



Managing Offshore Cable Risks

Thomas Boehme, Det Norske Veritas (DNV)



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Agenda

1. Offshore wind farm cable incidents
2. Offshore cable life cycle considerations
 - Planning and consenting
 - Cable design and manufacturing
 - Installation
 - Operation and maintenance
3. Conclusions

“Cable damage occurred in nearly every project on our books.”

Thomas Haukje, Marsh
in *New Energy*, Jan 2005

“Over 70% of all claims are related to cable damage.”

Niels Kragelund, Royal & Sun Alliance
at *utilityweek.co.uk*, Jan 2010

Cable Incidents

Robin Rigg
Cable barge evacuation
01/2009

Blyth
In-field cable damage
04/2006 – 01/2009

Horns Rev I
Installation damage
07/2002

Middelgrunden
3 cable damages
~2001

Q7 (Princes Amalia)
Cable vessel substitution
2007

Scroby Sands
Export cable replaced
2008

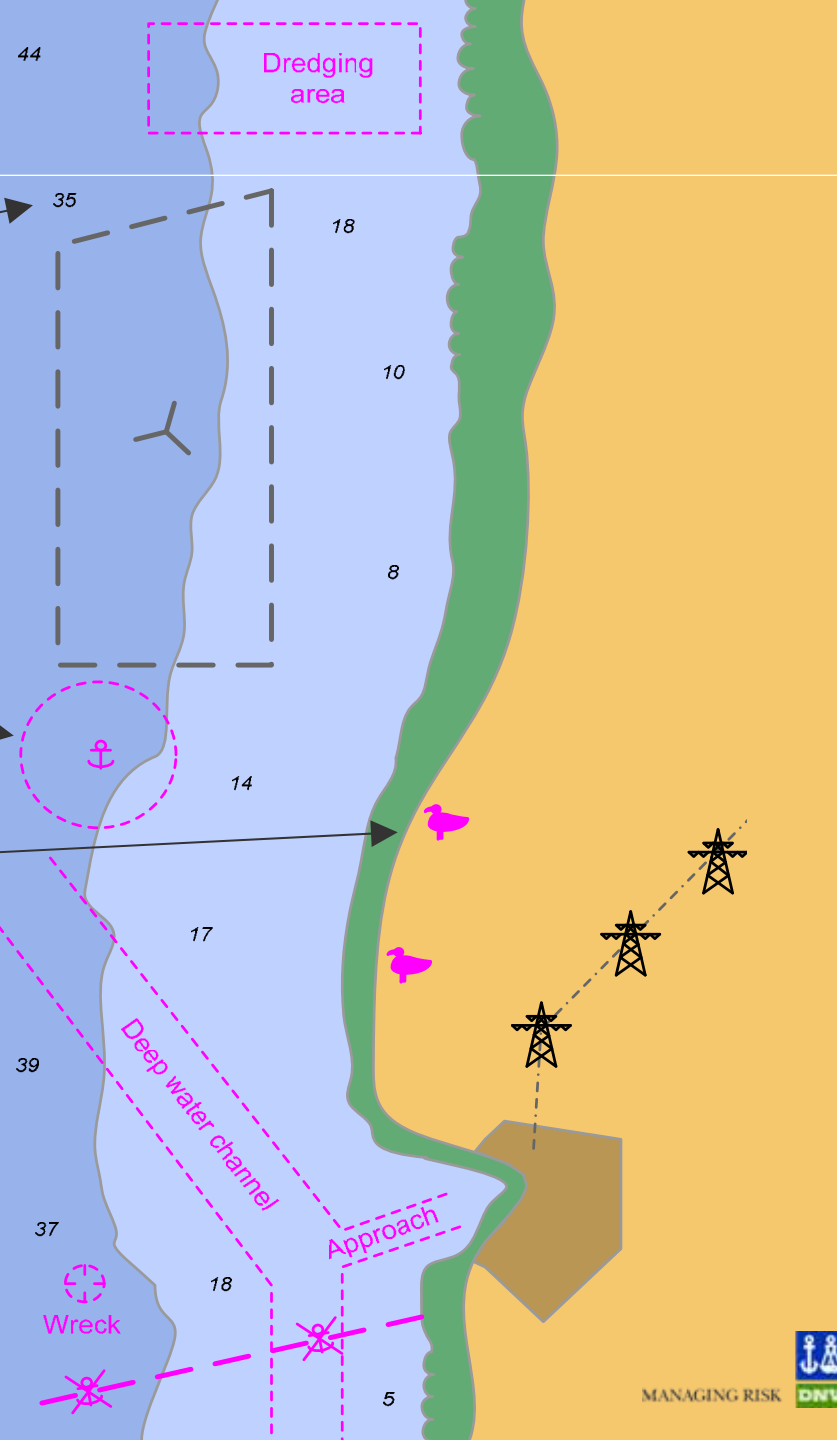
Arklow Bank
Anchor damage, 132 kV
01/2005

