

Submarine cables and installation

- Past, present and future technologies for interconnections

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Workshop TGEG'19, 27th June 2019



 **Nexans**
BRINGS ENERGY TO LIFE

Safety



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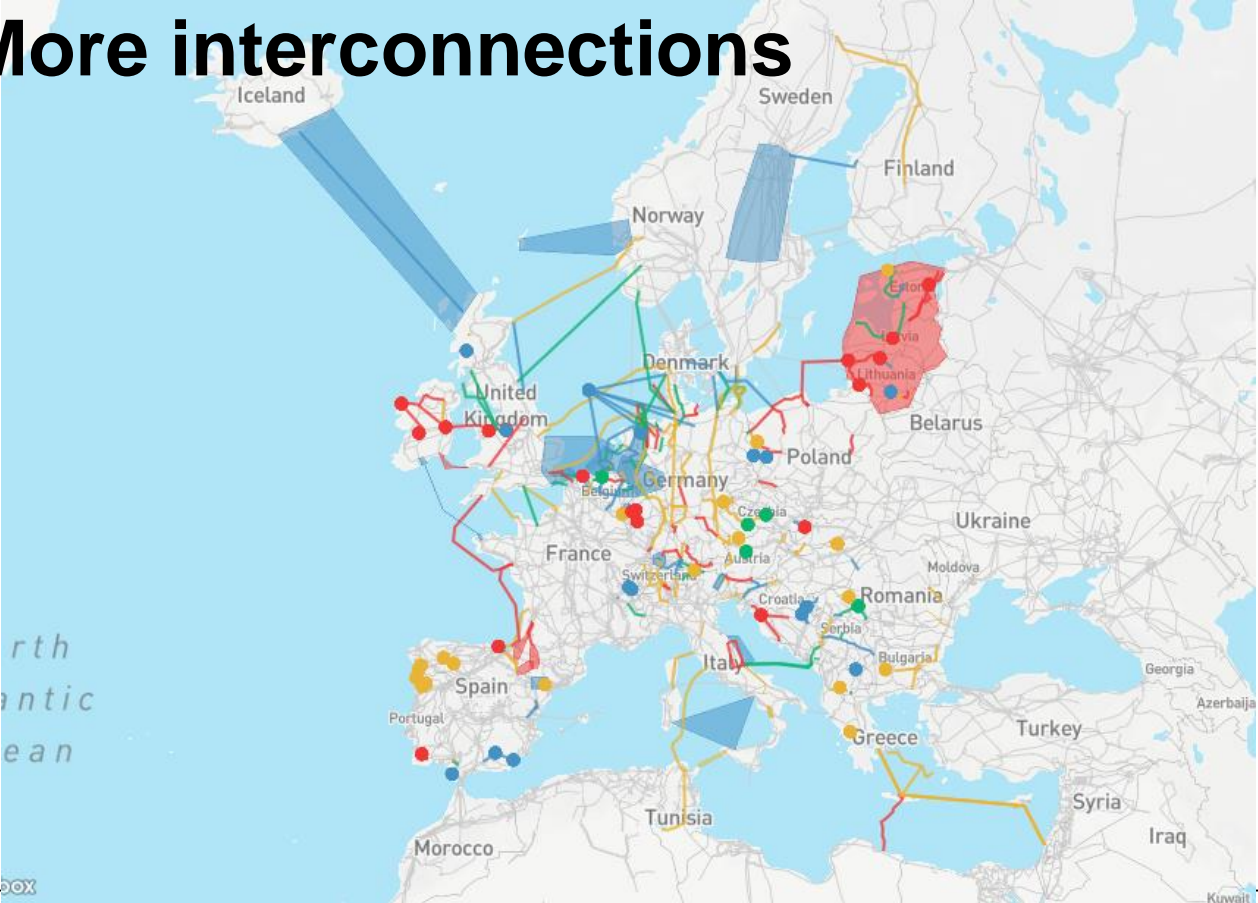
Drivers

