DNV Silent(E)

Merchant vessels

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Background – early 2000's

- Norwegian oil major with increased communication issues with subsea equipment
- Noise from ship traffic disturbed communication

DNV Silent Class

DNV was first classification society to publish a notation on underwater noise (2010)

Avoid harmful effects on marine life

Enhance operational and environmental performance

Benefit from incentives to reduce underwater noise

Document vessel noise emissions under water

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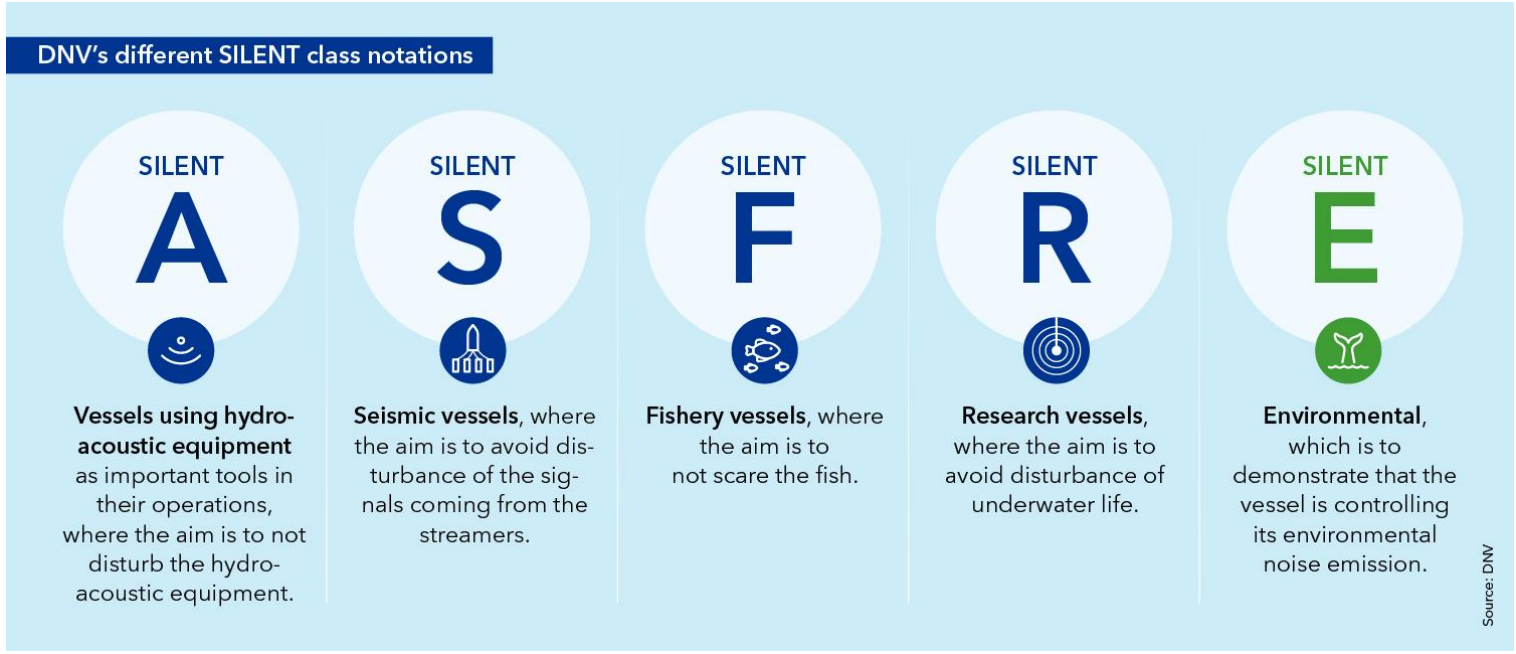
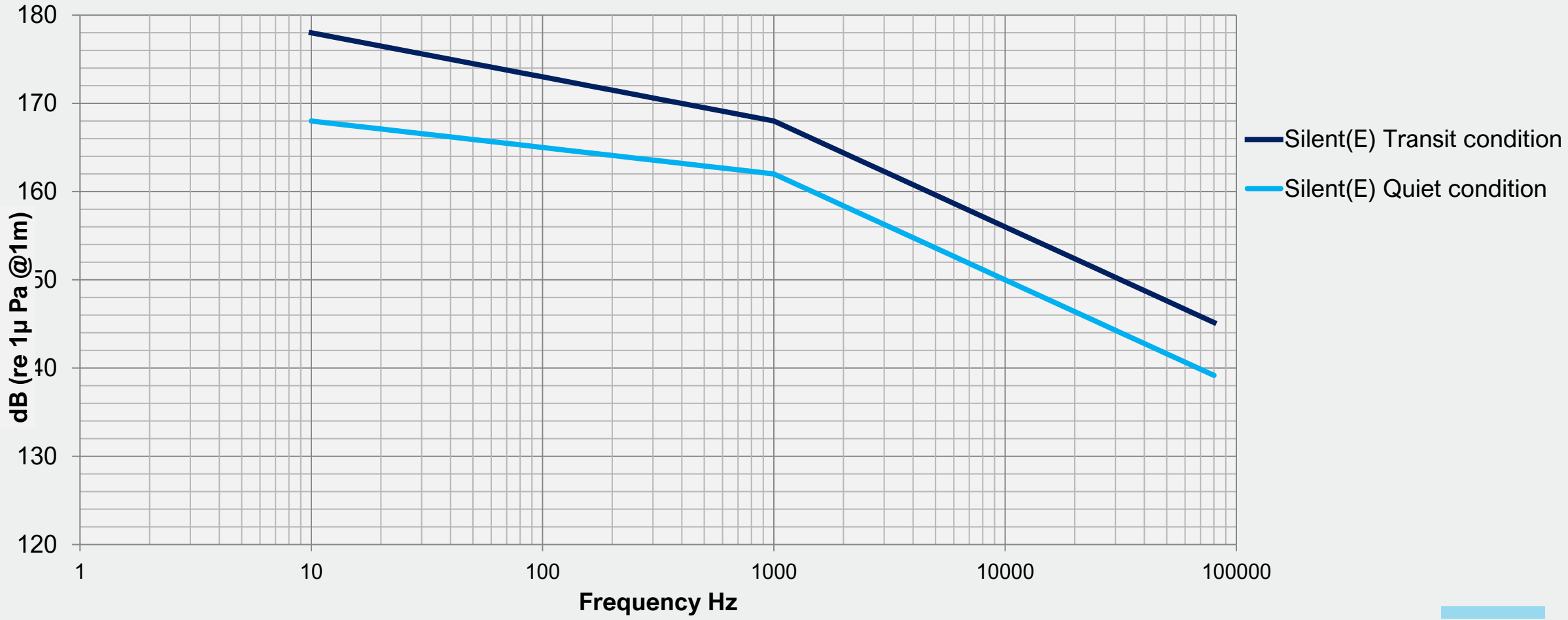
DNV Silent notations



