APPENDIX 12-2

ASSESSMENT OF A TURBINE RANGE

APPENDIX 12-2: NOISE ASSESSMENT OF TURBINE RANGE

This Appendix presents the methodology of the consideration of various turbine models in the noise assessment. There are four candidate turbines considered, as follows:

- Scenario 1: Nordex N163 at hub height (HH) of 103.5 m and tip height (TH) of 185m;
- Scenario 2: Vestas V162 at HH of 104 m at TH of 185 m;
- Scenario 3: General Electric GE158 at HH of 101 m and TH of 180 m;
- Scenario 4: Nordex N149 at HH of 103.5 m and TH of 178 m.

These candidate turbine models are considered representative of the type of turbine that could be installed.

The purpose of this noise assessment is to demonstrate the with any of the candidate turbines, the environmental noise criteria can be complied with.
The approach taken to include each scenario in the noise assessment is as follows:

- To predict a set of noise levels at each NSL over the wind speed range for each of Scenarios 1, 2, 3 and 4, resulting in four tables of noise levels;
- To combine these four sets of results into a single table by taking the highest of the four sets of results for each NSL and wind speed, and
- To compare the resulting table against the criteria.

1.1 Sound Power Levels

The following tables present the noise emissions in terms of sound power levels (SWLs) for each of the four candidate turbines.

Appendix Table 12-2-1. SWL for the Nordex N163 at a hub height of 103.5 m

Standardised 10m Height Wind Speed (m/s)	Octave Band (Hz) Sound Power Levels (dB re 10^{-12}W)								
	63	125	250	500	1k	2k	4k	8k	dB(A)
3	81.0	85.7	88.0	88.5	88.9	86.8	77.3	58.4	95.0
4	82.5	87.2	89.5	90.0	90.4	88.3	78.8	59.9	96.5
5	87.0	91.7	94.0	94.5	94.9	92.8	83.3	64.4	101.0
6	91.4	96.1	98.4	98.9	99.3	97.2	87.7	68.8	105.4
7	92.5	97.2	99.5	100.0	100.4	98.3	88.8	69.9	106.5
8	92.6	97.3	99.6	100.1	100.5	98.4	88.9	70.0	106.6
9	92.6	97.3	99.6	100.1	100.5	98.4	88.9	70.0	106.6

Appendix Table 12-2-2. SWL for the Vestas V162 at a hub height of 104 m

Standardised 10m Height Wind Speed (m/s)	Octave Band (Hz) Sound Power Levels (dB re 10^{-12}W)								
	63	125	250	500	1k	2k	4k	8k	dB(A)
3	75.2	82.9	87.6	89.4	88.1	84.0	76.8	66.7	94.2
4	76.8	84.5	89.2	90.9	89.8	85.6	78.5	68.3	95.8
5	80.8	88.5	93.2	94.9	93.8	89.6	82.5	72.4	99.8
6	84.4	92.1	96.8	98.5	97.4	93.2	86.2	76.1	103.4
7	85.2	92.9	97.7	99.4	98.3	94.2	87.1	77.0	104.3
8	84.8	92.7	97.6	99.5	98.4	94.2	87.2	77.0	104.3
9	84.8	92.7	97.6	99.5	98.4	94.2	87.2	77.0	104.3

Appendix Table 12-2-3. SWL for the General Electric GE158 at a hub height of 101 m

Standardised 10m Height Wind Speed (m/s)	Octave Band (Hz) Sound Power Levels (dB re 10^{-12}W)								
	63	125	250	500	1k	2k	4k	8k	dB(A)
3	76.5	83.2	87.0	87.4	87.8	86.6	81.1	65.3	94.0
4	78.4	86.3	91.0	90.9	89.8	87.9	83.2	68.8	96.8
5	82.5	89.5	94.6	96.0	95.6	92.9	87.1	72.9	101.5
6	86.5	91.9	96.4	98.9	100.6	98.4	91.0	75.2	105.3
7	88.2	93.4	97.9	100.4	102.4	100.3	92.8	76.8	107.0
8	88.2	93.4	97.9	100.4	102.4	100.3	92.8	76.8	107.0
9	88.2	93.4	97.9	100.4	102.4	100.3	92.8	76.8	107.0

Appendix Table 12-2-4. SWL for the Nordex N149 at a hub height of 103.5 m

Standardised 10m Height Wind Speed (m/s)	Octave Band (Hz) Sound Power Levels (dB re 10^{-12}W)								
	63	125	250	500	1k	2k	4k	8k	dB(A)
3	73.9	81.2	85.9	87.5	88.0	87.4	82.5	74.5	94
4	75.1	82.4	87.1	88.7	89.2	88.6	83.7	75.7	95.2
5	77.8	85.5	90.2	92.9	94.6	94.2	87.5	77.6	99.8
6	82.2	89.9	94.6	97.3	99.0	98.6	91.9	82.0	104.2
7	83.6	91.3	96.0	98.7	100.4	100.0	93.3	83.4	105.6
8	84.6	92.3	95.0	99.1	100.8	99.3	93.7	83.9	105.6
9	84.6	92.3	95.0	99.1	100.8	99.3	93.7	83.9	105.6

1.2 Predicted Noise Levels for Each Scenario and Selection of Highest Value

This section shows how predicted noise levels from four scenarios have been combined into a single set of predicted noise levels for assessment against the wind turbine noise criteria. For brevity, Table 12-4-4 shows predicted noise levels for the five closest locations to a proposed turbine, i.e.: H001, H030, H031, H032 to H346. In each case, the highest predicted noise level among the four scenarios is shown in boldface.

