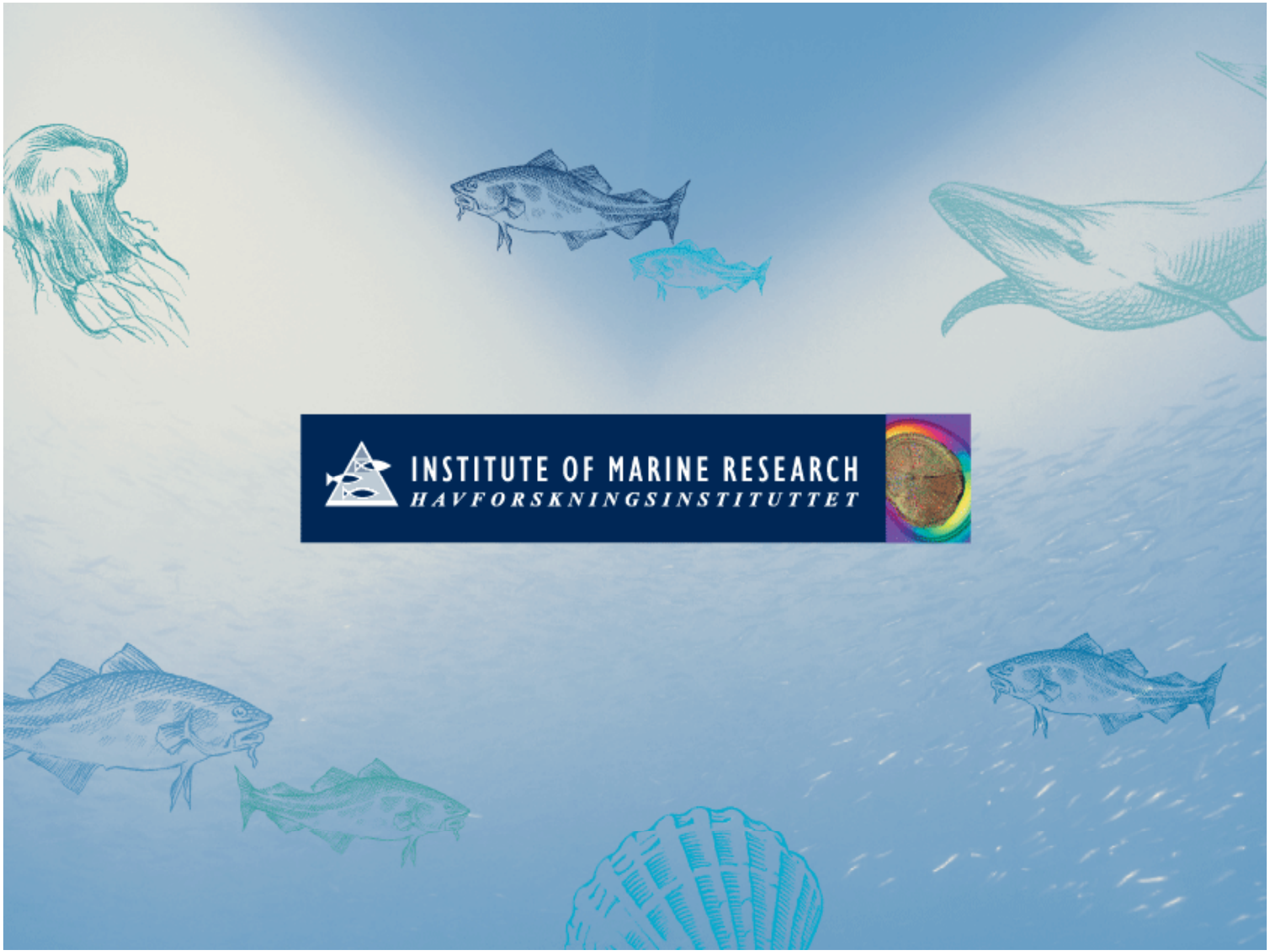
INSTITUTE OF MARINE RESEARCH
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