

Powering the world's navies



LIFECYCLE
RELIABILITY AND
EFFICIENCY

INTEGRATED
SOLUTIONS

EXTENSIVE
PRODUCT RANGE

LEADING
TECHNOLOGIES

Powering the world's navies

Wärtsilä Marine Solutions is a leading systems partner to the Naval industry. Through innovative solutions and services, Wärtsilä sets out to be the most values business partner with products that are capable of meeting the most stringent special naval requirements. Our experience in providing propulsion and powering solutions for Navy and Coast Guard vessels is long standing: more than 90 countries entrust Wärtsilä with the supply of equipment for their naval fleet.



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At Wärtsilä we optimise a vessel's efficiency by looking at the whole picture. We study the vessel's power and propulsion systems, the integrated automation systems, and the way that the vessel will be operated and maintained. We provide integrated Propulsion solutions, including engines, generating sets, reduction gears, propulsion equipment (propellers, shafts, nozzles, thrusters and waterjets), automation and power distribution systems as well as sealing solutions for vessels of all types and sizes.

Wärtsilä has an extensive track record in delivering propulsion solutions for Offshore Patrol Vessels. OPVs are used to perform

many non-military functions, including coast guard and rescue operations, as well as the policing of exclusive economic zones (EEZ), and even fishery related activities. Since the operational profiles of these various applications can be quite different, OPV propulsion systems need to be capable of adjusting to varying load requirements.

With a vast commercial marine experience, Wärtsilä can also assist in the development of propulsion concepts for Naval auxiliaries utilising COTS equipment.

Leading system integrator

Wärtsilä has set forward a new approach to the lifecycle of the vessel by getting involved at all stages, from ship design to new buildings or repowering of the complete propulsion system and finally for the services of the ship. The global question behind the design of a vessel is the efficiency of the propulsion system.

According to Wärtsilä, everything starts from the interaction between the hull and the propulsors. Then significant total savings can be found by optimising the propeller design and matching it with the prime movers. Engine selection is another key element to improve the overall efficiency. Wärtsilä offers the configuration which provides the ability to match and run the engines close to optimum efficiency. The propulsion packages are developed according to the mission profile of the vessel as designed by the end-user.

Wärtsilä provides complete integrated propulsion systems and dedicated support:

- System integration capability
- Close cooperation with marine institutes to provide hydrodynamic studies
- Technical abilities to meet specific naval requirements
- Through-life cost studies
- Integrated logistic support (ILS)
- Preventive and corrective maintenance



The benefits of having Wärtsilä as the single supplier throughout the entire life cycle of the vessel, from conceptual design to construction and operation provide value:

- One supplier – One responsibility – One single point of contact = Wärtsilä
- Reduced unforeseen incompatibilities
- Classification for complete systems
- Integrated system documentation
- Production schedule discipline
- Warranty handling

Technological leadership

Considerable research and development investments have placed Wärtsilä as a market leader capable of offering innovative technologies to boost energy efficiency and environmentally sound operation at sea. Even though these measures may make a significant difference, now or sometime in the future, they are just the beginning.

In addition to engine tuning by using a combination of superior propulsion solutions along with first class products and inventions, Wärtsilä can offer more than 30 different ways of making your vessel operate more efficiently. For our Navy portfolio, extensive research focuses on efficiency improvement, minimizing noise and vibration, reducing environmental impact and optimising maintenance requirements.

Leading hydrodynamic expertise

Wärtsilä Marine Solutions has all modern hydrodynamic tools and experience in-house to design and optimise propulsion to meet the most stringent requirements of modern shipping. By analysing the vessel's sailing pattern and incorporating the results into the propulsion unit design, Wärtsilä enables vessel owners to maximize efficiency and to minimize fuel consumption and environmental footprint. With more than 20 years experience in advanced numerical flow (CFD) simulations, the performance of the vessel's propulsion can be determined full scale and in an early phase.

Reducing environmental footprint

Environmental issues, especially emissions reduction and fuel consumption, have become increasingly important in the Navy sector where enforcement of environmental regulations, at both global and local levels, has notably increased. This puts pressure on the marine industry to constantly explore new ways of reducing the environmental impact of ships. As a result of long-term collaboration and interaction with our customers, Wärtsilä has continuously focusses on the development of high-quality, reliable, and environmentally sound solutions and services.

Enabling environment upgrades

Developments in environmental legislations are leading to a growing demand for environmental upgrades for existing Navy vessels. Wärtsilä is able to answer these needs and assume full responsibility for service and maintenance over the entire vessel lifecycle. With the needed service capability and resources in place globally and armed with a deep understanding of different ship systems, we are ready to take on even large conversion projects involving extensive dismantling of the vessel.



Engineering expertise

The remaining and most efficient means of decreasing the force transmissibility, from the excitation source to the machinery foundation, can be achieved through the mounting of the noise sources in accordance with the following main design features:

- Installation of the engine, generator and auxiliaries on a common base frame. A static and dynamic analysis of the base frame design (stiffness of the seatings below the engine and generator fittings, natural frequencies and mode shapes) is generally done through a finite element model.
- Selection of the number of resilient mount stages; at least one stage of resilient mounts between the common base frame and the machinery foundation on the ship's hull plating. If needed, in addition to the previous stage, a second resilient mounts stage is fitted between the engine and the base frame (and for some applications, between the generator and the base frame).



Photo in public domain

**US Navy - Lewis and Clark T-AKE class
USNS Lewis and Clark, T-AKE11**

- 1 x WFP propeller system and shaftline
- Wärtsilä Enviroguard and Floodguard seals
- Turning gear

- Selection of the type of resilient mounts (natural frequencies generally in the range of 3 to 10 Hz, displacement capability from 10 mm up to 70 mm for some Navy applications with shock requirements).
- Design of the auxiliaries fitting and pipe clamping, which may have a significant influence on the resilient mounting efficiency.

For some projects, an acoustic enclosure might be needed when the noise level in the engine room has to be below the standard engine airborne noise, or when the vibrations have been reduced to a very low level whereupon the underwater-radiated noise may be influenced by the airborne noise of the diesel-generating set.

New requirements on ship emissions

The International Maritime Organization (IMO) has approved amendments to the MARPOL Annex VI regulations on ship emissions. These regulations set stricter limits on emissions of nitrogen oxides (NO_x) from the engines, as well as on the sulphur content of the fuel. The new requirements will enter into force in various phases during the years 2010–2020.

