Mathieson maps out Baker’s ‘big change’
Completions come in from the cold
Subsea deep clean

PLUS: HOW ROV ACE SCHILLING AND FMC ARE PLANNING TO PAVE THE WAY TO THE ‘SILICON SEAFOOR’
Skid integrators get to grips with tubing challenge

Integrators charged with building chemical injection skids for medium-pressure applications face some formidable obstacles. Two of the chief obstacles concern critical fluid system components: medium-pressure instrument ball valves and reliable end connections for use with SAF 2507 tubing. Swagelok’s Bill Menz and AGI Packaged Pump Systems’ Tony Taylor discuss.

Under certain circumstances, instrument ball valves in the medium-pressure range are known to leak across the seat. After sealing at high pressure, they may have difficulty resealing at low pressure, especially if pressure in the system is being built up slowly.

End connections for the valves pose a special challenge when the tubing required is made of SAF 2507, a corrosion-resistant material preferred in many aggressive chloride-containing environments.

Until recently, the market has not provided simple, easy-to-use, mechanical grip-type tube fittings for SAF 2507 tubing at pressures up to 15,000psig. For such applications, the industry has relied on cone and thread fittings, which can be temperamental and difficult to fit and assemble.

AGI beta tests a new valve

As an integrator that has built skids for most of the major oil companies, AGI Packaged Pump Systems was acutely aware of the challenges concerning medium-pressure instrument ball valves and end connections for SAF 2507 tubing. Therefore, when it accepted a contract to build two medium-pressure skids with SAF 2507 tubing – a chemical injection skid and a methanol injection skid – AGI looked for a company that could provide new solutions.

Swagelok had developed – but not yet released – the FKB series medium-pressure ball valve, employing a new technology that would enable the valve to seal and reseal reliably across the entire pressure range up to 15,000psig.

Offering to beta test the valve, AGI built a testing fixture designed to put the valve through a rigorous set of cycles simulating conditions on a methanol injection skid for deep water exploration. The test employed methanol as the fluid medium and involved using a small pneumatic pump to slowly build pressure to 15,000psig on a closed FKB series medium-pressure ball valve; opening the valve and releasing the pressure to the atmosphere, closing the valve and repeating the process.

AGI planned to cycle the test valve until failure. The test ran for two and a half days, with the valve completing over 4000 cycles without failure. At that point, AGI was satisfied with the performance and stopped the test. Over the 20-year life of a chemical injection skid, an instrument ball valve is typically cycled 300 times, about once per month.

The challenges concerning medium-pressure ball valves apply to other oil and gas applications as well. In wellhead control panels, workover vessels or workover panels, medium-pressure ball valves are used to deliver hydraulic pressure to the large wellhead safety shutoff valves at the subsea wellhead. Pressures up to 15,000psig are required because of the depth of the wells. Medium-pressure ball valves are also used on hydraulic power units, where hydraulic pressure for platform utilities is maintained. In all of these applications, leakage is a serious issue. The substances under pressure are often flammable.

Finding the right connection

Integrators are frequently under very tight time constraints when they are building skids for platforms. The project may be behind schedule even before the fabrication begins. Therefore, efficient component assembly is critical to keep a project moving.

Cone and thread fittings are time consuming to assemble. Any imperfection in the cone or the nipple increases the likelihood of a leak. Concerns about quality have led some owner companies to require that the nipples be purchased from the factory rather than be made
where the sealing force is provided solely by the upstream seat. Another source of sealing force is system pressure itself. Valves that are not live-loaded may rely entirely on system pressure to generate the force between the ball and the downstream seat. In this case, sealing force may be adequate at the upper pressure range, but inadequate in the lower pressure range. Once the seat has become compacted – or ‘taken a set’ – at high pressure, resealing at lower pressures may be difficult. The seat material may not have enough memory to return to its original shape. Therefore, with low system pressure and no springs, there may not be enough force to make the seal.

Under such circumstances, a technician may crank the end screws tighter to prevent leakage. This action may correct the immediate problem but with an unintended result: Actuation will over the entire pressure range up to 15,000psig. The valve’s effectiveness may be attributed to a special type of patent-pending live-loading technology termed ‘direct loading’.

A ball valve seals because of contact pressure between the ball and the seats. One of the principal challenges in designing a ball valve is determining how to generate sufficient force to create this contact pressure. If the force is too little at any point in the pressure range, the valve will leak. If it is too great, the valve will be difficult to actuate and its cycle life may be compromised.

Live-loading is one means of applying force. Live-loading refers to a spring that fits somewhere between the end screw and the seat. Usually, the spring pushes against a seat carrier, which is a device that holds and positions the seat for ideal contact with the ball. Live-loading is especially important for three-way valves where the sealing force is provided solely by the upstream seat.

Another source of sealing force is system pressure itself. Valves that are not live-loaded may rely entirely on system pressure to generate the force between the ball and the downstream seat. In this case, sealing force may be adequate at the upper pressure range, but inadequate in the lower pressure range. Once the seat has become compacted – or ‘taken a set’ – at high pressure, resealing at lower pressures may be difficult. The seat material may not have enough memory to return to its original shape. Therefore, with low system pressure and no springs, there may not be enough force to make the seal.

New ball valve design

AGI’s beta test of the FKB series medium-pressure ball valve demonstrated that the valve reliably and repeatedly seals over the entire pressure range up to 15,000psig. The valve’s effectiveness may be attributed to a special type of patent-pending live-loading technology termed ‘direct loading’.

The FKB series valve design, in which the seat carrier is stepped, enabling the springs and the system pressure to act at different points on the seat carrier. Each force counts, regardless of its relative value. System pressure will not collapse the springs.
The initial pressurization of the system had compacted the seats and therefore the valves could not reseal as pressure in the system was being built back up. The FKB series ball valve and medium-pressure end connections saved AGI considerable time and costs during the initial fabrication and at final testing.

When a component is dependable and easy to use, there is a quantifiable savings in avoided guesswork, setbacks, reconfigurations, failed tests, and delays resulting from special tools that are not readily available or parts that need to be reordered and refitted. Additional savings are realized by the end user in reduced maintenance costs and ease of service throughout the life of the skid. Total cost of ownership over time – as opposed to the initial purchase price of a component – is the appropriate frame of reference when comparing costs.

The two new skids that AGI successfully fabricated with medium-pressure ball valves and end connections for use with SAF 2507 tubing are in service on platforms in the Gulf of Mexico.