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Shore power connection for offshore vessels – Measured noise reduction in port and dock

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Abstract

The presentation will summarize measured noise reduction for drilling, pipelay and offshore support vessels due to shore power connection. The noise level at office or storage building in distance of 100-250 m from the vessels without significant influence from other background noise has been registered continuously through days and nights. Noise levels at nights without and with shore power connection have been compared. A drilling vessel had L_w 110 dB and a noise reduction due to shore power connection of 18 dB. A pipelay vessel had L_w 105 dB without shore power, and a noise reduction of 15 dB due to the effect of shore power. Both drilling and pipelay vessel seem to have L_w of 90-92 dB with shore power connection. Two different offshore support vessels have also been measured with sound power level L_w of 107 dB and 100 dB. The noise reduction with shore power connection is 13 dB for the first and 6-7 dB for the latter. With shore power connection, both offshore suppert vessels have L_w of 94 dB. The two offshore support vessels show that shore power can give different noise reduction for ships with different design, and that the sound power level with shore power connection seems to be the same within a category of vessels, due to the fact that ship noise level from ventilation and fans seems to be the same. All of the vessels measured have sound power level between 90 and 95 dB with shore power connection.

1 Introduction

Noise from ships in port has been measured at Kongsgård-Vige from drilling and pipelay vessel, and noise from ships in dock has been measured from offshore support vessels at Andøya Industripark in Kristiansand in Norway. This document will compare the measured noise level with and without shore power connection. The method used will be explained, and also the considerations for the estimated noise reduction.

2 Hypothesis and method for estimating noise reduction due to shore power

The basic hypothesis is that shore power connection of a vessel will give a constant noise reduction compared to the situation without shore power. At daytime and evening there will normally be many sources and activities which contributes to a measured noise level. The best method for determining the effect of shore power should therefore be to compare noise levels at nights, with and without shore power. Nights without heavy rain and without strong wind have to be used, for background noise being as low as possible. The method

for determining effect of shore power is a continuous registering of noise level in port/dock area, for both nights with and without shore power connection.

The measurement method was to use one microphone position with instrument Norsonic N140 at port building with low influence from other background noise. If more microphone positions were used, the issue of background noise in different positions had to be carefully analysed. The microphone on port building is placed in height not shielded by the vessel. In noise calculations vessels are normally modelled as point source with omni-directional sound pressure level (same directivity in all directions), therefore it is considered as good enough to have one microphone position (due to omni-directional sound radiation) where it is known that the level from other background noise is significant low. The main purpose is to compare the measured noise reduction at port building, which is explained by shore power when other background noise is low.

The sound power level without shore power is calculated by modelling the vessel as a point source, calibrated against the measured level at night at the port buildings. Compared with literature about sound power from ships and vessels, the estimated L_w from measurements shows very good correspondence with what should be expected. The sound power level with shore power is estimated by the level difference measured at the port building, with and without shore power. Calculations with Cadna using L_w with shore power show very good match with measured noise level at the port building. The Cadna model with different ships/vessels gives noise levels which corresponds very well with short time measurements in different directions within the port area and surrounding neighbourhood.

The two situations are shown in the following figures.

