INSIDE VIEW:

WHAT MAKES QM2 GO?

A conversation with QM2 Chief Engineer Brian Watling

by

Richard H. Wagner

As Chief Engineer, Brian Watling is head of the Queen Mary 2's Technical Department. In the past, this department was called the engineering department but the name has been changed to reflect modern reality that it takes more than just the engines to make the ship operate. "We need the propulsion but we also need all the facilities outside of the engine room spaces. Technically, we are looking after all the external areas as well as the area down below; that is the lifeboats, the laundry, the galleys, the show equipment, the bridge equipment, air conditioning, and the plumbing. The area that people don't think so much about is the furnishing side. We are also responsible for the carpeting, the French polishing. the maintenance of all the outside areas."

To fulfill this broad mandate, the Technical Department has 27 officers and 70 ratings. This covers all disciplines from welding and plumbing to advanced electronics and computer science. "We have three technical staff on each watch, a senior, a junior and a motorman. Then there are 19 or 20 who are actually doing maintenance on the engines. The rest of the team are all around the ship."

Much of the activity takes place in the engine control room, a clean, well-lit room with banks of dials, computer screens and televisions. "The control room is a very sophisticated control center. A lot of it is automatic control but there is also manual intervention. They can open valves, start pumps, they can pump the bilges, they can transfer fuel and water from the control room. But you also have to have people patrolling the spaces as well. Part of it is safety and part of it is that there are things you have to do locally on site. You can't do everything from the control room." Accordingly, teams patrol the machinery spaces and other teams perform maintenance in those areas.

Powering The Ship

In the final analysis, everything on QM2 is dependent on electricity. It provides the force needed to make the ship move and it provides the wherewithal for the ship's hotel to operate.

QM2's power plant consists of four diesel engines and two gas turbine engines. "We have the fastest most powerful ship in the world, so we have a very powerful plant with the gas turbines and the four diesels."

The reason that QM2 has both diesel engines and gas turbines has to do with space. In order for the ship to achieve the maximum speed which Cunard felt was necessary to have in order

for the ship to do regularly scheduled transatlantic crossings, the propulsion plant had to be capable of generating a certain amount of electricity. An all diesel engine plant capable of producing that amount of power would have required large uptakes and water ducts connecting the engine room located low in the ship's hull to the funnel on the top of the ship. Those uptakes and ducts would have substantially reduced the amount of space available for passenger public rooms. Because gas turbines are relatively small and compact, they could be placed at the top of ship (behind the Queen Mary 2 sign) thus provide a significant amount of additional power without interfering with passenger space.

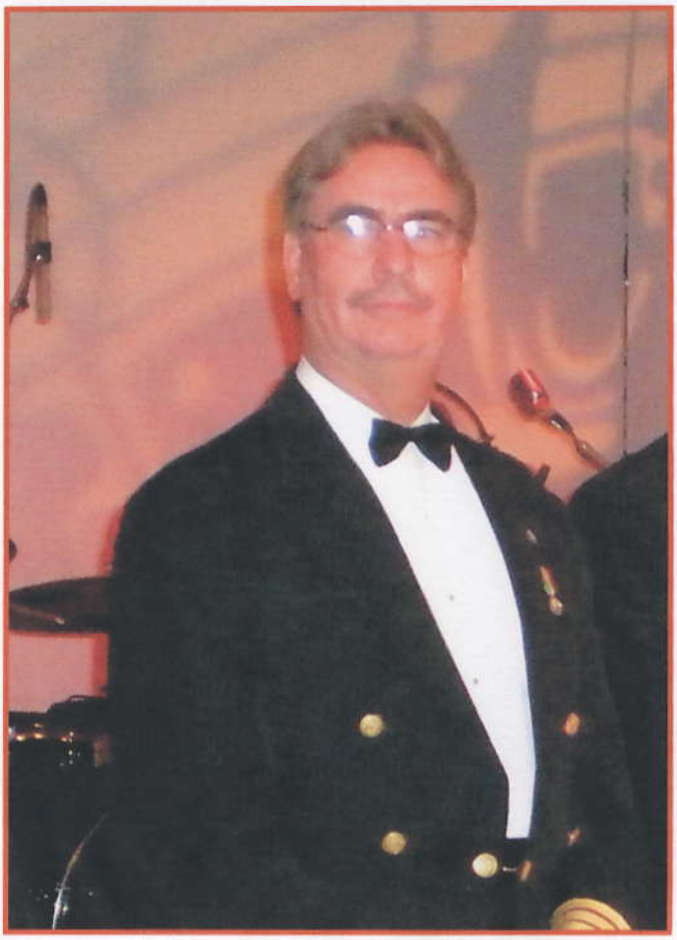
The four diesel engines are Wartsila W46 V1646C diesel generators each with a power output of 16.8 megawatts. They use Heavy Fuel Oil (HFO) and each can burn 3.1 tons an hour at 100 percent load. About 40 feet long, they are in a single engine room down in the ship's hull.

The two gas turbines are located in their own engine room high on the ship. They are General Electric LM2500+ gas turbines. "Each engine is 25 megawatts, which we can achieve in five minutes with a quick start. They are very powerful, quick engines."

