

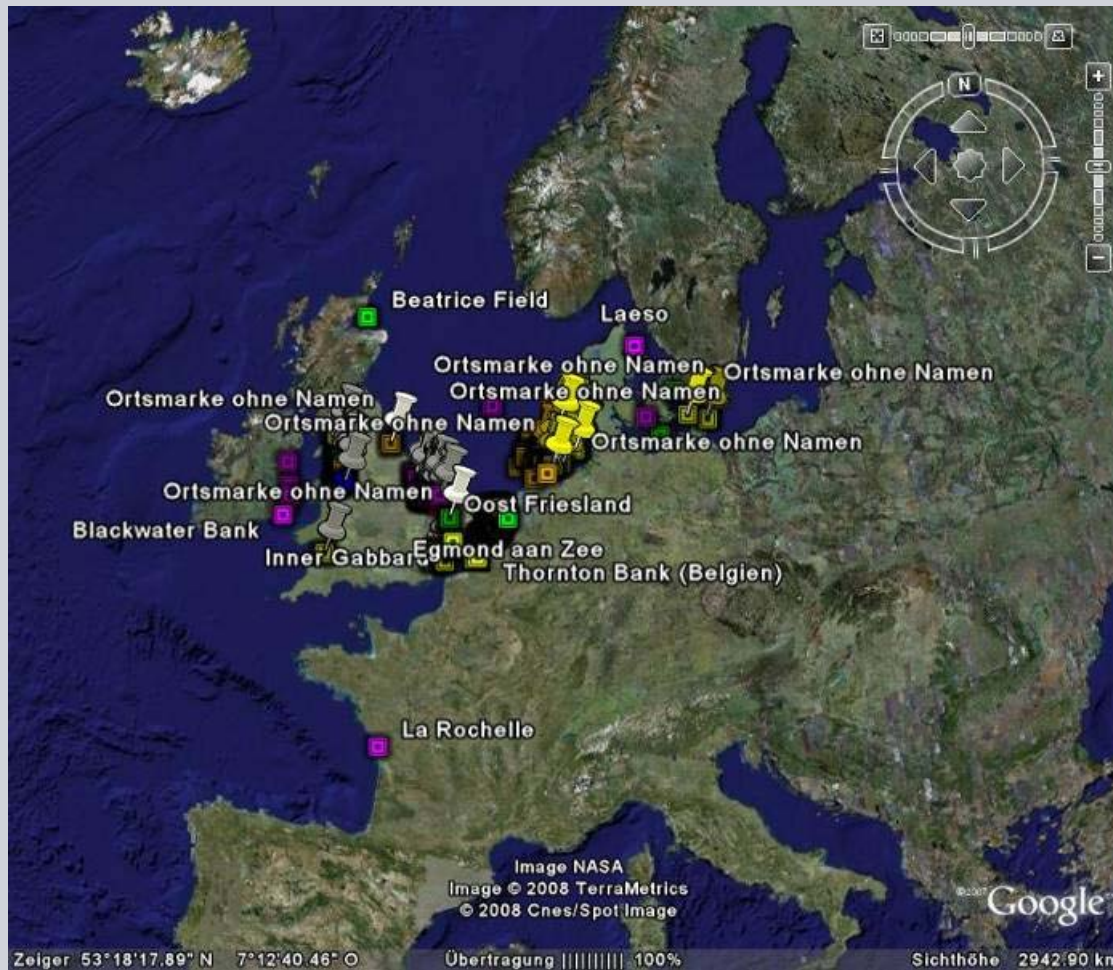
Offshore Wind Farms Europe 2010

by Hermann Koch

Wind Farms in Europe

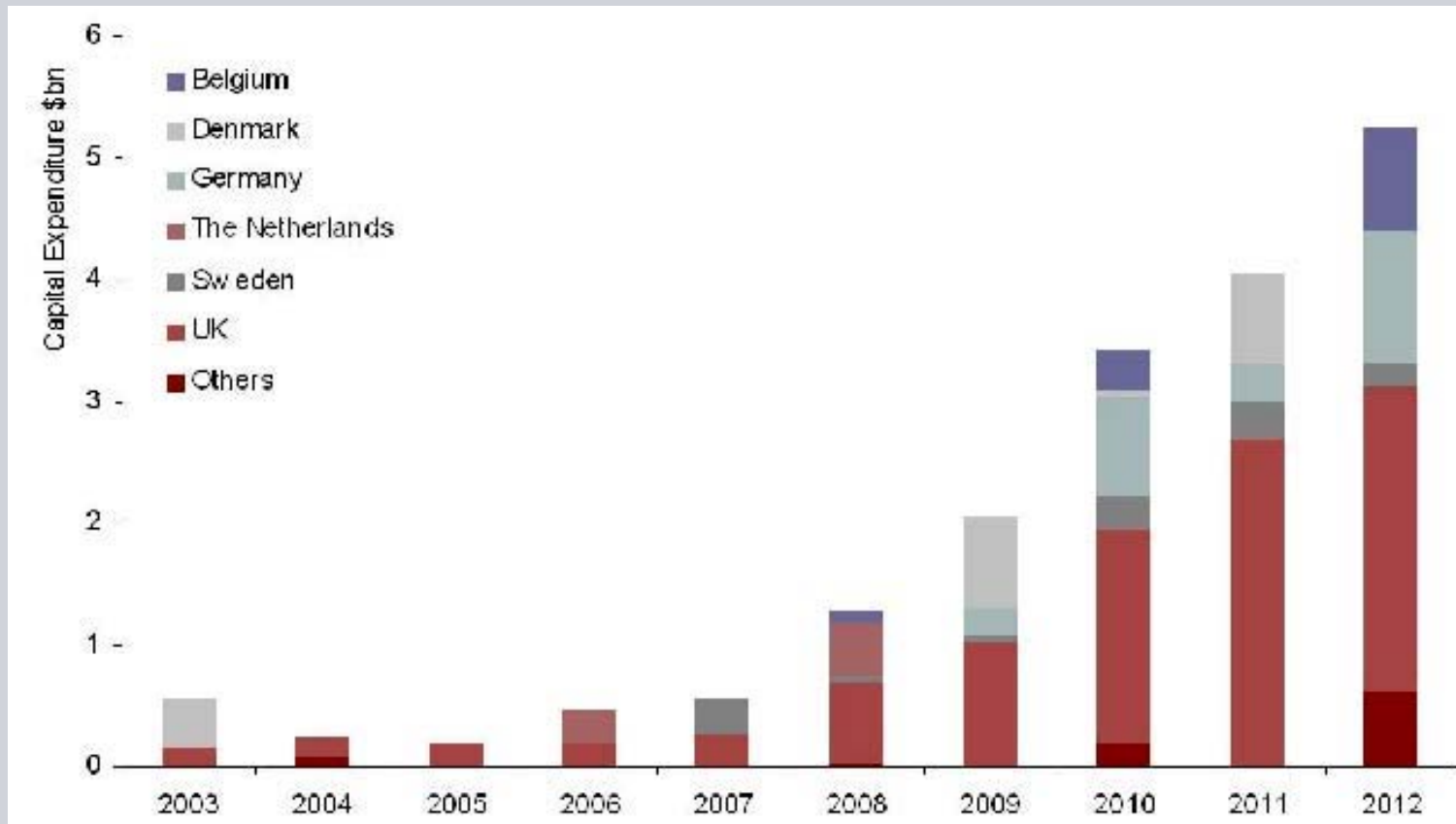
- Wind engines on land have reached high level
 - Germany: > 30 GW installed, > 10 GW delivered
- Next step in wind energy is: Offshore
- Offshore wind energy forecast in Europe:
 - 3 to 4 GW of offshore wind energy installed by 2010
 - 10 to 15 GW of offshore wind energy installed by 2015
 - 20 to 40 GW of offshore wind energy capacity operating in EU by 2020
- Europe looking to offshore wind energy to meet future renewable energy growth targets of 20% by 2020

Offshore Wind Parks in Europe



Offshore Wind Farms in Europe Capital Spend Forecast 2008 - 2012

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Douglass Westwood; The World Offshore Wind Report

