Originally appeared in:
March 2019, pgs 53-56.
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Cut costs and save time servicing valves during refinery turnarounds

Most refineries perform turnaround activities every 3 yr–5 yr to maintain and upgrade plant assets and equipment. How the timeline is planned, and how the scope is defined and executed, varies from refinery to refinery. Minimizing the amount of time and expertise needed is always critical to the success of the turnaround to meet budgetary constraints and deadlines. Each day a process unit is down for a turnaround, the refinery is not making profits, and the cost increases.

A 460,000-bpd Gulf Coast refinery determined that it was servicing too many control valves (FIG. 1) for maintenance during each turnaround. Refinery personnel and management questioned why so many control valves were being pulled, and how that number could be reduced. To find the answers to these and other questions, the refinery turned to its control valve vendor and service provider.

After running tests and determining if the valves actually needed to be pulled, the control valve scope for the site's turnaround was reduced from 309 valves to 218, resulting in a cost savings of $577,000. The reduction in scope included removing the need for scaffolding, extra labor, cranes, etc.

Reducing the time and cost of servicing valves during a turnaround is a matter of using readily-available modern technology, such as smart valves, coupled with the right tools and training. These strategies reduce the number of labor hours required for valve servicing, the number of valves pulled and the cost of purchasing parts or valves, leading to cost and time savings by eliminating unnecessary work.

Determining valves that require service. Analyzing data from valve smart positioners using built-in diagnostic tools can reduce the number of control valves that require service by identifying which valves are working well. Refinery staff or the control valve vendor can leverage smart positioners and diagnostic software to determine valve health and need for service (FIG. 2).

For those valves requiring service, these tests can provide information as to the nature of the required work and facilitate planning. This information can

FIG. 1. A refinery may have hundreds or thousands of valves that are serviced, repaired or replaced during a turnaround.

FIG. 2. A technician can run valve diagnostic tests using a handheld device, a laptop or from the control room.

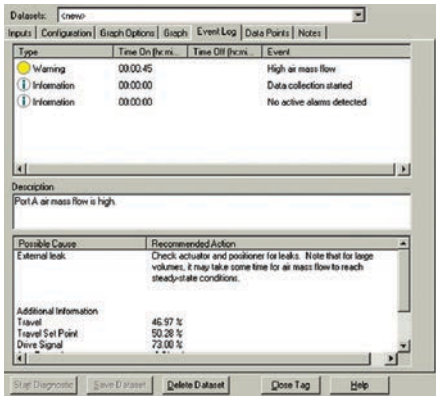

FIG. 3. This scan indicates an issue with the control valve, whether it needs more troubleshooting and if the valve must be removed from the line for maintenance.

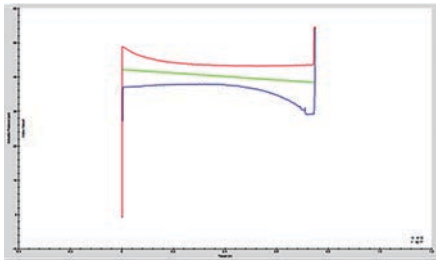

FIG. 5. A "valve signature" plot showing the integrity of the valve and actuator assemblies; the input (actuator net pressure) is plotted on the "y" axis, while the output (travel) is plotted along the "x" axis.

