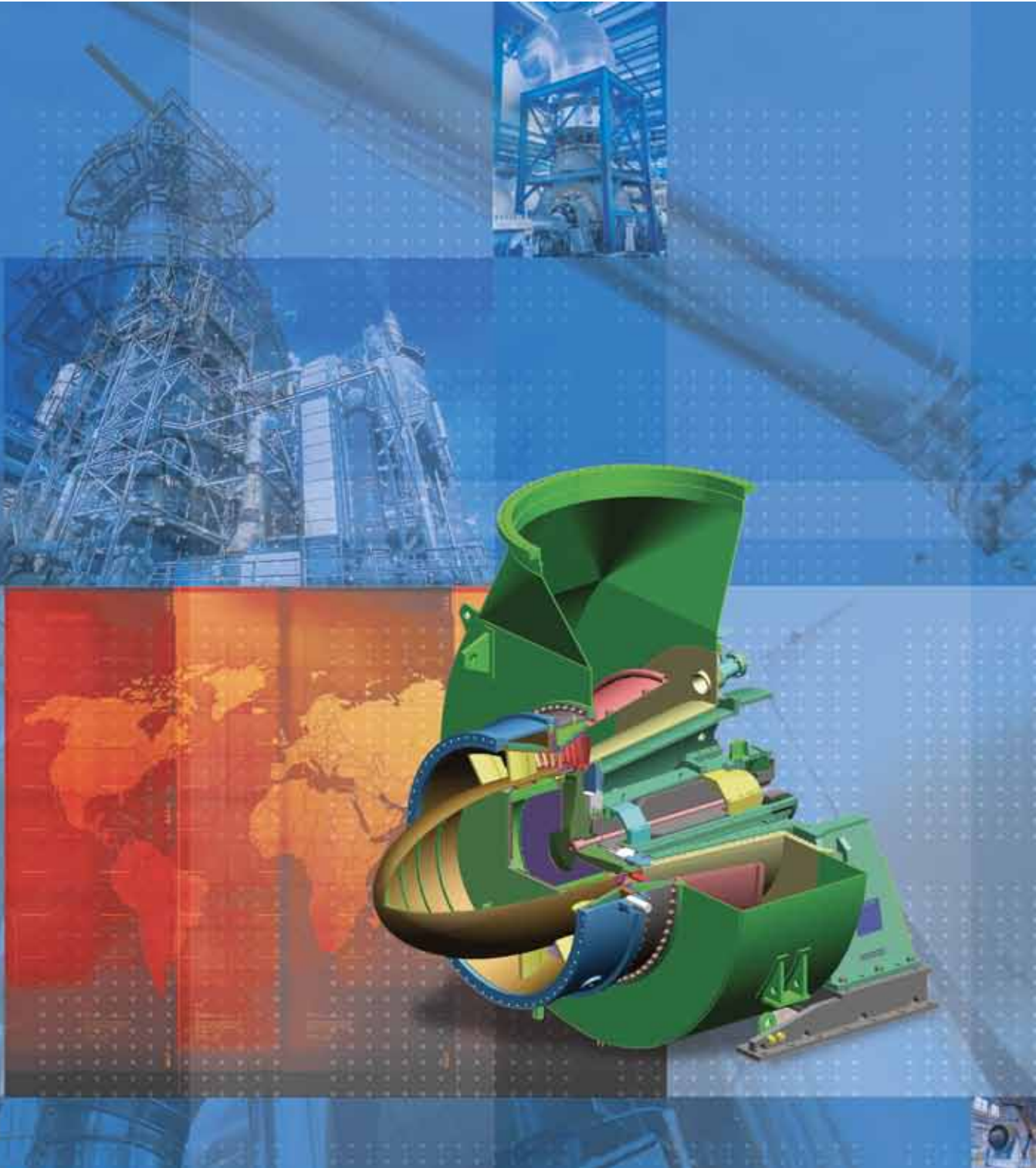


FCC POWER RECOVERY EXPANDERS



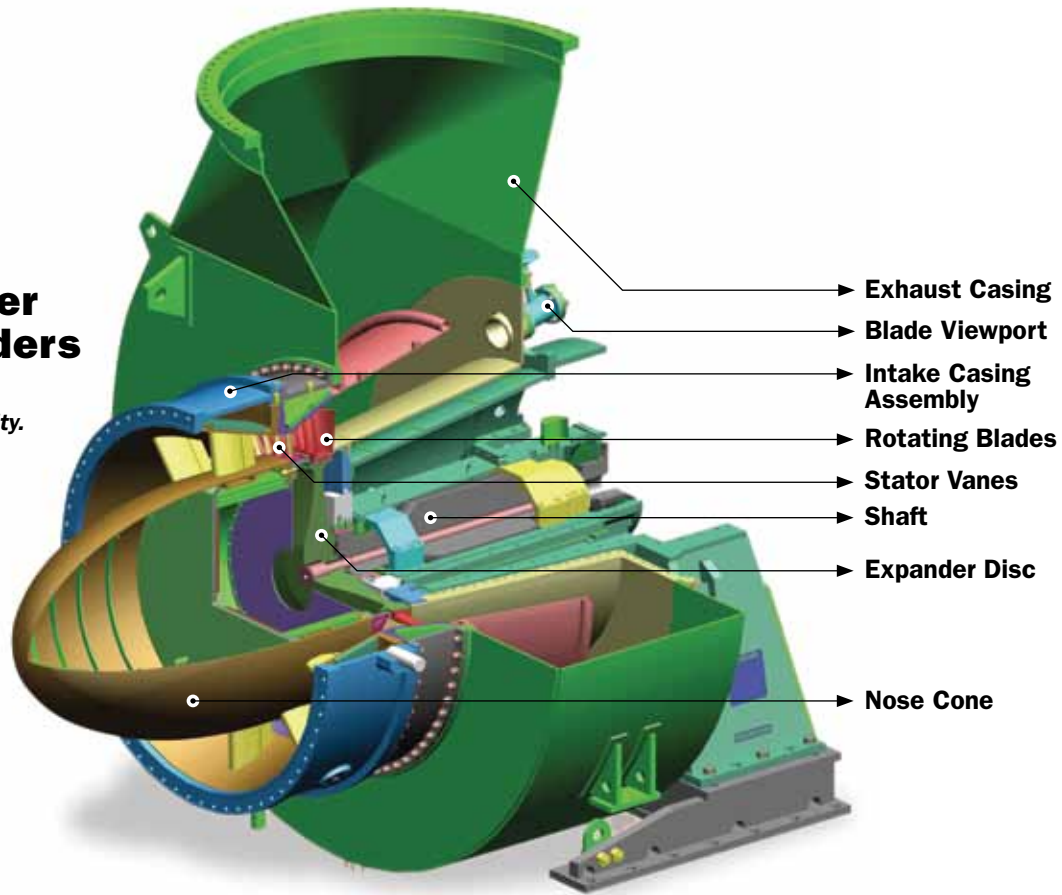
DRESSER-RAND[®]

Bringing energy and the environment into harmony.[®]



D-R FCC Power Recovery Expanders

Long-term availability and reliability.



E156 Expander

Dresser-Rand is a world leader in the design, manufacture, installation and service of power recovery expanders applied in oil refinery catalytic cracking units. Our machines are installed in both fluid catalytic cracking (FCC) and resid catalytic cracking (RCC) units, capturing energy from the high-temperature flue gas (that is normally wasted) across a throttle valve and converting it to mechanical energy. This power is then applied to drive a generator or the catalyst regenerator main air blower. This allows the refinery to reduce energy expense and to improve its overall energy index rating.

Dresser-Rand has provided power recovery units of various frame sizes to many of the oil companies worldwide, accumulating more than 11 million operating hours. In recent years, advancements in materials and design technology have served to further increase the reliability, maintainability, and efficiency of these machines.

D-R FCC HISTORY

Dresser-Rand entered the FCC power recovery business in the early 1960s, when an expander unit was designed and built to recover 7,350 hp (5.5 MW). Since then, Dresser-Rand has manufactured nearly 100 expanders designed specifically for FCC/RCC service, helping provide owners with significant, measurable energy savings.

