# Noise Control The Role Of Noise Control in Systems Engineering

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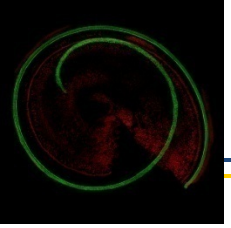


# Disclosures

- There are no conflicts of interest or financial interests to report.
- The views expressed herein are my own and do not necessarily reflect the official policy or position of the Department of the Navy, Department of Defense, or the U.S. Government.

# Topics

- Operational Noise
- Hearing Protection
- Noise Propagation/modeling
- Noise Control Techniques

# Hazardous levels of noise: Afloat and Ashore

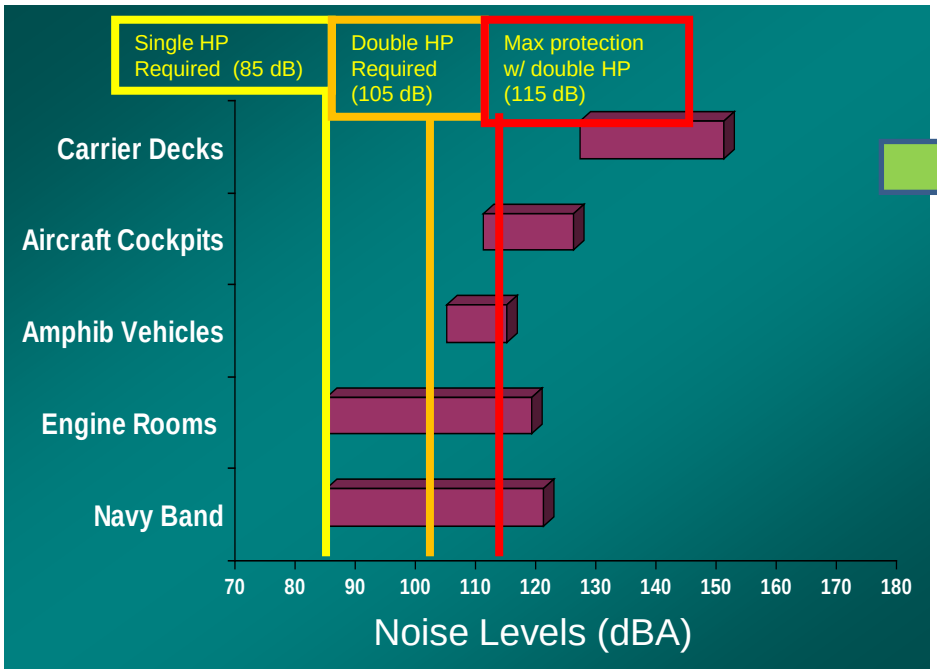


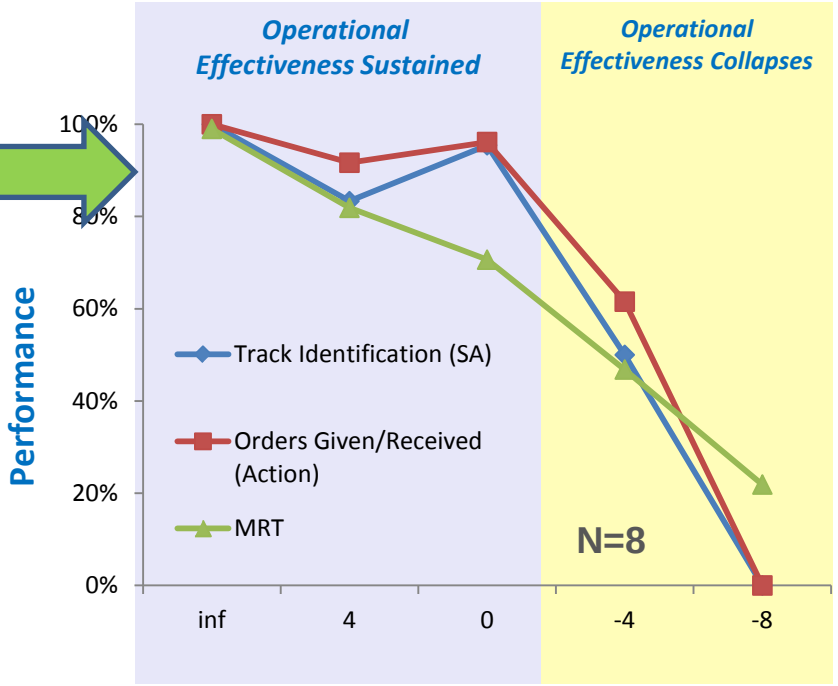
# Ships are loud places to work!

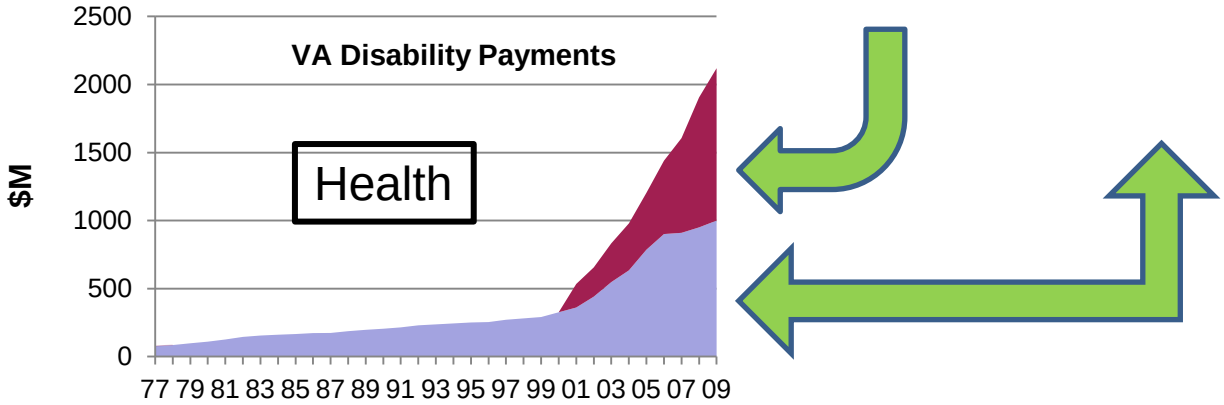
# How well do you have to hear to do your job?

