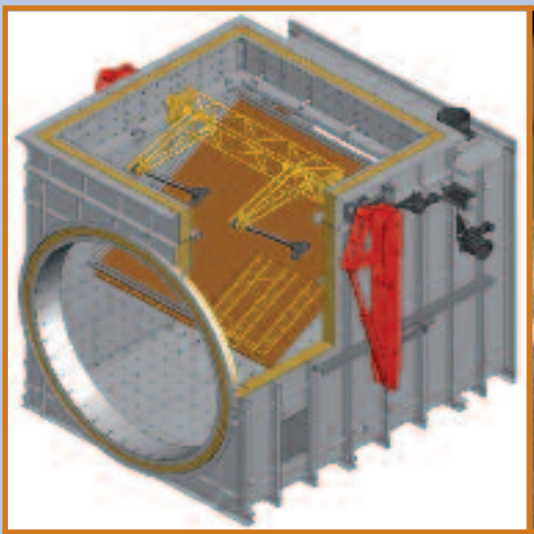
RAUMAG JANICH

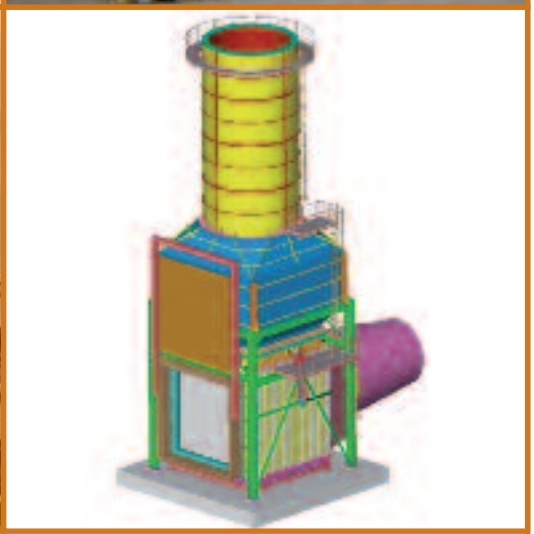
A LEADER IN DAMPER TECHNOLOGIES

TOP 100 Top-Innovator

Diverters of a new generation and exhaust gas systems for combined cycle power stations

PERFECT DAMPER TECHNOLOGIES FOR INDUSTRIAL PLANTS





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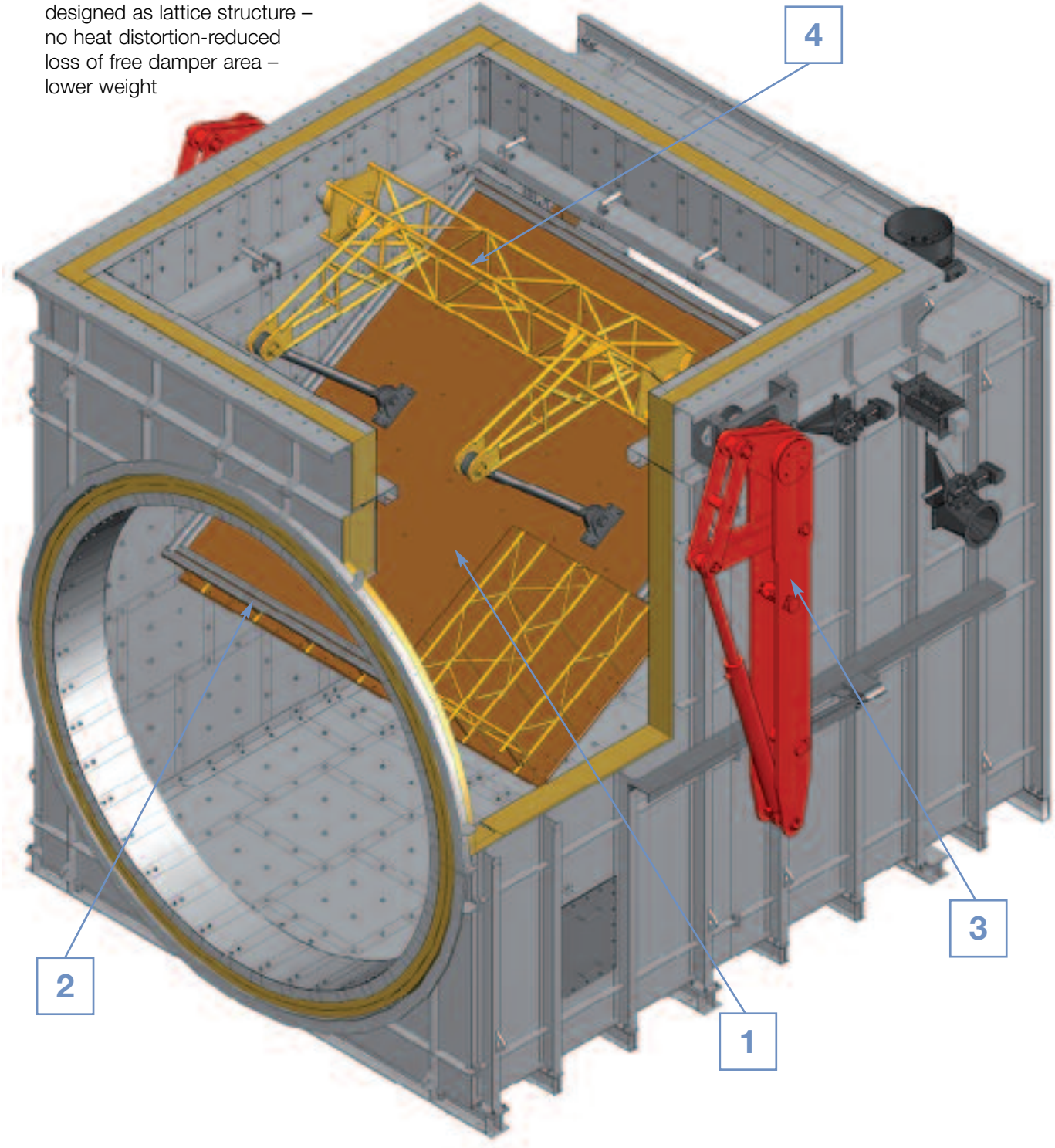
Technology lead through patented innovations

1 Blade with lattice support structure and free floating, cardanically attached diaphragm cover plates – no heat distortion – reduced weight

