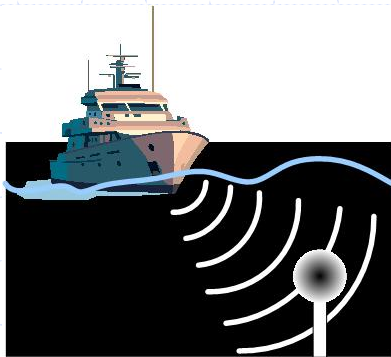


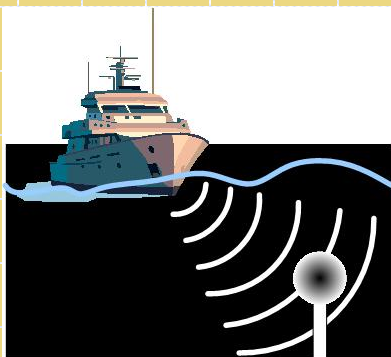
A Standard for the Measurement of Underwater Noise



Michael Bahtiarian

Vice President,
Noise Control Engineering, Inc.
Billerica, Massachusetts

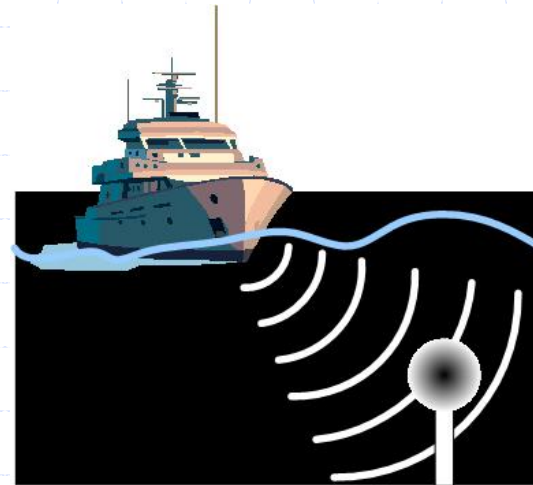
A Standard for the Measurement of Underwater Noise



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Presentation Summary

- ◆ Purpose of a New Measurement Standard.
- ◆ Need for a New Measurement Standard.
- ◆ Standard Committee Organizational Structure & Members.
- ◆ Questions & Comments.

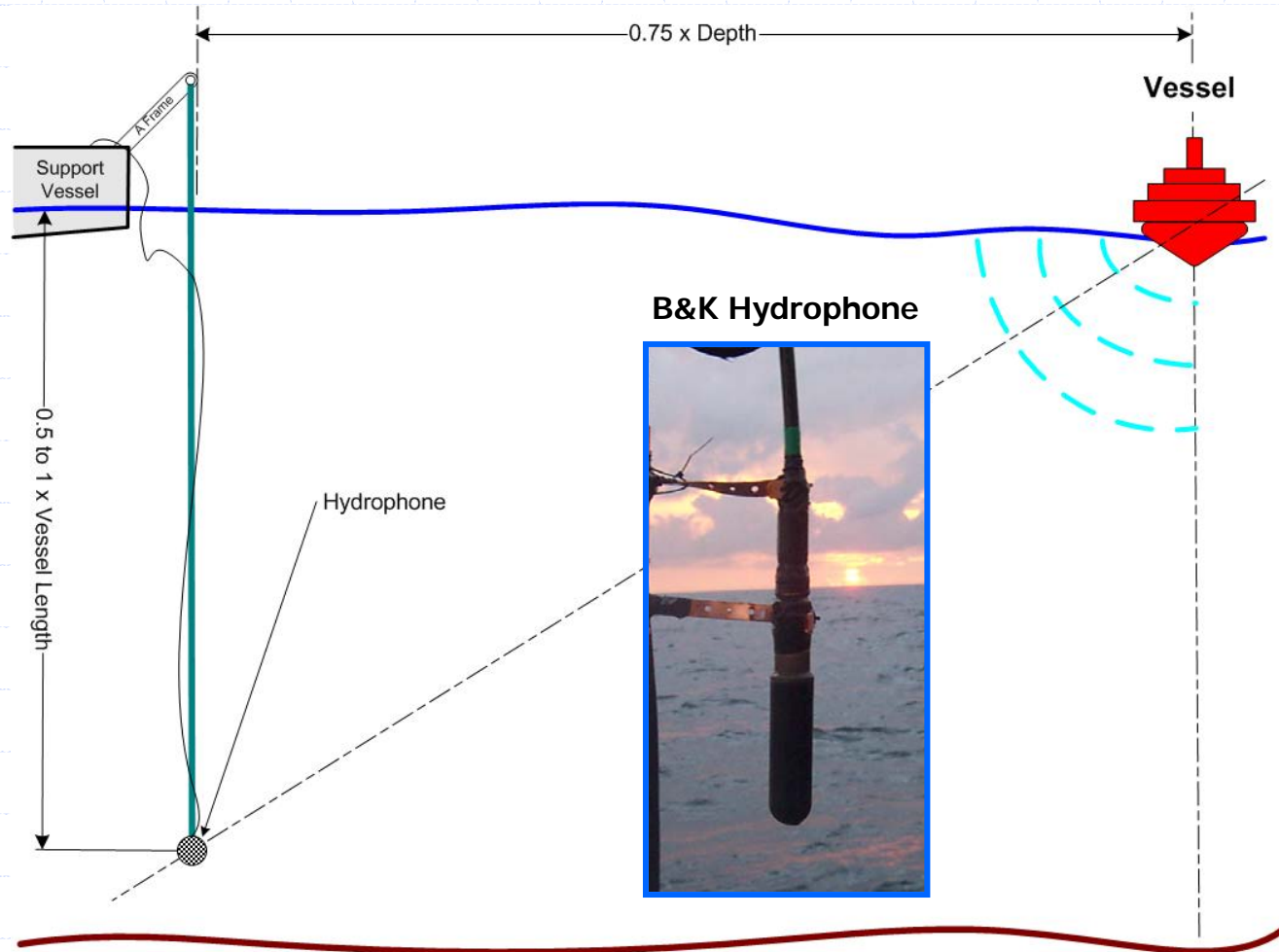


Purpose:

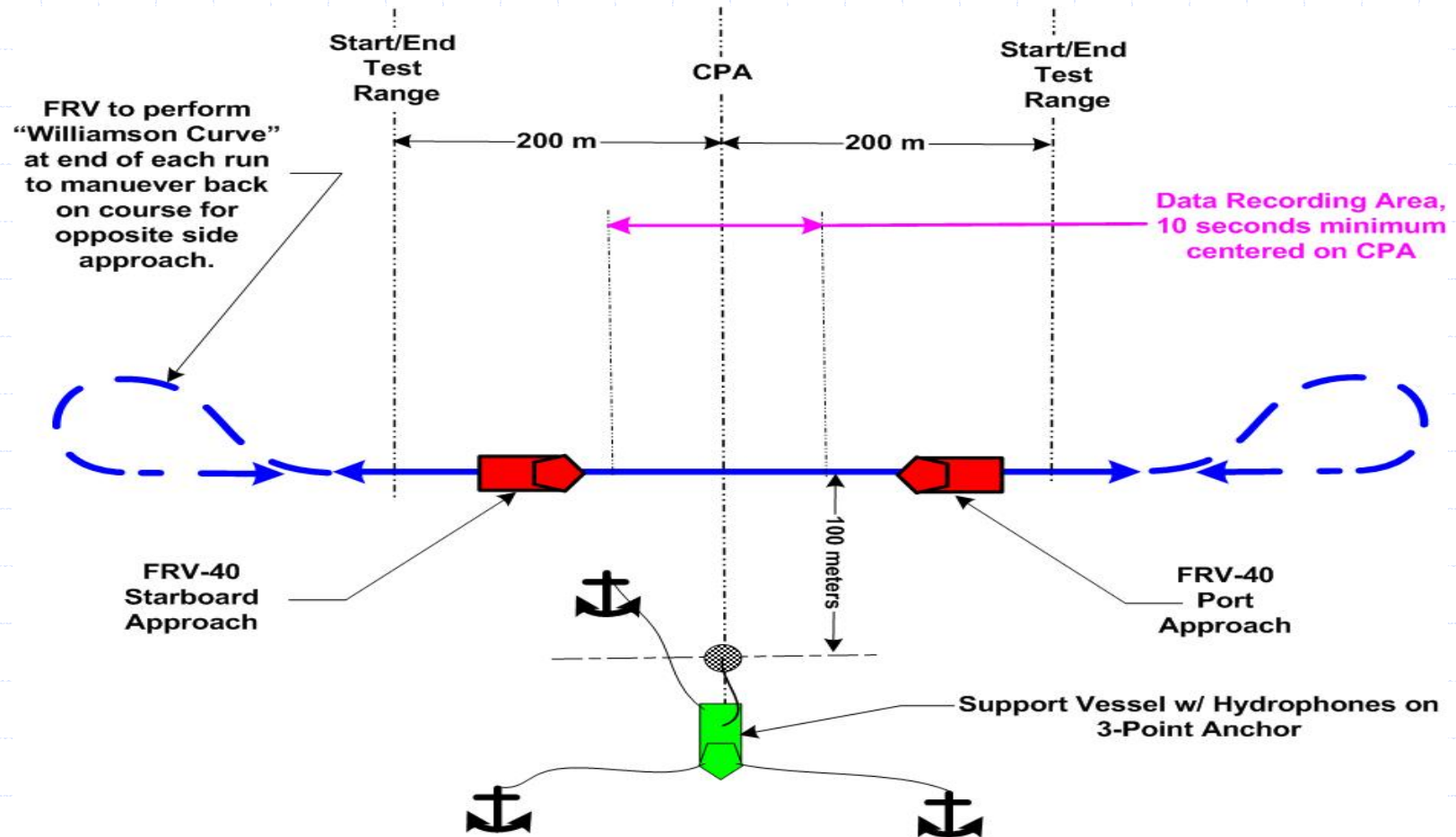
- ◆ Develop a NEW standard for the measurement of underwater (UW) noise from ships.
- ◆ Resulting data is referred to as "Source Levels" (i.e. sound level must be referenced to a distance, typically 1 meter).

