

MARINE STEAM TURBINES



DRESSER-RAND®

Solutions

**Marine Turbines designed
and developed for a variety
of applications.**

WORLD CLASS ENGINEERING

Dresser-Rand Company Limited began supplying steam engines for the warships of the British Royal Navy more than a century ago and has been designing and manufacturing steam turbines since 1907. Today, the company is an integral part of the modern marine industry.

Experience in supplying a large number of steam turbines for Royal Navy vessels during the 1940s and 1950s won the company widespread recognition as a major marine turbine manufacturer.

In the late 1950s, the number of vessels with steam turbine main engines began to diminish as diesel power became more common. Responding to the changing market, Dresser-Rand Company Limited concentrated its expertise on turbines for on-board auxiliary power generation.

In conjunction with a major tanker operator, the company designed and developed a steam turbo-generator system that uses waste heat from the main engine exhaust to produce the steam required for on-board electricity generation. As a result, the company quickly established itself as the leading supplier of turbine-based waste heat recovery systems. To date, it has supplied more than 250 machines with total capacity exceeding 300 MW for this type of application.

The same expertise in marine turbine technology has allowed Dresser-Rand Company Limited to meet the demands of other

applications, for example, turbo-generators for electricity generation on FPSO (floating production, storage and offloading) vessels.

WASTE HEAT RECOVERY TURBO-GENERATORS

The basic concept of a waste heat recovery system that includes a steam turbo-generator set is to produce additional electrical power from the heat energy in the exhaust gas of the main engine.

Successful system design depends on taking into account variables such as engine power, the proportion of the ship's life spent at sea and, of course, electrical power demands. Careful assessment of these factors, together with operating experience and crewing considerations, will give rise to different designs for different applications.

The initial cost of a waste heat recovery-based turbo-generator system is normally higher than that of an auxiliary diesel-powered generator. However, the absence of fuel costs and the lower maintenance requirements of a turbine-based system provide rapid recovery of higher initial capital investment.

*Dresser-Rand Company Limited
has supplied waste heat recovery
turbines for Maersk Line.*



.....
3.5 MW marine steam turbine
supplied to a Danish shipyard.



.....
One of twenty 6.0 or 8.5 MW
steam turbine packages supplied
to a Danish shipyard.

MARINE STEAM TURBINE DESIGN

Each Dresser-Rand Company Limited marine turbine is individually designed to meet the specifications of the client but is assembled in modular form from standard, service-proven components. This approach allows the company to manufacture components for stock, providing shorter delivery times and lower costs, without sacrificing turbine efficiency, quality, or design flexibility.

The turbo-generator unit is usually designed as a single package incorporating the oil tank and all auxiliary components and interconnecting pipework. This reduces installation time and complexity and allows the complete package to be assembled and tested at the factory prior to despatch.

Single- or dual-pressure Dresser-Rand Company Limited steam turbines are available with integral condensers or

connections for exhausting steam to separate condensers to suit specific layout requirements.

This ability to match existing equipment layouts makes Dresser-Rand Company Limited steam turbines ideally suited for retrofit applications, where waste heat recovery systems may be installed in ships that were originally built without them.

QUALITY & CERTIFICATION

Dresser-Rand Company Limited has extensive experience in meeting the full requirements of all relevant marine standards. An appropriate classification authority such as Lloyds, ABS, DNV, or Bureau Veritas certifies each marine steam turbine.

The company also conforms to the stringent quality assurance standard ISO 9001:2000 and the environmental management standard ISO 14001:2004.

.....
6,000 TEU container ship with a
Dresser-Rand Company Limited
auxiliary steam turbo-generator
set on board.



Waste heat systems

Developing innovative technical solutions for fuel savings.

APPLICATION OF TECHNOLOGY

The introduction of more efficient, long-stroke, slow-speed diesel engines for marine propulsion in response to the oil crises of the 1970s and early 1980s has meant a reduction in waste heat that can be used for electricity generation.

This has come at a time when on-board electricity demands at sea have been rising, particularly in cases where the growing requirement for refrigeration on container vessels is a factor.

