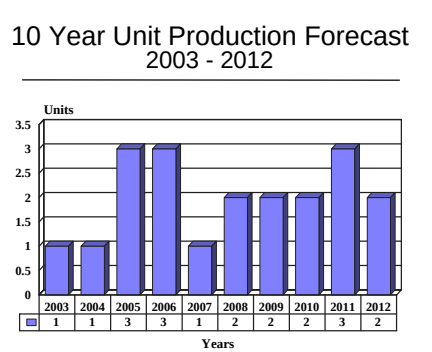
Thermodyn Steam Turbines - Archived 5/2004

Outlook

- This GE Oil & Gas entity's steam turbines are known for their rugged, reliable, innovative technology
- With the manufacture of centrifugal and reciprocating compressor and steam turbines, firm can be a single source for turbine applications
- Entity can supply small steam turbines for use with other GE Oil & Gas small gas turbines



Orientation

Description. Thermodyn manufactures impulse-type steam turbines for industrial power generation and process use. Steam turbine types include backpressure, multi-valve backpressure, condensing, and multi-valve condensing.

Sponsor. The Thermodyn line of steam turbines was privately developed by the prime/major contractor. The major contractor/manufacturer is identified as the "prime" in the **Contractors** section below.

Note: *In this report, Forecast International retains the use of the Thermodyn name in order to differentiate its line of impulse-type steam turbines from the Nuovo Pignone reaction-type steam turbines. Both Thermodyn and Nuovo Pignone are part of GE Energy's GE Oil & Gas, headquartered in Florence, Italy. As used below, Thermodyn means "the Thermodyn entity of GE Energy's GE Oil & Gas."*

Power Class. Thermodyn manufactures steam turbines with a power output up to 40 MW.

Status. At the start of 2004, all steam turbines described in this report were available for production.

Total Produced. As of the start of 2004, Thermodyn is estimated to have manufactured more than 1,500 steam turbines of all types, including machines for combined-cycle installations.

Application. Electrical generation for fossil-fired power plants and for commercial companies with a high demand for electricity; energy recovery by secondary generation of electricity for users of large volumes of steam, processes producing large amounts of heat, and domestic/industrial waste incinerators; mechanical drives for compressors, fans and blowers, and pumps. Its steam turbines are used in such markets as refineries, petrochemicals, chemicals, paper and pulp, energy recovery, sugar refining, and marine propulsion.

Price Range. The manufacturer has not supplied pricing information.

Competition. With steam turbine machines for combined-cycle installations up to 40 MW, steam turbine machines from several manufacturers worldwide compete with the Thermodyn line of steam turbines.

Contractors

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Technical Data

General. Thermodyn steam turbines are manufactured using modular subassembly design and component standardization. The modular system is composed of a varying mix of components, including inlet, controlled extraction, backpressure, condensing exhaust, bearing, and stop-pressure modules.

Design Features. Among the design features of the Thermodyn line of steam turbines are the following:

Casing. The outer casing of all turbines is horizontally split at the level of the shaft center line. The two-shell design of the casings protects the outer casing from full live steam pressure and temperature. The cast steel casings are made by using patterns built up from standard modules. Exhaust casings can be cast or welded depending on exhaust backpressure parameters.

Rotor. The turbine rotor is made from a solid forging in Cr-Mo steel. It is balanced dynamically, if necessary, at rated speed in a vacuum balancing stand.

Blades. Turbine blades are made of stainless steel. They undergo special treatment to improve their fatigue strength and resistance to erosion. Rotating blades have "fir-tree" roots, and are grouped in segments with riveted bands or welded wires.

Stop and Control Valves. The stop-valve is leak-tight and has an easily removable steam strainer and diffuser-type seal, ensuring instant closure when tripped.

For the backpressure and condensing steam turbines, there is one control valve regulating the steam flow through the turbine. It can be of double-seat type or single-seat with a diffuser.