Unfortunately, the downside of this technology is that these engines use Marine Gas Oil and burn 6.1 tons of it an hour at 100 percent load. "The gas turbines are very expensive. The fuel that they require is very high quality and it is actually much more expensive than the fuel for the diesels and they burn a lot more fuel per hour."

Consequently, the practice is to rely primarily on the diesel engines and only use the gas turbines to "top that power off." Thus, on a six-day westbound transatlantic crossing, the ship needs to maintain a speed of 23 and a half knots. If there is no wind or inclement weather, this is about the maximum speed that the four diesel engines can produce and so the ship has been able to do some westbound crossings without using the gas turbines on occasion. If the weather is bad or the ship is delayed leaving Southampton, however, "often we will put one on but just for two or three days and then we go on just the four diesels."

On an eastbound crossing, each day is only 23 hours because the ship loses an hour each night going from New York to Southampton due to the difference in the time zones. As a result, the required speed is 25 and knots on a six-day voyage and "we need at least one gas turbine all the way across. If it is rough weather or delayed departure,



Chief Engineer Brian Watling

we will need a second one for a short period of time." This is one of the reasons that the ship will be doing seven-day eastbound crossings in 2010.

At certain scheduled intervals relating to the amount of time it has been running, each diesel must be taken offline for an overhaul. During such an overhaul, the technical department, working with representatives of the engine's manufacturer, strip it down to its pistons and then rebuild the engine. This process can take about two weeks during which time the ship depends upon its other diesels and its gas turbines..

The total power produced by the engines is 117.2 megawatts, which is equivalent to 157,168 horsepower. "We are producing electricity, we are the biggest floating platform in the world, and we produce as much as we use."

Pulling Her Along

The electricity generated by the diesels and the gas turbines is fed into a high voltage main switchboard. From there it is distributed to the various consumers of electricity around the ship including the air conditioning, the galley, the

bridge, the refrigeration etc.

"The largest consumer of electricity is the pods." The pods are the propulsion plant that actually moves the ship through the water. QM2 has four Rolls Royce Mermaid pods. The pods are suspended below the ship's hull in steel casings and weigh 260 tons each.

Two of these are azimuthing pods (frequently referred to as "azipods"), which can rotate 360 degrees. The other two pods are fixed in position.

Each of the pods contains an electric motor. Attached to the shaft of the electric motor at the front of each pod is a fixed blade propeller with a diameter of six meters.

"At maximum power, [the pods use] about 86 megawatts at full speed. They are the most powerful pods ever built at 22 and a half megawatts each."

Besides being powerful, the pod system has other advantages over traditional propulsion systems. "If we had gone back to a normal propulsion, which is having large motors inside the ship with shafts, you tend to get a little more noise through the ship on maneuvering because of the cavitations of the propellers. We don't get that with the pods we have because they are tractor pods - - they are pulling the ship through the water so you get nice, clean water going into the blades which cuts down any noise cavitations. So, at the back end of the ship, you very rarely hear any noise."

The pods also give QM2 more space inside the ship than if she had had a traditional propulsion system. "It would probably have had to have been a four shaft ship so you would have had very large electric motors as well as the shafts taking more space out of the ship. So another advantage of the pods is that it takes those motors down under the ship and gives more space."

QM2 is not the only passenger ship using pod propulsion but most others have just two pods. "We needed four because we needed the power to propel the ship at the contract speed of 29 and a half knots. These pods were designed to give that speed. You will find that most of the other ships that have pods, the maximum is about 18 and a half megawatts. So, [the builders of QM2] went up quite a large step in power for [each] pod. But to be able to have the 86 to 90 megawatts of power required to propel the ship at that speed, they needed to have four of them".

In 2006, one of the pods was damaged in a collision with an underwater object. As a result, it was removed for repair and for most of the year the ship ran on three pods. "It was amazing how we really did not lose that much off the top-end speed. She could still do 27 and a half knots on three pods. It was quite impressive, really."

The two azipods are used to steer the ship. In the initial design for QM2, the azipods were only going to be used for maneuvering the ship in port. The ship was going to have a rudder and when at sea, the two azipods would have been locked in place and steering done with the rudder as on traditional ships. However, it was determined that the rudder produced too much drag, decreasing the ship's speed and so it was decided to eliminate the rudder and use the azipods instead for steering.

This has proven to be a fortuitous decision. "They are like an active rudder. On the [azipods]

the stem is like a big rudder anyhow so you are turning that but because that power is directly on that rudder itself, it moves the ship very quickly."

Where the azipods really come into their own is in maneuvering the ship when docking and undocking. The bridge can turn the two azipods 90 degrees and in conjunction with the ship's three large bow thrusters move the ship sideways towards the pier or away from the pier. As a result, QM2 rarely needs assistance from tugboats.

The four pod arrangement makes QM2 more maneuverable in such situations than ships with only two pods. The two fixed pods give the ship forward and aft thrust. Therefore, both azipods can be turned and used for lateral movement. On a ship with only two pods, "they keep one [azipod] fore and aft and they use the other one to move the ship sideways. This is more flexible."

