NSF Acoustics Brief

08 March 2011

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Sonar Requirements

- Three main issues are required for optimum sonar performance
  - Installation orientation
  - Background ship noise
  - Bubble free environment

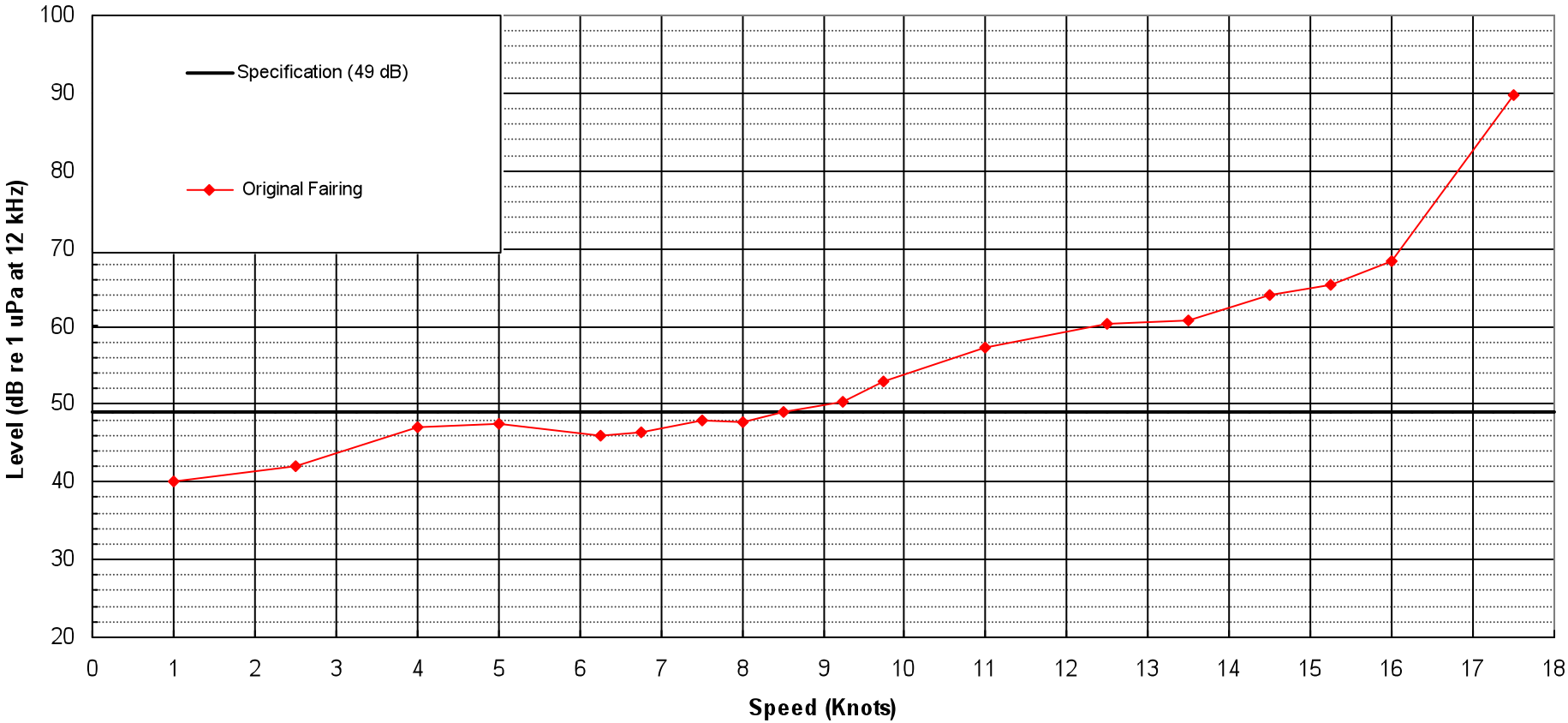
Typical Problems that can impact sonar performance

- Machinery Noise
- Hydrodynamic Flow Noise
- Propeller Cavitation
- Appendage Cavitation
- Sonar Interference
- Bubble Sweepdown

TAGS 60 Class Pre-Gondola

- Hydrodynamic Flow Noise
  - Fairing shape
  - Acoustic window roughness
- Appendage Cavitation
  - “Football” transducer fairing
  - Bilge keels
- Bubble Sweepdown