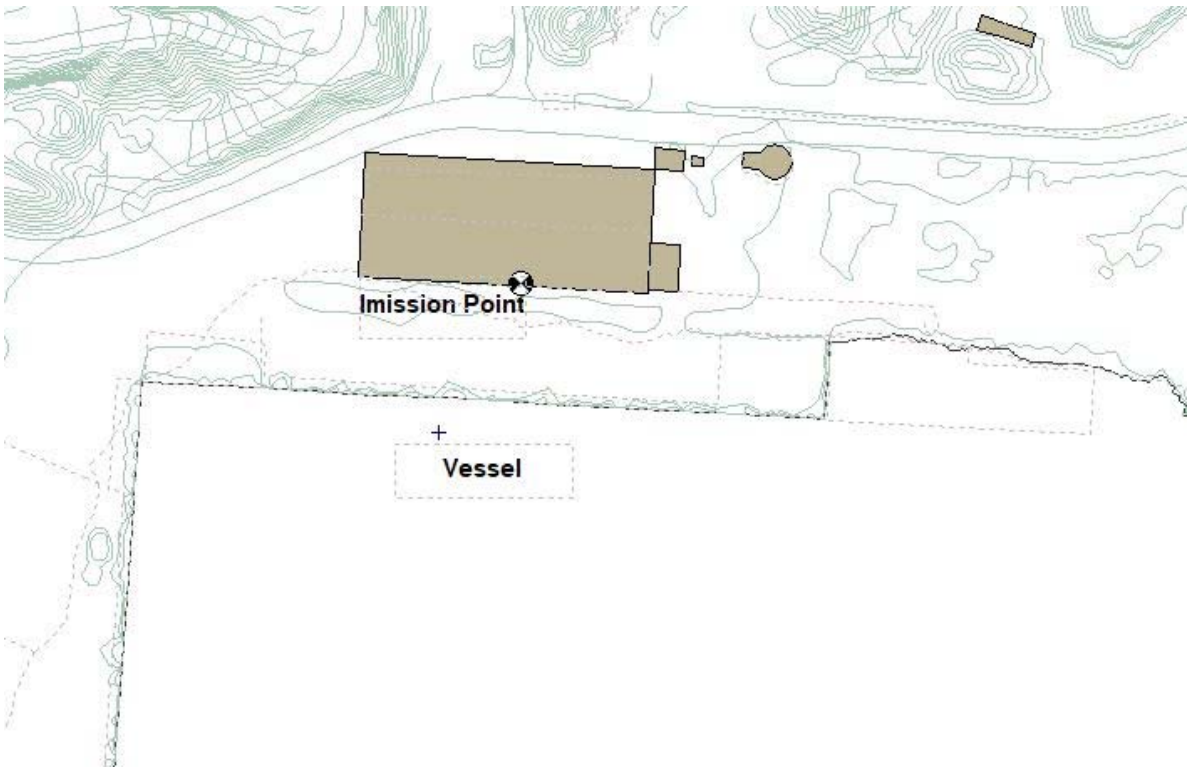

Figure 1a Vessel and imission point for noise registration at Kongsgård-Vige

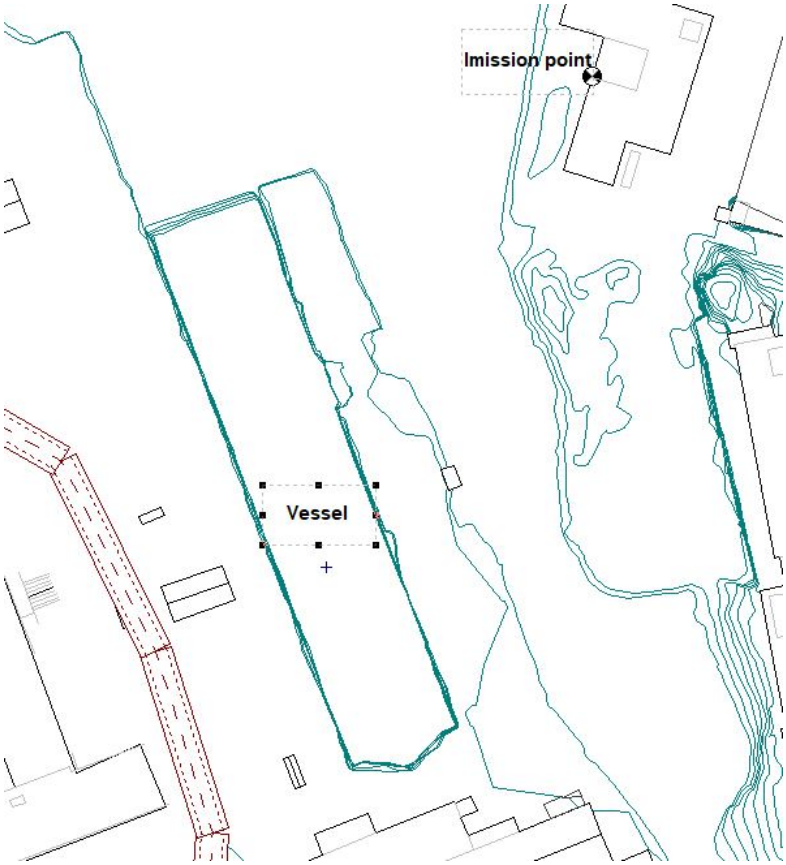

Figure 1b Vessel and imission point for noise registration at Andøya Industripark

3 Drilling and pipelay vessel – noise reduction due to shore power

Measurement of noise from drilling and pipelay vessel was done with continuously registering by a harbor building at Kongsgård-Vige. The noise levels at nights with and without shore power were compared.
The analysis of measurement data gives the following:

1. Drilling Vessel
    - L_w 110 dB without shore power
    - L_w 92 dB with shore power

2. Pipelay vessel
    - L_w 105 dB without shore power
    - L_w 90 dB with shore power

Picture 1 Drilling and pipelay vessel, Kongsgård in Kristiansand

Frequency spectrum shows significant reduction in all frequencies. Normally the annoyance from neighbours is related to low frequencies, where shore power connection shows very good effect. The L_w with shore power connection is dominated by noise from ventilation, fans and other noise sources on the ship and seems to be similar for the two vessels.

