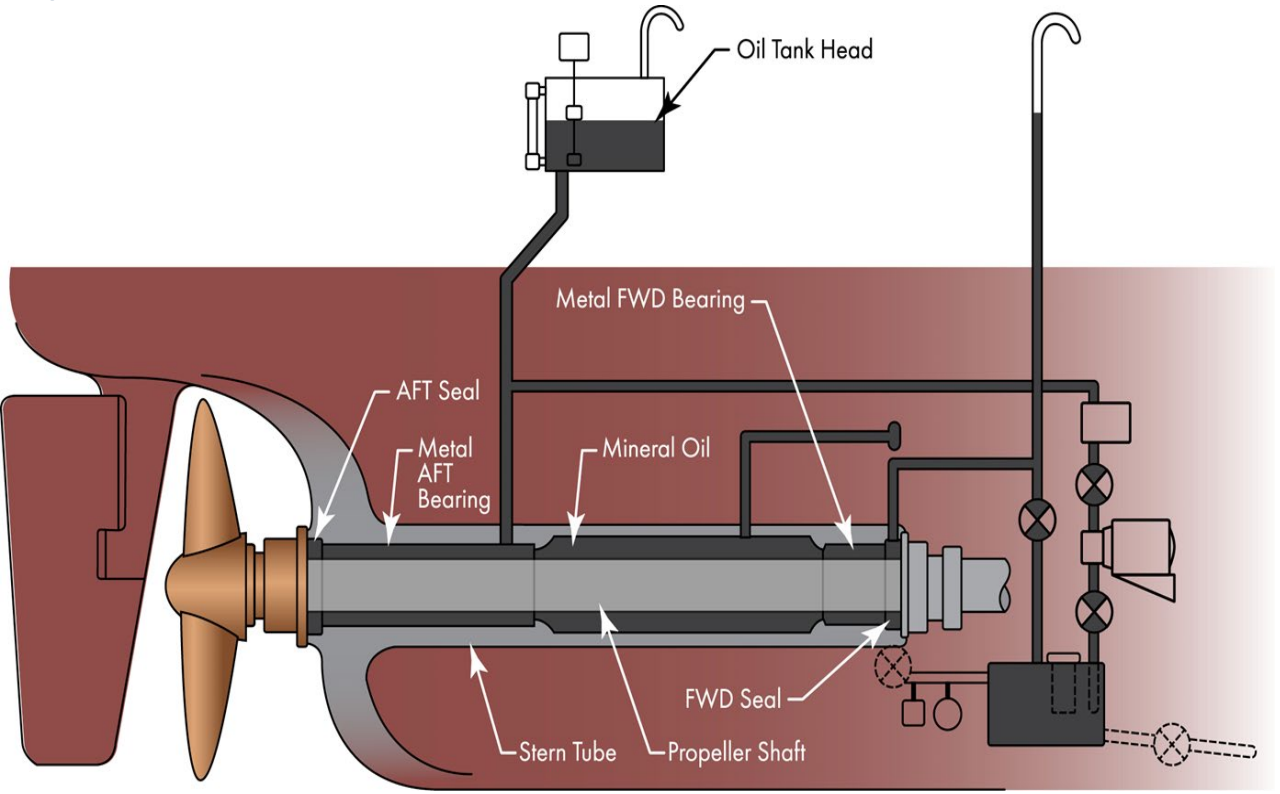
REVOLUTIONARY
T-BOSS STERNTUBE-LESS DESIGN
Saving Shipowners Thousands
While Keeping Oceans Clean

It’s all about stopping oil pollution



95% of Merchant Fleet still Use Sterntube Oil Bath System

Sterntube Oil pollution is a regular occurrence

Ship type	Discharge rate ($L\,d^{-1}$)
RoPax ship	6
Container/ro-ro cargo ship	4
Passenger cruise ship	2
Passenger ferry	2
Cargo ship	6
Refrigerated cargo ship	4
Container ship	5
Chemical tanker	4
Crude-oil tanker	4
Oil products tanker	3
LPG tanker	3
LNG tanker	1
Fishing vessel	2
Vehicle carrier	3

Source: J.-P. Jalkanen et al., 2021: Leakage rates of stern tube oil for different ship types.

Accidental Oil discharge from sterntube

Webinar hosted by Riviera Maritime Media, 25 Feb. 2021

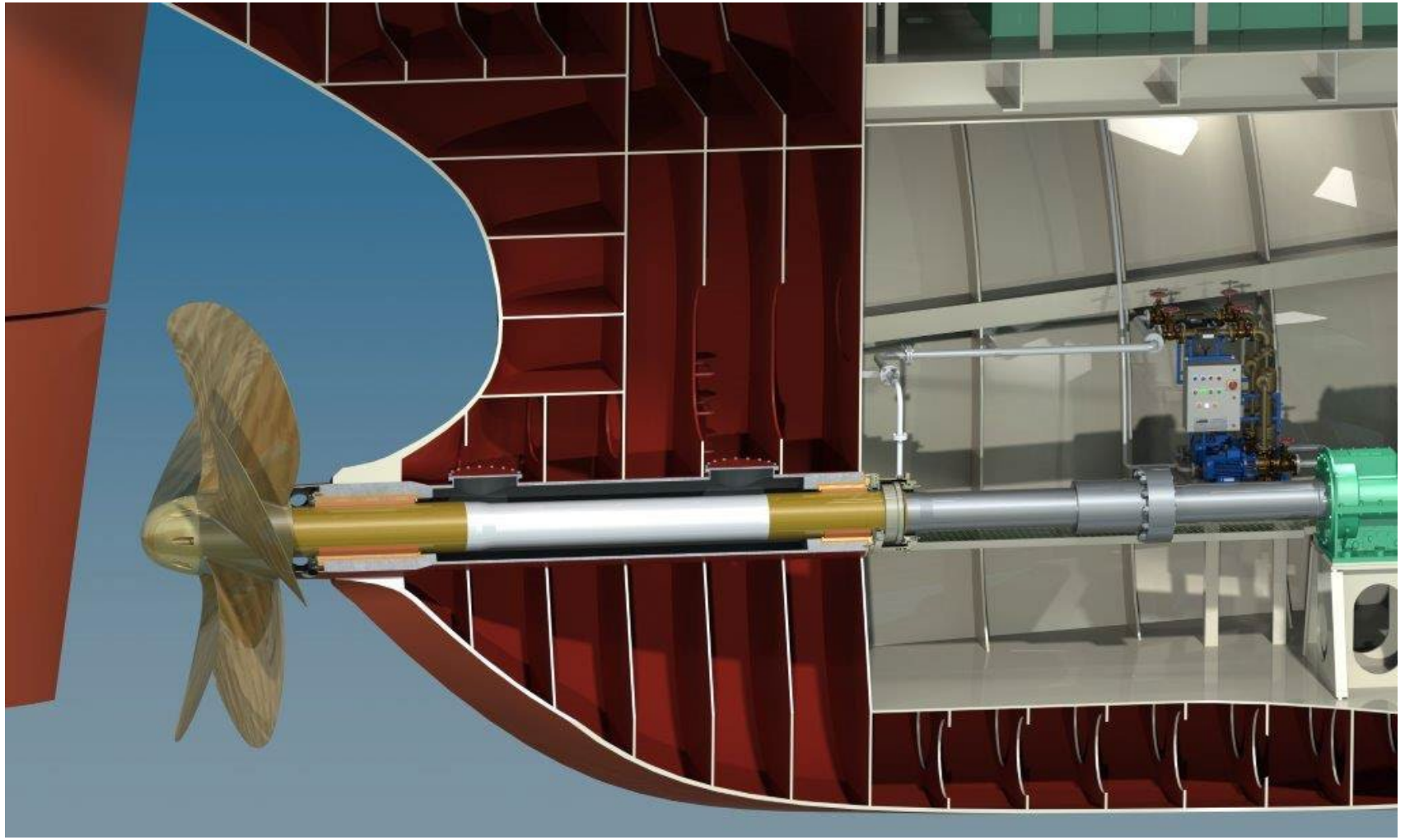
Q&A with Wartsila Shaft Line Solutions Team

Q: How many emergency seal repairs do you perform in a year?

A:* Good question.. *Several hundred I would say.
(Answered by Wärtsilä Shaft Line Solutions)

