Condition Monitoring and Control System Upgrade Give HPI the Power to Protect, Integrate and Communicate Seamlessly

Rockwell Automation Logix Control Platform and XM series modules ease configuration for turbine-control builder

Solutions
Rockwell Automation Logix Control Platform

Multidisciplined control capabilities help streamline machine operation

- Allen-Bradley ControlLogix Programmable Automation Controller (PAC)
- ControlNet and EtherNet/IP networks
- FactoryTalk View HMI software

XM series modules

Condition monitoring and vibration system provides reliability and eases configuration

- XM-120 dynamic measurement module for vibration protection
- XM-220 dual-speed module for overspeed protection

Results
Standardized digital control system

- Tightly coordinated activities and improved information sharing
- Easily configurable system reduced engineering time

Improved reliability

- End user has not experienced start failure since control upgrade

Enhanced monitoring and diagnostics information

- Information-enabled control system allows end user to operate machines remotely

Background

This year, the United States will consume about 3.3 terawatts – slightly more than 20 percent of the power used worldwide, according to the International Energy Agency (IEA). Global power usage is on the rise and could double by 2050, according to IEA projections, because of global population growth and improved living standards in developing countries. As electricity use continues to rise and power grids are pushed to the limit, utility companies are seeking out additional means of electrical production to ensure they can adequately meet demand.

For a large Southern utility that generates electricity for about 600,000 retail and wholesale customers, a review of previously applied techniques is helping improve electrical generation now and for years to come.

The utility dusted off a fleet of unused combustion gas turbine engines and wanted to modernize them for generating backup electricity during peak energy-consumption periods. Tasked with replacing the aging control systems on the engines was HPI LLC, a project developer specializing in providing retrofit controls for gas and steam turbine power generation, compressors and mechanical drive systems. HPI, headquartered in Houston, Texas, opened its doors in 2002 and since then has completed more than 70 different gas turbine models for more
A ControlLogix controller and XM modules offer reliability and enhanced turbine control.

than 20 manufacturers. The company designs, assembles, tests and packages replacement systems using high speed, state of the art, off-the-shelf programmable controllers.

Challenge

When the customer decided to update four General Electric MS5001 (Frame 5) turbo-generator packages, it wanted the engines online as quickly as possible. The main obstacle was the obsolete control system in the engines.

In addition to outdated controller technology and aging wiring, the existing control system was in dire need of updated condition monitoring and vibration protection. The controller for a gas turbine engine assures that the turbine runs safely and efficiently. Failure of either the controller or the protection system on a gas turbine is a costly and dangerous proposition. The utility's existing vibration protection system was comprised of a combination of the General Electric Speedtronic system, and a Bently Nevada 3300 vibration and monitoring system. To reduce costs, the customer wanted to retain the existing General Electric vibration probes, but because the Bently vibration and monitoring system would not interface directly with the existing probes, it was necessary for HPI to explore other solutions.

In addition to the condition monitoring and vibration system, HPI needed to update another critical protective circuit – the overspeed protection system. In retrofit situations, HPI's customers typically have an overspeed protection system that is either obsolete or hydraulic, which makes the system difficult to test and maintain. This was the case for the Southern utility project, and HPI needed a reliable and easy-to-service replacement system.

“If the overspeed protection was to fail, the entire unit would most likely be destroyed,” said Wheelwright. “For a customer like this, that would mean millions of dollars to purchase a new unit and months, if not a full year, to be up and running again.”

Solutions

HPI supplied a standardized digital control system solution for the utility that offered improved reliability, enhanced turbine control and diagnostics information, and remote start capabilities.

The success of the new system revolves around the use of complementary control, networking and visualization technologies – core to the Rockwell Automation Integrated Architecture®. Designed to facilitate seamless enterprise integration, the Integrated Architecture production control and information system consists of the Logix Control Platform and the FactoryTalk® integrated production and performance suite.

Leveraging the Allen-Bradley® ControlLogix® Programmable Automation Controller (PAC), ControlNet and EtherNet/IP networks, and FactoryTalk® View SE human-machine interface (HMI) software, the customer has a cohesive turbine control system. This translates to tightly coordinated activities and improved information sharing.

