



Non-intrusive intelligent electric valve actuators installed on tank farm manifolds.

INTELLIGENT ACTUATION

Sarah Kellett, Rotork, UK, explores how modern non-intrusive electric actuator technologies can assist the operation and automation of tank farms.

Valve actuators provide vital functions in automated tank farms. By controlling the flow of products throughout the import, export, transfer, filling and emptying processes, these actuators are involved in every aspect of routine tank farm operations. They are also responsible for taking swift, reliable and safe action in the event of emergency shutdown.

Tank farm automation projects for new installations and retrofitted upgrades typically choose the electric route for valve actuation and control for a number

of reasons. Firstly, electricity is required in every area of the tank farm installation for other equipment such as pumps, level and flow switches and instrumentation, and lighting. Secondly, the use of alternative technologies usually dictates the installation of constantly available air and/or hydraulic power supplies. These are expensive to install, operate and maintain, particularly in the spacious environments associated with tank farms.

The modern intelligent electric valve actuator incorporates many features that help simplify installation and commissioning, enable efficient operation and assist long-term asset management. These benefits are now also available in all-electric actuation solutions for essential failsafe and emergency shutdown (ESD) duties. It is easy to link electric actuators to distributed and centralised control systems via any of the preferred contemporary digital communication



Figure 1. An engineer downloads historical operating data from an actuator using a non-intrusive hand-held setting tool.

networks, which are economic to install due to reduced wiring requirements or, increasingly, the availability of reliable wireless alternatives.

Tank farm electric actuators fall into three main categories: isolating actuators for routine flow control around the plant, failsafe actuators for critical safety duties, and modulating actuators for process valve applications. This article will discuss how modern non-intrusive intelligent electric actuator technologies assist the operation and automation of tank farm applications.

Modern non-intrusive intelligent actuator technology

As a rule, safety and reliability depend on the correct combination of explosion-proof certification and environmental protection. Any actuator installed in a tank farm must have appropriate hazardous area certification for safety reasons, but environmental sealing is also important to enable long-term operational reliability without unexpected breakdowns. Non-intrusive technologies support this by ensuring that the intelligent actuator is always protected from the ambient environment, even when it is first installed and wired up.

Double-sealing the actuator terminal compartment means that the watertight certification of the unit, usually IP68 to include temporary submersion for up to 20 m depth for 10 days, is always maintained. Once the actuator is installed, with or without power connected, setting switches and commissioning is simply performed with a non-intrusive point-and-shoot wireless link via an intrinsically safe hand-held setting tool, thus permanently protecting the integrity of the actuator's internal parts from the moment it leaves the factory.

In addition to providing maximum reliability, the modern intelligent actuator is also designed for enhanced functionality, particularly in those areas

associated with predictive maintenance and asset management. In most cases, the indication window is the focus of attention for two-way wireless communication and multi-functional indication, encompassing menus for set-up, configuration and commissioning, local position indication, valve and actuator status, asset management and diagnostic operating information stored on the actuator datalogger. User selectable screens can include actuator settings, torque and position, simultaneous demand and position, and diagnostic graphics showing the valve torque profile and facilitating real time analysis.

Modern intelligent actuator technology is capable of providing a proliferation of data, recording all the activity with an immense amount of detail, including the number of valve operations, alarms, failure to respond events, valve torque profiles, unauthorised operation attempts and many other events. The ability to objectively analyse this information and identify the key areas that are important for each site's specific requirements is essential for effective asset management. For example, there are many different styles of valve and they each have their own unique torque demand curve. Capturing the torque demand profile from a newly installed and calibrated valve actuator assembly provides a reference point against which future curves can be measured. As the valve ages, it becomes more difficult to open and close because of internal and external factors, such as a threaded stem on a rising stem gate valve that has not been lubricated. Identifying these issues can be used to plan inspection and maintenance without interrupting the plant and improve overall asset management.

Actuator datalogger files can be downloaded and transported from plant to office for storage and analysis using dedicated software. Certain digital monitoring and control networks can also be used for this function, enabling data retrieval to be performed from the control room. Effective asset management programmes can then be planned and implemented, maximising plant utilisation and minimising the risk of unexpected interruptions.

