Scottish & Southern Electricity Networks

Creag Dhubh to Inveraray 275 kV OHL Connection Environmental Impact Assessment

Volume 4 |Technical Appendix 13.1

Noise

September 2022

13.1 Technical Appendix – Noise

This Technical Appendix provides details of the input noise data which inform the construction noise impact assessment (CNIA) and operational noise impact assessment. Detailed results of the noise assessment are presented.

13.1.1 Construction Noise

13.1.1.1 Quasi Static Forestry Noise

BS 5228 does not give sound power levels for forestry equipment. Hence a generic value of 116 dB(A) has been assumed. This is higher than the cumulative noise of all other activities in any given phase.

13.1.1.2 Static and Quasi Static OHL Construction Noise

Table 1-1 to Table 1-3 show the plant activities, items, their quantities, utilisation, and associated noise levels at 10 m from the source, based on worst-case construction activities from a similar overhead line construction. Combining the utilisation and quantity of equipment, an equivalent noise level at 10 m can be calculated for each row. These are then logarithmically summed to give a total value for the construction noise at 10 m. To ensure a worst-case assessment, it has been assumed that all works within the same phase will take place simultaneously. The nature of construction activities is localised, short term and intermittent.

Table 1-1: Assumed Construction Activities and Associated Noise Levels for Foundations

Activity	Plant Item	Quantity	Utilisation %	Sound Power, LW (dB(A))	Sound Power corrected for quantity and utilisation, LW (dB(A))	LAeq at 10 m (dB)
Foundations	C4.7 Concrete mixer truck	2	100%	107	***110***	***110***
	C4.24 Concrete pump	2	100%	96	***99***	***99***
	C2.15 Excavator	2	50%	104	***104***	***104***
	C4.33 Poker Vibrator	2	50%	106	***106***	***106***
	C4.95 Impact Wrench	2	50%	101	***101***	***101***
Total					***113***	***85***

Table 1-2: Assumed Construction Activities and Associated Noise Levels for Tower Erection

Activity	Plant Item	Quantity	Utilisation %	Sound Power, LW (dB(A))	Sound Power corrected for quantity and utilisation, LW (dB(A))	LAeq at 10 m (dB)
Tower Erection	D7.121 Lorry (pulling up)	1	50%	98	**95**	**67**
	D12.5 Wheeled loader	1	50%	114	**111**	**83**
	C4.57 Telehandler	2	50%	95	**95**	**67**
	C4.41 Crane	2	50%	99	**99**	**71**
Total					**112**	**84**

Table 1-3: Assumed Construction Activities and Associated Noise Levels for Stringing with Conductors

Activity	Plant Item	Quantity	Utilisation %	Sound Power, LW (dB(A))	Sound Power corrected for quantity and utilisation, LW (dB(A))	LAeq at 10 m (dB)
Stringing with Conductors	C3.7 Hydraulic jack	2	100%	98	**101**	**73**
	C.457 MEWP	2	50%	95	**95**	**67**
Total					**102**	**74**

The total equivalent noise level at 10 m for each activity can be used in a propagation calculation to find the specific noise at each noise sensitive receptor NSR.

13.1.1.3 Access Road Construction Noise from Mobile Plant Traffic

Mobile plant activities during access track build will be heavy plant movements to the access track from the remote borrow pit transporting the road build materials as the build progresses. It is intended that the base road refurbishment will be largely completed before road grading and profiling follow later. The pace of road refurbishment will be determined by the varying amounts of material required per unit run to provide adequate load bearing on varying qualities of ground surface. If the resource allocation is to be constant, the rate of progress will depend upon the nature of the surface upon which the road is being built or upgraded. As the access track build progresses, the pattern of road traffic movement will alter affecting the contribution from this source to the various receptors over the duration of the build of the access road.

The noise contribution from the lorries transporting material along the access road, at the receptors, will vary as the distance along the haul road varies. This contribution to the energy averaged noise level at the receptors can be calculated from the following expression from Section F.2.5 of BS5228-1:

$L_{Aeq} = L_{WA} - 33 + 10\log_{10}Q - 10\log_{10}V - 10\log_{10}d + A$ – air absorption – ground absorption where:

L_{WA} = Sound power level of plant item, taken as a single engine vehicle of sound power 118 dB(A)

Q = Number of plant item journeys per hour, assumed as 1.

d = Distance to centre of haul road

$A = 10\log_{10}(\alpha/180)$

α = Angle of view of the haul road

V = Speed of vehicle, taken as 24 km per hour

Air absorption is taken as 0.0035 dBm^{-1} and attenuation due to ground absorption is assumed negligible.

