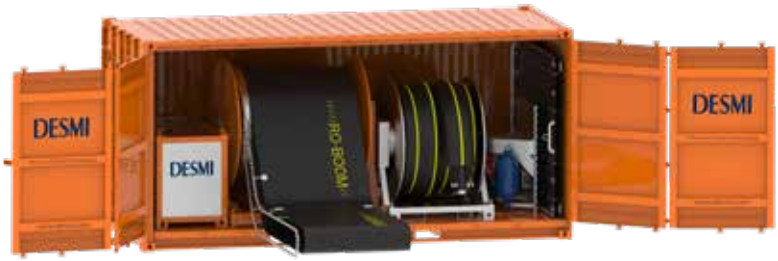

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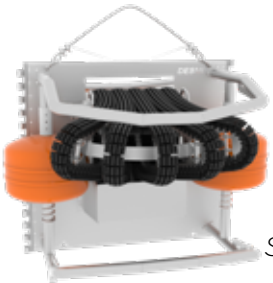

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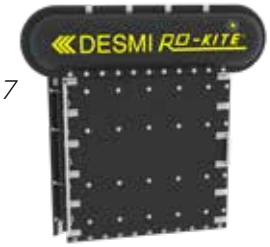


See more on page 12

DESMI SPEED-SWEEP SYSTEMS

The DESMI Speed-Sweep System, (fully tested at OHMSETT in USA) is a heavy duty advancing recovery system based on our world famous Ro-Boom fabric. It is designed to allow for the **collection of oil** at greater speeds than has previously been possible and allows the vessels of the Speed-Sweep system to travel **at up to 3 knots** relative to the water/oil. There are three 900mm / 35 inches 'Kevlar' vortex screens, fitted with special circular floats, which are used to interrupt the laminar flow and speed of the surface water/oil, creating a 'still' surface water/oil area at the apex of the system.

In this reduced flow water/oil environment it becomes an easy job to recover the oil with a suitable skimmer (our DESMI Ro-Skim or DESMI Octopus In-line Skimmer) integrated into the apex of the Speed-Sweep skimmer system or a free floating skimmer (e.g. our DESMI Terminator, DESMI Helix, and DESMI Giant Octopus).

The Speed-Sweep is manufactured from the Ro-Boom offshore containment boom made from a unique substrate compound of synthetic rubber with a CSM (Hypalon) external layer. The seamless and flexible structure has a very high abrasion resistance, peel resistance and tensile strength. It will withstand the effects of sun, seas and oils. Ro-Boom is suited for harsh climatic conditions, both hot and cold and has proven to give extremely long operating/storage lifetime.

The System complies nine individual three-meter buoyancy chambers, tapered down at each end to match DESMI Ro-Boom 1300, which is the ideal guide boom for the sweeping system. As the outer chamber in each end of the Speed-Sweep is gradually reduced in height from 1500mm / 59 inches to 1300mm / 51 inches and assembled with a 1300mm / 51 inches ASTM Slide connector the guide booms will fit directly on the Speed-Sweep.

Prior to the DESMI Speed-Sweep System, vessels were restricted to less than 1 knot relative speed between the boom and water when capturing oil. This resulted in significant 'clutching' between ship engines and propellers in an effort to control this relative speed between the water and boom.

- **Unique and High Efficiency**
- **Tough and Strong System**
- **Integral, High Capacity Air Blower**
- **Operates with 2 Vessels; 1 Vessel and a Jib Arm and/or 1 Vessel and a Ro-Kite**
- **Please note, DESMI Speed-Sweep is available in different sizes, namely 1500, 2000, 2200 and 3200**


DESMI
RO-BOOM

DESMI RO-KITE 1500

The DESMI Ro-Kite is a floating water kite based on a combination of trawl door and ram-air parachute principles. The purpose of this device is to act as a flow powered 'towing vessel' for oil boom systems. This can be either in fast flowing waters or in fast sweeping operations from OSR vessels.

The DESMI Ro-Kite obviates the need of an extra towing vessel, a jib arm system or, in fast flowing waters, the need of several anchor points.

The DESMI Ro-Kite 1500 has been designed especially for the requirements of a DESMI Speed-Sweep 1500 system, but can of course be used in combination with any other sweeping systems with similar force requirements.

DESMI Ro-Kite

Launching Ro-Kite

DESMI Ro-Kite

Ro-Kite Starts Towing Speed-Sweep

- “Soft” design that prevents risk of personal injuries by handling
- Easy dismantling and packing for compact storage
- Modular design for easy maintenance
- Robust and non-vulnerable design that allows collision with ship structure
- Hydrodynamic principles that minimize the required dimensions
- Choice of long term proven materials for oil boom design
- Can be handled manually on deck and does not require crane lifting
- Possible to deploy from Port and Starboard
- Simple to deploy
- Can pull DESMI Speed-Sweep incl. guide booms and DESMI Ro-Skim / DESMI Octopus In-line Skimmer
- Has a very little sensitivity to wave activity

Basic physical dimensions:
Draught: 1.80m / 5.9 ft
Freeboard: 0.52m / 1.7 ft
Operational width: 0.45m / 1.5 ft
Air chamber length: 3.00m / 10 ft
Tensile strength air chamber: 250N/mm
Tensile strength skirt section: 315N/mm

Deflated outer dimensions:
Overall length: 3.30m / 11 ft
Skirt length: 1.80m / 5.9 ft
Height: 3.00m / 10 ft
Weight: 155kg / 280 lbs.

Packed dimensions, approx.:
Assembled:
2,4m x 2,4m x 0,4m, 395kg
8 ft x 8 ft x 1 ft, 871 lb
Unassembled:
2.4m x 0.5m x 0.5m 245kg
8 ft x 2 ft x 2 ft, 540 lb

DESMI Ro-Kite

DESMI Speed Sweep with Ro-Kite

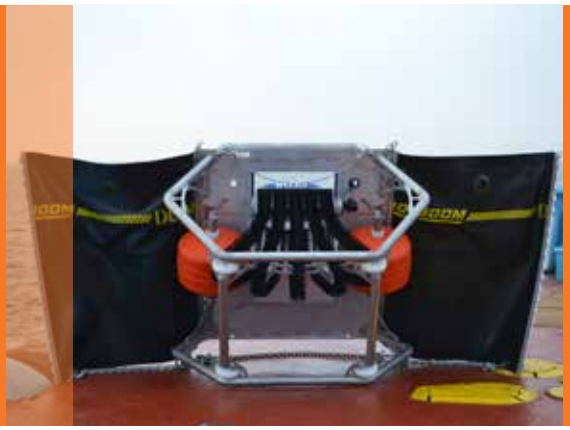
DESMI OCTOPUS IN-LINE SKIMMER

The DESMI Octopus In-line Skimmer is designed for collection of particularly medium viscous oil, but also performs very satisfactory on light oil, even down to 200cSt.