Actuators are installed on valves in every area of the plant. Therefore, by monitoring the condition of the valve, the actuator is also providing valuable data about the overall condition of the entire installation.

Failsafe ESD actuation

Safety considerations are of overriding importance for tank farm operations. The incorporation of non-intrusive, double-sealed intelligent technology into the electro-hydraulic actuator introduces the same level of control and monitoring functionality for failsafe applications. This should be combined with a hardwired ESD input for the safety system. A specialised electric actuator design is necessary to achieve the swift failsafe operation demanded by the ESD duty, which can be successfully delivered through the electro-hydraulic route. These actuators use a simple, reliable mechanical spring to provide failsafe

valve movement, while precise and swift valve movement in the opposite direction is achieved hydraulically by means of an integral electrically powered pump. With this design, reliable and failsafe performance can be combined with the benefits of intelligent electric actuation technologies.

Electro-hydraulic actuators can be equipped with integral circuitry designed to receive a separately hardwired discrete ESD alarm signal that will override any other input and move the actuator to the predetermined safe position, even in the event of electrical power failure. The ESD signal can be configured to control the shutdown through the hardwired circuit, bypassing the internal processor. In the ESD scenario, the actuator will immediately return to the predetermined safe position and be ready to operate on the next command when the ESD signal is reinstated. 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.

Typical tank farm safety applications for electro-hydraulic actuators include ESD and remotely operated shutoff valve ROSOV duties. These actuators should be designed for functional safety applications to SIL2 (1oo1) and SIL3 (1oo2) for use on safety critical applications and, in some cases, are also available with enhanced partial stroke testing (PST), enabling valves to be function tested without interrupting the process. The PST tests all of the final elements (actuator and valve) by measuring the time to move to a set position while monitoring the pressure.

Process valve actuation

In a tank farm, there may be a number of valve actuation applications that demand precise and continuous modulating duties such as those found on tank heating boiler plants. For these applications, electric actuators are now able to provide precise control valve operation with repeatability and resolution performance at less than 0.1% of full scale. Some models also include non-intrusive, double-sealed intelligent technology to enable simplified actuator set-up, auto calibration, adjustment and datalogging. The use of integral super capacitors extends the convenience of all-electrical operation to programmable failsafe applications, while explosion-proof certification with IP68 watertight protection facilitates the reliable operation demanded by the tank farm environment.

Digital monitoring and control

Tank farm automation systems utilise various open protocol digital control systems, including Foundation Fieldbus and Profibus, to control, monitor and communicate with equipment in the field. However, in many tank farm installations that use intelligent actuators, a dedicated digital control system is the preferred choice for linking actuators in the field to the control centre because a digital control system that has been designed specifically for valve actuators has



Figure 2. A self-contained electro-hydraulic actuator on a typical tank farm ESD valve installation.

actuator-focused features. For example, on one such system each communication highway has the capacity to monitor and control up to 240 actuators on a single fault tolerant field network, up to 20 km long without repeaters. This is an important reliability and economic consideration in the spacious environments of tank farms. Repeaters require separate power supplies, can slow the data transmission speed and introduce a single point of failure, while the failure of a repeater will result in loss of communication with all downstream field units.

It is important that dual host communication paths have the ability to isolate any field-based fault without interrupting communication with other units on the loop. This helps to ensure that vital information for the host controller on valve position, status and condition is as secure as possible.

The modular nature of some modern systems can also allow the user to have the choice of a wired or wireless network for control and monitoring. To provide robust on site communications, wireless options generally operate a meshing system, which will ensure that all field unit nodes have the facility of at least two routes back to the controlling master station. If the normal traffic route is blocked, the network will find another way to route the messages. The use of meshing and repeaters further increases the range to individual field units, enhancing the suitability of intelligent electric actuation with digital monitoring and control for the automated tank farm environment.

Conclusion

In the tank farm environment, modern intelligent electric valve actuation technology provides a simplified, secure and economical solution for routine and emergency flow control, incorporating operational data logging to support long-term efficiency and asset management. 