Burbo Bank
Onshore cable outage
10/2009

Thanet
Cable repairs
06/2010

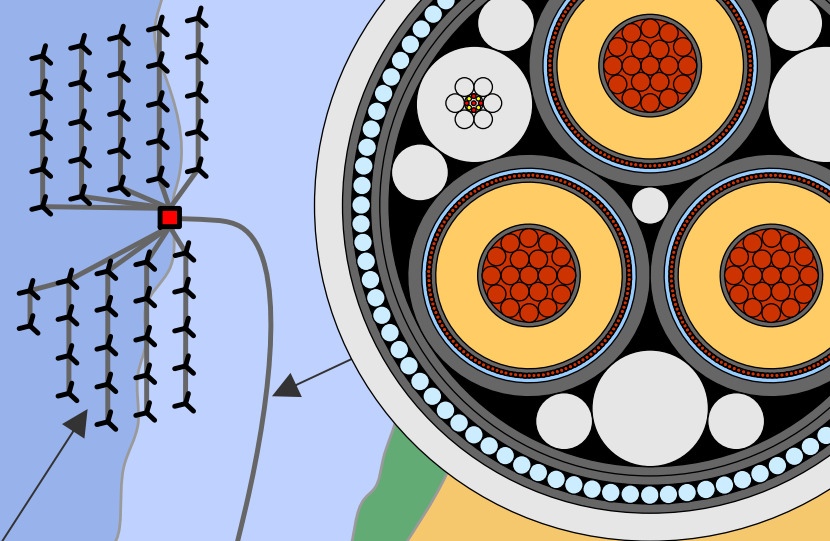
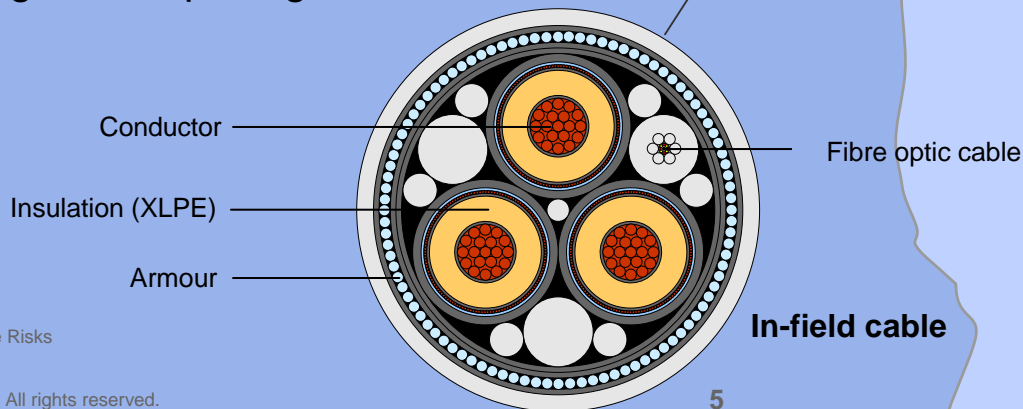
Planning and Consenting

- Marine conditions
 - Waves, currents, water level
- Geotechnical conditions
 - Soil type / mobility, sandwaves → burial depth
- Human introduced hazards
 - Anchoring, fishing, dredging → protection
- Obstructions
 - Wrecks, pipelines, cables → routing
- Environment
 - Spawning areas, reefs, bird habitats → routing, timing
- Cable reliability / damage history
 - CIGRE work, navigational risk assessment
- Consenting process
 - Burial requirements, exclusion zones, grid
- Safety considerations

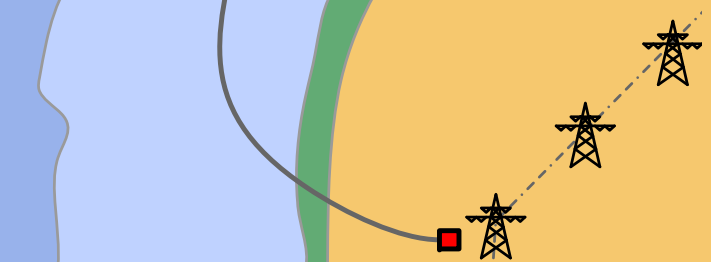


Cable Design & Manufacturing

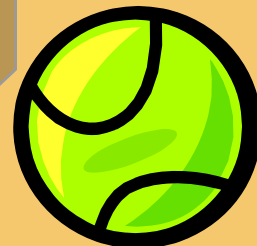
- Alternating current (AC) vs. direct current (DC)
- Single-core vs. three-core
 - Capacity, weight, jointing, unbalance
- Electrical design
 - Voltage (33 kV, 132 kV)
 - Power rating
 - Conductor resistance (Cu/Al, mm²)
- Thermal design (Germany: 2 K criterion)
- Mechanical design
 - Diameter, weight, armour
 - Bending radius, pulling force



