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COMPRESSOR

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Offshore
Technology



■ For the first stage of CO₂ compression, the project uses an Aerzen 536 VMY oil-flooded rotary screw compressor with a Lufkin speed increaser.

Supercharging A CO₂ Reciprocating Compressor >

To resolve problems, Neuman & Esser drops a stage of compression but supercharges others

BY ROBERT CROW

An international oil and gas exploration and production company operating a gas plant in West Texas required a unique and challenging carbon dioxide (CO₂) compressor application.

The requirement was for compression of 95% CO₂ with suction pressure from 0.5 psig (0.034 bar), dis-

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charge pressure to 2000 psig (138 bar), a total facility design flow rate of 25 MMscfd (700 x 10³ m³/d), and at an elevation of 2800 ft. (850 m).

The operator had been contracting compression services from a third party using antiquated, slow-speed, integral compressors. Due to emissions, reliability, parts and service availability issues, the gas plant required a new compressor solution.

Another key problem for the operator was that medium-voltage electricity was unavailable at the plant, so the new CO₂ compressors would have to be driven by natural gas fueled engines.

Solution

Initially, the operator requested Neuman & Esser to provide multistage reciprocating compressors driven by natural gas engines running at 1000 rpm.

Initial performance calculations indicated that the operator required approximately 10,000 hp (7355 kW) in at least five stages of compression.

However, Neuman & Esser had multiple concerns with such low suction pressure requiring very large first-stage cylinders with very high piston weights. From its experience, Neuman & Esser knew that rotating 24 to 28 in. (61 to 122 cm) cylinders at such high speeds would



■ For the second through fourth stages, the project uses a Neuman & Esser 3 SVL 320hs reciprocating compressor driven by a Caterpillar G3612 TA natural gas engine.

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.

Because of the challenges posed at this gas plant, Neuman & Esser proposed a creative solution based on its NEA Seismic Air Packages product line.

NEA SAPS 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.

Results

Neuman & Esser began working closely with the operator, its engineer-

ing firm and a key fabrication partner to develop and evaluate a compressor design based on the its SAPS-style compressor package.

It had proven experience with 1000 to 1500 hp (735 to 1123 kW) applications compressing air from ambient suction pressure to 3000 psig (200 bar) 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 3200 hp (2350 kW), driven by natural gas engines.

Neuman & Esser's calculations resulted in compression flow requirements of about 6 MMscfd ($170 \times 10^3 \text{ m}^3/\text{d}$) at the first-stage inlet, at a suction pressure of 0.5 psig (0.03 bar), and an additional 2.33 MMscfd ($66 \times 10^3 \text{ m}^3/\text{d}$) sidestream coming in at approximately 80 psig (5.5 bar).

With an appropriately sized rotary screw compressor, along with a Neuman & Esser reciprocating compressor designed for a full 8.33 MMscfd ($236 \times 10^3 \text{ m}^3/\text{d}$), this application appeared much more feasible to operate effectively at 900 to 1000 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.

Benefits

Drawing on its experience, Neuman & Esser was able to provide an alternative solution through advanced drive train design techniques.

Working 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 developed a concept that can be successfully applied in future anthropogenic CO₂ enhanced oil recovery compressor applications. [CT2](#)