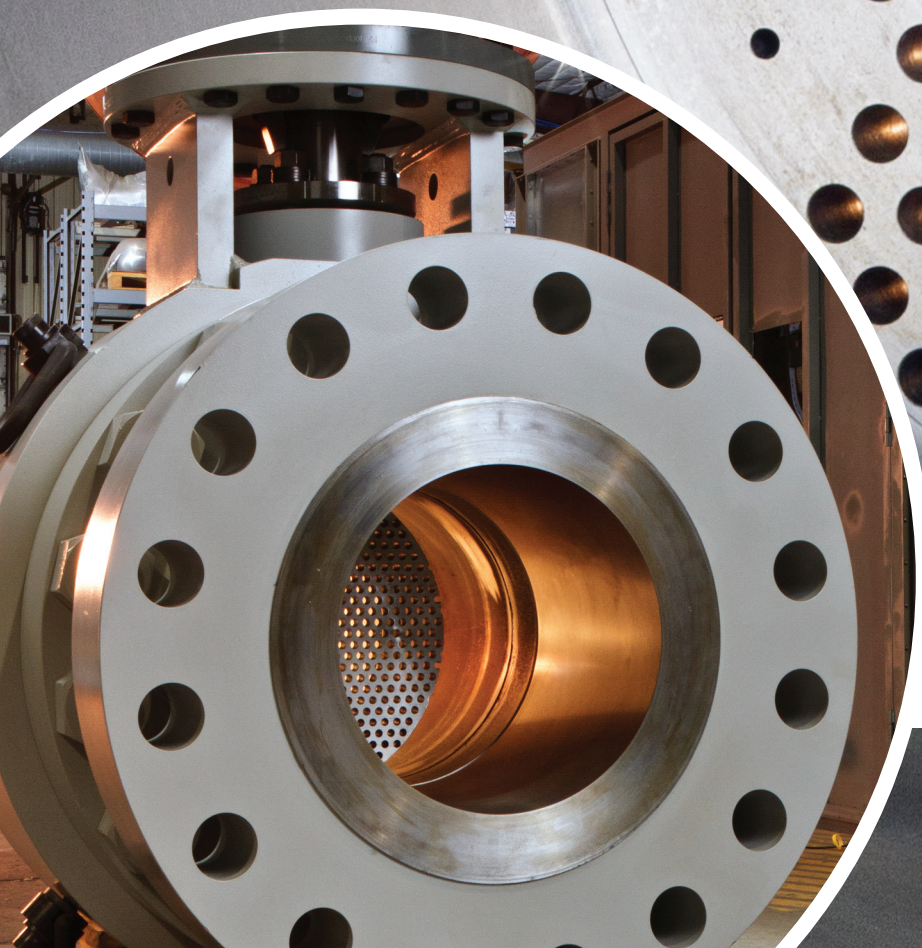
LNG INDUSTRY

Summer 2012

Increase Rangeability Using Control Ball Valves



COVER STORY

Figure 2. MOGAS FlexStream rotary control valve.

RESILIENT VALVES

Kevin Jackson, MOGAS, USA, examines the benefits of using ball valves for severe service applications over linear valves in this issue's cover story.

Since the LNG market started back in the early 1960s, the span or rangeability of control in control valves has always been an issue, especially in the tough severe service applications such as FEED gas regulation, compressor anti-surge/recycle, hot gas by-pass, depressurisation and others. For example, in such demanding applications as recycling/anti-surge gas for a compressor or a facilities start-up, the need for wider and wider rangeability (without the increase in pipe/valve size) has become more than a standard linear globe control valve can fit in. The restriction with the linear globe control valve is the need to hold the trim element between the seat and the bonnet that means the span/rangeability is