The critical access tracks around each receptor were approximated by straight lines. Only the access tracks that are within 1 km of each receptor were assessed. The noise contributions of each straight-line segment were logarithmically summed to find the overall sound pressure level at each receptor. These are logarithmically summed to the sound pressure level at the receptor due to each construction phase to find a total sound pressure level.

13.1.1.4 Construction Noise Results

The following tables Table 1-4 to

Table 1-6 show each receptor NSR, the distance to the nearest point of the Proposed Development, the estimated sound pressure level at the receptor, and the exceedance compared to the limit. Topographical screening is not considered in this assessment to maintain a conservative estimate.

Table 1-4: BS 5228-1 Assessment – Foundations – Daytime

NSR	Shortest Distance to OHL (m)	Daytime Construction Noise Limit (dB)	Sound Pressure Level at Receptor due to Access Tracks (dB)	Sound Pressure Level at Receptor due to Foundations (dB)	Total Sound Pressure Level at Receptor (dB)	Construction Noise Limit Exceedance
NSR 1 - High Balantyre	139.3	65	37	60	60	-5
NSR 2 - Sallachry	408.3	65	43	50	50	-15
NSR 3 - Kilmun	331.9	65	42	52	52	-13
NSR 4 - Three Bridges	669.5	65	41	45	46	-19
NSR 5 - Linneghlutton	695.1	65	32	44	45	-20
NSR 6 - Stronmagachan	806.0	65	38	43	44	-21
NSR 7 - Drimfern	494.0	65	44	48	49	-16
NSR 8 - South Tullich	333.4	65	49	52	54	-11
NSR 9 - North Tullich	224.4	65	38	55	56	-9

Table 1-5: BS 5228-1 Assessment – Tower Erection – Daytime

NSR	Shortest Distance to OHL (m)	Daytime Construction Noise Limit (dB)	Pressure Level at Receptor due to Access Tracks (dB	Sound Pressure Level at Receptor due to Tower Erection (dB)	Total Sound Pressure Level at Receptor (dB)	Construction Noise Limit Exceedance
NSR 1 - High Balantyre	139.3	65	37	59	59	-6
NSR 2 - Sallachry	408.3	65	43	49	50	-15
NSR 3 - Kilmun	331.9	65	42	51	51	-14
NSR 4 - Three Bridges	669.5	65	41	44	46	-19
NSR 5 - Linneghlutton	695.1	65	32	43	44	-21
NSR 6 - Stronmagachan	806.0	65	38	42	44	-21
NSR 7 - Drimfern	494.0	65	44	47	49	-16
NSR 8 - South Tullich	333.4	65	49	51	53	-12
NSR 9 - North Tullich	224.4	65	38	54	55	-10

Table 1-6: BS 5228-1 Assessment – Stringing to Conductors – Daytime

NSR	Shortest Distance to OHL (m)	Daytime Construction Noise Limit (dB)	Pressure Level at Receptor due to Access Tracks (dB	Sound Pressure Level at Receptor due to Stringing (dB)	Total Sound Pressure Level at Receptor (dB)	Construction Noise Limit Exceedance
NSR 1 - High Balantyre	139.3	65	37	49	49	-16
NSR 2 - Sallachry	408.3	65	43	38	44	-21
NSR 3 - Kilmun	331.9	65	42	40	44	-21
NSR 4 - Three Bridges	669.5	65	41	34	41	-24
NSR 5 - Linneghlutton	695.1	65	32	33	36	-29
NSR 6 - Stronmagachan	806.0	65	38	32	39	-26
NSR 7 - Drimfern	494.0	65	44	37	45	-20
NSR 8 - South Tullich	333.4	65	49	40	50	-15
NSR 9 - North Tullich	224.4	65	38	44	45	-20

13.1.2 Operational Noise

Wood has been provided with a document 'Overhead Line System Parameters -TG-NET-OHL-511'[1] detailing calculations performed for various OHL conductors and configurations. The contents of the document have been reviewed and the relevant audible noise (AN) value extracted for the Proposed Development.

The type of line indicated for the Proposed Development is a 275 kV L8 Rubus. The relevant data points from the received information are provided in **Table 1-7**.

The surface gradient calculation was reported as performed by the Markt & Mengele method.

Audible noise values are calculated based on the easement width for the voltage in question at the easement width of 35 m for 275 kV, in both dry and wet (L_{50}) conditions are presented in **Table 1-7**.

[1] TG-NET-OHL-511, Overhead Line System Parameters, SSEN, 2021

Table 1-7: Noise Emission Data		
Voltage	kV	275
Tower	-	L8
Conductor Code	-	Rubus
Surface gradient (Max)	kV/cm	11.56
Surface gradient (Average)	kV/cm	10.72
L50 fair weather AN	dB(A)	4.20
L_{50} rain AN	dB(A)	29.20

The data were incorporated into the calculations of received noise at NSR locations.

