



The Sub-Bottom Imager™

New 3D Sub-Bottom Investigation Tool
For ROV Deployment

6th BIENNIAL NRC-IOT
WORKSHOP ON UNDERWATER VEHICLE
TECHNOLOGY

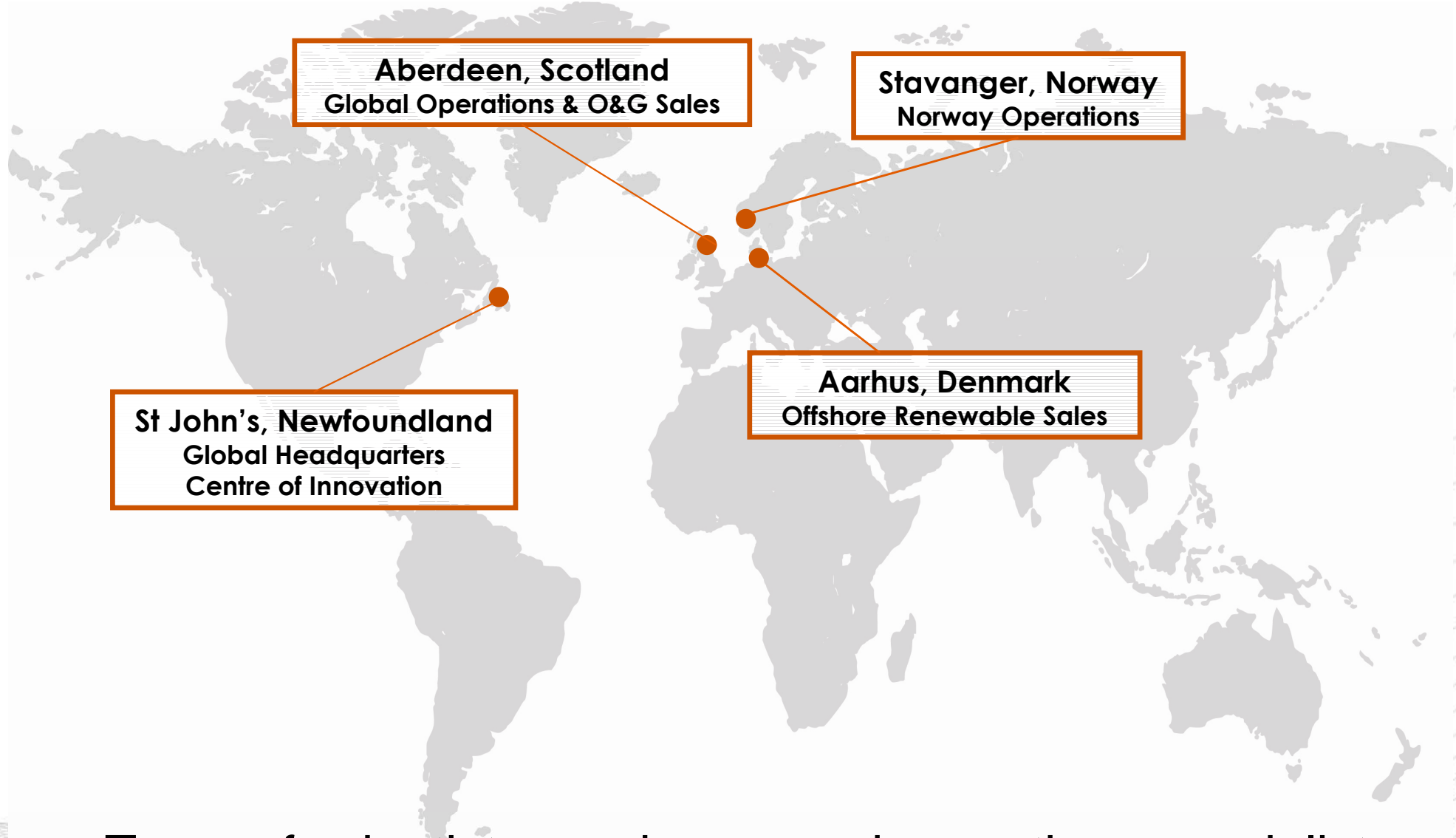
Gary J. Dinn, P.Eng.,
Vice President

- Technology development and service delivery company specializing in acoustic solutions to mitigate risk.
- Providing answer products that create unique value for our clients.
- Established in January 2006
- Equity Investment
 - Energy Ventures 2006
 - Lime Rock Partners 2009
 - Chevron Technology Ventures 2009
- ISO 9001: 2008 registered
- Academic Partnerships

energy ventures 



PanGeo Subsea Global Offices



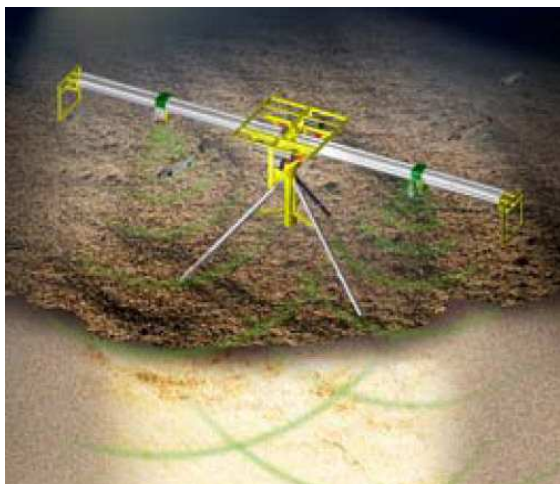
Team of scientists, engineers and operations specialists

