Veneklasen Associates
Consultants in Acoustics | Noise | Vibration | AV | IT

December 15, 2023

Tobin, Carberry, O'Malley, Riley & Selinger, P.C.
43 Broad Street
New London, Connecticut 06320

Attention: Mark J Cook, Esq.

Subject: **Hanwha QCells America Inc. ("QCells")**
State Pier Road; New London, Connecticut
Acoustical Analysis of Proposed Battery Energy Storage System ("BESS") Veneklasen Project No. 8408-001

Dear Mr. Cook:

At your request and authorization, Veneklasen Associates (Veneklasen) has prepared this report to summarize the acoustical analysis of the future operating condition of the QCells Battery Energy Storage System, including a medium-voltage transformer ("QCells BESS") to be installed at State Pier Road, New London, Connecticut (the "Property"). This report also evaluates the QCells BESS noise impact on the surrounding users. This report documents the noise modeling results of new equipment operating to show compliance with both Regulations of Connecticut State Agencies §§ 22a-69-1 through 22a-69-7.4 ("Regs. Conn. Agencies") as well as Zoning Regulations of New London Article 6, Sec.613. B.1 – Performance Standards – Noise.

1.0 INTRODUCTION

This study was conducted to determine the anticipated noise levels of the future operating condition of the QCells BESS with both the City of New London standards regarding noise as well as the State of Connecticut Control of Noise Regulations requirements during its operation. The new QCells BESS will be located immediately to the north of Connecticut Route 32 / Water St and west of Crystal Ave, New London, Connecticut (see Figure 1). The proposed equipment includes four Sungrow model ST2752UX-US Liquid Cooling Battery Storage Units, and a SC4000UD-MV-US Power Conversion System, containing the medium-voltage transformer.

The area around the Property is generally commercial and industrial in nature, including an electrical retail business to the immediate north and an auto repair shop to the northeast. The proposed QCells BESS is also bounded by an existing residential use to the northwest, Connecticut Route 32 / Water St to the south, and Crystal Avenue to the east.

Figure 1 – Areal View of the Project Location

2.0 NOISE CRITERIA

The proposed project is located in New London, Connecticut. To the best of our knowledge, noise criteria is governed by Regs. Conn. Agencies §§ 22a-69-1 through 22a-69-7.4 and New London Regulations Art. 6, Sec. 613.B.1. The proposed Q Cells BESS project comports with both standards.

2.1 State of Connecticut Control of Noise Requirements

Pursuant to Regs. Conn. Agencies §22a-69-2.1, Noise Zone classifications shall be based on the actual use of any parcel or tract under single ownership as detailed by the Standard Land Use Classification Manual of Connecticut (SLUCONN).

Class A Land Use Category

Pursuant to Regs. Conn. Agencies § 22a-69-2.3, lands designated Class A shall generally be residential areas where human beings sleep or areas where serenity and tranquility are essential to the intended use of the land.

The land uses in this category shall include, but not be limited to, single - and multiple-family homes, hotels, prisons, religious facilities, hospitals, religious facilities, nursing homes, cultural activities, forest preserves, historic and monument sites, and vacant land zoned for residential or related uses requiring such protection.

Class B Land Use Category

Pursuant to Regs. Conn. Agencies § 22a-69-2.4, lands designated Class B shall generally be commercial in nature, areas where human beings converse, and such conversation is essential to the intended use of the land.

The land uses in this category shall include, but not be limited to, retail trade, personal, business and legal services, educational institutions, government services, amusements, agricultural activities, and lands intended for such commercial or institutional uses.

Specific SLUCONN categories in Class B shall include: Utilities; Trade; Wholesale Trade; Automotive Dealers and Gasoline Service Stations.

Class C Land Use Category

Pursuant to Regs. Conn. Agencies § 22a-69-2.5, lands designated Class C shall generally be industrial where protection against damage to hearing is essential, and the necessity for conversation is limited.

The land uses in this category shall include, but not be limited to, manufacturing activities, transportation facilities, warehousing, military bases, mining, and other lands intended for such uses.

