

Propulsion Solutions for Frontline Combatants





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Wärtsilä has an impressive track record in supplying controllable pitch propellers & shafting for Naval combatants. The long standing success has been achieved thanks to the ability to meet stringent Naval requirements with the ships' performance, reliability and maintenance being optimised using advanced fluid dynamic modelling techniques in collaboration with the naval architect and testing basin. A wide selection of 4 & 5 bladed configurations is available for optimising the desired solution.

Silent, high performance controllable pitch propellers are Wärtsilä's main propulsion products for Navy. It is Wärtsilä's constant policy to select the most appropriate solution to naval requirements in close cooperation with their customers. The mission profile of a combat vessel is often more important than the maximum speed performance and therefore off-design operation conditions should always be taken into account. Depending on vessel type, the overall design of the shaft line has to be tailored. Shock resistance requirements, low noise capacity (High Cavitation Inception Speed – CIS), availability, maintainability and through-life costs are simultaneously dealt with and applicable solutions are proposed to select the most appropriate configuration.

Navy applications need tailor made solutions in order to meet the severe requirements such as high shock resistance, low noise and vibration levels. Wärtsilä Controllable Pitch Propellers for Naval vessels are available up to powers of

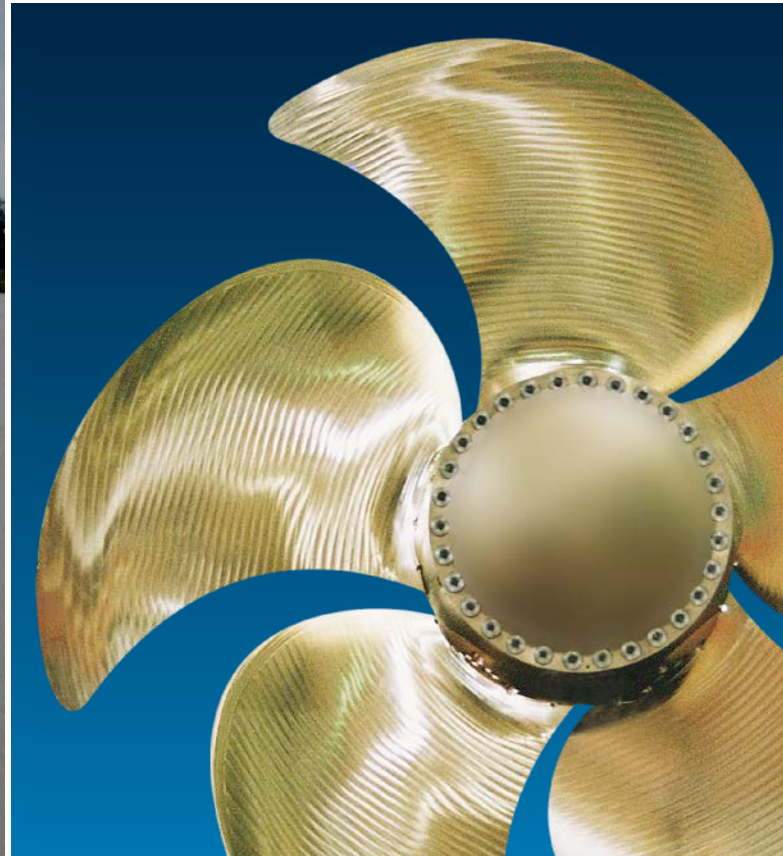
50 MW and can be used for ships as OPVs, Corvettes, Frigates, Destroyers and Aircraft Carriers. The Wärtsilä Controllable Pitch Propeller systems have been developed to provide outstanding reliability, low operating costs, environmental friendliness, easy installation/integration, and intuitive operating 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.

The Wärtsilä Controllable Pitch Propeller is composed of a minimum number of parts ensuring superior reliability. The CPP 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. Four and five blade propellers are specially designed to suit the projected operational profile, using hydrodynamic design, cavitation analysis, propeller-induced pressures and stress analysis.



