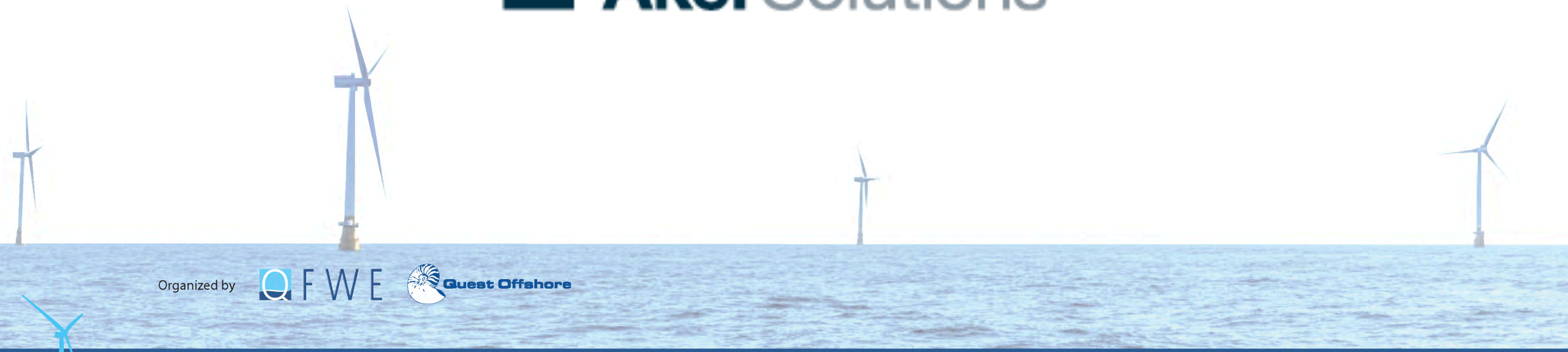
Dynamic Cables for Offshore Wind and PfS

Ricardo Serafim | Head of Umbilical, Power Cables and DE Systems

AkerSolutions

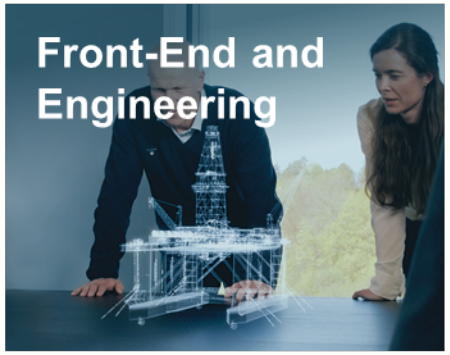


Organized by FWE Quest Offshore

FWS

The Westin Houston, Memorial City 28-29 June 2021

A stronger supplier company with an optimized portfolio



Global Presence

14,000 EMPLOYEES

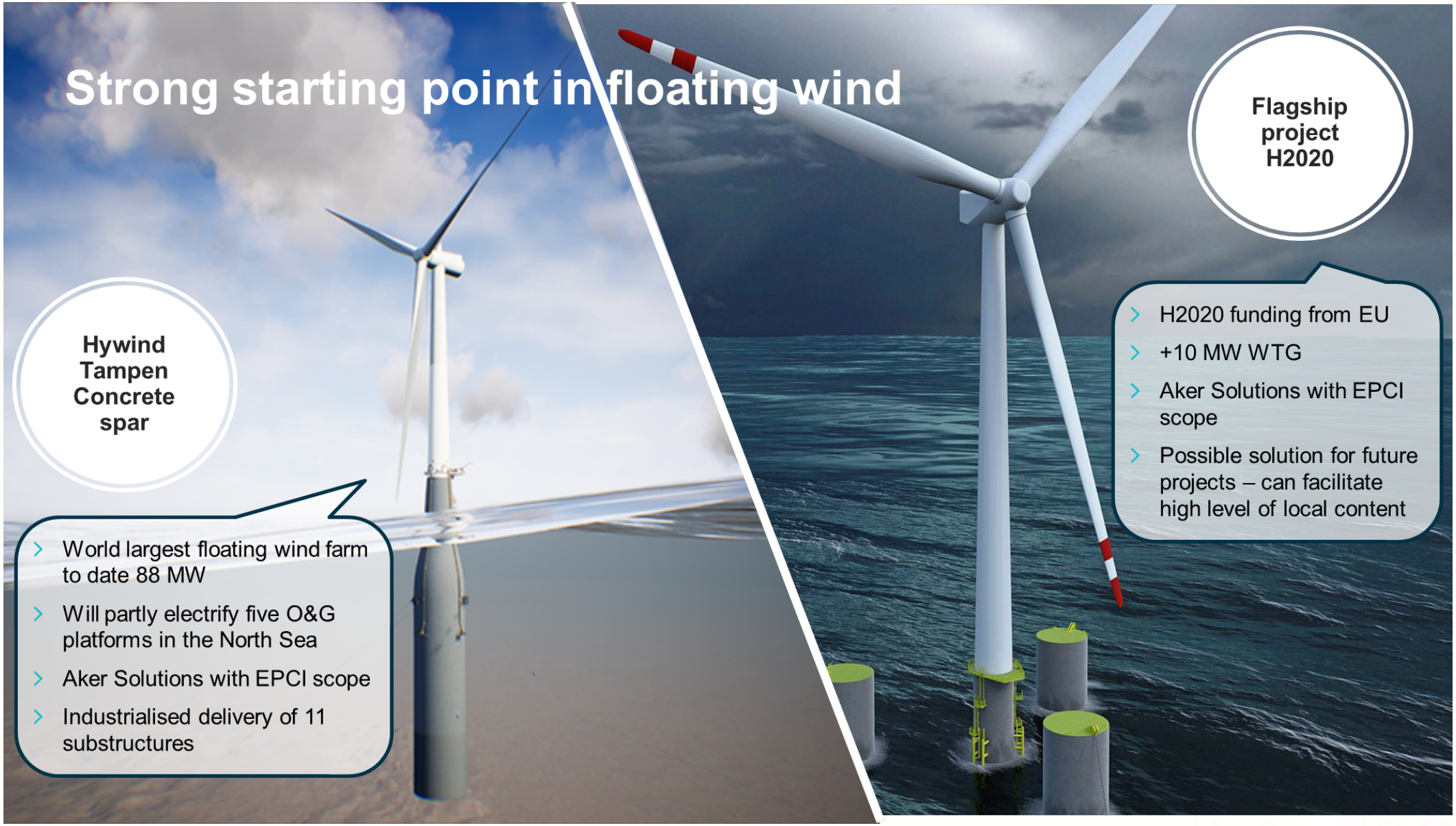
25 COUNTRIES

50+ LOCATIONS

Floating Wind *Solutions*


Complete Offshore Wind Solutions
Converter
Platforms
Gravity-Based
Structures
Cables
and Accessories
Steel Jacket
Substructures
Marine Operations
and Maintenance Services
Floating
Foundations
AkerSolutions

