



DRESSER-RAND[®]

Bringing energy and the environment into harmony.[®]

STEAM TURBINE SOLUTIONS AND SERVICES

Innovation

Dresser-Rand steam turbines are at work in applications for green power generation, such as biomass, co-generation, combined-cycle, and other renewable power generation applications.

Dresser-Rand is a world leader in designing, manufacturing and servicing steam turbines and turbine generator (TG) sets up to 100 MW. We have thousands of steam turbine installations in more than 140 countries.

With more than a century of experience providing innovative rotating equipment solutions, we offer a comprehensive steam turbine selection. Our custom-designed steam turbines provide reliable energy solutions for the following markets and applications, among others:

- Oil and gas
- FPSO (floating production, storage and offloading) vessels
- Process industries
- Biomass
- Waste-to-energy
- Sugar refining
- Universities
- Medical centers
- District energy
- Marine

- Paper manufacturing
- Palm oil

We manufacture our steam turbines at six worldwide, ISO certified facilities. Dresser-Rand supports rotating equipment with worldwide, strategically located service centers providing flexible, and responsive services for legacy and other OEM steam turbine equipment.

Look for our “more info” icons throughout this brochure indicating additional publications are available on our website for that product or service.

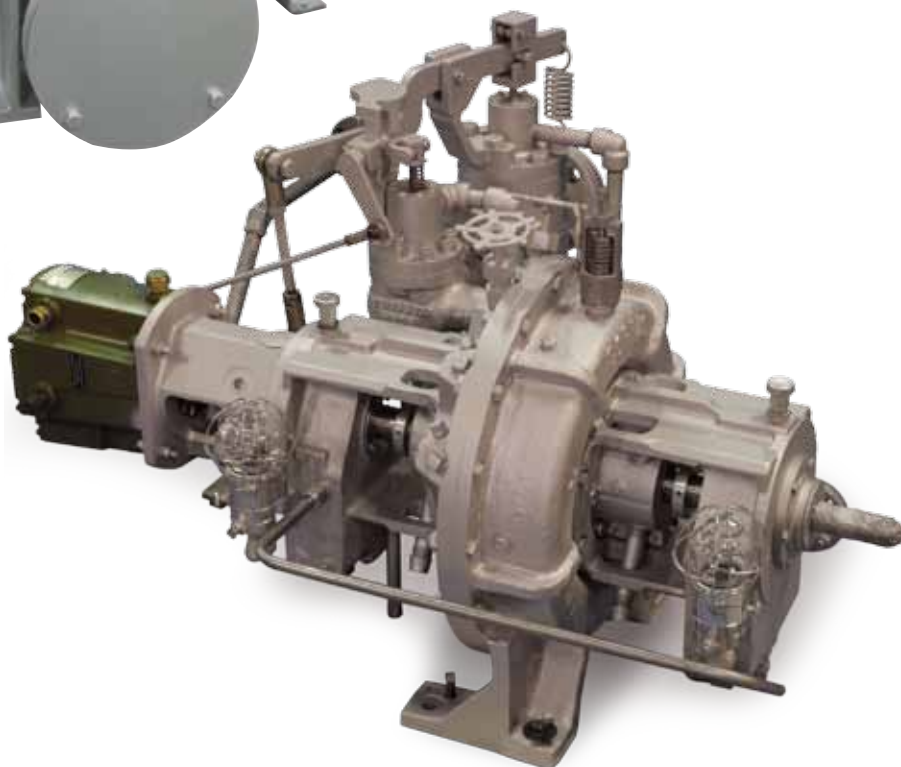




Process

Mechanical-drive steam turbines

Dresser-Rand provides reliable and efficient single- and multi-stage steam turbines for mechanical drive applications offering flexible design options to meet your power and steam conditions.



