



Naval solutions

WE MOVE YOU. WITH AGILITY
AND POWER.



A Rolls-Royce
solution



CONTENTS

01 Power to Protect Power to Perform	04	08 Emission reduction technologies	24
		Low emissions. Maximum flexibility	24
02 System solutions	06	09 Marine automation systems	30
More than steel. More than diesel engines	06	Controlling the power with	
A lifetime of intelligent power	08	mtu NautIQ marine automation solutions	30
03 Applications overview	10	10 mtu AR technology	36
Propulsion systems tailored to your needs	10	Enabling secure and	
		reliable naval operations	
04 Engines	12	in a challenging environment	36
Decisive action requires a strong heart	12		
All engines at a glance		11 Life cycle solutions	38
Ready for duty	14	Our mission:	
05 Gensets	18	Optimize your fleet availability and uptime	38
Gensets for service power and propulsion	18	In-service contracts	39
		Genuine spare parts	40
06 Propulsion systems	20	Local Support - worldwide	41
Combined propulsion systems - customized options	20	Turn back the clock	42
		Technical documentation	43
07 E-Drive solutions	22		
Higher performance	22		
More flexibility	22		

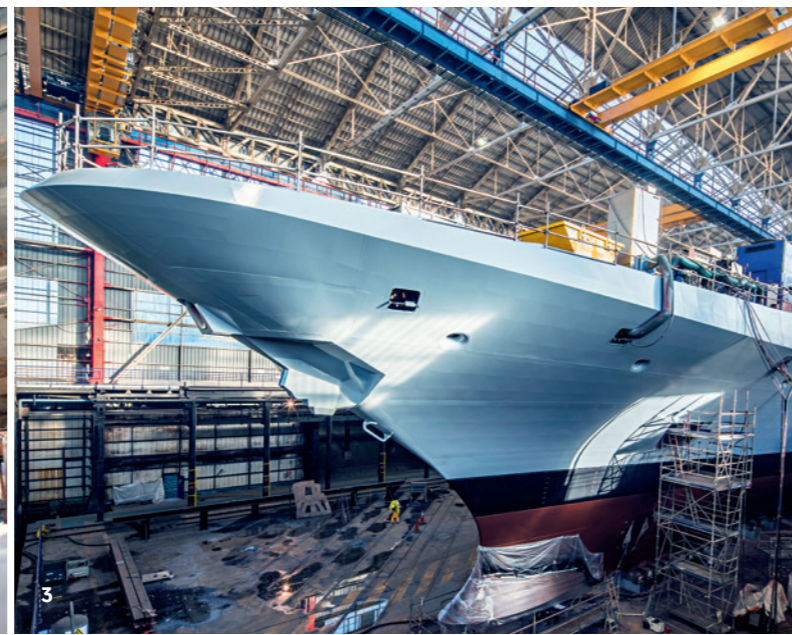
We provide comprehensive engineering and technical support for the design and implementation of a vessel's propulsion system.



POWER TO PROTECT POWER TO PERFORM

01

We at Rolls-Royce provide world-class power solutions and complete life-cycle support under our product and solution brand **mtu**. Fully utilizing the potential of digitalization and electrification, we strive to develop climate-neutral drive and power generation solutions that are even cleaner and smarter and thus provide answers to the challenges posed by climate change and the rapidly growing societal demands for energy and mobility. We deliver and service comprehensive, powerful and reliable systems, based on both gas and diesel engines, as well as electrified hybrid systems.



A solution provider

mtu systems power the most modern yachts, the strongest tugboats and the biggest land vehicles and provide energy for the world's most important mission-critical applications. With advanced solutions such as microgrids we integrate renewable energies and manage the power needs of our customers.

For over 110 years we have provided innovative solutions for our customers – meeting even the most demanding drive and power requirements. Our products and services span a wide range of applications and power needs, with both standard and customized options.

An expert in technology

mtu products are known for cutting-edge innovation and technological leadership. That same spirit of innovation inspires our sustainability efforts. Our focus is on developing and implementing system solutions that both maximize efficiency and reduce emissions – which in turn helps to reduce our impact on the environment.

A passionate and reliable partner

We at Rolls-Royce spend every day working together with our customers, to deliver engines, systems and complete life-cycle solutions that best fit their needs. We understand that each application is different and has its own specific demands. Our engineers embrace the challenge of finding the perfect solution for your unique power requirements. Every step of the way – from project planning, through design, delivery and commissioning; to the lifetime care of your equipment – we are dedicated to helping you get the most from your **mtu** investment.



You want to know more about **mtu** solutions?

 **Get in touch with us.**

1 U.S. Coast Guard National Security Cutter CODAG 2x 20V 1163 TB 93, gasturbine

2 We are a reliable partner that sets trends. We look ahead to ensure the best results for our customers.

3 We are passionate about fulfilling the needs of our customers with the utmost professionalism and precision.

4 As a supplier of high-quality performance propulsion solutions, we stand for the highest level of technological expertise.

System solutions

MORE THAN STEEL MORE THAN DIESEL ENGINES

02

Our engines and propulsion systems play an important role in many countries' armed forces. Our navy propulsion systems are based on **mtu** commercial shipping engines, thousands of which operate successfully all over the world. They are modified according to the special requirements of military and governmental vessels. High power density, low weight, compact design, and mechanical and thermal stability characterize **mtu** engines, just as much as simple operation, straightforward maintenance, and low life cycle costs.

Ready for your missions
More than half a century of experience and expertise
makes us a strong partner – worldwide, whatever
mission you are on.

System solutions

A LIFETIME OF INTELLIGENT POWER

Our propulsion is with you all the way, from planning and design to operation. Our expertise in ship applications encompasses every possible propulsion configuration, including engineering services, hardware, and software. No matter how extraordinary your requirements, we can supply tailor-made solutions for vessels ranging from small patrol boats to destroyers.

PLANNING AND DESIGN

Planning

We supply a complete propulsion solution. Our engineers provide extensive analysis, documentation, and risk mitigation services as well as integrated mechanical, electrical, and electronic interfaces.

Propulsion system integration

We provide comprehensive engineering and technical support for the design and implementation of a vessel's propulsion system. Our PSI team helps to reduce design, installation, and commissioning costs.

PROCUREMENT AND CONSTRUCTION

Propulsion and onboard power generation system

Our engines and propulsion systems are characterized by their high power density, low weight, and excellent response behavior as well as simple operation, optimized maintenance, and low life cycle costs.

OPERATION

Integrated Logistics Support

Designed to meet the unique challenges of Naval operations, Integrated Logistics Support (ILS) delivers a customized package – including analysis, spare parts, training and technical documentation – designed to keep your *mtu* equipment up and running and help you reduce costs throughout the entire life cycle.

mtu ValueCare

Every client is different. Our comprehensive *mtu* ValueCare service solutions portfolio allows us to tailor offerings for each individual customer aimed at maximizing performance, uptime, and lasting value – at every step:

- Complete support and service solutions encompassing spare parts, on-site support, technical documentation and customized support solutions

Modernization

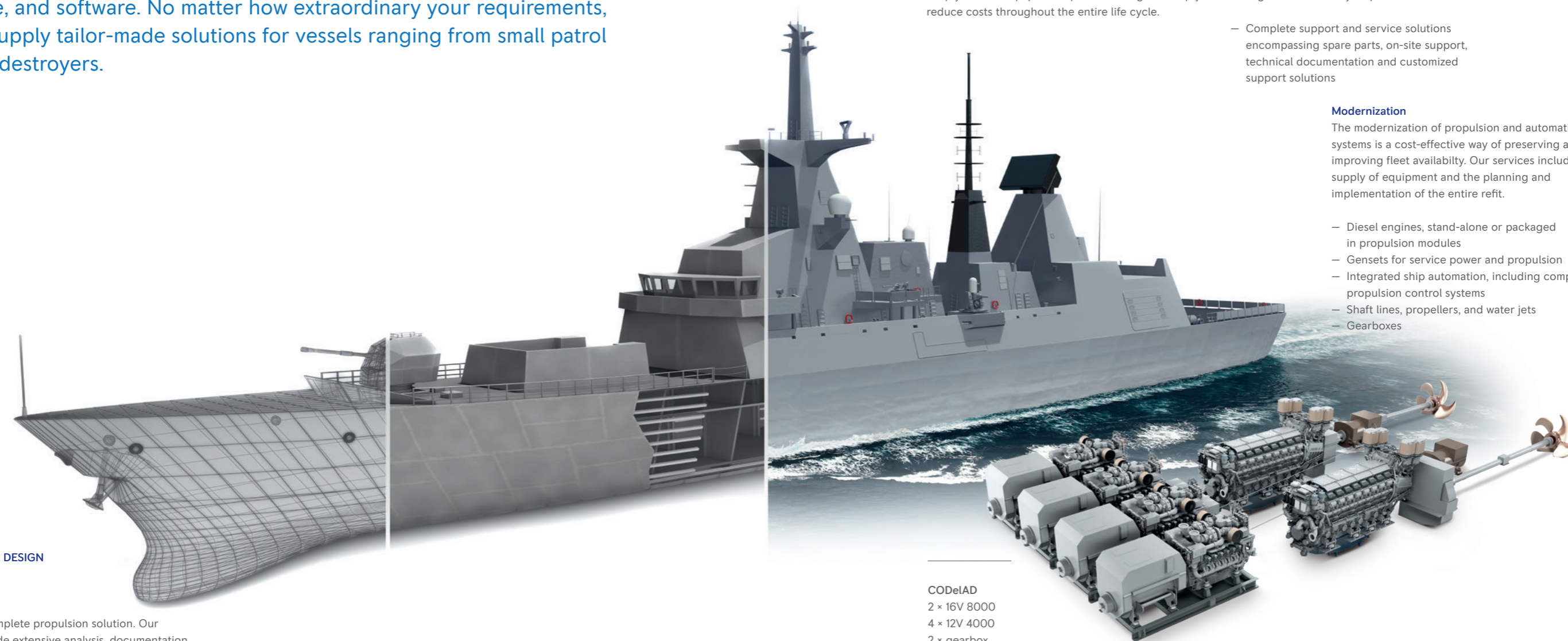
The modernization of propulsion and automation systems is a cost-effective way of preserving and improving fleet availability. Our services include the supply of equipment and the planning and implementation of the entire refit.

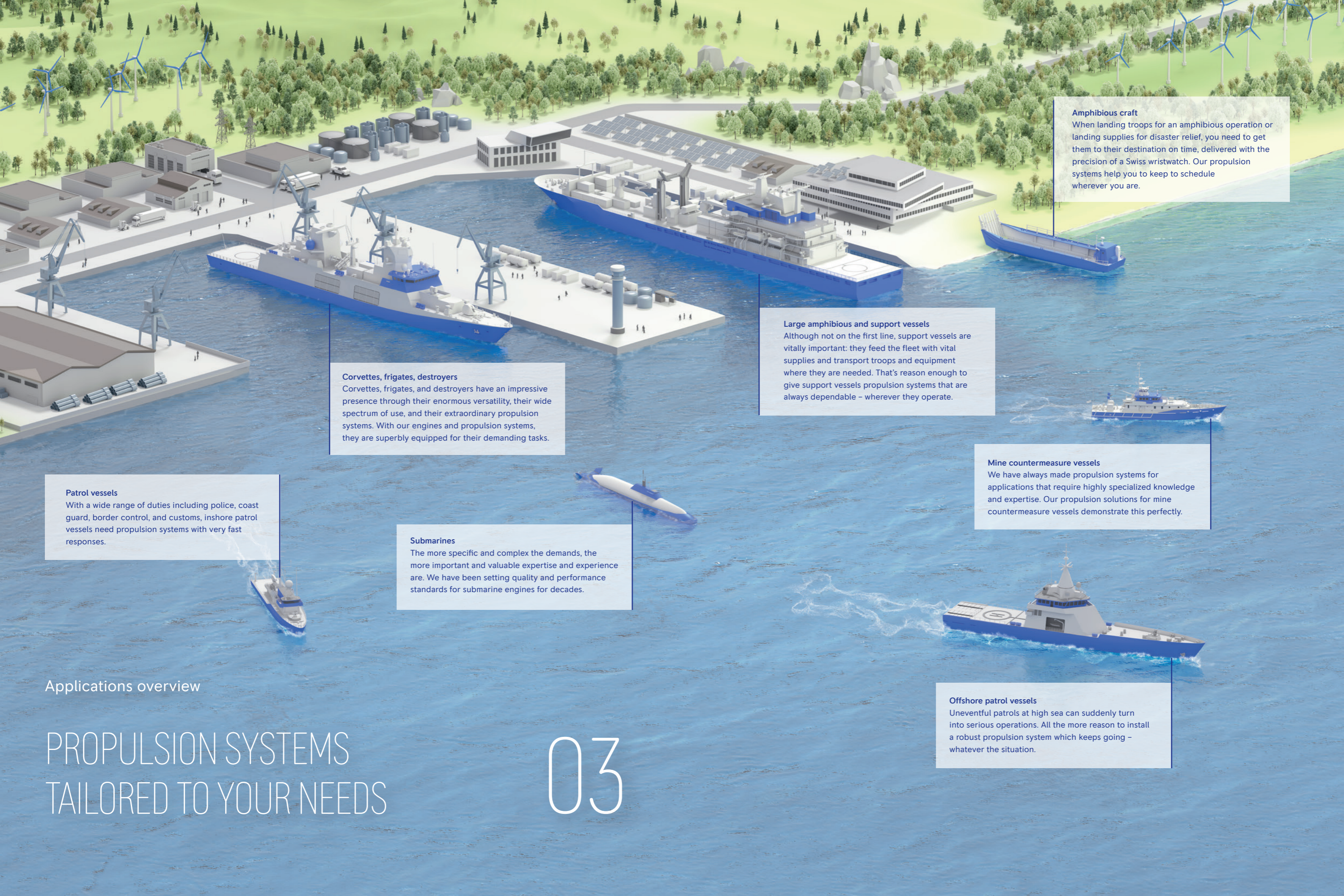
- Diesel engines, stand-alone or packaged in propulsion modules
- Gensets for service power and propulsion
- Integrated ship automation, including complete propulsion control systems
- Shaft lines, propellers, and water jets
- Gearboxes

CODeIAD
2 × 16V 8000
4 × 12V 4000
2 × gearbox
2 × e-drive

Integrated automation system

Our *mtu* NautIQ marine automation solutions allow operators to monitor and control the whole propulsion plant, the onboard power supply, and the entire vessel. Our automations systems are versatile, user-friendly, and modular.