- 1963** ▶ First unit shipped
- ▶ Early FCC expanders designed for inlet temperatures of 1100°F (600°C)
- 1982** ▶ First 1350°F (732°C) unit shipped
- 1984** ▶ Achieved five million operating hours



E148 expander hot mechanical spin test (Olean, NY, USA). Dresser-Rand has invested in the most advanced testing capabilities in the industry, and maintains world-class test facilities in Olean; and in Le Havre, France.

KEY FEATURES

- Vertically split, rear-pull design allows rotor replacement without disturbing process piping
- Forged inlet casing
- Axial inlet for optimal flow distribution and minimal losses
- Aerodynamic loading optimized to:
 - Minimize number of stages
 - Simplify maintenance
 - Reduce number of parts
 - Increase reliability
 - Reduce catalyst fouling
 - Tolerate process upset
- Customized flowpath for each application, with resizing options
- Multiple stator design options, including adjustable type
- Steam-cooled disc and rotor blade fir trees
- Waspaloy blading, forged for superior ductility and fatigue strength (Cast IN 738 available as an option)
- 100,000-hour creep rupture design life for all rotating components
- Gas turbine-style loose-fit blades for improved vibration characteristics
- State-of-the-art coatings for increased component life
- Viewports for on-line viewing of blades
- Borescope ports enable internal inspection without disassembly
- Exhaust casing man-way for internal inspection
- Casings and flanges designed to minimize thermal stresses
- Custom-fitted insulation packages for personnel protection, maximum expander efficiency and minimal thermal gradients
- Integral coupling flange
- Overhung stiff-shaft design

ENGINEERING TECHNOLOGY

- Process simulation
- 3-D finite element analysis (FEA)
- Rotor dynamics
- Blade stress and frequency analysis
- Computational fluid dynamics (CFD)
- State-of-the-art computer-aided design (CAD)
- Process controls
- Phase stability diagrams
- Complimentary on-line blade photography analysis

At our Olean, NY manufacturing facility, nearly one million square feet of space is dedicated to the production of leading technology for turbomachinery products. Key attributes of this facility include in-house manufacturing and industry-leading delivery cycle times for FCC expanders, in-house testing, and long-lead stocking programs for expander components.

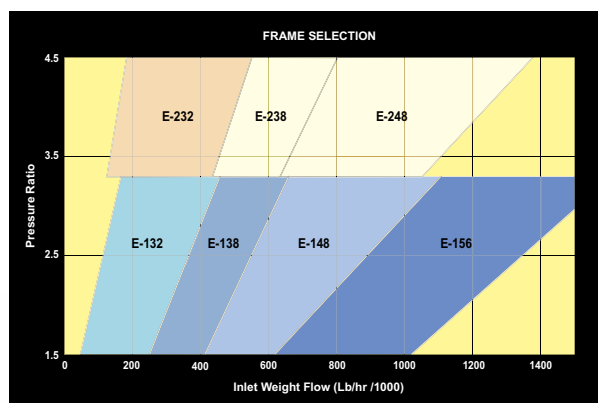
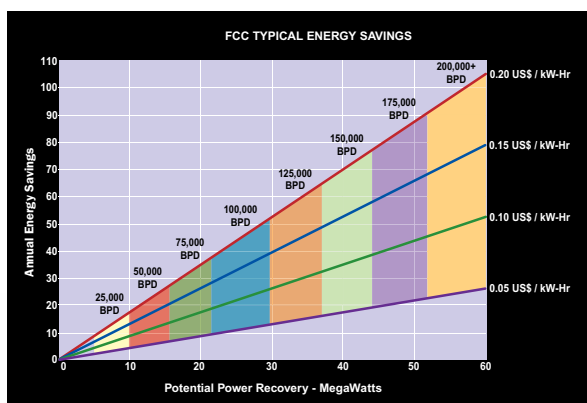
MANUFACTURING CAPABILITIES

Dresser-Rand is committed to producing high-quality products on time and to clients' exact specifications. To meet this commitment, we continue to upgrade our facilities worldwide which enables us to offer products and services that are second to none in the industry.

