Noise Measurement and Reduction Measures on Drilling Rigs

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Drilling rigs are used for the exploration and development of oil and gas reservoirs, for the construction of new underground storages and geothermal wells. Since central Europe is densely populated and has numerous nature preservation or recreation areas, noise produced by rig operation – even for a limited time – has to be considered for the rig crew but particularly for the adjacent neighbourhood, as the drilling job itself lasts typically between weeks and several months.

For the determination of the noise situation a prognosis on operational noise has to be made to ensure conformity with HSE regulations and authority requirements. Depending on the results, action has to be taken to ensure an allowable noise level.

The noise prognosis has to account at least for two main operating modes: drilling and tripping. During drilling, the drill-string rotates by means of the so- called top drive (a motor installed in the mast) or a rotary table (a motor installed at the rig floor) and moves slowly downwards. When the drill-bit needs to be changed or the casing pipe has to be installed and cemented, the drill-pipe is withdrawn pipe by pipe from the well, a procedure called "tripping" (Fig. 1).

The noise situation at the drilling site is dominated by specific sources of noise, which are different for the two main modes of operation. Measurements and calculations to determine the noise level of relevant emission sources at the rig site follow DIN EN ISO 3744 et seq. during typical operational modes.

The main sources of noise at drilling rigs are as follows:

- the top drive
- the mud pumps
- the centrifuges
- the mud agitators
- the shaker
- drawing tools
- diesel generators.

These units contribute to the overall noise level and have to be considered for a noise prognosis. If the rig and its components have not been analysed in detail, noise emission measurements need to be taken for each of these items (Fig. 2). Besides the emission data, further parameters like hookload, torque, mud volume flow or rotational speed of the drillstring need to be considered.

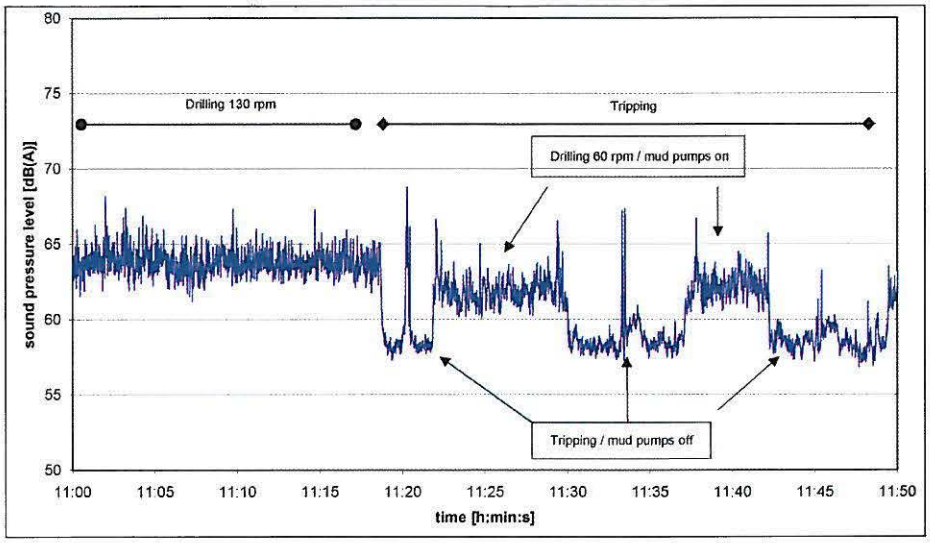

Fig. 1 Sound pressure level vs. time during drilling (left) and tripping (right)

Noise Prognosis for Specific Locations Based on Measurements

The noise propagation calculations are performed for example using the certified software CADNA/A. Based on a discrete 3-D computer model the noise emissions in the vicinity of the rig are predicted for different modes. This is done in strict compliance with DIN ISO 9613-2. The model compromises the geometric setup at the site (specific locations of container, tank-farm, rig orientation etc.). Furthermore, the topography of the landscape, possible reflections and shieldings (e.g. walls, buildings, containers) are considered. Each source of noise is documented with exact location, height over ground and duration of operation. The result yields the overall noise situation of the specific plant (Fig. 3). This can be visualized as a noise map showing the location-dependent noise level caused by the rig operation taking shielding effects into account. Noise levels are colour-coded in the map.

