

Tween Bridge Solar Farm

Environmental Statement Appendix 13.2: Noise Source Information

Planning Act 2008
Infrastructure Planning (Applications: Prescribed Forms
and Procedure) Regulations 2009

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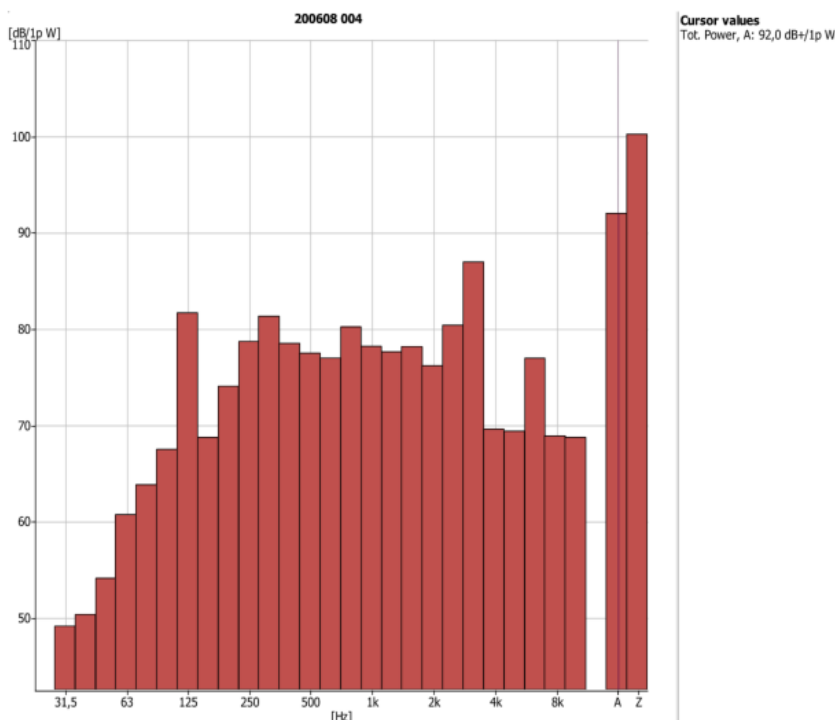
1 Introduction

1.1.1. As indicated in the main body of the **ES Chapter 13 Noise and Vibration [Document Reference 6.2.13 Revision 2]**, the precise specification of the noise generating equipment are not confirmed, however in keeping with the guidance of NPS EN-1 and EN-3, a worst-case assessment has been undertaken. Indicative noise source information has been used for the type of equipment typically used for Solar and BESS facilities.

1.2. Solar Central Inverter and Inverter Skid

1.2.1. The noise emission profile of the SMA inverter skid has been used. Noise data taken from the manufacturer’s specification sheets is presented below.

Sound Power Levels of the Third Octave Band Frequencies according to EN ISO 9614-2



Third octave band center frequency [Hz]	Sound - Power-level LwA [dBA/pW] 4600 kW
25 Hz	42,46
31,5 Hz	49,16
40 Hz	50,35
50 Hz	54,13
63 Hz	60,74
80 Hz	63,84
100 Hz	67,51
125 Hz	81,69
160 Hz	68,75
200 Hz	74,07
250 Hz	78,72
315 Hz	81,34
400 Hz	78,51
500 Hz	77,5
630 Hz	76,99
800 Hz	80,23
1 kHz	78,21
1,25 kHz	77,64
1,6 kHz	78,17
2 kHz	76,2
2,5 kHz	80,41
3,15 kHz	86,97
4 kHz	69,62
5 kHz	69,41
6,3 kHz	76,98
8 kHz	68,91
10 kHz	68,76
A	92,01
Z	100,24

1.3. BESS Storage Container – SunGrow ST2752-UX

- 1.3.1. The batteries of a BESS unit are largely silent during operation. That said, the manner in which the BESS units deal with the build-up of heat from the batteries, governs the noise emissions profile of the unit.
- 1.3.2. Noise generated during operation can vary depending on a number of factors including the prevailing ambient air temperature and the operational demand placed on the units.
- 1.3.3. The assessments presented in the ES chapter utilise data for the SunGrow ST2752 batteries. SunGrow are a well-established producer of solar and BESS equipment and manufacture a range of BESS units which would be suitable for the Scheme. Through experience on a wealth of other BESS schemes, it is considered that the noise levels produced by the SunGrow ST2752 equipment is typical of current BESS technology. The manufacturer’s data for the units is presented below.



