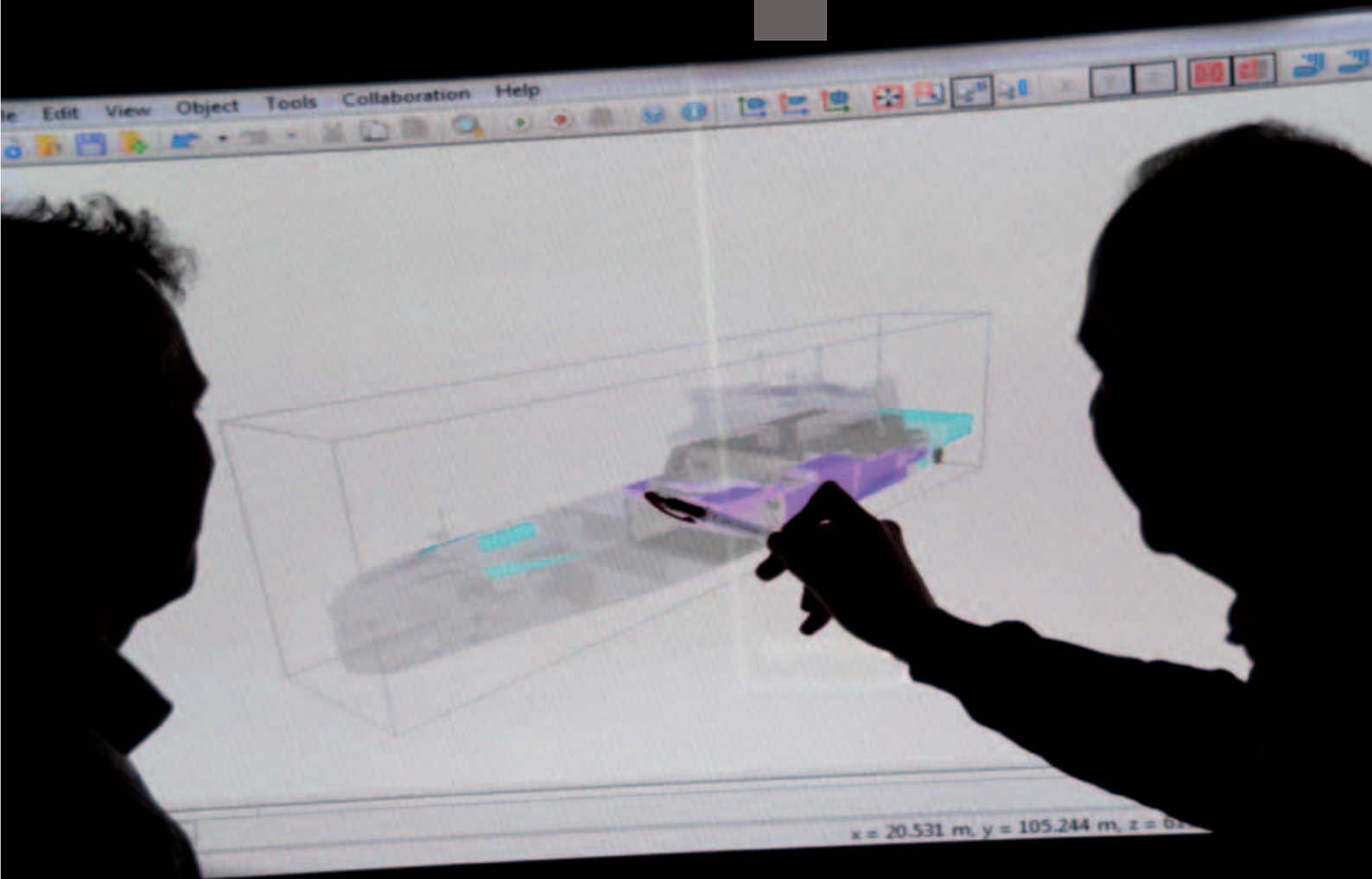




Rolls-Royce

in-depth

issue
19
2013



**INNOVATIVE
NAVAL SHIP
DESIGNS
INTRODUCED**

**LNG FUELLED VESSEL
DELIVERIES CONTINUE**

**ALUMINIUM WATERJETS FOR
EFFICIENT PROPULSION**



Natural Gas A new direction for marine propulsion

Good for the economy. Better for our environment. Natural Gas is the clear choice of fuel to power an energy-efficient, sustainable world.

Rolls-Royce gas engines reduce fuel costs and cut emissions to levels that comply with future environmental regulations.

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Now is a great time to chart a new course towards a cleaner, more sustainable future. Now is the time to switch to gas powered propulsion systems.

Better power for a changing world



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New naval ship designs are now being developed by Rolls-Royce for a range of applications that include patrol craft and logistics vessels. See page 8.

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EVENTS / 2013

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30-2

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OCTOBER

9-11

International Workboat Show

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9-11

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Aalborg, Denmark

22-25

Kormarine

Busan, Korea

NOVEMBER

5-8

Europort Maritime

Rotterdam, The Netherlands

DECEMBER

3-6

Marintec

Shanghai, China

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MARINE PRODUCTS AND SYSTEMS POCKET GUIDE



For your own copy of our new guide, scan this code or visit the link below

http://www.rolls-royce.com/marine/news_events/product_catalogue.jsp



Azipull thrusters power ZeroCat 120

A double ended ferry now on order will operate solely on battery power. Rolls-Royce hydrodynamics expertise and Azipull thrusters contribute to making the vessel efficient enough for this to be practical.

Norled has won the 10-year contract to operate ferries on the Lavik - Oppedal route across Sognefjord in Norway that forms a link in the E39 highway. From 2015, three ferries will serve the route; one of them

Brazilian shipowner orders oil spill

Two UT 535 E Oil Spill Response Vessels (OSRV) designed by Rolls-Royce have been ordered by Brazilian shipowner Asgaard Navegação S.A. The ships will be built by Aliança S/A Indústria Naval e Empresa de Navegacao, a subsidiary of Fischer Group. Delivery is scheduled for 2015 and the contract includes an option for two additional vessels.

They will have as their primary role the containment and clean up of oil spills in open waters, but will also have a secondary platform supply capability.

Each vessel carries a powerful 12m workboat in special davits. Once launched at a floating oil spill, it deploys one end of a floating oil boom on the mother ship in a U-shaped loop around the spill. Both vessels then move ahead to corral the spill in the boom. Then a skimmer equipped with its



The UT 535 E can remain on site for extended periods, carrying out oil skimming operations.

own propulsion and steering moves through the oil, pumping it to tanks on the OSRV. The boom has a high freeboard to stop oil being washed over it – even in rough seas.

Unlike typical North Sea practice, the



the innovative ZeroCat 120 battery ferry, designed and built by Fjellstrand, the other two conventional diesel engined ferries.

ZeroCat 120 will have space for 120 passenger cars or an equivalent mix of

The hull and propulsion system design of the ZeroCat 120 draw their inspiration from collaborative work done by Rolls-Royce and Fjellstrand more than a decade ago.

cars and heavy vehicles, and up to 360 passengers. Transit time across the fjord is 20 minutes, with ten minutes at the linkspan at each end. This departure frequency demands a service speed of 10 knots. Norled and Fjellstrand worked closely together to develop a ferry design whose energy requirements were low enough for a reasonably sized battery pack weighing about ten tonnes to provide the necessary energy for propulsion and all onboard services.

Two Azipull thrusters, mounted at each end of one hull and fitted with efficient slow turning propellers, are sufficient to drive and manoeuvre ZeroCat. The other hull only supports load. Both hulls are optimised to reduce drag, so the power requirement is as low as possible.

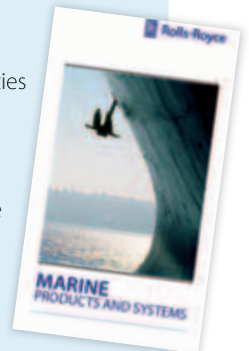
On the Lavik - Oppedal route, the villages at each end are served by a rather weak electrical grid, so a conventional charge is not possible in the time available during turnaround. Additional battery packs ashore will be used to rapidly recharge the ferries' batteries. They in turn will be recharged at a slower rate, so cutting demand on the grid.

Marine products and systems pocket guide

Rolls-Royce has a world leading range of capabilities in the marine market, encompassing vessel design, the integration of complex systems and the supply and support of power and propulsion equipment.

Today, the Rolls-Royce marine product range is one of the broadest in the world. This diversity means it is not always easy for customers to quickly get a clear understanding of what we can supply. We have therefore produced a product and systems guide. It provides a comprehensive top level view of our products and systems, together with their specifications, in an easy to use booklet.

To receive a copy, register at www.rolls-royce.com/marine/news_events/productcatalogue.jsp or scan the QR code on the previous page and we will be pleased to send the guide to you by return mail.



response vessels

UT 535 E has a limited capacity for recovered oil and does not transport it to land. Instead, the vessel acts as a buffer store and processor. Oil is heated in its 750m³ tanks to ensure it can be easily transferred at sea to tankers or other vessels. This means the OSRV can remain on site for long periods, continuously undertaking oil skimming operations.

In addition to the ship design, Rolls-Royce is also providing integrated equipment packages that include MTU engines, propulsion systems and thrusters, power electrical systems, DP system, automation and deck machinery.

Aliança shipyard is owned by CBO (Companhia Brasileira de Offshore) and has previously built ten Rolls-Royce vessels for CBO's own fleet.

New draglink cranes delivery

The new dual draglink cranes from Rolls-Royce are being eagerly received by the market, the latest order being for four shipsets of cranes, two per vessel for Detroit Chile SA. They will be installed on a series of platform supply vessels being built at the Detroit Brasil Ltda shipyard in Itajai, Brazil. On delivery, the vessels will work offshore Brazil on eight-year charters to Petrobras.

Dual draglink cranes are optimised for safer and more efficient loading in harbour and on the ship's deck while at sea. The parallelogram linkage formed by the boom and the two links offers efficient vertical and horizontal load handling and a wider operating envelope than conventional cranes. The cranes being supplied to Detroit Chile SA will run on powered trolleys mounted on tracks on the vessel's cargo rails, so they can load, move and unload



Dual draglink cranes allow fast and safer loading, unloading and moving of cargo over the entire length of the main deck.

cargo safely and efficiently over the whole length and breadth of the working deck.

The dual draglink crane also won the 'Innovation Award' at the Offshore Support Journal conference this year.



The NVC 386 can transport up to 450 tonnes of live fish in cargo holds equipped with sliding bulkheads and a pressure system for loading and unloading.

Repeat order for live fish transporter

A repeat order has recently been signed for a ship developed specifically for the transport of live fish. This will be the second vessel of this type for ship owner Sølvtans AS, the world's largest transporter of live fish.

The first ship is due for delivery this year, and this latest contract also included options to build two more vessels of the same type.

"This new vessel will be built to the same specification as the first," says Monrad Hide, General Manger – Fishing Vessels. "Our innovative hull design ensures cost effective operations and fuel efficiency as well as low emissions to air and sea."

The design incorporates the latest improvements in fish welfare and fish handling. Tank capacity of 3,000m³ provides a capability to transport up to 450 tonnes of live fish. Control of the water flow and circulation in the cargo compartments was a key design priority to ensure optimal conditions for the fish.