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Offshore Wind Farms in Europe Steps



- First installations in Denmark: Horns Rev
 - close to the coast line and new wind park will come
- Germany: Alpha Ventus for research 5 MW in operation
 - more than 30 GW are planned
- UK Round 2 projects of large scale (> 500 MW) since 2009
 - far from coast line (20-50 km)
- UK Round 3 to be launched in 2010 with large scale (> 500 MW)
 - more far from coast line (up to 200 km)
- Netherlands starts large offshore wind parks (>500 MW) now
- Spain begins its offshore development in 2012 – 2015

Greater Gabbard Project Description

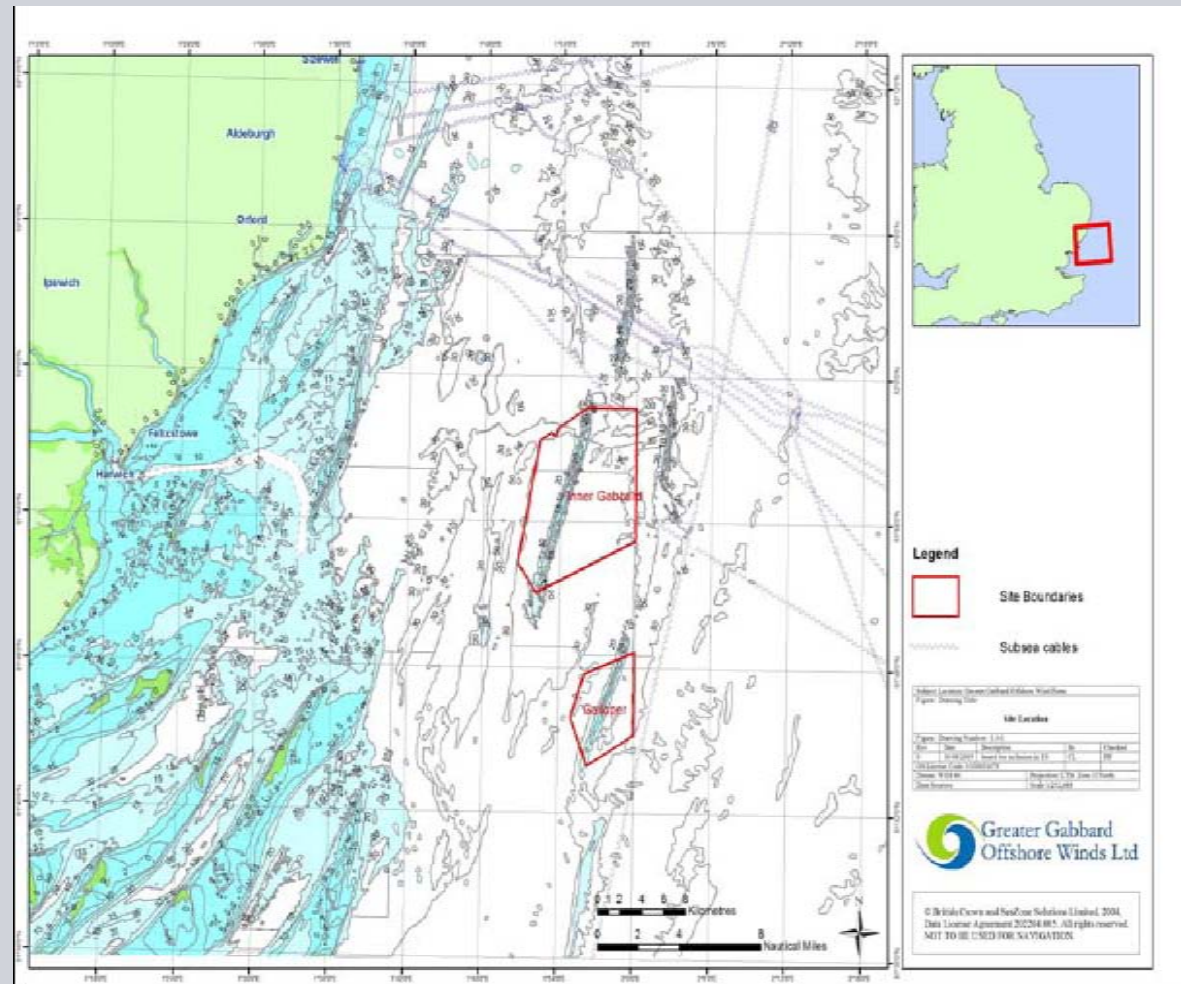
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Project Description