INTEGRATED POWER RECOVERY SOLUTIONS

Dresser-Rand and its industry-leading partners can provide extended scope services, including the following:

- Process design
- Third-stage separator
- Process control valves
- High-temperature piping design (including expansion joints)



- 1987** ➤ Shipped 50th E148 unit
- 1999** ➤ Shipped world's largest generator drive (45,000 hp/33.6 MW)
➤ World's largest FCC unit (more than 70,000 hp/52 MW of power recovery) starts up
- 2004** ➤ Shipped 9th generator drive expander

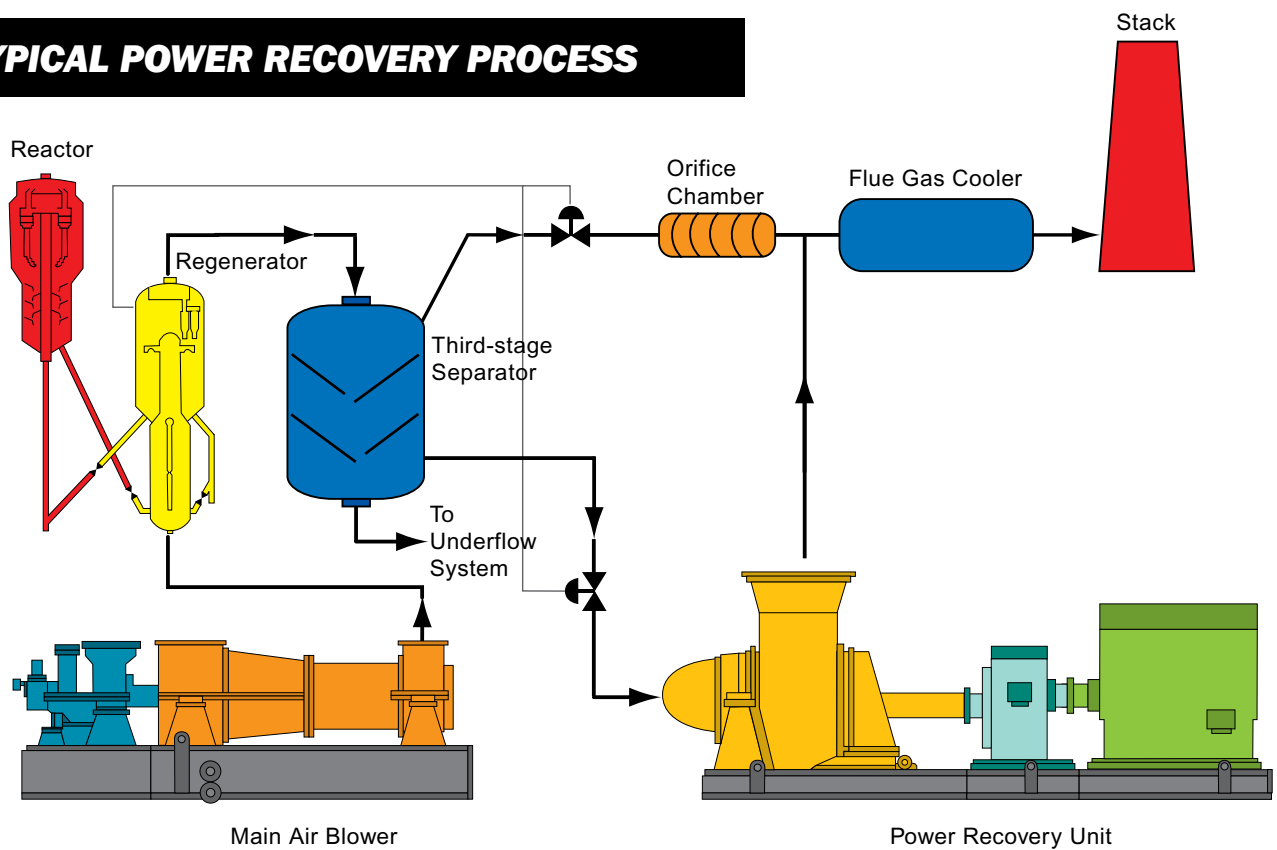
- 2006** ➤ Shipped 75th FCC unit to a refining complex that will become the world's largest single concentration of FCC power recovery (150,000 hp/112 MW)
➤ Sold 11th generator drive unit; electricity production now exceeds 175 MW/hr

