The LNG industry has seen high levels of growth in the last decade. Shell estimates that LNG trade grew from 100 million t in 2000 to nearly 300 million t in 2017.[1] Despite there being large quantities of natural gas available, it is often found in remote locations that are hard to access. These increasingly large volumes of LNG must be transported around the world in a safe and reliable way. Effective flow control plays a vital role at all stages of the journey, from the extraction of gas to its liquefaction, transport (both in pipelines and LNG carriers), regasification, and distribution. At all stages, products used need to focus on safety and efficiency.

Benefits of efficient flow control in LNG

The storage and transportation of LNG requires specific management and control. The extreme cold temperatures involved (-162°C is required to transform natural gas into its liquid state) necessitate the use of valves and associated equipment that are appropriate for use at these low temperatures. Cryogenically safe valves are often made from 316 stainless steel to maintain body strength at extremely low temperatures. They must meet specified safety standards, such as BS 6364. At Rotork, the focus is on the other flow control products that are used all along the LNG journey alongside valves, such as actuators. Flow control equipment must offer a high level of safety, reliability, and security for the extraction, liquefaction, low temperature storage, regasification to natural gas, and onwards transportation in often hazardous and challenging environments. Plants demand suitable products for critical applications in the LNG industry ensuring safety, maximising plant uptime, and operational efficiency. Intelligently designed and well maintained flow control systems will not only allow for efficiency and increased profit within the industry, but will allow for compliance with environmental standards and ensure safety.

Many flow control products along the LNG supply chain require high safety standards. Safety Integrity Level (SIL) is an established system of standards to indicate the performance requirements of a safety system. It is part of a functional safety plan that includes techniques, technologies, standards, and procedures that help operators protect against hazards. Effective safety systems should adopt a lifecycle approach to industries that deal with hazardous processes.

Technological solutions assist in the reduction of emissions

Flow control products assist in the reduction of emissions. The increase in demand of LNG production can partly be attributed to its lesser impact on the environment than other energy sources, with a cleaner burn than other fuels such as coal. It is also important to reduce rogue emissions from the LNG production process. There are specialist products that focus on the reduction of emissions during production and transportation. Accurate and reliable flow control equipment that focuses on process control is the obvious choice for these applications. The precision provided by process control actuators removes human error and therefore reduces the negative impact on the environment. Rapid control and intervention, when needed, results in less fugitive emissions.

The use of electric actuators is another obvious, easy choice in the fight against unnecessary emissions. Use of electric actuators immediately negates bleed gas emissions that can be produced by spring diaphragm pneumatic actuators. Electric actuator replacement (also referred to as retrofitting) for natural gas-powered pneumatic devices on control valves can help reduce or eliminate methane and volatile organic compounds (VOC) emissions. This updating of equipment to facilitate reductions in emissions can ultimately improve the operator's return on investment and profits.

The exploration and production stage

The first stage of the journey is exploration and production. Rotork has been involved in the expansion of LNG in Australia for several years, including at the Queensland coal-seam gas to LNG projects. These projects – Queensland Curtis LNG, Santos GLNG, and Australia Pacific LNG – are based in Queensland's Surat and Bowen Basins. Here, natural gas is extracted from wells drilled into coal seams in the Surat Basin before it is transported to a collection point for the removal of water and condensates. Electric actuators operate ball and v-ball valves on separator skids, in order to control the extraction process at onshore natural gas production sites in the Surat Basin. The ball valves shut off the gas and the v-ball valves carry out flow control by controlling pressure build-up during well operation.

For the upstream mainland wellheads on these Australian sites, modulating electric actuators provide process valve control. They also control the flow in the extraction procedures for coal seam water (a useful byproduct of this process is that water can be reused for agricultural and industrial uses – it can even supplement domestic water supplies). Use of these electric actuators means reduced emissions during valve operation, in comparison to a pneumatic actuator that may emit gas on every stroke or action. A trunk line transports gas to shore from subsea wells.

The transport stage

Effective flow control is important in midstream LNG activities. The safety and reliability of Rotork's range means that the flow control of LNG is looked after by precise, accurate actuators and related equipment. For example, IQ actuators can control the flow of liquefied gas onto carriers. They also ensure the complete isolation of hydrocarbon products to prevent any risk of contamination.

Carriers are one of the most common ways of transporting LNG across long distances. Process control actuators are used to minimise VOC emissions on these specialist carriers. The necessary release of vapour pressure

Don't just go with the flow

Nicola Curtis, Rotork, UK, explains how optimised flow control can support safety and emission reductions in the LNG industry.

Figure 1. Rotork CVQ electric actuators operate valves on separator skids at an Australian onshore natural gas site.

Figure 2. Rotork 4H multi-turn actuators mounted on a cryogenic globe valve on an LNG carrier.

is usually managed through manual release of the pressure once it approaches a pre-set point. This lacks accuracy and precise control, resulting in excess and unnecessary VOC emissions. Use of an actuator changes the valve position in response to a control signal from a reporting system. This removes the need for inaccurate manual venting, as well as reducing initial VOC loss by maintaining a constant vapour pressure in all the cargo tanks during the voyage.

Multi-turn actuators on carriers can overcome potential operational problems, particularly on the cryogenic globe valves used for cargo loading and unloading. High efficiency modulating actuators used for these duties (such as Rotork's 4H) are operated hydraulically, using a shipboard power supply with limited total capacity. Torque can be limited even at excess hydraulic pressure. This is important in an environment where the actuators may be subjected to pressure surges, which could cause damage to the control valve and product leakage if the torque is not restricted.

The regasification stage

Pneumatic scotch yoke actuators can often be found on LNG terminals and sites. They are ideal for use on main pipelines in terminals, usually operating butterfly valves. These valves are usually cryogenic to meet the extreme cold requirements of LNG. Pneumatic actuators can perform open/close functions, which controls the flow of both LNG and natural gas in its gaseous form. As these fluids are cryogenic, precise control over the pipeline is critical. In the event of an emergency, the flow can be cut off immediately by the fail-safe functionality of the pneumatic actuators. Fail-safe functionality – always essential in applications that involve LNG – can be provided in either direction due to the spring-return module inside the actuator. Gate, globe, and check valves are also often used at this regasification stage, in both cryogenic and ambient environments.

The vaporisers which convert LNG from liquid back to gas play a key role in the regasification stage. The valves in a vaporiser's system are often small and compactly arranged, therefore they need compact and fast acting actuators in order to operate them.

Conclusion

Natural gas is increasingly a preferred fuel for power generation, but growing demand cannot be satisfied by existing locally sourced production. Large quantities need to be extracted and transported over long distances. Effective, safe, and reliable flow control can help the LNG industry to meet the ever-increasing levels of demand placed upon it; forming part of the chain of LNG activities that ultimately leads to power being generated for homes, businesses, and industry. Quality flow control products offer a high level of safety, reliability, and security at all stages; in potentially hazardous and challenging environments.

The LNG supply chain is complex and technical, and reliable flow control plays a critical part in safely delivering LNG to support the ever increasing demand for this type of power generation. **LNG**

References

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