Strong starting point in floating wind



Hywind Tampen Concrete spar

- World largest floating wind farm to date 88 MW
- Will partly electrify five O&G platforms in the North Sea
- Aker Solutions with EPCI scope
- Industrialised delivery of 11 substructures

Flagship project H2020

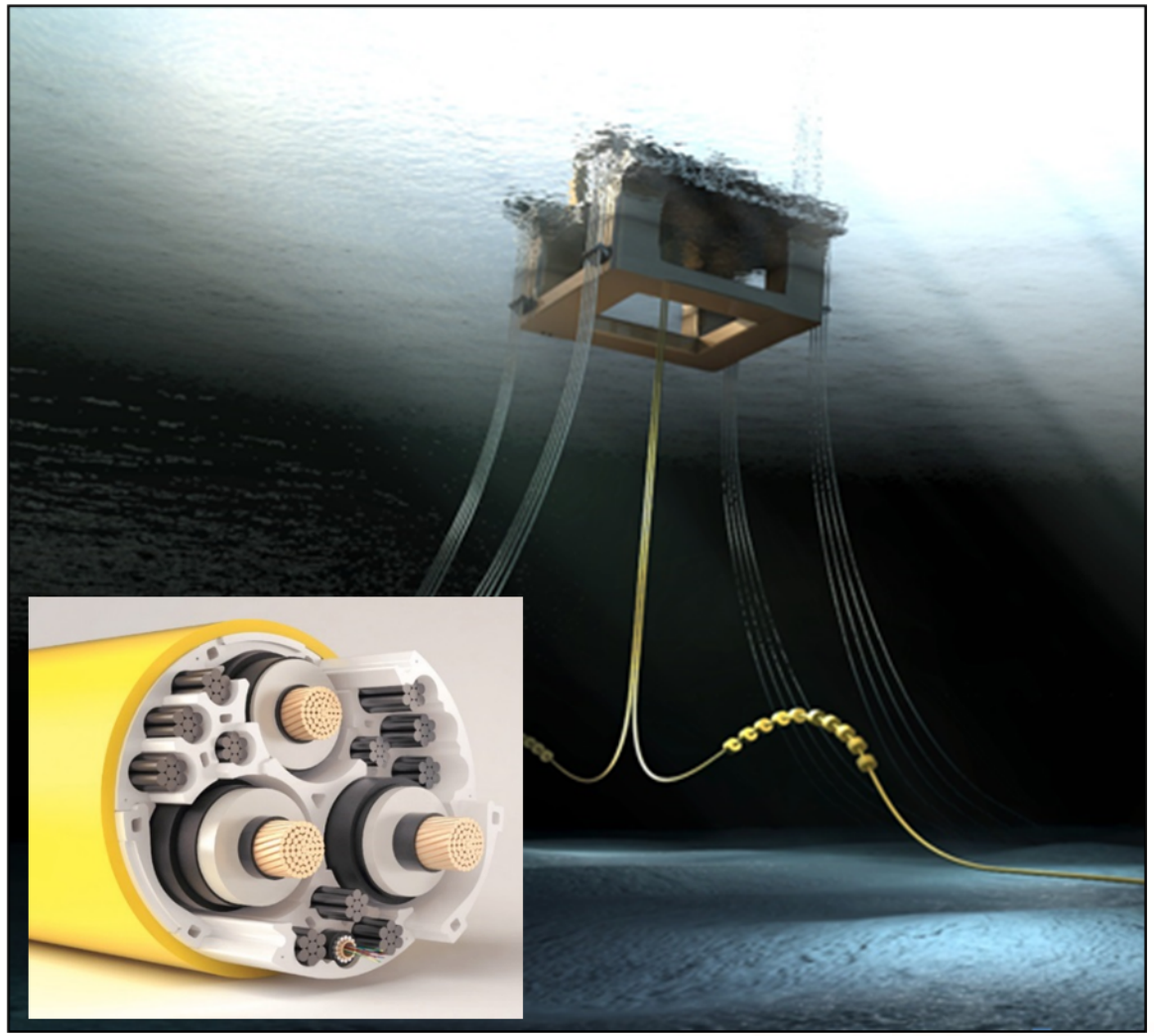
- H2020 funding from EU
- +10 MW WTG
- Aker Solutions with EPCI scope
- Possible solution for future projects – can facilitate high level of local content

World Class Facility for Execution in Mobile, Alabama

Aker Solutions legacy and capabilities for cables and umbilicals

Track-record

- Designed and delivered more than **550 umbilicals and power cables** worldwide for over 25 years (started in 1993)
- Delivered more than 100 cables and umbilicals in dynamic configuration, first **dynamic umbilical** in 1996
- Delivered first **dynamic power cable** in 2010 @ 2700m WD.
- A steady 30-35% yearly global market share for steel tube umbilicals / steel tube power umbilicals.
- Two manufacturing plants close to key markets;
  - Moss, Norway (Operational 1993)
  - Mobile, Alabama, US (Operational 2003)
- Able to produce high quality array cables for a growing offshore wind industry (NB! Cable failure rates)