- TODAY** ➤ Nearly 100 FCC units shipped, representing more than 1.5 million horsepower/(1,000 MW) of power recovery



Dresser-Rand single-stage FCC expander and axial flow 128,000 cfm air blower with motor-generator and steam turbine auxiliaries.

TYPICAL POWER RECOVERY PROCESS





A ftermarket Support

Helping you get the most from your rotating equipment.

SERVICE THAT IS SECOND TO NONE

A dedicated expander product team supplies new expanders, as well as parts, repairs, and overhauls. These professionals have the experience and vision to help you select the approach that maximizes the value of your power recovery unit by increasing its longevity, availability, reliability, and efficiency. As an OEM,



Dresser-Rand (D-R) understands the full implications of any changes, so we can help maintain the integrity of your system.

OEM REPLACEMENT PARTS

Our replacement and upgraded parts are designed for each application to maximize the reliability and availability of your power recovery expander. To minimize downtime associated with overhauls and turnarounds, packages and kits of consumable parts are readily available for use in standard maintenance procedures and repairs. In addition to custom stocking and “recommended spares” programs, we maintain a large inventory of replacement parts for rapid delivery.

COMPONENT UPGRADES

Many state-of-the-art design features found in our current FCC expander products also are available for retrofit into existing units. Upgrading and modernizing your installed power recovery expander can yield significant gains in reliability and availability. Other benefits include:

- New and improved materials
- Improved corrosion coatings

- Catalyst deposit removal
- Forged intake casings
- Adjustable stator vanes.

The latest design, material and manufacturing improvements, extensive engineering knowledge, testing capabilities, and many years of operating experience worldwide enable us to provide you with improved components that reduce maintenance, increase reliability/availability, improve performance, extend equipment life, and increase life cycle value.

ENGINEERING ANALYSIS

Dresser-Rand’s experienced engineers and technicians are available to visit your site to assess the physical condition and operating performance of your equipment, and to make recommendations to improve safety, reliability, availability, efficiency and operation. Our personnel have access to information that is simply not available to other service providers; this includes original designs, historical data and other proprietary information that help us to recommend the most effective solutions.

SERVICE CENTERS AND REPAIRS

Our dedicated staff is strategically located around the world for responsive, reliable support. There are more than two dozen Dresser-Rand service

centers offering the latest technology and overhaul skills to maintain, repair and rebuild your power recovery expander.

INTEGRATED CONTROL AND CONDITION MONITORING SYSTEMS

Dresser-Rand provides engineered solutions for a variety of turbomachinery needs. Drawing on more than 60 years of rotating equipment experience, Dresser-Rand Control Systems offers state-of-the-art control solutions that provide solid reliability and operational efficiency.

Dresser-Rand control systems are easy to maintain and are based on industry standards. This results in lower cost of ownership through seamless integration of control and condition monitoring.

D-R’s integrated control and condition monitoring system can be configured to monitor and protect the entire power recovery asset. The system provides complete train control and protection, including manual and automatic start/stop sequencing, local and remote operation, surge protection, vibration and temperature monitoring, regenerator pressure control, automatic generator synchronization, and critical machinery protection.

DRESSER-RAND FIELD SERVICES

Dresser-Rand’s Field Operations Group bundles services into added-value packages, helping you get maximum return on your equipment investment by offering the following field service programs:

- Training
- Technical services and field crews
- Reliability improvement programs
- Project services
- Long-term service agreements
- Turnkey services



DRESSER-RAND

Listening. Innovating. Delivering.