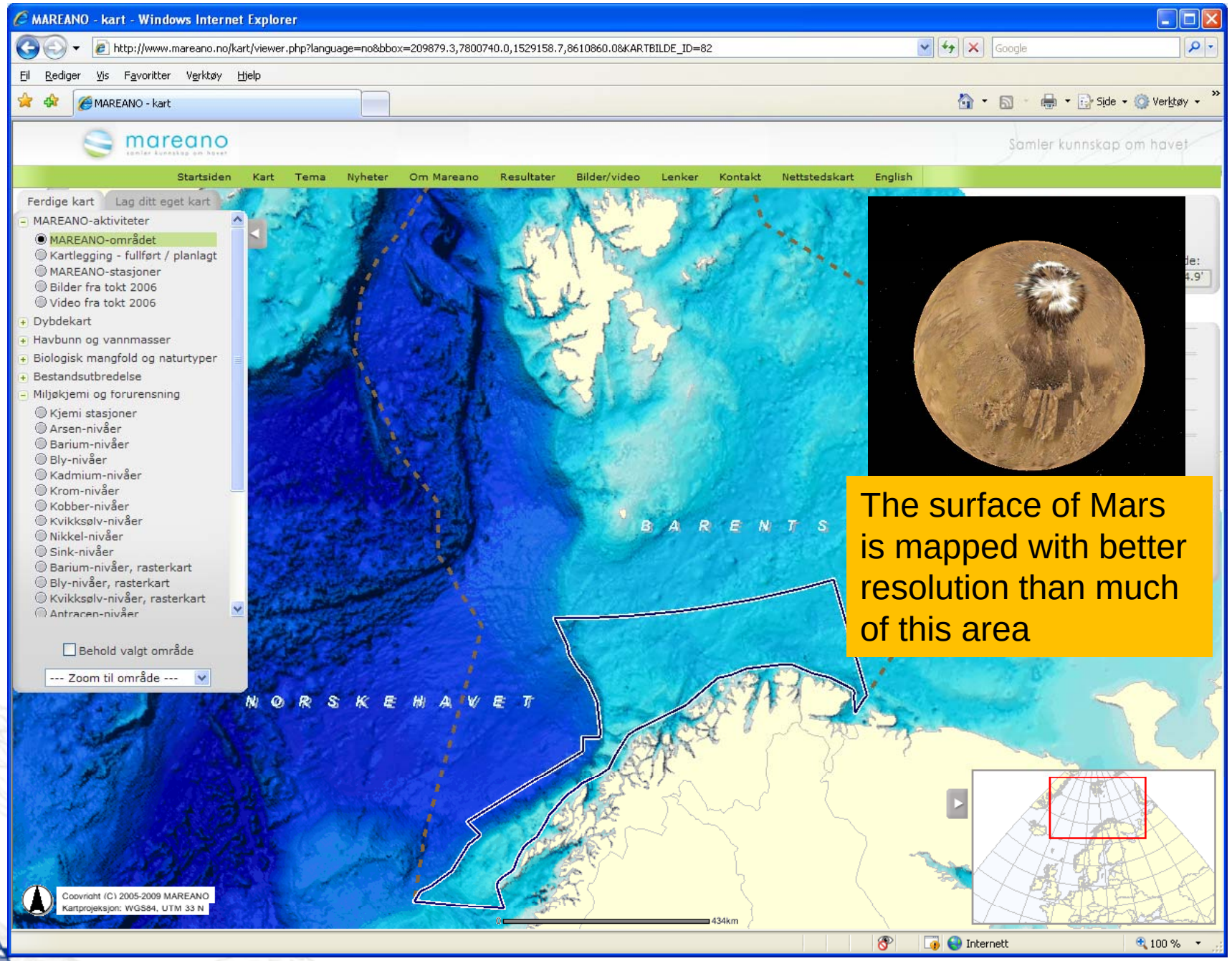
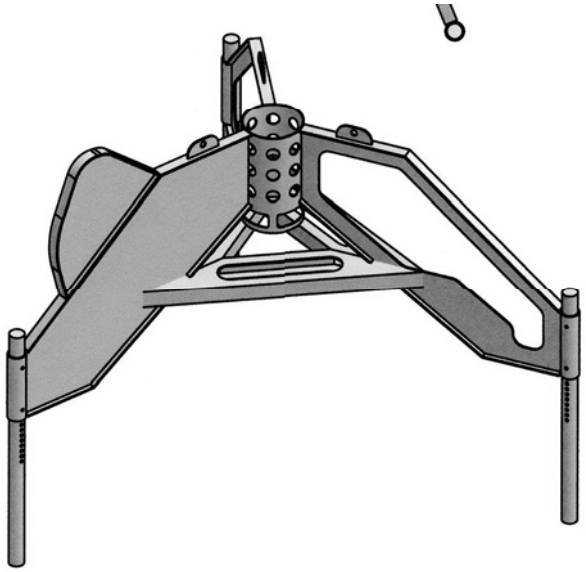
Synthetic cable for deep sea camera, update 2010

