



## Project Summary

### Organization

POWERCHINA Huadong Engineering Corporation Limited

### Solution

Mining and Offshore Engineering

### Location

Jiangsu, China

### Project Objectives

- Construct three concentrated wind farms offshore of Nantong, Yancheng, and Lianyungang as part of a larger offshore wind power project
- Design a range of wind turbine foundations including monopiles, jackets and high-rise pile cap structures, and also four-pile jacket offshore substation foundation forms for water depths that range from 2.6 meters to 20.5 meters

### Products Used

OpenWindPower™

## Fast Facts

- POWERCHINA Huadong performed infrastructure construction services for more than 94 percent of the offshore wind power market in Jiangsu, China.
- POWERCHINA Huadong has won over 60 patents for offshore wind power technology and substations.
- China is concentrating on the Jiangsu province for its abundant wind-energy resources.

## ROI

- As the largest offshore wind power project in the world, it will provide great economic, social, and environmental benefits.
- The wind farm complex will reduce carbon dioxide emissions, compared to conventional thermal power units.
- Using OpenWindPower, the project team optimized the construction and operation of the wind farm complex.

# POWERCHINA Huadong Engineering Designs Three Concentrated Wind Farms in Jiangsu Province

Powerful Design Capabilities of Bentley's OpenWindPower Overcame Project Challenges and Increased Efficiency

## Increased Demand for Wind Power

POWERCHINA Huadong Engineering Corporation Limited in Hangzhou, China performs infrastructure construction services for more than 80 percent of the country's offshore wind power market, as well as in the rest of Asia, Africa, Europe, and the Americas. With more than 4,000 employees, most of whom are state-registered engineers, the company specializes in the design, research, and construction of hydropower and urban environmental engineering projects. It has won over 50 patents for offshore wind power technology and more than a dozen patents for offshore substations. POWERCHINA Huadong has been recognized for 24 awards in offshore wind power.

With an increase in government support for offshore wind power projects, a reduction in equipment and installation costs, and the gradual maturity of supporting industries, China's offshore wind power industry finds itself in an accelerated development period. The country is focused on the Jiangsu province with its abundant wind energy resources, planning to advance China's offshore wind farming.

POWERCHINA Huadong has surveyed and designed over 94 percent of Jiangsu's connected grid capacity to date. Currently, the total capacity of connected grid in Jiangsu is just over 2,200 megawatts, including some newly added capacity. To further implement a sustainable development



*The project team used Bentley's OpenWindPower to optimize the construction and operation of this large wind power project.*

concept within the next three years, China's cumulative capacity for offshore wind power projects in Jiangsu province will need to reach 3,500 megawatts and have a further 1,000 megawatts capacity in construction. This project will include multiple wind farms along the Jiangsu coast, which will host thousands of wind turbines and many substations. When completed, the project will be five times larger than London Array, the largest offshore wind farm in the world.

## Leveraging the Province's Location and Natural Conditions

To achieve this growth, the Chinese government chose POWERCHINA Huadong to construct three concentrated wind farms, including wind turbines and substations, as part of a larger wind power project. The several-megawatt-base wind farms are off the coast of Nantong, Yancheng, and Lianyungang – three coastal cities in the province of Jiangsu. Each wind farm base consists of several hundred thousand kilowatt-level offshore wind plants. The largest of them, and the largest in China, is the Binhai North District H2# 400-megawatt wind power plant. The water depth of these offshore plants ranges from 2.6 meters to 20.5 meters, and the largest area of a single offshore wind farm is 42,500 square kilometers.

Among the challenges that POWERCHINA Huadong faced were the wind turbine foundation forms of this project group, which included large-diameter, single-pile foundations without a transition section, multiple-pile jacket foundations, and high-rise pile cap foundations. The offshore substation foundation forms commonly consist of single-pile foundations and four-pile jacket foundations, with voltage levels of 220 kilovolts and 110 kilovolts. To design the power plants and substations, POWERCHINA Huadong selected Bentley's OpenWindPower offshore structural design and analysis software for its ease of use, built-in specifications, and comprehensive capabilities. POWERCHINA Huadong used OpenWindPower to design the overall structure, including the main structure, pre-stage wind turbine foundation, and offshore substations. On this project, POWERCHINA Huadong designed the offshore wind farms to allow for finite element

*“Compared to a traditional load-iterative design method, the wind turbine foundation-based integrated design system significantly reduces the number of design iterations. OpenWindPower shortens the overall design cycle and effectively solves the problem of large design margins and reduces the cost of offshore wind power development.”*

*– Dr. Bin Wang, Deputy Chief Engineer of the New Energy Research Institute, POWERCHINA Huadong Engineering*

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simulations using OpenWindPower’s existing computing modules. The process allowed the project team to perform a host of analyses, including in-place static strength, pile soil interaction (PSI), seismic strength, and structure hoisting analyses.



*Bentley OpenWindPower was used to design a range of foundations, for wind turbines and offshore substation in water depths that range from 2.6 meters to 20.5 meters.*

Design proposals were adjusted and optimized based on the results of the OpenWindPower analyses to enhance safety and economic efficiency. While using the application, POWERCHINA Huadong developed a custom OpenWindPower data conversion and analysis software to pre-calculate the wind and turbine performance and soil parameters, as well as develop a basic wind farm control system. These new systems expanded the application’s capabilities and enhanced the efficiency and accuracy of the project’s design and computing input. While performing the wind turbine load analyses, the project team saved time because of OpenWindPower’s ability to automatically transfer the wind turbine load data with reference to the coordinate system of the wind turbine towers. This series of actions generated a OpenWindPower file for various wind turbine load conditions required for multi-condition static analysis and determined fatigue

analysis.

### **Complex Delivers Economic, Social, and Environmental Benefits**

Using OpenWindPower’s powerful design capabilities, the Jiangsu offshore wind power project reached many milestones. Through the adoption of a modular layout on the Longyuan offshore wind farm in Dafeng, the project team could determine a solution to overcome the site’s shallow water, which would have impeded the construction team’s ability to transport and lift the platforms into place. The software also helped determine the optimal design of the wind turbine foundations, allowing the team to carry out the pile static load test results and the overall machine structure to reduce energy and construction costs for the entire wind farm complex.

Based on the powerful features of OpenWindPower software, POWERCHINA Huadong shortened the project design cycle, expanded the scope of use of the software, and greatly increased the efficiency and accuracy of design parameter input. Using OpenWindPower helped form an integrated design and calculation system for wind-generator load and foundation calculations by automating the generation of files for turbine load time history input and foundation modeling. Now, these calculations can be implemented simultaneously.

The Jiangsu offshore wind power project will serve as not only a great economic benefit to POWERCHINA Huadong, but also provide significant social and environmental benefits. Offshore wind farms promote clean energy and help reduce pollution emissions that would have otherwise been discharged by conventional thermal power. The complex plays a role in improving the surrounding environment, promoting better air quality, increasing the proportion of clean energy, and reducing carbon emissions. The offshore wind power project will also showcase China as a leader in offshorewind energy.