The prospect of legislation and local rules with respect to stack emissions from ships has resulted in some cases where valuable cargo space has been taken up by extra fuel tanks for low sulphur fuels. A viable alternative to this in payback terms is a steam turbine generator-based waste heat recovery system. Dresser-Rand Company Limited

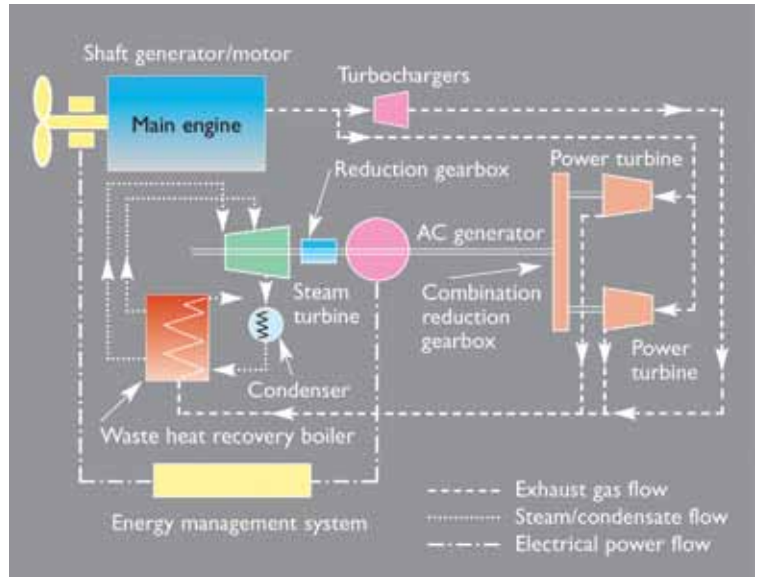


Figure 1. Dual-pressure compound system.

has been co-operating with leading shipping lines and shipyards to develop such systems for many years. Some examples of these are illustrated in the following sections.

ENERGY SAVING SYSTEMS

A novel energy saving system was installed on board a series of partially refrigerated container ships of the Maersk shipping line built between 1987 and 1991. This system used energy from the exhaust gases of each ship's main diesel engine to provide on-board electrical power and additional power, when available, to the propeller shaft.

Each system included a waste heat recovery boiler, a Dresser-Rand Company Limited steam turbine, two power

turbines, two gearboxes, a generator, and an AC generator/motor on the propeller shaft. (See figure 1)

The turbine is capable of delivering up to 60 percent of the generator's maximum power output of approximately 3.5 MW. Additional power comes from two power turbines connected to the other end of the generator by a twin-input gearbox. The power turbines extract energy from the main engine exhaust gases before the gases enter the waste heat boiler; the turbines can deliver more than 1.0 MW to the generator shaft. The package is arranged such that one or both of these power turbines can be operated under control of the power management system in order to match the ship's auxiliary electrical power demand.

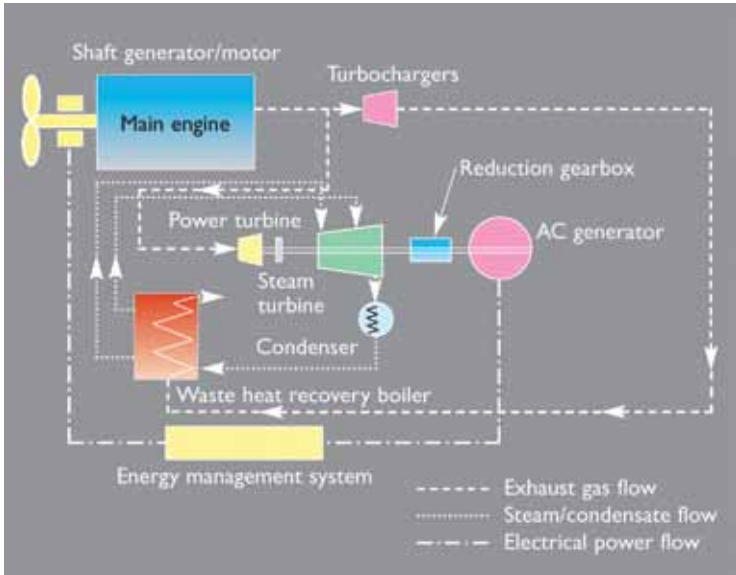


Figure 2. Further development of the dual-pressure compound system.

An advanced electronic energy management system controls automatic switching between different modes of operation and ensures efficient operation of the equipment. A further development of this system is illustrated in Figure 2. Here, a single, higher rating power turbine provides power through a gearbox to the steam turbine shaft (rather than the other end of the generator as in Figure 1). This means that the heat and power are both at the same end of the package and a standard generator can be used. In addition, the latest blading technology is used to maximize the exhaust vacuum, as is required to produce the higher powers (6 to 8.5 MW) associated with even larger container ships.



