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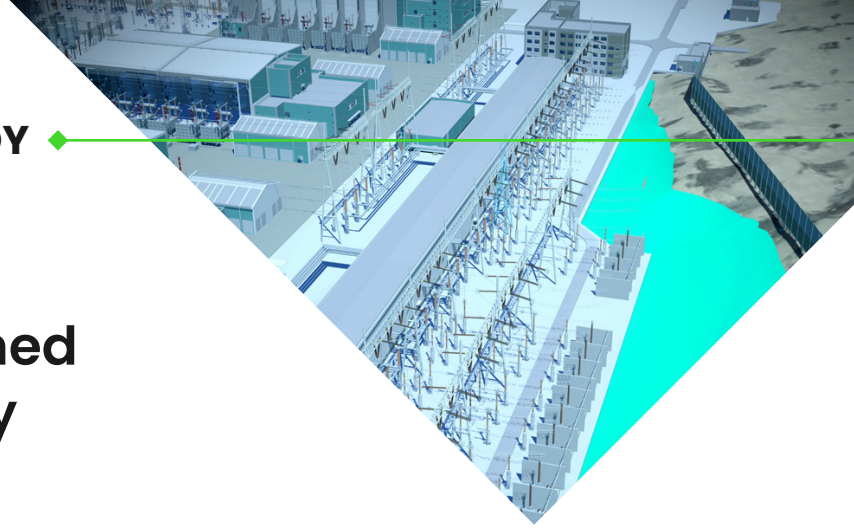
CASE STUDY



Southwest Electric Power Design Creates a Combined Power Distribution Facility in Mountainous Terrain

Bentley Applications Created a Digital Twin of the Project, Helping to Create a Stable Foundation while Improving Efficiency

TRANSMISSION TO A DISTANT LAND

Baihetan Hydropower Station, located on the upper reaches of the Yangtze River, is the second-largest hydro facility in the world, consisting of 16 power generation units with a capacity of 1 GW each. To improve transmission of the electrical energy generated by the facility to 75 million people in eastern China, solve ongoing power shortages in the eastern load center, increase the proportion of clean energy in the eastern region, and reduce carbon dioxide emissions, the state government built the Butuo ±800kV converter station. Now, energy generated by the Baihetan Hydropower Station is transmitted to eastern China, which is 2,000 kilometers away from the station, in just seven seconds. Southwest Electric Power Design Institute Co., Ltd. of China Power Engineering Consulting Group (SWEPDI) developed the project.

Since the government wanted to limit land use for the project as much as possible, SWEPDI adopted a "three stations in one" construction plan that would combine two sending-end converter stations with the main converter station, making the facility more compact. "Through the equipment and facilities sharing plan, the jointly constructed station saves about 10 hectares of land resources in total compared with the similar projects," said Mingyu Liao, senior engineer at SWEPDI. However, the completed station still sprawled over 63 hectares, equivalent to 90 football fields, which presented significant challenges.

BUILDING HUGE ON VARIED TERRAIN

To assist with development on such a large, complex project, SWEPDI wanted to apply digital technology in all areas, including planning, design, construction, manufacturing, operations, and maintenance. Ideally, a single digital representation of the plant would be used throughout the entire lifecycle of the station. They also needed digital design to help with selecting a suitable site. "The average altitude of the planned site area for the converter station is about 2,000 meters. It is a high-altitude, high-earthquake-intensity area with complex and diverse landforms, rugged terrain, and overlapped ridges and peaks," said Liao. Even after site selection, the teams would need to carefully verify the length of the pile foundations to ensure they could support the facility in a varied landscape.

Their design platform would also need to help them combine the two substations with the main transmission station within a complex, relatively compact space, all while meeting tight national building codes. Additionally, numerous disciplines had to collaborate closely to keep costs under control and to coordinate with the manufacturer. Older design techniques wouldn't work. "The 2D design can't enable the verification of 3D layout, and it is also not convenient for multi-disciplinary collaborative design and transfer of design data," said Liao. Early attempts to use other 3D solutions were not able to accurately position 3D models and support the large scale of the project. SWEPDI needed a solution that was robust and flexible enough to help them overcome all challenges and requirements.

IMPROVING DESIGN WITH A DIGITAL TWIN

The organization soon determined that Bentley applications could help them deliver the project. Using ProjectWise, they established a collaborative design management platform, enabling easy data sharing and control of permissions and workflows. With the connected data environment in place, teams used MicroStation to integrate models of the terrain with the preliminary project design,

PROJECT SUMMARY

ORGANIZATION

Southwest Electric Power Design Institute Co., Ltd. of China Power Engineering Consulting Group

SOLUTION

Transmission and Distribution

LOCATION

Liangshan, Sichuan, China

PROJECT OBJECTIVES

- To combine multiple electrical stations into a unified facility.
- To create a digital twin that could support the entire lifecycle of the project.