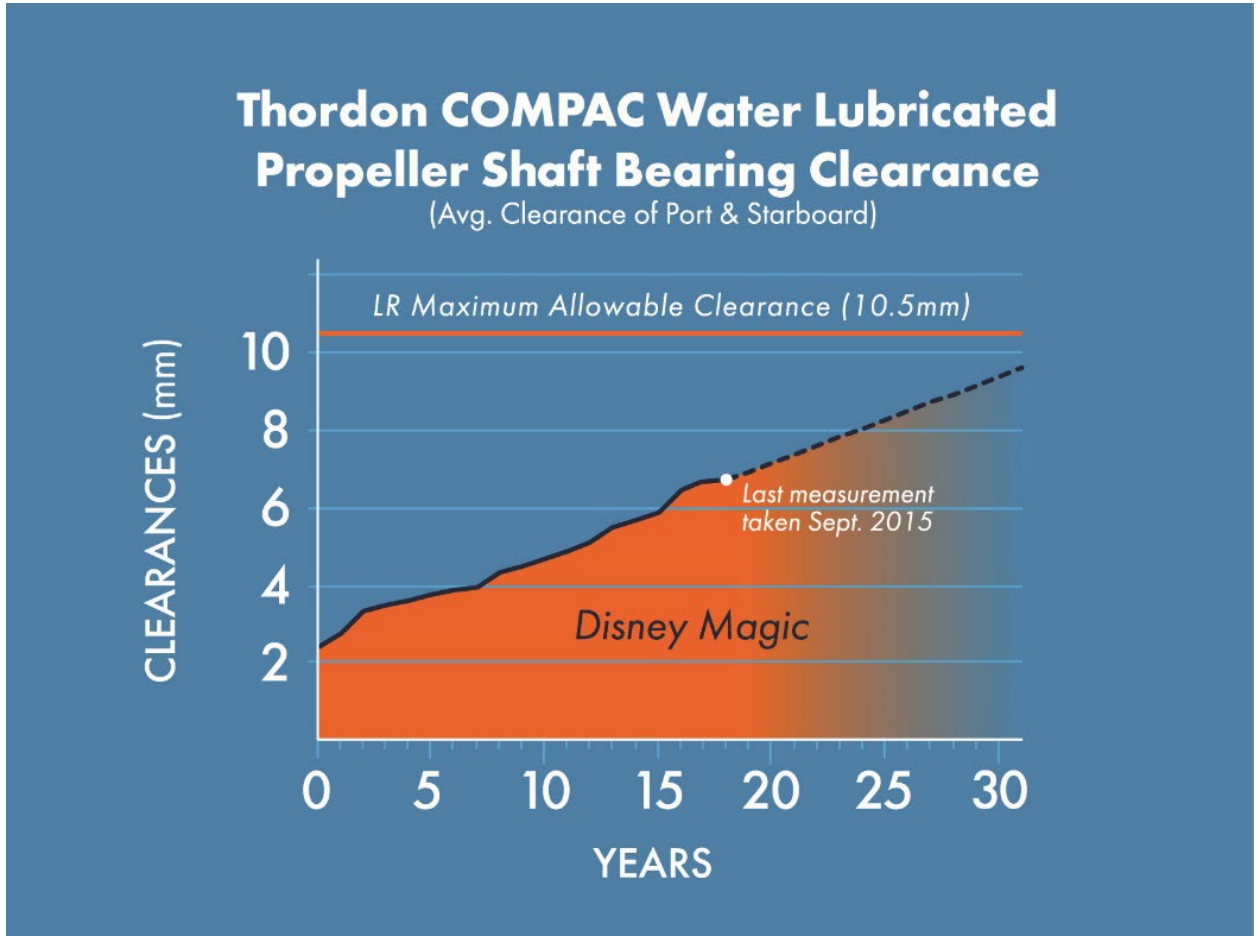
A: It is a tricky question and from the top of my head I cannot give an exact figure for emergency seal repairs. There are a good number of emergency repairs coming from fishing lines, ropes and some are done dockside and some underwater.
(Answered by Wärtsilä Shaft Line Solutions)

Modern open seawater-lubricated system (sterntube)



Modern Seawater-lubricated Bearings – Long Life

LIFETIME
BEARING WEARLIFE
GUARANTEE



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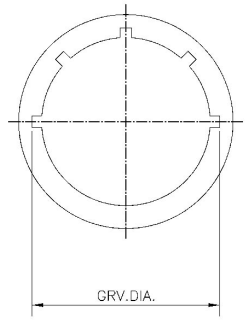
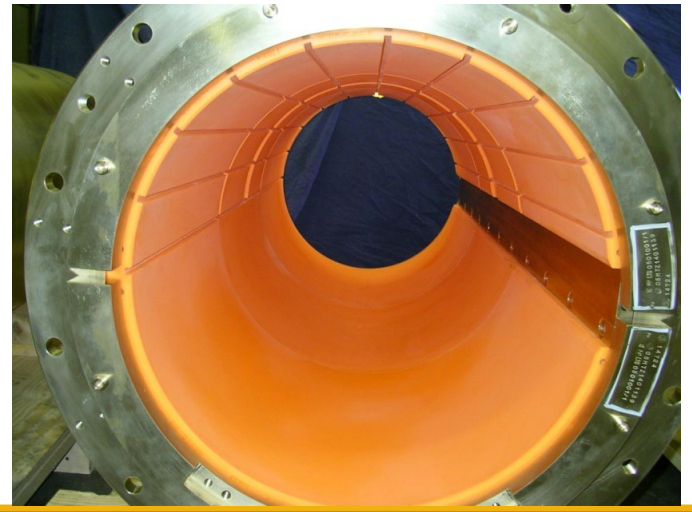
Elastomeric Polymer Alloy COMPAC Bearings



- Toughness, abrasion resistance, shock loading
- Typically, 2:1 L/D ratio for AFT bearing and 1:1 L/D ratio for FWD position
- Class approved design for pressures to 0.6MPa (87 psi or 6 Bar)
- Fitted in bronze carrier or installed directly into stern tube



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Thordon Bearings – Elastomers

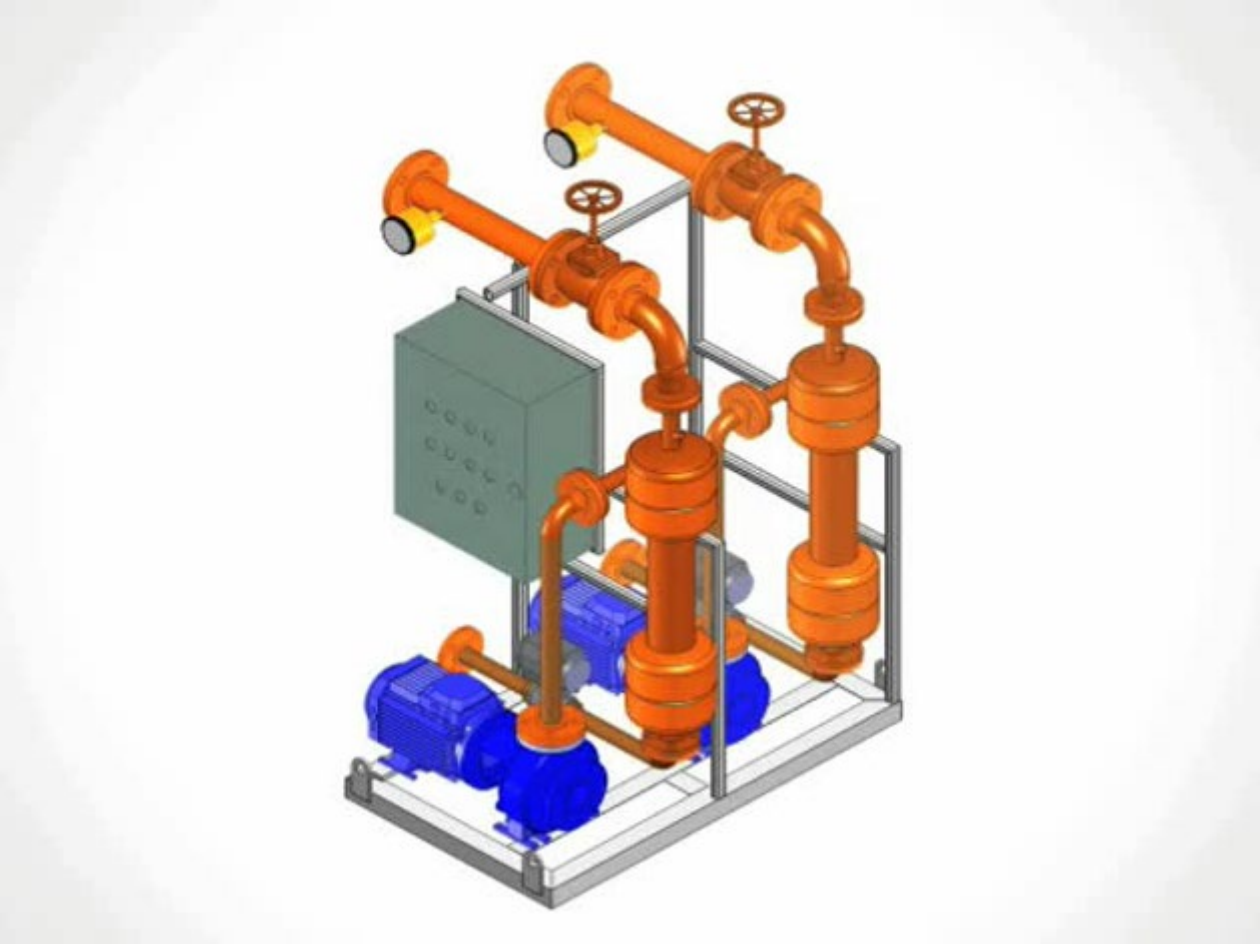
Thordon Bearings Inc. - YouTube

https://www.youtube.com › user › ThordonBearings

Water Quality Package

- Designed to provide a clean supply of water to the water lubricated bearings
  - Controlled environment
    - Flow is monitored and low flow alarms provided
  - Removes abrasives
  - Improves bearing wear life
  - Self contained unit
  - Several configurations available

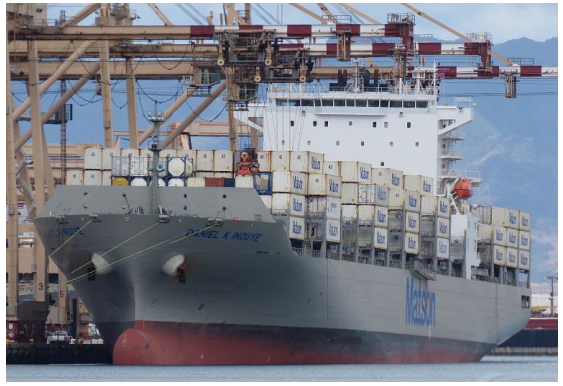
Thordon Water Quality Package



Seawater Lubricated Shaftlines…

Already in Use





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Why Seawater?

