

# OFFSHORE WIND FARMS

SELECTED PROJECT REFERENCES



# SELECTED OFFSHORE WIND TURBINE FOUNDATION DETAILED DESIGN PROJECTS



## DETAILED DESIGN OF MONOPILE FOUNDATIONS

### COUNTRY

Germany

### PERIOD

2019 – 2020

### CUSTOMER

Parkwind Ost GmbH

### RECIPIENT

Parkwind Ost GmbH

### ARCADIS OST

Arcadis Ost 1 offshore wind farm, a Parkwind Ost GmbH development, will be located in the German Baltic Sea within the 12-nautical mile zone North-East of the Rügen island in Mecklenburg-Western Pomerania.

The wind farm will give a total grid connection capacity of approximately 247 MW and generating enough energy to power 290,000 households. Working in the area requires special considerations for ice loads, chalk, glacial clay and soft soil, and a water depth that varies between 42 and 46 metres.

Arcadis Ost 1 is part of a territorial concession for the construction and utilisation of installations for the production of wind energy in the sea regions. The concession was granted by Staatliches Amt für Landwirtschaft und Umwelt Vorpommern and covered by the German renewable energy support system.

### FORMOSA 1, PHASE II

The Formosa I is an approximately 130 MW offshore wind farm, which will be located 3-6 km off the West coast of Taiwan at Miaoli County, and will cover an overall area of 11 km<sup>2</sup>. It will comprise up to 32 turbines. The offshore wind farm is planned to be installed in 2019. Water depths at the site range between 15 and 30 m TWVD. The overall scope of the project is a concept study (for two turbine types), front end engineering design (FEED) and detailed design of 30 monopile foundations with 20 years' service life. Besides geotechnical, primary and secondary steel design the project includes preparation of design basis part A (employer's requirements) and C (consultant's design basis), metocean study, scour and corrosion protection design, simulation of seabed micro-topography change, preparation of invitation to tender for EPC contractor and estimates of CAPEX and OPEX.

The WTG including foundation substructure will during typhoons be exposed to extreme wind speeds and extreme waves. In addition, the design takes severe earthquakes into account.

### COUNTRY

Taiwan, Province of China

### PERIOD

2016 – 2017

### CUSTOMER

Sinotech Engineering  
Consultants INC

### RECIPIENT

Formosa 1 Offshore Wind Ltd.  
COWI FEE

### PROJECT COST

EUR 2.087.300

### SAINT NAZAIRE

The Saint Nazaire offshore wind farm will be located between 12km and 20 km of the coast in the Northern part of the Bay of Biscay and cover an area of 78 km<sup>2</sup>.

The site was selected due to strong and steady winds, and a shallow water depth between 12 and 25 meters. The 480 MW wind farm will ultimately generate the equivalent of 20% of the Loire-Atlantique's electricity consumption needs.

The Saint Nazaire offshore wind farm project is developed by Parc du Banc de Guérande, a consortium of EDF Renouvelables and Enbridge, and was awarded in 2012 by the French Government. Construction and operating permits were given in 2017 with the final decision from the Conseil d'Etat in June 2019. The wind farm is due for commissioning in 2022.

The project is being developed as a part of the French government's aim to increase the country's renewable energy share of total consumption to 32% by 2030. COWI has been part of the project since the tender design in 2016 and was awarded the detailed design of the monopile foundations in 2019.

### COUNTRY

France

### PERIOD

2018 – 2019

### CUSTOMER/RECIPIENT

EDF Renouvelables and Enbridge

### ALBATROS

This offshore wind project, which has approval for 16 wind turbines of 5-7 megawatt rating, is located 105 kilometres from the coast in the German sector of the North Sea. The wind farm covers an area of 39 km<sup>2</sup> with a water depth of 39-40 metres. It is being developed by EnBW Energie Baden-Württemberg AG. On EnBW's neighbouring Hohe See project, Siemens Wind Power (with GeoSea as foundations contractors and COWI as GeoSea's designer) won the EPC contract. Siemens/GeoSea have now asked COWI to join them for bidding for and subsequently carrying out the Albatros project.

Detailed design of 16 monopile WTG foundations as well as one offshore transformer module (OTM) according to the requirements of the Federal Maritime and Hydrographic Agency of Germany. The design comprises design of primary and secondary steel, geotechnical design, design of the grouted connection, low voltage design and design of the cathodic protection system as well as ship collision analysis.