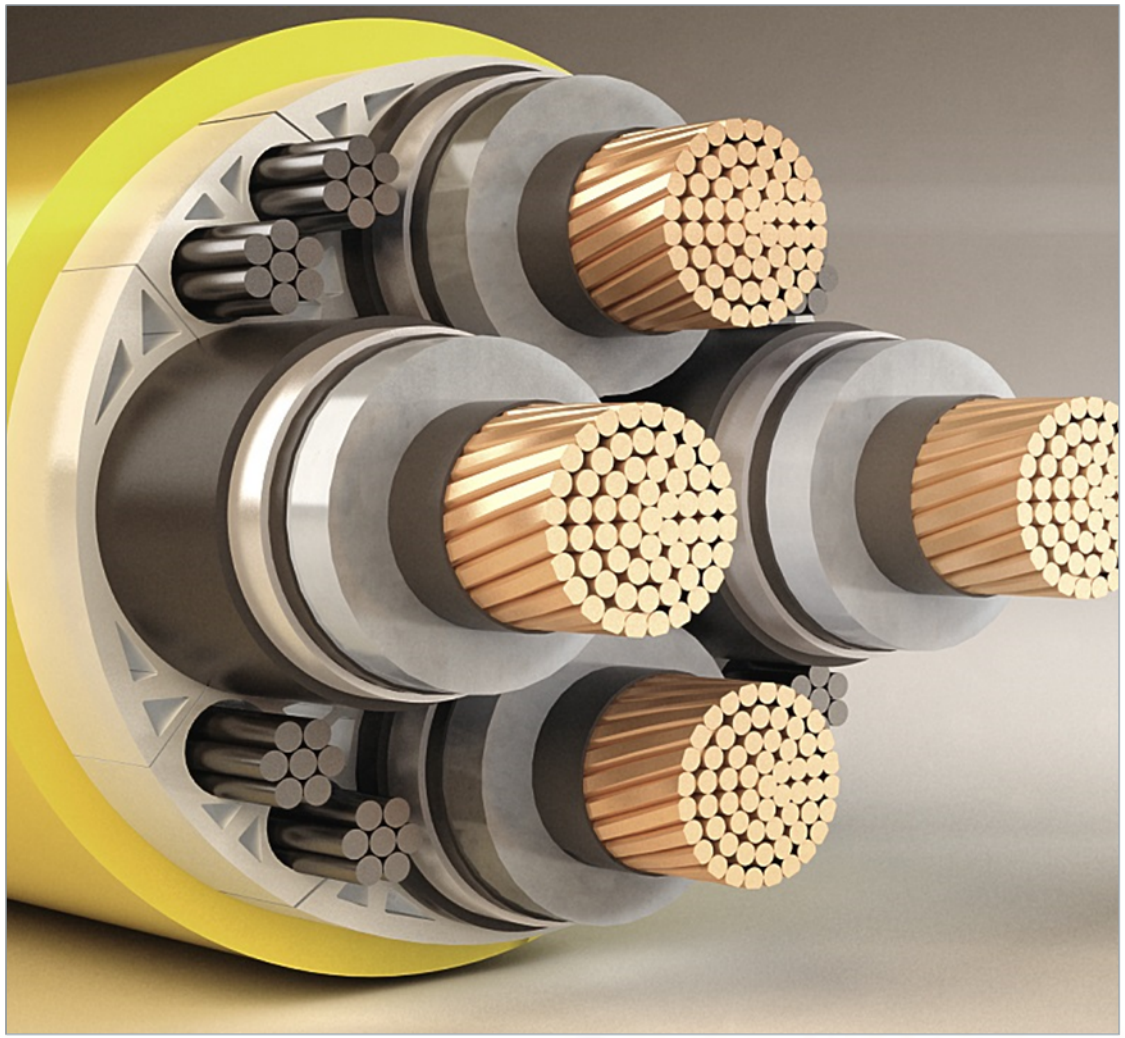
Aker Solutions Power Cable Product

Aker Solutions designs, manufactures, and deploys system packages to enable subsea connectivity.

- Separate conduits for the elements.
- No need for separate steel armoring on top
- Great impact resistance
- Long lay length – less fatigue stress
- Excellent behaviour and strength both under installation and operation

Key Components:

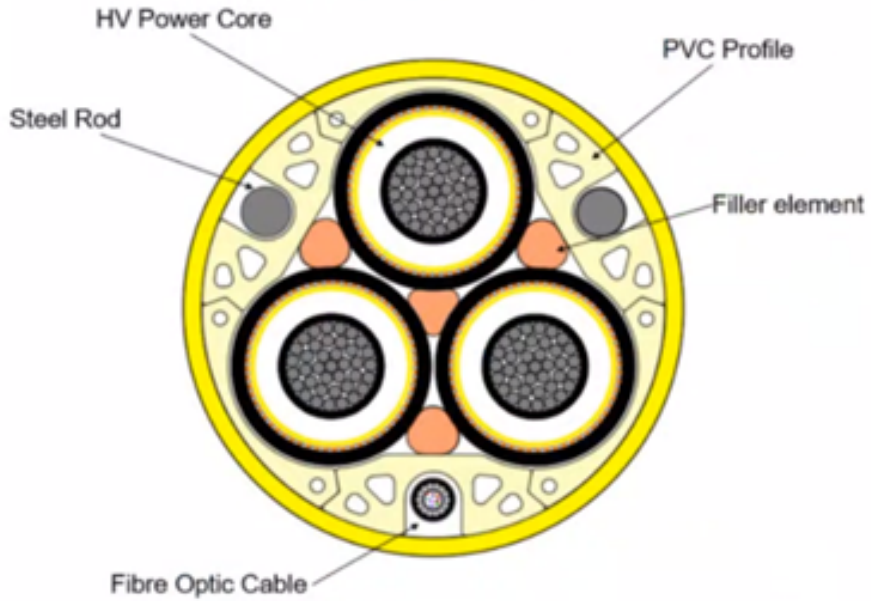
- Carbon fiber rods in the cross section control the strain of the components and improve fatigue properties;
- Power Cables with SoftClamp - suspension of the power cores below the fatigue exposed section of dynamic umbilical eliminates the combined bend and tension and significantly reduces contact force;
- PVC Profile matrix designed to meet specific requirements for crush and impact capacity;
- Polymer properties satisfy temperature and design life criteria.



Simplified and installation efficient dynamic cable system for floating wind

The Aker Solutions cable design utilizing internal strength members instead of outer armoring enables a flexible, efficient and robust method for pull-in and hang-off. The system can be customized to accommodate various loads, and all pieces are designed to be handled without lifting aids.

