Aging LM6000 control systems installed in the 1990s through the mid-2000s are beginning to negatively impact plant operations and reliability. Many of these vintage systems (such as Woodward Netcon 5000 and GE Speedtronic Mark V and Mark VI Millennium) contain components that are no longer supported and cannot be updated because of technology limitations, prompting plant owners and operators to investigate replacement options.

Emerson recently replaced Woodward Netcon 5000 controls and Wonderware HMIs on four LM6000 turbines with its fully engineered Ovation™ distributed control system. Moving from propriety controls to Emerson’s open-architecture solution, designed specifically to meet the mission-critical requirements of the power generation industry, offers numerous benefits—including the capability to easily modify logic without a service call and the ability to take advantage of the latest technologies. These technologies include integrated digital bus, smart instrumentation, wireless, diagnostic and predictive maintenance capabilities, and security features that help address NERC CIP requirements.

Use of a single DCS platform throughout the plant, or even across an entire fleet of generating assets, including renewables, offers significant advantages in the areas of maintenance, training, and parts and services. Even more importantly, Emerson offers an ongoing forward migration path to ensure users are well-positioned to incorporate the next generation of technological advancements as they become available.

Ovation now performs all of the fuel governor and sequencing logic for the LM6000. The fuel governor regulates the amount of fuel entering the gas turbine’s combustion system by modulating the fuel-gas control valve. The amount of fuel admitted is determined from the governor regulating loops N25, NSD, T48, T3, PS3, Accel/Decel, Min/Max Fuel, which are updated at 10, 20, 40 and 100 msec depending on the loop update specification.

A suite of gas-turbine algorithms was specifically developed to meet LM6000 function and performance requirements. As part of the controls upgrade, several features were added—including automatic NOx control, automatic venting of fuel-gas supply pressure upstream of the gas control valves, and replacement of the thrust-balance valves with additional logic.

Emerson executed all aspects of the LM6000 project—from engineering and software configuration, including electrical and connection drawings, to checkout and commissioning. To save time and money, Emerson placed mounting panels into existing Netcon cabinet shells. It also provided field-service supervision for the electrical installation.

One of the unique challenges of the project pertained to a lack of any documentation on how the LM6000 units run. Emerson spent significant man-weeks to create detailed documentation of every aspect of the LM6000 system, including sequencing, fuel-governor parameter settings, and all turbine auxiliaries.

Emerson also designed a steady-state and dynamic simulator representing all four LM6000 units as well as balance-of-plant processes. The simulator, based on virtual-controller technology, resides on a dedicated workstation. The simulator was used to test and verify every sequencing step, alarm, and trip condition, and every dynamic condition—including startup, speed, acceleration, deceleration, temperature, loading, unloading, droop, and isochronous modes. Every gas-turbine system—such as the hydraulic oil system—also was tested on an individual system basis to verify its correct response to all conditions and events.

The simulator, along with the detailed documentation, was used extensively during the factory acceptance test (FAT). This rigorous testing greatly streamlined check-out and commissioning.

Part of a comprehensive controls modernization initiative, the project was completed within an accelerated timeframe—just six months from contract award to startup, three months less than what is typical for a project of this size and scope. The first two units were back in operation at the end of November 2013, with the two remaining turbines coming online in January 2014. The units are running well and data are being collected to quantify operational improvements.

In addition to retrofitting the LM6000 controls, Emerson also replaced existing Rockwell Allen-Bradley PLC5/SLC controls with Ovation technology. BOP processes now controlled by Ovation include gas compressor, raw water supply, demineralized water, auxiliary cooling towers, plant air supply, and inlet air chillers. For the last phase of the project Emerson will replace the existing Cimplicity HMIs with Ovation to interface with the Mark V controls on four GE Frame 6Bs.

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