The unique designed brush belts ensures an optimal oil access to the bristles. The skimmer design base on one module comprising five brush belts. The brush belt module are forming a collection area in front of the buoyancy wall of the skimmer, where behind a DESMI DOP Dual 250 is placed. All connections for hydraulics and discharge are behind the boom system for easy connection.

This special designed skimmer has a progressive oil recovery capability compared to the well-known DESMI Ro-Skim, which is a more traditional weir skimmer. The buoyancy wall of the DESMI Octopus In-line Skimmer has hinge connectors to allow the incorporation in a DESMI Speed-Sweep, which have connectors in the center of apex. The collecting system enables the skimmer to operate at high pickup rates with a minimum of water content.

This was proven at the ASTM standard test protocol program in OHMSETT were an oil efficiency was measured to 98.4% on oil type I-II (7°C / 45°F) 500-800cSt.



- ✓ Giant Octopus Technology 98,4% efficient
- ✓ Multipurpose, low to high viscosity oil types
- ✓ DOP250 Dual Archimedes Screw Pump
- ✓ Hydraulic driven brush belt
- ✓ Simple point lifting
- ✓ In-line sweep apex skimmer

DESMI Octopus In-Line Skimmer 125 m³/h

Basic Physical Dimensions:	
Skimmer dimension:	Approx. 1.7 x 2.5 x 2.3m / 6 x 8 x 8 ft (Incl. lifting eye for crane lift)
Draft:	Approx. 0.7m / 2 ft when operating
Skimmer head:	Sea water resistant aluminum
Discharge connection:	6" DIN flange
Brush belt drives:	1 x Danfoss OMP 100
Brush capacity:	1 x 132.6m³/h / 584 gpm (DNV Certified)
Pump type:	1 x DESMI DOP-250 Dual
Pump casing:	Sea water resistant aluminum
Discharge pressure:	10 bar / 145 psi max.
Pump viscosity range:	0 - > 1 million cSt
Solids size:	Ø 50mm (2") max.
Pump capacity:	1 x 125m³/h / 550 gpm max.
Hydraulic motor:	Danfoss OMTS 160
Hydraulic flow input:	0 – 160 l/min / 42 gallons
Hydraulic connections in stainless steel:	2 x 1" P/R for pumps 1 x ⅜" P for drain 2 x ½" P/R for Brushes
Skimmer weight empty:	Approx. 350kg / 772 lbs.

DESMI Octopus In-line

NOFO test in oil

DESMI Octopus In-line

Speed-Sweep 2000 prepared for deployment

DESMI Octopus In-line

Speed-Sweep with Octopus In-line

DESMI RO-SKIM 1500

The DESMI Ro-Skim is a weir skimmer integrated in the apex of the Speed-Sweep skimmer system. This skimmer design is ideal in open sea sweeping operations.

When sweeping the oil will build up against the face of the Ro-Boom at the back of the U-Sweep formation. The Ro-Skim is placed at the back of the sweep were the oil is collected.

By building the skimmer into the highly buoyant boom system the weir lip will closely follow the wave movement and thereby the surface of the collected oil. A rough grid placed in front of the hydraulically adjustable weir lip prevents larger pieces of debris from entering the funnel. Depending on the thickness of the collected oil, the height of the weir lip can be adjustable while skimming.

The Ro-Skim is fitted with the powerful DESMI DOP vertical screw pump. The high outlet pressure from the screw pump allows pumping of recovered oil over larges distance. This is of high importance as it is in practice difficult to position an oil recovery tank near the skimmer.

Speed-Sweep, Guide Booms and Ro-Skim deployed and recovered to one winder without the use of a crane.

Very limited deck space is required for operations.

- High recovery efficiency
- Original DESMI DOP 160, 200 or 250 Dual Archimedes Screw Pump
- Weir skimmer design
- In-line sweep apex skimmer
- Adjustable weir opening port
- Wheels to ease launching

Basic Physical Dimensions:	
Skimmer dimension:	Approx. 1.5 x 1.1 x 0.75m / 5 x 4 x 2.5 ft
Draft:	Approx. 0.72m / 2 ft when operating
Skimmer head:	Sea water resistant aluminum
Discharge connection:	4" Kamlock with built-in water injection flange
Pump type:	1 x DESMI DOP-200 Dual (option: DOP 160 or DOP 250-Dual)
Pump casing:	Sea water resistant aluminum
Discharge pressure:	13 bar / 186 psi max.
Pump viscosity range:	0 - > 1 million cSt
Solids size:	Ø 40mm (1½") max.
Pump capacity:	66m³/h / 291 gpm max. Other pump capacities depending on pump type
Hydraulic motor:	Danfoss OMTS 160
Hydraulic flow input:	0 – 130 l/min / 34 gallons
Hydraulic connections:	1 x ¾" P/R for pumps 1 x ⅜" P for drain 1 x ½" P/R for weir lip
Skimmer weight empty:	Approx. 150kg / 331 lb

DESMI Ro-Skim

Hose set connected to manifold of skimmer

DESMI Ro-Skim

Recovery of Ro-Skim with wheels

DESMI ZIPPER UMBILICAL HOSE (ZUH)

A revolutionary approach to the management of hydraulic & discharge hose systems commonly found between skimmers and power packs. The DESMI ZUH not only enhances safety when dealing with high-pressure hoses, but also allows for the inspection and replacement of damaged or aged hoses.

Usually hose bundles (hydraulic and discharge hoses) are tightened loosely together and have loose buoyancy floats that may catch edges or even come loose during operation.

The DESMI Zipper Umbilical Hose is manufactured from a very robust, flexible, heavy weight, abrasion resistant polymer. It has integral sealed foam floatation and a very special & unique zipper that allows for the opening and closing of the umbilical.

The Zipper, which runs the length of the umbilical, has high tensile strength but is flexible enough to allow the DESMI ZUH to be stored and deployed from traditional hose reel systems. The DESMI ZUH can be manufactured in various lengths to accommodate most hose sets including the longer configurations.

The DESMI ZUH can be supplied with any number of hydraulic hoses and sizes which are neatly tagged to the inner skin. In addition, the customer is free to use either lay flat or semi rigid discharge hoses thus increasing the flexibility of the DESMI ZUH.
As a standard, the DESMI ZUH comes in three different lengths. Two standard lengths and a short connection sleeve, which makes it possible to build up lengths from 20 to 70 meters / 66 to 230 feet in 10-meter / 33 ft steps. This goes for all three sizes.