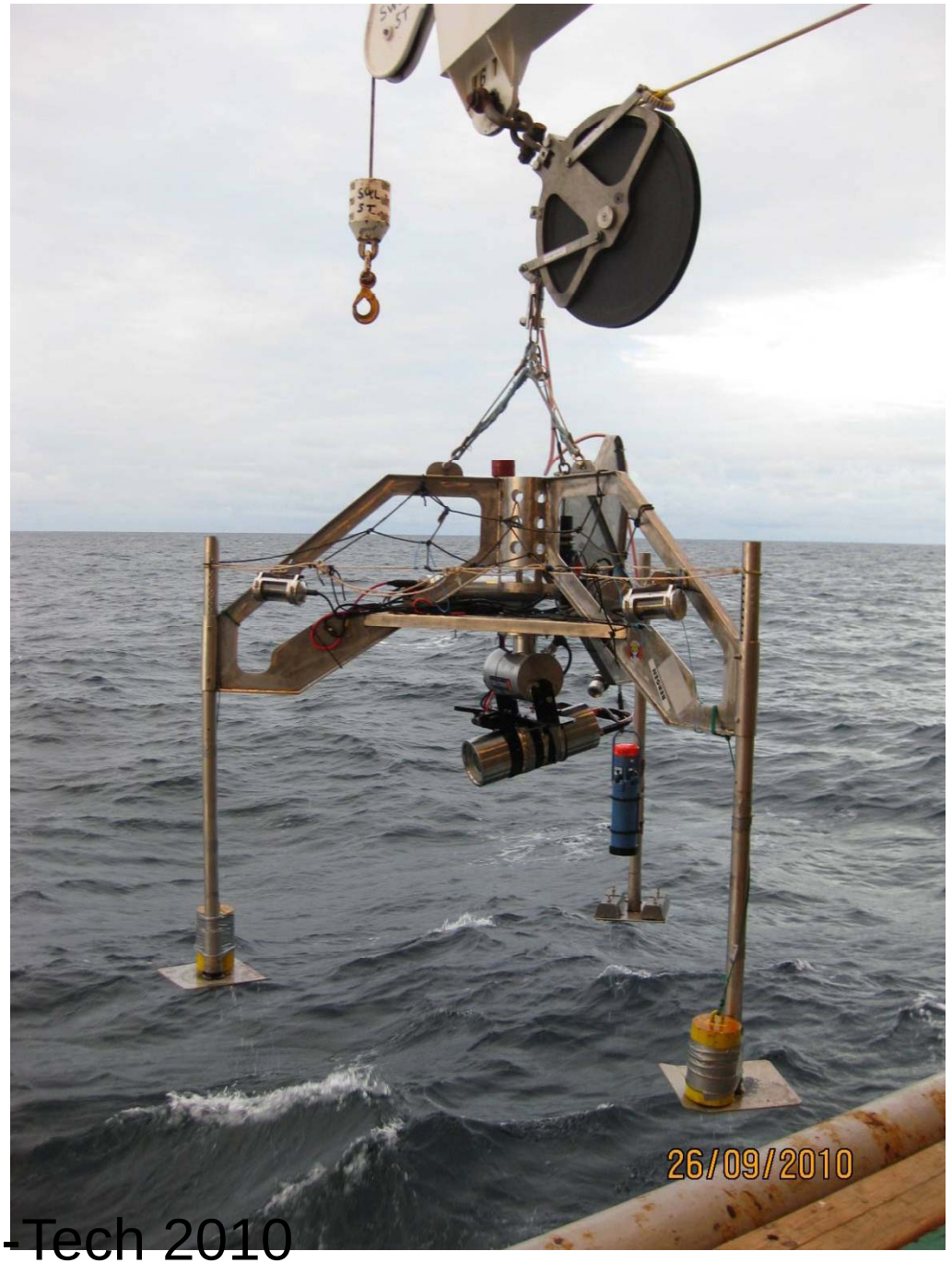
Hans Petter Knudsen

Ofeg-Tech Barcelona 24 -25 November 2009
Ofeg-Tech Kiel 1 – 2 December 2010

INSTITUTE OF MARINE RESEARCH
HAVFORSKNINGSINSTITUTTET


MAREANO - kart - Windows Internet Explorer
http://www.mareano.no/kart/viewer.php?language=no&bbox=209879.3,7800740.0,1529158.7,8610860.0&KARTBILDE_ID=82
Fil Rediger Vis Favoritter Verktøy Hjelp
MAREANO - kart
mareano
Samler kunnskap om havet
Startsiden Kart Tema Nyheter Om Mareano Resultater Bilder/video Lenker Kontakt Nettstedskart English
Ferdige kart
Lag ditt eget kart
MAREANO-aktiviteter
MAREANO-området
Kartlegging - fullført / planlagt
MAREANO-stasjoner
Bilder fra tokt 2006
Video fra tokt 2006
Dybdekart
Havbunn og vannmasser
Biologisk mangfold og naturtyper
Bestandsutbredelse
Miljøkjemi og forurensning
Kjemi stasjoner
Arsen-nivåer
Barium-nivåer
Bly-nivåer
Kadmium-nivåer
Krom-nivåer
Kobber-nivåer
Kvikksølv-nivåer
Nikkel-nivåer
Sink-nivåer
Barium-nivåer, rasterkart
Bly-nivåer, rasterkart
Kvikksølv-nivåer, rasterkart
Behold valgt område
--- Zoom til område ---
BARENTS
NORSKEHAVET
The surface of Mars is mapped with better resolution than much of this area
Copyright (C) 2005-2009 MAREANO
Kartprojeksjon: WGS84, UTM 33 N
434km
Internett
100 %





