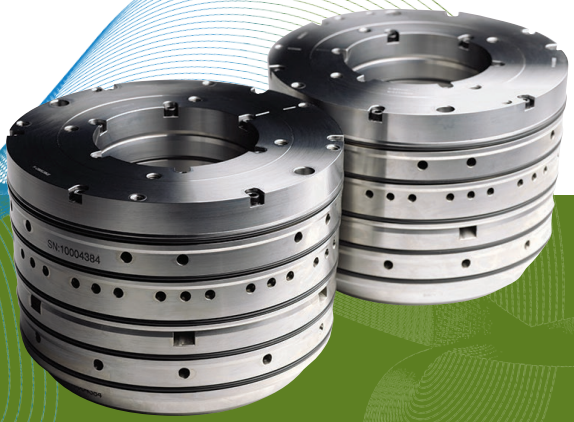
Revolutionizing Power Generation in the World's First Supercritical CO_2 (sCO_2) Power Cycle Plant



BACKGROUND
Industry: Energy, Power Generation
Site: sCO_2 Allam Cycle Oxy-fuel Power Plant
Location: Houston, Texas Working Fluid: CO_2

John Crane's Type 28XP dry gas seals were chosen to reliably handle fluid conditions of the compressor.

Customer Need

The customer's platform is a semi-closed cycle with a CO_2 working fluid. A net efficiency of 55% to 59% can be considered with capturing 97% of the CO_2. A key design consideration was the type of compressor solution best suited to this application.

CAPTURED **97%** CO_2

In a recent application, the end user chose an integrally geared (IG) compressor because of its smaller footprint, less weight, better polytropic coefficient and cost factors.

The challenges for the compressor were the high-speed driver, compressor-gas turbine-generator train and the high-pressure CO_2.

Highlights

John Crane was selected to provide the dry gas sealing technology for the supercritical CO_2 compressor manufactured by a provider of turbomachinery solutions for a 50-megawatt (MW) test plant.

John Crane is a leader in enabling solutions for carbon capture, utilization, and storage (CCUS) and a trusted partner in helping companies lower emissions and increase equipment efficiency.

Application

The OEM decision to use John Crane's seals followed a long cooperation in terms of arduous applications, particularly in terms of supercritical carbon dioxide (sCO_2) applications.

John Crane worked with the turbomachinery provider to design a seal capable of reliably handling the fluid conditions of the compressor, such as up to a pressure of 178 bar and temperature up to 204° C in the seal area, with the challenge to run at a speed next to 33,000 rotations per minute (rpm).

Application Parameters

The mechanical seal was designed so an additional labyrinth could be placed inboard to allow the injection of additional cooling gas to achieve a thermal barrier.

TYPE 28XP	PRESSURE UP TO **178 BAR**	TEMP UP TO **204° C**	SPEED UP TO **33,000 RPM**

Solution

John Crane chose their most common seal type, Type 28XP with polymer rings as secondary sealing elements in a single seal arrangement because the process gas is not hazardous in terms of rotor dynamic issues.

The mechanical seal needed to be designed in a way that the rotor weight was as light as possible, and the center of gravity was close to the bearing.

Results

The pilot site became operational in 2021, delivering power to the Texas power grid.

The dry gas seals were successfully commissioned and did not show any issues during operation, which enabled the safe and reliable operation of the sCO_2 compressor.

This site has successfully proven the adoption of sCO_2 as a working fluid in a power cycle, and a larger site is now being developed in the United Kingdom using this technology.

john crane
a smiths company

smiths
bringing technology to life