# Noise-Induced Hearing Loss

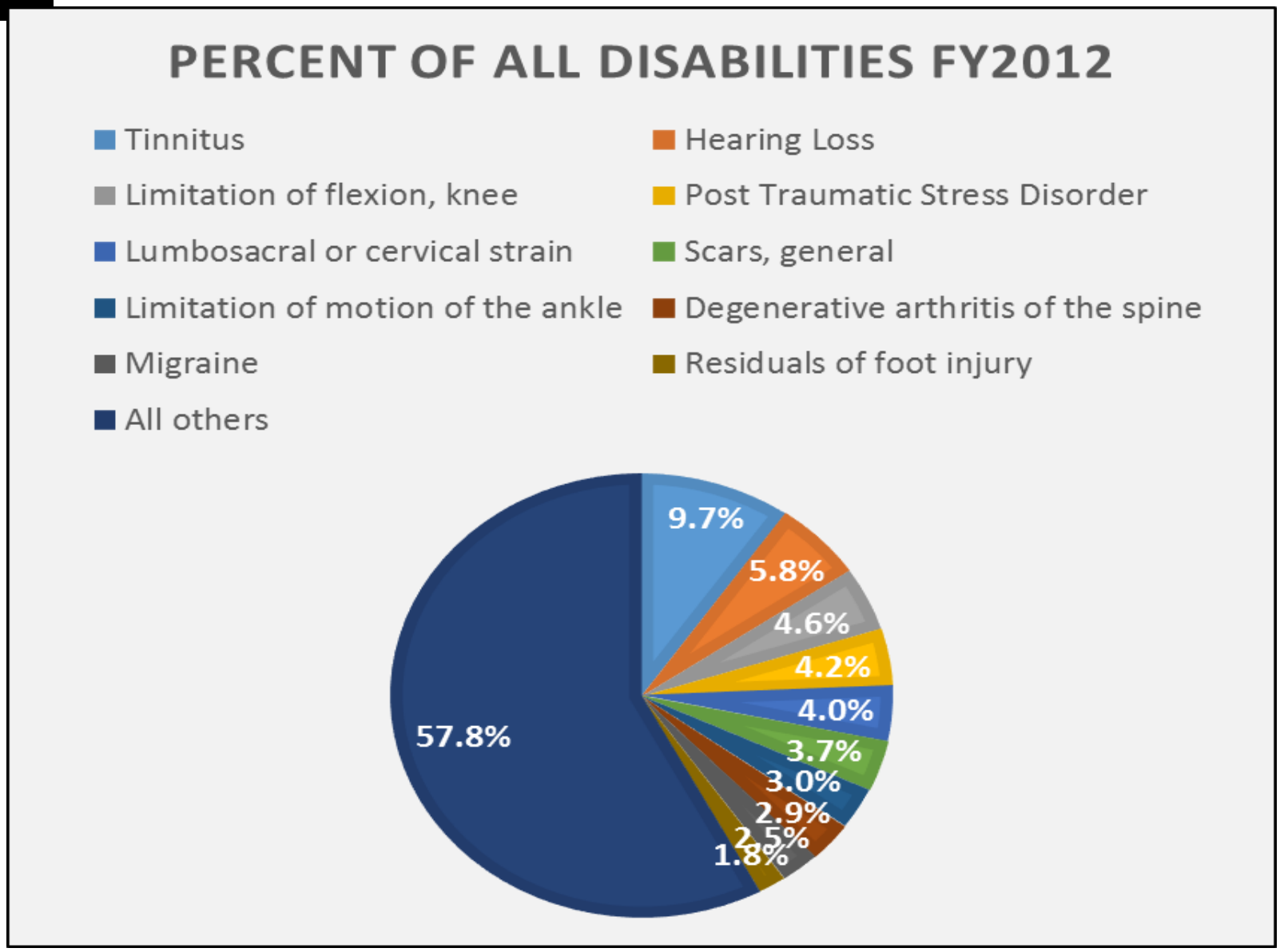
## Hazardous Noise Exposures Impact



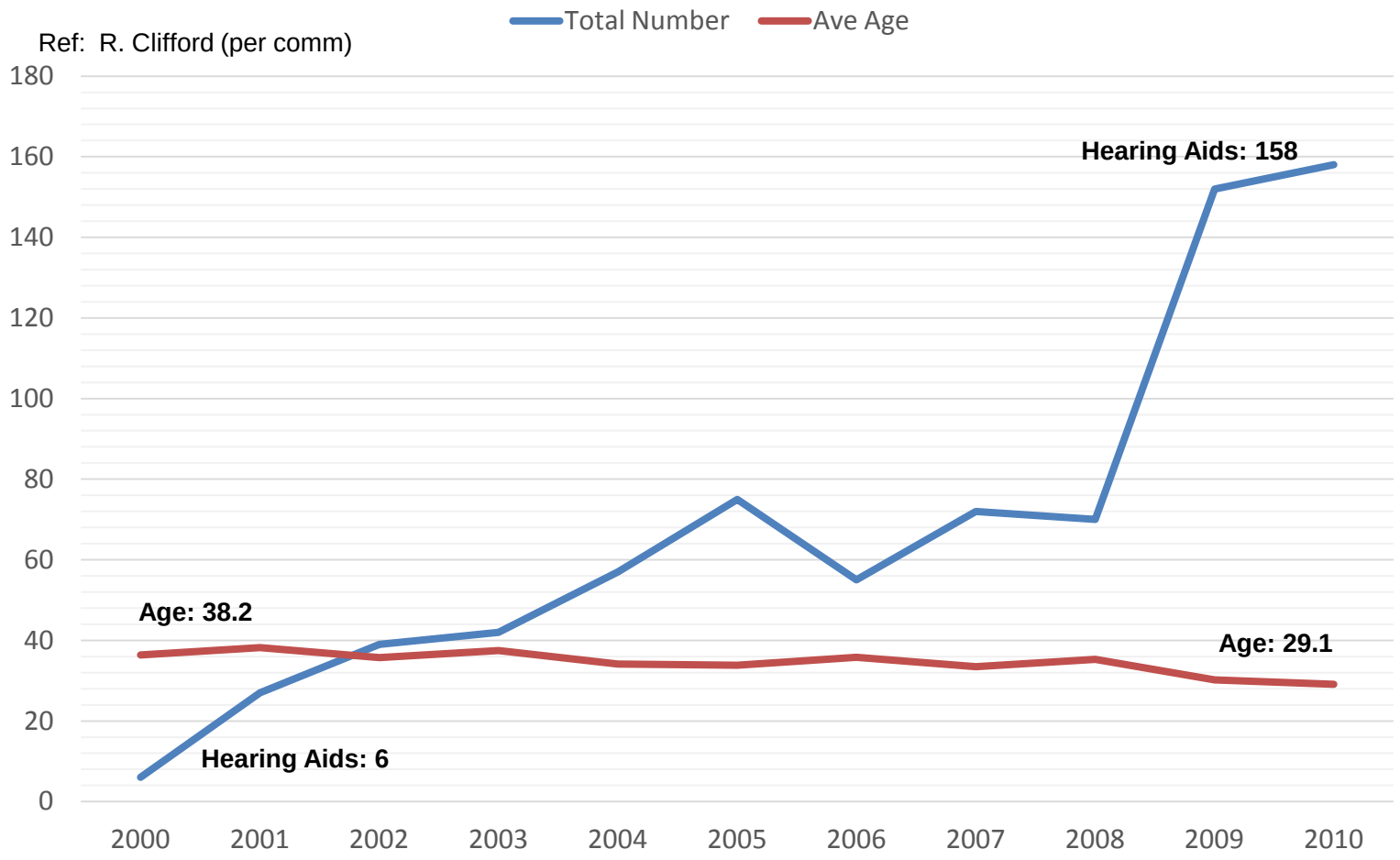



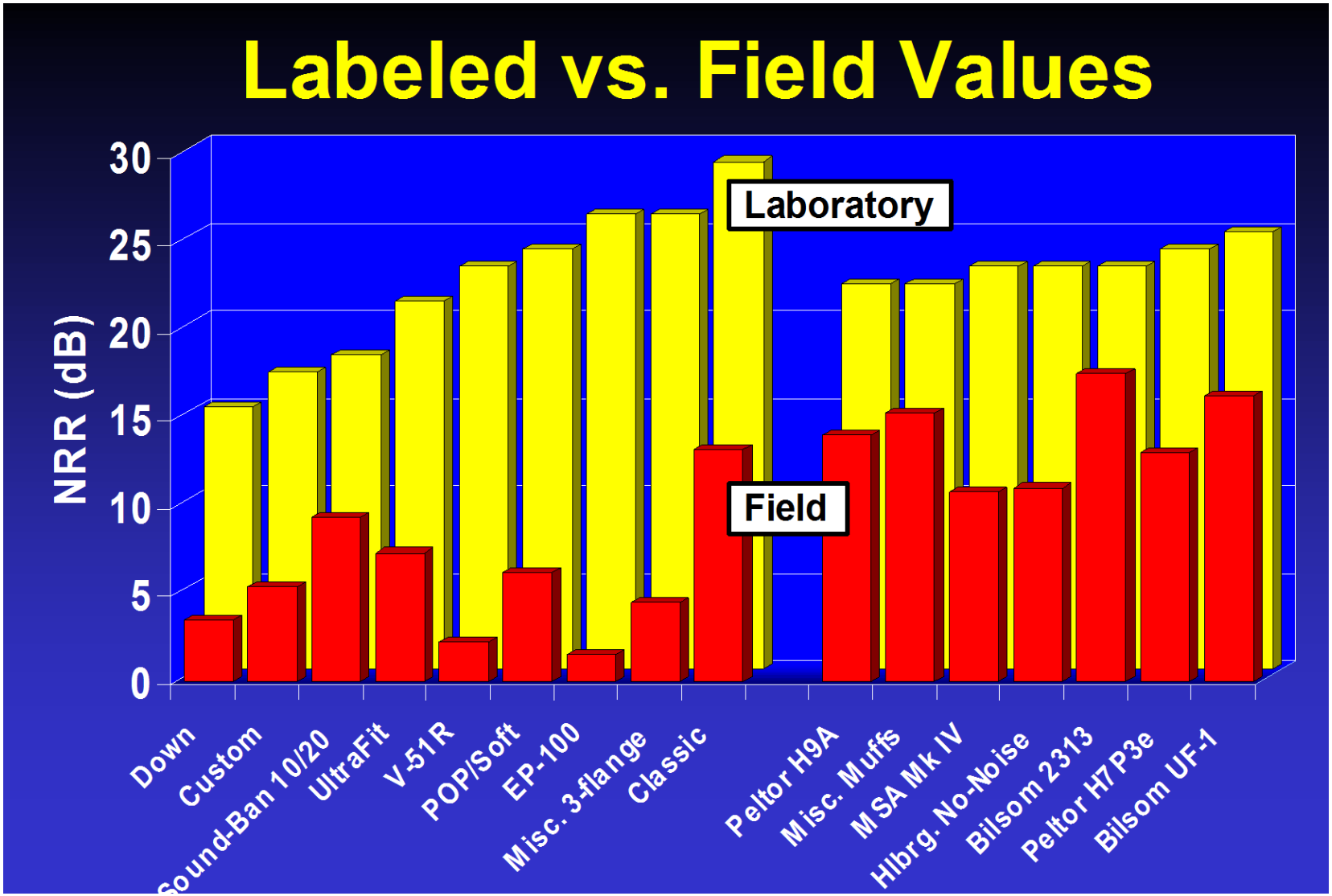
# VA Disabilities



# USMC Hearing Aids Dispensed

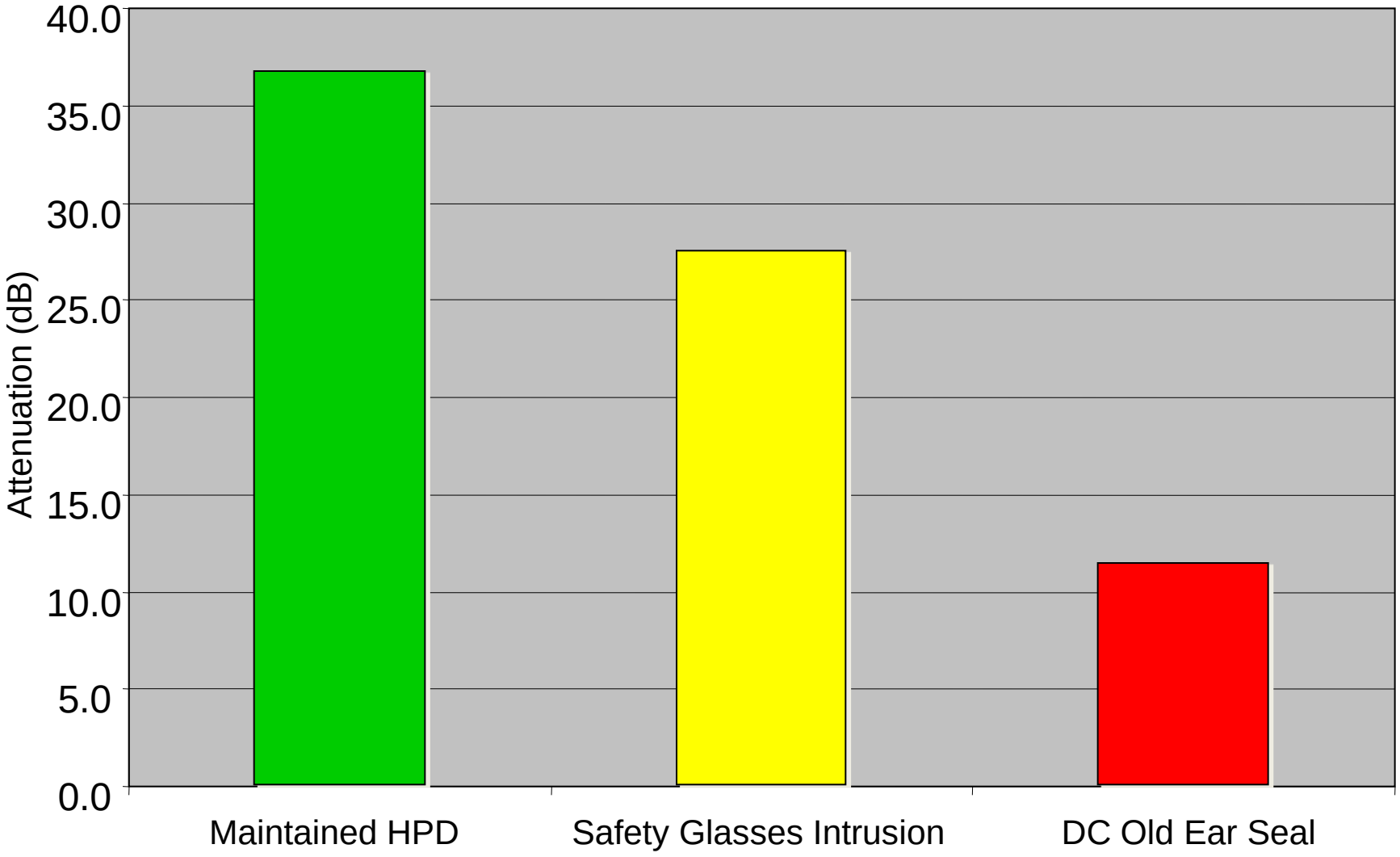


# Hearing Protection Effectiveness

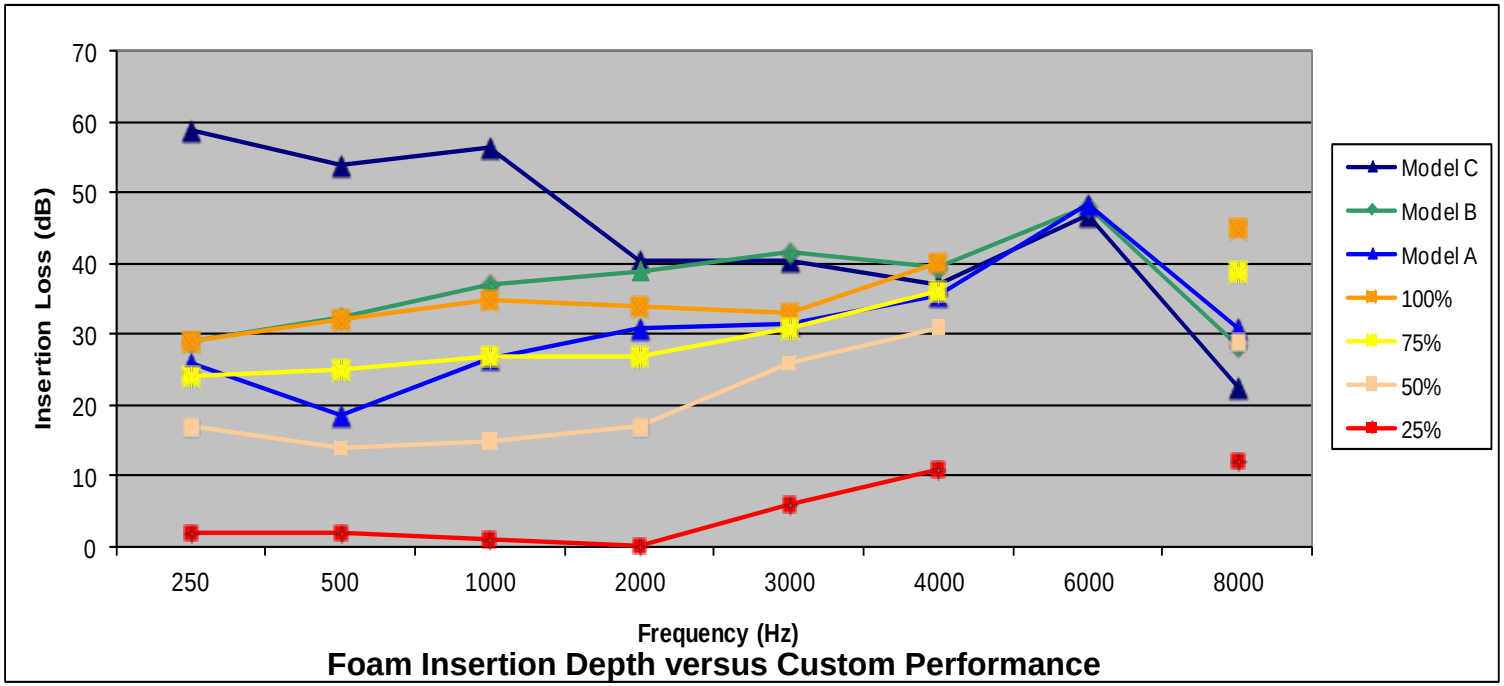



Ref: E. Berger, SAFE 02

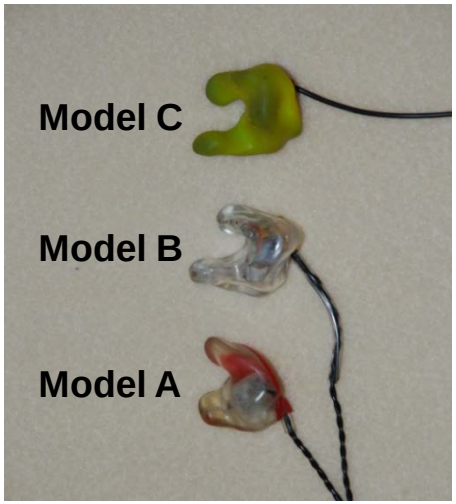
# Hearing Protection - Acoustic Performance



# Ear Plug Performance



Foam Insertion Depth versus Custom Performance




Match PPE to Noise Exposure

# Advanced Hearing Protection for LCS 1


## *Description of Need*

- Required double hearing protection have deficiencies for Navy applications in high noise environments, including engine rooms and flight decks resulting in noise induced hearing loss.
- Operational Scenarios frequently require communication in high noise environments which compromise speech intelligibility and mission effectiveness.