2 Nicroflex-Hiperform seals –
high resilience as well as stability during modulating service

3 Twin toggle lever actuation –
provides for 180 degrees rotary movement with optimal utilisation of the toggle lever kinematic –
lower actuating forces-only one cylinder each side required –
drive shaft free of bending stress

4 Diverter drive shaft and integral levers –
designed as lattice structure –
no heat distortion-reduced
loss of free damper area –
lower weight



The patented lattice structure supported Diverter blade

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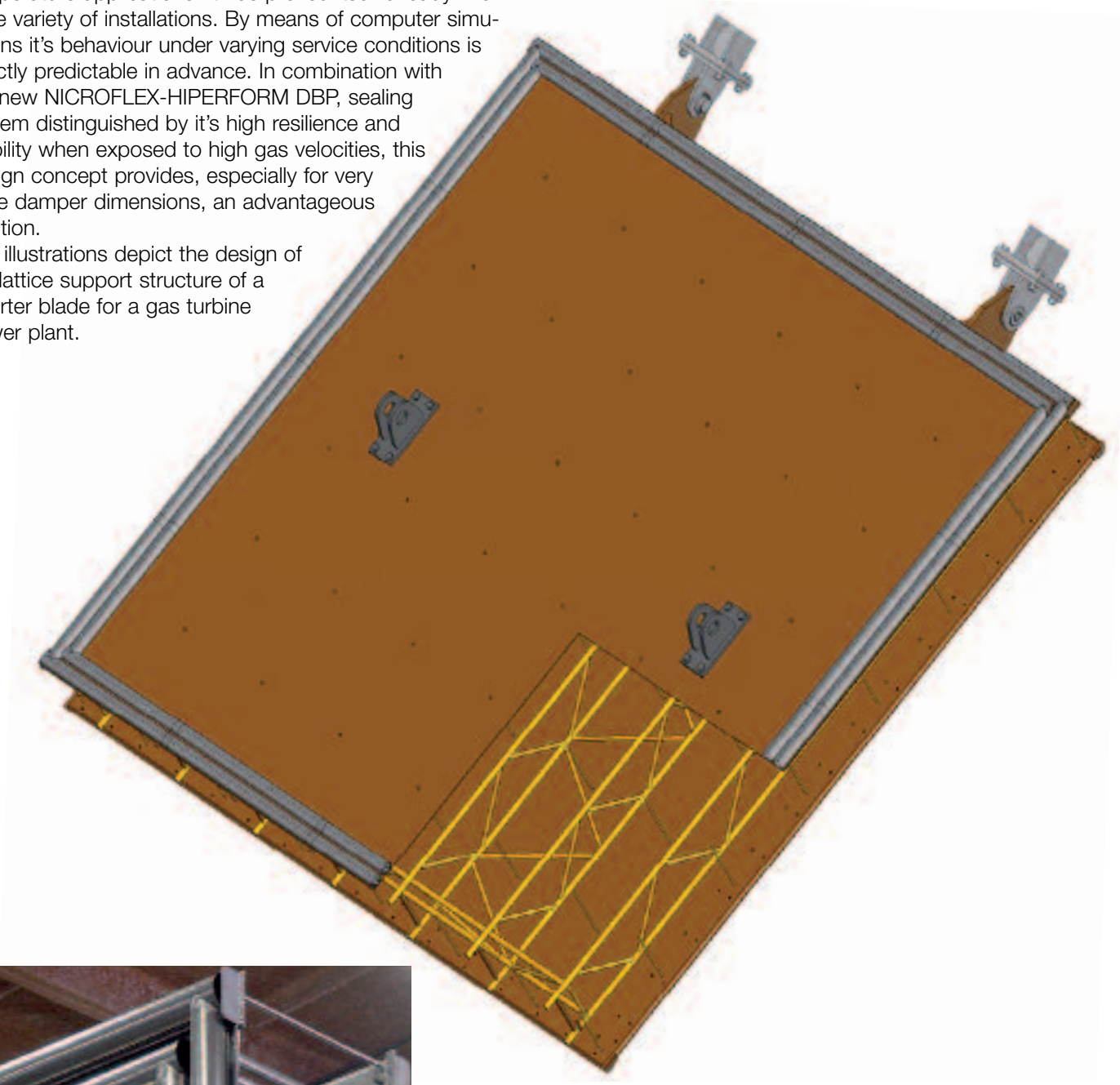
RAUMAG-JANICH has developed and patented a new diverter blade design for combined cycle gas turbine plants, although the design is also suitable for other high temperature applications. It has proved itself already in a wide variety of installations. By means of computer simulations it's behaviour under varying service conditions is exactly predictable in advance. In combination with the new NICROFLEX-HIPERFORM DBP, sealing system distinguished by it's high resilience and stability when exposed to high gas velocities, this design concept provides, especially for very large damper dimensions, an advantageous solution.
The illustrations depict the design of the lattice support structure of a diverter blade for a gas turbine power plant.



Two cover plates are fitted upon this structure by methods which permit them to expand and contract in all directions when heating up and thus avert any distortions. The hot gas flows freely through the lattice structure so that the temperature of its members change evenly and no deformations occur irrespective of the speed with which the temperature changes take place.
The blade may be equipped with single or double sided thermal lagging in order to reduce heat transfer into the closed down section of the plant.

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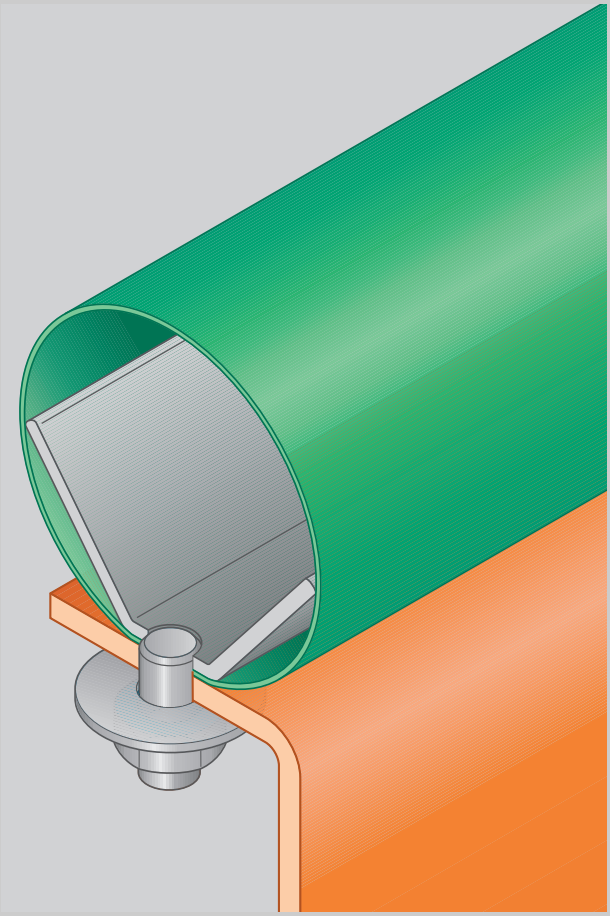
The Nicroflex-Hiperform sealing system, protected by world wide patents



