Longfield Solar Farm

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Appendix 11D: Operational Noise Modelling

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Quality information

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1. Operational Noise Modelling

1.1 Modelling Methodology

1.1.1 In order to determine potential operational noise emissions from the development, noise prediction models have been prepared using the CadnaA® v2020 software package which employs the noise prediction routines commonly used in the UK (e.g., ISO 9613 Acoustics – Attenuation of Sound during Propagation Outdoors – Part 1: Calculation of the absorption of sound by the atmosphere (1993) and Part 2: General Method of Calculation (1996).

1.1.2 The following assumptions and parameters have been used to prepare the noise model:

a) The modelled Scheme layout has been based on ***Figure 2-5: Illustrative Concept Design Layout*** **[EN010118/APP/6.3]**;

b) Sound source heights for inverters and transformers have been based on information in ***Chapter 2: The Scheme***, **Table 2-1**: 'Indicative details of the design parameters used for the ES assessment' **[EN010118/APP/6.1]**;

c) The ground acoustic absorption has been set to 1.0 (considered appropriate for predominantly open grass field and farmland in accordance with ISO 9613-2);

d) The maximum order of reflections was 2;

e) Air temperature was assumed to be 10 degrees and humidity 70%;

f) Building massing in the surrounding area outside of the Order limits has been sourced from Ordnance Survey Open Map data and modelled with a standard height of 8m.

g) Land topography has been sourced from Ordnance Survey Open Map data;

h) No boundary fences/walls have been included in the noise model;

i) Receiver points have been modelled as 1.5m above local ground level (representative of ground-floor windows); and

j) Modelling assumes the site is continuously operational during daytime and night-time.

1.2 Sound Level Data – Solar Station Inverters and Transformers

1.2.1 The proposed inverters are SMA MV power stations which are based on SMA Sunny Central inverters. Manufacturer test data for SMA Sunny Central inverters quotes sound pressure levels of up to 68 dB(A) at a measurement distance of 10m. The equivalent sound power level is calculated to be 96 dB(A).

1.2.2 Transformers associated with the inverters will have noise emissions approximately 10 dB(A) below that of the inverters. Noise from solar station

transformers will not be audible above noise from the inverters and have not been included in the modelling.

1.2.3 Inverters have been modelled as area sources with a source height of 3.6m.

1.3 Sound Level Data – BESS Battery Storage Units

1.3.1 The proposed battery storage units are Gridsolv Quantum units with the main noise source being associated cooling fans. The manufacturer has advised each unit has two chillers with a quoted sound pressure levels of 71 dB(A) at a measurement distance of 1.5m. The equivalent sound power level is calculated to be 83 dB(A).

1.3.2 Battery storage cooling fans have been modelled with a source height of 4.5m.

1.4 Sound Level Data – Substation Transformers

1.4.1 Sound level data of substation transformers at the Scheme are based on similar rated transformers for solar plant developments from AECOM library data. An assumed sound power level of 95 dB(A) has been applied for transformers across the Site (including within the BESS and substation areas). Substation transformers have been modelled as point sources with a source height of 3.5m.

1.5 Manufacturer Data Sheets

MV POWER STATION
2200 / 2475 / 2500 / 2750 / 3000

Robust
- Station and all individual components type-tested
- Optimally suited to extreme ambient conditions

Easy to Use
- Plug and play concept
- Completely pre-assembled for easy set-up and commissioning

Cost-Effective
- Easy planning and installation
- Low transport costs due to 20-foot container

Flexible
- Global solution for international markets
- Numerous options
- Compatible with MVPS 4400 – MVPS 6000

MV POWER STATION 2200 / 2475 / 2500 / 2750 / 3000

Turnkey Solution for PV Power Plants

With the power of the new robust central inverters, the Sunny Central or Sunny Central Storage, and with perfectly adapted medium-voltage components, the new MV Power Station offers even more power density and is a turnkey solution available worldwide. The solution is the ideal choice for new generation PV power plants operating at 1500 V_{DC}. Delivered pre-configured in a 20-foot container, the solution is easy to transport and quick to assemble and commission. The MVPS and all components are type-tested. The MV Power Station combines rigorous plant safety with maximum energy yield and minimized deployment and operating risk.