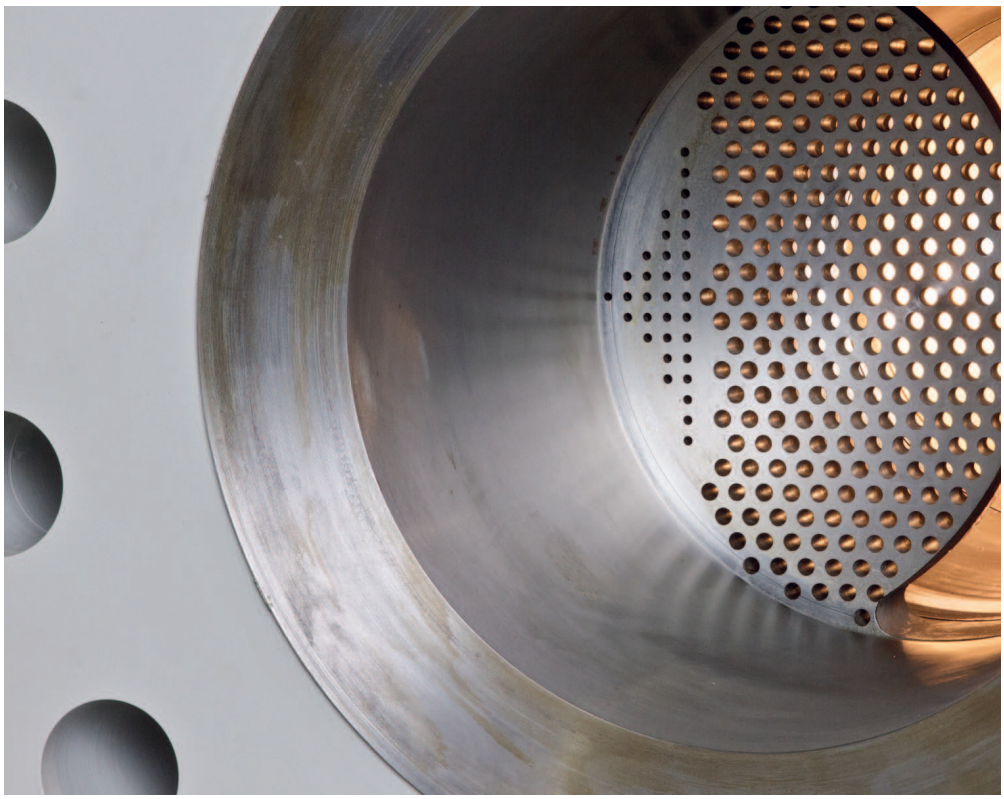


Figure 1. MOGAS FlexStream rotary control valve.

greatly reduced. This becomes an even bigger issue when these applications are on offshore structures such as FPSOs, production platforms and more recently floating LNG facilities. Linear control valves with linear rising stems have historically had operational design challenges with rangeability, gland sealing, size and weight.

In these types of gas applications there is a requirement for the control valve to be able to control two distinctly different flow regimes. Firstly, 'low flow rates with a high pressure differential' that require pressure to be let down using sophisticated technology in a controlled environment to prevent high levels of velocity, noise and pressure energy which are harmful to the valve and its surrounding pipe and equipment, causing failure and unsafe levels of noise and erosion. This pressure letdown has always been accomplished by creating a flow path, that consists of a number of right angle turns where the pressure drop is controlled equally at each 90° turn, thus controlling the velocity and noise. Secondly 'high flow rate and a low pressure differential' that require little or no pressure letdown technology because the process conditions do not generate harmful levels of velocity, noise and pressure energy and so is easily controlled using a far simpler technology. A failure in the valve can lead to unscheduled plant downtime and a risk to safety. The key is to design a valve that meets the demand for rangeability and limits these harmful elements in a valve size that is smaller than the traditional linear globe valve. The FlexStream® has been designed to provide the control where it is needed.