Amphibious craft
When landing troops for an amphibious operation or landing supplies for disaster relief, you need to get them to their destination on time, delivered with the precision of a Swiss wristwatch. Our propulsion systems help you to keep to schedule wherever you are.

Large amphibious and support vessels
Although not on the first line, support vessels are vitally important: they feed the fleet with vital supplies and transport troops and equipment where they are needed. That's reason enough to give support vessels propulsion systems that are always dependable – wherever they operate.

Corvettes, frigates, destroyers
Corvettes, frigates, and destroyers have an impressive presence through their enormous versatility, their wide spectrum of use, and their extraordinary propulsion systems. With our engines and propulsion systems, they are superbly equipped for their demanding tasks.

Patrol vessels
With a wide range of duties including police, coast guard, border control, and customs, inshore patrol vessels need propulsion systems with very fast responses.

Submarines
The more specific and complex the demands, the more important and valuable expertise and experience are. We have been setting quality and performance standards for submarine engines for decades.

Mine countermeasure vessels
We have always made propulsion systems for applications that require highly specialized knowledge and expertise. Our propulsion solutions for mine countermeasure vessels demonstrate this perfectly.

Offshore patrol vessels
Uneventful patrols at high sea can suddenly turn into serious operations. All the more reason to install a robust propulsion system which keeps going – whatever the situation.

Applications overview

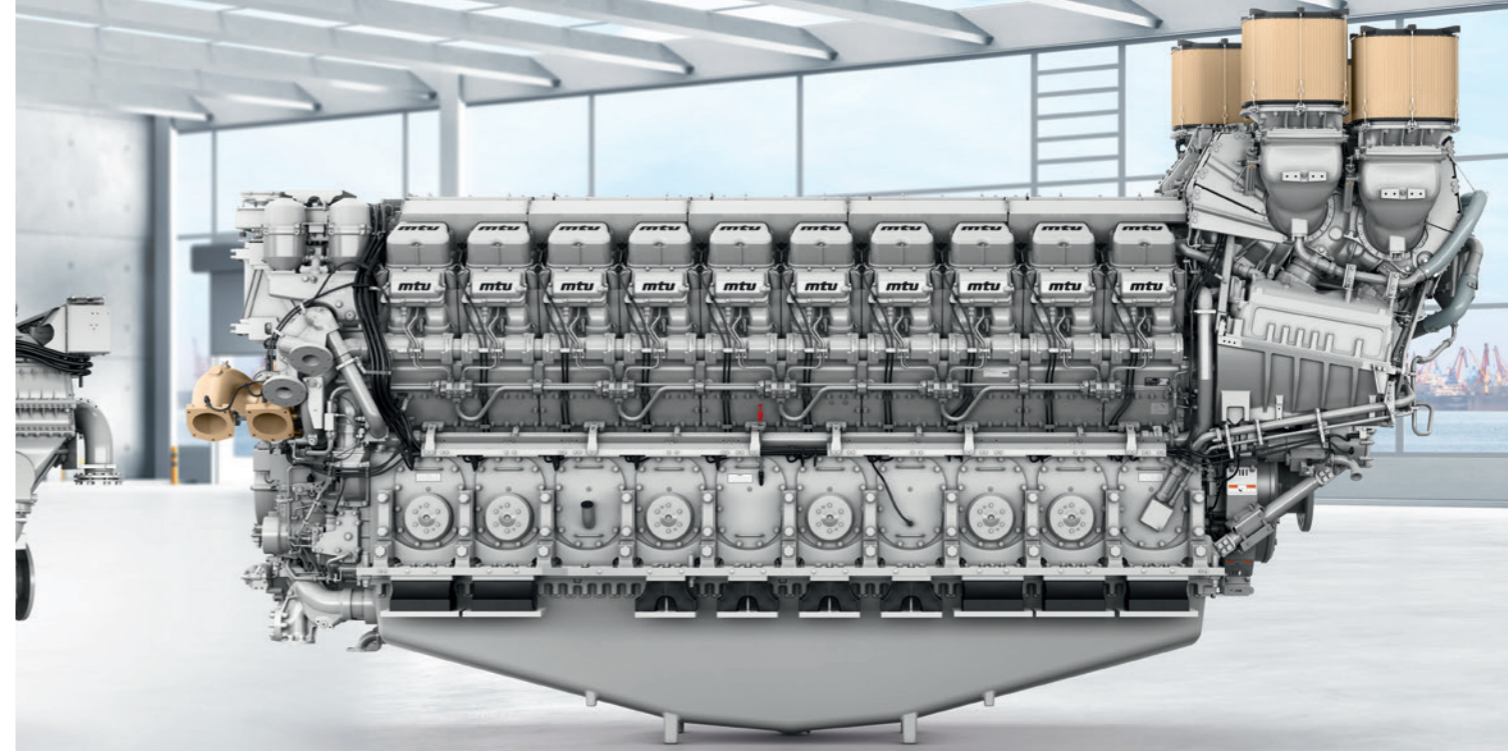
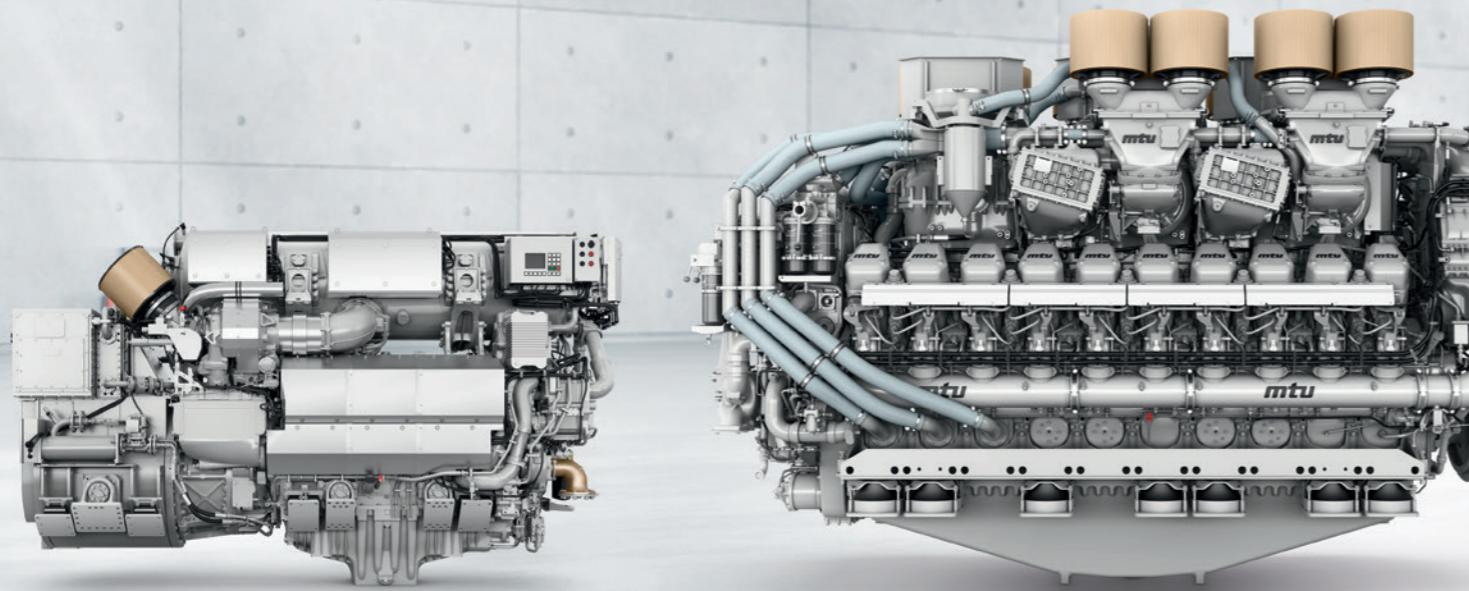
PROPULSION SYSTEMS TAILORED TO YOUR NEEDS

Engines

DECISIVE ACTION REQUIRES A STRONG HEART

04

The higher the requirements and the more specific the application, the clearer the need for one of our propulsion systems, including **mtu** engines, gearbox, shaftline, and propeller/waterjet. We develop the optimum propulsion solutions for all individual tasks – solutions with the highest performance, greatest reliability and availability as well as superior agility.

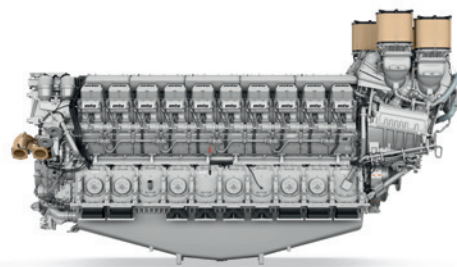


Engines

ALL ENGINES AT A GLANCE READY FOR DUTY

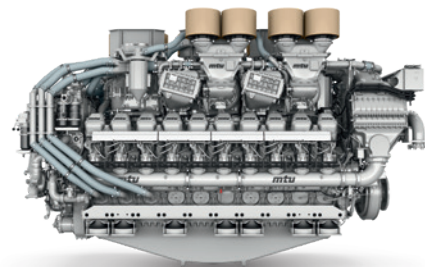
Our customized solutions for large military vessels correspond to strict navy standards and guarantee:

- High reliability and availability
- A broad engine characteristic map and unlimited low load capability
- High power concentration despite low weight
- Excellent maneuverability and acceleration
- Low acoustic, optical, and infrared signatures
- Substantial shock-proofing
- Low fuel consumption over the entire operating range
- Long maintenance intervals



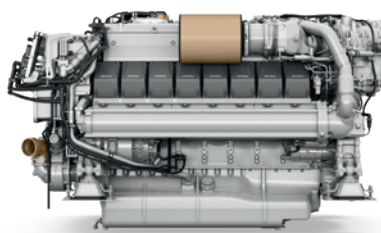
mtu Series 2000

The powerful heart for maximum agility
720–1,939 kW (966–2,600 bhp)
Available as: 8V, 10V, 12V, and 16V
Optional: SCR solution available to meet IMO III and EPA Tier 4 emission regulations



mtu Series 4000

One of the most successful heavy-duty engines ever
746–4,300 kW (1,000–5,780 bhp)
Available as: 8V, 12V, 16V, and 20V
Optional: SCR solution available to meet IMO III and EPA Tier 4 emission regulations



mtu Series 1163

The proven, evolved engine for the naval sector
4,800–7,400 kW (6,437–9,923 bhp)
Available as: 12V, 16V and 20V
Optional: we will offer SCR solutions to meet IMO III emission regulations

Analytics

We use the most diverse analysis and simulation tools to develop state-of-the-art propulsion solutions. That includes vibration analysis, component strength verification, and dynamic response simulations of entire propulsion systems.

Electronics

The latest generation of our electronic management system, Advanced Diesel Engine Control (ADEC), controls key systems such as fuel injection and turbocharging that improve fuel consumption, and emission levels as well as vessel performance.

Fuel injection

We optimize fuel combustion in the cylinder by means of its electronically controlled commonrail fuel injection system in combination with other technologies such as exhaust gas recirculation.

Power range

The wide range of engines meet the most extreme demands that can be required from propulsion systems. Solutions include the highest performance, greatest reliability and availability as well as superior agility.

Mounting

Our engines are installed on special rubber mountings to reduce the transmission of structure-borne noise to the ship's hull. New active mountings support the passive rubber mountings and make their noise reduction far more effective.

Demagnetization

We are a leader in the field of propulsion systems with low magnetic and acoustic signatures, allowing us to reduce the magnetism of all ferromagnetic parts with our own method to a stable minimum.