HPI chose ControlLogix due to its ability to integrate the full range of automation disciplines including discrete, motion, process control, batch, drive systems and safety using a single-development environment and a single, open communication protocol.

“We used to buy separate controllers and wire them together, but the Rockwell Automation Logix controller allows us to provide turnkey solutions that go beyond just the gas turbine control,” said Jerry Wheelwright, vice president of Engineering, HPI.

Another important benefit of the replacement for the customer came with the networking scheme and visualization solution. HPI networked Allen-Bradley FLEX™ I/O modules with copper and fiber optic ControlNet and EtherNet/IP network communications using 1756-ENTB modules and 1756-CNB modules. Using this networking scheme, they built a remote, panel-mounted PAC that includes digital, analog and temperature-monitoring FLEX I/O modules. To reduce the amount of required on-site wiring, all the terminals, fuses, relays and conduits were preinstalled in subpanels.

Using both ControlNet and EtherNet/IP networks, the customer took advantage of ControlLogix native communications over an industry-standard networking topology. EtherNet/IP extends commercial, off-the-shelf Ethernet with an open, industrial protocol for automation purposes – the same protocol used in the ControlNet network.

The information-enabled control system allows the customer to operate the system, which is driven by a ControlLogix controller from a site five miles away from the physical turbine.

“The ability to monitor and control the turbines at any time of the day from a remote location is a significant benefit to this customer,” Wheelwright said. “The utility can have gas turbines spread around the state and run the controls through larger steam turbine plants that are manned 24 hours a day, eliminating the need for them to staff each individual site.”

Because HPI used the Logix Control Platform to standardize the control panels, incorporating the XM™ series modules from Rockwell Automation for condition monitoring was a natural fit. HPI used the XM-120 dynamic measurement module for vibration protection. The XM-120 module is an intelligent, two-channel, general purpose monitor that allowed the customer to use their existing vibration probes.
HPI used two modules on each of the four turbines. The module supports monitoring of shaft, casing or pedestal vibration in rotating equipment, such as turbines, where real-time condition monitoring or protection is required. The XM-120 module interfaces with the equipment via ControlNet to DeviceNet interface modules.

Replacement of the overspeed protection system was also simplified using the Logix Control Platform. HPI replaced the obsolete overspeed protection system with the XM-220 dual-speed module. The XM-220 module is an intelligent, two-channel measurement module that accepts input from two tachometers. The module measures speed, rotor acceleration, and peak speed, and is capable of detecting zero speed, locked rotor and reverse rotation.

As the industry’s first machine-monitoring and protection system that successfully links maintenance tools into the control architecture, the XM-220 module can be deployed on an open standard industrial bus, allowing continuous, cost-efficient monitoring and protection of critical assets.

Results

HPI’s replacement control system provided the customer with consistent, repeatable and reliable performance. The utility’s turbines have not experienced a start failure since the control upgrade. HPI was so pleased with the flexibility of the XM series, the ease of configuration and the ability to see that the protective circuits are working, the company decided to standardize on the equipment for future upgrades.

“We chose the XM series for two reasons,” said Wheelwright. “One was availability. It was on the shelf when we needed it. The second reason was its ability to interface with other probes and the rest of the system.”

Because of the simplicity of the Logix Control Platform, HPI can build modular subpanels or build an entirely new cabinet that meets the specific space requirements of a plant.

HPI offers 24-hour service and technical assistance. By using the ControlLogix platform and Allen-Bradley products, its customers can get the hardware they need at any Rockwell Automation distributor location around the globe. Customers can then install the hardware themselves. From its headquarters in Houston, HPI will e-mail the software patches, do work on the control systems, and make sure the I/O model is integrated.

“Using Rockwell Automation saves time and money because we can provide top-notch service without sending our field reps all over the world,” said Wheelwright. “We trust it and our customers ask for it.”

The results mentioned above are specific to HPI’s use of Rockwell Automation products and services in conjunction with other products. Specific results may vary for other customers.