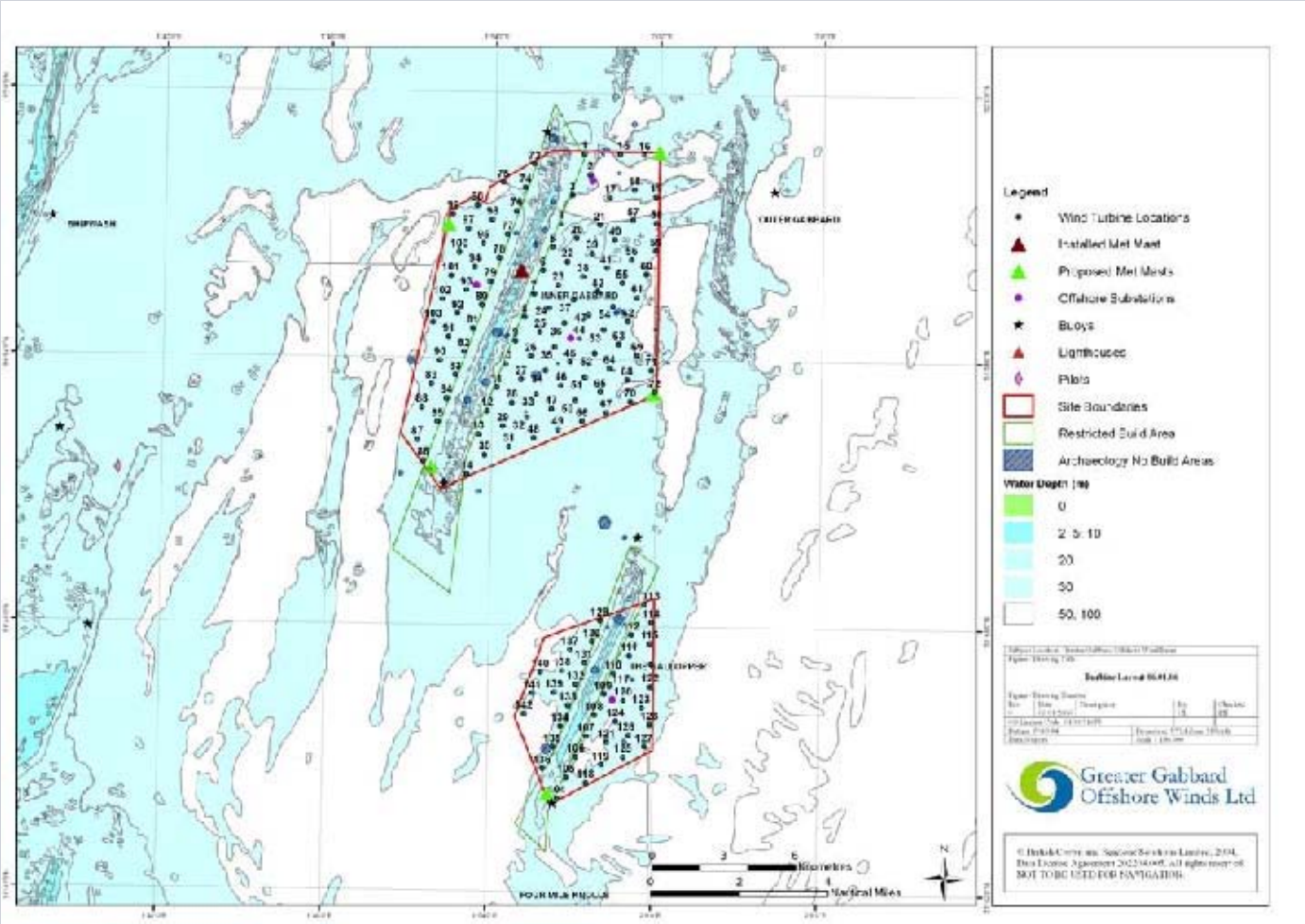
- 500 MW Offshore Wind Farm Project
- Electricity output: 1.8TWh/yr
- 140 x 3.6 MW Siemens wind turbines