Cables in a historical perspective

Answer to the drivers

Cable installation

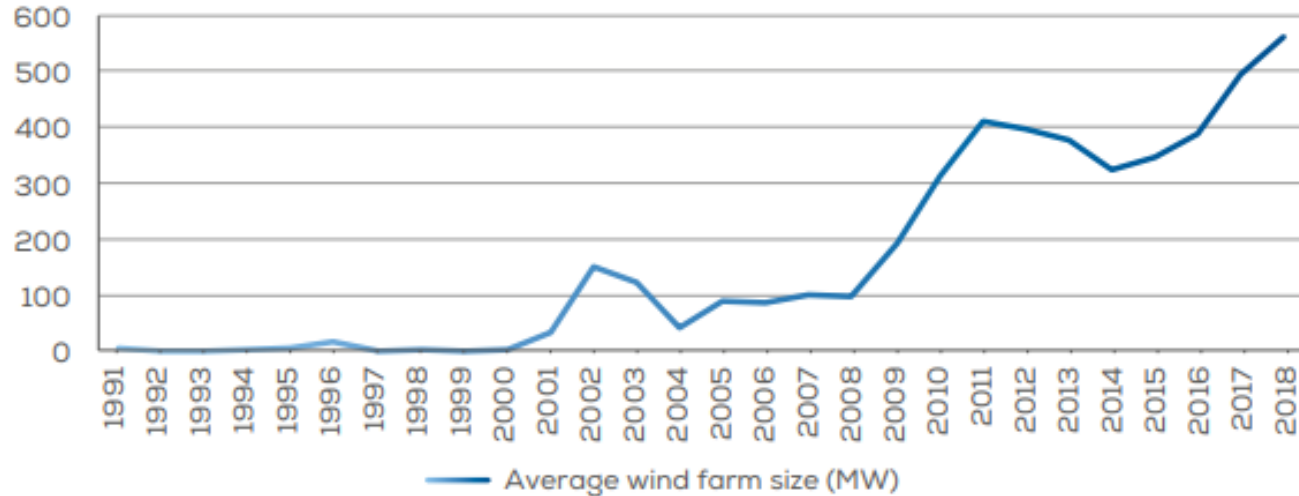
More interconnections



Offshore wind – More power

FIGURE 8

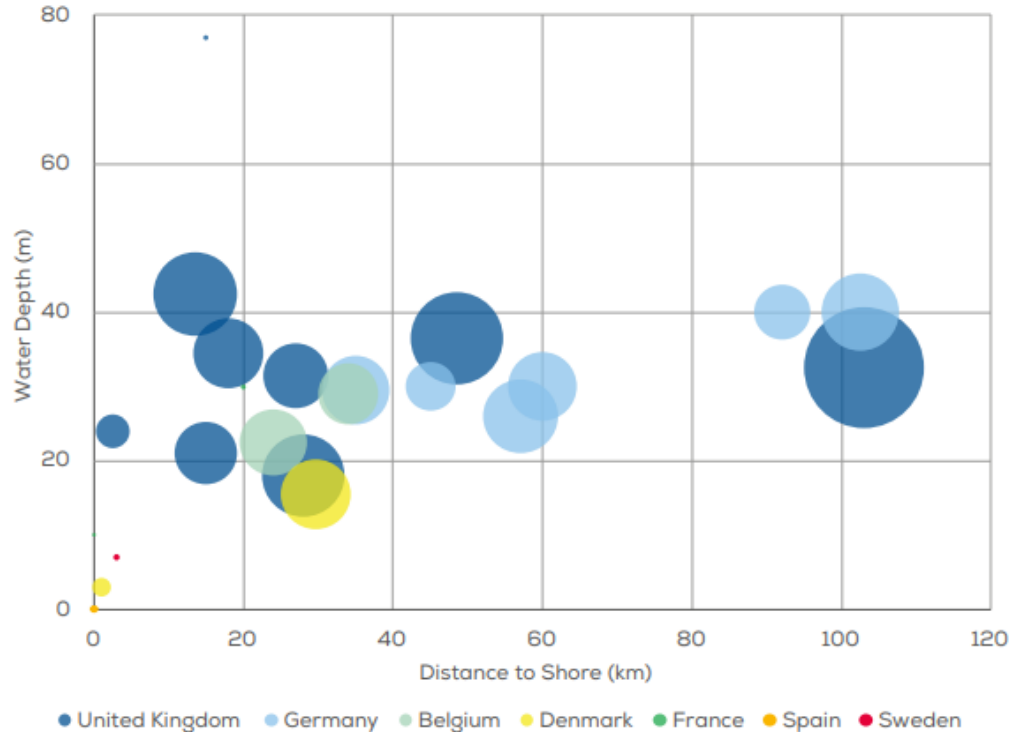
Average size of commercial offshore wind farms in construction and grid-connected in the given year



Source: WindEurope

Offshore wind – Further from shore

Average water depth and distance to shore of offshore wind farms under construction in 2018. The size of the bubble indicates the overall capacity of the site



