



The company is now completing the final phased contracts to install new electric actuators on approximately three hundred major valves as part of a strategic upgrade programme at the National Grid Transco Bacton gas terminal in the UK. It has replaced earlier versions of its own actuators, which in most cases have been operating since the Bacton plant first began processing North Sea gas in the early 1970s.

Valve actuators: vital elements for reliability and plant safety

In any hazardous area installation the requirement for safety is paramount and recent accidents at refinery and tank farm sites offer vivid illustrations of the catastrophic consequences of such events. Valve actuators have an important impact on safety as vital components for the movement and isolation of bulk fluids, providing not only the muscle to open and close the valves but also the 'brains' to communicate their activities and operating condition. The advent of digital communication technology has dramatically enhanced the functionality of modern actuators whilst a long history of development in the oil and gas industry environment has, in the case of Rotork, produced a comprehensive range of designs and technologies to meet isolating, modulating, failsafe and ESD (emergency shut down) duties. Selection of the appropriate equipment will enhance the reliability of the plant and meet the requirements for safety demanded by increasingly strict legislation.

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Intelligent actuator development

Rotork is celebrating its fiftieth birthday in 2007 and throughout its entire history the oil and gas industry has been and continues to be a market of great importance to the company. Within this industry, the company has extensive experience with hundreds of thousands of actuators installed on sites in every part of the world. Indeed, it was as a

result of oil industry activity in the early 1960s that Rotork began to develop design features in its electric actuators that have become benchmark industry standards. Probably the most significant is 'O' ring double-sealing, born out of the environmental challenges of the Middle East, where the practice of fitting breathers and drains to explosion-proof equipment caused problems with

condensation leading to breakdowns and high maintenance costs with traditionally designed actuators.

The company's solution was to adopt circular spigoted flange paths as an alternative to the customary flat flanges and fit them with 'O' rings to provide environmental sealing. The result was the first electric actuator design to feature an explosion-proof and watertight enclosure.

The double-sealing aspect of the design concerned the terminal compartment, where it was discovered that covers could be removed for days on site whilst wiring up was in progress, once again leaving the internal electrics vulnerable to the effects of the weather. Double-sealing prevented this through the introduction of a separately 'O' ring sealed terminal bung. As a result, when the terminal cover was removed any ingress of water or condensation could not reach any part of the actuator's internal electrical parts. This feature is now a standard in all of Rotork's electric actuator designs, but its introduction in the 1960's has also facilitated dramatic advances in the functionality of the modern electric valve actuator. Again, going back to the 1960's, the first of these was the ability to incorporate electric motor starter and control equipment within the actuator enclosure itself, instead of remotely siting such equipment in separate motor control centres. Introduced as Rotork Syncropak, this design created enormous savings in installation costs through reduced wiring, wiring trays and barriers as well as simplifying the overall layout. Today, the modern evolution of Syncropak is sold in virtually every actuator marketplace and application. The advancement of electronics has enabled increasingly sophisticated control and indication functions to be included within the actuator, such as remote monitoring circuits and standard multi-voltage control inputs. Further innovations include Syncrophase, whereby the actuator motor will always run in the required direction, no matter which way its three-phase connections are wired in, ending the threat of valve damage caused by incorrect phase rotation. By the 1990's a solid state gate array replaced numerous separate electronic components in the Rotork control module, securing optimum reliability in the harshest of operating environments. By that time three decades of development meant that the only cover that it was necessary to remove on site was for resetting the switch mechanism, and this was therefore the only time

when the actuator was potentially vulnerable to the effects of moisture in the environment. The introduction of the IQ intelligent actuator in 1993 eliminated this single surviving window of vulnerability.

The Rotork IQ broke new ground with the introduction of 'non-intrusive' data communication by means of a hand-held setting tool, utilising infra-red technology to enable actuators to be commissioned, even in wet or hazardous locations, without the necessity of removing any electrical covers. Electronic technology also enabled the commissioning of actuators without mains power connected. Another feature of the 'non-intrusive' design introduced local control switches (open/stop/close, remote/local) that do not penetrate the actuator enclosure, further protecting internal components from the threat of environmental harm. The IQ also utilised electronics to replace the traditional switch mechanism, combining it in a single module thus encompassing all the actuator's control and instrumentation functions. Now in its third generation, designated IQ Pro, the actuator has been constantly developed to optimise reliability and proactively improve plant utilisation.

Today's intelligent actuator

The IQ Pro is a rugged, mechanically simple and therefore reliable actuator for multi-turn or quarter-turn valves. Designed in the main for isolating duties

(although modulating versions are also available), the IQ Pro is mechanically simple, whilst its control and indication functionality is highly sophisticated (intelligent) and user friendly. These features facilitate automation, safety and optimum plant utilisation.

Non-intrusive communication

An intrinsically safe, hand-held setting tool is used to commission the actuator, following the instructions on the actuator's illuminated LCD display screen, utilising a non-intrusive cableless infrared communication link. Settings can also be downloaded by the same tool and used to programme other actuators, saving time in installations containing many units with similar commissioning requirements.

The screen provides a comprehensive numerical and textual representation of the status of the actuator, with user configurable multilingual capability. All actuators incorporate real time, instantaneous torque and position monitoring which is used to record and store valve performance during operation, enabling the effect of process changes, wear and duty to be evaluated. Using the setting tool the actuator display can be programmed to indicate real time torque and position. Also included are texts to assist in the identification of valve, control or actuator alarms. The idea behind these is that users only use these screens infrequently and therefore need immediate, clear information.