Wärtsilä 4-stroke engines are fully compliant with the IMO Tier II exhaust emissions regulations and can also be equipped with a SCR catalyst to meet IMO Tier III NO_x emission levels. Being at the forefront of technological developments gives Wärtsilä many opportunities arising from the tightening environmental regulations. Wärtsilä has a multifaceted gas engine strategy, and can provide gas engines for vessels. Wärtsilä multi-fuel solutions provide full control over fuel choice without compromising performance.



Finnish Border Guard Turva: Courtesy of Meyer Turku Oy

Finnish Border Guard OPV Turva

- 1 x Wärtsilä 12V34DF main engine
- 2 x Wärtsilä 6L34DF main engines
- Wärtsilä Airguard and Wärtsilä Sternguard seals

First patrol vessel in the world powered by LNG

The Finnish Border Coast Guard next generation OPV uses liquefied natural gas (LNG) with low emission levels and diesel oil as fuels, which keeps the ship's own emissions small.

The Turva is powered by three eco-friendly Wärtsilä 34DF dual-fuel engines burning either crude oil-based marine fuels or liquefied natural gas (LNG). The engines can alternate among fuels without loss of power or speed. In the design of the vessel, special attention has been paid to environmentally friendly and energy-efficient solutions.

As well as performing border management duties, the multipurpose vessel serves in maritime search and rescue missions and demanding environmental safety operations such as oil spill response.



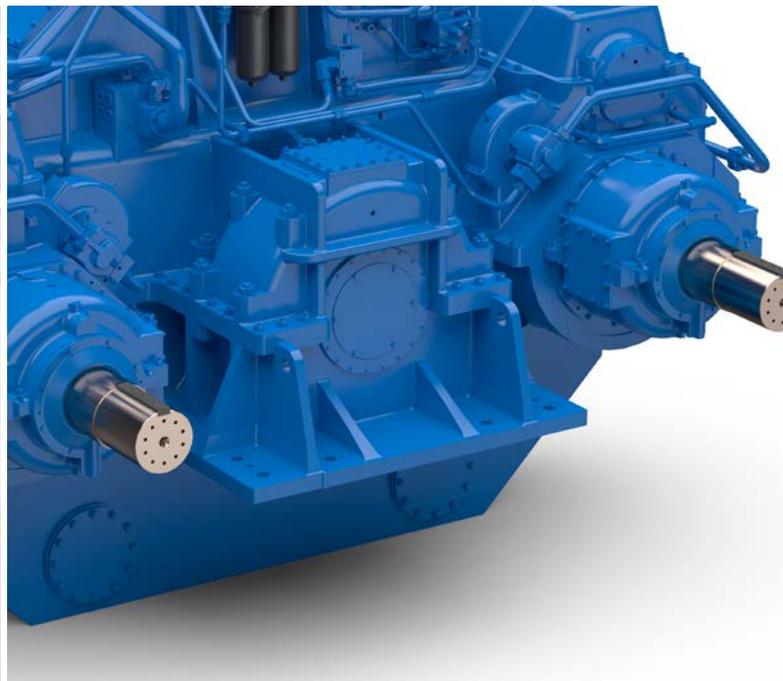
Engines

The design of the Wärtsilä medium-speed engine range is based on the vast amount of knowledge accumulated over years of successful operation. Robust engines and generating sets, developed from pioneering heavy fuel technology, have been engineered to provide unquestionable benefits for the owners and operators of naval vessels. These benefits include:

- Reliability and low maintenance costs
- High thermal efficiency and low emissions
- Modular construction and reduced parts count
- Ergonomic interfaces
- Minimised consumables
- Cylinder liner with anti-polishing ring
- Extended time between overhauls (up to 24,000 hours between top overhauls)
- Variable inlet closing (VIC) installed for low smoke and improved load response
- Emission compliant with IMO Tier II

Engine performance

Wärtsilä engines utilize the latest developments in turbo-charging technology, which enables Miller valve timing and the variable inlet valve closing (VIC) system to be employed. At full-load operation, early closure of the inlet valves enables a low effective compression ratio, and as a result, comparatively low temperatures at the end of the compression stroke. The charge air, being both somewhat expanded and cooled on its way through the receiver into the cylinders, has a low global temperature that is still high enough to guarantee reliable and stable ignition of the fuel/air mixture in the combustion chamber. Due to the quick expansion of the combustion gases, high temperatures that are most critical to the formation of intensive NO_x within the combustion chamber are rapidly abated. This combination creates a combustion process that is not only environmentally friendly, but also extremely efficient as the high expansion ratio produces the conditions needed for efficient utilization of the heat energy released by combustion at the beginning of the power stroke.



Generating sets

Wärtsilä provides generating sets complete with alternators mounted on a common base-frame which meet our customers' requirements for shock, noise and vibration levels. By utilising double mounting arrangements and acoustic enclosures, naval standards are met and exceeded. Wärtsilä generating sets are in operation with many of the world navies providing electric power for diesel-electric propulsion and on-board ship services.

Auxiliary & emergency generating sets

A wide range of generating sets is available for the supply of electric power for the vessel hotel load.

Additionally, the reliability and efficiency of Wärtsilä products have convinced our customers to fit our generating sets within their scope of equipment for the electrical power source in emergencies.



Gearboxes

Wärtsilä marine gears have been designed to meet the highest standards of operational efficiency, reliability, (low) noise and vibration levels. Our gears cover a power range from 1 to 24 MW for single input gears with vertical- or horizontal offset and 2 to 35 MW for double input gears. The Wärtsilä 2-speed gearbox enables lower propeller speeds with optimised propulsion efficiency and is available from 2 to 13MW in both vertical or horizontal execution.

Main characteristics and features

- Modular and flexible design
- Compact and reliable
- Plain bearings
- Rigid housing structure:
 - Minimal deformation
 - Low stress levels
 - Cast iron or welded
 - Low noise and vibrating levels
- Precision ground gearwheels with profile correction:
 - Optimal load distribution
 - Minimal efficiency losses
 - Low noise
- Optional PTO/PTI solutions enabling hybrid solutions
- Optional built-in hydraulic multi plate clutch
- Combined hydraulic system for gearbox and propeller



Controllable Pitch Propellers

The Wärtsilä Controllable pitch propeller systems have been developed to provide outstanding reliability, low operating costs, environmental friendliness, easy installation/integration, and intuitive operating control. The increasing demand in stealth and shock resistance capabilities for fighting vessels leads to a definite necessity of enhancement on the already reliable technology used for commercial vessels.