Sub-Bottom Imager



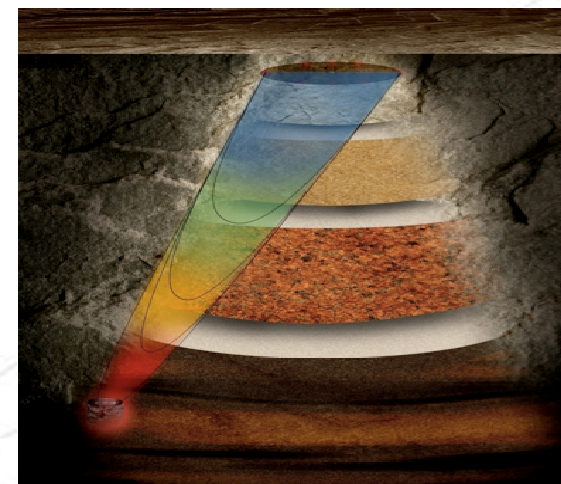
Interrogates to 5 m

Acoustic Corer



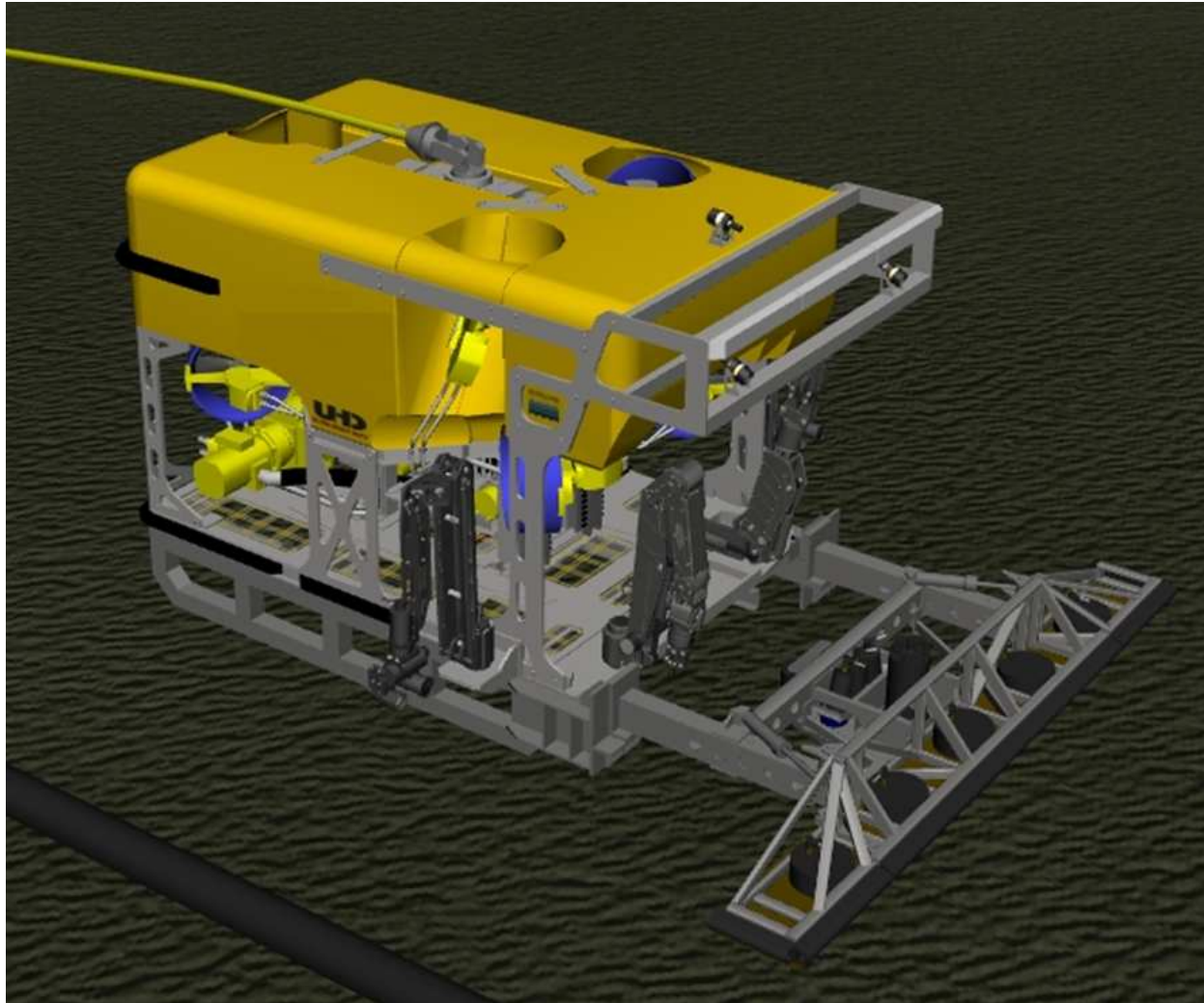
Interrogates to 60 m

Acoustic Zoom



Interrogates 6000 m

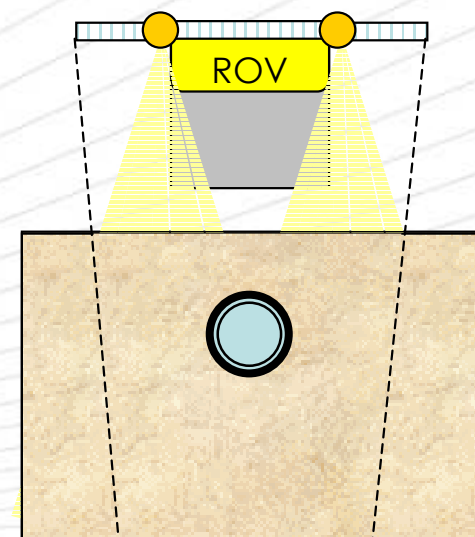
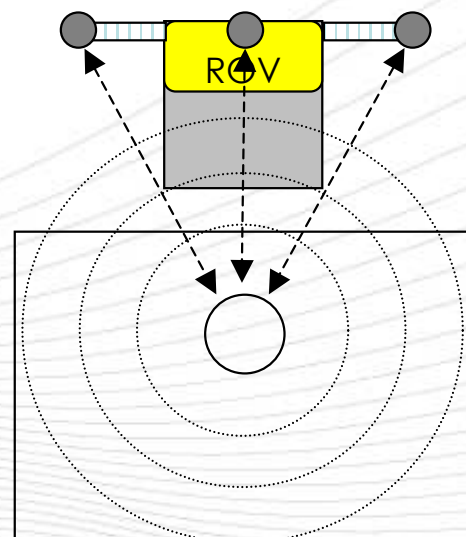
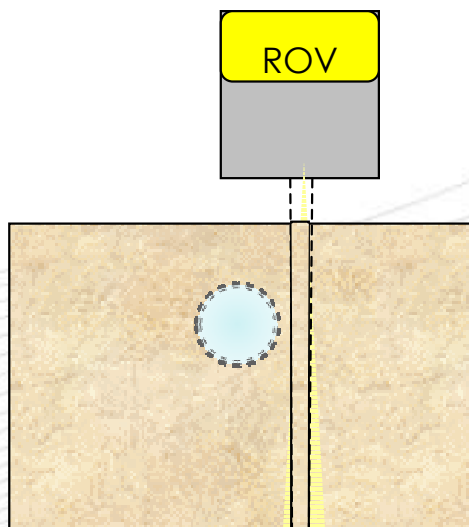
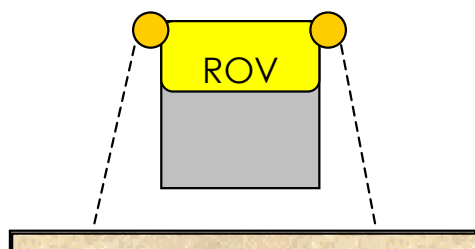
Sub-Bottom Imager™



- ROV Mounted
- 3D Volumetric images
- 5M wide x 5M deep swath below seafloor
- Applications
 - Pre-engineering surveys
 - Out-of-straightness / integrity surveys
 - Pipeline/cable surveys
 - UXO detection
 - Archeology

Pipe/Cable Inspection – Current Technologies

Conventional sidescan sonar & multi-beam	Sub-bottom profiler	Magnetometer	3D Sub-Bottom Imager PanGeo Subsea