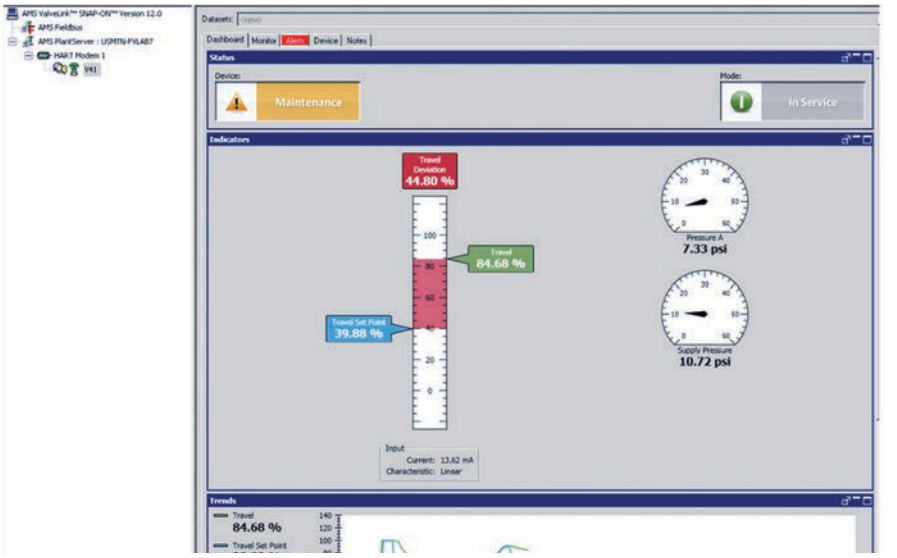

FIG. 4. Dashboard of smart positioner shows that the control valve cannot get to the commanded setpoint, so it is signaling the need for more troubleshooting.

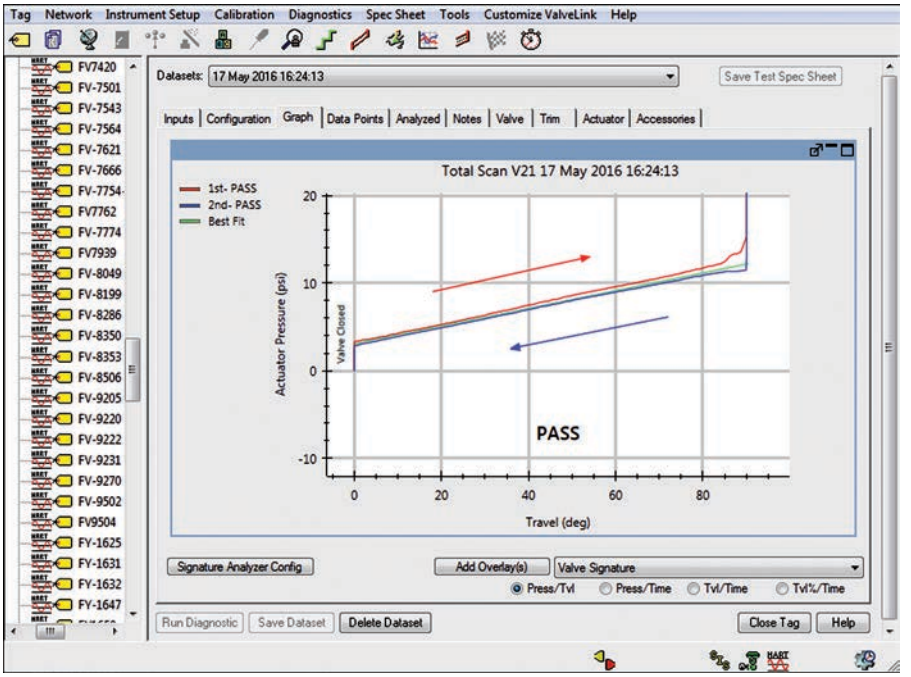

FIG. 6. A healthy operating valve, as the actuator pressure vs. travel is smooth, with full saturation at both ends of the travel.

often include the parts needed for service, which allows ordering in advance and avoiding any expedited fees from the valve vendor. Unplanned work is one of the main problems routinely encountered during turnarounds, leading to cost and schedule overruns. Reducing this work is critical.

Using initial installation baseline test data when the valve was installed, the control valve vendor can determine if a valve must be pulled for maintenance. The diagnostic tools in the smart positioner can show alert records stored in the device, as shown in **FIG. 3.** If the control valve assembly is performing incorrectly, alerts such as travel deviation, drive signal problems and supply air irregularities can reveal issues with a valve and assist in repair activities. In the case of the Gulf Coast refiner mentioned here, the site used the signature series data to determine which valves needed repair, and the servicing of healthy valves was removed from the turnaround control valve scope of work.

With the valve in bypass mode, a technician can run a series of tests. For example, one vendor's valve diagnostic software executes a 25-step functional performance test that starts at 50% and changes in 0.25%, 0.5%, 1%, 2%, 5% and 10% increments in both directions. Data is acquired to determine the minimum signal required to get the valve to respond, and an assessment is made of valve tuning (**FIG. 4**).