Leading hydrodynamic expertise

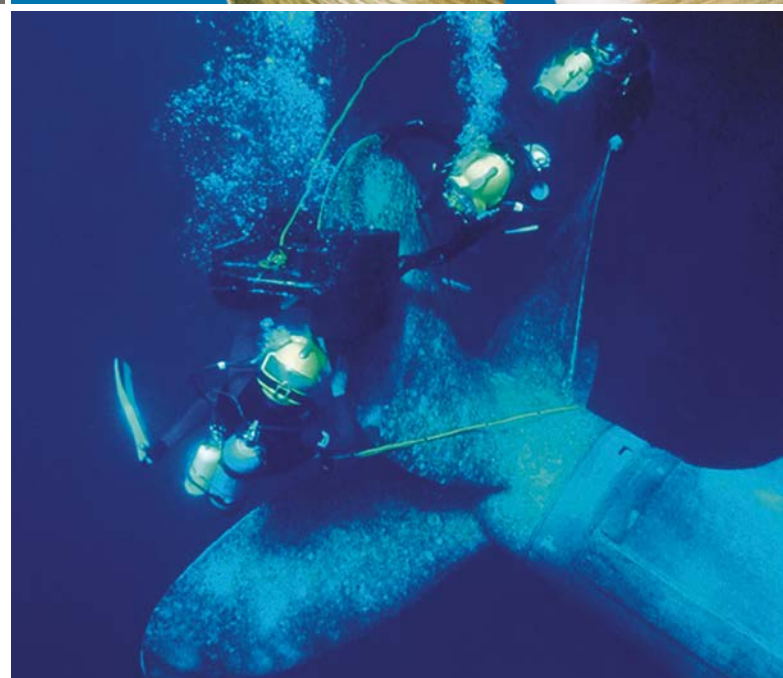
Wärtsilä Marine Solutions has all modern hydrodynamic tools and experience in-house to design and optimise the propulsion unit to meet the most stringent requirements of modern shipping. By analysing the vessel's sailing pattern and incorporating the results into the propulsion unit design, Wärtsilä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

