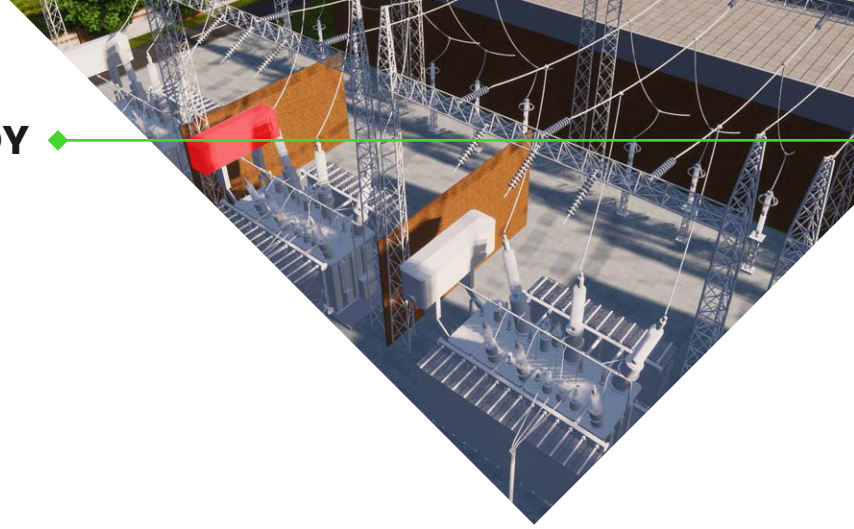
Bentley
Advancing Infrastructure

CASE STUDY



PowerChina ZhongNan Developed a 5-gigawatt Offshore Wind Farm in Less Than One Year

Bentley Applications Helped Create a Digital Twin, Increasing Efficiency while Reducing Project Costs

REPLACING COAL WITH WIND

Wanting to boost the availability of electricity in the Shandong province of China, Shandong Energy Group initiated development of Bozhong Offshore Wind Farm Site A. It now provides 5 gigawatts of power via 60 wind turbines, each with a capacity of 8.35 megawatts. Development also included an onshore centralized control center and a 220-kilovolt offshore booster station. "The project, which pioneers the intersection of submarine cables and oil and gas pipelines, is the largest intelligent, digital wind farm in China that has been built without interruption," said Wenjie Mi, director at PowerChina ZhongNan Engineering Corporation Limited, the organization responsible for designing the project.

Bozhong Offshore Wind Farm Site A is the first grid-parity offshore wind power project in Shandong and the first of its type to be approved. When it was activated at the end of 2022, it saved 519,000 tons of coal per year and reduced carbon dioxide emissions by 1.26 million tons. However, developing it posed a significant challenge.

DEVELOPING FASTER THAN EVER

Though the wind farm was officially approved in February 2022, the project had to be finished at the end of the same year. "As grid parity affects the economic performance of the project, it was necessary to optimize the routing of the submarine cables (bypassing the restricted areas/crossing oil and gas pipelines), the offshore booster station (improving equipment layout to reduce the size and weight of the platform), and other design solutions to reduce the cost," said Mi.

Further complicating the project, the seabed at the site posed complex hydrological and geological conditions, which greatly impacted the design and construction of the foundation structures. At the same time, the engineering quantity of the single-pile foundation needed to be optimized to reduce costs, and the teams had to coordinate a wide range of stakeholders. The designers realized that they needed advanced digital technologies and methods to bring the project online so quickly.

BETTER PLANNING AND VISUALIZATION WITH A DIGITAL TWIN

PowerChina ZhongNan decided that a digital twin created with the assistance of Bentley applications could help the teams overcome the numerous challenges they faced. They started by using ProjectWise as a connected data environment, establishing tight version control and ensuring that all collaborators and stakeholders could access needed information. Then, using MicroStation and Bentley Open applications, they modeled all project elements, including the control center, booster station, piping layouts, and the complex sand table, creating a digital twin of the project.

Rather than simply use out-of-the-box capabilities of Bentley applications, PowerChina ZhongNan supplemented them with their own bespoke solutions. "Leveraging Bentley applications, we developed many auxiliary design tools, such as the intelligent algorithm-based optimization software for the submarine connector line, a secondary development based on Bentley's MicroStation that can realize the intelligent construction of the collector line topology scheme," said Mi. As a result, they intelligently optimized the project site, automating the generation of the collector line. Their digital twin can also simulate weather and wave patterns, pile driving, and power flows.

PROJECT SUMMARY

ORGANIZATION
PowerChina ZhongNan Engineering Corporation Limited

SOLUTION
Process and Power Generation

LOCATION
Dongying, Shandong, China

PROJECT OBJECTIVES
- To develop a 5-gigawatt offshore wind farm within one calendar year.
- To use digital design to improve efficiency and lower costs.

