Bentley
Advancing Infrastructure

CASE STUDY


Image courtesy of MCC Capital Engineering & Research Incorporation Ltd

MCC CERI Uses Digital Design to Create Blast Furnace Generation Unit

Bentley Applications Help Significantly Reduce Steel Plant Emissions

TRANSFORMING SURPLUS GASES INTO ELECTRICITY

Manufacturing and processing metals requires a lot of heat, and being able to reuse that heat is critical to the sustainability of the steel making industry. The process involves heating coal to high temperatures to produce coke that is then used to convert iron ore into steel in a blast furnace. Both coke production and blast furnace operations generate massive amounts of superheated gas byproducts that are thick with carbon dioxide and other harmful chemicals. Steel companies have long sought methods to control the level of emissions and reuse the gas instead of letting it go to waste. Today, most steel plants harness the hot gases within power generators to generate electricity on site.

"The use of surplus gas at steel plants for power generation cannot only enhance the self-generation rate of enterprises, reduce outsourcing power and comprehensive energy consumption indicators, increase the economic benefits of enterprises, and improve competitiveness, but more importantly it can also reduce emissions, protect the environment, and generate environmental and social benefits," said Yang Bingsong, BIM manager at MCC Capital Engineering & Research Incorporation, a construction engineering organization working in the power generation and mining industry.

Though the ability to use surplus gas for on-site power generation has been a boon for metal manufacturing, current technology has its limitations. The thermal efficiency of on-site generators is significantly lower than other forms used to generate power. Additionally, the systems that are required to provide enough electricity for metals processing are very large, requiring significant footprints. MCC CERI has long worked to advance the industry, particularly when using surplus gas from blast furnace operations to generate electricity in iron and steel plants. In this case, they needed to find a way to improve the amount of energy generated on site and reduce the size of the generating equipment. The key to accomplishing both goals was to determine how to make the generating process significantly more efficient.

DETERMINING HOW TO BUILD NEW TECHNOLOGY

In 2020, MCC CERI made a technological breakthrough and discovered how to create the world's first ultra-high pressure, subcritical gas generator set with a very compact design and the smallest footprint. Their technology promised to boost the efficiency of surplus gas power generation by more than 60% while significantly shrinking the required footprint. Though MCC CERI developed the technology, they then had to put it into practice by building their new generator in an existing metal manufacturing plant. They partnered with LongTeng Special Steel Co. and their steel plant in Changshu, Jiangsu, China as the pilot site, then started planning how the new technology could be implemented onto the existing production floor.

MCC CERI soon ran into numerous challenges. Their new technology raised questions of how to control the power system load flow and prevent the reverse transmission of electricity. The design incorporated numerous disciplines, including equipment, heat power, gas and ventilation, electric engineering, and water treatment. Combining the various systems into such a limited space raised the risk of clashes in the overall design. Additionally, these disciplines were spread out through their partner's headquarters and project sites, making communication, coordination, and collaboration difficult. The design team also had to find a way to construct the new system while minimizing disruptions to ongoing factory operations. MCC CERI needed a method for designing the generating unit that could solve all the challenges they faced.

PROJECT SUMMARY

ORGANIZATION
MCC Capital Engineering & Research Incorporation Ltd.

SOLUTION
Power Generation

LOCATION
Changshu, Jiangsu, China

PROJECT OBJECTIVES
- To produce a power generation unit to demonstrate groundbreaking technology.
- To significantly reduce emissions at a steel plant.

PROJECT PLAYBOOK
AssetWise®, AutoPIPE®, AutoPLANT®, Bentley Raceway and Cable Management, ContextCapture, MicroStation®, OpenBuildings®, OpenComms Designer, OpenPlant®, OpenRoads Designer, ProStructures, ProjectWise®, STAAD®, SYNCHRO® 4D

FAST FACTS
- MCC CERI created new technology that greatly improves the efficiency of power generators using waste gas from metal processing.
- The design team ran into difficulties reducing the size of the generating unit and avoiding interference with ongoing plant operations.
- With the help of Bentley applications, MCC CERI created a digital model of the generating unit and the plant.

ROI
- Digital models helped eliminate clashes and improve the generating unit's design, which makes the generator 60% more efficient than similar ones.
- MCC CERI's client is now saving CNY 230 million in energy costs and the more effective production process has lowered the cost of production by CNY 70 per ton.
- Capturing and reusing the gas to generate power reduces blast furnace emissions by 1.4 billion normal cubic meters.

"Bentley software has become an indispensable tool for us in engineering digitalization. The company has been continuously exploring and developing new technologies, which will help us achieve engineering intelligence in the near future."

– Yang Bingsong, BIM Manager, MCC Capital Engineering & Research Incorporation Ltd.