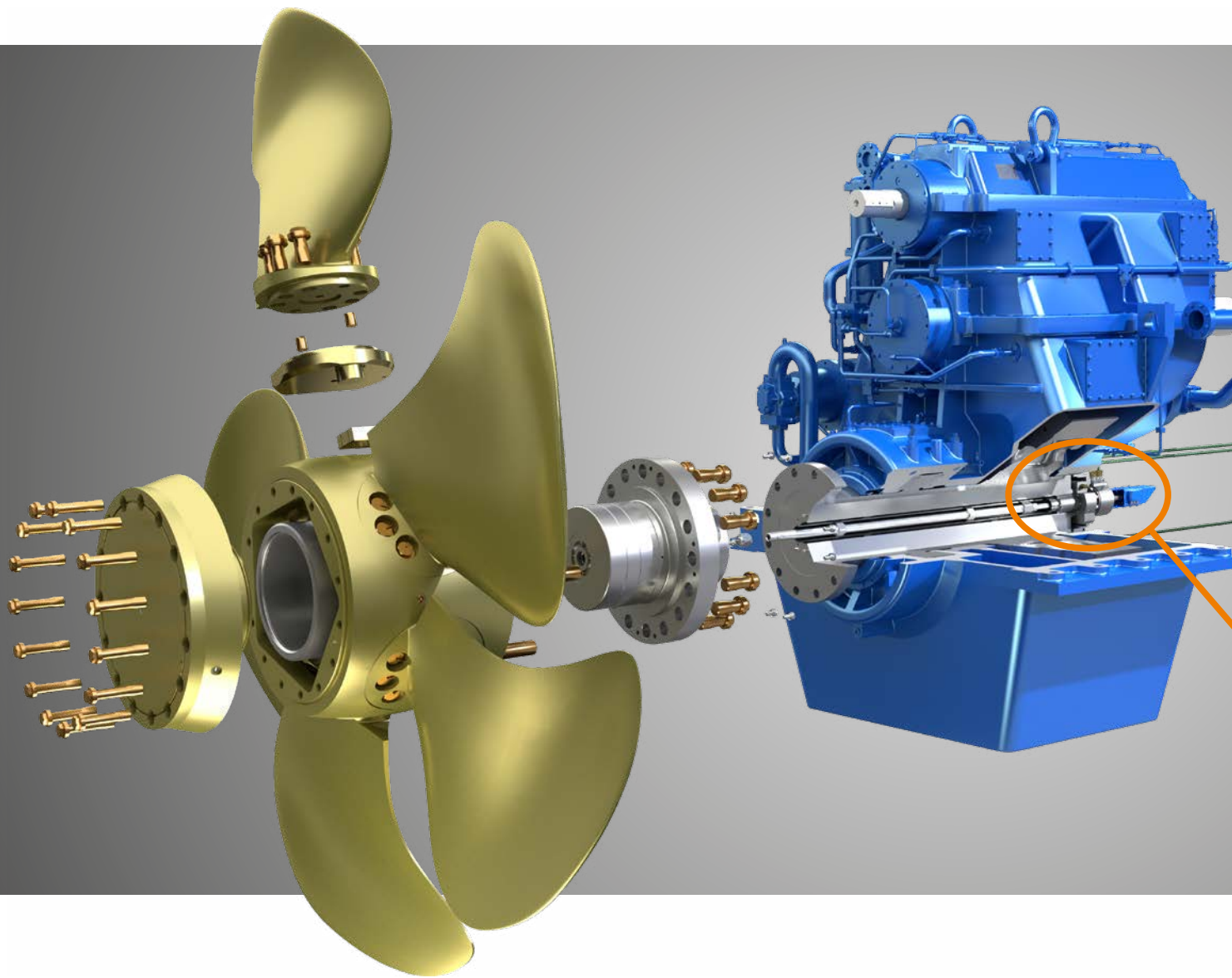


5 bladed CPP. Wärtsilä offers a wide range of 5-bladed propeller hubs. Through this design the power is spread over 5 blades instead of over 4 blades, whereby reducing vibrations in aft ship and accommodations. It also reduces underwater-radiated noise levels. For vessels with stringent noise requirements, a fully flush contour of the 5 bladed hub is available.

Feathering propellers. In general, feathering is a feature suitable for ships that operate regularly using one shaft line only. The Wärtsilä feathering Controllable Pitch Propellers are designed without restrictions in hydrodynamic or pitch setting capabilities.

Underwater blade replacement. This operation can be carried out efficiently with a minimum of equipment. The hub is cleverly designed with a sealing system that avoids getting water inside of the hydraulic system, ensuring a reliable actuating mechanism.





