



# REFERENCE PROJECTS

## OWF ALPHA VENTUS

### Concept Foundation Monitoring System – Observation Method

airwerk created a concept for the technical implementation of the observation method in accordance with EC 7 and DIN 1054 for fulfillment of BSH standards for the offshore wind farm Alpha Ventus (Borkum West) located in the German North Sea. This park consists of 12 WTGs with tripod and jacket foundations.

This extensive concept included the definition measurement parameters (target values and measured values) necessary for the creation of a model which would allow conclusions to be drawn regarding deformations in the substructure when comparing target values with the actual measured data. Furthermore, airwerk provided a concept for the development of a model for the adaptation of the value limits during the operation of the turbines. The data derived from the implementation of these models allows DOTI to observe the behavior of the substructure and thus verify the stability of the installed structures to certifying authorities.

Other important aspects of the concept provided by airwerk describe data flow, i.e. data pre-processing, data reduction, storage, transmission onshore, and user access, and reporting and notification functions. In addition to the specification of hardware (sensors, etc.) and software to be installed, airwerk provided a presentation of the technical feasibility and a cost analysis of possible alternatives.

This concept was later certified by Germanischer Lloyd Industrial Services – Renewable Energy Certification in Hamburg and submitted and approved by the BSH.

**CLIENT:** DOTI GmbH & Co.KG

**LOCATION:** Germany

**PROJECT AWARDED:** 2012



## OWF BORKUM WEST II

### Concept Foundation Monitoring of 10% of the OWECS

airwerk created a concept for the foundation monitoring of 10% of the 80 WTGs in the offshore wind farm Borkum West II. All 80 foundations are tripod structures. airwerk was contracted to create a concept in accordance to the BSH's requirement to monitor 10% of the foundations as outlined in the document 'Design of Offshore Wind Turbines, June 12, 2007' to be submitted to the BSH for approval. The particular focus of this concept was to apply the observation method for foundation monitoring. airwerk's concept included definitions of target values, measured values and analysis methods as well as the identification and description of appropriate sensors, sensor positions, data collection, data storage and maintenance intervals.

**CLIENT:** Trianel Windkraftwerk Borkum GmbH

**LOCATION:** Germany

**PROJECT AWARDED:** 2012



# OWF NORDSEE 1

## Pre-engineering Foundation Monitoring for OWF Nordsee1

airwerk was contracted to provide a foundation monitoring concept, which implements elements of the observation method, for certification and approval by the BSH in the pre-engineering phase of the tripod foundation construction. In addition to the concept, airwerk was to provide an equipment list for the condition monitoring system including dimension drawings, and assistance in cable routing and sensor mount design, as well as support during the design optimization phase.

**CLIENT:** RWE Innogy

**LOCATION:** Germany

**PROJECT AWARDED:** 2012



## OSS BALTIC 2

### Concept for the Periodical Inspection of the Grout Connection by Permanent Monitoring

airwerk wrote a monitoring concept for the offshore substation platform (OSS) in the offshore wind farm Baltic 2 located in the Baltic Sea. The offshore substation platform (OSS) will be erected on a jacket structure with 4 corner legs.

The monitoring concept proposed by airwerk is for the structure itself and for the grout connections used in the four corner legs of the OSS. It includes the specification of the required hardware, recommendations for the concept realization, a data flow concept, which takes data storage, redundancy into consideration, and a data evaluation concept. In addition it defines a measurement campaign schedule including intervals for maintenance and reports and recommendations for installation method statements, commissioning procedures and maintenance. This concept has been created for submission to the BSH (Bundesamt für Seeschifffahrt und Hydrographie). The necessity of the implementation of a structure monitoring derives from the individual case approval by the BSH (Bundesamt für Seeschifffahrt und Hydrographie) of the grout connection by Professor Schmidt / Prof. Fehling from the University of Kassel, Germany. The case approval states that "... a meaningful monitoring shall apply by permanent measurement system in the transition structure ..."

Airwerk, together with its project partner VCE, provided a concept detailing a global approach to grout monitoring using Ambient Vibration Monitoring (AVM) in order to avoid periodical visual inspections by divers.

**CLIENT:** Technologiekontor Bremerhaven (tkb)

**LOCATION:** Germany

**PROJECT AWARDED:** 2013



## OWF MEERWIND SÜD/OST

### Foundation Monitoring System

airwerk was contracted to provide the concept design, engineering, delivery, onshore installation and offshore commissioning of online condition monitoring equipment for the towers and foundation structures. The wind farm consists of 80 wind turbine generators. The foundation type is monopile with transition pieces. airwerk has equipped 10% monopile foundations with strain gauges, inclination sensors and accelerometers in accordance with the BSH (Bundesamt für Seeschifffahrt und Hydrographie) requirement to monitor 10% of all WTGs in the wind farm. Additionally, 100% of the monopiles were equipped with a grout monitoring system designed by airwerk to meet the requirements for the case-specific technical approval of the grout connection as determined by the BSH and the Federal Institute for Materials Research and Testing (BAM – Bundesanstalt für Materialforschung und –prüfung).