Original PATHFINDER Levels

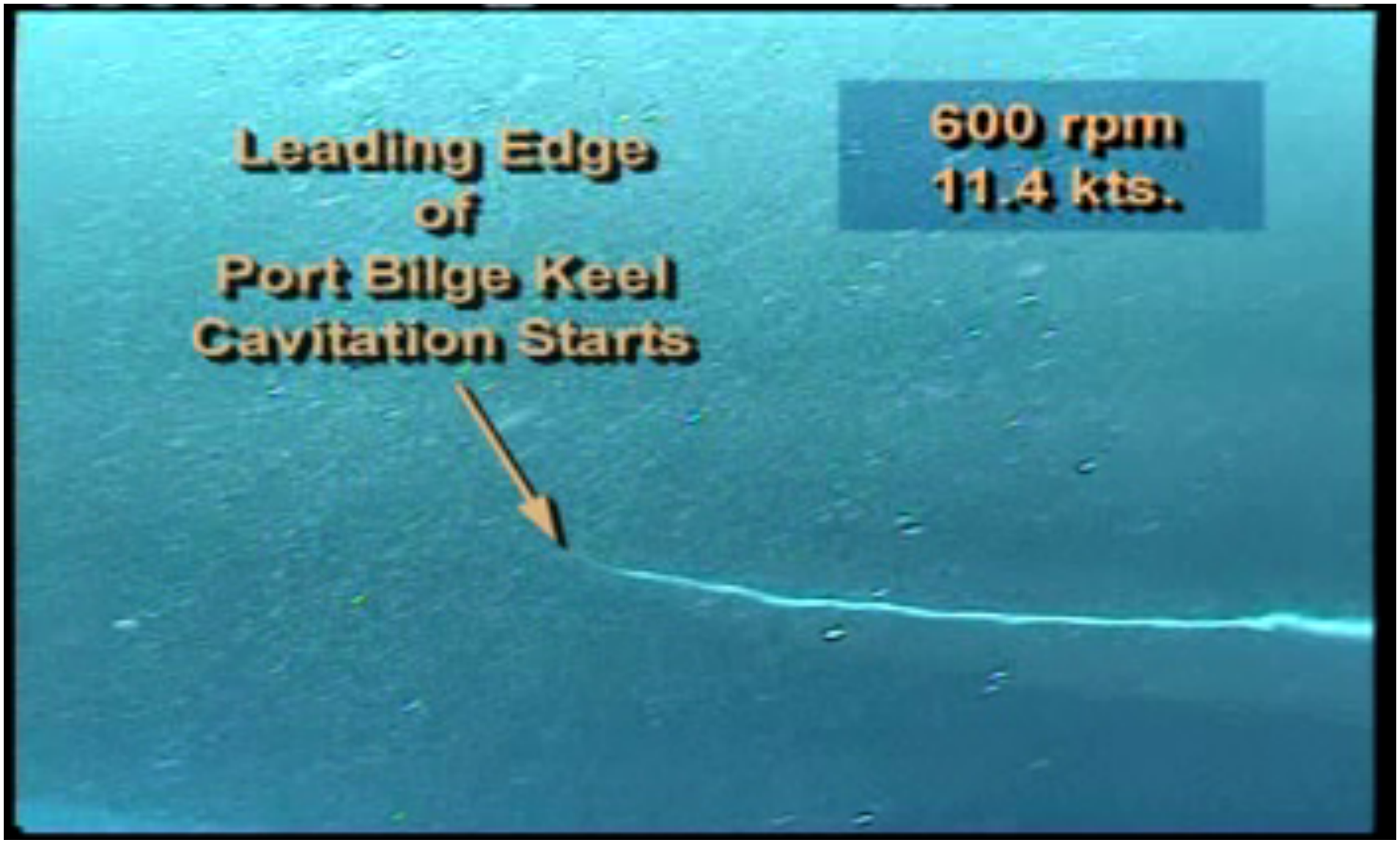


New Sonar Fairing

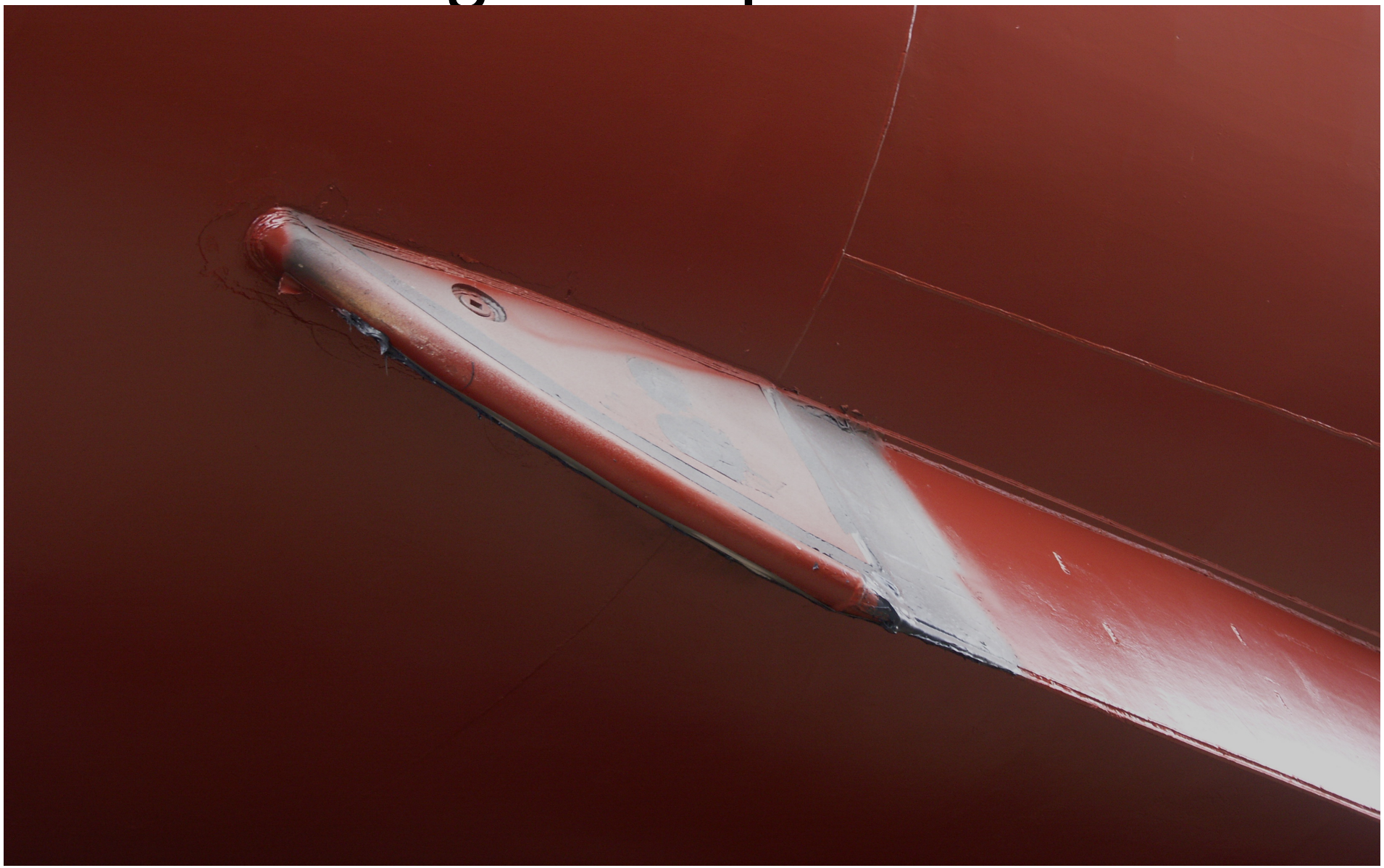
Original Transducer Pod

Re-designed Transducer Pod

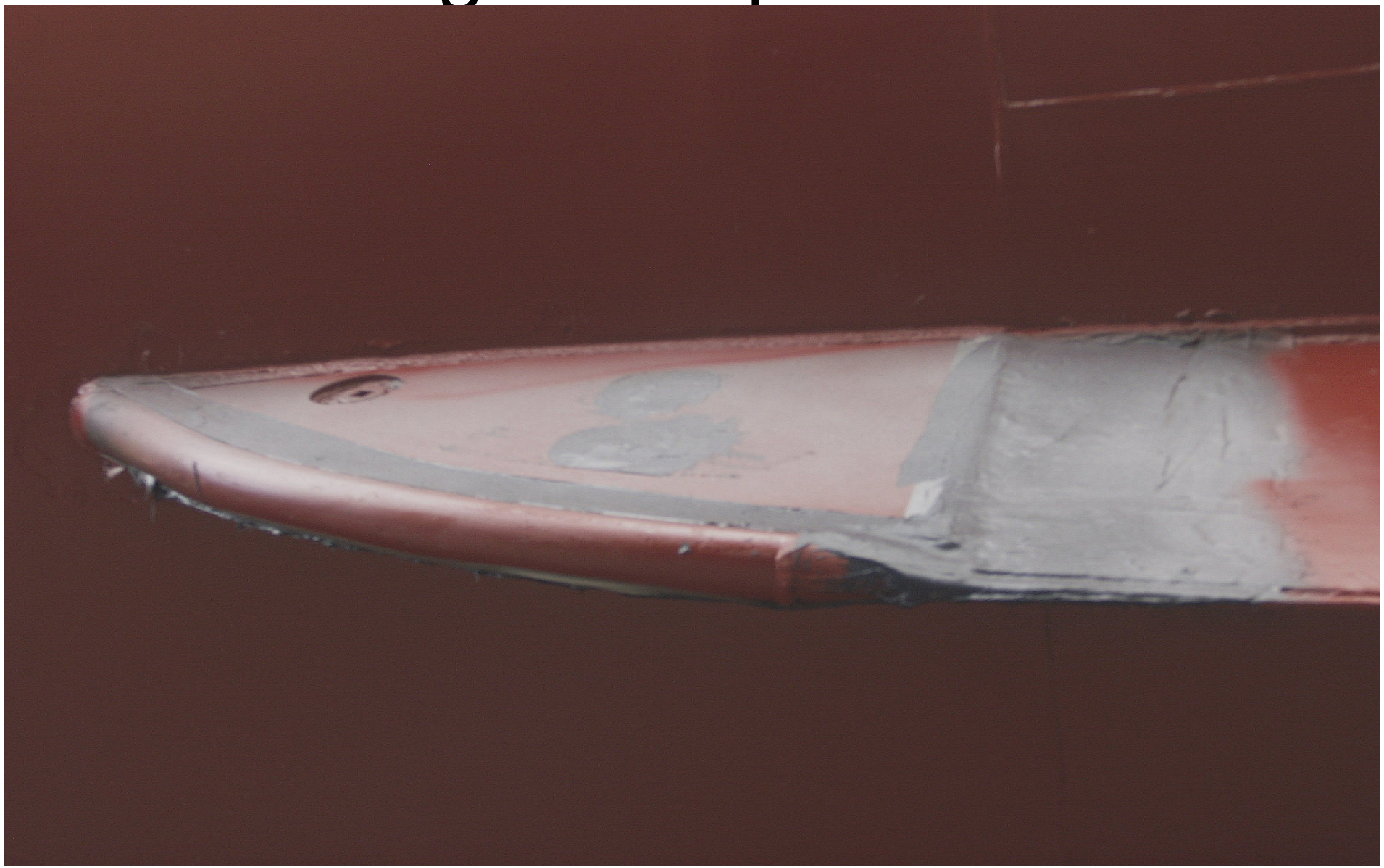
Bilge Keel transient



Bilge keel pictures

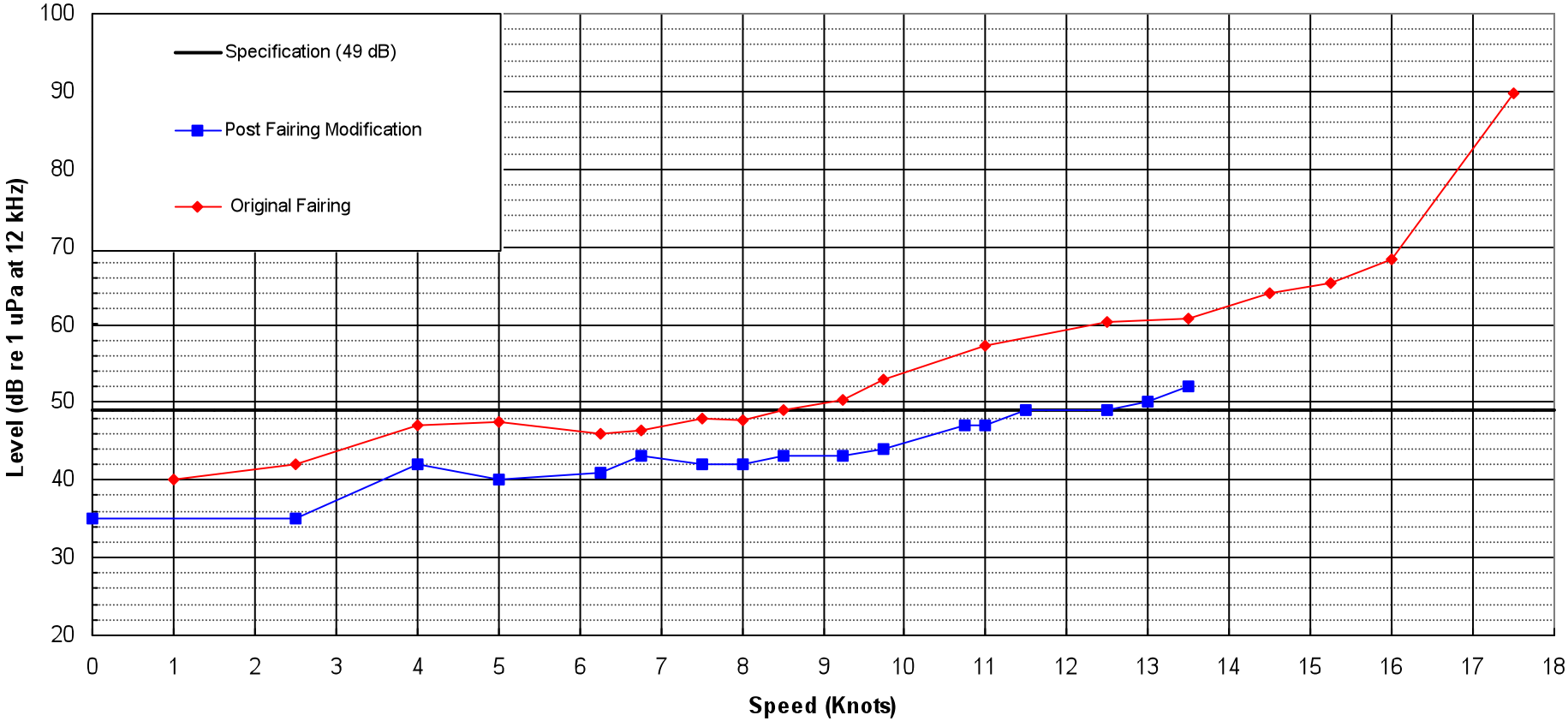


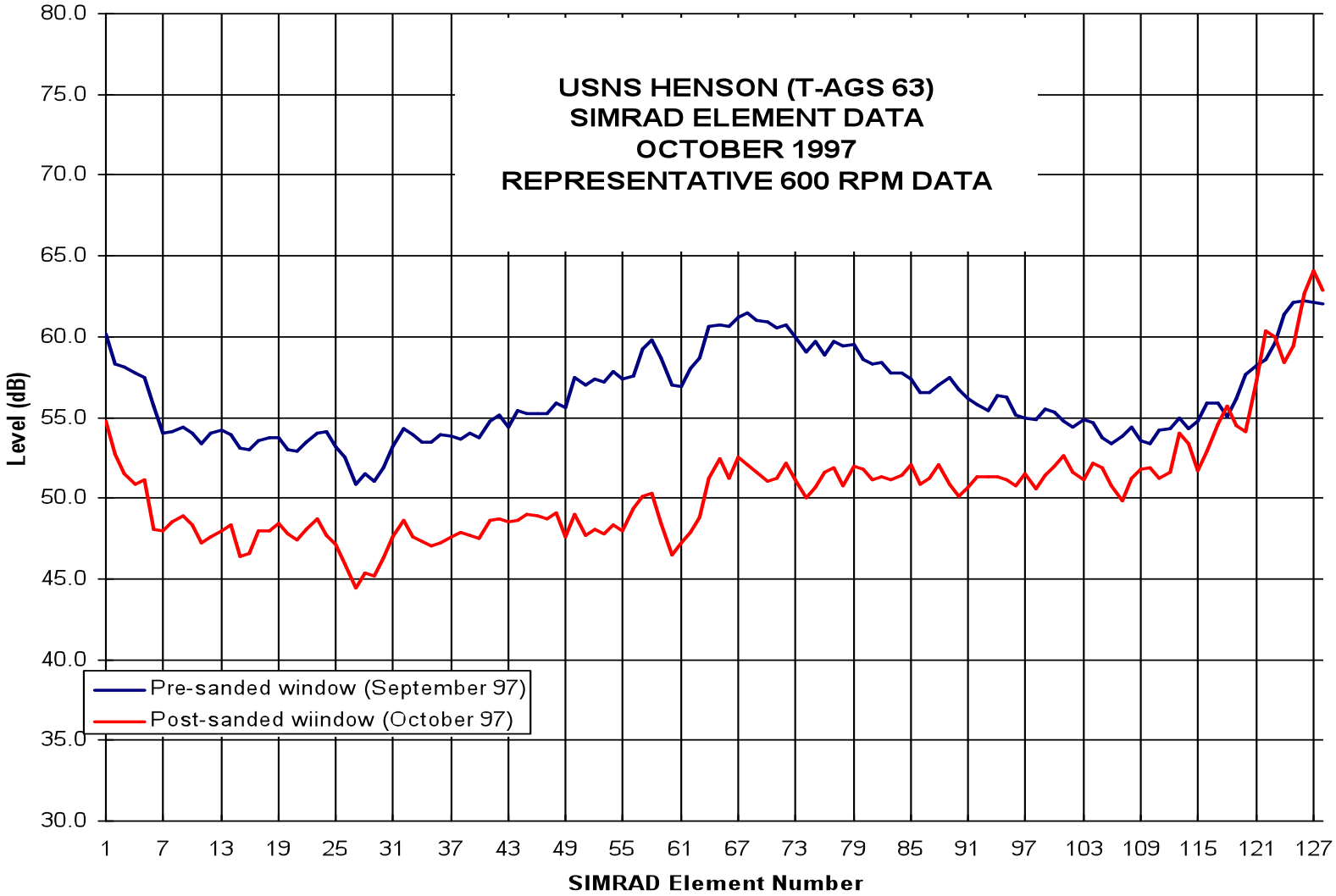
Bilge Keel pictures

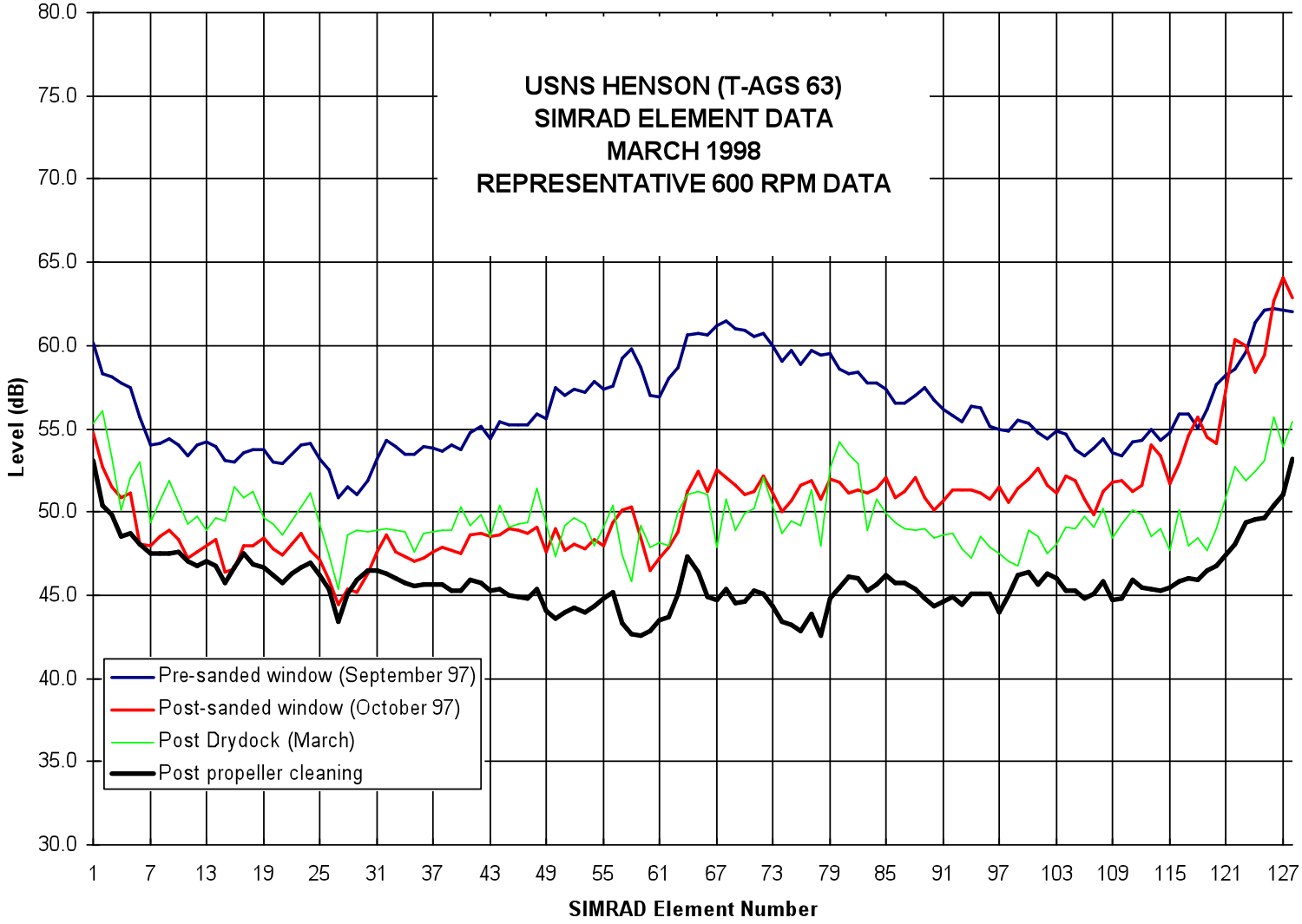


T-AGS 60 Class Current Configuration
Bubble Diverter

Photo courtesy of Mike Carver NAVO