Tritech, Kongsberg, Ulvertech etc.	Edgetech, Kongsberg, Ixsea, Innomar etc.	Innovatum, TSS	
Positional information but surface features only – no buried pipe imaging. Can only track exposed pipe.	Sub-seabed but single 2D line, low resolution, no positional information, cannot remain over pipe.	Field measurement, inferred position requires pipe details. Less accurate burial. Metallic only. Weak in areas of high debris.	Sub-seabed, 3D image, full swathe, able to track buried pipe. Accurate depth of burial. Non-metallic target imaging.



SBI top-level sonar design parameters

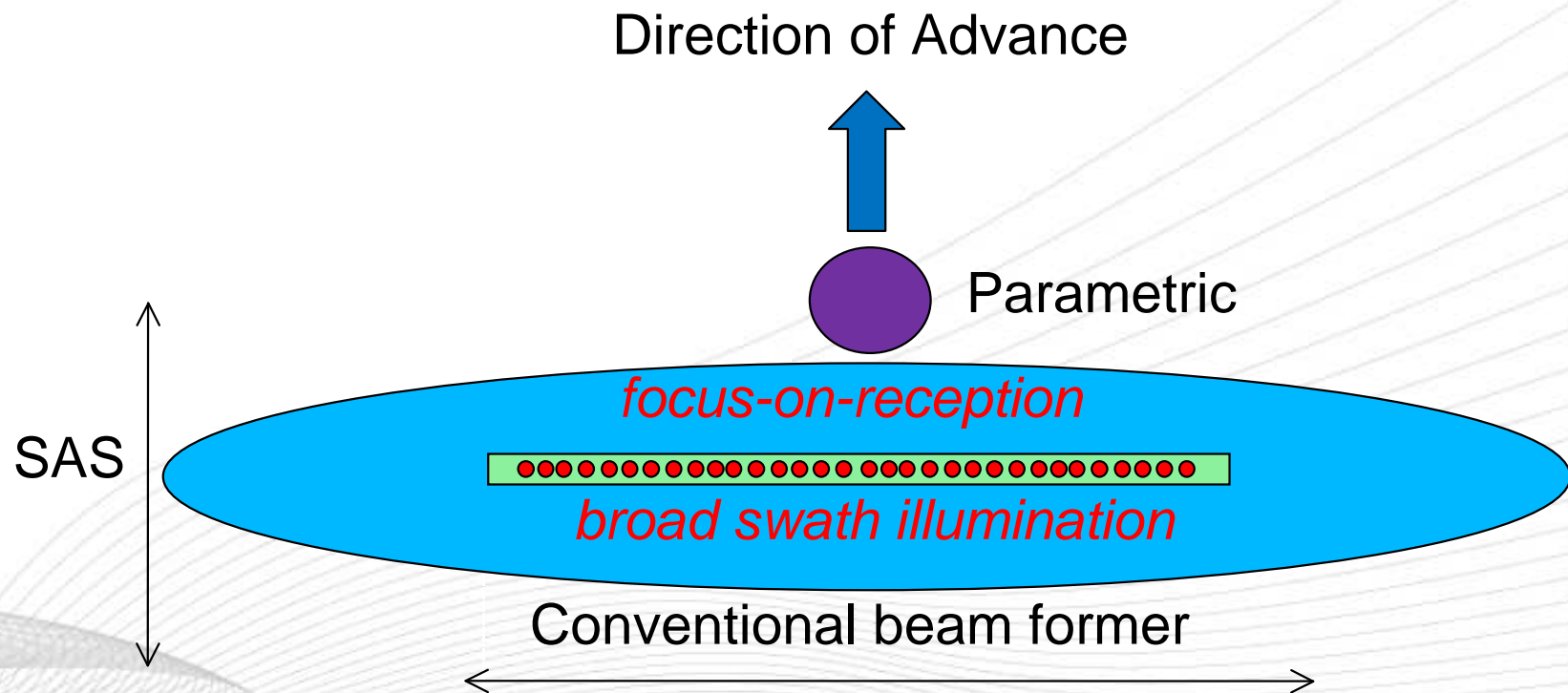
- Pipelines/cables, 10-100 cm O.D.
- 5 m swath to a depth of 5 m
- Depth of coverage with 5 cm accuracy
- Sonar operable from standard work-class ROV
- 0.5 – 2 knot survey speed

