MORAY WEST
OFFSHORE WINDFARM

Onshore Transmission Infrastructure Environmental Impact Assessment (EIA)

Moray Offshore Windfarm (West) Limited

Technical Appendix 10.2

Prediction and Assessment Methodology

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Acronyms	
Acronym	**Expanded Term**
dB	Decibel
HDD	Horizontal Directional Drilling
HGV	Heavy Goods Vehicle
Hz	Hertz
kV	Kilovolts
MSR	Mechanically Switched Capacitor Bank
NSR	Noise Sensitive Receptor
OnTI	Moray West Onshore Transmission Infrastructure
PPV	Peak Particle Velocity
SGT	Super Grid Transformer
SHR	Shunt Reactor
SVC	Static Var Compensation

1 Construction Prediction Methodology

1.1 Introduction

Noise and vibration levels have been predicted using information and methodology within BS 5228: 2009 (+A1: 2014), Code of practice for noise and vibration control on construction and open sites - Part 1: Noise and Part 2: Vibration.

1.2 Onshore Substation Construction Data

The following tables show the construction data, assumptions and results of the calculation of noise from the substation construction works.

Table 1.1: Construction data, assumptions and results of noise calculations from site clearance at Receptor 1

RECEPTOR LOCATION:				Receptor1 - C1						
ACTIVITY:	**Site Clearance**									
Static Noise Sources	BS 5228 Ref	Activity LWA	Distance to Receptor	On Time	'On Time' Correction	Hard or Soft Ground	Distance Correction	Barrier Correction	Façade Correction	LAeq,10hour (façade)
		dB(A)	m	%	dB(A)	(S or H)	dB(A)	dB(A)	dB(A)	dB(A)
Chain saw	Page 77 - Ref.44	114	690	10	-10.0	S	-72.0	0	3	35
Tracked Excavator (226kW, 40T)	Page 46 - Ref.14	107	690	50	-3.0	S	-72.0	0	3	35
Dozer (142kW, 20T)	Page 46 - Ref.12	109	690	50	-3.0	S	-72.0	0	3	37.0
TOTAL										40.6

Table 1.2: Construction data, assumptions and results of noise calculations from earthwork at Receptor 1

RECEPTOR LOCATION:				Receptor 1 - C1						
ACTIVITY:	**Earthwork**									
Static Noise Sources	BS 5228 Ref	Activity LWA	Distance to Receptor	On Time	'On Time' Correction	Hard or Soft Ground	Distance Correction	Barrier Correction	Façade Correction	LAeq,10hour (façade)
		dB(A)	m	%	dB(A)	(S or H)	dB(A)	dB(A)	dB(A)	dB(A)
Tracked Excavator (226kW, 40T)	Page 46 - Ref.14	107	690	50	-3.0	S	-72.0	0	3	35
Dump Truck - tipping Fill (306kW,29t)	Page 47 - Ref.30	107	690	50	-3.0	S	-72.0	0	3	35.0
TOTAL										38.0

Table 1.3: Construction data, assumptions and results of noise calculations from construction of foundations at Receptor 1

RECEPTOR LOCATION:	Receptor 1 - C1

ACTIVITY:	Foundations

Static Noise Sources	BS 5228 Ref	Activity LWA	Distance to Receptor	On Time	'On Time' Correction	Hard or Soft Ground	Distance Correction	Barrier Correction	Façade Correction	LAeq,10hour (façade)
		dB(A)	m	%	dB(A)	(S or H)	dB(A)	dB(A)	dB(A)	dB(A)
Concrete mixer truck (dischar	Page 51 - 28	103	690	50	-3.0	S	-72.0	0	3	31.0
Hydraulic Hammer Rig (4 t hammer	Page 48 - Ref.2	115	590	50	-3.0	S	-70.3	0	3	44.7
TOTAL										44.9

Table 1.4: Construction data, assumptions and results of noise calculations from installation at Receptor 1

RECEPTOR LOCATION:	Receptor 1 - C1

ACTIVITY:	Installation

Static Noise Sources	BS 5228 Ref	Activity LWA	Distance to Receptor	On Time	'On Time' Correction	Hard or Soft Ground	Distance Correction	Barrier Correction	Façade Correction	LAeq,10hour (façade)
		dB(A)	m	%	dB(A)	(S or H)	dB(A)	dB(A)	dB(A)	dB(A)
Mobile Telescopic Cr	Page 52 - Ref.39	105	690	50	-3.0	S	-72.0	0	3	33
Angle grinder	Page 54 - Ref. 93	108	690	10	-10.0	S	-72.0	0	3	29.0
TOTAL										34.5

