NOISE PROPAGATION IN SERIES OF AHTS SHIPS - CRITICAL STATISTICAL ANALYSIS

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Noise propagation inside a relatively small vessels such as AHTS, PSV is a growing issue. On one hand there is a growth in power demand on vessel (towing and DP purposes) and on the other hand maintaining crew comfort according to more restrict Classification Societies rules and recommendations. Usually in contract one puts strict conditions for accepting noise levels onboard (mostly according to IMO or Classification Society rules). In this paper one can see that statistical approach could be adopted in contract in order to benefit both sides, shipyard and ship-owner.

INTRODUCTION

Anchor Handling Tug Supply (AHTS) vessels are mainly built to handle anchors for oil rigs, tow them to location, anchor them up and, in a few cases, serve as an Emergency Rescue and Recovery Vessel (ERRV). They are also used to transport supplies to and from offshore drilling rigs.[1]

Fig.1. AHTS Vessel [2].

In order to fulfill the requirements of the continues growth in power demands, high power engines are being installed on AHTS vessels and hence HVAC and auxiliary equipment as well. This activity affects overall noise levels onboard. In order to satisfy ship-owner requirements, noise analysis is performed. As an output of this analysis one gets estimated noise levels in a contractual spaces (cabins, engine room, etc). Those levels are estimated mostly based on a data given by main noise sources producers, a data which are often poor. Therefore entry data for analysis has to be defined and calculated by the analysis specialist. All those steps lead to a cumulative uncertainty in predicted noise data. On the other hand levels achieved in analysis are compared with measurement results obtain onboard. As one can see in following chapters there is a certain standard deviation in measured data on the series of identical ships build according to the same initial documentation which was a source for a noise analysis in first place [3].

1. NOISE TRANSFER PATH

On AHTS and PSV vessels practically all major noise sources are localized in close vicinity to each other and to crew compartments. One has to be aware of the radiated noise frequency range of those sources. On fig 2 one can see graph of noise generated by ship main noise sources in frequency spectrum.

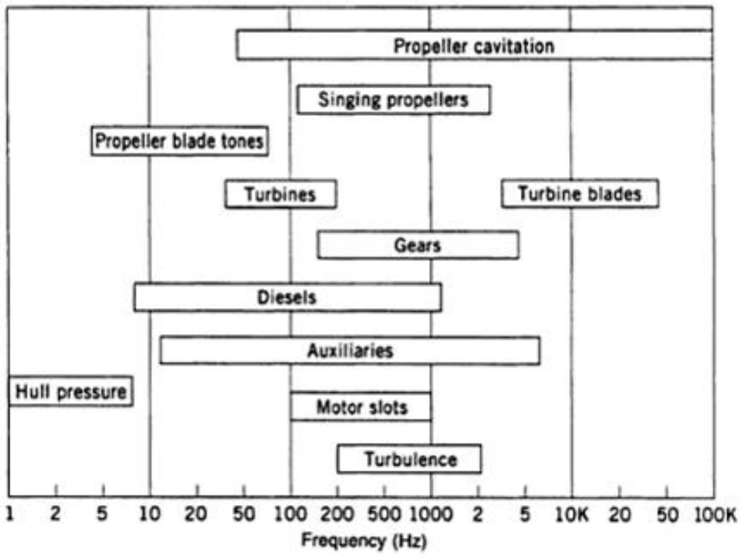

Fig.2. Noise generated by ship main noise sources.

One has to note that noise transferred inside the vessel is both a structure-borne sound and air-borne sound.