DESMI ZUH

Zipper sleeve for hydraulic hoses

DESMI ZUH

Zipper sleeve for hydraulic hoses

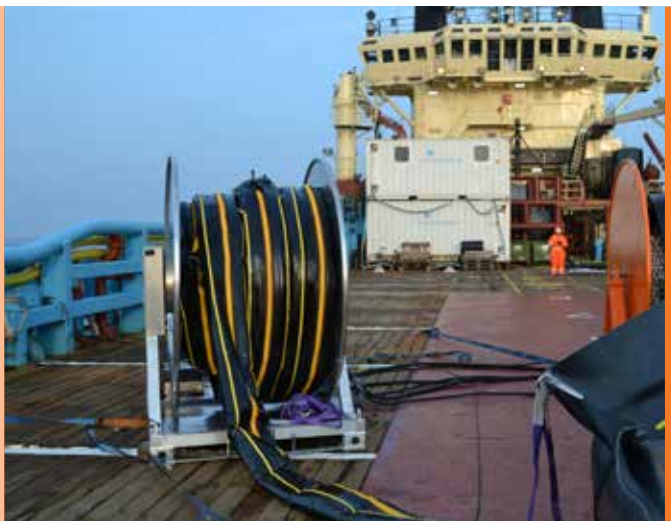
DESMI Zipper Umbilical Hose (ZUH)

DESMI Hose Reel is a durable and lightweight reel designed for transportation, storage and operation of large hose sets. It is hydraulic driven for easy deployment and recovery of up to 50m / 164 ft ZUH.

The hose reel is fitted with hydraulic connections on the side. The reel is easy to operate while operating the skimmer, even with part of the hose still wound on the reel.

The reel, completely made in marine grade aluminum, is equipped with ISO corners, lifting eyes at each bottom corner for lifting by crane. For forklift handling, forklift brackets are fitted under the reel frame.

Basic physical properties:	
Length: Length:	149cm / 59 in
Width:	181cm / 71 in
Height:	187cm / 74 in
Weight:	76kg / 186 lb
ZUH specifications:	Hose sleeves are available in three widths (minus zipper) 484mm / 19 in, 668mm / 26 in and 856mm / 34 in flat.
Cover layer:	OZ/yd2 PU Black
Inner layer:	PU/PVC Orange (900 gr/m^2 / 2 lb/m^2)
Floatation:	Closed cell PE-foam



DESMI Multipurpose Power Pack

The DESMI 50kW power pack is a multipurpose diesel driven power pack designed to supply the hydraulic oil flow to the DESMI skimmers as well as a hydraulic driven hose reel and boom winder. The hydraulic pump provides flow to the hydraulic circuits. Twin directional, proportional valves offer complete control of the skimmer operation, the speed of the reels and the air blower unit.

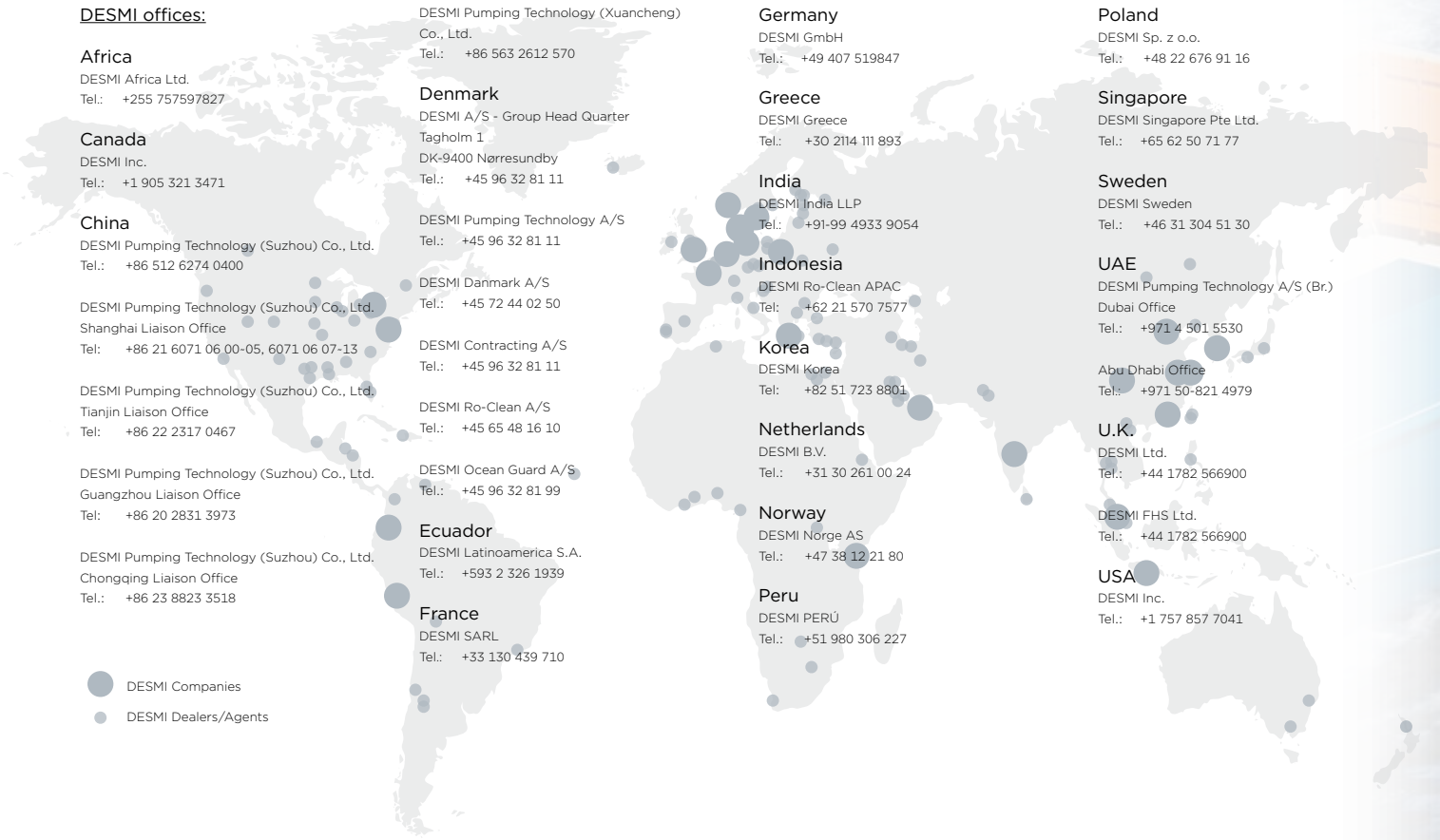
The high capacity air blower for boom inflation offers a typical airflow of 27m³/min / 119 gpm/min, delivered through the air hose set comprising of; 4" + 2 x 2" filling hoses including 4" quick coupling and two stainless steel air filling / emptying probes. The power pack frame is manufactured in steel and painted in highly visible orange. It has lifting eyes in the top corners for lifting by crane and 4-way forklift channels for safe handling by forklift.