Proven Performance

- Fitted to over 700 commercial ships
  - Thordon (500), Wartsila, KEMEL, Duramax, Lagersmit, Maprom

- Lifetime Propeller Shaft Bearing Wearlife Guarantee

LIFETIME BEARING WEARLIFE GUARANTEE

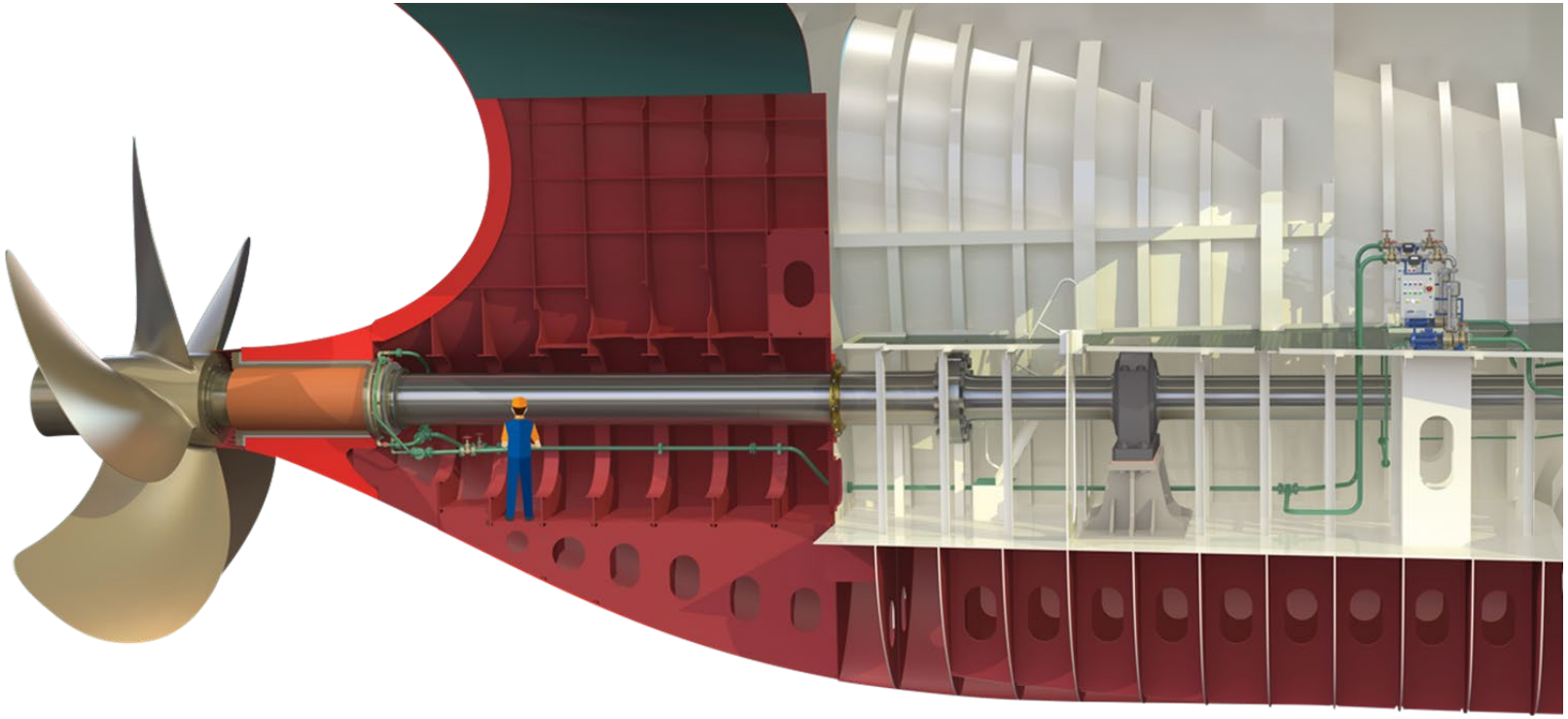
Zero Pollution Risk *(Zero Fines)*

- Eliminate oil from below the waterline
- Meets US Vessel General Permit (VGP) and Polar Code

THORDON BEARINGS INC.

All major Classification Societies agree…

THE FUTURE… REVOLUTIONARY STERNTUBE-LESS DESIGN – T-BOSS



A Joint Development Project

Elimination of the Stern Tube

Joint Development R&D and Innovation project with:

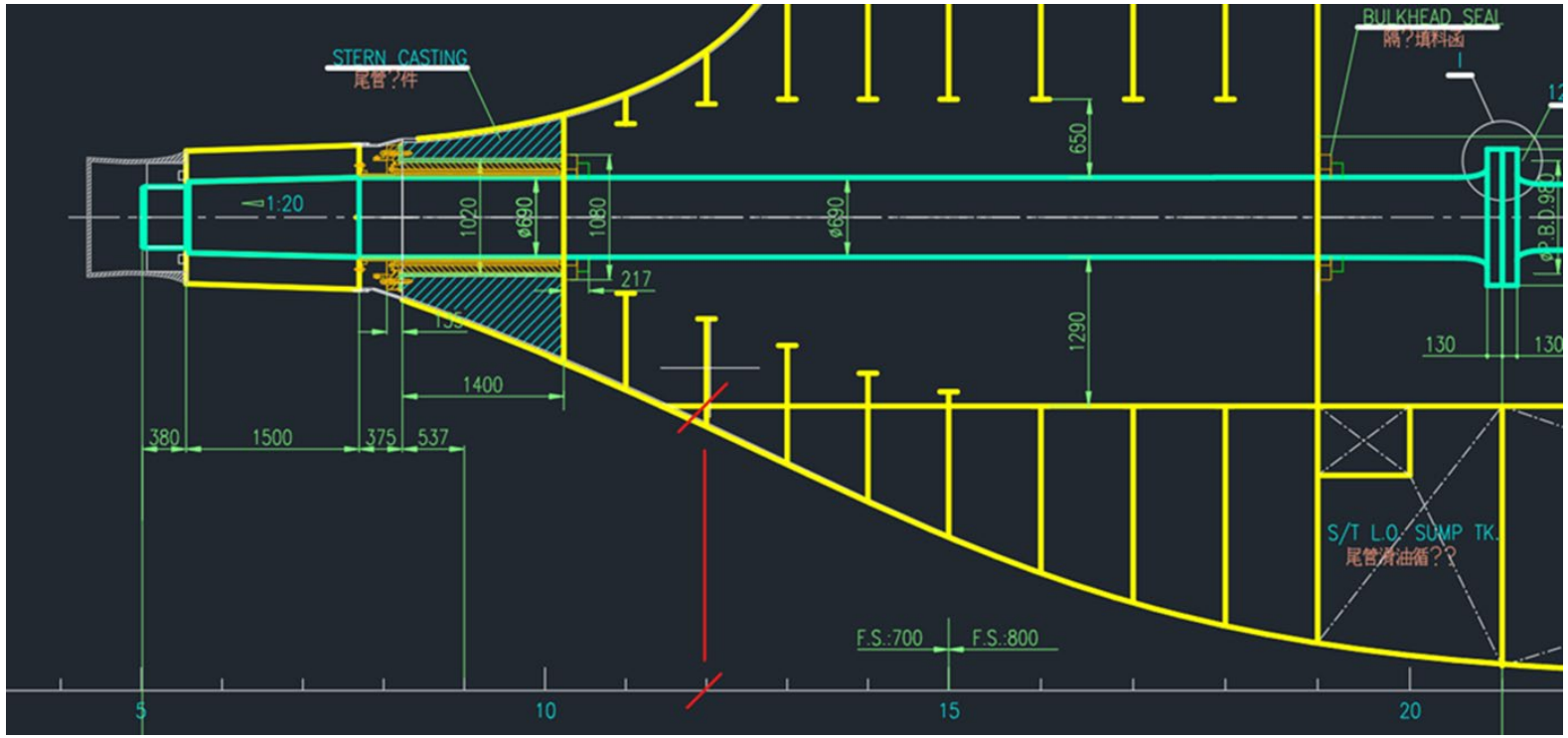
- ABS (American Bureau of Shipping), Greece office
- CSSC-SDARI, China
- Thordon Bearings, Canada
- National Technical University of Athens (NTUA), Greece

Key Focus

- Environmental impact by addressing the oil leakage from sterntube seals
- Sterntube removal and aft vessel interior re-designed
- Lower shipbuilding and maintenance costs for the ship owner
- No Shaft Withdrawal

Sterntube-less vessel Concept

- Sterntube, Aft Seal and Forward Sterntube Bearing Removed
- Aft Sterntube bearing replaced with Seawater lubricated bearing
- Irregularly Shaped Dry Aft Stern Chamber formed