Operational concerns with traditional designs

Linear globe valve design has gone part way to solving the problem of a lack of rangeability by using firstly, a variable pressure letdown layered trim element. This design consists of a trim element that has a higher number of pressure letdown stages at the lower end of the trim stack with a lower number at the top trim element. The flaw is that even the simplest trim design, which is a single drilled hole cage, only utilises approximately 40% - 50% of the available area to pass flow. In some designs large 'windows' are machined into the trim to get more flow, however it only goes some way in meeting the real demand of the application. Secondly, they also increase the stroke length of the actuator, thus providing long strokes, up to 24 in. or 600 mm. This too however creates problems with operating times, overshoot and stability. Finally, linear globe valves also use angle pattern valves to increase the outlet size of the valve so the velocity is greatly reduced as the outlet area is increased, however all of these design modifications have a knock on effect in the infrastructure in terms of size, weight, support structures and piping that leads to increased capital costs to both onshore and offshore structures when globe valves are used.

MOGAS recently had the opportunity to assist an LNG facility in Australia with two rotary control ball valves to handle flow control, where four linear control valves further down the pipe could only handle pressure differentials. The characteristics the client wanted for flow control were not being handled successfully with the traditional linear control valves.

Proven solutions using modern design

The MOGAS FlexStream rotary control valve is able to put a stop to the industry's compromise. This rotary control technology focuses on a design solution that incorporates a fully operational resolution for each part of the puzzle. Using a ball valve with a straight through bore path as its basic concept means that turbulence is not introduced by changing flow direction. By incorporating the trim element into a high quality metal seated ball valve means the valve has a quarter turn motion that supports a high speed of operation, which is extremely stable and is environmentally much better than a linear design. Having the trim housed inside the ball ID means that the ball can have a trim that takes up a certain percentage of the ball ID area (see Figure 1). The advantage with this placement

is that the FlexStream trim technology can be focused at the 'low flow rate with a high pressure differential' case with its multistage flow path. This is then able to achieve the same or better control of pressure let down, velocity and pressure energy as the traditional linear control valve. Also this configuration can address the 'high flow rate and a low pressure differential' condition with the ball having no trim allowing minimal pressure drop and maximum flow, resulting in a vastly reduced overall valve dimensional footprint thus saving on unnecessary additional structural costs. This more compact design allows for bottom line savings that can be repurposed for other plant needs.

In the Australia case study, 24 in. and 10 in. 1500#ANSI flanged FlexStream control valves were purchased to handle inlet pressures of 2871 psi/198 bar with pressure drops of 2190 psi/149 bar to 36 psi/2.5 bar. The 24 in. was at the main LNG gas inlet from offshore while the 10 in. ran in parallel, channelling some of the flow through a heat exchanger to warm up the inlet gas. These pneumatically actuated FlexStream control valves were installed upstream of the other four traditional linear control valves. As stated above, these two control valves were designed to control more on the low end of the stroke in order to handle a higher differential at the beginning, to avoid the inclusion of any additional start-up valves and at the higher percentage stroke (wider opening) pass a larger amount of flow (a higher turndown ratio). The differing hole pattern was characterised to meet the customer's specific requirement. An improved trim was ordered recently to give the rotary control valve even better flow control rangeability.

Innovative technology for total control

As process facilities increase throughput, operating pressures, and temperatures, many traditional linear valves have become unreliable and unstable. Problems such as high friction, shaft wear, erosion and backlash have been associated with linear control valves. Continual up and down action can lead to deterioration of stem packing and cause hazardous stem leaks. Stem packing integrity is essential to reduce emissions of volatile organic compounds of gases.

A rotary control ball valve is the best choice with its quarter-turn radial operation and straight-through bore pathway to allow flexibility of trim choices. The rotary action versus the linear operation is not as susceptible to stem wear, making high cycling not as problematic. Plant safety can be greatly impacted by the quarter turn construction by providing a fire safe design with low emissions to atmosphere through live loaded stem packing. Its compact footprint, which is a single 24 in. control valve versus possibly two 36 in. linear globe valves, is safer to install due to its size and weight and with the added features of virtually no overshoot, easy to achieve fast opening and/or closing and is extremely flexible in its design characteristic. **LNG**