

Offshore Substations for Wind Farms

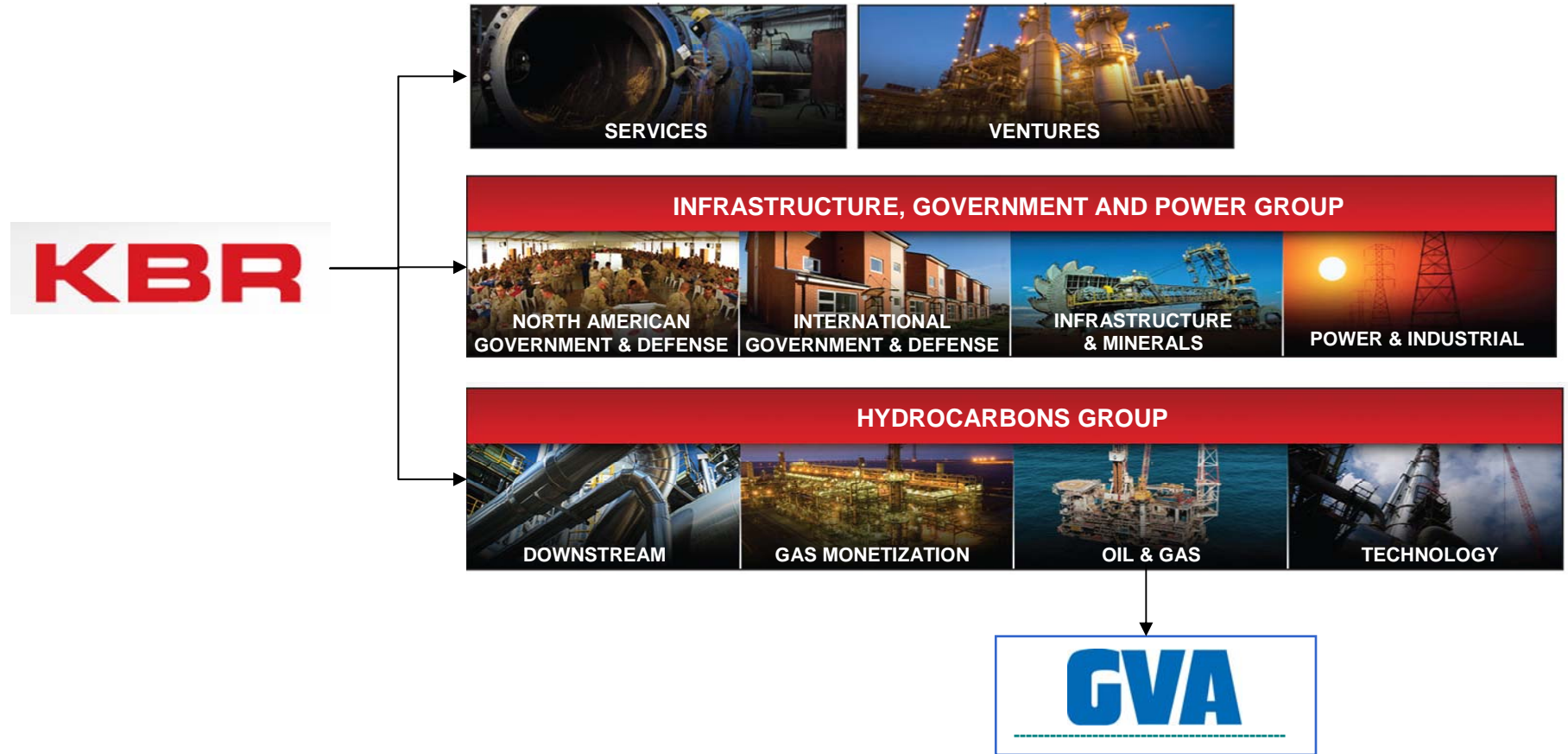


Kjell Vågfelt
GVA

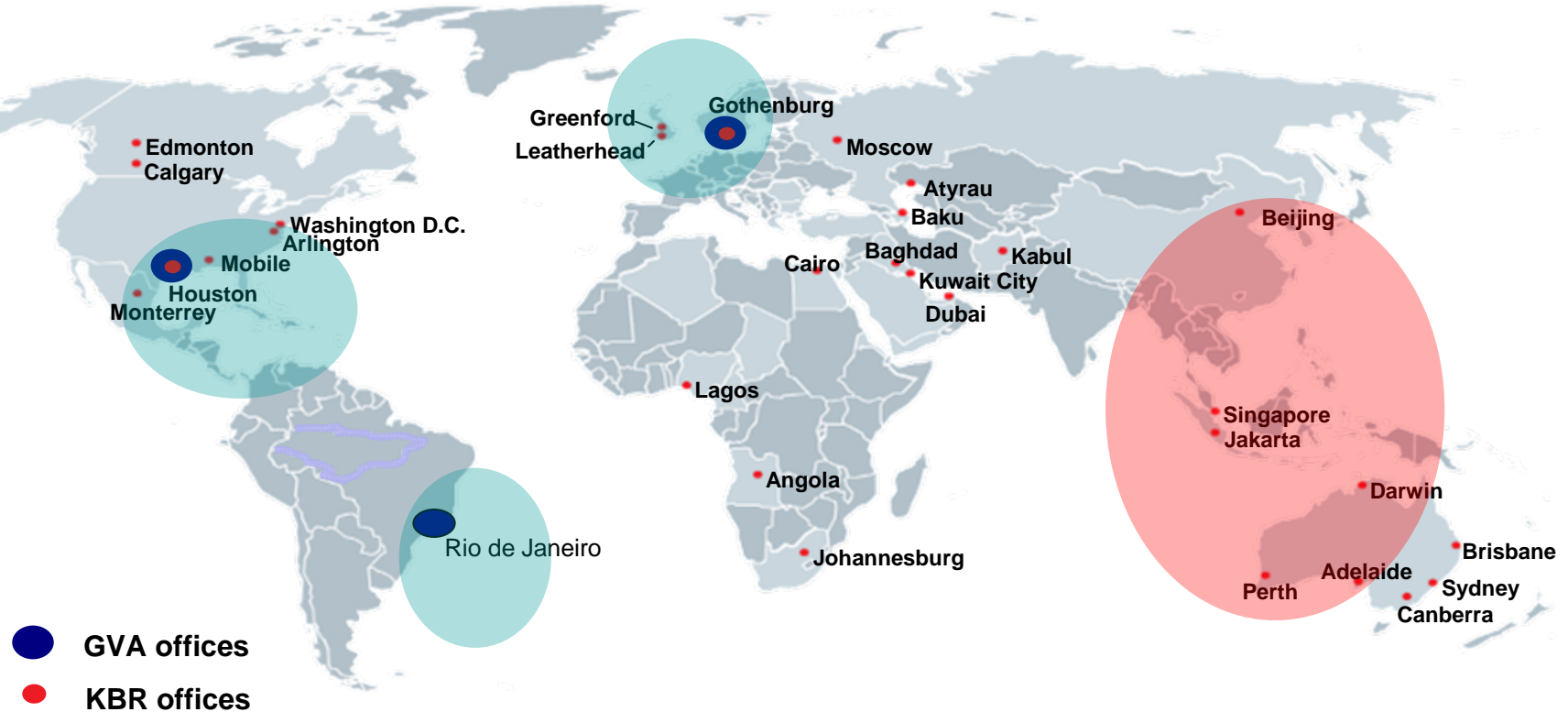
Kjell Vågfelt

- Uddevallavarvet Ship designer 1976 – 1981
- M.Sc. Naval Architecture Chalmers 1981
- Det Norske Veritas Ship Surveyor 1981 - 1983
- Lic. Eng. Marine Structures Chalmers 1986
- DNV Ingemansson N & V Consultant 1986 - 1995
- DNV Inspection Manager Des.Rev. 1995 - 2000
- Ingemansson Manager & Consultant 2000 - 2008
- GVA Senior Specialist 2008 - 2009
- GVA Manager Structural Analysis 2009 - present

KBR's Business Segments



KBR & GVA Global Marketplace



GVA Main Areas or Focus

- ▶ **North Sea** – GVA home market with several deliveries since early 70'ies
