Gas turbine compressor units

for the Olbernhau and Reckrod compressor stations
in the Wingas pipeline network

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MAN Turbo

250 years

MAN

The WINGAS pipeline network

Wintershall Gas GmbH (WINGAS) has a share of approx. 13 % of the German natural gas market. It obtains gas from the world's largest gas producer, the Russian OAO GAZPROM company. The Olbernhau and Reckrod compressor stations form part of the WINGAS pipeline network, which extends roughly 1,800 km.

Russian natural gas crosses the Polish border on the one hand at Frankfurt/Oder, entering the Mallnow compressor station and is routed from there via a section of the JAGAL, commissioned in 1999, to the STEGAL at Rückersdorf. Gas is also carried across the Czech border to the Olbernhau compressor station, where it is compressed and routed via the STEGAL to the Reckrod distribution and compressor station. The WINGAS pipeline network was extended in 1998 to include the WEDAL, providing a connection to the UK gas grid via the so-called interconnector. A further section was commissioned in 1999 with the JAGAL North, allowing the German network to be connected to the JAMAL pipeline.

The Olbernhau and Reckrod projects

The design of both gas compressor stations is virtually identical: at the heart of each installation (Fig. 1) are three machine sets, each comprising a gas turbine and a compressor. Before the gas enters the compressors, any liquid or dust present is removed via filters and separators.

The gas, which is heated during compression, is after-cooled in coolers. A control room, workshop, an administration block, the fuel gas preparation unit for the gas turbines and a gas metering facility are housed in various buildings. One important part of the Reckrod station is situated below ground: the pipelines and feed valves for distributing the gas in different transport directions. In metaphorical terms, this part of the installation constitutes a "shunting yard" for the gas.

Apart from the distribution function, the Olbernhau station differs from Reckrod in that it has a gas dehydration system.

The Components

1 Three MAN Turbo gas turbine/compressor machine sets: the heart of the installation.

2 Filter separators: these remove solid and liquid particles from the gas.

3 Gas coolers: Located behind the compressors, they cool the natural gas that is heated on compression.

4 Two emergency power generating units: these supply the compressor station with power in the event of a mains power failure.

5 Workshop: maintenance work is carried out here.

6 Administration block: This contains the offices for station staff, together with the local control centres in an integrated control room.

7 Fuel gas processing unit: This ensures that the gas turbines are supplied with fuel gas of the required quality.

8 Feed valves: Enable the gas transported to be distributed to the different gas pipelines.

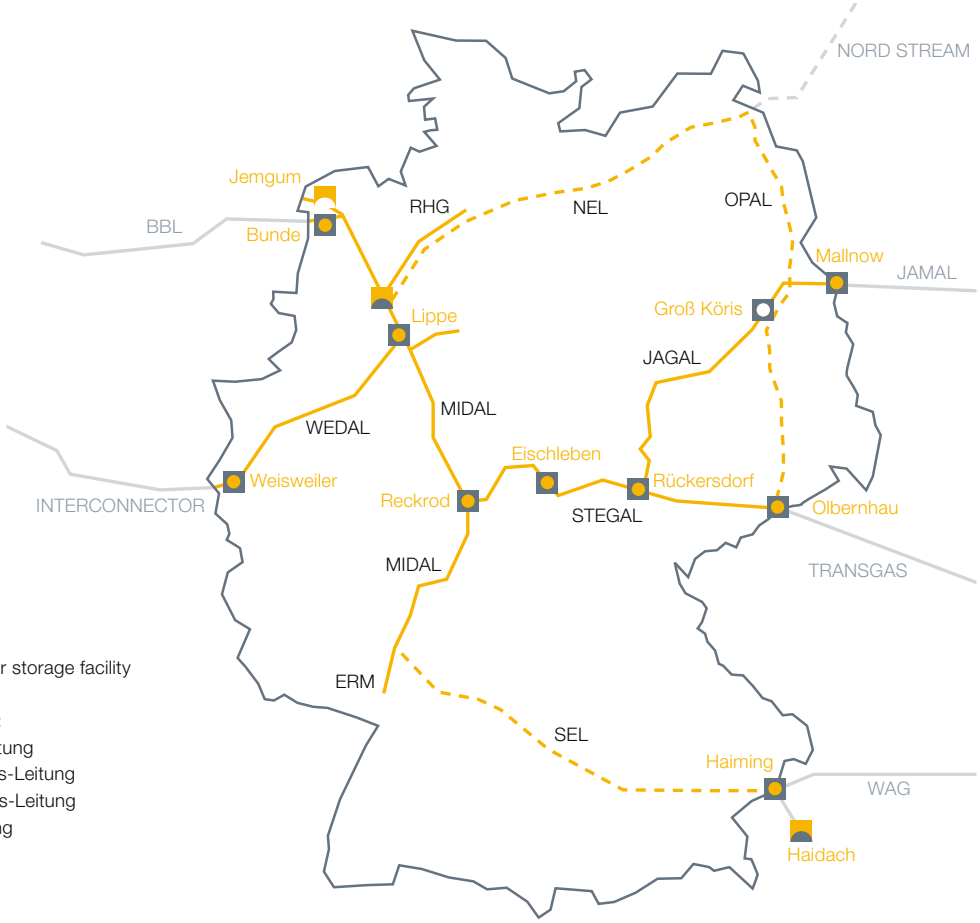
9 Transfer station: Some of the gas is made available here to a regional gas supply company.

