Rolls-Royce

in-depth

THE GLOBAL MAGAZINE FOR MARINE CUSTOMERS

ISSUE 21 2014

LUXURY REIMAGINED

THE FUTURE OF THE HIGH-END CRUISE

SPECIAL REPORT

UT AT FORTY

THE STORY BEHIND THE WORLD'S MOST SUCCESSFUL OFFSHORE VESSEL DESIGN

INSIDE ▸ MARINE NEWS AND DEVELOPMENTS / TECHNOLOGY / UPDATES / CUSTOMER SUPPORT


www.rolls-royce.com/UTstories
Rolls-Royce
Story No.03
" Safe? That's one of the most dangerous words I know "
As a member of the deck crew on board an anchor handling vessel, you have to stay focused. The work we do - connecting and disconnecting rigs and anchors, securing and delivering wires up to the platform - is extremely hazardous. A simple mistake like a twisted wire can have fatal consequences. As offshore vessels venture into deeper waters and more challenging conditions, we need ever more powerful and sophisticated equipment to lift and control the heavier anchors and chains. I trust Rolls-Royce deck equipment to help me and my crew mates meet ever greater challenges, but I don't think I'll ever allow myself to feel safe. It's just too dangerous.
Stian Tollås - AB
We met Stian Tollås while he was working on board the Island Valiant, Anchor Handling Vessel - UT 787 LCD. Explore the passion and commitment behind 40 years of UT design. You can find Stian's story and many more at www.rolls-royce.com/UTstories
UT. The ship that launched a thousand stories.

LAWRIE HAYNES, PRESIDENT – MARINE, ROLLS-ROYCE

A FUTURE BASED ON EXPERIENCE

It's 40 years since the first UT vessel, *Stad Scotsman*, entered service. In this issue of In-depth we look at how the design has developed and celebrate the achievements of the father of the UT concept, Sigmund Borgundvåg

NOW aged 75 and four decades after developing the UT design concept, Sigmund Borgundvåg still works for Rolls-Royce, mentoring our design teams and using his experience to influence their future direction.

Sigmund received a lifetime achievement award in recognition of his contribution to the offshore industry and we present an historic overview of the UT design in these pages. It is individuals like Sigmund who make a difference and we are proud to celebrate 40 years since his first design.

Reaching this milestone would not have been possible without the close cooperation of our customers. Gaining a deep understanding of the operating conditions and what a vessel is required to do is the key to developing a successful design.

Marine technology does not stand still. So we take a look at the future direction of ship design and the innovations that will be necessary for the next 40 years, when operating requirements and conditions are likely to get much tougher.

The first of these new designs to be ordered is the striking UT 777 offshore support vessel, developed in close collaboration with Island Offshore. It is based on operating experience gained from their vessel *Island Wellserver*. When delivered, it will be capable of working virtually anywhere in the world.

Innovation is at the heart of what we do. Our unified bridge is a good example, again developed in close cooperation with customers to provide a safe and efficient operating environment. With the first now

COVER: Sigmund Borgundvåg, who designed the first Rolls-Royce UT vessel in 1974.

being commissioned, 2014 has seen further orders for this technology.

In ship and systems design we are again pushing the boundaries. Providing our customers with options beyond the conventional is the goal, with a transparent view of operating and ownership costs. We focus on the smaller cruise segment in this issue.

As market leaders in pure LNG propulsion in Europe, our experience has now resulted in our first order for gas engines in China for tugs. We are also continuing to invest where our customers are. In Brazil we are building a new facility to assemble and test large thrusters, and our new training centre in Rio opened in March.

In this issue of In-depth you will see the spread of experience and innovation our customers can rely on. I wish you an enjoyable read.

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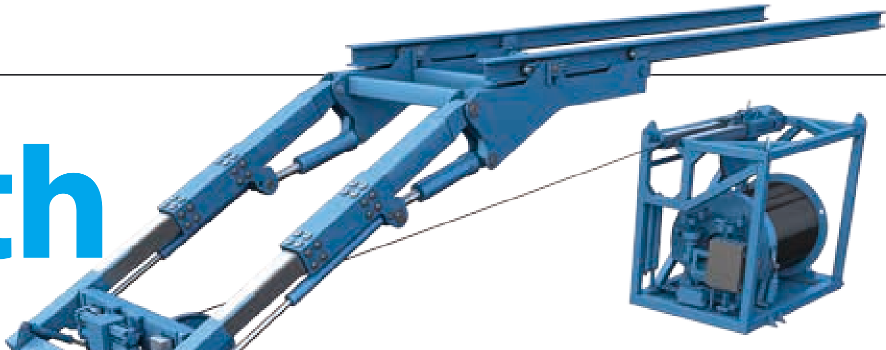

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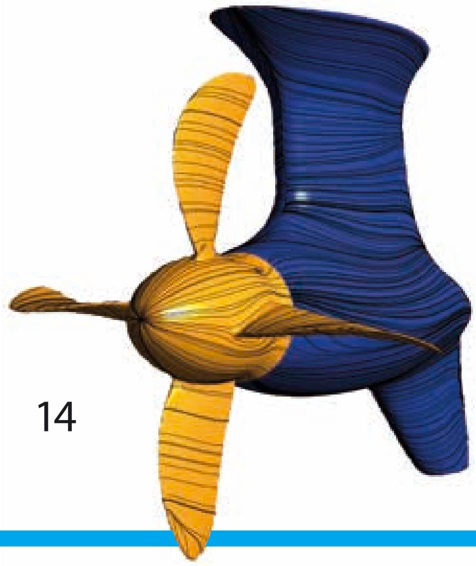
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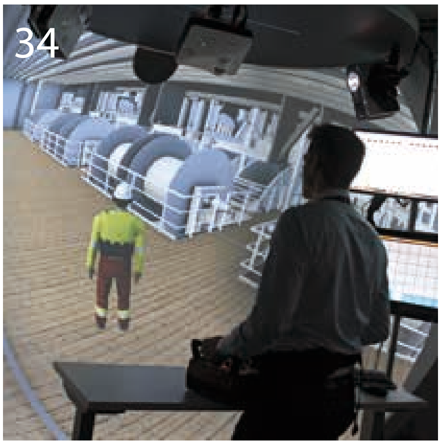

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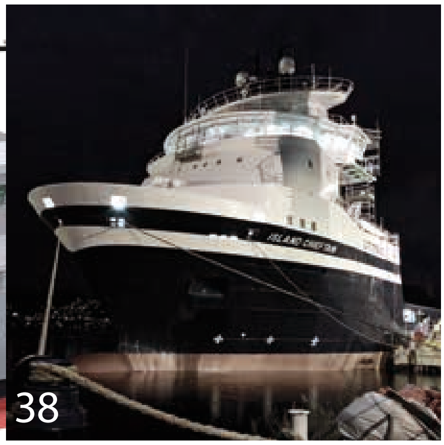

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ABOUT

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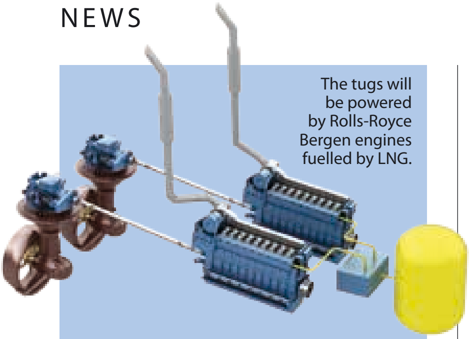


The tugs will be powered by Rolls-Royce Bergen engines fuelled by LNG.

Asia's first gas powered tugs

An order from Chinese state oil company CNOOC has been secured to power Asia's first gas powered tugs. It is for two tugs to be built at the Zhenjiang shipyard in Jiangsu, China, with an option for an additional two. The first tug is planned for delivery by the end of this year.

Each tug will be powered by a pair of Bergen C26:33L9PG engines fuelled purely by liquefied natural gas (LNG), driving reliable Rolls-Royce US 205 CP azimuth thrusters.

"This order is highly significant for Rolls-Royce, CNOOC, and Zhenjiang shipyard and marks a new era for tug boat propulsion in China," said Neil Gilliver, President – Merchant. "Rolls-Royce is proud to be selected to power Asia's first pure gas powered tug and to play a pivotal role in the state's focus on reducing emissions along the coasts and inland waterways."

The order follows the successful delivery of the world's first gas powered tug *Borgøy*, also powered by Rolls-Royce. The company's Bergen engines are the leading pure gas, medium speed engines in the marine market.

Brazil investment increase

Rolls-Royce has made further investments in Brazil to support customers in the country's expanding offshore oil and gas industry.

A new facility in Duque de Caxias near Rio de Janeiro will be used to assemble and test large thrusters and other propulsion equipment for semisubmersible rigs, drill ships, FPSOs and other offshore vessels.

Construction at the 2,700m² site will begin in May. Delivery of the first set of UUC 405 thrusters, for seven drills ships being built by Brazilian shipyard Estalerio Altântico Sul for Sete Brasil, will start in June 2015.

Francisco Otzaina, CBE, Regional Director, South America, said: "Rolls-Royce has long been committed to the development of Brazil's energy sector. This latest facility enables us to more closely support our marine customers' investment and operational needs as they contribute to the development of the country's deepwater oil and gas exploration and production activities."

This is the second investment Rolls-Royce has made in Brazil this year. In March a new training centre was opened at the existing Rolls-Royce Marine Services site in Niteroi, near Rio de Janeiro. It provides a range of training, initially in support of winch and dynamic positioning (DP) operations.

"The provision of training for our customers in Brazil is critical in ensuring they maximise the value and potential of the equipment and systems onboard their highly complex vessels," said Paulo Rolim, Country Manager – Marine, Brazil.

Courses are based on a mix of classroom instruction, hands-on exercises in the simulators and maintenance training. A main bridge simulator with two operator chairs allows for interactive team training with a diverse array of scenario planning options.

The simulators at the new training centre in Brazil represent the latest in bridge simulation technology.

2014 Marine Events

For further information, contact: **Donna Wightman** Global Event Manager donna.wightman@rolls-royce.com

May

5/8 OTC, Houston, USA
www.otcnet.org/2014

June

2/6 Posidonia, Athens, Greece

10/12 Seawork, Southampton, UK

10/12 UDT Liverpool, UK

16/20 ITS, Hamburg, Germany

24/26 Baltexpo Military, Gadansk, Poland

August

19/22 Nor-fishing, Trondheim, Norway

25/28 ONS, Stavanger, Norway

September

9/12 SMM, Hamburg, Germany

December

2/5 Exponaval, Valparaiso, Chile

3/5 International Work Boat Show, New Orleans, USA

Digital

See how to build a bridge in 60 seconds by downloading the In-depth app from iTunes or Googleplay

First Unified Bridge delivered

The first commercial example of the new Rolls-Royce Unified Bridge has been factory tested and supplied for an offshore platform supply vessel of UT 776 WP design being built for Simon Møkster Shipping.

The bridge itself is built up from a series of modular consoles with controls and screens. Its layout can be tailored to suit the type of vessel and owner specific requirements. But this is just the visible face of a high level of system integration.

Integration covers both Rolls-Royce and third party equipment and systems, from propulsion controls to the horn. The Rolls-Royce bridge displays incorporate and control the latest version of the Furuno INS navigation system.