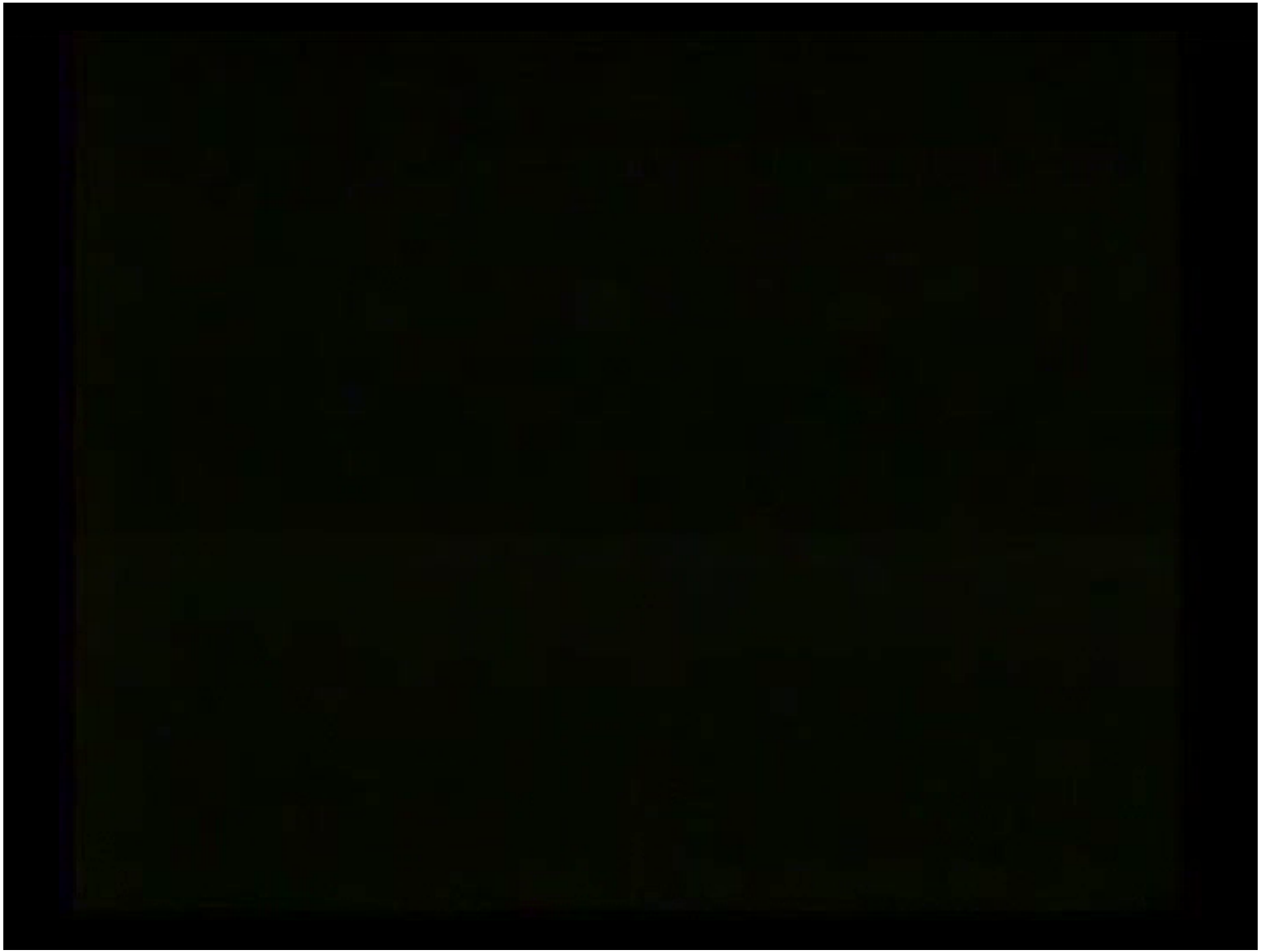

Specification (49 dB)
Post Fairing Modification
Original Fairing
Level (dB re 1 uPa at 12 kHz)
100
90
80
70
60
50
40
30
20
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
Speed (Knots)


USNS HENSON (T-AGS 63)
SIMRAD ELEMENT DATA
OCTOBER 1997
REPRESENTATIVE 600 RPM DATA
Level (dB)
80.0
75.0
70.0
65.0
60.0
55.0
50.0
45.0
40.0
35.0
30.0
1
7
13
19
25
31
37
43
49
55
61
67
73
79
85
91
97
103
109
115
121
127
SIMRAD Element Number
Pre-sanded window (September 97)
Post-sanded wiindow (October 97)