Another diagnostic generates a "valve signature" plot (**FIG. 5**) showing the integrity of the valve and actuator assemblies. The input (actuator net pressure) is plotted on the "y" axis, while the output (travel) is plotted along the "x" axis. By plotting data in this fashion, any increase or decrease in force is shown as a vertical change on the graph. In this case, the slope indicates that the actuator contains a spring, and the green line represents the computer's best fit between all data points.

For control valves that show no alerts,

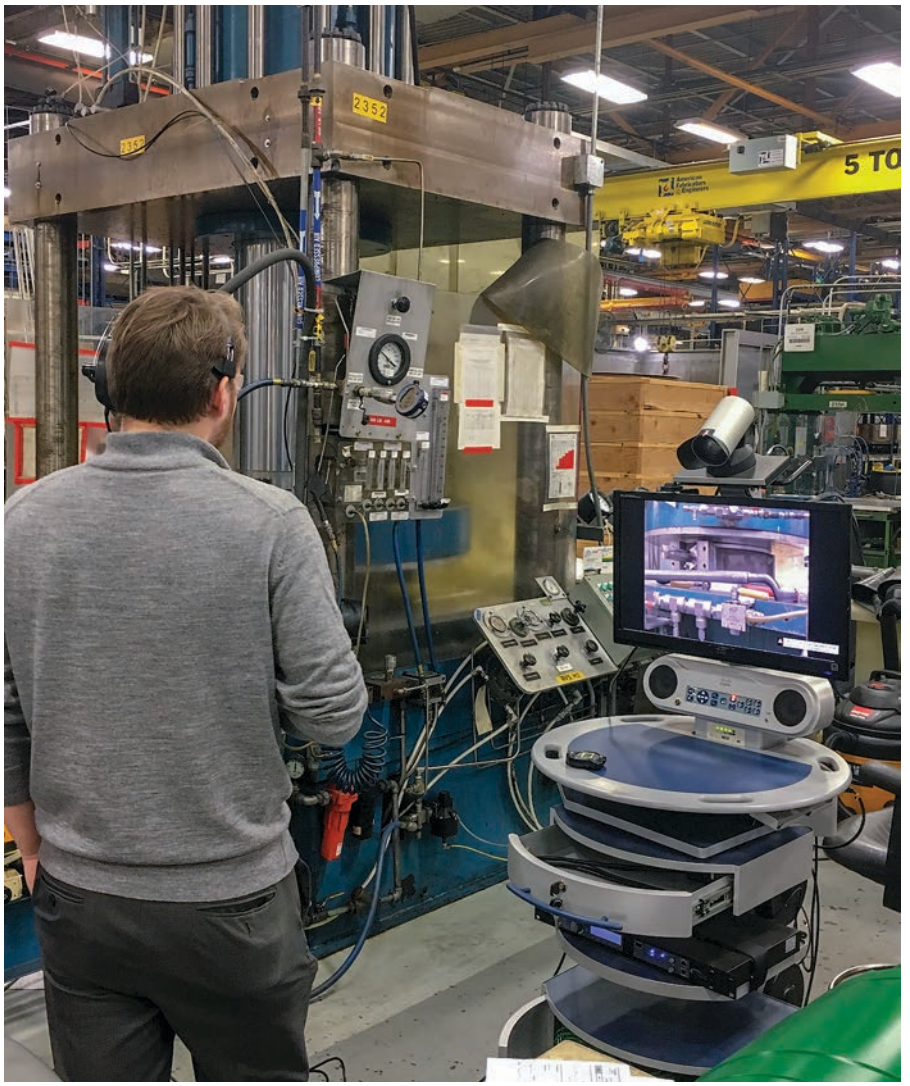

FIG. 7. With video conferencing, refinery personnel can witness control valve hydrostatic, seat leak and factory acceptance testing remotely, saving travel time and expense.

have an acceptable valve signature test and have no stroking issues, pulling the valve for maintenance is unnecessary.

In the case of the Gulf Coast refiner, using smart positioners and diagnostics (**FIG. 6**) eliminated 49 control valves from those requiring maintenance during the turnaround.

Tracking valves. At the start of each turnaround, a site turnaround team develops a list of control valves that require service. At the Gulf Coast refiner, 309 control valves were put on the list; however, valves are sometimes put on the list for no other reason than they have always been on the list.