Navy applications often need tailor made solutions based on standard equipment in order to meet the typical very severe requirements such as high shock resistance, low noise and vibration levels.

The controllable pitch propellers consist of a hub, the propeller blades, shafting, hydraulics and a remote control system, as well as any further accessories needed to meet the navies' requirements.

The technologies available include:

- Advanced design by finite element method (FEM) and computational fluid dynamic (CFD) giving high accuracy when designing the shock resistance capability and vibration modes of our installations
- Small hub size with reduced weight
- Increased loading capacity

- Compliant with EPA Vessel General Permit 2013 requirements
- Easy service (hub disassembly without pulling shaft)
- 5-blades option for increased noise and vibration reduction

Reduced noise and vibration

Wärtsilä offers a standardised range of 5-bladed propeller hubs. Through this design the power is spread over 5 blades instead of over 4 blades, whereby reducing vibrations in aft ship and accommodations. It also reduces underwater-radiated noise.

Key benefits of CPP:

- high propeller efficiency
- minimum noise and vibration levels
- reliable
- reduced fuel consumption
- reduced weight
- easier maintenance

Built up Propellers

The Wärtsilä Built-Up Propeller (BUP) is an attractive alternative for a monobloc propeller. Our flush and compact hub design in combination with efficiency optimised propeller blades makes the BUP fit for applications where low fuel consumption is important.

Built-up propellers are typically installed on heavy ice-class (commercial) vessels and offshore patrol vessels that operate in ice infested waters or operational areas with increased risk of propeller damage. The easily (de)mountable blades and the possibility of under water (de)mounting enable the propeller blades to be replaced or repaired without interruption to the normal operating service.



Wärtsilä Valves solutions for Naval applications

As the manufacturer of a comprehensive range of high alloy valves for multiple challenging applications Wärtsilä Valves is the most respected solutions provider in the valve industry. Our global reputation for excellence in product design, quality, reliability and our motivation to reach the highest levels of customer service, makes us your ideal partner.

As a key valve supplier to many navies and fleets around the world we are confident in our capabilities to constantly satisfy the needs of a market known for its arduous requirements of product performance and certification traceability for both sub-sea and surface vessels.

Our facility in Brough UK produces an extensive range of globe, ball, gate, check, butterfly and hydrant valves along with strainers in various grades of non-ferrous alloys, Duplex, Super Duplex and other exotic alloys.

Benefits

- Broad product portfolio
- Long history of valve engineering and expertise for marine and maritime applications
- High level of customer commitment.
- UK manufacturing base
- Enhanced repair and refurbishment service with quick turnaround times
- Complete lifecycle support.

OPTI Design

OPTI Design is the result of highly experienced design engineers in our European R&D headquarters having access to the very latest and most sophisticated software and analysis tools.

Computational fluid dynamic (CFD) analyses of 3D geometries, analyse not only the propeller performance but most importantly also, the interaction between the propeller and hull. This provides extremely accurate information for achieving design and parametric optimisation.

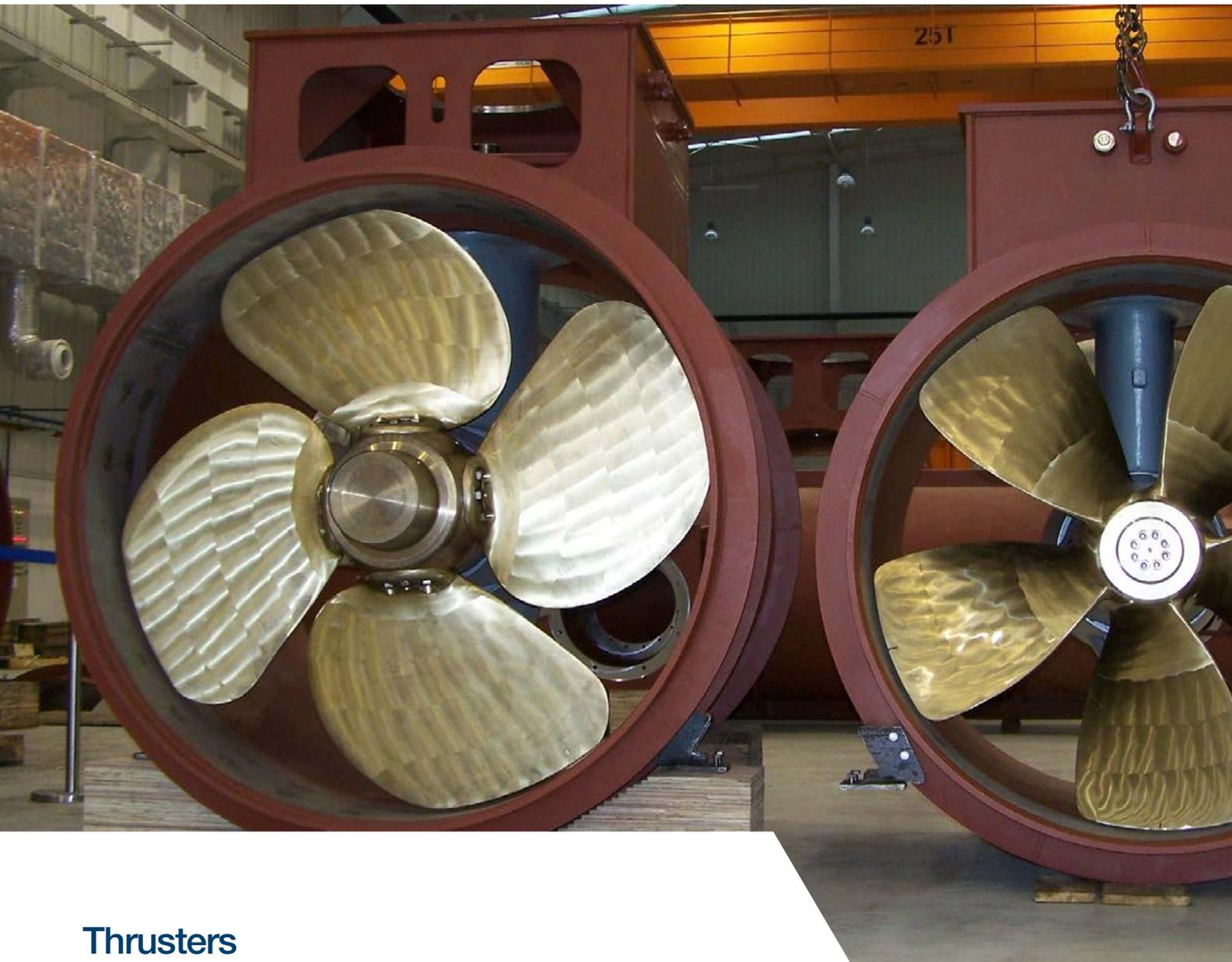
This state-of-the-art design protocol optimises the vessel's overall propulsive efficiency. OPTI Design can provide fuel savings of up to 4 percent. Each controllable pitch propeller is individually customised to meet specific application requirements, whereby improving the vessel's EEDI/EEOI. This in turn leads to reduced exhaust emissions.