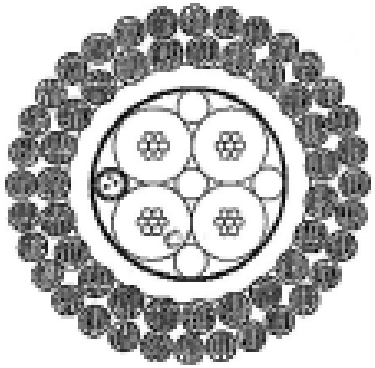
Campod

Mareano project

http://www.mareano.no/

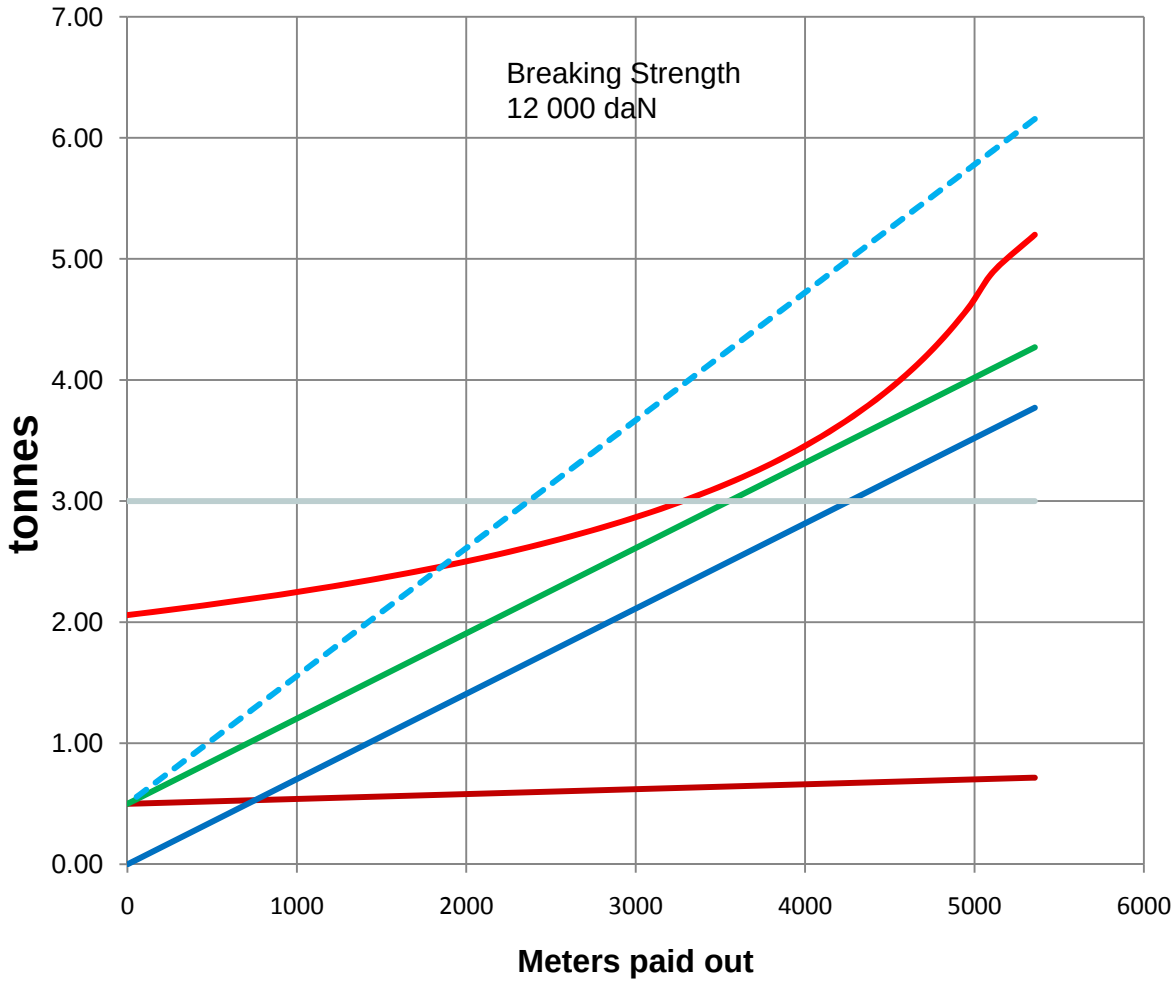
Vendor:
Sperre AS, Norway

http://www.sperre-as.com/no



	Steel armoured cable	Aramid armoured cable
Diameter	16 mm	18.5 mm
Breaking strength	126 kN	240 kN
Recommended WL max	25 kN	20 kN
Weight in air	887 kg/km	310 kg/km
Weight in seawater	704 kg/km	35 kg/km
Minimum bend diameter	800 mm	800 mm
Electrical conductors	4 x 1 mm^2	2 x 1 mm^2
Optical conductors	3 x Single Mode fiber	3 x Single Mode fiber

The original steel armoured cable was too heavy for operation on the deepest stations (>3000 m)



Nexans

Technical Description

ARAMID ARMOURED UMBILICAL

Document no.: RA427

Unit content:

UNIT-P1	Power conductor, 1mm², 4.5kV	2 off
UNIT-FO	Fibre optic element, 4SM	1 off

D-6902 Issue 3

Material description: Gs(4)+2x1mm² FMAM

Material no.: 10193666

Tender no.: KI-008/09

Contract no.:

Issue no.	Date	Document status	Prepared by	Approved by	Released by
03E	23.04.09	Approved for Construction	MHY	ANK	IJV
02T	20.01.09	Issued for Tender	MHY	ANK	IJV
01T	12.01.09	Issued for Tender	MHY	ANK	IJV

Revision / Status coding:

Issued for Tender	XXT	Issued for Company Comment (Review)	XXR
Issued for DIC / IDC (Draft)	XXD	Approved for Construction	XXF
		As-Built	XXA

