Oscar Propulsion

International GHG-URN Workshop

IMO headquarters, London, UK

18-19 September 2023

Lars Eikeland, Director Marine

Oscar Propulsion Ltd

Making Blades Better

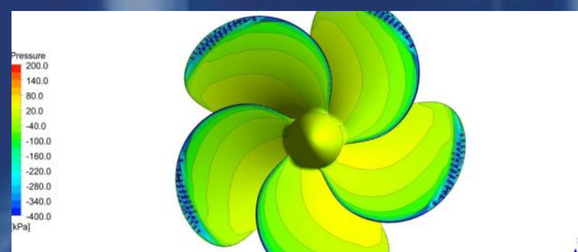
Oscar Propulsion

What do rowing and paddle blades, aircraft engines and marine propellers have in common?

They stand to be revolutionised by Oscar Propulsion

Sport

By meticulously placing angled cuts or slits in rowing and paddle blades, we're enabling athletes to push themselves harder and train for longer while reducing the risk of injury.



Marine

Cavitation not only damages marine propellers, it also creates significant levels of Underwater Radiated Noise (URN) that impacts the ocean and marine fauna. Our breakthrough solution is Oscar PressurePores™.

Aviation

As our skies become more crowded, particularly in urban areas, the need for quieter aircraft engines will be paramount. Our patented Noise Prevention at Source (NPaS) technology provides the answer.

URN harms…actions taken

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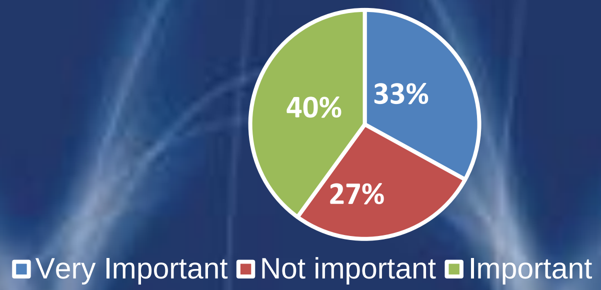
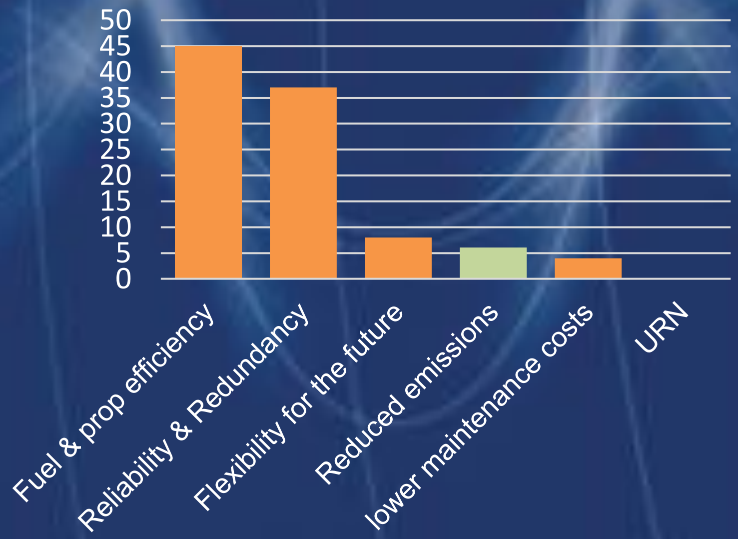
- **Commercial shipping growing**
- **Propeller cavitation main source**
- **IMO issued URN guidelines in 2014 – updated in 2023**
- **Other initiatives (selective)**
  - **Silent notation an industry standard**
  - **Port of Vancouver reduces docking fees**
  - **Transport Canada – Quiet Vessel Initiative**
  - **BC Ferries – Long Term Underwater Noise Management Plan**
  - **Global Environment Facility (GEF) introduces "GloNoise Partnership"**
- **Legislation → shipowners' decision making**

