HEATHLAND WIND FARM

TECHNICAL APPENDIX A13.2

CUMULATIVE NOISE EMISSION DATA

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1 TECHNICAL APPENDIX A13.2: CUMULATIVE NOISE EMISSION DATA

1.1 PEARIE LAW WIND FARM

- 6 x GE-3.2-103 wind turbines
- Hub Height of 75 m
- Rotor Diameter of 103 m
- Tip Height of 127 m
- Arcus modelling determined that a minimum of 1.6 dB headroom against consented limits was available at controlling properties most wind speeds, during both day and night.
- 1.6 dB has therefore been added to manufacturer's data in the cumulative assessment.

Table A13.2.1 details the noise emission data applied in the cumulative assessment.

Table A13.2.1: Noise Emission Data applied for Pearie Law Wind Farm

	Standardised 10 m Wind Speed, ms^{-1}								
	4	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
	Sound Power Level, L_w, dB(A)								
Manufacturer's data[1] + 2 dB for uncertainty	97.9	101.4	104.6	106.5	107.0	107.0	107.0	107.0	107.0
Modelled data, including 1.6 dB for headroom	99.5	103.0	106.2	108.1	108.6	108.6	108.6	108.6	108.6
Octave Band Centre Frequency, Hz	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**SUM**
Manufacturer's data[1] scaled to 108.6 dB(A)	83.0	93.2	97.7	99.5	101.1	102.8	102.6	96.8	108.6

1.2 TORMYWHEEL WIND FARM TORMYWHEEL EXTENSION WIND FARMS

- Tormywheel
  - 12 x Senvion MM92 wind turbines
  - Hub Height 65 m
  - Rotor Diameter 92 m
  - Tip Height 111 m
- Extension
  - 3 x GE-3.2-102 wind turbines
  - Hub Height of 75 m
  - Rotor Diameter of 103 m
  - Tip Height of 127 m
- Arcus modelling determined that significant headroom against consented limits was available during both day and night.

[1] GE Power & Water, Technical Documentation, Wind Turbine Generator Systems, 3.2-103 – 50 Hz and 60 Hz, Product Acoustic Specifications, Normal Operation according to IEX Incl. Octave Band Spectra Incl. 1/3 Octave Band Spectra, 2014

- 2 dB has therefore been added to manufacturer's data in the cumulative assessment.

Tables A13.2.2 and A13.2.3 detail the noise emission data applied in the cumulative assessment.

Table A13.2.2: Noise Emission Data applied for Tormywheel Wind Farm

	Standardised 10 m Wind Speed, ms^{-1}								
	4	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
	Sound Power Level, L_w, dB(A)								
Manufacturer's data[2] + 2 dB for uncertainty	94.5	101.9	104.2	105.1	105.2	105.2	105.2	105.2	105.2
Modelled data, including 2 dB for headroom	96.5	103.9	106.2	107.1	107.2	107.2	107.2	107.2	107.2
Octave Band Centre Frequency, Hz	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**SUM**
Manufacturer's data[2] scaled to 107.2 dB(A)	89.9	95.6	99.1	101.7	101.9	98.2	94.3	80.1	107.2

Table A13.2.3: Noise Emission Data applied for Tormywheel Wind Farm

	Standardised 10 m Wind Speed, ms^{-1}								
	4	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
	Sound Power Level, L_w, dB(A)								
Manufacturer's data[2] + 2 dB for uncertainty	98.2	101.3	104.5	106.6	107.0	107.0	107.0	107.0	107.0
Modelled data, including 2 dB for headroom	100.2	103.3	106.5	108.6	109.0	109.0	109.0	109.0	109.0
Octave Band Centre Frequency, Hz	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**SUM**
Manufacturer's data[2] scaled to 109.0 dB(A)									

1.3 PATES HILL WIND FARM

- 7 x Vestas V80 wind turbines
- Hub Height of 67 m
- Rotor Diameter of 80 m
- Tip Height of 107 m
- No decision notice for Pates Hill was available online.
- 2 dB has therefore been added to manufacturer's data in the cumulative assessment, assuming significant headroom as a worst-case scenario.