Specially intended for large shut-off dampers and diverters for combined cycle gas turbine power stations, RAUMAG-JANICH developed the new NICROFLEX-HIPERFORM sealing system.

Geometrically circular metal loop sealing elements afford a permanently high resilience of 30 mm, and more with enlarged loops. This facilitates the neutralisation of certain misalignments or heat expansion of very large damper blades.

In uncompressed condition (damper open) the internal vee-shaped stabiliser bars provide the loops with additional lateral strength. (illustration above)

The seal element is free of high metal stress points which normally appear when stainless steel seals are subject to cant operations in the course of their fabrication. Such operations are unnecessary in manufacturing the circular seals. Due to this they will be able to better withstand damage or destruction as a result of high gas velocities, vibrations or severe turbulences.
Reliable gas flow modulation during boiler start up is also possible without negative effects on the seal.

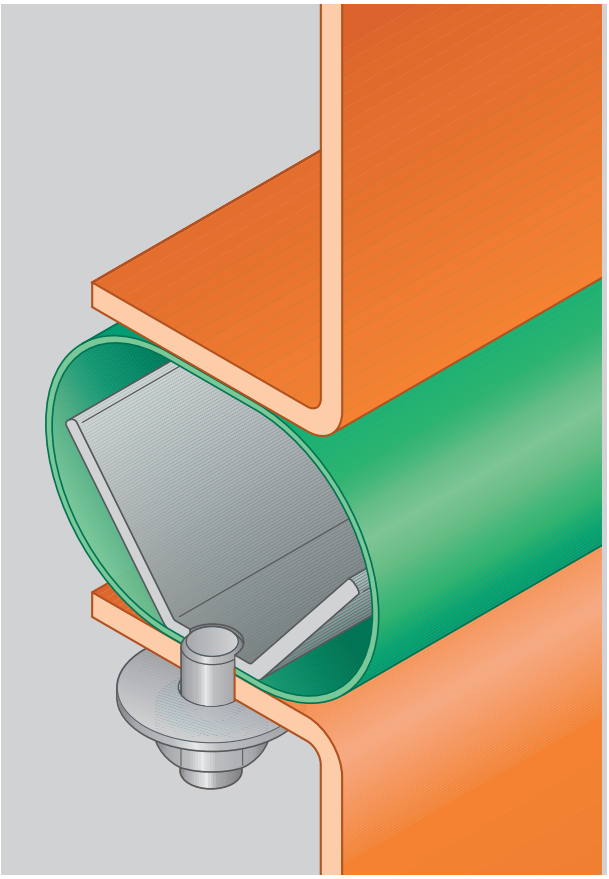


Illustration below: In compressed condition (damper closed) a wide area of contact is created between seal and mating surface which provides a very good initial tightness. The loop flattens and two semicircular shaped bulges extend sideways on both sides which provide the seal with strength to withstand high gas pressure.
The internal vee-shaped stabilizer also acts as an end stop limiting seal compression and preventing its unintended overdeformation.

The seals resilience can be easily adjusted to suit actual conditions by simply inserting one or more back up bars into the loop.

Even deformations by point loads (tramp material) are neutralized by the seal which regains contact with its mating surface within a very short distance.

With a single set of seals of this type the area equivalent damper thightness is 99,98%.
With double seals and seal air a 100% tight, man safe shut-off is accomplished.

The external dual toggle lever actuation (Patents applied)

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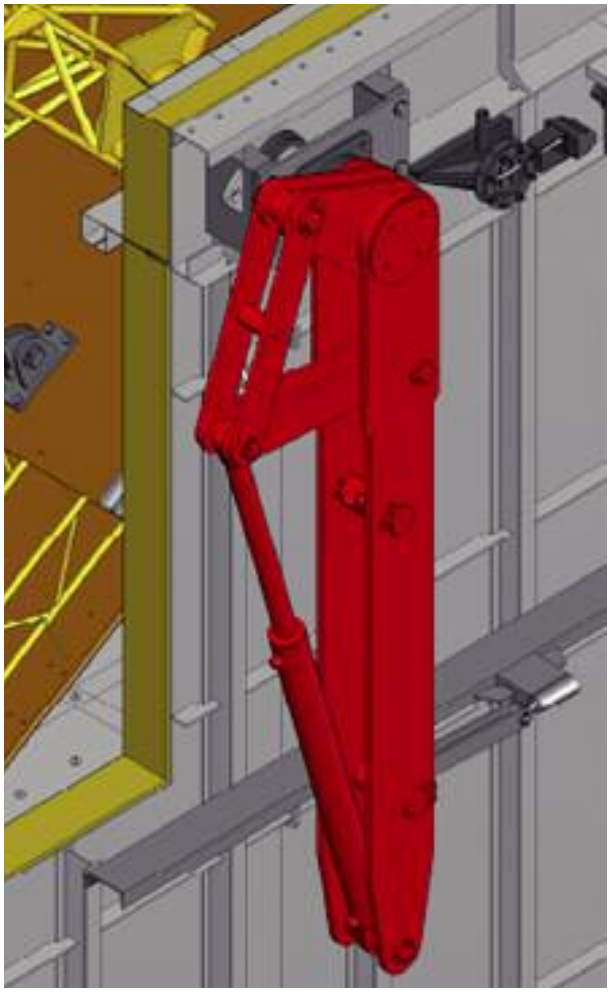


Picture below:
dual toggle lever actuation arrangement for a DIVERTER, ND 5600 x 5600 mm