DRESSER-RAND®

Bringing energy and the environment into harmony.®

For more information on Dresser-Rand's **FCC Power Recovery Expanders**, or for a complete list of products and services, visit www.dresser-rand.com or contact the following:

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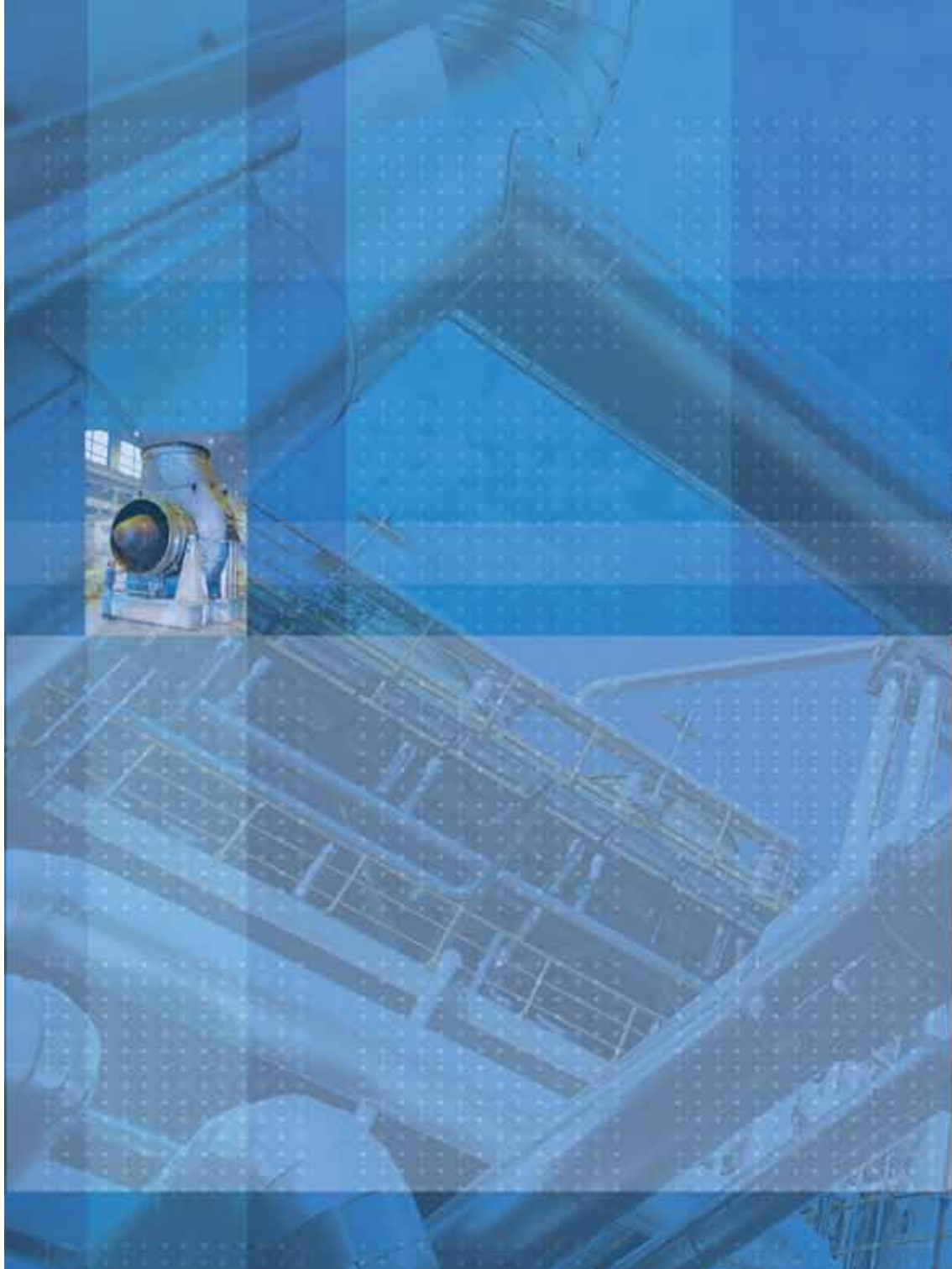
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