Typical Measurement Approach

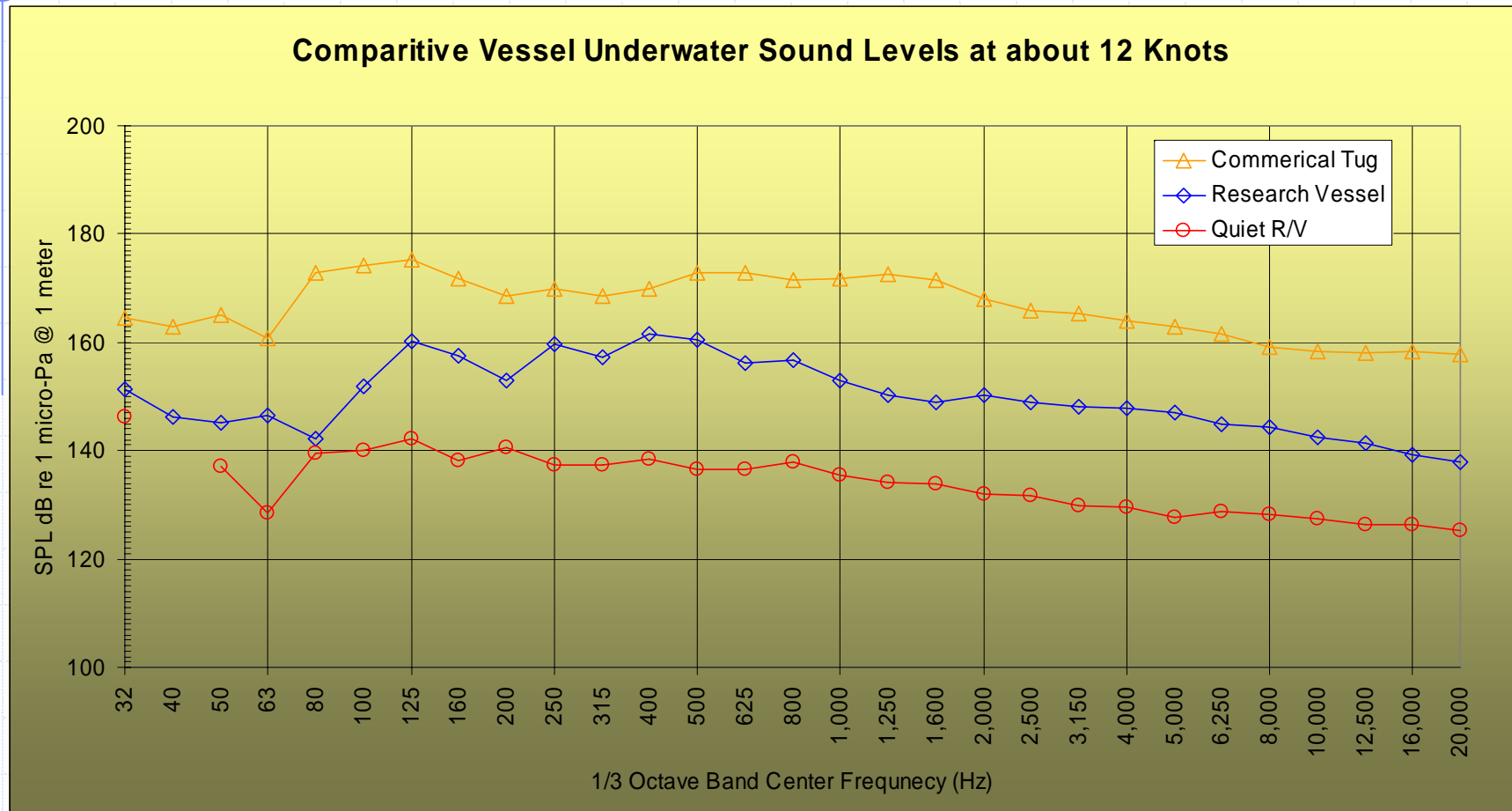
- ◆ Measure w/ Hydrophone (underwater microphone as shown on inset).
- ◆ Measure Distance between vessel & hydrophone
- ◆ Normalize sound level to 1 meter distance.
- ◆ dB values relative to 1 μ Pascal.



Typical Measurement Approach (continued)



Typical Measured Underwater Sound Data



Need for the Standard

- ◆ No non-military standard exists for measurement of noise from ships.
- ◆ New classes of quiet research vessels being produced in Europe (since 1995) and now in U.S. (since 2004).
- ◆ Green ships with low emissions.
- ◆ Reduction of Environmental Impacts

Relevant Documents

1. International Council for Exploration of the Seas (**ICES**) Cooperative Research Report No. 209, *Underwater Noise of Research Vessels Review and Recommendations*, 1995.
2. NATO Standardization Agreement (**STANAG**), "Standards for use when measuring and reporting radiated noise characteristics of surface ships, submarines, helicopters, etc. in relation to sonar detection and torpedo risk, May 29, 1995.