### COUNTRY

Germany

### PERIOD

2016 – 2019

### CUSTOMER

GeoSea NV

### RECIPIENT

EnBW



## DETAILED DESIGN OF MONOPILE FOUNDATIONS

**COUNTRY**  
Germany

**PERIOD**  
2015 – 2019

**CUSTOMER**  
GeoSea NV

**RECIPIENT**  
EnBW

### HOHE SEE

71 Siemens 7 MW turbines on monopile foundations. Water depth is 38.6-40.1 m. COWI's services comprised detailed design of foundations, geotechnical design, calculation of wave loads for the integrated load analysis, individual monopile design for all locations, pile drivability assessment, design of internal and external secondary structures, external and internal LV equipment, impressed current corrosion protection, grouted connections and ship collision analysis.

**COUNTRY**  
Germany

**PERIOD**  
2015 – 2018

**CUSTOMER**  
DEME GeoSea NV

**RECIPIENT**  
EnBW

### MERKUR

Offshore wind farm in the German part of the North Sea with up to 80 ALSTOM Haliade 150 turbines. COWI's services comprised detailed design of monopile foundations for offshore wind turbines, viz. design of primary steel design for monopile and transition piece, geotechnical design, hydrodynamic load calculation, scour protection, corrosion protection, low voltage design, and ship collision friendliness analysis.

**COUNTRY**  
Taiwan

**PERIOD**  
2014 – 2015

**CUSTOMER/RECIPIENT**  
Swancor Enterprise Inc.

### FORMOSA I, PHASE I

Foundation design for Taiwan's first offshore wind farm, Formosa 1. Taiwan is aiming at 600 MW offshore wind capacity by 2020 and 3 GW by 2030, and this project is the beginning of the offshore wind industry in Taiwan. In 2014-2015, COWI developed the detailed design of the first two monopile structures to be equipped with 6.0 MW turbines, and a FEED (front end engineering design) study for tendering a design-build contract for another 34 locations.

### RENTEL

Rentel NV has developed an offshore wind farm approximately 32 km off Zeebrugge and 42 km from Ostend, located between Northwind OWF on the Lodewijkbank and Thornton OWF on Thornton Bank, with water depths between 22 and 32 m LAT and sand dunes of 5 m in height. The farm has a capacity of 309 MW with turbines with a capacity of 7 MW. COWI carried out the detailed design of the monopile foundations.

### DANTYSK

The DanTysk offshore wind farm is located in the German North Sea 75 km from the island of Sylt. 80 Siemens 3.6 MW turbines are installed on monopile foundations at depths ranging from 17 to 31 metres. It was one of the first full-scale commercial OWF's approved under the German BSH approval system. The monopiles have a diameter of 5.8 metres, and a grouted cylindrical connection to the transition pieces with shear keys. The monopiles are equipped with internal cabling, steel working platforms and scour protection.

### LONDON ARRAY

With 175 monopiles, designed to carry Siemens 3.6 MW turbines, in total 630 MW, London Array is the largest operational offshore wind farm in the world. Monopiles of 4.7 m and 5.7 m in diameter were installed in water depths between 0 m and 25 m. With a total length of up to 85 m, these foundations range among the largest ever built. The contractor Aarsleff Bilfinger Berger Joint Venture (ABJV) engaged COWI as lead in a joint venture with IMS to carry out the detailed design of the steel foundations. COWI's services comprised detailed structural design of 175 monopiles with appurtenances, detailed geotechnical design for 175 locations and detailed hydraulic design.

