# WTG DECOMMISSIONING PROJECT

## ROBIN RIGG OFFSHORE WIND FARM

## CASE STUDY

In partnership with energy institute

**Identifying site issues and finding solutions through regular data monitoring and review**

| | | | |
|---|---|---|---|
| Project partners | E.ON, MPI, Hughes Sub-Service Engineering, Proserv | Duration | 9 months |

# Challenge

- **Confirmed downward trend in WTG operational frequency**
- **Reduction in seabed level**
- **Structural integrity compromised under extreme load events**
- **Challenging environmental conditions affected potential remedial options**

In Autumn 2013 the natural frequency of WTG A01 at the Robin Rigg Offshore Wind Farm (RROWF) was found to be at the 'high' end of operational frequency range. In January 2014, a significant frequency drop was observed, which by May 2014 had declined even further with the lower operational limit of the WTG now showing a **confirmed downward trend**.

A bathymetric survey was completed in May 2014, and on review of seabed levels at WTG A01 a **reduction in seabed of approximately 15m** since the previous bathymetric survey (May 2012) was recorded.

Extensive assessment of the foundation stability under the revised load and geotechnical conditions was carried out; this indicated that the **integrity of the structures was compromised under extreme load events**.

Further assessments were completed assessing potential remedial solutions; these included both structural enhancements to the existing structure or replenishment/ reinstatement of 'eroded' material through rock armour installation or similar. None of the solutions identified were considered feasible or deemed to carry too much risk with respect to potential to exacerbate the known stability/ integrity issues.

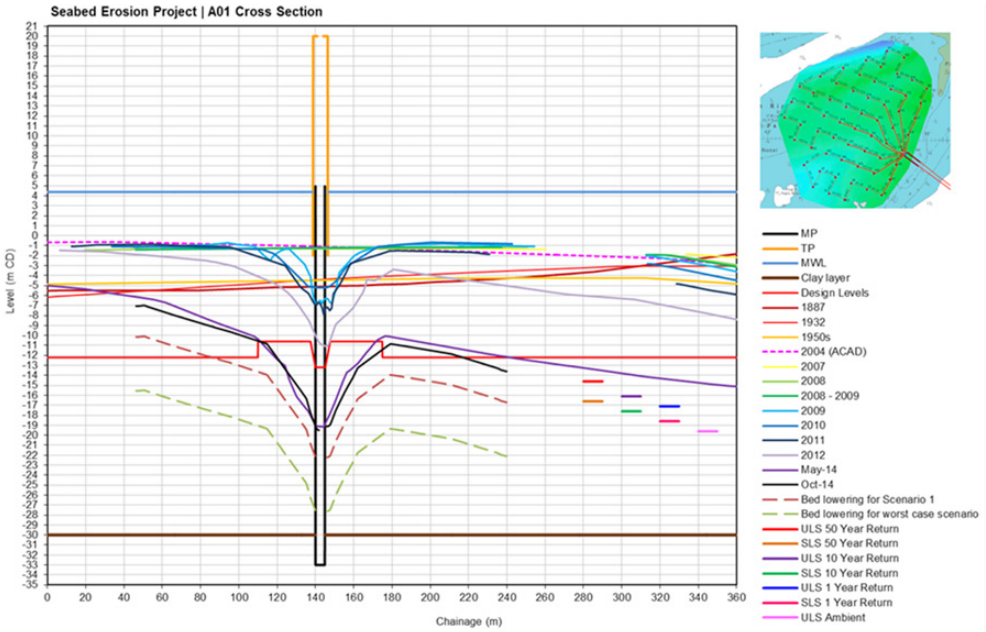
The **environmental conditions on site also significantly affected the potential remedial options**; the very strong currents and issues experienced during construction restricted the types of vessel that could be deployed on a location for a considerable period of time.

In March 2015 monopile embedment depth was circa 10m, design embedment depth was 20m. Seabed erosion modelling work indicated that ongoing erosion local to WTG A01 had the potential to reduce the seabed further with a final embedment depth of 5m anticipated.

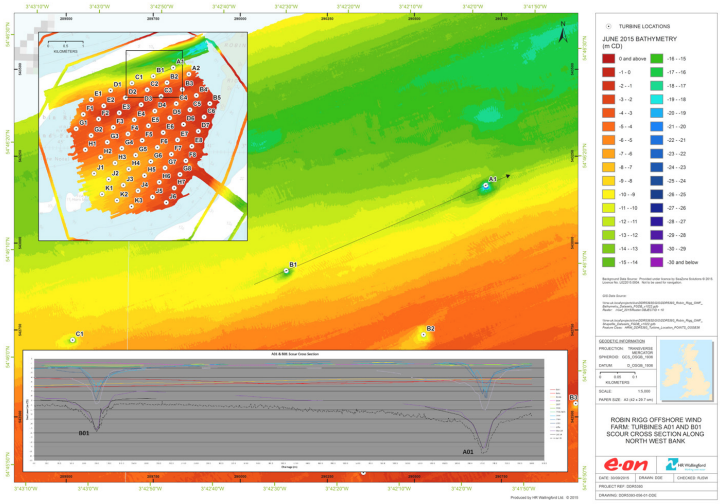
# Challenge (continued)

The key points of the engineering assessment conducted were as follows:

- Overall extent of scour hole local to WTG A01 was 120m x 60m x 20m in March 2015 – further analysis in June 2015 indicated this had increased further.
- Changes in seabed level driven by global effects, further lowering of the seabed local to WTG A01 was predicted with a further reduction in embedment depth.
- WTG B01 had also seen a significant lowering of the seabed and corresponding reduction in natural frequency.
- Extent of scour and effect of global lowering identified that installation of scour protection in the existing scour hole would not abate ongoing global lowering and associated scour i.e. **no intervention options at WTG A01**.




