BRAY: Valve Design for Repairability

Application of excessive torque is one of the ways gremlins sabotage valves

A new valve design often begins with an industry standard, such as ASME B16.34 or API 6D, and focuses on the end user's required performance of the valve for an application and set of service conditions. It typically includes consideration of safety, reliability, manufacturability, cost of manufacturing, and marketable features. But often the missing design parameter is one of the most important to an end user– repairability. After all, "Valves never leak." That statement will give any plant operator or startup engineer a good laugh. They know that even the best-designed and most robust produced valves can be damaged, experience seat wear, or require retrim.

By Stanley C. Allen – Bray International, Inc.

Catalyst upsets, seat wear due to erosion, stray weld rods during fabrication, chemical upsets, operator error, degradation of stem packing, excessive high cycles, excessive operating force, and many other factors make repairs of valves an unwanted occurrence in any operating facility. While some valve types are designed to be replaced when damaged or experience leakage, many valves require repair to keep an operation or process up and producing until a planned shutdown. A valve that can be easily and quickly repaired in the event of an unexpected event, or even for a planned shutdown, provides a major benefit that is often challenging to quantify. Seat replacement, ball/disc/plug replacement, and packing replacement are areas that offer the most opportunity for returning a process to production and efficiently managing a planned shutdown.

Why is "repairability" of valves often not a major design consideration, or in some cases, not even considered in new valve designs? The answers to this question are simple. Valve design standards focus on compliance with parameters to assure design integrity, quality and performance. Repairability is either not addressed or only to the extent it is part of existing valve technology. Adding repairability features to the design may possibly add costs above and beyond the minimal requirement of the standards, but that is not always the case.

Manufacturers may find it challenging to discuss repairability of a valve when trying to sell a valve that "will last" or when touting a valve's ability to perform for a specified application or set of service conditions. Discussing repairability is sometimes perceived as discussing vulnerability of the valve, and no one in the business of selling valves likes to discuss vulnerabilities. Different valve types (ball, gate, triple offset butterfly, plug) perform differently in an application and set of service conditions, and each of these designs has features and options that may be included in the design to better serve an application or set of service conditions. It must be acknowledged that some applications and service conditions need high quality and reliable valves, but still need the ability to quickly and easily retrim or repair a valve.

No one should be reluctant to say they have a spare tire in the trunk of their car. It would be foolish not to have one, particularly if driving across west Texas. Most automobiles provide tools and access points to easily jack up the car to replace a flat tire and avoid a major travel delay. The same principle applies to repairability of valves in a process.

Larger and Heavier Valves

A typical new valve design activity is to add a larger size or pressure class. As the weight and size of the valve increase, the ability to assemble and disassemble closure members, seats, and other major components is typically considered for factory assembly. But is field or in-line assembly considered during the design reviews? Weight and angles of access must be considered for lifting and maneuvering these components into valves with typical field tools and lifts. Protecting gaskets and seals, adding threaded holes or other attachment points, and adding features to prevent misassembly are all important considerations.

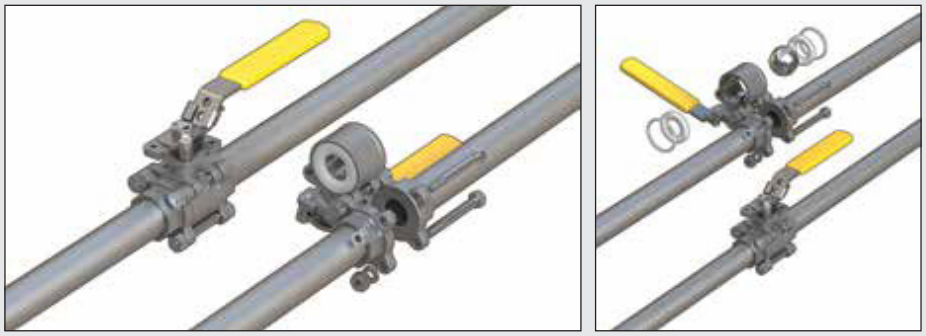
Downtime Costs Money

Continuous processes, particularly those within the oil, gas, chemical, and mining industries, need reliable equipment functioning as designed. The disruption of a process and resultant downtime directly impact production and profitability of the business unit. The implications of downtime while waiting on repair of valves go far beyond the cost of repair.