The data do not include spectra, and therefore the sound is assumed broadband in nature. In line with advice from TR(T)94, it is known that a 100 Hz tone can become prominent at higher rain rates and therefore a penalty of 5 dB is added at rain rates of 1 mm/hr and above.

Using published rainfall noise data and the above measured dry background noise levels together with a description of the ground cover and the sound power data for the conductors, the emission of conductor noise has been predicted and its impact on the NSRs assessed under wet conditions.

The distance between the line source and NSR have been calculated using line geometry. The calculation considers X, Y, Z coordinates of the Proposed Development towers with respect to NSR coordinates to determine an accurate distance between from source to receiver.

A TR(T)94 assessment has been conducted to determine where the results indicate complaints are likely rather than no observed reaction. The TR(T)94 assessment assesses the impact of noise during dry and wet conditions, based on the sound power level per metre of the conductor and the background noise level. The predicted noise level at the receptor is calculated based on a propagation model.

13.1.2.1 Dry Assessment

The noise impact from the Proposed Development during dry conditions has been assessed using the British Standard 4142:2014 noise assessment approach. The excess dry figure is calculated by assuming attenuation of 11.4 dB for each factor of 10 in distance or “11.4 dB/decade”. This is consistent with the BPA method of calculating OHL noise. This assumes the OHL produces no tonal or other distinctive noise characteristics when dry.

The dry noise input level has been taken from Table 1-7 reference levels. Giving the following reference value:

4.6 dB(A) at reference distance 35 m.

This value has been used in the following formula for each receptor:

$$AN(dry) = 4.6 - 11.4log_{10}\left(\frac{R}{35}\right) - BGN$$

Where; R= geometric distance to receptor, including Z + height of the line. BGN = assigned background noise at the receptor.

13.1.2.2 Wet Assessment

During wet conditions, the noise output from OHLs varies according to the number and size of rain droplets accumulated on the surface of the conductors. Therefore, there is a strong relationship between the rainfall rate and the noise output from an OHL. Background noise levels also increase with rainfall rate, such that during very heavy rain noise is generally inaudible. For these reasons, an alternative noise assessment method to deal with rain-induced noise is required. The external rain-induced noise levels will be assessed using the methodology developed by National Grid and detailed in their Technical Report TR(T) 94, which is recommended by the Department of Energy & Climate Change for the assessment of rain induced noise.

The excess wet figure is derived by integrating the total noise as a function of rain rate, weighted according to the probability of a given rain rate. Hourly rain distribution data are taken from Met Office stations Dunstaffnage and Tyndrum_no_3, assuming a lognormal distribution.

- Mean Annual Rain (mm/year) = 2071.48
- Mean Annual Rain = 2232.30 Hours
- Mean Rain Rate = 0.93 (mm/hour)

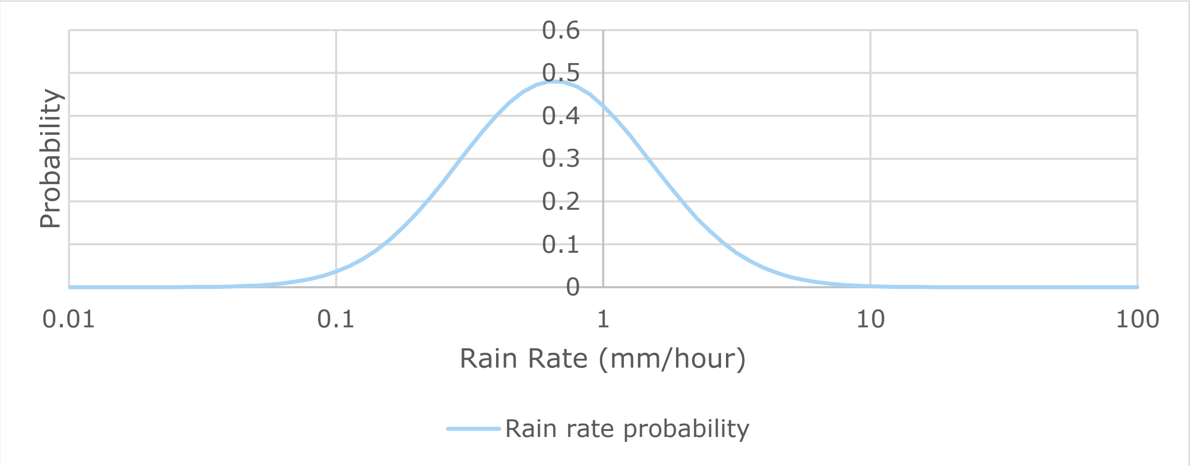

Figure 1.1: Rain Rate Probability Distribution

The excess wet figure is compared against a background noise level calculated through the addition of dry background noise levels and predicted noise due to rainfall according to the Miller curve value for that specific NSR. Miller curve descriptions are provided in **Table 1-8.**

