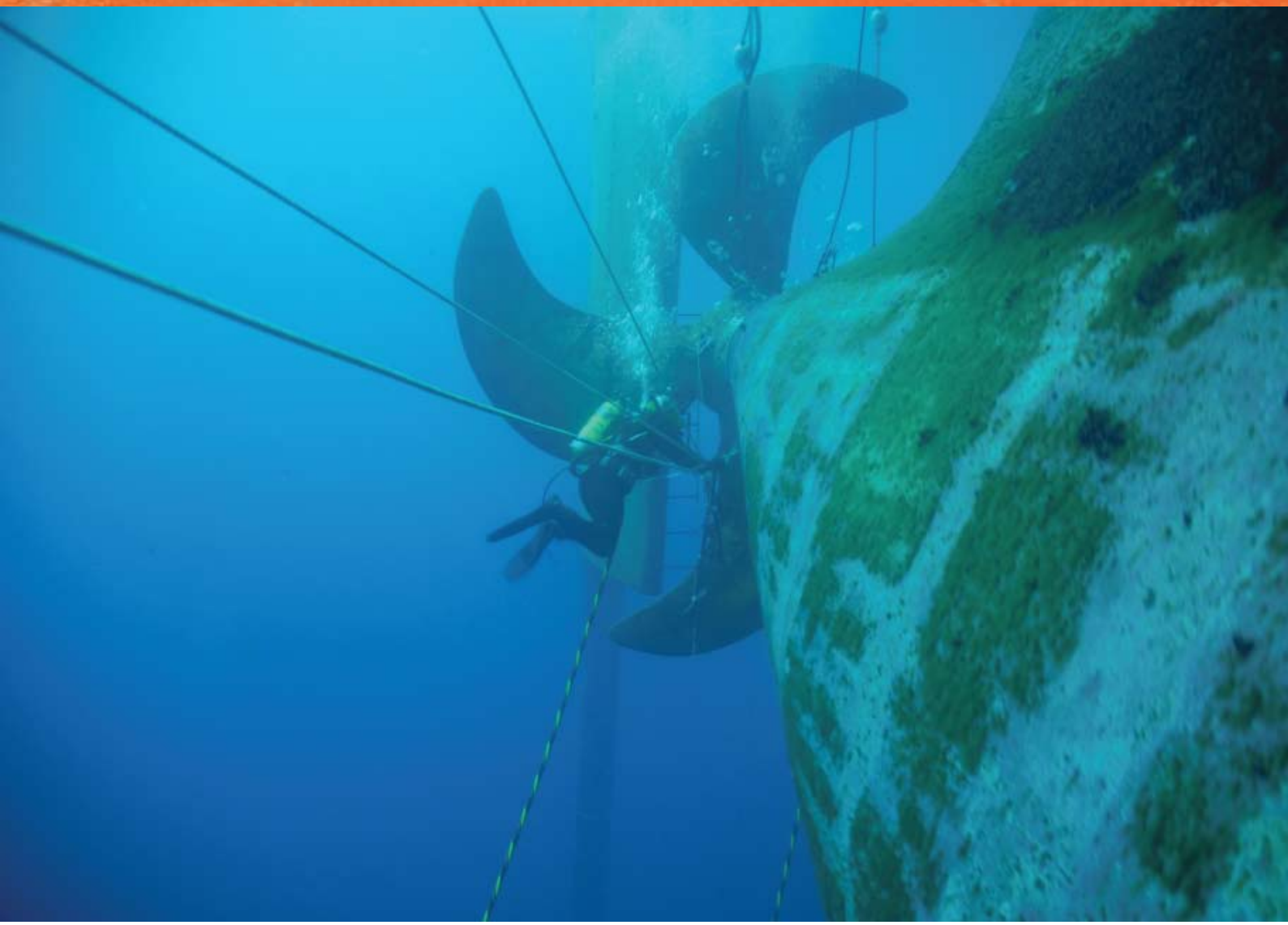
WÄRTSILÄ **Propulsion Services**

UNDERWATER REPAIRS



Equipment failures are never planned and typically come when you least expect them.

Performing critical maintenance to tunnel thrusters, propellers, azimuthing thrusters, and sterntube seals while keeping the vessel in service enables uninterrupted operation and continuity of performance.