Offshore floating wind

Great potential globally, we are not married to Hywind

We will deploy the **best available technology** for each project

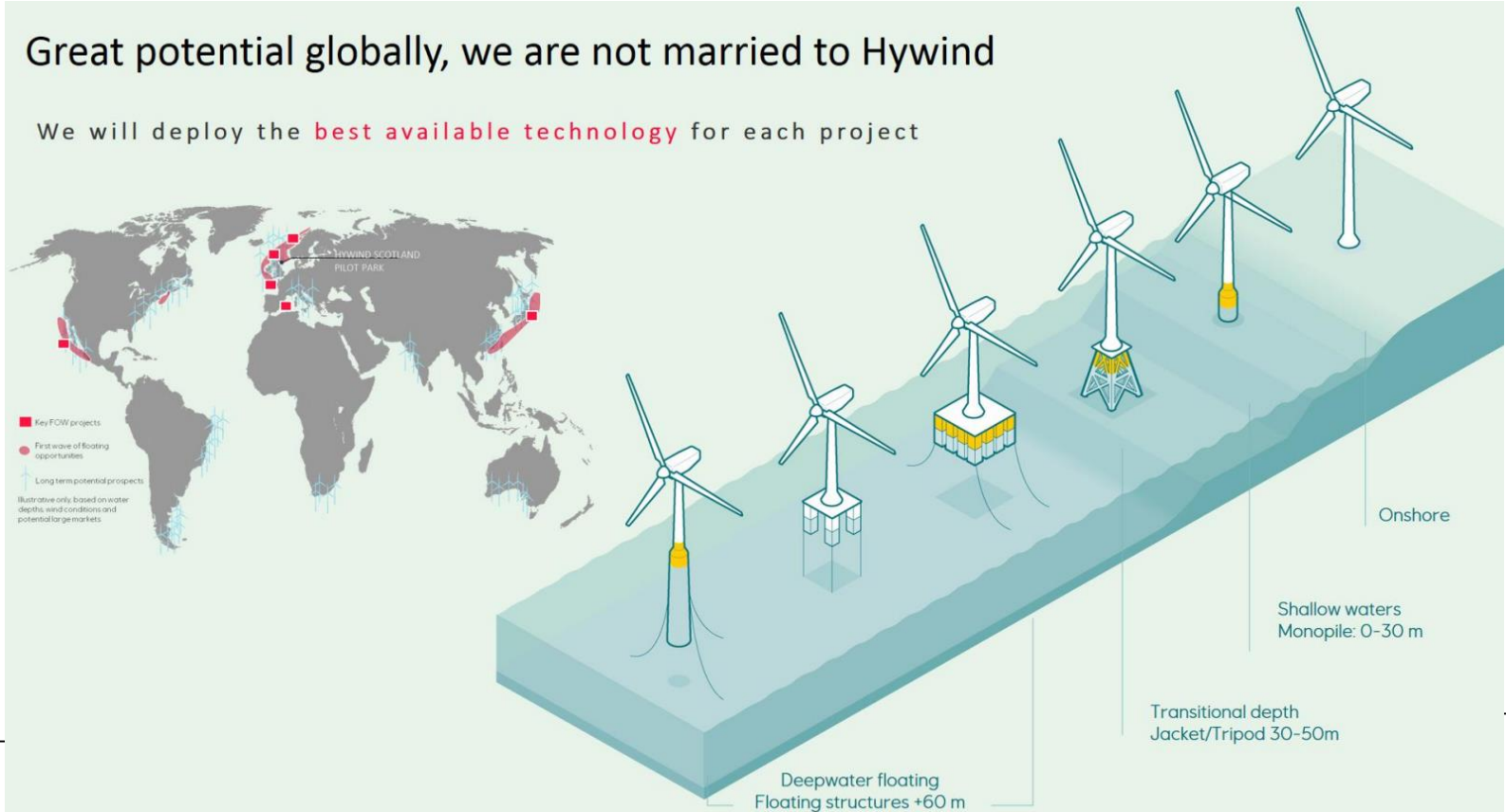


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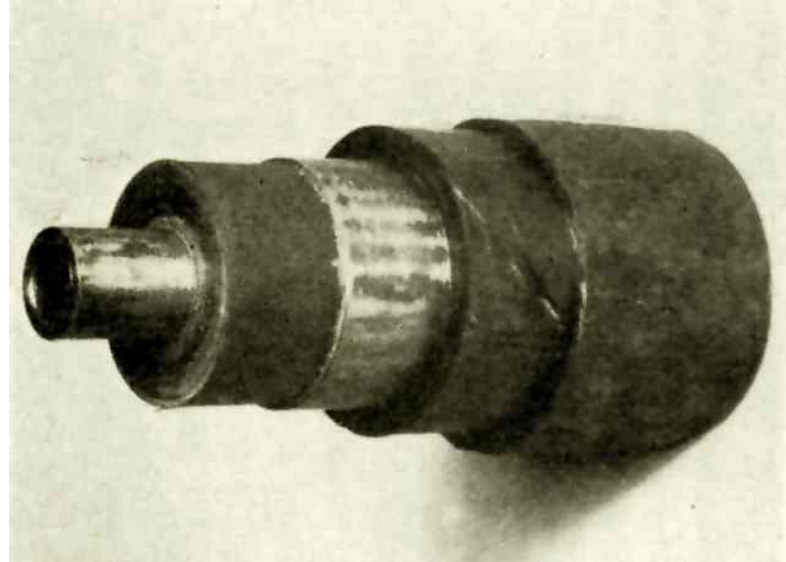
Cables in a historical perspective

Answer to the drivers

Cable installation

HV Cables – historical perspective (I)

1890



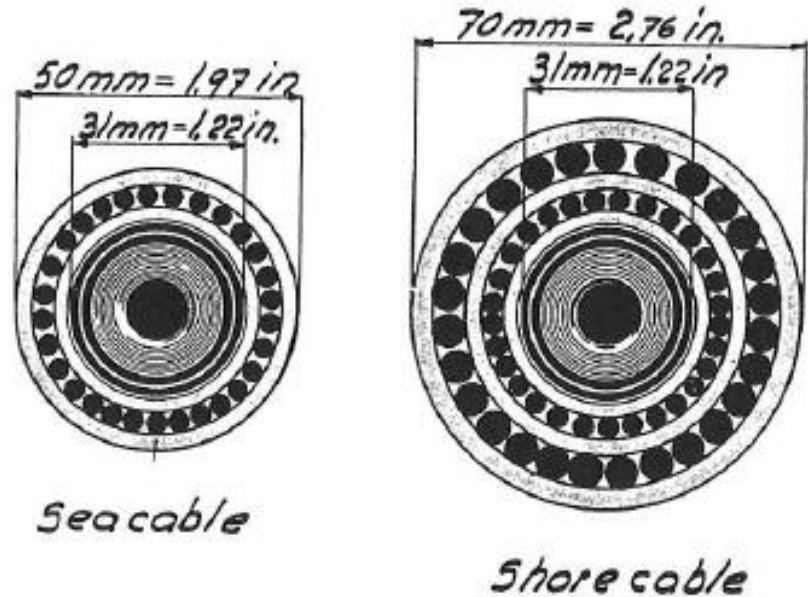
London: first installation of 10 kV electrical energy network for London Underground (paper and Wax)

HV Cables – historical perspective (II)

- HVDC Gotland link (Gotland 1)
 - 100 kV, 20 MW
- In service in 1954 until 1986

6. CONCLUSIONS

An HVDC cable which was in service for 32 years was thoroughly investigated. Its electrical, mechanical and chemical properties were analyzed to establish whether any ageing had occurred. The results show that in practically all respects the cable can be considered equal to new. It is of particular interest to note that the service of the cable with voltage and current has not caused any noticeable ageing. This is proved by the fact that the properties of the cable taken up from the sea are equal to those of the spare cable which has never been in service.



1 Source: *After-service analysis of the 32-year-old HVDC cable Gotland 1*, G. Hjalmarsson et al. Cigre session 1992

HVDC MIND cables still preferred for interconnectors

- Traditional MIND cables have shown excellent service performance over many years
- The inherent properties of the lapped insulation system makes it very robust → *well suited for long submarine transmission links*
- HVDC MIND: preferred technology for high power transfer with proven reliability



HVDC MIND cables – Further development

- Nexans believe in the future of MIND cables and continue development
 - “Quick” joint for MIND cables
 - Deep water solutions are being developed
 - Nexans consolidates its leading position by qualifying 600 kV MIND cables, with power rating exceeding 2 200 MW for bi-pole.