Total Cost of Ownership

Valves are a significant financial investment. By overlooking maintenance and repair costs, valve buyers waste company money. Total cost of ownership must be considered by applying a life cycle cost analysis. This concept is often used for pumps and other more expensive fixed equipment but should also be applied to valves. This move from focusing solely on the initial procurement cost to looking at the total cost of ownership generally results in a greater return on investment over the life of the valve.

Tri Lok design has both a seat and a seal ring that are independently field replaceable



Flow-Tek Triad and S7000 three-piece body design swings out for in-line repariability.

Besides loss of production, costs of valve repair may include labor, administrative, and inventory costs. Labor costs associated with the repair may involve electricians and instrumentation technicians (in the case of automated valves), welders (for welded-in valves), equipment lease, valve or mechanical technicians, material handlers, lock-out-tag-out activities, hazard prevention and cleaning activities, and inspectors. Some of the administrative costs include maintenance engineering involvement, consultation, equipment purchase, receipt and inspection of equipment, accounting, securing hot work permits, safety analysis and assimilation of MSDS, maintaining equipment service logs, and inspection.

Maintaining an inventory of replacement valves ties up capital that could be wiser spent elsewhere in the operation of a process.

On-site Repair

When a shutdown is planned for maintenance and repair, the obvious desire is to perform the repair as quickly and efficiently as possible. Sending valves back to a manufacturer or even an outside repair facility can be time-consuming and add to the cost of downtime. Onsite repair offers many advantages, but the most important are giving the plant and operator ownership for the priority, speed and quality of the valve repairs.

If a valve is welded in a pipeline, there is an added value to being able to service or replace seats and closure members (ball, disc, gate, plug, etc.) without removing the valve from the line. To cut a line, repair the valve, re-prepare the butt weld end, re-weld the valve back in line, and then stress-relieve the weld, which in most cases, can be a major time and costly undertaking. Being able to perform the repair without removing the valve body is the optimal service situation.

Reasons for repair

The most common reasons for requiring valve repair are (1) damage to seats and closure members (ball, disc, gates, plugs, etc.) from debris, contaminants, high temperature excursions, (2) internal corrosion of various wetted components,

(3) stem-packing leakage due to high cycle, debris, internal and external corrosion, (4) mechanical wear of stems and bushings from cycles and application of excessive torque, (5) cycle wear to seats resulting in seat leakage, and (6) actuator wear. Changes in process fluids and conditions, abrasive material carryover, acid cleaning, and process upsets are other occurrences that may cause valves to require repair.

Bray Tri Lok Triple Offset Valve with Field Replaceable Seat & Seal

The Tri Lok design has both a seat and a seal ring that are independently field replaceable. The valve may be re-trimmed or repaired on site without having to be returned to the manufacturer or specialized repair center. If operating conditions change, the seat and seal can be replaced. If the valve is damaged from weld slag, debris due to upset of a catalyst bed, or another unanticipated occurrence, the seat or seal can be replaced with minimal delay in startup and minimal downtime. Seats and seals are bolted to the body and disc and no special tools are needed. For most other triple offset valves with an integral seat, a small amount of wear or damage can result from the valve having to be removed and sent to a repair facility or manufacturing plant for additional seat material to be added, followed by re-machining the integral seat and its hardened surface. This usually results in significant delays and costs, including lost production.

Tri Lok Weld-End Body with Side-Entry

In a weld-end body, a side-entry access option is available with the Tri Lok design, which provides the optimal repair capability of a weld-end triple offset valve. Seats and seals may be replaced in a weld-end valve without removing the valve from the pipeline and incurring the significant delays and costs of cutting out the valve, reworking pipe and valve body, and welding it back into the line.

Flow-Tek Triad Three-Piece Body Design

The three-piece body design of the Flow-Tek Triad ball valve offers installation flexibility, including elimination of the need for two sets of flanges, and ease of in-line and out-of-line servicing. Maintenance is accomplished without special tools. The benefit with automated valves and weld end valves is significant reduction in downtime. During maintenance, the actuator and accessories can remain mounted on the valve body. The entire valve and actuator assembly is easily reinstalled with no need for recalibration of the unit.