The 76m long vessels, which are of Rolls-Royce NVC 386 design, feature an advanced diesel-electric propulsion system powered by two Bergen C25:336P diesels rated at 1,440kW, and a hybrid shaft generator which will significantly reduce energy consumption on board. Emphasis has also been placed on the living and working environment for the crew. Single cabins accommodate up to 11 people and there is a fitness centre and sauna.

The vessel ordered will be built at the Zamakona shipyard in Spain, with expected delivery in early 2014, with late 2014 and mid 2015 for the options.



Bergen Viking

Converting to LNG

Bergen Tankers has decided to convert its tanker *Bergen Viking*, built in 2007, from diesel to LNG fuel by installing gas engines from Rolls-Royce. The established shipowner has a fleet that transports chemicals and products along the long coastline of Norway.

At present *Bergen Viking* has a diesel electric propulsion system, with four diesel gensets. These will be replaced with two Bergen C26:33L6AG gas gensets, with LNG supplied from two 150m³ tanks mounted on the open deck. This will give enough fuel for about 15 days' operation.

Rolls-Royce will also supply the gas tanks and gas regulating equipment, two bunkering stations, ACON automation and switchboard conversions.

Kjell Olav Haugland, MD of Bergen Tankers, said: "For a relatively small shipowner, this represents a significant investment. However, with some financial support from the Norwegian NOx fund, we

are confident that the solution offered by Rolls-Royce will be cost efficient for us."

In Spain, Rolls-Royce has signed a memorandum of understanding with shipping company Baleària to design LNG-fuelled propulsion systems for three of Baleària's high-speed ferries that currently run on diesel.

"This is a strategic agreement for the future of the company," said Adolfo Utor, CEO of Baleària. "The change in fuels will allow us to have high speed, more competitive, vessels available and, at the same time, be more respectful to the environment, given that this fuel reduces CO₂ emissions by 25 per cent."

The project involves developing an economic and technical proposal to convert three ferries – HSC *Ramon Llull*, HSC *Jaume II* and HSC *Jaume III* to LNG fuel with Bergen gas engines. The first is a fast monohull, the other two are large wave-piercing catamarans.



LNG fuelled propulsion will be designed for three ferries.

The new Syncrolift has a docking platform 98m long and a width of 20m.

New Syncrolift® for Vietnam



The largest capacity Syncrolift® shiplift to be built in Vietnam to date, and installed as a key element of a major new shipbuilding and ship repair development at New Song Thu shipyard, was officially opened for service in June.

Rolls-Royce designed and supplied the Syncrolift, which is the eighth to be installed in Vietnam since 1968. Three more are under construction. The New Song Thu Syncrolift has a docking platform 98m long with a width of 20m, and a maximum net lifting capacity of more than 4,500 tonnes. Some 28 electric hoists rated at 210 tonnes provide the lifting power.

“New Song Thu is the most technologically

advanced shipyard in Vietnam today,” says Colonel Hai, Chairman the Song Thu Company. “We needed a state of the art shiplift with a proven track record for reliable, predictable and safe operation. Based on our 30 plus years’ experience in using Syncrolifts, the choice was a simple one, and it satisfied all of our requirements. This latest addition will enable us to provide the flexible and efficient docking services that meet the requirements of our growing customer base in the region.”

The new shiplift is the third Syncrolift installation within the Danang area. The first was built in 1968 and is still operating efficiently. The second was installed in 2000

by the same shipyard. The hoists from their existing system were reinstalled in the new and larger Syncrolift, demonstrating the unique flexibility offered by the modular Syncrolift system. The third Syncrolift will be a key tool in expanding the number of vessels that can be worked on at any one time at the yard.

“We are extremely proud to support New Song Thu as they advance their shipbuilding capabilities to a new level,” says Andrew Smith, Director Syncrolift. “We look forward to helping them to make this new venture a resounding success.”

More than 245 Syncrolifts have now been designed and supplied to 71 countries.

Patent for Environship bow

The innovative wave-piercing bow developed by Rolls-Royce for the Environship concept has been granted a patent by the European Patent Office. The new bow design reduces hull resistance in a seaway by up to 10 per cent, and Shipowner Eidsvaag AS is the first to put an LNG powered Environship into service. (See page 29)

The wave-piercing hull, with its vertical stem, has a slender, progressive entry to the water. When a wave is encountered, the cutting edge hull shape pierces through the water rather than riding over the top. This

gives less resistance, less acceleration, less bow impact and therefore a smoother ride for cargo and crew.

Compared to a conventional curved bow, the flare has been replaced with straightlined sections to allow the water to flow along the ship sides, rather than be thrown out and forward.

By stretching the waterline to the front of the bow, the waterline’s angle of entrance is reduced. Buoyancy will be moved slightly forward and the shoulder can be reduced. This gives significantly reduced resistance.



These features combine to allow for optimisation of the underwater hull for speed and resistance, without compromising the above waterline shape of the bow.

Technology



Operated by the Icelandic Coast Guard, the UT 515 L design *Thor* is a good example of Rolls-Royce ship design. It has a top speed of over 19 knots and a bollard pull of around 120t.

PHOTO Icelandic Coast Guard



Focusing on innovative naval ship and systems design

After steadily expanding its marine capabilities over the past decade and a half, Rolls-Royce has broadened the range of ship designs and systems available by creating a naval ship design 'bureau' at its Bristol, UK, base.

Listening and working with customers to provide tailored ship and system designs for the offshore and select merchant sectors is what Rolls-Royce has been doing for more than 40 years. Around 800 vessels of Rolls-Royce design have been delivered in that time. A natural evolution was to add naval ship design to the portfolio, although a number of designs have already been delivered for coastguard and offshore/fishery protection duties. The naval team is led by Garry Mills, Chief of Naval Ship Design.

Design capability is focused on four key naval vessel types – naval auxiliaries, offshore/coastal patrol vessels, fast attack craft and naval ice-breakers – and has already generated healthy customer interest.

A strong core team has been carefully recruited that incorporates senior naval architects, marine, electronic and instrument engineers, plus combat and sensor system experts. The team is set to grow further and will ultimately include niche skills such as whole-platform safety management.

“The core team will be big enough to cover all requirements for the development of the core ship and systems design, in a similar way to our Norway-based design teams,” says Mills. “For programme delivery purposes, we will bring in selected specific sub-contract skills as and when demanded by the level and type of tasks we are working on at that time.”

The naval ship design capability is also founded on the company’s strong pedigree with naval customers – providing propulsion for everything from fast patrol boats to aircraft carriers and submarines for over half a century – and also with operators whose safeguarding roles cover round-the-clock patrols of maritime assets such as fisheries and offshore fields.

“There is a growing trend of commercial marine technology crossing into naval markets as governments seek cost reduction through proven capability,” explains Mills. “Our proven commercial vessel designs provide a firm foundation. Naval vessels generally comprise many disparate and

complex technologies, and that’s what Rolls-Royce, with its broad product base, is good at – integrating bespoke whole-ship systems to minimise programme risk.”

The Bristol-based team is already working on naval auxiliaries, such as tankers and store ships. Here, the Rolls-Royce experience in designing merchant vessels fits well with the key support roles required like replenishment at sea. Rolls-Royce supplies world-class replenishment at sea systems, which feature heavily in these types of ship designs (see page 23).

Mills adds: “Interest in these types of vessels is growing. We currently have on the table a family of three designs, ranging from 20,000 to 40,000 tonnes. For applications where overall ship efficiency is vital, we are looking to use scaled versions of the award-winning Environship, which brings several ‘green’ and fuel-efficiency features together in one vessel.”

Environship-based designs incorporate the latest generation diesel or gas engine technology, the Promas integrated rudder/propeller and hybrid shaft generators to



1. Garry Mills (right) leads a team of experienced naval architects, marine electronic and instrument engineers, plus combat and sensor system experts.

reduce fuel bills and greenhouse gases, while the innovative wave-piercing bow design ensures improved seaway performance, even in rough seas. Taking these innovative technologies into the naval sector is another opportunity for operators to reduce through-life costs.

Coastal protection and offshore patrol vessels is another growing sector. Designs include power options using the MTU high-speed diesel family that are offered for smaller, faster craft through the recently formed Rolls-Royce Power Systems Holdings.

"We have produced a design for a very cost-effective multi-purpose 55-metre patrol/search and rescue/interception craft of around 500 tonnes – a scale model will be displayed at DSEI," says Mills, adding that a more capable 90m version will be on offer by the end of the year and a 75m craft in 2014.

"Larger patrol vessels will incorporate more sophisticated assets, such as aviation and RIB/USV-launch capability. We concentrated on getting the core design elements of our 'protection vessel family' in place due to the inevitable short timescales between an expression of interest and request for quotation for this type of vessel. The 55m design is generating interest and is already being evaluated for a new vessel programme."

A concept design for the fast attack craft market draws from earlier Rolls-Royce research and development work undertaken in Norway on fast ferry/container ship hullform designs. It is built around advanced propulsion capabilities within the Rolls-Royce product portfolio, including Kamewa waterjets, MTU high-speed diesels and the power-dense MT7 gas turbine.

The fourth market is for ice-breaking vessels, such as those used for research and exploration by countries with interests in Arctic and Antarctic waters. This niche role is one which Rolls-Royce can claim to be among the few companies with a proven design pedigree.

Designs for large combatants, for which the company is often a systems supplier, are firmly excluded from the Rolls-Royce naval design portfolio.

"The way we work with our customers is likely to be a major differentiator for us," says Mills. "From the outset, we proactively seek involvement on the team by engaging a customer representative with the appropriate skills and decision-making status to help us formulate the design.

"That way, we learn how the ship will be operated – which is very useful for the



PHOTO Royal Danish Navy

2. The 72m *Knud Ramussen* is one of a pair of Rolls-Royce NVC 810 vessels in service with the Royal Danish Navy for Arctic patrols.

3. A family of Logistic Support Vessel (LSV) designs uses the award-winning *Enviroship* hull form with Rolls-Royce energy-saving propulsion systems technologies.

4. The 55m MPV55 is the smallest in a new family of patrol vessel designs, others are aviation-capable 75m and 90m ships.



designer – while the customer builds an appreciation of the operational aspects of the emerging design and can feed in constructive comments that may signpost required changes early on. By engendering progressive acceptance, the design process is smoother and the overall project is executed more quickly and accurately."

The emerging designs are all based on many years of experience in designing and equipping coastguard, anti-pollution and emergency towing vessels, some for Arctic duties. The Royal Danish Navy operates two NVC 810 offshore patrol vessels – *Knud Ramussen* and *Ejnar Mikkelsen* – primarily off Greenland.

The 71.8m multi-functional vessels have a top speed of around 17 knots and are designed for a wide range of Arctic and coastal operations. Nearby, the UT 512 L *Thor* is now in service patrolling the coast of Iceland for the Icelandic Coast Guard. Rolls-Royce-designed vessels are also in

service with authorities to protect the coasts of Norway, UK, France, Spain, India and Australia.

Mills sees other advantages from concentrating on ship design.