The pipelay vessel Lorelay was in port, with and without shore power. In figure 2 the blue curve is noise level without shore power, and the other curves show noise level with shore power connection. By comparing noise level at nights for a period in autumn 2021 and winter 2022 (only with contribution from Lorelay) we can see the noise reduction due to shore power connection. The measurement in January 2022 shows more than 15 dB reduction in a wide frequency range. Some of the measurements (with shore power) will also contain other background noise.

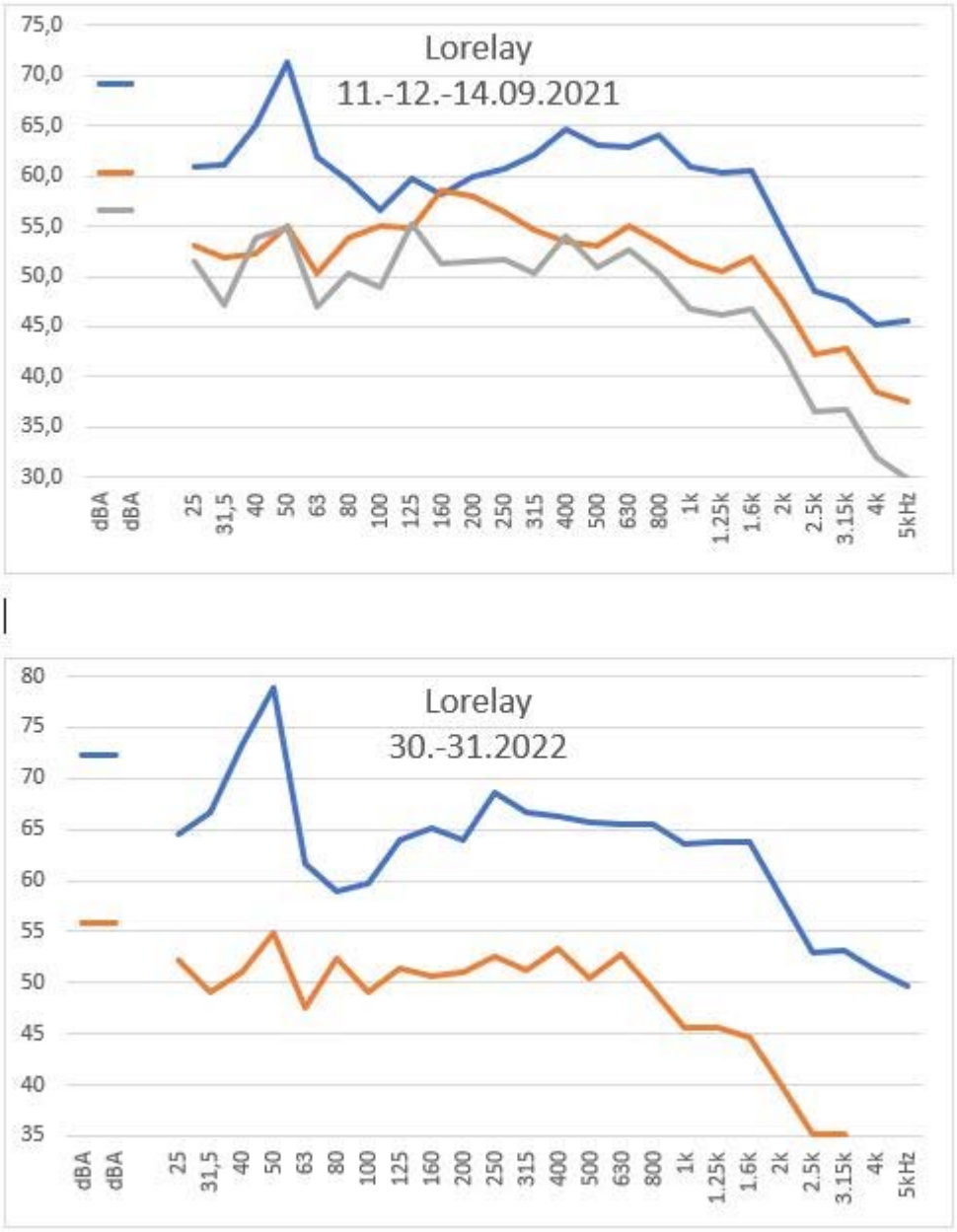

Figure 2 Frequency spectrum for the pipelay vessel Lorelay, with and without shore power, measured at port building

The noise levels from the two periods of Lorelay with shore power are summarized in the tables below.