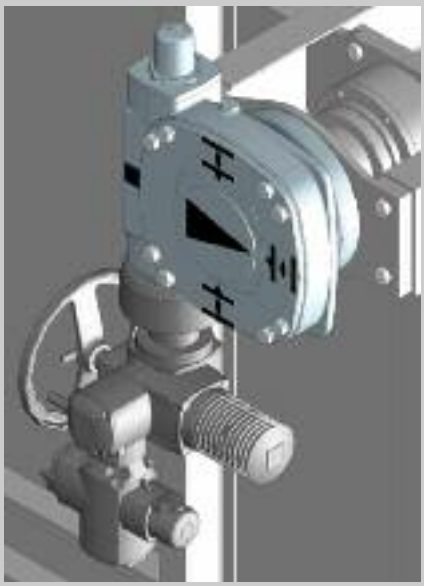
RAUMAG-JANICH has developed a unique new external dual toggle lever actuation method for diverters which provides for a turning angle of 180 degrees. This offers a number of advantages for the damper operation and its reliable function.
Large sized diverters are designed with an internal toggle lever system. With this it is of advantage to apply the actuation forces at the blade centre in order to obtain symmetrical loads on the blade and its seals. Also, in the blade end positions, when the blade is subjected to the highest differential pressure and the seals make contact with the landing bars, the toggle lever system provides for an effective conversion of drive torque into high closing force.

Hydraulic cylinders acting with single or double levers can, on account of the geometry of the lever system, attain only relatively small turning angles. To overcome this, the position of the main drive shaft is usually shifted towards the pivoting point of the blade. This however, results in an insufficient utilisation of the internal toggle lever system in the end positions of the blade when the acting differential pressure is greatest and the seals are pressed down firmly onto the landing bars. Consequently, the cylinders have to be dimensioned for higher forces. The required torque in the end positions is also higher. Generally, the whole drive system will have to cope with heavier loads.

The new dual toggle lever actuation method attains a 180 degrees turning angle, it facilitates the optimal utilisation of the internal lever system and therefore requires lower actuating forces. For these reasons, only one cylinder each side is required for the diverter operation.

Electric actuation

DIVERTERS requiring no modulating operations or emergency function are equipped with multiturn electric actuators.



The illustration on the right depicts a typical actuator arrangement.

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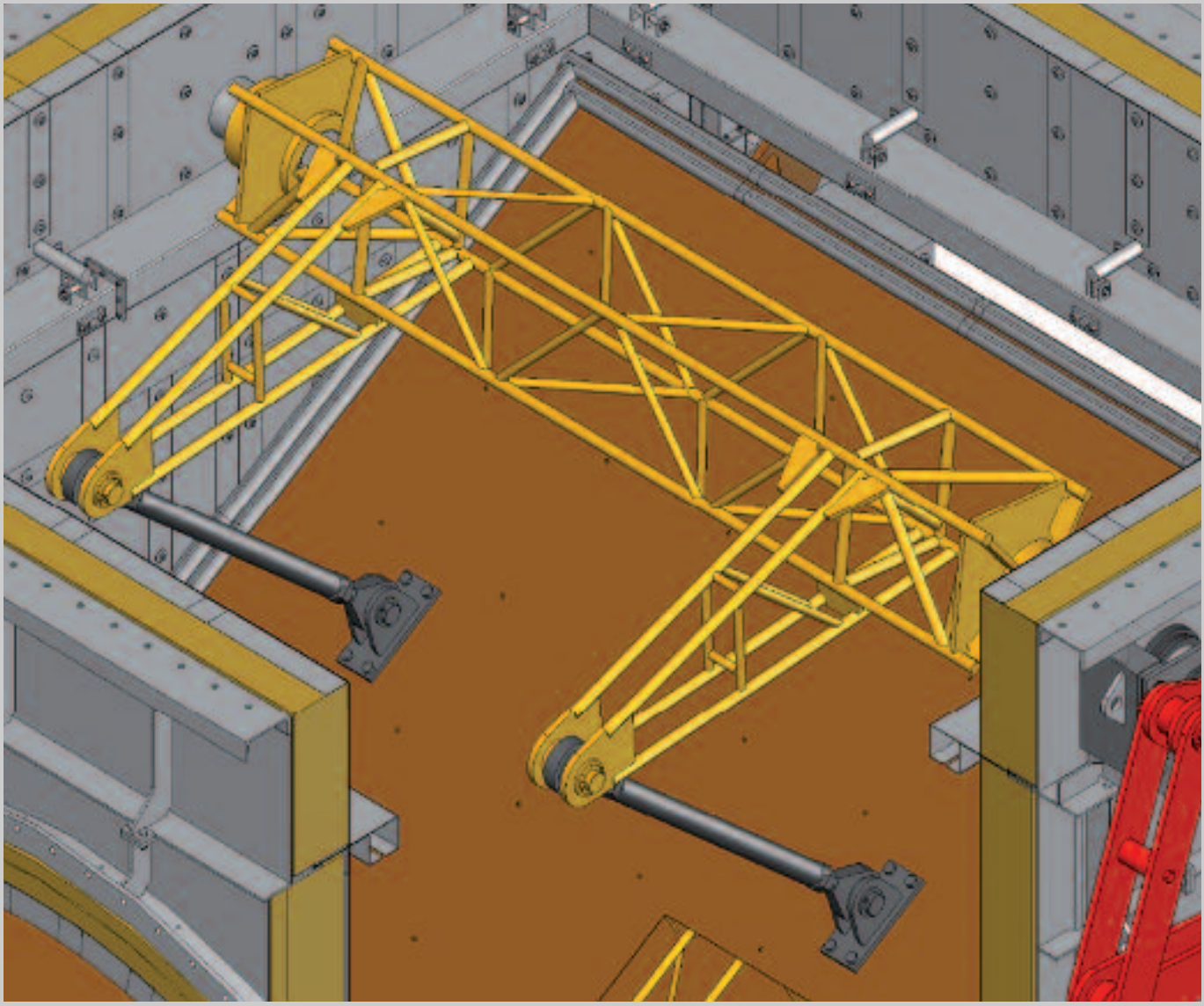
Latticed girder actuating mechanism

(Patents applied)



A new development of **RAUMAG-JANICH** is the lattice girder actuating mechanism for diverters.

This design supersedes the usually used heavy walled tubes, sometimes even fabricated by welding two U-shaped sections together. This causes a considerable loss of free damper area. Furthermore, on opening the bypass, the tube is temporarily exposed to high temperature gas flowing predominately from one direction as well as the release of welding stresses, both of which cause distortion of the hollow section.