20” Container comprising of 50kW Power Pack, DESMI Speed-Sweep 1500 and Guide Boom, ZUH-hose on Reel, Ro-Skim 1500 and Ro-Kite 1500.

Speed-Sweep is launched directly from container

ZUH hose and Speed-Sweep launched

Your DESMI contact for Oil Spill Response



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You can read more about our oil spill response solutions at www.desmi.com

MARINE & OFFSHORE | INDUSTRY | OIL SPILL RESPONSE | DEFENCE & FUEL | UTILITY

DESMI

The DESMI Speed Sweep.

7th March 2013.
Odense, Denmark.

DESMI

The DESMI Speed Sweep.

What it is & how it works.

The DESMI Speed Sweep is an advancing sweep system that can operate, collect and store oil at speeds of up to 3 knots without loss from the apex. The principle of operation is based on specially designed, high strength, flexible Kevlar cross members that slow the speed of the surface oil to prevent entrainment while in advancing mode. The Kevlar cross members are positioned across the apex of the boom. The physical size, shape and positioning of these member or inhibitors, are important and extensive testing and collaborative computer modelling has resulted in a proven product. The DESMI Speed Sweep has even been towed at speeds of up to 5 knots without damage or breakage. It can collect and store oil and can be off loaded using a traditional weir or oleophilic skimmer to pump out from the apex .The Sweep can operate with 2 vessels; 1 vessel and a jib arm and or 1 vessel and a boom vane. There are 3 basic sizes, 1500; 2000 and the Hi-Sors (High Seas) 3200 but other sizes can be easily accommodated. In addition to the basic models, the Speed Sweep swath width can be easily increased with the addition of Ro-Boom. Indeed, in a Hi-Sors version, there is a 750m swath and two sets of guide booms of 1.5kM each. An operational flexibility unique to the Speed Sweep.

TESTING.

The initial tests were conducted at Ohmsett by Applied Fabrics Technologies Inc (AFTI) and S.L. Ross on behalf of Exxon Production Research (EPR) in December 1998. This was part of their 'Fast Current Boom' project where they investigated the entrainment phenomena and ways to overcome it. The work was conducted under the direction of Dr. Andrei Chen, who was with Exxon Research. Dr Chen was behind the idea of inhibitors/barriers to reduce the speed of oil and prevent entrainment in an advancing mode. The DESMI Speed Sweep underwent further tests in 2009 at Odense & Kattegat using inflatable Ro-Booms. In 2010, tests were completed with NOFO in the months of March and June for the large, Hi-Sors, 3200 model. Then in May 2010 GPC, on behalf of the USA Navy, completed tests at Ohmsett. In addition to the extensive third party testing and verification, computational fluid dynamic (CFD) soft ware was employed to predict and model events. The correlation between actual and modelled confirmed that the DESMI Speed Sweep was a highly effective towable device to prevent the entrainment of oil in advancing mode. Separate test data and results are available.

OPERATION / CONFIGURATION

The DESMI Speed Sweep is available in 3 basic sizes, 1500; 2000 and 3200. For the purpose of this paper, we will focus on the popular and general 1500 Speed Sweep although reference will be made to the other models. The basic Sweep is mounted on a robust, steel reel with hydraulic drive, diesel hydraulic power pack and blower plus tow bridles. It is deployed in to the water apex first but there is an option to deploy the opposite way depending on how the system is recovered to the reel. Additional guide booms can be attached on one or both sides of the Speed Sweep to increase swath width if desired. The DESMI Speed Sweep easily lends itself to the use of Boom Vanes. The system would normally be operated 'behind' the vessel to give the lead tow line a low angle of attack and hence a more powerful 'pull' to the vane. It is also worthy to note that the Speed Sweep can be operated in 'significant' weather, typically up to 5-6 Beaufort. This is based on the Ro-Boom pedigree and proven technology.

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The DESMI Speed Sweep.

7th March 2013.
Odense, Denmark.

MATERIALS OF CONSTRUCTION

The Speed Sweep flexible fabric is the same as the world famous Ro-Boom material. It is extremely robust, abrasion resistant and proven in longevity. It has a special rubber compound with the addition of the Hypalon, external coating. This construction and coating exceeds any PVC, urethane and indeed nitrile material or coatings available in the market. Indeed, Hypalon coated rubber is the material of choice for most military rigid inflatable boats (ribs) for the very reasons mentioned above. The flow inhibitors are constructed with Kevlar adding to the strength of the system. Unlike other designs, the Speed Sweep can also be used in broken ice; high wax oils and debris due to its large 'throat' entrance and not being directed to and through a pinch point.

OIL STORAGE

The 1500 Speed Sweep has a significant volume for the storage of oil once collected. The gross storage is 48m3. In comparison to a 'similar' system, the DESMI Speed Sweep has twice the usable, net oil storage at 24m3 given at a conservative 50% of the available. All Speed Sweep sizes have significantly more storage volume than any other, similar product on the market. Once it is considered a sufficient thickness of oil exists, a separate skimmer, a vacuum hose or the optional onboard pump system can be operated to recover a very high oil to water ratio product. Similar to other systems, The DESMI Speed Sweep encourages the water to exit the lower apex leaving a high concentration of oil stored at surface and available for collection.

CONCLUSION & FEATURES

- Capable of encountering oil without entrainment at advancing speeds and in waves and significant weather
- Additional guide booms can be added to one or both sides of the Speed Sweep.
- Proven Ro-Boom, Hypalon material gives the best strength, durability and longevity.
- Single Point Inflation (SPI) is available and makes for a rapid and easy deployment
- Unlike other systems, the DESMI Speed Sweep can have a built in pump out system which eliminates the need to lower a skimmer in to the apex
- The Speed Sweep can be towed either between 2 vessels or 1 vessel with a jib arm or paravane.
- Full test data including Exxon Research and even collaborative CFD modeling
- The flow inhibitors can be easily replaced and maintained. A useful maintenance feature without having to replace the whole system.
- All systems can be power reel mounted for quick and easy deployment. The reels and storage containers can be DNV certified. .

DESMI is an engineering company that has been in business for nearly 175 years. Its range of Oil Spill Recovery equipment is known and used throughout the world. Customers include governments, response organizations, oil companies, exploration & drilling companies, Navy's, vessel operators plus ports and harbours.
For further information and brochures on this or other DESMI equipment please visit our web site www.desmi.com
Alternatively, please ask your local representative for further information.

