Keeping a steady flow

Nicola Curtis, Rotork, UK, explains how flow control supports safety and reliability in the LNG industry.

The growth of the worldwide LNG industry shows little sign of slowing down. Instead, the production and use of LNG is a clear area of growth, and McKinsey forecast that it is due to grow 3.6% every year up to 2035.[1] The use of LNG is increasing in importance as the demand for gas grows and large quantities of gas are processed and transported around the world. A key benefit of LNG is its ability to be moved around the world on specialist carrier ships or cryogenic tankers, providing easy access for customers. Once processed into LNG, the resulting liquid is 600 times smaller than its natural gaseous state. This makes transportation more economical than if the original natural gas was transported. Once regasified, LNG is used as a fuel source, increasingly as commercial transportation fuel and as a power source for domestic and industrial use. It can also fairly claim green credentials when used as a fuel source compared with other fossil fuel types such as oil and coal, as it releases reduced emissions into the atmosphere.

Despite the high quantity of natural gas available, it is often found in remote locations that are hard to access. This means that there are many complex processes involved at all stages of LNG production. The LNG supply chain is complex and technical, involving extraction and liquefaction, shipment on special tankers, regasification at import terminals, and distribution. Safe and reliable flow control has a key role within each part of the LNG industry process and specialist products and services are required.

How flow control products ensure safety within LNG

The extraction, processing and transport of LNG around the world must be completed in a safe and reliable way. Flow control plays a key role at every stage; from the extraction of gas, to its liquefaction, transport (both in pipelines and LNG carriers), regasification, and distribution/onwards transportation. During the exploration and production stage, natural gas is extracted by producing wells in either 'associated gas' deposits or sometimes a by-product of oil production or extracted from coal seams as a non-associated gas. The gas is dried and processed before it is converted into LNG, removing condensates, impurities (such as carbon dioxide and hydrogen sulfide), and water.

Figure 1. Flow control systems play a role at all stages of the journey of LNG.

Figure 2. Rotork actuator installation at a wellhead and separator skid in Australia.

Extremely cold temperatures are an inherent part of LNG. During the liquefaction process, the natural gas is cooled to -162°C, when it becomes the clear, colourless liquid that is known as LNG. The valves used to control the flow of this product must therefore be suitable to work at very low temperatures. For example, cryogenically safe valves are primarily made from 316 stainless steel, which maintains body strength at these very low temperatures, and they must meet safety standards such as BS 6364. The flow control equipment that controls the valves, such as actuators, must also provide safe and reliable operation within consistently hazardous environments. Products must allow for maximum uptime and operational efficiency. Flow control systems that have been well designed and correctly maintained will allow for this, as well as compliance with environmental standards.

The precision and control provided by actuators removes human error, increasing accuracy, efficiency and reliability within an automated process. For example, intelligent electric actuators, such as IQ actuators from Rotork, play a vital part in the transportation of LNG, controlling the flow of liquefied gas onto carriers in a safe, reliable and efficient fashion. Intelligent actuators have many other benefits in controlling the flow of LNG, such as detailed real-time and historical feedback information through data logs (e.g. alarms, valve torque profiles and number of valve movements/operations). They will be suitable for use in hazardous environments; actuators within the IQ range are explosion-proof, offer double sealed enclosures to prevent water ingress and are IP rated (IP66/68 at 20 m for 10 days).

Flow control in LNG downstream applications

Regasification usually occurs at a coastal import terminal. These terminals have specialised requirements to cater for the management and handling of LNG. The performance of actuators is a key part of safe and reliable operation during these processes and the flow control products used require high safety standards. Actuators are a constant presence at automated tanks farms, performing isolating duties for routine flow control, modulating actions and fail-safe activity for vital safety requirements. Tank farms will also use intelligent electric actuators for safety related duties such as emergency shut down (ESD), which is vital in case of dangerous events such as fire, flooding or any event where continued operation could be hazardous.

Pneumatic flow control equipment is another common sight on LNG terminals and sites. Pneumatic scotch yoke actuators, such as Rotork's GP range of pneumatic actuators, operate the cryogenic valves used on main pipelines. They perform open/close functions, controlling the natural gas before and after it is made into LNG, as well as the LNG itself. The precise control that these actuators offer is essential. For example, flow can be cut off straight away by the fail-safe functionality before any damage is caused due to the spring-return module inside the actuator. Some valves within vaporisers are small and compactly arranged, requiring compact and quick actuators that offer isolating and modulating duties in hazardous and cryogenic environments. The applications at this stage of the LNG process include tank pump discharge, vapour discharge, tank liquid fill, water cooling circuit valves and operation of gas outlet valves.

Control and monitoring centres also play a key role on LNG sites, controlling hundreds of actuators simultaneously. Rotork's 'Master Station' control system, for example, is in use across the world on LNG sites such as the Pengerang deepwater petroleum terminal in Malaysia, which has a regasification unit, two 200 000 m^3 LNG storage tanks, and berths for the loading and unloading of LNG vessels. While the actuators control the flow of LNG, a master station remotely controls the hundreds of intelligent actuators, using a field network (Pakscan™). This kind of system provides robust and reliable plant control and monitoring, which is essential within the LNG industry.

The importance of intelligent flow control asset maintenance

Intelligent flow control assets within the LNG industry maximise operational reliability and efficiency. This article has focused on the importance of these assets within the LNG industry, but their maintenance and smooth running is of equal importance. LNG flow control assets perform daily in challenging operating and environmental conditions. They often work within environments with extreme temperatures and excess vibration, yet still need to operate reliably. Maintenance programmes that support assets in working effectively (ensuring the availability of assets at all parts of the LNG journey) are essential. Asset failure or obsolescence has dangerous implications, including reduced quality, financial loss and even reputation damage. Unplanned downtime is undesirable and costly, but sites which have a full life cycle asset management programme (such as Rotork's 'Lifetime

Figure 3. IQ3 actuators at the Pengerang terminal, Malaysia, during the installation stage.

Management' programme) are likely to see improved performance, increased uptime and an important decrease in unplanned maintenance costs. These service programmes offer a steady, set cost to plant operators. A service plan for flow control assets all along the LNG journey should have a holistic view of an asset's life cycle, with flexibility and customer choice, allowing customers a bespoke approach to maintenance.

In addition to bespoke maintenance programmes, many flow control products must have Safety Integrity Level (SIL) ratings. SIL is an established system of standards of the performance requirements of a safety system. It is part of an overall shared safety plan that includes techniques, technologies, standards and procedures that help operators protect against hazards, an essential function within LNG.

Conclusion

The current demand for LNG has many explanations, including the multitude of ways in which it can be used (both domestically and industrially), a clean burn and subsequent reduction in combustion relayed emissions (compared to other fossil fuel sources), and the advances in technology within the natural gas industry which mean more is now being found. The ability to liquefy and then regasify this gas means it can be accessed by countries in every corner of the world. The LNG industry is complex, but with efficient and reliable flow control equipment such as actuators, LNG production, transportation and distribution can be conducted in a safe, productive and profitable way. Effective flow control and associated systems play a vital role at all stages of the LNG journey, meeting the ever-growing increase in demand.

Reference

1. 'Global gas and LNG market outlook to 2035', McKinsey.