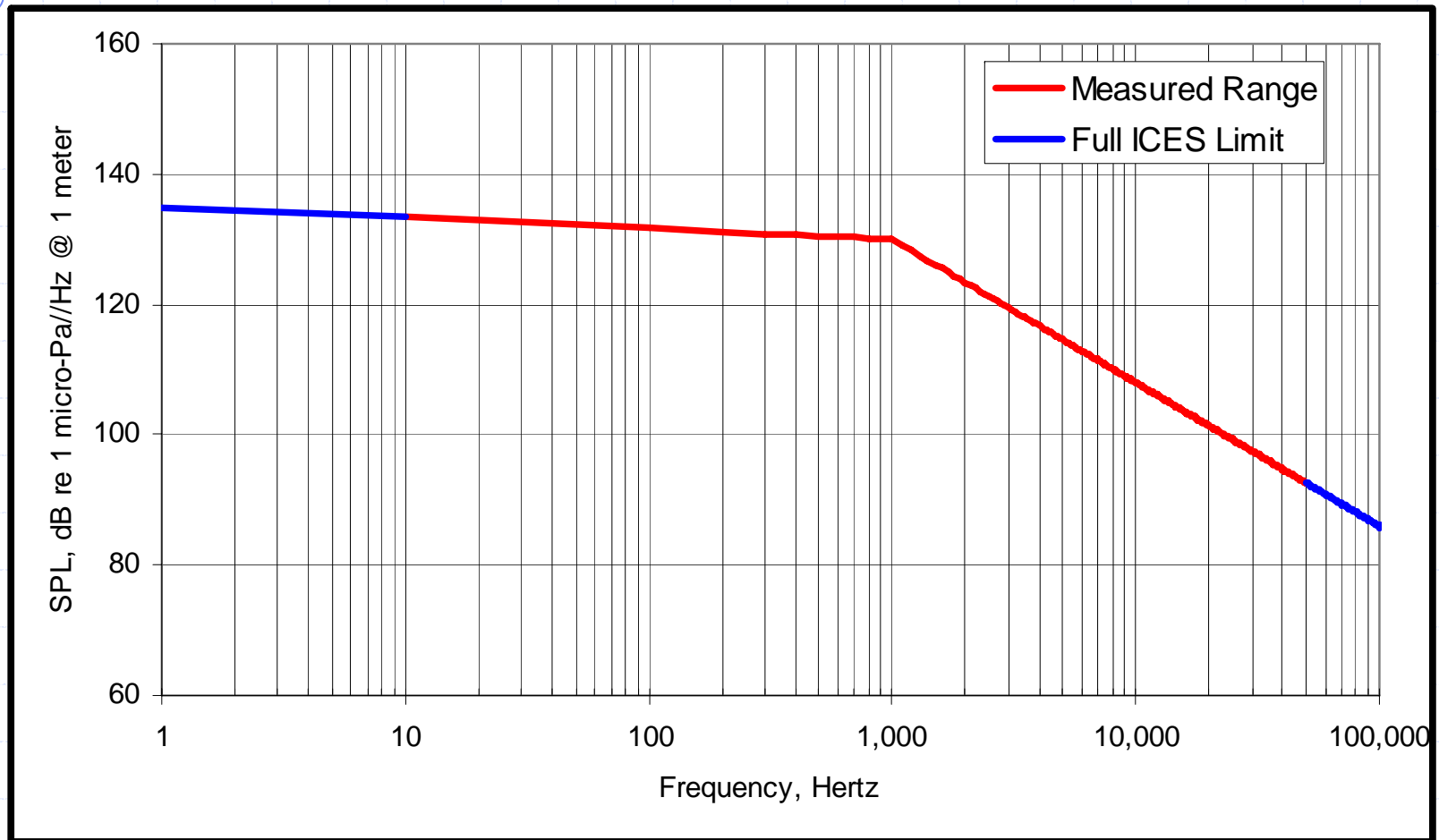
Ref (1) has underwater noise limits, but methodology discussion is very limited (2 pages of very general information). Note this document is a report not a standard.

Ref (2) is a standard and has detailed methodology, but applicable to military applications as title states.

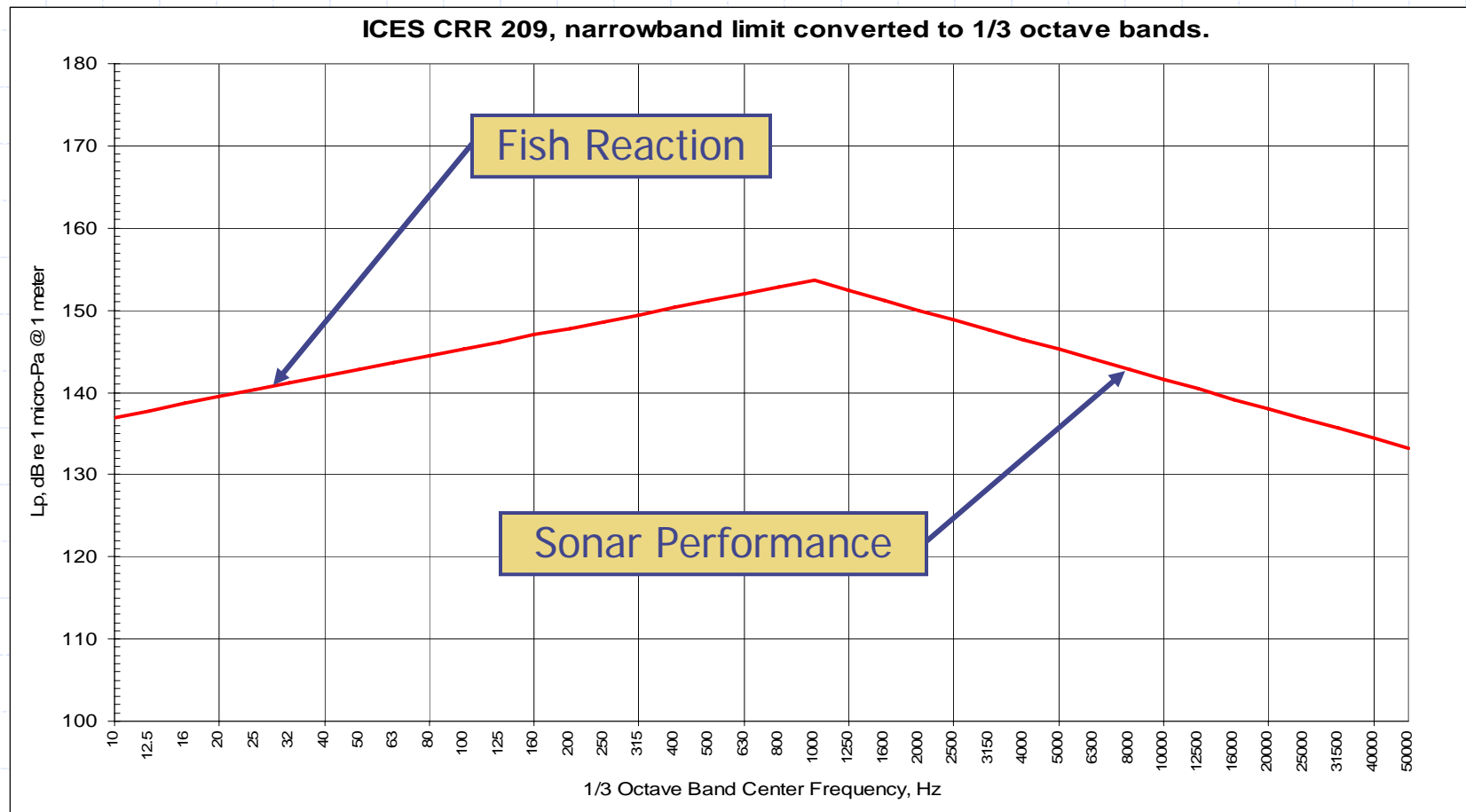
Underwater Noise Limits

- ◆ ICES only Commercial Underwater Noise Limit specified by the International Council for the Exploration of the Sea (**ICES**) in Report 209 dated May 1995.
- ◆ Applies to Research Vessels in order to avoid alerting marine life.
- ◆ Recommended for Speed of 11 knots.