The lattice girder design averts all those disadvantages. The high temperature gas flows freely through the lattice structure so that all its members heat up evenly with the result that heat distortion is completely absent. Not only is the loss of free damper area lower but the component weight is also reduced to a minimum.

The picture below depicts the lattice girder actuating mechanism of a DIVERTER, ND 5600 x 5600 mm.

Externally positioned spherical sleeve bearings support the drive shaft

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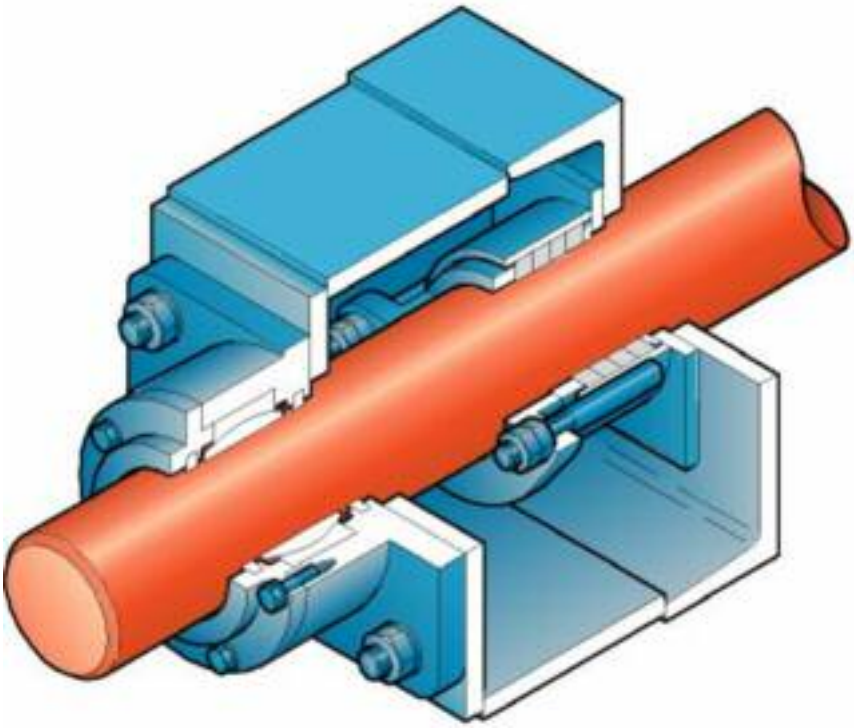

The main diverter drive shaft is supported by externally positioned, maintenance free, spherical sleeve bearings fitted into dust tight casings. Neither the medium nor the plant environment can harmfully effect them in any way.
The large, specially coated, spherical bearing surfaces prevent damage or stiff movement in the presence of severe vibrations. The passages of the shafts through the casing are sealed by packing glands with internal support rings.

The seal air system with standby facility

Dampers with double seals in conjunction with seal air injection between the two sealing planes attain a 100% tight, man safe, shut-off. The seal air pressure needs to be higher than the pressure of the flue gas. This type of system corresponds to UVV.
In order to prevent gas leakage into a shut-off section in case of a seal air fan breakdown a standby facility is provided.

The illustration depicts a typical arrangement of the seal air fans.

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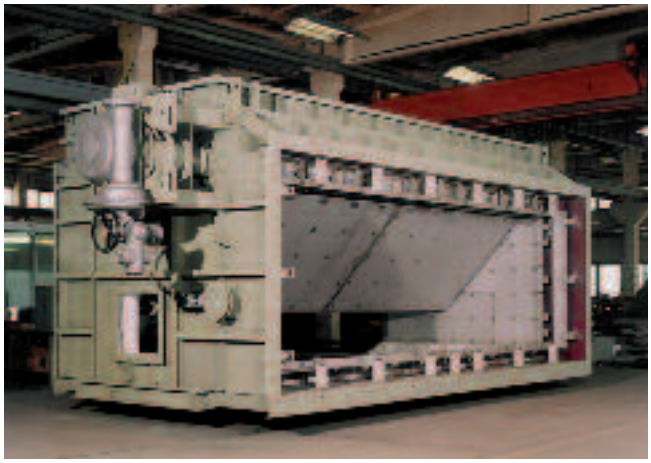
DIVERTERS for combined cycle gas turbine power stations

Pictures above, on the left and right: fabrication and erection of a diverter, ND 5600 x 5600 mm, including a blanking plate guillotine.
Based upon an order received from **Nooter-Eriksen** two diverters, ND 3900 x 3900 mm and one diverter, ND 5600 x 5600 mm have been supplied to the power station **Qarn-Alam** at Oman.

Picture on the left:
6 diverters, ND 3048 x 3048 mm have been supplied to the largest Russian combined cycle power station at **Moscow on the strength of an order received from Zorlu Energy.**

Picture on the left below:
Diverter, ND 5020 x 4640 mm for the extension of the **combined cycle power station at Linz,** Austria.

Picture below, right:
Diverter, ND 2000 x 6000 mm, for **Degussa's combined cycle power station at Antwerp.**



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Picture on the right:
Based upon an order received from **Gama Boiler** for the **combined cycle power stations at Entek and Ostim** Turkey, **RAUMAG-JANICH** supplied the diverters, ND 3150 x 3150 mm, the diffusers, the blanking plates and flexible joints.

Picture above: if required, **RAUMAG-JANICH** provides supervisors during erection.

Picture below: **RAUMAG-JANICH** secured an order for the supply of 3 diverters, ND 3048 x 3048 mm, for the **combined cycle power station Kayseri** Turkey. The diverters were made entirelyof heat resisting stainless steel.

