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PDGS Dry Gas Seal upgrade for Australian LNG project

EagleBurgmann PDGS with separation seal. Since modification, the seals have been running without incident and production is higher than predicted.

EagleBurgmann CSR10 separation seal can cope with ultra-dry nitrogen.

Numerous new natural gas sources have been developed in the coal seams of the Surat Basin in Queensland, Australia in recent years. The produced coal seam gas is collected, treated and compressed in central processing plants (CPP) and then pumped via a 340 km pipeline to Curtis Island near to the city of Gladstone on the East Coast. There it is liquefied and loaded onto LNG tankers.

The 250 hectare two-train LNG plant on Curtis Island is designed to liquefy and load around 8.5 mtpa (million metric tonnes per year). The full production capacity was achieved in mid-2016 and ten LNG ships can be loaded here every month.

The EagleBurgmann seals delivered

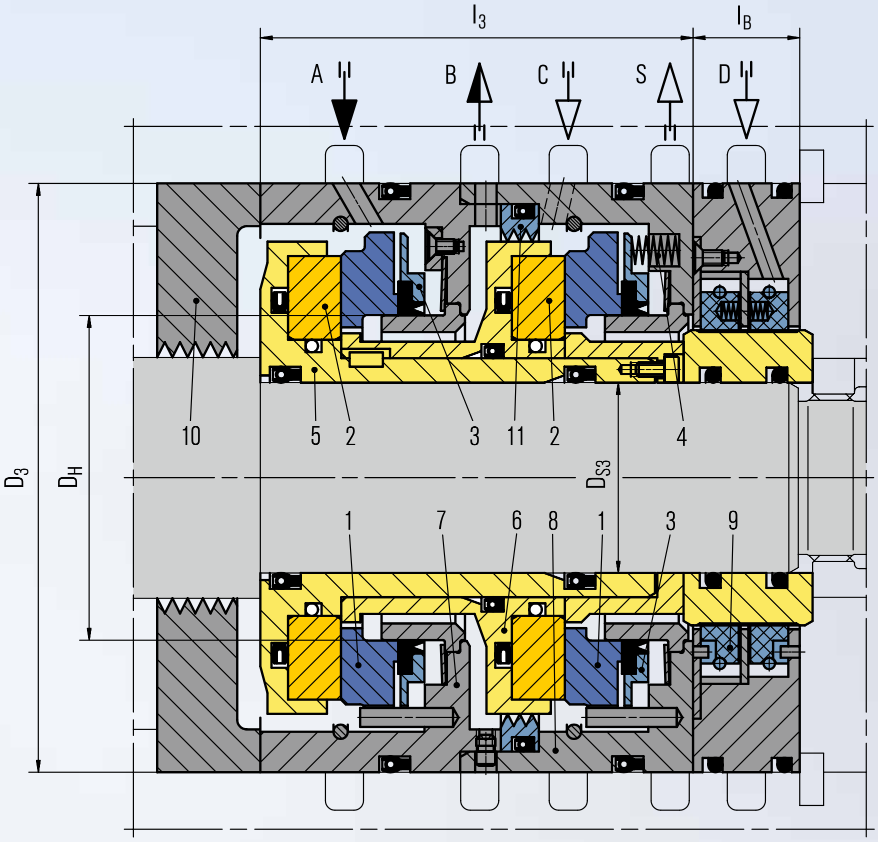
EagleBurgmann has supplied PDGS dry gas seals in tandem arrangement for several facilities of the integrated project, which covers the entire production chain from exploration in the Surat Basin to liquefaction on Curtis Island. Originally, 16 compressors (8 high pressure and 8 low pressure) were equipped with 32 EagleBurgmann seals and 32 EagleBurgmann CSR separation seals to match the compressor manufacturer's specification.

The problem: unexpected operating conditions

After the first CPP was commissioned, the PDGS seals installed in the compressors pumping the gas to Curtis Island had an average MTBM (Mean Time Between Maintenance) of just 6 to 8 weeks before the compressors needed to be shut down and the PDGS seals had to be changed. The CSR separation seals were also wearing prematurely so they were being changed at the same time as the PDGS seals as well.

