



**Scope**

- Project Background and Rationale
- Scope of Work
- Issues addressed
- Future actions

08.01.2019 | Page 2

The VARD logo is located in the bottom right corner of the slide, with the text 'a Fincantieri company' underneath it. A small 'built on trust' logo is in the top right corner of the slide.

built on trust

## Why VARD?

- Design of low-URN ships
  - CCG OFSC
  - CCG OOSV
  - SAN “Project Hotel”
- Strong R&D focus



08.01.2019 | Page 3



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## Background and rationale

- Underwater Radiated Noise (URN) increasingly recognized as a threat to the marine environment
- Transport Canada wishes to take a leadership role in URN initiatives:
  - Nationally
  - World-wide, through IMO and like-minded nations

08.01.2019 | Page 4

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## Scope of Work

- Provide Report on Technological Measures to Reduce Underwater Noise from Vessels
  - Develop matrix presenting applicable measures
  - Develop matrix describing URN prediction methodologies
- Present materials to workshop in Halifax, late November
- Update matrix and report based on feedback

Current status – draft report has been provided to TC and circulated to workshop attendees

This presentation is intended to stimulate discussion in breakout sessions

## Issues addressed

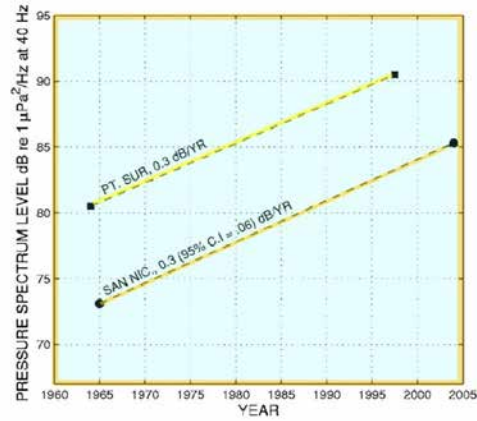
- Work covers main URN noise sources:
  - Hydrodynamic flow noise
  - Machinery noise
  - Propeller (propulsor) noise: particularly cavitation
- Mitigation measures covered include:
  - Flow noise reduction
  - Machinery noise reduction and treatment
  - Propeller noise reduction and treatment
  - “Other” forms of treatment
  - Operational measures – not the main focus of this work, as TC is conducting other work in this area



## URN Impacts

Noise can affect marine mammals, fish and invertebrates by:

- Physical damage, from loss of hearing to death;
  - Masking communications, affecting mating and other interactions;
  - Reduced foraging activity, particularly where animals use sound to locate prey;
  - Increased stress levels, with overall adverse impacts on health, in a wide variety of species;
  - Behavioural modification, including avoidance of high noise areas that may also be preferred habitats.
- Underwater noise levels have been increasing with time



## Principles

- “Noise” is undesirable sound; sound is energy transmitted by waves in any suitable medium, including water
- Noise is a by-product of almost any action producing or consuming energy
- Noise reduction can be:
  - at source, by reducing the amount of energy released
  - along the transmission path, by blocking (impedance) or absorbing the transmitted energy

## Matrix Design – URN Reduction Technologies

- Based on an approach used by US National Oceanographic and Atmospheric Administration (NOAA), adapted and extended
- Each entry covers (details on following slides):
  - Description of the method, and its underlying basis
  - Additional advantages and benefits
  - Drawbacks and disadvantages
  - Technology readiness level
  - Cost to apply
  - Applicability (new and/or existing ships, ship types)
  - Effectiveness in noise reduction (frequency range, intensity)
- Each entry is supported by citation(s) of references providing additional information
- Some items (e.g. costs, effectiveness) use Vard engineering judgement when information is lacking

## Matrix Contents (continued)

### Advantages/Benefits

- CC - Enhanced Crew/  
Comfort
- E- - Reduced Emissions
- F+ - Enhanced efficiency
- M- - Reduced Maintenance
- MA+ - Increased  
Maneuverability
- S+ - Decreased Space  
Demand
- W- - Decrease in Weight