Project Site

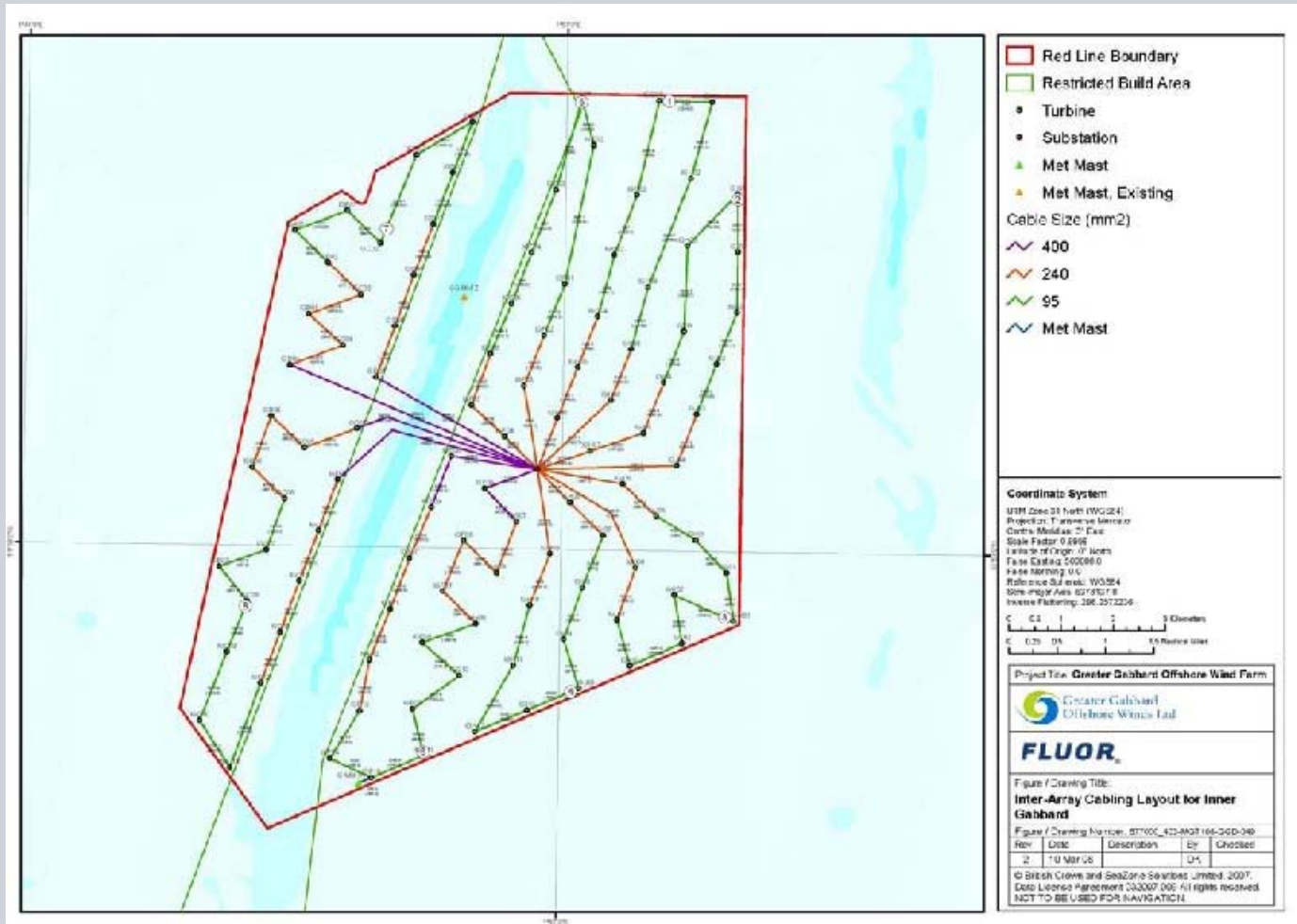
- Outer Thames Estuary, U.K.
- 25 km offshore
- Site area = 147 km²