Nexans

Nexans Norway AS, P.O. Box 6450 Etterstad, N-0605 Oslo, Norway

3. CABLE DESIGN

3.1 Element details

Process/ Material		Nom. thickness (mm)	Nom. outer diameter (mm)
UNIT-FO	**Fibre Optic element**		
Optical fibre	4SM (9/125µm)		0.25
Tube	Steel tube with filling compound	0.15	1.5
Sheath	Polypropylene, natural		3.2
UNIT-P1	**Power conductor, 1mm², 4.5kV**		
Conductor	Cu, 1mm²	7x0.43	1.3
Insulation	Semiconducting polypropylene Insulating polypropylene, colour coded		3.2

3.2 Element lay-up

Process/ Material		Nom. thickness (mm)	Nom. outer diameter (mm)
1st-layer			
UNIT-P1	Power conductor, 1mm², 2 off	3.2	7.1
UNIT-FO	Fibre optic element, 1 off	3.2	7.1
Filling	Soft adhesive compound		
Screen	Semicond.insul. 0.35mm² Cu, 3 off Cu/polyester laminate	1.6	7.3
Inner sheath	Thermoplastic polyester, orange		9.7
Armouring	Aramid, 4 layers		16.2
Outer sheath	Thermoplastic polyester, yellow		18.5

3.3 Characteristics

Physical characteristics	Unit	Nominal value	±
Cable outer diameter	mm	18.5	1
Weight in air, approx.	kg/km	310	
Weight in seawater, approx.	kg/km	35	
Minimum dynamic bending diameter	mm	800	
Armouring breaking strength	kN	240	
Safe working load	kN	20	

Electrical / Optical characteristics (target values)	Unit	Nominal value	±
UNIT-FO Fibre Optic element			
SINGLEMODE FIBRE:			
Attenuation @ 1310nm	dB/km	<0.6	
Attenuation @ 1550nm	dB/km	<0.4	
UNIT-P1 Power conductor, 1mm², 4.5kV			
DC resistance, max	Ω/km	20	
Insulation resistance @ 500 V DC	GΩ-km	>5	
HV test for 5 min.: Conductor - screen	kV DC	16	

3.4 Cable marking

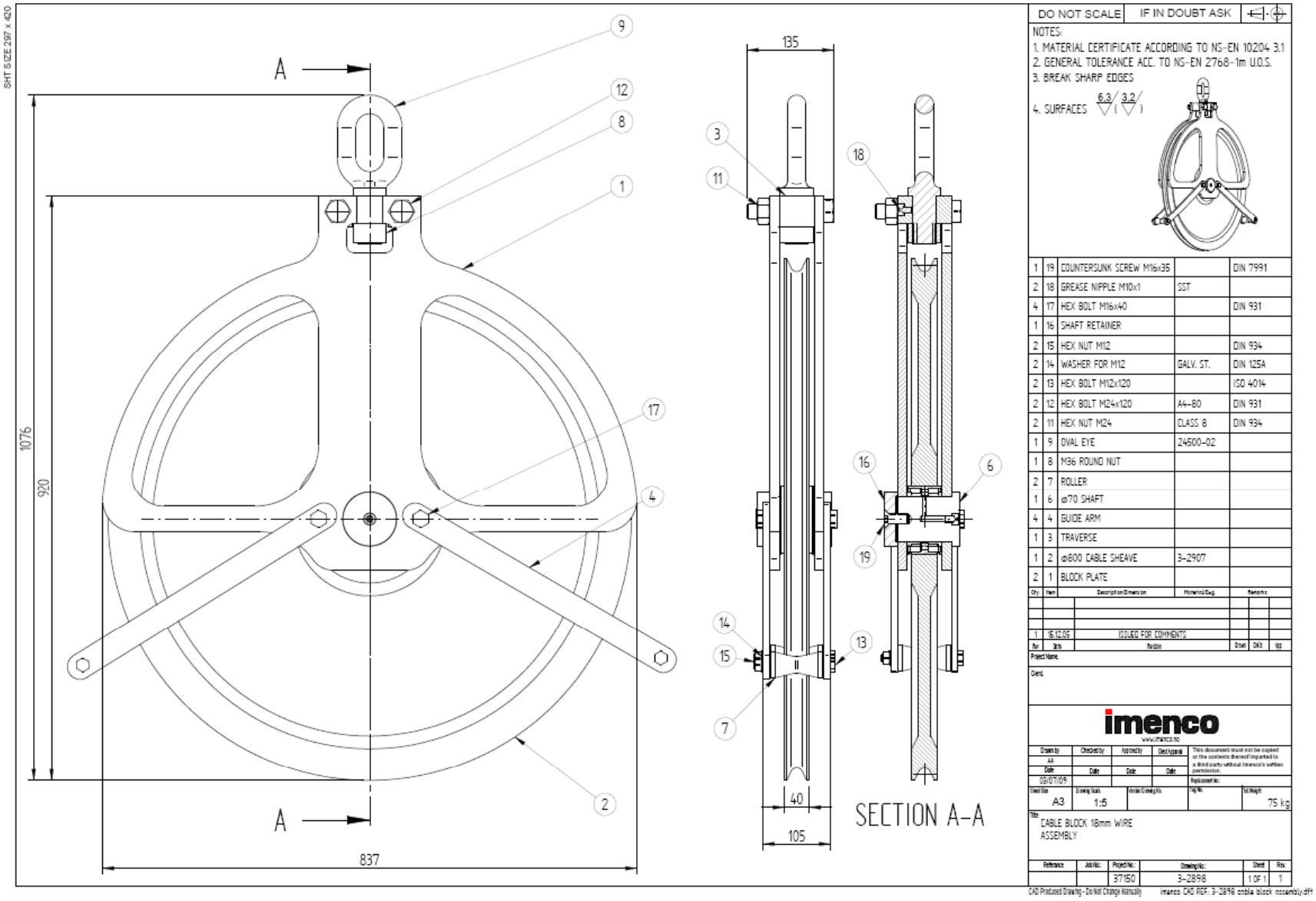
Element	Marking		
UNIT-P1	Conductor #1-#2: Blue and orange		
UNIT-FO	Natural	4SM fibres:	Red, green, blue, yellow
SHEATHS	<Production order no.> Nexans Norway High Voltage <year>, <meter>		