### Disadvantages/Challenges

- D - Increased Design effort
- E+ - Increased Emissions
- F- - Reduced efficiency
- M+ - Increased Maintenance
- MA- - Reduction in  
Maneuverability
- P - Increased complexity
- S- - Increased Space  
demand
- W+ - Increased Weight

## Matrix Content (continued)

▪ **TRL - Technology Readiness Level**

TRL expressed as 1-9; 1 represents a concept, 9 a method in routine use

▪ **Cost Estimation**

Cost is expressed in various ways

- Range of expected cost
- Percentage increase or decrease of system/equipment cost
- Payback Period: Time a technology will take to give return on investment (only applicable to measures that increase efficiency)
- Shorthand: Whether to expect an increase or decrease; where information is lacking

▪ **Applicability**

Can a method be applied to

- ReFit - RF
- New Build - NB

What types of ship

- All (default)
- Some (why)

▪ **Effect**

What effects will method have on:

Frequency Range - Broadband/Narrowband; Expected Frequency Range Affected in Hertz (Hz)

Noise Reduction - Amount of Expected Noise Reduction in Decibels (dB)

- Low (0-3dB),
- Medium (3-6 dB),
- High (>6dB)

## Examples – Propeller noise

- Measures are further categorized as design, wake flow modification, and supplementary treatments
- Main issue for propellers is reduction of cavitation noise, by increasing inception speed or reducing intensity

1. PROPELLER NOISE						
Treatment/Description	Advantages/ Benefits	Disadvantages/ Challenges	TRL	Cost Estimation	Applicability	Effect
				Percentage/ Range	RF/ NB	Frequency Range (Hz)    Noise Reduction (dB)
<b>1.2 WAKE FLOW MODIFICATION</b>						
<b>1.2.1 Pre-swirl Stator:</b> Consists of Stator blades located on the stern boss in front of the propeller, flow is redirected before entering the propeller, increasing over all flow performance, thus reducing cavitation and increases CIS. [17]	E- F+	D	9	Typical Payback Period: 24 months	RF/ NB	All    Low



## Examples: Machinery Noise

- Some methods are considered “enablers” of reduction using other treatments; e.g. selection of prime movers and transmission systems

2 MACHINERY							
Treatment/Description	Advantages/ Benefits	Disadvantages/C challenges	TRL	Cost Estimation	Applicability	Effect	
				Percentage/ Range	RF/ NB	Frequency Range (Hz)	Noise Reduction (dB)
<b>2.1 Machinery Selection</b>							
<b>2.1.1 Prime Mover Selection</b>							
The choice of prime mover (main engines) has a strong influence on the basic machinery noise characteristics of the ship and on the potential use of mitigation measures. Diesels are currently the default choice of prime mover for almost all commercial vessels and so are assumed here except where otherwise indicated. See main report for additional discussion.							
<b>2.1.2 (Diesel) Electric:</b>							
Using electric rather than mechanical transmission enables and/or facilitates many noise reduction approaches, from the use of mounts and enclosures to active noise cancellation. A wider range of propulsor selections are also available. Electrical transmission has worse efficiency than mechanical, and capital costs are higher so use is generally in vessels where other benefits outweigh these costs. [34]	MA+ (paired with azipods) S+ W-	F-	9	Unknown	NB	ALL	High

## Examples: Other

Work has considered a wide range of measures

5 OTHER MITIGATION TECHNOLOGIES							
Treatment/Description	Advantages/ Benefits	Disadvantages/ Challenges	TRL	Cost Estimation	Applicability	Effect	
				Percentage/ Range	RF/ NB	Frequency Range (Hz)	Noise Reduction (dB)
<b>5.1 Wind</b>							
<b>5.1.1 Kite Sails</b>							
Kites attached to the bow of a Merchant/commercial vessel, designed to create thrust that replaces power from conventional machinery and propeller thrust. [56]	F+ E-	D	8	Payback Period: 15+years [22]	NB/ RF	ALL	Medium to High (Depending on speed reduction and primary propulsion source)



## Matrix Design – Prediction methodologies

Covers:

- Propeller Noise
  - Analytical
  - Experimental
- Machinery Noise

Entries summarize the basis for prediction, with commentary on validity and accuracy