The Unified Bridge layout of the Simon Møkster UT 776 WP is an example of how the operator interface is laid out for an offshore vessel. A forward facing transit station focuses on ship control and navigation. There are two operator chairs on slides, one each side of a centre console, and outside each chair is an outer console. This open-fronted layout gives the watchkeepers an excellent view. The joysticks and control handles are positioned so that the operator can work comfortably from a standing or sitting position. Essential data such as the radar picture and electronic charts are displayed on 24-inch touch screens, while other systems are monitored and controlled from smaller touch screens in the consoles.

As most functions are accessed via touch screens the number of buttons on the consoles is greatly reduced. Those that remain are typically those where push buttons and indicator lights are either mandatory or desirable, for instance fire alarms. Main controls and screens are also located in consoles on the bridge wings. Being a PSV, the UT 776 WP bridge also has an aft-facing station for working cargo at rigs or platforms. The controls and displays are focused on dynamic positioning and tank information.

ABOVE: The role of Unified Bridge is to provide the operator with a functional and easily used human/machine interface with ergonomically placed control levers, touch screens to call up and control systems, and logically presented information.

Permanent magnet TT package

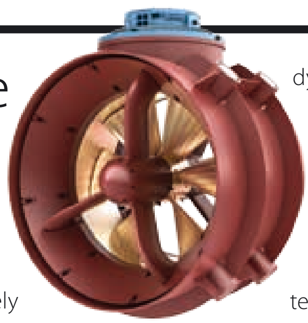
A contract has been secured to deliver a unique package of advanced ship equipment for a new offshore construction vessel currently being built for the Norwegian ship owner Volstad Shipping AS.

The equipment package includes the new Unified Bridge and the first commercial delivery of tunnel-thrusters powered by Permanent Magnet (PM) technology. The Permanent Magnet tunnel thruster is a new addition to the Rolls-Royce family of thrusters, building on a completely new approach to thruster design and motor integration. The TT-PM meets the strictest requirements for performance, noise and vibration.

In addition Rolls-Royce will supply engines, azimuth-thrusters, dynamic positioning, automation, navigation, drives, switchboards and electric motors.

John Knudsen, President – Offshore, said: "Volstad Shipping will receive a vessel that incorporates innovative technology from the control centre at the top with the Unified Bridge, down to the very latest thruster technology below the waterline."

The vessel will be 125m long and is designed with ice-class for operations in Arctic waters.



ABOVE: The new vessel will be equipped with space saving permanent magnet tunnel thrusters which meet the strictest requirements for noise and vibration.


Rolls-Royce

CRUISE CONTROL

The Rolls-Royce Blue Ocean team has challenged conventional design thinking for small vessels in the luxury cruise segment. Their new concept offers a unique experience for passengers and the best in fuel efficiency with low emissions for operators

The Sapphire Blue cruise concept from Rolls-Royce is LNG fuelled and can carry up to 950 passengers in comfort. Modular build and construction is a key part of the design philosophy, and four alternative propulsion systems enable the ship design to be closely matched to individual requirements for the lowest running costs.

One of the goals for the Blue Ocean team at Rolls-Royce was to design a cruise vessel where every one of up to 950 passengers would have a spacious cabin with plenty of natural light, as well as access to their own balcony.

The ship would also have to be cost-efficient to build, using a form of modular construction, and fuel-efficient to operate. That's where the Sapphire Blue cruise concept was born.

This innovative design provides novel cabin layout, generous seaside decks, and a unique combination of indoor and outdoor spaces. It also meets the shipowner's need for a revenue-maximised vessel of moderate size and capital cost that has a high fuel efficiency and minimum emissions.

Governed by function

"Cruise vessel design is all about best use of space and volume," says Oskar Levander, VP of Innovation, Engineering & Technology. "With a superstructure much narrower than the beam of the ship, the shape of our innovative cruise concept is governed by function. The idea is that all the passenger cabins run through the width of the superstructure, with windows to port and starboard in each case, maximising the spaciousness and natural light. There are no inside cabins or tiny portholes. Instead lifts and staircases give access to small groups of cabins by walkways and one-way glass protects privacy."

Decks of cabins extend upwards rather than sideways. Public rooms are on one deck in the full width of the hull, and also on the first deck of the narrower superstructure surrounded by a broad promenade deck where the infinity swimming pool, running the width of the ship, is located. There is further open passenger deck space on the outdoor rooftop above the accommodation, and for the adventurous, a spectacular waterslide will deliver them from here to the pool.

At the lower public deck level are the show lounge, conference and business centre, casino and library, play area and lobby/atrium, reception and main dining room and galley. At promenade deck level in the superstructure are the lido cafe, bars and shops which can be accessed from the open deck or the central corridor to give a feeling of informality. The layout maximises passenger space by allowing compact service areas.

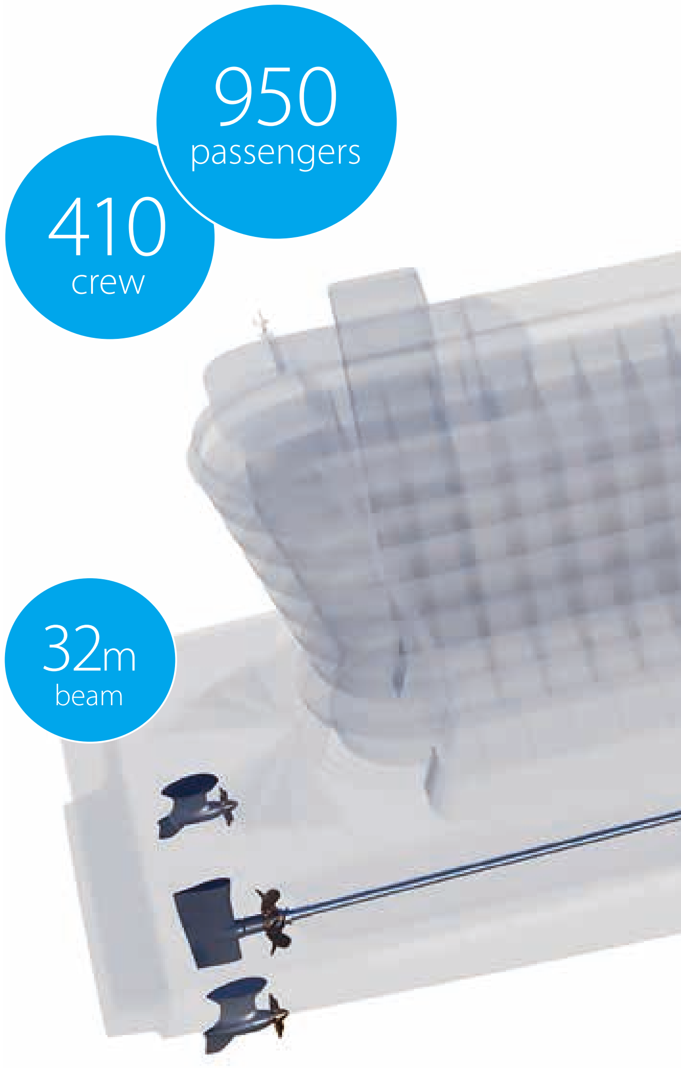
Compared to many of today's cruise vessels carrying thousands of passengers and competing for space in major ports, this ship can enter smaller and more interesting harbours thanks to its moderate size and good manoeuvrability. Essentially a vessel for warm water cruises of up to three weeks duration, for example in the Caribbean, it also has the range to cross the Atlantic on its sole fuel - LNG - to reposition for cruises in the Mediterranean.

LNG fuelled propulsion

The ship is about 42,000gt and has cabins for a maximum of 950 passengers, plus a crew of 410. It is 223m long and has a 32m beam.

"The Sapphire Blue cruise concept is based on a pure LNG power plant," says Esa Jokioinen of the Blue Ocean Team. "Running costs of the machinery is very attractive compared to diesel or heavy fuel. Emissions are also substantially lower, compared with diesel, and of importance to a cruise vessel close to shore or in port, NOx is greatly reduced, sulphur emissions are zero and there is no smoke."

Power levels have been selected to give a 19 knot design speed and maximum endurance at 16 knots, with 20-21MW of installed power to cover propulsion and hotel loads. In each case the power is provided by Bergen B35:40 pure gas engines. Four LNG tanks, each of around 500m^3 capacity, are located in the hull ahead of the engine rooms and are well protected against potential collision damage, with bunkering connections both port and starboard. For safety, access to the tank spaces is only from outside, with no doors to other decks.



Digital

Get a closer look at the Sapphire Blue cruise concept on the digital edition of In-depth, available free on iTunes and the Googleplay Android store.

Four propulsion system options

Four propulsion system options are illustrated, in each case based on LNG fuel. In combination with a low-resistance hull design, all of them offer good fuel efficiency and effective manoeuvring and the choice depends on the type of cruise itinerary and the operator's preference. RW

FIND OUT MORE ~
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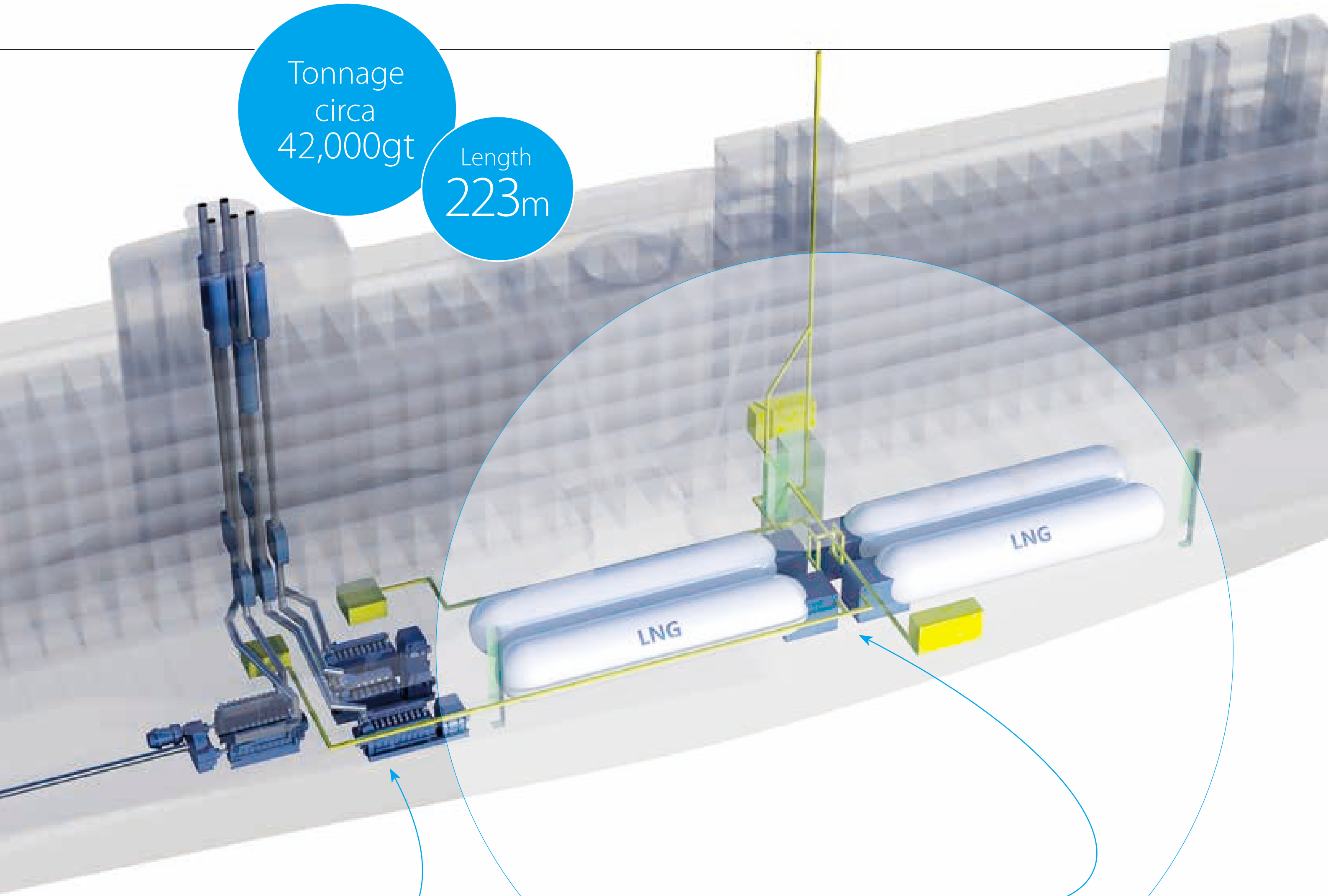