Table A13.2.4 details the noise emission data applied in the cumulative assessment.

[2] From Tormywheel Extension Environmental Statement

Table A13.2.4: Noise Emission Data applied for Pates Hill Wind Farm

	Standardised 10 m Wind Speed, ms^{-1}								
	4	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
	Sound Power Level, L_w, dB(A)								
Manufacturer's data[3] + 2 dB for uncertainty	*n/a*	100.8	104.3	105.7	106.1	106	105.7	105.5	105.2
Modelled data, including 2 dB for headroom	*99.3*[4]	102.8	106.3	107.7	108.1	108	107.7	107.5	107.2
Octave Band Centre Frequency, Hz	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**SUM**
Manufacturer's data[3] scaled to 108.1 dB(A)	89.1	93.5	99.5	101.7	103.0	101.2	96.1	87.4	89.1

1.4 HARBURNHEAD WIND FARM

- 22 x Enercon E82 2.3MW wind turbines with Trailing Edge Serrations
- Hub Heights of 78 & 85 m (all modelled as 85 m as worse-case)
- Rotor Diameter of 82 m
- Tip Height of 126 m
- Arcus Condition Discharge Report show significant headroom against consented noise limits.
- 2 dB has therefore been added to manufacturer's data in the cumulative assessment.

Table A13.2.5 details the noise emission data applied in the cumulative assessment.

Table A13.2.5: Noise Emission Data applied for Harburnhead Wind Farm

	Standardised 10 m Wind Speed, ms^{-1}								
	4	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
	Sound Power Level, L_w, dB(A)								
Manufacturer's data[5] + 1 dB for uncertainty	*n/a*	97.3	100.6	102.4	103.0	103.0	103.0	103.0	103.0
Modelled data, including 2 dB for headroom	*98.0*[6]	99.3	102.6	104.4	105.0	105.0	105.0	105.0	105.0
Octave Band Centre Frequency, Hz	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**SUM**
Manufacturer's data[5] scaled to 105.0 dB(A)	88.2	94.3	97.3	98.6	99.9	96.8	89.2	76.8	105.0

[3] From Tormywheel Extension ES
[4] Extrapolated from values at 5 and 6 ms^{-1}
[5] From Arcus condition Discharge Report
[6] Extrapolated from values at 5 and 6 ms^{-1}

1.5 BLACK LAW AND EXTENSIONS WIND FARMS

- Black Law Wind Farm
  - 54 x Bonus 2.3MW wind turbines
  - Hub Height of 70 m
  - Rotor Diameter of 82 m
  - Tip Height of 111 m
- Black Law Extensions I & II
  - 34 x Siemens SWT-2.3-93 wind turbines
  - Hub Height of 80 m
  - Rotor Diameter of 93 m
  - Tip Height of 127 m
- Arcus modelling determined that predicted noise levels for the combined effect of Black Law and Extensions I&II were within +/- 1 dB of consented limits.
- No addition has therefore been applied in the cumulative assessment.

Table A13.2.6 and A13.2.7 detail the noise emission data applied in the cumulative assessment.

Table A13.2.6: Noise Emission Data applied for Black Law Wind Farm

	Standardised 10 m Wind Speed, ms^{-1}								
	4	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
	Sound Power Level, L_w, dB(A)								
Manufacturer's data[7] + 2 dB for uncertainty	101.0	104.6	105.2	106.1	107.4	109.2	111.6	114.7	118.7
Octave Band Centre Frequency, Hz	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**SUM**
Manufacturer's data scaled to 107.4 dB(A)	91.2	98.4	99.3	100.4	100.7	100.0	96.8	88.2	107.4