- ▶ **Gulf of Mexico** – Several large FPU and drilling units designs delivered
- ▶ **Brazil** – Important ongoing and future market
- ▶ **Asia** – Important ship building and offshore market

GVA history

- ***Keillers Werkstad 1841***
- **Göteborgs Mek. Werkstads AB 1867**
- **AB Götaverken 1916**
- **GVA Consultants 1989**

- **American Bureau of Shipping 1862**
- **Det Norske Veritas 1864**

Götaverken Arendal Shipyard 1963 - 1989



27 October 2011

Slide 6

Master of the Oceans

GVA
A KBR COMPANY

GVA 7500 built at DSME South Korea



27 October 2011

Slide 7

Master of the Oceans

GVA
A KBR COMPANY

Services Rendered

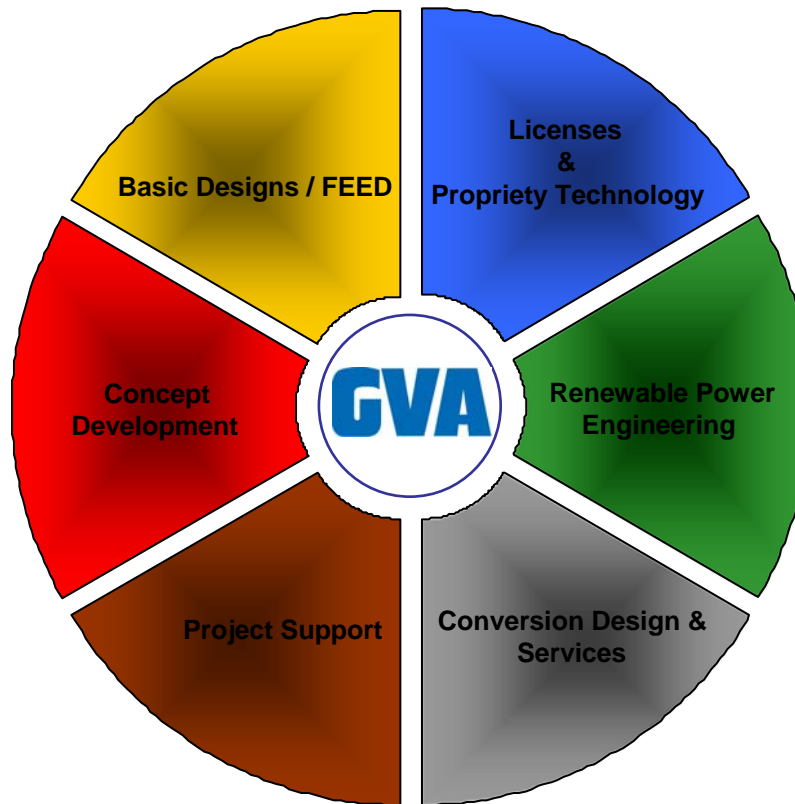


Basic Design/FEED of Semis, Drillships and FPSO's.