The WINGAS pipeline network (map of Germany)

	existing pipelines
	pipelines planned/ under construction
	transit-pipeline
	transit-pipeline planned/ under construction
	underground storage facility
	underground storage facility planned/under construction
	gas compressor stations
	gas compressor stations planned/under construction
Bunde	Name of compressor station or storage facility

WINGAS compressor stations:

STEGAL	Sachse-Thüringen-Erdgas-Leitung
MIDAL	Mitte-Deutschland-Anbindungs-Leitung
WEDAL	West-Deutschland-Anbindungs-Leitung
JAGAL	Jamal-Gas-Anbindungs-Leitung



Scope of the order

In 1992, in the course of further expansion of the WINGAS pipeline network, MAN Turbo secured an order for the delivery, installation and commissioning of a total of six gas turbine/compressor units for the two new pipeline stations, Olbernhau and Reckrod.

The machine units each consist of a THM 1304 gas turbine employing environment-friendly DLN technology and a pipeline compressor, type RV 056. The design pressure of the compressors is 90 bar.

The compressors at Olbernhau were designed with four impellers for a pressure ratio of up to 2, while the Reckrod compressors were produced with two and three impellers respectively for a pressure ratio of up to 1.7. The technical concept permits upgrading of the machines to a maximum of four impellers.

As the result of a change in the gas supply requirements of WINGAS, MAN Turbo moved one unit from Olbernhau to Reckrod in 2001.

The scope of supply for each compressor unit supplied by MAN Turbo includes the following:

THM 1304 gas turbine package
- Gas turbine with DLN combustion chambers
- Intake system
- Acoustic enclosure
- Exhaust system
- Lube oil system
- Starter
- Fuel gas system
- Instrumentation
- Fire extinguisher system

Compressor package
- Pipeline compressor with gas seals
- Base frame with sealing panel
- Accessible machine platform
- Instrumentation

Instrumentation and controls
- Unit control panel
- Low-voltage distribution system
- Blow-off valve
- Instrumentation in process lines

Erection
- Erection of gas turbine and compressor
- Installation of accessory fittings
- Laying of all control cables and vent lines
- All the cabling between the unit and the control room
- Hot and cold commissioning

Station design:

Machine sets

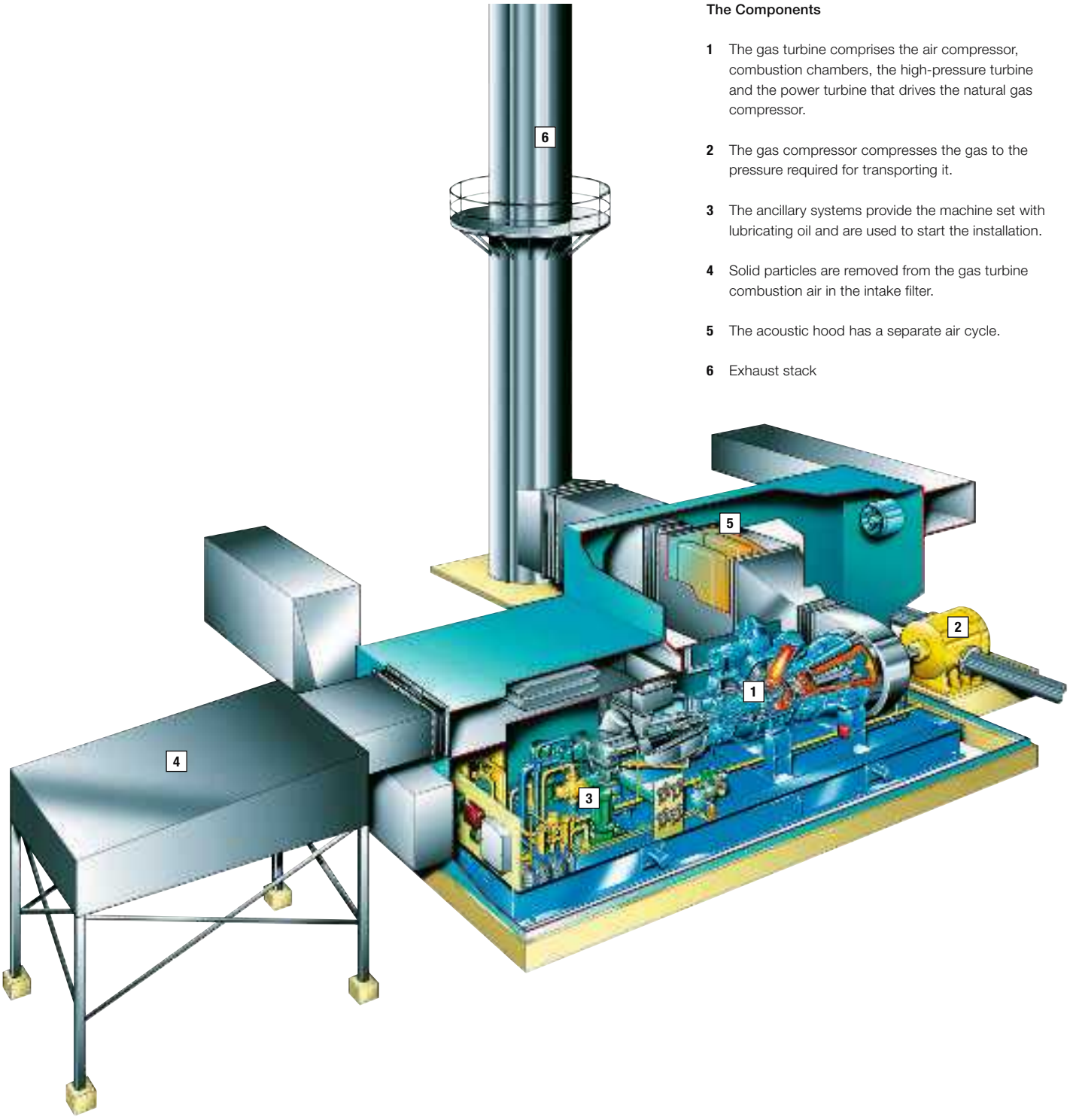
The components of a machine set for gas compression can be seen in Fig. 3: The low-pollutant fuel chambers of the gas turbine use a special combustion technique, so-called premix operation (DLN – Dry Low NO_x). In this process, the fuel gas and combustion air are mixed thoroughly prior to entering the combustion zone. This reduces the pollutant content in the form of nitrogen and carbon monoxide to well below the statutory emission limits prescribed in Germany.

In the high-pressure turbine that drives the air compressor for the gas turbine, the hot gas mixture is expanded initially to an intermediate pressure. A power turbine then expands the gas mixture to the ambient pressure level.

The mechanical energy released is used to drive the pipeline compressor via a coupling.

The pipeline compressor comprises a thick-walled barrel-type casing: the joint face seal between the casing and the end cover is vertical in this case.

The rotor with the radial impellers is supported in sliding bearings in the inner casing (barrel), which is inserted into the barrel-type casing by means of an assembly rig. The seals prevent leaks at the shaft passages through the casing.



The Components

1 The gas turbine comprises the air compressor, combustion chambers, the high-pressure turbine and the power turbine that drives the natural gas compressor.

2 The gas compressor compresses the gas to the pressure required for transporting it.

3 The ancillary systems provide the machine set with lubricating oil and are used to start the installation.

4 Solid particles are removed from the gas turbine combustion air in the intake filter.

5 The acoustic hood has a separate air cycle.

6 Exhaust stack

Pipeline compressor

1 Erection of the pipeline compressor
2 Horizontally split inner assembly
3 Sectional drawing of the inner assembly

The natural gas compressors were delivered fully assembled on their base frames and complete with all oil lines, seal gas lines and instrumentation, plus cabling to terminal boxes (packaged unit).

This compact, sturdy method of construction guarantees low erection costs and easy maintenance. The assembly as a whole is designed to take up the forces from the connected pipelines, thus guaranteeing the correct alignment of the compressor in relation to the turbine.

The bearings and seals are easily accessible for inspection and maintenance purposes without having to open the compressor casing (Fig. 1).