Table 1.5:Construction data, assumptions and results of noise calculations from site clearance at Receptor 2

RECEPTOR LOCATION:	Receptor 2 - C2

ACTIVITY:	Site Clerance

Static Noise Sources	BS 5228 Ref	Activity LWA	Distance to Receptor	On Time	'On Time' Correction	Hard or Soft Ground	Distance Correction	Barrier Correction	Façade Correction	LAeq,10hour (façade)
		dB(A)	m	%	dB(A)	(S or H)	dB(A)	dB(A)	dB(A)	dB(A)
Chain saw	Page 77 - Ref.44	114	330	10	-10.0	S	-64.0	0	3	43
Tracked Excavator (226kW, 40T)	Page 46 - Ref.14	107	330	50	-3.0	S	-64.0	0	3	43
Dozer (142kW, 20T)	Page 46 - Ref.12	109	330	50	-3.0	S	-64.0	0	3	45.0
TOTAL										48.6

Table 1.6: Construction data, assumptions and results of noise calculations from earthwork at Receptor 2

RECEPTOR LOCATION:		Receptor 2 - C2								
ACTIVITY:	**Earthwork**									
Static Noise Sources	BS 5228 Ref	Activity LWA	Distance to Receptor	On Time	'On Time' Correction	Hard or Soft Ground	Distance Correction	Barrier Correction	Façade Correction	LAeq,10hour (façade)
		dB(A)	m	%	dB(A)	(S or H)	dB(A)	dB(A)	dB(A)	dB(A)
Tracked Excavator (226kW, 40T)	Page 46 - Ref.14	107	330	50	-3.0	S	-64.0	0	3	43
Dump Truck - tipping Fill (306kW,29t)	Page 47 - Ref.30	107	330	50	-3.0	S	-64.0	0	3	43.0
TOTAL										46.0

Table 1.7: Construction data, assumptions and results of noise calculations from foundations at Receptor 2

RECEPTOR LOCATION:		Receptor 2 - C2								
ACTIVITY:	**Foundations**									
Static Noise Sources	BS 5228 Ref	Activity LWA	Distance to Receptor	On Time	'On Time' Correction	Hard or Soft Ground	Distance Correction	Barrier Correction	Façade Correction	LAeq,10hour (façade)
		dB(A)	m	%	dB(A)	(S or H)	dB(A)	dB(A)	dB(A)	dB(A)
Concrete mixer truck (discharging) & Concrete pump (Pumping)	Page 51 - 28	103	330	50	-3.0	S	-64.0	0	3	39.0
Hydraulic Hammer Rig (4 t hammer	Page 48 - Ref.2	115	330	50	-3.0	S	-64.0	0	3	51.0
TOTAL										51.3

Table 1.8: Construction data, assumptions and results of noise calculations from Installation at Receptor 2

RECEPTOR LOCATION:		Receptor 2 - C2								
ACTIVITY:	**Installation**									
Static Noise Sources	BS 5228 Ref	Activity LWA	Distance to Receptor	On Time	'On Time' Correction	Hard or Soft Ground	Distance Correction	Barrier Correction	Façade Correction	LAeq,10hour (façade)
		dB(A)	m	%	dB(A)	(S or H)	dB(A)	dB(A)	dB(A)	dB(A)
Mobile Telescopic Cr	Page 52 - Ref.39	105	330	50	-3.0	S	-64.0	0	3	41
Angle grinder	Page 54 - Ref. 93	108	330	10	-10.0	S	-64.0	0	3	37.0
TOTAL										42.5

Table 1.9: Construction data, assumptions and results of noise calculations from site clearance at Receptor 3

RECEPTOR LOCATION:		Receptor 3 - C3								
ACTIVITY:	**Site Clerance**									
Static Noise Sources	BS 5228 Ref	Activity LWA	Distance to Receptor	On Time	'On Time' Correction	Hard or Soft Ground	Distance Correction	Barrier Correction	Façade Correction	LAeq,10hour (façade)
		dB(A)	m	%	dB(A)	(S or H)	dB(A)	dB(A)	dB(A)	dB(A)
Chain saw	Page 77 - Ref.44	114	590	10	-10.0	S	-70.3	0	3	37
Tracked Excavator (226kW, 40T)	Page 46 - Ref.14	107	590	50	-3.0	S	-70.3	0	3	37
Dozer (142kW, 20T)	Page 46 - Ref.12	109	590	50	-3.0	S	-70.3	0	3	38.7
TOTAL										42.3