To perform in-line maintenance, two body bolts on opposing sides of the center body may be loosened so the valve can swing to the left or right depending on which bolts are removed. All body components can be serviced in this position without disturbing the piping system.

To perform out-of-line servicing by complete removal of valve from the line, all body bolts may be removed to lift the valve body out of the pipeline. The removed body can be serviced or replaced, then reinstalled without needing to realign the end connections or the piping system.

Eliminate Fugitive Emissions with an Add-on Containment Unit

Flow-Tek's Media Containment Unit (MCU) is designed to provide increased environmental protection and plant safety by offering a secondary seal that can be monitored for early detection of stem leaks. The ability to install an MCU over an existing Flow-Tek bonnet to stop a stem leak may arguably be considered as a best-available control technology (BACT) to eliminate emission of volatile organic compounds or other hazardous fluids. The installation of the MCU may be performed without removal of the valve from service, and with the valve under pressure, when immediate elimination of emissions is required. The investment cast stainless steel unit is highly corrosion-resistant and ideal for harsh environments. Designed for both automated and manual service, the MCU is easily installed in the field onto existing Flow-Tek ball valves. The MCU significantly lowers operating costs by reducing lost production time due to fugitive emissions and unscheduled maintenance.

Bray S98 scotch-yoke actuators have independent torque, pressure, and spring modules which are replaceable and convertible without complete removal of the actuator.

The Flow-Tek MCU features live-loaded stem seals that compensate for temperature and pressure fluctuations, maintaining a leak-tight seal for extended service life. Multiple TFM V-ring stem packing provides a secondary stem seal. A TFM gasket seals against possible leaks between the unit and the valves. Considering the valve may be a Flow-Tek API 608 design with API 641 qualified and certified low emissions design, this add-on technology may be considered an insurance policy for compliance with low emissions for extended periods.

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Flow-Tek MCU immediately stops packing leaks with valves still in service

In addition, a strategically placed monitoring connection to the MCU allows the customer/operator to use a pressure gauge or sniffer sensor for early detection of primary stem seal leaks. It can be adapted with a button head check valve to inject sealant for a third seal or for emergency shut-off.

An optional second port allows for a combination of monitors, check valve injection or pressure displacement line. A positive pressure seal can be accomplished by permanently connecting a pneumatic line to the unit to provide a positive pressure supply that slightly exceeds the valve line operating pressure.

Modular Scotch-Yoke Actuators

The importance of repairability extends beyond the valve itself to actuators and controls. Bray has extended designing for repairability to Bray scotch-yoke pneumatic actuators with the development of independent torque, pressure, and spring modules, which are

completely replaceable and convertible without requiring complete disassembly of the actuator. In addition, accessories are configurable and direct-mount to the actuator, which not only provides flexibility in the initial assembly, but allows safe and easy field modifications or repair with minimal impact on downtime. Modularity requires manufacturing to precise tolerances, which becomes an important part of the design specification. In addition, accessories are configurable and direct mount to the actuator, which not only provides flexibility in the initial assembly, but allows safe and easy field modifications or repair with minimal impact on downtime. The retrofit or elimination of a manual override, change in fail-safe action (from close to open, for example), a significant reduction in air supply pressure, additional sets of limit switches, and modification of control logic are examples of important field changes that can be easily supported using modules.

Conclusion

Valve repairability is an important design parameter that provides a value to the end user by reducing downtime and lost production. The value to the end user may be determined by analyzing the total cost of ownership and considering the multiple costs associated with valve repair and downtime.

For engineering and procurement companies, this is also important for a smooth facility startup. Valves are damaged by weld slag, over-torqueing, over-pressurization, incorrect installation, etc. and repairing valves easily can improve the efficiency and timeline in a startup. Actuators may require reorientation or even change of fail action during the construction phase.

Valve and actuator manufacturers who include repairability as a design parameter provide a needed and critically important value to both end users and engineering companies.