Specific SLUCONN categories in Class C shall include Manufacturing; Transportation, Communications, and Utilities – Except 46 and 47, Warehousing, Military Bases

Regs. Conn. Agencies § 22a-69-3.1 states: "No person shall cause or allow the emission of excessive noise beyond the boundaries of his/her Noise Zone so as to violate any provisions of these Regulations". The following Table 1 reflects the Noise Zone Class and commensurate noise level criteria for each Noise Zone Class as provided in Conn. Regs. Agencies § 22a-69-3.5:

Table 1 – Receptor Noise Zone Class

	C	B	A-Day	A-Night
Class C emitter to	70dBA	66dBA	61dBA	51dBA
Class B emitter to	62dBA	62dBA	55dBA	45dBA
Class A emitter to	62dBA	55dBA	55dBA	45dBA

Per Regs. Conn. Agencies § 22a-69-1.8(g) construction noise is exempted from the ordinance.

Regs. Conn. Agencies Sec. 22a-69-3.3 states: "Continuous noise measured beyond the boundary of the Noise Zone of the emitter in any other Noise Zone which possess one or more audible discrete tones shall be considered excessive noise when a level of 5 dBA below the levels specified in Section 3 of these Regulations is exceeded."

Regs. Conn. Agencies Sec. 22a-69-3.6 states, in part: "In those individual cases where the background noise levels caused by sources not subject to these Regulations exceed the standards contained herein, a source shall be considered to cause excessive noise if the noise emitted by such source exceeds the background noise level by 5 dBA".

2.2 City of New London Noise Requirements

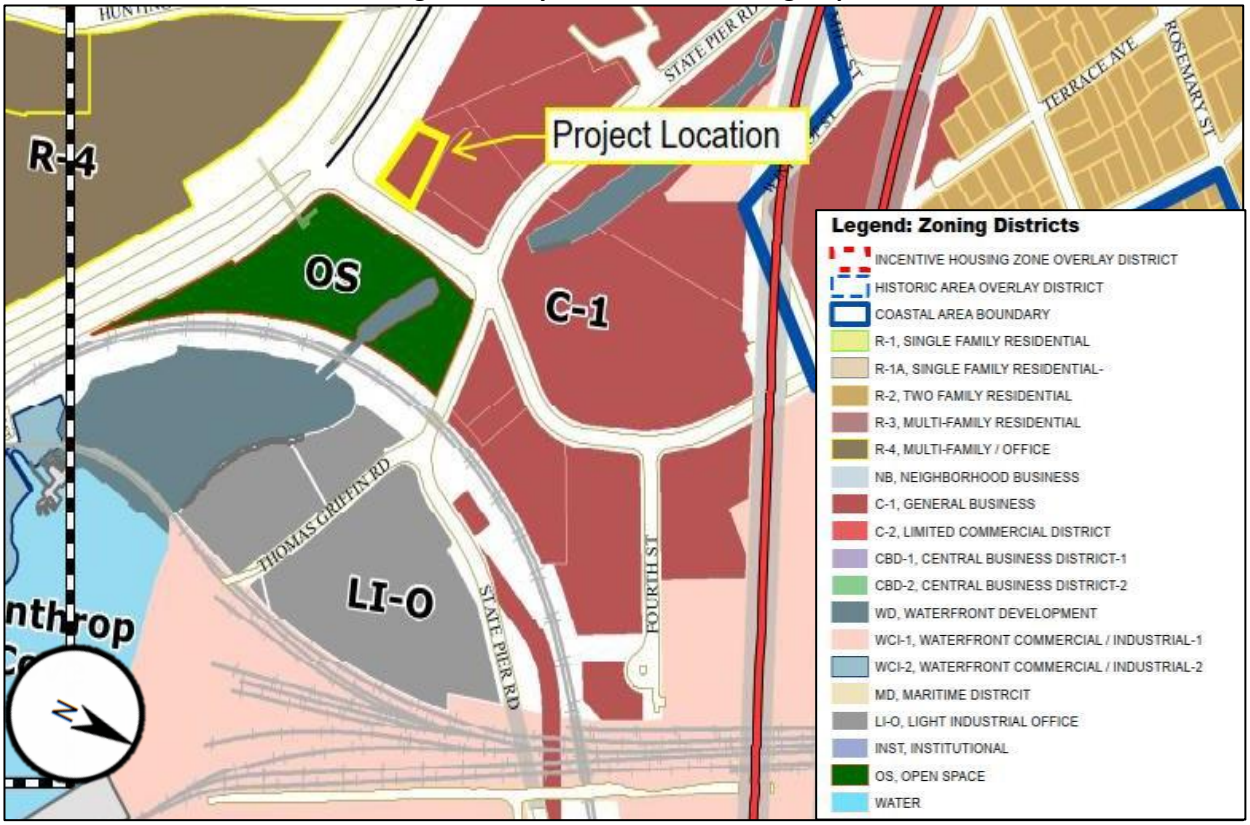
Article VI, Section 613.B.1 of the City of New London Zoning Regulations provides for the maximum noise limit to be generated or received by a zoning district, as shown in Table 2 below.

