Supercharging a CO_2 Reciprocating Compressor

Neuman & Esser reconfigures stages at a Texas gas plant to boost performance

To resolve problems at a West Texas carbon dioxide (CO_2) injection project, Neuman & Esser's solution was to drop a stage of compression but "supercharge" the others.

Challenge

A large, international oil and gas exploration and production company operating a gas plant in West Texas required a unique and challenging CO_2 compressor application: compression of 95% CO_2 with suction pressure from 0.5 PSIG to 2,000 PSIG discharge pressure, a total facility design flow rate of 25 MMSCFD, at an elevation of 2,800 ft (853.44 m).

The operator had been contracting compression services from a third party using antiquated, slow-speed, integral compressors. Due to emissions issues along with reliability, parts and service availability issues, the gas plant required a new compressor solution. Another key problem for the operator was medium-voltage electricity was unavailable at the plant, so the new CO_2 compressors would have to run off natural gas engine drivers.

Solution

Initially, the operator requested Neuman & Esser to provide multistage reciprocating compressors driven by natural gas engines running at 1,000 RPM. Initial performance calculations indicated that the operator required approximately 10,000 hp (7,354.99 kW) in at least five stages of compression.

However, Neuman & Esser was faced with multiple concerns with such low suction pressure requiring very large first-stage cylinders with very high piston weights. From years of experience, Neuman & Esser knew that rotating 24-in. to 28-in. (60.96-cm to 121.92-cm) cylinders at such high speeds would be problematic for existing compressor models. And high mass forces and inertia loading, combined with poor volumetric efficiency and excessive valve masking, would challenge even the best of currently available compressor models.

The operator also faced a potential requirement for a tandem/step piston-cylinder arrangement for final stages and very high discharge temperatures that would result in poor valve performance and shortened ring and packing life. Neuman & Esser knew it would take a creative solution to solve the set of challenges posed at this gas plant.

Neuman & Esser proposed a unique solution based on another product line known as NEA SAPS™. NEA SAPS™, or NEA Seismic Air Packages, is a compressor application that Neuman & Esser pioneered and engineered for offshore seismic compression applications using rotary screw and reciprocating compressors with a common driver. The use of a common driver results in fewer number of packages needed to compress air to high pressure, allowing for a more efficient and cost-effective operation with minimal service work.

Result

Neuman & Esser began working closely with the operator, its engineering firm and a key fabrication partner to develop and evaluate a compressor design based on the Neuman & Esser SAPS-style compressor package. Neuman & Esser had proven experience with 1,000- to 1,500-hp (735.5- to 1,123.25-kW) applications compressing air from ambient suction pressure to 3,000 PSIG using the combination rotary screw/reciprocating compressor on a common driver, both electric and engine driven.

Because the operator requested the minimum amount of compressor packages to solve the application, the best solution was to divide the application up into three units, each requiring approximately 3,200 hp (2,353.6 kW), driven by natural gas engines. Neuman & Esser's calculations resulted in compression flow requirments of approximately 6.0 MMSCFD at the first-stage inlet, at a suction pressure of 0.5 PSIG, and an additional 2.33 MMSCFD sidestream coming in at approximately 80 PSIG.

With an appropriately sized rotary screw compressor, along with a Neuman & Esser reciprocating compressor designed for a full 8.33 MMSCFD, this application appeared much more feasible to operate effectively at 900 RPM to 1,000 RPM. The rotary screw compressor allowed the removal of the large first-stage cylinders by increasing and "supercharging" the reciprocating compressor into the second, third and fourth stages. This application turned out to be an ideal high-performance solution.

Neuman & Esser was awarded the project in early 2011, and all partners began working on detailed engineering. Equipment was delivered to the site in early 2012, and installed, commissioned and started up by September 2012.

Case benefits

Neuman & Esser was able to provide an alternative solution through advanced drive train design techniques that no other competitor has had proven experience in completing. Along with vendor partners who played an integral role in the success of this project, Neuman & Esser reduced the overall required stages of compression and was able to complete the application with the fewest number of units, saving the operator time and money. Based on the success of this gas plant installation, Neuman & Esser has now developed a concept that can be successfully applied in future anthropogenic CO_2 enhanced oil recovery compressor applications.

Neuman & Esser *is a leading reciprocating compressor solutions provider. 180 years of history and experience has positioned the company as one of the leading manufacturers, packagers and service providers servicing the energy industry. Please visit* ***neuman-esser.com*** *for more information.*