A white paper

Engineering GREAT Solutions

Bypass function for online servicing and valve testing

Complete system fully SIL certified

Modular design

Reduced installation time

Redundancy and diversity

Manifold Wisdom
Redundant Valve Manifold Systems (RVM)
Executive Summary

Achieving the goals of process safety and reliability in both upstream and downstream oil, gas and chemical processing and power stations is a challenge which has tested the resources of system designers over many years. Redundant valve systems are widely recognised as the optimum means of achieving this but until recent years these systems have only been available in ‘piped’ versions, involving multiple components and many potential problems down the line. However, significant investment in research and development by leading players in the valve sector has created a highly innovative new system which brings unprecedented benefits in performance and whole life costs.

Phil Keating, Business Development Director
– Energy Sector
Working with high-value but potentially dangerous materials such as crude oil, natural gas, chemicals and petrochemicals presents a unique set of challenges.

On the one hand there is the need to minimise unplanned interruptions to production, with costs of £1 million per day in lost production alone not untypical. Meanwhile, the health and safety implications – and therefore the legal and reputational considerations – associated with mechanical problems or systems failure are considerable, involving operational and commercial costs which for most companies cannot be countenanced.

The solution in applications where unscheduled interruptions are not allowable is to use a “two out of two” (2oo2) system containing two valves which will allow media to flow even if one of the valves fails. In safety-critical situations, where the need to immediately shut down processing is paramount, a “one out of two” (1oo2) system is normally fitted.

Again, even if one of the two valves sticks in the open position or fails, the other can be used to shut off production.

While most processing plants use one of these two methods depending on their own specific requirements, there are still some facilities which use a single valve for process control, which introduces a number of issues. Not only is there no redundancy to shut off production in the event that the valve fails, but there is no guarantee that production can be rapidly restored either.

At the other end of the scale, customers are now demanding systems which offer the best of both worlds in terms of safety and availability, driving the development of the first “two out of three” (2oo3) valve systems.
Current system options – and the issues with them

Traditional redundant systems – whether 1002 or 2002 – tend to have the valves bolted to a backplate and connected together using either stainless steel or hard tubes. However, once a configuration has been chosen, it cannot easily be altered (for example to a 2003) without the costly and cumbersome addition of another backplate.

Meanwhile, these systems present a number of safety and operational issues. Firstly, even if a system itself uses only SIL (Safety Integrity Level) approved components, the final system itself will not be SIL-approved. Poor design, incorrect specification and sub-optimal installation and configuration can all contribute to the creation of a system which may be a long way from meeting local and international safety standards – very worrying given the potential safety issues associated with the system contents.

Meanwhile, the sheer volume of components used can itself create problems. Every additional component included will create further potential leak paths – even more so as distance between those components increases. Not only is this wasteful, but again potentially very dangerous. And of course each system will require a considerable time to assemble, with testing required at each stage.

However, the issue of downtime becomes even more pronounced when unscheduled maintenance or replacement is considered. It is inevitable that the entire process will have to be shut down, even for minor maintenance to the valve system. In most instances, this will entail a minimum of a day of downtime when the time for restarting and flushing out the system is factored in. Daily costs for downtime can range from £100,000 to upwards of £1 million in lost production alone in ‘cracker’ plants where oil is being distilled into different products – to say nothing of, for example, damage to heating elements which can burn out if not being ‘fed’. Of course, even these costs can pale into insignificance when compared with the costs of a missed order deadline and the reputational damage that can occur as a result of this.

Finally, with most piped 1002 or 2002 systems, there is no indication that one of the two valves has failed until or unless both valves fail.

Other options currently available on the market include systems which allow individual valves to be bolted together but which are far from simple to disassemble and are generally only suited to valve and filter regulator combinations. Meanwhile, ‘redundant control systems’ are frequently little more than a piped system in a cabinet. Not only does their large footprint create mounting issues, their operating temperature range is lower – typically only between 0°C and 50°C – while online servicing is not an option. Perhaps most importantly, though, they are only available in 1001 or 2002 configurations, making them unsuitable for safety-critical applications.
The redundant valve manifold solution

A system recently introduced to the market which addresses all of these issues is the redundant valve manifold (RVM) system. Working in conjunction with lead customers, the development of the system drew on the expertise of our engineers based at two facilities in the UK and one in Germany.

It is based around proven technology in the form of IMI Herion valves, with IMI Maxseal valves redesigned to have the same footprint to allow for simpler integration. This is the only system on the market which can accommodate combinations of valves in this way, offering unrivalled diversity.

As the name suggests, RVM is the first true manifold system commercially available for redundant applications in the energy sector. Able to be supplied in both aluminium and stainless steel, RVM products are compact modular units which for the first time negate the need for pipework by incorporating all functions governing both safety and availability in a compact, simple to install, low-maintenance, integrated valve control unit. The range offers all possible configurations – 1oo2, 2oo2 and 2oo3 – making it suitable for virtually all applications.

It has just one inlet and one outlet, making installation rapid and simple, while minimising potential leak paths. The complete unit is SIL approved, while it can operate at temperatures between -60°C and 90°C, making it suitable for the extremes of temperature commonly found in the global oil, gas and chemical sectors. RVM products use direct acting valves due to their higher force friction ratio (FFR) which gives a higher likelihood that the valve will operate when required, unlike some systems which use indirect valves. Given the extremes of temperature under which extraction occurs – friction necessarily increases at very low temperatures, while seals can become more ‘adhesive’ at higher temperatures, again increasing friction – this is a key attribute of RVM products.

Each unit features visual valve status indicators and/or electrical sensors to provide information on when a fault has occurred, allowing for quicker maintenance and replacement.

There are also options of a manual or electrical by-pass system to facilitate online servicing and testing of solenoid valves, without the need for a complete process system shutdown.

The range incorporates both standard flow and high flow models, meaning no requirement for a booster which may not itself be SIL approved, and again reducing component count. All RVM products have both TÜV and SIRA approval. Exhaust guards prevent particle ingress from the local environment, while cable terminations are inside the coil, meaning no additional Ex terminations are needed.
A number of other further developments are planned for the RVM range to meet ever changing customer requirements.

RVM versions with interlocks are being introduced for applications where total control of the system is required to meet local requirements for operator and maintenance engineer safety.

Meanwhile, for very high pressure applications of up to around 400 bar, where pneumatics systems are not an option and hydraulic systems have to be used, such as riser valves on oil platforms or turbine controls within power stations, hydraulic 2oo3 versions of RVM are being developed. In these applications, both process continuity and safety are key, but pipe systems are not an option due to the damage that could be caused to both operatives and equipment if a piped system were to suffer a stress fracture at high pressure.

Find out more about RVM at www.imi-precision.com/rvm