THE VALUE OF EFFECTIVE FLOW CONTROL

Dave Godfrey, Rotork, UK, discusses the importance of accurate and effective flow management within the growing LNG industry.

The amount of LNG in the world's energy mix is rising. The export of LNG has increased dramatically in recent years, with the US alone expected to double shipments to Europe by 2022.[1]

Over 100 billion m^3 of new LNG supply capacity is set to be commissioned between 2018 – 2023.[2] By 2030, liquefaction capacity is expected to double, while regasification capacity is anticipated to increase by 50%, as a result of the rising demand for natural gas and the growing importance of LNG.

LNG is being accepted as the lower-emission hydrocarbon bridge of the energy transition, as seen by the anticipated investment in liquefaction, regasification and transportation infrastructure over the coming years. As the gas must be converted back from its liquid state in order to be usable, a number of regions do not have the infrastructure to handle the necessary quantities.

In order to effectively regulate the process at each stage – from liquefaction and extraction through to regasification, transport and distribution – this increasing infrastructure needs reliable flow control across the whole process.

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Controlling cryogenic valves

When storing and moving LNG, there are certain requirements. Valves and related equipment must withstand the extremely low temperatures involved in the process (-162°C is required to change a gas into a liquid state).

Cryogenically-safe valves are frequently constructed from 316 stainless steel, which retains body strength at these extremely low temperatures. Due to the hazardous environment, the valves used to regulate the flow of LNG must be suited to work at very low temperatures, dependably. They also have to adhere to safety regulations such as BS 6364. Additionally, actuators that control the valves must offer safe and dependable operation in continuously dangerous conditions.

The valves used to transport large quantities of raw gas are generally between 36 and 72 in. dia. and are required to work at extremely high pressures. By applying pressure to the natural gas and reducing its temperature using compression trains and cryogenic systems, it can be converted into a liquefied condition.

The high-pressure gas continues to be an extremely dangerous medium throughout this process, making the safety features connected to emergency shutdown systems crucial. As such, LNG operators must rely on tried-and-tested solutions. Large valves can close at the high speed and high torque required for emergency shutdown (ESD) systems, using Rotork's pneumatic actuators.

Figure 1. Intelligent actuators in operation at a terminal.

Figure 2. Scotch yoke actuators in service at a marine terminal.

Ball and butterfly cryogenic valves used in storage and regasification facilities have been operated at LNG terminals all over the world using Rotork's pneumatic scotch yoke GP and CP actuators. These actuators are suitable and appropriate for hazardous use; they have corrosion-resistant cylinders and are ATEX certified. GNL Quintero is one of Chile's biggest energy security companies, and the company's site, Quintero LNG, required reliable, heavy-duty pipeline valve actuators to provide routine operations and safety shutdown duties. The cryogenic valves were installed in challenging environments – ranging from saline coastal locations to arid desert areas, with extreme temperature fluctuations. In remote locations, the lack of conventional power supplies dictated the requirement for renewable energy sources, such as solar power.

The LNG complex at Quintero Bay encompasses the installation of a sea terminal to receive LNG from tankers, and a plant for regasification and distribution by pipelines to central Chile.

The pneumatic actuators supplied were from the CP and GP range, the majority of which are operating cryogenic service ball and butterfly valves at the Quintero Bay marine terminal and adjacent storage plant. The exposed marine environment also dictated the use of carefully selected, corrosion-resistant materials in the packaged control systems and components that were supplied.

The necessity of actuation across midstream LNG pipelines

The pipelines used to transport natural gas are large and cover hundreds/thousands of miles, often in remote and inaccessible locations. As such, electricity or even compressed air may not be available. Sometimes, the actuator's only source of drive is gas from the pipeline. For the type of large valves found on pipelines, heavy-duty actuators perform routine and safety shutdown duties, especially in harsh environments such as salty coastal locations (where corrosion is a high possibility) and hot, arid, desert regions that experience extreme temperature fluctuations.

For instance, crucial locations on a cryogenic LNG pipeline in northern Venezuela installed actuators. The pipeline carries LNG and gas between several locations. The actuators provide the high degree of safety, dependability and security required at all phases of LNG production, by controlling the ball valves throughout the pipeline and offering ESD alternatives. The essential flow control involved maximises operational reliability and efficiency. The precision and control provided by actuators removes human error, increasing accuracy within an automated process.

The value of intelligent actuation for transportation

One of the most common methods for transferring LNG across large distances is via carriers. Process control actuators are installed on these specialised carriers. As an example, intelligent electric actuators, such as IQ actuators from Rotork, are essential for the safe, dependable and effective flow control management of liquefied gas into carriers during LNG shipping. Other advantages of using intelligent actuators for

LNG flow control include extensive real-time and historical feedback data through data logs (such as warnings, valve torque profiles, and the number of valve movements and/or operations). The explosion-proof certification of the actuators in the IQ product range ensures long-term dependability in even the most difficult conditions.

