AECOM

Shannon Technology and Energy Park (STEP) Power Plant

Appendix A9.2: Acoustic Modelling

Shannon LNG Limited

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Appendix A9.2: Acoustic Modelling

Modelling of sound levels from the development was undertaken using CadnaA (version 2023) acoustic modelling software. This software implements the sound propagation calculation methodology set out in ISO 9613-2 and BS5228.

ISO 9613-2

The propagation model described in this standard provides for the prediction of sound pressure levels based on either short-term downwind (i.e. worst case) conditions or long-term overall averages. For a downwind condition (for wind blowing 1 to 5 m/ s from the site towards the nearby receptors) worst-case noise levels will occur, and these have been adopted within the model.

When the wind is blowing in the opposite direction, noise levels may be significantly lower than those predicted. The ISO propagation model calculates the predicted sound pressure level by taking the source sound power level for each source and subtracting a number of attenuation factors according to the following:

$$\text{Predicted Sound Level} = L_{WA} + D - A_{geo} - A_{atm} - A_{gr} - A_{bar} - A_{misc}$$

The Sound Power Level (L_{WA}) defines the total acoustic power radiated by a noise source expressed in decibels (dB re 1 pW).

The directivity factor (D) allows for an adjustment to be made where the sound radiated in the direction of interest is higher than that for which the sound power level is specified. No directivity factor is considered within this assessment.

The geometrical divergence (A_{geo}) accounts for spherical spreading of the sound from the source within free-field conditions. Different sources at the installation have been modelled to take account of their geometry, as area, line or point sources. The divergence factor is calculated from the distance from the source to the receiver, and the relationship between the attenuation provided and distance is dependent on the type of sound source assumed.

The atmospheric absorption factor (A_{atm}) considers the attenuation offered by the atmosphere as a result of the conversion of sound to heat. The degree of attenuation is dependent on the relative humidity and temperature of the air through which the sound is travelling and is frequency dependent. Increasing attenuation occurs towards the higher frequencies of sound.

Modelling parameters have assumed an ambient temperature of 10 °C and 70% relative humidity which are found to result in worst case noise propagation. The corresponding atmospheric attenuation factors are summarised below.

Table A9.2.1. Atmospheric Attenuation (dB/ km) at 10 °C and 70% Relative Humidity

OCTAVE BAND CENTRE FREQUENCY / HZ	63	125	250	500	1K	2K	4K	8K
Atmospheric Absorption Coefficient dB/ km	0.122	0.411	1.04	1.93	3.68	9.66	32.8	117

The ground effect (A_{gr}) is the result of sound reflected by the ground interfering with the sound propagating directly from source to receiver, and the interaction of the sound with porous and absorptive ground cover. The prediction of ground effects depends on the source height, receiver height, propagation height between the source and receiver and the ground conditions.

The ground conditions are described according to a variable defined as G, which varies between 0 for ‘hard’ ground (includes paving, water, ice, concrete and any locations with low porosity) and 1 for ‘soft’ ground (includes ground covered by grass, trees or other vegetation).

The effect of any barrier or topographical obstruction (A_{bar}) between the sound source and the receiver position is that sound will be reduced according to the relative heights of the source, receiver and barrier and the frequency spectrum of the sound. Predictions have been carried out using receiver heights of 4 m, to represent first floor levels. This is because the focus of the assessment was night-time emissions.

Acoustic model settings

Acoustic modelling has been undertaken using the following model settings:

- Order of reflections = 1.
- Ground absorption is assumed to be 'acoustically soft' as defined in ISO 9613-2:1996 Acoustics — Attenuation of sound during propagation outdoors — Part 2: General method of calculation. Areas of water, the Proposed Development footprint and roads assumed to be acoustically hard/reflective.
- As a conservative approach, it is assumed that all sound sources identified as not exceeding a given sound pressure/power level would emit a level equal to the defined limit.
- Where spectral data was not available for certain sources, the sound power/pressure level has been input in the 500 Hz band.
- Where sound pressure level input data has been provided for external sources of small dimension (condensate pumps, vacuum pumps, steam jet air injectors, closed cycle cooling water pumps, oil mist outlet and control valves), the sound power levels have been calculated assuming hemispherical propagation over a reflective plane. The same approach has been applied to the various exhausts and intake/discharge points associated with the Proposed Development. These sources have been input as point sources within the 3D model.
- Where sound pressure level input data has been provided for larger external sound sources (e.g. Transformers), sound power levels have been calculated in accordance with the methodology detailed in BS EN ISO 3746:2010 Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Survey method using an enveloping measurement surface over a reflecting plane (ISO 3746:2010). It is assumed that the sound pressure level provided is representative of all measurement positions. These sources have been input as area sources within the 3D model at a height equal to 1 m below the total height identified in the associated Black and Veatch CAD model.
- Sound sources within the AGI are to be designed to not exceed 45 dB $L_{Aeq,T}$ at the boundary. Therefore, sound sources from this area of the Proposed Development were input as an area source at a height of two metres set one metre in from the boundary of the AGI and calibrated within the model to result in a sound level of 45 dB $L_{Aeq,T}$ at the boundary.