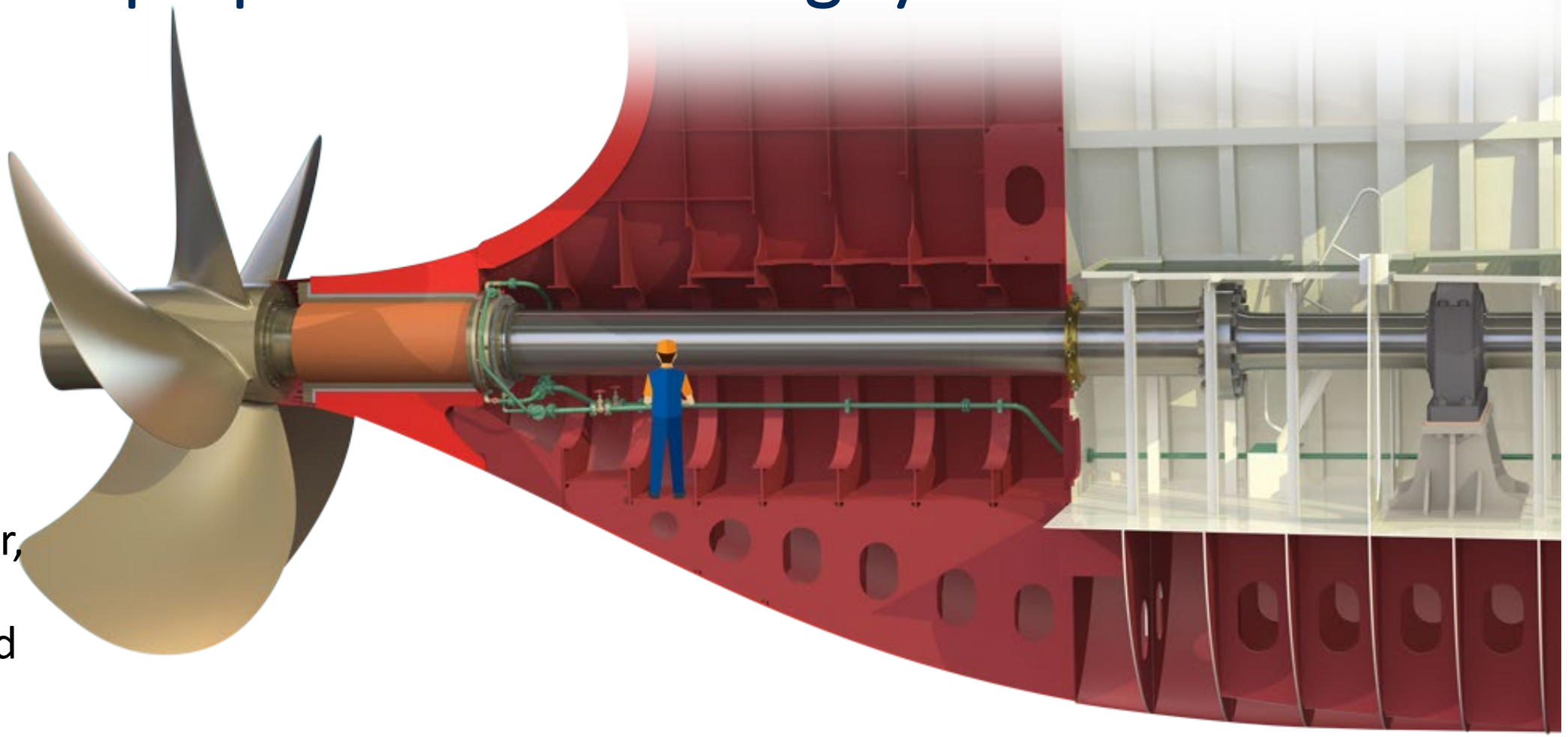
Design modifications to a sealed oil sterntube system

- Remove Sterntube
- Remove Forward Sterntube Bearing
- Replace AFT Sterntube Bearing with Water Lubricated Bearing
- No Aft Seal, Fwd Seal only
- Shorten shaftline, Optimize Engine Room Space, Increase Cargo Space

T-BOSS – Thordon Blue Ocean Stern Space

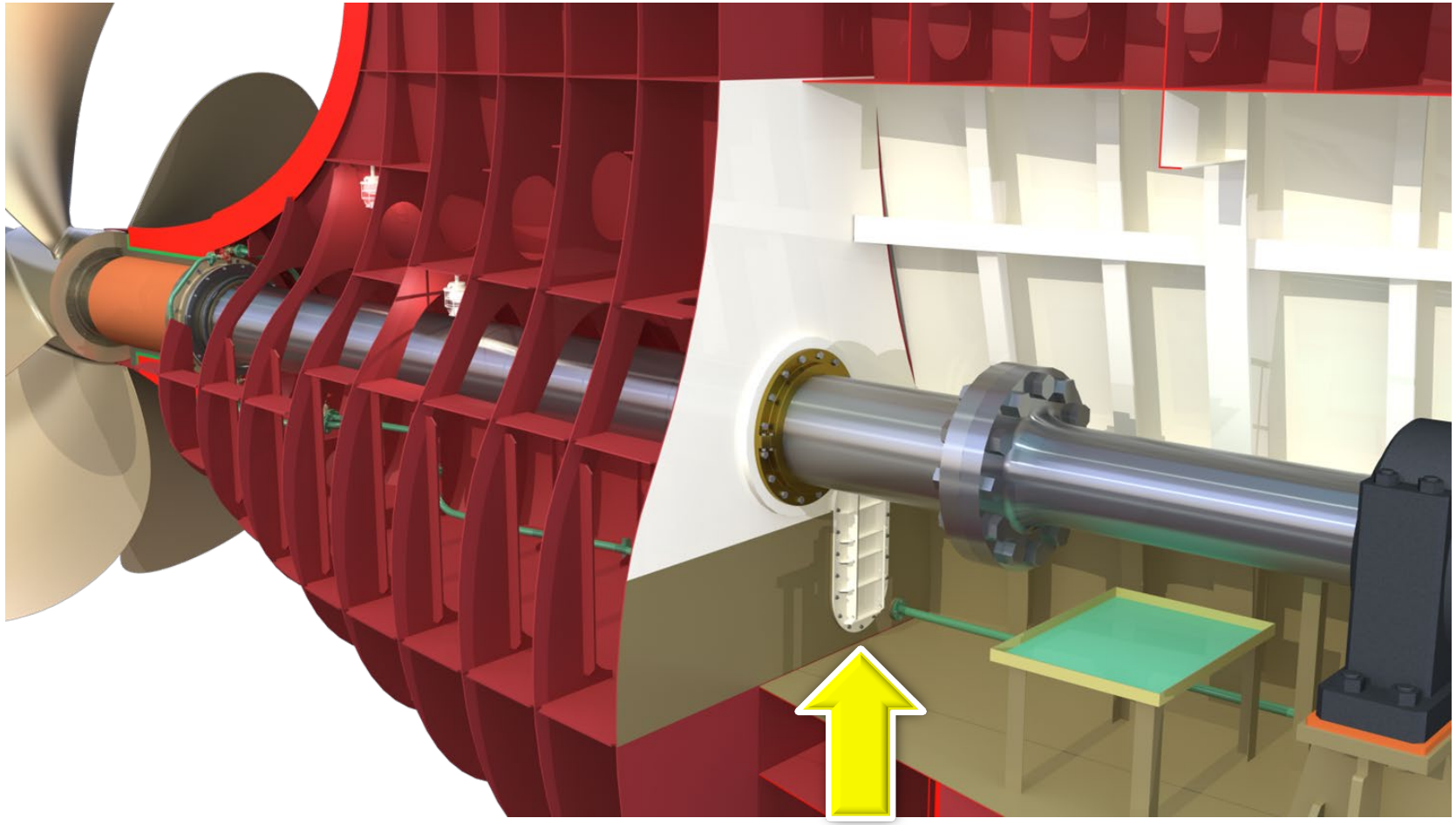
T-BOSS Sterntube-less vessel with seawater lubricated propeller shaft bearing system – 3D CAD

Formation of the Dry Aft Stern Chamber, where the sterntube used to exist.



T-BOSS Sterntube-less Ship

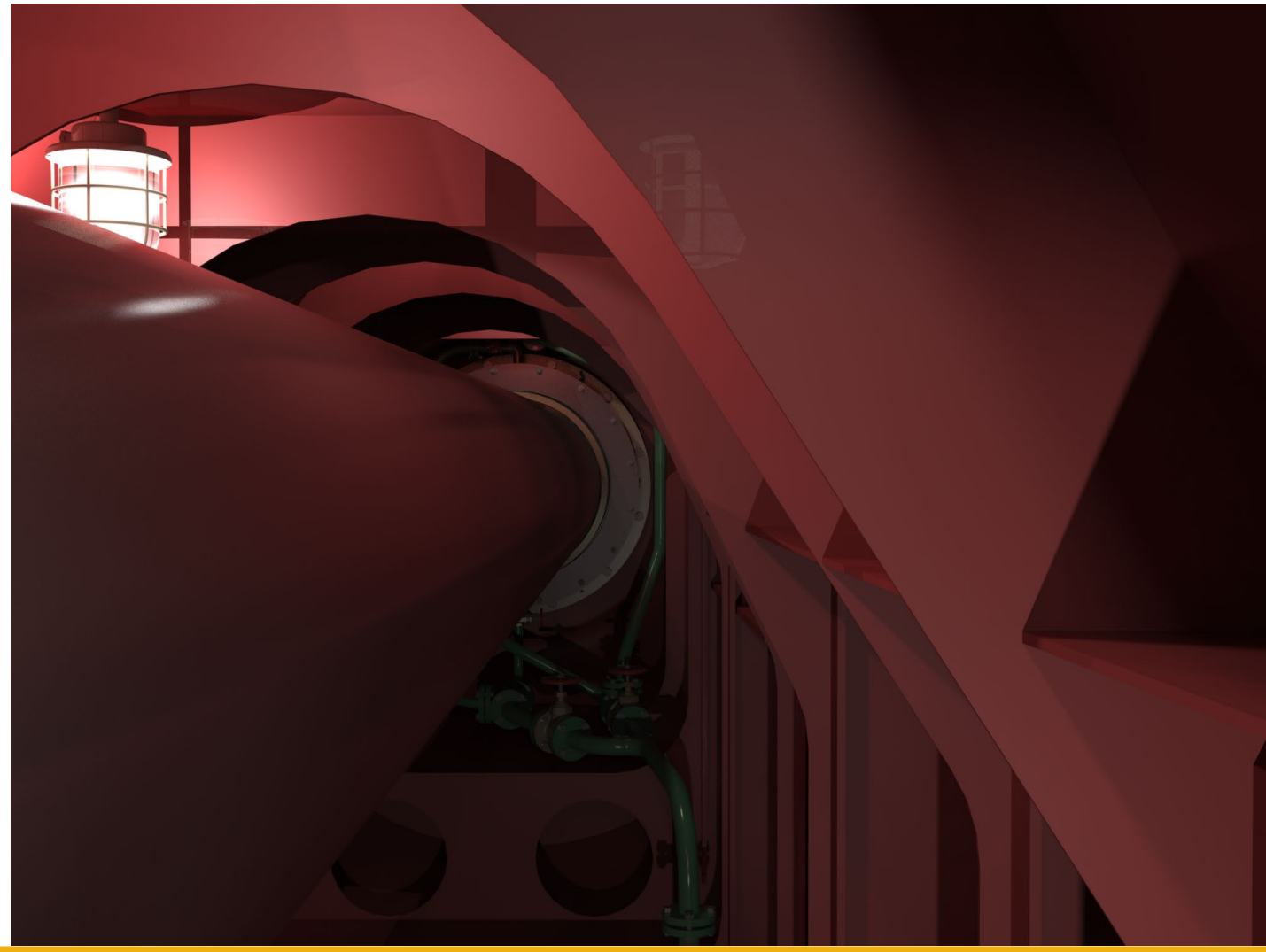
Opening to the Aft Stern Chamber (“temporary means of access”)