Key benefits of CPP

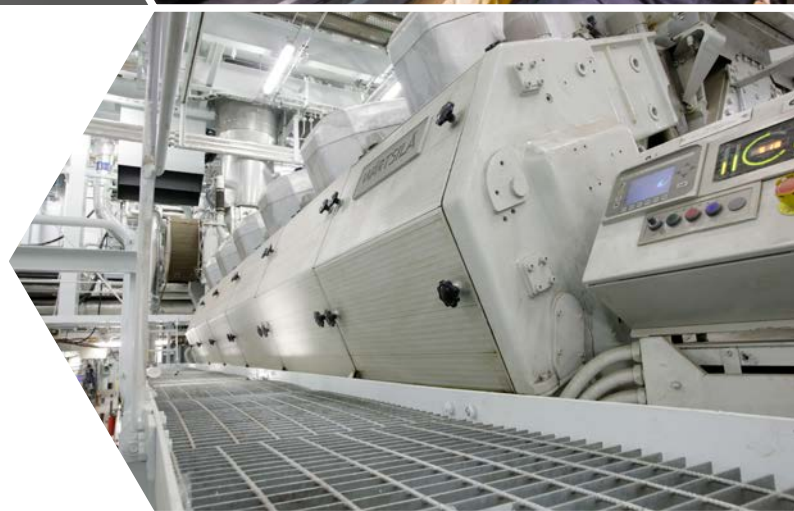
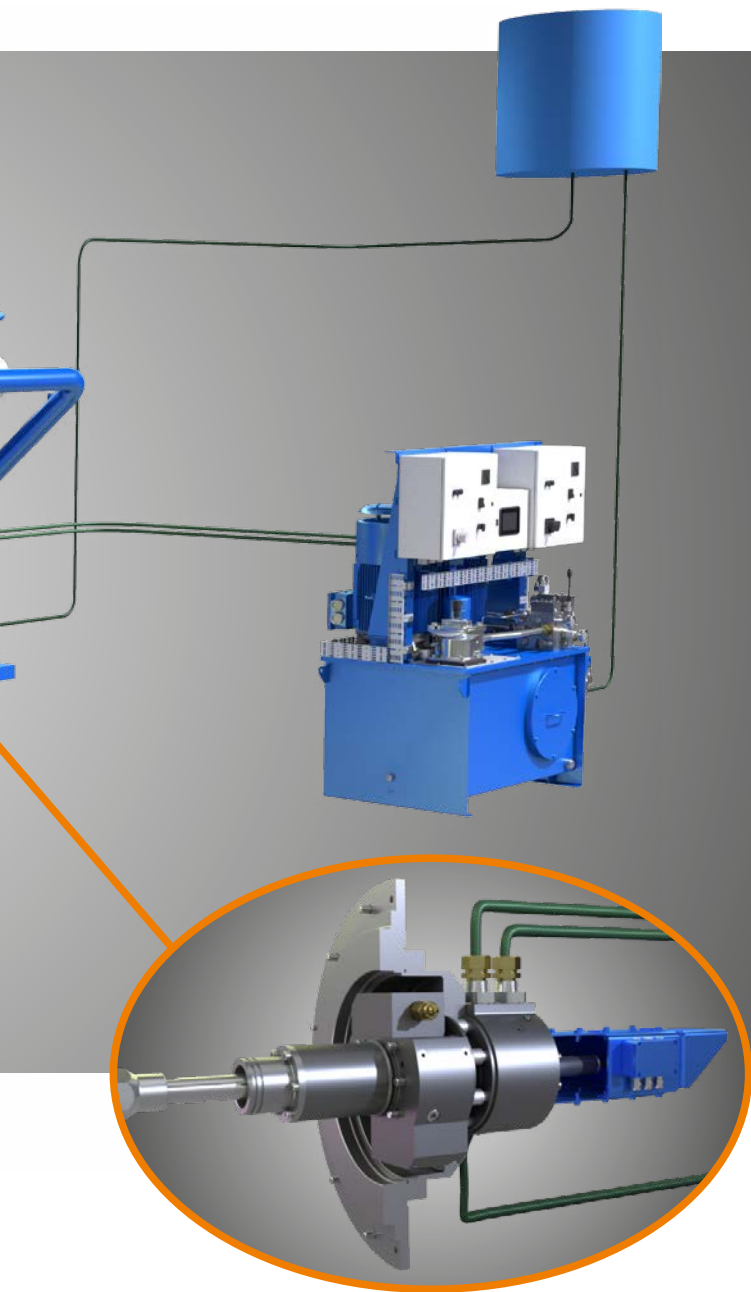
Minimum noise and vibration levels: Thanks to the use of the state-of-the-art technology, it has become possible to predict accurately the propeller induced forces acting on the hull. This valuable propeller design software asset is utilised to find the optimal balance between propeller-induced vibrations and propeller efficiency for applications where minimum noise is of importance. High-end cavitation models and modern CFD codes ensure well predicted noise levels for research and naval vessels.

Reliable: Since operational reliability is important for combatant vessels, Wärtsilä places high priority on the robustness of all components used in its products and solutions. The reliability of the CPP is the result of robust driveline components, such as seals, bearings and the pitch actuating system. Additional reliability can be achieved by the use of continuous moisture sensing in the hydraulic oil. The latest hub design features improved blade bearing loading, making the hub specifically suitable for demanding Dynamic Positioning (DP) and ICE class applications. The extensive product portfolio, including seals and bearing systems, and Wärtsilä's wide experience with applications in all marine segments, ensure lifelong and trouble free operation of the shaft line and stern tube.

High propeller efficiency: Wärtsilä Controllable Pitch propellers are custom-designed for each vessel. All Wärtsilä propellers are wake-adapted and, in cooperation with the customer, the propeller is designed for optimal performance in all relevant operating conditions. Targeting the highest possible propeller efficiency is a standard, while at the same time ensuring minimal noise and vibration levels on-board and maintaining excellent behaviour regarding cavitation. Advanced high lift blade profile sections and optimised propeller tip loadings are natural for us.