SUNNY CENTRAL
2200 / 2475 / 2500-EV / 2750-EV / 3000-EV

Efficient
- Up to 4 inverters can be transported in one standard shipping container
- Overdimensioning up to 225% is possible
- Full power at ambient temperatures of up to 35 °C

Robust
- Intelligent air cooling system OptiCool for efficient cooling
- Suitable for outdoor use in all climatic ambient conditions worldwide

Flexible
- Conforms to all known grid requirements worldwide
- Q on demand
- Available as a single device or turnkey solution, including medium-voltage block

Easy to Use
- Improved DC connection area
- Connection area for customer equipment
- Integrated voltage support for internal and external loads

SUNNY CENTRAL 2200 / 2475 / 2500-EV / 2750-EV / 3000-EV

The new Sunny Central: more power per cubic meter

With an output of up to 3000 kVA and system voltages of 1100 V DC or 1500 V DC, the SMA central inverter allows for more efficient system design and a reduction in specific costs for PV power plants. A separate voltage supply and additional space are available for the installation of customer equipment. True 1500 V technology and the intelligent cooling system OptiCool ensure smooth operation even in extreme ambient temperature as well as a long service life of 25 years.

SUNNY CENTRAL 1500 V

Technical Data	Sunny Central 2500-EV	Sunny Central 2750-EV	Sunny Central 3000-EV
Input (DC)			
MPP voltage range V_{DC} (at 25°C / at 35°C / at 50°C)	850 V to 1425 V / 1200 V / 1200 V	875 V to 1425 V / 1200 V / 1200 V	956 V to 1425 V / 1200 V / 1200 V
Min. input voltage $V_{DC\ min}$ / Start voltage $V_{DC\ Start}$	778 V / 928 V	849 V / 999 V	927 V / 1077 V
Max. input voltage $V_{DC\ max}$	1500 V	1500 V	1500 V
Max. input current $I_{DC\ max}$ (at 35°C / at 50°C)	3200 A / 2956 A	3200 A / 2956 A	3200 A / 2970 A
Max. short-circuit current rating	6400 A	6400 A	6400 A
Number of DC inputs	24 double pole fused (32 single pole fused) for PV		
Number of DC inputs with optional DC coupled storage	18 double pole fused (36 single pole fused) for PV and 6 double pole fused for batteries		
Max. number of DC cables per DC input (for each polarity)	2 x 800 kcmil, 2 x 400 mm²		
Integrated zone monitoring	○		
Available DC fuse sizes (per input)	200 A, 250 A, 315 A, 350 A, 400 A, 450 A, 500 A		
Output (AC)			
Nominal AC power at cos φ =1 (at 35°C / at 50°C)	2500 kVA / 2250 kVA	2750 kVA / 2500 kVA	3000 kVA / 2700 kVA
Nominal AC power at cos φ =0.8 (at 35°C / at 50°C)	2000 kW / 1800 kW	2200 kW / 2000 kW	2400 kW / 2160 kW
Nominal AC current $I_{AC\ nom}$ = Max. output current $I_{AC\ max}$	2624 A	2646 A	2646 A
Max. total harmonic distortion	< 3% at nominal power	< 3% at nominal power	< 3% at nominal power
Nominal AC voltage / nominal AC voltage range[1] [9]	550 V / 440 V to 660 V	600 V / 480 V to 720 V	655 V / 524 V to 721 V[9]
AC power frequency	50 Hz / 47 Hz to 53 Hz 60 Hz / 57 Hz to 63 Hz		
Min. short-circuit ratio at the AC terminals[10]	> 2		
Power factor at rated power / displacement power factor adjustable[8] [11]	● 1 / 0.8 overexcited to 0.8 underexcited ○ 1 / 0.0 overexcited to 0.0 underexcited		
Efficiency			