Fusion of two sonar approaches

- Parametric pencil beam TOF
- LFM chirp transmit, near field beam forming & SAS processing

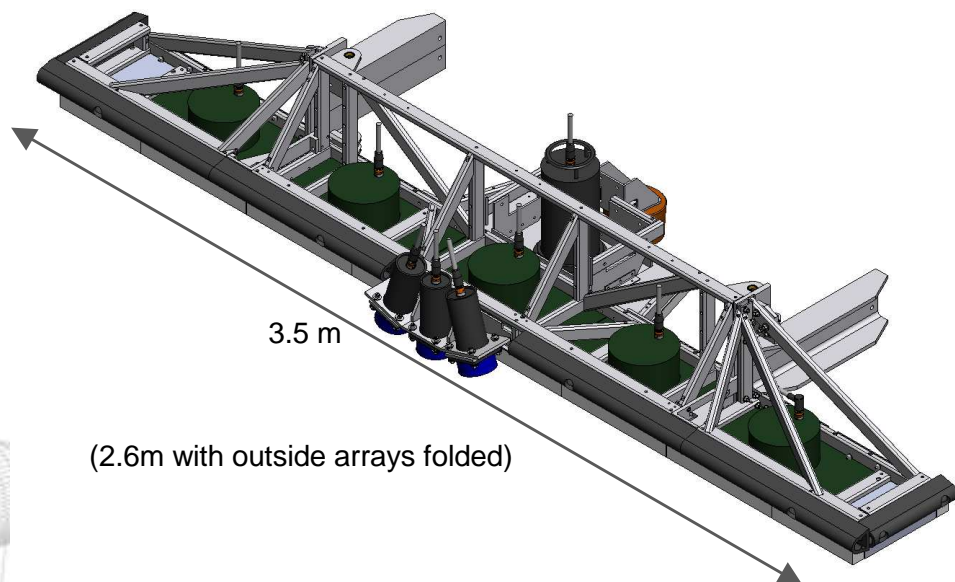
Sub-Bottom Imager™ - Focusing method

- LFM chirp transmit, with near field beam forming
- SAS processing in the along-track direction
- Parametric source operates independently for QA and precision top-of-pipe measurement



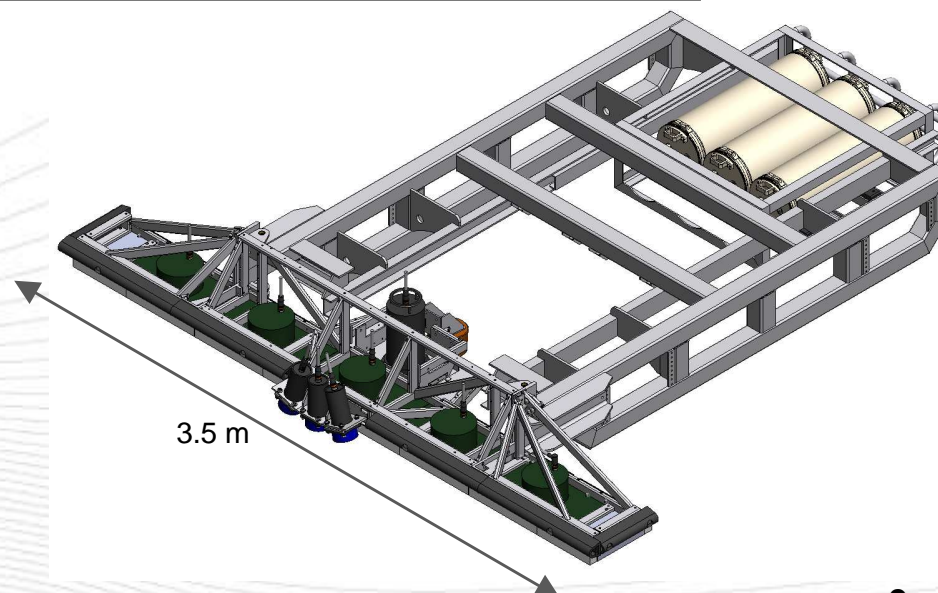
SBI – ROV Payload with Folding Array

- Array folds for launch/recovery
- 5 x 8 channel hydrophone arrays
- 1 x Parametric: 190 kHz primary with 15 – 30 kHz secondary
- 3 x HF chirp projectors: 4.5 – 14 kHz
- INS - IXSEA PHINS or similar c/w DVL