"As we're not a shipbuilder, we don't have the business imperative of filling our yard's production capacity," he says.

"Our core skills surround power and propulsion, and very few companies have the breadth of capability that Rolls-Royce has. So we can focus on our role as a proven systems integrator, reducing a prime contractor's risk and cost. We also have the advantage of being able to team with the best shipyard partner."

But creating effective designs is only part of the equation. The team is focused on being flexible and, for specific opportunities, in-country teaming arrangements may be formulated to ensure a suitable level of local content to suit government requirements. **GA**

New applications for permanent magnet motor technology

Azimuth thrusters are the latest development in Rolls-Royce permanent magnet motor applications. Two units will soon go to sea for a comprehensive programme of testing, propelling and positioning on the research vessel *Gunnerus*.



Permanent magnet tunnel thrusters are resiliently mounted in the tunnel to minimise noise and vibration. Installation and removal can be carried out without drydocking the vessel.

With its improved power density and efficiency, permanent magnet (PM) motor technology is increasingly finding its way into marine applications.

Rolls-Royce first applied PM technology in the form of a ring around the propeller in a tunnel thruster. Around the propeller blades is a rim carrying a series of strong magnets. Outside this rim is the stator with a series of electrical windings that, when activated, create the electromagnetic force which rotates the propeller.

Calculations, verified by testing, have shown that it was hydrodynamically beneficial to have a hub where the propeller blades come together at the centre. The hub also has bearings to take the thrust and radial loads which are transferred to the thruster frame by streamlined struts.

PM tunnel thrusters

Based on previous experience, pre-production 800kW PM tunnel thrusters have been installed in *Olympic Octopus*, a UT 712 L anchor handler currently operating off Cuba, and in a test rig in Norway. Each unit has been operated intensively, including long periods at frequently varying loads and thrust directions to simulate tough dynamic positioning situations. Ice testing was the most recent phase of the evaluation programme, where large blocks of hard ice were fed into the rig-mounted thruster, subjecting it to heavy loads and the propeller blades to ice impact. These trials were a success. The thruster at sea and the test rig unit have now accumulated more than 1,800 trouble-free running hours.

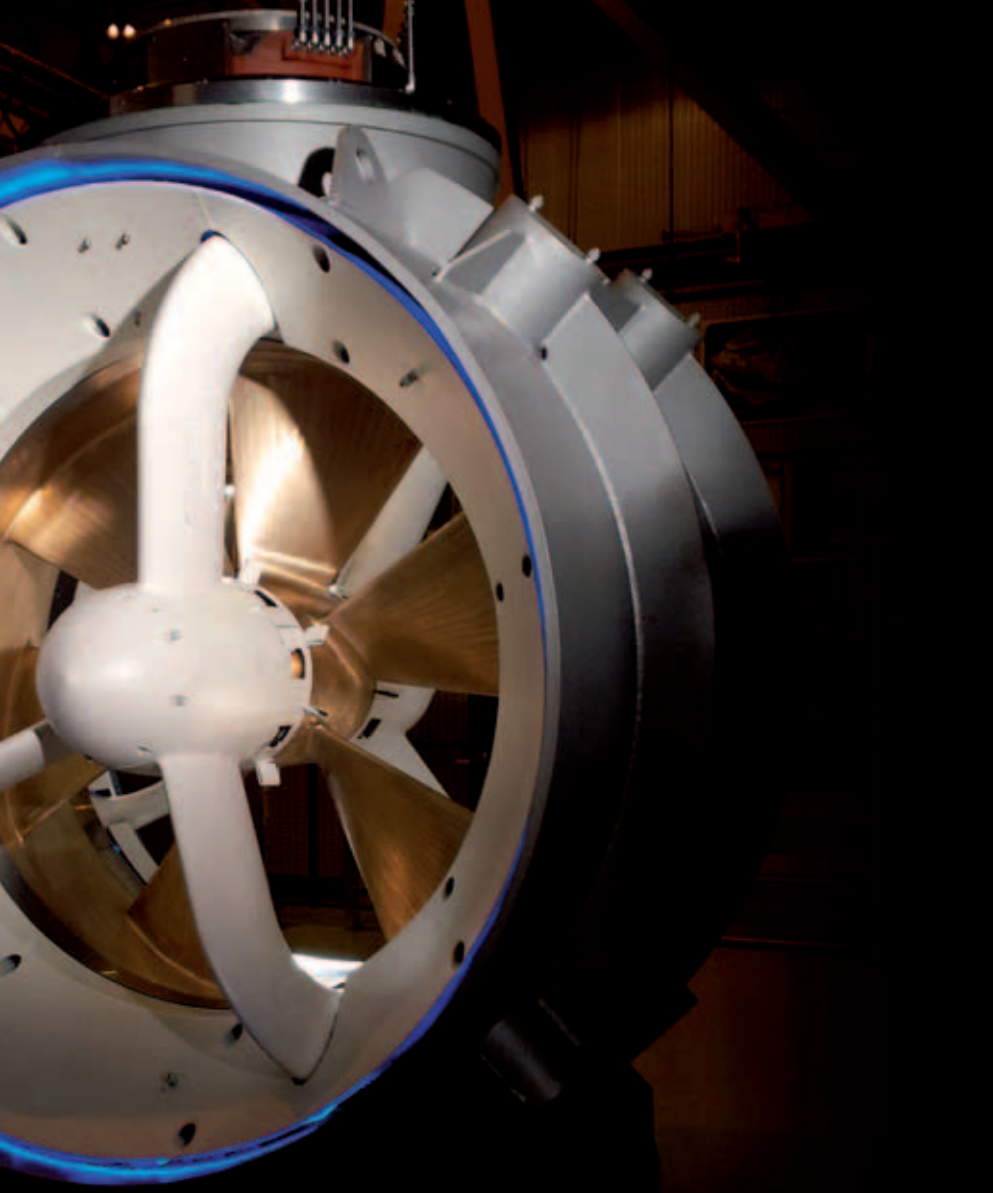
Rugged, space-saving PM tunnel thruster technology provides fast response times to full load and equal thrust in both directions – the robust centre shaft carries all propeller loads.

PM technology for quieter operation

A measurement survey has been carried out to compare the noise characteristics of a TTPM1600 thruster and a conventional geared tunnel thruster with CP propeller and electric drive, installed side by side in the centre skeg of an offshore vessel.

Results have demonstrated significant

The first size to be released is the TTPM1600 (with a propeller diameter of 1600mm) rated at 1,000kW. A larger TTPM2000 with a 1,600kW rating is also available. They have been engineered with reliability and low through-life costs as the focus, for the most demanding applications. PM technology increases efficiency and makes the installation more compact, only the variable frequency drive unit is housed in the thruster room, freeing up space on board.



Technology demonstrator PM steerable nozzles or azimuth thrusters with a rating of 500kW are being installed on the research vessel *Gunnerus*.

vibration and noise reductions. Measurements and corresponding analysis were carried out by the Noise and Vibration department of DNV (Det Norske Veritas). At a power setting of 100 per cent (800kW) the average noise levels generated by the TTPM1600 thruster were similar to those generated by the TT2000 thruster at about 30 per cent (240kW) load.

Based on these findings, rooms in a vessel's accommodation area could see a general reduction of 6-10dB(A) in noise levels at full power if a TTPM thruster was installed.

It also simplifies future maintenance as the patented resilient mounting firmly fixes the PM thruster to the tunnel in a simple procedure, which means units can be removed and replaced without drydocking. Electrical supply and monitoring cables enter the hull through a watertight connection arrangement.

PM tunnel thruster development is now being followed by a specially designed PM steerable nozzle or azimuth thruster for vessel propulsion and manoeuvring.

Noise reduction at lower powers are likely to be even higher.

For ships that operate for long periods in DP mode with bow thrusters directly below the living quarters, or cruise ships, there could be significant advantages.

TTPM thrusters may give ship designers freedom to cut out some of the expensive insulation usually needed to reduce the impact of structure-borne noise, saving costs while improving crew and passenger comfort.

PM azimuth thrusters

PM tunnel thruster experience is now being applied to azimuth thruster development. The first units to be constructed will have a rating of 500kW to match the test vessel's available power, but the propeller diameter is generous for the loading, so a thruster with the same diameter propeller and motor can handle up to 1,000kW. Two technology demonstrator PM azimuth thrusters are to be installed in an existing vessel, the research ship *Gunnerus*.

Gunnerus is owned and operated by

NTNU, the Norwegian University of Science and Technology based in Trondheim. The 31.25m-long vessel is equipped to carry out research in the fields of biology, technology, geology, archeology, oceanography and fisheries, and as such is an asset to many of the courses offered by NTNU.

Under a multi-partner agreement Rolls-Royce will be the lead partner, with NTNU as shipowner and operator. Other partners are Marintek, DNV, Olympic Shipping and the Technical University in Ålesund.

The *Gunnerus* has diesel electric propulsion in a traditional twin screw and rudders arrangement. It will go to Moen Slip in Norway for the conversion work to be carried out, and the PM thrusters installed. Polarconsult is designing the hull modifications required to accept the thrusters and the additional forces.

Each PM azimuth thruster has three main assemblies:

- PM motor/propeller/nozzle underwater unit
- Hull mounting system, with azimuth bearing and steering gear
- Inboard slip ring unit for the electric power feed.

The PM motor is built into the nozzle. Nozzle profile can be selected to suit a particular application – in this case, it is optimised for bollard pull to match the vessel's operations. In other respects, the azimuth thruster uses the same technology as the PM tunnel thrusters.

Developments are now underway for PM technology to be applied to swing-up azimuth thrusters. **RW**

Rolls-Royce is one of the pioneers in the marinisation of aero gas turbines for naval propulsion, an expertise that can trace its development back to the early 1950s.

The company has retained this niche since then, transforming propulsion systems predominantly in patrol boats and naval vessels. Space and weight constraints, the need for speed and the ability to maintain that speed for long periods – together with the utmost reliability – have been the key drivers behind their selection.

Rolls-Royce gas turbines also powered the world's largest hovercraft, the SRN 4, during the 1960s and 1970s. The company has recently re-entered this market with the selection of the MT7 to power the US Navy's future fleet hovercrafts, known as the Ship-to-Shore Connector (SSC).

Rolls-Royce is working with Textron Marine & Land Systems, an operating unit of Textron Systems, a Textron Inc company, which has been selected to build the initial development craft, in a programme that could extend to 73 craft. The SSC will replace the US Navy's current fleet of Landing Craft, Air Cushion (LCAC) hovercraft over the next 20 years. The new hovercraft will be used to rapidly deploy personnel, vehicles and equipment between US Navy ships and the shore.

The MT7 will provide both propulsion and lift and will deliver an increase in power of 25 per cent, compared to the previous generation engines, enabling each craft to transport up to 74 tonnes of cargo at speeds over 35 knots. At the same time, the engine will improve fuel efficiency by 11 per cent.

The greatest strength is the MT7's heritage. It is derived from the AE1107 aircraft engine, which already powers the US Marine Corp's Bell Boeing V-22 Osprey tilt-rotor aircraft. In fact, it retains more than 90 per cent component commonality with the aero parent. Only minor variations from the AE1107 are required for the SSC application including a new engine controller, bleed system and power take-off shaft to suit the requirements of the hovercraft. Rolls-Royce will work with Textron Marine & Land Systems, which is developing the SSC hovercraft to design the intake and exhaust architecture as well as the mounting system to suit the needs of the installation.