Greater Gabbard Site Layout



Greater Gabbard - Cable Layout



Greater Gabbard Cables

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Armouring hang-offs for the five inter array 33kV cables and 150kV export cable on the substation at Horns Rev

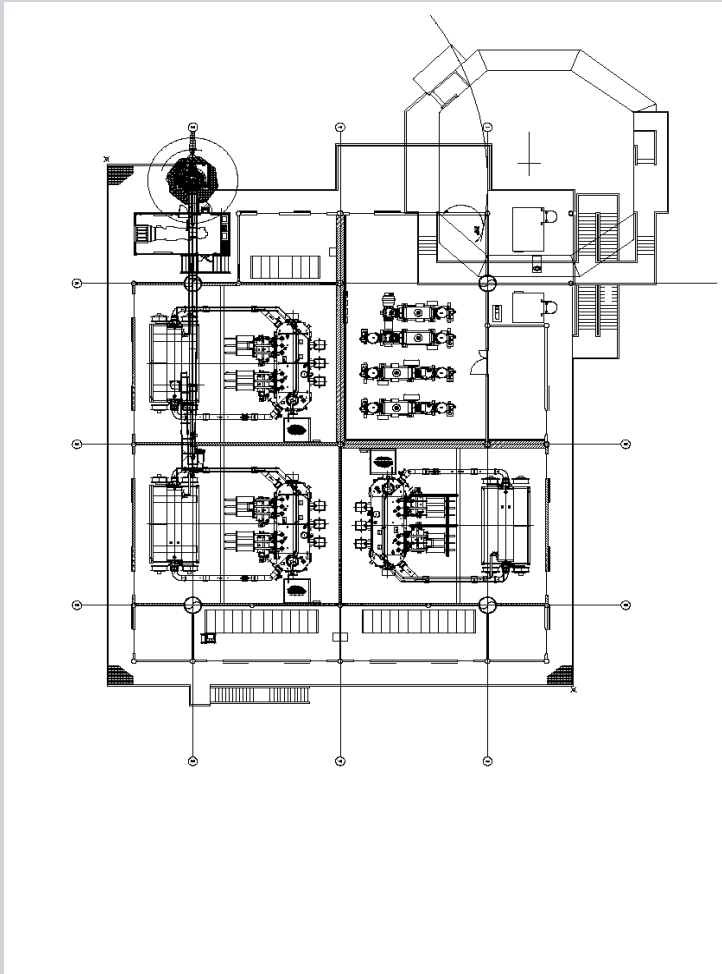
Greater Gabbard Landfall - Beaches vary

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Greater Gabbard Main Platform