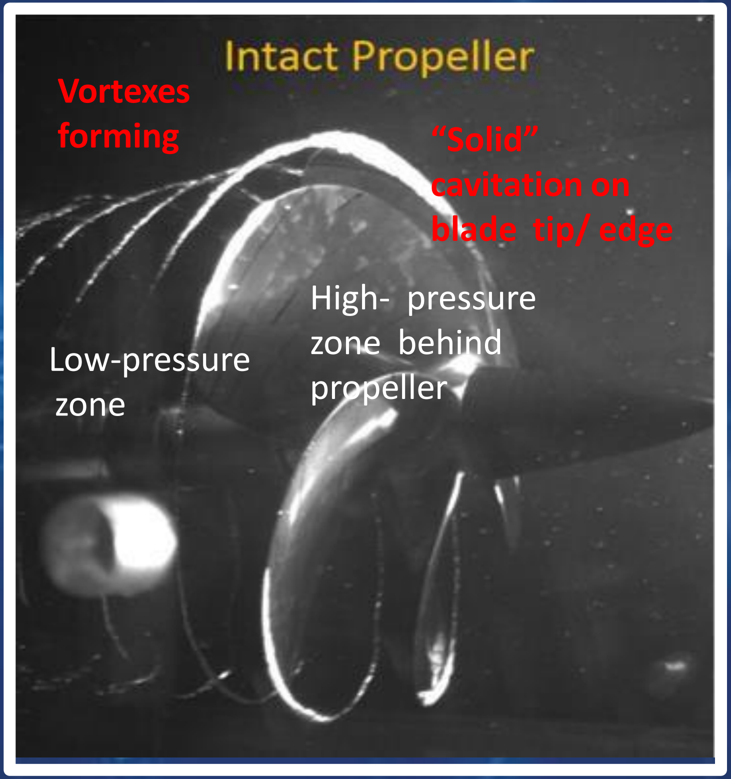
How **important** are noise-free propulsion solutions?

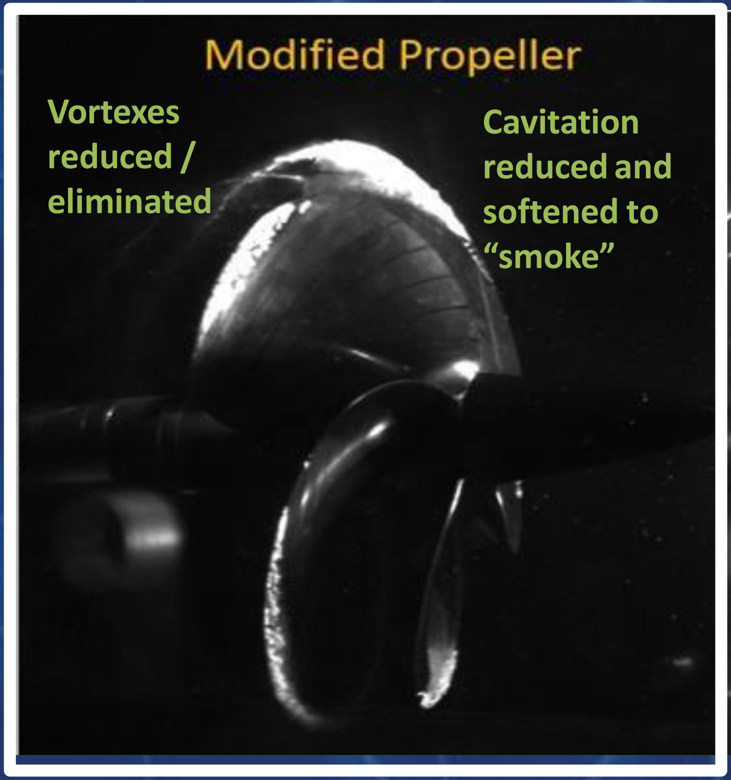


Most important **decision making criteria** when choosing propulsion solution



PressurePores™ – how?