ICES Radiated Noise Limit



ICES Radiated Noise Limit 1/3 Octave Band Format



Current Navy Facilities are Spread in Corners of N. America



NOAA-Fisheries Research Vessels (FRV-40)

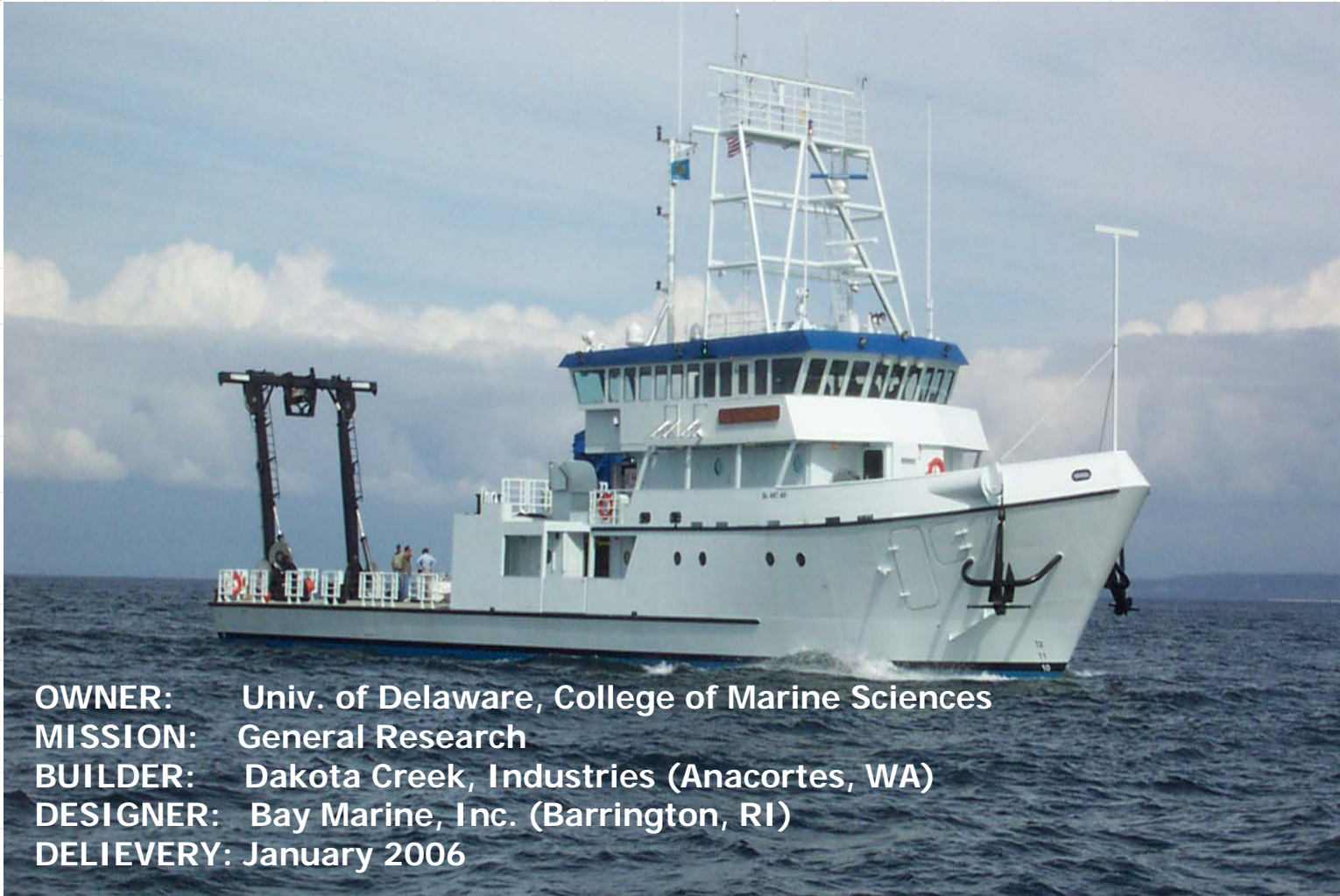


OWNER: National Oceanic & Atmospheric Administration
MISSION: Fish Stock Assessment / General Research
BUILDER: VT Halter Marine (Pascagoula, MS)
DESIGNER: VT Halter Marine (Pascagoula, MS) & NOAA
DELIVERY: January 2005, Dec 2006