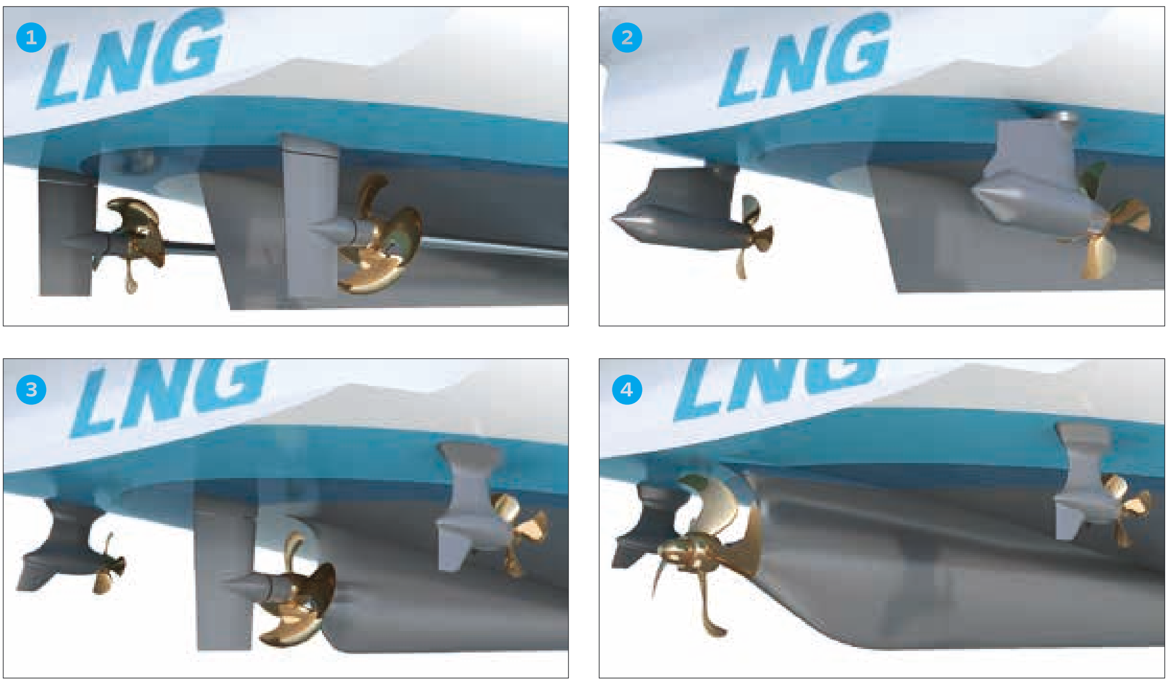
LNG FUELLED PROPULSION

Depending on the propulsion system selected, four or five gas engines provide all the power. Promas with wing thrusters are illustrated.

TANK ARRANGEMENT

- 4 x C-type pressurised LNG tanks
- Capacity: 4 x 480 m3 = 1,920 m3
- Fuel duration: 3 weeks
- Dedicated access from outdoor deck to tank storage compartments – no access from inside the ship.

PROPULSION SYSTEM OPTIONS



1 TWIN ELECTRIC PROMAS
- High reliability
- Low investment cost
- Good efficiency

2 TWIN PODS
- High propulsion efficiency
- Low noise
- Good manoeuvring

3 PROMAS/WING THRUSTERS
- High propulsion efficiency
- Excellent manoeuvring
- Proven technology
- Good total economy

4 LAP/WING THRUSTERS
- Best propulsion efficiency
- Low prop loads – low noise
- Good manoeuvring
- Best total economic performance

ROV SAFETY

Many anchorhandlers, drillships and deepsea construction vessels rely on remotely operated vehicles (ROVs) to do their work safely. Rolls-Royce's launch and recovery systems ensure safe operations in all environments, keeping vessels operational for as long as possible

Safely undertaking work at depths of 3,000m and beyond requires the deployment of robotic tools and remotely operated vehicles (ROVs).

Working in harsh environments can limit the time a vessel spends in revenue earning operation. Therefore the vessel equipment must be able to cope with extreme conditions and ROV operations maintained safely for as long as possible.

Getting ROVs and their tethering systems to their working depth and back safely is the task of the launch and recovery system (LARS). In addition to gently and safely moving the ROV to the sea, it must also ensure the umbilical cable is protected. The Rolls-Royce LARS range has been designed to meet these requirements with reliability and precision, and includes features that ensure safe operation in severe weathers. There are now almost 100 in service, and the range has been expanded to give customers a choice of performance as well as initial cost.

"Most operators have a clear view of what their equipment needs to do," says Lars Eide, Applications Manager – Subsea. "Our aim is to provide a high quality system that meets that requirement cost effectively."

Designed to handle the largest work-class ROVs with a safe working load of up to 13.5 tonnes and a maximum total submerged weight above 20 tonnes, the systems can still operate with a continuous speed of 2.4m/sec at depths exceeding 4,000m. Typical launch and recovery speeds are limited to around 1.5m/sec due to the delicate ROV instrumentation.

Broadly speaking, systems fall into two main groups; *overside LARS* – deck or overhead/gantry mounted and *moonpool-based LARS*. Six main designs accommodate most offshore applications and can be customised with a range of winch configurations, power units and sheave designs. Systems can be delivered with high-end hydraulic or electric winch drives, or as a basic system without active heave compensation. They are designed and certified in accordance to DNV Lifting Appliance 2.22.

Active Heave Compensation (AHC) – extending the operational window

AHC is an integral part of the LARS control system and enables operation in sea-state six and beyond, depending on the vessel's motion characteristics.

The AHC uses measurements of the vessel motion together with the feedback from the handling unit sensors, which indicate the umbilical overboard position, to automatically compensate for at least 97 per cent of the vessel motion by adjusting the winch speed and direction.

The control system also offers smooth latching between the ROV and handling unit, automatic synchronisation of the ROV winch and handling unit, automatic launch and recovery to a given target depth at a given speed and an umbilical management system.

Overside LARS

Five different designs provide a range of options. These flexible and modular units have an articulated and fully damped docking head, for security and full rotation of the ROV. It also gently handles the umbilical, accommodating off-lead angles of 40^0 left/right and 30^0 in/out tilt.

For increased safety most systems can be operated with the lower hangar door closed.

Moonpool-based LARS

Rolls-Royce moonpool systems dock the ROV subsea, where wave induced heave is reduced. An integral cursor and latch beam guides the ROV to the bottom of the moonpool. The latch beam and ROV continue to descend to the launch depth of around 30m. It is lowered to this depth by its own dual spool AHC winch and twin cursor cables. Releasing the mechanical lock on the latch beam launches the ROV in the normal way and transfers tension to the umbilical. When the ROV reaches its operating depth the latch beam is raised and parked together with the cursor at the base of the moonpool, providing guidance and protection for the umbilical during subsea operations.

Integrated single and dual-moonpool systems are ideal for Arctic vessels with fully enclosed ROV hangars and the scope of supply includes the moonpool hatches and deck skidding systems. AR

Digital

View the video of the LARS system in action on the digital edition of In-depth, available for free on Apple iTunes and the Googleplay Android store.

FIND OUT MORE ~

lars.eide@rolls-royce.com

LARS OPTIONS

❶ Telescopic or dual tilt A-frame designs ensure precise ROV launch and recovery with variations in reach, and can be easily retrofitted to existing vessels.

❷ A-frame dual tilt LARS are equipped with adjustable draglinks for increased flexibility.

❸ The gantry crane has low height and can be deck or roof mounted. Its flexible design means it can be combined with rails in the ship side, ideal for vessels where the ROV hangar is located higher up.

❹ Moonpool-based LARs deploy the ROV to its launch depth of around 30m with an integral latch system, with its own AHC winch.

DRIVING FORCE

Rolls-Royce hydrodynamics expertise and Azipull thrusters are key contributors to making the world's first battery-powered car ferry a reality

When Norwegian ferry operator Norled's ZeroCat 120 ferry enters service next year, it will be capable of carrying 360 passengers and 120 vehicles.

Norled has won the ten-year contract to operate ferries on the Lavik-Oppedal route across Sognefjord, the largest and deepest fjord in Norway. Centrally located, it carves its way from the coast 205km inland. The ferry route forms the link for the E39 highway to bridge the north and south of the country. Operating in an area of outstanding natural beauty, environmental protection is a key local government goal. So from 2015, three ferries will serve the route, one of them the innovative ZeroCat 120.

The battery ferry was designed and is being built by Fjellstrand to operate with zero emissions. The ZeroCat 120's 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 together to develop a design with energy requirements low enough for a reasonably sized battery pack, weighing about ten tonnes, to provide the necessary energy for propulsion and all onboard services.

The hull and propulsion system design draw their inspiration from collaborative work done by Rolls-Royce and Fjellstrand more than a decade ago, when a new concept in double ended ferry design was born, accompanied by extensive calculations and tank testing.

That was the FerryCat concept, where the traditional heavy steel low speed monohull, typically used on shortish routes, was replaced by an aluminium catamaran with an equivalent capacity for vehicles and passengers. It is propelled at about 22 knots instead of the traditional ten-12 knots by four Rolls-Royce Azipull azimuth thrusters with pulling propellers placed at each corner of the vessel.

The first ferry of this design, *Stavanger*, was put on the Stavanger-Tau route in west Norway, where the high speed allowed the required departure frequency to be maintained with fewer ferries. It has operated successfully there for ten years. *Stavanger* was followed by two ferries for IDO in Turkey, similar but with some changes to loading arrangements and passenger spaces to suit local requirements and a hotter climate. They operate on Sea of Marmara routes.

When the hydrodynamics of the FerryCat concept were being calculated it was found that the total resistance at slow sailing speeds was low, while the vessel's light weight in relation to the weight of vehicles and passengers meant that less energy was needed to accelerate and manoeuvre. This low speed knowledge was not forgotten.