USNS HENSON (T-AGS 63)
SIMRAD ELEMENT DATA
MARCH 1998
REPRESENTATIVE 600 RPM DATA
Level (dB)
80.0
75.0
70.0
65.0
60.0
55.0
50.0
45.0
40.0
35.0
30.0
1
7
13
19
25
31
37
43
49
55
61
67
73
79
85
91
97
103
109
115
121
127
SIMRAD Element Number
Pre-sanded window (September 97)
Post-sanded window (October 97)
Post Drydock (March)
Post propeller cleaning

AGOR 23 Class

- Sewage Pump
- Propeller hub vortex cavitation
- Bubble Sweepdown (REVELLE only)

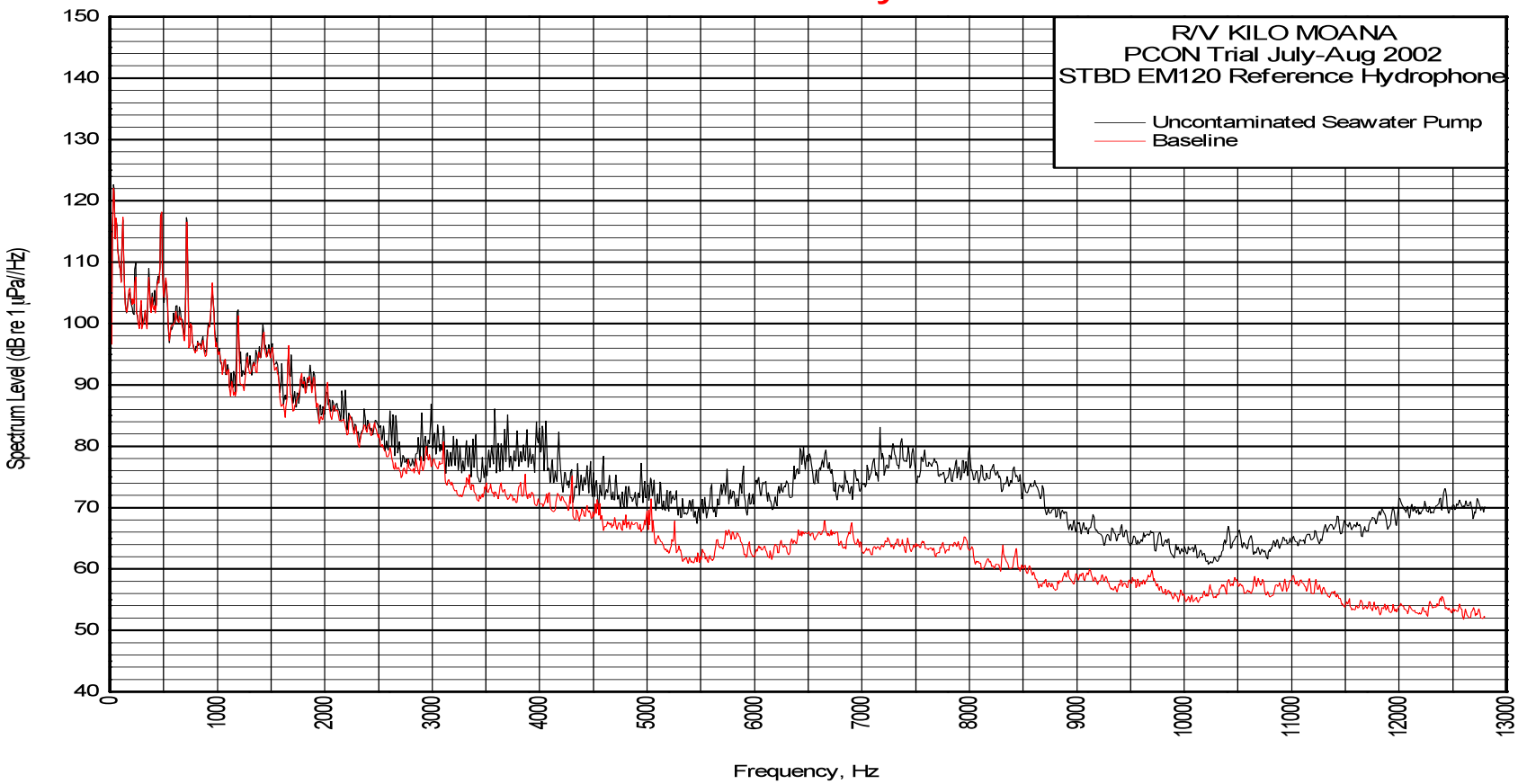


KILO MOANA (AGOR 26)

