Offshore solutions

FIRE EXTINGUISHER PUMP ON NORWEGIAN OIL PLATFORM DRIVEN BY SERIES 4000 ENGINES

Who Frank Mohn, Norwegian pump manufacturer for the natural gas and oil platform Gjøa built by Statoil Hydro off Norway's west coast

What Four MTU Series 4000 engines to drive the world's biggest fire extinguisher pump

Where Bergen, Norway

The Norwegian oil platform Gjøa is protected against serious fires by the world's largest and most powerful fire extinguisher pumps. They are driven by four 20-cylinder Series 4000 engines each delivering 2,800 kilowatts (kW) at 1,800 revolutions per minute. With their aid, the four-pump fire extinguishing system is able to drench fires with over 4,000 liters of water per second – equivalent to the amount delivered by roughly 100 modern fire engines.

A Rolls-Royce solution

The MTU engines were installed in the fireproof containers for the fire extinguishing system at Frank Mohn and subsequently delivered to Statoil Hydro for installation on the Gjøa offshore platform. (Picture: Frank Mohn)

Bergen, Norway – “Gjøa” was once the name of the converted fishing cutter on which Roald Amundsen completed the first successful navigation of the Northwest Passage from the Atlantic to the Pacific at the beginning of the 20th century. Today, that same name is borne by the oil and gas field discovered off the west coast of Norway in 1989. After 22 years of preparation work, the Gjøa field finally came on stream at the end of 2010. It holds reserves of 10 million cubic meters of oil and condensate and 37 billion cubic meters of natural gas. The field is being tapped by a semi-submersible platform and five well-heads on the sea floor. The natural gas from the Gjøa field is fed into the FLAGS (Far North Liquids and Associated Gas System) pipeline which reaches the shore at St. Fergus in Scotland.

Both the offshore platform and the connection to the FLAGS pipeline were built by the Norwegian company Statoil Hydro. In view of the complex geological conditions in the area, numerous safety precautions were required – including those for fire safety. In order to protect the environment and the production platform against the possibility of fires, Statoil Hydro contracted the pump manufacturer Frank Mohn to build a sufficiently powerful fire extinguisher pump. The requirements placed on it were very high because it has to be able to withstand even the worst possible weather conditions such as high winds and storms at sea. On the one hand, the pump was expected to have a high flow capacity, while on the other, there was only a very limited amount of space to accommodate the fire extinguishing system on the oil platform. The Bergen-based pump maker decided on a diesel-electric drive system. At the heart of the fire extinguishing system are four MTU 20-cylinder Series 4000 engines from Rolls-Royce – type 20V 4000 P83 – with an output of 2,800 kW each. Together with the generators, they form four gensets that supply the electricity for a total of four pumps.

Demanding requirements placed on the engines

The four engines had to meet strict technological standards. They were given a special paint finish designed to withstand the harsh North Sea weather. Although each genset is housed in a separate

1 The pumps are driven by four MTU Series 4000 20-cylinder engines capable of 2,800 kilowatts each. (Picture: Rolls-Royce)

2 For maintaining the engines, Rolls-Royce has a local agent, Bertel O’Steen in Bergen. (Picture: Rolls-Royce)

All four pumps together can draw in over

4.000

LITERS OF SEA WATER

waterproof container, the engines still have to be protected against the sea air with its high salt content. Apart from that, the engines are equipped with fast-closing valves for shutting off the air supply to the engine in dangerous situations, such as sudden gas penetration, so that they do not over-rev. “The engines can be stopped instantaneously at the push of a button – a feature that is of absolutely fundamental importance when driving a fire extinguisher pump,” explains Robert Wagner, senior manager for the oil & gas market at Rolls-Royce. In addition, all engine systems have “double sensors”, which means the engine has two of certain monitoring sensors. If one of those sensors fails, the second, backup sensor takes over the monitoring function. In addition, the engines have water-cooled exhaust pipes and turbochargers. “Both are designed to keep the surface temperatures as low as possible so that there is no danger of a fire if there are any fuel leaks,” Wagner explains.

