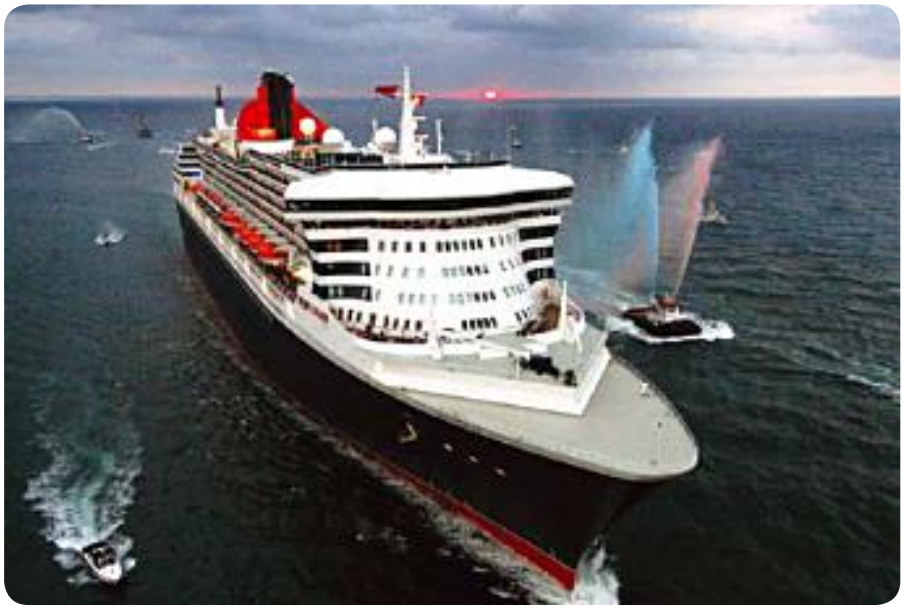
Marine industry

Queen Mary 2

On-line condition monitoring system



Global remote monitoring of the Queen Mary 2

Queen Mary 2 (QM 2) is the largest, longest, widest and most expensive passenger vessel ever built. She also has the biggest and most powerful pod propulsion system to date, with each pod constantly being checked by a condition monitoring system that includes remote monitoring by satellite. For anyone familiar with conventional ship propulsion systems the Rolls-Royce Mermaid pod propulsion system fitted to the QM 2 comes as quite a surprise. Instead of the usual large diesel engine driving a shaft and propeller, four pods are suspended below the ship's hull: two are fixed and two can rotate 360°.

Each pod contains an electric motor with a small shaft that projects from the pod to provide the propeller mounting. Four diesel engines and two gas turbines drive the generators that provide 118 MW of electrical power – enough to power a city of 300,000 people. The propulsion system takes more than two thirds of this power with each pod drawing 21.5 MW during full power, to produce a top speed of 30 knots. The diesel engines operate at constant speed, with the speed of the pod motors being controlled through transformers and frequency converters.

This means that the QM 2 never emits huge clouds of sooty black smoke whenever it has to accelerate during a cruise, eliminating the clouds of unburnt fuel and smoke that are often associated with the acceleration of large diesels. Another surprising feature is that the QM 2 has no rudder or stem thrusters. Steering and manoeuvring of the ship are achieved by swivelling the two rotating pods. This significantly improves the ship's turning ability and gives unparalleled manoeuvring potential in tight channels or ports.

Pod propulsion provides other benefits that please passengers and ship owners. For passengers the ship seems much quieter than a ship with diesel, shaft and propeller propulsion, with a noticeable lack of vibration, even when approaching speeds of 30 knots. For the ship owner there is more space for cabins, cargo or equipment, together with significant savings in fuel.

Results of measured vibration and temperature

To detect and give an early warning of any future mechanical problem in any of the four propulsion pods, an SKF on-line condition monitoring system has been installed.

The system is designed to measure vibration, temperature, speed and other significant parameters. It then relays the presence of any anomalies to maintenance personnel on board, together with advice for correcting any existing or impending condition. At the same time, the data is relayed via satellite to the SKF Condition Monitoring Centre in Luleå or to the Rolls-Royce Control Centre in Kristinehamn, Sweden. Alarms are presented as clear text messages to the maintenance crew on board together with additional information showing the condition of different pod components such as a bent shaft, cavitation, bearing condition and electrical faults.

One special problem that the system had to overcome was the pod operating environment. Signals from a pod have to be transmitted using slip rings; however, whenever the ship performs some manoeuvre such as increasing speed or changing course, the pod vibration pattern changes from the normal pattern recorded when cruising. This disturbance of the vibration pattern continues for some time after the manoeuvre and must be taken into account by the monitoring system. To do this the system is designed with rule-based diagnostics and a special gating system that checks the ship's speed, shaft speed and steering angle, before calculating when conditions are stable enough for normal monitoring to be resumed, eliminating the possibility of false alarms.

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