For the multi-valve backpressure and multi-valve condensing steam turbines, there are up to eight control valves regulating the steam flow through the turbine and maintaining a high-efficiency rate when the machine is operating at low power. To obtain the maximum efficiency, the extraction, if any, is adjusted by means of an extraction grid valve that is adapted to the high-volume flow rates admitted into the low-pressure section of the turbine. That element is composed of two grids that move in relation to each other and are equivalent to a group of six control valves with low throttling.

Seals and Bearings

Seals. The spring-back labyrinth seals reduce internal leakage in the turbine and prevent rapid deterioration of the steam sealing system.

Bearings. Journal and thrust bearings are of the tilting pad type, and are well suited for multi-valve turbines. The bearings provide stability at widely ranging operational speeds; they ensure integral safety at the highest rotational speeds.

Oil System. Thermodyn's oil units are designed to supply lube oil and high-pressure control oil. The units are free-standing consoles, but can be integrated into the base supporting the shaft line for compressor driving. The systems comply with API 614 code rules.

Speed Governing and Control. Electronic speed governors are employed: the advantage of digital electronic governors is that they are sufficiently versatile to adapt easily to any required configuration. The parameters are merely set in computerized form at startup or during turbine operation.

Performance (stability, dead band, response time) meets NEMA SM22, API 612 or CEI 45 recommendations depending on customer requirements.

Dimensions. The dimensions and weights of the Thermodyn steam turbines were not available for this report.

Performance. The Thermodyn steam turbines have the following performance parameters:

	xPn Backpressure	**xMPn Backpressure**	**xCn Condensing**	**xMCn Condensing**
Power Range	Up to 5 MW	Up to 40 MW	Up to 6 MW	Up to 40 MW
Speed Range	Up to 16,000 rpm	Up to 16,000 rpm	Up to 16,000 rpm	Up to 16,000 rpm
Max. Live Steam Pressure	80 bar	150 bar	80 bar	150 bar
Max. Live Steam Temp.	480°C	540°C	480°C	540°C
Steam Injection API 612	No	Yes	Yes	Yes
Steam Extraction API 612	No	Yes	Yes	Yes

Variants/Upgrades

Among the types of steam turbines produced by Thermodyn are the following:

Backpressure Steam Turbines. The Thermodyn P series steam turbines are impulse steam turbines with a single inlet valve and a backpressure exhaust designed to drive low-power machinery. The steam turbines are commonly used for compressor driving in petrochemical and refinery applications, for power generation, or for emergency power supply in environments such as nuclear power plants.

Multiple Backpressure Steam Turbines. The Thermodyn MP series steam turbines are impulse steam turbines with multiple inlet valves and a backpressure exhaust designed to drive variable-speed machinery

such as compressors, fans, blowers, pumps, and generators. Applications include petrochemical and refinery plants; power plants or CHP plants burning fossil fuels; sugar refineries; and garbage incineration.

Condensing Steam Turbines. The Thermodyn C series steam turbines are impulse steam turbines with a single inlet valve and with vacuum-condensed steam at the turbine outlet. The turbines are uses to drive low-power machinery. They are commonly used for compressor driving in petrochemical and refinery applications, for power generation, and for heat recovery processes such as household garbage and waste incineration.

Multiple Condensing Steam Turbines. The Thermodyn MC series steam turbines are impulse steam turbines with multiple inlet valves and with vacuum-condensed steam at the turbine outlet to increase cycle efficiency. The machines are designed to drive variable-speed machinery such as compressors, fans, blowers, pumps, and generators. The turbines are suitable for petrochemical and refinery plants; power plants or CHP plants burning fossil fuels; sugar refineries; incineration; and waste energy in heat recovery plants.

The MC turbines can offer controlled extraction, a supplementary regulating action that allows the production of heat and mechanical power to be optimized, based on the requirements of the application.

Program Review

GE Oil & Gas, a unit of GE Energy (formerly GE Energy Systems), is headquartered in Florence, Italy, the home of the entity once known as Nuovo Pignone. GE acquired Nuovo Pignone in 1994 and since then has continued to expand its oil and gas business by entering or developing partnerships with other industry leaders. Other members of the GE Oil & Gas family are Gemini, GE Packaged Power Odessa, Rotoflow, A-C Compressor and Conmec, all of the US; Thermodyn of France; and PII Pipeline Solutions of the UK.

