Electro-hydraulic actuation delivers the solution for remote operated shut-off valves

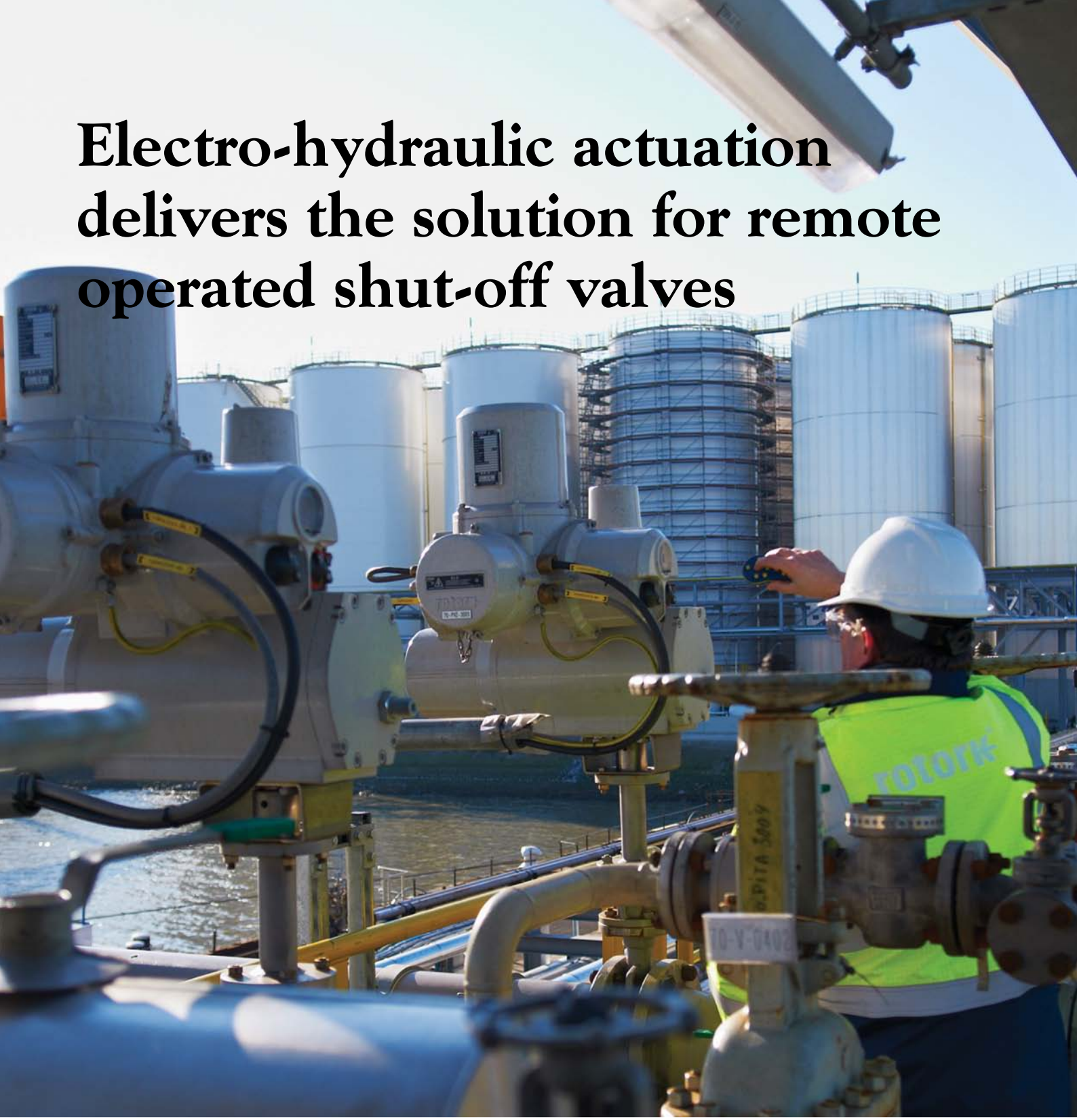

Fig 1 - A Rotork engineer uses the hand-held setting tool that enables non-intrusive programming of Skilmatic actuators and data downloading.

An extensive review of safety measures recommended by the MB Lal Committee in India, following an accidental fire at the IOCL Jaipur Terminal, has resulted in the introduction of electro-hydraulic failsafe actuators for critical tank farm Emergency Shutdown (ESD) applications. These valves, known as ROSOV (Remote Operated Shut-off Valves), now provide tank overfill protection at the majority of storage facilities owned by the Indian oil industry.

The application required the valves to be electrically operated, spring-return failsafe with SIL2 functional safety and certification for use in hazardous areas. During the two-year specification writing period, Rotork worked closely with the three main oil companies in India, providing live product presentations, technical advice and performance reports, leading to the selection of Rotork Skilmatic electro-hydraulic actuators operating triple-offset butterfly valves as the standard for the critical ROSOV application.

The Jaipur accident has similarities with the Buncefield fuel depot fire in 2005, since when much has been done to ensure that such a catastrophic accident should not happen again. In the UK, the Competent Authority/Industry Standards Task Group (COMAH) has led the way for safeguards to be put in place by the industry to provide additional safety and environmental protection at tank farms. Endorsing the recommendations of the Buncefield Standards Task Group, a key feature of these safeguards is the installation of ROSOV valves with failsafe actuation for ESD duties.

The majority of ROSOV valves are situated on the inlet and outlet ports of the fuel storage tanks and are designed to isolate individual tanks in the event of a potential emergency. The predominant tank farm actuation technology is electric, which suits the very spacious environments which typify these sites. Within such environments it would be very expensive to install a pneumatic ring main, whilst an electrical source for control and indication is traditionally available on these installations. It therefore makes economic and practical sense to use electricity to power the ROSOV actuators as well.