CREATING A DIGITAL REPLICA TO AVOID CLASHES

MCC CERI soon determined they could make their innovative new generation system a reality by going digital with Bentley applications. First, they established a collaborative digital environment with ProjectWise to allow teams in the disparate disciplines and locations to seamlessly work together, which greatly reduced errors, omissions, and clashes. Next, they used drones to capture images of the worksite area and the factory to create a reality mesh of the existing environment, which was then imported into Bentley applications, helping MCC CERI design and place components. Since all Bentley software that they selected is open source, the design teams could develop efficient design tools that closely aligned with their existing work habits, boosting efficiency. For example, creating custom tools for pipeline design roughly tripled their work efficiency.

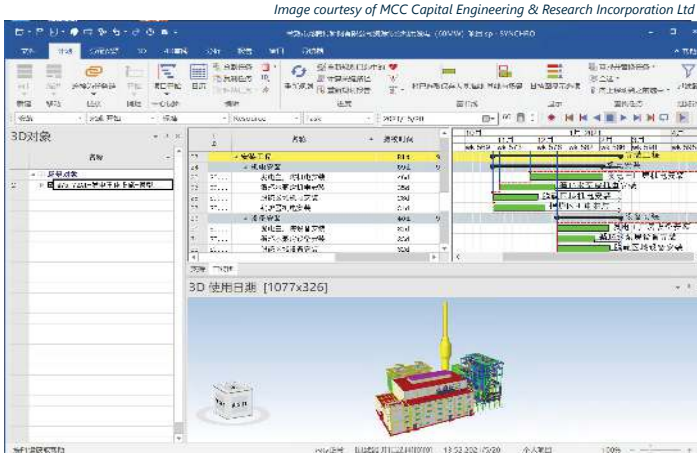
Once they finished designing individual components, they created a federated model of the entire power generation unit, optimized the design, and determined how to control the power system load flow and prevent reverse transmission of electricity. They then used AssetWise to establish an engineering data center that contained detailed information for the full lifecycle of the unit. Not only would that data center assist with construction, it is now also used for operations and maintenance. "AssetWise has become the basis for the establishment of a digital factory," said Bingsong. Lastly, they used SYNCHRO to create a 4D simulation and carefully plan construction around ongoing factory operations. They determined how to transport construction materials into the site, integrate new and old assets, and safely connect the gas emission pipeline from the blast furnace workshop.

REALIZING STRONG ENVIRONMENTAL BENEFITS

Digitalizing the entire design process helped MCC CERI reduce clashes and errors, making the final design more efficient. MCC CERI used the new technology to build the world's first 60-megawatt subcritical blast furnace gas power generator, which is a breakthrough in power generation miniaturization. As expected, the power generation efficiency of the unit is 60% higher than traditional medium-pressure power generation units, producing 0.45 billion kilowatt hours, enough power for 1 million people, and saving the plant CNY 230 million in electricity costs per year. In addition the efficient design enables them to produce steel more effectively, lowering the cost of production by CNY 70 per ton.

The new technology also produces significant environmental benefits. Capturing and reusing gas released from steel manufacturing to generate power reduces the emissions of the blast furnace by 1.4 billion normal cubic meters annually. Additionally, using wet desulfurization with an efficiency rate as high as 98%, along with an integrated chimney and cooling tower, significantly lowers emissions of sulfur dioxide, nitrogen oxides, dust, and other materials. Handling power needs within the plant itself has greatly reduced the load of the local power grid, which will help the region meet carbon neutrality goals, according to MCC CERI.

Image courtesy of MCC Capital Engineering & Research Incorporation Ltd



Digital models helped eliminate clashes and improve the design of the generating unit, which makes the generator 60% more efficient than similar ones.

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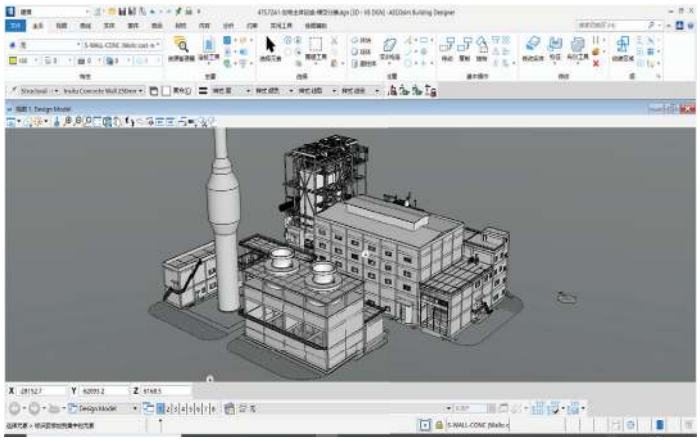

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