

Powering the Nation's Flagships



HMS Prince of Wales, the second of the UK's largest ever warships, has been handed over to the Royal Navy.

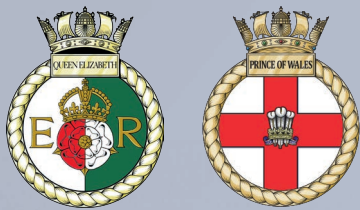


To commemorate the official commissioning, Tomas Leahy, Programme Director, reflects on Rolls-Royce's involvement in the Queen Elizabeth Class Aircraft Carrier programme. From design to assembly and build, to sea trials and the handover of the second ship, Tomas explains what it's been like to work on such a monumental national endeavour.

Rolls-Royce's involvement in the programme goes back to 1999 where we provided the power and propulsion expertise to the original two competing designs.



Artist impression of HMS Queen Elizabeth and HMS Prince of Wales © Aircraft Carrier Alliance

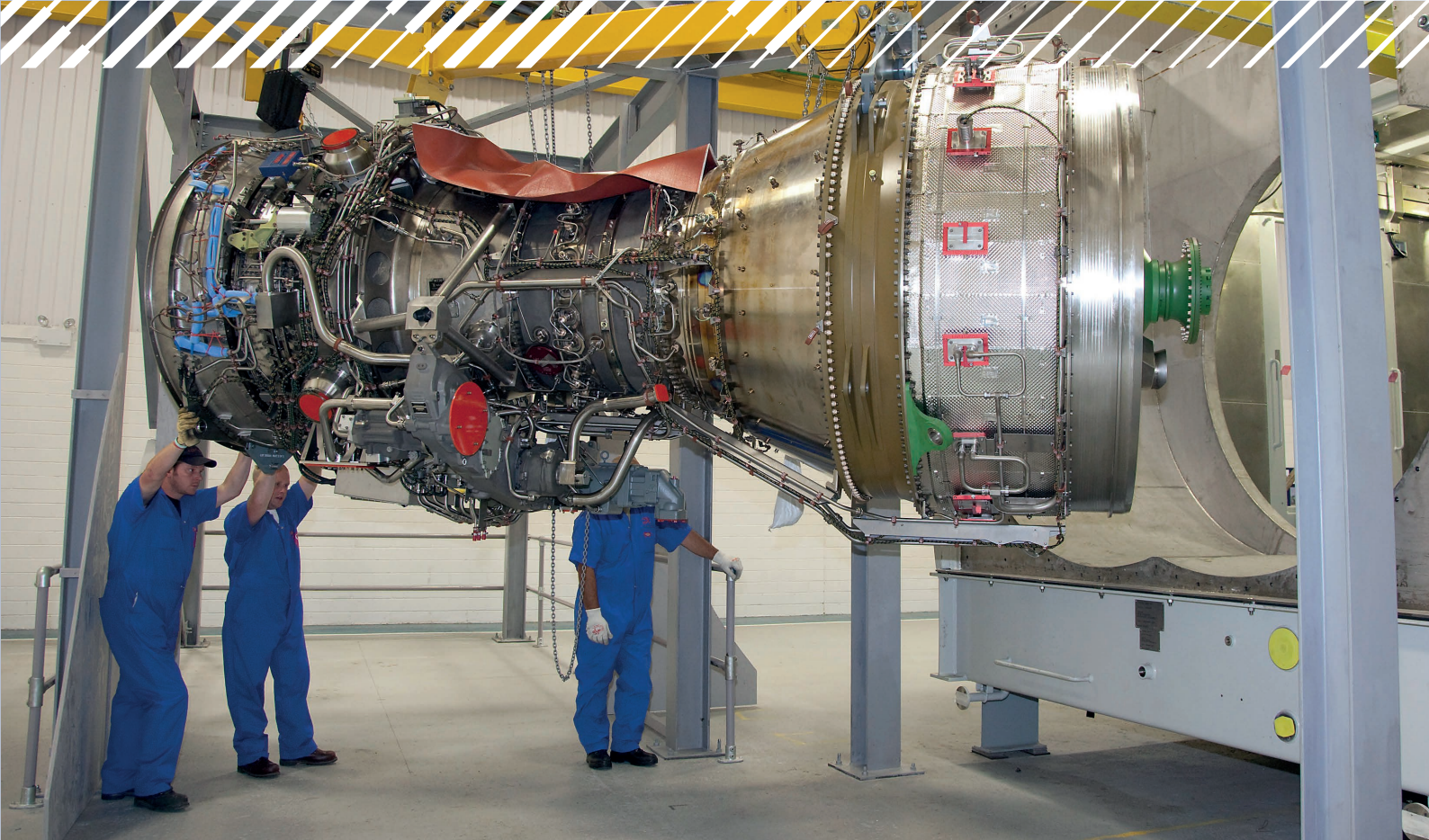


In **2003**, the UK Ministry of Defence (MOD) combined the two competing ship designs and, unlike any other UK shipbuilding programme, formed an alliance (which would ultimately become the Aircraft Carrier Alliance) between the MOD, Thales, Babcock and BAE Systems, to bring the ships to life.

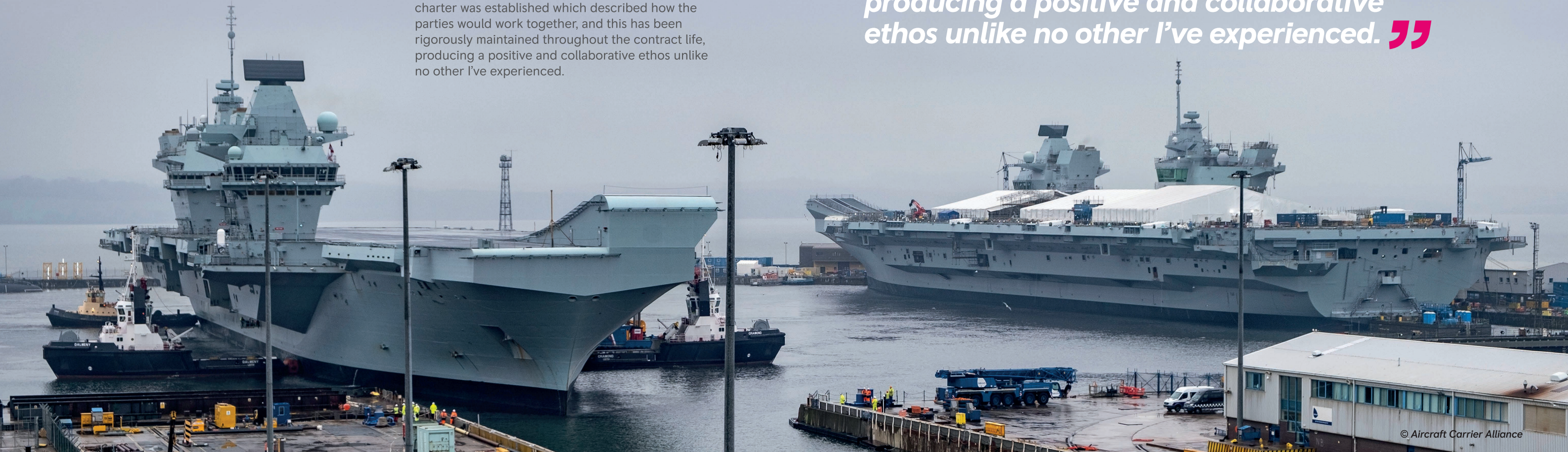
I initially started work on the programme in 2003, as Chief Engineer, in a team comprising Rolls-Royce and GE Power Conversion. We were tasked with looking at optimising the power and propulsion system arrangement for the new vessel design. I re-joined the programme in 2013 as the Programme Director for Naval, at which point the construction of Ship One was well underway, and I have remained involved ever since.

Working alongside GE Power Conversion, we looked at different power and propulsion options for the new vessels. In **2004** the propulsion system was selected - an Integrated Full Electric Propulsion system (IEP). IEP is one of the most advanced propulsion systems available today and was the perfect choice for the Queen Elizabeth Class (QEC) programme, providing the power, flexibility and reliability required by the vessel.

Subsequently, in **2008** a Power and Propulsion Sub-Alliance was established comprising Thales UK, L3, GE Power Conversion and Rolls-Royce, with responsibility for the design, procurement, manufacture, integration, test and delivery of the power and propulsion system. A Sub-Alliance charter was established which described how the parties would work together, and this has been rigorously maintained throughout the contract life, producing a positive and collaborative ethos unlike no other I've experienced.