Aftertreatment

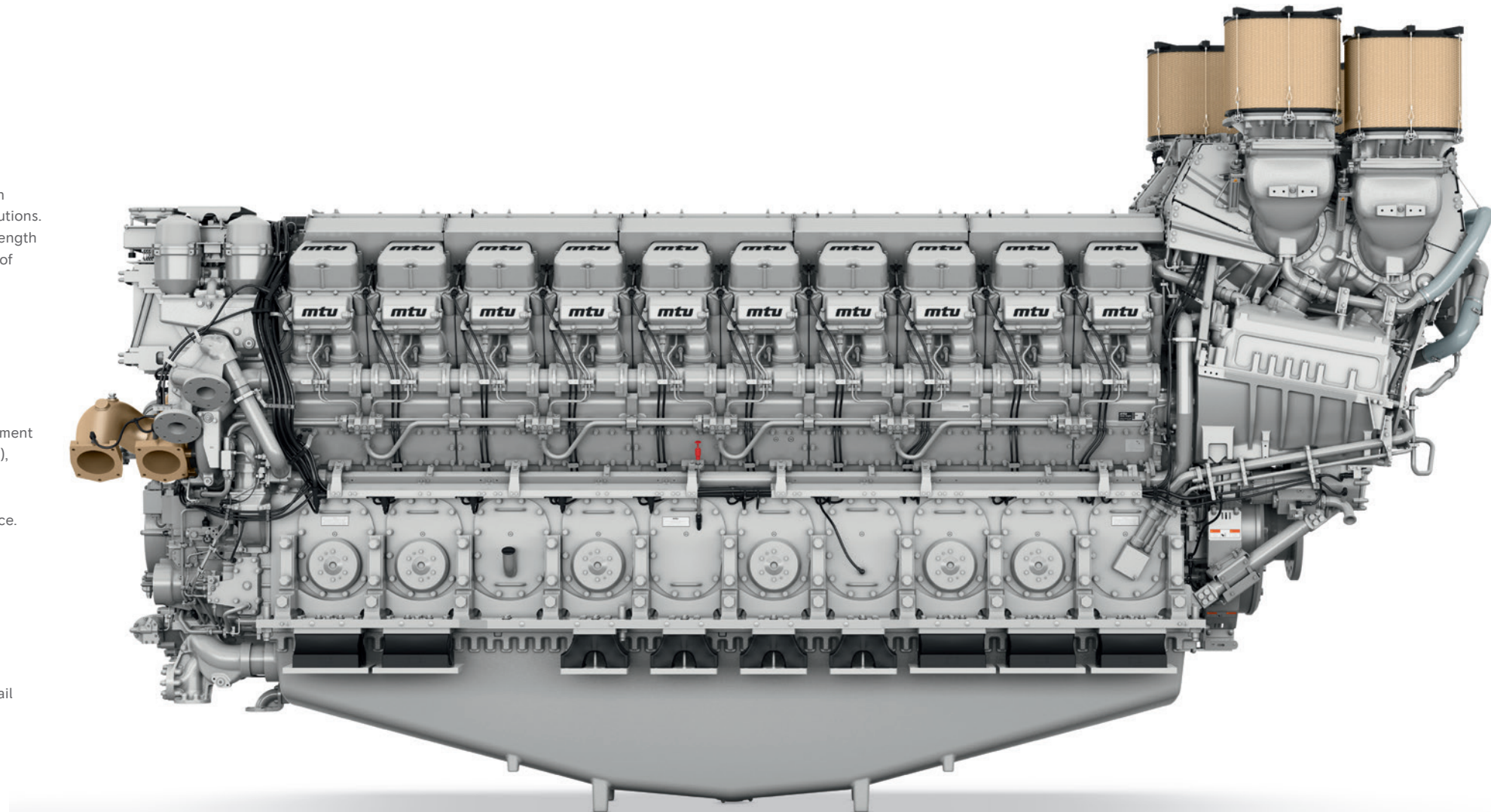
We offer selective catalytic reduction systems (SCR) to meet IMO Tier III emission regulations.

Renewable fuels

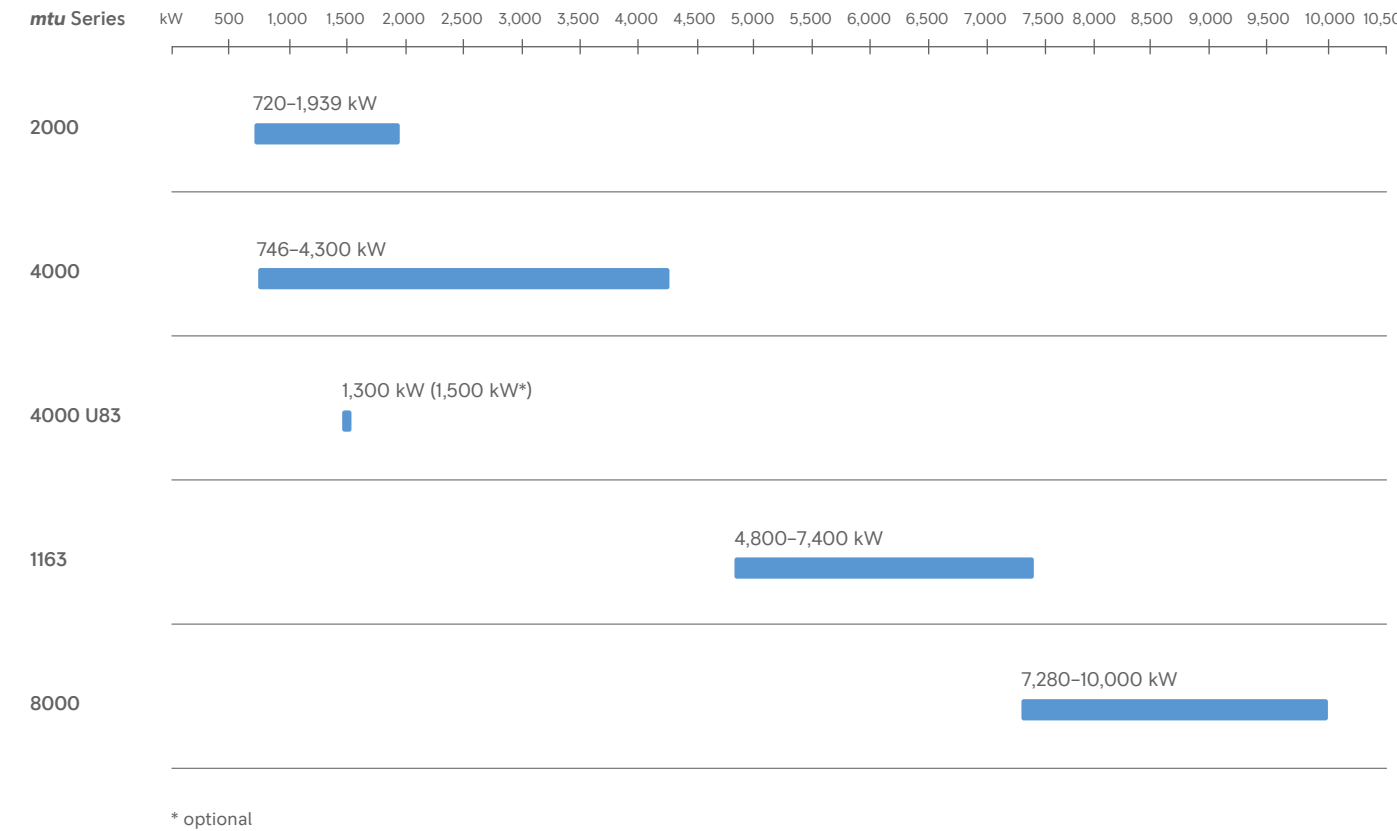
In addition to meeting the highest fuel efficiency standards, our **mtu Series 2000 & 4000** engines can also run on renewable fuels such as hydrogenated vegetable oil (HVO) and gas-to-liquid (GTL) in accordance with the EN15940 standard. The use of renewable fuels such as HVO can lead to a reduction in CO₂ emissions of up to 90%, depending on the fuel manufacturer. The use of these fuels has been successfully proven in practice on the test bench and in the field. EN15940 compliant fuels are approved for use in all **mtu Series 2000 & 4000** system configurations and emission calibrations from 2023.

Turbocharging

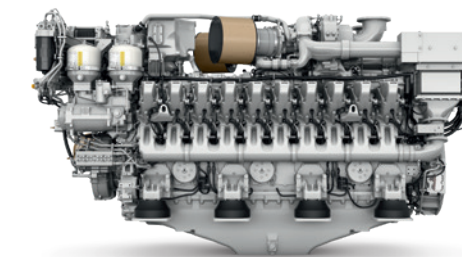
We develop and produce our own turbochargers for high-performance applications. Turbocharging helps to achieve low fuel consumption and high performance across a broad range of operating speeds.



You want to know more about the **mtu** engine portfolio?

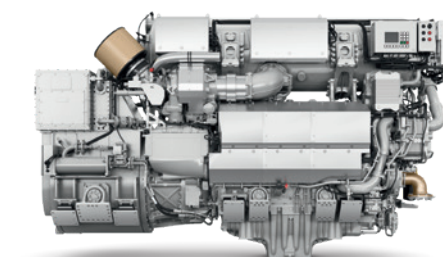


Scan the QR code for more information about marine solutions and detailed technical data.



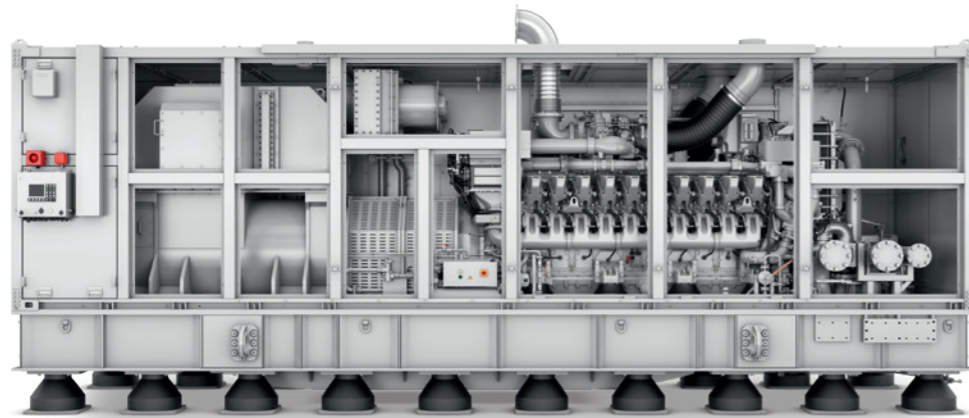
mtu Series 4000

One of the most successful heavy-duty engines ever
746–4,300 kW (1,000–5,780 bhp)
Available as: 8V, 12V, 16V, and 20V
Optional: SCR solution available to meet IMO III and EPA Tier 4 emission regulations

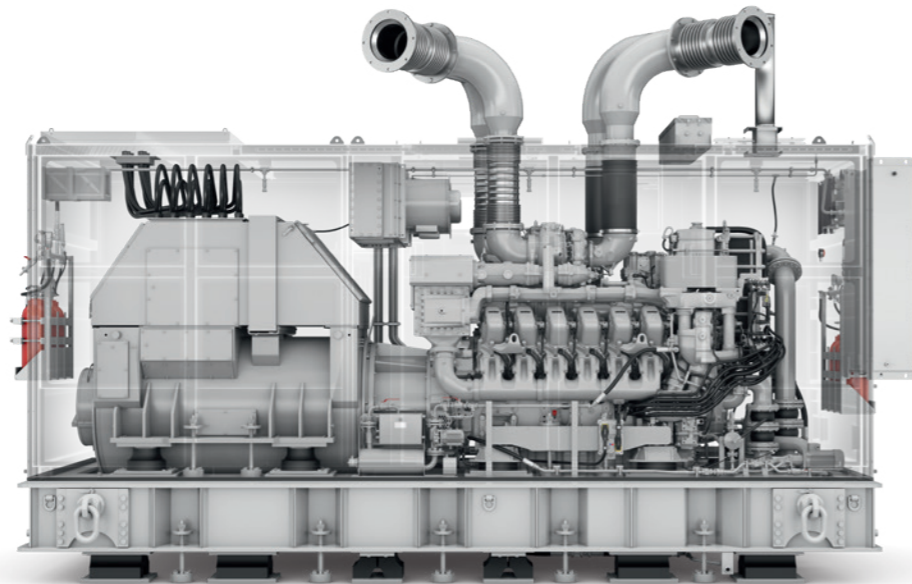


mtu Series 4000 U83

The battery charging unit for submarines
1,300 kW (1,500kW*)
Available as: 12V



20V 4000 M65L Genset



12V 4000 M53B Genset

Baseframes in different designs for different purposes



Gensets

GENSETS FOR SERVICE POWER AND PROPULSION

05

Our flexible genset solutions are tailored to your needs. You can order them in standardized or customized versions:

- Standardized gensets for cost-effectiveness and favorable lead times based on our proven **mtu** Series 4000 engines
- Customized gensets tailored to the specific requirements for the most challenging conditions

Based on our successful **mtu** Series 4000 engines, they serve power demands between 895 and 3,200 kWm.

System support from a single source

Upon request, we can act as single-source vendor to take on the technical and commercial responsibility for the entire propulsion, power generation, and automation system – from project engineering and management to support and service. Consolidating these responsibilities reduces the number of interfaces and, therefore, the risks both to the shipyard and the end user.