- Uniform compatible pouch improves accessibility.

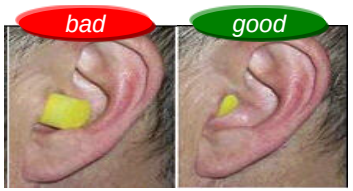
## *Solution*

- Developed prototype solutions, using Air Force developed custom molded earplugs and commercial state of the art hearing protection.
- New processes for custom molded earplug deployment are being developed through a Lean Six Sigma Project and will be implemented throughout Navy platforms. LCS 1 (NAVSEA) and CVN 69 (NAVAIR) are the initial deployments.
- Teamed with NAVAIR in flight deck variant of custom molded earplugs (SBIR project)

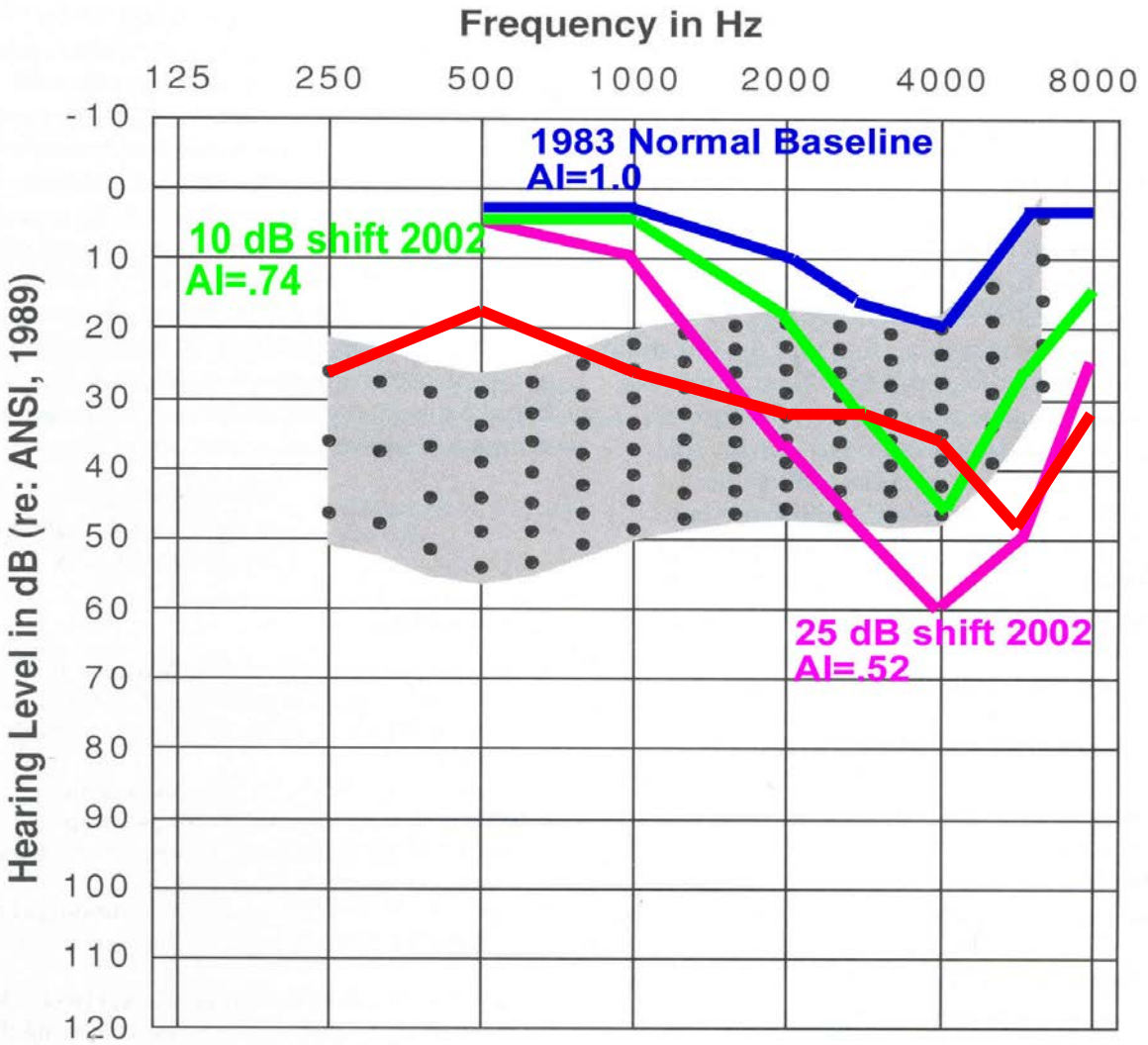
## *Benefits*

- Deployment of custom molded earplugs will result in :
  - •Sailor Buy-in
  - •More Effective Hearing protection
  - •Lower Noise induced hearing loss/tinnitus
  - •Reduced communication errors
  - •Situational Awareness
  - •Tactical Effectiveness

Legacy foam earplugs are difficult to consistently fit and achieve full protection.