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The Power house

At the heart of QEC's power and propulsion system sits two Rolls-Royce MT30 36MW gas turbine alternators, which combine with four medium speed diesel generators.

Back in 2004, MT30 was new to naval markets and QEC became its second successful selection for a naval programme; it's first being to power the US Navy's Littoral Combat Ship Freedom class.

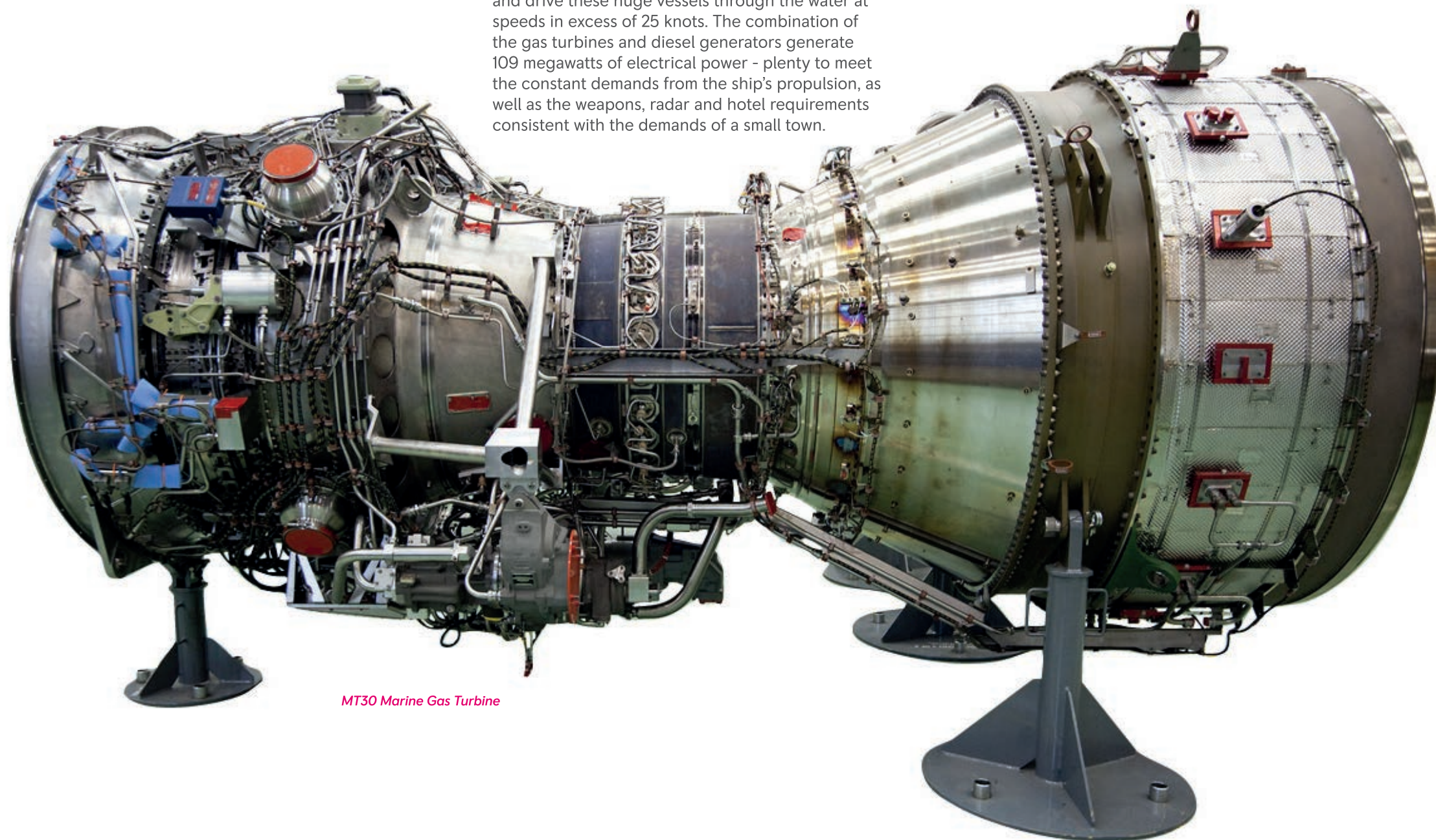
Having such powerful gas turbines available was unprecedented in the marine environment in 2004. If you consider the two WR-21 marine gas turbines which power the Type 45 integrated electric propulsion system – it would take six or seven WR-21s to provide the power required for the Queen Elizabeth Class aircraft carrier. This reduction in the number of gas turbines delivered huge design benefits to the ship and was made possible by the advancements in marine gas turbine technology.