"The AE1107 is the ideal choice for several reasons," says Paul Jones, SSC Programme Manager. "The marinisation of an aero gas turbine will normally require some special blade coatings so the engine can

Rolls-Royce has added a new marine gas turbine – weighing just 441kg it is the most power-dense engine in its class. Producing 4-5MW of power with significant improvements in fuel consumption over former designs, it has been selected by Textron Marine & Land Systems to power the US Navy's next generation hovercraft.

PHOTO US Navy



Introducing the MT7 marine gas turbine

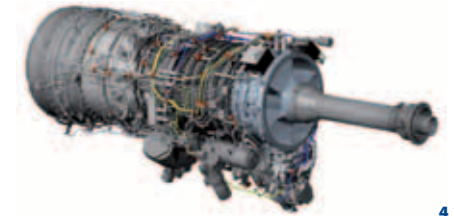


1. The US Navy's current fleet of Landing Craft, Air Cushion (LCAC) hovercraft shown here, will be replaced with the SSC hovercraft over the next 20 years.

2. The engine is a member of the successful AE family of aero engines that have accumulated more than 52 million operating hours.



PHOTO Textron Marine & Land Systems



3. MT7 gas turbines have been selected to power the US Navy's new Ship-to-Shore Connector hovercraft.

4. The MT7 shares proven common core architecture with the AE1107C-Liberty aero engine that powers the V-22 Osprey tilt-rotor aircraft.

withstand the maritime environment. But the Osprey is designed to fly from ships and has accumulated some 170,000 operating hours, including time spent in Afghanistan, so development risk is minimised. For the AE engine family, total operating hours now exceed 52 million. The MT7 will undergo endurance testing to become type certified to American Bureau of Shipping (ABS) Naval Vessel Rules (NVR)."

The twin-shaft axial design of the MT7 comprises a 14-stage compressor followed by an effusion-cooled annular combustor, a two-stage gas generator turbine and a two-stage power turbine. The engine is cold-end drive, featuring six stages of variable compressor vanes, dual channel Full Authority Digital Electronic Control system (FADEC), modular construction and an 'on-condition' maintenance capability. Fuel and oil systems are fully integrated on the engine assembly, making it a compact, lightweight yet powerful unit.

US Navy ships that carry the SSC hovercraft will also deploy V-22 Ospreys and having a common engine type will bring significant in-service benefits. Spares holdings can be rationalised and maintenance training for those on board is simplified.

The aircraft engine has a fully developed suite of component repairs, special tools and technical publications, all of which can be used for the MT7. Training on the engine can be conducted at the Rolls-Royce customer training facility in Indianapolis, with a stream of experienced operators and maintainers. If contracted by the Navy to provide engine

training, Textron Marine & Land Systems can draw on these resources to launch the new fleet of hovercraft into service with well-trained personnel.

As the Rolls-Royce AE engine family powers a range of aircraft – including the Lockheed Martin C-130J transport, the Northrop Grumman RQ-4A Global Hawk, the Cessna Citation business jet and Embreair's ERJ 145 – field-proven AE upgrades exist today. These could increase the MT7 available power by up to 20 per cent or extend engine life. This power growth capability can accommodate larger payloads or realise life cycle cost savings, making the MT7 the engine of choice in its class.

The contract award is for the supply of engines for the SSC development programme, four per hovercraft, which are scheduled for delivery to Textron Marine & Land Systems in 2015. The first test craft should begin trials in 2017 and become operational in 2020.

MT7 is also well suited to other naval applications and a variety of system configurations offering ship designers and builders increased flexibility, in terms of propulsion system layout, can be configured for either mechanical or electrical drive.

The MT7 is the latest Rolls-Royce gas turbine to be selected to power a major US Navy programme, and follows the MT30 which is already powering the Freedom-class Littoral Combat Ships and will provide the electrical power for the DDG-1000 Zumwalt-class destroyers. **AR**



A typical Promas newbuild installation, showing the twisted rudder.

Proven fuel efficiency gains

Promas installations have been specified for a variety of recently ordered vessels as shipowners improve fleet efficiency.

Two car and truck-carrying (PCTC) vessels being built for Neptune Lines in Japan will have Promas integrated propulsion systems, after tests showed additional efficiency gains.

The vessels are being built by Hyundai Mipo Dockyard, and HMD has signed an agreement with Rolls-Royce for further model testing of Promas to evaluate its suitability for other vessel designs.

Viking Cruises recently ordered two cruise ships from Fincantieri in Italy, with delivery scheduled for 2015 and 2016. Promas systems have been specified for these vessels – the first time that Promas has been ordered for cruise ship newbuilds.

“Our highly efficient Promas system demonstrated outstanding performance during tank testing,” reports Neil Gilliver, President-Merchant. “The installation during newbuilding will enable Viking Cruises to benefit from the start.”

Upgrades

To date, 15 cruise ships and ferries have been upgraded with Promas Lite systems. Installation is normally carried out during routine drydockings, with a prefabricated bulb welded on the existing rudder. Fuel savings provide a relatively short return on investment.

The latest order is part of a technical upgrade of Germany-based AIDA Cruises Sphinx series of cruise ships.

AIDA Cruises, part of the Carnival Group, will install Promas Lite on its *AidaSol* cruise ship during drydocking in December.

Announcing the contract, Andy Marsh, President-Services, said: “We are pleased to welcome AIDA Cruises into the group of leading cruise operators that have selected this relatively simple upgrade to significantly reduce operating costs.”

The latest version of the proven Promas system offers fuel savings and increased bollard pull for offshore vessels, tugs and fishing boats.

Promas+nozzle for efficient high bollard pull applications

Promas is a well-established Rolls-Royce propulsion system that integrates the open-water propeller and rudder of a conventional shaftline into a hydrodynamically efficient system with improved manoeuvrability.

A tapered hubcap is fitted to the hub of the propeller that streamlines the water flow on to a bulb which forms part of the spade rudder, effectively reducing flow separation immediately after the propeller.

The rudder has a twisted leading edge, optimised for the flow from the propeller, which converts into additional forward thrust some of the swirl energy in the slipstream that is normally lost. Promas installations on merchant vessels have given propulsion efficiency improvements of up to 6-8 per cent on newbuildings, and up to 15 per cent when fitted as an upgrade on existing vessels.

High-efficiency propulsion

Building on this success, Rolls-Royce has further developed the Promas system to suit

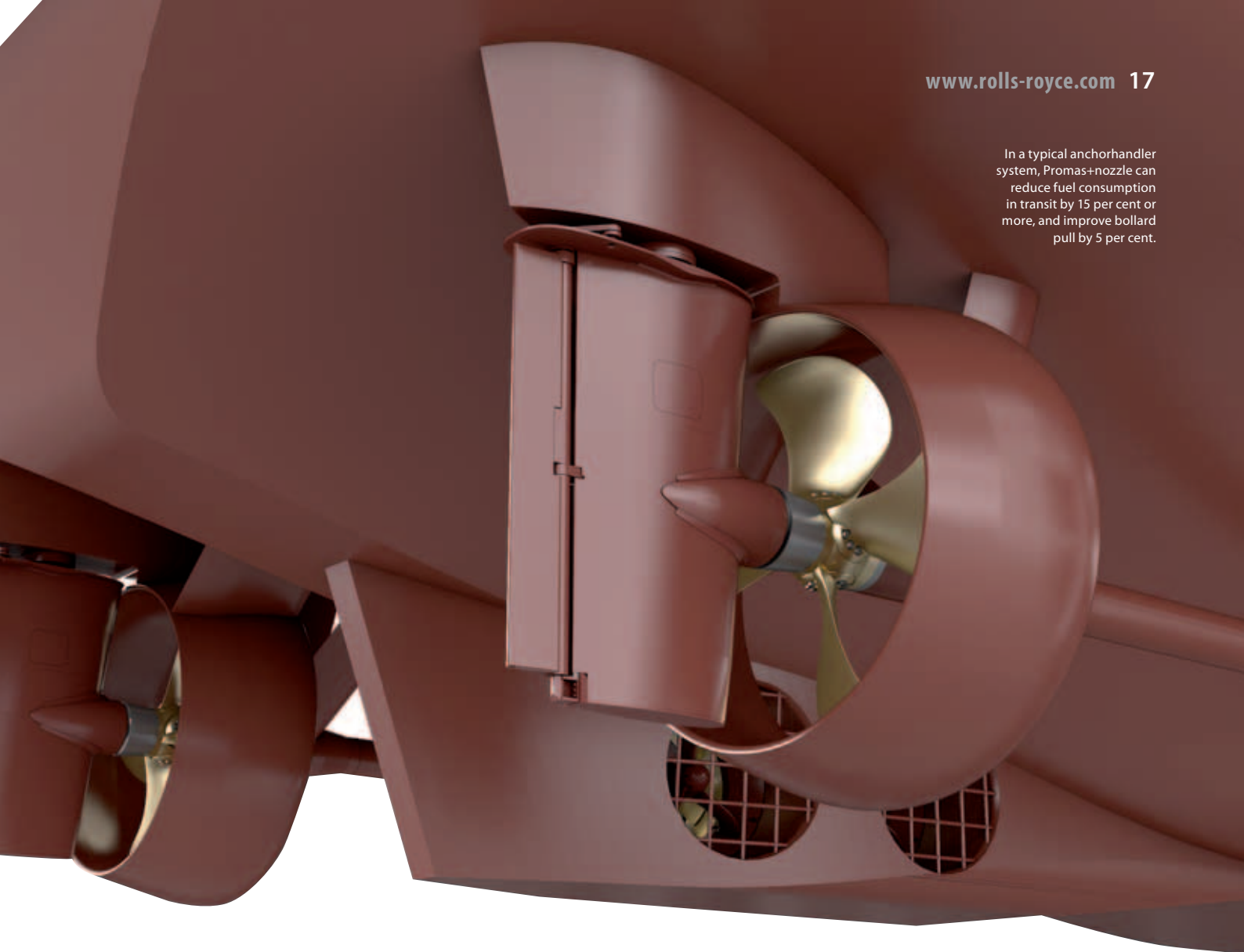
applications where there is a requirement for a high bollard pull, such as anchorhandling offshore vessels (AHTS), tugs, seismic survey ships and fishing vessels. Here, the requirement is usually for a large pulling power at low speed and also a high free-running speed in transit. This is a different operating profile from a merchant vessel or cruise ship, which will tend to run for long periods at a steady transit speed.

The Promas+Nozzle system is designed for these varying operating modes, in the case of anchorhandlers offering an increase in propulsion efficiency in both modes. The complete AHTS installation comprising Promas with nozzles and optimised propellers and rudders can reduce fuel consumption in transit by 15 per cent, in some cases more, with a consequent cut in emissions, and improve the bollard pull by typically five per cent.