Aker Solutions - 66kV Dynamic Power Cable



Typical competitor - Dynamic Power Cable

Electrical Benefits of Aker Solutions Dynamic Power Cable Design

Reduced carbon steel in cable design significantly decreases overall electrical power loss at maximum current capacity

Electrical cross-bonding of elements reduces net circulating currents, therefore further reducing power loss

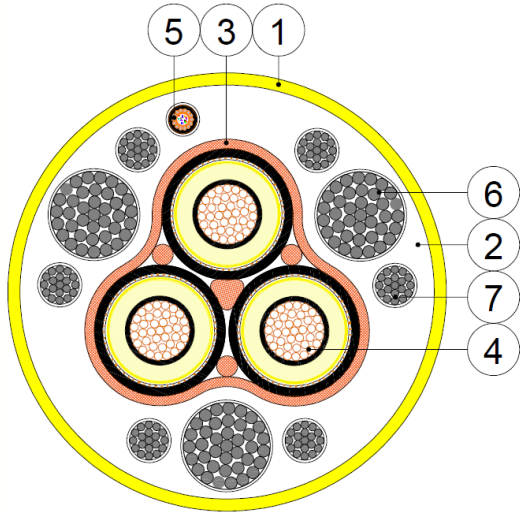
Design reduces AC induced corrosion phenomena that can cause hot-spots, contributing to component damage and eventually failure

Optical fiber cable out of magnetic field path reduces induced current heating and fiber embrittlement

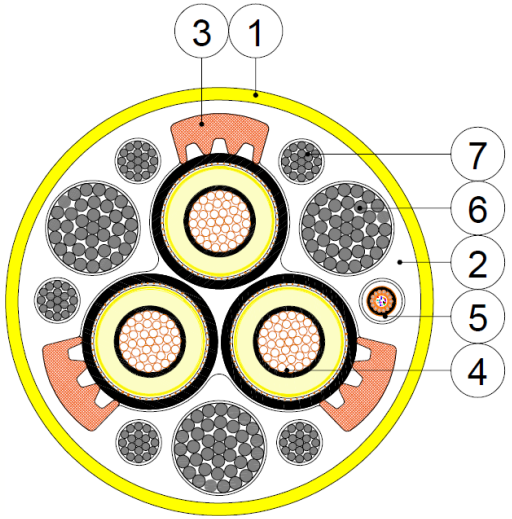
Mechanical Benefits of Aker Solutions Dynamic Power Cable Design

- Ease of access to components requiring repair since not enclosed with concentric wire armor
- Non-touching components provides exceptional mechanical support by evenly distributing mechanical loading.
- Evenly distributed radial loads eliminates point loading/sidewall pressure. Perfect for shore pull-ins
- Design allows for smaller bend radii, beneficial in both dynamic and static applications
- Dropped object impact testing to 8 kJ shows no damage below outer jacket surface

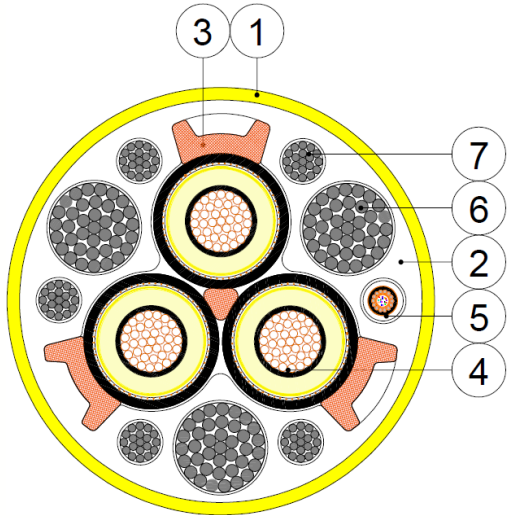
Different ways to address challenges…a lot in the toolbox!



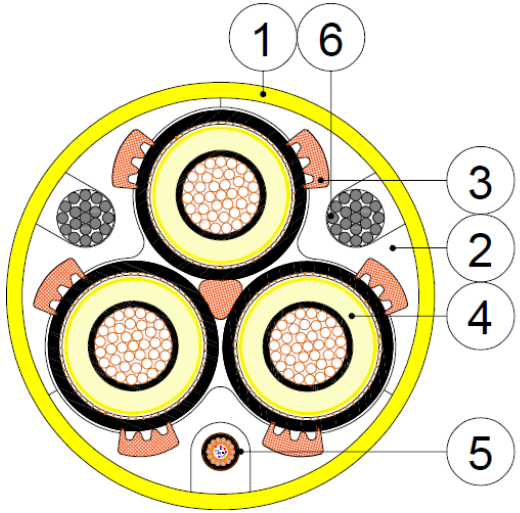
Dynamic Deepwater (>100m). High dynamic response. Increased friction.



Dynamic Shallow-water. (<100m). High dynamic response. Controlled friction.