Table 1.10: Construction data, assumptions and results of noise calculations from earthwork at Receptor 3

RECEPTOR LOCATION:				Receptor 3 - C3						
ACTIVITY:	**Earthwork**									
Static Noise Sources	BS 5228 Ref	Activity LWA	Distance to Receptor	On Time	'On Time' Correction	Hard or Soft Ground	Distance Correction	Barrier Correction	Façade Correction	LAeq,10hour (façade)
		dB(A)	m	%	dB(A)	(S or H)	dB(A)	dB(A)	dB(A)	dB(A)
Tracked Excavator (226kW, 40T)	Page 46 - Ref.14	107	590	50	-3.0	S	-70.3	0	3	37
Dump Truck - tipping Fill (306kW,29t)	Page 47 - Ref.30	107	590	50	-3.0	S	-70.3	0	3	36.7
TOTAL										39.7

Table 1.11: Construction data, assumptions and results of noise calculations from foundations at Receptor 3

RECEPTOR LOCATION:				Receptor 3 - C3						
ACTIVITY:	**Foundations**									
Static Noise Sources	BS 5228 Ref	Activity LWA	Distance to Receptor	On Time	'On Time' Correction	Hard or Soft Ground	Distance Correction	Barrier Correction	Façade Correction	LAeq,10hour (façade)
		dB(A)	m	%	dB(A)	(S or H)	dB(A)	dB(A)	dB(A)	dB(A)
Concrete mixer truck (discharging) & Concrete pump (Pumping)	Page 51 - 28	103	590	50	-3.0	S	-70.3	0	3	32.7
Hydraulic Hammer Rig (4 t hammer	Page 48 - Ref.2	115	590	50	-3.0	S	-70.3	0	3	44.7
TOTAL										45.0

Table 1.12: Construction data, assumptions and results of noise calculations from installation at Receptor 3

RECEPTOR LOCATION:				Receptor 3 - C3						
ACTIVITY:	**Installation**									
Static Noise Sources	BS 5228 Ref	Activity LWA	Distance to Receptor	On Time	'On Time' Correction	Hard or Soft Ground	Distance Correction	Barrier Correction	Façade Correction	LAeq,10hour (façade)
		dB(A)	m	%	dB(A)	(S or H)	dB(A)	dB(A)	dB(A)	dB(A)
Mobile Telescopic Crane (315kW, 80T)	Page 52 - Ref.39	105	590	50	-3.0	S	-70.3	0	3	35
Angle grinder	Page 54 - Ref. 93	108	590	10	-10.0	S	-70.3	0	3	30.7
TOTAL										36.2

Table 1.13: Construction data, assumptions and results of noise calculations from site clearance at Receptor 4

RECEPTOR LOCATION:				Receptor 4 - C4						
ACTIVITY:	**Site Clerance**									
Static Noise Sources	BS 5228 Ref	Activity LWA	Distance to Receptor	On Time	'On Time' Correction	Hard or Soft Ground	Distance Correction	Barrier Correction	Façade Correction	LAeq,10hour (façade)
		dB(A)	m	%	dB(A)	(S or H)	dB(A)	dB(A)	dB(A)	dB(A)
Chain saw	Page 77 - Ref.44	114	210	10	-10.0	S	-59.1	0	3	48
Tracked Excavator (226kW, 40T)	Page 46 - Ref.14	107	210	50	-3.0	S	-59.1	0	3	48
Dozer (142kW, 20T)	Page 46 - Ref.12	109	210	50	-3.0	S	-59.1	0	3	49.9
TOTAL										53.5

Table 1.14: Construction data, assumptions and results of noise calculations from earthwork at Receptor 4

RECEPTOR LOCATION:				Receptor 4 - C4						
ACTIVITY:	**Earthwork**									
Static Noise Sources	BS 5228 Ref	Activity LWA	Distance to Receptor	On Time	'On Time' Correction	Hard or Soft Ground	Distance Correction	Barrier Correction	Façade Correction	LAeq,10hour (façade)
		dB(A)	m	%	dB(A)	(S or H)	dB(A)	dB(A)	dB(A)	dB(A)
Tracked Excavator (226kW, 40T)	Page 46 - Ref.14	107	210	50	-3.0	S	-59.1	0	3	48
Dump Truck - tipping Fill (306kW,29t)	Page 47 - Ref.30	107	210	50	-3.0	S	-59.1	0	3	47.9
TOTAL										50.9

