

S&C Builds Ameren a Microgrid To Study Distribution Use Cases

S&C Featured Solution: EPC

Location: Champaign, Illinois

Customer Challenge

Ameren Illinois, a regulated electricity-delivery company whose parent Ameren Corporation serves 2.4 million electricity customers, was interested in building a microgrid with two nested microgrids at its Technology Applications Center near the University of Illinois campus to support the center and a 1-MW

“S&C was instrumental in helping Ameren pave the way for the industry in microgrid research, use cases, and understanding how to apply microgrids on the distribution level.”

—Richard J. Mark, Chairman and President, Ameren Illinois

Figure 1: A look at the various components of Ameren’s microgrid.



residential load. The project would help the utility learn more about the operations, control, and integration of distributed energy resources on its distribution system.

Ameren wanted to build a microgrid to test 16 use cases where it saw a potential to create a return on investment. This return could include improving grid resiliency and reliability; more easily incorporating renewable energy; and enabling the utility to go off-grid to supply power, which would be beneficial if a major storm knocks out overhead lines supplying electricity from the main source of power generation. Importantly, Ameren wanted the ability to “black start” the microgrid and be able to return to the grid from island mode without an outage occurring.

The traditional power-distribution approach is to send electricity hundreds of miles across its distribution system from centralized generation sources. Ameren recognized the need for examining a microgrid where local distributed energy resources are becoming new generation sources. These resources include primarily energy storage and natural gas, along with such renewable energy sources as wind and solar.

Ameren’s challenge was that it wanted a testing facility that simulated a real-world environment that used the same switchgear, sensing, and protections systems to accommodate both grid-connected and islanded power sources. This would be especially complicated because the main grid has a fault-current potential of thousands of amperes, while the faults within an islanded microgrid could be in the tens of amperes.

S&C enabled Ameren to run multiple renewable energy sources uncurtailed in a 12-kV islandable microgrid.



Adapting to the challenge of different power systems was an important factor in Ameren meeting its goals, and it had to have a partner that could take the project from concept to full construction in less than six months.

S&C Solution

S&C has supplied Ameren with grid protection and switching equipment for years. The utility was familiar with S&C's reputation and experience in establishing effective and sophisticated microgrids. Ameren ultimately chose S&C as the project's sole engineering, procurement, and construction contractor.

The project involved creating a nested 50-kW microgrid within a 1-MW microgrid, all interconnected at 12 kV. S&C would oversee the construction of both a 100-kW wind turbine and a 125-kW solar array for Ameren, and it would provide the utility with two 500-kW natural gas generators as additional alternative energy sources. Most importantly, S&C would provide a 250-kW/500-kWh energy-storage capability that would serve as the backbone of the 50-kW microgrid, enabling it to operate on 100% renewable generation.

Working with Ameren, S&C developed adaptive protection and control software to help transition the multiple generation sources into and out of "microgrid mode" without creating an outage. Separately, following a utility outage, S&C developed a means to "black start" the microgrid without the need for a reference voltage from the utility source.

To accomplish this, S&C deployed a PureWave® SMS-250 Storage Management System, which provides battery energy storage for the smaller of the two microgrids. The PureWave SMS-250 allows Ameren to fully integrate renewable energy sources, such as wind and solar. The wind and solar generation can run uncurtailed in the microgrid and can even exceed the load because the PureWave SMS-250 can be put into charging mode while still providing the microgrid reference frequency and voltage.

S&C supplied Remote Supervisory Vista® Underground Distribution Switchgear to integrate the various systems. It also provided SpeedNet™ Radios to support device communication. To provide the "glue" to make the various sources of generation work smoothly both on the main grid and within the islanded microgrid, S&C deployed IPERC's GridMaster® Microgrid Control System. Nine IPERC cybersecure, adaptive, and distributed Intelligent Power Controllers were installed on the system to provide control functionality of the microgrid.

Results

With a microgrid operating at a utility-scale voltage of 12 kV—with multiple levels of control—Ameren is now well on its way to researching microgrids and how to use them to supply power at the distribution level for future endeavors. This also was a "first-of-its-kind" engineering effort; no company had previously developed a way to conduct a seamless return to utility power after entering microgrid mode at utility-scale voltages.

S&C met its tight timeline to get the system online, and it worked with a dedicated Ameren engineering team to successfully apply the microgrid to all of the use cases Ameren wanted the microgrid to accommodate. S&C also demonstrated that Ameren could use 100% renewable energy resources such as wind or solar in conjunction with energy storage to power a microgrid. Moreover, S&C essentially took on four typically separate projects that would focus solely on generation through a generator, a battery, solar, or wind, and it created and tied each of the four generation sources together to provide power into the microgrid.

Despite having to manage 10 to 15 different contractors—with up to five being onsite at one time—and working 10-hour days, seven days a week, no injuries occurred during the project. S&C also provided a two-day training session with the customer and every contractor on the project to help transfer knowledge about the microgrid's operation and potential uses.

The Ameren microgrid became the first utility-scale microgrid to earn a Gold PEER (Performance Excellence in Electricity Renewal) certification. The certification recognizes systems that implement industry best practices and encourages the adoption of innovation strategies that improve efficiency, day-to-day reliability, and overall resiliency.



Figure 2. The Remote Supervisory Vista Underground Distribution Switchgear connects the various systems.