# Auditory Profiles

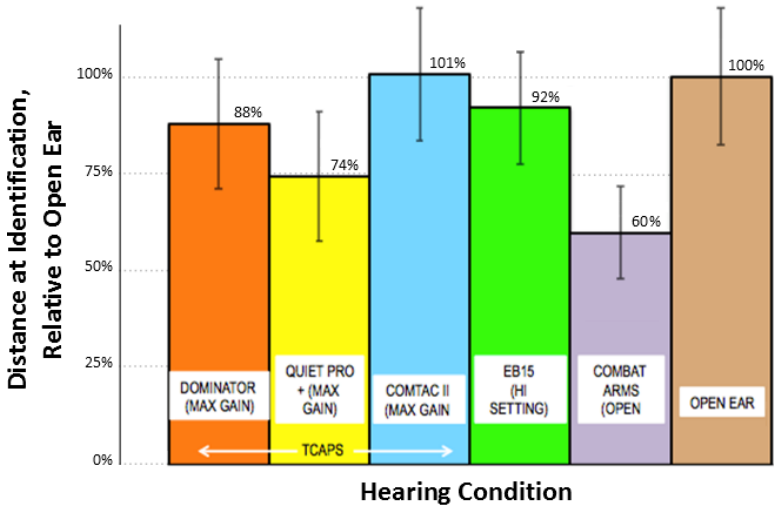



Ref: L. Wells

# Auditory Warfighter Performance

| | Good Hearing | Poor Hearing |
|---|---|---|
| *Time to Identify Target* | 40 sec | 90 sec |
| *Incorrect Command Heard by Gunner* | 1% | 37% |
| *Correct Target Identification* | 98% | 68% |
| *Enemy Targets Killed* | 94% | 41% |
| *Wrong Target Shot* | 0% | 8% |
| *Tank Crew Killed by Enemy* | 7% | 28% |

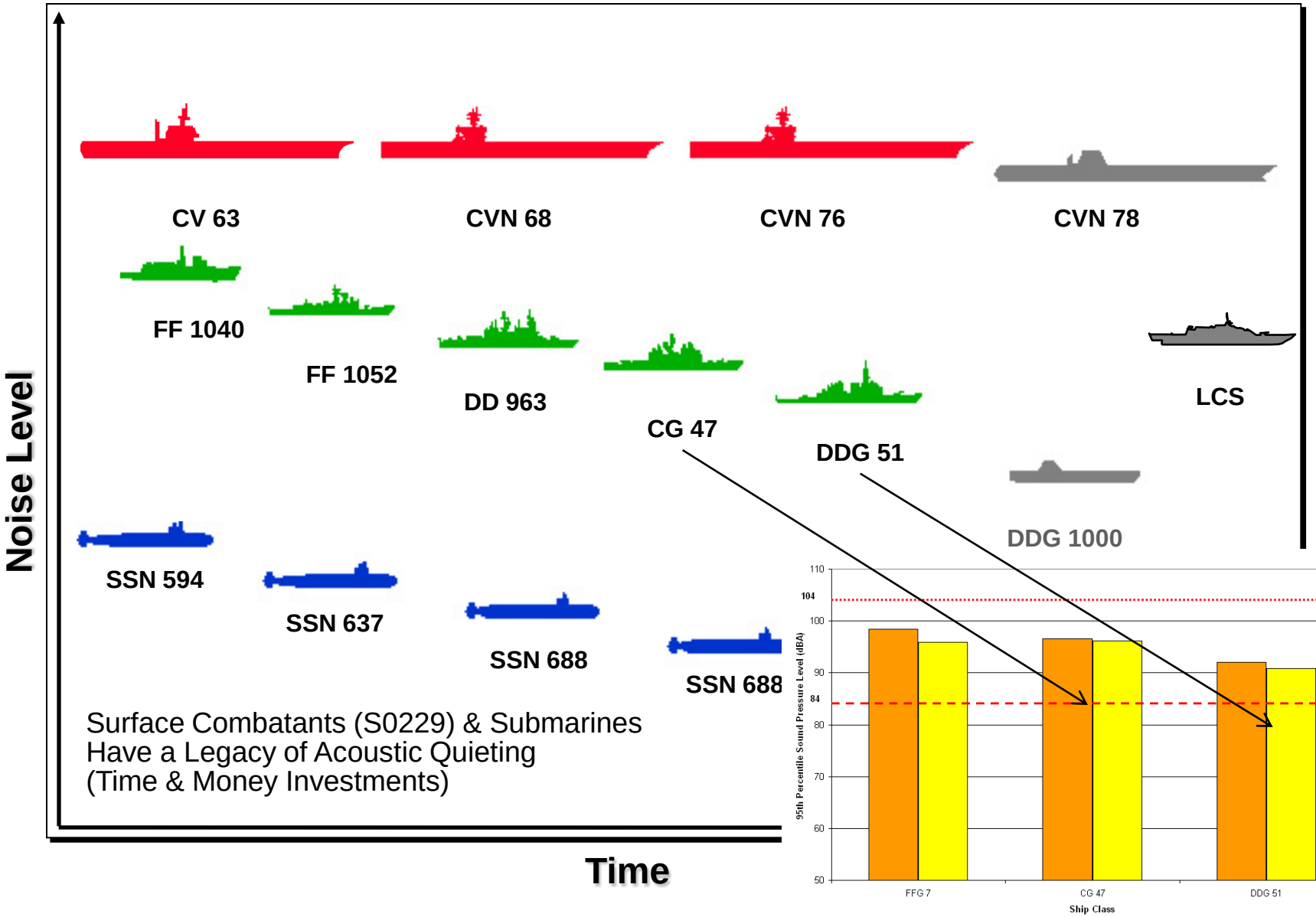
Ref: Tank Gunner Performance and Hearing Impairment
(Garinther & Peters, Army RD&A Bulletin 1990, Jan-Feb 1-5)




**Effects of Augmented Hearing Protection/ Enhancement Devices (HPEDs) on Auditory Detection and Identification**

Ref: J, Clasing, Virginia Tech

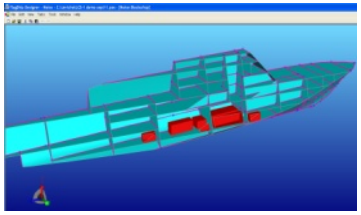
# Hazardous Noise Control



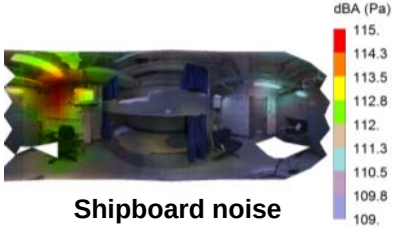
# Noise-Induced Hearing Loss Portfolio

## Systems Approach for an Integrated 6.1 / 6.2 / 6.3 Program

### Source Noise Reduction

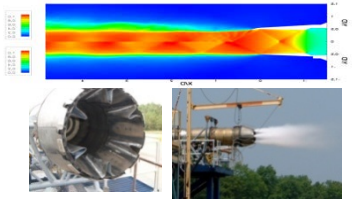


Shipboard noise assessment



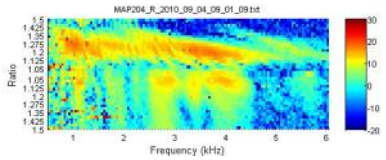

Shipboard noise path validation

Jet noise Reduction



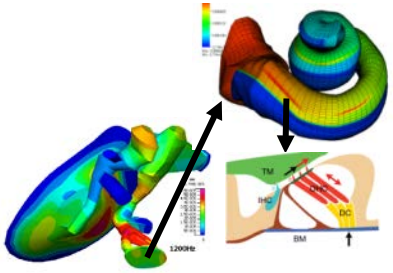
Laboratory modeling/ scale tests of jet noise reduction

