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How Valero Refinery Achieved Best Maintenance Practices

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Expanding asset management through expert services can add to savings, as well as improve work practices.

Between 2004 and 2012, the Valero Wilmington Refinery saved more than $900,000 by applying technology to minimize the number of control valves repaired during three maintenance turnarounds. Plans had been made to overhaul more than 250 control valves, but only 28 were found to actually need that level of maintenance. Hundreds of man-hours were saved, and there was no delay getting back into production due to valve maintenance.

The positive results of this single program led to an expansion of the asset management technology through services provided by Emerson Process Management. Our goal was to improve maintenance without increasing the workload of an already-thin staff. As a result, we have rapidly implemented predictive maintenance and other best practices with confidence that the long-term interests of the refinery are being served.

Ours is not a new facility, having been commissioned near Los Angeles in 1969. Valero's Wilmington Refinery can process 80,000 barrels of high-sulfur heavy crude oil per day; with the purchase of gas oil, the refinery output maxes out at 135,000 barrels per day. This is done with a permanent staff of 440. Careful turnaround planning that begins up to two years in advance has been a hallmark of our growth and efficiency.

Asset management

An important factor in turnaround planning and execution has been Emerson's AMS Suite: Intelligent Device Manager asset management software installed here in 2003. Smart field transmitters and digital valve controllers (DVCs) were connected to the distributed control system (DCS) through HART FTA panels. HART signals are passed through ELCON multiplexers and transmitted via fiber optics to the AMS Suite Server in the control room, where field-generated information can be accessed, evaluated and used by Reliability Group personnel.

Emerson's local business partner, Caltrol, assisted in setting up the original 500-tag asset management system and has provided an onsite control valve asset manager for at least two years. He surveys all control valves, interprets valve diagnostics, assists in troubleshooting poorly performing valves, provides solutions to unresolved valve problems and makes recommendations to improve operations.

At first, the server was employed to maintain an online library of documentation necessary to locate and work on control valves. This included manuals, P&IDs, photos, AutoCAD drawings, repair reports and special notes—*but other capabilities for calibration management, configuration and diagnostics were neglected.*

Control-valve evaluation utilizing valve signatures was the other early use of AMS Device Manager software. Unique signatures, captured since 2004 on nearly 1000 new or recently repaired valves, regardless of manufacturer, are maintained in the database. During turnaround planning or any time a valve is suspected of lagging performance, a current signature is compared with the original looking for changes in performance as an indication of potential failure.

Previous planning was based largely on considering those valves that were "always pulled at turnaround." Now, the on-site control valve asset manager works closely with the turnaround planners in determining exactly which valves really need to be pulled for repair and which ones can be left alone.

In each of the last three turnarounds, the only valves pulled were the ones confirmed in this way as needing to be overhauled. As a result, only about one-tenth of the valves considered were actually pulled and repaired. The cost of on-site manpower plus Repair Center charges were avoided for every valve not pulled. The net value calculated in 2011 dollars was $914,853. Equally significant, all of the valves left in place have continued to perform flawlessly between turnarounds. Not one of those valves has failed in service, proving the benefit of comparing valve signatures.

Implement services

The value derived from AMS Device Manager in turnaround planning prompted us to consider ways to take advantage of other features of the upgraded 1500-tag system: "How," we asked, "could we take this system to the next level and use it more in line with our strategy of predictive maintenance?" Caltrol's answer was Emerson's AMS Implement Services. This service group has helped the refinery move up to the next level of maintenance by providing the following services:

- Prioritizing critical assets
- Setting up a device-alert system

- Configuring device polling rates based on priority
- Developing key performance indicators (KPIs)
- Offering written procedures and work-process instruction

At the close of 2011, each operations group met with the Emerson engineers to assign priority rankings to the assets in their respective unit, based on the operational criticality of each device, probability of failure (often related to severity of the service), safety and regulatory compliance. From that ranking, Implement Services determined the polling rates and alerts to be programmed into the asset management software.

While alerts can be set up for all kinds of smart instrumentation, few devices other than DVCs are actively monitored in the Wilmington Refinery. More than 90% of our work is with control valves. If the performance of a device falls below an established norm, an alert is raised. A valve could be slow in responding, exceed travel deviation limits or lag in some other KPI.

Each day, a technician checks for alerts that may have come up within the previous 24 hours. Those are reviewed by Reliability Group personnel and the on-site asset manager to determine if a condition that must be acted upon is emerging. Often, it's worthwhile to simply know that certain assets are performing below par so they can be watched for signs of further deterioration. In some cases, corrective adjustments can be made online or at the valve. If failure of a critical valve is imminent, action is taken immediately to avoid an unplanned shutdown.

Without question, this kind of predictive maintenance has proved to be beneficial, minimizing costs and improving reliability. After about eight months of operation, online alerts have prevented operating problems at least six times, avoiding emergency situations and saving substantial amounts of money.