The MAN Turbo pipeline compressor has the following design features:

- forged steel compressor casing
- laterally opposed intake and discharge nozzles with 24" flanges, 600 lbs
- vertical split joint
- cover screwed on at non-driven end
- removable, horizontally split inner assembly
- tilting-pad radial and thrust bearings
- tandem gas seal with monitoring cubicle
- membrane coupling with torque measuring coupling

Inner assembly

The inner assembly includes all flow channels, the internals consisting respectively of a top and bottom half. Once the rotor has been inserted, the internals are screwed together at the horizontal split joint to form the so-called inner assembly (Figs. 2 and 3).

This is then fitted into the outer casing in an axial direction using an assembly and removal rig.

Operating modifications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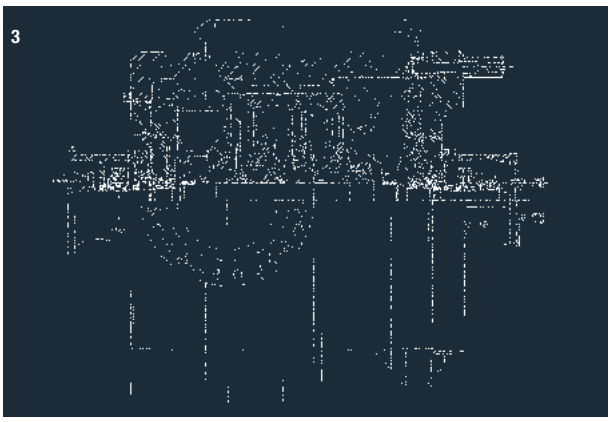
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Thanks to its modular design, the MAN Turbo pipeline compressor is capable of adaptation to a change in operating conditions.
A change in such conditions at the Reckrod station in 1997 made it necessary to increase the pressure ratio of the pipeline compressors. The two three-stage compressors thus acquired an additional impeller.

The maintenance-friendly concept of MAN Turbo pipeline compressors and the prefabricated additional impellers permitted modification to be carried out in the minimum of time:
The inner assembly was removed on site under the supervision of the MAN Turbo service team. The modifications, including balancing of the rotor, were then carried out in the workshop in Oberhausen.

Installation of the inner assembly in its entirety, including operating trials, was completed in just ten days. It was not necessary to detach the process lines or to remove the compressor from its foundation during assembly.

The compressors were operational again after a modification period of three and five weeks respectively.

The modular design of the pipeline compressors demonstrated its flexibility once again in 1999, when the complete inner assembly of the two-stage compressor at Reckrod was exchanged with one of the four-stage internals at the Olbernhau station to adapt these to a change in operating conditions at both stations. Of course, the fact that identical compressor casings were used in spite of a difference in operating conditions at Olbernhau and Reckrod was a prerequisite for this. Without the manufacture of new parts, it proved possible to modify the compressors within 18 days, without dismantling the compressor casings.

Shaft seal

The compressors in Olbernhau and Reckrod are fitted with tandem gas seals. An extensive monitoring system ensures that the seals are supplied with filtered natural gas as a sealing medium. The small gas leaks required for functioning of the gas seal are discharged via the roof. Proper functioning of the seal is monitored by checking the leakage amounts and pressures.
To separate the gas seal securely from the bearing oil, air is supplied as the sealing medium between the bearing pedestal and the seal gas chamber.