### Incidence, Susceptibility & Evaluation



Assessment tools

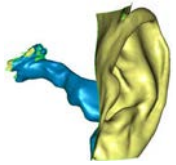
Hearing loss simulator



Modeling Tools

### Personal Protective Equipment (PPE)

Shipboard PPE



3D Digitization for "Prescription" Ear Plugs

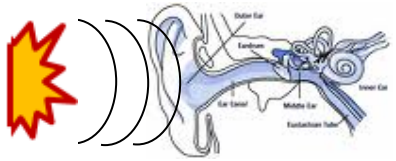
In-Ear Dosimetry

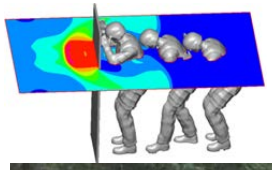
Underwater comms & hearing protection

### Medical Prevention & Treatment

Cell regeneration

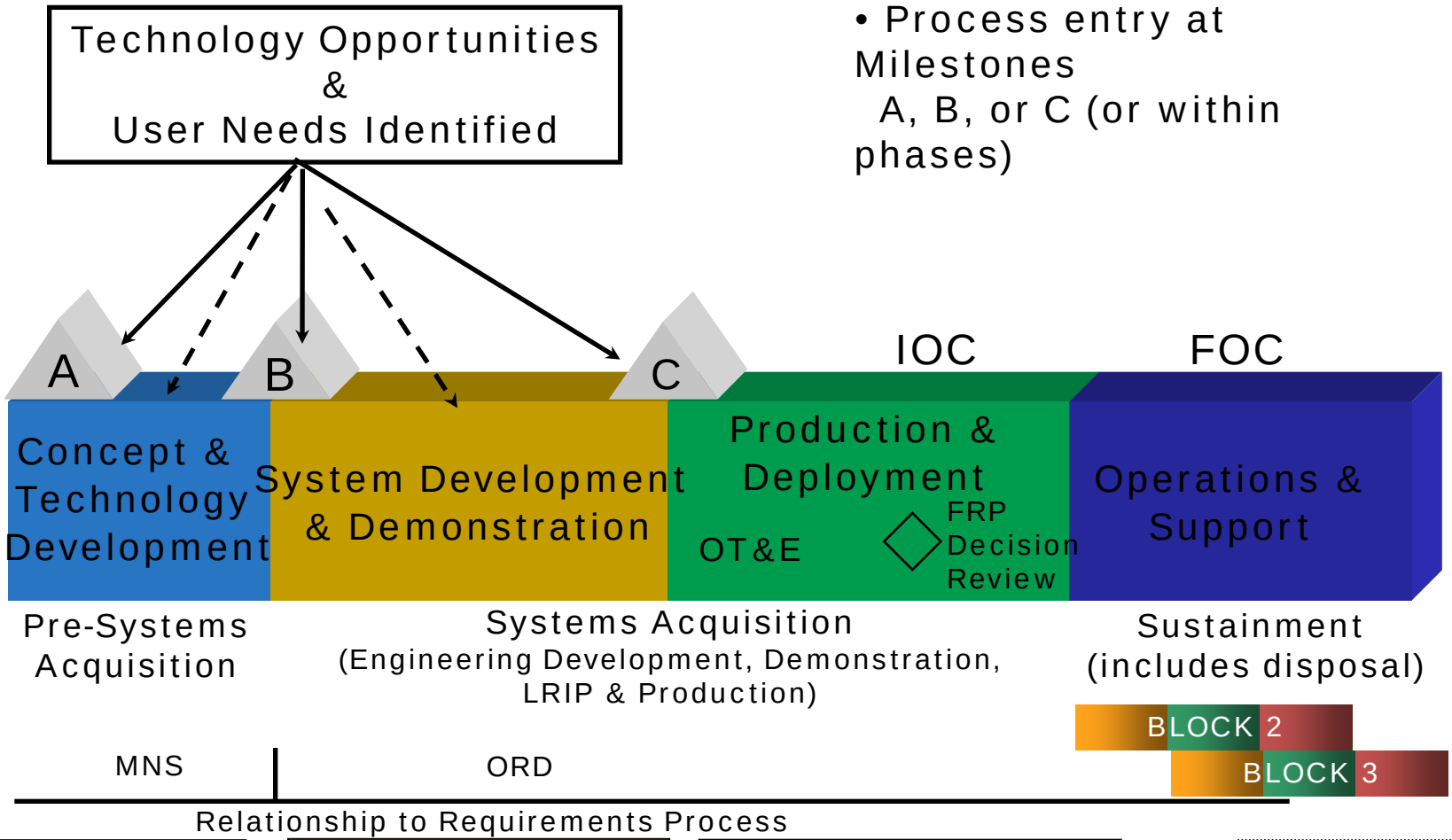
Pharmacologic interventions and drug delivery



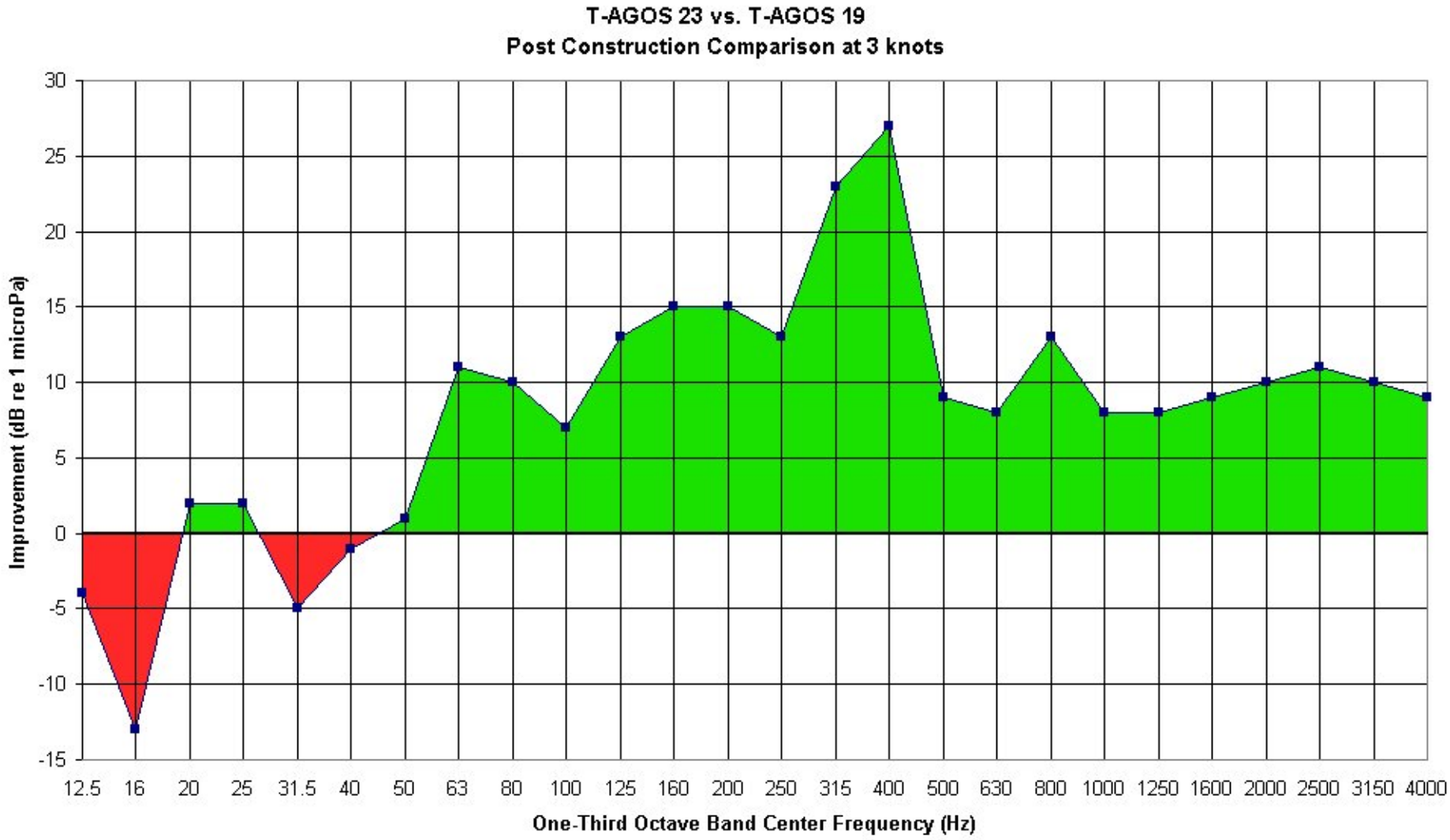


Blast interventions

# Technology Development

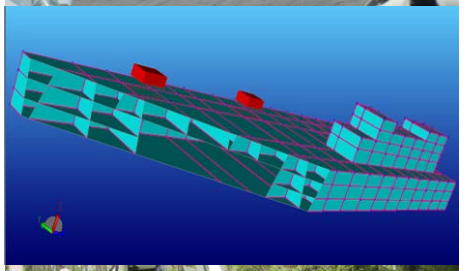


# Integrated Ship Specification: T-AGOS 23



# Acoustic Modelling

- Acoustic modeling tool - Designer NOISE™
  - Continued to add features/technology
    - Redesigned GUI
    - Additional source elements
    - HVAC module updates
    - Updated treatment algorithms
  - Validated on CVN and LHD
    - Better understanding of F18 and JSF source levels
    - Better understanding Airborne and structureborne transmission paths
- Novel treatments for noise control
  - Validated effectiveness of spray-on treatment on CVN
  - Identified replacement treatment for CVN island acoustic shielding
- Noise control methodologies
  - Applied to marine vehicle
  - Reclamation powerplants



