There can be far more than the loss of mere dollars associated with valve failures. Regular monitoring and analysis can help you maintain these essential plant components the right way: proactively and cost-effectively.

The stakes are high

If a valve should fail, there can be a serious risk of environmental impact, production losses or, worse, the safety of workers. For example, according to a study on containing fugitive emissions published in Chemical Engineering magazine, 60% of such emissions in refineries come from leaking valves. Because of this, plant operators need to pay particular attention to leaks—*which occur most frequently in control valves*
. As operations become further integrated, one failure can have serious consequences. Add social media and a 24-hour news cycle, and a single mistake can turn into a global news story and damage a plant's reputation beyond repair. Even plants that have operated for more than 50 years without incident are not exempt.

If valves are to be properly maintained to avoid the above scenario, the question is this: How does one determine when and how often valves need to be serviced?

Maintenance on the rise

In response to managing risks associated with valves, operators have increased maintenance spending. But in today's refineries, that spending, which averaged $27 billion in 2011 [Ref. 1], is growing faster than capacity. Even with increased maintenance spending, however, the number of unplanned downtime events continues to increase. These days, 50% of refinery maintenance is now unplanned–*double the rate of a decade ago [Ref. 2].* In fact, in 2011 alone, there were an estimated 2700 unplanned events in refineries [Ref 3].

Plants and refineries are responding by increasing valve maintenance planning. Certainly, good maintenance planning helps keep valves serviced and operating properly. Good maintenance

planning means doing the right maintenance on the right valve at the right time—and that differs for individual valves. Automatically scheduling valve maintenance on a single pre-determined cycle doesn't take into account the unique operating conditions that an individual valve experiences in service. This results in valves that fail sooner than expected (in between maintenance cycles) or valves that don't need to be serviced at the maintenance cycle. To optimize maintenance (including reducing its costs), a customized and integrated approach to valve maintenance is in order.

Maintenance optimization challenges

An integrated approach to valve maintenance planning requires plants to consider many factors that may contribute to downtime and safety and environmental risks.

They include:

- Changes to plant process conditions
- Equipment used throughout the plant's operations and any changes made to it
- Safety records and training of the workforce
- Service records and parts used
- Amount of maintenance needed to avoid failure
- Analysis of repeat breakdowns
- Quantity on hand and availability of spare parts
- Changes in regulations

It's common for plants to not have complete and accurate records of their valve assets and the past service work that was done. Moreover, what records are maintain-ed can be stored in different locations by various personnel. This makes it difficult to optimize maintenance—*and almost impossible to identify trends*
. Compounding the issue, operations often choose to schedule regular planned maintenance across the board, hoping that will allow for the repair of any potential problem valves before they fail. This approach can lead to even more issues as it doesn't take into account prior performance or repair history.

Valve asset-management solutions

An alternative approach to more thoroughly and regularly maintaining and monitoring a plant's valve assets is to utilize an asset-management solution. Operators work with a service provider to determine a predictive and preventive maintenance schedule customized for the site's specific valve population—*a schedule that based on each valve's service and performance*

history.

Via a predictive as opposed to an automatic approach, an operator prioritizes maintenance and service based on data that includes experience, observation, historical data, failure modes and testing, coupled with analysis of the probability and impact of a valve failure. This determines when maintenance should be scheduled. A comprehensive asset-management solution includes the following:

- Plant asset data including testing of all assets as well as an ongoing service schedule for them
- Historical performance of the assets as well as the current condition of the asset and its components
- Inventory management and planning system detailing the location and count of each asset and spare parts
- Performance indicator report with comprehensive metrics and charts showing calibration records and trending information
- Real-time monitoring and diagnostics tracking repair cycles and data on assets that will help set maintenance schedules
- Proposed preventive/planned maintenance schedule detailing how often each asset should be scheduled for maintenance based on its performance

Valve asset-management maintenance techniques

Risk-Based Inspection (RBI) is a key analysis to achieve the optimum maintenance interval by assessing how likely the asset is to fail and how large the impact of a failure would be. When assessing the probability of valve failure, inspection detail is carried forward to create an RBI path. Previous inspection history is reviewed and a revised probability score is determined. The RBI probability score is then mapped to the RBI scheme to get a low, medium or high determination of the probability of failure.