Through this innovative electrical propulsion system arrangement, the MT30 gas turbine alternators provided the power needed to turn the propellers and drive these huge vessels through the water at speeds in excess of 25 knots. The combination of the gas turbines and diesel generators generate 109 megawatts of electrical power - plenty to meet the constant demands from the ship's propulsion, as well as the weapons, radar and hotel requirements consistent with the demands of a small town.

The MT30 marine gas turbine has been specifically designed for 21st century naval ships. It surpasses its predecessors in that it packs a mighty punch of power and uniquely guarantees that power throughout the life of the ship. This is important for the QEC programme with a 50 year service life expectancy; a guarantee that the engine will be able to deliver the power demands of tomorrow such as increasing requirements from upgrades to weapon and radar systems.

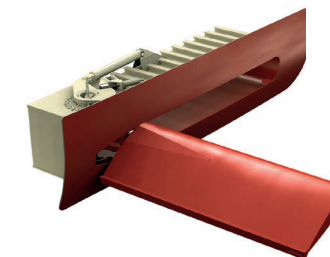
In addition to the marine gas turbines, both the shaftlines and the two enormous nickel aluminium bronze propellers were provided by Rolls-Royce in Sweden.

At almost seven metres diameter and weighing in at a massive 33 tonnes each, they combine to deliver up to 80MW of power into the water – enough to power 50 high-speed trains.



MT30 Marine Gas Turbine

Sixty-Six Tonnes of Propellers per Ship



Neptune stabilisers

LV distribution system



These are the most powerful propellers ever to have been produced by Rolls-Royce AB.

Rolls-Royce also supplied the thrust blocks, shaft brake, bearings, shaft seals, steering gear and rudders as well as the stabilisers which perform the essential role of steadying a ship during various operations such as refuelling or during the launch and recovery of aircraft.

Our Electrical team also made a massive contribution, supplying the low voltage electrical distribution system that delivers the electrical energy supplies throughout the vessel. For each ship, this consists of 13 main switchboards, 34 electrical distribution centres, 27 group starter boards and 415 distribution panels. This system distributes enough electricity to power the equivalent of 5,000 family homes.

Rolls-Royce also designed and provided the Heavy Replenishment at Sea reception points which allows the aircraft carriers to receive loads containing ship consumables such as munitions and food in conditions of up to Sea State 5 for up to six tonne loads.



A retractable sliding highpoint is located at each of the hangar deck lift openings and incorporates a variable speed electric drive. They are retracted up into the hangar deck when not in use to allow clear movement of aircraft from the hangar deck onto the aircraft lift.

How did this significant project impact the Rolls-Royce team?

For Rolls-Royce, this was a massive scope of supply. It has been such a significant programme for us. The Queen Elizabeth Aircraft Carriers will be the flagships of the Royal Navy for the next 50 years and will travel the globe many times in that role, representing this country and our allies.



The size, the power, the importance of these vessels and the external interest in them has made this an interesting and exciting programme to be involved in.



F-35B Lightning II

The size, the power, the importance of these vessels and the external interest in them has made this an interesting and exciting programme to be involved in.

It has touched hundreds of our naval employees throughout the term of the programme; from Bristol to Newcastle, Portsmouth to Dunfermline and across to Sweden and Norway. The programme has enjoyed a high degree of visibility extending across and upwards within Rolls-Royce.

We're always extremely proud to be involved in delivering capability to many great ships world-wide, but to have the responsibility of powering your very own nation's flagships, the largest ships ever built for your nation's navy, it just brings a different dimension to that sense of pride – you really feel privileged.

This is what has made this programme so special to us.