MECHANICAL-DRIVE APPLICATIONS

- Compressors
- Chillers (air conditioning)
- Boiler feed water and oil pumps
- Milling equipment
- Fans and blowers

MULTI-STAGE POWER CAPABILITIES

- 500kWe to 70 MW
- Inlet pressures up to 2000 psig (138 barg)
- Inlet temperatures up to 1050°F (566°C)
- Exhaust pressures from 0.5 HgA vacuum to 800 psig (55 barg)
- Up to 17,000 RPM

MULTI-STAGE DESIGN CAPABILITIES

- API 611 and 612 specifications
- Single- and multi-valve inlet
- Controlled extraction
- Extraction/condensing
- Mixed pressure induction
- Up/down or axial exhaust
- Electronic governors
- Remote monitoring controls

SINGLE-STAGE POWER CAPABILITIES

- 1HP (0.75 kW) to 4695 HP (3500 kW)
- Inlet pressures up to 900 PSIG (62 barg)
- Inlet temperatures up to 950° F (510°C)
- Exhaust pressures to 300 PSIG (20 barg)
- Up to 8000 RPM

SINGLE-STAGE DESIGN CAPABILITIES

- API 611 and 612 specifications
- Radial and axial split casings
- Horizontal and vertical shaft orientations
- Integral reduction gear



For additional information on specific models, visit:
<http://www.dresser-rand.com/products/steam/>



TG Sets

Steam turbine generator sets

Custom-designed turbine generators engineered to meet specific requirements.

Dresser-Rand impulse designed steam turbines provide robust, economical and efficient generator drive solutions from 500-kWe single-stage to 100 MW multi-stage equipment. Our wide range of models and flexible design capabilities allow us to meet most on-site steam conditions within our power range.

We furnish a complete turbine generator package and work closely with our clients to meet their job-specific needs. Our custom-designed, direct drive or geared turbine generators include a wide range of capabilities and configurations.

POWER CAPABILITIES

- Up to 100,000 kW
- Inlet pressures to 2000 psig (138 barg)
- Inlet temperatures to 1050°F (566°C)
- Exhaust pressures from 0.5 HgA to 800 psig (55 barg)

DESIGN CAPABILITIES

- API 611 and 612 specifications as required
- Condensing or noncondensing
- Controlled and uncontrolled extraction(s)
- Multi-valve inlets
- Mixed steam induction
- Up, down or axial exhaust flow configurations





Cogeneration

Raising the bar on efficiency

IS COGENERATION RIGHT FOR YOU?

If you are reducing steam pressure or venting steam or heat to the atmosphere, you are wasting valuable energy that can be recaptured to help reduce your operating costs. Whether for new or existing facilities, your Dresser-Rand representative and its engineering teams can help you find the best steam turbine solution for optimizing the energy potential of your facility.

Steam turbine generators are typically considered for process industries and institutional facilities (universities, medical centers and municipalities) that can combine their primary

steam needs for manufacturing or heating with on-site power production, commonly referred to as cogeneration or combined heat and power (CHP).

Industries that can take advantage of cogeneration can select from a variety of design options and system configurations to match their steam conditions, energy requirements and physical plant capabilities. Cogeneration is the complementary production of energy from a single source. Steam and heat are two energy resources that can be recovered before or after a manufacturing process to drive a TG set to generate electricity.

WASTE STEAM TO POWER

Steam is usually produced at a higher pressure than required for manufacturing processes. The steam pressure can either be reduced through a pressure reduction valve or more efficiently through a steam

turbine to produce useful shaft power to drive a generator and create electricity. The exhausted or extracted steam, which preserves its heat energy, can then be used for the manufacturing process. A steam turbine can be used either before the process (topping cycle) or after it (bottoming cycle).