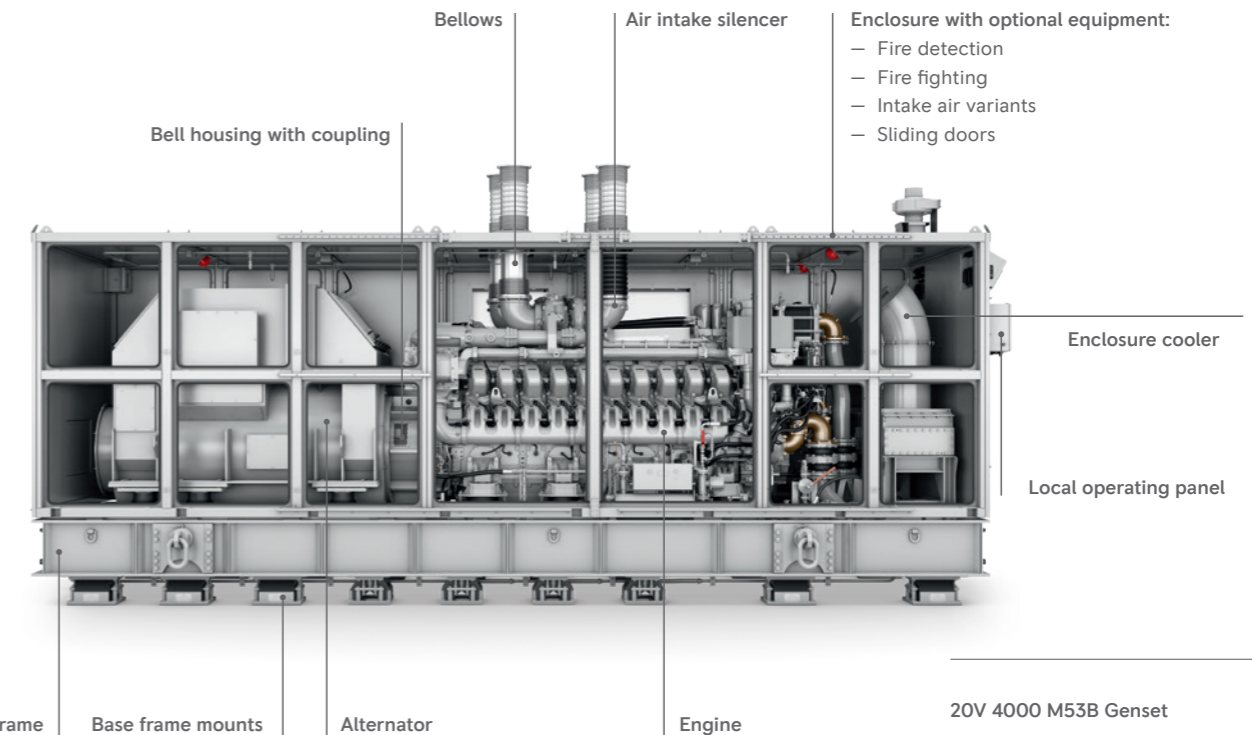
Resilient mounting system for acoustic and shock requirements

mtu advanced gensets are engineered and based on a proven design. Depending on your individual requirements, you can choose between a constant or variable speed configuration.

The characteristic feature of these gensets is its double-resilient mounting system, which reduces structure and airborne noise emissions that can significantly reduce the acoustic signature of the vessel.

Preinstallation of components such as filters directly on the base frame reduces installation work and space, allowing easy connection to the ships' interfaces and fast commissioning. All gensets are fully pretested at our test facilities with respect to technical guarantees so that component function and readiness for operation on board are proven.

Overall, **mtu** advanced gensets provide the most attractive cost/performance ratio on the market. The **mtu** genset will be operated and monitored by the **mtu** NautIQ Genoline NG system including a local operating panel (LOP).



20V 4000 M53B Genset

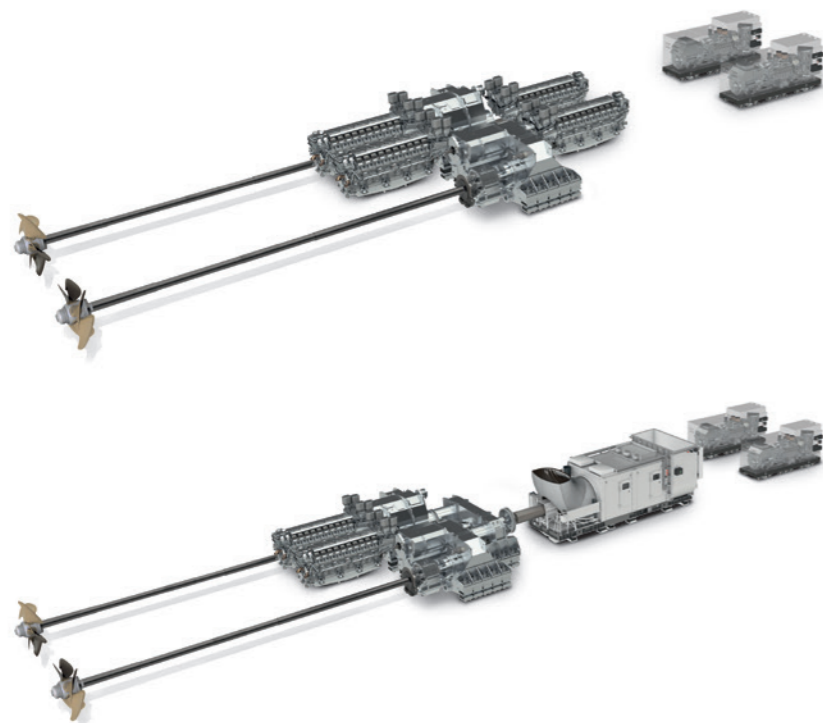
Propulsion systems

COMBINED PROPULSION SYSTEMS – CUSTOMIZED OPTIONS

06

We can deliver combined propulsion systems customized to your needs. You can rely on us to design, build, and integrate the complete propulsion system including gearbox, shaftline, propeller/waterjet, and automation systems. Our engineers provide extensive analysis, documentation and risk reduction services, as well as integrated

mechanical, electrical and electronic interfaces. Our propulsion systems demonstrate excellent reliability and flexibility. Our on-site engineers supervise the installation of the system, ensuring efficient propulsion system commissioning and trials. The automated control of the system is performed by the **mtu** NautIQ.



1 CODAD (Combined diesel and diesel) with controllable pitch propellers, e.g. 4 x mtu 20V 8000

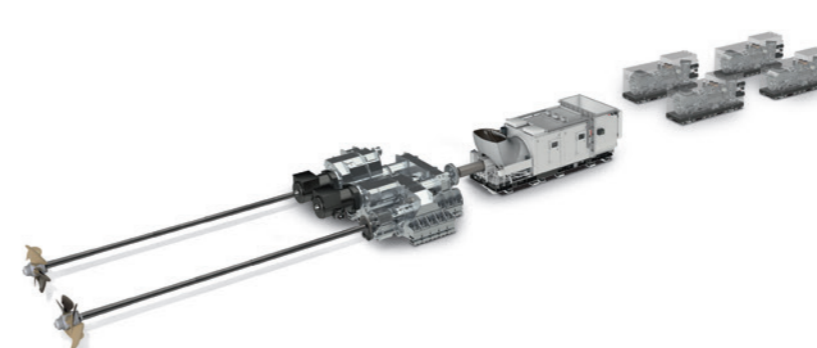
Four diesel engines power two controllable pitch propellers (CPP) through two main gearboxes. In cruising operation, one diesel engine powers both shafts; for maximum speed the other two diesel engines are also switched on.

2 CODAG (Combined diesel and gas turbine) and CODOG (Combined diesel or gas turbine) with controllable pitch propellers, e.g. MT30 + 2 x mtu 20V 8000

Two diesel engines and/or a gas turbine power both CPPs through two main gearboxes and a cross-connect gearbox. If only one diesel engine or only the gas turbine is running, the two CPPs are equally powered through the cross-connect gearbox. If both diesel engines are running, this gearbox can be declutched. Using a two-stage gearbox, one diesel engine can bring the ship to cruising speed. Top speed is reached with the gas turbine or diesel engines and gas turbine.



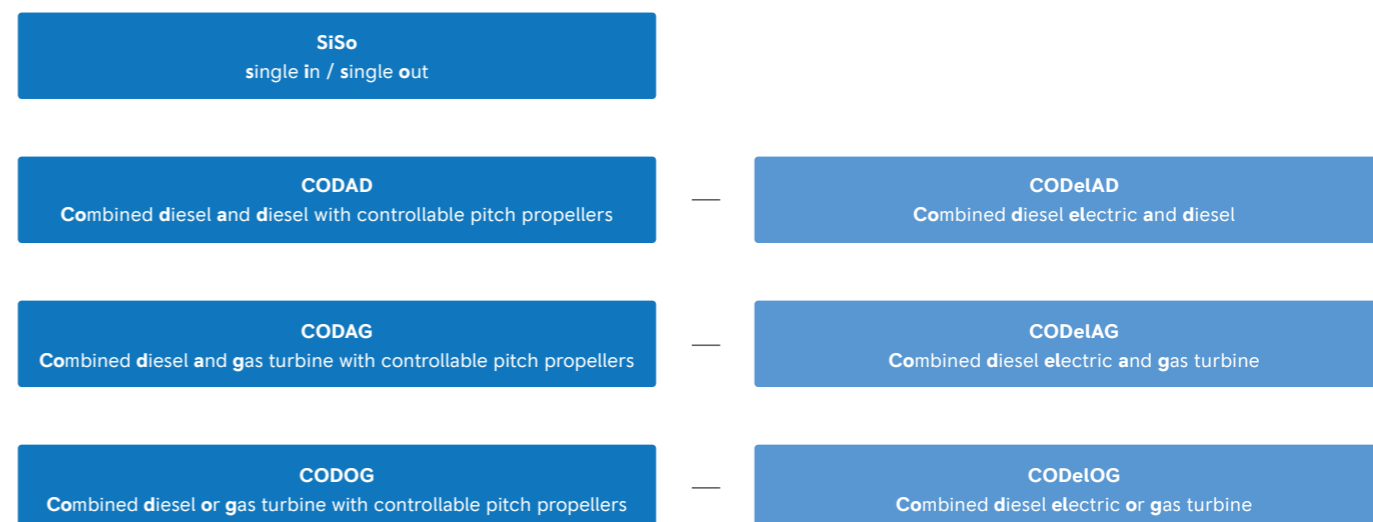
You want to know more about **mtu** propulsion systems?



3 CODelAG (Combined diesel electric and gas turbine) CODelOG (Combined diesel electric or gas turbine), e.g. MT30 + 2 x E-Engine

The diesel engines drive generators, which produce electricity for two electric propulsion motors. A gas turbine drives two propeller shafts with CPPs via a gearbox either alone or in combination. The diesel-electric propulsion units ensure the cruising speed of the vessel. Maximum speed is reached when the propulsion system of the vessel runs in combined mode, i.e. diesel-electric plus gas turbine.