For the team in Bristol, where I am based, the MT30 gas turbine alternators have been a particular focus. The 11th, 12th, 13th and 14th MT30 engines built were delivered to the QEC programme. We have just delivered our 50th engine to an international customer, which demonstrates how successful MT30 has become.

HMS Prince of Wales is now affiliated with the City of Bristol and MT30 is assembled and tested here. This will enable us to maintain a close relationship with the ship and her crew and we look forward to hosting them on-site at Rolls-Royce in the future.

For the Portsmouth Electrical Automation and Control team, the switchboards and electrical equipment filled the old Cosham workshop for years.

We should not forget the teams in Sweden, Norway, Dunfermline and Newcastle who are now part of Kongsberg, but have continued to support the commissioning and sea trials of HMS Prince of Wales, without missing a beat. They will also continue to support the vessels in-service.

We know we've created a legacy for those that come after us. This ship will be sailing well beyond mine and many of my colleagues' careers.

Rolls-Royce's unique LiftSystem® provides the Short Take-Off and Vertical Landing capability for the F-35B supersonic jets on-board the Queen Elizabeth aircraft



Memorable highlights

There have been many.

The installation and subsequent first light (first start once installed) of the MT30 gas turbine alternators in both vessels has to be at the top of the list. We delivered them so far ahead; they were tested here in Bristol and were then stored for just under eight years before their next re-start - the first light on the ship.

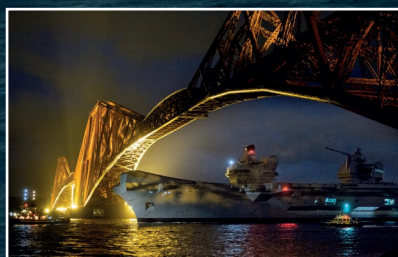
I will never forget the official naming ceremony of HMS Queen Elizabeth with Her Majesty The Queen in attendance. HMS Illustrious, one of the previous class of aircraft carriers, was also alongside and it really demonstrated the sheer scale of the new aircraft carrier. That was a very special day for us all. I remember the event being streamed to industry sites around the country so around 300 of our people in Bristol and Portsmouth were able to watch it live and share in the celebration. We've never experienced anything like that before or since.

The flooding up of HMS Queen Elizabeth and seeing her in the water for the first time was a real milestone. Then that was followed by the pictures of her passing under the Forth bridges under her own power - all three of them!

The diagnosing of and carrying out the repair to the starboard propeller after it developed problems was all completed within a matter of days during Queen Elizabeth's sea trials allowing her to quickly resume her testing schedule. This was a great opportunity for our team to demonstrate their responsiveness to operational issues.



Her Majesty The Queen takes the salute at the commissioning of HMS Queen Elizabeth.



I am also extremely proud of the critical reliability, responsiveness and performance of the MT30s during the power and propulsion integration testing and sea trials on both ships and this has frequently been acknowledged by the Royal Navy crew.



HMS Prince of Wales

The commissioning of HMS Prince of Wales fills me with pride to have been involved in this programme from drawing board, through CGI realisation and build, to seeing the ships in-service with the Royal Navy.

But particularly, it has been the privilege of working with a group of professional, talented and hugely dedicated people, not just across Rolls-Royce but also across the Sub-Alliance and Main Alliance, many of whom have been involved in the programme since the very beginning. It really has been an memorable experience for all the members, not just for Rolls-Royce.

The Sub-Alliance ethos has really been at the very core of the programme and it has enabled us to successfully overcome any number of hurdles throughout the project. It's like leaving your parent company and joining a new one all focussed on the same objective. The ethos really brought people together which enabled such a successful delivery.



Once HMS Prince of Wales is formally handed over to the Royal Navy on Vessel Acceptance Day after the commissioning, she will then come under the Marine Systems Support Partner (MSSP) contract, run by Babcock, alongside her sister ship HMS Queen Elizabeth. For Rolls-Royce, this means that we will continue to support all of this equipment on the vessel through our MSSP contract with Babcock, but my remit ends here as the project will transfer to our Naval Fleet Services team.

Seeing an important programme like this through from drawing board to in service warship is incredibly rewarding even if it does make me feel rather old given the timescales involved! But it is programmes like this, and particularly the people involved, that make this job so enjoyable and fulfilling.

A job well done!



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