Solar

Customer case study

Getting the most out of a solar system through a control and monitoring system

Highlights

- When installing a rooftop photovoltaic system at its U.S. headquarters, the Phoenix Contact facilities team wanted to improve efficiency and plan for predictive maintenance
- The facilities team turned to Phoenix Contact's own engineering services department to design and build a control and monitoring system
- The system, built with Phoenix Contact components, provides real-time data about the system's operations and helps measure progress toward the company's long-term sustainability goals

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>
> **ABILASH APPANVEL**

Customer profile

Phoenix Contact USA is a subsidiary of Phoenix Contact GmbH, in Blomberg, Germany. About 750 employees work at the U.S. headquarters, located just outside of Harrisburg, Pennsylvania. The 475,000-square-foot facility is home to U.S. sales and administration offices, development and manufacturing, and the logistics center for the Americas.

Challenge: Getting data from a photovoltaic system

In 2021, Phoenix Contact installed a nearly 1-megawatt photovoltaic system on the roof of its logistics center. Large distributed energy resources (DER) like this require continuous monitoring and control at the segment level to achieve maximum efficiency. (Figure 1)

Figure 1: Phoenix Contact installed a nearly 1-megawatt photovoltaic system on the roof of its logistics center.

The PV system has numerous potential data points, such as inverter operational information, camera systems, string currents and voltage, meteorological data, PV module soiling, and temperature. The facilities management team desired to collect the data from the monitoring/control system to improve day-to-day operations and plan for predictive maintenance.

"We need to have a robust control/ monitoring system that can be used for several reasons," said Doug Ferguson, Senior Vice President of Americas Operations Services. "First, to have a quick and easy monitoring system to alert the facility team of potential issues impacting the system performance. Second, data collection and analysis to understand the impact of the weather (temperature, humidity, sun location) on the intensity of the energy output of the PV system and its impact on the overall campus energy profile. Finally, to have a location where our facility team

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can work together with our solutions engineering and solar vertical market management teams to collaborate on the development of array performance enhancing solutions and the integration of PV solar with building management systems."

Solution: In-house expertise

The Phoenix Contact facilities management team looked to its own engineering services department for help, based on the company's 20+ years of experience in the solar industry.

"During that time, our knowledge expanded from just parts and components to designing entire solutions with the customer requirements in mind," stated Abilash Appanvel, associate manager for engineering services. "We have a complete portfolio designed specifically for the solar industry, and this project is a showcase for those solutions."

Phoenix Contact's experience in the solar industry helped Abilash and the team understand facility management's needs regarding the building management system (BMS). The system includes several of Phoenix Contact's core product groups.

Controllers based on PLCnext Technology are the brains behind the system. With the associated I/O modules, the controller aggregates data and transmits it to a cloud service provider.

An industrial PC runs a SCADA software to collect data for history and run user-based reports. Phoenix Contact's Solarworx software libraries are designed specifically to manage data for the solar industry. Solarworx supports communication protocols and standards for the industry. Phoenix Contact offers standard and customer-specific solutions for the automation and visualization of photovoltaic systems, as well as innovative software products such as libraries for function blocks in accordance with IEC 61131. Various drivers for dataloggers and interfaces for inverters complete the overall package.

Numerous networking products ensure the reliability of the system. Radioline wireless modules communicate wirelessly with PV module temperature and soiling sensors via RS-485 without cables. Power over Ethernet (PoE) devices transmit data and power at the same time. Managed and unmanaged switches integrate and protect the network. FL mGuard security devices provide firewall security and user management.

The system monitors a wealth of data, including:

- **Automation and visualization:** The system collects all types of data available from all the inverters and the weather sensors. Camera systems monitor for any additional interference.

Figure 2: The Phoenix Contact facilities team has real-time access to the PV system's important data.

- **Inverters:** For each inverter, operational status, and faults, as well as array performance metrics such DC input power, AC output power, active and reactive power are monitored.
- **Current and voltage from individual strings:** There are six strings at each inverter and 12 inverters in total, connecting more than 2,600 panels. The system continuously monitors and evaluates the data for secure and highly reliable operation of the photovoltaic system.
- **Meteorological data:** Wind speed, wind direction, temperature, air temperature, relative humidity, air pressure, compass.
- **Solar irradiance:** Measured by two pyranometers, one horizontal and one at a 10-degree angle similar to the panels.
- **Soiling sensor:** High-quality instrument designed for measuring the light loss resulting from the soiling of the panels.
- **Panel temperature:** Multiple temperature sensors monitor this data.
- **Feed-in control for stable power grids:** Distributed photovoltaic systems also need to play their part in ensuring high grid stability. PGS controllers record the voltage and reactive power present at grid connection points and determine the corresponding control values for the inverters. A hardware- and software-based solution from Phoenix Contact ensures that the engineering effort involved is kept to a minimum. (Currently, this is not used due to restrictions within the local grid, but the information is available if needed and circumstances and standards change in the future.)

These solutions easily integrate into the monitoring and control system and provide easy access to operation data. The system not only aggregates the data, but makes it possible to perform analytics via third-party systems to provide valuable statistics and prognosis on the installed system. (Figure 2)

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Results: Accurate data management, visualization, and communication

With historical data and continuous monitoring, Phoenix Contact now has complete access to long-time duration inverter and PV module data. If PV module or other issues are noted in the future, it will be easy to compare data from past years to rapidly identify the problem. This is especially relevant in a large system.

Monitoring each string is essential to keep disturbance and maintenance low for uninterrupted feed-in power. Missing one inverter due to a fault could eventually mean losing thousands of kilowatt hours of power fed by Phoenix Contact into the grid.

Doug stated, "While our overall energy demand exceeds our current maximum solar output, when you combine this with our 1 MW of microturbine generation, there are times throughout the year when we can provide electricity back to the utility (net metering) and be compensated for this generation."

Figure 3: The solar installation will help Phoenix Contact meet its long-term corporate goal of becoming a carbon-neutral company.

Phoenix Contact has set a corporate goal to become carbon-neutral by 2030, and this data will help measure progress toward that goal. All of the data from the U.S. installation is shared with the headquarters in Germany. As subsidiaries in other countries implement solar and other green initiatives, they too can join the same platform. Phoenix Contact will be able to collect this data and measure the global impact of Phoenix Contact's progress toward that goal. (Figure 3)

"This project was unique since we are owner and solutions provider at the same time. We were able to experience both sides to help us better understand our own solution," Abilash stated.

Russ Kolacek, Building Automation Engineer at Phoenix Contact, explained, "There are a lot of environmental factors that can degrade the production of a PV system, such as dust, snow, and outside temperature. Having environmental data monitoring on our system allows us to offset the expected production to the real-world conditions day by day. Our system is running efficiently and generating the expected quantities of energy, enough so that when combined with our microturbine generators we are producing all our own power independent of the utility grid."

"We are excited to have realized this solar PV project, and Abi and Russ have been working diligently to bring the monitoring system online and enhance its capabilities. The system is working really well, but it will take us a full year of data collection to experience the full range of the seasons to gain a better understanding of overall system," Doug concluded.

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