Table A13.2.7: Noise Emission Data applied for Black Law Extensions I &II

	Standardised 10 m Wind Speed, ms^{-1}								
	4	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
	Sound Power Level, L_w, dB(A)								
Manufacturer's data[8] + 2 dB for uncertainty	94.5	101.5	105.8	107.4	107.4	107.4	107.4	107.4	107.4
Octave Band Centre Frequency, Hz	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**SUM**
Manufacturer's data scaled to 107.4 dB(A)	87.2	94.9	96.9	100.7	102.1	101.2	97	84.4	107.4

[7] From Black Law Extension I ES
[8] Siemens, Standard Acoustic Emission, SWT-2.3-93, Rev. 4

1.6 MUIRHALL WIND FARMS

- Muirhall Wind Farm
  - 6 x Senvion MM92 wind turbines
  - Hub Height of 80 m
  - Rotor Diameter of 92 m
  - Tip Height of 126 m
- Muirhall Extension Wind Farm
  - 3 x Senvion 3.2M 114 wind turbines
  - Hub Height of 90 m
  - Rotor Diameter of 114 m
  - Tip Height of 147 m
- Muirhall South Wind Farm
  - 3 x GE 2.75-120 wind turbines
  - Hub Height of 85 m
  - Rotor Diameter of 120 m
  - Tip Height of 145 m
- Arcus modelling determined that predicted noise levels (without consideration of directivity) for the combined effect of the Muirhall Wind Farms exceeded consented noise limits at two receptors.
- No addition has therefore been applied in the cumulative assessment.

Table A13.2.7 to A13.2.9 detail the noise emission data applied in the cumulative assessment.

Table A13.2.7: Noise Emission Data applied for Muirhall Wind Farm

	Standardised 10 m Wind Speed, ms^{-1}								
	4	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
	Sound Power Level, L_w, dB(A)								
Manufacturer's data[9] + 2 dB for uncertainty	96.6	102.4	104.3	105.2	105.2	105.2	105.2	105.2	105.2
Octave Band Centre Frequency, Hz	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**SUM**
Manufacturer's data[10] scaled to 105.2 dB(A)	87.9	93.6	97.1	99.7	99.9	96.2	92.3	78.1	105.2

Table A13.2.8: Noise Emission Data applied for Muirhall Extension Wind Farm

	Standardised 10 m Wind Speed, ms^{-1}								
	4	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
	Sound Power Level, L_w, dB(A)								
Manufacturer's data[9] + 2 dB for uncertainty	98.4	102.5	105	105.2	105.1	104.8	104.8	104.8	104.8

[9] From Muirhall South ES, further 1 dB added here
[10] Senvion, Power Curve & Sound Power Level MM92 [2050kW/50&60Hz]

Octave Band Centre Frequency, Hz	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**SUM**
Manufacturer's data[9] scaled to 105.2 dB(A)	87.2	93.1	99.9	100.1	98	94.9	89.7	81.9	87.2

Table A13.2.9: Noise Emission Data applied for Muirhall South Wind Farm

	Standardised 10 m Wind Speed, ms^{-1}								
	4	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
	Sound Power Level, L_w, dB(A)								
Manufacturer's data[11] + 2 dB for uncertainty	101.0	106.5	108.0	108.0	108.0	108.0	108.0	108.0	108.0
Octave Band Centre Frequency, Hz	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**SUM**
Manufacturer's data[11] scaled to 108.0 dB(A)	90.3	96.6	100.4	102.5	102.6	99.6	91.1	74.1	108.0

1.7 SINGLE WIND TURBINES

Table A13.2.10 Details the single turbines developments included in the cumulative noise assessment.