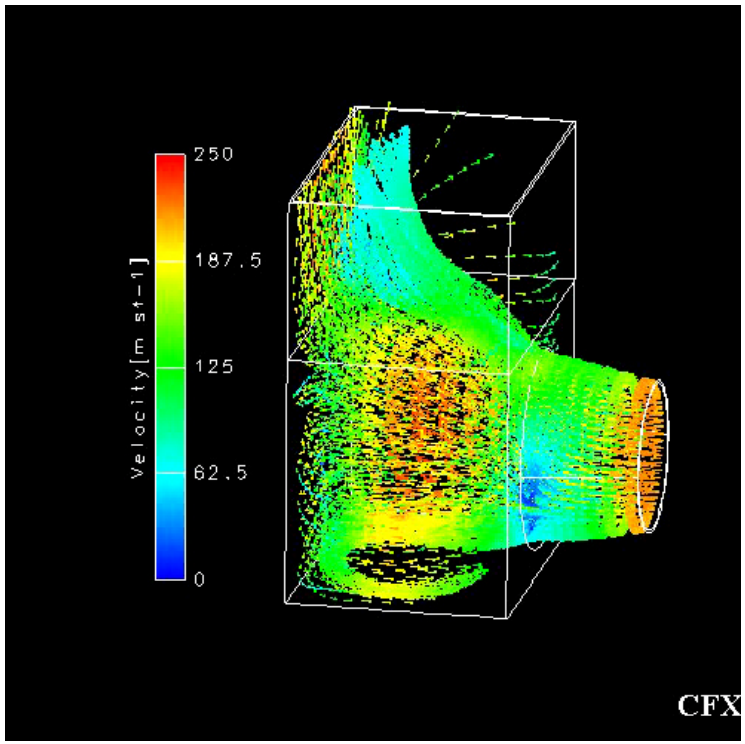
# HVAC - Construction

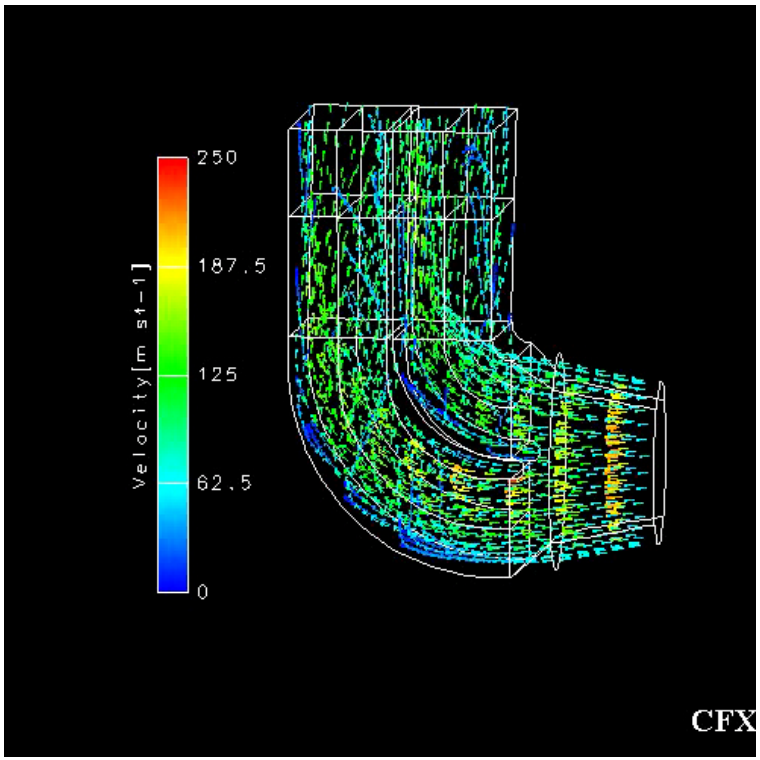
# HVAC – High Velocity


**Acoustic Insulation Compromised by a Larger Fan**

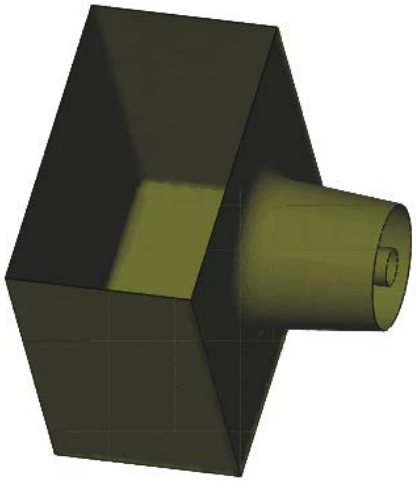
# GT EXHAUST

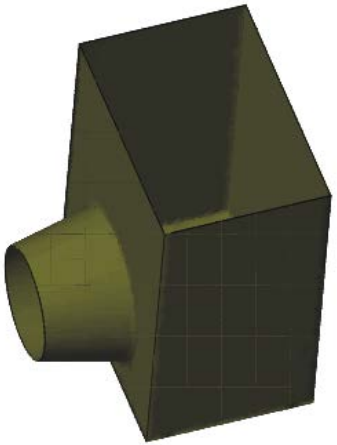
- PROBLEM
  - Recirculation evident
- SOLUTION
  - Smooth flow

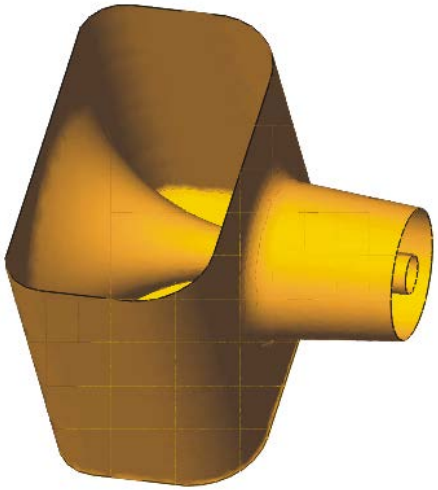


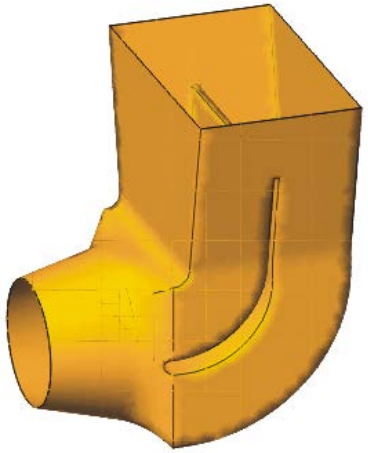



# Flow Control



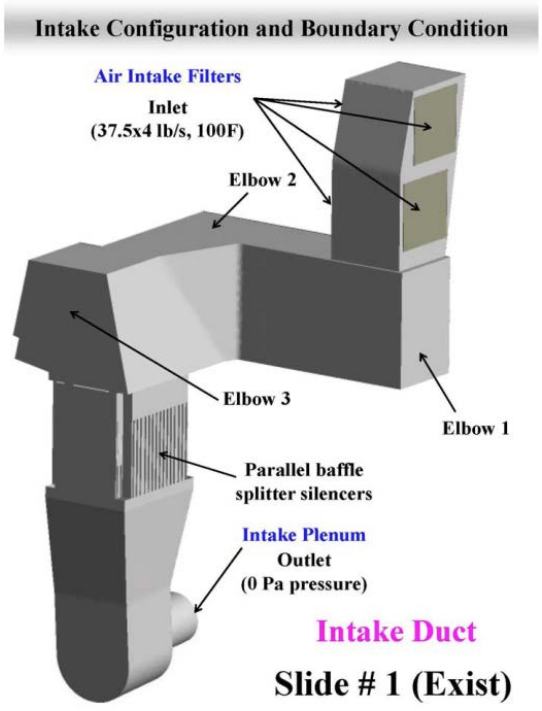


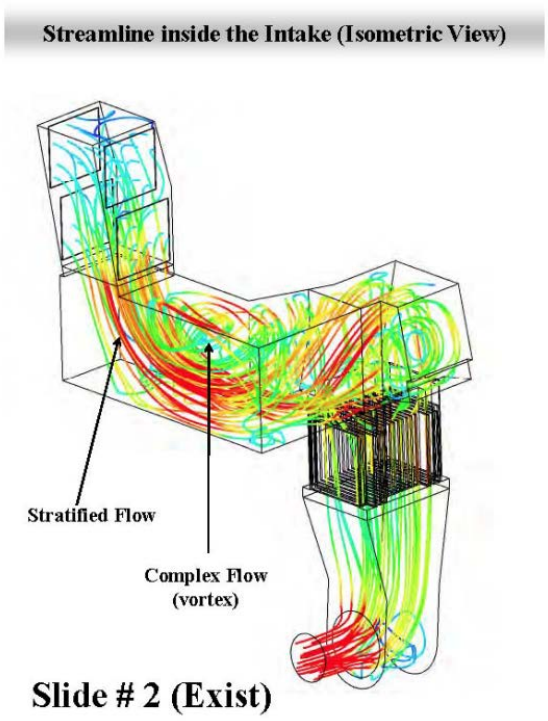


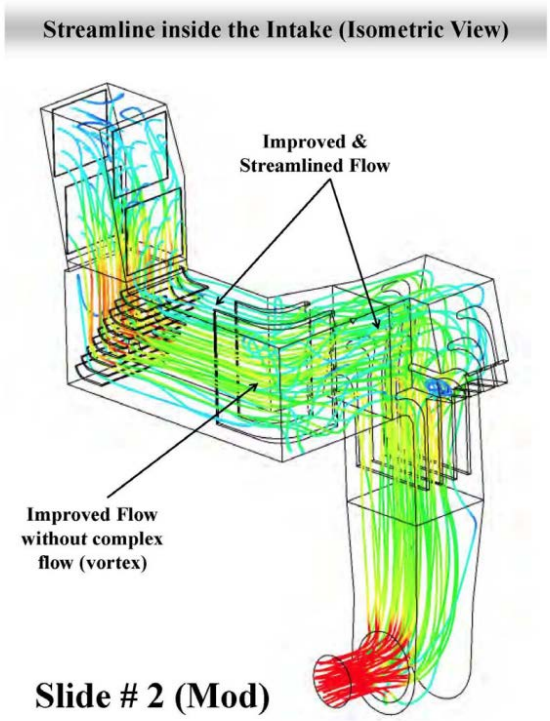


# GT Intake and Exhaust

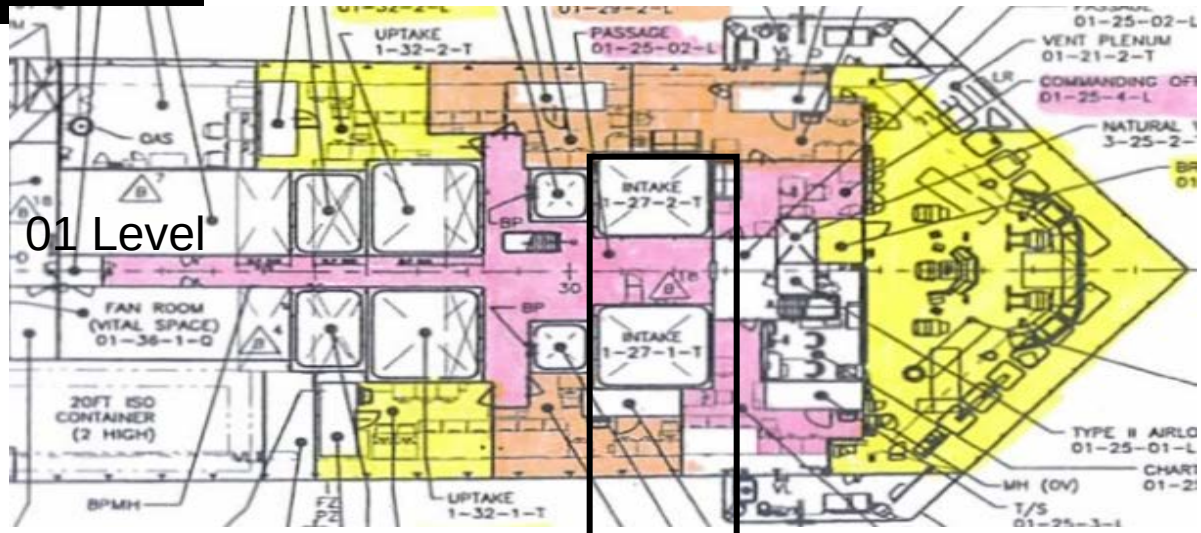
- Problem:
  - Inefficient design with much turbulent flow
- Solution
  - Use CFD to design smooth flow