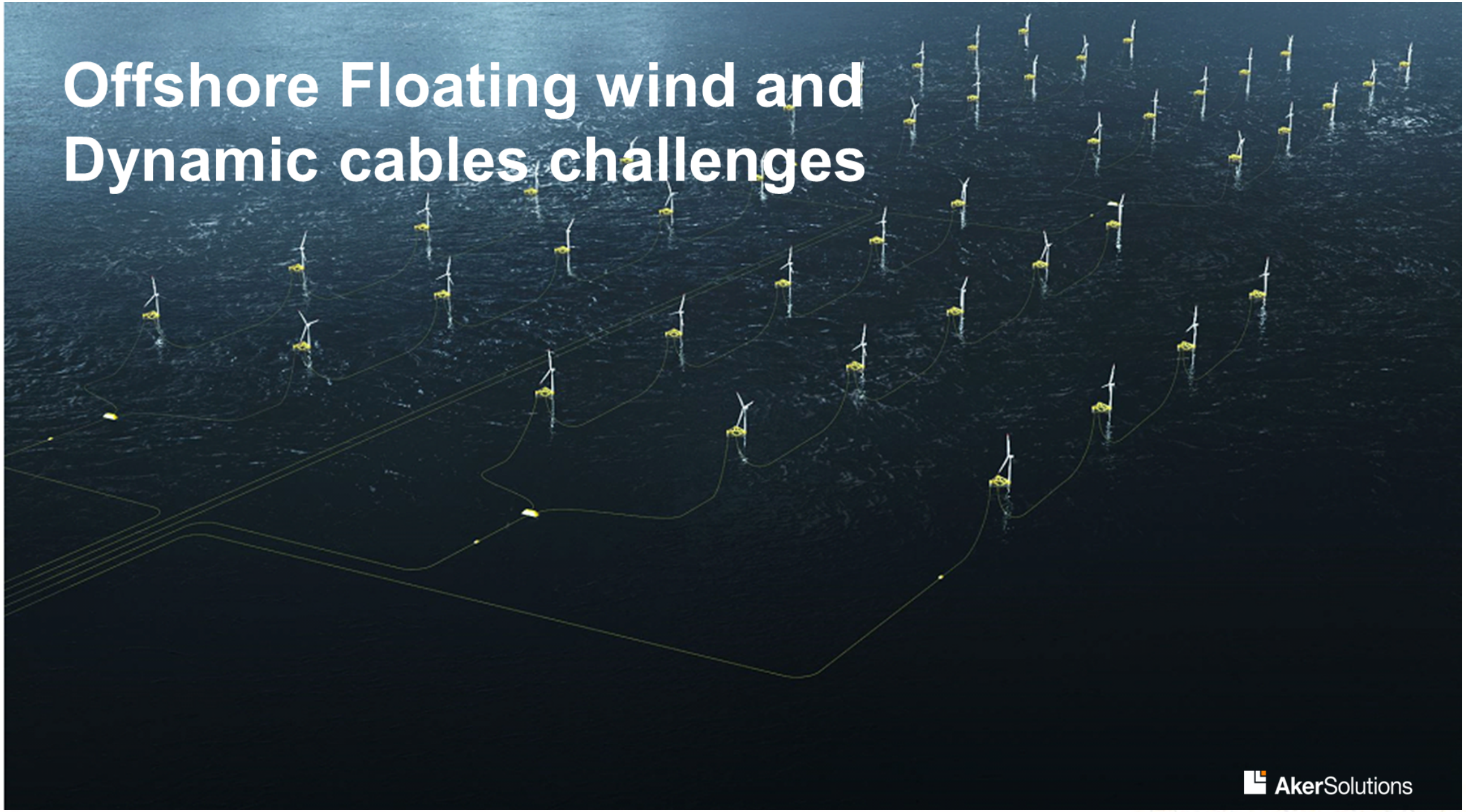


Dynamic Shallow-water. (<50m). Weight added. On bottom stability critical. Increased friction.



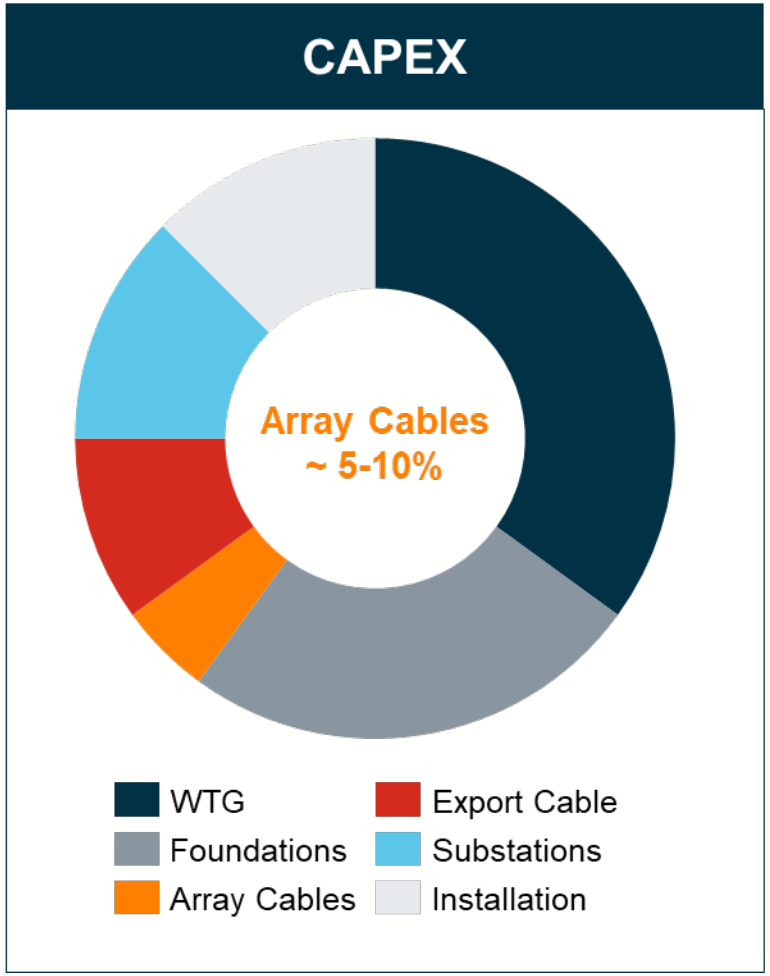
HV Dynamic-Static, long length, shallow water (<50m). Lower Friction.

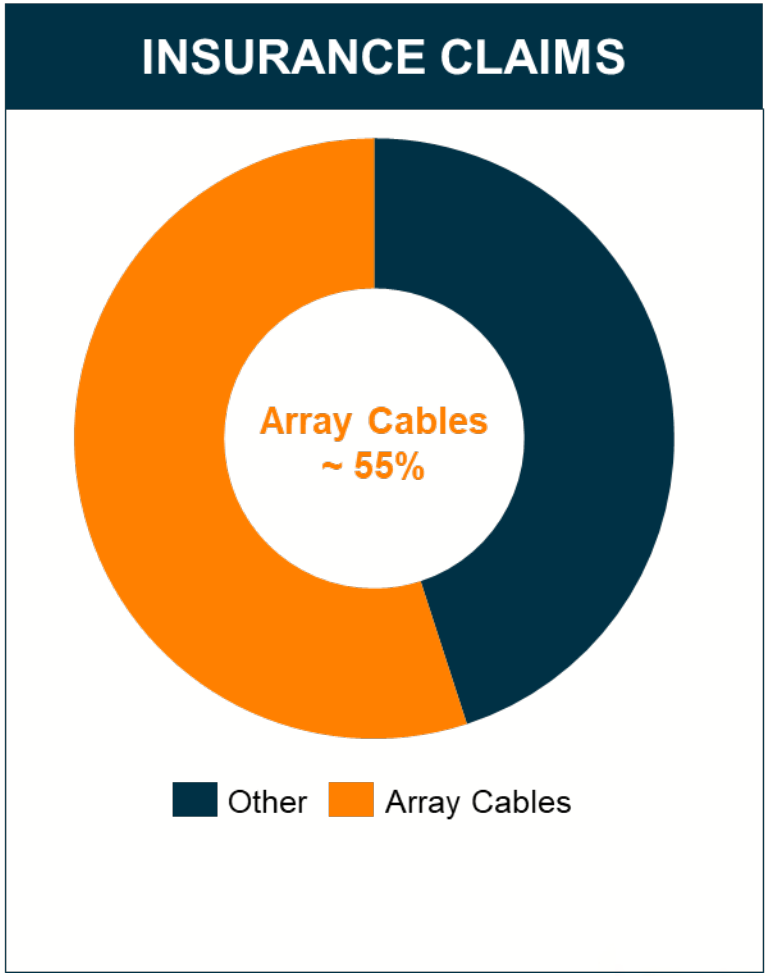
Offshore Floating wind and Dynamic cables challenges