**COUNTRY**  
Belgium

**PERIOD**  
2015 – 2017

**CUSTOMER**  
DEME/Geosea

**RECIPIENT**  
Rentel NV

**COUNTRY**  
Germany

**PERIOD**  
2012 – 2013

**CUSTOMER**  
Aarsleff Bilfinger Berger JV

**RECIPIENT**  
DanTysk

**COUNTRY**  
United Kingdom

**PERIOD**  
2010 – 2012

**CUSTOMER**  
Aarsleff | Bilfinger Berger JV

**RECIPIENT**  
London Array Limited



## DETAILED DESIGN OF JACKET FOUNDATIONS

### COUNTRY

Taiwan

### PERIOD

2018-2019

### CUSTOMER

Jan De Nul NV

### RECIPIENT

TPC

### CHANGHUA – PHASE 1

The Changhua Pilot TPC OWF is an offshore wind farm of 110 MW. The site is located 7.6 km off the west coast of Taiwan at Changhua County, and will cover an area of 11 km<sup>2</sup>. Water depths at the site range between 18 and 28 m TWVD. The Changhua Pilot TPC OWF is planned to be installed in 2020 and commissioned in 2021. After establishing a design basis, COWI carries out the detailed design of a 4-legged steel jacket structure. The design comprises hydraulic design, scour assessment, geotechnical design, primary and secondary steel and corrosion protection design. Design loads also consider earthquakes and typhoons.

### FORMOSA II

The Formosa II is an offshore wind farm of approximately 378 MW located 6-12 km off the West coast of Taiwan at Miaoli County on 35-55 m water depth. COWI updates the concept design of jacket foundations on 35-55 m water depth. The design considers typhons and earthquakes.

### WIKINGER

Offshore wind farm with 70 jacket foundations for 5 MW turbines installed in the German sector of the Baltic in water depths of 36 to 42 m. COWI A/S, in joint venture with IMS, carries out the design of the foundations and transition pieces. Services rendered by COWI: Project management, geotechnical engineering, detailed design of foundations and transition pieces incl. secondary steel. Also ship collision analyses, HSE management, risk management, interface management, quality management, and options for fabrication and installation support services.

### COUNTRY

Germany

### PERIOD

2012 – 2018

### CUSTOMER/RECIPIENT

Iberdrola Renovables Offshore  
Deutschland GmbH

### HORNS REV 3 OFFSHORE SUBSTATION

2x400 MW and 1x200 MW substations. Concept study of 400 MW and 200 MW topside structure, detailed design of 400 MW and 200 MW substation, detailed design of foundations and structures, design review, equipment layout and 3D design, project management, tendering and transport and installation design. Also process design, supply systems and mechanical installation as well as piping, HVAC, accommodation, electrical installations, instrumentation and SCADA, fire and safety.

### COUNTRY

Denmark

### PERIOD

2013 – 2014

### CUSTOMER

Energinet.dk

### RECIPIENT

Energinet.dk

### THORNTON BANK

The 2<sup>nd</sup> and 3<sup>rd</sup> phase of the Thornton Bank project are the industrial phases following the first, pilot phase. Phase 2 and 3 consisted of 48 5 MW Servion turbines, 24 in each concession sub-area. The wind turbines are installed on jacket foundations. COWI's services comprised detailed design of the 48 jacket foundations for REpower 6 MW turbine. The services included structural design of primary and secondary steel.

### COUNTRY

Belgium

### PERIOD

2010 – 2011

### CUSTOMER

OWEC Tower

### RECIPIENT

C Power

### ORMONDE

Ormonde is an offshore wind farm located in the Irish Sea, around 10 km from the coast at Barrow-in-Furness in the north-west of the UK. It is innovative in many respects:

- › First commercial deployment of one of the world's largest 'market-ready' wind turbines, the 5 MW REpower
  - › First commercial use of steel jacket foundations fabricated in Scotland
  - › Longest 'single-pull' electricity export cable installation in UK waters (42 km)
- COWI's services comprised detailed structural design of 30 jacket foundations.

### COUNTRY

United Kingdom

### PERIOD

2008 – 2009

### CUSTOMER

OWEC Towe

### RECIPIENT

Vatenfall

### ALPHA VENTUS

Alpha Ventus was first German offshore wind farm. The construction phase was just 12 months, a pioneering feat in a location with a water depth of about 30 m and a distance from the coast of 60 km. Alpha Ventus operates two types of wind turbines with two foundation designs, jackets and tripods. The output of the wind farm is 60 MW. COWI's services involved detailed structural design of six jacket foundations. The jacket foundations are designed for the REpower 5 MW turbine and based on BSH regulations.