When the concept of a battery ferry for the E39 route was being explored, it became clear that the Fjellstrand lightweight aluminium catamaran with Rolls-Royce Azipull propulsion was an excellent starting point. Resources were devoted to refining the FerryCat to obtain the lowest energy consumption for the carrying capacity and the 10 knot speed demanded by the Lavik-Oppedal service, also with an eye to many other potential routes with comparable transport needs.

The result is ZeroCat 120. Unlike the majority of vessels, this ferry is symmetrical end to end, but not from side to side, making full use of the opportunities offered by multihulls. It is double ended, 80m long by 20.8m beam, with loading gates offset to dock at the standard side wall and linkspan terminals. Above deck the layout is Norwegian best practice.

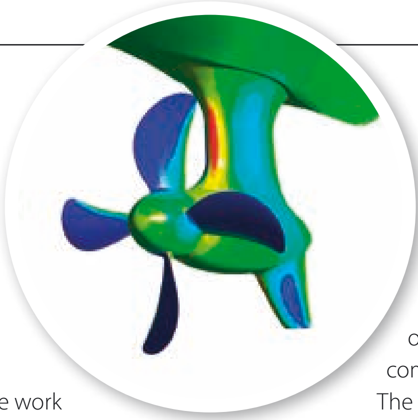
But it is the propulsion system with the extremely low propeller speeds, the slim thruster body with feathering front propeller combined with the catamaran demi-hulls, that are the key drivers of low energy consumption. Each hull is symmetrical end to end, but they are very different. The hull at the opposite side from the superstructure houses the propulsion system; the hull under the superstructure just carries its share of the weight and is shaped for minimum resistance.

The propulsion hull is formed to integrate hydrodynamically with the two Azipull thrusters, with bulbs at each end of the hull. A ferry with thrusters at each end can in principle choose to supply 100 per cent power to the aft unit, and nothing to the forward one, or split the power. For ZeroCat120 the best solution is for all the power to drive the aft thruster, with the propeller blades of the forward thruster set to a minimum drag feathered position. On the return trip the thrusters are rotated and the two units swap roles. These will be the first Azipull 085 units to have feathering propellers and electric steering to reduce energy consumption further.

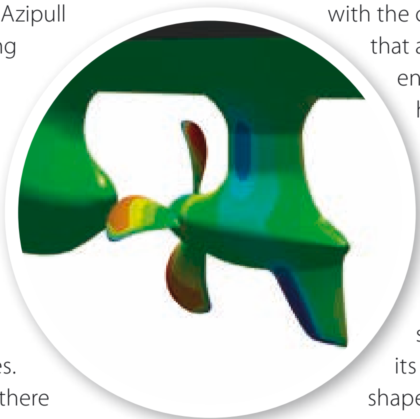
"Because the power is so low for the required transit speed it is possible to profit from a virtuous circle in the propeller design," says Leif Vartdal, Section Head for Hydrodynamic Research and Technology.

"The ideal efficient propeller has a large diameter and turns at low speed. The low propeller rotation rate in this case is possible because Azipull units have a high torque capacity. Yet propeller diameter is often restricted because of space or draught limitations. But for ZeroCat's thrusters Rolls-Royce has been able to use very large diameter propellers for the power they transmit, rotate them at an optimal low speed, and give them a low blade area of a very efficient shape. So propulsive efficiency is improved and the drain on the battery minimised."

Norled's new ferry is scheduled to enter service in 2015, and will produce no local emissions. Norway, on a yearly basis, derives most of its electrical energy requirements from hydro power, so the all-electric ZeroCat 120 will provide a corresponding reduction in CO_2 emissions compared with a conventional-diesel engined ferry. RW



ABOVE: The two Azipull thrusters use large diameter propellers with a low blade area of very efficient shape.



BELOW: The propulsion hull, with a bulb at each end, integrates hydrodynamically with the two thrusters.

BELOW: The ZeroCat 120 battery-powered ferry will have space for 120 cars and up to 360 passengers.

40 YEARS at the helm

Since the concept was born in 1974, nearly 800 UT vessels have been launched, or are now on order. Although they have been built all over the world, the design goes back to a small boat repair yard in Norway. The dawn of the North Sea offshore industry was the catalyst for the innovation – a tradition that continues to this day

1970s

UT 704
AHTS
Stad Scotsman

UT 705
PSV
Tender Carrier

UT 708
Heavy duty anchor handler
Stad Sailor

1980s

UT 706
MP Supply
Northern Fortress

UT 718
Safety standby
Normand Draupne

UT 725
Well stimulation
Big Orange XVIII

UT 734
AHTS
Star Spica

Digital

Delve deeper into the history of the UT design by downloading the digital edition of In-depth for free on iTunes and the Googleplay Android store.

UT 722
AHTS
Far Sailor

UT 755
PSV
Torm Kestral

UT 767
Well Intervention
Island Wellserver

UT 754
WP
Far solitaire

1990s

UT 753
Seismic
Western Trident

UT 730
AHTS
Far Santana

2000s

UT 776 LNG
PSV
Island Crusader

From small BEGINNINGS

The UT concept has come a long way from its genesis on the west coast of Norway

Offshore service vessels in the UT series were a response to tough operating conditions as offshore oil and gas exploration and production gathered pace in the North Sea. Winning oil from beneath the seabed had begun in the shallow waters of the Gulf of Mexico. To service the rigs and platforms special vessels had been developed, but when the 1970s arrived, the focus was on developing fields between Scotland and Norway. Service vessels designed for Gulf of Mexico conditions were found to be lacking in seakeeping ability.

What proved to be the definitive answer to this problem came from a small shipyard group on the west coast of Norway. Ulstein Trading, which was the starting point for today's UT activities, was set up in 1967 as the sales and ship design company in the then Ulstein Group. A decision was made to develop vessels suitable for North Sea conditions, following a study of the requirements of the emerging North Sea offshore support market, the existing fleet and through consultation with the Norwegian owners of fishing vessels operating under these tough conditions.

Principal requirements were good sea keeping and a large capacity for cargo, particularly cargo carried on deck. Design was also influenced by the need to come under the 500GRT tonnage rule, as this has a major impact on manning levels and harbour dues.

ABOVE: *Northern Gambler* is one of the larger of the PSV designs, UT 745.

BELOW: *Balder Torungen* in typical North Sea conditions. The UT 704 design was created to tackle these kinds of tough conditions. Delivered in 1982, it was the 59th ship of the type and is still operating.

Anchorhandlers and supply vessels

The result of this analysis was the UT 704 anchorhandling tug supply vessel (AHTS) and the UT 705 platform supply vessel (PSV). The first example of the UT 704 was *Stad Scotsman* and of the UT 705, *Tender Carrier*, the latter designed for and in close cooperation with Wilhelmsen Offshore Services, which went into service in 1974.

PSVs transport everything necessary to keep rigs and platforms working from supply bases on shore. Supplies range from fresh water, food and diesel oil, to items used in drilling, such as cement and drill pipes. The UT 705 proved an immediate hit with owners. Among its attractions was a working deck long enough to transport four pipe lengths. Its deck load capacity was exceptionally large, capable of carrying a load equal to its own structural weight as deck cargo. Basically the UT 705 defined the capable PSV and altogether 31 examples were built, the last in 1992 some 18 years after the first.

The other need was for capable anchorhandling and towing vessels capable of operating in tough weather conditions. Many of the drill rigs would require towing to move them from site to site, while there was also a market for towing out production platforms to the location where they would be fixed to the sea bed.

FORTY YEARS OF UT DESIGN HAS SEEN CONSIDERABLE CHANGES IN ORGANISATION WHILE KEEPING THE CONTINUAL PURSUIT OF EXCELLENCE

Anchorhandler *Far Sailor* relocating a rig in Brazilian waters. The UT 722 vessel is owned by Farstad Shipping ASA.

Once a floating rig was at the correct location for drilling it would be positioned by laying out a mooring spread of heavy anchors. The UT 704 was the definitive vessel developed to carry out this work in the North Sea. The first *Stad Scotsman* entered service in 1975. The design immediately became popular as it exactly met the oil company's requirements. During the course of 1975 alone, 13 vessels to the UT 704 design were delivered from yards in Norway, Finland, Germany and the UK.

Design developments did not stop there, as the UT 704 continued to be a popular choice for newbuildings until the last in the series was delivered in 1993, after 91 examples had been built.

These offshore vessels, although originally aimed at meeting North Sea requirements, proved to be suitable for many regions around the world, as oil exploration and production moved into locations far from land and in ever deeper waters.

More than a ship design

The UT concept did not only cover ship design. Underlying the activities was the principle of providing ever more comprehensive packages of equipment and systems. This meant that yards around the world could, with a low degree of risk, offer their customers effective and reliable ships. Over the four decades of UT design the scope of equipment supply and the levels of integration of ship systems available from Rolls-Royce has regularly increased, so today's designs can be seen as reaching a new level of integration.

UT designs themselves have evolved in a number of different directions. Some can be broadly classified as designs that meet the general requirements of the market. On the PSV side they are typified by the UT 745, a large PSV, and its smaller stable mate the UT 755, which has been an immensely successful design worldwide since its introduction in 1996. Since then more than 160 vessels have been put into service or are on order.

ABOVE: Since its introduction in the 1990s, the UT 755 has grown to be the most popular supply boat yet, with 160 now in service. Long and short versions have been introduced to match market requirements.

Naturally, the UT 755 design has not stood still over its 20 years. It fills the same market slot but improvements in hull design and propulsion make for a more efficient vessel. The design has also more than kept up with stricter demands for cuts in emissions and improved comfort and working conditions for the crew, particularly from the point of view of noise and vibration. The general needs of the market for a larger PSV are catered for today by the UT 776 PSV. On the AHTS side the design has progressed from the UT 722 to today's UT 790, which includes features such as the wave piercing bow design.

Running parallel to the designs that meet the general needs of the market, there have always been specialised vessels. These have more often than not been developed from close cooperation between the UT design team and leading ship owners. Many of these have been designed to be ready when an emerging market requirement from the oil companies actually crystallises. Some of the most significant examples are reviewed in the following pages.

Forty years of UT design activity has seen considerable changes in organisation, while keeping the continual

BELOW: Les Abeilles International in Groupe Bourbon operates two UT 515 coastal protection vessels, on charter to the French Navy.

Abeille Liberté with *MSC Napoli* in tow in the English Channel

pursuit of excellence. In the early years the activity was based at the local Norwegian shipyard and many of the lead vessels were built at the yard in Ulsteinvik. Ship building as a whole has always been cyclical and the offshore support vessel industry has had booms and slumps related to swings in the oil price.

Time of change

The biggest change came in 1999, when the former Ulstein Group design and equipment activities were sold to Vickers plc, leaving the shipyard in the hands of the Ulstein family. The Vickers business had seen many changes itself, including the hiving off of the naval shipbuilding activities. So when Vickers acquired Ulstein Group, it already had a portfolio of marine equipment.

Integration of the various product activities was underway as Vickers Ulstein Marine Systems when Rolls-Royce bought Vickers plc and the modern era of UT design started. The philosophy remains the same – offering offshore vessel designs which meet or anticipate the requirements of the market, together with an ever more comprehensive range of equipment and systems.

