Dresser-Rand INTRODUCES Advanced Digital Governor System

THE INTRODUCTION of an advanced digital governor system for safety critical emergency standby turbines used at nuclear power facilities worldwide has created new opportunities for Dresser-Rand's aftermarket parts and services business segment. Replacing the obsolete hydraulic controls with the latest digital technology and actuation system can help prevent serious crises at these power facilities. Dresser-Rand has aligned with Engine Systems, Incorporated (ESI), of Rocky Mount, North Carolina in the development of this state-of-art technology.

For years, nuclear power plants worldwide have relied on steam turbines to provide power as pump drivers for emergency feedwater systems. While the first Terry™ solid-wheel steam turbine was installed in 1943, a majority of the current Terry turbines went online in the 1970s. During the past 30 years, technological advances have improved the performance and reliability of these systems.

At present, more than 440 nuclear reactors worldwide generate nearly 400,000 MW of electricity. As a safety critical component in plant operation, the emergency feedwater system remains on constant standby in the event of an emergent need for reactor cooling water. Feedwater systems, such as the auxiliary feedwater system in pressurized water reactors and reactor core isolation cooling (RCIC) and high-pressure coolant injection (HPCI) in boiled water reactors (BWR), provide additional makeup water to a plant's reactor following reactor shut down. Consequently, the reliability of the steam turbine that drives a plant's backup cooling supply cannot be overemphasized.

Original Terry turbines installed at nuclear power facilities were equipped with controllers supplied by Woodward Governor Company that incorporated an electronic governor module (EGM), electronic governor regulator (EGR), and remote servo-drive. These components worked in conjunction with the turbine's mechanical linkage and governor valve to control the unit's speed. This current governor system relies on turbine hydraulic pressure to activate, and provides speed control only after the turbine is spinning and supplying oil to the actuator. The result is a turbine that can experience an over speed condition before the governor can achieve adequate speed control. Additionally, the original hydro-mechanical turbine control systems have become outdated, and in most cases spare parts are no longer in production and unavailable for servicing these turbines.

Recognizing the need to address these critical dependencies, Dresser-Rand recently introduced the latest advancement in turbine speed control technology for the nuclear power market. Dresser-Rand's digital governor control system combines the proven capabilities of digital controllers with the rugged design of electro-mechanical actuators to address the critical concerns surrounding the existing hydraulic speed control system.

"The governor systems on these units have become antiquated," says Bob Shepard, a project development manager at Dresser-Rand. "With the older hydro-mechanical systems, the turbine has to actually be running for the governor to operate. The system relies on oil supplied by the turbine to the actuator. In essence, the operator may not actually be able to control the system in the event of a failure."

To address this critical need, Dresser-Rand has entered into an agreement with ESI to combine the experience of the steam turbine OEM with the expertise of an OEM-authorized control systems company. ESI serves as Woodward Governor's only authorized supplier to the nuclear market.

The new Dresser-Rand digital governor system is a state-of-the-art technology that eliminates the issues associated with hydraulic control, as well as component obsolescence. The updated system offers a nuclear-qualified Woodward 505 digital controller supplied by ESI; an electro-mechanical, direct-coupled actuator; a servo amplifier; and speed probes.

"The benefits of the new digital system are significant," Shepard adds. "Elimination of the hydraulic system allows for immediate governor control of the turbine. Consequently, the potential of a speed overshoot shutdown event is

significantly mitigated. System response time is improved from seconds to milliseconds."

With the Dresser-Rand digital governor, turbine speed is monitored by a magnetic speed pick-up that provides a signal to the 505 digital controller. The controller provides a 4-20mA-demand signal to the servo-amplifier that controls the electro-mechanical actuator. The actuator is mounted directly on the governor valve stem and includes a built-in internal resolver that provides positional feedback.

Dresser-Rand's new digital solution eliminates the current EGM, EGR, the remote servo and hydraulic subsystem, the mechanical linkage between the servo and valve stem, the ramp generator speed converter (RGSC), and the voltage dropping resistors. It offers programmability via laptop computer; power supply compatibility at 125 or 250 VDC; power consumption of 1 AMP or less, and can be operated in both mild and harsh conditions.

In addition to the reliability advantages, the new governor eliminates much of the need for calibration and maintenance, according to Shepard. "With no hydraulic system to maintain, operators no longer need to check hydraulic tubing for leaks, align or repair mechanical linkages to the valve stem, or replace faulty dropping resistors."

System maintenance is limited to routine replacement of the electrolytic capacitors used in the Woodward 505 controller every five to seven years, and the replacement of the actuator every 10 years. These standard service requirements are easily accomplished through the use of a rotatable component pool. It is recommended that the Woodward 505 be returned to ESI for authorized replacement of the electrolytic capacitors.

PROVEN, RELIABLE TECHNOLOGY

The digital governor system is based on field-proven technology and components. The Woodward 505 digital controller has been used on both steam and gas turbine applications since 1998, with an installed base exceeding 4,000 units worldwide. The system's electro-mechanical actuator is based on an inverted roller screw design that has been employed successfully in more than 500 commercial and military applications. Similarly, the servo-amplifier matched to the actuator also has been used successfully in both commercial and military applications.

The Dresser-Rand digital governor system underwent comprehensive performance testing at the company's Wellsville, New York facility. Using a spare nuclear turbine, the system was tested uncoupled to a pump, with a steam pressure of 900 pounds at a temperature of 550 degrees Fahrenheit (steam energy rating of approximately 1,200 pounds). The unit was operated with ramp rates of 30 and 15 seconds in both open valve and closed valve configurations. Additional operational testing included steady-state testing, load-transient testing, component variation, as well as system limitation testing with ramp-rate variations.

The digital control system also has been completely tested for seismic and environmental conditions. Testing was performed seismically per IEEE 344, environmentally to IEEE 323, and for EMI/RFI to EPRI TR 102323 and Reg. Guide 1.180. Environmental testing included radiation exposure, cyclic aging, and temperature aging. Dresser-Rand also performed software verification and validation (V&V) on the digital components to EPRI TR 106439 and Reg. Guide 1.152.

"Installation of the new digital governor on existing Terry turbine units in a nuclear facility application is a relatively simple process," Shepard added. "We are able to connect a secondary control panel to the plant's existing turbine control box, or build and install a new, drop-in control box to replace the existing one."

Shepard estimates that there are approximately 200 to 250 Terry steam turbine units currently operating in nuclear power facilities worldwide, with two-thirds of those in use in the United States. "Replacing the obsolete hydraulic controls with the latest digital technology and actuation system just makes sense," Shepard noted. "With an emergency standby turbine, the unit has to work if a crisis ever arises. By aligning with ESI, we've formed an OEM team that knows these systems the best."■