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Account No.: 3201-4368023078

AFTI/DRC "SPEED SWEEP"
ADVANCING BOOM SYSTEM

Throughput Efficiency Calculations

Test #23 -- at 2.0 knots

Volume of Oil Collected

Oil collected into Ohmsett Recovery Tanks # 6, 7 and 8
Measurements 1 ¼", 3 ¾" and 14" = 19" total
19 x 5.83 gal/in = 110.8 gallons

TE = 110.8 (collected oil) = **92%**
120 gal encountered

Test #24 -- at 3.0 knots

Volume of Oil Collected

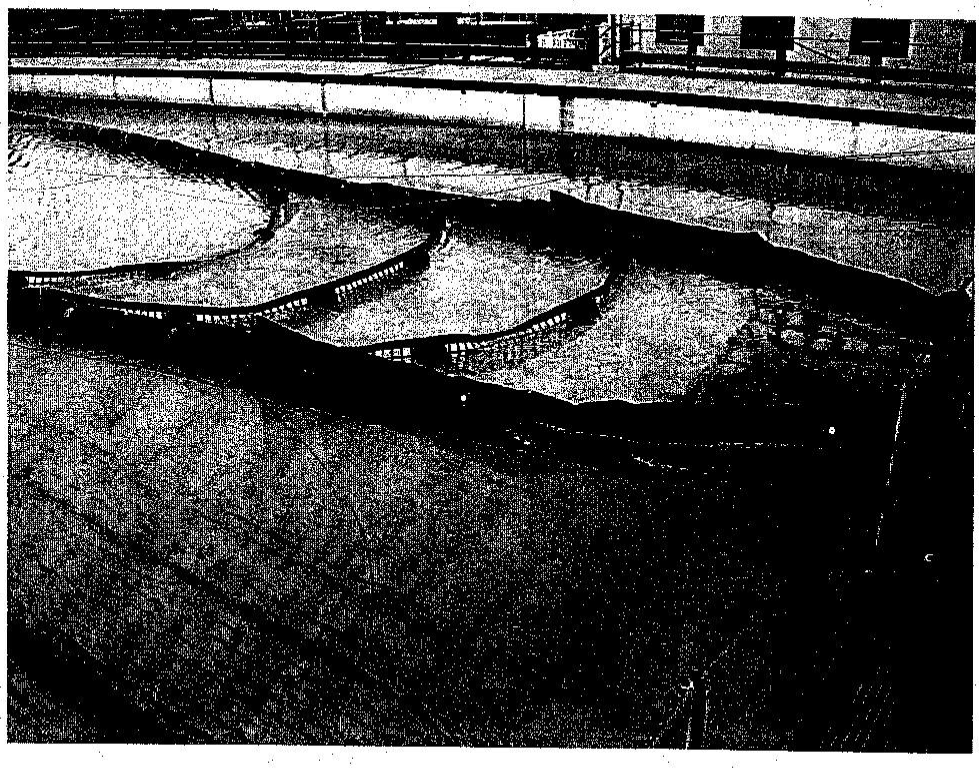
Oil collected into Ohmsett Recovery Tanks # 6, 7 and 8
Measurements 7 7/8",and 15 1/4" = 23 1/8" total
23 1/8 x 5.83 gal/in = 134.8 gallons

TE = 134.8 (collected oil) = **90%**
149 gal encountered

Contract No M07PC13061

Task Order 473

Evaluation of Applied Fabric Technologies / Ro-Clean Desmi 'SpeedSweep' Boom for Global PCCI Joint Venture (GPC) at Ohmsett



May 10 – 14, 2010

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EXECUTIVE SUMMARY

EVALUATION OF THE AFTI/DRC "SPEED SWEEP" ADVANCING BOOM SYSTEM

During the week of 5/10/2010 the Applied Fabric Technologies, Inc. / Desmi Ro-Clean (AFTI/DRC) new advancing boom system was evaluated at the Ohmsett Test Facility. The Speed Sweep is a newly designed and fabricated prototype system incorporating numerous years of knowledge and experience of leaders in the oil spill equipment industry with research previously performed at Ohmsett. A main objective is to test the; the effectiveness of flow inhibitors (netting) when used perpendicular to the direction of tow within a catenary boom to reduce relative flow velocities in the catenary apex.

The Speed Sweep is primarily a rubber boom system comprised of sweep legs (standard USS-26 boom) measuring 54' long and 52' wide at the mouth narrowing to 26' at the transition section. The transition section is 33' long and narrows to approximately 20' at the mouth of the apex collection area. Spanning across the transition section there are three rubber nets designed to reduce relative flow velocity in the direction of tow. The collection area is constructed of modified inflatable Ro-Boom 1300 and vented rubber panels secured to the skirts forming a virtual tank bottom. Ballasted line is attached at the tank bottom leading edge to provide a tension member and help to maintain shape when advancing. The connection bridle is a standard navy style connector (similar to a shot gun connector).

The test series began with tows at 1.0, 1.5, 2.0 and 2.25 knots in calm water and 3.0 knots with approximately a 1.9 Hz -16" wave to evaluate the performance of the system, (test 1-5). As a result of observations, adjustments and changes were made to the system. A total of eight more tow tests were performed at speeds ranging from 1.0 to 3.0 knots during which adjustments were made and satisfactory behavior of the boom system was achieved (tests 6-13).

There were two objectives during subsequent oil testing: one; determine first and gross oil loss at relative current speeds (tow speeds) as per ASTM 2084-01 and two; determine the throughput efficiency of the Speed Sweep as a system. Table 1 defines the test parameters performed and the results. First loss tests are performed by accelerating the system to a speed below which first loss may occur, allow the system to stabilize and then incrementing speeds until first loss is identified. First loss is defined as the speed at which oil is observed to continually escape the boom. The test oil used was Hydrocal 300, at test temperature the viscosity was 280cPs and the S.G. was .90.

Throughput efficiency tests were performed by advancing the system at a constant speed while encountering the equivalent of a slick 0.5mm thick. Test began with an empty apex (collection area) from which oil was recovered for measurement. During all testing, qualitative evaluation of the system was an important aspect in which decisions and performance results achieved were based. As such, to fully understand the capabilities of

the Speed Sweep requires a review of above and underwater video and still photography. Relative current measurements were obtained at approximately 6" below the water line in the apex collection area and in the space between the second and third cross net. The results are included within the daily test log section.