HVDC Extruded developing fast

- And, of course, HVDC extruded is developing fast, both delivery projects and qualification status
- The joint effort by the cable community (material suppliers, cable manufacturers, TSOs, universities...) is unprecedented
- This topic is well covered during Jicable



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Drivers

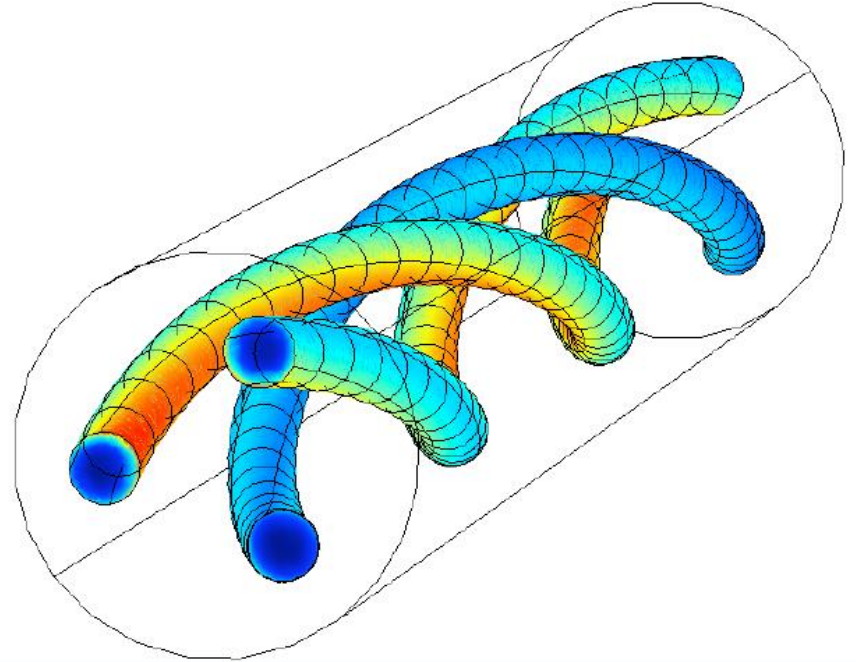
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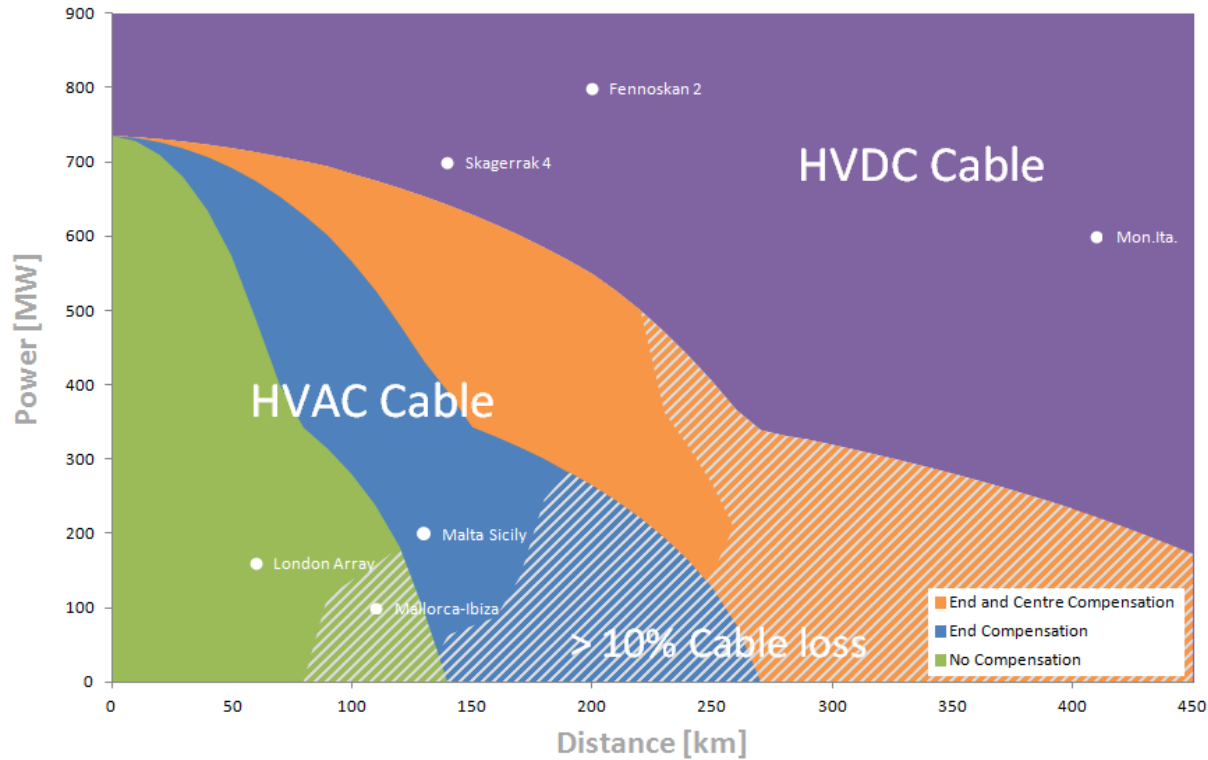
Cable installation

