Environmental Impact Assessment Report

Volume 4

Appendix 24.6 OTI operational phase modelling

codling
wind park

Table of contents

List of tables

Abbreviations

Abbreviation	Term in Full
CWP	Codling Wind Park
CWP OIW	CWP Onshore infrastructure works
EIA Report	Environmental Impact Assessment Report
GIS (switchgear)	Gas insulated switchgear
GIS	Geographic Information System
OIW	Onshore infrastructure works
O&M	Operations and maintenance
OMB	Operations and maintenance base

Definitions

Glossary	Meaning
A-frequency weighting	i.e. 'A'–weighting to compensate for the varying sensitivity of the human ear to sound at different frequencies.
dB	Decibel - The scale in which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the RMS pressure of the sound field and the reference pressure of 20 micro-pascals (20 μPa).
Hertz (Hz)	The unit of sound frequency in cycles per second.
L_{AT}(DW),	The average downwind sound pressure level
L_{fT}(DW)	An octave band centre frequency component of LAT(DW) in dB relative to 2x10-5Pa
noise	Any sound, that has the potential to cause disturbance, discomfort or psychological stress to a person exposed to it, or any sound that could cause actual physiological harm to a person exposed to it, or physical damage to any structure exposed to it, is known as noise.
noise sensitive location	NSL – Any dwelling house, hotel or hostel, health building, educational establishment, place of worship or entertainment, or any other facility or other area of high amenity which for its proper enjoyment requires the absence of noise at nuisance levels.
octave band	A frequency interval, the upper limit of which is twice that of the lower limit. For example, the 1,000Hz octave band contains acoustical energy between 707Hz and 1,414Hz. The centre frequencies used for the designation of octave bands are defined in ISO and ANSI standards.
L_w, sound power level	The logarithmic measure of sound power in comparison to a referenced sound intensity level of one picowatt (1pW) per m^2 where: $Lw = 10Log\frac{P}{P_0}$ dB Where: p is the rms value of sound power in pascals; and P_0 is 1 pW.
sound pressure level	The sound pressure level at a point is defined as: $Lp = 20Log\frac{P}{P_0}$ dB

APPENDIX 24.6 OTI OPERATIONAL PHASE MODELLING

1 Introduction

1. Codling Wind Park Limited (hereafter 'the Applicant') is proposing to develop the Codling Wind Park (CWP) Project, which is located in the Irish sea approximately 13 - 22 km off the east coast of Ireland, at County Wicklow.

2. This appendix forms part of **Chapter 24 Noise and Vibration** of the Environmental Impact Assessment Report (EIAR) for the CWP Project.

3. The following sections detail the operational noise modelling for the OTI substation and associated plant.

2 Operational noise modelling details and assumptions

2.1 Noise Model

4. A 3D computer-based prediction model has been prepared in order to quantify the noise level associated with the proposed OTI substation site including its associated operational plant. This section discusses the methodology behind the noise modelling process.

2.2 DGMR iNoise

5. Proprietary noise calculation software has been used for the purposes of this modelling exercise. The selected software, DGMR iNoise v2023.02 , calculates noise levels in accordance with ISO 9613: 1996 *Acoustics – Attenuation of sound during propagation outdoors, Part 2: General method of calculation.*

6. DGMR iNoise v2023.02 is a proprietary noise calculation package for computing noise levels in the vicinity of noise sources. iNoise calculates noise levels in different ways depending on the selected prediction standard. In general, however, the resultant noise level is calculated taking into account a range of factors affecting the propagation of sound, including:

- the magnitude of the noise source in terms of A weighted sound power levels (L_{WA});
- the distance between the source and receiver;
- the presence of obstacles such as screens or barriers in the propagation path;
- the presence of reflecting surfaces;
- the hardness of the ground between the source and receiver;
- Attenuation due to atmospheric absorption; and
- Meteorological effects such as wind gradient, temperature gradient and humidity (these have significant impact at distances greater than approximately 400 m).

2.3 Brief Description of ISO 9613-2: 1996

7. ISO9613-2:1996 calculates the noise level based on each of the factors discussed previously. However, the effect of meteorological conditions is significantly simplified by calculating the average downwind sound pressure level, L_{AT}(DW), for the following conditions:

- wind direction at an angle of ±45° to the direction connecting the centre of the dominant sound source and the centre of the specified receiver region with the wind blowing from source to receiver, and;
- wind speed between approximately 1ms^{-1} and 5ms^{-1}, measured at a height of 3m to 11m above the ground.

8. The equations and calculations also hold for average propagation under a well-developed moderate ground based temperature inversion, such as commonly occurs on clear calm nights.

9. The basic formula for calculating L_{AT}(DW) from any point source at any receiver location is given by:

$$L_{fT}(DW) = LW + Dc - A$$

Where:

- L_{fT}(DW) is an octave band centre frequency component of L_{AT}(DW) in dB relative to 2x10^{-5}Pa;
- L_W is the octave band sound power of the point source;
- D_c is the directivity correction for the point source;
- A is the octave band attenuation that occurs during propagation, namely attenuation due to geometric divergence, atmospheric absorption, ground effect, barriers and miscellaneous other effects.