General Specifications		
Item	Weight in Air (Kg)	Weight in Water (Kg)
Hydrophone Array excl Frame	90	15
Acoustic Projectors	15	5
Subsea Electronic Bottles and Rack	250	27
INS/DVL	65	53
Skid	150	88
TOTAL	570	188

Power/Comms requirements from ROV
120v AC, 50/60Hz, 5 amps
2 x 100Mb Ethernet or 1 x 1GB Ethernet
1 x hydraulic JIC4 port



INS Test Program

- Completed at Institute for Ocean Technology (IOT)

Scope of Work

- To quantify rotational and translational jitter
- Assess Doppler Velocity Log (DVL) gains
- Implement and confirm INS data integration



SBI Inertial Navigation System



IOT 200m tow tank

CDL MiniPos/NAV T16 - INS/DVL

Test Plan Highlights:

- Motion reference from tow carriage
- Assess focus quality with INS reference
- Determine gains from DVL

Conclusions:

- Desired image quality requires T24 or equivalent INS (IXSEA PHINS)



Core signal processing steps are

- Digital band limit filtering
- Matched (correlation) filtering
- SAS rendering

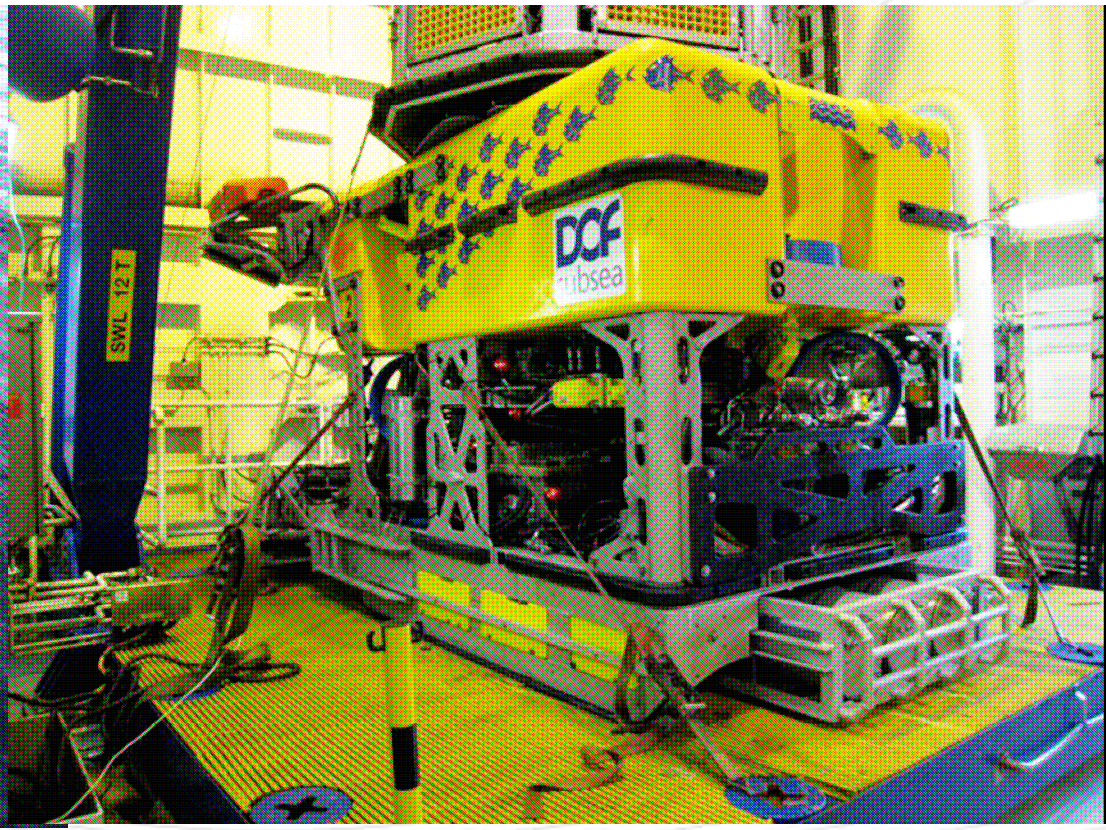
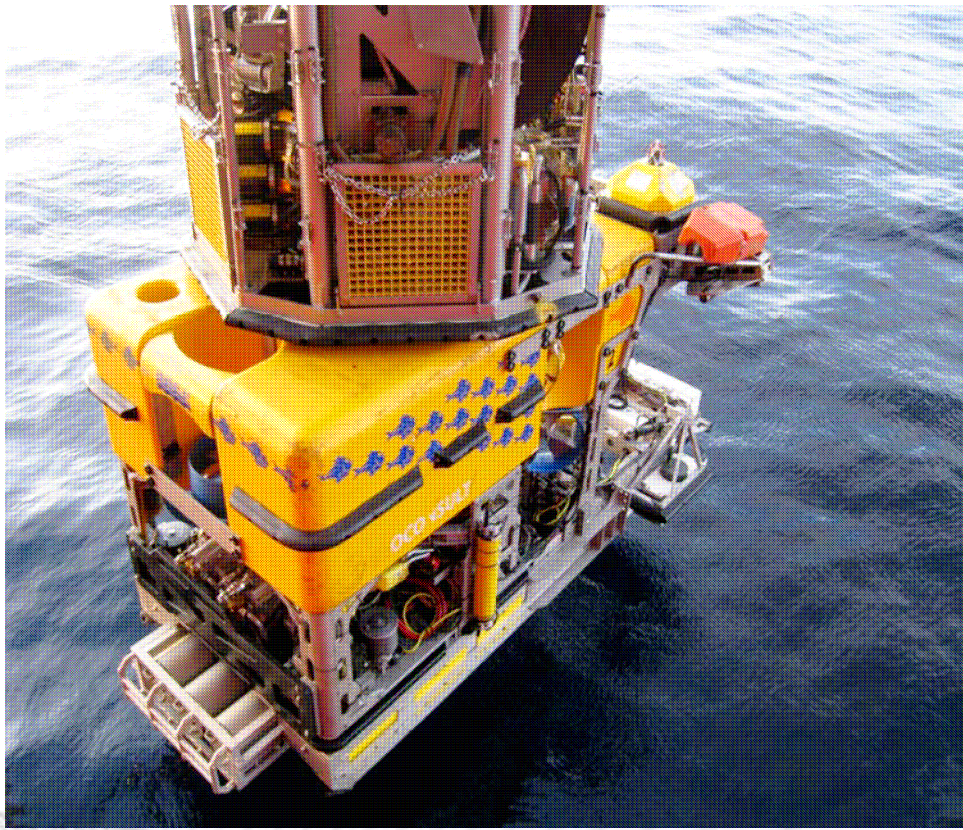
Our Approach