Within the design remit has always been the need for a vessel which is sea kindly and an efficient platform for offshore activities in tough weather conditions.

These design skills and experience translate easily into the design of vessels for other duties, which include vessels for exclusive economic zone management (EEZ). Many countries with sea boards have a requirement for coastguard vessels of various types to protect their economic interests.

They can range from emergency towing and rescue ships aimed at preventing marine casualties causing oil or other pollution off shores to patrol and fisheries protection.

Requirements vary considerably and have led to a number of successful UT solutions being deployed around Europe's coast line. Notable examples are the *Abeille Bourbon* and *Abeille Liberté*, UT 515s that protect the French coast.

As the UT story reaches 40 years, offshore requirements continue to develop with the demand for new types of vessels and innovative responses. Among the factors is

TOP: The UT 712 anchorhandling vessel *Olympic Octopus* was the world's most innovative when it entered service in 2006, with an array of safer deck equipment, DP2 and automation.

ABOVE: With a total bollard pull of 423 tonnes, UT 761 CD *Far Samson* is the world's most powerful towing vessel. It can trench for pipelines and cables in water depths of 1,000m and undertake many other tasks.

the continued move to exploiting oil and gas reserves in deeper waters. This explains the popularity of what were originally North Sea type offshore vessels, now that the Gulf of Mexico activities have moved into the deep water areas. Likewise many of the offshore vessels in operation for Petrobras in offshore Brazil are to UT designs.

Continued innovation

Deep water work demands new techniques, and among these is a move to subsea installations and away from fixed platforms. With this comes the need for heavy lifting capacity and active heave compensation to enable equipment to be located precisely at great depths.

At the same time, as existing fields start to become depleted, there is pressure to extend their lives using new techniques. Improved seismic surveying can delineate oil and gas reserves more accurately and determine how best to extract more from a given reservoir.

Another growing field is light well intervention. Working with a ship owner, Rolls-Royce has developed UT designs capable of doing this work successfully and more economically from a purpose-built vessel. RW

STILL INNOVATING

If any one person can lay claim to introducing the UT concept, it's Sigmund Borgundvåg. Now in his 70s, he is still involved in designing ships at Rolls-Royce. Here, he recounts his memories of the early years and discusses 40 years of UT vessels

Sigmund Borgundvåg, or SB to his colleagues, became project leader in the newly-formed Ulstein Trading in the mid 1960s. The UT concept was introduced shortly afterwards. It provided yards and owners with vessel designs and an associated range of equipment. To begin with, fishing vessels, passenger ships, ferries and tugs formed much of the work. But as North Sea offshore activity took off in the early 1970s, so did the requirement for support vessels.

SB saw the need for designs better suited to the North Sea's harsh and demanding conditions; vessels with more freeboard, better seaworthiness and optimised carrying capacity. Much of the inspiration came from successful fishing boat designs. The result was the UT 704 anchorhandler and the UT 705 platform supply vessel, designs which set the trend in offshore support vessels.

They were followed by a succession of UT designs developed to meet future needs and fielding customers' requirements as design input. During 1999 the UT design team became part of Rolls-Royce. In 2005, having reached retirement age, SB handed over to the next generation. But he has continued to work on new design concepts.

Many of the vessels designed by him or with his guidance are illustrated in these pages. In-depth asked him for his view on what has influenced offshore vessel design over the last 40 years.

"I've always been focused on the way a ship behaves in a seaway," says SB. "The need for a platform with easy motions is important when people are working on deck. This applies to fishing vessels as well as offshore supply boats and anchorhandlers. Vessels must also be efficient in terms of fuel consumption in adverse conditions, which is a combination of propulsion system and hull design.

"Our design goal for offshore vessels was to have no water on the working deck, mainly achieved by good freeboard and very high margins of stability, but sometimes regulations such as tonnage rules and load line requirements work against this.

"Load line rules are of course a vital element of marine safety, but were largely framed for cargo vessels and not for PSVs, where deck cargo capacity is a key economic factor, or for towing and anchorhandling forces in AHT vessels. Tonnage rules have break points, above which manning levels and expenses jump, for example at 500 gross tonnes. The way in which gross tonnage is calculated does not lead to the optimum offshore vessel.

"Energy efficiency is a priority, so we moved to low resistance hulls and hybrid propulsion systems. Now most UT designs have Clean Design class notation.

"Crew comfort and safety has improved greatly and noise and vibration reduced. Safer Deck Operations systems are a feature of our designs. This includes automatic deck cargo lashing systems and remotely operated manipulators on cargo rail cranes to eliminate heavy manual work and risk when handling wires and chains.

"Designers like challenges, and the oil industry's move into deeper waters has been interesting. It brought with it the need to lay longer moorings and heavier anchors, and an increase in the size of the winches built into anchorhandlers and propulsion powers over 20,000hp.

"We always make sure that stability is well in excess of what is required for a given bollard pull, so the vessel can work to the limit safely. Unfortunately it took an accident to show that some vessels were being used beyond their safe capability. The positive outcome has been definite rules linking reserves of stability to advertised pull.

"Looking back, we have responded to the needs of the offshore industry and can look forward to future design challenges. We will be moving into new areas, for example well intervention and drilling operations from moderate size ships, and more subsea construction."

Digital

Watch more of our interview with SB on the digital edition of In-depth, available for free from iTunes and the Googleplay Android store.

FIND OUT MORE ~
www.rolls-royce.com/UTstories

LIFETIME ACHIEVEMENT AWARD

At a ceremony in London in February, Sigmund Borgundvåg was presented with Offshore Support Journal's Lifetime Achievement award for his contribution to offshore support vessel design over 40 years.

DESIGN AND BUILD

Balancing requirements

Torill Kleppe Kleven, Technical Manager, UT Design Projects, looks at the need for cooperation in the design and build process

UT vessels now have multiple functions. They are bigger, carry more equipment and a wider variety of loads, which means more documentation to get the necessary approvals.

Speeds have increased and there are reduced margins on weight, so structures have to be lighter but cope with greater loads as operations move into deeper waters. The level of engineering analysis required today is much higher than even 20 years ago. Now we have teams of 50 people working for one and a half years to provide documentation for complicated vessels.

My job is organising our engineering delivery to the shipyards to ensure they can build UT vessels. At the outset we agree what drawings they need. Some only require basic drawings, while others want a full package.

Basic design documentation is the minimum we provide to ensure the vessel can be built to our specification. But normally significant engineering time is spent ensuring the equipment will work efficiently as a system.

When it comes to detailed engineering and production documentation, the shipyard can purchase it or do it themselves.

To deliver the right package we need to adjust our engineering deliveries accordingly. The challenge is to ensure maximum productivity, establish communication and ways of integrating our systems. We have to balance the desire to build quickly with our need to develop the design to the quality we are proud to deliver.

Digital

Torill Kleppe Kleven talks more about UT design in the digital edition of In-depth, available on iTunes and the Googleplay Android store.

Børge Nakken, Vice President Technology and Development, Farstad Shipping

Why do shipowners and shipbuilders think the UT design has been so successful and what does the future hold? In-depth talked to two customers to get their views

An operator's view
Farstad Shipping ASA

Farstad was the first company to order a UT design back in 1974. Børge Nakken, Vice President Technology and Development at Farstad, gives his views of the UT evolution to date

Both Farstad and Rolls-Royce are part of the strong maritime cluster in Norway's northwest. It is an area of shipowners, shipbuilders, designers, crews, universities and manufacturers, and I think the success of this cluster is due to the way we have been working together both formally and informally. We cooperate when we can and compete when we have to. That is the secret behind being able to invent so many things that have been beneficial for the global offshore vessel industry.

Farstad Shipping has always been an important part of this cluster. The company's headquarters has been in Ålesund since the 1950s and our new headquarters is now being built here.

Farstad moved from being a deep sea shipping company to investing in offshore, ordering the first UT design in 1974. Since then there have been many designs developed between Rolls-Royce and Farstad, and we are proud of what Rolls-Royce has achieved over the years with their portfolio of designs for the OSV market as well as being an important provider of ship equipment.

Farstad's main markets are currently Australia, Asia, Brazil and the North Sea, so we are dependent on Rolls-Royce's global aftermarket services. It is important for us to have local competence available where our fleet is.

Over the years Farstad has built a number of various designs. One is the UT 755 that came on the market during the mid 1990s. Nobody at that time realised how successful it would be in filling a gap in the PSV market. During the mid 1990s I worked as a new building supervisor and looked after the construction of the first UT 755 built by a British company at Søviknes Shipyard. I think the success behind the design is it is simple to operate, it's easy to maintain for the crew, it's efficient, and you have low operation expenses and a high degree of redundancy. It is also easy to build and has proven a great success for our clients.

> **Digital**
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> These are edited versions of our video interviews with Børge Nakken and Cesario Mondelli. Watch the full interviews on the In-depth app.

Another modern design is the UT 731 CD anchorhandler. Farstad Shipping has been present in Brazil since the mid 1980s and we have worked closely with Petrobras. So together with Rolls-Royce we have developed several vessels for that market.

One of these is the UT730 *Far Santana*, built in 2000, which has proven very successful in Brazil. When we started the development of the UT 731 CD in 2005, we put together a project team to transfer knowledge and experience from *Far Santana's* operation. Out of that came the series of UT 731 CD vessels. The first one was delivered in 2009 and the last one in April 2014, eight vessels which have proven successful for our clients in the North Sea, in Brazil and in Australia.

When the UT 731 CD was developed we focused primarily on deepwater anchorhandling, but at the same time the vessel needed to be flexible. Among the innovations we introduced for efficient and safe operations was the anchor recovery frame for launching torpedo anchors,

Cesario Mondelli, right, Shipbuilding Director, Rosetti Marino

as well as placing the ROV in a separate hangar, not occupying the work deck. One of the key criteria for developing the UT 731 CD was fuel efficiency. So we ended up with a hybrid propulsion system which has proven efficient because it is so flexible.

Looking to the future, the biggest challenge, apart from safety, is our environmental footprint. We need to control and limit fuel consumption and emissions from the vessels in every operational mode. Of course safety is always the top priority, so we must continue to innovate to improve on board safety. Another factor is comfort. If we are to retain the best crews, we need to offer the best facilities.

We depend on support from Rolls-Royce to develop and to maintain our position as one of the industry leaders. But we also need to be competitive in the marketplace. We always have to be aware of increasing operating expenses and capital costs for new offshore vessels, and keep in mind that the industry as a whole has to be price-competitive.

As the industry moves into distant areas, deeper waters and harsher environments, we will be even more dependent on the quality of the equipment, redundancy, and the aftermarket service from our suppliers like Rolls-Royce in order to maintain a safe and efficient operation for our clients.

A shipbuilder's view

Rosetti Marino

The Italian shipyard has now built almost 20 UT design vessels. Shipbuilding Director, Cesario Mondelli gives his view of the UT concept

Of the 60 plus ships we have built, around 20 of them have been UT designs, a mix of anchorhandling tug supply vessels and PSVs. Some are repeat orders. Our relationship with Rolls-Royce goes back over the years and has grown with the number of vessels we have built.