4. CROSS-SECTIONAL DRAWING

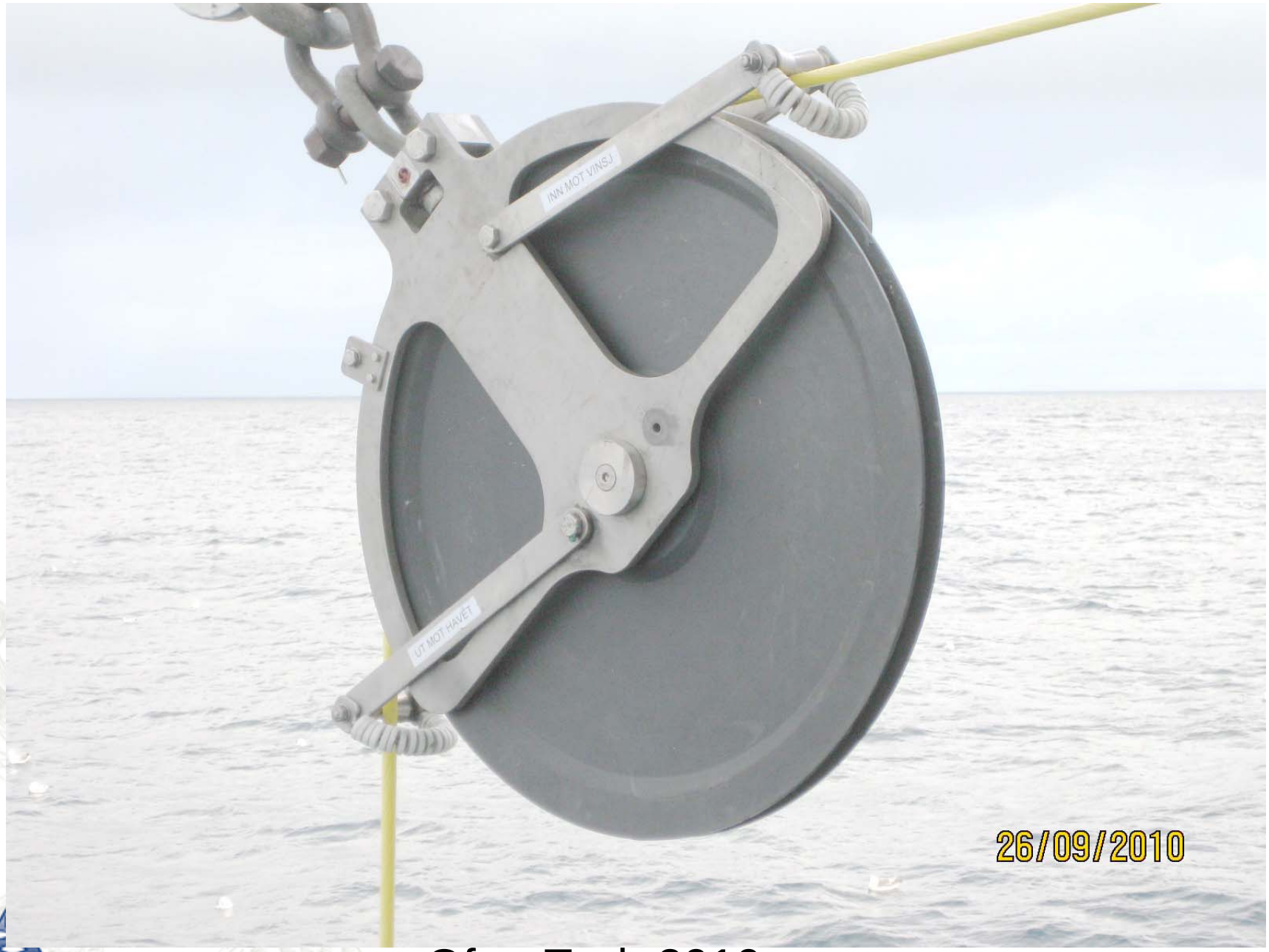
D-8902 Issue 3

5. AMENDMENT LIST

Issue no.	Date	Amendments
03E	23.04.09	• Document status updated to Approved for Construction. • Removed option 2. • Updated from 2 to 4 aramid layers.
02T	20.01.09	Replaced UNIT-P2.5 with UNIT-P1.
01T	12.01.09	First edition.