PROPULSION VARIANTS

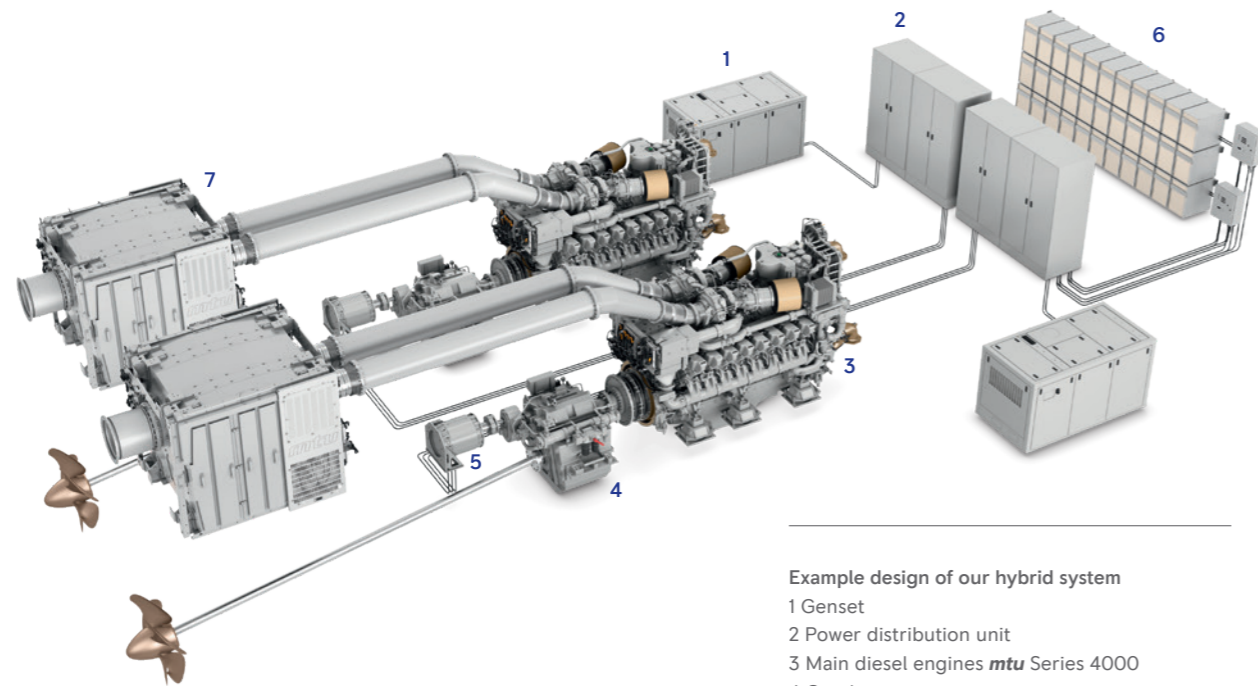


E-Drive solutions

HIGHER PERFORMANCE MORE FLEXIBILITY

07

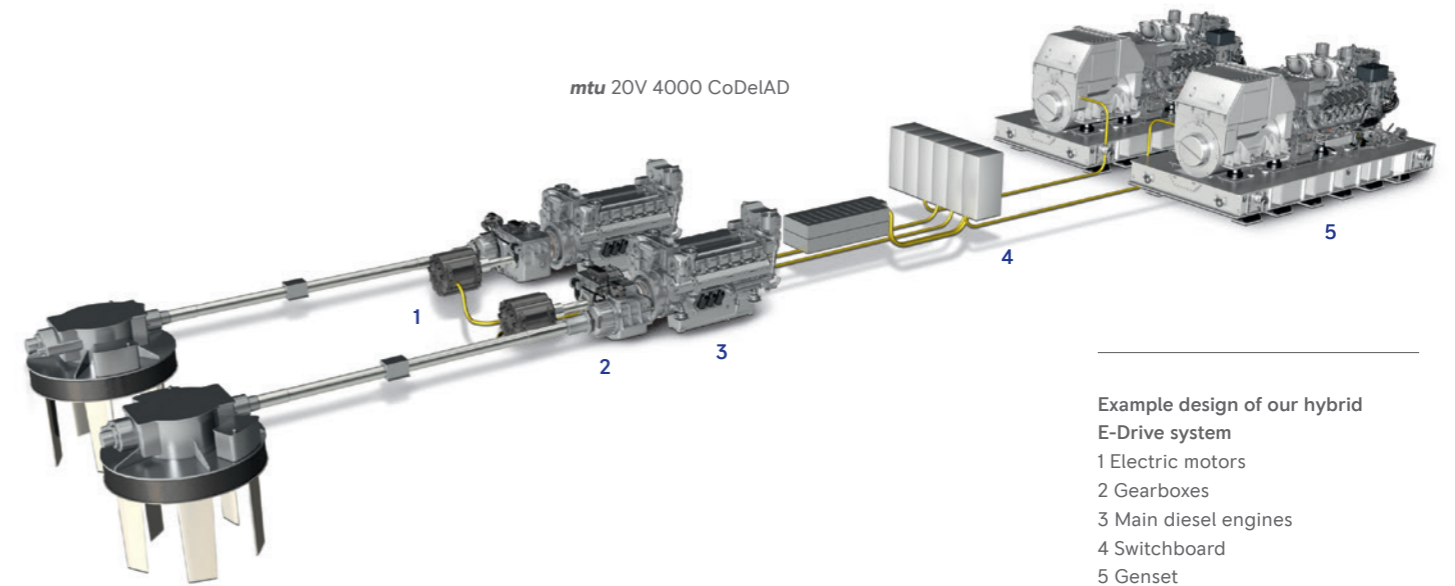
Hybrid PropulsionPacks based on the proven **mtu** Series 2000 and 4000 and E-Drive systems are ideal for more flexibility and maximum ease of use. What's more, conventional electric drive systems can be upgraded using optional battery modules to enable silent operations.



Example design of our hybrid system
1 Genset
2 Power distribution unit
3 Main diesel engines **mtu** Series 4000
4 Gearbox
5 Electric motor module
6 Battery module
7 SCR box (selective catalytic reduction)

mtu hybrid propulsion for patrol vessels

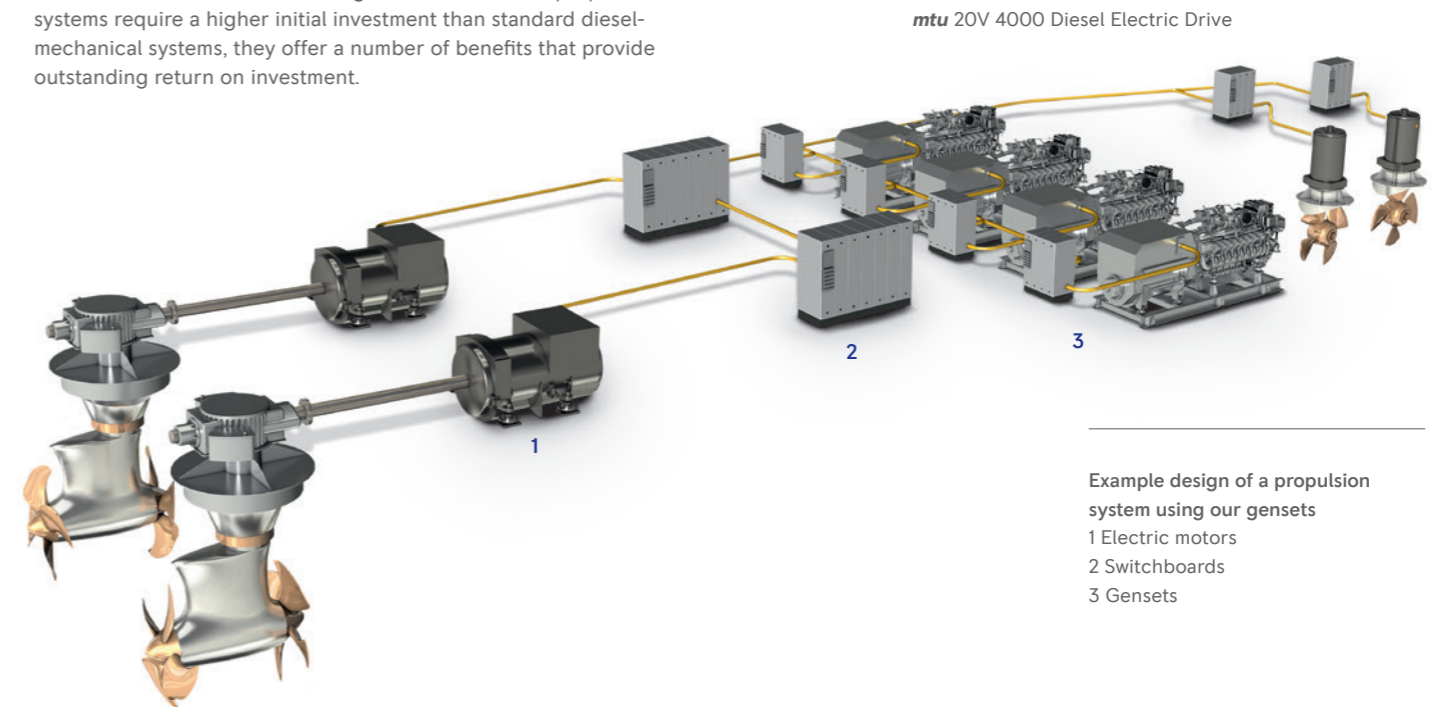
The main advantages of hybrid systems for marine applications is to optimize the vessel's maneuverability through its high system redundancy and flexibility. In addition hybrid systems are improved in reducing noise and vibration, the ability to enter ECA (Emission Controlled Areas) and the reduction of life cycle costs for the diesel main propulsion system through ideal engine utilization.



Example design of our hybrid E-Drive system
1 Electric motors
2 Gearboxes
3 Main diesel engines
4 Switchboard
5 Genset

Innovative E-Drive solutions

Our mechanical, electrical, logical, and thermal system integration engineering helps manage the complexity of E-Drive systems. We design and supply customer-specific E-Drive systems including fully integrated automation systems based on the proven **mtu** Series 2000 and 4000 marine diesel engines. While E-Drive propulsion systems require a higher initial investment than standard diesel-mechanical systems, they offer a number of benefits that provide outstanding return on investment.



Example design of a propulsion system using our gensets
1 Electric motors
2 Switchboards
3 Gensets

Emission reduction technologies

LOW EMISSIONS MAXIMUM FLEXIBILITY

08

The sea is a sensitive environment. Assuming responsibility for protecting the water and air and keeping them clean is second nature to us. We have always played a leading role in developing environmentally friendly engines and, in particular, solutions for reducing emissions. All the key technologies are bundled within our company.



You want to know more about *mtu* after treatment solutions?

Selective catalytic reduction solution

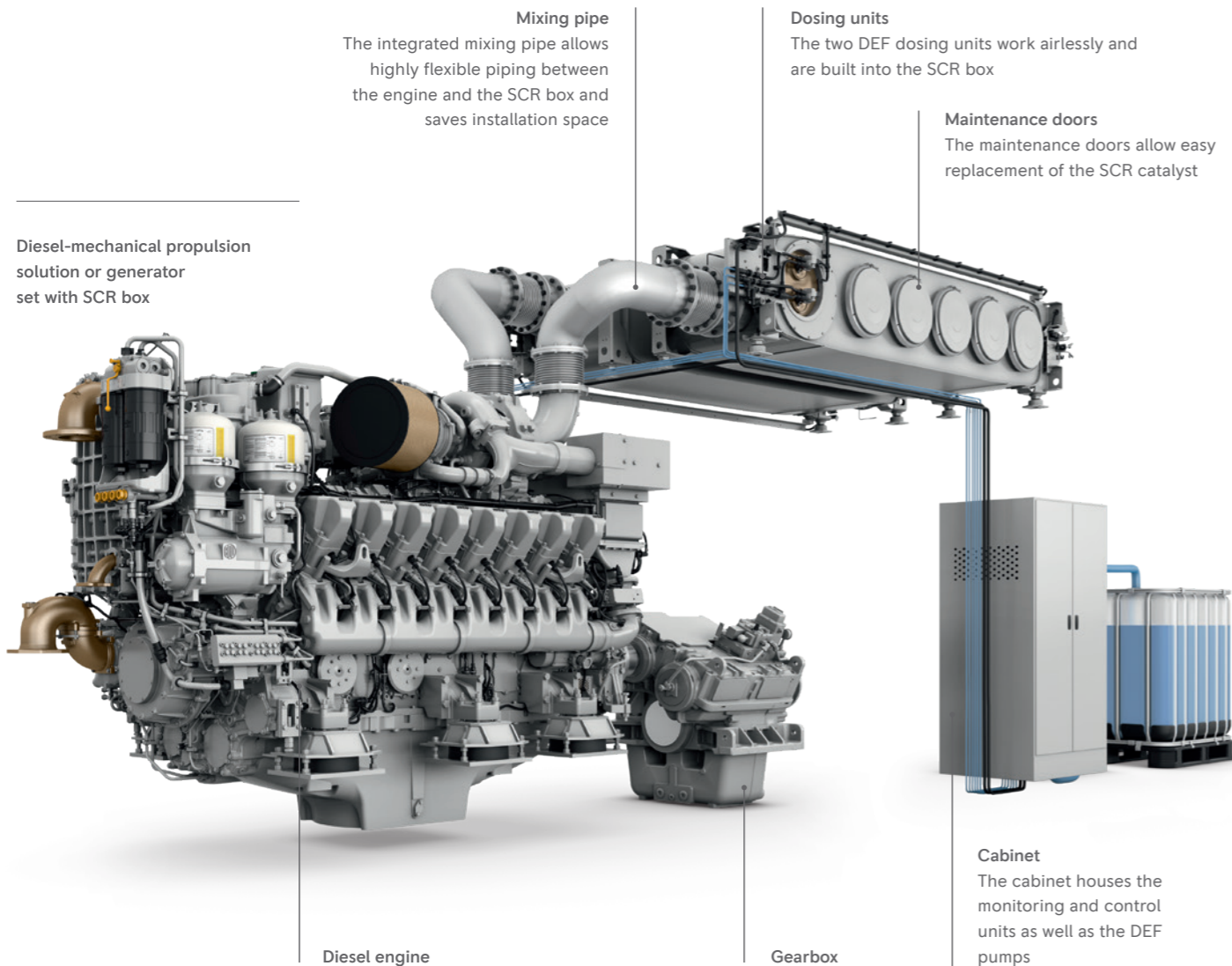
The airless SCR (selective catalytic reduction) solution developed by us is compact and maintenance-friendly. It has easily accessible doors for the replacement of the SCR catalysts. Highly flexible pipework options make integration easy for the shipyard.

The extra space needed for the exhaust gas aftertreatment system is reduced to a bare minimum. Ammonia slip is prevented under all operating conditions by a closed loop regulated control system.

SCR – the ideal solution for the marine world

We regard SCR as the preferred solution to maintain the reliability of our engines and the safety of your vessel and crew. SCR technology allows lower-quality fuel to be used. As well as reducing emissions, our SCR system also helps achieve lower noise levels.

Developing all major key technologies – such as SCR, exhaust gas recirculation, turbocharging, and common rail fuel injection – in-house means we can design the ideal solution to meet IMO III and EPA Tier 4 emissions regulations.



Vertically arranged SCR box.