Picture above: depicted is a lattice structure supported blade with thermal lagging on both sides for a diverter, ND 3050 x 3050 mm

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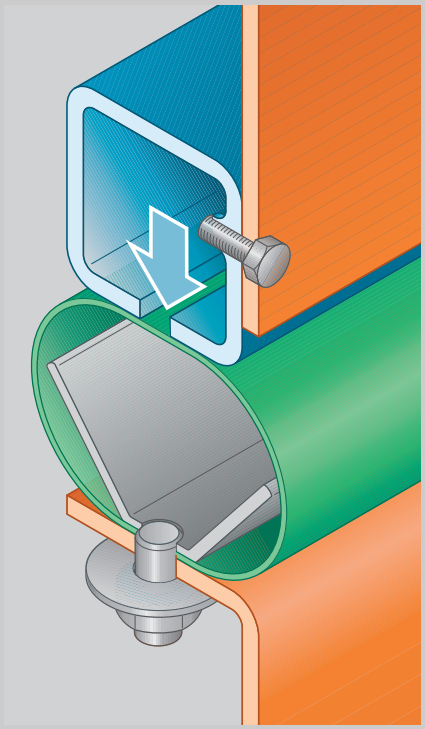
DIVERTERS for Off-Shore installations

RAUMAG-JANICH developed diverters specially for off-shore service.
In view of the operating conditions casing and all internals are made of stainless steel.
The diverters are powered by hydraulic or pneumatic systems with accumulators for emergency operation in case of power failure.
The design incorporates the proven lattice structure blade concept. The NICROFLEX-HIPERFORM sealing system permits gas flow modulation in all positions.



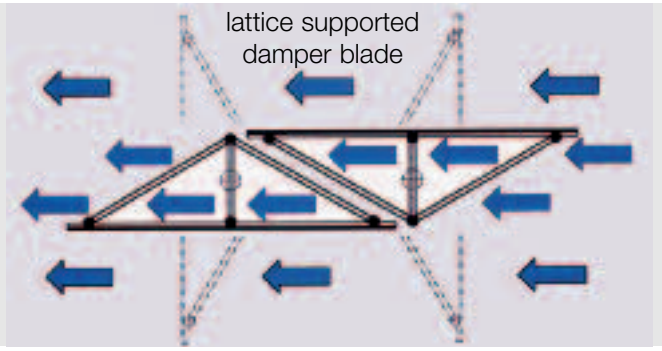
Picture left and on the right below: depict a new, also patented, sealing arrangement with which a 100% tight shut-off is accomplished by using only a single seal system. On account of the broad contact surface created when the damper is closed it is possible to effect a shut-off by creating two sealing surfaces.
Gas leakage is prevented, as usual by the injection of seal air. This method is of special advantage for off-shore diverters.

Picture on the left:
Based on an order received from **Alstom Energy Systems UK, RAUMAG-JANICH** designed and supplied 10 tandem dampers, ND 3200 x 3200 mm, for shut-off and modulating service for the gas turbines of the world's largest liquefied natural gas plant **Snovit** operated by **Statoil** at Hammerfest.
Decisive for the order award to RAUMAG-JANICH were the innovating techniques developed during the last few years. Of particular importance was the proposed solution for modulating the gas flow in view of the extreme operating and climatic conditions .

RAUMAG-JANICH secured an order from **KANFA-TEC** for the design and supply of diverters destined for the WHRU's of off-shore generator plants in the Barents sea. They were made completely of heat resisting stainless steel and of a special design developed by RAUMAG-JANICH for such applications. Apart from the high exhaust gas temperature the local outside temperature of minus 46 degrees C. had to be taken into consideration.

Picture below and right: If required **RAUMAG-JANICH** does supply diverter type dampers with louver type blades. The lattice frame supported single shroud blade design minimizes the pressure drop across damper. High temperature gas flows freely through the support frame with all members heating up evenly. Therefore heat distortion is completely averted. (Off-shore plant **Alvheim**, Norway).

Picture above: **RAUMAG-JANICH** supplied to **Alstom Energy Systems UK** for the **Statoil** operated **Siri** off-shore plant a diverter, ND 2100 x 2100 mm.



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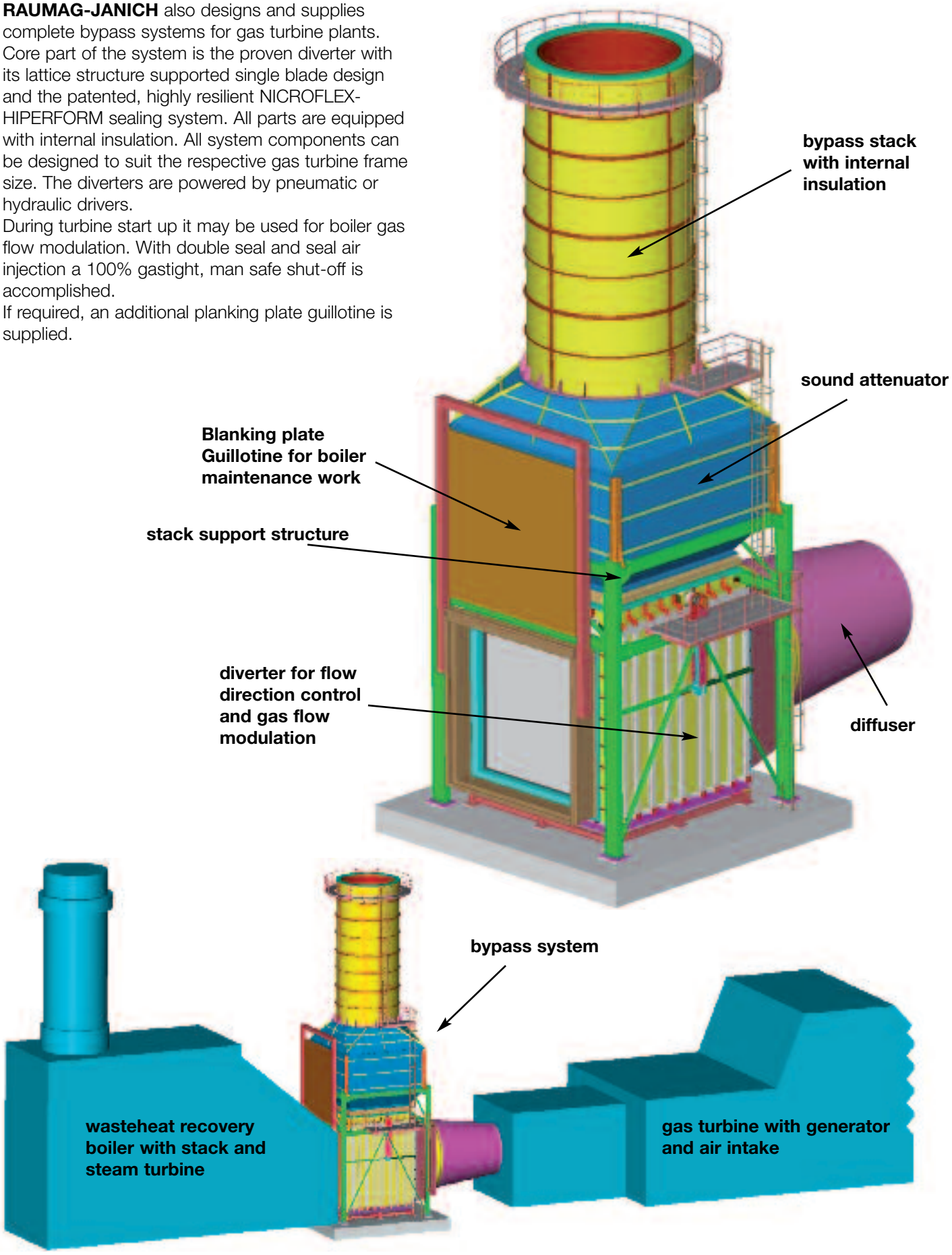
BYPASS-Systems for combined cycle gas turbine power stations

