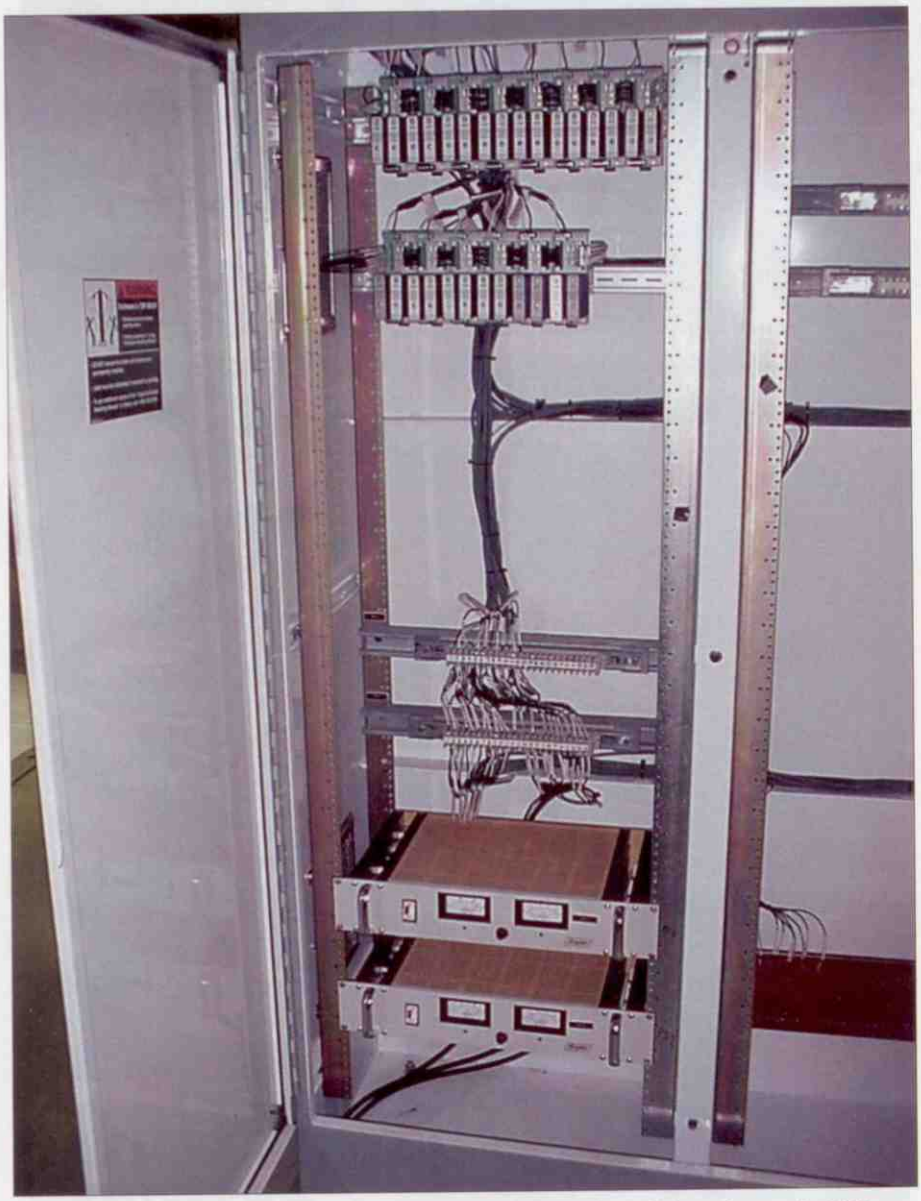
Feedwater heater systems updated to digital at STP

Replacing pneumatic controllers with digital controllers has improved plant performance, lowered costs, and enhanced worker safety.



Close-up of a digital valve controller on one of the heater drain globe valves at the STP nuclear plant (Photos: STP)

BY INSTALLING ADVANCED digital controllers to replace old pneumatic controllers on selected feedwater heater systems, the two-unit South Texas Project nuclear power plant has gained benefits in operations and economics. The new technology consists of digital level measurement devices (DLMD) and digital valve controllers (DVC) that work together in independent control loops to efficiently maintain feedwater tank levels, resulting in lower costs and greater energy output. These digital devices receive inputs from transmitters and then calculate whether to open or close tank valves.