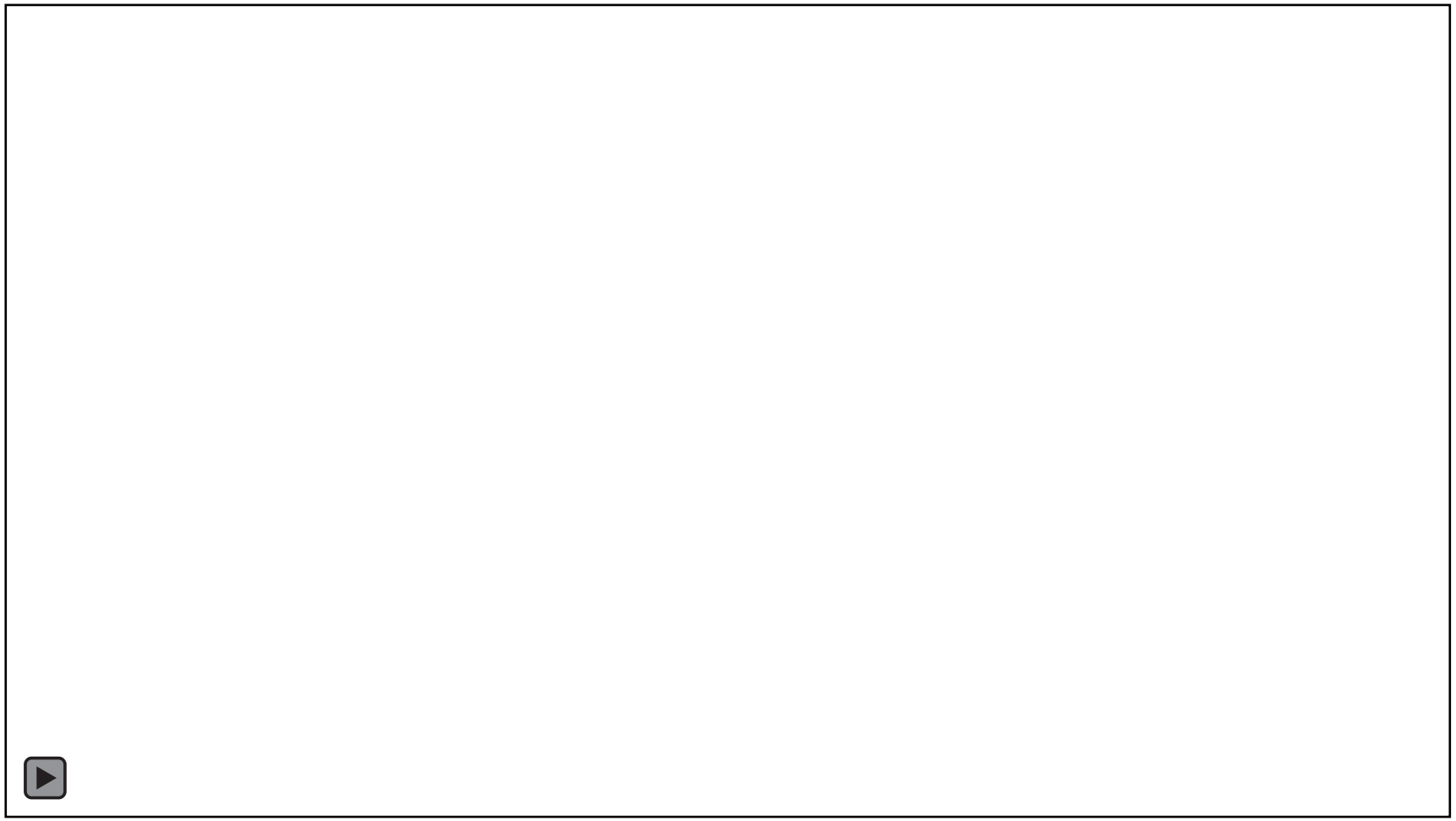
T-BOSS Sterntube-less Ship

Access to the Irregularly Shaped Chamber

View from the inside



T-BOSS Sterntube-less Ship

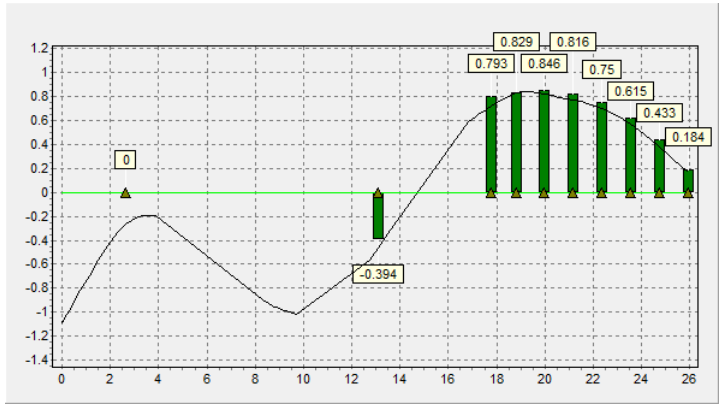


Access to the bearing from the inside of the vessel (animation video)

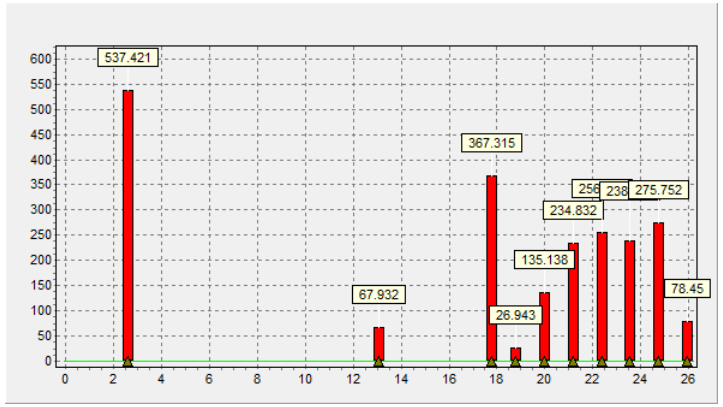
Sterntube-less Vessels – ABS Rule Compliance

- Shaft Alignment Optimization

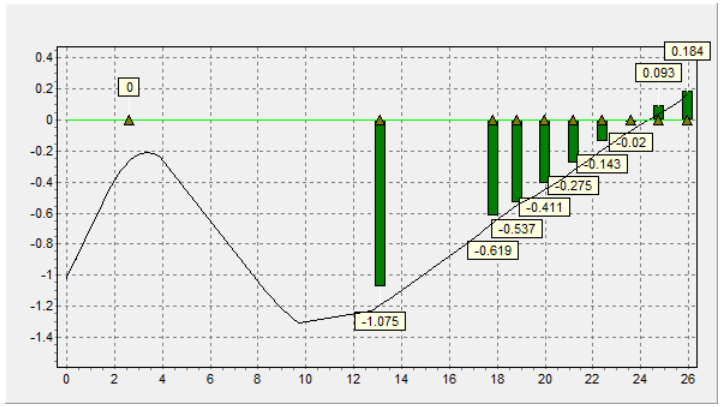
	Optimised Drydock offsets [mm]	Fully Laden Hot Static Offsets [mm]	Ballast Hot Static Offsets [mm]
ASTB	0	0	0
I/M Bearing	0	-0.394	-1.075
M/E 1	-0.146	0.792	-0.619
M/E 2	-0.146	0.828	-0.536
M/E 3	-0.146	0.846	-0.41
M/E 4	-0.146	0.816	-0.276
M/E 5	-0.146	0.75	-0.143
M/E 6	-0.146	0.615	-0.02
M/E 7	-0.146	0.433	0.092
M/E 8	-0.146	0.184	0.184