PROJECT PLAYBOOK
Bentley Raceway and Cable Management™, MicroStation®, OpenBuildings®, OpenPlant®, OpenRoads™, PLAXIS®, ProjectWise®, ProStructures™, SACS™

FAST FACTS

- Bozhong Offshore Wind Farm Site A now provides 5 gigawatts of power via 60 wind turbines.
- The wind farm needed to be completed in less than a year, despite challenging site conditions.
- Teams created a digital twin of the project to optimize design and simulate weather and wave patterns.

ROI

- With 3D design, PowerChina ZhongNan improved project design and improved efficiency by 30%, shortening construction time by 20%.
- The company optimized the engineering quality of the foundations and eliminated the need for 8,557 tons of material, greatly lowering development costs.
- The wind farm saves 519,000 tons of coal per year and reduces carbon dioxide emissions by 1.26 million tons.

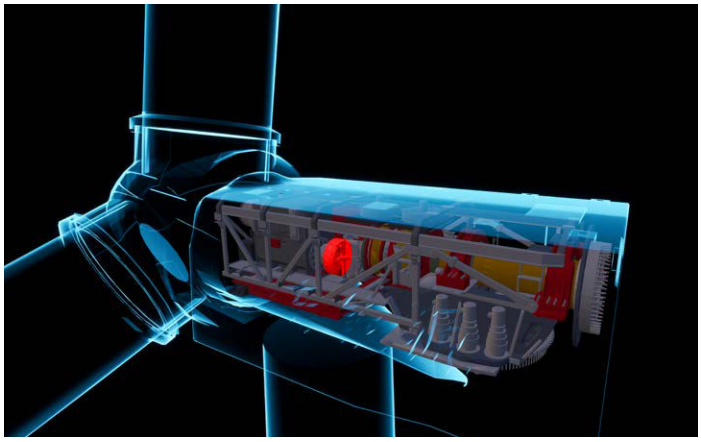
"Digital BIM design with MicroStation enabled the Bozhong Offshore Wind Farm Project to achieve grid connection successfully. As a result, the project was approved, constructed, and grid-connected in the same year it was planned."

– Wenjie Mi, Director of Digital Engineering, PowerChina ZhongNan Engineering Corporation Limited

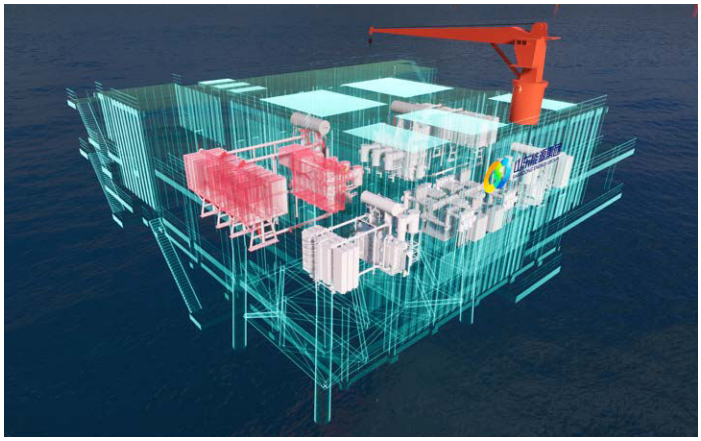
SPEEDIER DEVELOPMENT WITH IMPROVED EFFICIENCIES

With 3D design, PowerChina ZhongNan improved project design and improved efficiency by 30%, shortening construction time by 20%. Through careful calculations within SACS and PLAXIS, the company optimized the engineering quality of the foundations and eliminated the need for 8,557 tons of material, greatly lowering development costs. Teams further reduced costs by developing software within MicroStation that enabled them to intersect submarine cables with oil and gas pipelines. "As a result, this project has the lowest cost per kilowatt among the first batch grid-parity offshore wind farm projects approved," said Mi.

Because of the improved collaboration and efficiencies, the project began construction in April, hoisted its first turbine in June, and achieved full capacity grid connection in December, setting a record for project planning, approval, construction, and grid connection in the same year. "By virtue of the intelligent construction control system and through collaboration with all project participants including owner, designer, supervisor, and constructor, the project realized visualized, standard, and intelligent construction driven by the data chain," said Mi. The digital twin is now being used for full lifecycle asset management and maintenance.



With 3D design, PowerChina ZhongNan improved project design and improved efficiency by 30%, shortening construction time by 20%.



The company optimized the engineering quality of the foundations and eliminated the need for 8,557 tons of material, greatly lowering development costs.

Bentley
Advancing Infrastructure

FIND OUT MORE AT BENTLEY.COM

1.800.BENTLEY (1.800.236.8539) | Outside the US +1.610.458.5000 | **GLOBAL OFFICE LISTINGS** bentley.com/contact