1 Complete view of set control system
2 Control system structure for unmanned operation of a pipeline compressor station

Process control automation

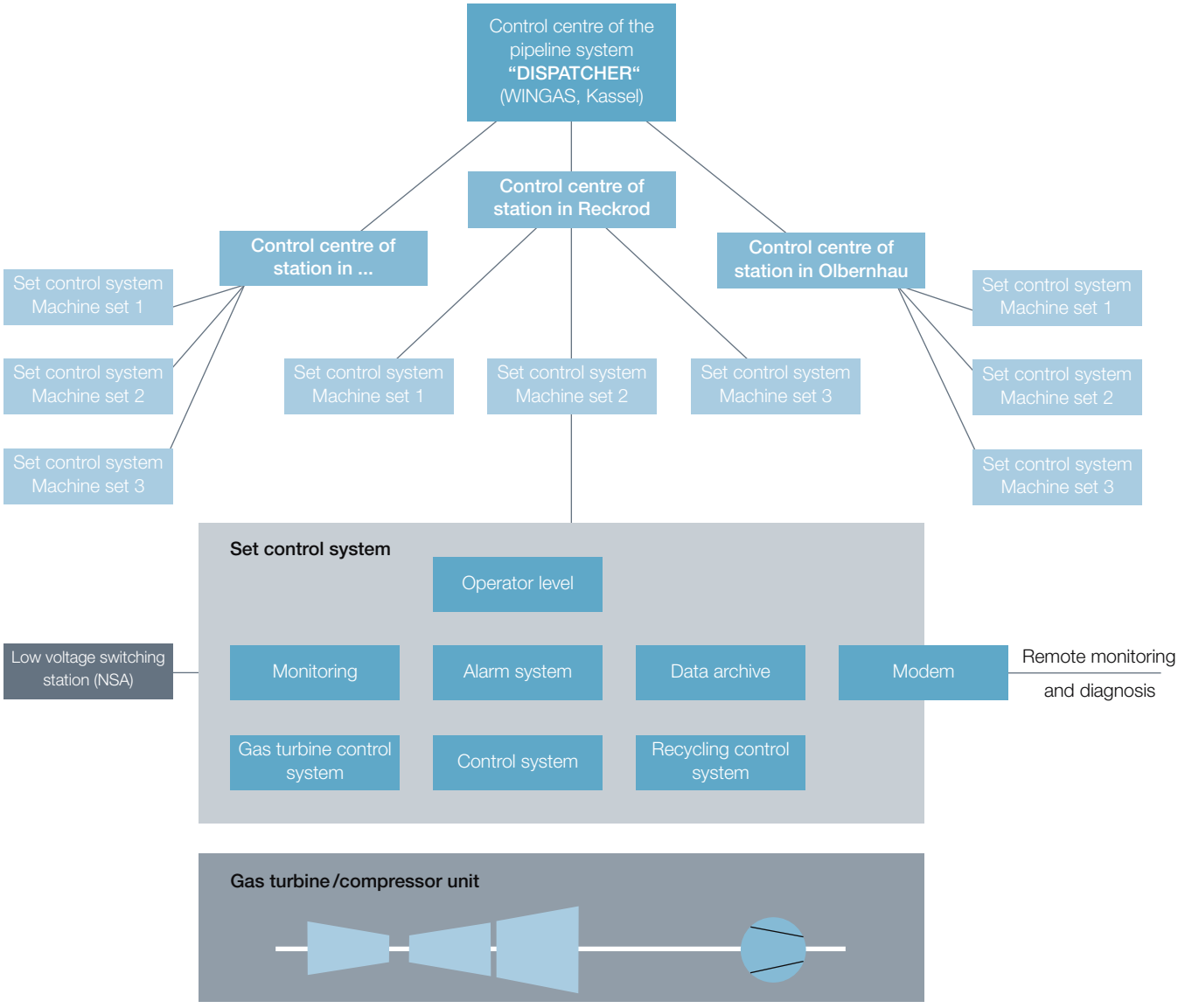
WINGAS, the operator, controls the overall pipeline system shown on page 3 via a central control room in Kassel.

A control and instrumentation system is required for unmanned operation of each of the compressor stations:
Starting out from the network control room, the system accesses the respective station and then the relevant machine set (Fig. 1).

The control system for each set (Fig. 2) consists of the turbolog® DSP system developed by MAN Turbo and the standard fuel gas control system of the gas turbine.The control system comprises all the components required for control, starting and shut-down of the gas turbine, start-up and shut-down sequences for compressors, fittings for connecting the set to adjacent pipelines and all the equipment required to monitor and control the compressor, such as bypass control and vibration monitoring systems, temperature displays, alarm panels etc.

This data is transmitted to the higher-level automatic station systems via suitable interfaces.

The software required for this comprises:
- control and monitoring software for all drives
- start-up and shut-down control system
- monitoring and protection of the set in line with DVGW regulations
- surge limiting and anti-surge control of the compressor
- processing of all measured values
- ascertaining the flow and the delivery head for displaying performance data
- recording and processing messages



The operating console with monitor and keyboard displays various process images, such as:

- the plant layout
- the fuel gas system
- turbine layout
- compressor layout
- compressor characteristics
- oil supply system for turbines and compressors
- seal gas system
- vibrations etc.

Extensive testing of the set control systems at the manufacturer's plant has confirmed their reliability.

Erection

1 Reckrod compressor station following expansion in 2001
2 Olbernhau compressor station

The gas turbines and compressors were produced as integral units complete with pipes and cabling, making it easier to erect the machine sets in the plant. The first six complete units were commissioned and underwent trials in 1993 and 1994.

Outlook

2

As of 2002, the two stations had completed approx. 250,000 operating hours. They will continue to play an important role in the WINGAS network in future.

MAN Turbo AG
Steinbrinkstrasse 1
46145 Oberhausen/Germany
Phone +49. 208. 692-01
Fax +49. 208. 692-2019
www.manturbo.com

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