Concept Development, Feasibility studies & Vessel Assessment studies



Project Support Consultation, Advisory / Technical / PM Services, Site Supervision, Training & Commissioning, initial Marine Operations



Licenses & Proprietary Technology for various floating units, drilling systems, utility systems

Renewable power
Wind power
Wave power
Current power

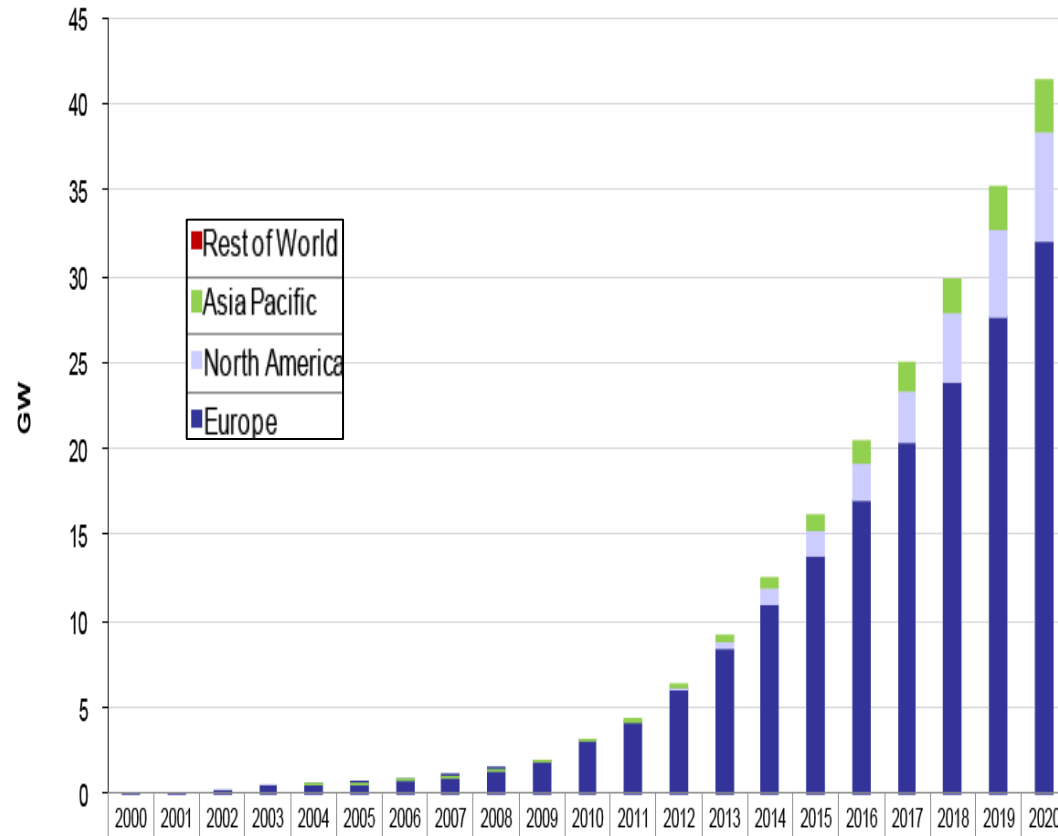


Conversion Design & Services
Life extension services, Technical services, optimizations, upgrades

Why does GVA go into the renewable power market?

- Very large expansion planned
- Few design companies
- Lack of offshore competence

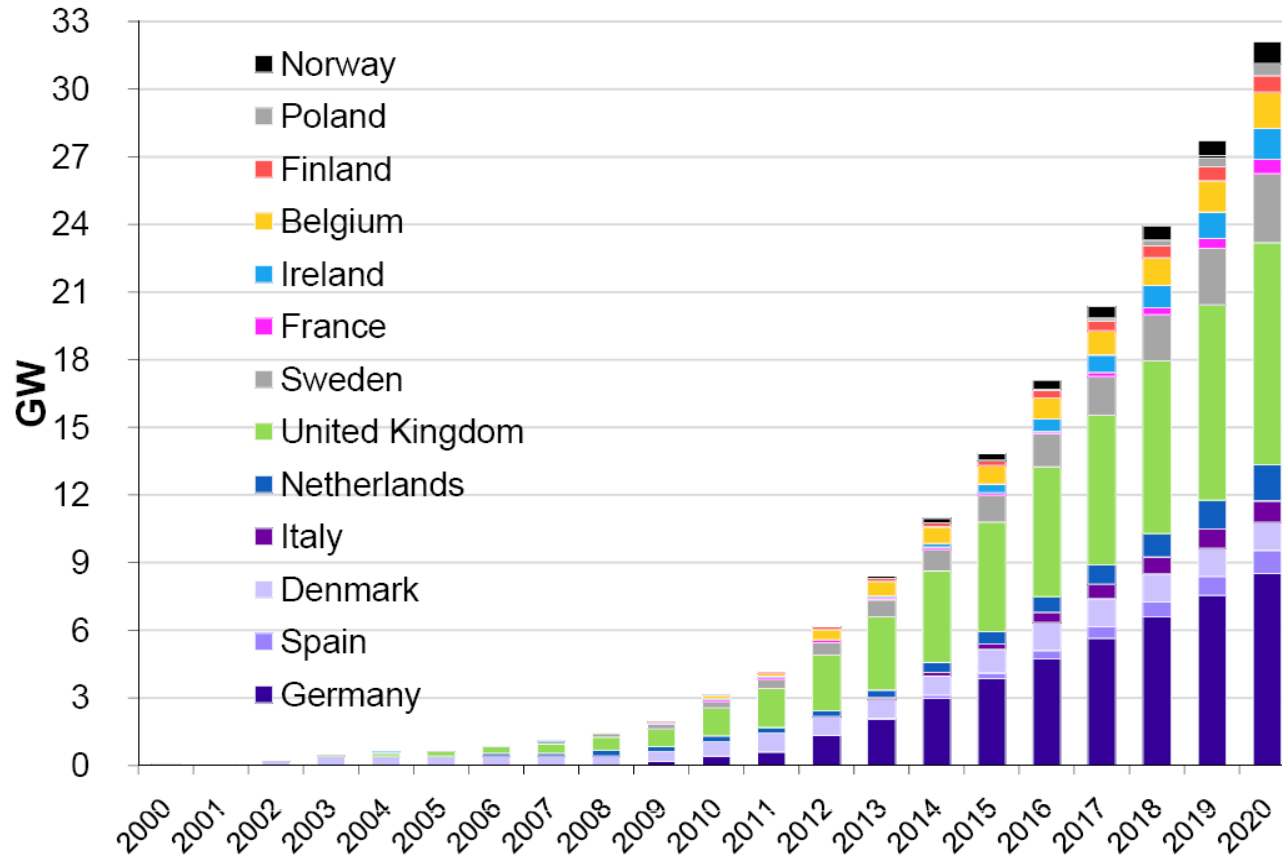
World Market – Wind Farms



- Exceptional growth from 3 GW to 42 GW
- Europe very dominant
- Estimated investment in connections 800 MUSD/GW

Source: Emerging Energy Research July 2009

Europe – estimated growth in offshore wind generation



- UK and Germany by far the largest markets
- Exceptional growth in Europe from 3 GW to 33 GW

Source: Emerging Energy Research July 2009

Why High Voltage Direct Current (HVDC) transmission?

