

Combine-X expansion joints for exhaust gas turbines at a FPSO unit

## Reliable compensation in exhaust system

**Every FPSO unit is self-sufficient when it comes to energy generation to feed all electric equipment for the process of oil and gas extraction, including laser equipment and lighting of the complete vessel. This is necessary because an FPSO unit (FPSO: Floating Production and Storage Offloading) is located offshore, hundreds of kilometers from the coast.**

An FPSO unit located at the east coast of South America uses cogeneration to produce the electrical power. This means natural gas is extracted from the oil wells as an energy source in order to drive a set of thermoelectric turbines. As these turbines exhaust gas at very high temperatures, it makes sense to recover its heat with a Waste Heat Recovery Unit (WHRU). Therefore, the exhaust gas flows into a heat exchanger of the WHRU and heats again a liquid fluid.

The support structure and the exhaust gas system of the WHRU have to compensate all movements, for example thermal expansions in all directions. To prevent damages due to expansion of other

pipes, vibrations, etc., both the air inlet and exhaust outlet of the WHRU are equipped with expansion joints to compensate for the thermal axial and lateral expansion of the exhaust ducting.

### Differently designed expansion joints soon failed

In the particular case of this FPSO unit, the power generation system and its WHRU were engineered by different manufacturers. The exhaust system therefore ended up with two very differently designed and fabricated expansion joints, one directly installed on top of the other. Due to this poorly arranged configuration, the two expansion joints couldn't compensate each other's movements. They failed prematurely soon after entering service, reducing the availability of operation, harming productivity and, consequently, bringing financial damages to the operator of the FPSO, not to mention the potential risk of gas leaking at high temperature into the atmosphere.

Unsatisfied with the low performance and the increase of risks, the operator asked



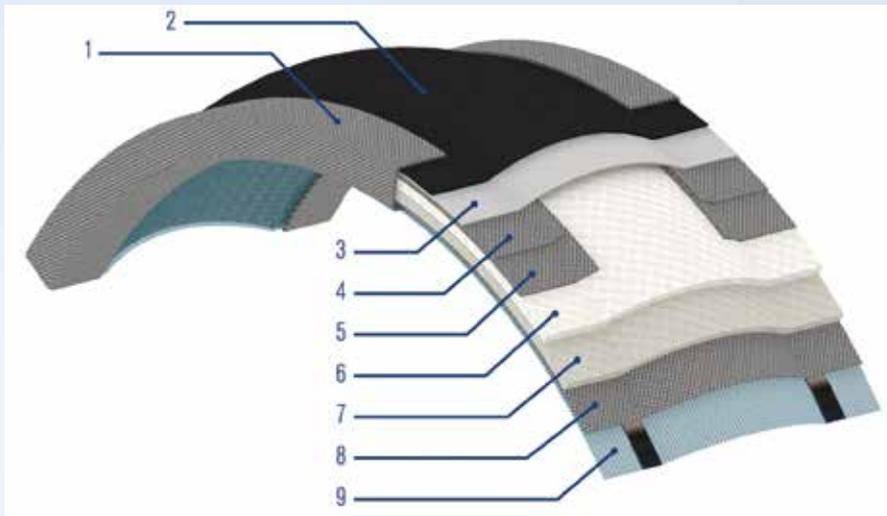
Combine-X expansion joints are available in hot-to-hot, hot-to-cold, or cold-to-cold designs.

EagleBurgmann to study and analyze the configuration of the expansion joints. Together they determined that the expansion joint installed on the exhaust system did not match the exhaust gas turbine's operating conditions such as high temperature, high flow velocity, high turbulence as well as the important necessity of no thermal change of the exhaust gas with the environment.

After the analysis, the operator requested EagleBurgmann to design and develop new



A WHRU meets various heat demands in the production processes at the FPSO.



- 1 Flange reinforcement
- 2 Pressure carrying layer
- 3 Gas seal layer
- 4, 5 Insulation strips
- 6, 7 Insulation layer
- 8 Support layer
- 9 Mechanical reinforcement

The multi-layered design meets the most severe requirements.

expansion joint units to remove the two existing bellows and install the new units instead. The operator specified the required features including minimum axial and lateral movements. Internal insulation was a must as well as the consideration of thermal expansion of the ducting and features to enhance ease of installation.

### Process efficiency increased, risks eliminated

In 2018, EagleBurgmann installed two new pre-assembled expansion joints of the Combine-X series into two energy lines of the FPSO. The function of the expansion units is to compensate thermal expansion, seal the air inlet and exhaust outlet and maintain the gas temperature in the duct. It consequently increases the efficiency of the process and eliminates risks.

Combine-X expansion joints are designed especially for gas turbine systems. Type G particularly meets the project conditions established by the control equipment which measures the axial and lateral movements. It has a multi-layer design and consists of thermal insulation layers, wire mesh to increase mechanical resistance of the component, extra sealing layer with PTFE and external glass fiber layer with PTFE, laminated on both sides. The expansion unit was installed in the superior flange with the intention to avoid cracks in the structure by gradually reducing the temperature and matching the thermal expansion of the upper part of the bellow with the WHRU ducting, which is of a different material.

### Severe conditions, but no maintenance needed

This unit from EagleBurgmann converts two expansion joints into a single component, reducing the quantity of necessary items for maintenance. Compared to the former solution, which forced interruptions for correction every two months, Combine-X is completely reinforced to meet severe conditions without maintenance.

In August 2018 after nine months of operation, the operator's "Reliability Team" made a bore-scope and thermal analysis of the expansion joint. All internal steel components were in perfect condition. Furthermore, low temperature in the "cold flange" and in the external layer of the unit was observed, as expected.

In this project, all engineering in terms of steel components as well as all steel support for the expansion joint and its thermal insulation was provided by EagleBurgmann. To ensure correct installation and use of the expansion unit, EagleBurgmann was in charge of the complete

service. Soon after installation, the operator perceived an increase in equipment availability, technical reliability and operational safety.

Due to the complexity of this project, the operator decided to first purchase two expansion units for one FPSO. In the meantime, he has purchased seven expansion units to standardize all its FPSO units that use cogeneration to produce energy.



Engineering, manufacturing and installation of the new expansion joint units was completely carried out by EagleBurgmann.