Propellers for research vessels

All the parts of a vessel contribute to the underwater-radiated noise, the active inner parts (such as machinery) as well as the passive outer parts (the hull and its appendages) due to turbulence in the flow on these surfaces. The propellers become one of the essential sources of noise with the increasing vessel speed because of the occurrence and the extension of the cavitation phenomenon, which increases dramatically the noise levels at all frequencies.

Research vessels typically have varying operating modes, thus requiring the propulsion machinery to have sufficient operational flexibility. Wärtsilä has been able to demonstrate that its solutions meet this requirement. Furthermore, the absence of noise is essential. By applying steerable thrusters – without a nozzle - the propulsion noise is minimised, whereby enabling the research vessel to do what it is intended for. Undisturbed.





Thrusters

For Navy and Research vessels, high manoeuvrability, dynamic positioning or dynamic tracking can be achieved with steerable thrusters for main propulsion, supported by auxiliary retractable thrusters and transverse thrusters.

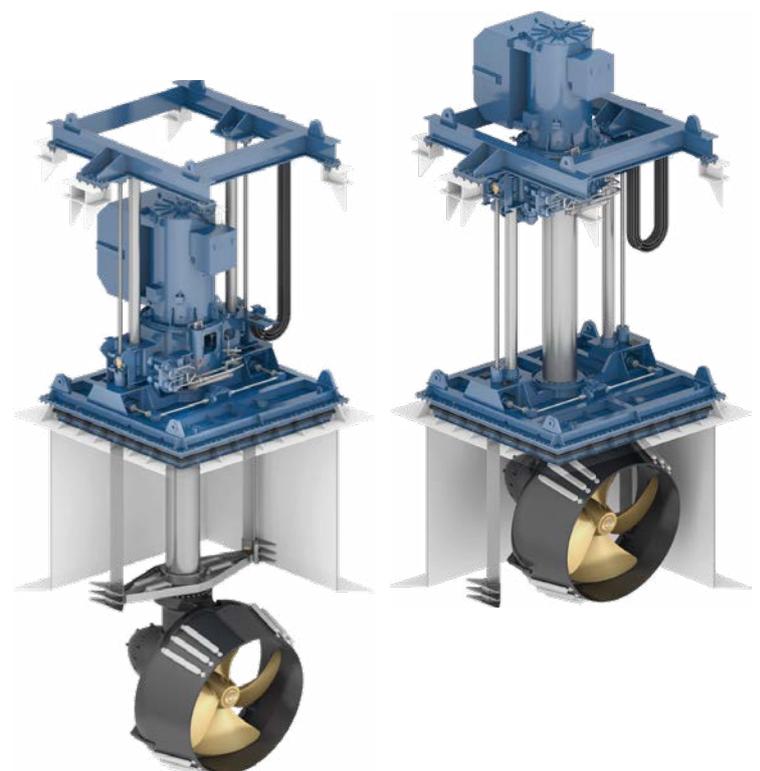
To minimize noise and vibration levels of the main thrusters, an open propeller with a tailormade propeller design is often selected.

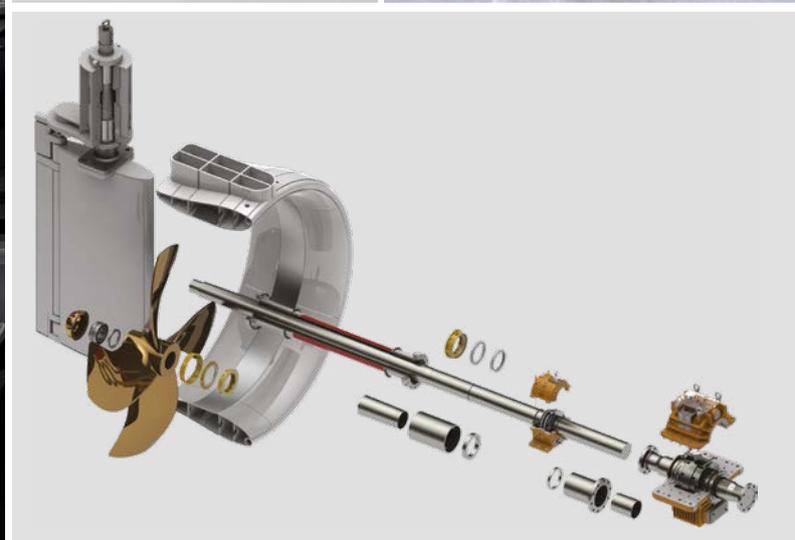
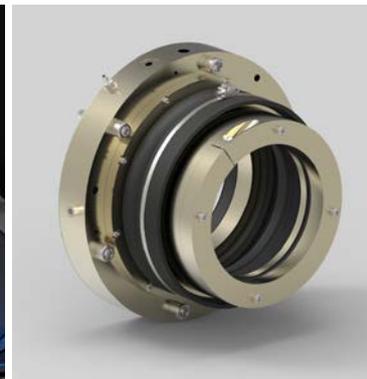
Steerable thrusters

Wärtsilä Steerable Thrusters generate considerable savings in cost due to their reliable and durable components, efficient propellers and maintenance friendly design. Next to weld-in or bolt-in thrusters, retractable, underwater mountable and containerized thrusters in fixed pitch and controllable pitch executions are available in a range from 1000 to 6500 kW.

Transverse thrusters

Wärtsilä offers a wide range of Transverse Thrusters from 400 to 5500 kW, available with fixed pitch or controllable pitch propellers for auxiliary or dynamic positioning usage. Transverse Thruster design and layout focus on high efficiency, low noise and vibrations, as well as reliability, ease of maintenance and inspection, leading to minimum operational cost.