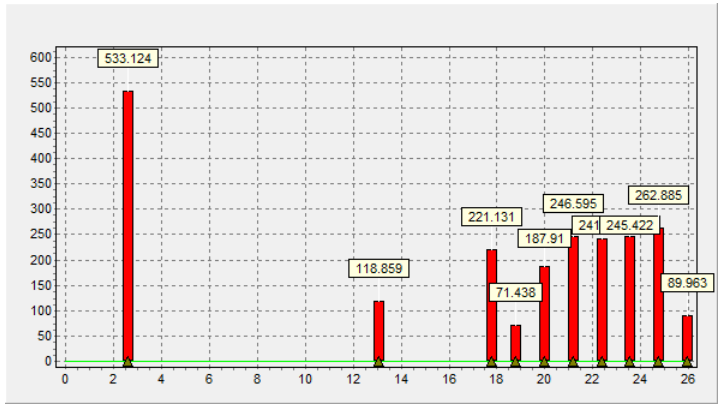
Fully Laden Offsets [mm]



Fully Laden Bearing Reactions [kN]



Ballast Offsets [mm]



Ballast Reactions [kN]

All bearings are positively loaded and within their maker's limits

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Sterntube-less Vessels – ABS Rule Compliance

- Engine Flange Shear Force- Bending Moment Envelope

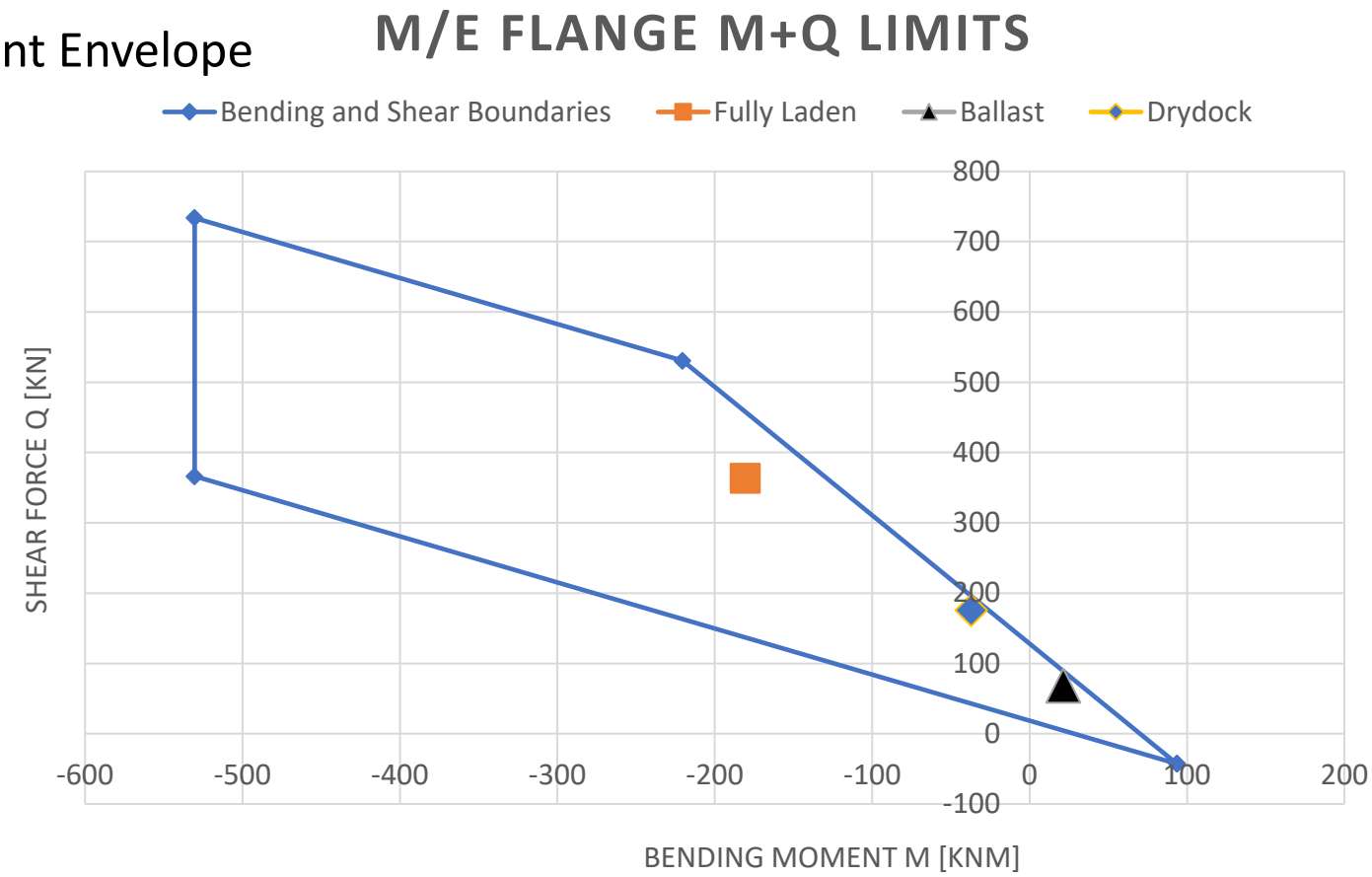
	Bending Moment M [kNm]	Shear Force Q [kN]	Flywheel Weight G [kN]
Fully Laden	-196.0	363.5	125.2
Ballast	21.4	68.4	125.2
Drydock	-37.0	175.9	125.2

All above conditions are “Hot Static”

Total Shear Force Q = F + G, where:

F: Model-calculated Shear Force [kN]

G: Flywheel Weight [kN]



Engine Flange Bending Moment – Shear Force Envelope within maker’s limits

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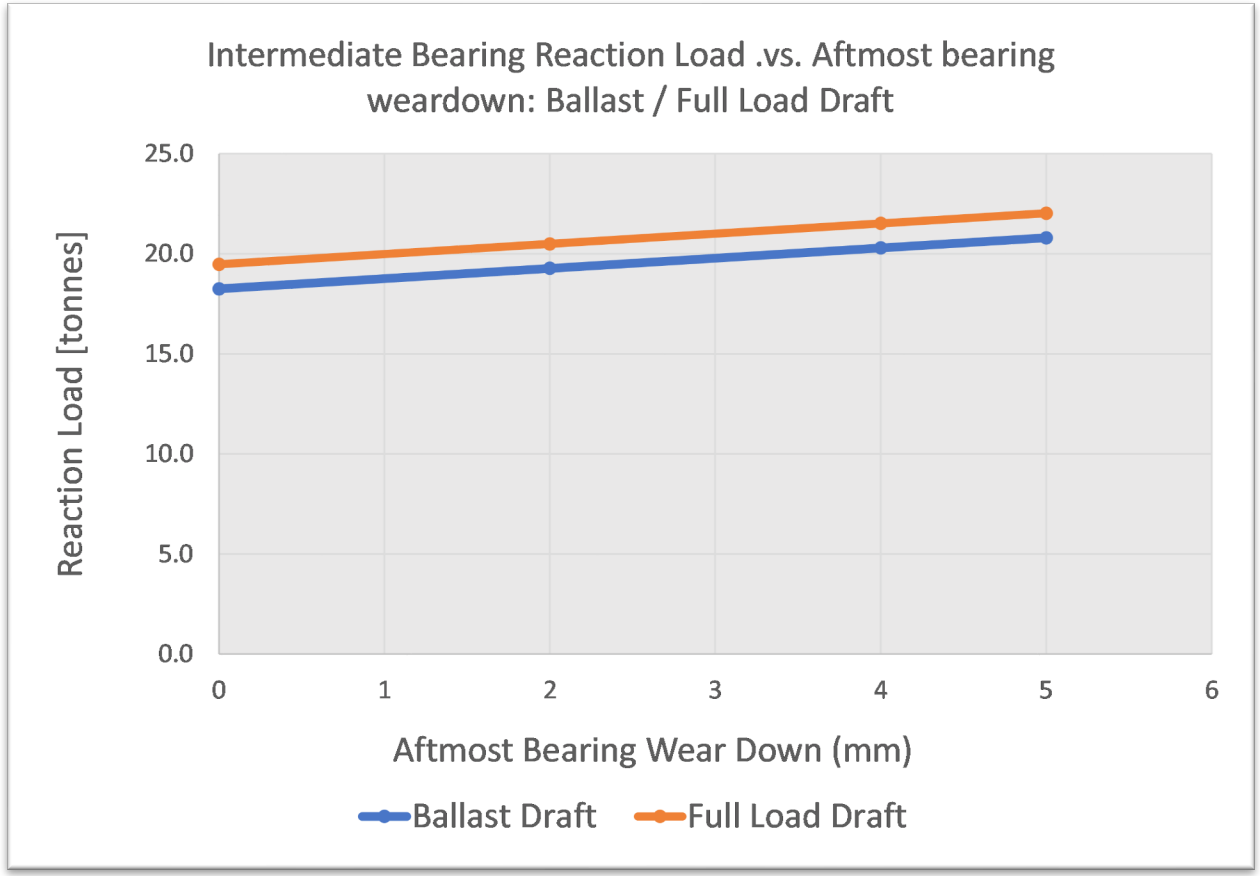
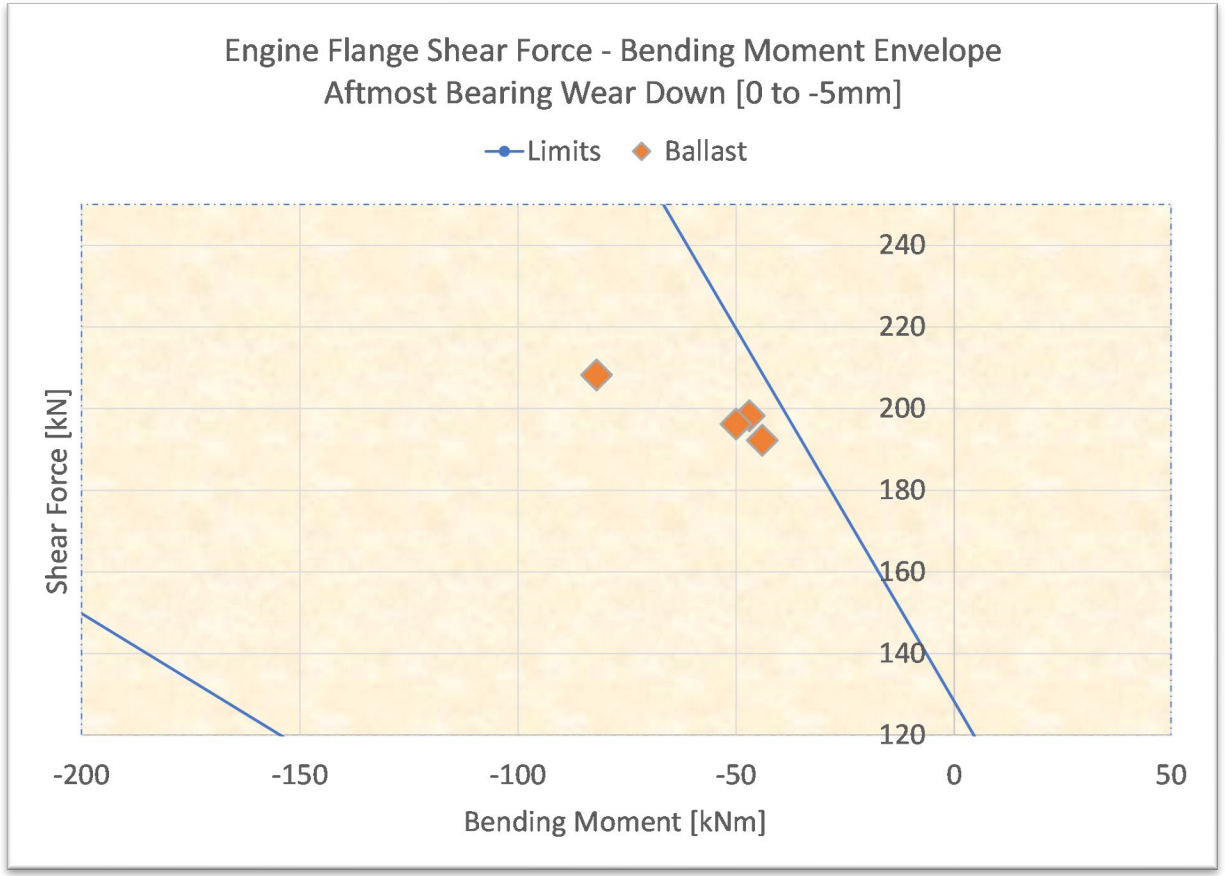
Sterntube-less Vessels – ABS Rule Compliance

