POWERING THE World's Largest FPSOs is No Small Task

ACCORDING TO DRESSER-RAND, several energy business analysts and industry sources such as the International Energy Agency forecast continual growth in the demand for floating production, storage and offloading vessels (FPSO) and LNG solutions. Fossil fuel energy supplies will increasingly require extraction from deposits that are more difficult and costly to exploit – including deepwater and non-conventional oil and gas reserves. Greater attention is also being given to transporting fossil fuels trapped in the world's economically stranded reserves, or ESRs (also known as 'stranded fields' or 'stranded reservoirs'). With an estimated 90 trillion m^3 of natural gas remaining untouched in ESRs, these remote locations represent billions of dollars in potential energy supply.

With long-term worldwide population growth, rising living standards and energy prices, environmental pressures and growing markets, this change in focus is fostering the development of new technologies – for both the LNG and FPSO industries.

Peter Brotherhood Ltd. began supplying steam engines for the Royal Navy's warships more than a century ago and had been designing and manufacturing steam turbines since 1907. During the 1940s and 1950s, the company became widely recognized as a major marine turbine manufacturer. In 2008, Dresser-Rand Company Ltd acquired certain assets of Peter Brotherhood Ltd. Since the late 1950s, when diesel became the preferred means of powering ships, Dresser-Rand concentrated its expertise on turbines for on-board auxiliary power generation. Today, that same expertise in marine turbine technology is enabling the company to meet the growing demands of other applications such as generating electricity on board FPSOs used to recover offshore oil and gas.

Reliable, Efficient Power

Dresser-Rand's Peterborough operation has supplied more than 40 steam turbines (up to 27 MW) for generator sets that ensure reliable and efficient power for 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 FPSOs. Not only is the technology required to power the massive FPSO vessels critical, but the generator sets must be designed and manufactured for on-board use.

Inside the Technology

Dresser-Rand offers a complete range of turbine generator (TG) sets in sizes from 0.5 MW to 100 MW. The sets accommodate inlet temperatures to 566 ºC, inlet pressures to 138 bar, and exhaust pressures from 55 bar. A variety of direct-drive or geared configurations are available:

- Condensing or non-condensing
- Single- or multi-valve
- Single- or double-automatic extraction
- Mixed-pressure designs.

Exhaust flanges can have an axial, side, upward, or downward orientation depending on the power and frame selection. The turbo-generator unit is usually designed as a single package incorporating the oil tank and all auxiliary components and interconnecting pipes. This reduces installation time and complexity and allows the complete package to be assembled and tested at the factory before dispatch. Turbo-generator sets can be designed to exhaust to the ship's existing condensers; alternatively, Dresser-Rand can supply the condenser.

Rigorous, In-house Testing

Steam turbines manufactured at Dresser-Rand's Peterborough operation are subjected to a

rigorous, in-house functional test before delivery. Each turbine is run at full speed, no load and, whenever possible, at full operational temperatures. The testing of the turbine, complete with its control panels, ensures that all monitoring and safety systems are functioning properly. The turbine is then dismantled and all components checked before re-assembly and preparation for delivery. In this way, Dresser-Rand minimizes the scope and amount of work required to install and commission the set on board the ship.

In addition to complying with relevant marine classification society rules, Dresser-Rand can fulfill individual client requirements such as API and ASME standards, hazardous area compliance, and extensive instrumentation and monitoring.

Success Measured in Megawatts

In the last five years, Dresser-Rand has manufactured 25 turbines for installation on board FPSOs. Since 1981, the company has installed 43 turbines on board 24 FPSOs, with total power output of more than 430 MW. These turbines are on board FPSOs moored off the coasts of West Africa, Indonesia, Thailand, Vietnam, Brazil, and Australia, and in the North Sea.

The company has supplied the most powerful steam turbines ever installed on an FPSO vessel. The two 27MW condensing steam turbine-driven generator sets were supplied to Fred Olsen Production ASA for the Knock Allan FPSO which is located in the Olowi field off the coast of Gabon. The sets were tested on-steam at Dresser-Rand's manufacturing facility in Peterborough, UK before being delivered to Dubai Drydocks for installation on the top deck of the Knock Allan FPSO vessel. The vessel has been converted from a tanker to an FPSO at Dubai Drydocks. Once operational, the Knock Allan will be able to store one million barrels of oil and produce 22,000 barrels a day.

For another recent project, Denmark-based Maersk FPSOs (formerly Maersk Contractors), a leading drilling company and supplier of floating production solutions, chose Dresser-Rand (then Peter Brotherhood) to design and manufacture three 24MW condensing steam turbine-driven generator sets for the Peregrino development. Located about 85 km from Brazil, in approximately 100 m of water, recoverable resources in the Peregrino field are estimated at between 300 million and 600 million barrels of oil.

The generator sets are currently being installed and commissioned on board the Peregrino FPSO by Dresser-Rand's international service engineers. Each set comprises a turbine, gearbox and generator, all mounted on a common bedplate that incorporates the oil system. The turbines will be driven by steam from gas-fired boilers on the vessel and each turbine will exhaust to a separate condenser, also supplied by Dresser-Rand.

Another client, Single Buoy Moorings (SBM), has worked with the company several times, ordering eight steam turbine-driven generator sets in the past five years. The latest order called for two 14MW condensing steam turbine-driven generator sets for the Espirito Santo (BC-10) FPSO, to be moored off the coast of Brazil.

The Espirito Santo (BC-10) project would be the first full field development based on subsea oil and gas separation and subsea pumping. Espirito Santo technology requirements included artificial deepwater lift via high power electric pumps in seabed caissons and horizontal wells. The double-hulled FPSO design included significant power and heat delivery systems required to drive the system and process the heavy crudes that ranged from 16 to 24 degrees API.

With more than 40 steam systems delivered to date – including the most powerful steam turbines ever installed on an FPSO vessel – Dresser-Rand has proven experience in supplying steam turbine-driven generator sets to power some of the world's largest FPSOs. ■