Owners and operators can improve the financial performance of their assets by reducing off-hire time while, at the same time, maintaining the equipment in accordance with recommended service intervals. Improvements in hydrodynamic efficiency can also provide faster returns on investment.

Out of the box solutions are what you expect from Wärtsilä, the leader in innovative "Total Service" solutions

Wärtsilä is pleased to introduce a new service; "Underwater repairs".

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STERNTUBE SEAL MAINTENANCE AND REPAIR

Sterntube seal failures require immediate repair if operating performance and environmental safeguards are to be maintained. The conventional industry solution has been to immediately take a vessel out of service and steam to the nearest dry dock. This costs both profits and time, both of which are valuable. Vessels operating in critical trades and/or traversing environmentally sensitive areas expose owners to severe penalties for sterntube defects.

TECHNICAL DISCUSSION

To rectify a sterntube seal defect, a proprietary hyperbaric air bag shelter is installed around the aft sterntube/propeller hub section of the vessel. The erected habitat assembly is extremely durable, stable, and can withstand sea state 5 conditions (13.1 ft wave heights at 9 second intervals) and 3.3 knot currents. This can be performed offshore to sea depths of 60 ft. Within the air-filled Habitat structure, there is a dry and stable environment that enables divers to perform highly reliable stern seal replacements, hyperbaric seal bonding, and various specialized types of stern tube liner and propeller shaft repairs.

ADVANTAGES OF THE UNDERWATER PROCESS

- Surrounds the entire sterntube seal and part of its propeller hub,
- Quick and easy to erect and tear down.
- Proven- no reported failures or safety incident since its inception in 1998.
- Complete oil removal and remediation
- No special wet tools are needed.
- 100% of sterntube seal structures and liner interfaces can be completely cleaned and thoroughly inspected before encapsulation.
- Highly reliable deep curing and seal integrity bonding.

TUNNEL THRUSTER REPAIR AND MAINTENANCE

Why waste valuable time in dry dock repairs? Why pay additional costs entering and leaving port with unnecessary tug assistance when your vessel has a disabled thruster? Why wait until the dry dock to find out that there is severe damage to a tunnel thruster gear set, forcing yet another emergency dry docking in the future? Instead, thruster repairs and maintenance can be carried out underwater.

TECHNICAL DISCUSSION

Wet or dry environments can be employed to perform these essential repairs.

A wet environment can be employed to carry out:

- Tunnel thruster grate repairs or inspections
- Blade repairs or straightening
- Weld repairs
- Condition inspections

A dry environment is employed when performing critical inspections or repairs that require dismantling of the tunnel thruster:

- Blade seal or other seal replacements
- Gear lash inspections
- Any maintenance or repairs that necessitate opening he thruster.

ADVANTAGES OF THE UNDERWATER PROCESS

- Can be performed in phases during normal 8 to 12 hour port calls.
- Allows the vessel to remain in service with unrestricted performance
- Environmentally friendly
- Allows proper planning and economical use of dry docking maintenance schedules.

PROPELLERS

Damaged or leaking propeller blade seals can cause vessel delays or render vessels out of service. Bent or damaged propeller blades can affect vessel performance and cause secondary damage to other portions of the shaft line. Regulatory and environmental restrictions may require the vessel to be repaired prior to leaving port, or could result in significant fines for non-compliance being levied. Various solutions are available to minimize such impacts.

Propeller optimization upgrades are available to improve fuel efficiency and vessel speed. A full range of propeller upgrades can be performed whilst the vessel is in the water.

CONTROLLABLE PITCH PROPELLER REPAIR ALTERNATIVES

- Blade seal replacements
- Hub removal, dry shaft seals replacement
- Replacement of pitch rods, o.d. boxes and hoses, dry

REPAIR ALTERNATIVES

- Straightening large bends
- Wet and dry liner repairs
- Removal of damaged blade sections
- Crack repair and propagation control
- Restoration of hydrodynamic edge contours
- Static balancing (calculations on-site)
- Hydrodynamic balancing (calculations on-site)
- Replacement of C.P. blades and blade seals

DESIGN MODIFICATIONS AVAILABLE

- Pitch and camber alterations
- Diameter and blade area reductions
- Propeller induced engine overloads corrected
- Contour modifications to eliminate cavitation
- Edge modifications, anti-singing edge corrections

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