Offshore Wind – Cable segments
Inter Array cables (66kV)
Export cable (+220kV – HVAC and HVDC)
AkerSolutions

Feedback from Insurance Companies





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Damaged offshore wind cables to cost Orsted almost half a billion dollars: CFO

Danish giant will add additional layer of protective rocks on some cable routes and conduct further seabed investigations until 2023

29 April 2021 8:51 GMT *UPDATED 4 May 2021 16:46 GMT*

By **Bernd Radowitz**

Repairing damaged cables at already operating offshore wind farms such as the UK's Race Bank, or boosting inadequate protection systems elsewhere, will cost Orsted about DKr3bn ($489m), chief financial officer Marianne Wiinholt revealed.

"We found out a short time ago that we had cable failures at one of the array cables at Race Bank," Wiinholt said during a media call on first quarter results.

"When we investigated the cause of that, we found that more cables were damaged.

"The damage is caused by the fact that the cable protection system, which is both from the turbines and links to the cable, is placed on top of rocks. With the movement in the sea, this cable protection system gets damaged."

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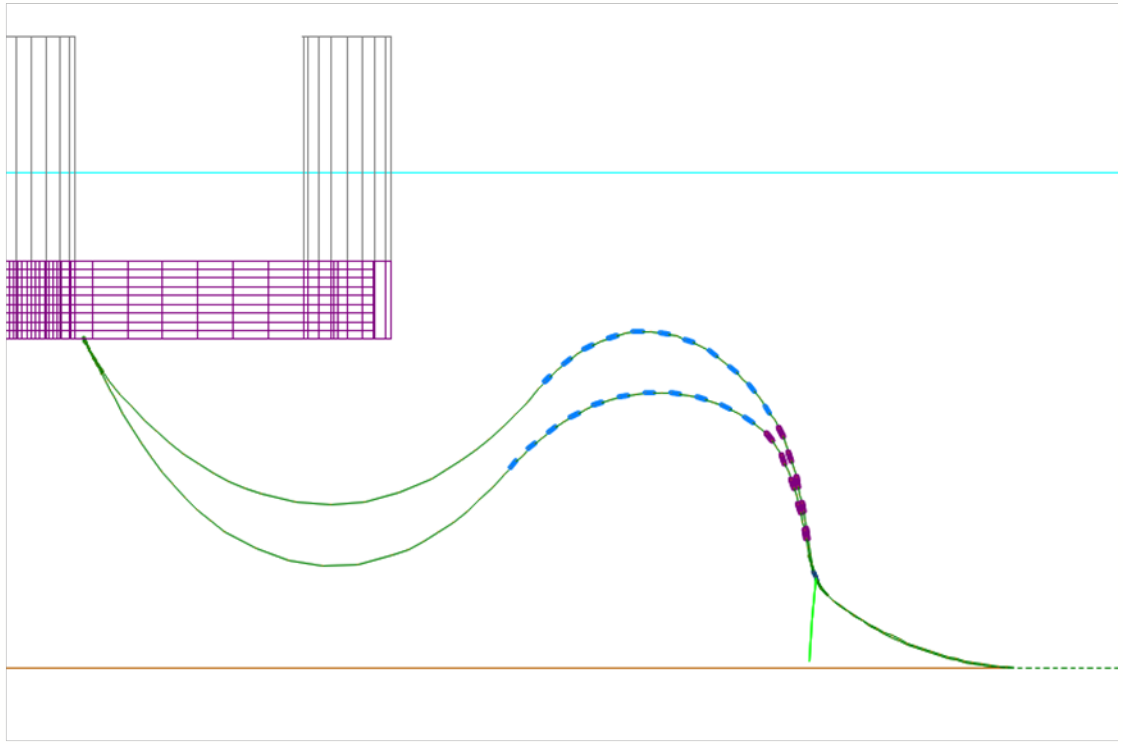
16 April 2021 7:27 GMT