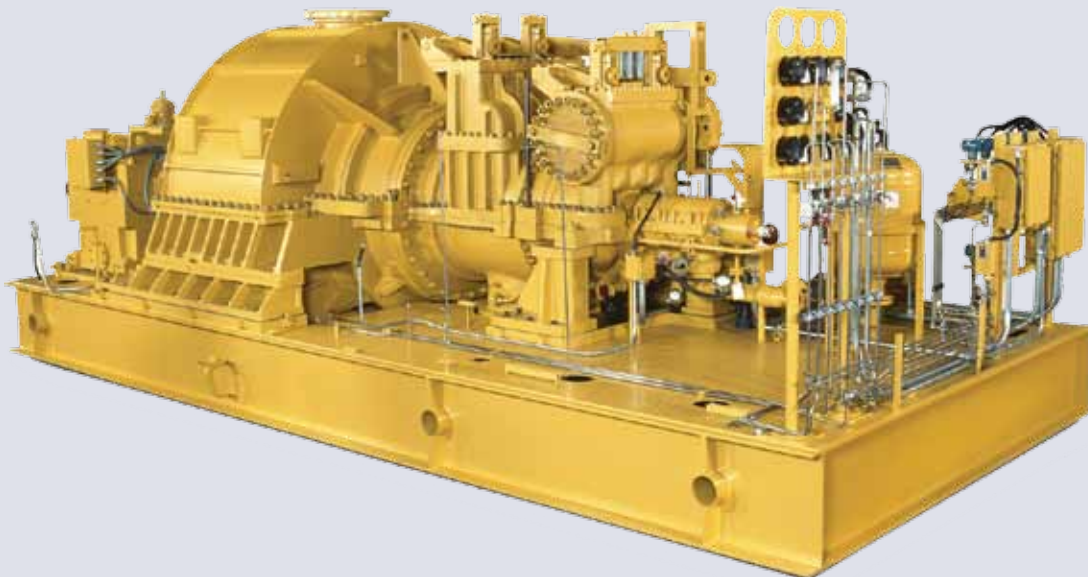
WASTE HEAT TO POWER

A combined cycle cogeneration plant uses the exhaust heat from a gas turbine or diesel engine. The recovered heat is directed to a waste heat recovery boiler that provides steam for a TG set.

ORC WASTE HEAT RECOVERY

Waste heat can also be recovered to vaporize organic materials using an Organic Rankine Cycle (ORC) recovery system with a specially designed Dresser-Rand ORC turbine.

ORC heat recovery systems use lower temperature heat (less energy) than what is required for producing steam through a heat recovery boiler. Waste heat is directed to a heat exchanger that heats and vaporizes organic materials such as pentane, ammonia, isobutene, and others, which are then expanded in a specially designed Dresser-Rand ORC turbine driving a generator. The exhaust vapors are condensed to liquid and returned to the heat exchanger to begin the process once again.



Sustainable alternative energy

BIOMASS

Steam turbine generators play a major role in biomass power generation initiatives. Steam turbines do not produce power directly from the fuel source, but as a by-product of heat (steam); therefore, they can use a variety of fuels to provide mechanical power. Manufacturers, institutions and municipalities are increasingly searching for ways to produce “green” power from renewable waste resources.

Dresser-Rand has extensive experience in biomass-to-energy initiatives around the world and in providing power generation from fuels as diverse as:

- Animal waste
- Sewage digester gas
- Mine gas
- Coke oven gas
- Landfill gas
- Agri-crop waste
- Clinical waste
- Sewage sludge
- Wood
- Processed wood waste
- Forest residue
- Solid waste
- Food waste
- Used-vehicle tires



RENEWABLE ENERGY

Dresser-Rand installations can be found in virtually every industry that uses steam for process and/or power production. Among our wide range of clients, biomass installations have continued to increase in size and numbers. Our large array of product offerings and many years of experience have made us a leader in renewable energy initiatives around the world. These installations are primarily burning a variety of organic waste material to drive TG sets of various sizes and configurations. Dresser-Rand has worked successfully with OEMs, contractors, engineering companies, and end users to complete hundreds of biomass projects.

For example, in southern Spain an olive oil processing plant operates two condensing TG sets (*see photo below*). The 7 MW and 4 MW turbine generators at this combined cycle plant produce onsite power and distributed power during peak harvest season.





Offshore

solutions

MARINE WASTE HEAT RECOVERY

The basic concept of a waste heat recovery system is also used on ships, where a steam turbine generator set produces additional electrical power from the heat energy in the exhaust gas of the main engine.

Successful system design depends upon:

- Engine power
- Proportion of the ship's life spent at sea
- Electrical power demands

Careful assessment of these factors, together with operating experience will give rise to different designs for different applications.