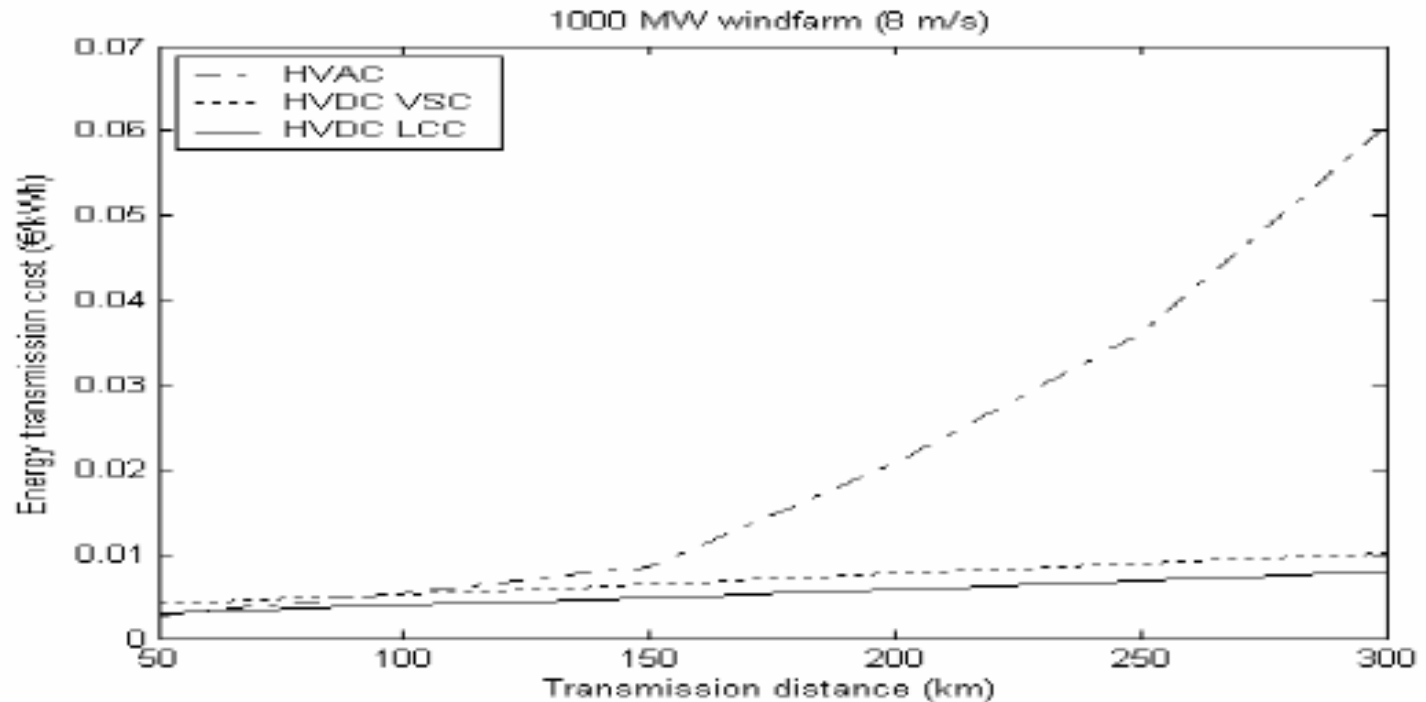
- More complex AC -> DC -> AC
- Larger investment
- Lower transmission losses

