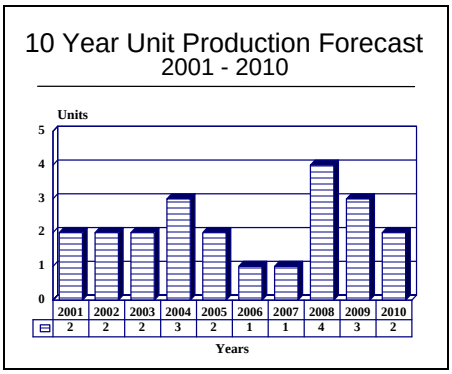
Dresser-Rand Steam Turbines – Archived 10/2002

Outlook

- Worldwide emphasis on the benefits of combined-cycle power will keep D-R steam turbine production active, albeit at a low level
- Worldwide base of installed compressors and pumps creates a potential customer base for steam turbines
- D-R possesses extensive technical and manufacturing expertise, spilling over into steam turbine-based CC P/Ps



Orientation

Description. Dresser-Rand Company manufactures steam turbines for use in such industries as oil and gas production; refining; chemical and petrochemical; industrial; gas processing, storage and transmission; and industrial power generation and energy recovery. Its products include steam turbines for mechanical drives: condensing and non-condensing; single- or multi-valve; single- or double-automatic extraction; or induction mixed-pressure.

Note: *This report focuses on the multi-stage steam turbines. Information regarding single-stage, single-valve turbines is included when deemed necessary.*

Contractors/Manufacturers. The prime manufacturer is Dresser-Rand Company; Olean, New York, USA.

Production Location. The Dresser-Rand steam turbine product line is manufactured in Wellsville, NY, USA.

Power Class. Dresser-Rand's mechanical drive turbines have a power range up to a maximum of 70,000 hp (52,200 kW) in a coupling arrangement; its single-stage steam turbines generate up to 3,500 hp (2,610 kW). The company's Packaged Geared Turbine Generators (PGTGs) have a power output in the range of 5-15 MW.

Status. At the start of 2002, all steam turbines described were currently in production.

Total Produced. At the start of 2002, Dresser-Rand is estimated to have fabricated and installed over 80,000 steam turbines of all types and for all applications, including single-stage units and larger multi-stage units for various mechanical drives and for combined-cycle operation. The average annual sales quantity in the recent past has been about 500 machines of all types and for all applications per year.

Of the 80,000 machines, about 65,000 are single-stage, single-valve steam turbines, while the remaining 15,000 are multi-stage units. Of the 15,000 units, about 9,000 units were installed as mechanical drivers and about 6,000 units for power generation. Overall, fewer than 50 steam turbine generator sets are assumed to have been installed for power generation in combined-cycle applications, with those units' power outputs being in the range of 20-70 MW.

Application. Dresser-Rand's products include steam turbines for mechanical drives, including single-stage, single-valve steam turbines; multi-stage, single-valve steam turbines; and multi-stage, multi-valve steam turbines.

Its steam turbines are used in such industries as oil/gas production; refining; chemical and petrochemical; industrial; gas processing, storage and transmission; and industrial power generation and energy recovery.

Price Range. No pricing information is available on a general basis since each application is priced individually based on location, use, composition of equipment, operating cycle, and fuel used

Technical Data

General. Dresser-Rand's line of steam-end designs, single- or multi-valve, satisfies virtually all pressure and temperature conditions.

Single-Valve Units. Single-valve units should be procured when justified by the end-user's economic needs. When used, the nozzle ring segments of this steam turbine form are controlled by individual hand valves. Hand valves can be specified for reduced steam consumption at part load, design load with reduced steam, or overload conditions. Hand valves can be manually or automatically actuated.

Multi-Valve Units. Multi-valve units are most appropriate when frequent load changes or varying outputs are anticipated of when inlet volume flows are high. The multi-valve arrangement automatically improves efficiency throughout the turbine's full operating range.

Design Features. Design features of the Dresser-Rand line of standard multi-stage turbines include the following:

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Dimensions. Dresser-Rand's standard multi-stage turbines have the following overall dimensions and weights:

	Metric (SI) Units	**English Units**
Length	54.86 meters (54,86 m)	180 feet
Width	22.86 meters (22,86 m)	75 feet
Height, with exhaust	9.45 meters (9,45 m)	31 feet
Weight, dry, with accessories	745 metric tons (745 000 kg)	821US tons

Performance. Dresser-Rand steam turbines operate within the following range of parameters:

	SI Units	**English Units**
Multi-Stage, Multi-Valve Turbines		
Power Output	Up to 52,200 kW	Up to 70,000 hp
RPM	20,000 rpm	20,000 rpm
Inlet Steam Pressure	Up to 138 bar (g)	Up to 2,000 psi (g)
Inlet Steam Temperature	538°C	1,000°F
Exhaust Conditions	From 362 kg to condensing	From 800 lb to condensing