The absence of fuel costs and the lower maintenance requirements of a turbine-based system give rapid capital payback from the initial investment. Dresser-Rand has produced a series of turbo-compound systems (TCS), each incorporating a dual-pressure steam turbine and power turbine (gas expander) driving either a 6 MW or 8.5 MW generator. These machines provide the power needs on partially refrigerated container ships.

FLOATING PRODUCTION VESSELS

Having considerable experience with marine standards, classification society requirements, and petroleum industry standards, Dresser-Rand is in a unique position to provide steam turbines for FPSO vessels. Dresser-Rand has supplied more than 50 steam turbines that ensure reliable and efficient power, and has also supplied equipment up to 27 MW to many of the world's leading FPSO operators. We also provide gas turbines and centrifugal and reciprocating compressors to the FPSO market.



Service

Revamps, upgrades and repairs

Dresser-Rand offers a comprehensive range of services and solutions including **parts, upgrades, revamps, reapplications, rerates, repairs, field services, controls and condition monitoring, and customized training.** Additionally, we are continually developing new value-added services and solutions for our equipment, as well as equipment supplied by others.

With a global network of field services and service centers, Dresser-Rand is prepared to deliver service quickly, efficiently and safely – anywhere, anytime and for any brand.

Our dedicated team of service professionals has the expertise to assess your requirements and recommend the best service solution for your specific application and to apply our technology in every product and service we offer. In recent years, we've maintained that commitment with substantial investments in key areas such as:

- World-class manufacturing and test facilities
- Comprehensive inspection and testing equipment
- Unigraphics CAD/CAM



- Environmental compliance
- Finite element analysis
- Dynamic simulation analysis
- Blade stress and frequency analysis
- Rotor dynamics analysis
- Computational fluid dynamics analysis

OEM REPLACEMENT PARTS

Our replacement and upgraded parts are designed for the application to maximize the reliability and availability of your rotating equipment assets.

- Packages and kits of consumable parts are readily available for use in standard maintenance procedures and repairs.
- We maintain a large inventory of ready-to-ship replacement parts.

UPGRADES

With options ranging from quick change-out or "bolt-on" applicability to more complex solutions, Dresser-Rand offers an extensive range of value-added, state-of-the-art upgrades and modernizations for most Dresser-Rand legacy brands. Our latest design, material and manufacturing improvements, our extensive engineering knowledge, testing capabilities, and field operating experience provide you with improved components that:

- Maximize safety
- Reduce maintenance
- Increase reliability/availability
- Improve performance

- Extend equipment life
- Reduce life-cycle costs

REVAMPS, REAPPLICATIONS AND RERATES

We can often meet your operating needs by fully evaluating and implementing the necessary changes to your existing equipment. We can apply our full range of engineering services, including:

- Feasibility
- Performance
- Emissions
- Torsion
- Pulsation studies
- Piping mechanical analyses

Visit <http://www.dresser-rand.com/upgrades/steam/> for more information on Dresser-Rand steam turbine upgrades.

RESTORED CLASSICS PROGRAM

A "classic" is a previously owned steam turbine that Dresser-Rand has upgraded and completely reconditioned and reengineered to meet your needs. Restored Classic steam turbines come with a "new unit" warranty.



Improve operating safety and performance

*Gimpel valves can be found in
refineries, petrochemical facilities
and power plants around the world.*



GIMPEL® TRIP AND THROTTLE VALVES

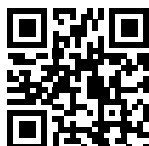
The operational reliability of shutdown components is of critical importance to ensure personnel, plant and equipment safety. Dresser-Rand can provide “drop-in” trip valve upgrades for all legacy single- and multi-stage steam turbines.

