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OFFSHORE INTENSITY MEASUREMENTS

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INTRODUCTION

The tight packing of powerful equipment in reverberant steel modules on offshore platforms, makes the determination of their radiated sound power levels difficult using normal pressure measurements. Sound intensity measurements with their inherent ability to describe direction as well as level, have made the determination of equipment sound power levels (in-situ and during normal operations) much easier.

The work presented in this paper is part of a larger project "Guidelines for noise control on offshore facilities", which is financed by Statoil, Norsk Hydro and Saga Petroleum. The main objective of the project is to produce a guideline containing noise data for specific equipment.

To date we have used both a FFT based system [1] and a two channel real time 1/3 octave analyser measuring system [2]; the FFT system using the two microphone method and the 1/3 octave analyser using both two microphone and a special pressure & partical velocity transducer. We have carried out measurements on various types of equipment on five platforms including both fixed and floating.

MEASUREMENT METHOD

One of the objectives, of the project carried out for the norwegian oil companies, was to develop a measuring method with particular emphasis on offshore measurements [3]. This method was to be compatible with the ISO standards (series 3740-46) for the determination of radiated sound power levels from machinary situated in defined acoustic conditions.

The advantage of measuring intensity, in that it can ignore extraneous sources, is that it allows the determination of radiated sound power levels under "very" difficult conditions. The possible level of difficulty is much greater than that allowed when the determination is carried out using pressure measurements, in certain cases the pressure level is as much as 15dB higher than the intensity level.

The measurement method uses the scanning technique with the addition of the measurement of the quality factor L_p-L_I for a number of test areas. After the assessment of the expected difficulty, using the quality factor test, the distance between the transducer and the "average" physical surface can be determined; 0.05m for $L_p-L_I > 10$dB and 0.5m for $L_p-L_I < 10$dB. The measuring surface is then divided up into smaller areas which are consistent with the physical construction of the machine. The intensity of each of these sub-areas is measured.

The power level (Lwi) from each sub-area is calculated from the intensity level (L_Ii) and sub-area surface area (Si) as follows:-

$$Lwi = L_Ii + 10\ Log(Si) \qquad (dB) \qquad (1)$$

The sub-area power levels are summed to produce the total power level (Lw) as follows:-

$$Lw = 10\ Log\left(\sum_i 10^{Lwi/10}\right) \qquad (dB) \qquad (2)$$

If the small measuring distance is used with $L_p-L_I < 10$dB and small sub-areas, the method can be used for source localisation. This can be used to rank the components of a machine and gives a good idea as to the most effective and economic areas to treat with noise control measures.

OFFSHORE MEASUREMENTS

The measurements we have carried out to date have mainly been concentrated in the drilling, mud processing and main generation areas. To test the quality of the measurements, a Brüel & Kjær sound power source type 4205 was placed in the main generator room of a drilling platform. The source was situated 1m from the side of the main generator diesel engine, the probe was scanned over the source in two hoops at a radius of 0.3m with total measuring time of two minutes. The source has also been measured in a reverberent room in the laboratory.

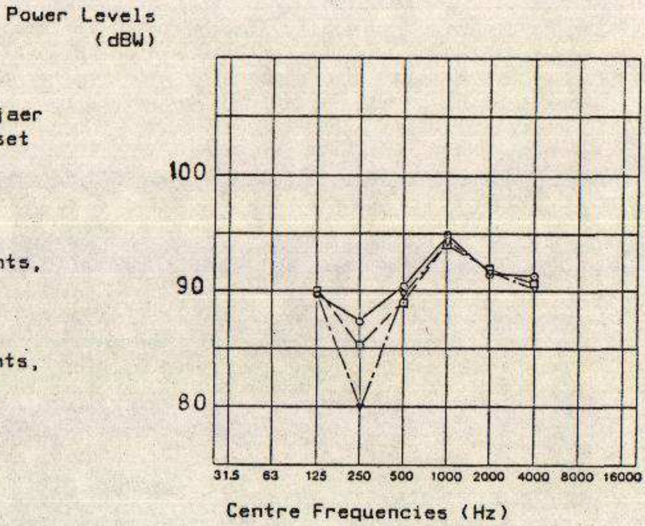

Figure 1, Bruel & Kjaer sound power source set to 100dBW.

o——o ISO 3741.

□— —□ Intensity measurements, scanning, in a reveberant room.

▽—·—▽ Intensity measurements, scanning, in a main generator room.

Figure 1, shows that, except for the 250Hz octave band, the intensity derived power levels are within +0.6/-0.5dB and within +0/-1.1dB of the ISO 3741 pressure derived power levels. In the 250Hz octave band the offshore measurement is -5dB compared with the reverberation room intensity measurement and -7dB compared with the ISO measurement.

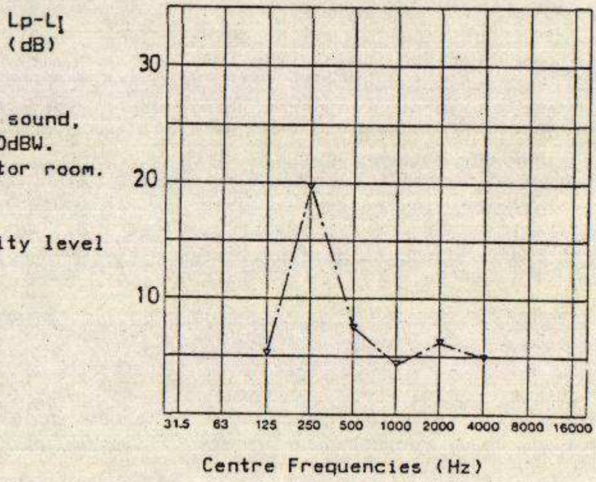

Figure 2, Bruel & Kjaer sound, power source, set to 100dBW. Measured in main generator room.

▽—·—▽ Quality factor:- Pressure level - Intensity level

Figure 2, shows the quality factor L_p-L_I for the offshore measurement. The quality factor has a maximum value of 19dB in the 250Hz octave band, thiscorresponds with the highest error in the determination of the radiated power level.

Figure 3, photo of measuring equipment in main generator room

DIFFICULT PHYSICAL CONDITIONS

Under difficult physical conditions it is often useful to use a tape recorder and analyse the data later. We have used a FM tape recorder but due to its limited dynamic range and phase errors between the two channels we now use a video recorder with PCM digital converter, which has a greater dynamic range and much smaller phase errors.

The recording system has been used to measure a cementing unit, in the room where this was situated there was 20mm of water on the floor and it was generally very dirty.

Figure 4, photo of cementing room.

The video recorders normal audio channel can be used as a "cue" track and obviously this does not affect the measuring channels. The video recorder and PCM converter use recharagable batteries which last one hour, if the PCM converter is switched off between sub-areas this is enough to measure one machine. The charge-up time is also one hour.

Using a tape recording obviously does not allow any analysis while measuring, hence the small measuring distance is recommended for all such measurements. The tape recording does allow the evaluation of the quality factor L_p-L_I for all sub-areas, by analysing the tape twice, (i) for intensity and (ii) for pressure, with the advantage that the same probe path is also traced for the two measurements.

CONCLUSIONS

Intensity measurements show great promise under difficult conditions where pressure measurements produce unreliable results. The application of intensity measurements to offshore platforms has been very useful in the determination of radiated power levels from equipment. It is the only method which can be used to check that a guarenteed level is met by a vendor's piece of equipment and gives a guide to the most effective and economic noise control measure.

REFERENCES

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