Propulsion control systems

The Wärtsilä PCS (propulsion control system) is a comprehensive system of levers, touch-screen interfaces, displays, indicators and modules designed to suit all the possible propulsion configurations of a modern ship. Wärtsilä ProTouch is the human interface of the Wärtsilä PCS. It represents a state-of-the-art response to market demands for control devices that are modern and compact.

User-friendly controls

The Wärtsilä Propulsion control system controls all the thrust, steering, and auxiliary system functions. The ProTouch panel design is space saving and designed to allow easier and more intuitive operation of the thruster functions. Installation of the control cabinets, panels and cabling is straightforward since all components of the propulsion control system are interconnected by means of CAN-open buses.

Seals, bearings and stern tubes

By supporting your propulsion systems with a range of integrated products, dedicated services and 24/7 support, Wärtsilä Seals and Bearings is on hand to ensure every vessel in your fleet remains equipped to respond. Wärtsilä seals and bearings has worked with more than 76 of the world's navies since 1966 and our products are fitted to more than 1,800 naval, governmental or coastguard vessels in service today. Features such as built-in redundancy and in-situ replacement options help you to keep vessels in active service for longer, by avoiding the need for dry docking. By extending the service life of our market-leading equipment, Wärtsilä enables you to improve both the mean time between overhaul (MTBO) and mean time to repair (MTTR) of your propulsion systems.

The Wärtsilä Sea-master condition monitoring system collects real-time data, providing valuable information about the operational health of the tail shaft equipment, helping customers to maximise uptime and lower lifecycle costs. The Wärtsilä Sea-master system is Approved in Principle by DNV-GL and enables customers to meet DNV-GL TMON requirements for unlimited intervals between tail shaft withdrawal surveys.

**US Navy, Expeditionary Fast Transport
EPF-7 USNS Carson City**

■ 4 x WLD1400SR waterjets



Courtesy of Austal USA

Waterjets

Wärtsilä waterjets have been developed in line with the latest operating demands for naval vessels. The aim, as with all Wärtsilä products and solutions, is to ensure optimal efficiency, excellent hydrodynamic performance, and less maintenance. With two alternative options, ranging from 500 to 50.000 kW, Wärtsilä waterjets enable vessels to meet and exceed the performance levels required for today's competitive operating environment.

Wärtsilä offers two main waterjet executions: a pre-assembled (midsize) range, and a modular jet range.

The pre-assembled waterjets consist of an inlet duct and a skid that allows for installation directly onto the ship's hull. All auxiliary systems, such as the hydraulics and coolers, are

mounted on the assembly and the piping connections are then installed. These units are available in five sizes up to approx. 4500 kW.

For the large waterjets, the design of the inlet duct is optimised to fit the specific vessel requirements. Because of its size, the waterjet inlet is part of the ship construction. Our design capability for these larger waterjets includes units of up to 50 MW.

Axial jet technology

Wärtsilä axial waterjets are single stage, compact, high performance systems that combine mixed flow properties with an axial construction. This results in much less space being needed on the vessel's transom, and greatly increased waterjet cavitation margins for optimum vessel operational flexibility.



Waste and fresh water management

Wärtsilä Water systems set the global standards in waste management by being the world's leading manufacturer of marine sewage treatment plants and fresh water generation, ensuring naval ships can operate worldwide with minimal potential for regulatory constraints.

MBR technology

Wärtsilä Hamworthy's innovative MBR technology is based on biological degradation and membrane separation and allows for the treatment of grey and black water to satisfy the most stringent standards. The process produces the highest quality discharge without requiring any addition or generation of chemicals that are hazardous to the environment or ship operation.

Effluent quality tests conducted by the US National Sanitary Foundation on Wärtsilä Hamworthy's MBR produced results exceeding the most stringent future legislative pollutant standards envisaged.

The technology also achieved outstanding performance in Alaska under the scrutiny of the local authority, USCG and USEPA studies over the past seasons. The membrane permeate quality exceeds the most stringent coliform standards even without additional UV or chemical disinfection. The latest system optimisation has achieved over 25% savings on energy consumption and consumables, and over 50% reduction in operational man-hours. Satellite communication allows the MBR systems to be remotely monitored by specialists as part of our fleet support program.

Proven capabilities

Wärtsilä Hamworthy supplied MBRs to type 45 anti air warfare destroyers, whose primary role is the protection of ships, carriers, auxiliaries and merchant vessels from air, surface and subsurface threats. Specific MoD requirements for the work cover shock resistance, special safety obligations, reduced noise levels and electromagnetic compatibility (EMC) testing for electronics.

The reduced transom space requirement is achieved without reducing the inlet duct diameter or the size of the waterjet pump in order to maintain maximum efficiency for the lowest fuel burn. For naval architects, the axial jet technology creates the possibility to apply a larger power density onto narrower hulls in order to achieve top vessel performance.

Average 25% reduced transom occupancy. Unlike a non-axial design, the Wärtsilä axial design waterjet does not expand in a radial direction downstream. As the water flow is directed through the pump along the most efficient path, it is easier to fit the jet to the available transom space.

On average 15% less weight. The reduced transom size also decreases the weight of the installation significantly. These weight optimisations and savings can be as high as 15-20% compared to non-axial jet designs.

Improved operating flexibility and manoeuvring. Thanks to the increased pump cavitation margin of 35% and the lower impeller tip speed, more power can be introduced to the pump during manoeuvring. This results in a 15% higher manoeuvring thrust and faster response to acceleration. The operating flexibility is improved because of the combination of the reduced number of shaft lines and the higher loads of the remaining engines.



Electrical & Automation solutions

Wärtsilä Electrical & Automation is a leading systems partner to the marine industry. We provide electric propulsion and drives, power generation and distribution systems, navigation, automation and communication systems, dynamic positioning, safety and security solutions, entertainment systems, as well as sonar and hydroacoustic sensor technology for vessels of all types and sizes.

Our products and solutions are state-of-the-art, efficient, reliable and cost effective, and are supported by 24/7 customer service around the world.

The products and services of Wärtsilä SAM Electronics, Wärtsilä Lyngsø Marine, Wärtsilä Valmarine, Wärtsilä Dynamic Positioning, Wärtsilä JOVYATLAS EUROATLAS and Wärtsilä ELAC Nautik are well known and respected throughout the navy market. We provide our customers with the latest technologies and greater opportunities for meeting their present and future needs. We can proudly claim that this makes Wärtsilä the marine industry's leading Electrical & Automation provider.