### COUNTRY

Germany

### PERIOD

2007 – 2009

### CUSTOMER

OWEC Tower

### RECIPIENT

DOTI



## DETAILED DESIGN OF GRAVITY BASED FOUNDATIONS

**COUNTRY**  
Sweden

**PERIOD**  
2012 – 2013

**CUSTOMER**  
Jan De Nul NV

**RECIPIENT**  
E.ON KÅREHAMN

### KÅREHAMN

COWI carried out the detailed design of 16 wind turbine gravity foundations up to 1800 tons in 8m to 21 m water depths in the Baltic Sea off Oeland in Sweden. The foundations are founded at 8.2 m to 20.5 m MSL. Jan de Nul is the contractor responsible for design, construction, transportation and installation of the offshore foundations. COWI was engaged by JDN to prepare the geotechnical and structural design (consisting of contract, basic and detailed design) of the primary foundation structures. Vestas supplied the sixteen 3 MW wind turbine generators type V112 to E.ON, as well as the turbine and environmental loads on the foundations. DNV was engaged by E.ON as certifying agency.

**COUNTRY**  
Denmark

**PERIOD**  
2008 – 2011

**CUSTOMER**  
Aarsleff – Bilfinger-Berger Joint  
Venture

**RECIPIENT**  
EON Vind Sverige

### RØDSAND II

An offshore wind turbine park with 90 wind turbines has been built with turbines placed on ballasted caissons in 5 to 12 m water depth. COWI's services comprised establishing a design basis on the basis of the owner's design basis, basic design of the foundation structure to the level defining concrete dimensions, detailed structural design of the 90 gravity foundations, structural design – construction and installation forces (IBDAS model), geotechnical design determining bearing capacity, overturning capacity, sliding capacity and foundations, and soil reaction, hydraulic design including hydrodynamic loads and design, determination of ice forces, scour protection design and detailed design of appurtenances.

### RØDSAND

Design of a transformer platform for an extension of the Rødsand offshore wind farm at Nysted south of the Danish island of Lolland. The platform dimensions are approx. 18x15 meter in base area and 15 meters high and supported by a concrete gravity-based foundation. The weight of the transformer is around 280 tonnes, and the total platform weight is about 800 tonnes. The foundation is a 1200 tonnes gravity base structure at water depth 6 m MSL. The total power of the extended wind farm is 215 MW. COWI services comprised design of the entire offshore platform -including all mechanical, electrical and structural components – and the foundation. Follow-up on equipment contractors and yard fabrication as well as offshore transport, installation and commissioning was included in COWI's scope of work at a later stage.

**COUNTRY**  
Denmark

**PERIOD**  
2007 – 2008

**CUSTOMER**  
Energinet.dk

**RECIPIENT**  
Energinet.dk  
DESIGN OF  
RØDSAND B TRANSFORMER  
PLATFORM AND FOUNDATION

### THORNTON BANK OWF PHASE 1

Detailed design of six offshore gravity foundations for 5 MW RePower wind turbines, set in 21 to 27 m of water depth some 30 km from the coast. COWI's detailed design of foundation structures and appurtenances comprised structural, geotechnical and hydrodynamic design as well as installation analysis, programming and analyses of mathematical and physical modelling of shear leg movements and sling forces during transport and installation.

**COUNTRY**  
Belgium

**PERIOD**  
2006 – 2007

**CUSTOMER**  
Dredging International

### NYSTED

Detailed design of gravity foundations for 72 wind turbines and one transformer (OSS) located 9 –10 km from the coast in the southern part of Denmark. The total production capacity of the wind farm is about 480 GWh. The wind turbines are 68.5 m high and founded at 7.5 m – 12.75 m depth. COWI carried out the structural design, geotechnical design, design of scour protection and evaluation of limiting wave conditions for the operation of placing the foundations on the seabed. Hydraulic model testing was carried out in connection with scour design and evaluation of the motion of the laying barge exposed to waves. Project follow-up in the construction phase.

**COUNTRY**  
Denmark

**PERIOD**  
2000 – 2001

**CUSTOMER**  
Per Aarsleff A/S

# OFFSHORE WIND DESIGN SERVICES



## COUNTRY

India

## PERIOD

2016 – 2019

## CUSTOMER

European Union

## RECIPIENT

Ministry of New and Renewable Energy of India (MNRE) and National Institute of Wind Energy India (NIWE)