Type designation	ST2752UX-US
Battery Data	
Cell type	LFP
Battery capacity (BOL)	2752 kWh
Battery voltage range	1160 – 1500 V
General Data	
Dimensions of battery unit (W * H * D)	9340*2600*1730mm
Weight of battery unit	26,400kg
Degree of protection	IP 54/Type 3R
Operating temperature range	-30 to 50 °C (> 45 °C derating)
Relative humidity	0 – 95 % (non-condensing)
Max. working altitude	3000m
Cooling concept of battery chamber	Liquid cooling
Fire safety	Fused sprinkler heads, NFPA 69 explosion prevention and ventilation IDLH gases
Communication interfaces	RS485, Ethernet
Communication protocols	Modbus RTU, Modbus TCP
Compliance	UL 9540, UL 9540A/NFPA 855
2 HOURS APPLICATION-ST2752UX*4-5000UD-MV-US	
BOL kWh(DC/AC LV Side)	11,008kWh DC/10,379kWh AC
ST2752UX Quantity	4
PCS Model	SC5000UD-MV-US
4 HOURS APPLICATION-ST2752UX*8-5000UD-MV-US	
BOL kWh(DC/AC LV Side)	22,016kWh/21,448kWh
ST2752UX Quantity	8
PCS Model	SC5000UD-MV-US
Grid Connection Data	
Max.TH.D of current	< 3 % (at nominal power)
DC component	< 0.5 % (at nominal power)
Power factor	> 0.99 (at nominal power)
Adjustable power factor	1.0 leading ~ 1.0 lagging
Nominal grid frequency	60 Hz
Grid frequency range	55 – 65 Hz
Transformer	
Transformer rated power	5,000 kVA
LV/MV voltage	0.9 kV / 34.5 kV
Transformer cooling type	ONAN (Oil Natural Air Natural)
Oil type	Mineral oil (PCB free) or degradable oil on request

1.4. BESS Medium Voltage Substation – SunGrow MVS 5140–LS–US

1.4.1. The assessments presented in the ES chapter utilise data for the SunGrow MVS5140–LS–US. As above, the SunGrow equipment is considered a reasonable representation of the type of noise levels produced by typical MVS plant. The manufacturer’s data for the units is presented below.



Product Name	MVS5140-LS-US
MV transformer	
Rated power	5140 kVA
MV / LV voltage	34.5 kV / 0.69 kV
Transformer vector	Dy1
Windings	2 windings
Rated frequency	60 Hz
Impedance	9 % (± 7.5 % , IEEE tolerance)
Efficiency standard	99 % @ 100 % load
Material of winding (MV / LV)	Aluminum / Aluminum
Legged core design	3 Legged core Design
High voltage configuration	Loop-feed, Dead Front
Overcurrent protection	Expulsion fuses in series with Partial-Range Current-Limiting Fuses
Cooling method	KNAN
Insulation fluid	Degradable oil
Smart control cabinet	
Protection	AC Breaker
Surge protection	Type II
AC Insulation detection	Support
Cooling Method	Air cooling and HVAC
UPS	15 min (Default) 2 / 3 / 4 h (Optional)
General data	
Dimensions (W * H * D)	6058 mm * 2896 mm * 2438 mm 238.5" * 114.0" * 96.0"
Weight	15300 kg 33730 lbs
Cable entry	Bottom entry
Degree of protection	Type 3S
Anti-corrosion degree	C4
Operation temperature range	-40 °C – 60 °C -40 °F – 140 °F > 40 °C (104 °F) derating (Default) > 45 °C (113 °F) derating (Optional)
Operation humidity range	0 % – 100 %
Max. operating altitude	3000 m 9842.5 ft
Communication	Ethernet, Optical fiber, RS485
Standard	UL 891, IEEE C57.12.00, IEEE C57.12.80, IEEE C57.12.90

* 15min UPS only supplies power for the control and communication devices in the MVS
 ** 2 / 3 / 4 h UPS supplies power for the control and communication devices in the the MVS, and the ventilation system in the battery container

2.4 Test result and conclusion

a. The test results of sound power level under each operating condition are as follows:

No.	Operating condition	Sound power level/dBA	Expanded uncertainty U/dBA
1	MVS SCC operates at full power	83.76	2.5

Note: The sound power level of MV transformer is 58.64dBA, which has little impact on the test results of sound power

b. After correction, the sound pressure level test results at the measuring point 1m away from the machine surface are as follows:

No.	Operating condition	Front/dBA	Right/dBA	Back/dBA	Left/dBA	Top/dBA	Expanded uncertainty/dBA
1	MVS SCC operates at full power	58.8	51.5*	70.9	61.3	62.0	2.5

Note: The data with * is close to the background noise, and the noise correction result is given according to the test value of -3dBA.

1.5. 400kV and 132kV Substation

1.5.1. The mechanism by which transformers typically generate noise is called magnetostriction and is effectively the deformation of magnetic elements within the transformer during operation. Noise data for substation transformer units is scarce and varies significantly depending on the type of unit and manufacturer.