Our experience in providing propulsion and powering solutions for navy and coast guard vessels is long standing: more than 90 countries entrust Wärtsilä with the supply of equipment for their naval fleet. Many Wärtsilä products meet special naval requirements such as noise reduction and shock resistance.

We optimize efficiency by looking at the whole picture and offer user-oriented, integrated solutions that ensure outstanding operability and maintainability.

Turnkey solutions

Wärtsilä provides innovative and custom-made solutions for all types of naval vessels and takes over responsibility for the integration of the complete electrical and electronic packages up to turnkey solutions. Our scope ranges from highly sophisticated and proven system installations to standardized systems and individual products for naval applications like main switchboards, load center, distribution boards, power supply, conversion equipment, degaussing and magnetic ranging as well as navigation systems.

The turnkey solutions business unit offers the system integration competence and is acting in the sense of an EPC contractor for complete electrical packages – typically in a close partnership with shipyards. Your benefit is our systems engineering competence, creating clever solutions with less cost and less installation time. Combining this service with the overall responsibility of detailed design for the electrical systems, our focus is in optimization the entire system on board. In this role, we also take care of the interfaces to all shipyard's subcontractors.



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Backed by 30 years of experience, we are proud to have participated in many national and international projects like Littoral Combat Ships for the Royal Malaysian Navy, MEKO Algerien and Offshore Patrol Vessels RMN. Our contribution to the German Navy is demonstrated through our performance on the Class 123, 124 and 125 frigates, Class 130 corvettes, and Class 702 combat support ships.

Our core competences are in system engineering and integration, project management, procurement and site supervision.

We are the shipyards single point of contact for the integration from bridge to propeller and provide:

- Project management
- System integration
- Planning
- Cable engineering
- Cables and supports
- Cable installation
- Lighting system
- Testing and commissioning
- Procurement of subsystems
- Training
- Logistic support
- Service worldwide



Royal Navy, HMS Daring, BVT Surface Fleet Ltd

Propulsion and drive systems

Our innovative diesel-electric propulsion systems are used on ships with special requirements. These systems are based on the principle of speed controlled AC motors in driving the propeller directly or by gearing. The most reliable and low noise design is the direct drive. Depending on the rated power the system will be designed in LV or HV technology.

For propulsion power on board the most economical drive solution is to install synchronous or induction motors fed by frequency converters with LCI synchro converters or with PWM converters, depending on the arrangement of the propulsion system and on the operational profile of the vessel. PWM converters are usually designed in a 12 or 24-pulse arrangement or as transformer less active front end (AFE) solution. Optional the Wärtsilä's patented Low loss concept (LLC) could be proposed. Active front end PWM converters are also available with modular multi-level infeed up to 6,6kV. This converter type provides an almost sinusoidal input voltage, low harmonics without the use of additional line filter units.

Switchboards

Wärtsilä is offering the full range of switchboards for navy applications. Depending on the power demand of the vessel, from low voltage up to medium voltage. Our switchboard design considers shipbuilding and classification societies requirements as well as special requirements regarding shock resistance capabilities. On request, we offer system integration, short circuit and voltage drop calculations as well as selectivity studies as per classification society requirements.

For protection and control of power supply systems, Wärtsilä integrates its own developed protection system with the brand name GPM 500.

On request, an integrated power management function for control of the power supply system is available. The protection system can be operated as stand-alone or in combination with other systems via data bus. Interfaces to automation systems and other control systems can be provided.

Degaussing and ranging/treatment systems

Wärtsilä is one of the worldwide leading supplier of ship-borne degaussing systems for all kinds of surface vessels and submarines.



Our expertise and know-how covers the full range of magnetic silencing. For all types of naval vessels our state-of-the-art degaussing systems provide a significant contribution for magnetic protection against the hazard of magnetic sea mines. More than 220 systems have been contracted for the German Navy and for various navies abroad.

Our multi-influence ranging systems for acquisition of underwater signatures of naval vessels including but not limited to magnetic, acoustic, electric and pressure signatures for mobile and stationary employment enable navies to adjust and validate the degaussing settings of their vessels.

Sophisticated software for modelling and analysis of the ranging results forms an integral part of our supplies.

The design of all customized systems are based on corresponding modeling and calculations where Wärtsilä has a many years of successful experience.

Wärtsilä degaussing and ranging application portfolio includes:

- Degaussing systems for ferro and non-magnetic vessels/submarines
- Signature modelling, FEM and dipole
- Mobile and stationary magnetic ranging systems
- Mobile and stationary multi-influence ranging systems (magnetic, acoustic, pressure and e-field)
- Treatment systems for surface vessels and submarines
- Component treatment and measurement systems.

Wärtsilä EUROATLAS power converters

Wärtsilä EUROATLAS is an experienced and reliable manufacturer of ruggedized power conversion products for advanced military and civilian applications.

For more than 50 years, we have been supplying advanced products for the world's top military and civilian platforms, such as the: MEKO 200 class frigate, F125 frigate, Submarine classes U209, U212, A17, A19, A26, Collins, Agosta, S80, Tiger helicopter, Tornado, Saab Jas 39 Gripen, Airbus, Boeing, Fokker, Leopard 2, Fox, German Railway and many others.

We offer technical support during the customer's design phase, with customer specific product design and qualification according to demanding standards. Thanks to our in-house production, monitoring and improvement services as well as our worldwide installation and after sales support, we are there for you whatever you need whenever you need it. We also provide fully integrated logistic support (ILS).

Power converters and services for naval applications:

- AC/DC rectifier
- AC/DC converter
- DC/DC converter
- DC/AC inverter
- UPS solutions
- Customer specific solutions.



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Sophisticated integrated bridge systems for naval ships

For more than 10 years, Wärtsilä has developed and supplied Integrated Bridge Systems (IBS) for high-profile naval ships.

The Wärtsilä Integrated bridge system (IBS) includes a complete range of multi-functional workstations that form a versatile and extremely redundant system. The Wärtsilä IBS offers a full range of functions such as navigation radar, warship ECDIS, conning and sonar displays as well as the possibility to integrate several other systems.

Each workstation is a master containing software for all applications, rendering the system autonomous from other client or server based systems.

A variety of military and commercial radar heads may be employed as sensors. The Wärtsilä IBS offers full interfacing capabilities towards market leading combat management systems, platform management systems, integrated automation

systems, INS and more. Ships with full integration between IBS and IPMS have been in service for several years. Furthermore, the IBS may be interfaced with a variety of other sensors and sub-systems.