IQ Pro actuator and hand held setting/communication tool.



Skilmatic actuators installed at Chevron Texaco, Plymouth, UK.

Predictive maintenance

A data logger in each actuator stores commissioning settings, valve torque signature profiles, a historical log of valve operations and a record of torque values during each opening and closing operation. The setting tool allows the user to extract and store this information, which can be downloaded and viewed on a PC running IQ-Insight software. Process changes, such as differential pressure, tight spots in valve travel and changes in torque profiles can be identified by analysing this data, facilitating predictive maintenance of the valve in service. In this way unexpected interruptions to plant operation are avoided and safety is enhanced.

Spread of intelligence

The company's IQ actuator intelligence, functionality and asset management benefits, as epitomised by non-intrusive communication, datalogging and performance analysis, were originally developed for actuators designed for valve isolating duties and modulating duties within the range of 1200 starts a

hour. Such actuators are generally not suitable for failsafe and emergency shut down duties unless additional plant such as independent electric power sources are provided, and therefore these specialised applications still tend to be fulfilled by fluid power (pneumatic and hydraulic) actuators with spring-return capabilities.

A recent development in which considerable investment has been placed is the electro-hydraulic actuator, which is a self-contained unit providing the speed and flexibility of hydraulic operation for double-acting, spring return, failsafe and ESD operation with the convenience and control benefits of the electric actuator, including IQ intelligence and 'non-intrusive' technology.

Electro-hydraulic actuators are equipped with an integral hydraulic reservoir and pump to provide the operating motion, for quarter-turn or linear valve operation. Rotork offers several variants of the actuator type, including the Skilmatic SI Range. The benefit of electric operation has made these popular with the owners of tank farm facilities

who have been seeking to improve failsafe emergency shutdown valve performance.

At the Chevron Texaco site in Plymouth, for example, Skilmatic electro-hydraulic actuators have been installed to replace obsolete equipment on ESD valves fitted on the product lines between the storage tanks and export loading bays.

Emergency pushbuttons on each loading bay and at other strategic areas cause these actuators to close immediately and stop the flow of product in the event of a perceived or potential hazard.

Large electro-hydraulic actuators are also manufactured by the company's Fluid Systems Division to suit applications such as mainline block valves and ESD valves on cross country pipelines. In a recent contract, the firm's PCI electro-hydraulic actuators have been supplied for the operation of such valves in sizes up to 42 inches on the Baku-Thilisi-Ceyhan (BTC) strategic oil pipeline. These large, heavy duty actuators are custom-built to suit precise control and safety procedures, and include integral accumulators to guarantee valve operation without the hydraulic pump running. Other special safety features include earthquake-proof solenoid valve assemblies and partial stroking function testing capabilities.



Electro-hydraulic actuators have also been installed during an upgrade on the BP Unity platform, a vital unmanned facility that receives the oil from five fields in the North Sea and sends it ashore through the Forties Pipeline System. Eleven actuators perform ESD duties on high pressure (Class 1500) riser valves, replacing traditional hydraulic actuators and associated compressor plant.

Rotork's intelligent data logging and diagnostic capabilities enable valve and actuator conditions to be remotely monitored and logged - in this case at the BP Unity onshore control centre - minimising the risk of unexpected problems and helping to maintain the platform's very high availability commitment.

Fireproofing

The equipment described so far has an impact upon improving safety and the prevention of accidents. If, however, an accident does occur it will often result in a fire of some description. Danger and damage from fire can be minimised by the effective protection of the systems controlling the plant, which for the most part are valves and actuators. This is when fireproofing plays a crucial role. A number of different fireproofing systems are available for actuators, each enabling the unit to continue to function when engulfed by the fire, in some cases for periods of up to two hours. In all cases it has to be emphasised that successful fireproofing is also dependant on the effective protection of the elements (cabling, air lines, hydraulic lines) that bring power and control to the actuation, as well as the valve itself. If space around the actuator is not greatly restricted a rigid enclosure system can be used to protect against a flame temperature of 1200°C for up to two hours, as well as repeated exposure to minor fires. This system comprises a box manufactured from high thermal performance materials which is built around the actuator with removable panels fitted for maintenance and inspection purposes.

A similar approach utilises a steel sub-

frame, silicate fibre blanket and glass fibre cloth to provide a semi-rigid enclosure which can be individually tailored to minimise the amount of space taken up. The semi-rigid product has been tested at the Warrington Fire Research Centre in the UK and provided protection for an actuator for 30 minutes at 1093°C.

The same level of protection can also be achieved with a flexible enclosure system consisting of protective jackets which fit snugly around the actuator. These are extensively used in offshore oil and gas

and petrochemical applications where there are often space restrictions around the actuator installations.

The final fireproofing option offered by Rotork can only be specified for new actuators. Known as System-E it comprises an intumescent coating which has been developed with a leading fireproofing specialist. In the event of a fire the patented coating will swell to between four and five times its original thickness to form a lava-like char which insulates the actuator and reflects heat back to the fire.



Actuators protected by rigid fireproof enclosures.



A semi-rigid fireproofing installation.



Flexible fireproofing system.