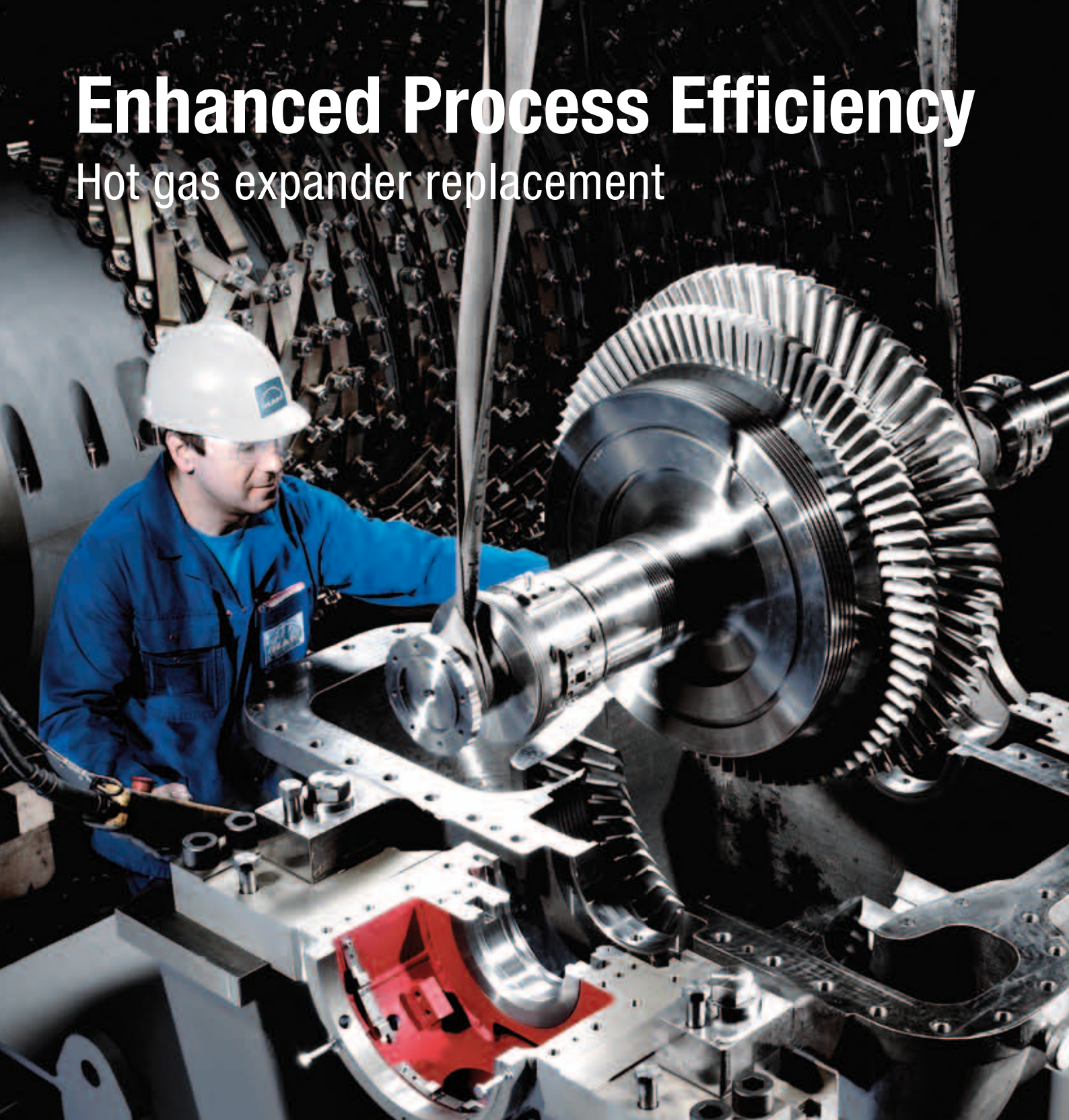


Enhanced Process Efficiency

Hot gas expander replacement



Enhanced Process Efficiency

Technical complexity and tight schedule



With increasing operational problems and the declining reliability of a 30-year-old expander, for which the OEM was no longer in a position to offer the necessary technical support, the customer decided to have the work carried out by a qualified third party. Following a competitive bid procedure, MAN PrimeServ was entrusted with this demanding assignment.