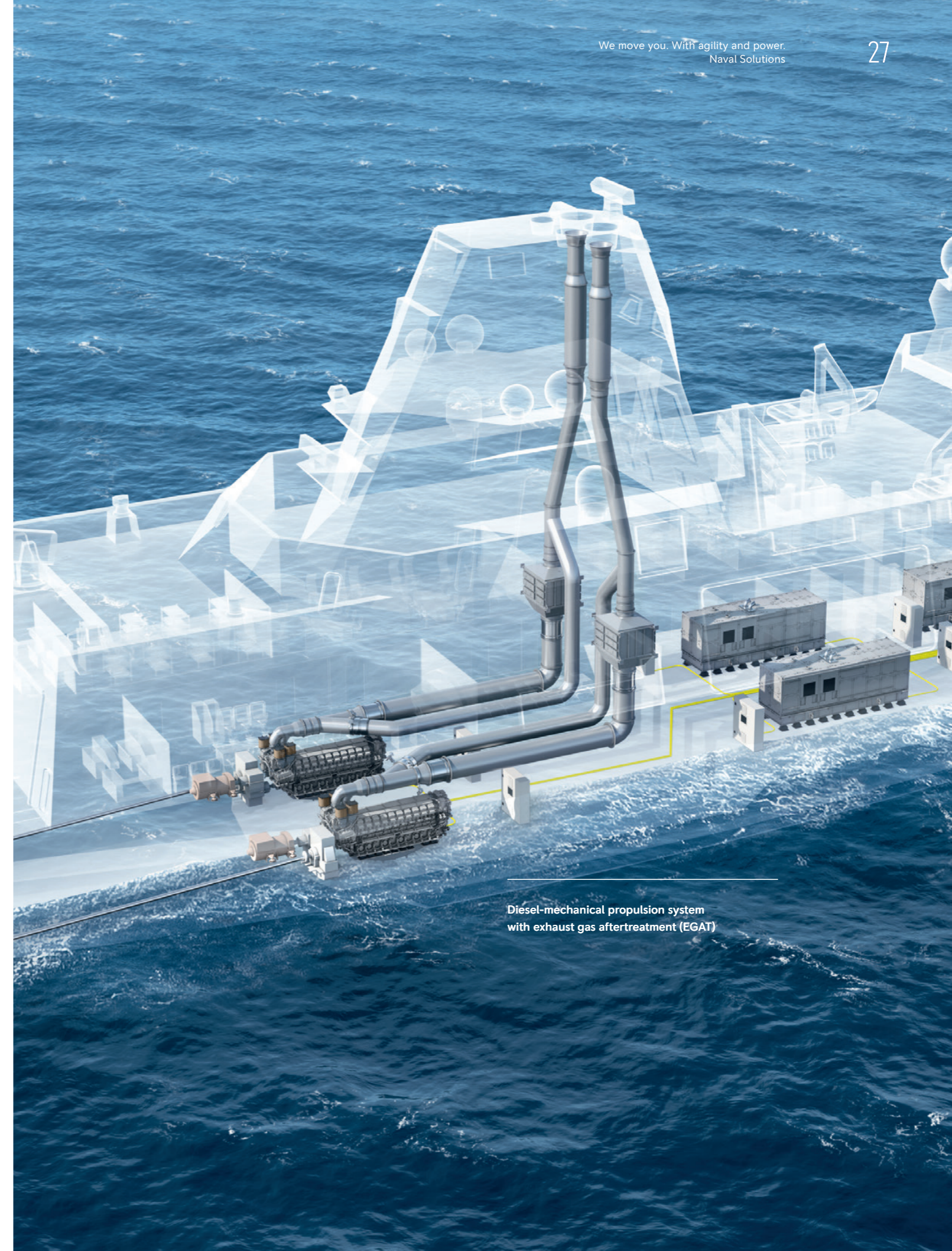
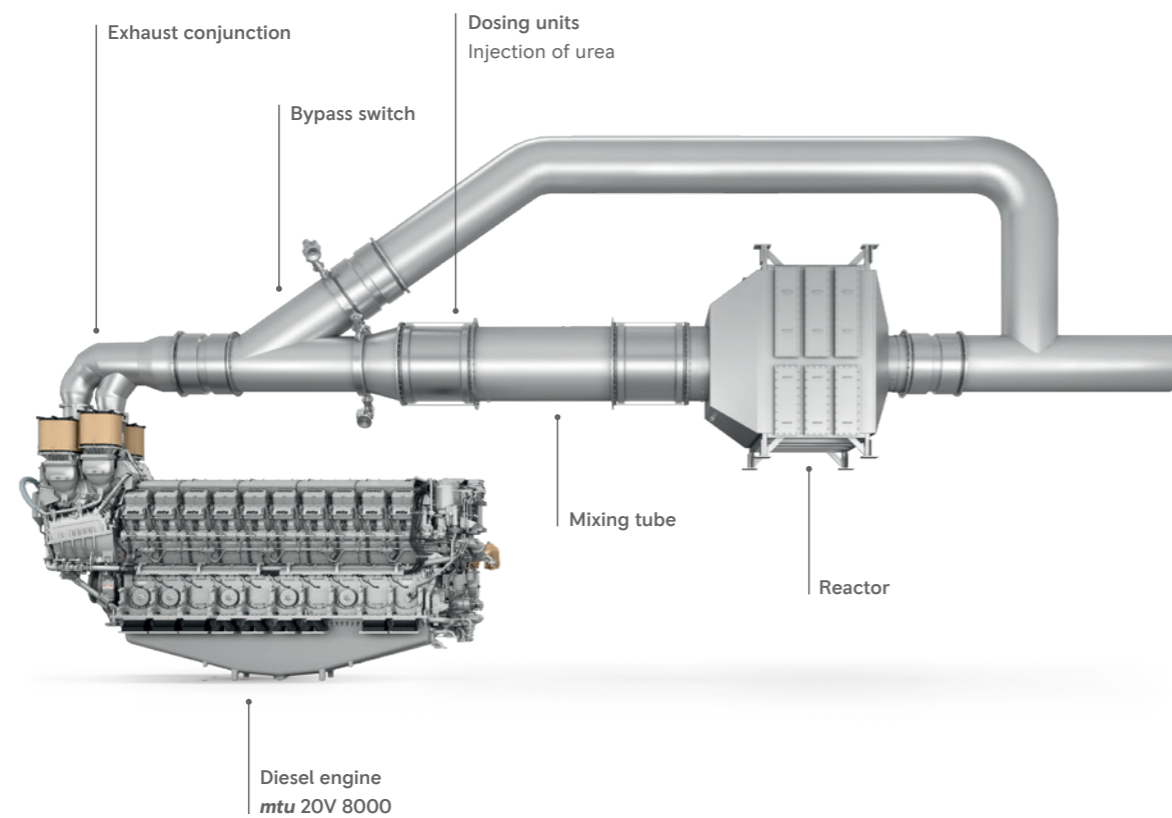


SCR box designed as a cube, for assembling in horizontal direction.

Emission reduction technologies

UNLIMITED POWER
LIMITED EMISSIONS

With new-generation emissions technologies, we are once again combining the strongest performance with sustainability: We are further developing our proven large marine engines of the **mtu** Series 1163 and 8000 by equipping them with exhaust gas aftertreatment with SCR system to comply with the IMO Tier III emissions directive. With this step, we are continuing the journey towards net zero emissions.



Fuel solutions

POWERING THE JOURNEY TO NET ZERO

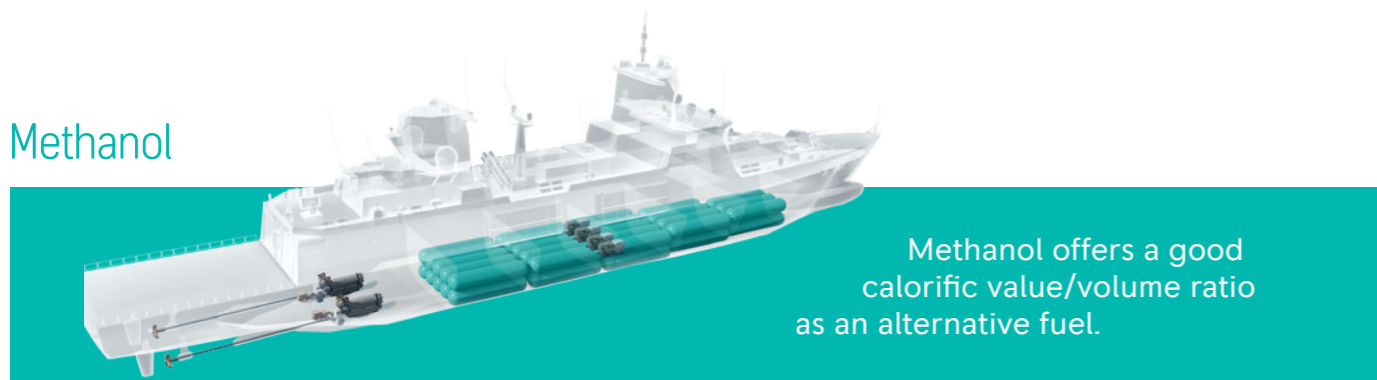
Helping navies to achieve ambitious emissions targets requires solutions that are both innovative and individually adaptable. Our **mtu** engines already address greenhouse gas reductions by meeting the highest standards in fuel efficiency. On top of that, we optimize our systems to support your journey to net zero by enabling the use of sustainable fuels.

Fuels are the key element to future propulsion systems.

eDiesel



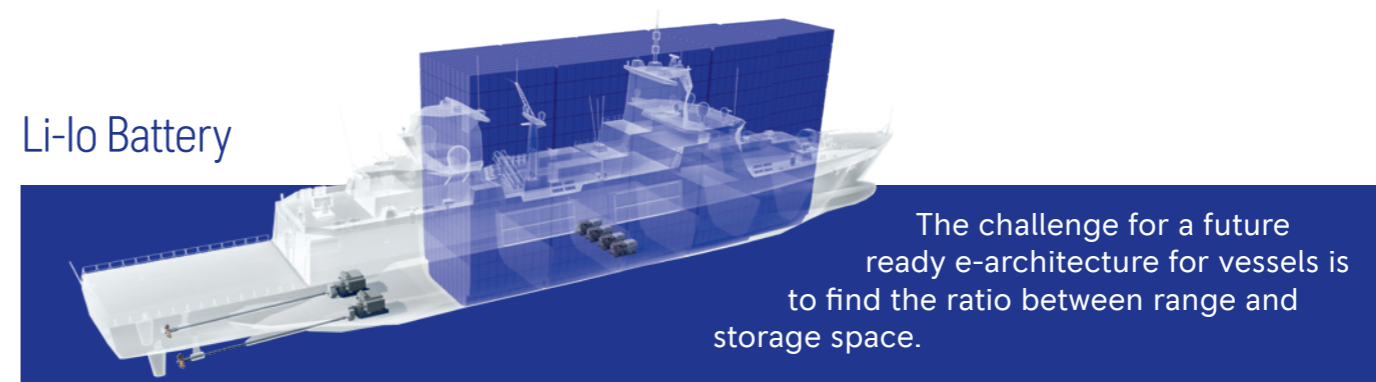
Methanol



Hydrogen



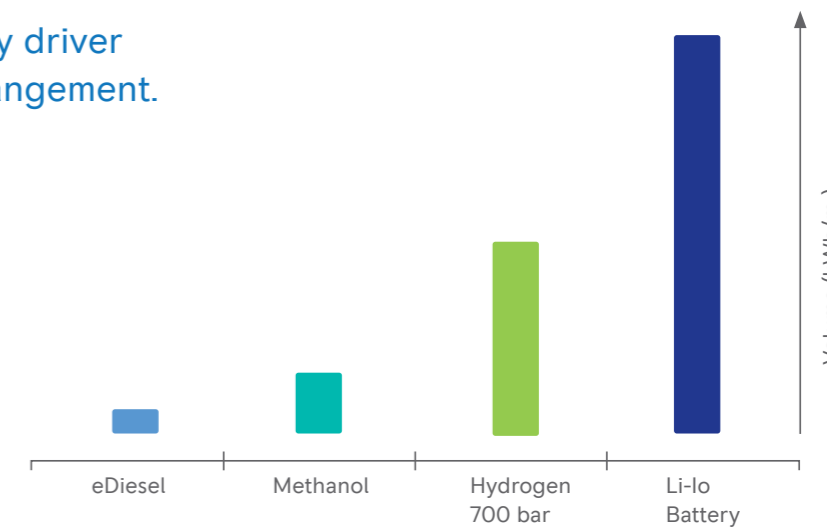
Li-Io Battery



The mission purpose is the key driver for the propulsion system arrangement.

Volume/weight ratio

The choice of the best technology depends on the specific vessel and operational profile and requirements. The fuel energy density (volume and weight) is an important criteria for the ship design. For the future, HVO or eDiesel is the best sustainable option to meet the high performance power and energy density requirements for naval applications.



Marine automation solutions

CONTROLLING THE POWER WITH **mtu** NautIQ SOLUTIONS

09

Our engines are powerful and technologically advanced. But in order to offer the best efficiency, reliability, safety, and environmental compatibility, they need more than just power. They need intelligent electronic management. Modern engine management systems handle the control and monitoring of the hardware and enable perfect performance. Our marine automation solutions **mtu** NautIQ are designed to offer the ideal combination of performance and precision individually for your applications from a wide range of solutions.