Highly advanced integration technology allows all applications to be selected, monitored and even operated from any IBS workstation. This provides unmatched flexibility and redundancy. If one section of the systems should become inoperative, all functions will be fully accessible from any of the other multi-functional workstations (MFWs) on board.

The Wärtsilä IBS is based on rugged COTS components certified for the marine environment, which allows easy future upgrading of hardware and software. MIL STD components are optional. Quality assurance of software development and documentation follow MIL STD guidelines.



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Dynamic positioning system

Wärtsilä DP (dynamic positioning) offers the latest generation ship control system. With more than 50 years of experience supplying DP systems, Wärtsilä combines industry-leading software with commercially available hardware components for an easy-to-operate, innovative and reliable system. Wärtsilä DP system satisfies the most demanding requirements of the community.

Completely redesigned with the help of ergonomics professionals, DP captains and ship controls experts, the Wärtsilä DP user interface represents a leap forward in intuitive ship control. Offering full touch operation to engage the user for safer and more efficient operation, we lead the way in connecting the operator with the control system.

The buttons are sized and located for actual touch operation similar to the familiar electronics in most households. The user-oriented design offers easy learning for both experienced operators and those new to ship controls. Only necessary and required information is presented, preventing confusion during critical operations. Simple page tabs allow access to more detailed parameters when desired.

Integrated platform management system

The Integrated platform management system (IPMS) from Wärtsilä Valmarine offers a high level of integration between the



ship's main control and monitoring systems, such as machinery automation, HVAC automation, emergency shutdown and integrated bridge systems.

Redundancy is built into all levels of the system, preventing a system failure from causing loss of control, monitoring or safety functions.

The workstations are multi-functional and any station can be used for any task. The system communication network is redundant and based on fiber optics.



Safety management system (battle damage control)

The safety management system (SMS) is a central part of the platform management system for all activities concerning crew and ship safety.

The SMS provides access to all information and procedures related to the handling of incidents and emergencies. Layer-based graphics give the user the possibility to filter away information irrelevant to the actual incident or emergency.

The system can include control functions related to the interfaced safety systems. Efficient training of users and crew is supported by a simulation mode.



Safety, security and entertainment systems

The speed of technology convergence requires expertise in many systems, including internal communication.

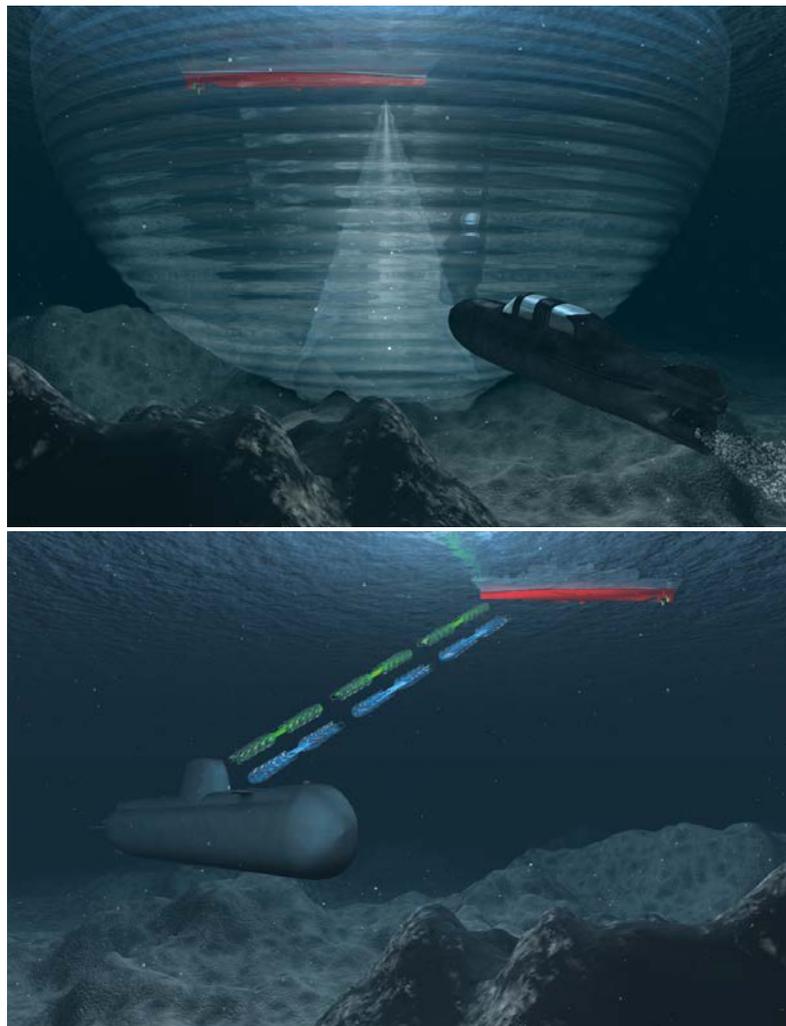
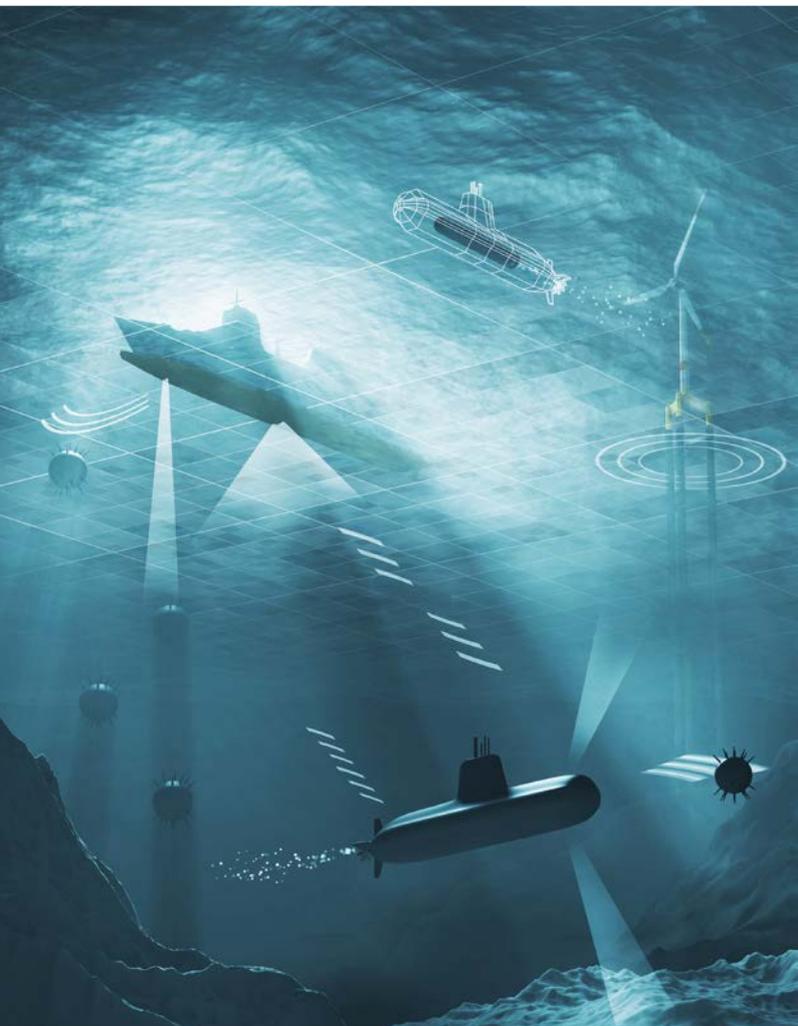
The Wärtsilä Shipwide system includes:

- IP network
- Public address and general alarm system
- Satellite reception
- Security system and door access
- Fire detection
- CCTV
- Communication system
- People tracking
- IPTV systems.

Process control stations have main and reserve units distributed in different compartments. I/O field buses are redundant with electrically isolated branches for ensured availability and operational safety.

The system integrates control and monitoring of all the basic machinery systems such as:

- Propulsion plant
- Power plant
- Auxiliary machinery
- Fuel plant/bunker system
- Bilge system
- Power management
- Ventilation system.



Naval acoustics

Wärtsilä ELAC Nautik has supplied equipment and systems for surface vessels and submarines to more than 50 navies worldwide. We combine decades of experience with innovative solutions in order to develop high-end state-of-the-art and cost-effective systems.

Our particular strength is the quick and flexible implementation of customer-specific requirements that can not be fulfilled with standard systems.

Wärtsilä ELAC Nautik's underwater communication systems are renowned worldwide. They form an important part of the security system onboard of submarines and at the same time, they perform operational communication tasks.

Passive and active sonar systems for surface vessels and submarines are also developed and produced at the Kiel facility in Germany. The acoustic sensors, transducers and hydrophones produced by Wärtsilä ELAC Nautik are integrated into systems of other well-known international manufacturers.

Sonar systems

Obstacles such as shoals, reefs or lost containers as well as planned attacks by small submarines and mines pose extreme risks to surface combatants and submarines. Only sonar systems allow you to 'look' or 'listen' under water. Our systems

– being especially adjusted to their separate tasks – enable the operator to get an exact picture. Wärtsilä ELAC Nautik's sonars perform integrated surveillance as well as automatic detection and tracking of surface or submerged contacts. For submarine distress operations, the sonar supports the rescue forces by detecting the damaged submarine by active and passive means.

Scope of sonar systems:

- Wärtsilä ELAC KaleidoScope – Open architecture sonar suite for submarines
- Wärtsilä ELAC LOPAS – Compact and economic passive sonar system for submarines
- Wärtsilä ELAC VANGUARD – Navigation and detection sonar
- Wärtsilä ELAC SCOUT – Mine avoidance and bottom mapping sonar for submarines
- Wärtsilä ELAC PILOS – Pinger localization sonar for rescue ships.

Echo sounder

The naval echo sounder Wärtsilä ELAC VE 5900 is a compact modular system with one to four frequencies for surface vessels or submarines. Control and display elements are combined in a single unit, built according to military standard.

The Wärtsilä ELAC SBE 1 sonar emergency pinger for submarines is designed to transmit acoustic signals in case of emergency.

Services

Optimising your operations and preventing the unexpected is our shared passion – we serve you whenever, wherever. Companies now focus on efficiency and impact of their operational expenses. Wärtsilä Services serves and supports customers in improving and optimising their operational efficiency throughout the whole lifecycle of the installation. Wärtsilä Services provides full service throughout the product lifecycle for naval customers, and constantly develops its network worldwide.

We offer lifecycle efficiency solutions in the following areas of expertise:

- Engine services
- Propulsion services
- Electrical & automation services
- Boiler services
- Environmental services
- Service agreements
- Service projects
- Training services

Our services cover everything from basic support with parts, field service and technical support to service agreements and condition-based maintenance; from installation and commissioning, performance optimisation, including upgrades and conversions, to environmental solutions, technical information and online support. The choice available to you extends from parts and maintenance services to a variety of comprehensive, customised long-term service agreements, including performance and operations and management agreements.

Additionally, we are continually broadening our range of services by adding valuable solutions and specialist services to our portfolio. In this way we support you around the globe through our workshops and in key ports, regardless of your equipment make.

Our Services organisation currently features more than 11,000 dedicated professionals in 70 countries.

Wärtsilä adds value to your business at every stage in the lifecycle of your installation. With us as your service partner, you receive many measurable benefits such as availability and performance, productivity gains and cost benefits.

Above all, peace of mind in the knowledge that your installation is being serviced by the most experienced partner you could have – Wärtsilä.

Underwater communication

The Wärtsilä ELAC UT 3000 is the very first underwater communication system combining analog and digital communication in one unit. In addition to the telephony and telegraphy mode, the Wärtsilä ELAC UT 3000 offers unique features such as own noise measurement, horizontal distance measurement and transmission of SOS signals.

Transducers

In addition to complete systems, Wärtsilä ELAC Nautik offers approx. 50 different sonar components. These include nearly the complete range of outboard sensor technology for submarines such as hydrophones or transducers for active, passive, intercept and flank array sonars as well as transducers for active sonars onboard of frigates.

Navigation systems

In order to avoid the collision of a submarine with an offshore structure, the German Navy requires a sonar transponder system to be installed at each edge of a wind farm.

We provide our customers with the sonar transponder Wärtsilä ELAC ST30, a compact system with minimal effort for installation and maintenance. The system consists of well-proven elements, in particular the transducer TSE5, which offers an outstanding longevity and has been in operation at navies worldwide for many years.





Wärtsilä is a global leader in smart technologies and complete lifecycle solutions for the marine and energy markets. By emphasising sustainable innovation, total efficiency and data analytics, Wärtsilä maximises the environmental and economic performance of the vessels and power plants of its customers.

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