



Failure at We Energies' Valley Power Plant could leave much of downtown Milwaukee, Wis. without heat. To ensure plant reliability, the company has invested in electronics and asset optimization technologies.

Smart Technologies Sustain Plant Reliability, Help Control Costs

By Todd Gordon, We Energies

All power stations strive to be reliable. We Energies' Valley Power Plant, as the largest utility-owned co-generation facility in the country, however, may be unique in its need for reliability.

If a generating unit elsewhere goes down, replacement power can be obtained from other facilities through the grid. If this nearly 40-year-old plant loses the District Heating Steam System, much of downtown Milwaukee will be without heat.

To prevent a steam outage, each of Valley Power Plant's two units has a pair of boilers along with a single extraction steam turbine-generator capable of generating 140 MW of electricity. Peak extraction steam production to the District Heating Steam System has exceeded 1 million pounds per hour. To ensure reliability, because there is no backup

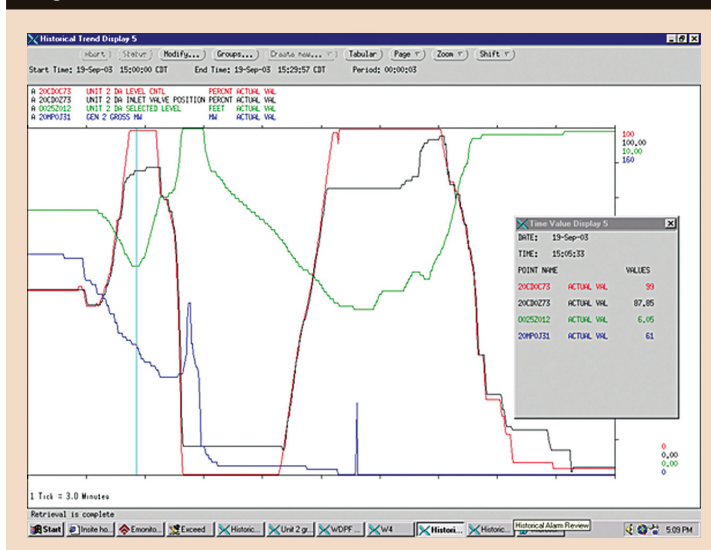
for steam beyond the four boilers, the company has invested in electronics and asset optimization technologies capable of identifying potential problems early, so they can be corrected without incident. This saves on maintenance costs, as well.

We Energies began installation of smart, microprocessor-based instrumentation in the mid-1980s, and converted the old analog controls to a Westinghouse distributed control system (DCS) in the early 1990s. This resulted in greater measurement accuracy, easier calibration, repeatability and higher reliability.

Reliability increased further in the late 1990s with the arrival of the first smart digital valve controllers (DVC) along with the means to access their diagnostic capabilities. When mounted on or near process control valves,

DVCs not only support faster, more positive valve action with less variability, they provide accurate feedback regarding the

Figure 1 HISTORICAL TREND DISPLAY FOR DA INLET VALVE



operating characteristics and condition of the valves to which they are mounted.

Equally important from the standpoint of power plants having a variety of control valves, these digital valve controllers can be mounted on most valve brands in addition to the Fisher valves for which they were designed (Photo 1). As a result, Valley Power Plant now has DVCs on its toughest applications, including the valves for desuperheating spraywater, boiler feedwater, turbine steam bypass, the

potential problems. Initially, a handheld communicator had to be connected directly to the device in the field to access its information. Such communicators are still widely used in the process industries. Later, a laptop computer loaded with special valve management software from Emerson's AMS Suite of asset optimization applications became a more user-friendly means of examining control valves in the Valley Power Plant. This gave the plant's technicians a whole

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sootblower system and dearator inlets for all four boilers (Photos 2 and 3). These digital devices facilitate control and improve the operation of critically important, expensive and older but still useful valves without having to replace them.

The advanced diagnostics (AD) version of the DVC supports diagnostic testing when the valves are offline. The newer performance diagnostics (PD) version, which was introduced in about 2004, can be examined even as it controls an operating valve. This allows technicians to see things remotely without having to bypass a valve and take it offline for evaluation.

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new way of observing the operation of the DVC equipped control valves.