2.4 Input Data and Assumptions

10. The noise model has been constructed using data from various source as follows:

- Site Layout: The general site layout has been obtained from the drawings forwarded by the project architects.
- Local Area: The location of noise sensitive locations has been obtained from a combination of site drawings provided by the project architects and others obtained from Ordinance Survey Ireland (OSI).
- Heights: The heights of buildings on site and in the immediate Poolbeg area have been obtained from site drawings forwarded by the project architects.
- Contours: In this instance the DTM ground topography for the site was provided by the project architects.

11. The final critical aspect of the noise model development is the inclusion of the various plant noise sources. Details are presented in the following section.

2.5 Source Sound Power Data

12. The noise modelling competed indicates the following limits in relation to various items of plant associated with the overall site development. Plant items will be selected in order to achieve the stated noise levels and or appropriate attenuation will be incorporated into the design of the plant/building in order that the plant noise emission levels are achieved on site.

2.5.1. Internal onshore substation operational plant items

13. **Table 1** presents the noise data assumed for the various plant items located internally. Data has been supplied by the project designers.

Table 1 Summary of internal noise data for EIAR onshore substation operational plant noise model

Plant Item	Quantity	Location	Building	Sound Power Level, dB L_{WA} per item
Statcom transformer	3	Internal	Statcom 1 to 3	78
Stand by generator	1	Internal	GIS building	88

14. Based on the information above and the calculation of a statcom building volume of 13,858m^3 and a reverberation time of 3.0s reverberant internal noise levels within each statcom building estimated as 55 dB(A).

15. Based on the information above and the calculation of a generator room volume of 550m^3 located inside the GIS building and a reverberation time of 3.0s reverberant internal noise levels within the GIS building estimated as 79 dB(A).

16. The wall and roof façade compositions of the buildings are assumed to be formed from metal façade (11 kg/m^2) that offer the minimum sound reduction performance presented in **Table 2**.

Table 2 Summary of internal noise data for EIAR onshore substation operational plant noise model

Element	Octave Band Sound Reduction Index (R) dB							
	63	125	250	500	1000	2000	4000	8000
Wall metal façade	4	9	14	16	20	25	29	29
Roof metal façade	5	10	16	19	21	24	24	24

2.5.2. External plant items

17. **Table 3** presents the noise data assumed for the external shunt reactors and harmonic filters. Data has been supplied by the project designers.

Table 3 Summary of external noise data for EIAR onshore substation operational plant noise model

Plant Item	Quantity	Location	Sound Power Level, dB L_{WA} per item	Equipment height (m)
Shunt reactor	3	External	84	7
Harmonic filters	3	External	80	8

18. The shunt reactors have been modelled as fully external plant. The sides of shunt reactors have been modelled as emitting facades and the top as an emitting roof noise source. The model has assumed that the dimensions of each shunt reactor are 8.2m long by 3.2m wide and 7m high.

19. The sides of the harmonic filters have been modelled as vertical area sources and the top as an area source. The model has assumed that the dimensions of each harmonic filter are 3.7 m by 3.7 m wide and 8 m high.

2.6 Modelling calculation parameters

20. Prediction calculations for the onshore substation operational facility have been conducted in accordance with ISO 9613: *Acoustics – Attenuation of sound outdoors, Part 2: General method of calculation, 1996.*

2.6.1. Operating times

21. All the plant is operating simultaneously 100% of the time.

2.6.2. Directivity

22. 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. In this case the sound power level is measures in a down wind direction, corresponding to the most conservative propagation conditions and needs no further adjustment.

2.6.3. Ground effect

23. Ground effect is the result of sound reflected by the ground interfering with the sound propagating directly from source to receiver. The prediction of ground effects is inherently complex and depend on 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 0.0 for hard ground (including paving, ice concrete) and 1.0 for soft ground (includes ground covered by grass trees or other vegetation).

24. Our predictions have been carried out using various source height specific to each plant item, a receiver heights of 1.5m for single storey properties and 4m for two storey properties. An assumed ground factor of G = 0.0 has been applied off site.

25. Noise contours presented in the assessment have been predicted to a height of 4m in all instances.

2.6.4. Geometrical Divergence

26. This term relates to the spherical spreading in the free-field from a point sound source resulting in attenuation depending on distance according to the following equation:

$$A_{geo} = 20 \text{ x log (distance from source in meters)} + 11$$

2.6.5. Atmospheric Absorption

27. Sound propagation through the atmosphere is attenuated by the conversion of the sound energy into heat. This attenuation is dependent on the temperature and relative humidity of the air through which the sound is travelling and is frequency dependent with increasing attenuation towards higher frequencies.

28. In these predictions a temperature of 10^{o}C and a relative humidity of 70% have been used, which give relativity low levels of atmosphere attenuation and corresponding conservative noise predictions.

29. The atmospheric attenuation outlined in **Table 4** were used for all calculations.

Table 4 Atmospheric attenuation assumed for noise calculations (dB per km)

Temp (°C)	% Humidity	Octave Band Centre Frequencies (Hz)							
		63	125	250	500	1000	2000	4000	8000
10	70	0.12	0.41	1.04	1.93	3.66	9.66	32.77	116.88

3 References

30. ISO 9613 (1996): *Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation.*