Siemens helps Earl Energy bring distributed power generation to U.S. Army in Afghanistan

Flexible, high-performance SINAMICS S120 Drive System integrates with energy dense lithium ion batteries to improve fuel efficiency by up to 75 percent

With global headquarters in Virginia, Earl Energy designs and manufactures rugged and reliable, high efficiency distributed power generation systems for off-grid government, military and industrial applications worldwide. Examples include armed forces outposts, oil and gas drilling sites and remote industrial operations.

"Our systems are essentially mobile ‘micro-grids’ that are applicable anywhere. Reliable electrical power is mission-critical but hard to deliver because the grid is difficult to access, unreliable or non-existent," said Doug Moorehead, Earl Energy’s president. "Our typical customer relies on diesel or gas generators for power, but fuel and maintenance logistics are challenging and expensive."

Challenge: Clean, remote power economically.
Moorehead explained that his company has won contracts with the U.S. Army and U.S. Navy to provide distributed power generation systems for running the lights, HVAC, communications and other electrical gear on forward operating bases in remote reaches of Afghanistan. As a U.S. Naval Academy graduate and former Navy Special Warfare officer deployed in Iraq, he has first-hand experience.

"They have several problems with power out there," Moorehead explained. "One is that the full costs of getting diesel fuel to those outposts for their generators average $7-40 per gallon. Another is that the generators operate at full throttle but their load is only 10-20 percent, so most of the fuel is wasted. Finally, the power is only as clean as what the generator delivers, so its quality can vary depending on the generator’s motor operation."

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Solution: Dynamic, high-efficiency power storage

After his military service, Moorehead worked for one of the industry leaders in lithium ion battery technology and energy storage systems. With that experience he joined Earl Energy in 2010 to design, manufacture and sell FlexGen™ Power Systems.

"Siemens focused support of battery machine builders was perfectly aligned with our company's needs. Their experience in the battery industry, global support, and robust technologies made them a natural partner for our rapidly growing business. They understand the complexities of the battery industry and helped make our solutions more competitive."

A FlexGen system dynamically manages generators, renewables, and a proprietary lithium ion storage system. Its line of distributed power generation systems features 15 models ranging from 3 kW to 240 kW in capacity. Each easily integrates—often with just "plug-and-play" simplicity—with both fossil fuel generators and renewable power sources.

"FlexGen's concept is straightforward," describes Moorehead. "You run your generator at full capacity to charge its high-capacity storage batteries, shut it off when your storage is fully charged, then draw down the stored power until the batteries need recharging."

For FlexGen's drive components Earl Energy turned to Siemens, which has extensive experience in distributed power generation. At its architectural core is a Siemens SINAMICS S120 based distributed generation (DG) inverter system that provides a bi-directional power conversion between the generator's AC output and the batteries' DC storage requirements. The inverter is able to use multiple sources connected to its DC-bus input and convert the energy into a clean AC Microgrid source, or change the batteries using the generator power.

"We chose the Siemens SINAMICS S120 solution for two reasons," Moorehead said. "One was the modularity of its components, which gave us a lot of flexibility in designing our various models. The other was its capability to manipulate the power transfer via an industry standard DC bus. This means we can easily use commercial, off-the-shelf components for the rest of the FlexGen system."

The latter was especially important because Earl Energy avoided the time and complexity of engineered-to-order power solutions. In addition, standardized components helped future-proof its FlexGen systems. More and more, customers avoid specialty designs that can become obsolete in just a few years.
Most impressive, he added, was the amount of engineering support Siemens offered. “Our company is relatively small, but Siemens engineering team treated us as if we were their most important customer.”

The SINAMICS S120 bi-directional AC/DC inverter in Earl Energy’s FlexGen systems also enable them to provide three functions that are especially critical to mini-grid applications:

- **Automatic Grid Re-synchronization** - It dynamically synchronizes power output frequency, voltage and phase with another incoming AC source while in island mode for automatic grid reclosing. Competitive solutions require separate components.

- **Blackstarts** - Most inverters need to sense a grid before providing power but the SINAMICS S120 active infeed inverter doesn’t. It can ramp voltage almost instantly and establish AC power within a Microgrid when storage energy is available, without the need of a running generator.

- **Dynamic Grid and Droop control** - Generators are prone to voltage swings due to variations in fuel and loads, causing lights to flicker and endangering sensitive electronic devices. Droop can also occur when another generator comes online. The SINAMICS S120 inverter is constantly sensing operating parameters of the grid and stabilizes its voltage and frequency. Additionally, it adapts automatically to allow seamless connection or disconnection of other generators attached to the grid. Its easily programmable, intelligent firmware keeps power in the grid clean and synchronized.

**Results: Better utilization, clean power and a 12-month ROI**

Moorehead said the FlexGen units are saving military customers nearly 70 percent of their previous diesel consumption. “With our optional FlexGen Solar Kit, those savings can exceed 75 percent,” he said. “Generally fuel savings alone provide an ROI in less than a year.”

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In addition to maximizing power output while reducing fuel consumption, FlexGen systems also reduce generator maintenance requirements (and costs) as well as noise, vibration, and hazardous emissions. These benefits help make already hostile environments like those in remote Afghanistan outposts a lot more hospitable.
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