21st Century Boiler Controls
by James Piper

Wave of computerization sweeps boiler operations into the digital age

A FUNDAMENTAL CHANGE is taking place in the way boilers are controlled, operated and maintained. Following the computerization trend that moved through the temperature control industry over the past 10 years, boiler controls are going digital. Manual and pneumatic control systems are giving way to the microprocessor. Intelligent field devices and programmable logic controllers are replacing gauges, hand valves and pneumatic actuators.

Results of these changes include better performance, improved safety, enhanced maintenance and lower operating costs. They are the result of several key features of new control systems, including centralized operation, remote capabilities, enhanced diagnostic tools and an emphasis on energy efficiency.

Centralized operation

Digital control systems bring all monitoring and control operations into one location. When conditions call for a change in system operations, those changes come from a central console. Gone are installations in which multiple boilers have individual control panels. Single and multiple boiler installations now can be run from one location. The result is increased system efficiency and faster response time for operating personnel.

Centralized operation found with digital control systems shouldn't be confused with what is common in many large steam plants that operate multiple boilers. Many such plants have pneumatic and electric control systems and a central monitoring station, typically located in the superintendent's office. The primary purpose of these systems, however, was to inform the superintendent of the boilers' status. They weren't designed to provide the same level of monitoring and control that can be achieved with digital systems.

For example, most modifications to boiler operation still required that an operator go out to the boiler to make the adjustment. With digital systems, operators can make most adjustments from the central console, often automatically. Centralized reporting and control functions in the boiler system provide another edge: The boiler system and other operations within the facility can share data. For example, current and projected weather conditions and the occupancy schedule can be used to determine if more boilers need to be brought online.

Remote capabilities

One major advantage of new-generation boiler controls is they can be remotely monitored and controlled. With conventional manual and pneumatic systems, remote monitoring was limited to a few gauges, charts and graphs, usually in the plant manager's office.

With digital controls, no such limit exists. Through a PC connected to the system, personnel instantly can access all system data points and monitor boiler operation. Using a modem, a remote computer can be located nearly anywhere there is a suitable telephone jack.

Remote PCs are not limited to simply monitoring the status of the boiler system. Any control function that can be performed locally also can be performed remotely. Even diagnostic operations can be initiated from the remote location to help troubleshoot operations without having to call in operators. Some

systems include a connection to a telephone-operated paging system.

In the event of a boiler system alarm or malfunction, the control system can automatically page operators in nearby or remote locations, permitting more efficient use of operating personnel's time.

Enhanced diagnostic tools

Conventional boiler control systems typically monitor less than 10 operating parameters of the system. Of these points, only a few are tracked over time. As a result, when problems in the boiler's operation occur, little information on the events leading up to the malfunction is available.

In contrast, digital-based boiler control systems typically monitor about 80 system parameters. Any parameter can be logged by the system and tracked over time. These additional data points can help operators identify problems as they develop and provide operators with additional data to help troubleshoot system operations. They even can be used to help diagnose problems that are slow to develop, over months and even years.

For example, key boiler operating characteristics - feedwater, fuel bum, blowdown and steam generation rates - can help estimate overall boiler efficiency at that particular load. If the boiler is in good condition and operating properly, estimated efficiencies shouldn't vary significantly over time for the same load.

A digital-based control system provides a way to compare the performance of the boiler under a range of loads and for the same load over months or years. If the performance varies greatly, operators can begin the process of tracking down the causes.

Energy efficiency

Use of a digital boiler control system improves operating efficiency at all loads, but particularly at part load, where conventional control systems cannot closely manage boiler operations. Conventional control systems suffer from two major sources of error that impair operating efficiency:

- Offset occurs when the control system operates the boiler close to, but not at, the desired setting.
- Overshoot occurs when the control system overcompensates for a change in operating conditions, such as load or system pressure, and overshoots the desired setpoint. The system, sensing it has overshot the desired setting, overcorrects in the other direction, leading to a condition called "hunting."

These errors result in decreased system performance and increased energy use. All are virtually eliminated using digital control systems. These systems automatically adjust burner fire rates to match changes in system loads in increments as low as one-tenth of a pound.

The future

Today's systems use proprietary hardware and software. Once installed, the boiler owner is locked into the original system manufacturer for modifications. Proprietary systems once dominated the building automation industry, but pressure from owners and building trade associations launched the development of standards governing how components connected to the system, how sensor and control signals were transmitted between the computer and the sensing devices and actuators, and how software operated.

Look for the same standardization to take place in boiler control systems. Besides providing greater flexibility at a lower cost, standardization will allow boiler control systems to interface more readily with other building control systems.

Operators also can expect to see increased system intelligence. In spite of the power of digital systems, system manufacturers and operators are pushing for more capabilities. Many will come from intelligent

field devices; self-contained microprocessor-based sensors, transmitters, and actuators that will perform many functions now done by the central computer.

Finally, look for systems to have software built into the system to aid in training. Ease of operation has always been a strong factor promoting the use of digital control systems. Their near fully automatic operation, coupled with well-designed graphical interfaces, makes learning basic operation of the system relatively easy. But while basic operation is relatively easy, making full use of the system capabilities requires that the operators spend a significant amount of time undergoing training.

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