Table 1.15: Construction data, assumptions and results of noise calculations from foundations at Receptor 4

RECEPTOR LOCATION:				Receptor 4 - C4						
ACTIVITY:	**Foundations**									
Static Noise Sources	BS 5228 Ref	Activity LWA	Distance to Receptor	On Time	'On Time' Correction	Hard or Soft Ground	Distance Correction	Barrier Correction	Façade Correction	LAeq,10hour (façade)
		dB(A)	m	%	dB(A)	(S or H)	dB(A)	dB(A)	dB(A)	dB(A)
Concrete mixer truck (discharging) & Concrete pump (Pumping)	Page 51 - 28	103	210	50	-3.0	H	-54.4	0	3	48.5
Hydraulic Hammer Rig (4 t hammer	Page 48 - Ref.2	115	210	50	-3.0	S	-59.1	0	3	55.9
TOTAL										56.7

Table 1.16: Construction data, assumptions and results of noise calculations from installation at Receptor 4

RECEPTOR LOCATION:				Receptor 4 - C4						
ACTIVITY:										
Static Noise Sources	BS 5228 Ref	Activity LWA	Distance to Receptor	On Time	'On Time' Correction	Hard or Soft Ground	Distance Correction	Barrier Correction	Façade Correction	LAeq,10hour (façade)
		dB(A)	m	%	dB(A)	(S or H)	dB(A)	dB(A)	dB(A)	dB(A)
Mobile Telescopic Cr	Page 52 - Ref.39	105	210	50	-3.0	H	-54.4	0	3	51
Angle grinder	Page 54 - Ref. 93	108	210	10	-10.0	S	-59.1	0	3	41.9
TOTAL										51.1

1.4 Horizontal Directional Drilling Construction Data

Distances from horizontal direction drill (HDD) works within which residences would experience exceedances of various BS 5228 criteria were predicted based on the data within Table 1.17.

Table 1.17: HDD Construction Data

BS 5228 Ref.	L_{Aeq} at 10 m	Equipment Type	On-Time %	Duration Subtraction	Time Corrected	Number Operational Onsite	Quantity Corrected SWL
Page 49, Ref. 21.	79	Drill.	100.00 %	0	79	1	107
Page 53, Ref. 83.	65	Lighting and welfare generator.	100.00 %	0	65	1	93
Page 47, Ref. 45.	65	Water pump.	100.00 %	0	65	1	93
Page 47, Ref. 45.	65	Recycling unit (pump).	50.00 %	-3	62	1	90
Page 50, Ref. 14.	67	Backhoe loader.	10.00 %	-10	57	1	85
HDD Receiving Pit							
Page 53, Ref. 83.	65	Lighting and welfare generator.	100.00 %	0	65	1	93
Page 47, Ref. 45.	65	Water pump.	100.00 %	0	65	1	93
Page 50, Ref. 14.	67	Backhoe loader.	10.00 %	-10	57	1	85

1.5 Construction Traffic Data

Distances from construction traffic within which residences may experience exceedances of various BS 5228 criteria were predicted based on the data within Table 1.18. The noise levels predicted for the with and without scenarios are calculated 10 m from the kerbside.

Table 1.18: Traffic Data and Predicted Noise Level

Road	Existing Speed Limit (mph)	Future 2023 All Vehicle	Future 2023 - HGV %	2023+Dev Traffic - All Vehicle	2023+Dev - HGV %	$L_{A10, 18\ hr}$ Without OnTI	$L_{A10, 18\ hr}$ With OnTI	Diff
A98 south of Buckie.	60	8833	10.6 %	8892	10.6 %	66.9	67.0	0.0
A98 Cullen.	30	6175	10.4 %	6234	10.5 %	62.2	62.3	0.0