Easier maintenance: The smart connection method between the propeller shaft and hub, allows the servicing of all hub parts while keeping the propeller shaft in place. The double cylinder support has proven low maintenance requirements and is reliable. Oil monitoring can be done manually or via a dedicated monitoring system such as the Wärtsilä Propulsion Condition Monitoring Service (PCMS).

Reduced fuel consumption: The OPTI Design propeller 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 valuable information for achieving design. 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.

Environment: The innovative hub designs feature forced lubrication and allows the use of environmentally acceptable lubricants (EAL), as required for vessels operating in US inland and coastal waters. The WCP propeller system is prepared to meet the US EPA's VGP 2013 regulatory requirements.

User friendly controls: The thrust force is controlled by the Wärtsilä Propulsion Control system. The ProTouch panel design is space saving and designed to allow easier and more intuitive operation of the propulsor functions. Installation of the control cabinets, panels, and cabling is straightforward since all the propulsion control system components are interconnected by means of CAN OPEN field buses. Pitch control with constant engine speed, and combinator control with pitch and engine speed control with one lever are available, as well as load control, running up and slow-down programmes, and also single-lever control.



Seals & Bearings

Wärtsilä has been active in the seals and bearings business for over a century, and has worked with more than 76 navies worldwide. As a result, our seals and bearings are fitted to more than 1,800 naval, government or coastguard vessels in service today. Our products are designed and tested to be shock resilient approved, long lasting, quiet and efficient in operation.

Wärtsilä Envirosafe Water Lubricated Bearings

Wärtsilä's Envirosafe seawater lubricated composite bearings for brackets, rudders and stern tubes are an environmentally friendly solution that offer excellent performance. The bearings shells are available in non-split tubes, fully split shells, with or without housings.

Wärtsilä Sternsafe Oil Lubricated Bearings

Should the stern tube be oil lubricated, then Wärtsilä can supply suitable bearings, either of the white metal type or of the composite type.

Stern Tube and Rudderstock Seals

Wärtsilä can supply both oil and water lubricated seals, depending on the specific requirements of the vessel. Our range of seals are suitable for both blue-water and abrasive water environments. Partially and fully split options are available for ease of maintenance and seal replacement. In addition, our seals have proven reliability and can accommodate high axial and radial shaft movement and withstand shock events with minimal leakage.

Water Quality System

Wärtsilä Water quality systems are designed to provide filtered water for open and closed lubricated stern tube systems, significantly improving the longevity of installed equipment. They are designed to increase the life of both the seal and the bearing by filtering the water supply to the required standard.

Condition Monitoring

At sea, knowledge is often your best form of defence. Wärtsilä seals and bearings has developed systems that monitor the ongoing condition of your hardware in-situ, enabling navies to plan maintenance based on the true status of installed equipment.

Wärtsilä Floodguard Bulkhead Seals

Wärtsilä Floodguard bulkhead seal is a water lubricated face type seal suitable for both standard and high speed applications.

Line Shaft Bearings

Wärtsilä intermediate shaft bearing solutions are fully split, self-aligning, oil lubricated radial support bearings. The spherical, self-aligning design promotes easy alignment and reduces wear. The designs are also prepared for cooling and be fitted enable temperature and oil level monitoring on request. Also available in watertight and forced lubricated versions, the bearings can be modified for higher shaft loads.

Wärtsilä Ropeguard and Cutter Systems

The Wärtsilä Ropeguard and net cutter consists of one rotating blade and one stationary blade. This system instantly cuts the ropes and nets before they become entangled and damage the stern tube seal.

Hydraulic Sleeve Couplings

The hydraulically fitted sleeve coupling is designed to make a simple connection between cylindrical shaft ends. This coupling is easy to mount and dismount and provides a high torque capability through a powerful friction joint. Outboard couplings can be made either of stainless steel or of standard steel, protected by a special glass fibre reinforced coating. In addition, Wärtsilä offers a new generation of high friction hydraulic couplings that reduces the surface contact pressure while increasing torque transmission capacity by 30%, offering substantial cost-savings in the shaft line.

Hydraulic Loose Flange Couplings

This coupling is usually used between a cylindrical or conical shaft segment and a forged flange. The fitting is based on the same principles as the sleeve coupling.