Water Lubricated Bearing Wear-Down Effects





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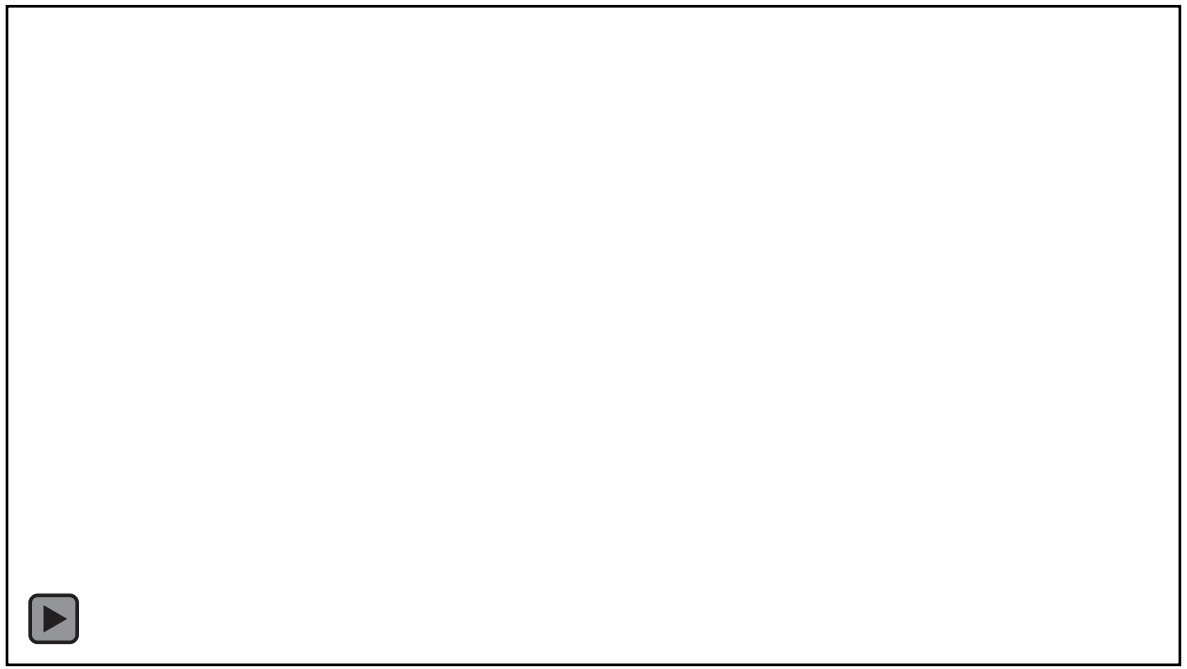
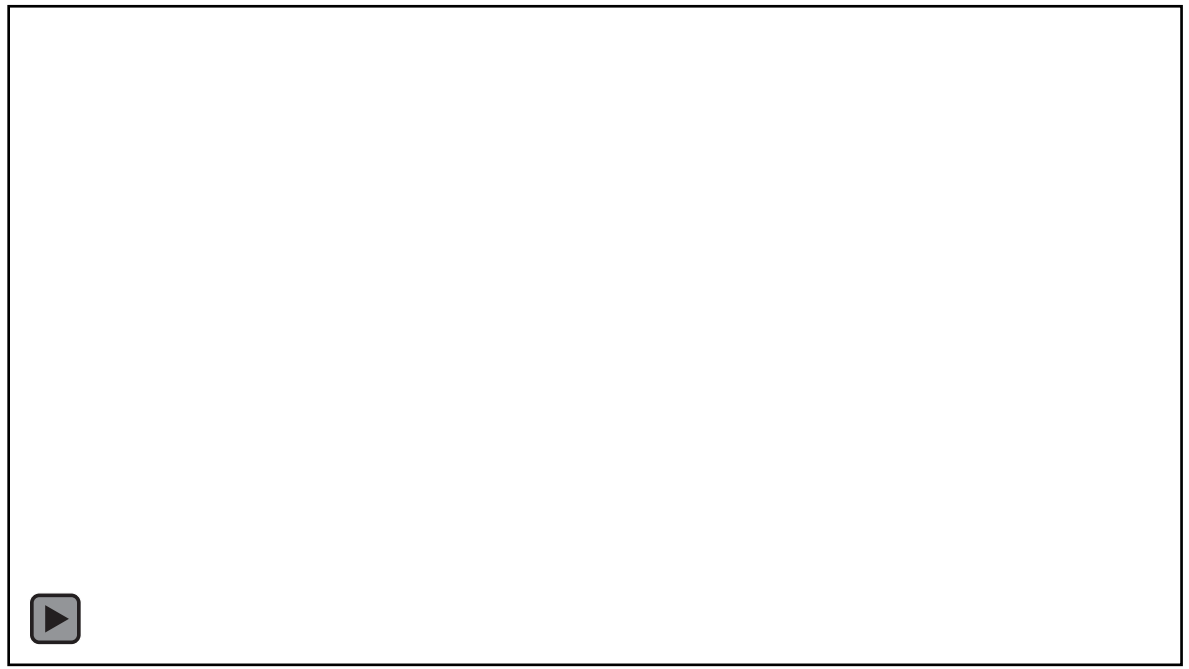
Sterntube-less Vessels – ABS Rule Compliance

Torsio-axial mode

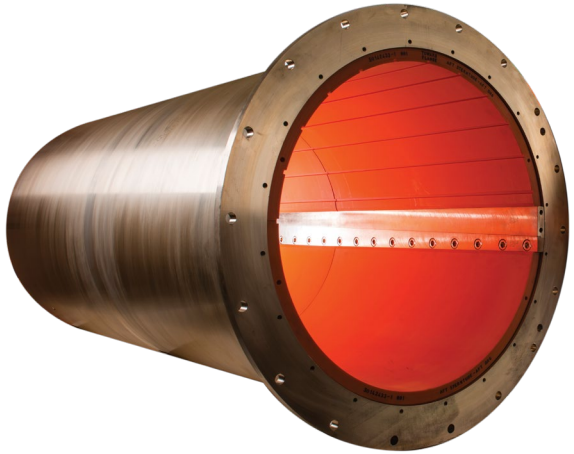


Lateral (whirling) mode



ABS Approval in Principle (AIP) for Sterntube-less Vessel

June 2022



APPROVAL IN PRINCIPLE — ABS

as requested by:

SHANGHAI MERCHANT SHIP DESIGN & RESEARCH INSTITUTE CSSC

Date of Issuance: 09 June 2022

Certificate Number: T2258617

ABS has reviewed the documentation as specified in the ABS letter dated 13 May 2022 (Task No. T2258617) in accordance with the ABS 2017 *Guidance Notes on Review and Approval of Novel Concepts*, and considers that the conceptual engineering as proposed is feasible for the intended application, and the facilities as presented are, in principle, in compliance with the applicable requirements of the ABS Rules for Building and Classing Marine Vessels 2022, International Convention for the Safety of Life at Sea (SOLAS 1974).