Still, "there are occasions when we will still take tugs. The side of the ship is massive - - about 6,000 square meters. When the wind blows on that, it can be significant when you get up to the real high strength winds. There have been times in New York where the wind was right on the beam that we have had to take tugs to get that extra pull right off the dock."

A Different World

In the old Hollywood films, the captain would call down to the engine room over a tube or use a ship's telegraph to signal the engine room that he wanted more power. That colorful procedure has had its day. On QM2, the technical department will start the engines when the ship is preparing to leave port and "when we are happy that everything is correct, we will change control over to the bridge. When they take control on standby, they have control [through the instruments] on the bridge for the power and azimuthing the pods. The Commodore has to have full control of the pods from the bridge. There are times when we will want to do something, checking something out or whatever, and we will take control and do whatever we want to do. But most of the time, the control stays with the bridge when the ship is at sea."

Along the same lines, in the days of steam engines, it could take most of a day for a ship to become ready to move. Those days are gone. Typically, when QM2 is in port, she has one diesel engine turned on. "To start the others up, put the power onto the pods and bow thrusters can be very, very quick. There are other times, when we go through a slower process because we are not in a rush and that can be up to half an hour or fifteen minutes. If necessary, we can start a gas turbine up from zero in five minutes and that would give you 25 megawatts of power. In emergency situations, that can be useful."

Keeping Things Stable

QM2 has two pairs of Brown Bros./Rolls Royce stabilizers. These devices have a surface area of 15.63 meters and fold into the hull. They can be deployed individually and in pairs when the ship is at sea. (In port, all of the stabilizers are folded into the hull). "They are incredibly efficient. All they are is like an airplane wing and they stick out of the ship on each side. They just rotate. There are motion sensors and they react to that. They can't stop the roll completely but they can reduce it. During the tank tests [which tested the ship's design], the model was put through a Force 12 [gale] and with four stabilizers out, it reduced the roll by 90 percent."

Keeping Things Green

When she is on her transatlantic runs, QM2 makes all of her own fresh water. This is done using three Alfa Laval Multi Effect Plat Evaporators, each of which can produce 630 tons of water a day "which is far in excess of what we actually consume". When the ship is doing a cruise, the time at sea tends to be less and thus there is not as much time to make water. As a result, QM2 does have to purchase fresh water in some ports of call.

Waste water is treated in a 'filtration plant. It goes through a bio-reactor, which breaks it down. It goes through these very, very fine filters and then the liquid is discharged out - - basically, a clear liquid. Any solid residue from that is collected off and that goes into an incinerator and is burned."

"The incinerators burn a lot of the other garbage from the ship - - cardboard, paper. All the glass that gets broken in the bars etc. is smashed up and we land that for recycling. All the tins are crushed and they are landed for recycling as well."

Exhaust gas from the diesels and the gas turbines is captured to make steam that is used to heat the accommodations, the laundry, domestic water and fuel oil. It is also used for steaming in the ship's galleys.

Other Responsibilities

As noted earlier, the Technical Department's responsibilities are not just limited to the engines but extend to a number of areas, some of which come to mind more readily than others.

There are miles of pipes running through QM2. Through them move water, fuel, waste materials and other fluids. Maintaining these networks is part of the technical department's responsibilities. "If it is in the accommodations, ship's services looks after it - - the sanitary pipes, the fresh water pipes. If it is down in the engine room, the day maintenance teams will look after it."

Similarly, the ship's electricians and electrical officers do not just work on the radars and other high tech equipment. "They can be working on a coffee machine one minute and a steam oven or a grill the next."

"There are 45 elevators onboard - - passenger elevators, crew elevators, handicapped ones. There are usually two or three people working on them all the time. Very labor intensive, elevators." The elevators are marine elevators and have a different arrangement for holding them into the shaft than elevators in buildings in order to allow for more movement.

The ship's carpenters maintain the furniture throughout the staterooms and public rooms on the ship. "It gets marked from time-to-time since it is in use all of the time. The carpenters will either rotate them or take them down to the workshop, sand them down and re-paint or polish them."

"Carpets, they take a beating so they have to be replaced from time-to-time. We have the materials and skills aboard and we change carpets. Painting, wallpapering - - we do all of these."

To make these types of repairs, the ship carries spare parts on each voyage. For the transatlantic season, the company also maintains stockpiles of materials in Southampton and New York. During the yearly world cruise, QM takes on additional stores and containers full of spare parts meet the ship in certain ports such as Sydney and Hong Kong.

The most noticeable spare parts on the ship are the spare propeller blades, stored on the open deck just in front of the superstructure on Deck 7. "We can take the blades off while the ship is still in the water. We do not actually need to be in a dry dock to do that. We have an organized plan for doing that. We wouldn't do it at sea - - it would be in port - - so you would have a big crane to lift [the spare blades] off.."

These curving forms frequently attract the attention of passengers strolling the open deck. "Because they are stainless steel and very shiny, it was decided to put them up there and use them as a bit of art work as much as anything else." Indeed, Watling has argued tongue-in-cheek that their cost should be borne by the ship's art budget rather than the technical budget.