Max. efficiency[2] / European efficiency[3] / CEC efficiency[3]	98.6% / 98.3% / 98.0%	98.7% / 98.5% / 98.5%	98.8% / 98.6% / 98.5%
Protective Devices			
Input-side disconnection point	DC load-break switch		
Output-side disconnection point	AC circuit breaker		
DC overvoltage protection	Surge arrester, type I & II		
AC overvoltage protection (optional)	Surge arrester, class I & II		
Lightning protection (according to IEC 62305-1)	Lightning Protection Level III		
Ground-fault monitoring / remote ground-fault monitoring	○ / ○		
Insulation monitoring	○		
Degree of protection: electronics / air duct / connection area (as per IEC 60529)	IP65 / IP34 / IP34		
General Data			
Dimensions (W / H / D)	2780 / 2318 / 1588 mm (109.4 / 91.3 / 62.5 inch)		
Weight	< 3400 kg / < 7496 lb		
Self-consumption (max.[4] / partial load[5] / average[6])	< 8100 W / < 1800 W / < 2000 W		
Self-consumption (standby)	< 370 W		
Internal auxiliary power supply	Integrated 8.4 kVA transformer		
Operating temperature range[4]	-25 to 60°C / -13 to 140°F		
Noise emission[7]	67.8 dB(A)		
Temperature range (standby)	-40 to 60°C / -40 to 140°F		
Temperature range (storage)	-40 to 70°C / -40 to 158°F		
Max. permissible value for relative humidity (condensing / non-condensing)	95% to 100% (2 month / year) / 0 % to 95%		
Maximum operating altitude above MSL[8] 1000 m / 2000 m[12] / 3000 m[12]	● / ○ / –	● / ○ / –	● / ○ / –
Fresh air consumption	6500 m³/h		
Features			
DC connection	Terminal lug on each input (without fuse)		
AC connection	With busbar system (three busbars, one per line conductor)		
Communication	Ethernet, Modbus Master, Modbus Slave		
Communication with SMA string monitor (transmission medium)	Modbus TCP / Ethernet (FO MM, Cat-5)		
Enclosure / roof color	RAL 9016 / RAL 7004		
Supply transformer for external loads	○ (2.5 kVA)		
Standards and directives complied with	CE, IEC / EN 62109-1, IEC / EN 62109-2, BDEW-MSRL, IEEE1547, Arrêté du 23/04/08		
EMC standards	EN55011:2017, IEC/EN 61000-6-2, FCC Part 15 Class A		
Quality standards and directives complied with	VDI/VDE 2862 page 2, DIN EN ISO 9001		
● Standard features ○ Optional – not available			
Type designation	SC-2500-EV-10	SC-2750-EV-10	SC-3000-EV-10

1) At nominal AC voltage, nominal AC power decreases in the same proportion
2) Efficiency measured without internal power supply
3) Efficiency measured with internal power supply
4) Self-consumption at rated operation
5) Self-consumption at < 75% Pn at 25°C
6) Self-consumption averaged out from 5% to 100% Pn at 35°C
7) Sound pressure level at a distance of 10 m
8) Values apply only to inverters. Permissible values for SMA MV solutions from SMA can be found in the corresponding data sheets.
9) AC voltage range can be extended to 753V for 50Hz grids only (option „Aux power supply: external" must be selected, option "housekeeping" not combinable).
10) A short-circuit ratio of < 2 requires a special approval from SMA
11) Depending on the DC voltage
12) Available as a special version, earlier temperature-dependent de-rating and reduction of DC open-circuit voltage

WÄRTSILÄ

GridSolv Quantum

SPECIFICATION SHEET

Flexible Design.
Speed of Delivery.
Optimised Energy.