Answers to the drivers

- *Optimised solutions*
- Improved calculation methods and extensive testing by the supplier industry
→ optimised solutions



Answers to the drivers



Answers to the drivers

- *Innovation*
- Innovative solutions to reduce losses
 - Replace armour wires by polymer fillers
 - Significant reduction of armour losses
 - Solution will be used on contracted project

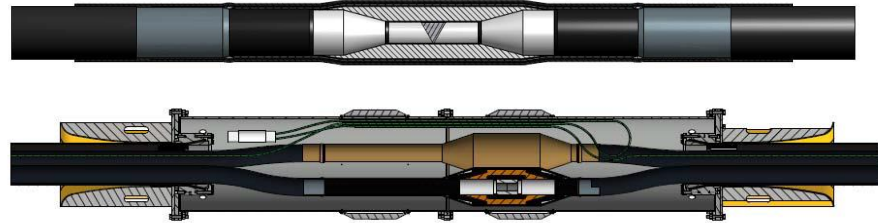
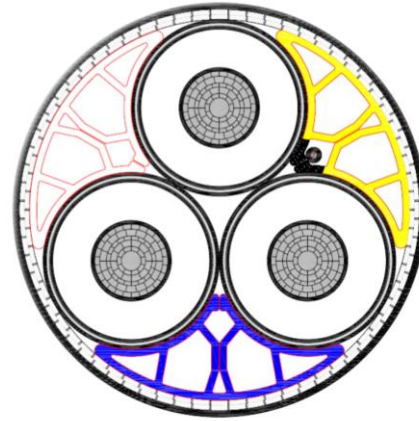


(TKRA 245 kV 3x1x1800 mm² AQ + 2xFO)



Answers to the drivers

- *Increased power transfer*
- Nexans is qualifying 3-core 420 kV (PQ and TT)
- 420 kV, 3x2000 mm² Al conductor:
 - Cable Ø = 300 mm
 - Dry weight = 126 kg/m
 - Wet weight = 69 kg/m
 - ~700 MVA transmission capacity
 - FO-element with 48 fibers



Answers to the drivers

- *Floating offshore wind*
→ Dynamic cables
- Wet designs?
- Engineering and testing intensive, need of standardisation