The South Texas Project (STP) site in Wadsworth, Texas, is operated by STP Nuclear Operating Company. The site has two Westinghouse pressurized water reactors, each rated at 1250 MWe. Unit 1 started commercial operation in August 1988, and Unit 2 in June 1989.

The purpose of feedwater heater systems at nuclear power plants is to capture internal energy from spent steam and use that energy to help preheat condensate feedwater. Each feedwater heater tank has a specific water-level point at which it operates most efficiently.

Under the old pneumatic control at STP, feedwater heater levels fluctuated by as much as 30 percent, meaning that energy was lost. The fluctuations were the result of inaccuracy in pneumatic positioners. When coupled to local pneumatic controllers, these positioners could not be adjusted properly for optimum performance. This loss of efficiency also had a negative financial impact: For one of STP's reactor units, a 0.1 percent drop in efficiency due to poor heater level control translated into $280 000 in lost revenue per year at typical market rates.

In addition, because of the pneumatic equipment's poor control of water levels, STP was sometimes forced to divert flow to a high-level dump so that maintenance workers could go in and correct the problem. This meant powering the reactor down by 7 percent for five or six hours per occurrence, costing the plant in maintenance and operations time.

A globe-style reheater drain valve

Looking for ways to improve plant performance and reduce maintenance costs, STP's management approved a program to convert 56 pneumatic level gauges at both reactors to Rosemount 3051 DLMDs, with a review of the new equipment's performance planned for five years down the line. The conversion took place in 2000 and was the plant's first use of fieldbus digital instruments.

The next year, seven DVCs were installed. The purpose of each DVC is to receive inputs from a transmitter and calculate whether to slightly open or close the valve on which it is mounted in order to maintain the water level in the tank being monitored. Each control loop is isolated and totally independent of other systems in the plant, but each one can have a positive or negative impact on plant efficiency. STP modifications engineer Rajesh Mehta said that a key point is that the fieldbus approach eliminates the need for a separate controller in the loop. Instead, the DVC and the level sensor work together, utilizing what is typically called "control in the field."

The DVCs installed at STP are microprocessor-based digital-to-pneumatic valve-mounted instruments that rely on fieldbus communications protocol to obtain information from the DLMDs. Each DVC receives direct feedback on the valve travel position, along with data on supply and actuator pneumatic pressures. The instrument diagnoses itself, and it can also diagnose the valve and actuator on which it is mounted. This predictive maintenance information enables users to perform required maintenance on the instrument or valve only when necessary, according to Mehta.

The new digital loops have been operating flawlessly for more than four years, providing steady flows and optimizing tank levels. The digital system is also easy to demonstrate. A worker has only to walk out to one of the tanks equipped with a digital valve controller and look at the sight gauge. Instead of swings of up to 30 percent, the water level in the tank is where it is supposed to be, within ½ inch. The tighter control of levels means that feedwater temperature is maintained where it needs to be to optimize efficiency, and the 7 percent power derates that once happened at the plant are now ancient history.

Another plus is that the DVCs are mounted near the floor, making it easier for workers to access them than the old pneumatic controllers, which were installed high up near the tank in a hot environment. The DVCs are also easily tuned during planned outages by hooking up a laptop to a nearby junction box, where changes can be made to the instrument configuration. With the use of AMS ValveLink software, workers can run diagnostic tests and check the health of valves and instruments to identify issues that should be addressed during the planned maintenance period.

Maintenance costs have been driven down due to the fact that all the components in and around the heaters are lasting longer because of their stable operation. For example, the heater drain valves move less, and so they incur less wear. This means that the digital devices require less worker attention to stay up and operating, reducing the manpower needed for instrument maintenance. There is also a personnel safety factor in that it is no longer necessary to send workers into high-temperature areas of the plant in order to tune or replace pneumatic components.

Continued expansion of the digital capability is part of long-term planning at STP. More digital controls will be added as budgets permit. Mehta said that STP engineers also envision tying these independent loops together in a fieldbus informational network so that workers can monitor diagnostics on each loop from a central location. NN