

IEC 61850: A NEW LEVEL OF CONTROL

Implementing IEC 61850 at the cutting-edge Oklahoma Wind Project

Andy Clary, a Power Delivery project manager in POWER's Clarkston, WA office, got the phone call from long-time associate, who had recently taken a job as one of Apex Wind Energy's top engineers.

"I've got a problem," Clary heard on the phone.

Apex was well into construction at a 300 MW complex near Oklahoma City that would be the state's largest wind farm. However, they were confronting a series of daunting challenges.

For one thing, the wind farm was split into five smaller components, and each component had to be managed separately to meet regulatory requirements and other obligations related to grid stability and interconnection. For another, the 135 turbines were manufactured by two different companies, and one set of turbines was configured for advanced control functions, while the other was not.

At the same time, Apex needed a single cost-effective control system to manage the entire wind farm. Yet the control equipment used at most wind farms isn't designed to talk to five different groups of turbines, and Apex's existing engineering consultant was struggling to come up with a solution.

"Do you think you can help me out?" The client asked. That can be a tricky question, laden with many unknowns, but from a trusted client it can also be promising. "Absolutely," Clary responded.

At the time, Clary had no idea the project would offer POWER the chance to implement its most advanced wind farm control system to date. The key to it all was one of the first implementations in North America of IEC 61400, a wind farm-specific application of an emerging international standard known as IEC 61850, which is considered to be the vanguard of substation protection and control.

Sizing up the challenge

It was clear from the outset that POWER's team, led by Clary and project engineer Chris Canine, both from the Clarkston, WA office, could build on some of the cutting-edge work they had done recently for other wind farms, achieving pinpoint voltage control using a small "blue box" known as a Real Time Automation Controller (RTAC).



PHOTO: KEN DONATHAN & TERRY MAIER

Wire prep. Making a connection to the junction box.

The difference this time is that the controls had to be applied at each of the five wind farm components simultaneously, with more complex overall control needed.

They also had to deal with the requirements of the two different types of turbines. The 62 turbines manufactured by Mitsubishi would only work with a basic control system, the kind currently used at most other wind farms. The 73 turbines produced by REpower, a leading European manufacturer, were designed for more sophisticated control. At a minimum, there would need to be two self-sufficient systems, somehow linked together.

After initial conversations with the manufacturers, POWER's team concluded they would need to use IEC 61400 for the REpower turbines. It would allow them to communicate directly between those turbines and their "blue box," manufactured by Schweitzer Engineering Laboratories (SEL). On the Mitsubishi side, POWER would have to use a basic turbine control system with limited capabilities, but it would also be linked to the RTAC.

REpower had never used IEC 61400 in North America, and they also had never worked with SEL before. Additionally, European manufacturers have been interpreting the new IEC 61400 standard differently from American manufacturers, so that meant the team would have to establish communication between the RTAC and the REpower turbines with no history to draw on.

For Clary, Canine and the rest of POWER's team, getting the REpower and SEL equipment talking turned out to be more challenging than expected.



PHOTO: KEN DONATHAN & TERRY MAIER

IEC 61850 (and the 61400 wind farm application) uses Ethernet connectivity and object-oriented data models that, in theory, should allow one machine to talk to another with an almost "plug-and-play" functionality.

The vision behind IEC 61850 is to produce standardized, easy-to-manipulate data that tracks everything from voltage levels to equipment performance to faults (down to the level of 4 milliseconds). It enables connections between devices that were previously isolated, and it also allows for more continuous monitoring and error checking.

Some foresee a day when an engineer might walk into a substation and pull up all that data with a few finger swipes on an iPad. Then, with the right software and analysis, the data could provide a valuable picture of overall substation operations, including the state of a breaker or the details of what happened just before a fault.

The problem was that the standard was still new, and manufacturers interpret it differently. So, getting the REpower turbines and the RTAC to communicate directly ended up causing countless headaches and delays for the POWER team.

"We were the first in the U.S. market to do this," says Clary. "And anytime you're the first, there are bound to be problems."

The payoff

Shortly after POWER was hired, Apex Wind Energy began a sale of the wind farm to a Boston developer. Apex would remain as the operations and construction manager, but the change in ownership ultimately meant that POWER would be working for a new client.

POWER quickly gained the new owner's trust. The company signed up for POWER's Integration 24-7 on-call service and hired POWER to implement similar IEC 61400-based systems at other wind farms. They also provided a referral to another wind energy company, which hired POWER to design a similar system for a wind farm in Michigan.

For these new projects, the POWER team shortened its development time and is able to rapidly deploy systems.

"Even though there was a steep learning curve and all these hurdles, it's paying off immediately and will pay off for years to come," says Canine. "The struggles we worked through have not only benefited us, but also the many other clients we work with. The work we did is not only helping carry forward our own work, but a small section of the industry as well."

*This is an excerpt of an article originally written for **POWER Surges**, a magazine for the employees of POWER Engineers.*