Four ratings based on vessel performance during different operations – A, S, F, R

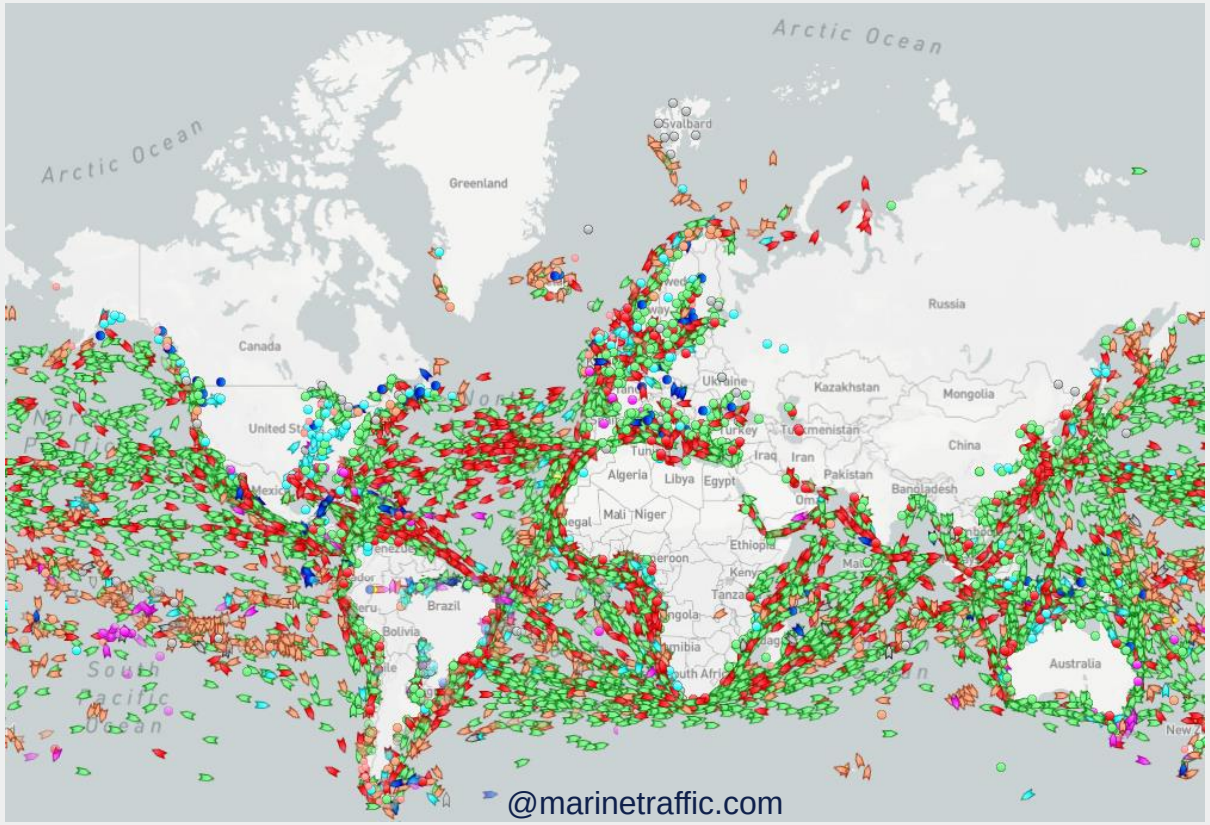
One rating based on environmental impact – E

DNV Silent(E)


180
170
160
150
140
130
120
dB (re 1µ Pa @1m)
1
10
100
1000
10000
100000
Frequency Hz
Silent(E) Transit condition
Silent(E) Quiet condition