- Multi-core computer image rendering implementation needs 360X speedup
- Redesign core signal processing steps for processing on GPU (NVIDIA + CUDA operating system)
- Multiple Tesla Fermi card implementation being employed
- Theoretical Tesla speed up factor 960X
- Achieved speedup approximately 600X



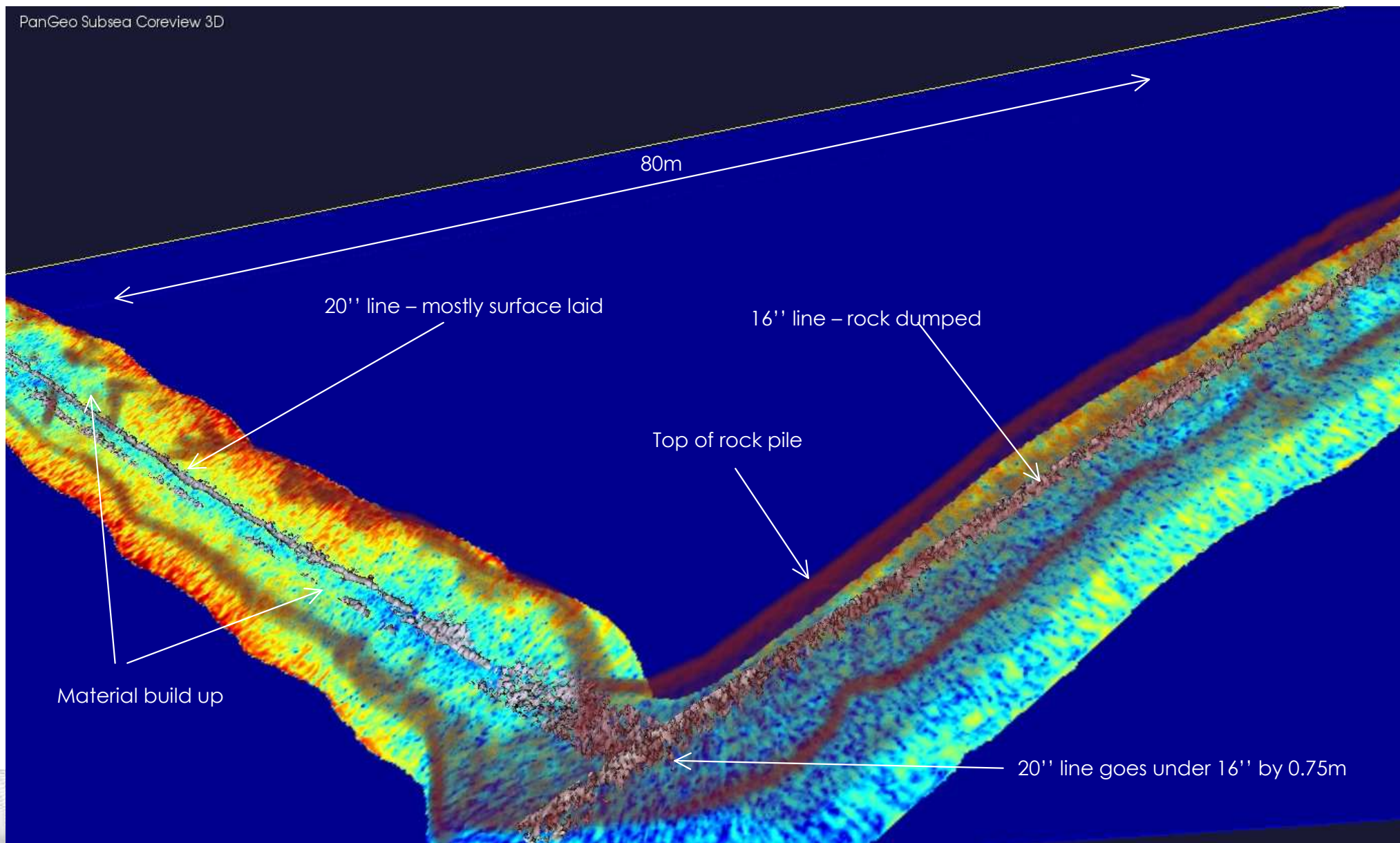
Fall 2009 Pipeline Survey

March 2010 NorNed Cable Survey



Asgard and Hedrun Line Crossing

PanGeo Subsea Coreview 3D



SBI Survey NorNed Cable

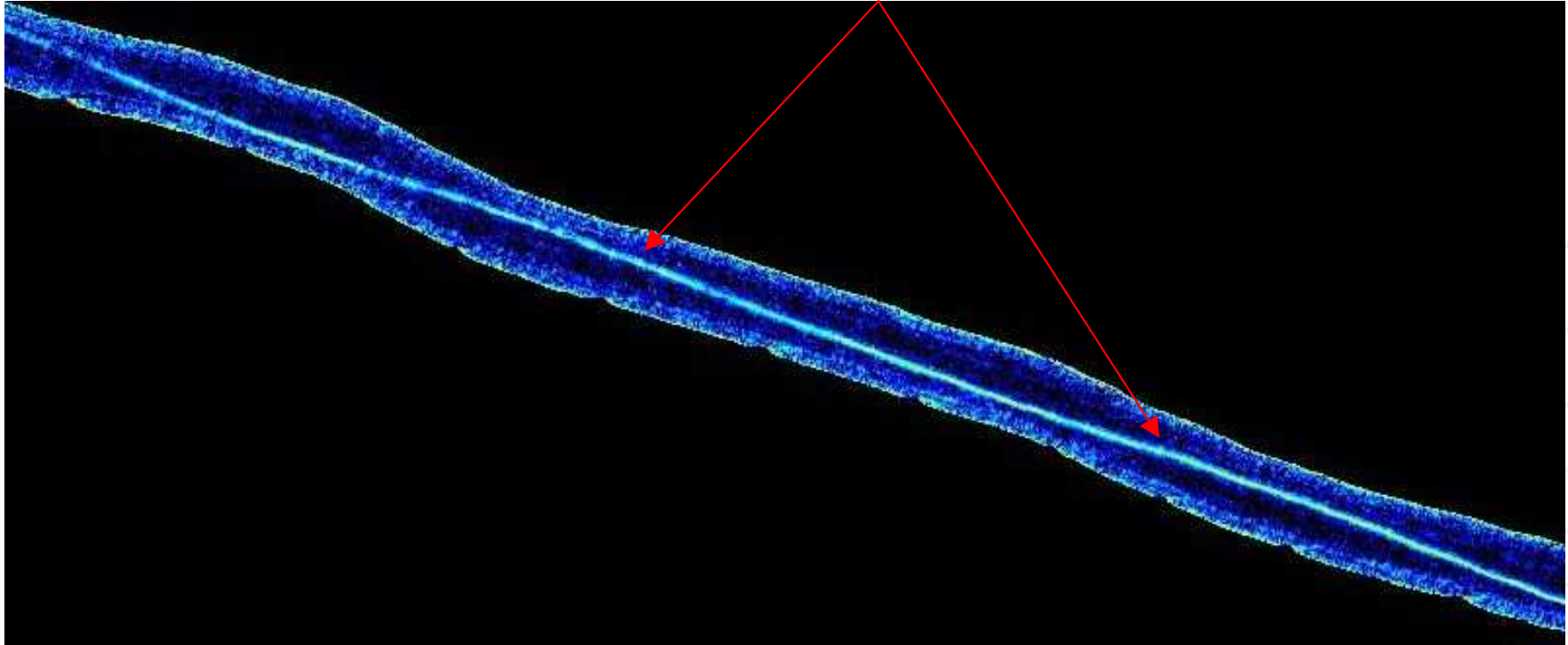