	SI Units	**English Units**
Single-Stage Steam Turbines		
Power Output	Up to 2,610 kW	Up to 3,500 hp
RPM	Up to 3,500 rpm	Up to 3,500 rpm
Inlet Steam Pressure	Up to 104 bar (g)	Up to 1,500 psi (g)
Inlet Steam Temperature	482°C	900°F
Exhaust Conditions	To 136 kg	To 300 lb

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Program Review

Background. Dresser-Rand provides parts, services, and support for all of its steam turbine equipment bearing the Terry, Moore, Worthington, Whiton, Turbodyne, Dresser-Rand and Ingersoll-Rand name-plates.

Dresser-Rand's Industrial Standard Multi-Stage Turbine line offers up to nine stages, and, in order to meet a variety of energy conditions in industrial environments, it offers 13 frame sizes that product up to 6,000 kW. It offers seven turbine frame sizes for its single-stage turbines.

Casing. All turbines have casings that are horizontally split at the centerline for ease of maintenance and service. Among the features is removable bypass piping for lower half admission.

The casing components are modular designs, selected from standardized components. The inlet or high-pressure section of the casing in cast carbon or low alloy steel; a combination of cast steel and fabricated steel construction can also be used. Each section of the casing is hydrostatically tested to API Standard 612 requirements.

Rotor. The turbine rotor is a single-piece solid rotor designed and constructed in compliance with API Standard 612 specifications; it provides smooth running throughout the operating range.

Blades. Dresser-Rand utilizes the latest computer-aided analysis and modeling coupled with laboratory and field testing to develop efficient, heavy-section blade profiles.

Depending on stage conditions, stress factors and design conditions, the steam turbine blades are final-assembled using a shroud band made from stainless steel strip and riveted to the blades in five-blade or six-blade segments.

Control Valves. The company individually sizes and sequences valves for optimal efficiency at the end-users' specified operating points. To prevent spinning, chattering and sticking, valve stems are positively held with controlled vertical movement. To seal valves against leakage, surface-hardened stainless steel bushings guide the valve into lapped seats. Control valves are precisely positioned by a low-pressure servo oil system; they close on a trip signal.

For added reliability, the company uses electronic control and overspeed trip devices. By eliminating the mechanical connections commonly required for conventional mechanical systems, maintenance time and cost is reduced. Dresser-Rand's basic governing system includes a digital electronic speed and/or process control. The system includes a redundant speed digital governor and an electro-pneumatic valve actuator. Electro-hydraulic actuators are also available to meet customers' needs.

Bearings. Proven bearing designs are used to maintain machine reliability under demanding operating conditions.

Thrust Bearings. The thrust bearings withstand heavy load thrusts with very small frictional losses and a low rate of wear. The babbitt-surface multi-segment shoes pivot during operation, providing a tilting action that forms a wedge-shaped oil film between the rotating thrust collar and the bearing surface. The thrust load automatically distributes in either direction equally to the several shoes, maintaining internal alignment as well as holding the rotor in its axial position.

Journal Housings. For proper rotor dynamics in critical-service applications, Dresser-Rand utilizes tilting-pad, center-pivot, and aligning pad-type journal bearings.

Shaft Packing. To minimize steam leakage and maintain peak efficiency, Dresser-Rand uses labyrinth packing where the shaft passes through the casing end glands and diaphragms. Fabricated of a relatively soft material, the labyrinth packing is segmented and assembled concentric to the turbine shaft and is held in position by coil springs. Due to Dresser-Rand's precise machining capabilities and the characteristics of the soft packing, no shaft sleeves are required.

In addition to appropriate packing, as part of its steam sealing system Dresser-Rand provides its turbines with a gland seal system. Its standard scope of supply includes leakoff manifolds, gland condensers, air ejector, and air condensate tanks.

Turning Gears. If necessary, a rotor turning gear is employed during cooling-down periods to maintain uniform temperatures along the machine's shaft to eliminate distortion or shaft bow. With such a system, the turbine can be restarted during cooling-down periods without shaft bow.

Variants/Upgrades

Dresser-Rand's products include steam turbines for mechanical drives, including single-stage, single-valve steam turbines; multi-stage, single-valve steam turbines; and multi-stage, multi-valve steam turbines. This report excludes the single-stage, single-valve steam turbines.

The outputs and operating parameters of Dresser-Rand's steam turbine product line are continuously refined and upgraded.

Funding

It is unknown to what extent the Dresser-Rand line of team turbine line was developed with outside resources. US government funding, if any, has not been identified.