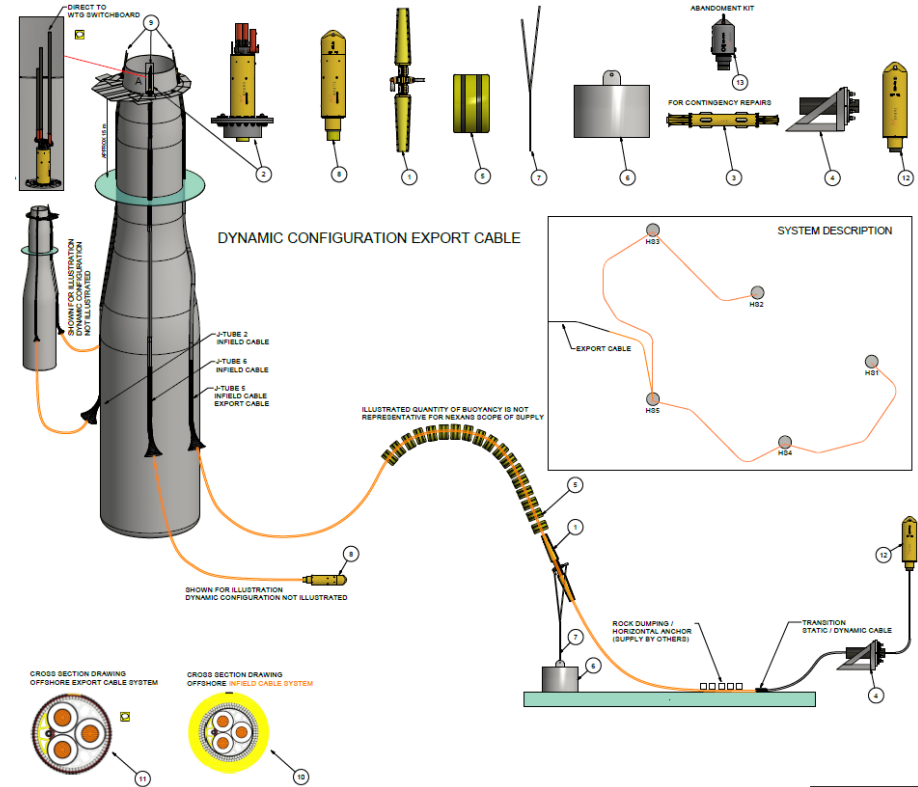


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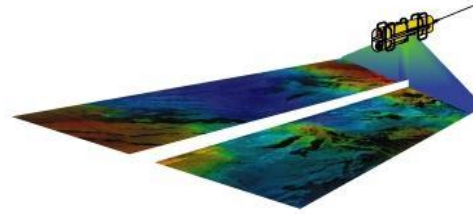
Answer to the drivers

Cable installation

Installation – more than cable laying



- Engineering
- Risk management
- Planning



- Seabed mapping
- Feasibility study
- Route design



- Load out
- Transport
- Laying
- Shore landing
- Repair



Cable protection

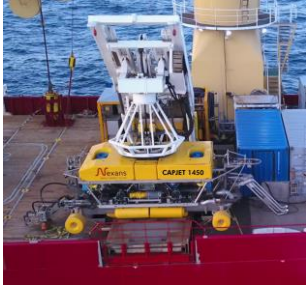
- Jetting
- Trenching
- Rock Dumping
- Near Shore



- Onshore civil works
- Onshore cable pulling
- Cable end terminations
- Jointing

Trenchers

CapJet 1450



- Trenching module and water pumps
- Adjustable front and aft swords
- Vertical lifting 600 mm
- Horizontal adjustment of sword opening 200 mm
- 2 x 420 KW water pumps
- Pressure from 10 to 16 bar
- dependent of project requirement.

Rock Cutter



Rockcutting module

- 1 x 195 kW HPU cutting system
- 1 x 195 kW ejector system
- 4 x wheel drive (adjustable side to side)
- 4 x wheel individual level adjustment

CapJet 1700



- Trench module and water pumps
- Adjustable front and aft swords
- Vertical lifting 600 mm
- Horizontal adjustment of sword opening 200 mm
- SWD Sword (Selective Water Distribution Sword).
- HP and LP front arm nozzles (Valve controlled)
- LP transport (Valve controlled)
- 2 x 420 KW water pumps, Pressure from 20 to 30 bar
- 1 x 200 KW water pump, Pressure from 8 to 12 bar

CapJet Mini



Trench module and water pumps

- Adjustable swords (lift and angle)
- Vertical lifting 500 mm
- Fixed horizontal opening between swords 270 mm (sword dependent)
- Fixed water distribution swords.
- LP front nozzles (fixed water distribution)
- Transport valves integrated in swords
- Topside 1 x 240 HP LP water pump, 12 bar pressure @ 300m3

Vessels

Elektron



DP2 Vessel for trenching, nearshore and Array cable installation

Length o. a. :	87.35 m
Length p. p. :	82.55 m
Breadth :	18.00 m
Depth :	4.80 m
Depth mid 1st. deck :	6.50 m
GT (ITC 69) :	3205 t
NT (ITC 69) :	961 t
GWT :	3514 t

Skagerrak



DP2 Vessel for high capacity cable installation

•Length oa incl. laying wheel :	118.25 m
•Breadth moulded :	32.15 m
•Depth moulded :	8.00 m
•Draught at 9373 t :	5.40 m
•incl. stern thrusters :	6.25 m
•Deadweight :	9373 t
•Turntable capacity	7000t
•Vessel speed :	10 kts

Polar King



DP2 Vessel for trenching, survey, and cable installation

•LOA	110.6m
•Breadth	20.0m
•Depth	9.8m
•Max draught	7.6m
•Design draft	6.0m
•Deadweight	abt. 4358 mt
•Tank capacity MDO	1 722 m3
•Tank capacity FW	1 200 m3

Barge UR141k



Transport / Storage Barge

•Length oa incl. laying wheel :	100
•Breadth moulded :	30
•Turntable capacity	7000ton