PROJECT PLAYBOOK

Bentley LumenRT™, MicroStation®, OpenBuildings®, OpenSite®, OpenUtilities®, ProjectWise®, STAAD®

FAST FACTS

- The Butuo ±800kV converter station project was initiated to improve transmission of electrical energy to 75 million people in eastern China and solve ongoing power shortages.
- Southwest Electric Power Design Institute Co. had to determine how to build a large, combined power distribution center within mountainous terrain.
- Since 2D design could not verify the stability of the foundation, designers created a digital twin of the project for better visualization.

ROI

- The digital twin improved project design, layout, and efficiency, saving a total of CNY 320 million.
- Compact, efficient design eliminated the need for 1,000 cubic meters of concrete, 200 tons of steel, and 390,000 cubic meters of earthwork.
- The completed project is projected to reduce coal consumption by 27 million tons, lowering annual carbon emissions by 49.5 million tons.

"Through the application of digital technology, the design quality and work efficiency are improved, project investment is greatly saved and construction period is shortened, thus bringing significant social and economic benefits to the project."

– Mingyu Liao, Senior Engineer, Southwest Electric Power Design Institute Co., Ltd. of China Power Engineering Consulting Group

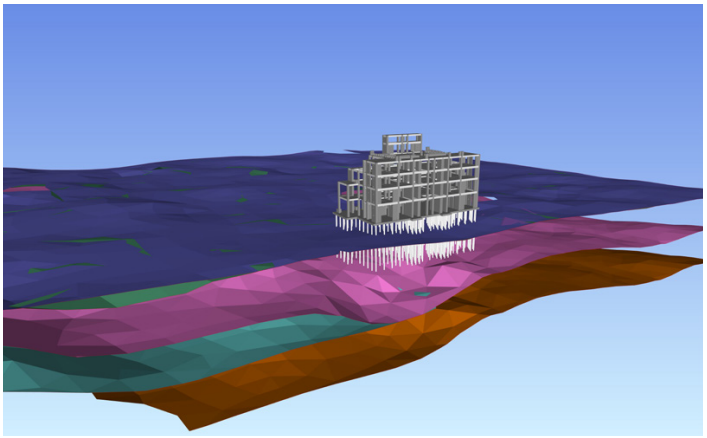
and then created detailed animations with Bentley LumenRT. This visualization helped them compare digital representations of potential project sites, helping them to select the optimal location.

Using MicroStation, OpenBuildings, and OpenSite, SWEPDI created a digital twin of project assets. With OpenUtilities Substation, they designed and optimized the station site plan, shrinking the amount of space needed and avoiding unnecessary impact to the surroundings. "Based on various professional databases, a 3D model of the converter station was built, the 3D model verification was completed, and the design drawings of the converter station were produced to enable the automatic calculation of project quantity and cost control," said Liao. To assist development, the company built an artificial intelligence-based quality assurance system within their development environment that further improved efficiency. STAAD assisted SWEPDI with determining and verifying the required length of the pile foundations, ensuring stability in the varied terrain.

NUMEROUS COST SAVINGS

By establishing a connected data environment and creating a digital twin of the project, SWEPDI was able to combine the three stations, reduce the footprint, and significantly lower project costs. "The joint construction plan proposed a solution for shared equipment and facilities of the jointly constructed station, able to save CNY 320 million in project investment," said Liao. Efficient layout of pipes and cables shortened the overall length of the facility by 38 meters, resulting in a footprint savings of 10 hectares. Improved efficiency throughout the development eliminated the need for 1,000 cubic meters of concrete and 200 tons of steel, reducing costs by CNY 6 million.

Using digital design as part of the site selection process not only found an area that could best support the foundation, but also helped the teams avoid affecting urban planning or farmland while lowering land acquisition costs by CNY 45 million. Furthermore, SWEPDI used OpenSite to adapt the project to the sloped terrain, creating a stepped layout that eliminated 390,000 cubic meters of earthwork, lowered engineering costs by more than CNY 7 million, and improved the design accuracy of pile foundation lengths by 50%. The digital twin was used for 4D construction planning and for managing the construction process. The completed project is projected to reduce coal consumption by 27 million tons, lowering annual carbon emissions by 49.5 million tons.



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