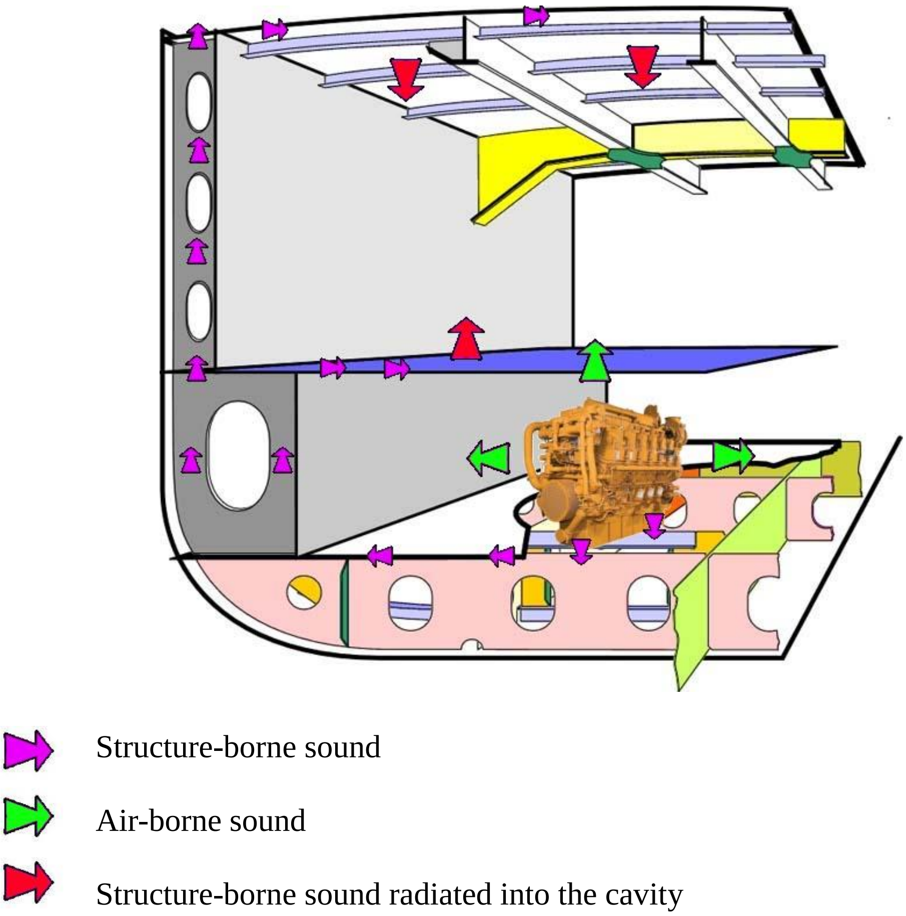

Fig.3. Noise transfer paths.

As one can see from Fig.3 structure-borne sound is directly transmitted form noise source (engine structure) to the double bottom and then propagated within hull structure. Structure-borne noise induces plates, which start to radiate secondary noise. Air-borne sound mostly affects closest vicinity of noise sources (the same compartment and adjacent rooms). To sum up, total sound level in given location is a sum of effects of structure-borne and air-borne sound.

2. NOISE MEASUREMENTS

On a series of 6 AHTS vessels equipped with identical power propulsion and build according to the same initial technical design noise measurements has been executed. Measurements has been performed in 47 locations (crew cabins, engine room, etc).