This often happens because refineries have trouble tracking the status of all valves. Written documents and emails from the maintenance and operations departments and the control valve vendors get lost or misplaced, so the site turnaround team simply lists all valves for servicing. To address this issue, a refinery and its valve vendor can use modern, cloud-based technologies.

For example, a refinery can work in conjunction with its valve vendor using SharePoint or another collaboration tool to track valve repair status, assign priority to valves, list parts prices, and store photos, repair reports and repair histories. Whenever anyone at the refinery or the vendor's service technician performs maintenance, repairs or replacements on a valve, the necessary paperwork can be stored in this collaboration tool.

With such data, the site turnaround team can see individual valves that have been serviced, and when, and determine whether they require service during the turnaround.

Witnessing from a distance. In many cases, a refinery will order replacement valves or repairs to existing valves as part of a turnaround, and plant personnel will need to witness control valve hydrostatic, seat leak and factory acceptance testing at the control valve vendor. The shop performing the function could be 45 min away, or it could be hours away by car or plane. Scheduling such trips can cause delays on reassembly and shipment of the valve, as the control valve vendor waits for witnesses to arrive for acceptance tests.

Using modern technology, refinery personnel can use live video conference software, such as WebEx, to view the testing without leaving the office, saving costs for the refinery and the vendor and avoiding schedule delays.

Video conferencing allows refinery personnel to be at the service shop virtually, rather than in person. The control valve service provider sends a link to a virtual meeting, and then uses multiple high-definition cameras to show the test to remote users, (**FIG. 7**). With audio available, the refinery expert can ask the shop technician to show a closer view of equipment on the control valve. If necessary, the valve vendor's shop technician can remove the camera from the stand and physically hold the camera closer to the assembly.

This method was used for a turnaround for another Gulf Coast refiner. The site personnel were only about an hour away from the service shop, but traffic delays often added to trip time. The control valve service provider sent an invite to join a video conference for a scheduled time. The video conference took 30 min to run through the test, without site personnel needing to leave their office. This allowed the test to be performed exactly at the scheduled time, and reduced plant personnel time from 2.5 hr or more to 30 min.

Bring in the valve vendor. Most major control valve vendors and service providers have experience with shutdown, turnaround and outage engagements across different end users and industries. Engaging these experienced teams can help a refinery increase clarity on the control valve scope and timeline for repairs, dis-

cover opportunities to reduce cost, and bring control valves back to an OEM state by using certified parts installed with factory procedures performed by trained factory technicians.

Discussions can begin as early as 24 mos–60 mos before a planned turnaround to define the scope and unit scheduled for maintenance. Typically, the process involves:

- Operational planning (24 mos–60 mos prior): Future projects are planned at a high level with key stakeholders for a future successful turnaround that is on time and safe. These key customer stakeholders are maintenance, engineering, reliability and safety leaders.
- Alignment (12 mos–24 mos prior): The initial scope definition is generated, and preliminary schedule milestones and budgets are defined. The project goals and objectives are also defined, work lists are prioritized and a scope freeze date is determined.
- Work scope definition (12 mos–18 mos prior): Customer kickoff meeting held with the valve and service vendor to define a list of assets to be addressed. A walkdown of these assets is executed to capture all relevant data. Diagnostic tools are used to validate if the asset can be repaired immediately, or if it needs further inspection.
- Detailed planning (4 mos–12 mos prior): The customer has agreed to the proposal and scope. Critical valve spares with long lead times must be put on order, along with stocked items. The need for extra labor should be planned and scheduled. Mobile service centers must be booked, and other final approvals from the customer should be secured.
- Pre-planning (2 mos–6 mos prior): All resources are aligned for the execution. This step prepares for execution, risk reduction and all communication plans, safety checks, procedures and signoffs to commence shutdown.
- Execution: Once the unit is brought down safely, cleaned and is safe to approach, the work can begin. Daily meetings, reports and communication are key. Safety is also key during this stage because a de-energized plant can be dangerous. Training on new technology for site personnel is performed here.
- Post evaluation: The unit is back online, and the plant is producing product. Key stakeholders review the execution, measuring the effectiveness of the strategy and benchmarking maintenance and reliability comparisons for future turnarounds.

Takeaway. Use smart positioners and diagnostics to determine if a control valve needs service. A control valve vendor can assist with all other turnaround needs, including defining the control valve scope, testing control valves and valve repair. HP

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