Six years of product development

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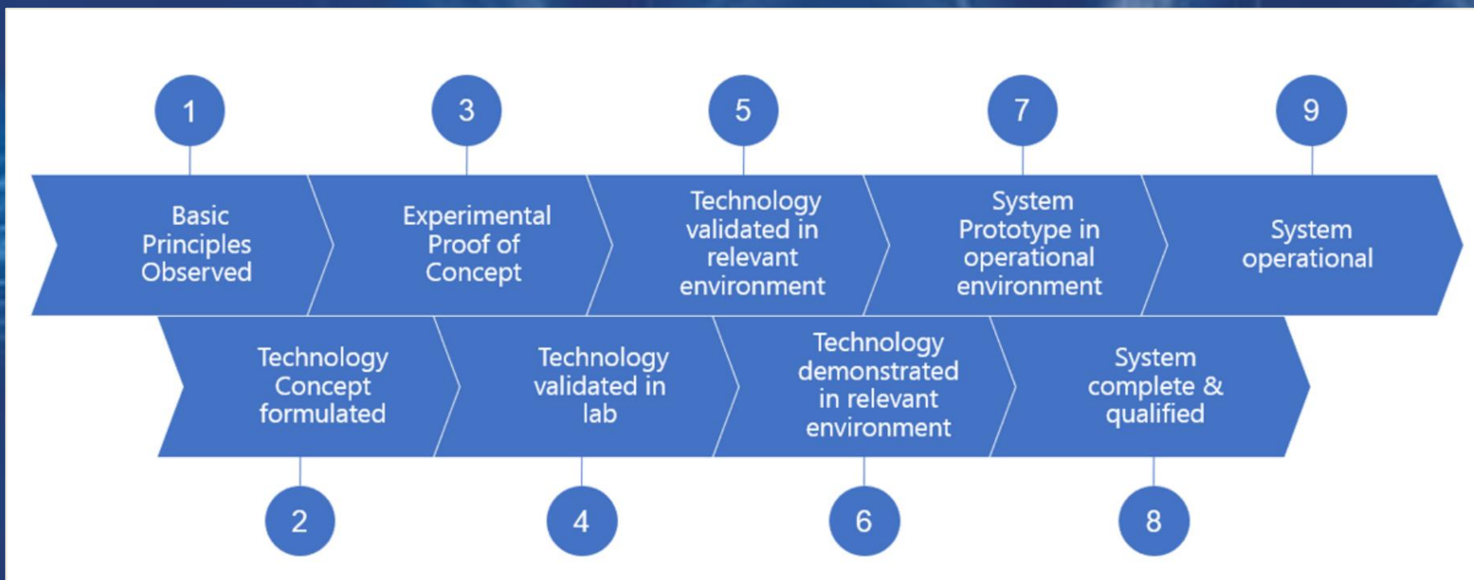
2016 – 2018: Invention and testing of PressurePores™

2020: Full Scale sea trial to confirm model experiments

2021: Studies proving no compromise to the structural integrity of the propeller



2021: Joint research project with a global propeller manufacturer

2022/23: URN prediction module in our CFD model

2023→: Qualify and make it operational

Invention, testing & hole application

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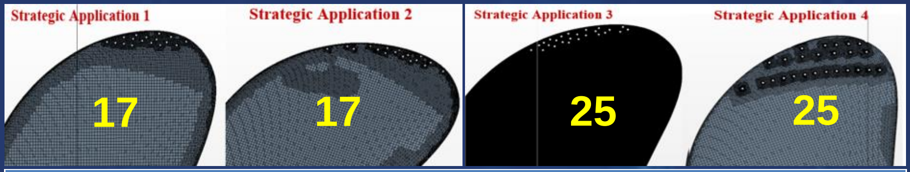
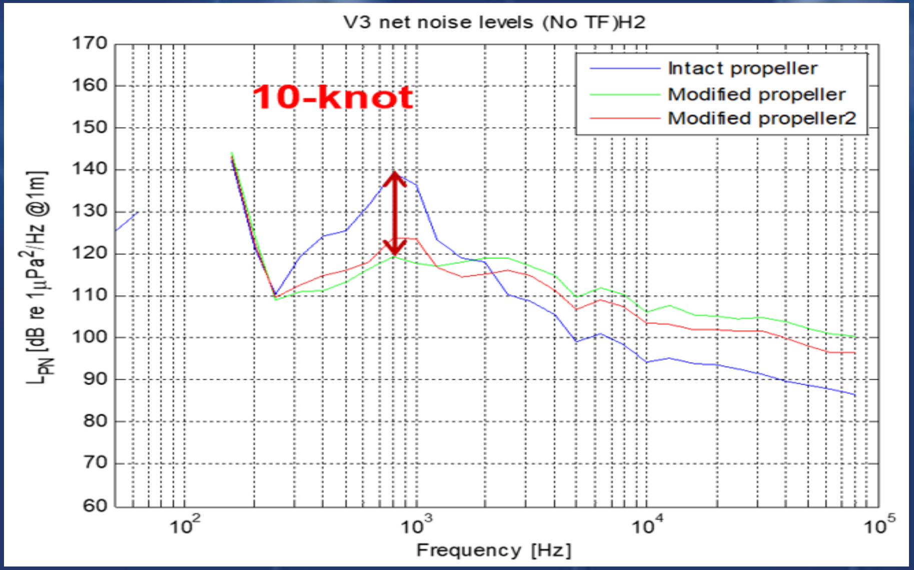


	BASE_AM	SA1_AM	SA2_AM	SA3_AM	SA4_AM
Thrust (N)	290.57	290.76	288.93	288.05	288.58
Torque (Nm)	14.78	14.86	14.79	14.78	14.72
Cavitation Volume (m³)	2.44E-06	2.10E-06	2.32E-06	2.27E-06	2.26E-06
Efficiency	59.13%	58.84%	58.76%	58.63%	58.96%
KT	0.1089	0.1090	0.1083	0.1080	0.1082
Δ%Thrust		0.07%	-0.57%	-0.87%	-0.68%
Δ%Torque		0.57%	0.07%	-0.01%	-0.40%
Efficiency Loss (%)		0.50%	0.64%	0.86%	0.29%
Δ%Cavitation Volume		-13.83%	-4.71%	-6.92%	-7.09%