It's important to involve the process owner when assessing the consequence of valve failure. That's because the process owner will have the best vantage point as to the impact of failure and be able to discuss and determine what it considers high, medium and low impact of failure for that valve at that point in the process.

Plants can then schedule their maintenance on critical plant areas based on these insights. Considering that 60% of valves are replaced or serviced prematurely [Ref. 4], RBI can offer considerable performance improvement and savings by providing the planning that leads to

servicing valves when they need it, not on an averaged schedule.

Another effective technique in an asset-management portfolio is Failure Mode & Effects Analysis (FMEA). This type of analysis helps identify potential failures, evaluate the effects of failures and identify the actions that could eliminate or reduce the chance of the potential failure. FMEA helps to minimize valve failures and maximize valve operational reliability.

Root Cause Failure Analysis (RCFA) is a troubleshooting maintenance method that investigates, analyzes and identifies the root cause of a valve failure. Identifying the root cause of valve failure and utilizing the information to make necessary changes to equipment, processes or maintenance regimes can prevent it from happening again. Solutions may involve replacing the valve with a more suitable option or changing a service interval.

Payback from improved valve asset management

The benefits of an effective valve asset-management program are improved uptime and reliability—*with optimized maintenance spending*. An effective valve asset-management system helps a site avoid duplication of spares by improving inventory and availability. The valve population and maintenance schedule are used to optimize spares and maintain the right levels without compromising safety and production. (Table I reflects common issues and implications that are addressed and solved by implementing a valve asset-management program.)

Table I. Effective Valve Asset-Management Solves A Range of Problems

ISSUE	IMPLICATIONS
Asset records not up-to-date	Delays future turnarounds
Service history not complete	Delays project management schedule
Obsolete or recalled assets still in use	Increased costs to replace
Planned maintenance not based on analysis	Unnecessary repairs and downtime
No standardization of assets	More inventory than needed
OEM parts not available	Risk of failures

The final word

Remember that you don’t have to “go it alone” when it comes implementing a valve asset-management program. Close collaboration among plant operators, valve service providers and valve manufacturers will yield the best result. **MT**

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As part of Tyco Valves and Controls Global Oil and Gas Marketing Group, Michael Romano is responsible for the Unconventional Oil and Gas and After Sales Service. He has published numerous papers in key Oil & Gas publications over his 20+ years in the industry, and has been nominated by API and participated in the development of ISO standards, including chairing several U.S. Technical Advisory Groups. Romano has received five U.S. and three Canadian patents on materials and processes related to the Oil and Gas segment. A chemical engineering graduate of McMaster University (Canada), he’s a registered professional engineer in Ontario, Canada.

(EDITOR’S NOTE: One of the cornerstones of an asset-management program is real-time monitoring of asset repairs. Tyco’s Asset Management solution offers real-time and transparent monitoring using the company's proprietary eDge™ Asset Management System. According to Tyco, it can simplify the task of tracking valves through the entire repair process and help customers efficiently plan for future maintenance.)

Case Study: The Benefits of Preventive Valve Maintenance for a Major Refinery

Scope of work

- Refinery signed a five-year preventive maintenance contract with Tyco Flow Control that was renewable after the period for an additional five years. Contract is currently on its 14th year.

- An intensive investigation was conducted that was used to feed inputs into the RBI scheme in order to develop the probability and consequence of failure.
- Service intervals were then analyzed and re-defined based on the inputs.
- Problem valves were identified, analyzed and issues addressed.
- By replacing these problem valves, the safety and performance of the plant was improved.

- The average service interval went from 26 to 43 months, saving the refinery $2 million in service costs.
- By 2006, 50% of valves required an inspection only every 36 months or less.
- By 2011, this was further reduced to 20%.