Robin Rigg Offshore Wind Farm Seabed Erosion Project - A01 Cross Section



Robin Rigg Offshore Wind Farm Bathymetry June 2015 Data

# Solution

Following review of the bathymetric survey data, structural support options and geotechnical enhancement schemes it was decided that **intervention options presented too higher risk** and attracted excessive cost with no guarantee of delivering continued WTG operation.

A **decision was made in March 2015 to decommission the two WTGs (A01 and B01) on safety grounds**, with the work to be completed during summer 2015 to ensure that the integrity of the structures was not further compromised during winter months when the structures would be exposed to high frequency, high load events.

**E.ON established a Project Team responsible for delivery of the decommissioning works.** Communications were established with the key stakeholders and their requirements with respect to required works established and agreed in the early planning stages.

The Project Team conducted a review of existing O&G and conventional inshore decommissioning techniques to identify potential techniques which may fit the technology. Robin Rigg was an environmentally challenging site due to location, plus there had been vessel stability issues during construction and scouring around jack-up barge legs. To minimise the risk E.ON decided to utilise the existing Charter with MPI who had previous experience operating with the Robin Rigg area.

A Marine Warranty Surveyor was utilised throughout planning stages and present on the vessel for the majority of the campaign. The actual works methodology was developed in conjunction with MHI Vestas for the WTG and tower sections, and with Proserv, Hughes SSE and MPI for the substructure works.

# Results

- A HAZID was completed in July 2015 as a means for identifying risks posed during the operational/construction phase. This was a coordinated approach with all key stakeholders involved in open and active discussion.
- Additional measures introduced:
  - Dive trial with cutting tool – diver familiarity, MPI understanding of lifting and fitting requirements
- Limited planning time meant that full fracture mechanics failure assessment was not completed, therefore all cutting required the foundation to remain on the hook of the main vessel crane to ensure stability of the foundation structure throughout the decommissioning works.
- All decommissioning procedures were written from first principals and subject to a detailed review process and peer review.
- Enabling works to isolate the WTGs and remove the HV cables from the WTG were completed in early September 2015.
- The site remained operational whilst the decommissioning works were taking place.
- Decommissioning works commenced in October 2015 with the towers removed within a few days of arriving on site; the second WTG and tower was dismantled in less than 24 hours.
- Removal of the TP at location A01 was completed in mid-October 2015. No further works were carried out on site post November 2015.
- The full transition piece remains at location B01 and houses the HV connection to the array cable string. A monopile stub remains at location A01.

# Key findings

- Site teams should conduct Bathymetric surveys regularly and review the data sets to understand their site in detail.
- A period of 'No Change' is not always an indication of 'No Future Change'.
- Decommissioning was only envisaged by those in the industry when an Offshore Wind Farm was at the end of its' operational life. As such no established methodology or consents/licenses were in place to allow the works that were required to be completed.
- Designs should consider site and partial/site decommission when being planned.
- Post construction documentation handed over to operations should consider how the site will be decommissioned.
- Decommissioning techniques should be clearly identified and documented, including vessel requirements, site wide issues and key consent/planning issues that may be impacted at the point of decommission.
- Decommissioning of the substructures took considerably longer than anticipated due to challenging site conditions and short available weather windows.
- Robin Rigg grouted connection introduced added complexity.
- Robin Rigg monopile diameter was greater than any decommissioning undertaken to date in the O&G industry; the length of monopile to be removed required decommissioning of foundation structure to be completed in two sections.
- Avoidance of spring tides and monitoring or scouring around the jack-up barge legs during operations was essential.
- Logistical and resource impact on existing operational teams.

# Contact details


**G+ General Manager**

Kate Harvey e: kharvey@energyinst.org

**EI Technical Manager**

Andrew Sykes e: asykes@energyinst.org

@gplusglobalofw

**www.gplusoffshorewind.com**


# Organisations involved

The **Robin Rigg Offshore Wind Farm (RROWF)** is 11km from the Dumfries and Galloway coast and 13km North West of the Port of Workington. It comprises 58 Vestas V90 3MW Wind Turbine Generators (WTG) connected to the 2 offshore substations by subsea cables. These substations are connected to the national grid system across two 132kV cables. These cables come ashore near Seaton, Cumbria where they travel 2km inland to the onshore substation. The site was constructed in 2008 and commissioned in 2009.

The **G+ Global Offshore Wind Health and Safety Organisation (G+)** comprises Europe's biggest offshore wind farm developers and operators who focus on H&S improvement in the offshore wind industry.

The **Energy Institute (EI)** is a not-for-profit registered charity, which exists to promote and advance knowledge, skills and good practice in energy for society's benefit.