09/11/2004

R/V HUGH R. SHARP

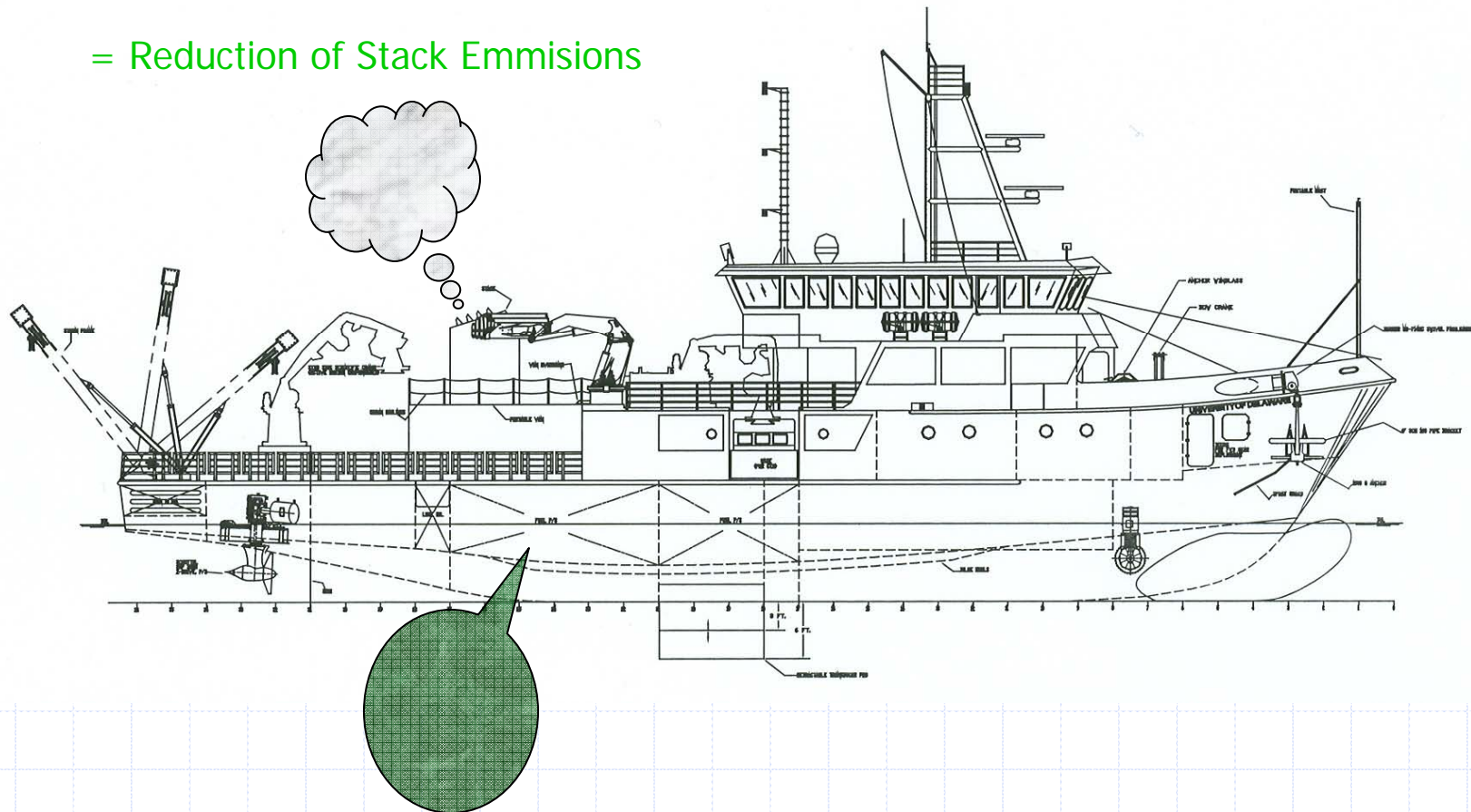
University of Delaware



OWNER: Univ. of Delaware, College of Marine Sciences
MISSION: General Research
BUILDER: Dakota Creek, Industries (Anacortes, WA)
DESIGNER: Bay Marine, Inc. (Barrington, RI)
DELIVERY: January 2006