CLV Nexans Aurora

State of the art technology



Main particulars

Type: Cable Lay Vessel

Design: Skipsteknisk ST-297 CLV

Class: DNV GL

CABLE LAYING VESSEL,

E0,SF,NAUT(AW),CLEAN(DESIGN),SPS,DYN

POS(AUTRO),COMF(V3),ICE(C),BIS,BWM(T),

VIBR,SILENT(E),RECYCLABLE,STRENGTHENED(DK)

Flag: Norwegian

Loa: 149,90 m

Bm: 31,00 m

Depth Main deck: 12,80 m

Max Draft: 9,0 m

Halden max with 8000 t HV plus 450 t = 7,0 m

DWT: 17000 t

Speed: 14 kts

Accommodation: 90 persons in single cabins

Power: 6 x 3450 kW 720 rpm

Propulsion:

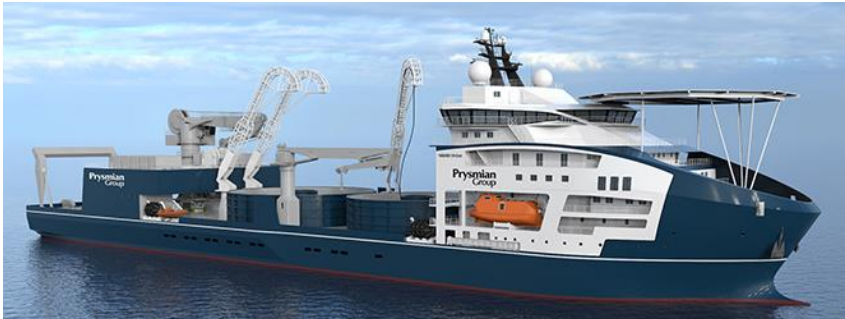
3 x 3200 kW Azimuth(Stern)

2 x 3000 kW Tunnel (bow)

1 x 3000 kW Retractable Azimuth (bow)



Many new cable laying vessels on the market



Turnkey solutions supplier

Nexans has the inhouse capability to design and deliver turnkey solutions

- Engineering of all required cable laying operations and cable protection work
- From R&D to completely installed and commissioned cable system

Seabed

- Seabed mapping
- Feasibility study
- Route design

Services

- Engineering
- Testing
- Risk management
- Planning

Vessels

- Load-out
- Transport
- Laying
- Shore landing

Cable protection

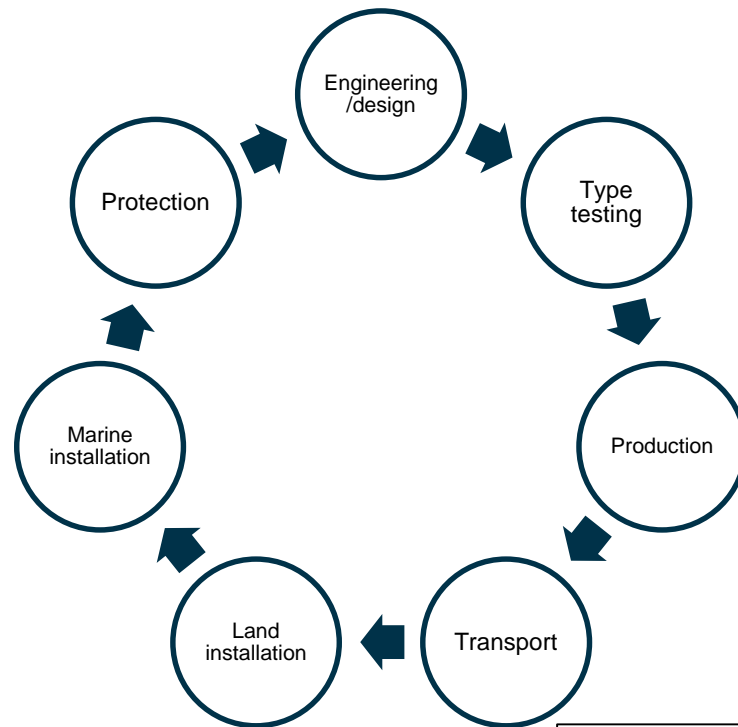
- Jetting
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- Rock Dumping
- Near Shore

On shore

- On shore civil works
- On shore cable pulling
- Cable end terminations
- Jointing

Additional services

- Inspection Maintenance & Repair
- Cable & Umbilical transport
- Factory support



Concluding remarks

- Safety standards positive trend
- There are strong drivers for cabling solutions in the coming decades
- The cable industry is responding to the drivers by developing and testing solutions
- We are in for an interesting time!

Thank you for your attention!