Dresser-Rand Gimpel® trip-and-throttle valves provide fast and reliable protection in a wide range of steam conditions and applications for multi-stage turbines. Gimpel hydraulic-operated valves:

- Use turbine-control oil systems (100 to 2500 PSIG / 7 to 172 BARG)
- Are sized to 24 in. (600 mm)
- Have pressure class ratings to 2500 PSIG (172 BARG)
- Use advanced technology to achieve temperatures to 1100°F (593°C)

Mechanical, latch-type valve trip cylinders operate with lubrication oil pressures as low as 10 PSIG (0.7 BARG). Optional servo-valve and linear variable differential transformer (LVDT) designs are available for precise flow control.

Improve safety and performance with trip and throttle valve upgrades for COPPUS® TF, COPPUS RL and single-stage steam turbines (Turbodyne®).



Visit <http://www.dresser-rand.com/products/gimpel/> for more information on your specific model.

for more information on your specific model.



CONTROL SYSTEMS

For more than 50 years, Dresser-Rand Control Systems (D-RCS) has been designing and manufacturing reliable, state-of-the-art control systems for the following:

- Gas and steam turbines
- Expander-driven compressors and generators
- Motor-driven compressors
- Reciprocating compressors
- Plant, station, supervisory control and data acquisition (SCADA)
- Process applications

The D-RCS product engineering team continually strives to provide the most advanced control technology in systems that are easy to use, understand and operate. Project engineers work closely with clients to design control systems that meet demanding operating requirements. All phases of design, manufacturing, installation, training, and documentation are coordinated to ensure the effective performance and reliability of these modern control systems.

D-RCS also provides upgrades and complete replacements of existing control systems.

ADDITIONAL SERVICES

- Long term service agreements (LTSA)
- Product training courses
- Turnkey services
- Project services

Flexible

**services that
broaden your options**



STEAM TURBINE REPAIR

Dresser-Rand provides complete repairs for all single- and multi-stage makes and models of steam turbines from .074 kW to 1000 MW. We can service your steam turbines in-house. Our in-house solutions for steam turbines include the following:

- Diaphragm repair, sidewall, hook fit restoration and computer area analysis
- Blade ring restoration (for casings and blades)
- Nozzle plate and nozzle box restoration
- Complete repair of high-pressure inner shells and cylinders
- Repair or manufacture of oil deflectors, shaft or diaphragm packing, spill strips, and hydrogen seals
- Complete rotor refurbishment (including reblading and shaft welding)
- Valve repair

HIGH BAY ROTOR FACILITY

We provide services on all brands of industrial gas and steam turbine rotors, including blade replacement, un-stacking and re-stacking, balancing, and NDT. In-house capabilities include:

- Vertical balancing system for wheels and discs 5000 lbs. (2268kg) and 9000 lbs. (4082kg)
- Four horizontal balance systems with capacity up to 175,000 lbs. (79,378 kg)

- Engine lathe capacity up to 120 in. (305 cm) and a swing of 384 in. between centers
- 80 tons of overhead crane capacity and hook height of 50 ft. (15.24 m)
- 60 x 20 x 20 ft. (18.2 x 6.1 x 6.1 m) blast cleaning facility in full environmental compliance
- Rotor stacking pits/platform capable of handling large gas turbine rotors
- Rotor welding
- Rotor life assessment program
- Rotor storage

ENGINEERING EXPERTISE

Our engineering team provides repair solutions and efficient process applications, ensuring state-of-the-art repairs and on-time deliveries.