Table 1-8: Miller Curve Description

Miller Curve	Description
R-1	Essentially bare, porous ground (that is ploughed field or snow covered ground); no standing puddles or water. Relatively small-leafed ground cover vegetation, such as grass lawn, meadow, hayfield shortly after mowing, field of small-leaf plants.
R-2	Non-porous, hard, bare ground or pavement, falling raindrops splash on thin layers of puddles of collected water; or in or beside wooded area of deciduous trees without leaves or with only small leaves; or in or beside wooded area of coniferous trees or evergreens having needles rather than leaves; or thin-leafed ground cover of crop, such as hay, clover or grain.
R-3	A few small, fully leafed deciduous trees 15 to 30 m or a few large, fully leafed trees 30 to 90 m distance.
R-4	Large area of fully leafed trees or large-leafed crops or vegetation, such as corn starting 15 to 30 m distance.
R-5	Large area of fully-leafed trees or large-leafed crops or vegetation entirely surrounding the area of interest.

The wet sound level is based on data from **Table 1-7** reference levels.

- 29.2 dB(A) at reference distance 35 m

A 5 dB tonal penalty has been applied at rain rates over 1 mm/hr in accordance with TR(T)94.

Tables 1-9 and **1-10** below show the results of the operational noise assessment that has been prepared for the purpose of assessing the effects of dry and wet overhead line noise on any nearby residents.

13.1.3 Operational Noise Assessment Results

Table 1-9: Overhead Line Preferred Alignment

NSR ID	X	Y	Background Noise Level (LA90)	Miller Curve	Distance to Line (m)	Closest Tower	Dry Excess dB (rounded)	Wet Excess dB (rounded)	Dry Assessment	Wet Assessment
NSR 1 - High Balantyre	207862	711720	24.1	R-1	139.4	34	-26	1	No Observed Reaction	No Observed Reaction
NSR 2 - Sallachry	207677	712233	21.4	R-1	407.5	32	-29	0	No Observed Reaction	No Observed Reaction
NSR 3 - Kilmun	207831	712720	22	R-2	332.2	30	-29	0	No Observed Reaction	No Observed Reaction
NSR 4 - Three Bridges	208795	712402	36.4	R-2	670.5	31	-46	0	No Observed Reaction	No Observed Reaction
NSR 5 - Linneghlutton	208932	712951	45.3	R-3	696.6	30	-56	0	No Observed Reaction	No Observed Reaction
NSR 6 - Stronmagachan	208222	714089	24.3	R-1	807.5	27	-35	0	No Observed Reaction	No Observed Reaction
NSR 7 - Drimfern	208094	714620	25.5	R-1	495.3	22	-34	0	No Observed Reaction	No Observed Reaction
NSR 8 - South Tullich	208510	715433	28	R-1	335.5	29	-35	0	No Observed Reaction	No Observed Reaction
NSR 9 – North Tullich	208880	716078	23.4	R-2	226.6	16	-28	0	No Observed Reaction	No Observed Reaction

Table 1-10: Temporary Diversions

NSR ID	X	Y	Background Noise Level (LA90)	Miller Curve	Distance to Line (m)	Closest Tower	Dry Excess dB (rounded)	Wet Excess dB (rounded)	Dry Assessment	Wet Assessment
NSR 1 - High Balantyre	207862	711720	24.1	R-1	107.2	D1	-25	1	No Observed Reaction	No Observed Reaction
NSR 2 - Sallachry	207677	712233	21.4	R-1	407.5	32	-29	0	No Observed Reaction	No Observed Reaction
NSR 3 - Kilmun	207831	712720	22	R-2	332.2	30	-29	0	No Observed Reaction	No Observed Reaction
NSR 4 - Three Bridges	208795	712402	36.4	R-2	670.5	31	-46	0	No Observed Reaction	No Observed Reaction
NSR 5 - Linneghlutton	208932	712951	45.3	R-3	696.6	30	-56	0	No Observed Reaction	No Observed Reaction
NSR 6 - Stronmagachan	208222	714089	24.3	R-1	807.5	27	-35	0	No Observed Reaction	No Observed Reaction
NSR 7 - Drimfern	208094	714620	25.5	R-1	495.3	22	-34	0	No Observed Reaction	No Observed Reaction
NSR 8 - South Tullich	208510	715433	28	R-1	335.5	29	-35	0	No Observed Reaction	No Observed Reaction
NSR 9 – North Tullich	208880	716078	23.4	R-2	226.6	16	-28	0	No Observed Reaction	No Observed Reaction