For example, control room operators will occasionally report a valve that is "leaking through," meaning it is not shutting off completely. With the laptop connected to the valve offline, a technician can stroke it and use the AD diagnostics to "view" the action inside that valve. By comparing a current "signature" with one made earlier when the valve was known to be operating properly, he or she can identify actual problems and confidently suggest possible solutions.

Going Online

Offline diagnostics were valuable, but that was only the beginning. In late 2005, more advanced predictive maintenance software was installed in the laptop, enabling it to communicate with either HART or Foundation fieldbus smart devices via multiplexers that interface with the plant's distributed control system (DCS). With this arrangement, instrument and control (I&C) personnel could monitor the smart devices online from a single location and gather information on their condition. In addition, the PD version



Photo 2. DVC mounted on Unit #1 steam bypass valve on a 10 X 20-inch steam line.

could be examined remotely while operating.

Data obtained in this way are stored, organized and presented on easy-to-understand displays. Any change in the performance of an operating valve can be spotted quickly after a "status alert" indicates that certain preset levels have been exceeded. Just having knowledge that some type of problem exists is valuable, because that information can be used by plant personnel to predict when a repair or replacement might be necessary, hence the name predictive maintenance software.

For nearly two years, that online system continuously retrieved information generated by 12 DVCs on critically important valves in Unit #2 at the Valley Power Plant. A valve's condition could be evaluated from one spot in a controlled environment. It was not necessary to go to half a dozen different elevations in the plant to find the valve and connect the laptop.



Photo 3. DVC mounted on a 6-inch feedwater valve on boiler #4.

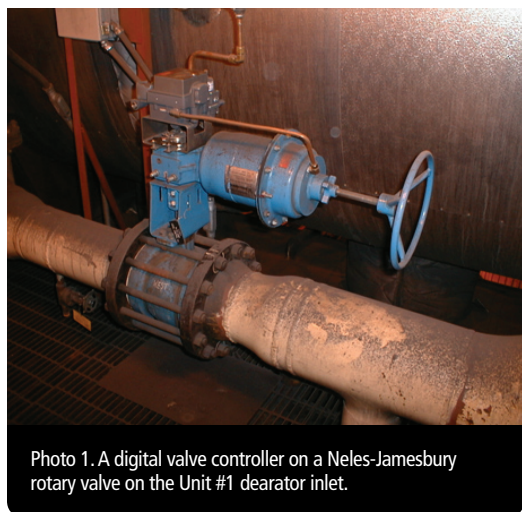


Photo 1. A digital valve controller on a Neles-Jamesbury rotary valve on the Unit #1 dearator inlet.



Photo 4. Digital valve controllers eliminated persistent problems with the desuperheating spraywater valves on all four boilers.

Personnel could simply page through the screens to access the alerts and online diagnostics to assess potential problems. Visual checks were required on only those valves where further investigation seemed necessary. That eliminated a lot of footsteps and saved time.

The initial setup with the 12 control valves in Unit #2 proved to be so beneficial

connected to the plant-wide LAN so the database can be accessed from any other site on the LAN by employing a standard feature of Windows XP called “remote access.”

In the meantime, a version of the software still resides in the laptop, which can be taken into the field at any time to closely examine any valve with a DVC or any other smart instrument on the network. Specifications on any of these devices can be exported to the “roving” laptop for testing in the field or for calibration, if necessary. Any new information can be imported back to the base station to update the database. This is another example of how the system can be tailored using available technologies.

Trending provides another means of looking at the action of a valve over a period of time to see if subtle changes are taking place that could affect the performance of the valve.

Reporting is another frequently used capability. A comprehensive Word document with embedded screen

signal and valve position were at or near 100 percent open. Because these valves are “air-to-close,” there is no supply air in the actuator when 100 percent open. The problem was temporarily solved by setting a high travel limit of 96 percent in the DVC. This left some air in the actuator to minimize the oscillations, which were affecting header pressure and influencing the downstream sootblower devices. The valves were not fixed, but utilizing the high level limit in the DVC enhanced their performance, and boiler efficiency was improved as a result. These valves are now being replaced, but the same DVCs can be mounted to the new ones.

Recently, an excessive air consumption problem was found at a sootblowing regulator valve on Boiler #4 through the online diagnostic capability. Using the roving laptop, plant personnel actually observed the valve’s operation getting progressively worse. The problem was determined to be a leaking diaphragm, which turned out to be hard and nearly inflexible when it was removed and replaced. That diaphragm was leaking at least 350 standard cubic feet of instrument air per hour in addition to allowing a steam loss when the valve was supposed to be shut.