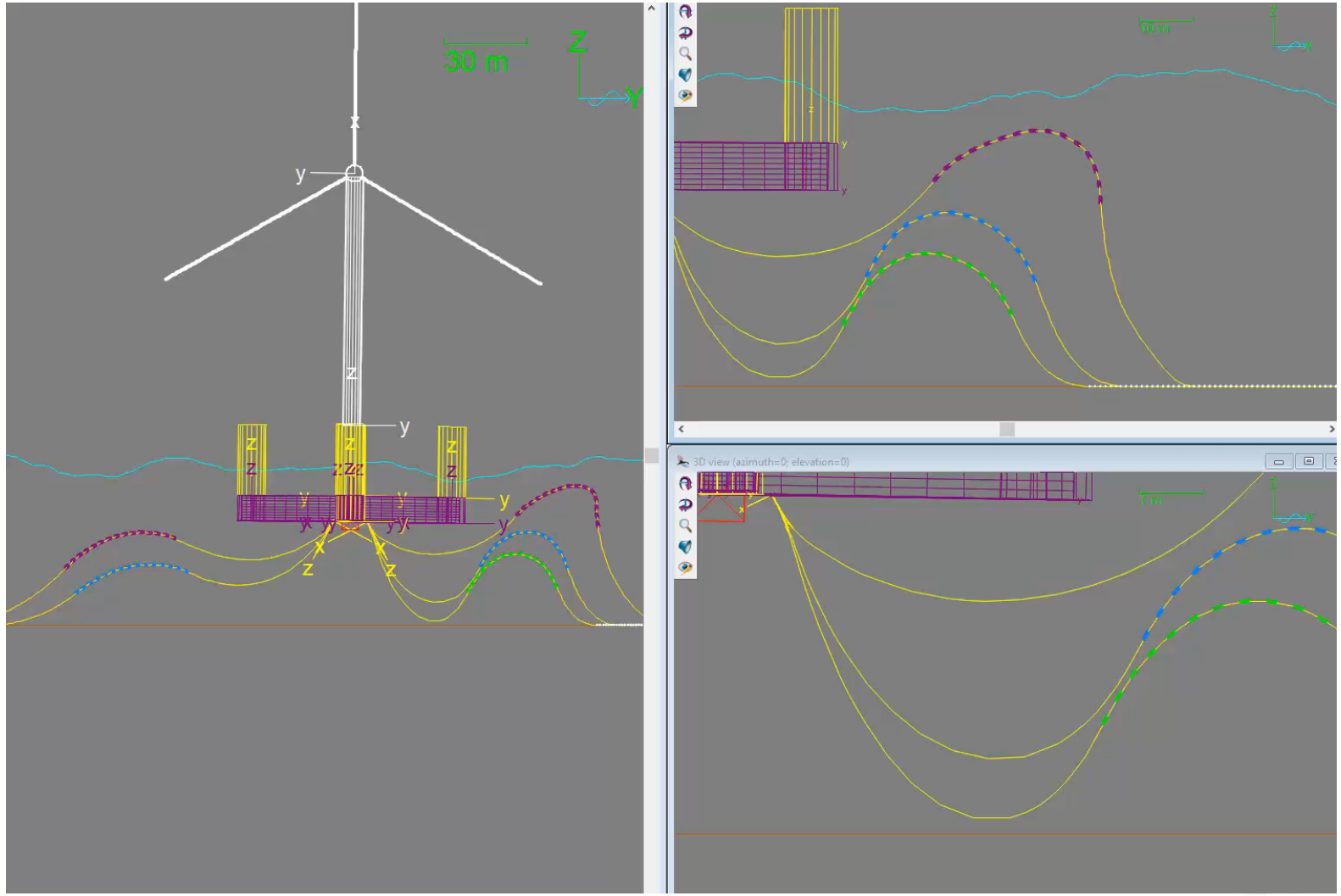
Orsted wraps part-sale of landmark US

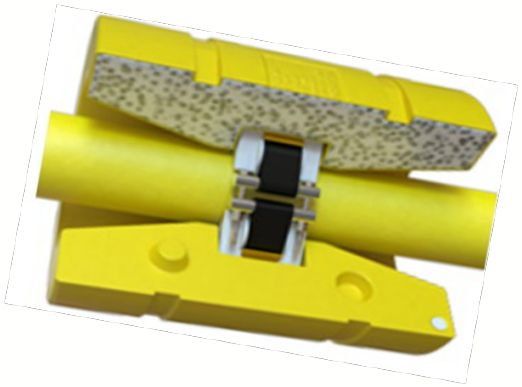
Floating wind – cable challenges

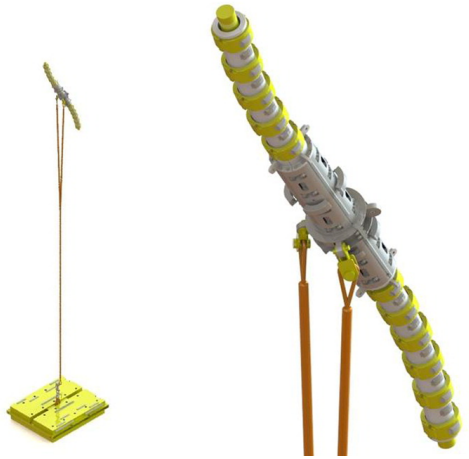
- Shallow water with large platform offset requires buoyancy section to add flexibility for near and far cases.
- High currents and marine growth adds on to the challenge and drive the need for tether system.

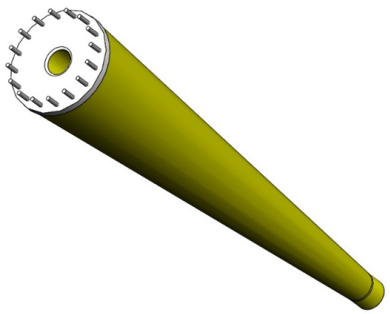


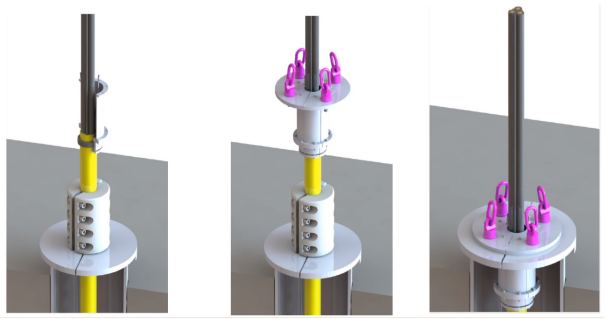
Issues with “shallow” water ….