HVAC vs HVDC

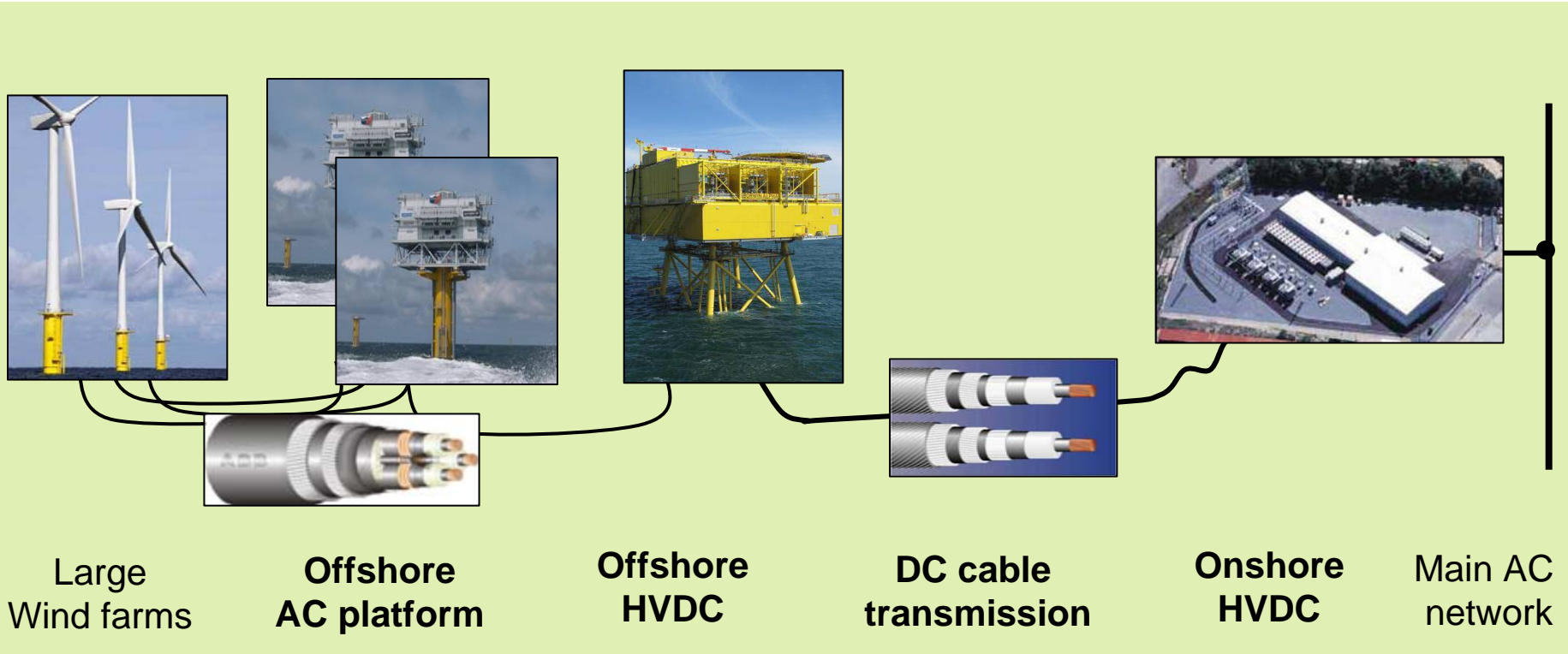
1000 MW windfarm

8 and 9 m/sec average wind speed

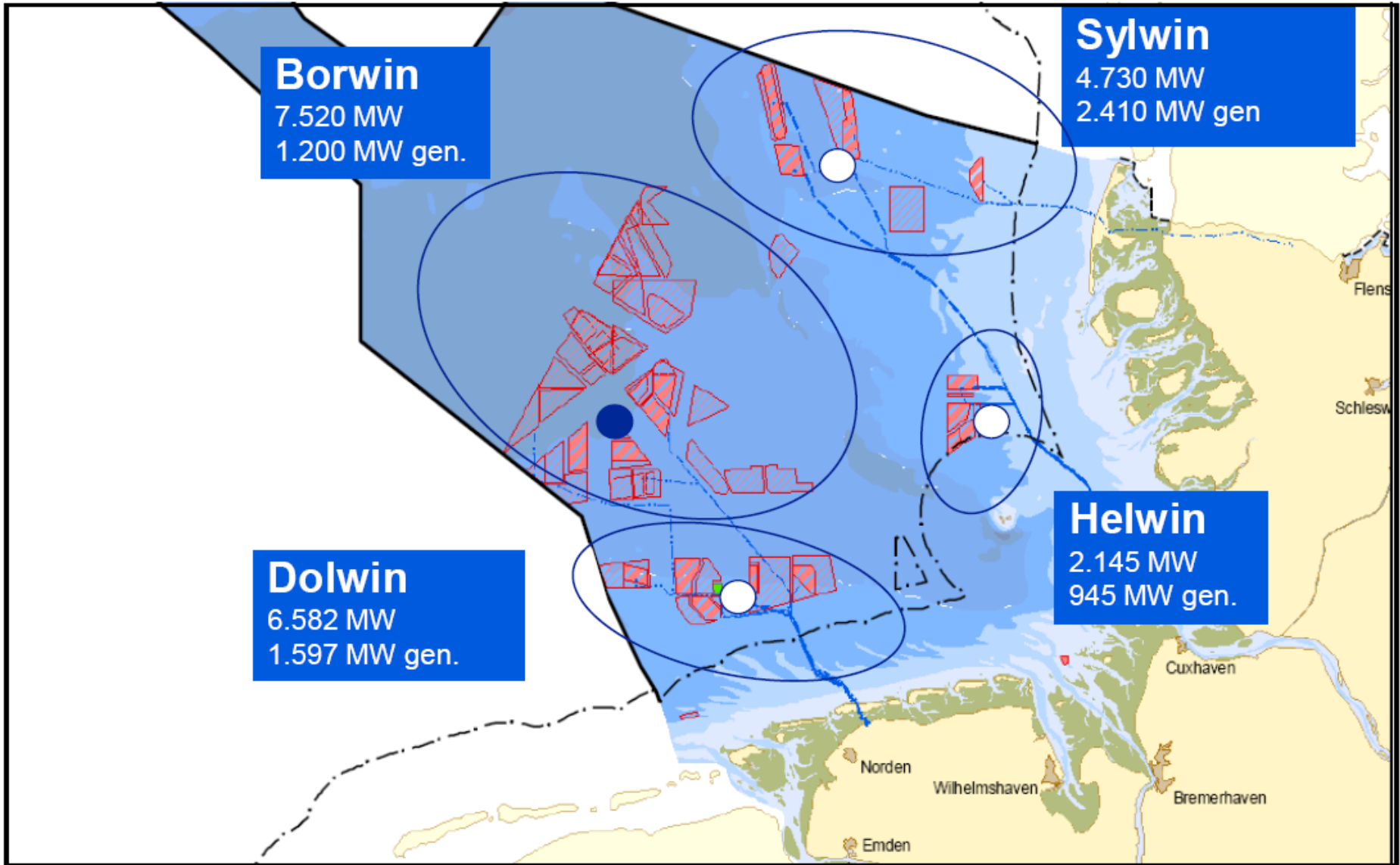
50 – 300 km transmission length



Offshore HVDC wind power connections



North Sea German Sector



Platform fabrication



Around 10 yards in Europe
Typical Weight of platforms (topside):