- Guardian propeller
- 95,000 dwt
- Prop diameter ca. 7m
- Results from CFD simulation
- Optimising relationship between cavitation reduction and efficiency impact

- Princess Royal
- 7.3 dwt
- Prop diameter ca. 70cm
- Results from cavitation tunnel
- Green 33 PP | red 17 PP
- Up to 17dB noise reduction in the 200-1,000Hz band



Full Scale Trial at Sea

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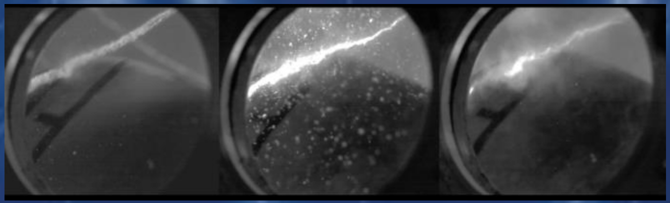
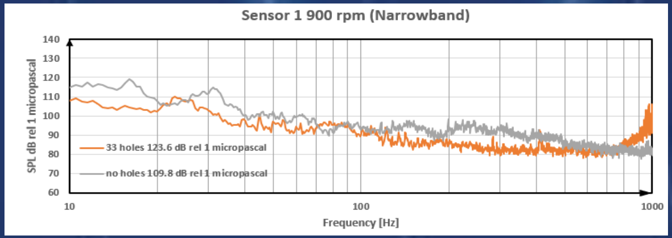
- Tested 17 & 33 pores/blade v. intact prop
- Cavitation through porthole video camera
- URN measured using traditional hydrophone system and a Hydrone
- 600 | 900 | 1200 | 1500 | 1750 | 2000 rpm
- Modification of propellers – 3 hours
- No fouling in holes observed

- **Validated** experiment results
- **10dB** URN reduction with 33 holes
- **Reduced cavitation** volume for modified propellers
- **Frequency peaks** at higher speed range showed **decrease in amplitudes** with more holes





Finite Element Analysis (FEA)

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High cycle fatigue investigation

full-speed-ahead operation of the propellers at the engine MCR

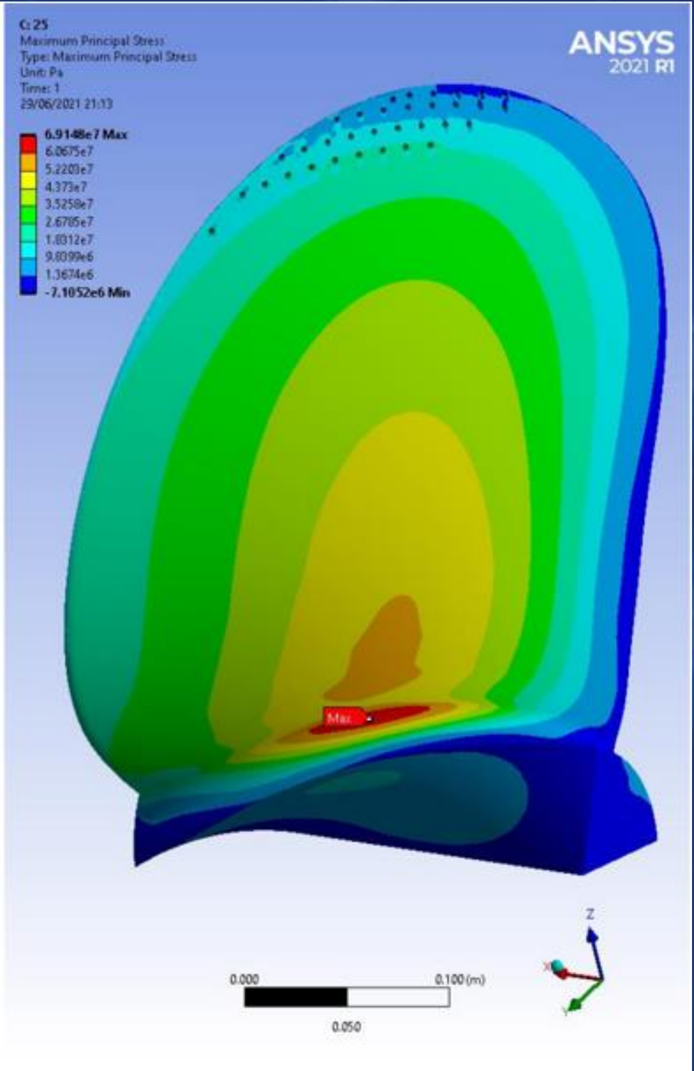
- Root section: 2.55 (min 1.8)
- 0.6r section: 4.06 (min 1.6)
- PP section, >0.85r: 3.42 (min not defined)