The UT design portfolio of vessels gives us the possibility to undertake different projects with many different clients. We started with Italian shipowners and now we are attracting orders internationally.

With a UT design we receive a complete package, from the vessel design to a full equipment package, which allows us to organise our project management activities. The vessel design and all the equipment that can be fitted gives us the flexibility to provide for different shipowners' needs around the world.

For the offshore industry innovation is a constant, so we also need designs that are evolving to meet the next challenge. As the industry moves into deeper waters, today's vessels need to have a large main deck, helideck, good accommodation, moonpool, and equipment with active heave compensation for handling ROVs. These are all within the Rolls-Royce scope of supply if we need them.

We benefit from the innovation Rolls-Royce brings with its systems and equipment. Reliability is also key as the vessels we build will operate around the world. We know our customers need support wherever they are operating.

The introduction of increasingly strict emission regulations is already bringing in changes to propulsion systems with the uptake of LNG by some vessel operators. At the moment there are issues with logistics of supply for vessels, but that will change. We will continue to look at the opportunities for LNG in our sector, and as Rolls-Royce has already provided gas engines for the first LNG fuelled tug, we can tap into their experience.

Passion, innovation and continual improvement are at the heart of everything we do, and we're satisfied to be working with companies which have the same goals.

Experience the SPRINGBOARD

Effectively harnessing the knowledge gained over 40 years is key to ensuring future designs operate safely and efficiently around the world and maintain the UT pedigree

The UT XXXX SCV is the generic title for a series of subsea construction vessels of different sizes – 21 to 30m beam. The hull design is optimised as a working platform with low motions in a seaway.

ABOVE: The UT XXXX SCV is a series of different size vessels. The size is mainly determined by the capacity of the offshore crane, which can be from 150 to 600 tonnes.

Digital

Explore the UT 771 WP PSV in more detail by downloading the In-depth app for free from Apple iTunes and the Googleplay Android store.

Over the years UT designs have been created for a wide range of applications. But how will these vessels develop? How will technology be applied? And what will they look like? Here, we take a closer look at four key offshore vessel types in the UT design stable.

Subsea construction

Subsea construction calls for vessels with offshore cranes and other equipment that enables them to accurately position heavy modules on the seabed. Many of the vessels built to date are basically large platform supply vessels fitted with a crane and systems for deploying ROVs.

Rolls-Royce has developed a family of subsea construction vessels designed specifically for this type of work. With the generic title UT XXXX SCV, this is a series of vessels of different sizes, the size mainly determined by the capacity of the offshore crane which can range from 150 to 600 tonnes.

The family comprises vessels with breadths of 21, 23, 25, 28 and 30m. The hull design is optimised as a working platform with low motions in a seaway. Together with the ability to meet DP3 dynamic positioning rules and the location of the helideck over the wheelhouse, this allows the operator to work the maximum number of days per year.

The vessel with its large open deck area can be configured for different tasks. In addition to construction, it is prepared for a tower, top hole drilling and well intervention, and with its ROV hangar and handling systems can carry out subsea inspection, maintenance and repairs.

A length of 123m overall has been chosen for the 23m beam member of the SCV family, providing a deck area excluding the moonpool of 1,400m^2. An offshore crane rated at 250 tonnes is mounted on the starboard side and the ROV hangar has space for three ROVs with the option of an ROV moonpool.

There is accommodation for a total of 120 under the SPS2008 rules. The UT XXXX SCV has a flexible diesel-electric propulsion system with two main azimuth thrusters at the stern, and tunnel and retractable thrusters forward. It will meet ERN 99,99,99,99 standard for propulsion redundancy.

Building these SCVs has been simplified as far as possible by simple plate development and logical building block construction.

Platform supply vessels

Platform supply vessels are the workhorses, supporting offshore oil and gas operations in various ways, taking supplies from shorebases to rigs, platforms and floating production vessels and also increasingly undertaking construction work using an offshore crane of moderate size.

The UT 771 WP is an 85m long design which builds on years of experience and handles the type of commodities that have to be transported, including low flashpoint cargos, in a safe and efficient way. Intended to meet the general needs of the market for a medium size PSV and complementing other UT designs, it has a deadweight of 4,200dwt and a free deck space of 840m^2. The deck has the capacity to take about 2,000 tonnes of cargo.

Ability to maintain speed in rough seas and elimination of bow slamming are ensured by the hullform which incorporates the wavepiercing bow. The low resistance hullform is powered for 14.5 knots, with a low fuel consumption at typical transit speeds of 10-13 knots.

Accommodation is provided for up to 50 people, and the vessel has low noise and vibration levels.

BELOW: The UT 790 WP anchorhandler has a bollard pull of 250 tonnes, scalable to meet customer requirements.

ABOVE: The efficient UT 833 with up to 180 tonnes of towing force gives a highly competitive fuel cost per square kilometre surveyed.

Clean Design class notation implies a minimum of emissions to air or water, and this PSV design can also provide oil spill cleanup services.

This Rolls-Royce design has diesel-electric propulsion for maximum efficiency in various operating modes, such as transit and dynamic positionin g. Four compact MTU 4000-series diesels provide the power and propulsion. Manoeuvring requirements are satisfied by two Azipull main thrusters and two forward tunnel thrusters.

Various equipment options are offered for the UT 771 WP, including firefighting and ROV operations. The vessel is also designed for a 50 tonne active heave compensated offshore crane and a helideck rated for six tonne helicopters.

Emerging PSV requirements

The offshore industry is constantly developing new techniques that lead to the need to safely transport new commodities. At the same time new regulations covering carriage of potentially hazardous cargoes arrive, and old rules are rewritten.

Rolls-Royce develops designs to meet these emerging needs and constraints, working closely with supply ship operators and their customers. One example is where cargo is classed as hazardous or noxious and there is a need to carry increasing quantities, requiring novel arrangements. Another is low flashpoint cargo or acids, where special cargo tank arrangements and venting may be required. In the near future there will be a need to transport increased volumes of non-traditional commodities, while some existing products carried by supply vessels may be reclassified.

Anchorhandlers

The UT 790 WP design embodies Rolls-Royce design thinking for capable offshore anchorhandlers. This 92m long vessel integrates efficient and safety conscious deep water anchorhandling, easily driven and seakindly hull lines with reduced emissions and enhanced crew safety and comfort in a single package, summarised as: cleaner, safer, deeper.

These goals interact with each other and balancing the conflicting requirements has involved extensive calculation and testing.

Shifting moorings in waters up to 2,000m deep means long and heavy wires and chains and a requirement for a highly effective bollard pull, which in turn demands stability. The UT 790 WP has a bollard pull of 250 tonnes, and a top speed of 17.5 knots is combined with economical cruising at 12 knots. The design is scalable, allowing owners to go for higher or lower bollard pulls.

Anchorhandlers operate in several modes; heavy pulling, transit, dynamic positioning and standby, leading to varying power demands. To meet these with maximum efficiency and minimum emissions, this Rolls-Royce design has a hybrid propulsion system. Two Bergen main engines (2 x 6,000kW) drive two CP propellers via reduction gears with shaft generators. Four Bergen gensets, each rated at 1,843kWe, supply electrical power when required. In some operating modes the shaft generators supply all electrical loads, in others the main engines can be shut down and the shaft generators act as motors, turning the main propellers, which are supplemented for DP and manoeuvring by two tunnel thrusters and a retractable azimuth thruster forward and two tunnel thrusters aft.

AHTS are to a great extent built around the main winch, which in this design is a three drum type with two towing/working drums and one anchorhandling drum, the latter able to hold 18,400m of wire rope, backed up by secondary winches.

The UT790 CD meets all current and anticipated stability requirements, both for stability reserve when laying moorings, and if damaged. Safety-oriented features include a view from the wheelhouse unobstructed by uptakes. The UT 790 CD also carries the full range of Safer Deck Operations equipment developed by Rolls-Royce over the past few years, that reduces the exposure of the deck crew when handling wires and chains and eliminates much heavy manual work.

Taken together, the combination of form and function in the UT 790 CD offers shipowners a tool that can be tailored for today's and future AHT operations.

BELOW: The UT 771 WP complements other PSV designs and can carry a range of cargoes in a safe and efficient way. It has a deadweight of 4,200dwt.

Seismic survey

Seismic survey vessels tow an array of streamers – cables containing a great number of hydrophones. Other towed equipment emits sound pulses which are reflected from sub-seabed strata and received by the hydrophones. Analysis allows a 3D picture of geology and oil and gas reservoirs to be built up. Areas to be surveyed are large, and there is a demand for towing ever wider and longer streamer arrays to cover the maximum search area.

Rolls-Royce is no stranger to seismic vessel design, and since the acquisition of Odim the company can provide a range of seismic handling equipment as well as designs and systems for the ship.

The UT833 WP is an advanced seismic survey vessel design meeting present and future needs with specification options to suit individual owners' requirements. It can deploy 18 streamers each 10km long plus the air gun array. The efficient design of the ship with up to 180 tonnes of towing force gives a highly competitive fuel cost per square kilometre surveyed.

This 110m long ship has hybrid propulsion with Promas/InnoDuct system and meets Clean Design class with low emissions. In normal seismic mode the UT 833 WP has a range of about 10,000 nautical miles, or 30,000NM at a 14 knot cruising speed and an endurance of up to 80 days with 72 people on board.

The seismic systems deployed from the ship are extremely valuable and could be hazarded by equipment failure on board, so the UT 833 WP has a high level of system and equipment redundancy. Surveying work is also increasingly carried out in the Arctic, and this vessel can be delivered with de-icing and Ice class. Its Rolls-Royce wavepiercing technology with a hullform is efficient in all wave headings and gives less speed loss in head seas than conventional designs.

The UT 833 WP is offered with all main systems from Rolls-Royce, including engines, propulsion, controls, unified bridge and a full range of seismic handling winches. RW

NEW ORDER

An offshore game-changer

UT 777 CD is the name of a new offshore vessel design that can undertake a variety of subsea tasks, including top-hole drilling, subsea construction and inspection, and maintenance and repair work in deep waters. It can also be adapted to undertake light well intervention.

The UT 777 CD design has been developed in close cooperation with the Norwegian shipowner Island Offshore, to be used in offshore drilling operations during harsh weather conditions. The vessel (classed as a Mobile Offshore Unit, or MOU) will be built in Japan by Kawasaki Heavy Industries and is scheduled for delivery in 2017.

When placing the order for the design and equipment package, Håvard Ulstein, CEO of Island Offshore, said: "We are excited about building another game-changer in the offshore market. Our collaboration with the Rolls-Royce design team in Norway has been vital in this process."

"This new design is based on many years of operating experience, especially from the vessel *Island Wellserver,* which we designed in 2005," said John Knudsen, President – Offshore. "The UT 777 will be unlike anything seen before and marks the latest chapter in the story of the UT design."

The Ice-class vessel will have DP3 dynamic positioning and comfortable accommodation for 91 people. It will be 168m long with a beam of 28m.

Island Offshore's new tailor-made unit will incorporate an enclosed module handling tower to ensure a safe and comfortable working environment for the crew while operating in harsh and cold conditions. The high operability extends the number of days it can continue to work in the North Sea and at the new frontiers in the north.