New nozzle design

This system unites a new type of nozzle with an optimised propeller, hubcap,

In a typical anchorhandler system, Promas+nozzle can reduce fuel consumption in transit by 15 per cent or more, and improve bollard pull by 5 per cent.



rudder bulb and a special rudder profile. Components are designed to work together to provide a ducted system, maximising efficiency and minimising disturbances to the water flow both through and around the nozzle. The profile of the nozzle for

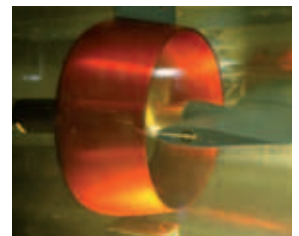
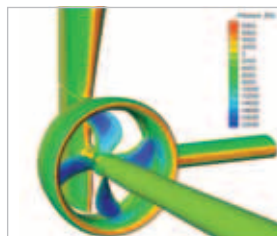
the new system has been developed through CFD analysis and testing, and represents a major advance on the profile which is widely used for conventional nozzle propeller installations.

Water flow leaving the nozzle interior

passes over a rudder of special profile developed to provide very high steering side forces yet minimise drag. Depending on the exact requirements the rudder may be either a one-piece design or a medium flap type. **RW**



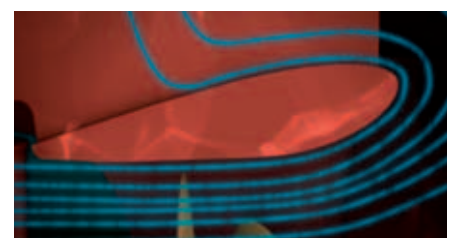
Rudders of a special profile have been developed to provide high steering side forces with minimum drag, either of a one piece or medium flap-type design.



CFD calculations have been confirmed by tank testing with large-scale models (centre) and at the Rolls-Royce Hydrodynamic Research Centre (right).



The Promas nozzle in a free-running situation, showing the profile controlling the water flow to minimise drag.



In towing condition, showing the vortex-free flow into and around the nozzle that improves thrust.

Project Focus

Queen Elizabeth is taking shape

Work on the first of class, *Queen Elizabeth*, is progressing to programme at Rosyth's No 1 Dock near Edinburgh, Scotland.

With a complete flight deck and both islands in place, *Queen Elizabeth* is now clearly recognisable as the aircraft carrier that will be at the centre of the Royal Navy for decades to come.

Work Safely! Then Welcome Onboard





With just a few sections now remaining to be assembled, the ship platform is firmly on schedule to be physically complete inside Rosyth's No 1 Dock in Scotland by the end of this year, and Rolls-Royce has been playing a significant role.

A major milestone in the build of the aircraft carrier *Queen Elizabeth* was achieved at Babcock's Rosyth dockyard in late June when the ship's aft island was lowered into position on board, following delivery from BAE Systems' Govan yard on the Clyde.

The Queen Elizabeth Class (QEC) programme entails the design, construction, integration, commissioning and test of two 65,000-tonne aircraft carriers, *Queen Elizabeth* and *Prince of Wales*, for the Royal Navy. The programme is being delivered by the Aircraft

Carrier Alliance (ACA), a groundbreaking arrangement between industry – BAE Systems, Babcock and Thales UK – and the Ministry of Defence (acting as both partner and client).

As Sean Donaldson, Babcock's Warship Programmes Director & General Manager, explains: "The QEC programme is one of the largest construction projects in progress in Europe at the moment. But it's also a truly national endeavour, with the three companies working in an alliance with the Ministry of Defence.

"The ships themselves are assembled from large hull blocks and sponson sections fabricated at six yards around the UK – here in Rosyth, on the Clyde, in Birkenhead, on Tyneside, at Appledore in North Devon, and in Portsmouth – that have been transported to Rosyth for consolidation and integration.

"But of course, it is far more than just joining up the steelwork. The build programme must also integrate machinery, systems and components being supplied from the wider supply chain across the UK. Nationwide, it is employing about 10,000 people."

The ACA has been structured to ensure that all partners take collective responsibility for the project. But, according to Donaldson, it has evolved into something greater than just a business arrangement.

"This alliance was established as a contracting strategy drawing on commercial models previously used in the North Sea oil and gas industry.

"But, in fact, it's developed into far more than that. I'd describe it as a way of working, pulling together companies that have unique skills and capabilities so as to

best use those skills for the benefit of the programme.”

Rolls-Royce is playing its part in the QEC programme as part of a Power and Propulsion Sub Alliance with L-3 Marine Systems UK, GE Power Conversion, and Thales UK (the latter acting on behalf of the main ACA). Collectively, the four companies are responsible for the design, procurement, manufacture, integration, test and delivery of all the equipment that will ultimately power and drive the ship.

In terms of QEC’s scope of supply, Rolls-Royce has supplied a comprehensive range of propulsion equipment and systems from a number of manufacturing sites. This includes MT30 gas turbines, adjustable bolted propellers and shaftlines, bearings and thrust blocks, steering gear and rudders, retractable stabilisers and the low-voltage electrical system.

Donaldson has been impressed with the company’s performance to date.

“Delivery, as you would expect from Rolls-Royce, has been right on time,” he observes. “But what has also stood out is the way in which the company has contributed to the overall team effort. That was very much in evidence when we lifted and installed the gas turbines on board *Queen Elizabeth* earlier this year.”

Developing 36MW apiece, the two MT30s will deliver around two-thirds of the electrical power generated on board.

Each MT30 has been integrated as part of a gas turbine alternator (GTA) weighing a total of 120 tonnes (including the alternator and gas turbine enclosure). The two GTAs, assembled by Cullums Detuners in Derbyshire, are sited in sponsons high up on the starboard side of 4 Deck.

Installation on board involved the lifting of each MT30 gas turbine and ancillary equipment – housed in a steel package known as the gas turbine enclosure – on to the ship structure. With the enclosure in situ, the associated alternator was then hoisted into place.

“The Rolls-Royce team worked closely with the heavy handling team here at Rosyth to ensure the MT30s were installed as per the design,” Donaldson says. “The guys carrying out the installation and Rolls-Royce got a lot of confidence from each other, which was down to very close collaboration beforehand. Indeed, the team that engineered the seats for the GTAs had already been to the Rolls-Royce plant to ensure everything was exactly as it needed to be, in an engineering sense.”



Looking forward, Donaldson does not underestimate the challenges that will be faced in *Queen Elizabeth's* test and commissioning phase. At the same time, he is confident that the ACA has the skills and resources to deliver.

“The analogy I’d use is a relay race. Each stage of the QEC programme has been a massive challenge. For example, if you go back five or six years, engineering was the challenge. We have moved through that stage into block build. And we have moved through that phase into whole ship assembly, which we are now drawing to a close. The next progression is into commissioning, and then whole ship system integration.

“So it’s not a sprint, it’s a relay. Different teams have taken the lead at different parts of the programme. And again, that’s where

the different strengths of the companies within the Alliance come into play.”

He adds: “I think what has been achieved to date in terms of a testament for engineering endeavour within the UK is evidenced in No 1 Dock. There is not one company, no single group of individuals that has done that, but rather a massive UK effort that everyone should be proud of.” **RS**

1. The Rolls-Royce MT30 has been integrated as part of the gas turbine alternator, and removal routes trialled prior to installation.
2. The first MT30 and its enclosure arrive at the dockyard. It will be installed on 4 Deck of the carrier.
3. When complete, *Queen Elizabeth* will be the largest ship to serve in the Royal Navy.
4. Sean Donaldson, Babcock’s Warship Programmes Director & General Manager.

Updates



The rig is set up to simulate the transfer of larger payloads weighing up to five tonnes over a distance of 55m.

Safely transferring five-tonne loads at sea

With a capacity more than twice the payload of existing NATO standard rigs, the latest heavy RAS system for the UK Royal Navy builds on extensive Rolls-Royce jackstay winch experience.



Supplying naval fleets with fuel, food, stores and ammunition to keep them operational while away from port is the role of the sealift groups that support them, with their range of specialist ships and equipment. For more than 60 years, Rolls-Royce has been involved in the design and development of Replenishment at Sea (RAS) systems for the UK Royal Navy and the Royal Fleet Auxiliary (RFA), and has also supplied similar equipment to a number of other navies around the world.

However, as warships have grown, the technology needed for RAS operations has also had to keep pace. The Royal Navy's new *QE* class aircraft carriers are the largest surface warships ever built in the UK and new systems for replenishment are required, capable of handling larger stores volumes with improved transfer rates that their greater size demands.

Under contract from the UK Ministry of Defence, Rolls-Royce has designed and built a new Heavy Replenishment at Sea (HRAS) land-based demonstrator at HMS Raleigh in the UK south west. Rolls-Royce is now carrying out trials to prove the HRAS system, as well as working on the joint development of safe operating procedures for the equipment that will be fitted to the next generation of Royal Fleet Auxiliary supply ships.

The HRAS system is designed primarily for the *QE* class carriers and is capable of transferring loads of up to five tonnes when transiting at 10-14 knots, with a requirement of being able to transfer 25 loads per hour for up to five hours in sea-state 5 – which equates to a 4-5m swell with up to 30-knot winds.

The weight requirement has been set around the engine module of the F-35 Joint Strike Fighter, but another target weight is the maximum weapons load. Key to the system is the automatic-tension jackstay winch and drive, which keeps the jackstay wire at the correct tension without breaking or slackening as the two ships roll towards or away from each other. To cope with these loads, the main jackstay line is tensioned to 18 tonnes, whereas the current two-tonne RAS rig requires a tension of eight tonnes. The main jackstay winch uses two 455kW AC motors to maintain tension.

"Our objective is to prove the system before putting to sea. It could have been done in many ways, but by building this land-based demonstrator, we also provide a training facility that should be operational for at least 25 years, offering a greater value proposition for our UK MoD customer," says

Matt Nadin, Head of Naval Programmes.

Steel structures which represent the receiving stations for a carrier, a Type 45 destroyer and a Type 23 frigate, and a working Type 23 ship's bow structure to teach wider seamanship skills, were all built locally to ship standards by A&P Marine, Falmouth.

Rolls-Royce designed the main delivery platform, which has a 25m steel supply mast, with control rooms on either side that fully replicate those on RFA vessels. The platform at the base of the mast simulates the deck of the supply ship. It can mimic sea-state 5 conditions through a hydraulic motion simulator, governed by winches and motors that introduce slack into the tensioned jackstay, to replicate vessel roll. The distance between the simulated ships is 55m, although the average RAS operating distance is normally between 36 and 42m.

Nadin adds: "Being 55m apart is not far when a 65,000-tonne aircraft carrier is steaming alongside a 30,000-tonne RFA vessel. At that distance, it's a bit like delivering a letter through a letter box."

The solid RAS system incorporates a traveller block that carries the payload along the jackstay wire. Water cooled AC in-haul and out-haul winches control its movement. In automatic mode, the system

controls the acceleration, deceleration and stop positions of the payload, with the operator just providing the 'transfer' or 'return' commands.

"The all-electric RAS system will deliver lower through-life costs, with lower noise and vibration than comparable hydraulic/pneumatic solutions, which require more maintenance," says Russell Thompson, Head of engineering RAS/FAS.

"The three winches have been specifically designed and manufactured by Rolls-Royce for RAS operations and incorporate a slipping clutch to keep the tension within the safe working limits."