Table 1.18: Traffic Data and Predicted Noise Level								
Road	**Existing Speed Limit (mph)**	**Future 2023 All Vehicle**	**Future 2023 - HGV %**	**2023+Dev Traffic - All Vehicle**	**2023+Dev - HGV %**	**$L_{A10, 18\ hr}$ Without OnTI**	**$L_{A10, 18\ hr}$ With OnTI**	**Diff**
B9018 Lintmill.	30	744	14.6 %	859	24.5 %	53.1	53.8	0.7
A98 south of Sandend.	60	4472	17.1 %	4568	18.8 %	64.0	64.1	0.1
A98 Portsoy.	30	5304	12.1 %	5399	13.7 %	61.6	61.7	0.1
A9022 East of Longmuir Farm.	60	1027	12.4 %	1171	22.3 %	57.6	58.2	0.6
B9018 northeast of Berryhillock.	60	533	17.3 %	648	30.0 %	54.8	55.7	0.9
B9018 Grange Crossroads.	60	867	13.5 %	911	13.2 %	56.9	57.1	0.2
A95 Drumnagorrach.	60	1326	17.1 %	1470	24.5 %	58.7	59.2	0.5
A95 west of Davoch of Grange.	60	2117	16.0 %	2262	20.9 %	60.8	61.1	0.3
A96 Keith.	30	15746	6.7 %	15977	7.5 %	66.3	66.3	0.1
A96 northwest of Forgie.	60	8124	14.6 %	8227	14.6 %	66.6	66.7	0.1
A95 east of Rosarie.	60	1914	19.8 %	1914	19.8 %	60.3	60.3	0.0
A96 Moss Street northeast of Blackhillock Quarry.	60	8239	16.8 %	8470	18.1 %	66.7	66.8	0.1

1.6 Vibration

Predictions of vibration are based on the following formula as presented in BS 5228-2.

Peak particle velocity (PPV) at receptor = $180/(\text{distance})^{1.3}$

The resultant PPV levels are:

- 0.29 mm/s at 140 m;
- 0.88 mm/s at 60 m; and
- 3.66 mm/s at 20 m.

2 Operational Noise Prediction Methodology

2.1 Modelling Software

An onshore substation sound model was created using the Stapelfeldt LimA modelling suite. The LimA noise-modelling suite allows a 3-dimensional environmental model to be constructed using digital mapping and topographic data. LimA takes into account the following factors potentially affecting levels of noise propagation in the area surrounding a particular noise source:

- Sound source locations as shown by a draft site layout on Image 2.1 (G85221-MFW-D0-V001);
- Relative distances between sound sources / receptors;
- Locations and dimensions of barriers (man-made or topographic) and buildings between sound source and receptor;
- Ground contours, determining the relative heights of sources/ receptors and barriers; and
- Ground cover effects such as soft ground attenuation etc.

Calculation heights for daytime and night-time were considered at heights of 1.5 m and 4 m.

2.2 Calculation Methodology

The calculation methodology outlined within ISO 9613-2 (ISO 9613-2: 1996 Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation) was implemented for the sound propagation model. The ground cover was assumed to be a mix of hard and soft ground (G=0.5) and calculations were undertaken using octave frequency data for bands 63 Hz to 8kHz, sourced from publicly available data (Rampion Offshore Wind Farm, Environmental Statement Section 27 – Noise, December 2012 and Nemo Link UK Onshore Components, Environment Statement Section 12 – Noise and Vibration, February 2013).

2.3 Model Input Data

The model has been developed using OnTI plans and elevations and a daytime and night-time model was developed both with and without proposed mitigation. Furthermore, a number of other sources of data were added to the model, including;

- Ordnance Survey VectorMap Local mapping data, including locations of relevant buildings;
- Building and receptor locations outside the development boundary and assuming all buildings heights to be 8 m above local ground; and
- Topographical information in the form of 5 m digital terrain mapping contours.

2.4 Model Outputs

The outputs of the model were expressed as 10 m by 10 m grids with a height of 4 m and single receptor points on the closest façade of the noise sensitive receptor (NSR) to the substation for the following noise indicators:

- $L_{Aeq,1h}$ (07:00-23:00) – The equivalent continuous daytime sound exposure level according to BS 4142:2014; and
- $L_{Aeq,15min}$ (23:00-07:00) – The equivalent continuous night-time sound exposure level according to BS 4142:2014;

2.5 Selected Potential Noise Sensitive Receptors

The outputs of the model were expressed as noise grids and single receptor values with the results detailing the noise exposure at the closest NSRs. These receptors are identified in Table 2.1.