### COST FEASIBILITY STUDY – FOWPI – FIRST INDIAN OWF DEVELOPMENT

Preliminary design and technical specifications for the first offshore wind farm off the coast of Gujarat with a capacity of up to 200 MW, including foundations, electrical network (substation and grid connection), foundation design, wind turbines, specific technical studies for the selected site, metocean assessment, coastal surveys, EIA scoping, cost-benefit analysis, transmission layout, geophysical survey, geotechnical desktop study, safety measures, wind resource assessment, energy yield calculation and wind farm layout optimisation etc. All to be used as advisory material by a wind farm developer considering investing in the project. The services comprised building an Indian knowledge bank with data on Indian and European stakeholders and capturing European experience in offshore wind, and wind turbine technology guidance, coastal & onshore study, including guidance on construction and O&M harbour, development of a financial investment model, procedures for permit management, certification and health and safety based on EU experience and best practice, enhance the capacity of National Institute of Wind Energy (NIWE) to act as the nodal agency for the offshore wind sector in India. Also assist in capacity building of the MNRE for offshore wind. Secretariat services including support for stakeholders with technical input and logistical support.

### GEOTECH STUDY- KRIEGERS FLAK

Offshore wind farm located 15 km east of the Danish coast in the southern part of the Baltic Sea with a capacity of 600 MW. The number of turbines will be between 60 and 200. The site area of 250 km<sup>2</sup> encircles the bathymetric high called “Kriegers Flak” with water depth between 16 and 30 m. The options are driven monopiles, gravity based structures, jackets or suction buckets. COWI’s services comprised preliminary review and assessment of available geotechnical data to determine the suitability of ground conditions for gravity based foundations.

## COUNTRY

Denmark

## PERIOD

2014-2014

## CUSTOMER

Per Aarsleff A/S

### YARD HANDLING – WIKINGER

The four-legged jacket foundations for Iberdrola’s Wikinger offshore wind farm have been fabricated at Bladt’s site at Lindø and are to be upended and loaded onto barges for transport to the site. The foundations are approximately 65 m tall and weigh 650 tons each. COWI supported Bladt Industries during fabrication of the jacket foundations which were designed by COWI. COWI has verified the structural integrity of the jacket during the upending operation and the structural integrity of the existing support pipes.

### SCOUR ENGINEERING SERVICES FOR OFFSHORE WIND PROJECTS

On a staff secondment basis, support of all offshore wind projects under development by DONG Energy Wind Power, as well as existing offshore wind farms owned by DONG Energy Wind Power. COWI’s services comprised scour engineering services: Establishing design basis, design methodologies and detailed design of scour protection for WTG foundations, offshore substations and cable crossings. Establishing design basis and design methodologies for prediction of scour depths around unprotected offshore foundations depending on soil conditions.

### PRE-INVESTIGATIONS AT SIX NEARSHORE WINDFARMS

The Danish Ministry of Climate, Energy and Building has appointed Energinet.dk (ENDK) to conduct pre-investigations at six nearshore wind farm sites in Danish seas towards the process of tendering the operational licenses as well as to conduct environmental impact assessments for each of the proposed six sites: Vesterhav Nord, Vesterhav Syd, Bornholm, Sæby, Sejerø Bugt and Smålandsfarvandet. Energinet.dk contracted COWI A/S as metocean consultant to carry out the meteorological and oceanographic studies for each location. Additionally, Energinet wished COWI to study and emit a second opinion on the wave conditions at a seventh location, Horns Rev 3, for a 400 MW farm 15 km of the west coast of Denmark.

## COUNTRY

Denmark/Germany

## PERIOD

2015 – 2016

## CUSTOMER

Bladt Industries A/S

## COUNTRY

Denmark

## PERIOD

2013 – 2015

## CUSTOMER

DONG Energy Wind Power A/S

## COUNTRY

Denmark

## PERIOD

2013 – 2015

## CUSTOMER

Energinet.dk



**COUNTRY**  
Sweden

**PERIOD**  
2012 – 2013

**CUSTOMER**  
Storgrundet Offshore AB

#### DESIGN BASIS FOR STORGRUNDET

Storegrundet Offshore AB is developing an offshore wind farm east of the island Störungfrun located southeast of the town Söderhamn in Sweden. COWI's services comprised preliminary design basis, specifying applicable standards, wave, wind and current climates, water levels, ice conditions, soil conditions, environmental conditions and ship impacts for the design of the foundations.