Rolls-Royce is to supply the design and engineering package together with the main ship systems, including the six main diesel generator sets powered by Bergen B32:40 series engines, the propulsion and positioning system of three azimuth thrusters at the stern and two retractable azimuth thrusters, plus two tunnel bow thrusters. The scope of supply also includes the control, automation and low voltage systems, a full outfit of anchoring and mooring winches plus a cargo rail crane and a bulk cargo handling module.

The new UT 777 design developed in close cooperation with Island Offshore is based on the operating experience gained from the 2005 designed *Island Wellserver.*

The burning QUESTION

The internal combustion engine is unlikely to lose its dominant position any time soon, but developing alternatives to meet tighter emission limits is costly. So what are the options? Oskar Levander, VP Innovation, Engineering & Technology, shares his views

Oskar Levander

Although nobody can predict how long our oil reserves will last, we can forecast that demand for it, and with it the price, will continue to stay high.

For vessel operators, fuel now makes up an increasing proportion of costs. And prices will rise next year, with the switch to low sulphur distillate fuel, assuming that a 0.5 per cent global sulphur cap comes into effect in 2020. That's in addition to the 0.1 per cent sulphur requirements expected to be enforced in Emission Control Areas (ECAs) in North West Europe and North America.

Owners operating almost exclusively within these zones have been seeking solutions to these issues. They are the main reasons owners, designers and equipment providers such as Rolls-Royce have been investing in maximising the efficiency of ship and propulsion systems. These new rules mean there is no alternative but to switch to more expensive low sulphur distillate fuel. Compounded by supply worries, that is driving a move to engines that can burn more environmentally friendly fuels, or fit appropriate abatement technologies.

Until now, fuel selection has mainly depended on two factors – ship size and ship type. Large vessels have predominantly used heavy fuel oil (HFO), with market sectors such as offshore support vessels favouring more expensive fuel grades.

In the future, fuel selection will have

many more dimensions. In addition to size and type, operating region and pattern will play a larger role in the demand in ECAs for low sulphur fuels. Pricing and availability also varies from one region to another. Vessel range impacts fuel feasibility due to space and cost constraints. So, for two similar ships with different operating profiles, one may opt for LNG while the other will select diesel. In fuel selection there is no longer a simple right choice.

The main alternatives

Today, HFO powers 90 per cent of the world's ships. Marine gas oil or diesel powers the rest. Over the last ten years, LNG has emerged and is now gaining acceptance, mainly due to attractive pricing and its environmental benefits. The industry has become more accustomed to it. In the early days the concern was safety, now it is developing adequate bunkering infrastructures within the ECAs. With the move to LNG by a number of operators, infrastructure development is moving ahead at a rapid pace.

I have long held the view that LNG will be the fuel of the future for a growing number of ships.

There is no doubt that gas will be available much longer than mineral-based fuels. Engines that burn it comply with the emission limits which diesel engines can only meet with the help of expensive exhaust aftertreatment. Gas engines run cleaner and quieter. Pure gas installations simplify the machinery fit, resulting in a very lean and cost-efficient installation, when diesel and auxiliary systems are removed.

Discussions around methanol as a marine fuel are cropping up more frequently. It is available in other industries and we are used to handling it as a cargo offshore. But there are issues as it is toxic and requires twice the space of diesel. As with anything, it is economics that will either favour or reduce its wider take-up. The price is what will matter. Currently it is running some ten-15 years behind LNG, but is not likely to play as big a part in the fuel mix as LNG.

Dimethyl ether (DME) is another fuel linked to methanol, but likely to play a smaller part. It is a very clean-burning fuel and requires pressure tanks onboard.

Biofuels are a different story. Here we have many different types and no binding specification. Although today's engines are suitable for many grades, the lack of standards makes uptake difficult, hence the need to mix with fossil fuels. They are also limited by production, due to the impact on the world's ability to produce food. So as a marine fuel it is only likely to appeal to niche markets. But this could change when we move to the next generation of biofuels.

Hydrogen is unlikely to become a primary fuel for ships any time soon. It makes no sense to use LNG or electricity to produce it. These feedstocks should be used directly as the fuel unless there is an abundant supply and turning it into hydrogen would be useful for energy storage. So H2 is only practical in a handful of countries with surplus onshore energy.

"I HAVE LONG HELD THE VIEW THAT LNG WILL BE THE FUEL OF THE FUTURE FOR A GROWING NUMBER OF SHIPS. GAS WILL BE AVAILABLE MUCH LONGER THAN MINERAL-BASED FUELS"

What are the alternatives?

BIODIESEL

Derived from vegetable oil which is transesterified with roughly ten per cent methanol and then purified. The resulting fuel is similar in its combustibility to conventional diesel fuel. However, rising food prices have raised doubts over the viability of production in the long term. A breakthrough is expected with the arrival of second generation diesel, when it can be made economical. In contrast to today's biodiesel it uses the entire plant, so that three times the quantity can be produced from the same crop acreage. Its storage lifetime and NOx emissions are still too high to comply with forthcoming regulations.

METHANOL

Is readily available and produced from feedstocks that include natural gas, biogas, coal and biomass.

The environmental benefit depends greatly on the method of production. Transport and distribution is similar to gasoline and ethanol.

It is toxic and its flammability range is greater than diesel fuel with a lower flashpoint and it is not yet covered by international regulations.

Conversion costs are lower than for LNG. Pressurised tanks are not required. Storage volume is roughly twice that required for MGO. Combustion produces no SOx and low particulates, but NOx levels do not comply with IMO tier III when powering a diesel.

DIMETHYL ETHER (DME)

Produced from the same feedstocks required for methanol production. It can also be made from methane that occurs from decomposing cow and chicken manure, rotting grass clippings and landfill gas.

Its properties are similar to LPG and can therefore be transported and stored in a similar way.

It is non-toxic and burns cleanly producing no SOx, with reduced levels of NOx and CO2.

LIQUIFIED NATURAL GAS (LNG)

Natural gas is a mixture of gases that consist primarily of methane. LNG is natural gas that has been cooled to -162°C and liquefied. In this form it occupies around a 600th of the space in its gaseous form.

LNG does not explode or burn. It needs to be in vapour form and mixed with air to burn and there is no direct environmental damage from a spill.

It must be returned to its gaseous form by a regasification unit to be burned in an engine, where it burns much cleaner than other marine fuels. The first LNG ferry powered by Bergen gas engines commenced operating in 2006.

COMPRESSED NATURAL GAS (CNG)

It is a highly compressed from of natural gas which can be as much as 99 per cent methane. Normally compressed to a pressure of around 215 bar it is commonly used as a gas fuel for motor vehicles.

PATROL LEADER

Rolls-Royce is expanding its range of offshore patrol vessels (OPVs), integrating military capability into a commercial platform for cost-effectiveness, which can be easily tailored to individual requirements

The Rolls-Royce naval ship design capability comes from the company's 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 who undertake Exclusive Economic Zone (EEZ) and fisheries protection patrols and offshore standby duties.

In Europe, Iceland, Norway, France and Denmark already operate vessels designed by Rolls-Royce for EEZ duties and emergency towing. That experience, together with a deep knowledge of power and propulsion with commercial and naval ship design expertise, has been brought together in the naval design team, led by naval architect Garry Mills, Chief of Naval Ship Design.

"In arriving at our base designs we have worked closely with a number of customers to learn how they want to operate their ships," says Mills. "We then took these factors into the overall design. As a result, our designs are flexible and can easily be adapted to suit individual requirements in terms of performance and affordability."

Core designs are now available for patrol vessels to 90m and fast attack craft.

Skadi 90

Designed for a broad range of EEZ duties, the Skadi 90 is suitable for fisheries protection, search and rescue and border control, as well as anti-smuggling and piracy operations, and traditional naval patrols. It is 92m long with a beam of 14m and a draught

GARRY MILLS

"These designs maximise their use alongside bespoke naval equipment. This can bring cost reduction and simplification to the design as well as the best in systems efficiency."

of 4m. Displacement is 2,100 tonnes.

The propulsion system is designed for optimum fuel efficiency at cruise speeds up to 14 knots, with a top speed of 25 knots. Roll control is provided by active fin stabilisers for unrestricted operations in conditions up to sea-state six.

The flight deck and hangar accommodate a medium-size helicopter and are suitable for night operations. A mission bay and stern ramp allow the launch and recovery of fast interceptor craft and unmanned surface vehicles (USVs). The design was conceived to be suitable for a range of missions and compatible with future 'offboard' modular mine warfare requirements.

Accommodation is provided for 38 in addition to 12 officers, with stores space for a 28-day deployment. Additional accommodation is provided for an embarked force of up to 30 personnel. Fuel storage provides for a range of over 6,000 nautical miles at cruise speeds. It is designed for unrestricted operations and is fully compliant with relevant class, SOLAS, IMO and MARPOL requirements and resolutions.

The CODLOD (Combined Diesel Electric or Diesel) propulsion system drives Kamewa controllable pitch propellers. The two electric motors get their power from three MTU 12V 4000 M23S gensets rated at 1,380kWe. Two MTU 20V 1163 TB93 diesels

BELOW: The Skadi 55 OPV has as its prime role a Mothership for high speed interceptor RHBs, for asset protection and anti smuggling duties.

ABOVE: The Skadi 90 OPV design was conceived from the outset to be suitable for a broad range of missions and compatible with future 'offboard' modular mine warfare requirements.

RIGHT: Garry Mills leads a team of experienced naval architects, marine and instrument engineers plus combat and sensor system experts.

BELOW: Variants of the 70m Fast Attack Craft have been developed with propulsion systems powered by three or four MT7 gas turbines giving top speeds of 50+ knots, as well as a smaller version for mid 50 knot speeds.

rated at 7,400kW deliver top speed. Armaments can include a main gun of up to 76mm, short range self-defence guns and short-range anti-air missiles.

Skadi 55

This multi-purpose 55-metre patrol, search and rescue craft has a prime role as Mothership for high-speed interceptor RHBs, for asset protection and anti-smuggling duties. The hull form with a 9m beam and 2.4m draught is designed for fuel efficiency at cruise and speeds of 22 knots and above. Displacement is 500 tonnes. Propulsion is provided by two MTU 12V 4000 M93L diesels rated at 2,580kW driving Rolls-Royce fixed pitch propellers.

Active fin stabilisation is incorporated and the craft is capable of unrestricted operations within 250nm of the shore. Fuel capacity gives a range of 4,000nm.

Accommodation is for five officers and 20 ratings, with space for stores for a 25-day deployment. A reverse osmosis plant provides fresh water and armament can include a 30mm cannon as well as self-defence guns These two OPV designs will soon be complemented by a 70m craft.

Fast attack craft – 70m

This design draws on Rolls-Royce research and development work on fast ferry hullforms. It is 70m long, with a beam of 9.8m and a design draught of 2.3m.

Displacement is 780 tonnes. Power is provided by an advanced combined diesel and gas turbine (CODAG) propulsion system, for cruise speed economy with a maximum speed in excess of 40 knots. Two Kamewa S3-140 waterjets are driven by two MTU 20V 4000 M93L diesels and two power-dense MT7 gas turbines rated at 5,000kW.

Variants have also been developed with systems powered by three or four gas turbines for speeds of 50+ knots, as well as a smaller version for mid 50 knot speeds.