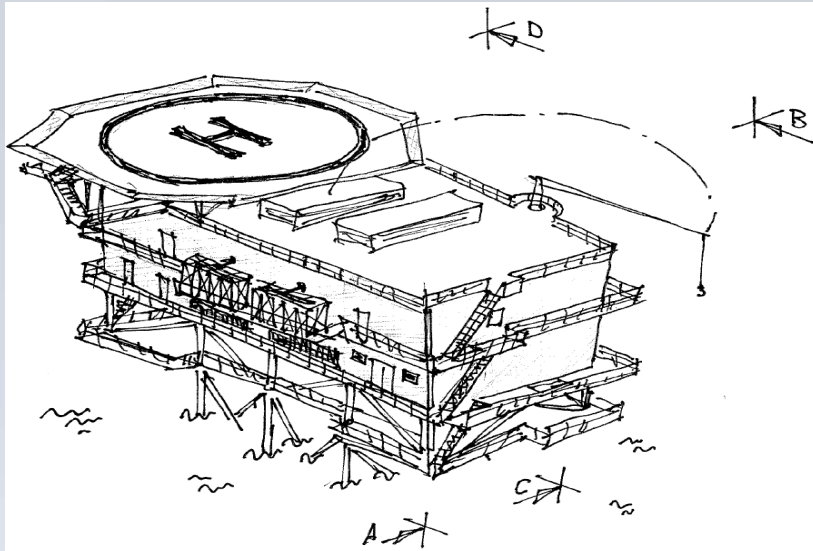
- 100 to 300 MW AC-substations –
1000 to 2000 mt
- 400 to 1000 MW HVDC stations –
5000 to 14000 mt



Key issues:

- Yard capacity
- Co-ordination with offshore
- Health & Safety for offshore works
- Minimize offshore commissioning and maintenance
- Compact solutions

Platform Design issues



- Adverse environmental conditions
- Expandability options included
- Extensive monitoring of primary and secondary systems
- Minimize offshore commissioning and maintenance
- Service and repair must be planned
- Access by air and sea
- Health & safety for service personnel
- Compact solutions and when possible move equipment to onshore station



Example of applicable regulations

- **BSH** Bundesamt für Schifffahrt und Hydrografie
- **DNV** Det Norske Veritas
- **GL** Germanischer Lloyds
- **API** American Petroleum Institute
- **NORSOK** Norwegian Offshore Standard
- **SOLAS** Safety of Life at Sea IMO Convention
- **MARPOL** Maritime Pollution Prevention IMO Convention
- **ISO** International Standardization Organisation
- **IEC** International Electrical Commission
- **CAP437** Helideck Standard

Germany, BorWin 1

400 MW HVDC Offshore Wind Power Connection



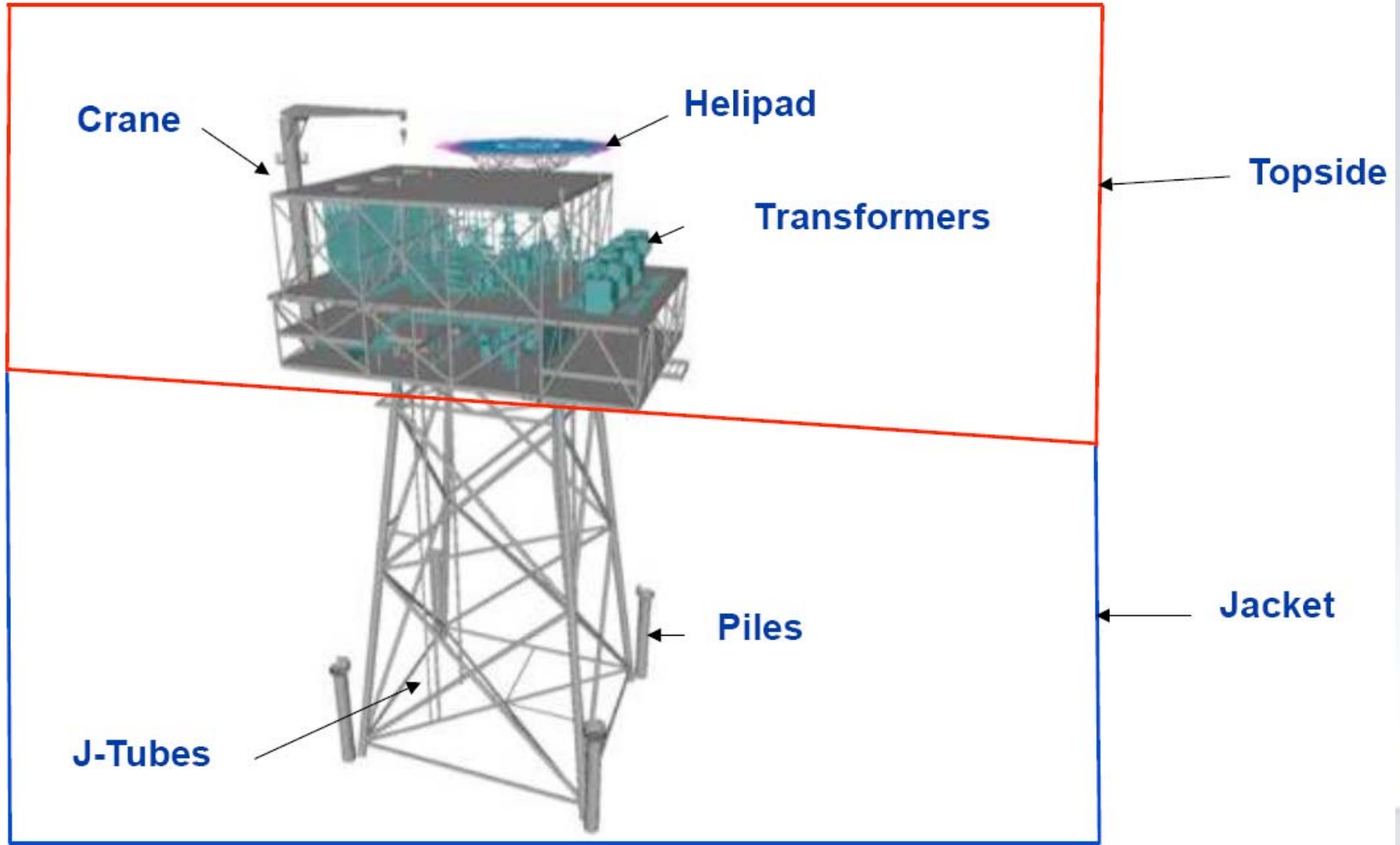
First HVDC Offshore
Wind Power Connector