Table 2.1: Identified Potential NSRs				
Receptor ID	**Location**	**Description**	**Easting**	**Northing**
NSR1	Marypark	Representative of the closest receptor to the north-west of the onshore substation.	343800	846530
NSR2	Newtrack	Representative of the closest receptor to the north-east of the onshore substation.	344470	846360
NSR3	Mains of Pitlurg	Representative of the closest receptor to the south-west of the onshore substation.	343730	845580
NSR4	Whitehillock	Representative of the closest receptor to the south-east of the onshore substation.	344638	845630

2.6 Sound Source Data

This section outlines the data and assumptions used in the model. This data includes the number and associated sound emission data for the main sound emitting sources associated with the onshore substation development. Sources of data used in the modelling were as follows:

- Super grid transformer (SGT) x 2;
- Shunt reactor (SHR) x 4;
- Mechanically switched capacitor bank MSR reactor x 6;
- Static Var compensation (SVC) reactor x 6;
- 400 kilovolt (kV) harmonic filter x 6;
- 200 kV harmonic filter x 12;
- SGT coolers x 4;
- Shunt reactor coolers x 4; and
- SVC cooling fans x 40.

Each source has been modelled using the indicative frequency spectrum shown in Table 2.2. The indicative spectrum was considered to represent a reasonable conservative assumption of low frequency dominance in the 125 Hertz (Hz) octave band. A 3 decibel (dB) correction has also been added to the sound sources to account for hemi-spherical radiation as opposed to spherical radiation of which the model will calculate. A full list of the individual point sources used within the model is presented in Table 2.3 with the sound reductions used within the mitigated scenario. The indicative site layout is presented in Image 2.1. Heights for point sources were based on the indicative full height of equipment.

Table 2.2: Model Spectrum Sound Levels for Onshore Substation Sources									
Point Sources	**Octave Band (Hz) Sound Levels, dB(A)**								**Broadband Total, dB(A)**
	63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	
SGT	88.5	90.5	82.5	66.5	60.5	60.5	58.5	56.5	93.0
SHR	89.5	91.5	83.5	67.5	61.5	61.5	59.5	57.5	94.0
MSR reactor	76.5	78.5	70.5	54.5	48.5	48.5	46.5	44.5	81.0
SVC reactor	76.5	78.5	70.5	54.5	48.5	48.5	46.5	44.5	81.0

Table 2.2: Model Spectrum Sound Levels for Onshore Substation Sources									
Point Sources	**Octave Band (Hz) Sound Levels, dB(A)**								**Broadband Total, dB(A)**
	63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	
400kV filter	89.5	91.5	83.5	67.5	61.5	61.5	59.5	57.5	94.0
200kV filter	89.5	91.5	83.5	67.5	61.5	61.5	59.5	57.5	94.0
SGT coolers	73.5	75.5	67.5	51.5	45.5	45.5	43.5	41.5	78.0
SHR coolers	82.5	84.5	76.5	60.5	54.5	54.5	52.5	50.5	87.0
SVC cooling fans	78.5	80.5	72.5	56.5	50.5	50.5	48.5	46.5	83.0

Table 2.3: Onshore Substation Sources used in Model		
Name	**Mitigation Correction (dBA)**	**Height (m)**
200kV1A_A	-20	4.5
200kV1A_B	-20	4.5
200kV1A_C	-20	4.5
200kV1B_A	-20	4.5
200kV1B_B	-20	4.5
200kV1B_C	-20	4.5
200kV2A_A	-20	4.5
200kV2A_B	-20	4.5
200kV2A_C	-20	4.5
200kV2B_A	-20	4.5
200kV2B_B	-20	4.5
200kV2B_C	-20	4.5
400kV1_A	-20	5.0
400kV1_B	-20	5.0
400kV1_C	-20	5.0
400kV2_A	-20	5.0
400kV2_B	-20	5.0
400kV2_C	-20	5.0
MSR1_A	-15	6.0
MSR1_B	-15	6.0
MSR1_C	-15	6.0
MSR2_A	-15	6.0
MSR2_B	-15	6.0
MSR2_C	-15	6.0

Table 2.3: Onshore Substation Sources used in Model		
Name	**Mitigation Correction (dBA)**	**Height (m)**
SGT1	-25	5.5
SGT1_COOL_A	0	9.5
SGT1_COOL_B	0	9.5
SGT2	-25	5.5
SGT2_COOL_A	0	9.5
SGT2_COOL_B	0	9.5
SHR1	-15	4.5
SHR1_COOL	-9	7.5
SHR2	-15	4.5
SHR2_COOL	-9	7.5
SHR3	-15	4.5
SHR3_COOL	-9	7.5
SHR4	-15	4.5
SHR4_COOL	-9	7.5
SVC_COOL_A	-5	2.8
SVC_COOL_B	-5	2.8
SVC_PR_1A	-15	5.5
SVC_PR_1B	-15	5.5
SVC_PR_1C	-15	5.5
SVC_PR_2A	-15	5.5
SVC_PR_2B	-15	5.5
SVC_PR_2C	-15	5.5