INTEGRATED SHIP AUTOMATION AND FLEET & HEALTH MANAGEMENT SOLUTIONS

- mtu** NautIQ Master
- mtu** NautIQ Core
- mtu** NautIQ Foresight

PROPULSION AND GENSET MONITORING & CONTROL SOLUTIONS

- mtu** NautIQ BlueVision NG
- mtu** NautIQ Genoline NG

REMOTE & AUTONOMOUS CONTROL SOLUTIONS

- mtu** NautIQ CoDirect
- mtu** NautIQ CoOperate
- mtu** NautIQ CoPilot

Scan the QR-code for more details about
mtu NautIQ solutions portfolio



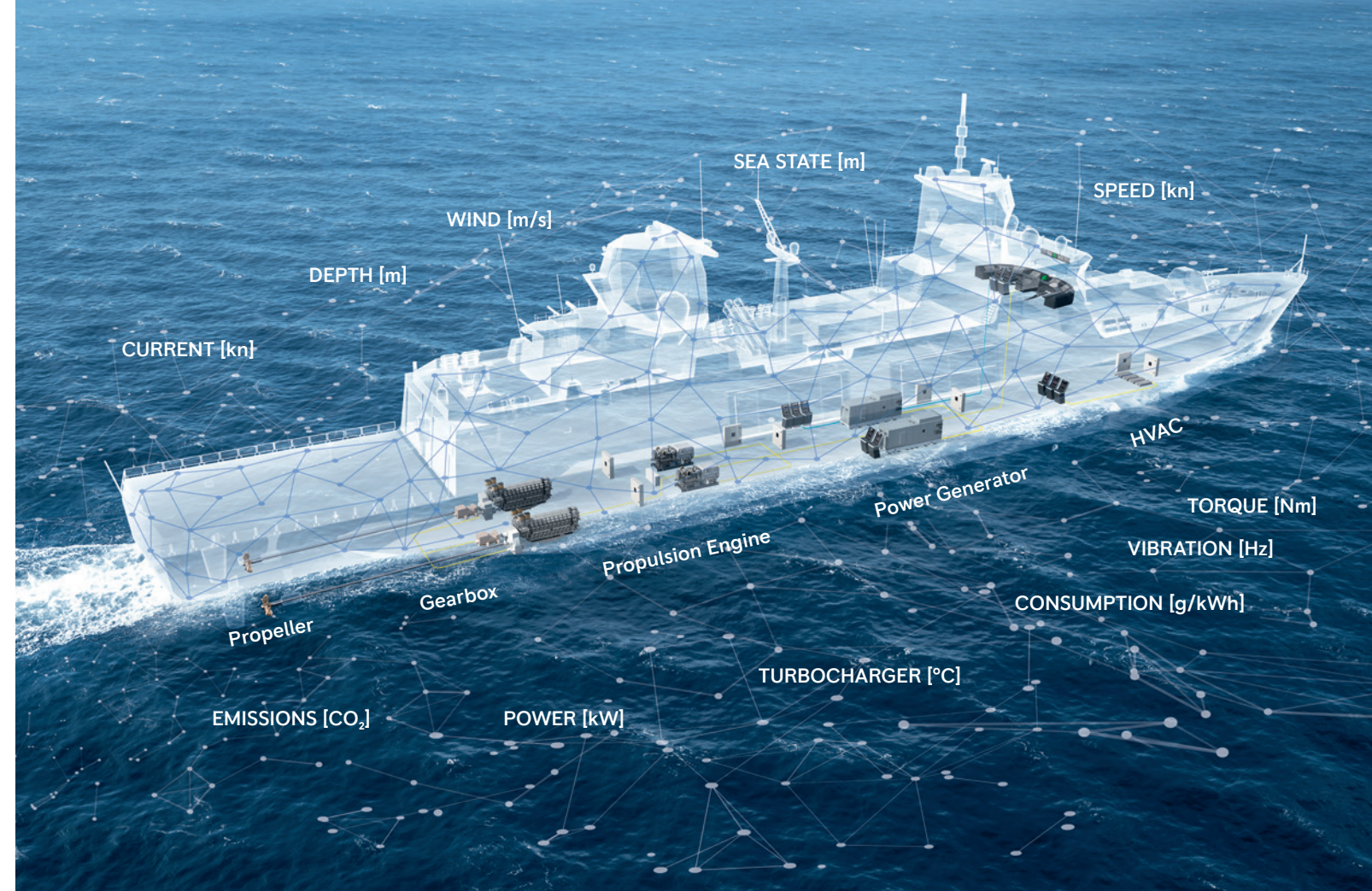
mtu NautIQ Foresight

FLEET & HEALTH MANAGEMENT FROM BRIDGE TO PROPELLER

mtu NautIQ Foresight is a Fleet & Health Management System. It allows you to monitor and have full control over the technical condition of your vessels from bridge to propeller.

The system maximizes the availability of your vessel, and you can even use it to monitor a whole fleet. By providing system status at a click, mtu NautIQ Foresight makes availability management easier than ever before. It provides support for the maintenance and upkeep 24 hours a day, 7 days a week – and thus helps minimize vessel downtime.

With mtu NautIQ Foresight you can collect and analyze data from mtu systems and third-party key components on the vessel, considering additional factors, such as navigational data.



Improved vessel availability

It's all about uptime. Real-time data analytics combined with artificial intelligence and machine learning techniques reduce unplanned downtime and maximize asset availability. The real-time sensor data on vibration, pressure, and temperature is compared with long-term figures for the respective operating conditions and ideal characteristic curves. The results enable optimum operation.

Optimized life cycle costs

Maximized availability and peaked performance optimize life cycle costs. Due to the improved plannability, downtimes are reduced to a minimum and unplanned maintenance is turned into planned maintenance.

Peaked performance

Monitoring fuel oil consumption and measuring torque is the first step to understanding the state of the vessel. This information, combined with the health monitoring data, allows you to analyze and improve the vessel's performance. Weather and navigational data let you draw conclusions about factors such as hull condition. Additionally, the optimal speed can be determined. This performance monitoring system enables fuel cost optimization and contributes to reduced emissions.

Reduced emissions

mtu NautIQ Foresight bundles all operational data in one system. The combination of engine, power generation, navigational and weather data enable in-depth analytics of the vessel's movement and its performance. In the next step, the operation of the vessel can be adjusted to run in a more efficient and environment-friendly manner.



Scan the QR-code for more details about mtu NautIQ Foresight

mtu NautIQ MasterINTEGRATED PLATFORM
MANAGEMENT SYSTEMScan the QR-code for more details about **mtu** NautIQ Master

mtu NautIQ Master is an Integrated Platform Management System and offers the optimal solutions to meet a wide range of needs for all types and sizes of vessels. Optimal for the special requirements of military and governmental vessels.

Integrated Platform Management System (IPMS)

With marine naval design becoming more sophisticated, and more capability being integrated with fewer people on board, only proven designs and software functionality can truly meet the demands within modern project time scales and risk profiles. As world experts in the field of integration, we introduce **mtu** NautIQ Master, the latest evolution of our powerful IPMS solution, allowing more COTS product integration. It is a true System of Systems capable platform.

This powerful mix of **mtu** NautIQ Master distributed processing and highly redundant architecture, coupled to industry standard equipment and protocols allows for a truly supportable platform, with minimal obsolescence risk. This reduces platform cost, integration time and commissioning/installation issues, whilst retaining the survivability and power of the original **mtu** NautIQ Master, with its scalability and flexibility in terms of system architecture.



Multiple operator workstations



Integratable Automatic Power Management System (APMS)



Integratable Propulsion Control System (PCS)



Equipment Health Monitoring and Dynamic Analysis



Damage Control System (DCS)



Remote Data Collection and Control Units



Multi-level redundant networking including fibre optics



On Board Training Systems (OBTS)

mtu NautIQ Master overview

mtu NautIQ Master offers advanced bespoke solutions designed to suit the complex automation and integration requirements for operators of specialist vessels.

mtu NautIQ Master is capable of providing a fully integrated turnkey electrical and automation solution, being a scalable and feature rich system capable of incorporating the following sub-systems and plug in modules:

- Navigation Bridge System
- Vessel Management System
- Communications
- Digital CCTV Surveillance
- Propulsion Control
- On Board Training System
- Power Management
- Condition Based Monitoring System
- Damage Control System

mtu NautIQ CoreALARM, MONITORING
AND CONTROL SYSTEMScan the QR-code for more details about **mtu** NautIQ Core

mtu NautIQ Core Alarm, Monitoring and Control System (AMCS) option is an entry-level system that offers a reliable and highly cost-effective solution and is designed using pre-engineered building blocks incorporating built-in expansion for future proofing. A selection of display systems are available to meet operational requirements and console design.

mtu NautIQ Core has been specifically created to deliver Commercial Off-The-Shelf (COTS) solutions for all shipping sectors including: bulk carriers, container ships, tankers, passenger ships, offshore support vessels, tugs and salvage vessels, inland waterway and small leisure

craft. The standard **mtu** NautIQ Core packages are future-proofed allowing for later integration of additional hardware, software and auxiliary equipment through the vessels lifetime.

Key Features:**Cost Efficient**

- Placing Remote Terminal Units (RTU) near the process reduces cabling
- Pre-engineered solution reduces engineering costs
- Self-diagnostic features help to improve maintenance scheduling

**User-Friendly**

- Unified interface across devices
- Intuitive HMI
- Simple modular design

**Flexible**

- Option to interface with external systems
- Modular design allows for customisation
- Up to 50% expansion available within each RTU

**Safe and Reliable**

- Multiple levels of redundancy
- BITE safeguards the network while safeguards the vessels systems
- COTS hardware with no moving parts

mtu NautIQ Gate**Opens up a new world of connectivity**

mtu NautIQ Gate has been specifically created to deliver compact and modular solutions for all shipping sectors including: smaller passenger ships, offshore support vessels, tugs and salvage vessels, inland waterway and luxury yachts. The standard **mtu** NautIQ Gate packages are future-proofed allowing for later integration of additional hardware, software and auxiliary equipment through the vessel's lifetime.

The **mtu** NautIQ Gate unit is the latest design from the **mtu** ship automation solutions featuring unparalleled flexibility across the entire range of legacy, current and future **mtu** NautIQ installations. The NautIQ Gate platform allows a single unit to be built with the correct number of interfaces. The **mtu** NautIQ Gate platform allows connection to Ethernet and/or ARCNET networks via single or preferably, dual interfaces. This allows **mtu** NautIQ Gate to function not only within any **mtu** NautIQ system but it can also be used to retrofit most other manufacturers' old, unsupported systems.

mtu AR technology

ENABLING SECURE AND RELIABLE NAVAL OPERATIONS IN A CHALLENGING ENVIRONMENT

10

Operators of naval vessels are faced with an ever-growing number of challenges: Vessels have to fulfil more demanding missions, staying at sea longer with smaller crews. At the same time, advancements in propulsion and energy conversion technologies also mean growing complexity of these systems. Our **mtu** AR technology could help to solve these challenges in the future.

It serves several purposes:

- Improving the understanding of system's functionalities
- Structured visual guidance for on-board maintenance tasks
- Enabling self-help (without the need for longstanding experience)
- Increasing safety on board

It does so by providing:

- Up-to-date and reliable information and documentation about the propulsion and energy conversion system anytime, anywhere
- Visual explanation of engine functions, e. g. of fluid systems
- Detailed step-by-step instructions for maintenance and repair
- Integrated guide for locating engine components

All information for the **mtu AR technology is stored on the device and does not require any cloud connection. It can be used with different standard COTS hardware:**

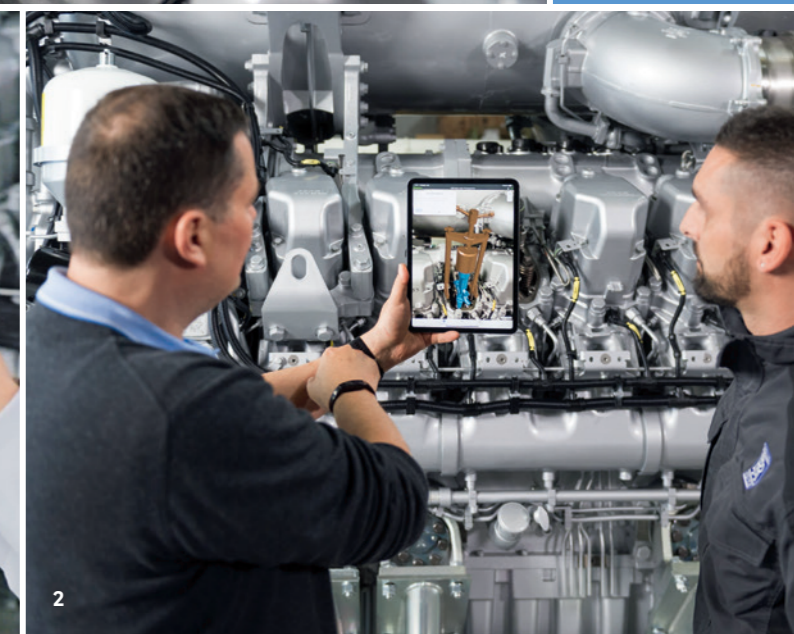
Via head-mounted device:

The virtual content (e. g. maintenance instructions) is projected via the glasses and added as an additional layer into the user's normal view of reality

Via mobile device (tablet or mobile phone):

The camera shows a live view of reality, virtual content is laid over the live view shown on the display

The **mtu** AR technology functions as a kind of "portable experienced engineer": It can illustrate system functionalities through a combination of text, animations and videos in a very clear and easily understandable way and aid the operator with the same guidance for maintenance and repair tasks as during training courses in our factory training centre. Unlike in a printed repair manual, the AR system projects information onto the real hardware, showing on the spot what steps have to be done how, using which parts and tools.