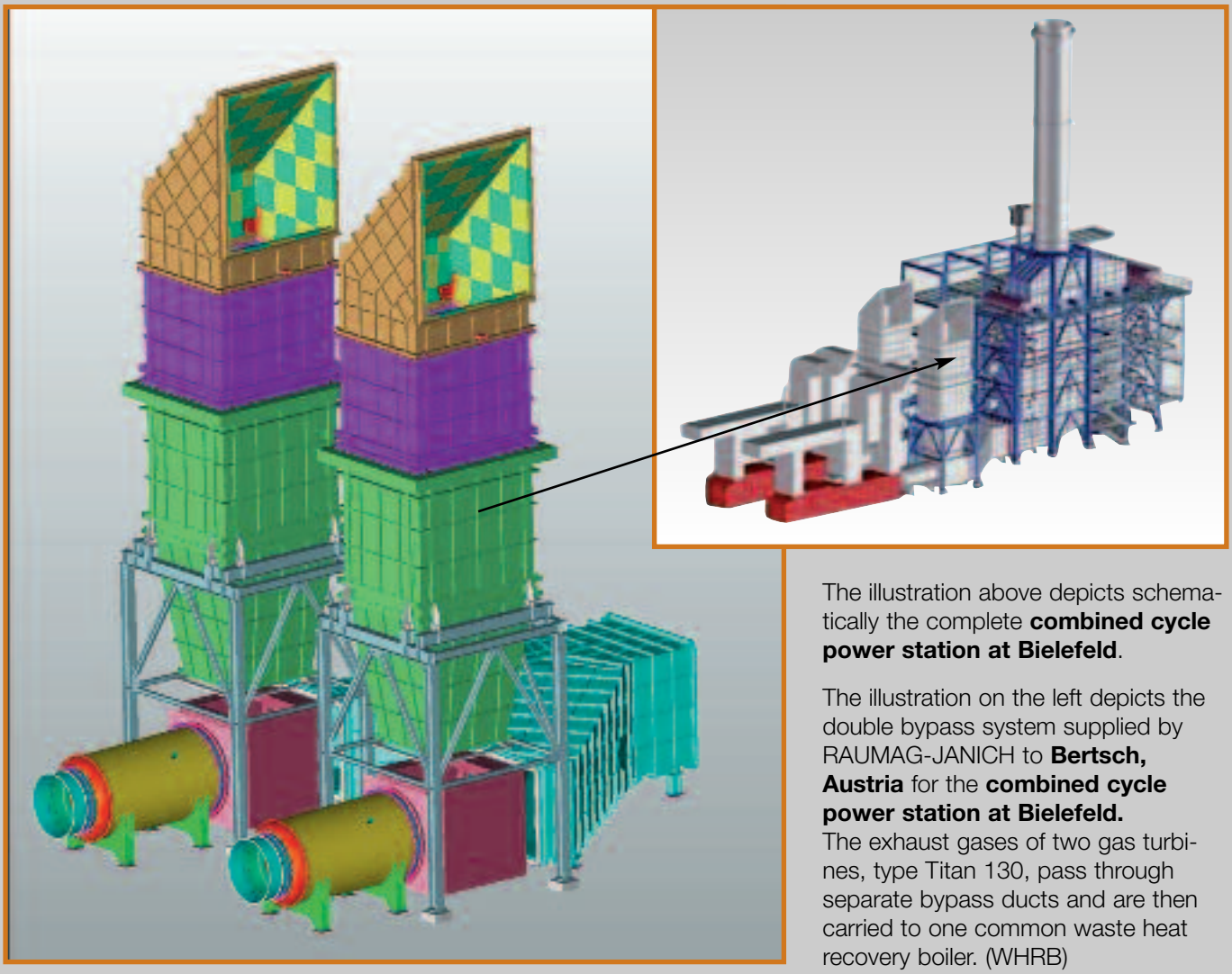
RAUMAG-JANICH also designs and supplies complete bypass systems for gas turbine plants. Core part of the system is the proven diverter with its lattice structure supported single blade design and the patented, highly resilient NICROFLEX-HIPERFORM sealing system. All parts are equipped with internal insulation. All system components can be designed to suit the respective gas turbine frame size. The diverters are powered by pneumatic or hydraulic drivers.
During turbine start up it may be used for boiler gas flow modulation. With double seal and seal air injection a 100% gastight, man safe shut-off is accomplished.
If required, an additional planking plate guillotine is supplied.



Picture above: view of the combined cycle power station **Entek**, Turkey with the bypass system in the centre.

Diverter with bypass system during erection at **Ostim** power station in Turkey with a RAUMAG-JANICH supervisor in attendance

Double Bypass Systems



The illustration above depicts schematically the complete **combined cycle power station at Bielefeld**.