Table A13.2.10 Single Turbine Development Details

Name	**Planning Reference**	**Status**	**Hub Height (m)**	**Rotor Diameter (m)**	**Tip Height (m)**	**Model**
Muldron Farm	LIVE/0422/FUL/13	Approved	50	54	77	EWT DW54
Greenwall Farm	CL/13/0433	Operational	71	56	99	PowerWind 56
Climpy	CL/11/0517	Approved	73	53	99.5	Enercon E-53
Upper Haywood 1	CL/11/0070	Operational	40	52	66	EWT D52
Bing Field	CL/14/0430	Approved	40	30	55	WTN 250
Burnfoot Poultry Farm	CL/3/0332	Approved	50	54	77	EWT DW54
Moutainblaw Farm	CL/12/0243	Operational	15	11	20.5	C&F 11-15m mast

Table A13.2.11 details the sound power levels in relation to wind speed assumed for each in the cumulative assessment, inclusive of appropriate additions for uncertainty in accordance with the GPG, plus a further 2 dB cumulative assessment addition.

[11] GE Power & Water, Technical Documentation, Wind Turbine Generator Systems, 2.75-120 – 50 Hz and 60 Hz, Product Acoustic Specifications, Normal Operation according to IEC, Incl. Octave Band Spectra, Incl. 1/3rd Octave Band Spectra

Table A13.2.11: Noise Emission Data applied for Single Wind Turbines

Develop-ment	Turbine Model	Standardised 10 m Wind Speed, ms^{-1}								
		4	5	6	7	8	9	10	11	12
		Sound Power Level, L_w, dB(A)								
Muldron Farm[12]	EWT DW54	99.0	102.5	101.0	102.0	103.0	103.5	103.5	103.5	103.5
Greenwall Farm[13]	PowerWind 56	96.5	99.7	102.9	106.1	107.8	108.2	107.8	107.8	107.8
Climpy[14]	Enercon E-53	96.5	98.2	101.7	104.1	105.5	106.5	106.5	106.5	106.5
Upper Haywood 1[12]	EWT D52	98.5	102.0	100.5	101.5	102.5	103.3	103.5	103.5	103.5
Bing Field[15]	WTN 250	98.5	102.0	100.5	101.5	102.5	103.3	103.5	103.5	103.5
Burnfoot Poultry Farm[12]	EWT DW54	98.9	100.0	101.1	102.2	103.3	104.5	105.8	108.2	109.4
Moutainblaw Farm[16]	C&F 11-15m mast	87.6	89.0	90.4	91.8	93.2	94.6	96.0	97.4	98.8
Octave Band Centre Frequency, Hz		**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**SUM**
Muldron Farm	EWT DW54	86.0	92.1	97.3	98.5	96.7	94.1	87.3	75.8	103.5
Greenwall Farm	PowerWind 56	86.9	92.2	101.2	100.5	102.9	101.4	97.8	85.2	108.2
Climpy	Enercon E-53	88.4	95.4	100.2	98.5	100.9	99.3	92.3	82.1	106.5
Upper Haywood 1	EWT D52	85.7	91.8	97.1	98.4	97	94.5	87.6	75.8	103.5
Bing Field	WTN 250	84.4	95.5	100.0	99.8	97.8	97.7	92.6	85.6	105.8
Burnfoot Poultry Farm	EWT DW54	86.0	92.1	97.3	98.5	96.7	94.1	87.3	75.8	103.5
Moutainblaw Farm	C&F 11-15m mast	-	-	96.0[17]	-	-	-	-	-	96.0

[12] Data from Tormywheel Extension ES, 9 ms^{-1} spectrum, includes tonal penalty at 5 ms^{-1}, 1 dB added for uncertainty as addition applied in ES not stated
[13] Data from Tormywheel Extension ES, 9 ms^{-1} spectrum, includes 2 dB for uncertainty
[14] Data from Tormywheel Extension ES, 9 ms^{-1} spectrum, includes 1 dB for uncertainty
[15] Data from planning application documentation, 2 dB added for uncertainty
[16] Data from ES Appendix for original Heathland Wind Farm Application
[17] As no spectrum was available for the C&F11-15, in accordance with the GPG all noise emission was modelled at 250 Hz.