**COUNTRY**  
Finland

**PERIOD**  
2012 – 2013

**CUSTOMER**  
Suurhiekkä Offshore Oy

#### METOCEAN STUDY FOR SUURHIEKKA

The Suurhiekkä Offshore wind farm is located in the Bothnic Bay, Finland, in an ice prone region in 3-15 m water depth exposed to breaking waves. The wind farm comprises 80 3 MW offshore wind turbines and two substations totalling 240 MW installed power. COWI's services comprised preparation of a metocean study and preliminary design basis. The metocean study included MIKE21 wave and current modelling with subsequent analysis of results. External description of wind conditions, ice conditions and geotechnical conditions were included in the preliminary design basis.

**COUNTRY**  
USA, Australia, United Kingdom  
and Denmark

**PERIOD**  
2016 – ongoing

**CUSTOMER**  
Various

#### SECONDMENTS FOR TECHNICAL ADVISORY IN OWF DEVELOPMENT PROJECTS

Many COWI employees are seconded to positions with leading developers of offshore wind farms, such as Ørsted, Vattenfall, Copenhagen Infrastructure Partners who have developed and implemented a wide range of projects.

**COUNTRY**  
U.S.A., Germany, Great Britain,  
Denmark, Netherland

**PERIOD**  
Ongoing

**CUSTOMER**  
Various

#### TECHNICAL DUE DILIGENCE OF OWF PROJECTS

Due diligence performed for numerous banks, financial institutions, development agencies, multilateral development banks and investors, among others Pension Danmark, BNP Paribas, Nordea, Arctas Capital Group, Danida, IFC, ADB and EIB. COWI assists with transaction management to minimize the risks through identification and assessment of technical, environmental and financial issues. Our vast pool of experts within every relevant discipline ensures that we have the necessary experience and knowledge to assess and evaluate any kind of challenge. Specific references cannot be shared as most due diligence is carried out under strict non-disclosure agreements.

#### CONCEPT AND REFINEMENT DESIGN FOR FID -INCH CAPE

The Inch Cape Offshore Wind Farm is located approximately 15 km to the east of the Angus coastline in Scotland and covers an area of around 150 km<sup>2</sup>. The water depths at the WTG locations range from 42-55 m below LAT, while the extreme water depths are 35.5 m to 63.3 m LAT. The foundations for the 72 Vestas 9.5MW turbines are jacket structures.

COWI's services comprise:

1. Concept design for CFD (contract for difference) submission 26.11.2018 – 28.03.2019
2. Design refinement for FID (final investment decision) 20-05-2020

#### FINE SCREENING OF DESIGNATED AREAS FOR NEW OWF DEVELOPMENT

Fine screening of four areas for potential development of new offshore wind farms with a capacity of 800 MW. An economic ranking of the four areas shall be made by performing a fine screening with respect to several aspects such as seabed conditions, environmental and spatial constraints, grid connection and wind resource. The services comprised GIS modelling of environmental and spatial constraints, mesoscale modelling of wind resources, assessment of grid connection, including load flow analyses, preliminary inter-array cabling layout, substation solutions, export cable, geotechnical assessment including screening of seabed conditions, determination of optimal placement of offshore wind farms within each designated area, detailed layout optimisation, annual energy yield estimation, economic assessment and ranking.

#### SCREENING FOR GREEN FIELD POSSIBILITIES

Screening of the Danish North Sea for green-field project possibilities and drafting of pre-investigation permit applications for the five most promising projects with a capacity of minimum 1000 MW and up to 3000 MW. The services comprised constraint mapping of the whole Danish North Sea, mesoscale modelling of wind resources and mapping of wind potential, pre-feasibility assessment of grid connection, sea-bed conditions and energy yield estimation.

**COUNTRY**  
United Kingdom

**PERIOD**  
2018 – 2020

**CUSTOMER**  
Boskalis Offshore Ltd.

**RECIPIENT**  
Inch Cape Offshore Ltd.

**COUNTRY**  
Denmark

**PERIOD**  
2018 – 2018

**CUSTOMER**  
Confidential

**COUNTRY**  
Denmark

**PERIOD**  
2018 – 2018

**CUSTOMER**  
Confidential



**COUNTRY**  
Baltic Sea Region

**PERIOD**  
2018 – 2018

**CUSTOMER**  
EU Commission

**RECIPIENT**  
BASREC Countries

#### SCREENING OF OFFSHORE WIND POTENTIAL IN BALTIC SEA REGION

Identification and ranking of potential offshore wind farm areas in the Baltic Sea. The capacity is in the range of 500 MW to 2000 MW. Furthermore, an assessment of the market situation and a gross value-added analysis were performed. The services comprised localization of potential offshore wind farm areas in the Baltic Sea based on environmental and spatial constraints, wind resource, seabed conditions, analysis of potential grid connection points, annual energy yield estimates, ranking of identified sites and market and gross value added analyses.