The current dual-pressure compound system.

A specifically designed and optimized steam turbine-based waste heat recovery system can produce fuel savings in excess of 10 percent.

The boiler uses the exhaust gases, enabling the power turbines and the gases that have passed through the main engine turbochargers to generate steam. The boiler supplies this steam at two different pressures to the multi-stage, mixed-pressure steam turbine.

The generator/motor on the main engine shaft is used either to supply additional electrical power when demand is high or, in motor mode, is powered by surplus electricity when electrical demand is low.

FPSO Vessels

Supplier to FPSO operators worldwide.



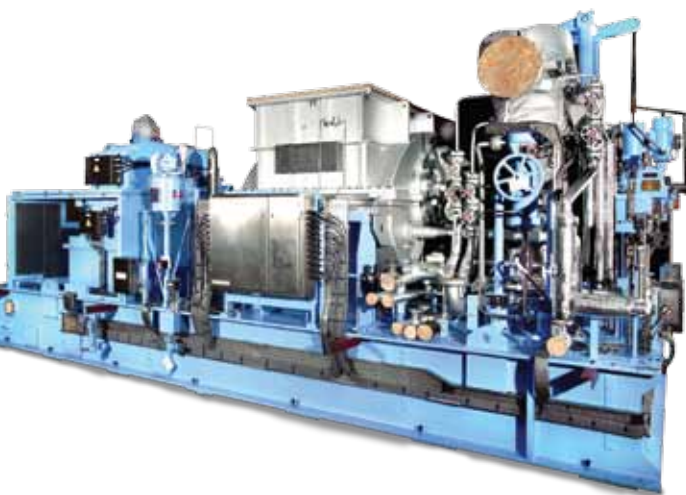
Two 12 MW condensing turbo-generator sets supplied to SBM for their FPSO vessel in the Marlim Sul Field.

TURBO-GENERATOR SETS FOR FPSO VESSELS

Dresser-Rand Company Limited has considerable experience in supplying steam turbine-driven generator sets for FPSO vessels. The use of such vessels for the recovery of offshore oil and gas is growing and Dresser-Rand Company Limited has supplied more than 40 steam turbines that ensure reliable and efficient power supplies to this market. The company has supplied equipment up to 27 MW to many of the world's leading FPSO operators including Woodside, Single Buoy Moorings (SBM), BW Offshore, Saipem, Bluewater, Aker Floating Production, Fred Olsen Production and Maersk Contractors.

As well as complying with all the relevant marine classification society rules, Dresser-Rand Company Limited can also incorporate individual client requirements such as API and ASME standards, hazardous area compliance, and extensive instrumentation and monitoring.

Turbo-generator sets can be designed to exhaust to the ship's existing condensers; alternatively Dresser-Rand Company Limited can supply the condenser. For power outputs up to 6 MW, the condenser can often be incorporated into the turbine bedplate if required.



One of two 27 MW steam turbines supplied to Fred Olsen Production for the Knock Allan FPSO vessel.

Two 24 MW steam turbines are installed on the Berge Helene FPSO vessel.



DRESSER-RAND



C apabilities

Experience and expertise.



Peterborough facilities test bed.

STEAM TURBINE TESTING

All steam turbines manufactured by Dresser-Rand Company Limited are subjected to a rigorous, in-house functional test before despatch. Each set is run at no load and wherever possible at full operational temperatures. The testing of the set, complete with its control panels, ensures that all monitoring and safety systems are proved to function correctly.

The set is then dismantled and all components checked before reassembly and preparation for despatch and delivery. In this way, Dresser-Rand Company Limited minimizes the scope and amount of work required to install and commission the set on board the ship.

ENGINEERING SERVICES

Dresser-Rand Company Limited's aftermarket division offers a unique combination of the experience and expertise of an original equipment manufacturer, coupled with the responsiveness of a service organization.

Engineering capabilities and products include:

- Steam turbine spares
- Re-engineered spares
- Plant repairs and overhauls
- Installation and commissioning
- Plant upgrades and maintenance
- Turbine blades and rotor repairs



Three 5 MW steam turbines supplied to Aker Floating Production.

DRESSER-RAND®

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