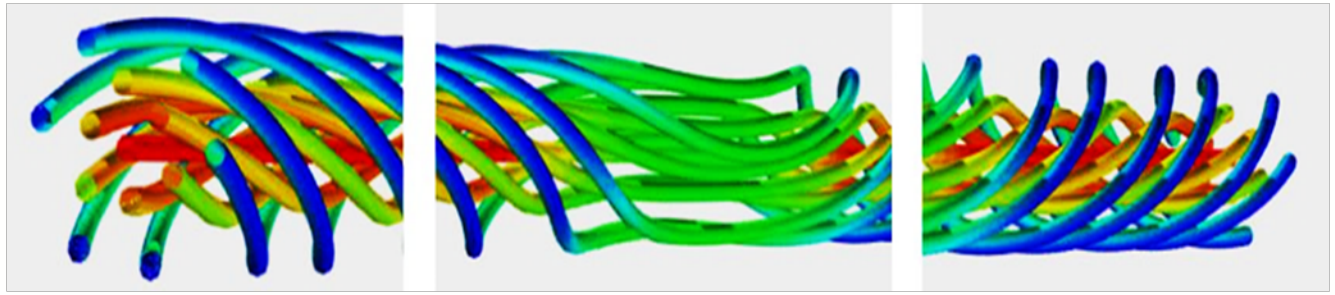


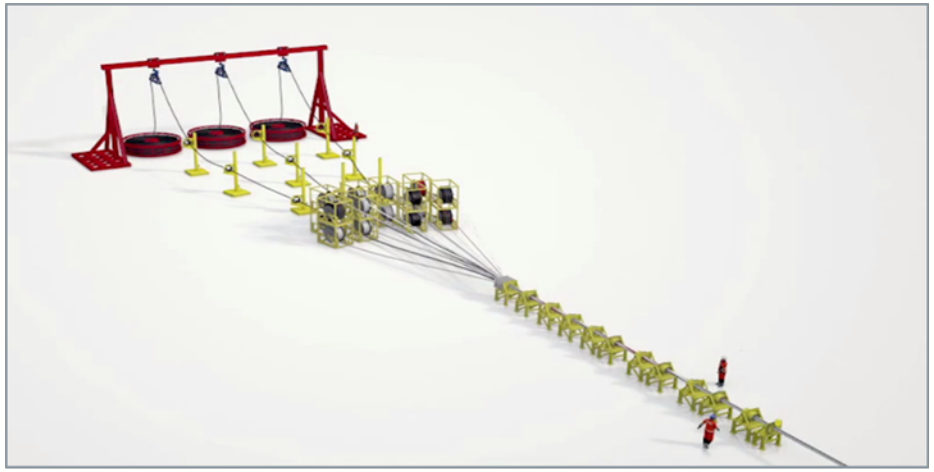


Typical auxiliary equipment:

- Bending stiffener w/connector
- Buoyancy modules
- Vertical tether
- Hold back clamp
- Connect – Disconnect – Weak-link
- Topside Hang-off

New Manufacturing Process Aimed at Wind Industry





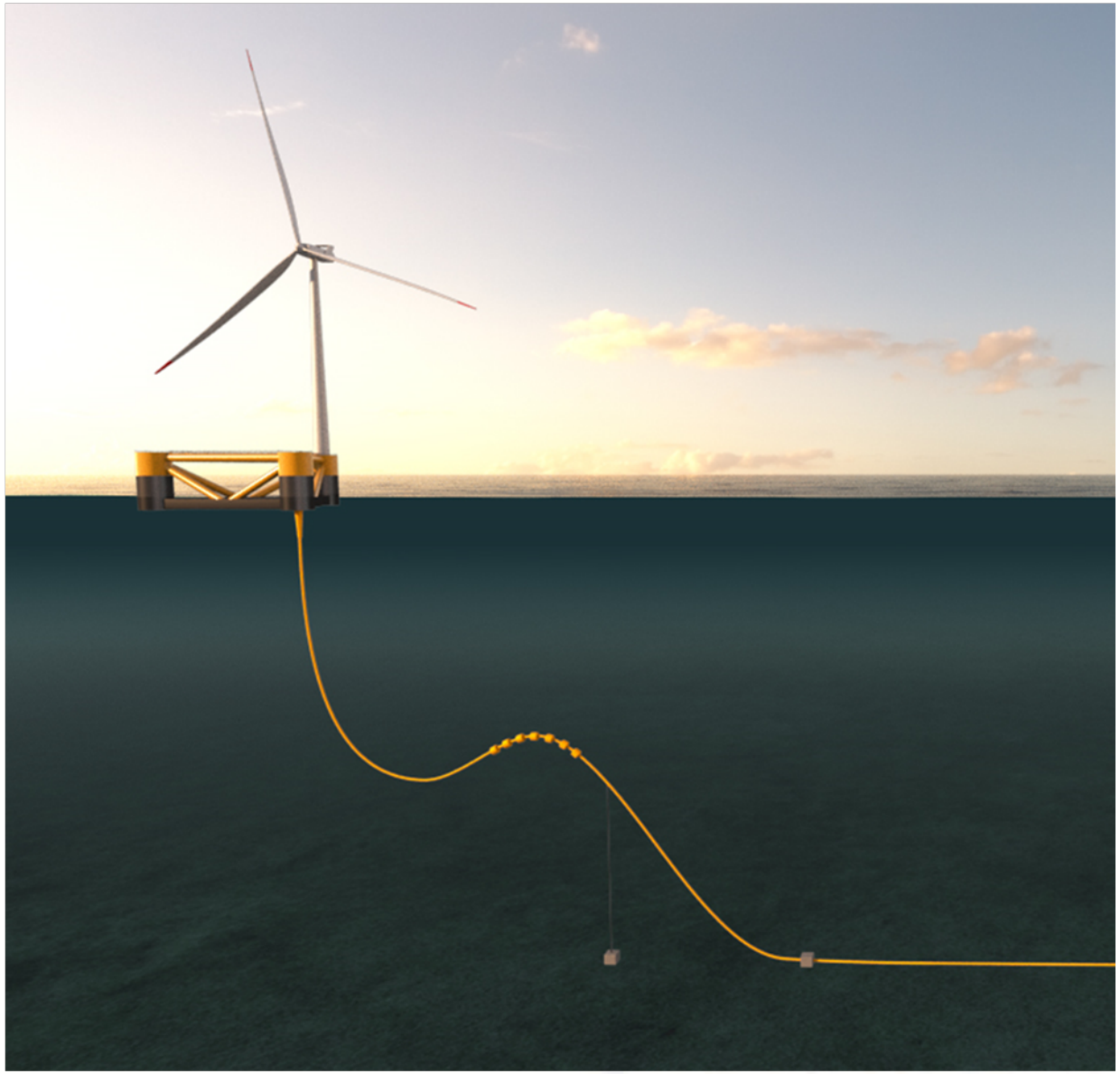
OsciLay™ is ideal for

- Power Cables & Static Umbilical
- Complex cross sections (high number of elements)

- Lower cost process for power cables and static umbilical
- Expands the benefits to include:
  - Fewer cable joints and Welds
  - More Elements
  - Machine Simplicity & Flexibility
- Design features of Aker Solutions' product makes OsciLay™ possible

Summary

- Auxiliary equipment is key to get the cable system to work as engineered in addition to the cable design itself
- The iterative process and cooperation between the floater design and cables system is paramount to find the optimized solution
- Aker Solutions experience both in design and delivery of floating offshore units and mechanical engineering is key to solve the dynamic cables challenge for floating wind



Thank You!