The measurement system provided by airwerk included the design, construction and installation of two types of controller modules for WindMW. One type of controller module was designed specifically for use in those 8 foundations with a comprehensive monitoring system and the other type of control module for use in the other 72 monopiles with a grout monitoring system. In the case of the grout monitoring system, airwerk also provided the design, engineering, supply and installation of offshore-appropriate displacement sensor mounts.

Furthermore, airwerk designed, configured and supplied a data server for data collection and storage (software and hardware) appropriate for integration in the park's SCADA system.

**CLIENT:** WindMW GmbH

**LOCATION:** Germany

**PROJECT PERIOD:** 2012

**EXPECTED COMPLETION:** 2014



## OWF BUTENDIEK

### Foundation Monitoring System

airwerk has been contracted to provide the concept design, engineering, delivery, onshore installation and offshore commissioning of online condition monitoring equipment for the towers, foundation structures and the OSS of wind park Butendiek. The wind farm consists of 80 wind turbine generators of type Siemens SWT 3.6-120. The foundation type is monopile with transition pieces. 10% of the structures (8 structures) will be equipped with measurement equipment including strain gauges, inclinometers, accelerometers, temperature sensors and displacement sensors for grout monitoring. Additionally, the OSS (Offshore Sub Station) will be equipped with a monitoring system. A data storage system, which will collect and store measurement data from all 8 monitored structures, will be placed on the OSS.

**CLIENT:** wpd offshore GmbH

**LOCATION:** Germany

**PROJECT AWARDED:** 2013

**EXPECTED COMPLETION:** 2015



## OWF BALTIC 2

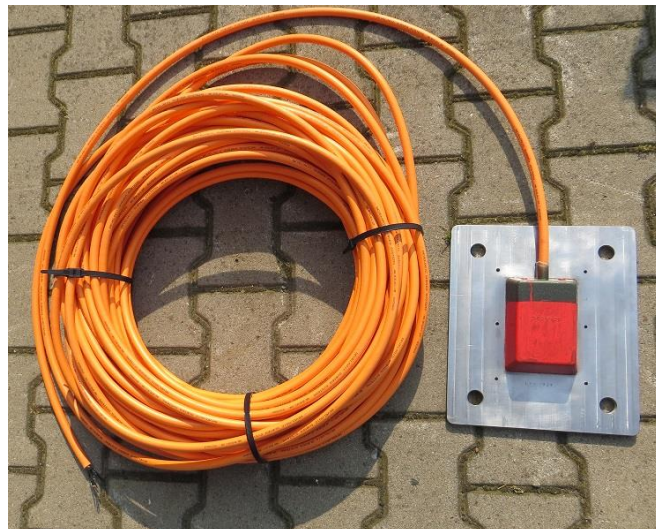
### Design, Engineering & Supply of Underwater Accelerometers incl. Sensor Mounts

airwerk consulted Hochtief Solutions AG, as part of the working consortium Hochtief Solutions AG, GeoSea, and Hochtief Offshore Crewing involved in OWF Baltic 2, on the installation of accelerometers below the water level in the offshore tower. Here it was necessary to design, engineer and supply a water-tight housing for the supplied accelerometers, including integrated cables suitable for underwater installation and appropriate sensor mounts. airwerk designed a testing process for the verification of waterproofing and supplied the corresponding test documentation.

**CLIENT:** Hochtief Solutions AG / ARGE Baltic 2

**LOCATION:** Germany

**PROJECT AWARDED:** 2014





## ROTOR BLADE MONITORING

### Implementation of Rotor Blade Monitoring System

airwerk was contracted to implement and commission a Condition Monitoring System for rotor blade monitoring in a total of 30 wind turbines located throughout Germany. Structural noise sensors were installed in the three blades of the wind turbine. In addition, airwerk installed and routed the sensor cables as well as the necessary connection boxes, data acquisition units (DAU), data processing units (DPU) and WLAN devices in each turbine.

**CLIENT:** Wölfel GmbH

**LOCATION:** Germany

**PROJECT PERIOD:** 2014



# OWF NORDSEE 1

## Design and Implementation of a Structural Monitoring System

airwerk was contracted to design a Structural Monitoring System for the offshore windfarm NordseeOne. The implementation of the system is planned after the financial close of the overall project. The wind farm consists of 54 wind turbines on monopile foundations. Five of these structures are planned to be equipped with a structural monitoring system in compliance with the BSH requirements.

**CLIENT:** SAM

**LOCATION:** Germany

**PROJECT PERIOD:** 2014 – 2015



## OWF WIKINGER

### Design of a Concept for a Structural Health Monitoring System and Preparation of Tender Specifications

airwerk was contracted to design a Structural Monitoring System Concept for the offshore windfarm Wikinger. The airwerk global monitoring approach is being used.

The wind farm consists of 70 wind turbines on jacket foundations.

**CLIENT:** Iberdrola

**LOCATION:** Germany

**PROJECT PERIOD:** 2015