The Thermodyn line of steam turbines is manufactured in Le Creusot, France.

Thermodyn has been producing steam turbines since 1903. Its steam turbines have become known for being rugged and reliable, with innovative technology. Thermodyn designs, manufactures, and services centrifugal compressors, reciprocating compressors, and steam turbines.

It has supplied over 180 steam turbines worldwide since 1974, including 93 machines for generator drive applications and 85 for mechanical drive applications. It has also supplied steam turbines for French nuclear submarines.

The company also has the technical expertise to design and produce complete compression units; those can range from compression modules for offshore platforms to complete turnkey compressor stations. As a multifaceted firm, it has the ability to deal with all site installation and connection problems involved in installing steam turbine-driven units. In addition, it designs its own water condensers.

Thermodyn uses computer-aided design and manufacturing (CAD/CAM) for the complete design process and for numerically controlled production. That allows the integration of aerodynamic, thermodynamic, and mechanical design, and of shaft line behavior-analysis software. CAD is also used for all installation and control design.

Thermodyn shares the sales team with GE Oil & Gas' Italian (i.e., Nuovo Pignone) entity. It has 20 service shops worldwide (14 NP service shops and six GE/NP integrated service shops).

Funding

No government funding pertaining to the Thermodyn line of steam turbines has been identified.

Recent Contracts

No major military contracts involving the Thermodyn line of steam turbines are known to have been issued.

Timetable

Month	Year	Major Development
	1905	First steam turbine produced
Jul	2000	GE Nuovo Pignone acquired Thermodyn from Framatome SA
	2001	Entity name GE Oil & Gas became widely used; name Nuovo Pignone rapidly withdrawn

Month	Year	Major Development
		from promotional/descriptive literature
Thru	2013	Continued steam turbine production projected

Worldwide Distribution

As of the start of 2004, Thermodyn is estimated to have fabricated over 1,500 steam turbines of all types for all applications, including turbines for combined-cycle installation. A large number of machines have been installed in **France**; other countries having numerous customers include **Indonesia**, **Kuwait**, **Russia**, and the **USA**.

Forecast Rationale

The Thermodyn entity of GE Oil & Gas has fabricated and installed steam turbine machines for well over 50 years. It has installed more than 1,500 machines worldwide, including machines for combined-cycle power plants. As the construction pace of power plants increases worldwide, Thermodyn can supply its machines for utilities and industrial customers. As an entity of GE Oil & Gas, it can supply small steam turbines up to 40 MW to accompany small gas turbines built by other parts of GE Oil & Gas (including the Nuovo Pignone entity).

In the decade extending through the year 2013, we project that the Thermodyn entity of GE Oil & Gas will fabricate 20 steam turbine machines for use in combined-cycle power plants. Of that total, 16 machines are projected to be in the power range of 20-49 MW and four in the power range of 50-124 MW. We expect low-total, and infrequent, production of steam turbine machines below 20 MW during the decade.

Note: *In the forecast chart below, the absence of totals in the "thru 2003" column is not intended to infer that no machines in those power bands had been built for installation in combined-cycle facilities. Rather, it is intended to indicate than an exact production total for each power band had not been provided to us as of the date of this report.*

Ten-Year Outlook

ESTIMATED CALENDAR YEAR PRODUCTION

			High Confidence Level				Good Confidence Level				Speculative			
Engine/Machine	Application	thru 2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total 2003-2012
THERMODYN													
20-49 MW STEAM TURBINES	COMBINED-CYCLE GENERATION	–	1	1	2	2	1	1	1	2	3	2	16
50-124 MW STEAM TURBINES	COMBINED-CYCLE GENERATION	–	0	0	1	1	0	1	1	0	0	0	4
TOTAL PRODUCTION		–	1	1	3	3	1	2	2	2	3	2	20