Project goals

In order to keep costs as low as possible by eliminating costly alterations to pipe work and foundations, the new unit had to be adapted to the existing process and constructional infrastructure. The machine was required to be upgraded to the latest technical standards, with the focus on reliability in particular. Process modifications performed by the operator further required an increase in the unit thermal efficiency to allow the retention of the original 2,300kW electric drive motor. A delivery period “not to exceed 12 months” with a maximum plant outage time of six weeks was an absolute requirement.

The MAN PrimeServ solution

The original expander was a two-stage unit with a separate axial bearing. This type of expander design concept was new to MAN PrimeServ.

Already the first preliminary investigations showed that it would be difficult to modify the existing casing to accommodate the new rotating and stator components. The time required for such modifications would also far exceed the specified outage time. The chosen solution was, therefore, based on a new, cast casing. The casing interfaces with the process equipment and the foundation had to remain the same, which presented a major design challenge. The original two-stage design with a separate axial bearing was retained, based on a solid forged rotor with four-segment radial bearings.

Additionally modern instrumentation for bearing temperature, rotor vibration and speed monitoring as well as online power measurement was to be installed. The unit instrument rack was also mounted on the base frame. In order to demonstrate the increased efficiency, a torque meter was integrated into the system between the new expander and the existing air compressor.

Project results and customer benefit

Customer's specifications posed a major engineering challenge, which had to be solved within an extremely tight time frame. The two-stage concept, using standard aerodynamic technology (blading and flow channels) was complex with correspondingly high risk factors, especially considering the contractual efficiency guarantees. A major factor in maintaining the specified plant downtime was MAN PrimeServ's ability to carry out high-speed balancing and mechanical testing of the complete unit at the company-owned facilities prior to delivery. Despite the technical complexity and the extremely tight schedule, the new unit was delivered on time, installed and commissioned within the specified six-week plant downtime.

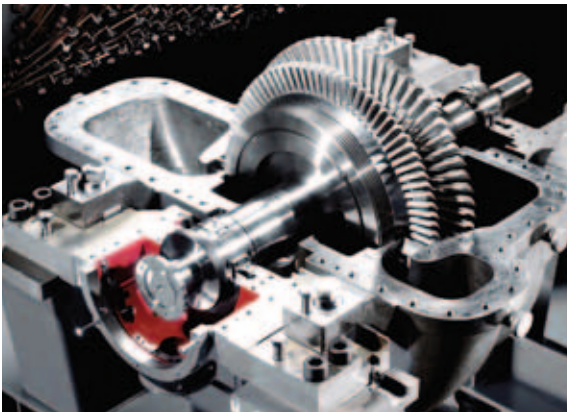
The installation of the new expander, combined with other system and process modifications not included in the MAN PrimeServ scope of supply, has resulted in major operational and economic benefits for the user. The customer now operates a modern, state-of-the-art machine with significantly improved efficiency and high reliability. The carefully planned retention of the interfaces with the existing process equipment allowed all plant modifications to be carried out cost-effectively and with an absolute minimum of production downtime.



Original expander prior to the rebuild



State-of-the-art production of expander blades



Works assembly of the new expander with the cast lower half casing and the newly designed two-stage expander rotor with separate axial bearing



Fully assembled new expander package with instrument rack, ready for dispatch



New expander in operation

Technical Data

Inlet pressure	bar	3.47
Inlet temperature	°C	460
Discharge pressure	bar	1.02
Mass flow	kg/h	48,690

Gas composition 92.7% N₂, 7.2% O₂, 0.05% SO₂, traces H₂O, SO₃, H₂SO₄

With the selected blade stage design the net power at the guarantee point is 2,300 kW with an isentropic efficiency of 79.9%.
The discharge temperature is 298 °C.

Calculation of static pressure at stator and rotor blades