Increased security is another benefit. In the past, our AMS technician could log into the asset management system and manipulate valves or change the configuration of a transmitter. Our work process required a work order and permit for work to be done in the area, but no separate password other than the standard user access to the AMS server was required.

Now, AMS-administrator access to these instruments is limited to a restricted list of supervisors—*and only a few persons are qualified to evaluate control valves and write instructions*. Even the technician who checks the Alert Monitor on a daily basis can't write instructions to a valve. According to our Best Practice rules, technicians must obtain permission in terms of a work-order approved by the operations department. Then, he/she goes to the unit operations manager or maintenance supervisor to get a working window (usually three hours) before going into the field to perform the required maintenance. No one can work on an operating control valve without the necessary approvals, so a valve position cannot be changed without the knowledge of control-room personnel. This conforms with work practices recommended by Emerson.

Expanding the power

Understanding the power of asset management has come with experience and familiarity with its full capabilities. As a result, use of this tool is expanding throughout the refinery, including the use of instrument diagnostics to evaluate more and more critical assets.

In many areas, old FTA panels don't have HART connections, so wireless networks are being evaluated to possibly serve the asset management system. Long-term, having the wireless structure in place will bring further benefits, but for now, we are just looking to monitor additional devices.

As a progressive company, Valero is leveraging the new work practices to other refineries. That's a nice confirmation of the value of predictive maintenance and the best practices now in place here. **MT**

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Services Lead to Improved Asset Performance

By Jane Alexander, Editor

The compelling case study about the Valero Wilmington Refinery in the accompanying article isn't an isolated one. Emerson's service offerings are helping other sites around the globe write their own success stories. Consider the following:

At a major Midwest refinery. . .
A long pump-repair backlog and unclear maintenance work processes were among the existing problems leading to a series of unplanned environmental, health and safety (EHS) events, culminating in a serious pump fire in 2008. The refinery's vibration monitoring program was only partially effective, advanced analysis techniques were not used and no limits were in place to shut down a pump showing signs of severe degradation. Fortunately, management viewed the situation as an opportunity to engage in a number of pump-improvement initiatives.

The first step was a gap analysis conducted by Emerson's Asset Optimization Services group. The existing condition monitoring and maintenance program came under considerable scrutiny, leading to identification of several issues that were corrected through organizational changes or technology.

The use of advanced portable vibration data collector/analyzers and predictive maintenance software was expanded. The refinery established alarm limits, identified key performance indicators (KPI) and integrated vibration data with the OSI/PI database. Rotating equipment engineers and technicians received training to strengthen their understanding of pump vibration and its impact on operations. In addition, the pump-repair backlog was reduced by employing outside contractors.

A separate but related program to improve pump reliability incorporated a new root cause failure analysis (RCFA) procedure that led to better hardware, better operating methods and better maintenance. Using improved diagnostics, pump repairs are now done right the first time, pumps run longer and fewer repairs are necessary in the long run. Finally, better vibration analyses and predictive decision-making have essentially eliminated costly unplanned EHS events.

The overall program resulted in an 18 percent improvement in mean time between repairs over an 18-month period up to March 2011.

At the Emirates National Oil Co. (ENOC), wholly owned by the Government of Dubai. . .
Asset Optimization Services personnel established a program to protect essential assets from unexpected failure and assure their long-term, high-performance operation. The program called for Emerson technicians to collect and analyze vibration data on more than 400 rotating assets, including pumps, compressors, and fans. Many are critical to maintaining uninterrupted production.

Over the past 10 years, this service has proven its value many times. For example, when excessive vibration led to the identification of misalignment on a critical pumping unit that moves gas oil product from a gas oil stripper to the diesel oil drawing unit, the pump was taken out of service as soon as possible. If the problem had not been detected through advanced analysis, an unexpected breakdown would have occurred eventually, forcing a shutdown and causing substantial financial losses due to emergency repairs and lost production.

At the SECCO Petrochemical Co., in Shanghai, China. . .
Here, Emerson's Asset Optimization Services group conducted a site audit to find solutions to several challenges. The study included an assessment of the process technology and the current level of automation, as well as a benchmark gap analysis designed to reveal areas of improvement. Recommended actions included making better use of diagnostic information generated by smart field devices in the plant, adopting a predictive maintenance strategy to cut reactive maintenance to just 10%, and improving internal communication of maintenance information.

AMS Suite asset management software was implemented to optimize a maintenance program driven by diagnostics accessed from 1000 key field instruments and control valves. These assets were prioritized by a criticality ranking according to the needs of the process. The priority assigned to each determined the scope and timing of the maintenance provided, whether predictive or preventive.

Plant personnel now use information from all available sources to determine which assets might be failing and estimate how long the process can continue to run without risking an unplanned shutdown. Cost-effective corrective measures are then employed.

The optimized maintenance strategy promotes a clear understanding of critical asset health and how to apply this knowledge to protect the plant over the long term. As a result, according to Emerson, the reliability improvements and production increases can be sustained. In fact, unscheduled shutdowns in this plant have been essentially eliminated, and availability is now greater than 98%.