Cable sheave special designed


INN MOT VINSJ
UT MOT HAVET
26/09/2010

Strain relief with integrated counterpart for the latch

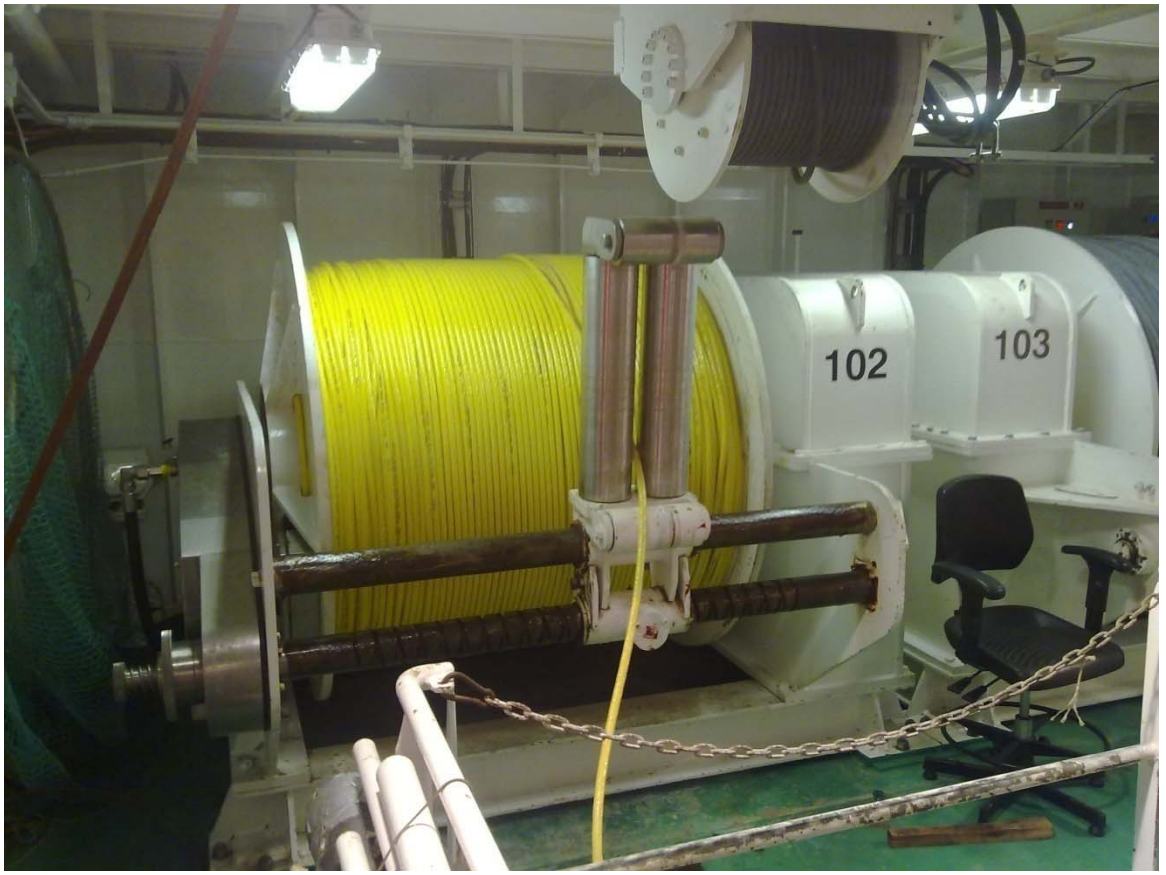
Makers list

Aramid armoured cable	Nexans Norway AS http://www.nexans.no
Strain relief	Seaproof Solutions AS http://www.seaproof.com/ Imenco AS http://www.imenco.no/
Termination and installation of cable	Seaproof Solutions AS
Cable sheave	Imenco AS