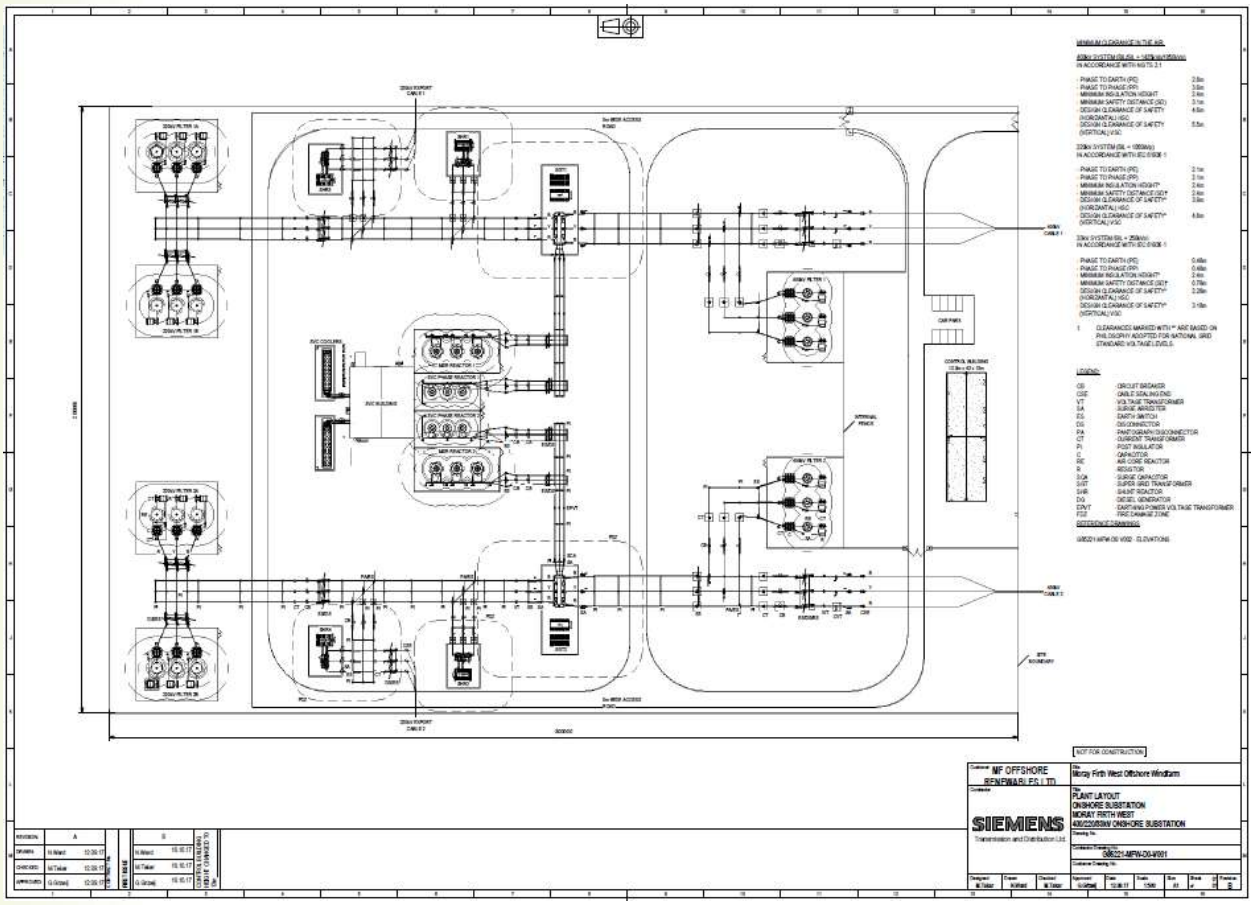

Image 2.1: Indicative Onshore Substation Site Layout

3 Assessment Criteria

The delineation of different magnitudes of impact are based on relevant British Standards and advice within the Technical Advice Note for noise as follows.

