APPLICATION NOTE

CONTINUOUS FEEDWATER AND CONDENSATE MONITORING HELPS ENSURE BOILER LONGEVITY AND TURBINE PERFORMANCE

Because condensate can become contaminated when steam cycle leaks occur, continuous monitoring of demineralized feedwater and condensate is crucial to providing timely detection of condenser leaks in power generating plants. Hach instrumentation is allowing a Pacific Northwest power plant to further optimize its feedwater and condensate monitoring and control programs, while providing a reliable baseline for total boiler water treatment performance.

Enhanced Measurement Sensitivity

High-tech analyzers from Hach have enhanced measurement sensitivity at the power generating plant to guard against flow - accelerated corrosion and sodium pitting.

Each unit of the dual-unit plant is served by its own boiler. Boiler feedwater consists of the makeup water plus condensed steam; the raw water source for boilers in both plants is a deep well. The quality of the water moving through the boiler is critical to turbine performance and boiler longevity. Impurities in the feedwater can deposit on surfaces inside the boiler, causing heat transfer loss and reduced efficiency. Impurities that carry over into the steam from the boiler can cause scaling and turbine blade corrosion.

To help guard against these problems, the plant continuously monitors critical water chemistry parameters of both the demineralized feedwater and the condensate, including sodium and dissolved oxygen (DO) levels. Sodium and DO are two important indicators of the potential for corrosion and pitting.

Sodium levels must be kept as low as possible because at the plant's operational temperature and pressures, sodium will plate out on the blades. If the sodium concentration is allowed to build, the turbine blades can become seriously pitted. Even small fluctuations in the sodium level can indicate trouble.

Figure 1: A Hach 9245 Sodium Analyzer installed in the plant's condensate system allows operators to quickly identify and correct sources of contamination.

With proper instrumentation, sodium measurement is much more precise than conductivity monitoring for detecting excursions, and it allows operators to quickly identify and correct the source of contamination. The sodium alarm level is set at 10 ppb, which is lower than the detection capability of conductivity analyzers.

Precise DO control is critical for preventing flow-accelerated corrosion (FAC). The plant's Unit 2 has a de-aerating condenser, and products are used there to passivate the piping. Unit 1, however, is more susceptible to FAC, so technicians need to run it with more DO than Unit 2. About 15 ppb DO is standard for Unit 1.

Analyzer Upgrade

In mid-2008, both the existing sodium and DO analyzers at the generating plant were replaced with a Hach 9245 On-Line Sodium Analyzer and a Hach Orbisphere G1100 Luminescent Dissolved Oxygen (LDO) sensor. According to one technician at the plant, this has been a strong positive change for the facility.

The former sodium analyzer had calibration problems, and tended to lose sensitivity as it approached the scheduled calibration point. The loss of sensitivity meant that shifts in sodium concentration could go undetected for a significant period of time unless the analyzer was manually regenerated.

The plant's previous DO analyzers also experienced chronic problems, says the technician. "We always had to be right on top of our old DO analyzers. The membranes had to be changed monthly and they were not friendly on calibrations." The probes had to be removed from the sample stream and placed in a saturated air environment to stabilize prior to performing the calibration.

Sodium Monitoring

The Hach 9245 On-Line Sodium Analyzer was installed in the Unit 1 condensate system. It has helped plant operators overcome the problem of dwindling responsiveness they experienced with the previous analyzer. With conventional analyzers, continuous exposure to low sodium concentrations can dull responsiveness. The 9245 analyzer features a probe regeneration function that extends the probe's sensitivity between calibrations. A reactivation solution is injected into the stream to help ensure that the analyzer response remains stable and reliable. A sodium level alarm is also one of the earliest signs of cation breakthrough in demineralizers and polishers caused by exhaustion of the cation resin bed.

LDO Monitoring

The generating plant installed the new, Hach G1100 LDO sensors at the condensate pump discharge and boiler feedwater inlet. Unlike the old membrane-based DO probes, the Hach sensors work on the principle of luminescence. The dry LDO sensor requires neither electrolyte nor chemicals for operation. Calibration is performed on a monthly basis by exposing the luminescent spot on the sensor to pure nitrogen. The instrument can be programmed for manual or automatic calibration, and after each calibration, it self-verifies that the signal is operating and stable within an acceptable range.

The sensitivity of the G1100 quickly became apparent to technicians. Almost immediately after the G1100 LDO sensors were installed, an oxygen leak was found in the gland steam skid in Unit 2. "Our condensate had been running in alarm mode constantly and we found a packing on the gland skid valve

that was allowing air to enter into the condensate system." There had been some indication of this with the prior membrane DO analyzer, but the technician says it was difficult to detect a significant response that would prompt corrective actions.

"With the G1100 LDO sensor, it doesn't take long to see a reaction. If we started our off-line condensate pump right now, within less than a minute we would see an elevation of DO until it stabilizes, which usually happens fairly quickly. But we can watch the numbers change as it happens."

Ensuring Reliability

All the plant's monitoring processes are controlled by a Bailey Distributed Control System (DCS). Both the 4-20mA output from the G1100 sensors' Orbisphere 410 Transmitter and the sodium analyzer output can be read at the instrument site or on the DCS. The new, low-maintenance sensors provide plant staff members with continuous, accurate monitoring and have significantly reduced the time required for manual testing and calibration tasks. "They are clean machines," says the plant technician. "They're simple to install, simple to hook up, easy to verify. These sensors have really cut down the amount of work that we have to do in the lab to ensure reliability."

Figure 2: Hach Orbisphere G1100 Luminescent Dissolved Oxygen (LDO) sensors are installed at the condensate pump discharge and boiler feedwater inlet.

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