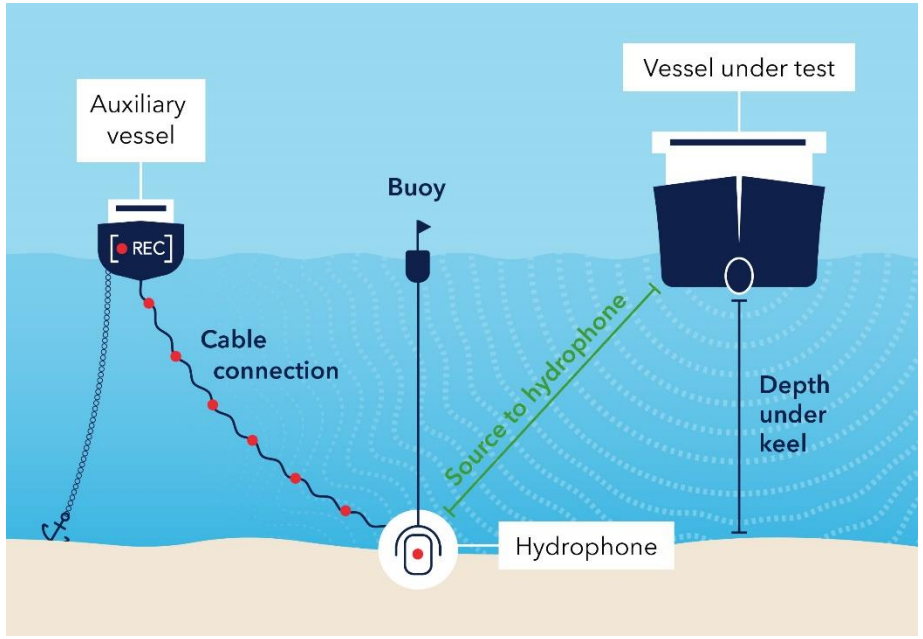
Quiet ship notations

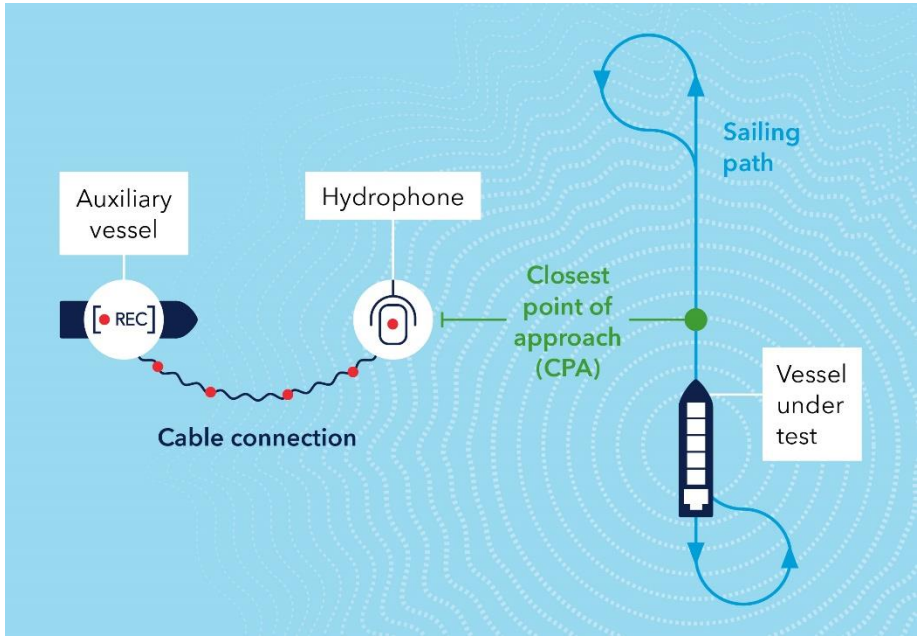
- Quiet ship notations are becoming common for smaller vessels and cruise ships
- So far, larger commercial vessels have been excluded
  - Need for simplification of measurement procedures
  - Generally higher noise levels from sources that are generally not subject to noise-control
- Increased interest from charterers/owners/yards show that there is significant potential in this segment
- The merchant fleet is a major contributor of anthropogenic noise
  - Quieting the merchant fleet is expected to have a major noise-reducing effect



- How to benchmark a large number of vessels?

Verification measurements

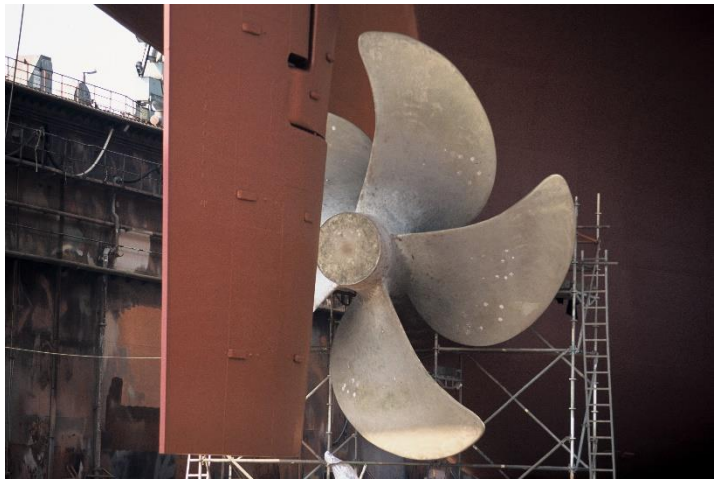




- Shallow water method employing bottom mounted hydrophone is the DNV preferred method – other methods also available
- Two passages with the hydrophone at starboard and port side of the vessel required
- Data acquisition and monitoring from onboard an auxiliary vessel or on shore

NOTE: For ships with resiliently mounted engines and diesel electric propulsion system the measurement procedure may be simplified to near field pressure pulse measurements.

URN* from merchant vessels



- Large two-stroke engines – rigidly mounted
- Engines acting as a noise floor for low power operating conditions (propeller operating below its cavitation inception point)
- Reduction of machinery noise will reduce URN at low power conditions

- Propeller is the dominating noise source when cavitating
- Reduction of propeller noise will reduce URN at high power conditions

(*) Underwater radiated noise

URN reducing measures on merchant vessels

Propellers

- Increase propeller diameter and/or number of blades
- Tip off loading
- Optimize wake and inflow

Machinery

- Reduce structureborne noise levels/excitation into the steel structure
- Resiliently mounted machinery and noisy equipment

Propeller strength

DNV class rules and guidelines have been revised for more flexibility in propeller design:

- New energy efficiency requirements (EEDI/EEXI) lead to the need for more efficient propellers
- Introducing reduced safety factors when strength assessments are based on more reliable calculations (CFD + FE)
- Guidelines for strength assessments and material testing for materials in corrosive environment
- Meeting industry needs by allowing more optimized propeller designs while still maintaining the safety

Hyundai Samho H8064 M/V ONEX Peace

First merchant vessel awarded the Silent(E) notation

Aframax tanker

- Loa: 250 m
- B: 4 m
- Max speed 16 knots

Main noise sources

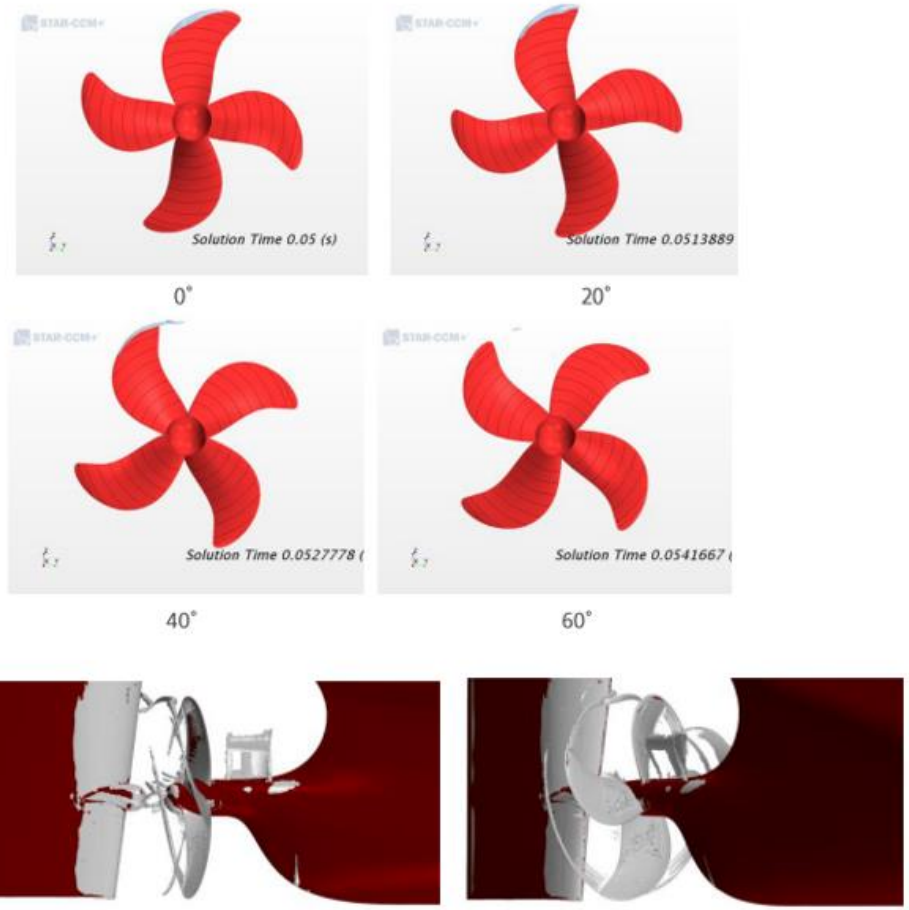
- Two-stroke engine (6 cylinders, 12000 kW)
- Propeller (4 blades)

Case introduction – ONEX Peace

- URN [Underwater Radiated Noise] JDP between DNV, HHI(*) and KRISO(**)

- Design of propeller for URN reduction as a top priority : Not a strategic design approach
  a. Decrease of propulsive efficiency
  b. Consequent increase of GHG to keep the ship speed

- Propeller design for ONEX Peace,
  a. In consideration of the propulsive efficiency within an acceptable level of cavitation
  b. NOT designed for factitious URN reduction
  c. Using state of the art CFD technology



(*) Hyundai Heavy Industries, (**) KOREA Research Institute of ships and Ocean Engineering

ONEX Peace

Followed the new strength assessment guideline and load analysis by CFD.

- **Large diameter / low rpm**
- Thinner propeller blades
- Lightly loaded propeller blades
  - Hyundai VsPropeller design
- Optimized wake – combination of
  - pre-swirl duct (Hi-PSD)
  - hull lines

Found a sweet spot between efficiency and noise emissions

Turn uncertainty into confidence

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