- Propeller Cavitation
- Scientific Seawater pump
- Main Diesel Noise

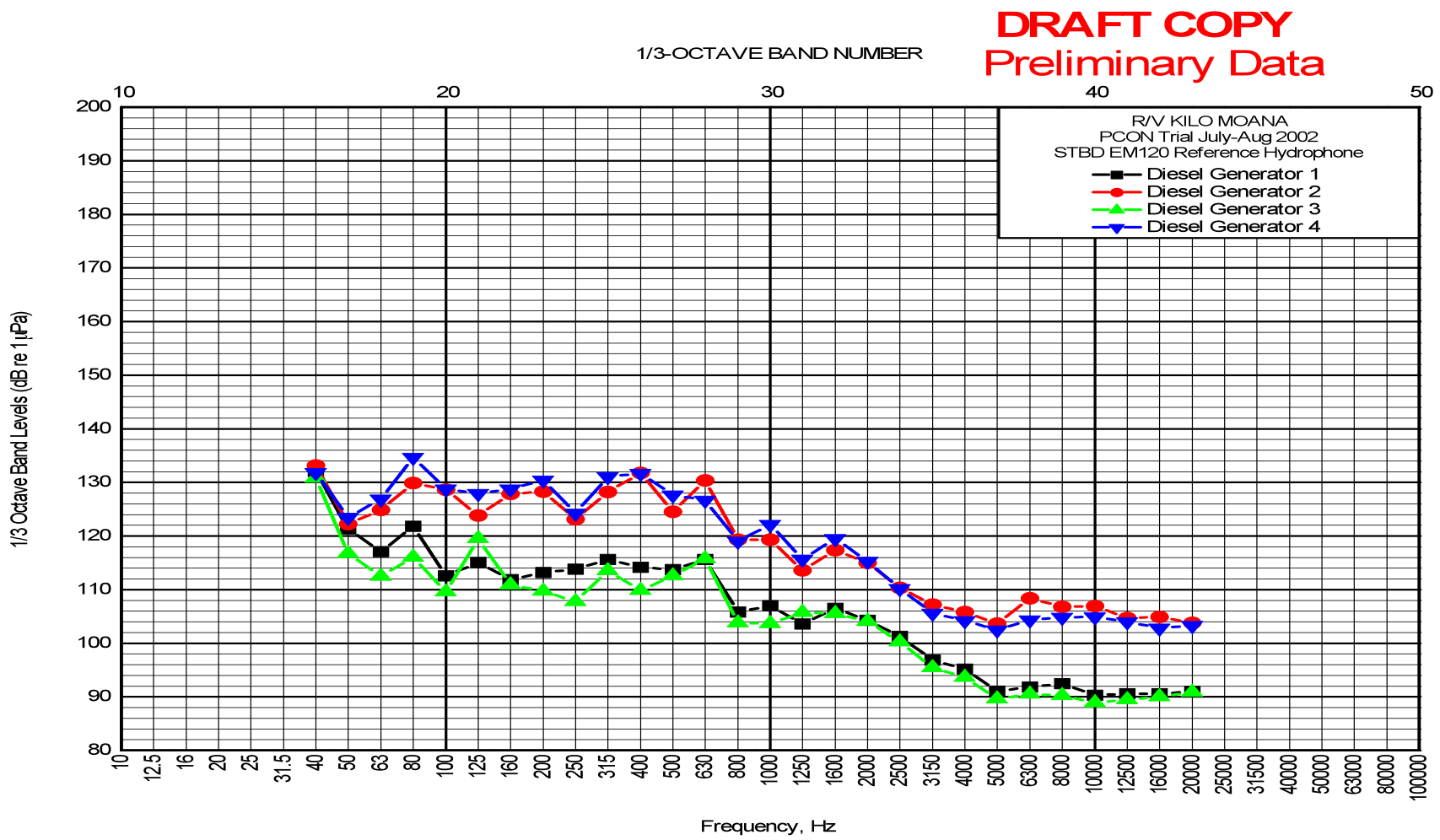
Kilo Moana
Scientific Seawater Pump

DRAFT COPY
Preliminary Data



Note: Data converted to Spectrum Level (1 Hz resolution) from 8 Hz resolution data.