Test #	Type of Test	Dist Rate – 0.5mm slick (gpm)	Results
22	Throughput efficiency test at 1.0 knots	65	No Losses/ 100% efficient
23	Throughput efficiency test at 2.0 knots	130	Minor Losses observed at netting-refer to video for qualitative assessment. Measured TE = 92%
24	Throughput efficiency test at 3.0 knots	195	Measured TE = 90%
25	First Loss- after apex chain removal	Nom-300	2.5 knots
26	First Loss- after apex chain removal	Nom-600	2.4 knots
27	First Loss- after apex chain removal	Nom-900	2.3 knots

Test in Odense Harbour January 2009

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System speed up to 3,5 knots, without exceeding 1,0 knot in apex

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First tests

Test in Kattegat April 2009

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Test on G Thorson performed with rape seed oil

Test in Norway (NOFO)

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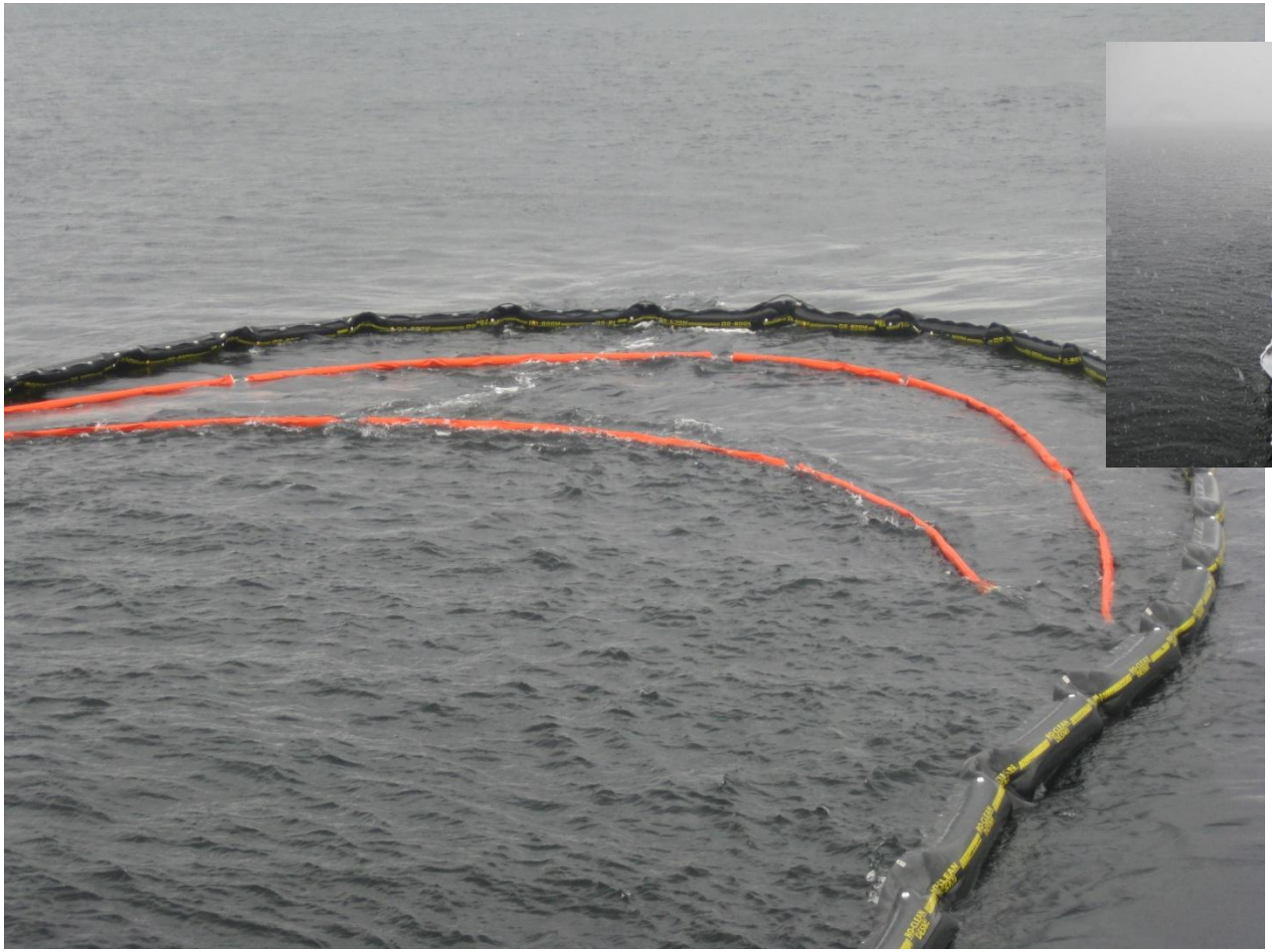
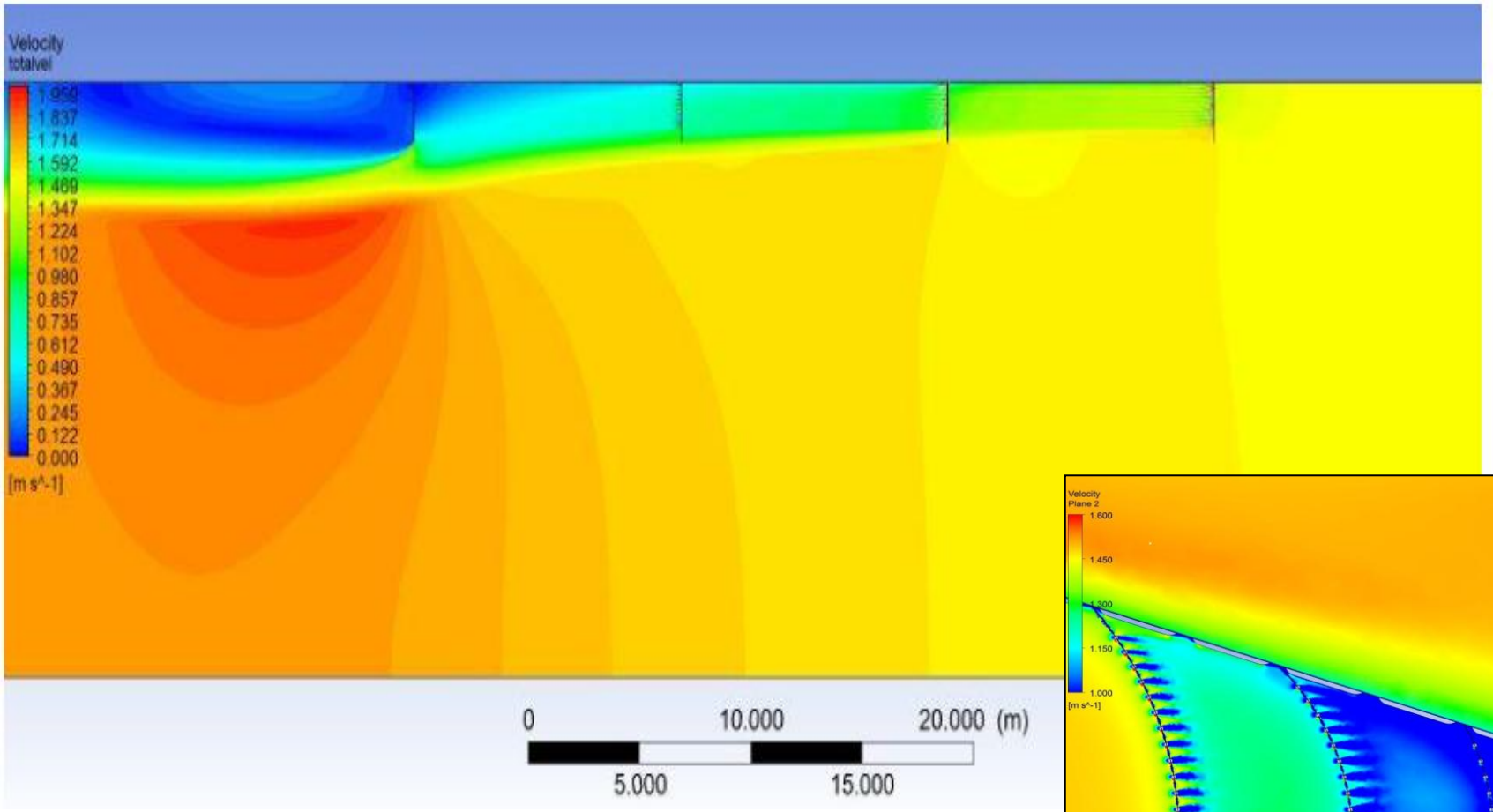