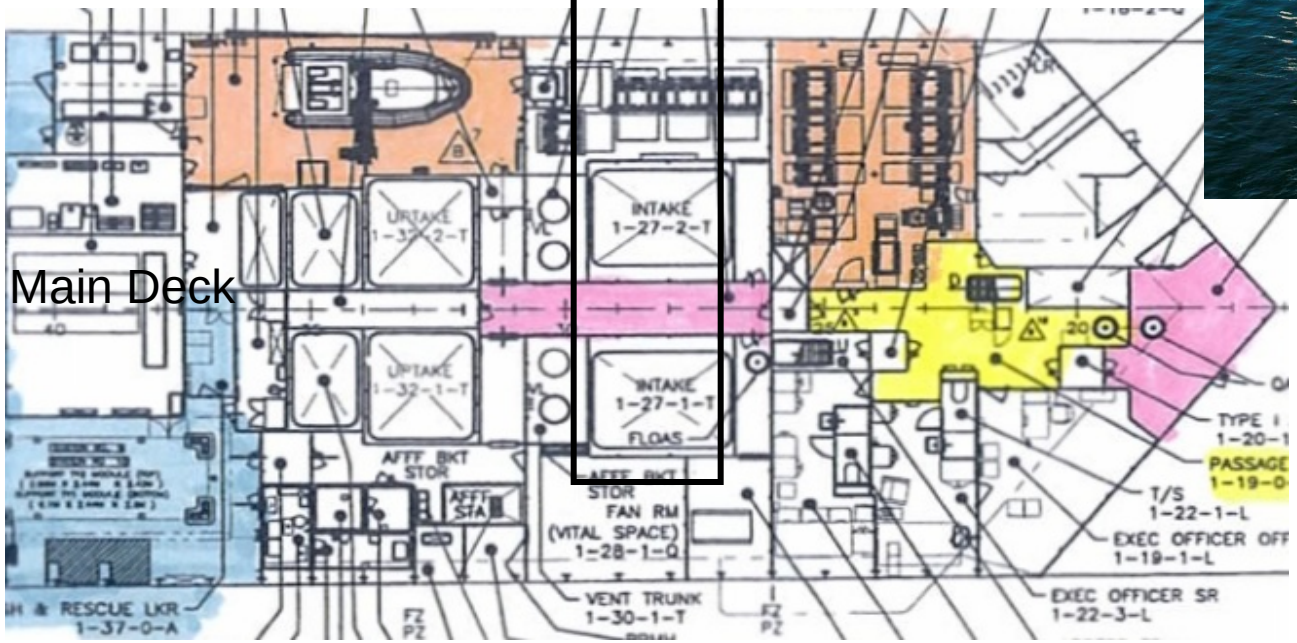


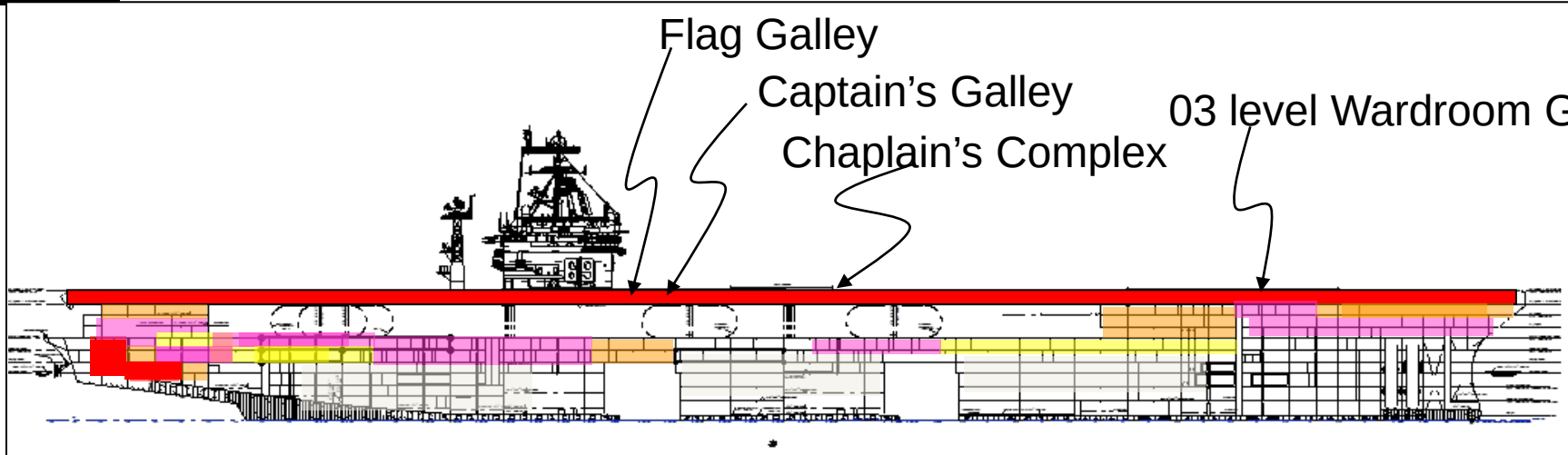



# LCS 1 Noise Overages



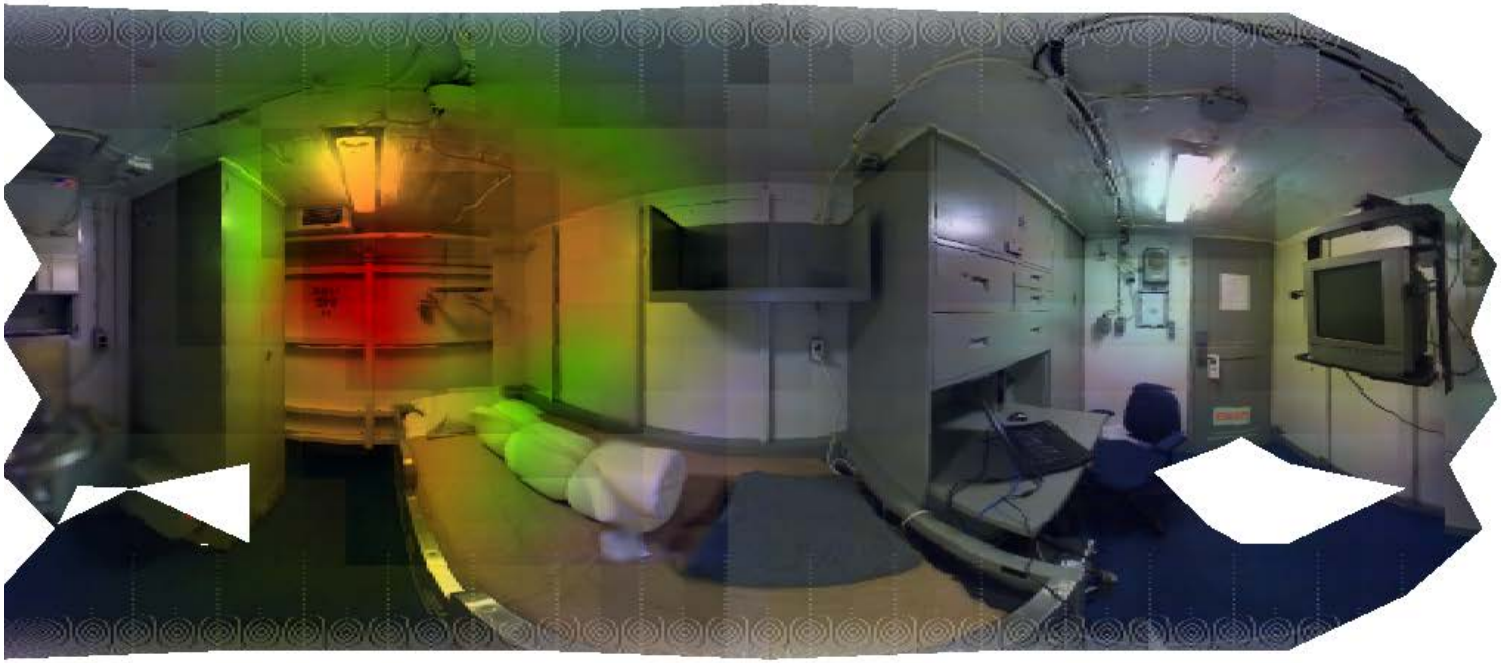
# Location Risk: Airborne Noise Levels



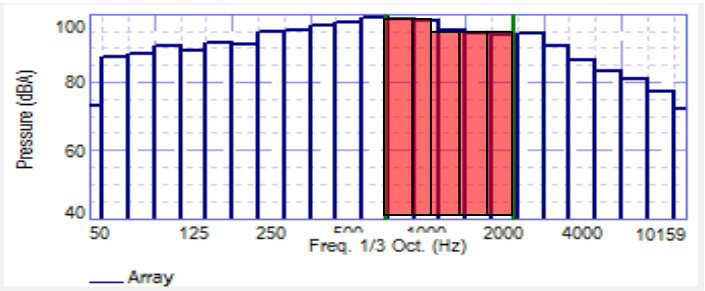

| | |
|---|---|
| Sound levels | > 84 dB |
| Sound levels | 80 ≤ 84 dB |
| Sound levels | 70 ≤ 80 dB |
| Sound levels | 65 ≤ 70 dB |
| Sound levels | ≤ 65 dB |
| Sound levels not estimated | |

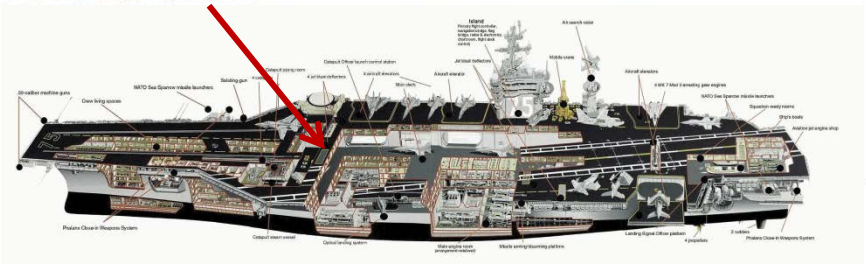
# Acoustic Holography

**SR-03-96-0-L**
**Run5 – Cat 2 Launch – Hornet (F-18C)**
**800-2500 Octave Band**



dBA (Pa)
100.
99.4
98.8
98.2
97.6
97.
96.4
95.8
95.2
94.6
94.