Export cable

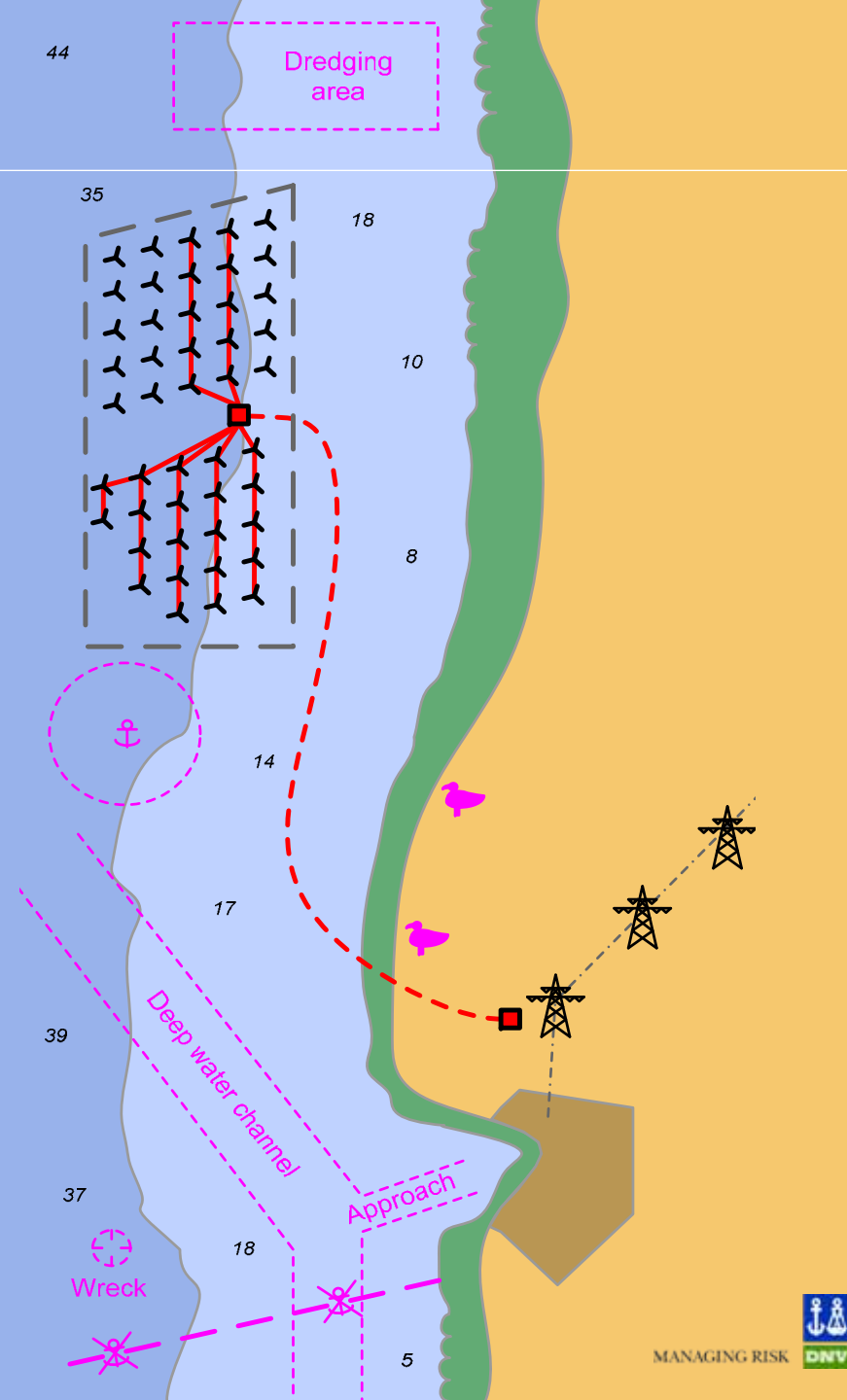


Size comparison



Installation

- Installation company experience
- Cable lay vessel selection
 - Type and suitability
 - Capacity
 - Availability
- Process
 - Detailed planning, calculation and visualisation
 - Cable reel-in and transportation
 - Onshore landing (floating cable, over rollers)
 - (Crossings)
 - Laying and burial (plough, mech. trencher, jet trencher)
 - (Jointing)
 - Pull-in (quadrant, S-curve)
 - Termination and testing
 - Fixing and protection
- Diver intervention



Conclusions

- Potential **consequences** of cable issues
 - Delay of wind farm commissioning
 - Cable repair time ~ 3 months
- Assess cable **risks** for whole life cycle
 - Optimisation of measures
 - Demonstration to stakeholders, authorities, investors and insurance companies
- Project **design** focus
 - Understand site-specific conditions
 - Chose appropriate cabling design
 - Work with experienced partners
 - Plan with contingencies
- Remaining **uncertainties**
 - Manage risks
 - Obtain optimal insurance terms



Safeguarding life, property and the environment

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Expression of Interest

Joint Industry Project
on offshore wind farm
power cable issues

Thomas.Boehme
@dnv.com

Stand 142



MANAGING RISK