CFD Analyses



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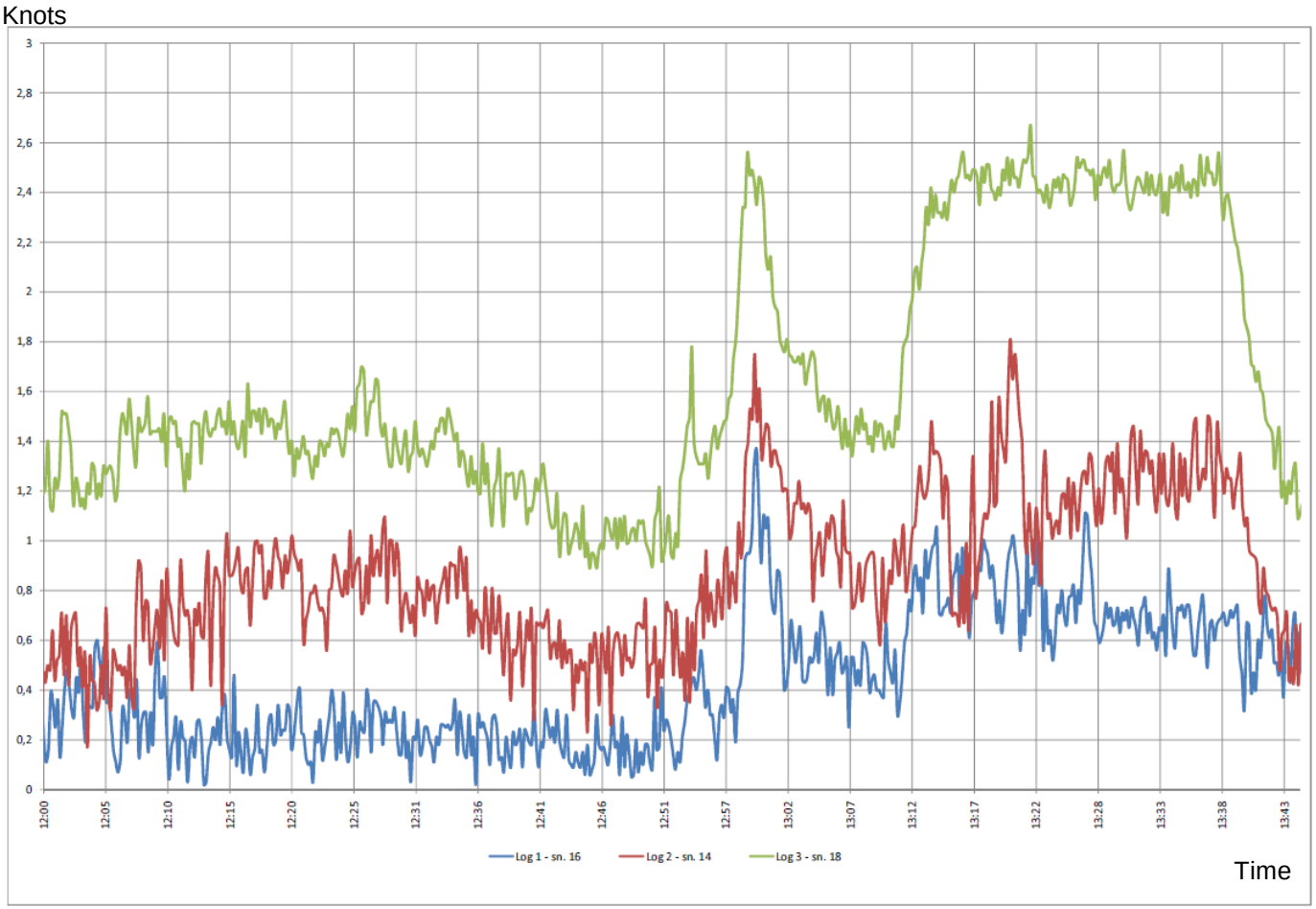
Test in Kattegat April 2009