Space and weight savings despite high power

As there is little space to spare on an oil platform, the gensets had to be kept as compact and light as possible. The Series 4000 engines are 3.6 meters long, 1.5 meters wide and 2.1 meters high and offer very high power density, i.e. they produce more power from less weight compared with engines made by other manufacturers. Furthermore, in order to accommodate the gensets in the smallest possible containers, a generator requiring as little space as possible but nevertheless delivering the specified electrical output had to be chosen. The biggest challenge was that the pumps had to be capable of delivering their maximum capacity within 20 seconds of start-up. Traditionally, it would only be possible to meet the capacity requirements using a disproportionately large generator or a soft start-up controller such as a frequency converter. In this case, neither option could be considered due to reasons of weight respectively cost.

Since the power requirements when the pump’s electric motor is started up can be around two or three times as much as the rated output of the diesel engine, the solution consisted of optimizing the start-up sequence and the engines’ starting characteristics so as to avoid excessive power demands. Together with the generator manufacturer, Rolls-Royce adapted the electrical characteristics of the generator to the diesel engine power demand during the start-up phase. To prevent the engine from stalling at start-up, the load could not be connected too quickly. To that end Rolls-Royce optimized the time sequence for generator excitation during genset start-up in order to use as much of the system’s kinetic energy as possible for starting up. Compared with other solutions, that reduced the weight of the gensets by around 50 percent, meaning that space requirements were also smaller, which in turn saved on building costs. Consequently, the propulsion systems specialist was able to provide a compact drive system solution for the fire extinguishing system which met all requirements for operation on the oil platform.

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Erik Bergesen
Buyer at pump manufacturer Frank Mohn

The MTU engines were installed in the fireproof containers for the fire extinguishing system at Frank Mohn and subsequently delivered to Statoil Hydro for installation on the Gjøa offshore platform. Consisting of four pumps, the system is unique in this form. Each pump has a water production capacity of 3,600 cubic meters, i.e. all four pumps together can draw in over 4,000 liters of sea water a second and deliver it at a pressure of 16 bar for fire-fighting purposes. That roughly equates to the combined capacity of 100 modern fire engines.

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The platform was commissioned by the energy supplier Gaz de France at the end of 2010. So one of the largest projects currently operating in the North Sea is ideally equipped to quickly and safely fight any fires that may occur with the most powerful fire extinguishing system currently in existence.

Specially trained service staff on site

Wagner is certain that it will stay that way for a long time: "Our engines are designed for a service life of several decades." For servicing, Rolls-Royce has a local agent, Bertel O'Steen in Bergen. The staff there really knows their way around an MTU engine. They have also completed the training courses which qualify them to work on offshore oil platforms. One of the tasks they have to complete involves being lowered into a gigantic water tank from a helicopter. The aim is to get out again unscathed. It is one of many tests designed to realistically simulate the dangers to which crew can be exposed on an oil platform.

30 years of engines from Rolls-Royce on oil platforms

Wagner and his team have plenty of dealings with oil platforms on a regular basis. "We have been supplying engines that can withstand the special conditions on offshore rigs for 30 years," he points out. That length of experience is something that Erik Bergesen, a buyer at pump manufacturer Frank Mohn, also values: "Rolls-Royce is one of the few diesel engine builders in the world whose products meet the criteria for our fire extinguisher pumps." Power, start-up time, safety, and especially reliability are the key factors for him. But a willingness to make individual adjustments is also important to him: "Rolls-Royce is flexible enough to be able to make engines precisely for the requirements of a particular project." There is no doubt that this is why Frank Mohn has been doing business with Rolls-Royce for over 25 years now. "The Rolls-Royce team has always impressed us with their cooperative and professional approach," Bergesen adds.

Rolls-Royce has been supplying oil platforms all over the world with engines for the most diverse applications for over 30 years. And on the Gjøa platform too, there are two more of the drive system specialist's engines in use. As well as the engines for the fire extinguishing pump, Rolls-Royce supplied a complete genset known as an "essential generator" driven by a 20V 956 TB33 with an output rating of 6,250 kW, which provides the power supply for important electrical equipment if the main supply fails. Another MTU genset with a 16V 4000 P61 engine capable of 1,760 kW serves as emergency backup.

The pumps are driven by four MTU Series 4000 20-cylinder engines capable of 2,800 kilowatts each. (Picture: Rolls-Royce)

End of 2010, the Gjøa field off Norway's west coast came on stream. The fire extinguisher pumps are driven by four MTU 20-cylinder Series 4000 engines. (Picture: Tommy Solstad)