

■ **The three, 30 in. DRAG control valves shown prior to shipment. These valves are reported to be the largest ever produced for critical and severe-service. The valves handle both start-up and continuous flow through three gas-conditioning trains in the Troll gas plant in Kollsnes, Norway.**

# Severe-Service Control Valve Package For Troll Natural Gas Processing Plant in Norway

**New Plant to Provide a Significant Part of Europe's Gas Via North Sea Pipelines – CCI Builds Largest Control Valve of its Type**

CCI, manufacturer of custom-engineered, severe-service control valves used in piping applications worldwide, provided all of the severe-service control valves for a natural gas processing plant now under construction at Kollsnes, Norway. As part of the package, the company also designed and built its largest control valve ever produced – a 30 in. (762 mm) 600 ANSI class valve. The processing plant, Troll Kollsnes, is part of a combined production and processing project operated by the Troll Partners, a consortium of seven oil companies, which include Shell, Statoil and Conoco. The plant is designed to supply a significant part of Europe's natural gas energy for the next half century.

CCI, based in Rancho Santa Margarita, California, U.S.A., supplied three identical, highly specialized 30 in. valves to handle both start-up and continuous flow through three gas-conditioning trains. CCI also has supplied some 54 critical control valves in various dimensions to the Troll onshore gas facility. Among them are anti-surge valves for the Dresser-Rand compressors.

Originally, the Troll plant was to handle critical flow startup-up with smaller severe-service valves in 12 in. (305 mm) pipes that ran parallel with the larger lines for that purpose. Once start-up pressures were equalized, normal flow would be handled in the 30 in. lines by conventional ball valves. Before the plant was actually completed, Statoil decided to increase the export pressure. The project was labeled KEPU for Kollsnes Export Pressure Upgrade. The project influenced seven CCI valves. Two had to be changed out completely and five only need a change in the trim (disc, stack, plug, etc.)

When asked to build the 12 in. start-up valves, CCI looked at the flow conditions within the entire system, and realized that a better solution was to handle plant start-up through the 30 in. valves. The concern was that the start-up conditions would push the limits of the 12 in. valves, so a solution was needed to minimize any potential problems that might occur from this. The company proposed that it could design and build a trio of highly

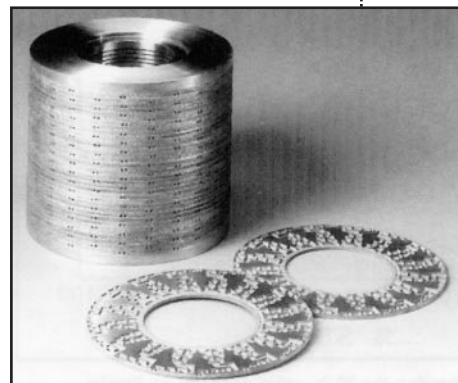
specialized severe-service valves which could replace the ball valves on the 30 in. pipes. Although unprecedented in size for such an application, the CCI valves would handle both the critical start-up phase and the normal, ongoing gas flow; thus eliminating the need to handle start-up through the 12 in. lines.

CCI met the double-duty operational requirements of the Troll application by designing a valve that employed the company's patented DRAG® trim technology to handle the start-up release of gas into the downstream pipes. This proprietary technology allows a valve trim to be custom engineered to have the flow characteristics that redirect fluid exit velocities; thereby eliminating potential problems with noise, vibration and piping fatigue. Building a specialized valve of such large proportions had not been attempted for an application with such stringent performance requirements. Each of the three units can be compared to a small European automobile in size. Nominal external dimensions are 12 ft. (3.66 m) high by 5 ft. (1.52 m) wide; length flange-to-flange

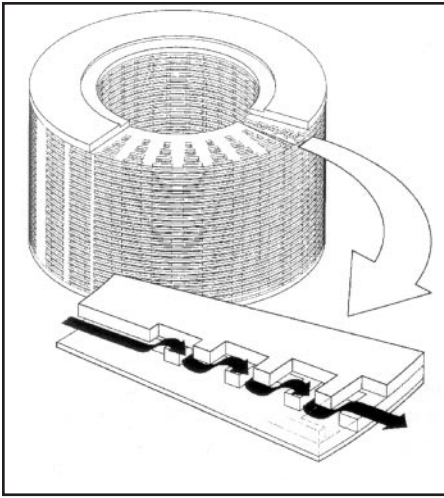
is 8-1/2 ft. (2.59 m). Opening and closing is pneumatically actuated, with manual back-up. Cast in special, high carbon steel, to meet the critical low-temperature requirements, each valve weighs 25,000 lb. (11,350 kg).