DESMI



Readings from Doppler-logs

Ohmsett test facility USA

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With oil

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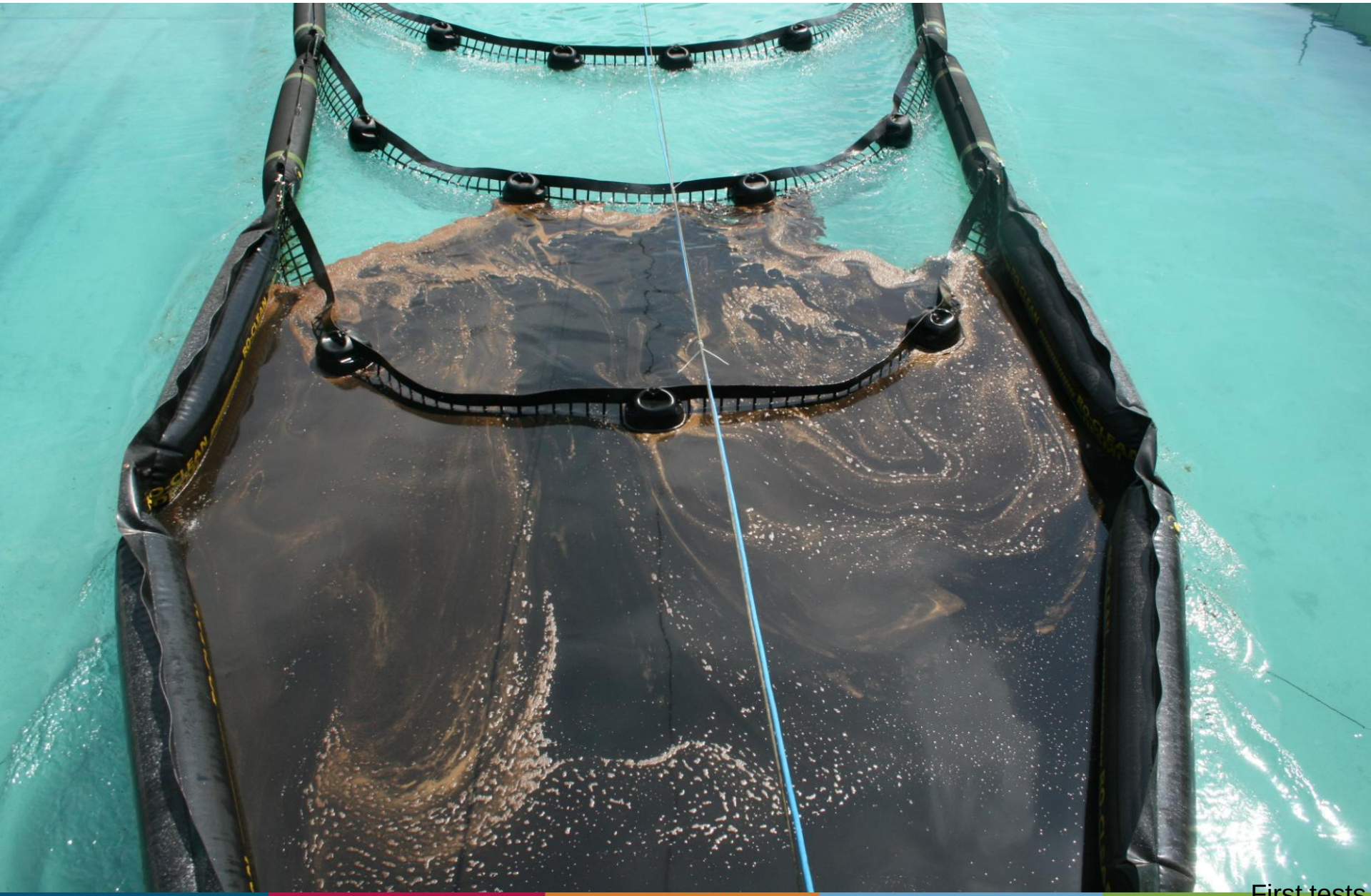

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First tests

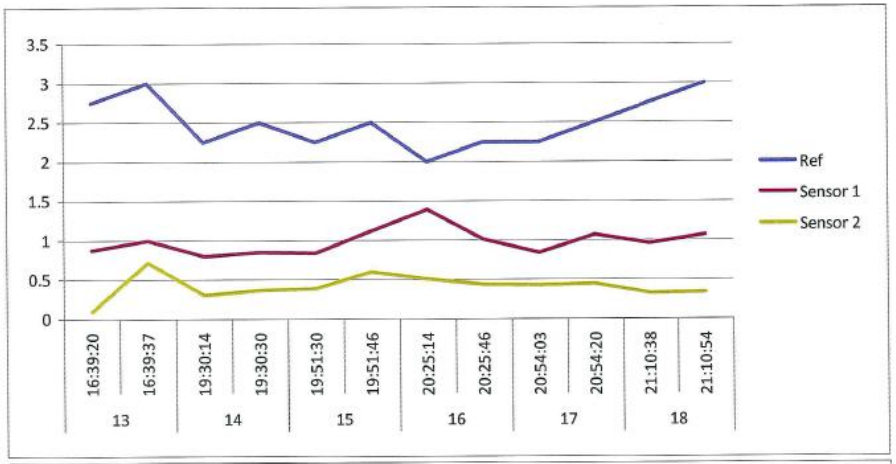
SPEED SWEEP

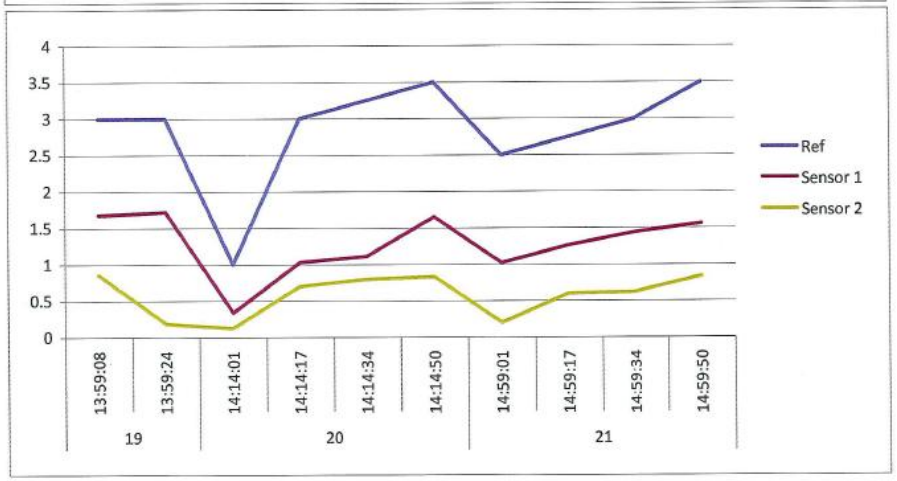
Onsdag 12.05.10

Test No	Time	Ref	Sensor 1	Sensor 2
13	16:39:20	2.75	0.88	0.1
	16:39:37	3	1	0.72
14	19:30:14	2.25	0.8	0.31
	19:30:30	2.5	0.85	0.37
15	19:51:30	2.25	0.84	0.39
	19:51:46	2.5	1.12	0.6
16	20:25:14	2	1.39	0.51
	20:25:46	2.25	1.01	0.44
17	20:54:03	2.25	0.84	0.43
	20:54:20	2.5	1.07	0.45
18	21:10:38	2.75	0.96	0.33
	21:10:54	3	1.07	0.34

Torsdag 13.05.10

Test No	Time	Ref	Sensor 1	Sensor 2
19	13:59:08	3	1.68	0.86
	13:59:24	3	1.72	0.19
20	14:14:01	1	0.34	0.13
	14:14:17	3	1.03	0.7
	14:14:34	3.25	1.11	0.8
	14:14:50	3.5	1.65	0.83
21	14:59:01	2.5	1.02	0.2
	14:59:17	2.75	1.26	0.6
	14:59:34	3	1.44	0.62
	14:59:50	3.5	1.56	0.84





Readings from Doppler-logs