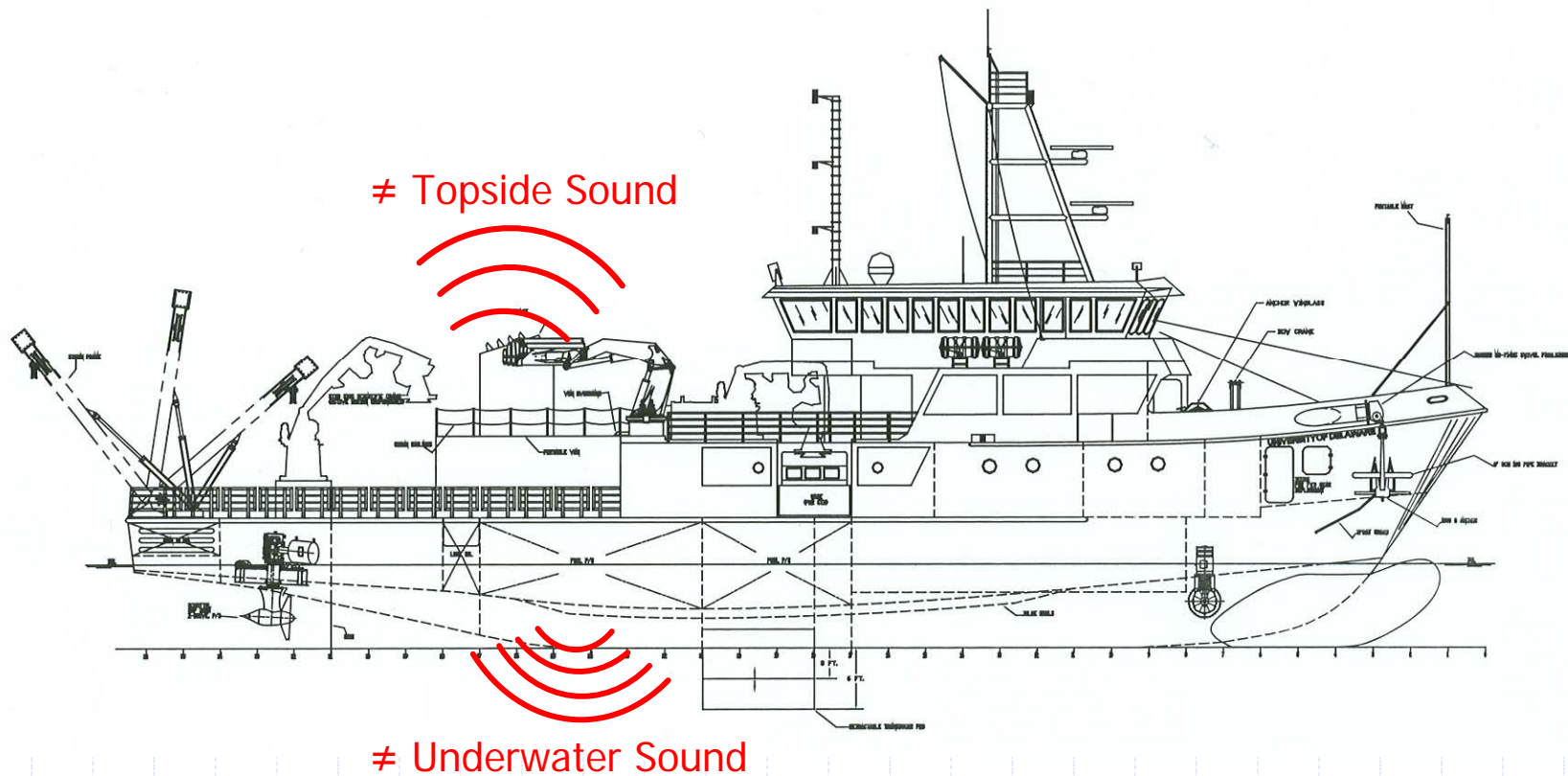
Green Ships = Stack/Water

= Reduction of Stack Emissions



= Reduction of Ballast Water

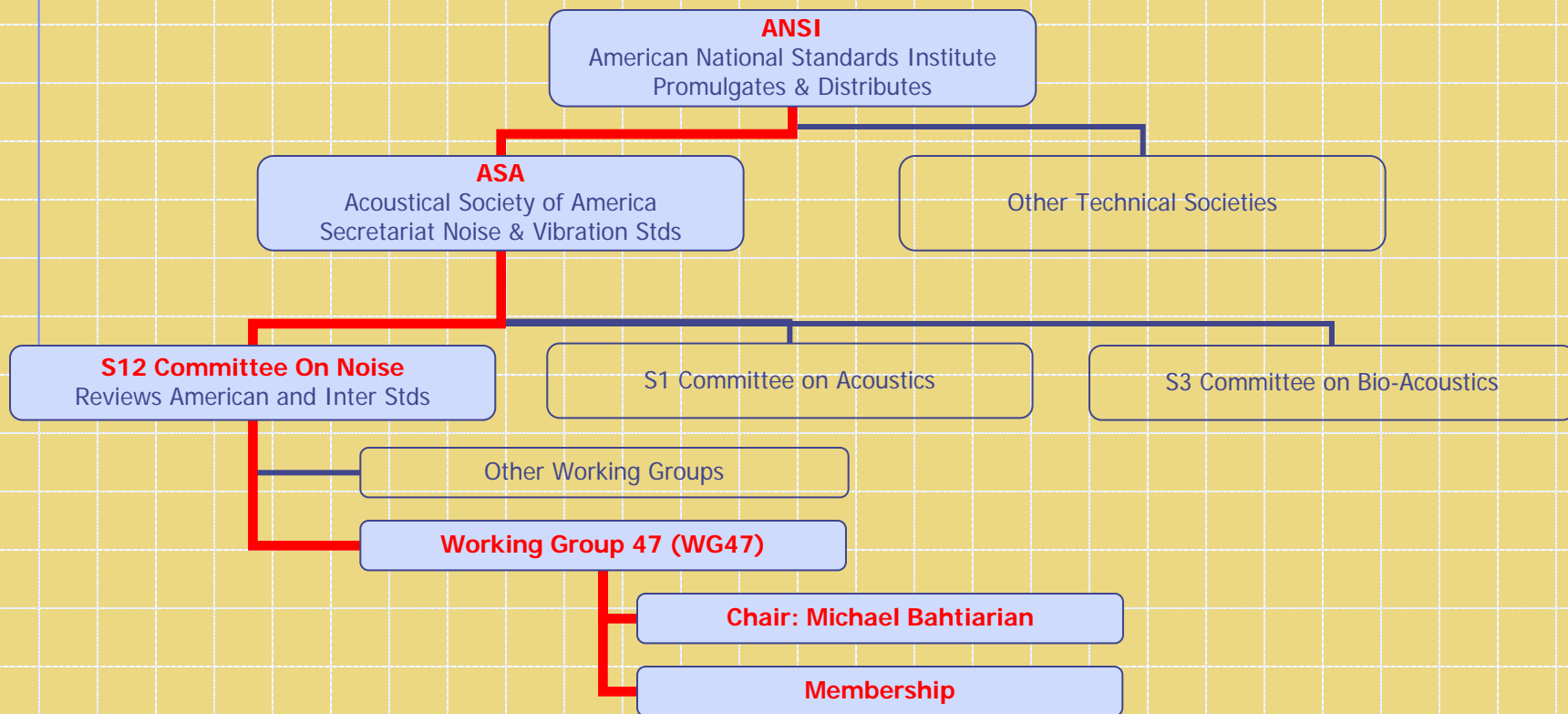
Green Ships \neq Sound



ASA – Working Group 47 (*WG-47*)

- ◆ Organizational Structure
- ◆ Membership
- ◆ Mission Statement
- ◆ Grades Matrix
- ◆ Schedule
- ◆ Next Meeting

U.S. Acoustical Standards Organizational Structure



WG-47

Membership

12 U.S. Navy:

(NAVSEA, NSWC-Carderock, NSWC-Dahlgren, NUWC)

5 Universities:

(Lamont Doherty, University of Delaware, Florida Atlantic, University of Rhode Island)

4 NOAA:

(Northeast Fisheries, Acoustics Program, Fisheries Resources, National Fisheries Service)

5 Private Consultants:

(Noise Control Engineering, Acoustical Technologies, Mantech, Beechwood Consulting, Carlen Associates)

2 Naval Architects:

(Glosten Associates, Bay Marine, Inc.)