200 km cable connection
(125 km sea, 75 km land)

Turnkey supply including
buildings and platform

Contract Sep 2007
Completion Nov 2009

Borwin Alpha – Platform Overview



Heavy lift cranes

- Very expensive
- Few with capacity > 3000 tons
- Not suitable for shallow water



Ongoing Work

Offshore Wind Switchgear / HVDC Platforms

Clients:	ABB ; Scottish & Southern Energy
Operation area:	Northern Europe & UK
Rules and regulations	DNV ; GL Noble Denton

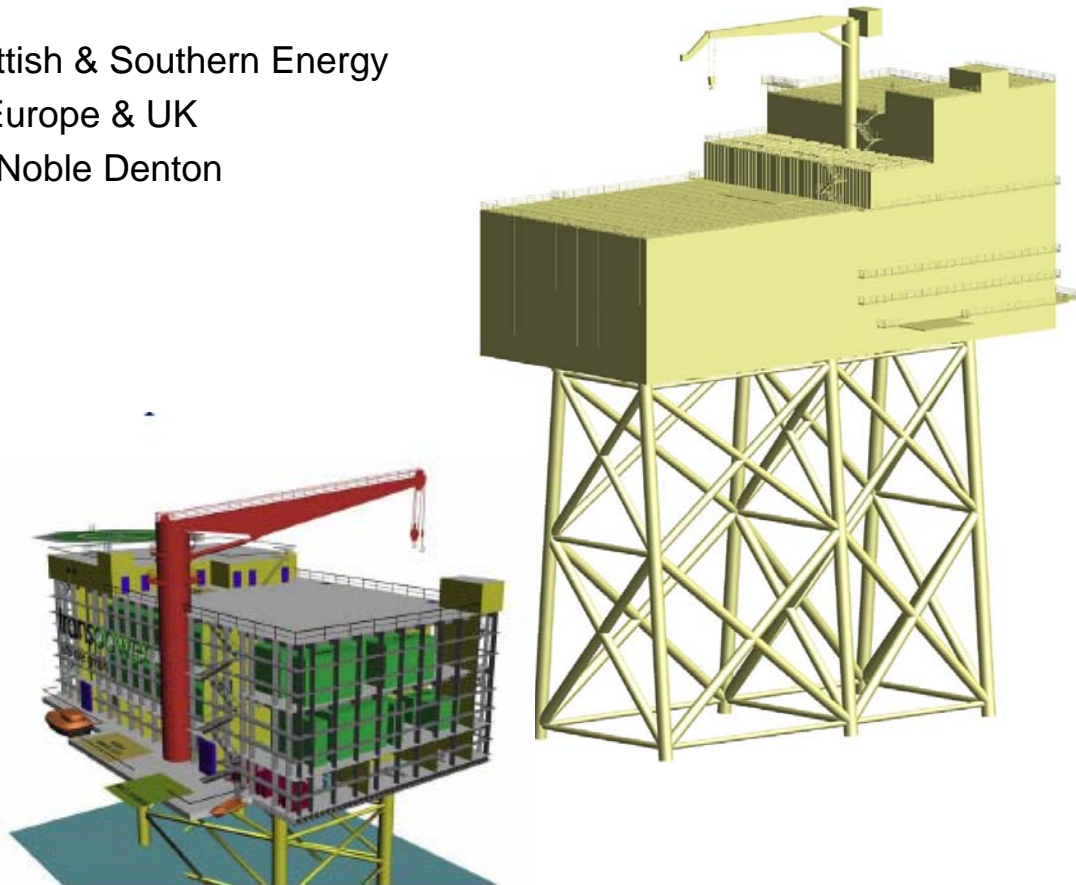
Platform Requirement

Topside

Length:	abt 80 m
Breadth:	37 m
Height:	30 m
Total Weight	6 000 – 9 000 tonnes
Accommodation:	16 persons
Helideck:	S-92, S-61N

Jacket

Height:	50 – 75 m
Weight	3 000 – 5 000 tonnes
No. Of J-Tubes	10 – 24



Ongoing Work

Offshore Wind Switchgear / HVDC Platforms

Clients:	ABB ; Scottish & Southern Energy
Operation area:	Northern Europe & UK
Rules and regulations	DNV ; GL Noble Denton

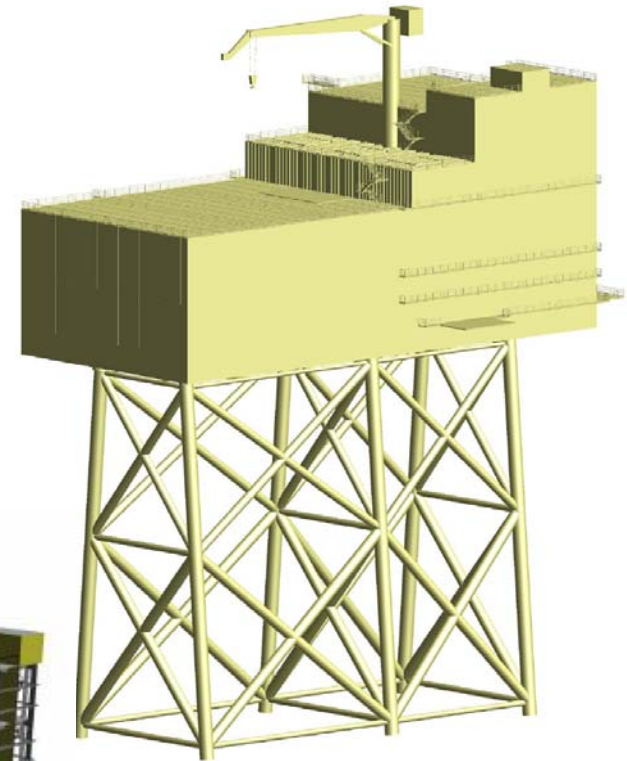
Topside Utilities Equipment

Diesel Generators, Diesel Tanks, Water Tanks
 HVAC system for equipment, HVAC system for utility areas
 Lifting Crane, AC transformers, Water Treatment

Topside Architect Specifications

Accommodation Areas designed in accordance with the relevant regulations.