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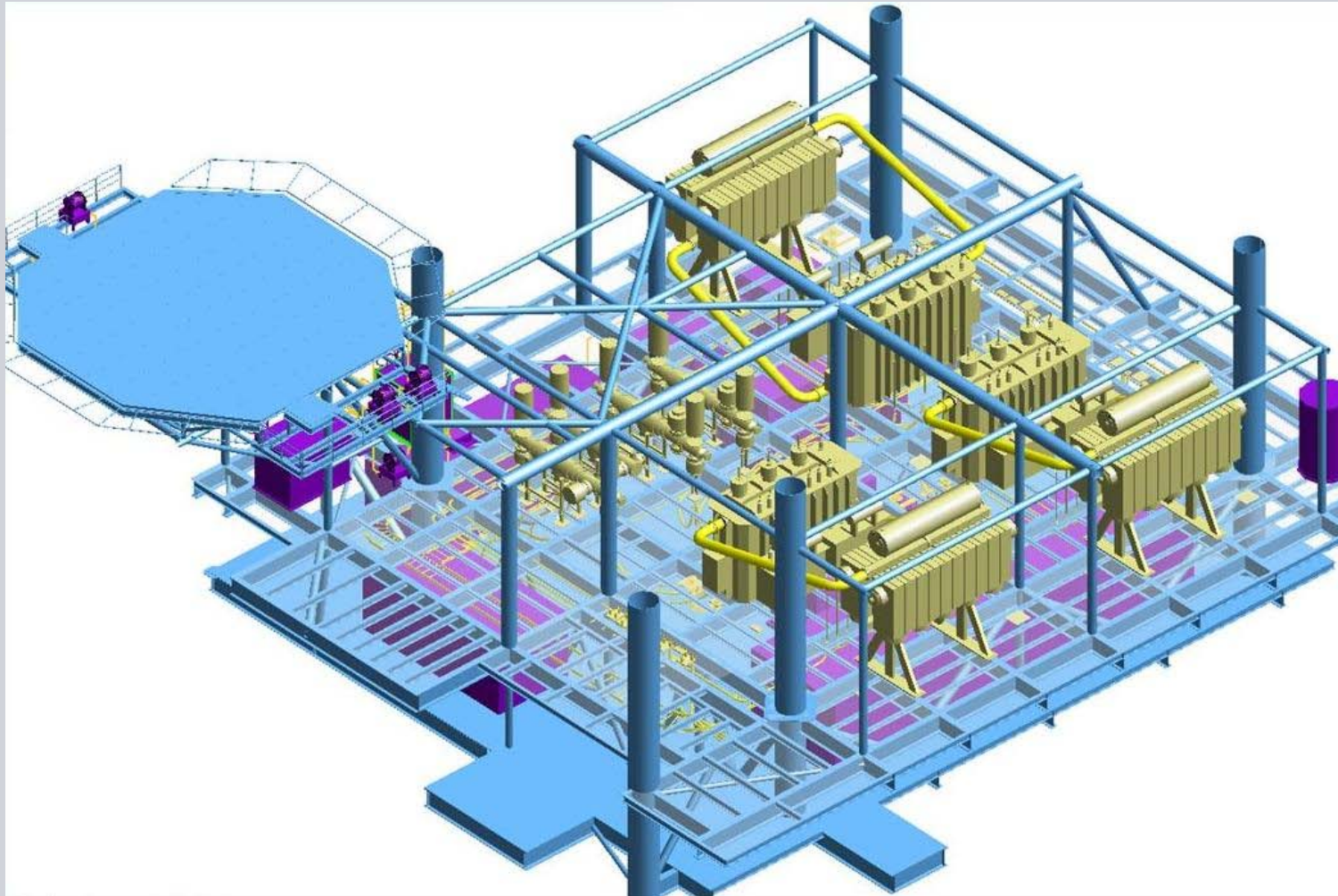


2 Decks, Topside approx. 2000 t:

- 16 incoming 33 kV Cables from Wind Turbine Array
- 3 GIS 33 kV Switchboards
- 3 x 33/132 kV Transformers, 3 Winding 90/90/180 MVA
- Auxiliary/Earthing Transformers
- 4 GIS 132 kV Circuit Breakers
- 132 kV Cable Connections to Transformers
- Generator, Refuge, Fire Suppression, Metering, etc.
- Helipad

Greater Gabbard Offshore Substation

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Greater Gabbard On the barge before sailing

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Greater Gabbard Sailing Out

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Greater Gabbard Installing onto Jacket

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Greater Gabbard Removing the Lifting Frame

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Greater Gabbard Offshore Substation installed on Jacket