1 Guidance to locate components on the system
2 Virtual instructions on the actual hardware



Life cycle solutions

IN-SERVICE CONTRACTS

Our versatile service portfolio adapts flexibly to the needs of authorities. We can offer optimal support throughout the entire life cycle, tailored to every requirement. The result is ease of mind that allows authorities to focus entirely on the goals of their operations.

In accordance with national public procurement laws, we offer In-service contracts, where all elements of our modular service portfolio can be integrated based on authorities individual needs for maintenance and local set-up.

Your In-service contracts benefits

- Increase operations uptime
- Guarantee parts availability and service quality
- Predict equipment-related costs
- Optimize maintenance planning
- Attain ease of mind

Life cycle solutions

OUR MISSION: OPTIMIZE YOUR FLEET AVAILABILITY AND UPTIME

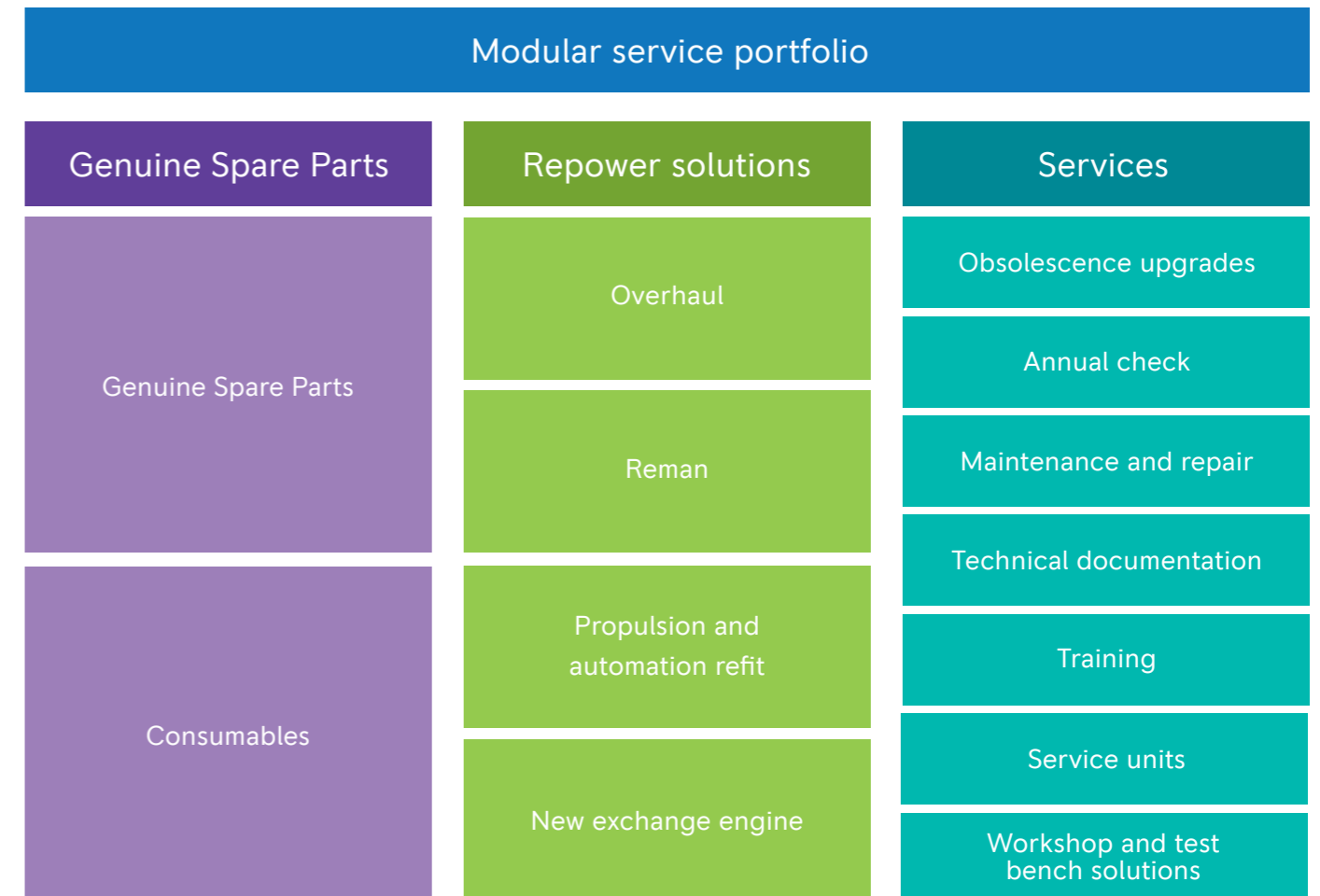
11

Integrated Logistics Support

Designed to meet the unique challenges of military operations, Integrated Logistics Support (ILS) offers customers a customized package that includes analysis, spare parts, training, and technical documentation. ILS keeps your **mtu** equipment up and running at the highest level of availability and reliability.

Our Integrated Logistics Support includes:

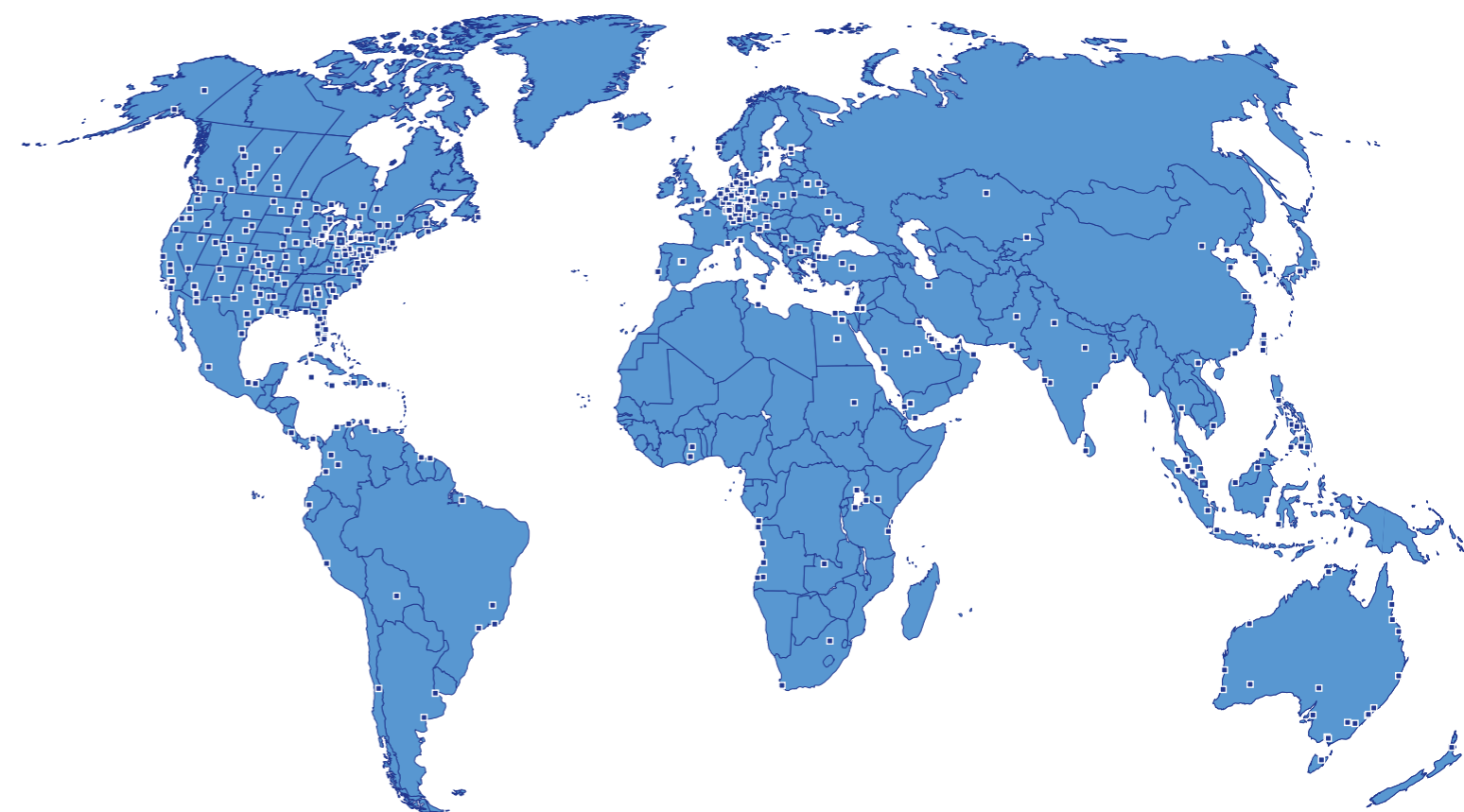
- RAM / LCC analysis
- Technical documentation
- Training
- Genuine spare parts and consumables



Life cycle solutions

LOCAL SUPPORT – WORDWIDE

The most important part of your propulsion system isn't a part at all – it's your local service team. With more than 1,200 service locations worldwide – backed by our own regional Parts Logistics Centers in Europe, Asia, and America – you can count on responsive support by expert technicians, wherever the next mission takes you.



GENUINE SPARE PARTS

Only we can guarantee genuine spare parts that are designed, tested and approved specifically for **mtu** engines and systems to reach maximum uptime.

Genuine parts maximize performance, prolong engine life and meet today's strict requirements (e.g. emission regulations), all thanks to years of intensive research and development, quality audits, and progressive modifications – making them the best possible match for your engine and guaranteeing state-of-the-art technological fit. We offer a supply chain management, optimizing your purchasing and ordering processes.

Take advantage of broad benefits of **mtu** genuine spare parts:

- Engineered to secure high engine reliability and availability
- Value sustainability of your equipment / the only parts that live up to **mtu** standards
- Factory / OEM warranty coverage incl. professional service support
- Long-term supply solutions through the entire equipment lifetime
- State-of-the-art Parts Logistics Centers

Non-genuine parts are simply not worth the risk of endangering your mission.



Scan the QR-code for more information about our **mtu** life cycle solutions.

Life cycle solutions

TURN BACK
THE CLOCK

Your **mtu** equipment was built to last thanks to our legendary high engineering standards and unwavering commitment to service and support. And after a long and productive life, we provide options to help you go even further.

Overhaul solutions

Factory overhaul solutions involve the complete restoration of your original equipment. This solution is best for classic and specialized engines that lack the necessary population for a meaningful core exchange program or require a greater level of customization during the restoration and validation process, covering 50+-years legacy engines as well as state-of-the-art IMO T3 DieselGenerator Sets.

Reman solutions

Factory remanufactured solutions involve replacing your existing engine and system with a remanufactured unit provided by your **mtu** service partner, and returning your original core for a credit. Utilizing the core exchange program minimizes downtime.

Automation refit solutions

With obsolescence upgrades as part of mid-term refits, we provide assistance to propulsion systems in the middle of the vessels life cycle. The result extends the life of the systems and the entire vessel with less downtime and lower maintenance costs. Thus, you can avoid extensive waiting time for new ship construction and keep your fleet available and ready.

The refit includes the replacement of obsolete engine components like the mechanical governor and the modernization of bridge components which are a prerequisite to install a state-of-the-art intelligent electronic management system as our **mtu** NautIQ solutions.

TRAININGS —
LEARN FROM THE BEST

Training is a great way to become proficient with **mtu** engines and systems and get maximum efficiency from your equipment. From preventive maintenance to diagnostics and repair, our training programs provide a hands-on learning experience with knowledgeable, expert trainers. We offer a wide range of customized training programs around the world to maximize your return on investment.



TECHNICAL DOCUMENTATION

Our high-quality technical documentation is easy to understand and available at the right time, in the right place and in proper format.

Our technical documentation can be individualized to specific propulsion system configuration in order to support the optimal fleet availability by providing the appropriate technical specifications for seamless operations on board and onshore.

Scope of supply: Manuals for Operation, Maintenance, Repair and Workshop Spare Parts Catalogs

- Available in all standard structures and formats
- Fulfills specifications: ASD S1000D, ASD S2000M
- Material number codification in accordance with the customer standards for the entire life cycle

Configuration management

Configuration management at **mtu** solutions fulfills ISO 10007, STANAG 4159 and JSP886 in terms of content. Monitoring of design status and obsolescence to ensure supply availability and increase system availability with annual reports and updates of technical documentation. Logistic processes are ensured.

Scope of supply

Configuration management plan, obsolescence management plan, change memos if required, yearly reports and updates of technical documentation.

Interactive 3D technology

New 3D visualization technology for systems, engines and components is available and fully interactive offering support for trainings with state-of-the-art technology for greater efficiency and clarity.

3D animated maintenance tasks

Animated step-by-step support for execution of maintenance and repair tasks. Format: HTML

Augmented Reality

AR for maintenance task descriptions with supportive functions and information.



Stay posted with more powerful information
and follow **mtusolutions** under:



Rolls-Royce Group
www.mtu-solutions.com/marinedefense

The Rolls-Royce name, Rolls-Royce badge and Rolls-Royce monogram logos are registered Trade Marks of Rolls-Royce plc