The problem was eliminated by installing a new \$75 diaphragm at the first opportunity. The part was fairly easy to replace, but more importantly, the time and expense of tearing apart a perfectly good valve were avoided, because the asset optimization software made it apparent that there was no problem inside the valve.

The predictive maintenance software residing in the base station continuously monitors all the smart devices to which it is connected. It issues status alerts when any of them exhibit behavior outside preestablished norms.

in saving time and money that the laptop was recently replaced by a Dell PC as a base station permanently connected via the multiplexers to smart devices in the field. In addition, the online network has been expanded to include 12 identical valves with DVCs on Unit #1 and a few smart field transmitters, as well. After the next planned outage, plant personnel will be able to remotely access diagnostic data from the analytical probes measuring the amount of oxygen left in flue gases after combustion. The information provided by those probes is critical to the efficient operation of the boilers, so being able to verify the condition of those measurement devices is yet another way technology is supporting plant reliability.

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prints can be created with a few mouse clicks. This can be used for training purposes or presentations to upper level management, operations and/or the mechanical maintenance group.

Problems Solved

Desuperheating Spraywater Valves

– This was the first system to have DVCs installed. Previously, these valves were a persistent maintenance challenge. Finally in 1999, four Fisher severe service valves with DVCs were installed (Photo 4). After that, the chronic operating and maintenance problems disappeared, with only a routine trim replacement required since then.

Sootblowing Regulator Valves – Old valves that were installed when the plant was built were given new life when remote mounted DVCs were attached (Photo 5). It was immediately obvious that the sootblowing regulator valves on Boilers #2 and #4 were oscillating significantly during normal sequencing when the demand



Photo 5. Sootblowing regulator valve with remote DVC mounted on the adjacent wall.

That particular valve is scheduled for replacement in a few months, but in the meantime the instrument air loss alone would have cost the plant approximately \$65 per month.

DA Inlet Valves – Sticking has been an ongoing problem with the two dearator inlet valves that control every drop of water supplied to the four boilers. In Figure 1, the red line represents the command signal and the black line represents the valve position, indicating the valve sticking point. Prior to having valve feedback to the control system, operators had no way to



Photo 6. New sliding stem valve replaces rotary valve with tendency to stick on Unit #1 dearator inlet line.

recognize this kind of subpar performance. Additionally, a status alert is now raised when the DVC command signal and valve position deviate by more than 3 percent for more than five seconds, making the operators aware of the situation before the DA tank level becomes critical. They can then take action to avoid a tripped unit. The ultimate solution was to change valves (Photo 6).

Technology Benefits

Digital valve controllers actually do improve the performance of control valves, resulting in less wear and tear on the valves, longer life and greater reliability. They allow better valve control, which translates into better boiler control and more efficient steam production. Monitoring valve action remotely through the DVCs creates substantial cost savings by identifying valves that are leaking steam or losing instrument air.

The diagnostics support faster troubleshooting to identify potential problems in time to prevent damage to equipment and possible reduction in the supply of steam to downtown Milwaukee’s District Heating Steam System.

Lessons Learned

It’s been more than 20 years since the Valley Power Plant began converting to smart instrumentation, often without

having to replace anything but an old instrument. Since then, a number of complementary new technologies have been added, including digital valve controllers and asset optimization software.

During this long-term conversion, the plant’s staff has learned that “smart” field instruments generate useful diagnostic information that can be accessed online with asset management software. They’ve also discovered that generally the technology pays for itself through improved operation and cost avoidance. In addition, they’ve found that the newer automated control systems work well, particularly when they receive accurate inputs from smart field devices.

Plant personnel have also learned that as technology improves, it is beneficial to have a system that can grow with it. Therefore, one of the next steps will be installation of an Emerson Ovation DCS upgrade. Once this is complete, the multiplexers will no longer be needed because Emerson’s asset management software can be directly interfaced with Ovation. **pe**

Author: Todd Gordon has been with We Energies for 32 years, and a computer/instrument technician leader for more than 24 years at its Valley Power Plant. Starting in the mid-1980s, Todd worked on the transition of the Valley Power Plant from an analog control system to a microprocessor distributed control system.