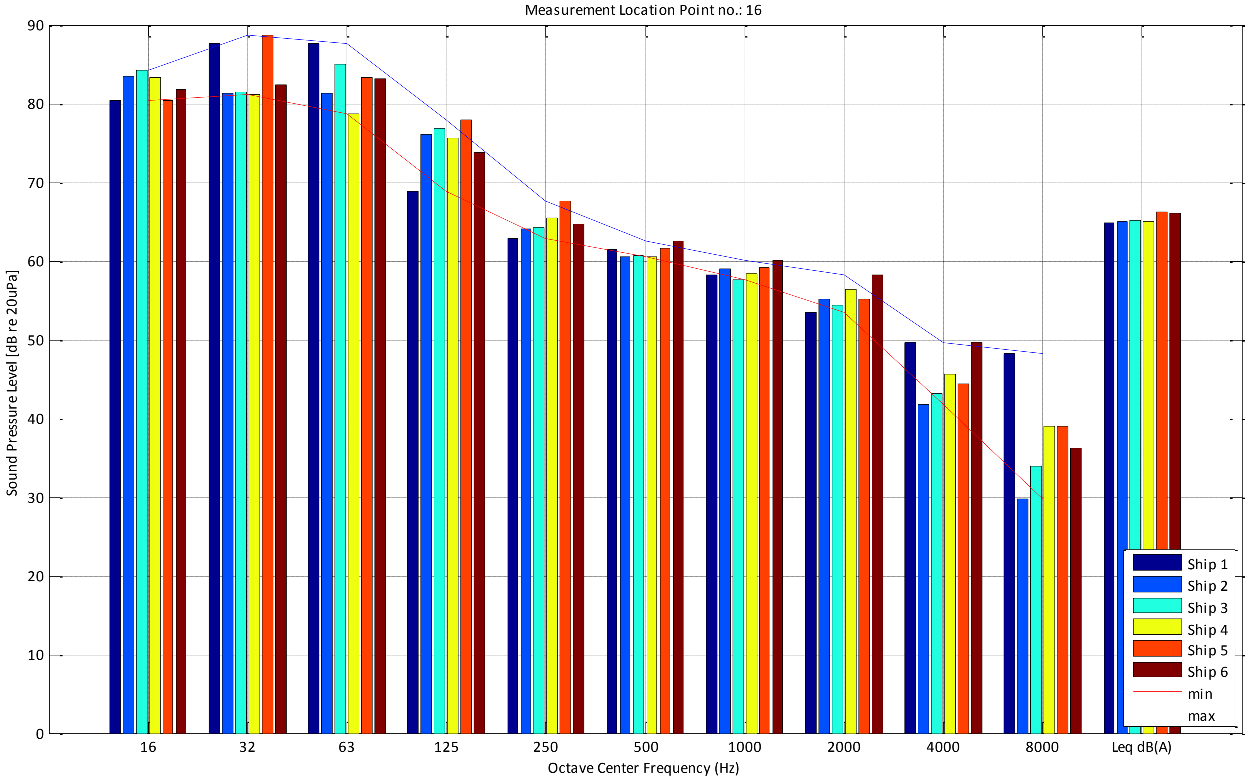

Fig.4. Noise measurements on 6 AHTS vessels for given location.

On Fig.4. one can see an example of noise measurements results for a given location. For all measurements standard uncertainty analysis has been performed.