The seals were thoroughly inspected and the root cause analyzed. Liquid and dirt contamination was regularly found between the seal faces. Other issues were signs of elevated temperatures in the secondary dry gas seals, along with wear of the contacting carbon ring separation seals caused by supplying ultra-dry nitrogen.

Before the gas can be liquefied, unwanted solid matter, mineral oil fractions, coal finds and heavy hydrocarbons have to be removed from the gas stream. It can happen that some of these contaminants are reaching the compression units.



EagleBurgmann PDGS tandem seal with intermediate labyrinth and CSR separation seal.

Item	Description
1	Seal face, stationary
2	Seat, rotating
3	Thrust ring
4	Spring
5	Shaft sleeve and seat retainer
6	Intermediate sleeve
7, 8	Housing (size matched to installation space)
9	Separation seal (CSR)
10	Labyrinth
11	Intermediate labyrinth
A	Primary seal gas supply
B	Primary vent
C	Secondary gas seal supply
S	Secondary vent
D	Separation gas supply

In the beginning of this case, these contaminants caused problems for the dry gas seals, resulting in high leakages and failures. Therefore one of the first measurements that were taken was to use gas from the end of the gas treatment process as an external seal gas source to keep the dry gas seals clean during operation.

However, this change created another problem. Natural gas usually also contains a large amount of water. One of the last steps in the gas treatment process is the dehydration process, which is using triethylene glycol (TEG). The new external seal gas was now supplying clean gas but still contained some liquid TEG. This again caused liquid contamination of the dry gas seals and short service intervals.

The solution: leave the seal supply unchanged but modify the seals

The common solution of heating the gas to 20 K above its dew point to avoid liquid condensing inside the seals, was not available in this case. TEG has a high boiling point of 291 °C (556 °F), even at atmospheric pressure. The temperature needed to transform it into the gas phase would be unacceptable for almost all the other system components. Neither would a seal gas booster improve the situation. There was already an external gas supply used during standstill operation.

EagleBurgmann Australasia worked with the operator for 12 months, both onsite and in the design office, with close support from EagleBurgmann Germany, to change from the standard seal to a modified design that could handle the liquid contamination with no other changes to the seal supply system.

One problem that arises for dry gas seals, when exposed to liquid contamination is that the seal faces are "glued" together by adhesive forces. This is caused by liquid that gets in between the seal faces during standstill. When the compressor is starting up and the seals begin to rotate the seal faces have to be separated again. The separation of the "glued" rings is then causing very high forces on the seal faces and the torque transmission devices in the seal. Therefore one of the tasks was to reinforce the torque transmission mechanism and make sure that no damage will appear during start up with "glued" seal faces.

Additionally, the separation seals were upgraded with a special type of carbon ring which can cope with ultra-dry nitrogen without wearing. Special additives in the carbon can provide the lubrication between the carbon rings and shaft, which the missing moisture in the ultra-dry nitrogen cannot.

What sounds like a quick and easy solution was actually the result of a detailed root cause analysis, conducted in close collaboration between all parties involved. The dry gas seal modifications were eventually delivered by EagleBurgmann Germany in just four weeks, while the separation seals were upgraded locally at EagleBurgmann Australasia. The compressors have been in operation ever since. Today production is higher than it was predicted at project stage and the customer has enjoyed trouble-free operation.

Operating conditions

High pressure applications
Pressure: p = 120 barg (1,714 PSIG)
Temperature: t = -20 °C ... +150 °C (-4 °F ... +302 °F)
Speed: n = 11,800 min^{-1}
Primary seal gas: Methane, nitrogen

Low pressure applications
Pressure: p = 79 barg (1,146 PSIG)
Temperature: t = -20 °C ... +150 °C (-4 °F ... +302 °F)
Speed: n = 10,000 min^{-1}
Primary seal gas: Methane, nitrogen