Delivery of an Offshore Wind Farm

An overview of the expectations and challenges of planning, consenting, installing and operating a large (5>MW Turbines) offshore wind farm.

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Introduction

• GEODATA MANAGEMENT FOR OFFSHORE WINDFARMS

• MARINE SURVEY – EARLY PLANNING
  • Planning and Consenting
  • Foundations and Turbines
  • Cables

• SITE ENGINEERING – ADVANCED PLANNING
  • Monopile Siting and Jack Up Stability
  • Cable Burial Risk Assessment

• INSTALLATION – CONSTRUCTION PHASE
  • Protecting installed Foundations
  • Protecting cables during installation
  • Protecting cables for lifecycle of project
Planning and Consenting

Brief Summary (Example Gwynt Y Mor)

• 2002-2003 Planning and Tendering of Round 2 Wind Farms
• 2004-2005 Regional survey data acquisition / FEED Study
• November 2005, Developer submits application
• 2006-2008 Stakeholder discussions/negotiations
• Consent granted December 2008 (3 years and 1 week later)

Typical Timelines for future projects:
• Renewable UK - Offshore Wind Project Timelines May 2014
• Multiple year consenting process
• Financial Investment Decision; 1-2 years before construction
• Technology and resources - are the projects possible?
Planning and Consenting

Source: RenewableUK
Gwynt Y Mor Windfarm

- 4 Export Cables linking 2 offshore substation platforms (OSP)
  - 20-22km in length

- 162 Array Cables linking the 2 OSP with 160 monopile turbines
  - Typically 1km in length

- Water depths 0m to 30m
- Varied seabed terrain
- Existing infrastructure
- (pipelines, cables, windfarms)

- Surveys 2002-2013
- Construction 2012-2014
Marine Survey Data for Offshore Wind Farms

- **What types of Data?** How is it collected?

  - **GEOPHYSICAL**
    - Regional/area survey – low to medium resolution – turbine planning
    - Cable Survey – medium resolution – export & inter-turbine areas
    - UXO Survey – high resolution – export and array cables

  - **GEOTECHNICAL**
    - Boreholes at foundations, OSP and metmast locations (40m+)
    - CPT at turbine foundations 5m+
    - CPT for cable routes top 0-3m
    - Vibrocores/sampling – for sediment classification (top 0m-3m)
Survey Data for Offshore Wind Farms

- GEOPHYSICAL
- Seabed Conditions – Hazards, sediments, hardness, mobility
- Bathymetry – water depth, slopes, tides, (currents)
- Equipment – survey vessel – sidescan sonar, echo sounder, sub bottom profiler, shallow seismic, magnetometer, sampling
Survey Data for Offshore Wind Farms

- **GEOTECHNICAL**
- Soil Conditions – composition, hardness/softness, layers
- Equipment – Drill Jack Up/Vessel – Borehole Drilling, Cone Penetrometer Testing, Vibro-coring, drop coring, grab sampling
- Lab Testing – further testing of soil characteristics
Survey Data for Offshore Wind Farms

• OTHER SURVEY DATA SOURCES

• HISTORICAL DATA
  • Cable Databases / Oil & Gas Concessions
  • UKHO charts
  • 3rd Party Datasets (academic, government and commercial)

• DURING CONSTRUCTION
  • Diver Swim Investigations (rock dump and aperture areas)
  • Pre Survey ROV survey (cable route and lay down areas)
  • Post lay inspection and bathymetry surveys (cables/rock dump)
  • Detailed UXO surveys (2014 after 3 x WW2 bombs discovered)
Survey Data Acquisition on GYM

- sidescan sonar
- sub bottom profiler
- shallow seismic
- single beam bathymetry
- multibeam bathymetry
- coring
- grab sampling
- magnetometer
- towed gradiometer
- ROV gradiometer
- AUV hi res sidescan
Survey Data Management

• **DATA HANDLING** - creating a unified mapping database

Seabed bathymetry
Sediments
Seabed Hazards (boulders, wrecks, UXO)
Infrastructure (pipelines, cables, buoyage)
Boundaries (permits, shipping zones etc)
Planned construction (foundations/cables)
Temporary infrastructure (jack-ups etc)
As built construction (foundation, topsides, cables)

• **CAD and GIS DATABASES**
• **Evolving as works continue**
Cable Burial Assessment: Data Usage

- **CHART SERIES**
  - 1:15000 OVERVIEWS
  - 1:3000 ANCHOR PLANNING
  - 1:500 TURBINE FOOTPRINTS

- **DATA FORMATS:**
  - CAD
  - GIS (SHAPE DATA)
  - PDF (CAN BE VIEWED BY ALL)

- DIGITAL BUT CAN BE PLOTTED
Lessons Learned: Survey

• Good survey data is required to select appropriate cable burial methodology and equipment

• Early planning of cable routes, orientation of turbine connections

• Consideration of data coverage to accommodate anchor patterns

• Educating the end user on data suitability, resolution and data deficiencies/shortcomings

• Ensuring project flexibility to collect additional survey data when needed

• Standardise mapping and vertical reference datums
Lessons Learned: Installation

- **Good quality survey data** is vital for safe installation
- Engage with construction contractors early in project lifecycle
- Design cable routes with flexibility for different burial tools
- Carefully consider the threat level vs difficulty of installation
- Ensure lessons learned are passed on to other projects
- **We are still installing, there will likely be more lessons!**
Conclusions:

• GYM generated first power in September 2013

• Construction to be completed 2014 (turbines), early 2015 (cables)

• Remedial works will be required on array cables

• High scour area - seabed monitoring will be required across site

• **Expect the unexpected.** We discovered 3 WW2 bombs on site

THANK YOU, ANY QUESTIONS ?