Appendix Table 12-4-4. Maximum Predicted Noise Level among 4 Scenarios

Ref.	Parameter	Predicted Omni-directional $L_{A90,10\ min}$ Levels (dB) at various Standardised 10m Height Wind Speeds (m/s)						
		3	4	5	6	7	8	9
H001	Scenario 1: N163	**32.6**	34.0	38.6	**42.8**	**44.0**	**44.2**	**44.2**
	Scenario 2: V162	31.8	33.4	37.4	41.0	41.9	41.9	41.9
	Scenario 3: GE158	31.1	**34.2**	**38.8**	42.3	44.0	44.0	44.0
	Scenario 4: N149	30.8	32.0	36.2	40.6	42.0	42.3	42.3
	Highest	32.6	34.2	38.8	42.8	44.0	44.2	44.2
H030	Scenario 1: N163	**31.6**	33.1	37.6	**41.9**	**43.1**	**43.2**	**31.6**
	Scenario 2: V162	30.8	32.4	36.4	40.0	40.9	40.9	30.8
	Scenario 3: GE158	30.2	**33.2**	**37.9**	41.4	43.0	43.0	30.2
	Scenario 4: N149	29.8	31.0	35.2	39.6	41.1	41.3	29.8
	Highest	31.6	33.2	37.9	41.9	43.1	43.2	31.6
H031	Scenario 1: N163	**31.9**	33.4	37.9	**42.2**	**43.4**	**43.5**	**31.9**
	Scenario 2: V162	31.1	32.7	36.7	40.3	41.2	41.2	31.1
	Scenario 3: GE158	30.4	**33.5**	**38.2**	41.6	43.3	43.3	30.4
	Scenario 4: N149	30.1	31.3	35.4	39.8	41.4	41.6	30.1
	Highest	31.9	33.5	38.2	42.2	43.4	43.5	31.9
H032	Scenario 1: N163	**31.5**	33.0	37.5	**41.6**	**43.0**	**43.1**	**31.5**
	Scenario 2: V162	30.7	32.3	36.3	39.9	40.8	40.8	30.7
	Scenario 3: GE158	30.0	**33.1**	**37.7**	41.2	42.8	42.8	30.0
	Scenario 4: N149	29.6	30.8	35.0	39.4	40.9	41.1	29.6
	Highest	31.5	33.1	37.7	41.6	43.0	43.1	31.5
H346	Scenario 1: N163	**29.6**	31.0	35.6	**39.3**	**41.0**	**41.2**	**41.2**
	Scenario 2: V162	28.8	30.4	34.4	38.0	38.8	38.8	38.8
	Scenario 3: GE158	28.1	**31.2**	**35.8**	39.1	40.8	40.8	40.8
	Scenario 4: N149	27.6	28.8	32.9	37.3	38.8	39.0	39.0
	Highest	29.6	31.2	35.8	39.3	41.0	41.2	41.2

In this instance, the Scenarios 1 and 3 result in the highest predicted noise levels, depending on the wind speed.

1.3 Assessment of Highest Predicted Noise Levels against Criteria

The last stage of the assessment of turbine range is to compare the highest predicted noise levels among the scenarios against the proposed turbine noise criteria. This is shown in Table 12-4-5 for locations H022, H041, H063, H317, and H349, these being the five nearest non-involved NSLs to a proposed turbine.

Appendix Table 12-4-5. Maximum Predicted Noise Level among 4 Scenarios

Ref.	Parameter	Predicted Omni-directional $L_{A90,10\ min}$ Levels (dB) at various Standardised 10m Height Wind Speeds (m/s)						
		3	4	5	6	7	8	9
H022	Highest Predicted	29.6	31.3	35.9	39.2	41.2	41.2	41.2
	Daytime Criterion	40	40	40	40	45	45	45
	Daytime Excess	--	--	--	--	--	--	--
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	--	--	--	--	--	--	--
H041	Predicted	28.1	29.7	34.3	37.7	39.6	39.7	39.7
	Daytime Criterion	40	40	40	40	45	45	45
	Daytime Excess	--	--	--	--	--	--	--
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	--	--	--	--	--	--	--
H063	Predicted	29.6	31.2	35.8	39.1	41.0	41.2	41.2
	Daytime Criterion	40	40	40	40	45	45	45

	Daytime Excess	--	--	--	--	--	--	--
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	--	--	--	--	--	--	--
H317	Predicted	28.5	30.2	34.7	38.0	40.0	40.1	40.1
	Daytime Criterion	40	40	40	40	45	45	45
	Daytime Excess	--	--	--	--	--	--	--
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	--	--	--	--	--	--	--
H349	Predicted	29.0	30.6	35.2	38.6	40.4	40.6	40.6
	Daytime Criterion	40	40	40	40	45	45	45
	Daytime Excess	--	--	--	--	--	--	--
	Night-time Criterion	43	43	43	43	43	43	43
	Night-time Excess	--	--	--	--	--	--	--

Conclusion

As the highest predicted noise levels among the four scenarios comply with the wind turbine noise criteria, thus any one of the turbine models considered could be selected and the Proposed Wind Farm would be capable of achieving compliance within the noise criteria as per the Guidelines (DEHLG, 2006).