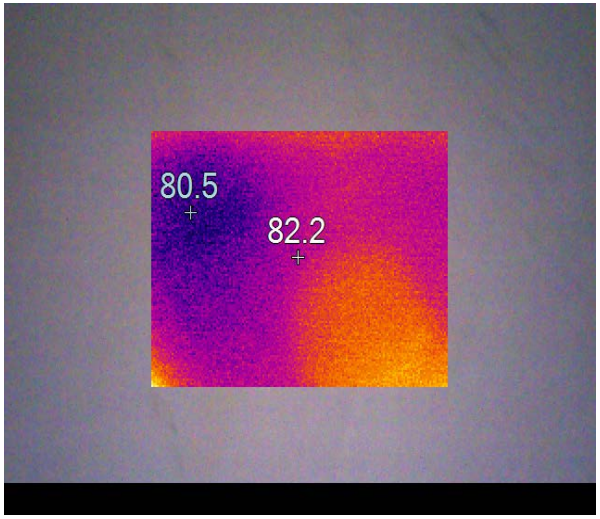



# Innovative Treatments: Tech21 Temp-Coat

## Thermal Advantages of the TEMP-COAT System


### Un-coated section of the steam catapult trough

- Temperature of steel plate is 109°F
- Thermal Transfer entering ship envelope can escape into interior of vessel at damages area of lagging
- Allows potential for condensation to develop
- Personnel discomfort due to high heat buildup in rooms in which catapult passes

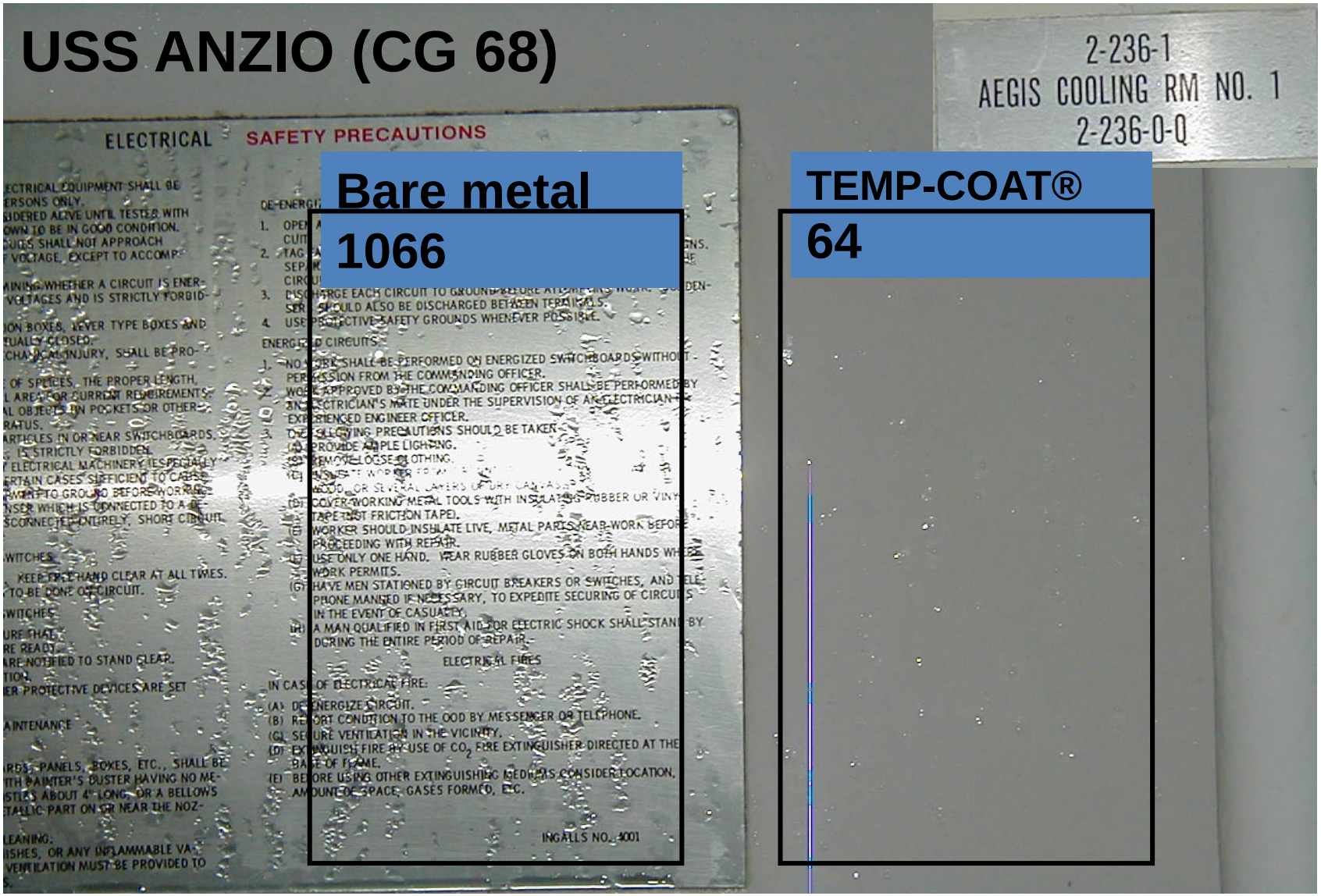



### Coated section of the steam catapult trough

- Temperature of steel plate is 82.2°F
- Adheres directly to substrate blocking thermal transfer from entering the ship envelope
- Allows the ability to significantly curb or stop condensation aiding the fight against Corrosion Under Insulation
- Reduces temperatures in spaces

# Condensation Mitigation

## USS ANZIO (CG 68)

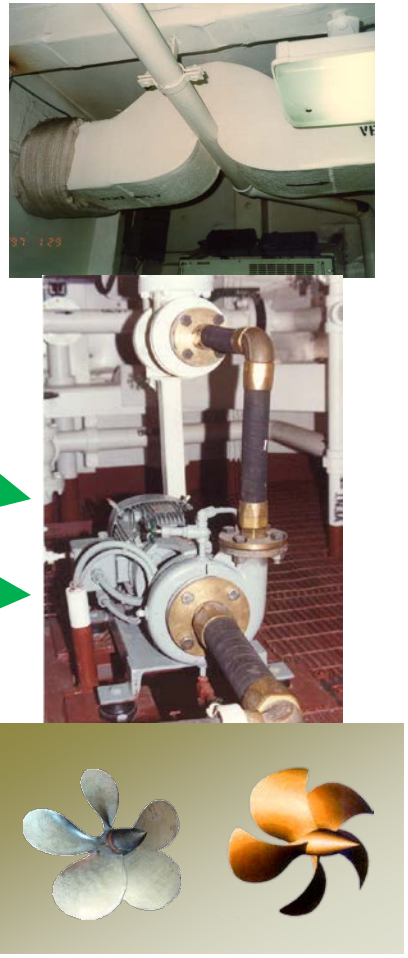


# Shipboard Noise Control

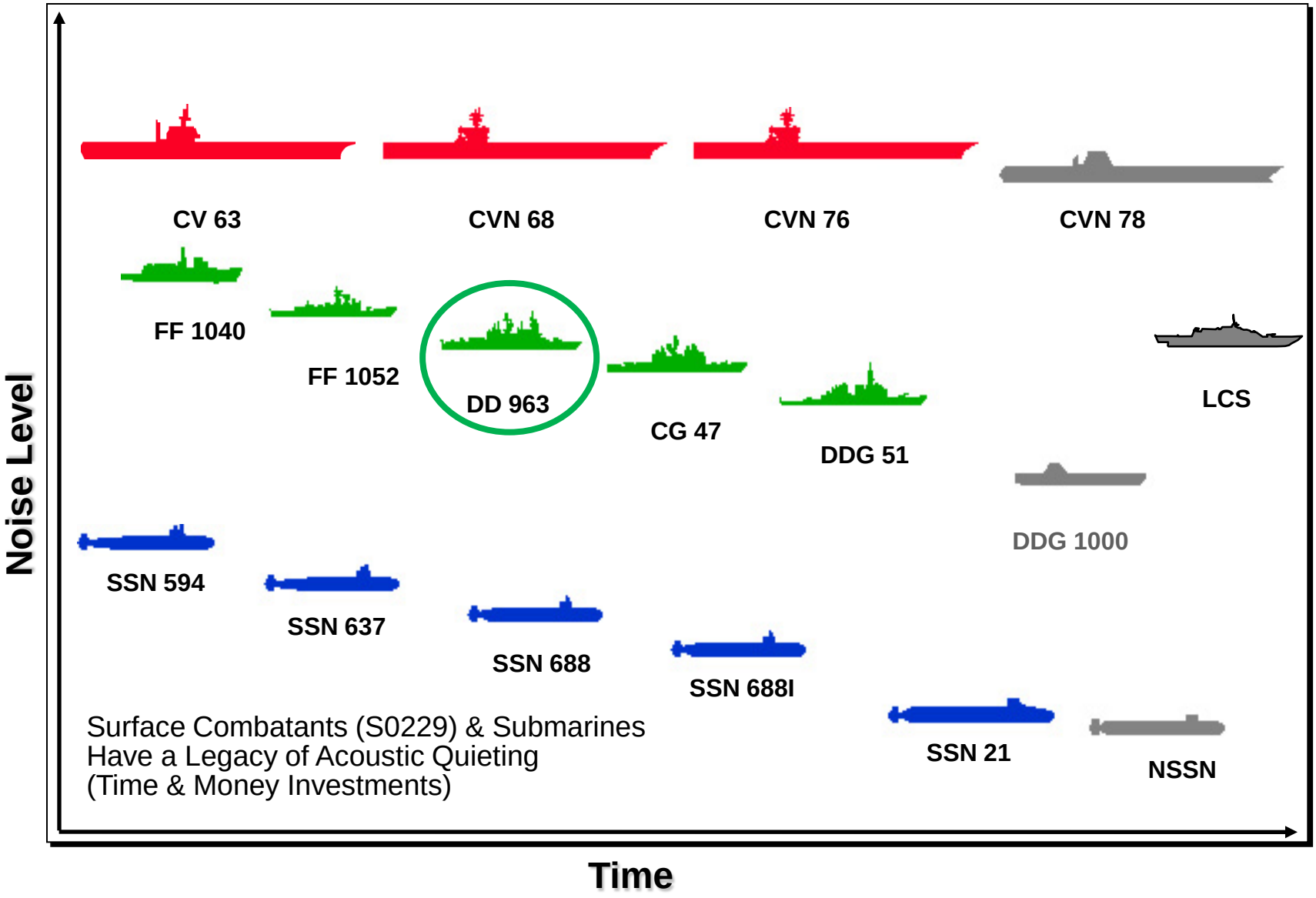
Sources of Noise are well known !

The usual acoustic culprits:

- Fans
- Ventilation
- Motors
- Pumps
- Propellers



# Hazardous Noise Control



# Engagement Required

- Advocacy for noise control
- Noise Control is Systems Engineering
  - Requires less acoustic treatment (i.e. weight)
  - Less maintenance (DD 963)
  - Fuel savings
  - Readily accomplished in design
- Vigilance on instruction revisions
- Hearing preservation vice hearing conservation

# Questions ?