3.1 Construction Noise

The noise assessment utilises the example criteria within Appendix E of BS 5228-1. Example Method 2 states that noise generated by works are deemed to be potentially significant if the total noise (including baseline) exceeds pre-construction baseline by 5 dB subject to the lower cut-off values of 65 dB during the day (07:00-19:00), 55 dB during the evening (19:00-23:00) and 45 dB during the night-time (23:00-07:00) from work noise alone. BS 5228-1 states that exceedance of these levels could potentially be significant if continued for a period of one month or more, unless a shorter duration is likely to result in a significant effect.

To capture potentially significant effects for a shorter duration, the assessment has also considered the criteria for noise insulation and temporary housing eligibility in section E.4 of BS 5228-1. This example suggests that noise insulation could be offered if noise levels from construction works exceeds the levels in Table 3.1 or 5 dB above the existing pre-construction noise level, whichever is higher, for either of the following periods:

- A period of 10 or more days in any rolling 15 day period; or
- A total number of days exceeding 40 in any rolling 6 month period.

Table 3.1: Construction Noise Criteria for Short-term Works (<1 month)

Time	Relevant Time Period	Averaging Time, T	Noise Insulation Trigger Level dB $L_{Aeq,T}$
Monday to Friday	07:00-08:00	1 h	70
	08:00-18:00	10 h	75
	18:00-19:00	1 h	70
	19:00-22:00	3 h	65
	22:00-07:00	1 h	55
Saturday	07:00-08:00	1 h	70
	08:00-18:00	5 h	75
	18:00-19:00	1 h	70
	19:00-22:00	3 h	65
	22:00-07:00	1 h	55
Sunday and Public Holidays	07:00-21:00	1 h	65
	21:00-07:00	1 h	55

The eligibility for temporary rehousing is suggested for noise levels 10 dB above the trigger levels or existing pre-construction noise level, whichever is higher.

3.2 Construction Traffic Noise

The assessment of magnitude for traffic noise impacts uses criteria within the Design Manual for Roads and Bridges (Highways Agency, 2011) for short-term increases in noise as referenced in the Technical Advice Note: Assessment of Noise (Scottish Government, 2011).

3.3 Construction Vibration

The magnitude of impacts for vibration have been based on the perception of effect level described within BS 5228-2 as replicated in Table 3.2.

Table 3.2: Construction Vibration Effects

Vibration Level	Effect
0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.3 mm/s	Vibration might be just perceptible in residential environments.
1.0 mm/s	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents,
10 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure to this level in most building environments.

Criteria for vibration effects on buildings tend to be less stringent than on human perception (except at very low frequencies) and therefore the above criteria are considered as the constraining factor in an assessment of vibration levels from construction works.

3.4 Operational Noise

Industrial noise is assessed in accordance with BS 4142:2014 Methods for rating and assessing industrial and commercial sound. BS 4142:2014 contains guidance on the monitoring and assessment of industrial and commercial sound sources (including fixed installations comprising mechanical and electrical plant and equipment) affecting sensitive receptors.

The methodology detailed for determining the effects of new or existing sound sources relies on comparing the operational rating level, LAr,Tr, with the background sound level, LA90,T (i.e. the level that would be present without the development) over a representative time period. The representative time period depends on the time of day that the sound source operates, i.e. 1 hour during the daytime and 15 minutes during the night-time. It provides guidance on the measurement of background sound, the determination of specific sound and calculation of the rating level.

Certain acoustic features can increase the significance of effect over that expected from a basic comparison between the specific sound level and the background sound level. Where such features are present at the assessment location, a character correction should be added to the specific sound level to obtain the rating level.

The BS 4142:2014 assessment methodology also states that:

- Typically, the higher the rating level is above the background sound level the greater the magnitude of impact;
- The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact;

- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context;
- A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context; and
- Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

The context of assessment can include a variety of factors including the absolute noise level, the number of receptors affected, the historic and existing noise environment and the importance of the development to the affected residences or local, regional or national requirements.

4 References

International Standards Organisation (1996). ISO 9613-2: 1996 Acoustics – Attenuation of sound during propagation outdoors – Part 2: General Method of Calculation.

Highways Agency (2011). Design Manual for Road and Bridges, Volume 11, HD 213/11.

Scottish Government (2011). Technical Advice Note: Assessment of Noise.

British Standards Institution (2014a). BS 4142:2014 Method for rating industrial noise affecting mixed residential and industrial areas.

British Standards Institution (2014b). BS 5228-1: 2009 +A1: 2014 Code of practice for noise and vibration control on construction and open sites – Part 1: Noise.

British Standards Institution (2014c). BS 5228-2: 2009 +A1: 2014 Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration.

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