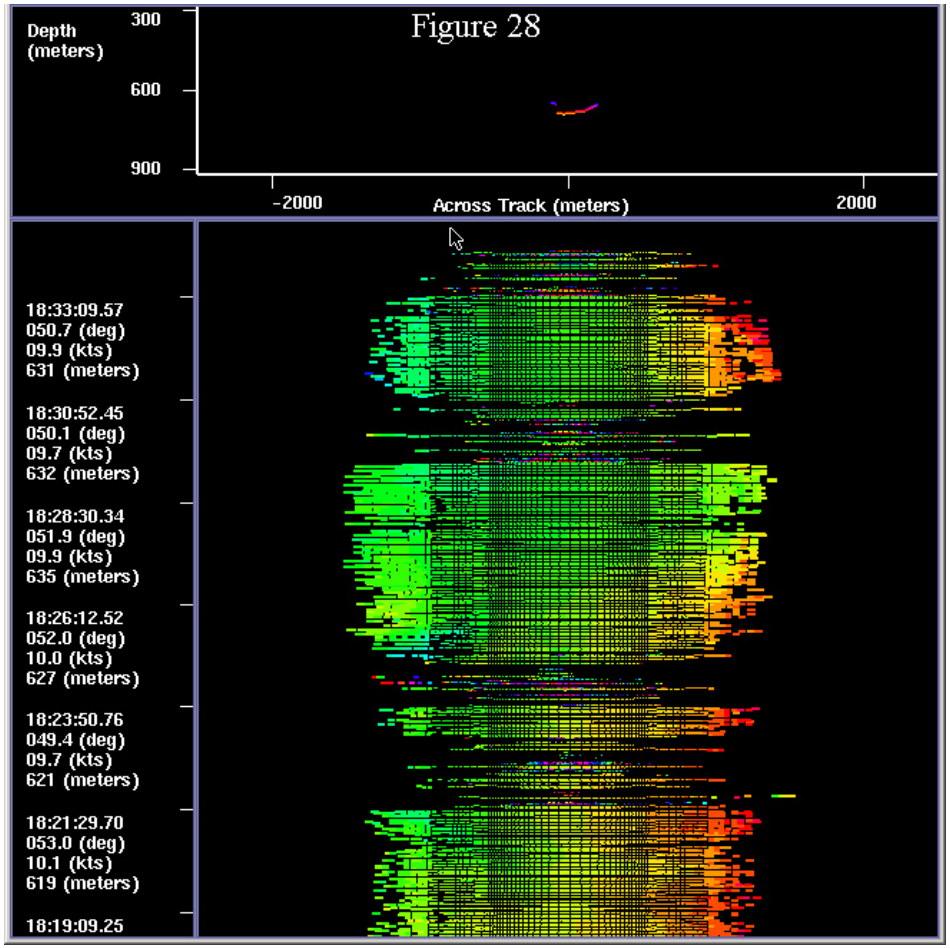
Kilo Moana
Diesel Noise



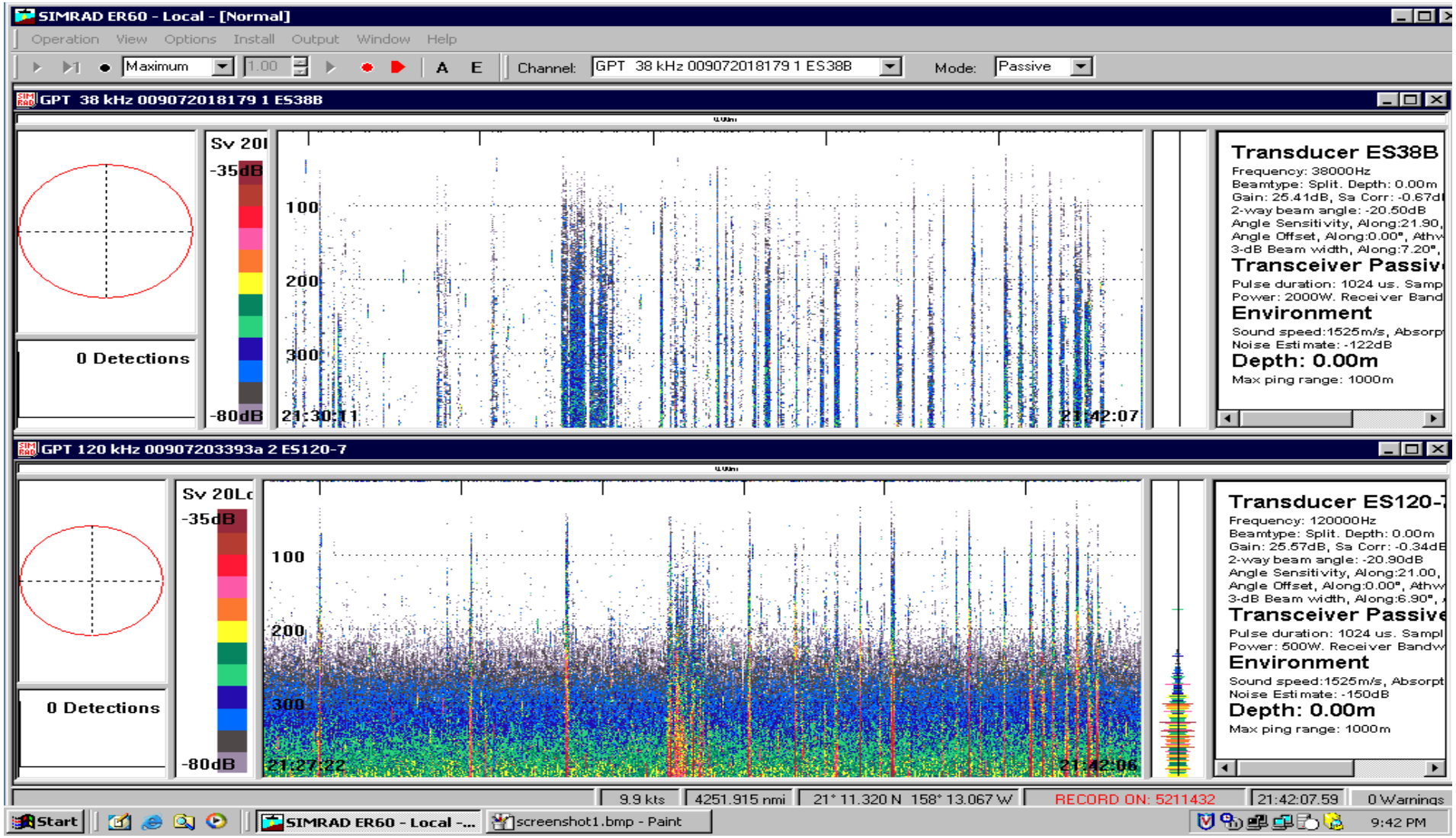
NOAA T-AGOS Conversions

- Hi'Alakai
  - Bubble Sweepdown
  - Machinery
- Oscar Elton Sette
  - Bubble Sweepdown
  - Machinery