Aim is to present general methodologies, with examples of commercial offerings

- Report does not endorse any product or service provider

## Thank You – Questions?

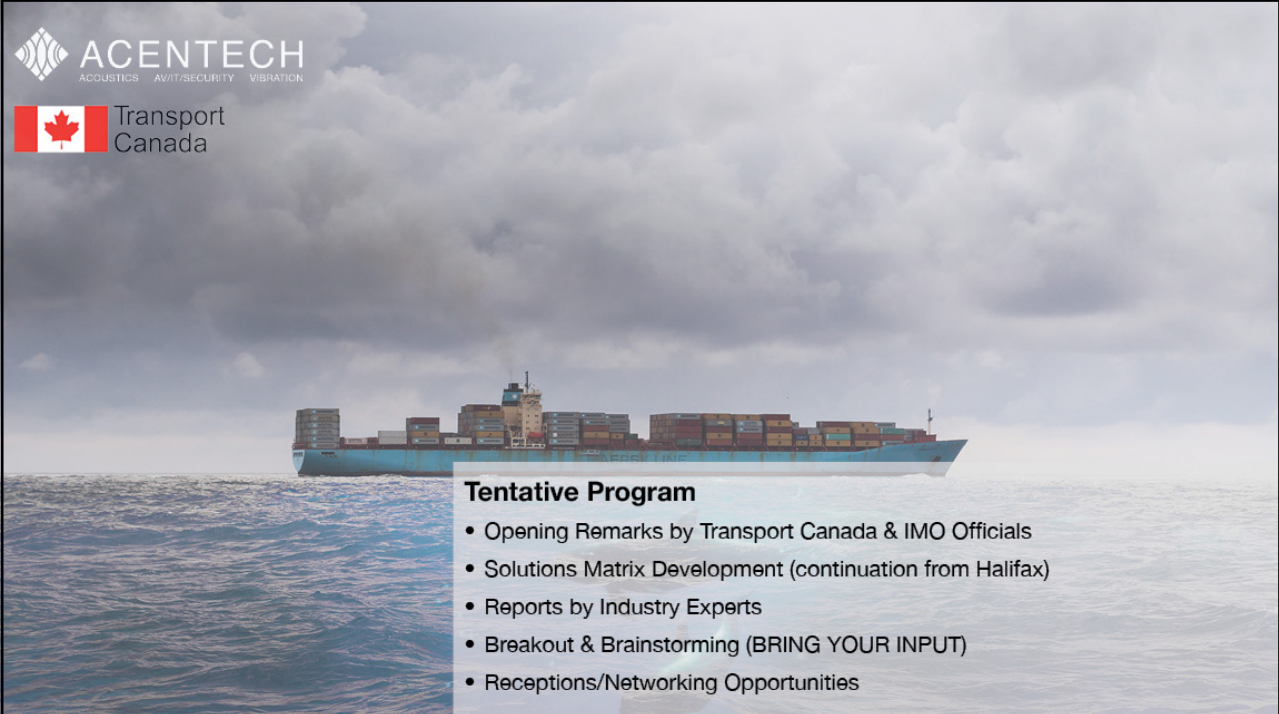







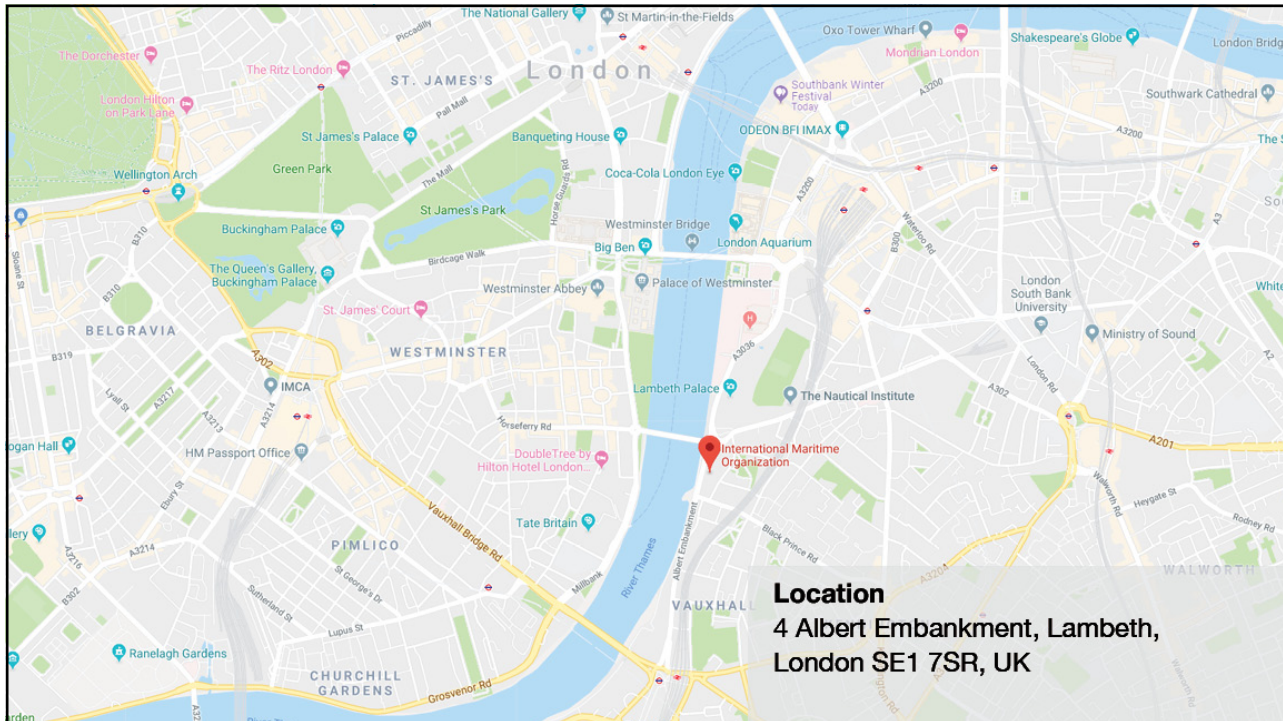
**Quieting Ships To Protect The Marine Environment**  
Technical Workshop  
Hosted by Transport Canada

Venue: International Maritime Organization (IMO) Headquarters; London, UK  
Dates: Wednesday, 30 Jan 2019 12:00 to Friday, 01 Feb 2019 15:00



**Tentative Program**

- Opening Remarks by Transport Canada & IMO Officials
- Solutions Matrix Development (continuation from Halifax)
- Reports by Industry Experts
- Breakout & Brainstorming (BRING YOUR INPUT)
- Receptions/Networking Opportunities



**ACENTECH**  
ACOUSTICS AVIATION SECURITY VIBRATION

Transport Canada

**Who Should Attend?**

- Underwater Noise Experts
- Naval Architects/Marine Engineers
- National Policy Makers/Industry Associations
- Ship Owners/Operators
- Shipbuilders
- Researchers/Academics

**For Background Information**  
Consult MPEC 73/18/4

**Registration**  
<https://en.xing-events.com/FUPYYKX.html?page=1667799>

## Acknowledgements

- Many thanks for your participation and contributions, especially speakers for their excellent talks.



C I S M a R T

## Acknowledgements

- Financial support the following partners is greatly appreciated.

Canada



Transport  
Canada

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Canada



- CISMART appreciates the partnership with Transport Canada on this workshop.

C I S M a R T

## Membership

- Visit [cismart.ca/members/](http://cismart.ca/members/) for the complete list and the membership form.



C I S M a R T

## Next steps

- Provide additional input to Wei Qiu ([qiuw@mun.ca](mailto:qiuw@mun.ca)):
  - collaborative R&D and training projects
  - projects involving CCG ship time
  - Ship noise mitigation technologies
- Please send additional comments/suggestions on VARD's report to [Andrew.Kendrick@vard.com](mailto:Andrew.Kendrick@vard.com)

C I S M a R T

## Next steps

- Draft reports on the two workshops are expected to be released for comments in early January 2019.
- Upload workshop materials in PDF format to [cismart.ca](http://cismart.ca)?
- Next CISMART workshop is anticipated to be held in Fall 2019.

*See you at the London Workshop in January 2019 and the CISMART Workshop in Fall 2019!*