The assessment of the noise situation is carried out according to the TA Lärm (German regulation on acceptable noise levels for different areas and times). In the case of excessive noise levels suitable reduction measures like enclosures, shieldings or walls can be

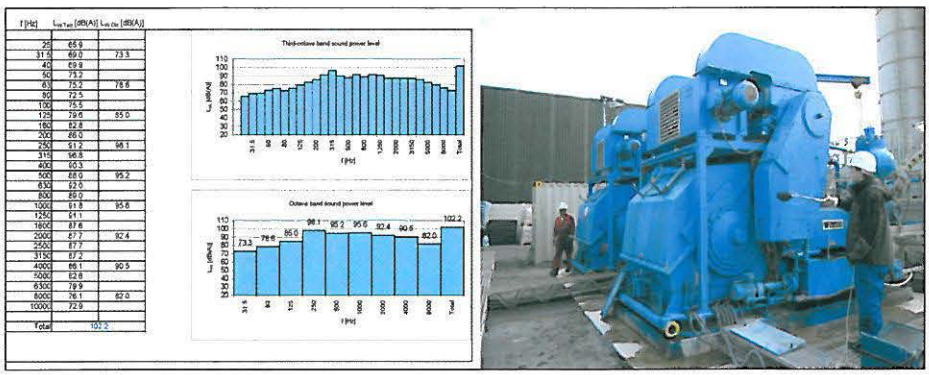

Fig. 2 Third-octave band noise power of mud pumps, measurement at mud pumps at site

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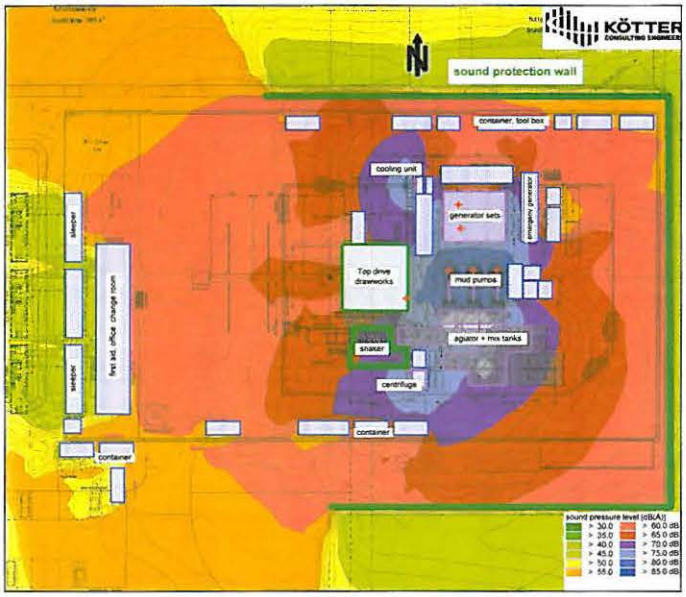

Fig. 3 Typical noise map, showing a rig with protection wall

Fig. 5 Drilling rig with noise measurement equipment

discussed in close cooperation with the rig operator.

The precise measurement data obtained in preparing the noise map quantifies the noise contribution (immission – and partial noise level) for all relevant immission areas. This facilitates design and evaluation of appropriate noise reduction measures (Fig. 4). Moreover, relocation of the rig or of single components can be easily simulated with the model to obtain a noise-optimised setup.

Furthermore, as the noise emission data for each main component is available, the model can be used for other drilling locations. Thus it is possible at a very early planning stage to clarify, if for example a diesel generator set could be used for power supply instead of tapping the high-voltage grid to avoid noisy GenSet operation.

Fig. 4 Top drive with sound protection hood

Generally, a 3-D model of a drilling rig contains a list of sources of noise for the specific operational mode, the calculation of the noise situation for all residential buildings in the vicinity, the calculation of the noise situation at the rig location itself as well as the calculation of immission levels at a defined distance and orientation to the centre of well. Furthermore, the noise contribution of each noise source for all immission places is listed. This enables authorities, neighbours and staff to obtain a detailed view of the situation before commissioning.

If required the actual noise can be measured during the complete drilling period. A monitoring measurement records the noise level at a defined distance continuously, giving direct feedback to the driller, the toolpusher or indeed via internet to the public (Fig. 5). The offensive and open handling of the actual situation and the presentation of reduction measures increases the acceptance within the population considerably.

Conclusion

The application of modern measurement methods to analyse sources of noise delivers very good results for a precise sound propagation model at different heights over ground. The recorded data is the basis for the design and implementation of appropriate economic noise protection measures. Available data can easily be adapted to create an authoritative forecast for future drilling jobs. The resulting noise register helps to follow the HSE regulations with respect to noise exposure of the rig crew. Accompanying onsite measurement documents the actual noise level, reveals the impact of background noise and – if made available – leads to a much better acceptance by the public.

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