Electro-hydraulic ESD valve operation

A specialised electric actuator design is necessary to achieve the swift failsafe operation demanded by the ESD duty. Experience has shown that this can be successfully delivered through the electro-hydraulic route. Electro-hydraulic actuators use a simple and therefore very reliable mechanical spring to provide failsafe valve movement, whilst precise and swift valve movement in the opposite direction is achieved hydraulically by means of an integral electrically powered pump. With this design, reliable failsafe performance can be combined with the benefits of the latest electric actuation technologies, facilitating a high level of asset management encompassing accurate control, monitoring and alarm signalling, operational data logging and diagnostics. Further savings in capital and maintenance costs can be achieved by the simplification resulting from the adoption of an all-electric solution for the overall plant control system.

Fig 2 - Rotork Skilmatic electro-hydraulic actuators selected as standard for the operation of triple-offset butterfly valves for ROSOV applications on critical tank farms in India.

Around the world the electro-hydraulic solution for critical ROSOV applications is being provided by Rotork Skilmatic actuators. In addition to tank farms, areas of application include the isolation of sections of pipelines between pumping stations and the protection of remotely sited natural gas wells. Combining all-electric simplicity with the precision of hydraulic actuation, standard Skilmatic features include non-intrusive setting, performance monitoring and configurable data logging of valve and process data for analysis, preventative maintenance and asset management. The actuators operate on a pump and bleed principle utilising a motorised vane pump to provide hydraulic pressure in one direction and spring-return in the opposite (bleed) direction.

When the actuator is commanded to open from the closed limit, the bleed solenoid valves are energised. The motorised vane pump is started under no-load condition as a result of the delay in energising the by-pass solenoid valve. With the by-pass solenoid energised, the system pressure acts against a spring opposed piston to drive the actuator in the open direction. When the actuator is commanded to stop or reaches the open limit, the by-pass solenoid valve is de-energised, followed by the motorised vane pump after a preset time unless a new command is given. The bleed solenoid valves remain energised and the system pressure is maintained to hold the actuator position.

When the actuator is commanded to close or receives the ESD signal, the by-pass solenoid valve, bleed solenoid valves and motorised vane pump are de-energised. Pressure is released; the hydraulic fluid returns to the reservoir and the spring

Fig 3 - Rotork 3rd Generation Skilmatic SI3 self-contained electro-hydraulic valve actuator.

returns the drive shaft to the failsafe position. ESD can be configured to operate on loss of mains power supply or control signal (ESD signal). The ESD action can be configured to failsafe closed, open or stay put.

There is also an option to add a second ESD circuit with the following functionality. Two independent ESD signals operating the same solenoid valves; if either ESD signal is removed the actuator will perform the safety function by using the same final elements. Two independent ESD signals operating independent solenoid valves; if either ESD signal is removed the actuator will perform the safety function by using different final elements.

As an added safeguard, an optional ESD manual reset can be enabled to restrict the actuator from operating until locally reset at the actuator or with an externally mounted switch. Closing speeds can be adjusted to meet the specific requirements of the application.

Skilmatic actuators – new developments

Specifiable for three-phase, single-phase or DC electrical power supplies, the Skilmatic range delivers a range of rotary torque or linear thrust outputs that are suitable for valves of virtually any size and design. The advanced control and monitoring functionality of the range has been further developed with the introduction of the 3rd Generation SI3 Range, incorporating proven Rotork IQ3 intelligent electric actuator technology (Rotork IQ3 intelligent valve actuators are designed for isolating, regulating and modulating duties on multi-turn and part-turn valves). Communication and data logging capabilities have been increased in response to end users' desire to access more valve related data, both in the field and in the control room.

Skilmatic SI3 actuators combine established features with an extended torque output range, increased functionality and enhanced availability of valve and process data for asset management and data analysis, displayed in a new, large and information-rich format. Safe valve positioning is selectable for failsafe to open, failsafe to close or lock in position on either loss of power or a range of programmable ESD signal options.

The control module facilitates simple, safe and swift non-intrusive commissioning by means of an intrinsically safe hand held setting tool with infra-red and Bluetooth® interfaces. Settings including internal hydraulic pressure, position, limits, control, alarm and indication functions can be accessed and adjusted using user-friendly Rotork 'point and shoot' menus. Actuator status, control and alarm icons are provided on an advanced new dual-stack toughened glass illuminated display which also gives access to real-time information such as pressure, diagnostics and help screens. Data from the actuator can be transferred to a PC for storage and analysis by means of Rotork Insight2 software. Offering flexibility of customisation to suit the application, the actuators can be integrated into the majority of digital bus control systems, including Pakscan™, Foundation Fieldbus®, DeviceNet®, Profibus®, Modbus® and HART®.

Designed for functional safety applications to SIL2 (1oo1) and SIL3 (1oo2) for use on safety critical applications, the actuators are also offered with enhanced partial stroke testing (PST), enabling valves to be function tested without affecting the process. Performed either locally with the setting tool or remotely from the control room via hardwire or fieldbus communications, PST tests all the final elements (actuator and valve) by measuring the time to move to a set position whilst monitoring the pressure. PST results are recorded by the integral datalogger, shown on the display screen and optionally remotely indicated.

All actuators are available with hazardous area certification encompassing ATEX, INMETRO, IEC, FM, CSA and GOST.

The double-sealed electric enclosure is watertight and dustproof in ratings up to IP68 (submersed to a depth of 7 metres for 72 hours).