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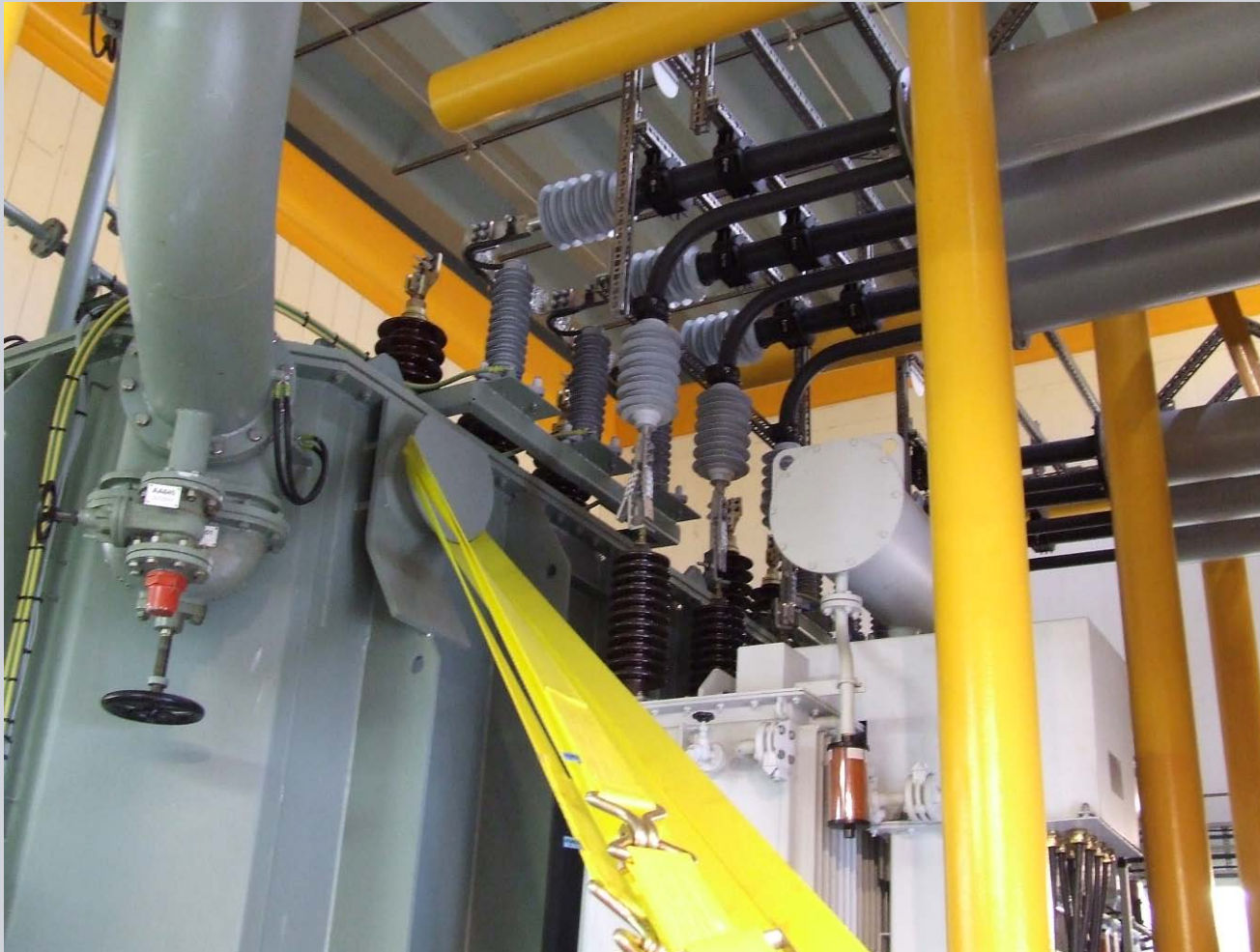
Greater Gabbard Access offshore

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Greater Gabbard View of Transformer

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Greater Gabbard Platform GIS Switchboard

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Greater Gabbard 33kV Switchroom – installing seaworthy packing

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Galloper Substation Platform

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Galloper Substation Platform

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Galloper Lower Level Substation Platform

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Lower Level Substation Platform - Cable Connection

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Galloper Upper Level Substation Platform

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Upper Level Substation Platform - 33 kV Switchgear

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Galloper Upper Level Substation Platform - 132/33 kV Transformer



Galloper Upper Level Substation Platform - 132 kV GIS

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Offshore Wind Farms Europe 2010 Conclusion

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- The usable wind energy resources in the European North Sea are larger than 100 GW
- New technology for substations on offshore platforms is required to be:
 - compact in design
 - reliable in operation
 - easy to maintain
 - withstand offshore weather conditions
- The future of renewable energy from large scale offshore wind farms has already started in Europe.