Internal Wall finishes within the equipment areas designed to equipment supplier's specifications to minimise current discharge



Ongoing Work

Offshore Wind Switchgear / HVDC Platforms

Clients:	Scottish & Southern Energy
Operation area:	UK
Rules and regulations	GL Noble Denton

Project Information : HVDC Conceptual Platform Design

Project tasks: Produce Different Layout Options

& Cost Estimate

Various Layouts for flexible future development

Jacket and Topside Structures

Platform Utilities Equipment

Architectural

Safety

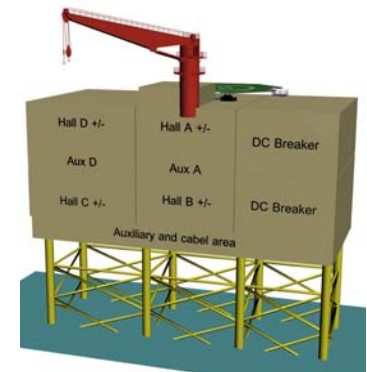
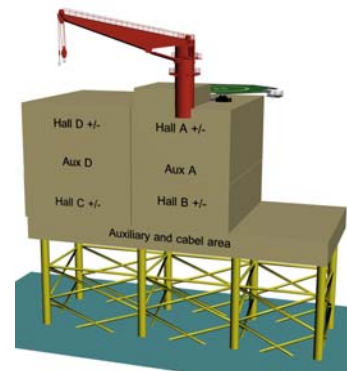
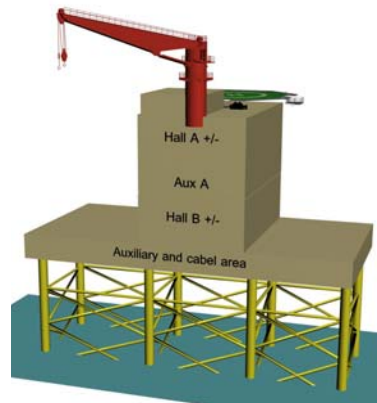
AutoCAD Layout drawings

Marine Installation Development

Cost Estimate for various options

Topside

Length:	49 m
Breadth:	37 m
Height:	25 m
Total Weight	4000 - 7000 tonnes
Accommodation:	20+2 persons
Helideck:	S-92, S-61N



Ongoing Work

Offshore Wind Switchgear Platforms

Clients:	ABB
Operation area:	Northern Europe & UK
Rules and regulations	DNV ; GL Noble Denton, API Allowable Stress Design

Platform Information : Thornton Banks AC Platform

Project tasks:

Provision of a Site Manager for ABB
Design Review

Topside

Length:	36 m
Breadth:	18 m
Height:	15 m
Total Weight	2 150 tonnes
Accommodation:	4 persons
Helideck:	S-92, S-61N

Platform Information : Dolwin Alpha HVDC Substation

Project Tasks:

Conceptual Design and Estimating
Design Review
Quality Assurance
Engineering & Management

Topside

Length:	63 m
Breadth:	42 m
Height:	35 m
Total Weight	9 000 tonnes
Accommodation:	16 persons
Helideck:	S-92, S-61N



Project Development

Offshore Wind Switchgear / HVDC Platforms

Clients:	ABB
Operation area:	Northern Europe & UK
Rules and regulations	DNV ; GL Noble Denton, API Allowable

Project Information : HVDC Conceptual Platform Design

Project tasks: Basic Design

Jacket and Topside Structures

Platform Utilities Equipment

Architectural

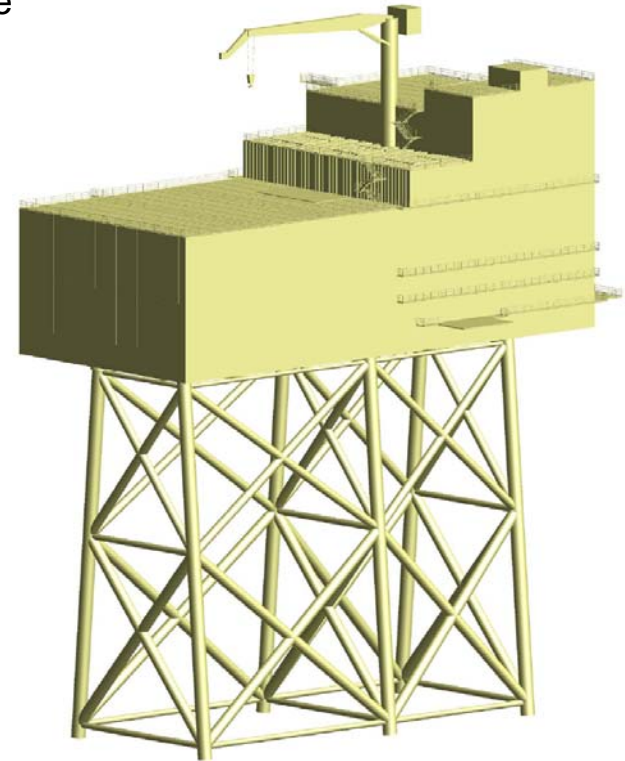
Safety

Design adopting PDMS

Marine Installation Development

Topside

Length:	83,2 m
Breadth:	38,4 m
Height:	20,3 m
Total Weight	8 000 tonnes
Accommodation:	16+8 persons
Helideck:	S-92, S-61N



Thank you!



Kjell Vågfelt
GVA