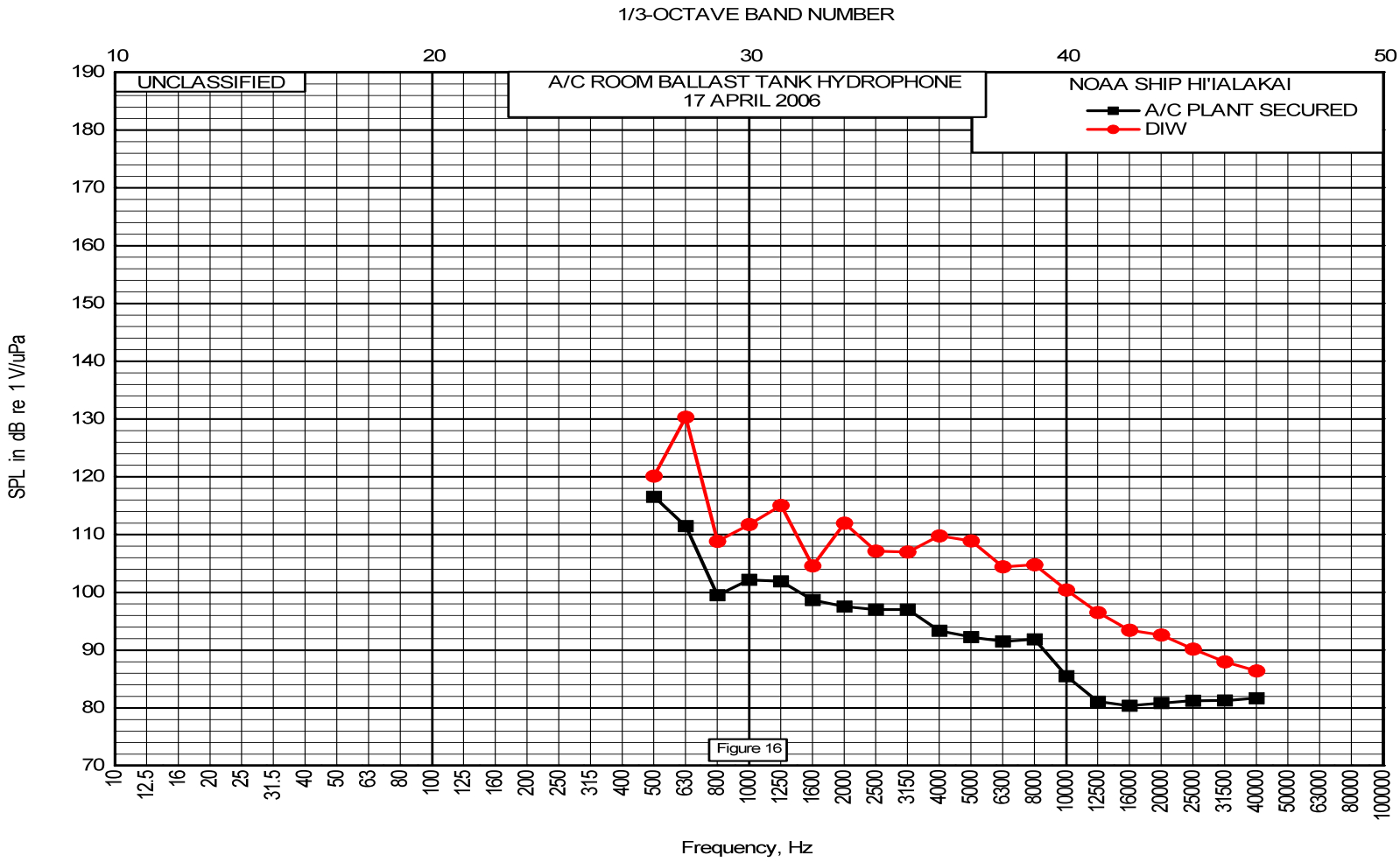
EM 300 Sonar Display on HI'IALAKAI



EK 60 Sonar Display on OSCAR ELTON SETTE



HI'IALAKAI
air conditioning problem



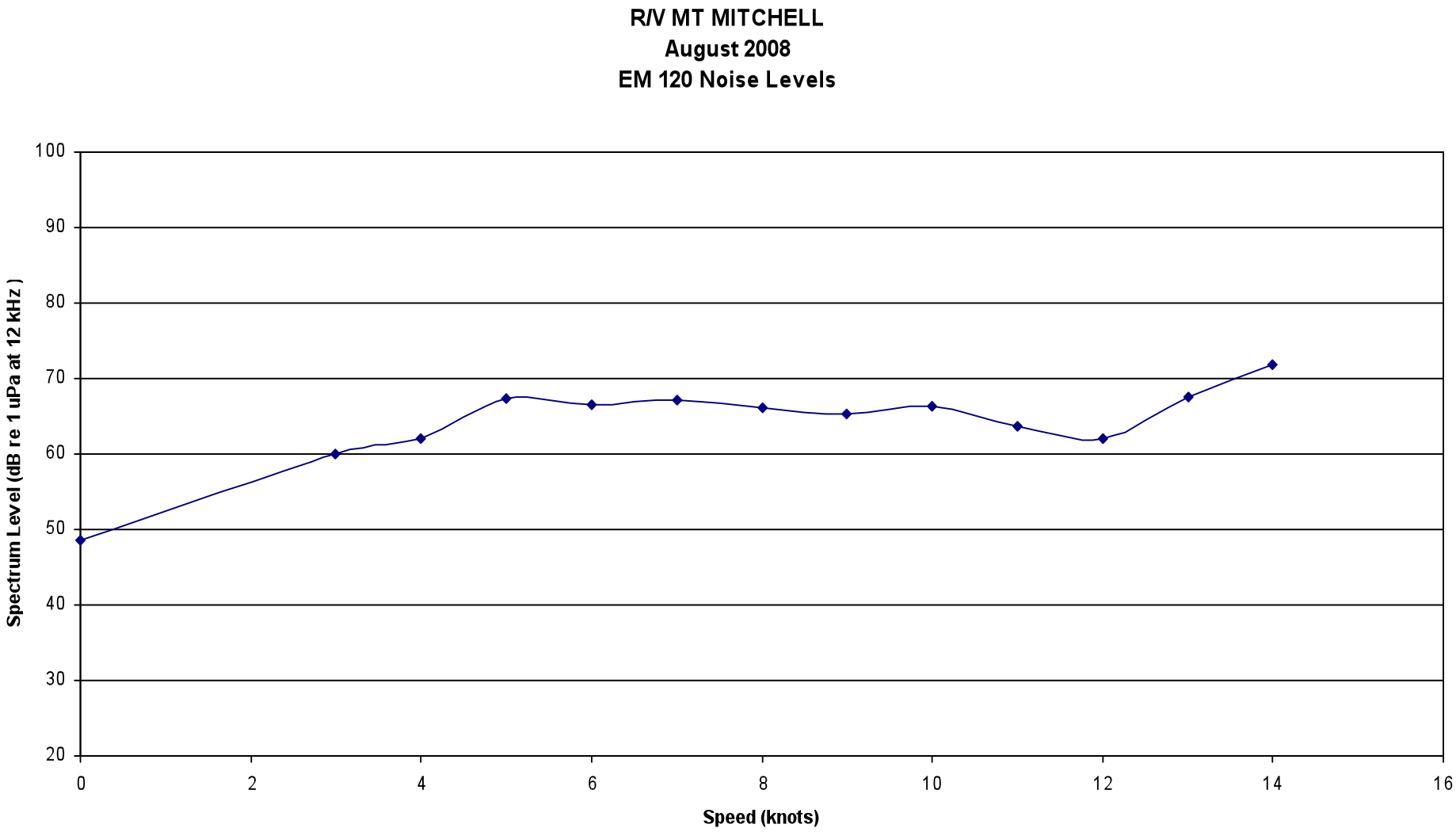
UNCLASSIFIED

UNCLASSIFIED

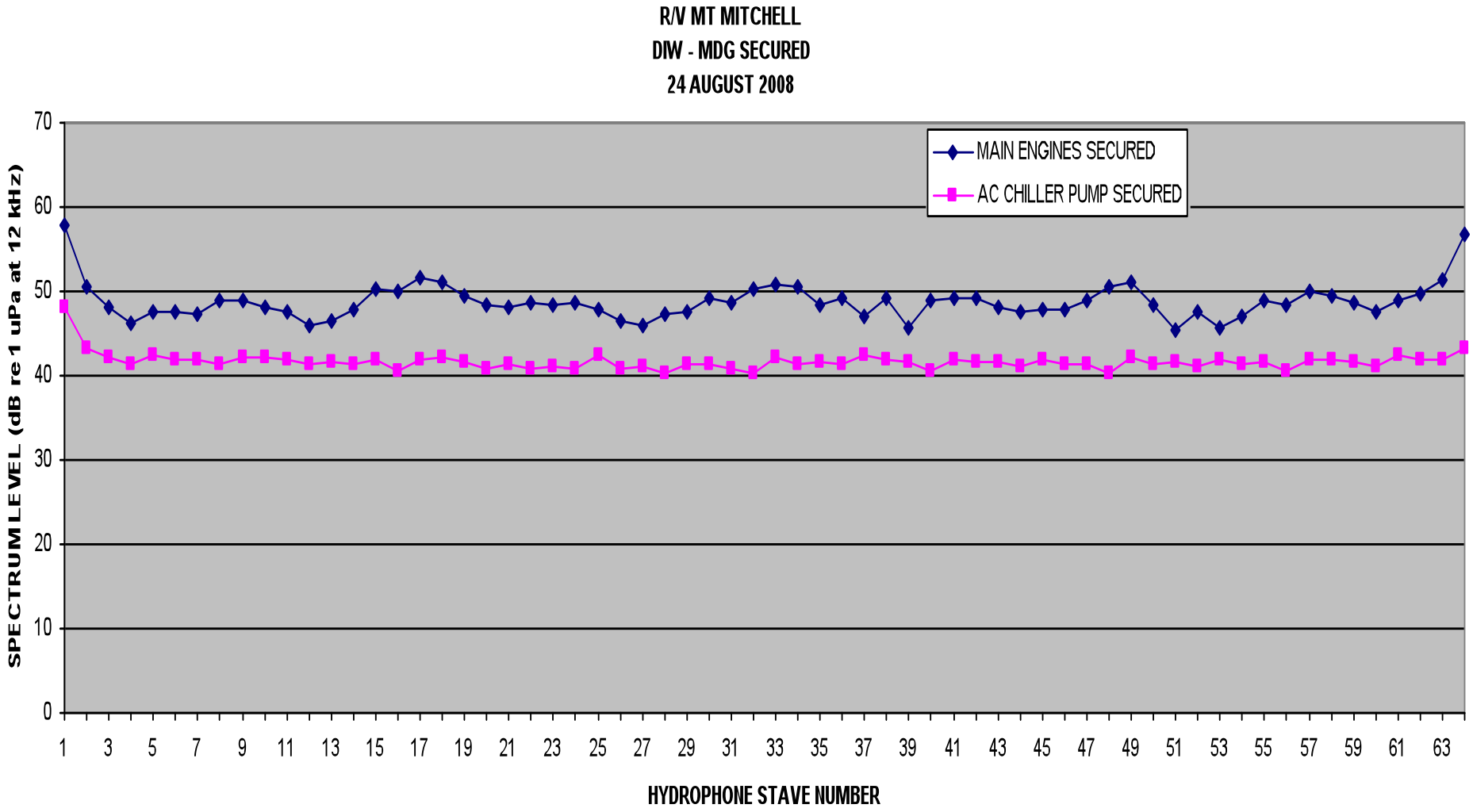
R/V MITCHELL

- Propeller Cavitation (CPP prop)
- Machinery Chill Water Pump

EM120 RX Noise Levels

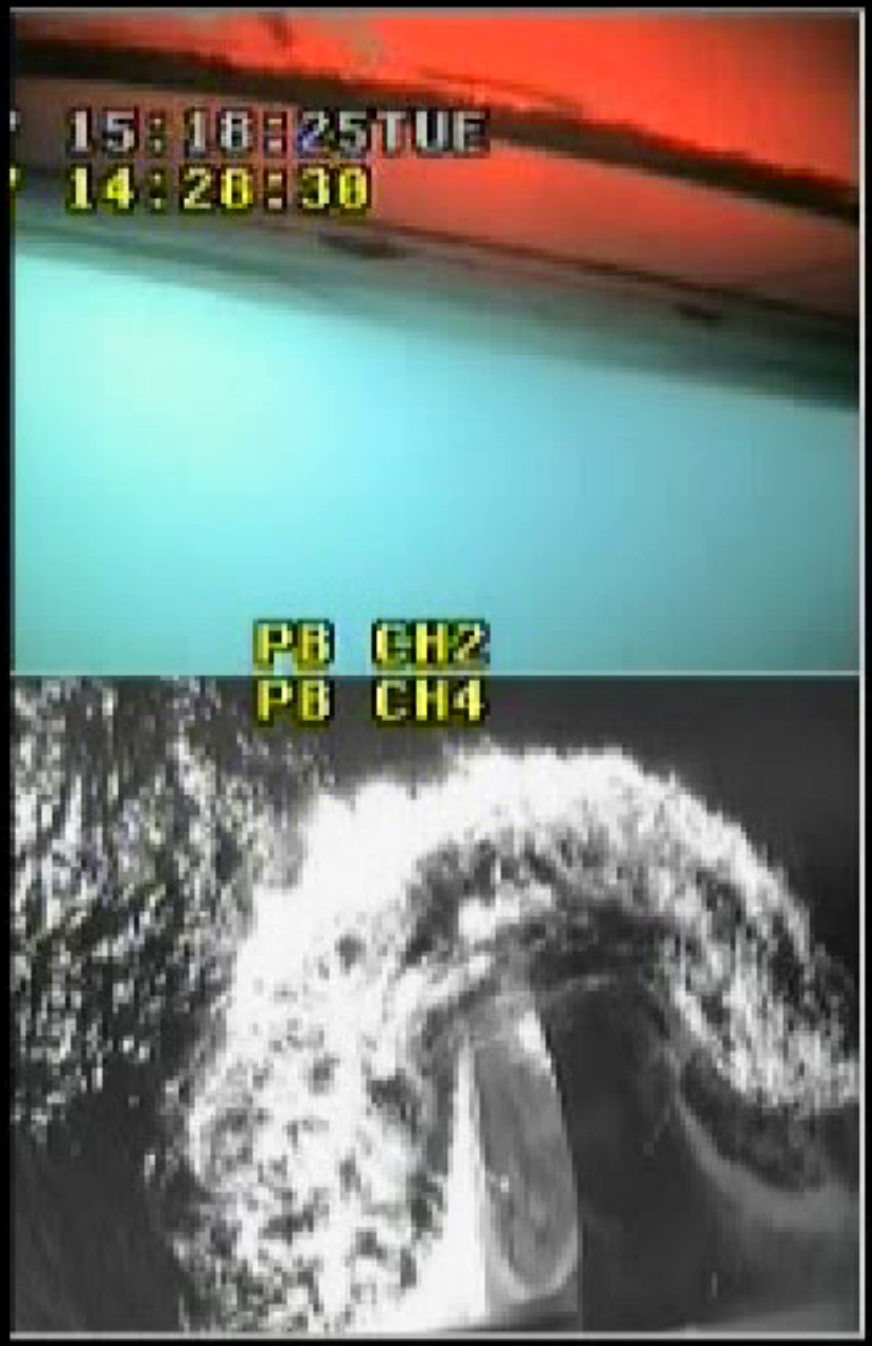


AC Chiller Pump Secured



COOK

- Bubble Sweepdown problem significant limits sonar performance
- Bulbous bow is cause of bubble ingestation


15:16:25TUE
14:20:30
PB CH2
PB CH4

ACOUSTIC MONITORING

ACOUSTIC MONITORING SYSTEM

Sonar Performance Requirements

- High performing (expensive) sonars require a quiet background noise to ensure optimal operation
- Quiet ships don’t stay quiet
- If acoustic housekeeping isn’t conducted, a research vessel’s overall noise level will degrade over time

