Asset-management software improves valve-maintenance program

Ken Howard

In 2003, Chevron Corp. established a pilot program at its El Segundo, Calif., refinery to determine the value of asset-management software for online monitoring of digital valve controllers. Chevron has profited from the pilot program and expects to expand this program to incorporate other types of smart field instruments.

The program has shown that careful continuous monitoring of control valves leads to better troubleshooting and fewer valve repairs. The El Segundo refinery has saved:

•$45,000 on troubleshooting in the first year.

•$135,000 by authorizing in-shop valve repairs only when diagnostic information shows that such actions are necessary.

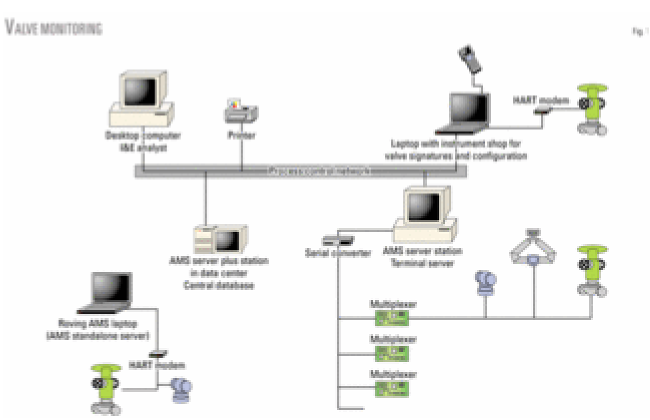
•More than $90,000 through improved valve performance.

•$100,000 through a new valve-reclamation program.

In the past, suspected problems were evaluated in a logical and orderly fashion-an effective but burdensome and time-consuming method of troubleshooting. Up to 10 man-hr involving as many as eight different employees in a 1-week period might be required before the maintenance department decided to pull a certain valve for repair or replacement.

Using available technology to monitor and gather information about the condition of smart, microprocessor-equipped valves allows refinery personnel to shorten the troubleshooting period and make timely decisions regarding valve repairs.

The program, based on Emerson Process Management's AMS Suite: Intelligent Device Manager software, provides access to diagnostic information generated by more than 950 smart digital valve controllers in two different ways: online and offline.



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In the online system (Fig. 1), a centrally located server retrieves information from a network of 103 online digital valve controllers. These continuously available data are stored, organized, and made available to maintenance personnel. Any change in the performance of an operating valve on this network is sensed instantly; a status alert is generated when certain preset levels are exceeded.

The instrumentation and electrical (I&E) reliability analyst in charge of the program (Fig. 2) evaluates each alert and makes recommendations regarding the need for immediate or delayed repairs.

In addition, diagnostic information generated by hundreds of other “smart” valves throughout the refinery is accessible offline with a portable (roving) laptop computer. This method enables us quickly to examine a suspected malfunction of any smart valve not in the continuously monitored group. The analyst can then evaluate the valve’s condition by comparing current readings with a “signature” of that valve’s performance characteristics when it was new.

Valve troubleshooting

In the traditional procedure, if an operator suspects a problem with a control valve, he or she notifies the head operator who may do a step change to determine whether the valve can move. If that fails to define the problem, a process engineer tries to adjust the tuning.

If the problem is not resolved after 2-3 days, the head operator notifies a maintenance planner, who assigns the job to the I&E department and a technician checks the valve. If the valve is stroking, the technician concludes that it is not an I&E problem and sends the work order back to the planner.

A machinist is then sent to look at the valve. If he doesn’t hear a noise or find some mechanical problem, he also sends the job back. If the operator still thinks there is a problem, the I&E department is notified to disconnect the positioner so the valve can be pulled for visual inspection and repair, if necessary.

This process can take several days and consume the time of eight employees, who are frequently unsure if anything is wrong with the valve until it is opened and inspected.

This procedure has been streamlined with the AMS Device Manager. If the valve in question is part of the online network of 103 valves that are monitored continuously, a developing fault will show up long before an operator notices it.

If the valve is not in this monitoring system, the head operator can notify the reliability analyst of a potential problem, sometimes as a last resort before a valve is pulled and taken to the maintenance shop. A roving laptop is then used to check the valve offline. Wire-piercing leads can be attached at the terminal strips in the control room to gain access to the valve’s incoming signal.

In come cases, the valve should be checked in the refinery with the laptop. Although this increases the time required for diagnosis, it gives the analyst an opportunity to observe the valve in action while extracting valuable diagnostic data.

If the valve is equipped with the performance-diagnostics version of the digital valve controller, the analyst can obtain the diagnostics while the valve continues to operate. Chevron has 25 to 30 performance-diagnostics positioners in the refinery, with more on order.

With the older advanced-diagnostics version, the valve must be out of service during diagnostic tests. That means an operator must block in the valve before a current valve signature is taken, which can be done in about 10 min.

More time is needed to compare the current signature with the original performance characteristics of the same valve when it was new. A trained analyst often knows, within 20 min, what is wrong with the valve and what needs to be done to correct the problem.

Troubleshooting that removes the valve from the line occurs about twice weekly, on average; the new procedure requires 20 min to 3 hr, depending on the valve and how the problem is identified initially.

Given an average labor cost of $55/hr, the annual cost of control-valve troubleshooting using the intelligent device manager technology is about $11,400/year. This is a minimum saving of $45,800/year vs. the established troubleshooting procedure.

Avoiding valve repairs

Field-based knowledge allows the analyst to determine when a valve can be restored to full functionality using online calibration, bench-set adjustment, or some other noninvasive action vs. actually pulling it for inspection and repair in the maintenance shop. It is much less expensive to upgrade a valve's operation without having to remove it from service.

It costs about $4,500 each time a valve is pulled, torn down, and repaired, a procedure that has been avoided at least 30 times in the first year of the asset-management program for a savings of about $135,000.

Just one valve

Improving the performance of just one valve can often have a significant economic impact on the entire refinery. For example, a steam valve (steam to B-train turbine) in the cogeneration plant was operating spasmodically, cutting into the amount of steam available to the turbine and reducing electrical power production by 3-6 Mw. This loss of power was most costly during peak use hours.

Because regular troubleshooting procedures revealed no specific problem, we used valve diagnostics and found a slight abnormality-barely enough to justify pulling the valve. But this valve is critically important to the cogeneration plant, and its performance can affect power production. Therefore we pulled it out of service. If the valve had failed during peak demand, the refinery could have incurred an $80,000 charge.

Visual examination confirmed a problem: a gap in the packing and a heavy-duty seal that was not allowing the ball to move freely. A signature taken after the valve was repaired showed a significant improvement. It was reinstalled and remained trouble-free for another 6 months.

We calculated the economic benefit of improved performance and avoiding unscheduled downtime at $90,800.

Additional benefits

The intelligent device manager software enables faster calibration of all smart instrumentation. In fact, the 103 valves in the monitoring network can be calibrated directly from the maintenance shop without sending personnel into the refinery.

We also implemented a valve-reclamation program based on the signatures of operating characteristics for each valve when it is new. These signatures were compared with valves that had been sent to the reclamation yard to be junked to determine if they could be salvaged economically.

An inventory of 35 valves, showing the exact repairs that would be necessary before returning the valve to service, is listed on an in-plant database to which every engineer has access. If a specific type and size of valve is needed, a suitable replacement is often found in the reclamation yard.

Because the average cost to repair these serviceable valves is only about $2,000 each, the refinery enjoys a substantial savings when valves are reclaimed instead of buying new valves. In fact, we saved about $100,000 in the reclamation program in 1 year. □

The author

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