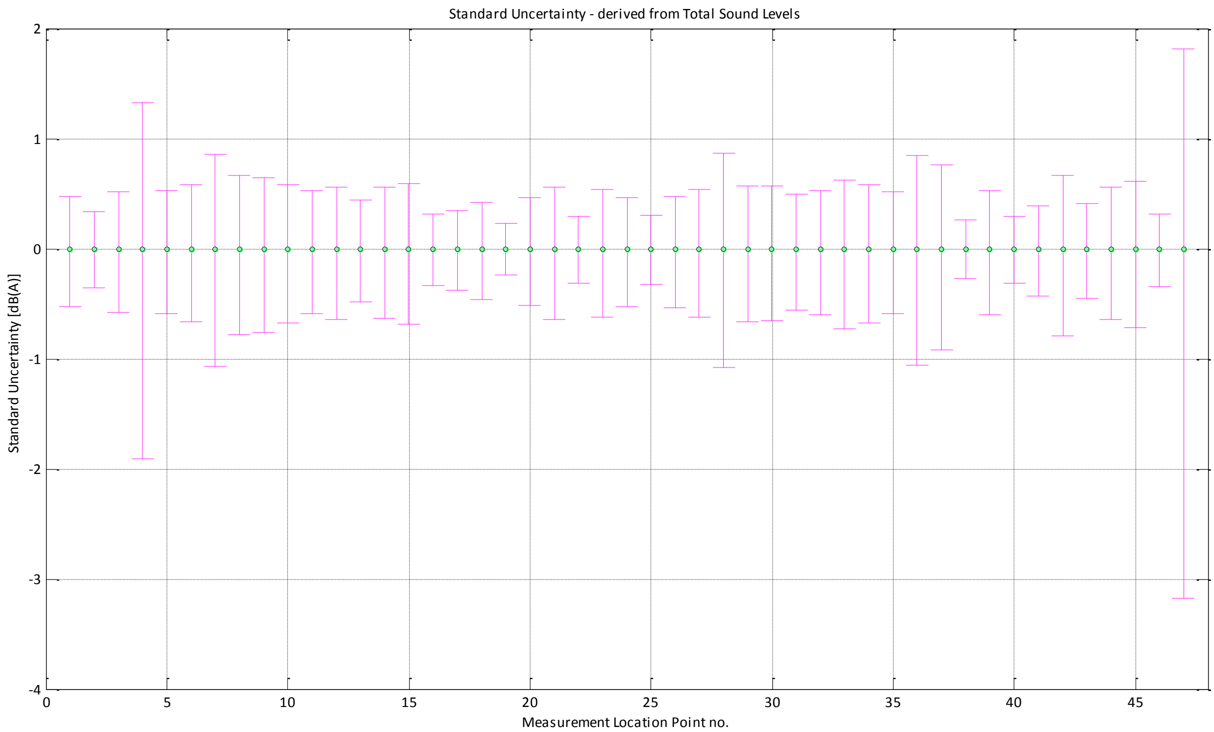

Fig.5. Standard uncertainty for total noise in 47 locations on 6 AHTS vessels.

As one can see from above figure almost 90% of St dev results for Total Sound Levels do not exceed a level of **1dB.** Knowing that measurement results for measurement location no. 4 was influenced by other unstable noise sources almost **98 %** of St dev results for Total Sound Levels do not exceed a level of **1.1 dB.**

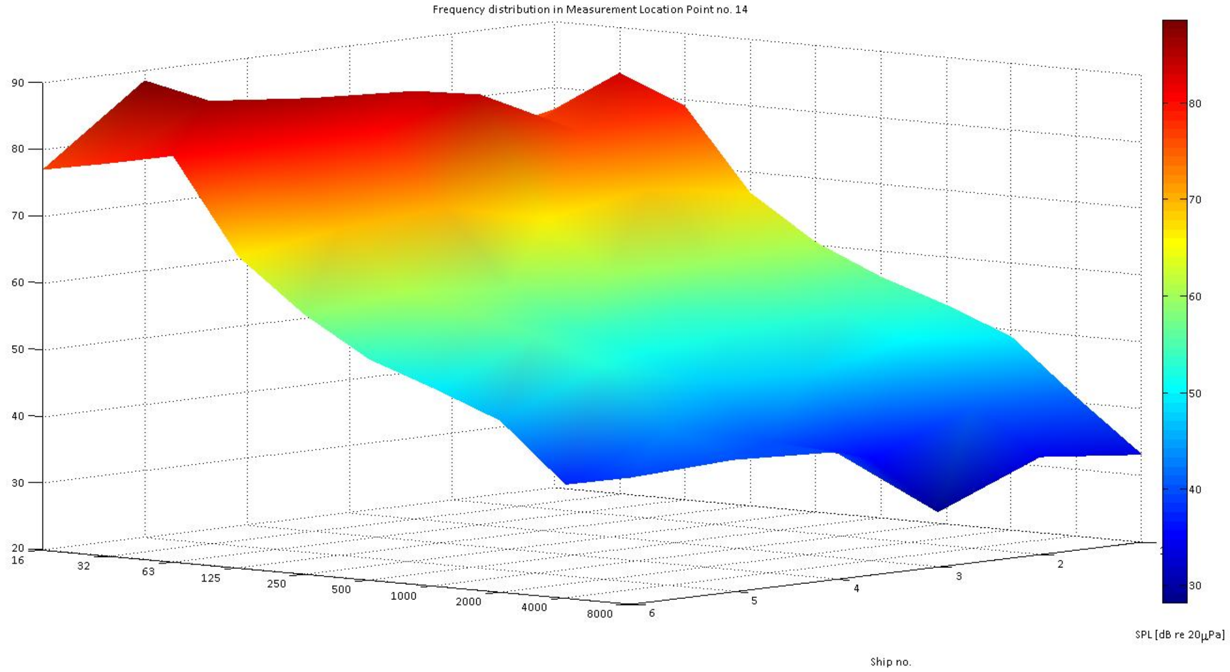

Fig.6. Noise measurements on 6 AHTS vessels for measurement location no 14.