The HRAS trials are now being undertaken by Rolls-Royce service engineers. When the trials have been completed, the demonstrator will be handed over as a training facility to Defence Equipment and Support (DE&S), part of the MoD, who will then hand it over to the Royal Navy.

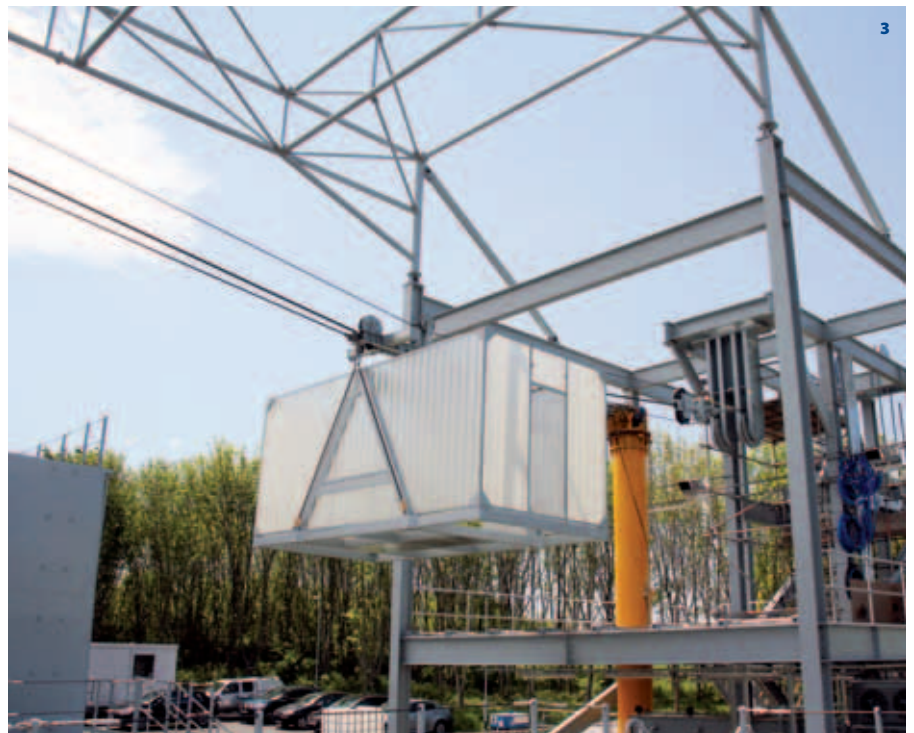
"We are pretty confident that the new facility will be of great value for up to the next 25 years," says Captain Bob Fancy, Commanding Officer of HMS Raleigh.

"We are extremely proud to have this facility at Raleigh. It is a significant investment and will become one of the most up-to-date replenishment operations in the world. It is world class." **MB**





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1. The HRAS system has been primarily designed to handle the increased weight and larger volumes of stores that will be required by the new QE class carriers.
2. View of the operator's compartment, which has a clear outlook over all operations.

3. A container approaches the end of its journey at the receiving station, which has steel structures to represent the carrier, a Type 45 destroyer and a Type 23 frigate.

Kamewa A3 series waterjets from Rolls-Royce have established themselves as the preferred propulsion system for a wide variety of vessel type – successful installations continue to grow.

Aluminium waterjets deliver on performance and reliability

Although mainly specified for new vessels from fast ferries to crewboats, there is also interest in replacing other propulsion systems with these aluminium waterjets.

Fast ferries

Kilimanjaro IV is the latest fast ferry to join the Coastal Fast Ferries' fleet in Tanzania offering high speed, high passenger capacity and rugged efficiency.

In recent trials, the 44.7m *Kilimanjaro IV* achieved a loaded service speed of 35 knots, and is capable of a top speed of 38 knots propelled by its four Kamewa 50A3 waterjets.

Coastal Fast Ferries has seen a rapid growth in demand for its passenger and fast freight services, and *Kilimanjaro IV* is the seventh vessel of this type to go into service with the company, all designed in Australia by Incat Crowther. The catamaran was built by Richardson Devine Marine in Tasmania and can carry up to 606 passengers in an economy, business and premium class layout where each class has seating in lounges in the superstructure with additional economy seating on deck.

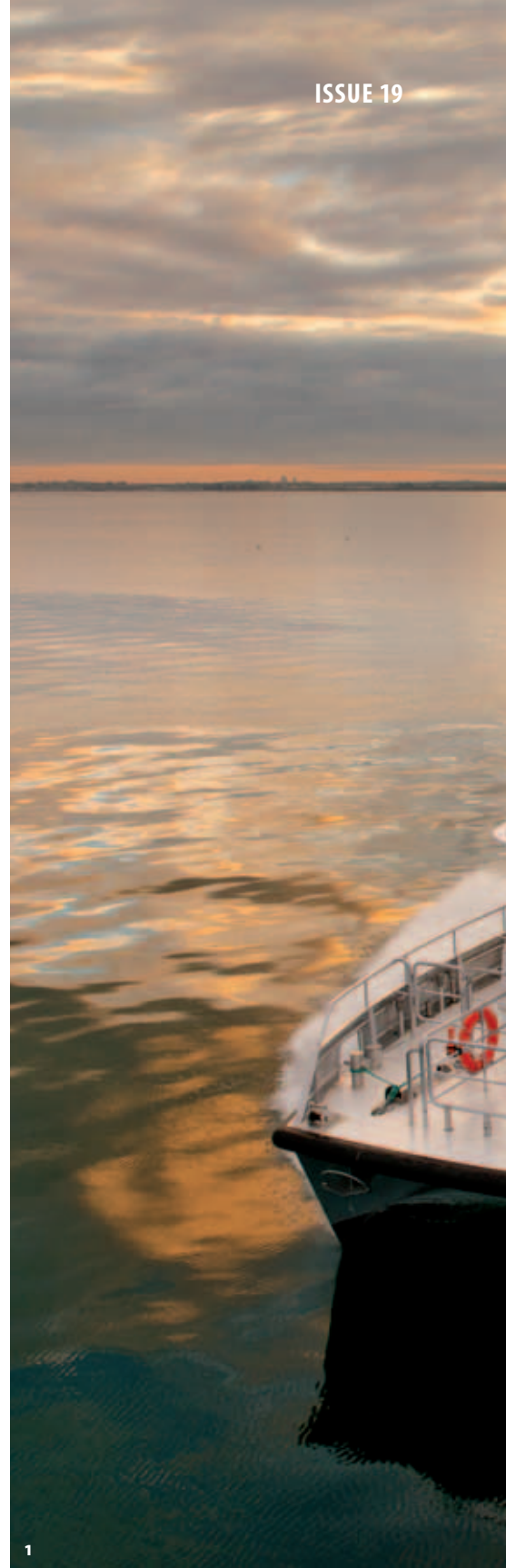
Crew transfer

Crew transfer boats are an active and developing market where waterjet propulsion provides the right performance. *Leicon CTV9* is a good example, an 18m by 6m aluminium boat designed by One2Three Naval Architects in Western Australia and built by Evolution Commercial. As time was short, the catamaran was launched less than 15 weeks after the design was started.

Leicon CTV9 will support oil and gas activities at Barrow Island off the coast of Western Australia. It is operated by a crew of two and carries 32 passengers and will be followed by a second craft of the same design.

Two 650kW diesels each drive a Rolls-Royce Kamewa 36A3 waterjet. On trials they gave a speed of 32.1 knots with full fuel and water and 16 passengers on board. The vessel achieved its contract speed of 26 knots at 65 per cent of maximum continuous rating.

The waterjet control system is positioned at the main helm and an aft docking station, which makes for pin point docking with excellent visibility from both stations.



1. The 18m *Leicon CTV9* is propelled by two Kamewa 36A3 waterjets for a service speed of 26 knots.

2. Fast ferry *Kilimanjaro IV* is propelled by four Kamewa 50A3 waterjets for a service speed of 35 knots.

3. The 24m catamarans designed and built by South Boats IOW are powered by two MTU diesels driving Kamewa 56A3 waterjets for speeds up to 30 knots.

4. Two Kamewa 40A3 waterjets give the elegant 15.2m commuter yacht a top speed approaching 60 knots.

Wind farm support

Supporting the construction and maintenance of offshore wind turbines is an active business, with Rolls-Royce waterjets playing a leading part.

A popular size is now around 24m, and catamarans provide an effective balance of speed, seakeeping and carrying capacity. A good example is a two-boat order placed by Seacat Services with South Boats IOW in southern England. One is already in service.

The 24m aluminium cats are built to DNV class and the UK MCA workboat code. The deck area is sufficient to transport three 10ft containers and other cargo. The resiliently mounted superstructure gives low noise and vibration levels and has a modular internal arrangement so it can be reconfigured to suit different projects. Rolls-Royce waterjets have again been selected, two Kamewa 56A3 units per vessel driven by MTU 12V2000M72 diesels for speeds up to 30 knots.

Commuter yacht

Kamewa 40A3 waterjets have been chosen for a distinctive yacht with a top speed approaching 60 knots. From the board of Zurn Yacht Design in Marblehead, and built by New England Boatworks in Portsmouth, *Rhode Island*, the 15.2m commuter yacht has something of the style of the classic New England lobster boat, but a modern specification and a simple but elegant interior. The hull is of epoxy/glass/foam core construction for strength with light weight, and two high-speed 1,150kW diesels drive the twin Rolls-Royce waterjets.

Upgrading

While most waterjets are supplied for newbuilds, they can also be installed in existing vessels, replacing propellers. A current project is to remove the propellers, shafts and rudders from the fast catamaran passenger ferry *Trondheimsfjord 1* and replace them with a pair of Kamewa 50A3 waterjets and the Rolls-Royce Compact Control system. **RW**

PHOTO True North Mark www.truenorthmark.com



LNG power for cruise ferry and Enviroship

The use of LNG as a marine fuel on European ferry routes and for coastal shipping has taken another significant step forward with the entry into service of the cruise ferry *Stavangerfjord* and the fish feed transporter *Eidsvaag Pioneer*.

PHOTO Fjordline

Cruise ferry

The first of two cruise ferries operated by Fjord Line AS that will run solely on LNG has entered regular service between Hirtshals in Denmark and ports in Norway.

Rolls-Royce Bergen LNG-fuelled engines power *Stavangerfjord*, which was built at the Bergen Group Fosen AS yard in Norway and will be followed by its sister ship *Bergensfjord*. Each vessel is powered by four Bergen gas engines individually rated at 5,600kW, driving highly efficient Promas integrated rudder and propeller propulsion systems for optimum fuel efficiency.

Originally the ferries were ordered with diesel engines, but Fjord Line made the decision to replace these with Bergen BV35:40P12G gas engines so as not to be adversely affected by regulations which apply in Emission Control Areas (ECAs), such as those around the coast of Norway, that limit emissions of NOx and SOx.

Norway has a number of regional ferries that are fuelled by LNG, but none as large as the 170m-long *Stavangerfjord*, which can accommodate 1,500 passengers in significant comfort, and up to 600 cars or their equivalent in other vehicles. It boasts a 'Sky Lounge', a large outdoor area on



the tenth deck, with food served from seven different restaurants and ample opportunities for duty free shopping.