Potential Acoustic Degradations that can occur over time

- Machinery Noise
  - Failed vibration isolation mounts
  - Clogged/restricted piping
  - Pump/machinery mechanical failure
- Propeller Cavitation degradation
- Fairing damage
- Hull Fouling

Acoustic Monitoring

- Monitoring the overall vessel acoustic signature can predict and determine degraded sonar performance
- An acoustic baseline can be used to compare current acoustic levels to assess current sonar performance
- While this is a simple procedure, the current trend has been to ignore the acoustic signature of a research vessel and just “take what you get”

The NSF Initiative

- NSF has recognized the value and importance of maintaining research vessel acoustics
- Based on recent sonar upgrades in the UNOL fleet that have had poor sonar performance, all UNOL/NSF funded sonar upgrades will attempt to understand and control acoustic signatures of research vessels

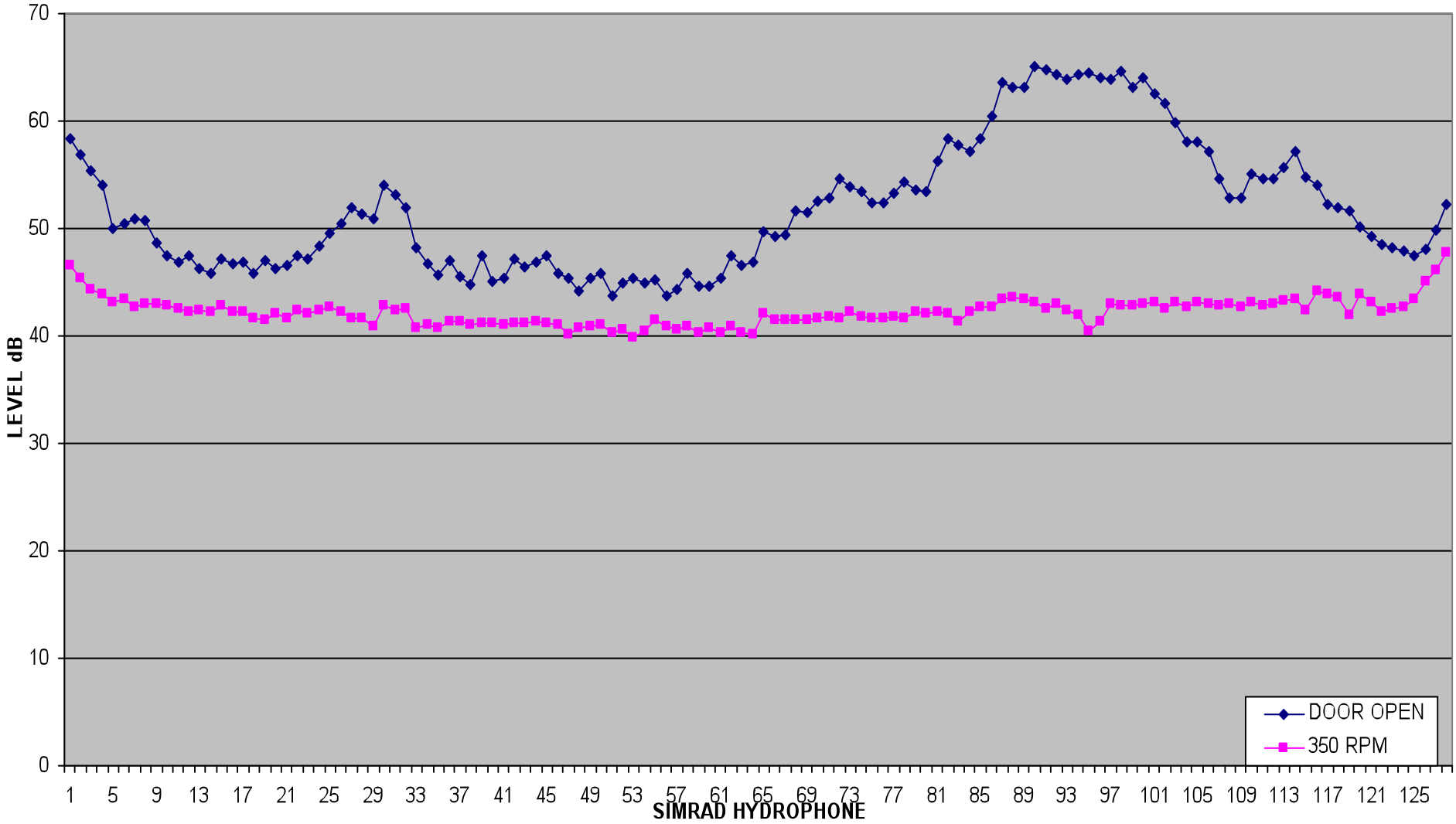
ACOUSTIC MONITORING SYSTEM

- During most first acoustic evaluation with new system onboard background noise levels were significantly higher than expected
- Acoustic monitoring system was utilized to identify high level squealing transients present in data
- Transients were isolated to unsecured squeaking door

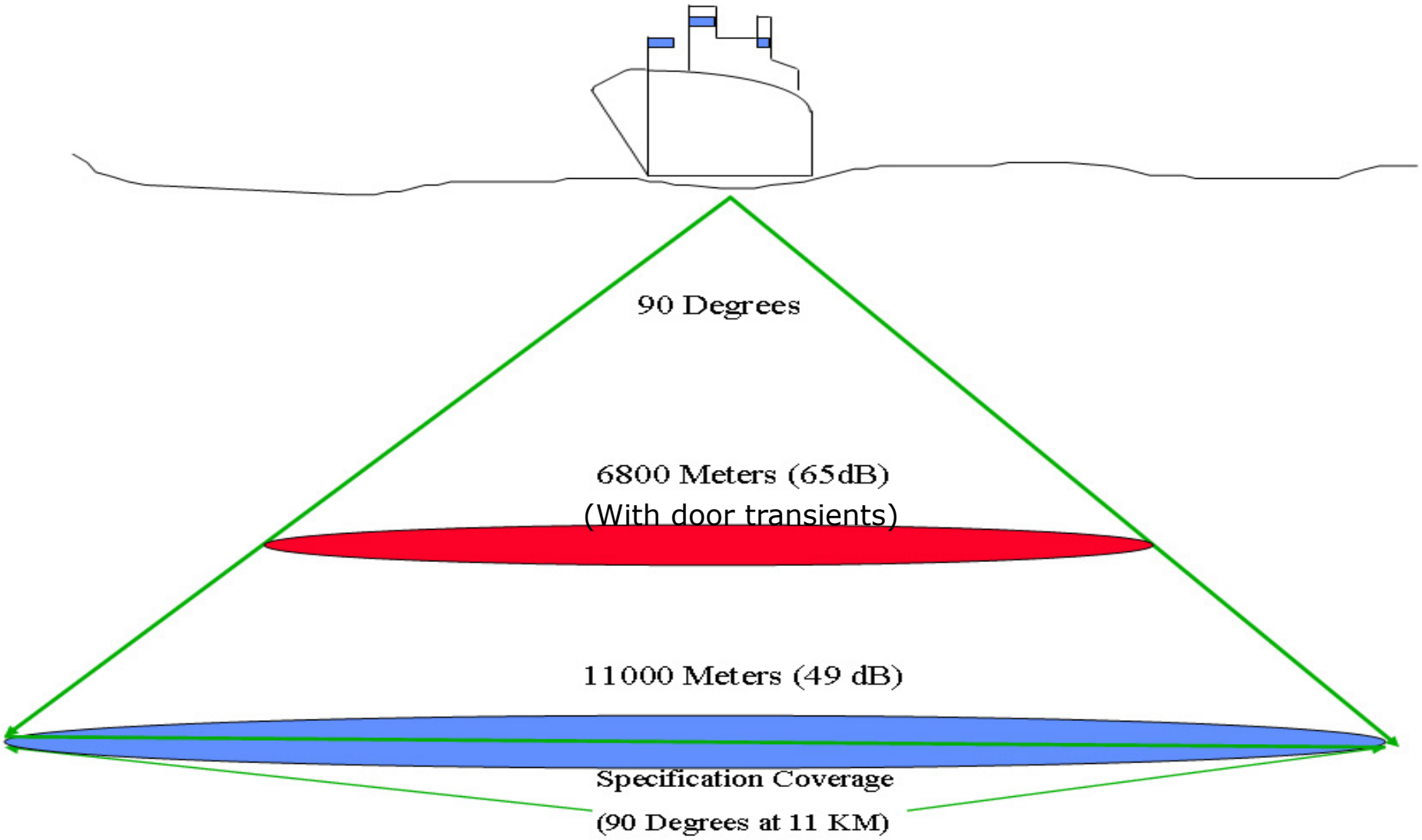
USNS MARY SEARS (T-AGS 65)

10 APRIL

350 VS UNSECURED DOOR



Bottom Swath at Noise Goal



Fairing damage

Bio-fouling

Conclusions

- Every vessel has a different noise source/ problem that could limit sonar performance
- Acoustic preparation for high performing sonars must be considered
- Acoustic levels should be monitored over the life of a research vessel to ensure optimal performance for EVERY mission