**COUNTRY**  
Denmark

**PERIOD**  
2016 – 2016

**CUSTOMER**  
Siemens Wind Power A/S

#### DESIGN BASIS FOR NISSUM BREDNING WINDFARM

Design basis assistance for nearshore windfarm with four Siemens Wind Power 7 MW wind turbines. The windfarm is located offshore in Nissum Bredning at Thyborøn. The services comprised metocean analysis of water levels, loads, wave, current and ice conditions, estimation of design wind conditions for each wind turbine position (wind shear, wind speed, extreme wind, turbulence, air density, etc), desktop study of marine cable route and seabed mobility, soil investigations including geophysical survey, geotechnical drillings and CPTs, laboratory tests.

**COUNTRY**  
Denmark

**PERIOD**  
2017 – 2017

**CUSTOMER**  
Vattenfall Vindkraft A/S

#### WIND AND SITE CONDITIONS FOR KRIEGERS FLAK

Estimation of wind and site conditions for design basis input for the 605 MW Kriegers Flak offshore wind farm. A combination of mesoscale modelling and analysis of data from a nearby offshore mast was used to estimate the design wind conditions for the site. The results were certified by DNV GL.

**COUNTRY**  
Denmark

**PERIOD**  
2017 – 2017

**CUSTOMER**  
Vattenfall Vindkraft A/S

**RECIPIENT**  
Vattenfall Vindkraft A/S

#### WIND AND SITE CONDITIONS FOR VESTERHAV NORD AND SYD

The project consisted in an estimation of wind and site conditions for design basis input for the Vesterhav Nord and Vesterhav Syd nearshore wind farms. The nearshore wind farms will have capacities of 180 MW and 170 MW respectively. A combination of mesoscale modelling and analysis of data from offshore and onshore meteorological masts were used to estimate the design wind conditions for the site. The results were subject to a certification from DNV GL.

#### WIND AND SITE CONDITIONS FOR LILLEBÆLT SYD

The project involved assessment and or/estimation of design wind and site conditions, metocean, geotechnical conditions, design basis and concept design of gravity based foundations for the Lillebælt Syd Wind Farm. The offshore wind farms will have capacities of approximately 160 MW.

**COUNTRY**  
Denmark

**PERIOD**  
2017 – 2017

**CUSTOMER**  
Sønderborg Forsyning A/S

**RECIPIENT**  
Sønderborg Forsyning A/S

#### TENDER DESIGN FOR BORSSELE III & IV

680 MW total capacity. The scope of work included design basis, primary steel design including load iteration with turbine supplier, secondary steel design, geotechnical design, scour protection design including analyses of sand waves, corrosion protection strategy, design of low voltage systems.

**COUNTRY**  
Netherlands

**PERIOD**  
2016 – 2017

**CUSTOMER**  
DEME

#### ST. NAZAIRE & COURSEULLES OWF - TENDER DESIGN

Two offshore wind farms off the coast of France: Courseulles-sur-Mer has 75 Alstom Haliade 150 6 MW wind turbines on monopile foundations. Saint-Nazaire OWF has 80. COWI's services comprised tender design of monopile foundations for the two offshore wind farms.

**COUNTRY**  
Belgium

**PERIOD**  
2015 – 2017

**CUSTOMER**  
Eiffage Construction Métallique

#### TENDER DESIGN FOR FÉCAMP

Gravity based foundation for 83 Alstom Haliade 6 MW turbines at water depths from 26 to 33 m. COWI supplied a review of geotechnical background data, establishment of own soil parameters, geotechnical and structural design, gravel bed and scour protection design, corrosion protection design of foundation and appurtenances, assessment of temporary phases and concept study of jacket alternative.

**COUNTRY**  
France

**PERIOD**  
2015 – 2016

**CUSTOMER**  
VCGP-SDI



[www.cowi.com/tags/wind-energy](http://www.cowi.com/tags/wind-energy)



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