Ingvald Fardal, Chief Executive of Fjord Line, said: "Fjord Line has a clear environmental strategy and choosing single fuel gas engines makes us pioneers in the cruise ferry industry. We now have the first and largest cruise ferry ever to run on LNG as the sole fuel type. Rolls-Royce is the leading manufacturer of these well-proven engines and we are very pleased to have its technology on board."

These 170m-long vessels will serve two routes. One is the existing Fjord Line service linking Hirtshals in Denmark with Stavanger and Bergen in west Norway, and the other is a new route between Hirtshals and Langesund in south Norway. A daily service on both routes is offered year round.

During the recent Norshipping exhibition in Oslo, the Fjord Line cruise ferries picked up an Energy Efficiency award from the International Maritime Organisation (IMO). It pays tribute to the ship that makes the greatest contribution toward energy efficiency in relation to its function or operation.



1 PHOTO Harald W. Valderhaug



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1. With LNG fuel and the Environship hullform, *Eidsvaag Pioneer* carries pelletised fish feed to fish and shrimp farms on the Norwegian coast with the minimum of emissions.

2. At a farm the pellets are transferred while the ship holds its position without anchoring or tying up by using its DP system.

First Environship

The NVC 401 LNG forage carrier *Eidsvaag Pioneer* is owned by Eidsvaag AS and is now in service carrying pelletised fish feed for Skretting AS to fish and shrimp farms along the Norwegian coastline.

Rolls-Royce supplied all the main systems and equipment for the 75m-long vessel and the innovative Environship ship design. It was built at the Vard Brattvåg shipyard.

"Our NVC 401 LNG design was developed to meet a very specific requirement," says Rune Ekornesvåg, Rolls-Royce Sales Manager for merchant vessels. "The vessel will operate a weekly voyage along the Norwegian coast delivering fish feed. On arrival at the often-remote storage location, the ship will hold its position using DP, while the pellets are delivered by a crane operated transfer system over the bow. Up to 1,450 tonnes of feed can be carried in the 58 specially designed tanks on board. The speed needed to meet the weekly schedule is 15 knots.

"The newly developed Environship hullform means the vessel is easily driven and has optimum seakeeping. This helps reduce fuel

consumption, and because the customer requirement was for minimum emissions to air and water, it was logical to choose LNG as the fuel and a Bergen C-series gas engine to power Eidsvaag's new vessel."

On an overall length of 74.7m, *Eidsvaag Pioneer* has a beam of 13.6m and a loaded draught of about 5m. The superstructure is located forward with accommodation for eight people, and the machinery and LNG tank are aft, with the cargo tanks occupying the main part of the hull.

A Bergen C26:33L9PG gas engine developing 2,430kW at 1,000rpm turns a CP propeller in a Promas solution that integrates the propeller and rudder into an efficient propulsion system. The reduction gearbox handles power take-off and take-in for the 1,000kW shaft generator that is part of the variable speed HSG (Hybrid Shaft Generator) system linked to two 400kW auxiliary gensets.

Rolls-Royce also supplied the LNG system, auxiliary thrusters, engine and thruster controls, an integrated automation system with gas control and monitoring, the DP1 system with joystick and the electrical system. **RW**





Walk to work offshore

Island Crown is the latest vessel to come from Rolls-Royce's relationship with Island Offshore. Once again, the UT 776 CD has been selected as the basis for a vessel to meet some special offshore requirements.

PHOTOS Vard Brevik

Over the past few years, the Norwegian shipowner Island Offshore has added several batches of the UT 776 platform supply vessel to its fleet, including two fuelled with LNG.

This time around, the design brief was for a vessel that will spend much of its time connected to an offshore platform, acting as a hotel for personnel working on the platform. *Island Crown* can also carry out a separate set of functions – subsea construction and ROV operation – and is additionally equipped to transport all the liquid and bulk supplies needed by rigs and platforms.

It was logical to choose the latest and longest version of the Rolls-Royce UT 776 CD. It is 99.8m long with a 20m beam and the design has proven low motions in a seaway.

Also specified were other Rolls-Royce ship systems similar to those on other Island Offshore vessels, such as a four-generator set diesel-electric propulsion system, Azipull main thrusters and twin tunnel thrusters plus a swing-up azimuth thruster at the bow. This arrangement provides the high level of redundancy required for the DP2 dynamic positioning system. The vessel was built at the Vard Brevik shipyard.

Island Crown has the UT 776 CD superstructure layout favoured by Island Offshore. This provides comfortable accommodation for a vessel crew of about 40, including supernumeraries. The hotel block is placed aft of the main superstructure, with a hospital and services at main deck level and two decks of two-person cabins, with day and meeting rooms above. The main galley supplies the food and there are also pantries in the hotel section.

Platform workers living on the ship have



1. *Island Crown* was named in early June at the quayside of Oslo city centre in Norway.

2. The personnel access system is fitted in the port aft corner of the deck and comprises a telescopic tower and staircase with a gangway.

3. The longest variant of the successful UT 776 CD family of designs, *Island Crown* has a large accommodation unit and is fully equipped for other offshore roles.

to transfer between ship and platform at the change of shift. To do this, they use a transfer gangway positioned at the port aft corner of the deck. *Island Crown* is flexible enough to link to many different types of platform, with a variety of heights above water level of the platform entry port. The access system is made up of two main components: one is a telescopic tower and staircase which takes care of the initial height differences; the other is the gangway itself, linking the top of the tower and the docking point at the entry port.

The gangway is hydraulically positioned but free to pivot, allowing for relative motion. Its length can also be varied. Normally the vessel will maintain a fixed distance from the platform under DP, at a heading that as far as possible minimises the energy required by the thrusters to keep station. Uptime supplied the gangway and Ulmatec provided the telescopic tower.

Passengers transfer first up a gangway from the main deck to the tower staircase, then up to the transfer gangway. If the system has to match a very low platform height, the tower

telescopes down, and the deck gangway then leads downwards to a mezzanine deck at the foot of the staircase. Passengers and crew can be transported to and from land by helicopter. The helicopter platform is above the hotel near the point of minimum ship motions, with access to the reception area.


Island Crown is designed to SPS (special purpose ship) rules, which set strict limits on stability and angle of heel under various collision or damage scenarios. With 100 people on board, there must be extensive evacuation equipment, in this case two enclosed lifeboats and two man overboard boats.

For its platform service and subsea construction roles, *Island Crown* is equipped with a boom crane, with a capacity that ranges from 10t at 40m to 100t at 10m. The ROV handling area with cursor is aft of the hotel block.

Island Offshore's new vessel is built and equipped to a very high standard, and provides offshore operators with a ship with an excellent pedigree and capable of efficiently fulfilling several distinct roles. **RW**

Customer Support

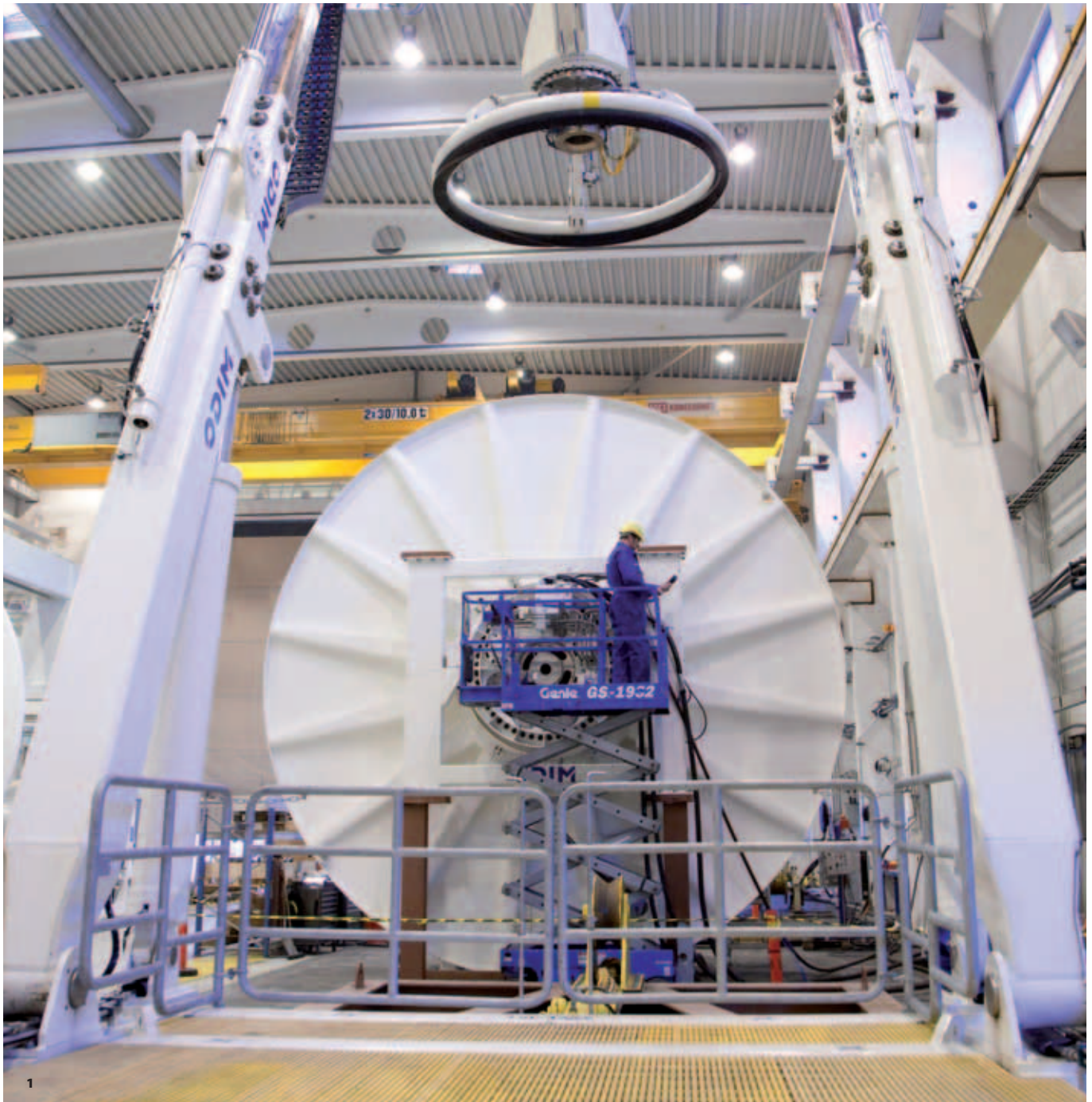




Honing the skills that help locate offshore oil and gas

Seismic survey is an important component in the ever widening search for new reserves of oil and gas. Complex ships tow arrays of hydrophone streamers worth millions. The winches and systems that handle them need to be operated correctly and the right maintenance is vital. Rolls-Royce provides specialist training for the seismic crews.

Arstein Erdal from the Rolls-Royce training team instructing a crew from the seismic company Fugro.



One of the courses run at the new Rolls-Royce Training and Technology Centre in Ålesund, Norway, is devoted to the operation and maintenance of hydraulic seismic winch systems. Since the Centre was opened in November 2012, the five-day course has been run several times for different groups of students and companies and more are scheduled.