The DRAG trim controls start-up velocity by forcing the gas through a tortuous path of right-angle turns that are cut into a series of stainless steel disks. The disks are custom-stacked to form a velocity restrictive trim. By careful calculation of the passage dimensions, the turns, and disk-stack configuration, the potentially damaging fluid velocity and the pressure difference in the pipes is controlled by the flow restriction; until the downstream pipes are filled and balanced. When fluid pressures are equalized, the valve plug is opened beyond the confines of the DRAG trim, allowing unrestricted, normal high-volume flow.

CCI can custom engineer its DRAG trim design to meet two sets of operational parameters: linear or characterized. In a linear trim, all disks in the stack have the same number of passages and turns, and the same flow area; flow is directly proportional to the valve's stroke at constant differential pressure. In a characterized stack, all disks are not the same. The passages, turns and flow area are varied according to precise calculations to balance the potentially damaging velocity-versus-pressure-drop over the full range of the valve. The three large valves for the Troll application use characterized trim technology.



■ **The DRAG trim in the CCI control valves consists of a series of discs in a stack (in the case of the Troll valves, these discs are characterized) that force the gas through a tortuous path to control velocity.**



■ A diagram showing the gas path configuration of DRAG disks in the CCI control valve.

is critical if they are to go the distance. Once start-up is accomplished, the carefully designed, streamlined shape of these valves must deliver ongoing, unrestricted, gas flow at the specified operational flow rate of

1.58 million lb. (.72 million kg) of gas per hour.

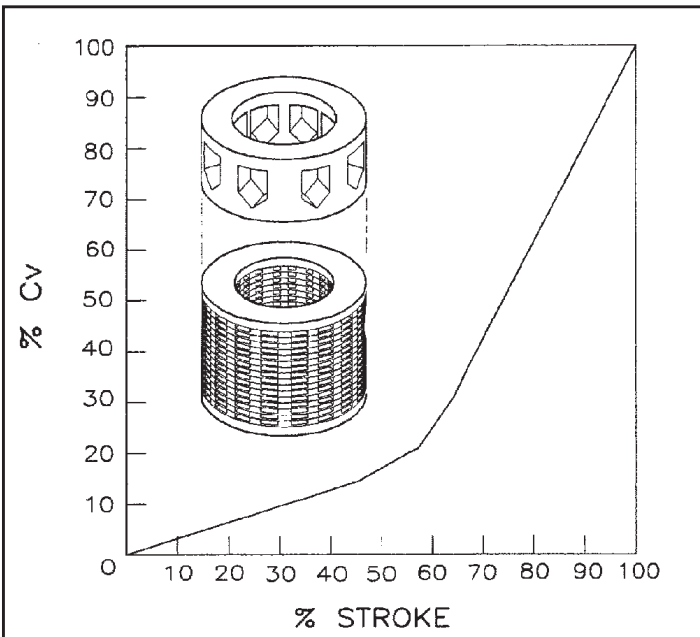
"Without this engineering solution, the Troll plant could have experienced minor shutdowns for equipment replacement several times during its operational life," Smirl continues. "With these 30 in. valves in place, the plant can be expected to operate for the next 50 years without such problems."

At \$4.6 billion, the Troll project is one of the largest of its kind ever attempted. Towed to its drill site in May 1995, the Troll-A Offshore platform will feed untreated gas via sub-sealines directly to the processing plant some 40 miles (64 km) away; the longest distance to date for such a transfer. Weighing about

750,000 (681,000 metric) tons, and a total structural height exceeding 450 yards (411 m), the gravity base platform will be the world's largest offshore concrete structure.

CCI designed, built and patented the first DRAG valve in 1967, at a time when there were no valve solutions available for controlling high-velocity fluid flow in severe-service piping applications. Today, DRAG valves deliver dependable, low-maintenance, economical performance in handling liquids and gases such as steam, water, petroleum products, and chemicals, where temperature or pressure is a critical factor to safe plant operation. These valves are the field-proven standard in such industries as oil and gas production and refining, fossil-fuel and nuclear power plants, chemical and petrochemical production and processing, and other similar applications where severe service performance is a requirement.

"The DRAG section of the valves has to control the release of the gas during start-up in a safe manner," says Paul Smirl, lead engineer of the Troll Project at CCI. "If flow velocity is not handled properly during this phase, the vibration and erosive effects of the high-pressure gas will damage the valve and pipeline components over time. This can cause equipment failure well before the 50-year life expectancy of the plant. An additional factor that can affect successful long-term operation is the operating environment here. Not only can the ambient temperature be harsh, the gas is very cold, operating at a normal inlet temperature of -30°F (-34°C). The physical design and metallurgy of these valves



■ Performance curve showing the 30 in. valve capacity vs. stroke.