NorNed at
KP506: SBI
Survey 3&4

NorNed Fault
Location at
KP71: SBI
Survey 1&2



Survey of NorNed Buried Cable for Statnett

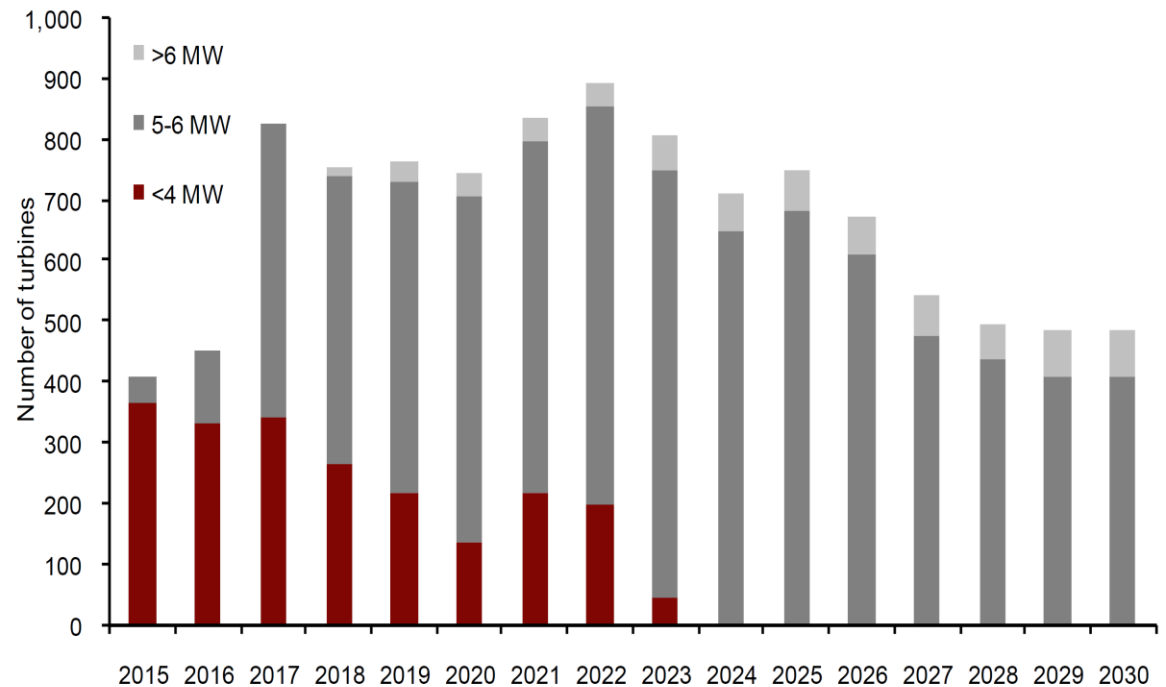
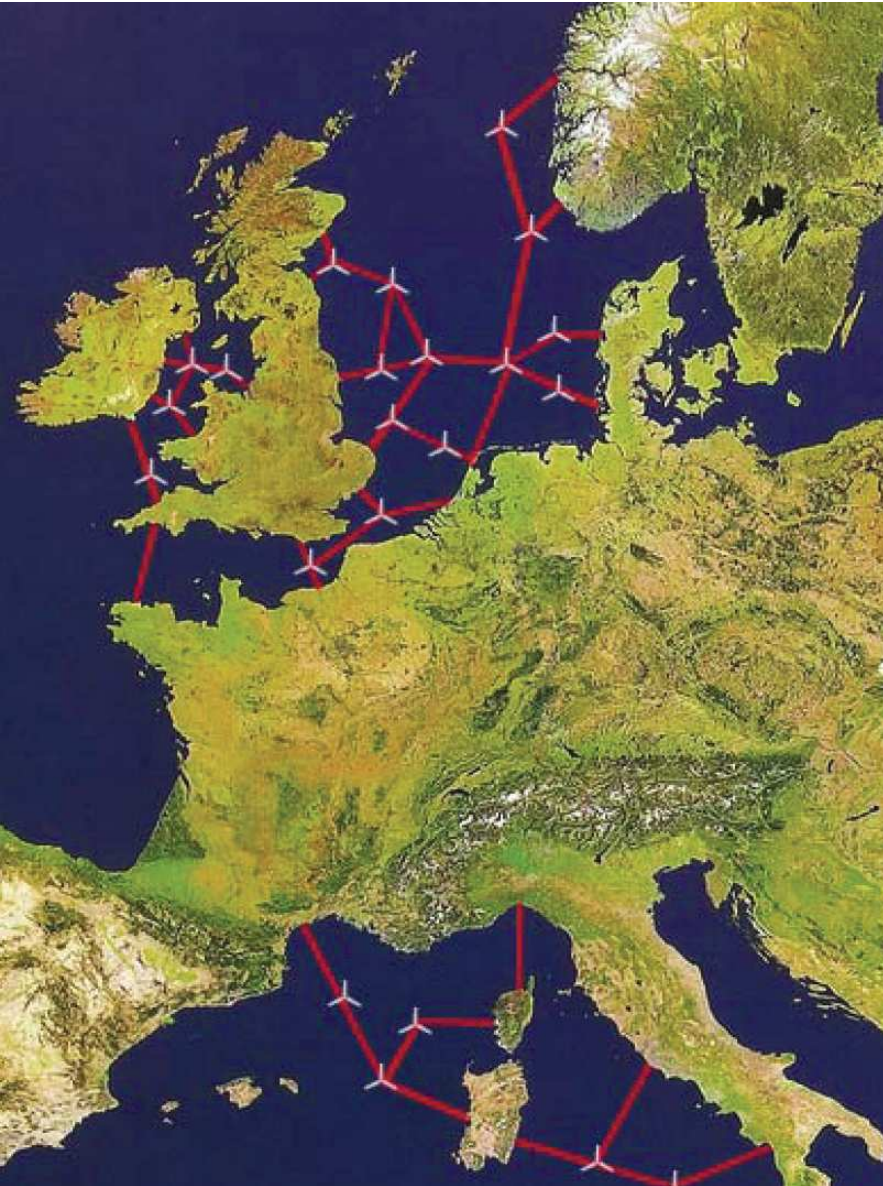
13cm diameter cable buried 0.8m



- 450 kV HVDC Cable
- Outer serving: 4mm polypropylene
- Reinforcement: 2 layers, galvanized steel wire armour
- Conductor: Twin-core copper wires
- Dimension : 217mm x 136mm
- Weight in air: 84kg/m



Forecast European Offshore Wind Installations



Forecast Offshore Turbine Installations

Source: Douglas-Westwood

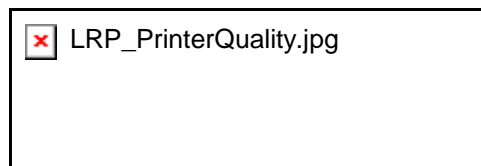
- Over 500 turbines p.a. to be installed 2017-30
- Peak of around 900 turbines per year
- Massive requirements for manufacturing and installation

Lots of Cables to Survey!

HVDC Supergrid for Europe

Capital Investment and Support

Capital Investment



Joint Industry Partnerships



Commercialization Support



Atlantic Canada
Opportunities
Agency

Agence de
promotion économique
du Canada atlantique

Canada

Research Support



The Research Council
of Norway, DEMO 2000