Low cycle fatigue assessment

Bollard astern operation at maximum rpm

- Root section: 2.80 (min 1.8)
- 0.6r section : 2.37 (min 1.6)
- PP Section : 2.36 (min not defined)
- Peak Stress Region : 1.62 (min not defined)

No critical effect – blade structure satisfied required safety factor limits



New propeller design project

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Baseline propeller @ **66.8%** efficiency and URN @ **124.9dB**

Used baseline to redesign new propeller (upper radii of blade)

1 **Efficiency up 1.4% to 68.2%**
URN up 2.3dB to 127.2dB

PP = 5 holes

2 **Efficiency down 0.6% to 67.6%**
URN reduce 2.7dB to 124.5dB

PP2 = 2 holes (cover up bottom 3)

3 **Efficiency up 0.3% to 67.9%**
URN increase 0.5dB to 125dB

Net result

- **Efficiency up 0.9%**
- **URN minor change**

Using CFD to predict URN impact

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- Traditional approach to start
- Used Mesh structure and DAMR technique, implying a total element count of ca. 45 million
- Noise predictions incorporated convective effects (FW-H), acoustic analogy and Navier-Stokes equation

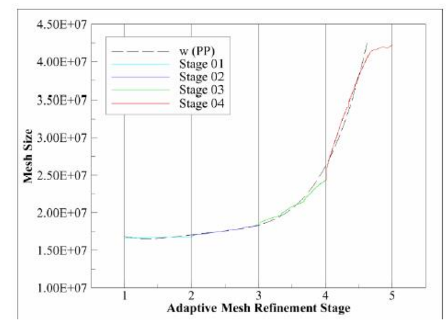

Figure 3.4. The number of the elements during the mesh refinement stages

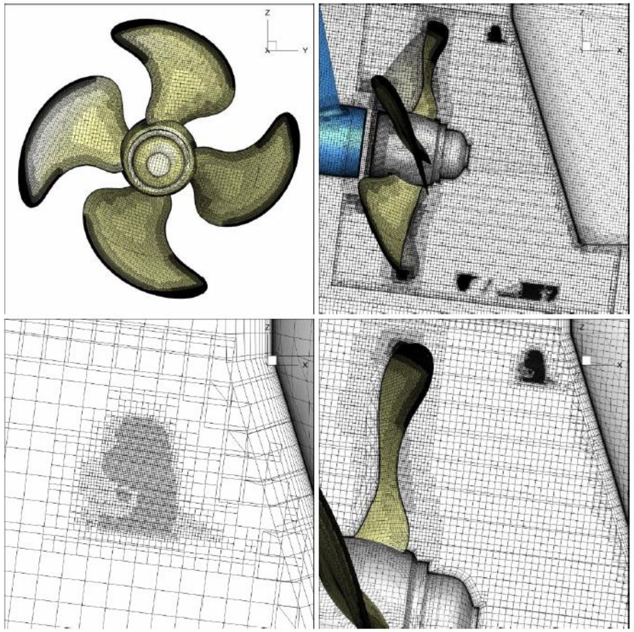

Figure 3.5. Mesh structures around the propeller and hull

<u>Results</u>

- TVC **11%** lower
- Turbulent kinetic energy **3.7%** lower
- Vorticity **5.2%** lower
- Harmonics of pressure pulses reduced by **13.9%**, **41.2%** and **27.2%** on 1st, 2nd and 3rd respectively
- Harmonics of Blade Rate Frequencies showed **0.4 to 3.6dB** noise reduction
- The results **corresponded well with cavitation tunnel results**, where applicable

Consulting offerings

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Retrofit | Assess one – or more – vessels/propellers from the client's fleet

Novel | Design a new propeller for the client

Reduce URN by applying *PressurePores*^{TM} at agreed operating condition and level of propeller efficiency

Combine *PressurePores*^{TM} with other EE features

- The client provides key input data in CAD format
- Oscar Propulsion runs the simulation, using **Simcenter Star-CCM+** CFD software combined with experience
- Ca. ***2-6 weeks to complete***, depending on the complexity and availability of input data


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Thank you !