Results of above analysis are clearly visualized by the 3D graph of noise measurements - there are linear in terms of different ships for given octave bands.

3. NOISE ANALYSIS

Having in mind there is a certain standard deviation for a noise levels in a series of a AHTS Ships one should expect that prognosis values of noise should be treated in same manner. As one can see from Fig 7 computed noise spectrum (with a use of Statistical Energy Analysis method [4]) deviates from a mean value line extracted from a measurements however it is still within the range of min-max region.

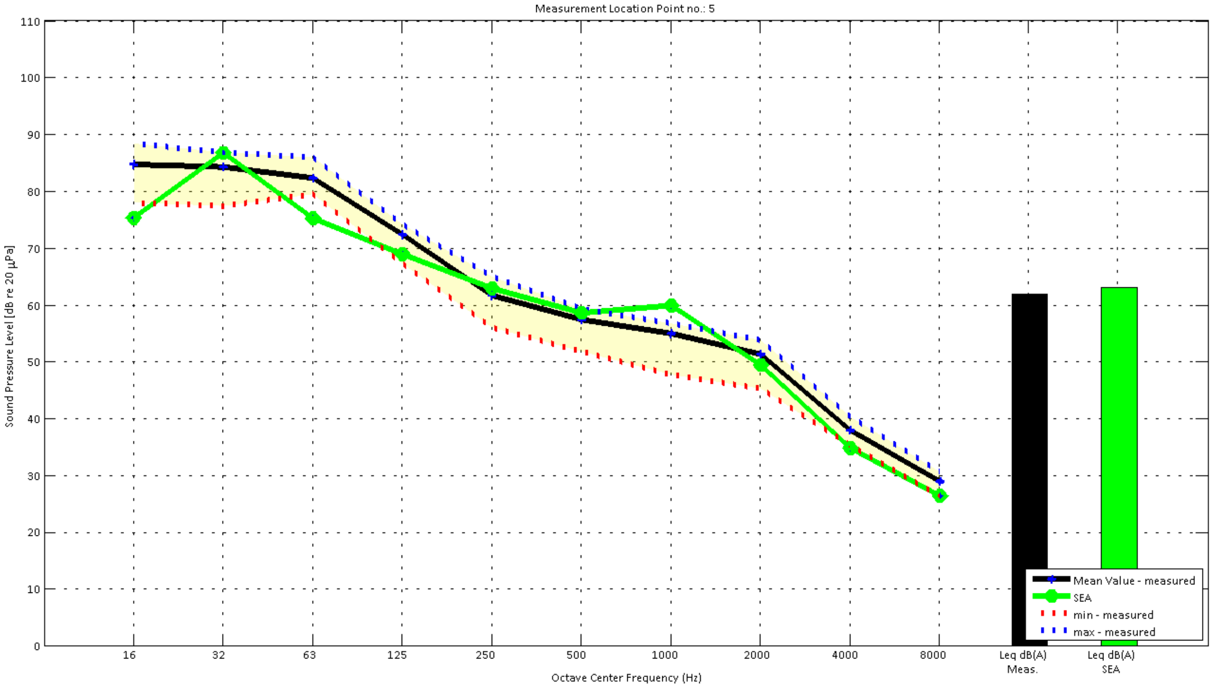

Fig.7. Comparison of noise analysis and noise measurements at measurement location no 5 (2nd Accommodation Deck).

3. SUMMARY

This article is an introduction to general view on contract entries regarding noise levels. There is a common practice that Ship-owner require noise levels below certain value however shipyards should, having in mind outcome of this work, be aware of certain deviation for identical Ships and therefore negotiate maximum contractual noise levels with a margin of mean standard deviation for certain vessel type.

REFERENCES

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[4] RH. Lyon, Statistical energy analysis of dynamical systems : theory and applications. Cambridge, Mass.: MIT Press, 1975, p. 388 p.