1.5.2. Noise data for a 132kV transformer is presented below. Note, this is significantly lower than the levels used in the assessments; therefore, the calculations presented in **ES Chapter 13 Noise and Vibration [Document Reference 6.2.13 Revision 2]** are considered a worst-case assessment.

11.2 Determination of Sound Levels

Maximum sound power levels in Table 4 are replaced with the following -

Primary voltage	ONAN Sound Power Level dB(A)	ONAF/OFAP Sound Power Level dB(A)
33kV	65	80
66kV	74	80
132kV	75	80

1.5.3. As above, noise data for a 400kV transformer is not readily available and can vary significantly depending on the type of transformer and manufacturer. The

information below presents noise data for a number of oil / fluid filled transformer units over a range of rated power levels.

Mineral oil or Midel 7131 fluid filled

Rated power	315kVA	500kVA	800kVA	1000kVA	1250kVA	1500kVA	2000kVA
Rated frequency	50Hz	50Hz	50Hz	50Hz	50Hz	50Hz	50Hz
Phases	3	3	3	3	3	3	3
Rated primary voltage	11kV	11kV	11kV	11kV	11kV	11kV	11kV
Rated primary insulation level	12kV	12kV	12kV	12kV	12kV	12kV	12kV
Power frequency test voltage (r.m.s.)	28kV	28kV	28kV	28kV	28kV	28kV	28kV
Basic Impulse Level (BIL) (peak)	75kV	75kV	75kV	75kV	75kV	75kV	75kV
De-energised tappings by switch (6 position)	±2.5%, ±5% & +7.5%	±2.5%, ±5% & +7.5%	±2.5%, ±5% & +7.5%	±2.5%, ±5% & +7.5%	±2.5%, ±5% & +7.5%	±2.5%, ±5% & +7.5%	±2.5%, ±5% & +7.5%
Secondary voltage at no-load between phases	433V	433V	433V	433V	433V	433V	433V
Secondary voltage at no-load phase to neutral	250V	250V	250V	250V	250V	250V	250V
Rated secondary insulation level	1.1kV	1.1kV	1.1kV	1.1kV	1.1kV	1.1kV	1.1kV
Power frequency test voltage (r.m.s.)	3kV	3kV	3kV	3kV	3kV	3kV	3kV
Vector group	Dyn 11	Dyn 11	Dyn 11	Dyn 11	Dyn 11	Dyn 11	Dyn 11
No load loss (maximum loss - no positive tolerance)	324w	459w	585w	693w	855w	1015w	1305w
Load losses at 75 C (Maximum loss - no positive tolerance)	2800w	3900w	6000w	7600w	9500w	11285w	15000w
Rated impedance at 75 C (subject to BS EN 60076 tolerances)	4.75%	4.75%	4.75%	4.75%	5.00%	5.50%	6.00%
Sound power level	54dB(A)	56dB(A)	58dB(A)	59dB(A)	60dB(A)	61dB(A)	62dB(A)
Sound pressure at 0.3 m	42dB(A)	44dB(A)	46dB(A)	47dB(A)	48dB(A)	49dB(A)	50dB(A)
Maximum ambient temperature for operation	40 C	40 C	40 C	40 C	40 C	40 C	40 C
Daily average ambient temperature for operation	30 C	30 C	30 C	30 C	30 C	30 C	30 C
Yearly average ambient temperature for operation	20 C	20 C	20 C	20 C	20 C	20 C	20 C

1.5.4. Data for 'dry' transformers, being those transformers with no liquid cooling mechanism, are presented below.

Note: Table details IP00 core and coil type transformers – no enclosure

Rated power	kVA	500	630	800	1000	1250	1600	2000	2500	3150
Length (L)	mm	1410	1420	1500	1530	1660	1750	1800	1840	1980
Width (W)	mm	800	800	800	950	950	950	1230	1230	1270
Height (H)	mm	1450	1550	1680	1860	1780	1940	2130	2330	2560
Total weight	kg	1459	1652	2060	2368	2874	3460	3960	4700	6120
Technology										
PIR : Pre-impregnated Resin on foil conductor	LV	PIR	PIR	PIR	PIR	PIR	PIR	PIR	PIR	PIR
VCR: glass-fibre insulated winding, encapsulated in Vacuum Cast Resin	HV	VCR	VCR	VCR	VCR	VCR	VCR	VCR	VCR	VCR
Noise level										
Sound power Lw(A)	dB(A)	60	61	63	64	66	67	69	70	73
Sound pressure at 1 m Lp(A)	dB(A)	47	48	50	50	52	53	55	55	58

1.5.5. The noise data used in **ES Chapter 13 Noise and Vibration [Document Reference 6.2.13 Revision 2]** for the 400kV transformer is considered a worst-case assessment.