Different levels

Rolls-Royce training courses cover a wide spectrum of product groups and systems and are offered at several levels. Level 0 is based on e-learning with instructor

support and provides a good grounding. Level 1 is more advanced, and Level 2 is a further step up in detail and complexity. These levels cover the main requirements of shipowners who want to train their crews. Level 3 is aimed primarily at Rolls-Royce service engineers as they broaden the range of products for which they have detailed theoretical and practical knowledge, but may be relevant for some customers. Courses can be open or closed. Closed courses are typically arranged for a shipowner, who nominates about eight people to take part. The participants may be all crew from the company's ships, or crew plus technical shore staff.

The course that In-depth recently attended was technically an open one, but in fact all the participants were from the seismic company Fugro, which has become part of CCG. It was also nominally Level 1, but as the course instructor Arnstein Erdal points out, "Because these are experienced mechanics and observers from a single company we have flexibility to tailor the course to suit the participants' interest, as well as delivering the agreed content. Some of them are working on board with exactly the winches we use for the practical exercises in the training workshop here. I would therefore class this one as Level 1-2. Closed courses, where everyone is from

the same company though probably from different ships, offer the chance to exchange ideas and practical experience in a more confidential situation."

Wide range of equipment

Before considering the structure of this course it is worth looking at how a seismic survey vessel functions and is manned, and the nature of the hydraulic winches involved.

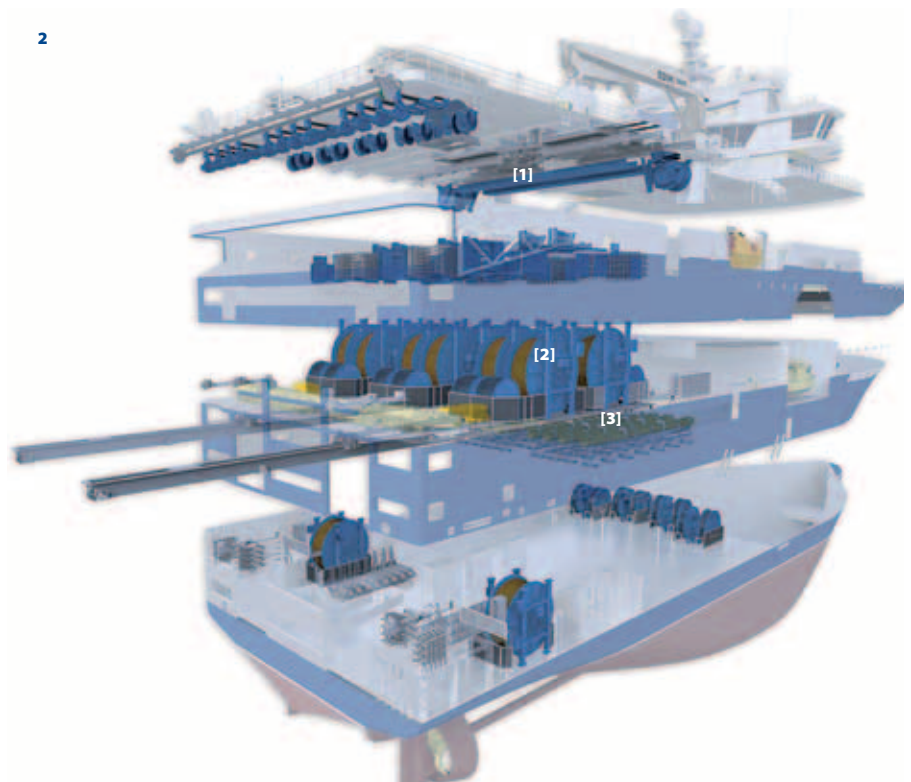
The range of essential equipment that enables a seismic survey vessel to deliver the specified output starts with the air guns that provide the sound source. The sound travels through the water, penetrates the seabed and is reflected with different time delays from geological structure deep below. The waves travel back up and are received by hydrophones at the surface, which are connected to the logging system on board. The hydrophones are embedded at intervals along streamers. Earlier, the streamer cables were filled with a fluid (often a hydrocarbon derivative) to provide positive buoyancy, but now they usually comprise of a solid fill material, about 54mm diameter and made up in segments, so should one part be damaged it can be changed. This is important when a typical active streamer length is 8-12 km.

Multiple streamers are deployed parallel side by side, pulled out to the required separation by vanes, similar to using doors to spread a fishing trawl. When operating the ship will tow a huge array of streamers. Modern seismic vessels may tow upwards of twenty streamer cables and cover an area of sea 12km by 1 km.

Since each hydrophone in the array is providing data from its own position, the vessel is capturing a detailed picture in three dimensions of the seabed surveyed. Skilled analysts ashore then interpret the data to identify geological formations likely to hold oil or gas.

The ship is essentially a platform to carry the survey system and has its own marine crew. Rolls-Royce provides the handling systems for all the gear as well as designing the specialist vessels and supplying the main ship systems.

The seismic surveying task is performed by a specialist acquisition crew, working for the seismic company, divided three ways. The navigation section plans the survey route and steers the vessel to cover the area without any gaps. Observers are responsible for setting the streamers, electrical systems and for the instrument room. Shift mechanics under the Chief Mechanic deal with the mechanical and hydraulic systems,



1. A typical streamer winch.

2. The course covers the main seismic equipment, [1] Wide tow system, [2] Streamer systems, [3] Source handling systems.

a considerable job given that there may be from ten to upwards of twenty streamer winches alone, plus all the other winches and handling gear for air guns and vanes.

Focusing on troubleshooting

This course is designed primarily for mechanics, and for observers dealing with the electrical controls on the hydraulic systems. Day one is devoted to hydraulic systems in the classroom, ensuring that everyone understands the principles of hydraulic drives, can read system schematics and understands the symbols used to represent the various components. Safety is an important subject, a reminder that oil at high pressure needs to be treated with respect.

The second day is split between classroom and workshop, covering the filtering and cooling unit that keeps the oil in good condition, and the streamer winches. In the workshop the students can dismantle valves, motors and other components to fully understand function and maintenance requirements, while the instructor is putting faults on the streamer winch that the participants have to find and fix.

There is a strong emphasis on troubleshooting. As the Fugro mechanics say, "seismic vessels are paid by results, not simply time taken. A complete and accurate

survey is what is needed, and if a vessel is not shooting it is not earning. Equipment has to work with the minimum of downtime."

The other days of the course cover other parts of the seismic handling system. For this particular course there was a change of Fugro personnel part way, with two mechanics finishing and two observers arriving for the section of the course dealing with electrical matters.

Popular

This seismic course is proving popular with several of the leading seismic companies who are sending their personnel to the Rolls-Royce Training Centre. Schlumberger is an exception as it has its own training campus in Abu Dhabi, covering many other of the company's land and offshore activities, not just seismic. In this case Rolls-Royce instructors go to Abu Dhabi and run the courses there.

Several other seismic and subsea courses are run at the Rolls-Royce Training Centre. They include a two-day observer course and one of the same duration on operation and maintenance of launch and recovery systems. Later this year two new courses will be offered; a five-day one on seismic operation and maintenance, and a two-day crane operation and maintenance course. **RW**

Upgrading MY *O'Mega* for a new level of comfort

A Rolls-Royce system that significantly reduces the roll of yachts and mega yachts in all conditions is already a success for newbuilds, and is now proving to be a cost effective upgrade for older vessels.

Yacht owners are some of the most demanding customers in terms of the vessel comfort specification and privacy of the anchorage.

Anchorage that provide adequate privacy and the most dramatic scenery tend to be more remote, and therefore in areas that can experience significant swells. Global

weather has also become more unreliable, variable and extreme, even during the summer. Both can cause significant discomfort for the passengers. Therefore over the last decade or so, a number of technologies have been brought into service to improve the all-important on board experience.

A stable vessel in all conditions

Rolls-Royce pioneered the introduction of stabilisation at zero speed with retractable stabilisers, using modified stabilisers from its Aquarius range over six years ago. Today over 20 systems are either in service or on order. Older yachts can also benefit from fitting the technology and it can normally be fitted during an off season drydocking in a few weeks.

Passenger comfort when at sea on the 1985 built 82.5m mega yacht *O'Mega*, operated by Sovereign Sea Hermes (SSH), was identified as a potential issue for some of the companies' more discerning charterers. *O'Mega* is particularly attractive for larger groups. With 11 double cabins and five single cabins the vessel is capable of taking up to 30 guests and has a crew of 30.

To give the magnificent *O'Mega* an equally impressive 21st century operating specification, around two years ago SSH began an upgrade programme. The latest stabilisation technology, to improve underway stability, would be fitted together with the commonly requested feature of stabilisation while at anchor.

After a lengthy evaluation of the available stabilisation options, SSH contracted for the



PHOTO: SSH

Rolls-Royce all condition solution, and the installation work was undertaken during a short docking during early 2013 at the Neorion Syros Shipyard, Greece.

The Rolls-Royce system is designed to provide 85 per cent roll reduction while underway at 10 knots and above in sea state 6 conditions, as well as a high degree of list control when manoeuvring. At rest, 80 per cent roll reduction was specified to cope with the Mediterranean Sea conditions, as required by SSH. A pair of Aquarius 50 stabilisers with 5.74m² fin area would replace the original retractable units that were only effective when the yacht was underway.

Following a full pre-installation survey, laser scan of the hull and working with original vessel design drawings, Rolls-Royce designed the bespoke stabiliser modules. They consisted of the fin box together with a section of the vessel's hull plate cut to fit directly into the vessel hull with minimum modification, for ease of installation by the shipyard. The modules fitted easily into the space envelope of the existing units, although the new Aquarius units were larger and longer.

With the installation of the hardware complete a Rolls-Royce engineer was on hand to oversee the connection of the ancillary equipment, hydraulic power units (HPU) and the control system, which were accommodated in the existing stabiliser compartment with space to spare. He also set up the system and undertook commissioning and sea-trials.

The new stabilisers did not add significantly to the power demand on the yacht's existing system. Total power absorbed by each power pack is in the region of 20kW. Emergency motors are rated at 3.5kW and are capable of centring and housing the fins in the event of a primary power failure. The HPU has also been designed specifically for the yacht market with modern hydraulics for very low noise and vibration.

"Feedback from the crew has been very positive," says Peter Bonallo, Sales Manager. "Cruises in rough weather are now a much more comfortable experience for all on board."

Rolls-Royce stabilisation at rest systems have now been retrofitted to three yachts and have garnered similar positive feedback. To meet growing interest, the larger Neptune retractable stabilisers have also been re-engineered for stabilisation at rest duties, suitable for 80 – 110m yachts. **AR**



1. The 82.5m MY *O'Mega* is now fitted with a pair of Aquarius retractable stabilisers to provide roll reduction in all conditions, including at anchor.
2. The new pair of stabilisers were fitted in two weeks during a recent drydocking.
3. The stabiliser machinery space before and after the upgrade. Although longer, the new units fitted easily and took up little extra space.
4. The Aquarius retractable stabilisers have a fin area of 5.74m² to provide an 80 per cent roll reduction.

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