Facility: None Associated Facilities

Description: Sterntube-less Vessels with Thordon COMPAC Split Water Lubricated Aftmost Bearing

New Technology Maturity Level: Subsystem A – Feasibility Stage

To achieve final class approval of the subject design, the conditions and requirements as specified in the Approval Road Map [ABS letter dated 13 May 2022, Task No. T2258617] must be satisfied.

Bin-Hong Wang
Director of Engineering, ABS

By: Salin Li

Ya-Lin Li
Manager – Global Engineering Shanghai ESD, ABS

Note: This certificate evidences compliance with one or more of the Rules, Guides, standards or other criteria of American Bureau of Shipping or a statutory, industrial or manufacturer's standards and is issued solely for the use of the Bureau, its committees, its clients or other authorized entities. Any significant changes to the aforementioned product without ABS approval will result in this certificate becoming void. This certificate is governed by the terms and conditions in the ABS Rules.

T-BOSS Sterntube-less vessel benefits – for the Shipowner

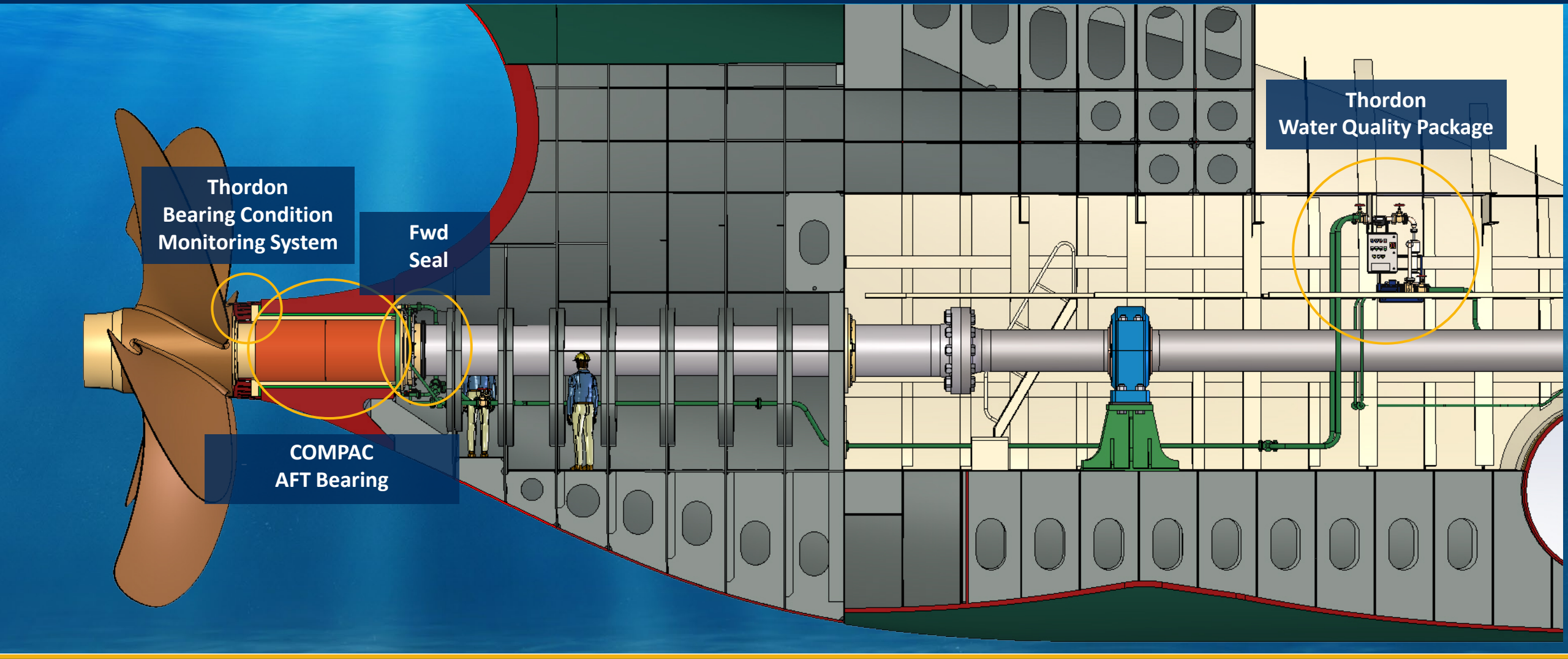
- **Lower operating expenses**
  - No oil, no risky aft oil seal to maintain
  - lower friction with elastomer polymer bearing in water = **fuel savings** compared to sealed oil/metal bearing shaftline
- **No shaft withdrawal**
  - maintain and inspect bearings, liners and seals without drydocking the vessel
  - A 2-week re-alignment job (100k USD) in the dry-dock can be done in 1 day afloat, dispensing with the need for a drydock !
- **Zero pollution**
  - open seawater lubricated propeller shaft bearing system = **regulatory compliance** world-wide
- **Improved EEDI**
  - reduced fuel consumption and ME Emissions

T-BOSS Sterntube-less vessel benefits – for the Shipyard

- **Reduced cost with simplified scope of supply**
  - No Sterntube
  - Single propeller shaft Bearing
  - No Oil and Oil piping systems
  - No Shaft Coating
  - No Aft Seal
  - Less Steel

- **Simplified Installation Procedures**
  - Fewer Components
  - Easier Alignment

T-BOSS Propeller Shaft Bearing System



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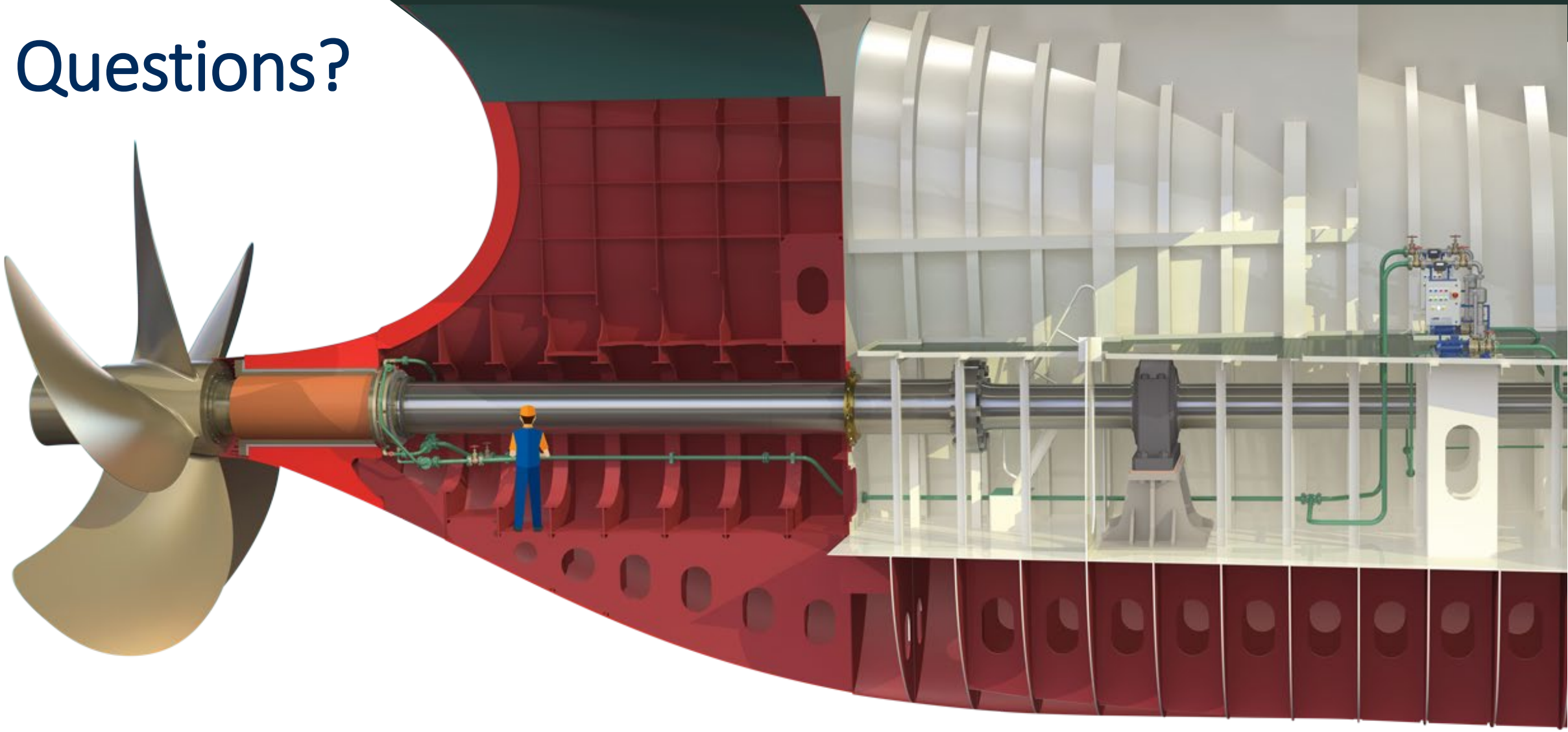
Questions?



Questions?

Thank You!

Thordon Bearings Inc.

3225 Mainway, Burlington, ON L7M 1A6 Canada

www.ThordonBearings.com