Table 1 Pipelay vessel Lorelay – Noise level without and with shore power September 2021

Lorelay – September 2021							
Octaveband	**63 Hz**	**125 Hz**	**250 Hz**	**500 Hz**	**1000 Hz**	**2000 Hz**	**4000 Hz**
Without shore power	**72**	**63**	**66**	**68**	**67**	**62**	**51**
Shore power	**57**	**57**	**56**	**58**	**53**	**48**	**39**
Reduction	**15**	**6**	**10**	**10**	**14**	**14**	**22**

Table 2 Pipelay vessel Lorelay – Noise level without and with shore power January 2022

Lorelay – January 2022							
Octaveband	**63 Hz**	**125 Hz**	**250 Hz**	**500 Hz**	**1000 Hz**	**2000 Hz**	**4000 Hz**
Without shore power	**79**	**68**	**72**	**71**	**69**	**65**	**56**
Shore power	**57**	**55**	**56**	**57**	**52**	**46**	**36**
Reduction	**22**	**13**	**16**	**14**	**17**	**19**	**20**

Table 2 shows different and more noisy activity than table 1. The noise reduction due to shore power is good in all frequencies. It is to be noted that the noise level with shore power connection is quite similar in all octave bands for the two periods. This shows that in both cases the noise level is reduced to a similar level which is dominated by ventilation, fans or other noise sources on the vessel. The reason for the different level without shore power in September 2021 and January 2022 is not exactly known, but the sound power level with shore power is approximately the same for both measurements. Some of the nights in September shore power connection gave noise level according to the orange curve, the reason for this is assumed to be that noise sources due to testing or other activity gave higher level with shore power than expected (the grey curve in September). The noise data summarized for shore power in September last year is based on the grey curve.

4 Offshore support vessels – noise reduction due to shore power

Measurement of noise from offshore support vessels was done with continuously registering by an office building at Andøya Industripark. The noise levels at nights with and without shore power were compared. The analysis of measurement data gives the following:

Offshore Support Vessel

- L_w 100-107 dB without shore power
- L_w 94 dB with shore power

Picture 2 Offshore support vessel in dock

The difference in sound power level for the two different offshore support vessels is mainly explained by different design of these two vessels. Registration of noise level at the facade of office building was done for two different vessels in December 2021 and January 2022:

1. MMA Pinnacle
   - Noise level 61-62 dBA at nights 13th to 15th of December
   - Noise level 49-50 dBA at nights 20th to 21st of December, and most quiet periods noise level of 42-43 dBA

2. Normand Jarstein
   - Noise level 54-55 dBA night between 11th and 12th of January
   - Noise level 48-49 dBA night between 12th and 13th of January – with shore power

MMA Offshore Asia has confirmed that some of the nights MMA Pinnacle was in dock were without the harbor generators running. This explains the reduced noise level the night between 20th and 21st of December. It seems that both vessels give noise level of 49-50 dBA when harbor generators are off or the vessel is connected to shore power. The noise level of 48-50 dBA is assumed to be dominated by fans and ventilation on the vessels. The low noise level of 42-43 dBA from MMA Pinnacle in some quiet periods the night between 20th and 21st of December may be explained by that either fans or ventilation were turned off such periods.

The frequency spectrum for Normand Jarstein (with shore power connection in dock) is shown in the table below.

Table 3 Normand Jarstein – Noise level without and with shore power January 2022 measured at office building

Normand Jarstein – January 2022							
Octaveband	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
Without shore power	59	74	53	52	51	46	40
Shore power	52	51	50	53	51	47	41
Reduction	7	23	3				

From the table we can see that the noise level by the office building is dominated by background noise from 250 Hz due to either weather/wind or ventilation/fans on the vessel. Since the level in the upper frequencies are quite similar with and without shore power, it is highly probable that the noise level from 250 Hz and above is due to a constant source like ventilation or fans. The measurement for Normand Jarstein shows very good effect of shore power in the low frequencies, which normally gives annoyance for the neighbourhood.

Because there is no sure knowledge of what installations were turned off for MMA Pinnacle, noise level from this vessel regarding frequency spectrum is not summarized. In the night with lowest level, it is registered that the noise level in the lowest frequencies (50-200 Hz) is 50-55 dBA as for Normand Jarstein.

Picture 3 Continuous measurement at facade of office building

Picture 3 shows the measurement point for continuous registration at the office building. The frequency spectrum for the situation with and without shore power are based on the levels registered at this building.

5 Conclusions

Shore power connection for drilling and pipelay vessels brings the sound power level L_w down from 105-110 dB to 90-92 dB. For offshore support vessels, the sound power level is 94 dB with shore power connection in dock. In all cases, shore power connection gives significant reduction of low frequency noise. For drilling, pipelay and offshore support vessels, the level measured at port or office building is 50-60 dB in the frequency range from 63 to 1000 Hz with shore power connection. The effect of shore power seems to be much better than predicted in earlier international project [2] and shows similar results as for offshore rigs [1].

Acknowledgements

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References

[1] Bernt Mikal Larsen. “Emitted noise in harbors – Effect of shore power” – BNAM AND INTERNOISE 2018

[2] Rob Witte. “Regulation of noise from moored ships in ports” – EURONOISE 2015