Another choice is electro-hydraulic actuators, which combine the ease of electrical operation with the accuracy of hydraulic control and the reliability of mechanical spring-return or accumulator fail-safe action. Typical applications for Skilmatic SI actuators include functional safety-related ESD inputs and Remotely Operated Shutoff Valve (ROSoV) duties, and they are hazardous area certified. They have ESD options with single or dual inputs and partial stroke testing (PST) for use in these applications.

The importance of actuation at the regasification stage

Regasification often takes place at coastal import terminals that have specialised requirements for handling LNG. The functionality of the actuators is a crucial component of safe and dependable operation throughout these processes, and the flow control products selected require high safety standards. At automated tank farms, actuators are a constant presence. They carry out isolating duties for regular flow control, modulating actions, and fail-safe activity for essential safety requirements. Tank farms also use intelligent electric actuators for safety-related tasks such as ESD, which is essential in the event of dangerous circumstances.

On LNG sites, control and monitoring centres are essential for simultaneously controlling hundreds of actuators. Throughout the world, 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, use Rotork's Master Station control system. A Master Station uses a field network (Pakscan™) to remotely manage the hundreds of intelligent actuators, while the actuators regulate the flow of LNG. This type of technology offers dependable and strong plant management and monitoring, which is crucial in the LNG sector.

Intelligent actuation to reduce emissions

Flow control products can also help in the reduction of emissions. One option for reducing needless emissions is electric actuators. By replacing spring diaphragm pneumatic actuators with electric ones, bleed gas emissions are removed. Methane and volatile organic compound (VOC) emissions can be decreased or completely eliminated by replacing natural gas-powered pneumatic actuators on control valves with electric actuators (also known as retrofitting).

Throughout the LNG process, emissions can be reduced significantly. In Belgium, an LNG terminal, a 4000 km pipeline, and an underground storage facility have all been upgraded by Rotork. The part-turn intelligent IQT actuators were installed at the site to control butterfly valves on boilers in unmanned gas pressure-reducing stations in Belgium, which lower the pressure of natural gas so that it can flow through a network that operates at a lower pressure, or be transferred to an end consumer facility.

This operation cools the natural gas and requires the gas to be preheated by boilers to keep the downstream temperature within specific ranges. The previous actuators at this site were pneumatics that were driven by gas, which resulted in the unintended release of greenhouse gases into the environment. To reduce the operation's impact on the environment, Rotork Site Services installed the electric actuators on the site. The actuators control the valves, which now perform a more accurate regulating function, are more dependable, and avoid any emissions that the earlier pneumatic actuators would have produced.

Extremely accurate flow control, no emissions, simple set-up, diagnostics, and dependable operation were all made possible by the installation of IQT actuators. At several locations, Rotork Site Services adapted the IQTs onto existing valves. They provide continuous position tracking at all times, even when there is no power. They are protected against water ingress (double-sealed to IP66/68 at 7 m for 72 hours) and are explosion-proof to international standards.

Maintaining operations on an LNG site

While the importance of these assets within the LNG sector has been highlighted in this article, maintaining and properly operating these assets is equally important. Intelligent flow control assets within LNG processes optimise operational reliability and efficiency. These assets perform in challenging operations and environmental conditions every day. They frequently operate in abrasive, extreme-temperature conditions and excess vibration, and they must perform reliably. The effectiveness of assets depends on maintenance to ensure their availability at all points of the LNG trip. Asset failure or obsolescence has dangerous implications, including reduced quality, financial loss, and even reputation damage. Unplanned downtime is costly and undesired, but locations with a full life cycle asset management programme (such as Rotork's Reliability Services programme) are likely to see improved performance, increased uptime, and a reduction in unexpected maintenance expenditures. These service plans provide plant operators with a consistent, fixed cost. A service plan for flow control products should take a comprehensive approach to an asset's life cycle, be flexible, and allow customers to make their own maintenance decisions.

Conclusion

More natural gas will need to be extracted, liquefied, transported, and converted back into gas in order to fulfil the rising demand in the natural gas market. These processes require accurate and effective flow management that can operate in difficult conditions and minimise total emissions across the supply chain.

The LNG business is intricate, but with effective and dependable flow control assets such as actuators, it is possible to produce, transport and distribute LNG in a way that is safe, efficient and reliable.

References

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2. 'LNG Market Trends and Their Implications', IEA, (June 2019), https://www.iea.org/reports/lng-market-trends-and-their-implications