Thrust Bearings

Wärtsilä's thrust bearings transmit the thrust from the shaft to the bearing housing which minimises the tilting effect with the benefit of low stress levels. The standard is for axial loads only and there is an option for axial and radial loading. As well as forced or self lubricating options, oil and temperature monitoring is also available.

Stern Tubes and Steel Construction

Wärtsilä stern tube solutions are ready to install stern tubes, designed to meet individual customer requirements and specifications. The solution encourages a fit and forget concept as bearings and all additional items are already fitted and installed on delivery. The steel construction encompasses the manufacturing of brackets, nozzles, rudders & tunnel fabrications.

Services

Navies can rely on Wärtsilä to provide complete lifecycle management, delivered through a range of hardware, commercial and technical support services. From responding to technical support queries to turnkey delivery and management of major projects. Wärtsilä has its own specialised workshops in various locations, and also offers a full range of underwater repairs and an entire scope of measurement and alignment services. Our global field service support is available around the clock to perform on board and underwater maintenance jobs, ranging from surveys and repairs, to complete overhauls. In addition, Wärtsilä holds a global stock of spare parts which allows quick delivery and expert installation of retrofits and upgrades.

Wärtsilä has a worldwide service network that assures you of reliable and efficient support and the quickest possible solution to any propulsion problem during the full operational lifetime of the vessel. Service activities provided include:

- Worldwide field service
- Underwater service and survey
- Original Wärtsilä spare parts
- Metallurgic repairs
- In-house overhaul/repair.
- Retrofits and upgrades
- Personnel training programmes
- Helpdesk

References

Customer country	Ship type	Class	Ships per class	Displ. (tons)	Speed (Knots)	Wärtsilä products, equipment per shipset
Algeria	Frigate	A-MEKO A-200	2	3,648	28	2 x CPP 5C09 + 1 x WTJ LJX2180
Argentina	Frigate	Drummond	3	1,230	23	2 x CPP
Australia	Destroyer	Hobart	3	6,350	28	2 x CPP 5C14
Bulgaria	Frigate	Wielingen	3	2,469	26	2 x CPP 4C10
Canada	Destroyer	Iroquois	3	5,385	27	2 x CPP 5LH410
Chile	Frigate	Latorre	2	3,810	30	2 x CPP 5C14
France	Frigate	Floreal	6	2,997	20	2 x 4C08
Greece	Frigate	Elli	9	3,688	30	5C14
India	Aircraft Carrier	Vikrant	1	40,642	28	2 x CPP 5C20 + 24000 kWe DG sets
India	Frigate	Shivalik (P17)	3	4,277	28	2 x CPP 5C14 + 1000 kWe DG sets
India	Corvette	Kamorta	4	3,150	25	2 x CPP 5C10 + (2x1000 + 2x500 kWe) DG sets
Indonesia	Frigate	Fatahillah	3	1,473	30	2 x CPP 5C09
Italy	Frigate	Maestrale	7	3,251	32	2 x CPP 5C13
Italy	Frigate	Artigliere (Lupo)	2	2,566	35	2 x CPP 4C12
Malaysia	Corvettes	Gowind	6	3,000	28	2 x CPP 5C12
Netherlands	Frigate	Karel Doorman	2	3,340	29	2 x CPP 5C15 + 2 x 12SW280 ME
Netherlands	Frigate	De Zeven Provinciën	4	6,145	28	2 x CPP 5C15 + 2 x 16V26ST ME
Pakistan	Frigate	F22	4	2,980	29	2 x CPP 5C11
Peru	Frigate	Carjaval	3	2,540	35	2 x CPP 4C12
Peru	Frigate	Aguirre	4	2,540	35	2 x CPP 4C12
South Africa	Corvette	Valour	4	3,648	28	2 x CPP 5C9 + 1 WTJ LJ210E
Spain	Frigate	Alvaro de Bazan	5	5,947	28	2 x CPP 5C14
Thailand	Helicopter carrier	Chakri Naruebet	1	11,669	26	2 x CPP 4C14
Thailand	Frigate	Chao Phraya	4	1,955	30	2 x CPP 5C10
Turkey	Corvette	Burak	6	1,194	23	2 x CPP 408
Venezuela	Frigate	Modified Lupo	6	2,560	35	2 x 4C12



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

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