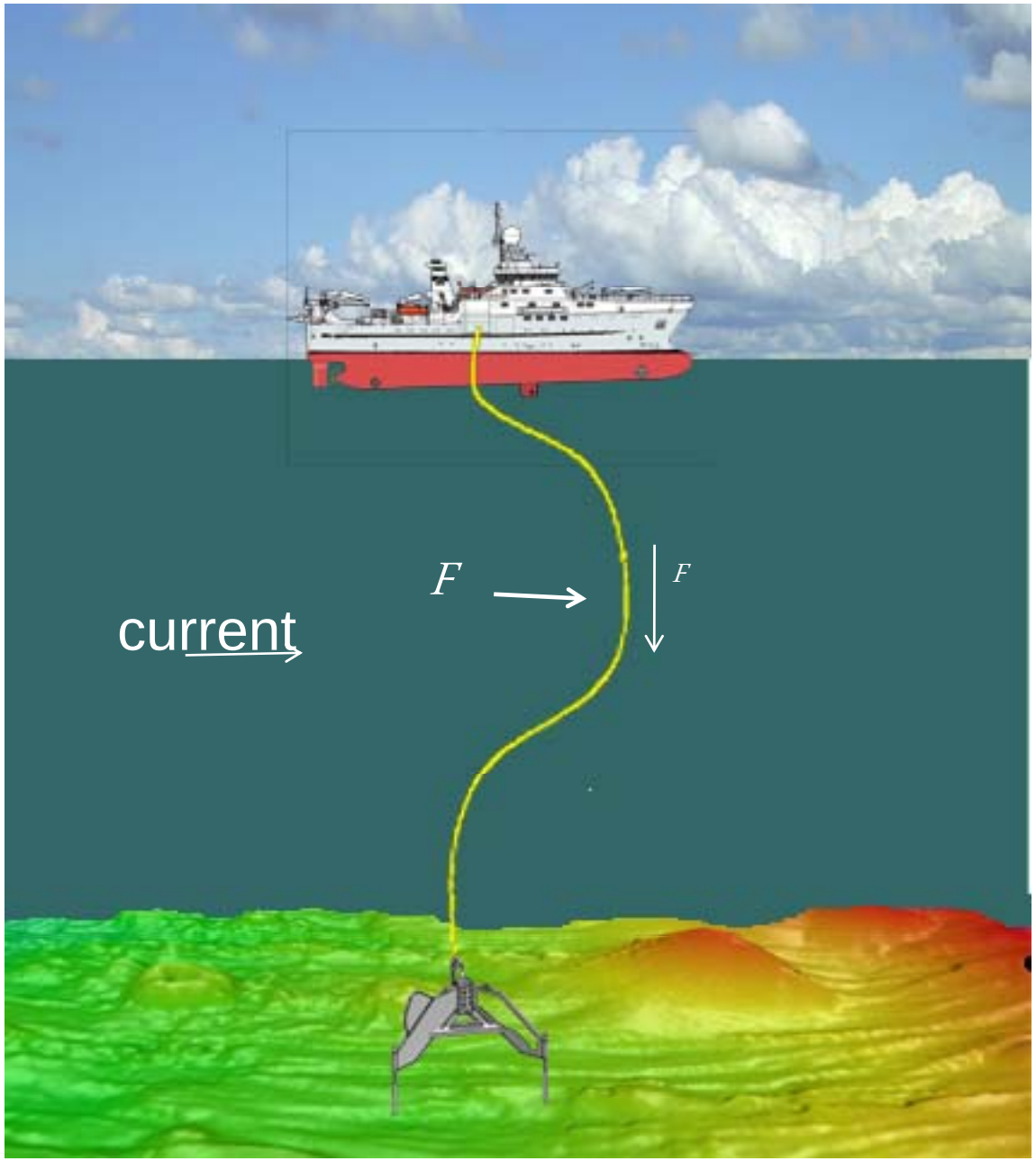
Originally the factory had spooled the cable to the transport reel with 7 kN tension. By a mistake the cable was spooled to the winch without tension.

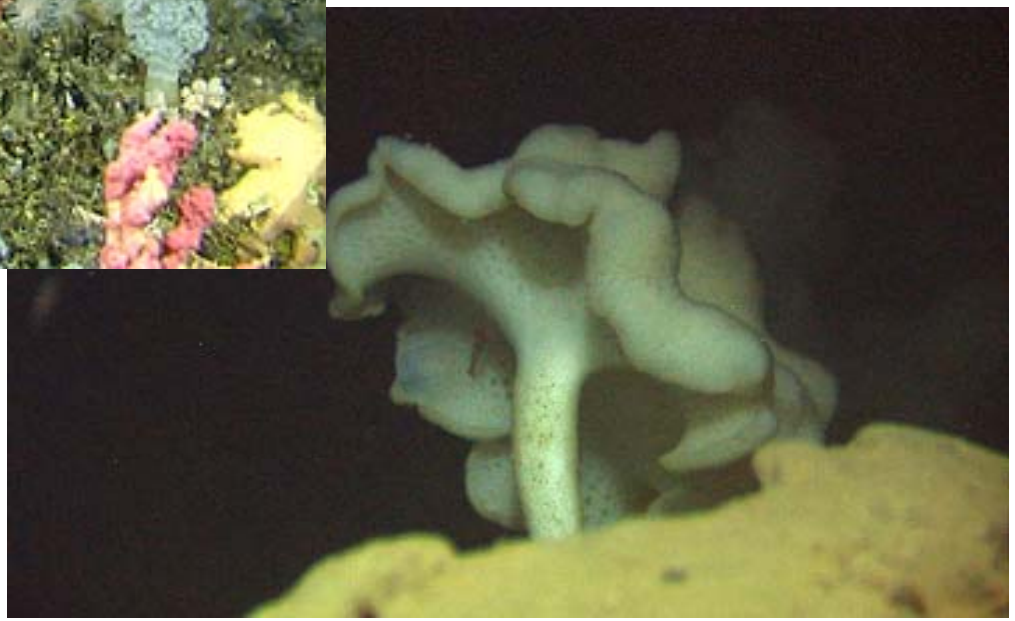
At the first station, when a few layers were payed out, problems caused by loose spooling occured.

After an operation with almost all cable payed out with a dummy load on deep water, the problem was solved, and the spooling was reasonable good.



The Campod is towed above seabed in transects, and landed regularly for detais studies.





In 2010 the Campod has been used on several transects down to 2100 m without any problems.

Thank you for your attention.