1 Hydrophone Vendor:

(International Trandcuer Corporation)

2 International:

(Defense R&D, Canada & Bureau Veritas, United Kingdom)

TOTAL 31 MEMBERS AS OF MARCH 2007

WG-47

Mission Statement

The mission of the ASA Standards Committee, Working Group 47 (WG47), "*Underwater Noise Measurement of Ships*" is to develop a commercial standard describing the instrumentation systems and methodologies for the measurement of the a vessel's underwater noise signature. The standard shall have the following attributes:

1. The standard will have multiple "Grades" of measurement, each with a stated applicability, test methodology, instrumentation accuracy, system repeatability and complexity. Such issues can be directly and indirectly related to cost of performing the measurement. However, the standard as such, cannot and will not directly address cost.
2. For all "Grades", the standard will only be applicable to surface vessels, either manned or unmanned. This standard will not be applicable to submerged vessels or aircraft (either manned or unmanned).
3. All "Grades" will be achievable with commercial-off-the-shelf (COTS) technology for all aspects of methodology, instrumentation and data processing.
4. The Standard will impose NO underwater noise limits and make NO comments on what is acceptable or unacceptable for any application.
5. The Standard will NOT address issues related to the following: vessel self-noise, diagnostic measurements, noise reduction techniques, environmental consequences of noise, effects of noise on marine life or passive underwater noise monitoring. While such matters are certainly related, these issues are typically considered outside the scope of a measurement standard.

WG-47

Grades Matrix (in development)

GRADE	A	B	C
GRADE NAME	Precision Method	Engineering Method	Survey (in-situ) Method
Expected Use/Application	Contract Require'ts Conformance	Contract Require'ts Conformance Annual Check-Up	Annual Check-Up
Expected User/Type of Ship	Navy Non-Combat NOAA Quiet R/V's	UNOLS R/V Commercial ships Navy/NOAA	UNOLS R/V's Commercial ships
Driving Factor	Accuracy	Best Accuracy/Cost	Cost (water depth)
Measurement Units		SPL dB re 1 μ Pa	
Source Level Correction		1 meter from Far Field	
Distance Correction Method	Complex; ???	???	Simple; Spherical Spreading

WG-47

Grades Matrix (continued)

GRADE	A	B	C
GRADE NAME	Precision Method	Engineering Method	Survey (in-situ) Method
Measurement System Accuracy	± 1½ dB	± 2 dB	± 3-5 dB
Measurement System Repeatability	± 1½ dB	± 2 dB	± 3-5 dB
Frequency Response	10 to 50,000 Hz	10 to 25,000 Hz	100 to 10,000 Hz
Frequency Analysis (required)	Narrowband	1/3 octave band	???
Frequency Resolution (required)	1 Hertz	23%	???
Frequency Analysis (optional)	1/3 octave band	Narrowband	???
Frequency Resolution (optiona)	23%	1 Hz	???

WG-47

Grades Matrix (continued)

GRADE	A	B	C
GRADE NAME	Precision Method	Engineering Method	Survey (in-situ) Method
Maximum Hydrophone Sensitivity	???	???	???
Hydrophone Frequency Response	???	???	???
Minimum Number of Hydrophones	Three	Two	One
Minimum Water Depth	≤ 200 meters	≤ 100 meters	≤ 50 meters
Minimum Measurement Distance		1-1½ x ship length	
Distance Ranging Accuracy	±3 meters	±10 meters	±?? meters
Weather/Sea Conditions	≤ Sea State 2 ??	≤ Sea State 1	≤ Sea State 0
Deployment Requirements	No limitations. May use bottom mounted hydrophones.	Small craft, such as crew boat. No divers shall be required.	Small “launch” such as RHIB. No divers required.
Auxiliary Measurements	Sound Velocity Profiles	???	???
Other Factors	Account for cable strum and sea surface affects.	Account for cable strum and sea surface affects.	None
Calibration	Hydrophones field calibrated and Insert Voltage (i.e. full system calibration)	Hydrophones field calibrated	Hydrophones, factory calibration acceptable

WG-47

Schedule, Meetings

1st Year: Standard Draft Development

Jan-June: Outreach

March 27th: Kick-off Meeting, Washington DC

June 6th: Next Meeting, ASA Conf Salt Lake City

May-July: Grades Matrix Development

July-Dec: Standard Writing

2nd Year: Draft Completion & WG-47 Review

3rd Year: S12 Committee, Public Review

Comments & Questions – Acknowledgements

- ◆ Underwater Noise Measurement Standard is in Development.
- ◆ Time for Input is Now.
- ◆ Committee open to all interested parties.
- ◆ Thanks to:
 - **NOAA, Brandon Southhall & Amy Scholik**
 - **WG-47 Members**

WG-47

Contact Information

WG-47 Chair:

Michael Bahtiarian

mikeb@noise-control.com

978-670-5339

WG-47 Website:

www.noise-control.com/wg47