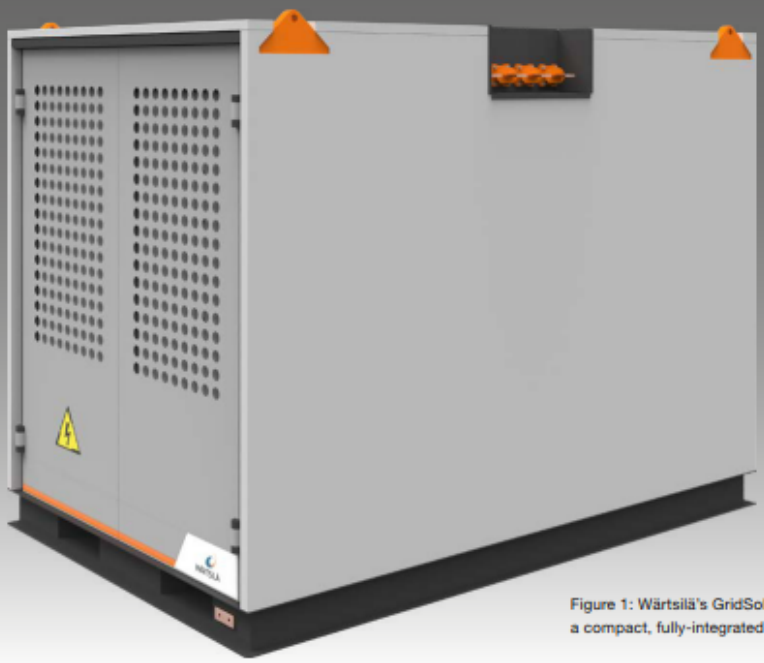

Figure 1: Wärtsilä's GridSolv Quantum, a compact, fully-integrated ESS

Wärtsilä's **GridSolv Quantum** is a fully-integrated modular and compact energy storage system (ESS) designed for ease of deployment and sustainable energy optimisation across project locations and market applications. Optimised for flexibility and functionality with several sub-systems, the product is compliant with North American and international standards.

COMPONENTS

GridSolv Quantum consists of the following components:

- Enclosures with pre-installed liquid-cooled battery racks
- AC and DC outdoor rated cabinet, which connects battery strings with the inverter and provides an interface for auxiliary power and communications

GridSolv Quantum can be paired with leading inverter manufacturer's products, lending the flexibility to parallel a number of enclosures needed to configure an ESS to meet project needs and grid connection options.

KEY BENEFITS

The enclosure is optimised to fulfil the following criteria:

- Lowest lifecycle cost
- Smallest system footprint given the selected system configuration
- Shortest overall deployment time (equipment + transport + installation + commissioning)
- Minimised scope and complexity of installation

1.6 Sensitivity Testing

1.6.1 Noise modelling of the option with 1,800 small scale string inverter option has been undertaken as a sensitivity test to confirm that the central inverter option is the reasonable worst-case. The 1,800 small scale string inverter units were place arbitrarily across the site with approximate equal spacing. The units were applied with a sound power level of 79 dB (equivalent to a sound pressure level of 68 dB at 1 m). The results of sensitivity testing of the small-scale string inverter option are illustrated in ***Figure 11-3***. A comparison of noise predictions for the small-scale inverter option at receptor locations against predictions for the central inverter option that was used as a reasonable worst-case are presented in **Table 1.**

Table 1: Small Scale Inverter Option Sensitivity Test

Receptor	Predicted rating level $L_{Ar,1hr}$		Difference dB
	Central Inverter Option	Small Scale String Inverter Option	
R1	43	37	-6
R2	45	33	-12
R3	46	38	-8
R4	28	24	-4
R5	45	37	-8
R6	46	39	-7
R7	41	30	-11
R8	45	34	-11
R9	44	37	-7
R10	44	35	-9
R11	30	27	-3
R12	42	32	-10
R13	37	27	-10
R14	43	32	-11
R15	44	33	-11
R16	46	39	-7
R17	40	32	-8
R18	37	34	-3
R19	46	35	-11
R20	38	25	-13
R21	45	38	-7
R22	43	37	-6
R23	45	38	-7
R24	40	38	-2
R25	38	32	-6
R26	37	33	-4
R27	44	35	-9
R28	36	34	-2