Recent Contracts

No major identifiable commercial or military contracts specifically pertaining to the Dresser-Rand line of steam turbines have been awarded or received in the recent past.

Recent Activity. In September 1999, Dresser-Rand announced plans to reconfigure its worldwide operations, including the company's three major plants in the southern tier of New York. The announcement indicated that the focus of the activity would be on growing the business.

As part of the announcement, Dresser-Rand would create a strategic business unit for its Standard Steam Turbine Products in Wellesville, NY. The business unit would be formed by combining functions from other D-R locations in the US and overseas.

In the fourth quarter of 1999, Ingersoll-Rand purchased the Dresser Industries' shares of two joint ventures: Dresser-Rand Company and Ingersoll-Dresser Pumps.

Timetable

Month	Year	Major Development
	1840	Henry R. Worthington designed and built first direct-acting steam pump. Worthington Pump and Machinery Corporation founded
	1906	E.C. Terry incorporated the Terry Steam Turbine Company in Windsor, CT.
	1916	James Leonard Moore formed the Moore Steam Turbine Company in Wellsville, NY.
	1937	Worthington Pump purchased Moore Steam Turbine Company.
	1968	Terry Steam Turbine Company purchased by Whiton Machine Company.
	1970	Terry Steam Turbine Company purchased by Holwarth Gasturbinen and Kuhnert Turbinen of Oberhausen, (West) Germany.
	1974	Ingersoll-Rand buys Terry Steam Turbine Company.
	1979	McGraw Edison Company purchased Studebaker Worthington.
	1981	Turbodyne made part of the Worthington Group, along with Worthington Pump and Worthington Compressors.
	1983	Dresser-Rand steam turbines ordered for city of Columbus, OH.
	1984	A new Turbodyne Division formed by McGraw Edison Company.
	1984	Turbodyne Division acquired by Dresser Industries.
	1987	Dresser Industries and Ingersoll-Rand create Dresser-Rand
	1999	Dresser-Rand announced plans to reconfigure its worldwide operations.
4Q	1999	Ingersoll-Rand bought all shares of Dresser-Rand Company.
Thru	2010	Continued production of Dresser-Rand steam turbine projected.

Worldwide Distribution

As of 2001, we estimate that Dresser-Rand has built and installed over 80,000 steam turbines of all types and for all applications in 90 countries worldwide, including single-stage units and larger multi-stage units for various mechanical drives and for electrical power generation in the guise of combined-cycle operation. About 50 steam turbines are assumed to have been installed for gas turbine/steam turbine combined-cycle application. The majority of those gas turbine/steam turbine installations are assumed to be in the **US**.

Forecast Rationale

In 1999, Dresser-Rand began to actively pursue the power generation sector, focusing on steam turbine machines for use in combined-cycle operation for electrical power generation. Since that time, it has become involved in machines for Arizona Public Service, for Pan Canada and for Formosa Plastic in Texas.

Dresser-Rand's increased attention on the power generation arena is seen as a proactive move. With so large an installed base of compressors – and pumps also – and with a well-based and distinguished worldwide reputation, it should be able to leverage that synergy into steam turbines for combined-cycle power generation. Worldwide, there are a many aging power plants in need of updating that would benefit tremendously by the addition of a steam turbine from Dresser-Rand.

In the decade extending through the year 2010, we project that Dresser-Rand will fabricate just over steam turbines, whose power outputs are 20 MW and larger, for combined-cycle power generation application. That total is about equally split between the 20-49 MW machines and the 50-124 MW machines, with the latter looking more closely at 50-70 MW. Machines below 20 MW are expected to be produced as time goes on, especially given Dresser-Rand's presence in the compressor sector.

Note: *The absence of a total in the "Thru 2000" column below is not intended to infer that no production occurred in this combined power band or for this specific application prior to 2000.*

Ten-Year Outlook

ESTIMATED CALENDAR YEAR PRODUCTION

			High Confidence Level				Good Confidence			Speculative			
Engine /Machine	Application	Thru 2000	2001	2002	2003	2004	2005	22006	2007	2008	2009	20120	Total 2001-2010
DRESSER-RAND													
10-19 MW STEAM TURBINES	COMBINED-CYCLE GENERATION	–	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
20-49 MW STEAM TURBINES	COMBINED-CYCLE GENERATION	–	1	1	0	1	1	1	0	2	2	1	10
50-124 MW STEAM TURBINES	COMBINED-CYCLE GENERATION	–	1	1	2	2	1	0	1	2	1	1	12
TOTAL PRODUCTION		**–**	**2**	**2**	**2**	**3**	**2**	**1**	**1**	**4**	**3**	**2**	**22**

(a) Production of these machines is expected to develop in the forecast period.