The illustration on the left depicts the double bypass system supplied by RAUMAG-JANICH to **Bertsch, Austria** for the **combined cycle power station at Bielefeld.** The exhaust gases of two gas turbines, type Titan 130, pass through separate bypass ducts and are then carried to one common waste heat recovery boiler. (WHRB)

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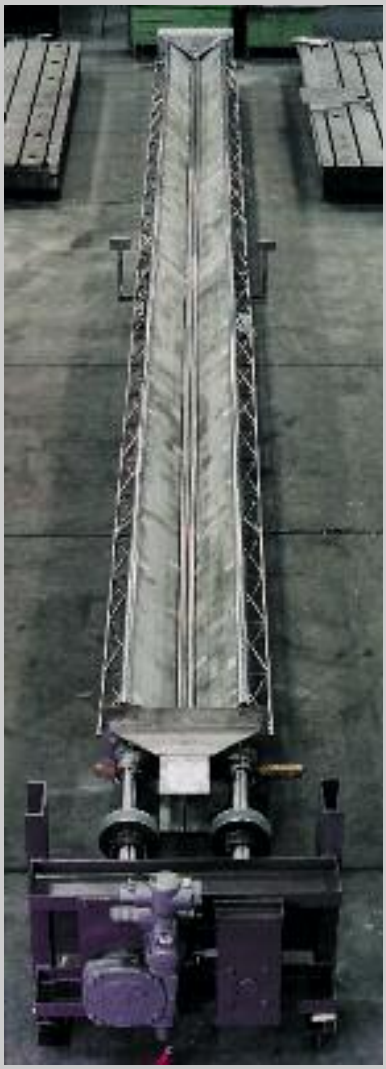
Special dampers for combined cycle plants



Picture above:
Blanking plate guillotine, ND 3050 x 3050 mm for the **Entek power station.**

Picture on the right and left:
Patented shut-off and gas modulation system, ND 600 x 17500 mm, for the **combined cycle power station at Bitterfeld.** This damper serves to either shut-off the integrated boiler bypass or for gas flow modulation towards it. Covering a blade span of 17500 mm was made possible by using the new, patented lattice structure supported blade design. The blades are made up of 17500 mm long latticed girders upon which free floating cover plates are fitted.
The **NICROFLEX-HIPERFORM** seals high resilience guarantee a tight closure of the blades. In open position and high velocity, high temperature gas flow, the suitably stabilised sealing elements permit trouble free modulating operations.The system operates at temperatures of **up to 700 degrees C**. Even at such conditions **no blade distortion** has been observed.

Special dampers for combined cycle plants

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Picture above:
Stack damper, ND 7000 mm dia supplied to **BALKCE-DÜRR, Austria** for the **HRSG unit at Kastroe** plant, Norway.

The damper is electrically operated and opens automatically by means of counterweights if a certain, preset duct pressure is exceeded. (emergency function)

Picture below:
4-Way damper, ND 2500 mm dia. for a diesel generator plant in Turkey.

Stack damper, ND 5400 x 5400 mm,
supplied for the exhaust stack of a gas turbine plant. It is suspended into the stack in a way which leaves its support structure uninterrupted.
The damper blades are closed by manual actuator. In case of power failure or upon exceeding a duct pressure of 150 mbar the blades open automatically to protect the plant.
When closed the damper prevents the ingress of rain water into stack and silencer below it.

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Special purpose dampers for

- **Power stations**
- **Gasturbine plants**
- **Off-Shore-Installations**
- **Flue gas desulphurisation plants**
- **Flue gas denitrification plants**
- **Cement plants**
- **Steel smelters**
- **Waste heat recovery plants**
- **Garbage incinerating plants**
- **Chemical process industries**
- **Other industrial plants**

Large, tailor designed dampers for Gasturbine plants

- **Diverter** for the isolation, rerouting and modulation of the turbine exhaust gas. With double seals and seal air 100% gastight in terms of UVV regulations.
- **Diverter** for gasturbine-off-shore plants, designed to meet the specific service requirements.
- **Flap dampers,** also for modulating operations, with seal air, 100% gastight in terms of UVV regulations.
- **Louver** and
- **double louver** dampers for modulating service and shut-off.
- **Stack caps**, also as
- **emergency dampers.**
- **Blanking plate Guillotines** for combined cycle plants, also with double seals and seal air for 100% gastight shut-off in terms of UVV regulations.
- **Flexible joints** for combined cycle plants.

Shut-off and modulation dampers

- **Shut-off dampers**, of round or rectangular configuration
- **Shut-off dampers** of high tightness, 99,98% minimum
- **Double-shut off dampers**, with seal air 100% gastight to UVV
- **Tandem dampers**, cost economic alternative to double shut-off damper, with seal air 100% gastight to UVV
- **High efficiency louver dampers**, for modulation or shut-off.
- **Double louver dampers**, with seal air 100% gastight to UVV
- **Tandem louver dampers**, cost economic and space saving alternative to Double louver dampers, with seal air 100% gastight to UVV
- **Lever flap dampers**, also with double sealing and seal air, 100% gastight to UVV
- **Diverter dampers**, with double sealing and seal air, 100% gastight to UVV
- **Emergency dampers**, fast opening or closing, also on loss of energy
- **Stack dampers**, also with emergency features
- **RK10 sandwich dampers**, for fitting between existing flanges
- **Dopex shut-off valves**
- **Toggle disc valves**, DVGW approved, as shut-off or emergency dampers
- **Hot gas valves**, also air or water cooled

Isolators

- **Guillotine dampers** for FGD plants. 100% gastight to UVV
- **High efficiency guillotine dampers**
- **Guillotine dampers**, with double sealing and seal air 100% gastight to UVV
- **Sickle isolator**, 100% gastight to UVV
- **Goggle valves**, DVGW approved, 100% gastight to UVV
- **High temperature isolators**, with or without internal lagging or refractory lining
- **High temperature isolators**, with air or water cooling

Service and maintenance

- **Professional maintenance** of flue gas modulation and shut-off-dampers
- **Conversion and moderni sing** of existing flue gasmodulation and shut-off dampers
- **Upgrading of obsolete sealing systems and operating systems**

Fabrication for industrial machinery and process industries

- **Cooler** for dusty bulk materials
- **Fabricated**, welded components made of **steel and stainless steel**, also machined if required
- **Boltless wear liners** for cyclones and air separators etc.

RAUMAG-JANICH – Perfect technique, Quality and Security

RAUMAG JANICH-Systemtechnik GmbH
Im Grund 6
96528 Rauenstein/ Thüringen
Telefon: 0049 36766 881-0
Fax: 0049 36766 81032
Mail: info@raumag-janich.de
Web: www.raumag-janich.de

TOP 100 Top-Innovator

RAUMAG JANICH-Systemtechnik GmbH
Zweigniederlassung Beckum
Kirchstrasse 9
59269 Beckum
Telefon: 0049 2525 4141
Fax: 0049 2525 6332
Mail: info@raumag-janich.de