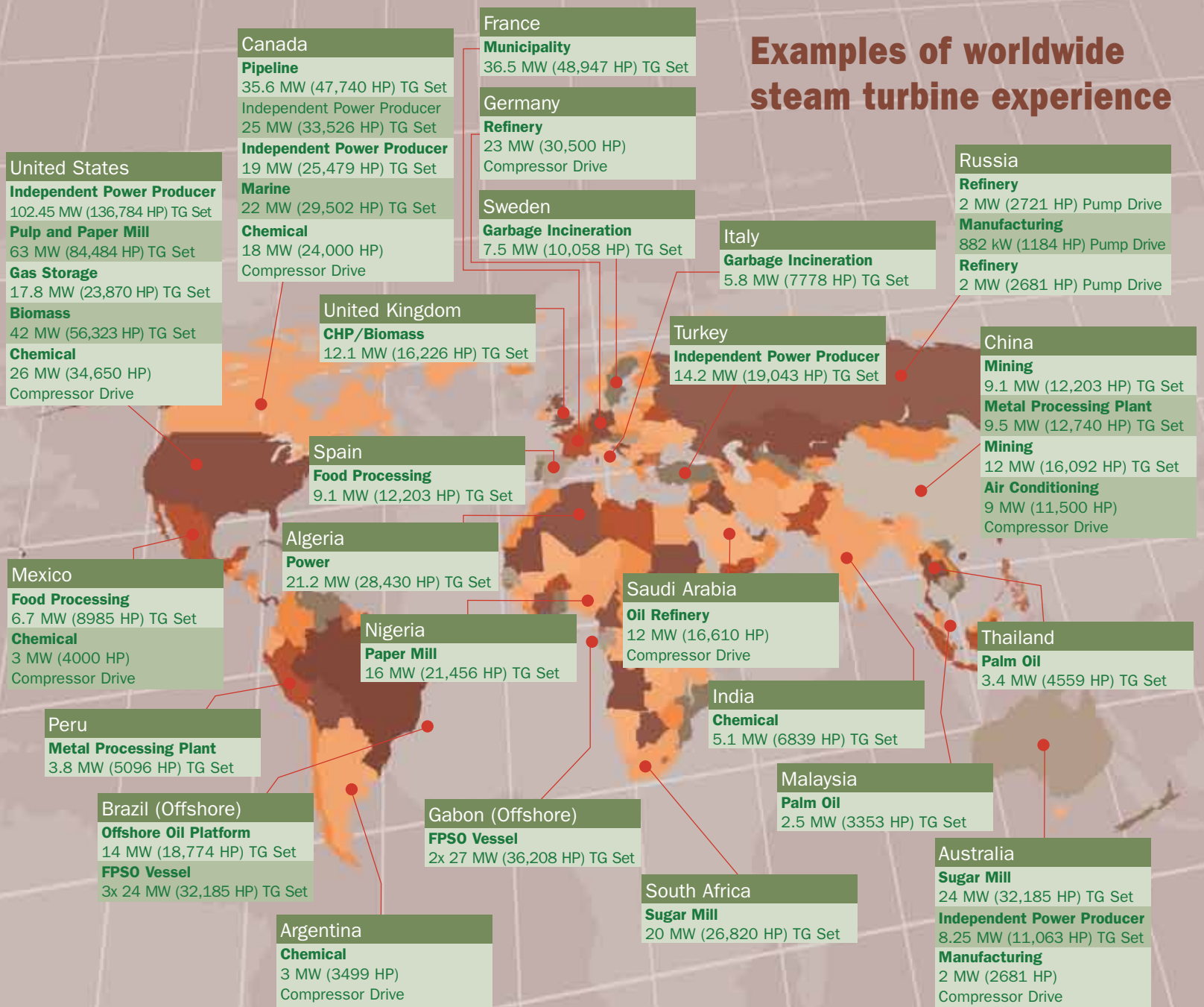
FIELD SERVICE

Our worldwide field service organization and network of service centers allow Dresser-Rand to provide the right bundled service solutions for your outage, including the following:

- Steam turbine installations
- Training
- Technical services
- Field crews
- Borescope services by trained technicians
- Major maintenance agreement



Examples of worldwide steam turbine experience



The above map shows some examples of steam turbine and TG set projects manufactured by Dresser-Rand in a variety of different markets/industries/applications around the world.

**STEAM TURBINE
MANUFACTURING OPERATIONS**

Bielefeld, Germany
Tel: (Int'l +49) 521-1085-0
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Fax: (Int'l +49) 208-653900

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Fax: (Int'l +1) 585-593-5815

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Le Havre, France
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**STEAM TURBINE
TECHNOLOGY CENTER**

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For a complete list of
products and services, visit
www.dresser-rand.com
or contact the following:

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Complete list of local offices and service centers can be found on our website at:
<http://www.dresser-rand.com/contactUs.php>

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