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Simulating THE AFT DECK

Operations on seismic vessels to deploy streamers and sources can be complex and lengthy, making effective training vital. The latest simulator from Rolls-Royce mimics the aft deck and the challenge of deploying equipment safely and efficiently

As any apprentice will tell you, there is no substitute for experience. But some jobs are so critical and expensive to practise that the opportunity to learn and make mistakes without the pressures of being part of a real operation are becoming less commonplace.

Harnessing technology and simulation is now becoming the norm for many operations. As a result, the range of Rolls-Royce equipment with a bespoke simulator capability for crew training located at the Rolls-Royce Training Centre continues to grow. The latest addition is the aft deck simulator pod for the equipment and control systems onboard the latest generation seismic streamer vessels.

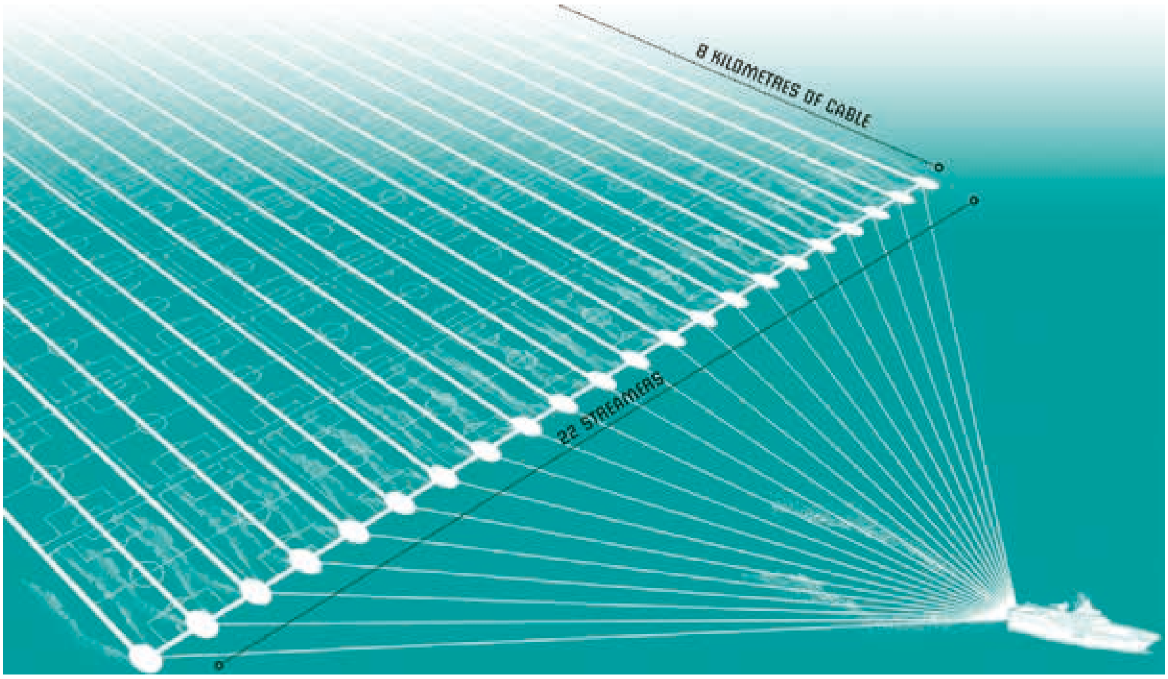
These 3D seismic survey vessels are deployed by the oil majors, and their systems provide geoscientists with the subsurface information they need to pinpoint and map potential hydrocarbon deposits and the geological formations around them.

With the sensitive equipment deployed from the vessel's stern worth up to 60 per cent of the value of the vessel, the cost of human error can be high. A full set of streamers can also take a number of days to deploy, depending on the size. Working 24/7 requires more than one exceptionally well trained crew, to minimise the potential for mishaps.

RIGHT: The simulator gives the operator access to the aft deck to perform the complex range of operations using the actual control systems that would be on board.

Digital

Experience the seismic simulator in the digital version of In-depth, available for free on Apple iTunes and the Googleplay Android store.



LARGE SCALE

This schematic illustrates the number and length of cables that can be deployed from the latest seismic survey vessels.

Although ship designs vary, the back deck of the vessel is the hub of activity during mobilisation – the deployment and retrieval of the towed streamers and sources. All are linked together and controlled from the vessel's control centre throughout the acquisition phase of the mission. The success of each mission depends on teamwork on the deck for a timely and trouble free mobilisation of a range of complex equipment.

Seismic operations

Seismic surveying relies on an energy source sending sound and pressure waves into the earth's crust, with some of the energy reflected back and recorded on sensors. The sensors record the time taken to travel through the earth's crust and back to their various locations.

On a vessel the energy is normally provided by air guns powered by compressed air. The pressure wave generated travels into the earth's crust and gets reflected back when it meets a geological boundary, for example the boundary between sand and rock layers.

After a few seconds the reflected pressure wave is detected by recording sensors, embedded at intervals along the streamers. The time it takes for the pressure wave to return to the streamers is recorded by the onboard logging system and indicates how far down the geological boundary is located.

The recordings are then analysed and transformed into detailed visual images for analysis by experts ashore. As multiple streamers are deployed and run in parallel about 50m apart, pulled out wide by vanes, similar to the doors that spread a fishing trawl, a detailed three-dimensional map of the subsurface can be created.

The number of streamers deployed depends on the vessel and the survey being undertaken. The latest vessels are designed to deploy up to 24 streamers. Each streamer can carry several hundred thousand recording sensors and a complete streamer rig can cover an area greater than $12km^2$, over eight times larger than Hyde Park.

Careful sequence of events

The designated survey area will have been programmed into the vessel's integrated navigation system. The seismic aft deck crew of four to five personnel work closely with the captain and monitor wind and weather. With the latest vessels capable of deploying streamers which can be between six and 12 km long, the streamer reels are normally two decks high.

Each streamer is deployed individually by its own winch, through a fairlead and out over the stern. The first thing to reach the sea is the float attached to the end of the streamer, containing GPS sensors with a radar beacon. To keep the streamer at its required depth, monitoring and control devices (birds) are attached at regular intervals. Great care must be taken to ensure they are correctly ballasted as the salinity of the water in the area being surveyed can affect the streamers in built buoyancy. Where the streamer is attached to its 1km long lead-in cable to the ship, the forward float is added and a spar line is connected to the deflector plate that is used to spread the streamers many times wider than the vessel.

"This complex process is repeated for each streamer," says Arnstein Erdal, Lead Product Trainer at the Ålesund Training Centre. "It requires constant monitoring and adjusting of the control system, while constantly adding equipment to the streamer. It is vital the deck crew work

"EFFICIENT CREWS ALSO SAVE TIME, WHICH IS IMPORTANT FOR THE VESSEL OPERATOR, AS THE VESSEL IS ONLY EARNING WHEN IT IS WORKING"

ABOVE: View of the actual aft deck with streamers deployed.

RIGHT: A short walk from the simulator, in the training workshop, is a working seismic winch, enabling students to also train on real equipment.

Photograph by Peter Otto Dybvik

together seamlessly and can second guess each other's action in any given situation.

"This only comes by working together. Efficient crews also save time, which is important for the vessel operator, as the vessel is only earning when it is working."

With the streamers in position the energy source equipment, normally air guns, can then be deployed. The normal arrangement is six to eight arrays with multiple guns towed some 500m behind the vessel. They are programmed to fire at ten-12 second intervals. All the in-sea equipment can be checked for position and is operated from the control room.

The new simulator has been designed to accurately represent the view of the aft deck and links to the control system that would be on board. "Our aim is to give a near true life experience where all the complexities of these operations can be practised," adds Arnstein. "Faults and difficult working scenarios are injected as confidence increases, to ensure the crew can cope with virtually any set of circumstances. We are constantly developing the simulator to provide more functionality."

As the deployment of a full streamer set-up can take a number of days working 24/7, simulator training means multiple crews can be trained.

Real equipment

Crews can also step from the simulator into the real world

in just a few seconds. The workshop area of the Training Centre is a neighbouring room and houses a fully functioning streamer winch with its hydraulic control system and remotes. All operating modes can be run, including cable parameter setting as well as maintenance and trouble shooting on both the electrical and hydraulic equipment, as installed on the actual vessel.

Several other seismic and subsea courses are run at the Centre, with others soon to be added. Instructors also regularly visit customers to provide bespoke courses. AL

FIND OUT MORE ~
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Taking care of THE FUTURE

Rolls-Royce is introducing a new concept to provide long-term service for its customers' vessels

Owners and operators are always looking for ways to drive down through-life costs while improving the availability of their vessels.

Maintenance is a key consideration, and Rolls-Royce has introduced an agreement known as MarineCare, which will provide individual solutions matched to the specific vessel and its operating profile. The first such contract is now being piloted with offshore vessel owner Island Offshore.

Optimised manning, tighter budgets and more demanding operations are driving the need for new support concepts. MarineCare works with customers to move the focus to an agreement focused on availability, with fixed costs that offer an incentive to both sides to meet agreed service levels.

MarineCare contracts will be tailored to the customer and matched to each vessel. The agreed annual fee is based on the level of service selected and the vessel's operating profile. This provides visibility, with predictable maintenance costs, and unplanned breakdowns are minimised with the integration of planned maintenance and Equipment Health Management (EHM).

As the designer of most of the vessel's equipment, Rolls-Royce is best placed to make decisions on the level and type of maintenance required, and what parts may need to be replaced, allowing the customer to focus on core activities. Under the terms of the arrangement, Rolls-Royce will take full support responsibility for the engines, thrusters and its other equipment installed on Island Offshore's platform supply vessel, *Island Chieftain*, over the next eight years.

This is a pilot project for both companies, with an emphasis on optimising vessel availability, maintenance planning and enhancing knowledge of Rolls-Royce

Rolls-Royce will support the engines, thrusters and its other equipment installed on Island Offshore's platform supply vessel, *Island Chieftain*, over the next eight years for a fixed annual fee.

INSET: Trond Hauge, Technical Manager of Island Offshore.

systems in operation.

"Effective through-life support is important to us and our customers," says Geir Oscar Løseth, Sales Manager - Offshore Supply & Services Europe. "This agreement will focus on maximising vessel availability through the provision of comprehensive planned and unplanned service support, together with use of our EHM capability to continuously monitor equipment during operation. This information will be regularly communicated to the crew to prevent unforeseen problems from occurring."

EHM provides a clearer view of how the ship's main equipment is performing, to spot trends that could affect maintenance scheduling and vessel availability.

Having an in-depth knowledge of how a vessel's power and propulsion system is operating gives confidence to the operator for continued safe performance, and means the data generated can be used to help control through-life costs and ensure that maintenance is carried out when needed.

Island Offshore will pay a fixed annual fee throughout the contract period, with key performance indicators and regular review meetings agreed to ensure that we are focused on delivering against customer expectation.

Trond Hauge, Technical Manager of Island Offshore, said: "Our goal is to save costs through increased up-time, longer service intervals and improved operational technical support from Rolls-Royce – one of our key suppliers. It is also important that we have the maker involved in service and maintenance work, to avoid conflicts with class requirements. If the *Island Chieftain* agreement proves successful, we will consider entering into contracts for several ships."

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