Table 2 –Maximum Noise levels

WC-1, LI-0	C-1, C-2, CBD, WD, NB	R-1, R-3, WD	R-2, R-4, INST
70 dBA	66 dBA	61 dBA (Day*)	51 dBA (Night**)

- * day= 7 a.m. to 10 p.m., on Sunday 9 a.m. to 10 p.m.
- ** night= 10 p.m. to 7 a.m., on Saturday 10 p.m. to 9 a.m.
- Per the City of New London zoning map, substantially all the adjacent properties around the proposed QCells Battery Energy Storage System are designated by the City of New London as General Commercial District: C-1 with the exception of an R-4 zone 370 feet to the southwest and an Open Space District 200 feet to the east.

Figure 2 – City of New London Zoning Map



Land designated Open Space by the City of New London is adjacent to the proposed BESS. This receptor type is not covered under the City's noise regulations. As a result, the State of CT noise requirements will be referenced for the corresponding Receptor Measurement Location.

3.0 NOISE MODELING

Veneklasen developed a noise model to represent the proposed QCells BESS running condition. The model was conducted using the noise modeling software package Predictor version V2021 by Envirosuite. Predictor is an advanced noise propagation modeling software that considers geometric spreading, atmospheric sound propagation, ground impedance effects, site topography, and geometric, vegetation, and environmental conditions. The calculations performed in Predictor were conducted in accordance with the ISO 9613 standard, which is generally followed for environmental noise assessments.

ISO 9613 uses a slight downwind condition from each noise source to each receiver. The model temperature was set to 68 °F (20 °C) and a relative humidity of 50%. As such, the ISO 9613 model produces results representative of metrological conditions favoring sound propagation, and the environmental condition modeled represents the "close to worst case" sound propagation condition.

3.1 Noise Modeling Method

The project site layout was obtained from drawings sent by the client and from Google Earth. The overall sound power levels were determined through the manufacturer's data provided by the client. The noise spectrum is estimated from the Test Report dated November 29, 2021, provided by the client.

The transformer sound data is not available in the provided manufacture cut sheets, and Veneklasen calculated the sound power level in the theoretical method. All calculations were undertaken in octave bands. The computer model was used to determine the future noise levels at the Modeling Receptor locations shown in Table 5 with the future equipment running. The results were compared with the Noise criteria as governed by Regs. Conn. Agencies §§ 22a-69-1 through 22a-69-7.4 as well as City of New London noise standards.

Per the Test Report, the total sound power levels of the QCells Battery Storage Units are shown in Table 3 and theoretically calculated Transformer sound power levels are shown in Table 4

Table 3– Battery Server Sound Pressure Level (dBA) @ 1m

Frequency Hz	63	125	250	500	1000	2000	4000	8000
Sound Pressure Level (dBA)	48	58	75	74	72	68	63	62

Table 4– Transformer Sound Pressure Level (dBA) @ 1 m

Frequency Hz	63	125	250	500	1000	2000	4000	8000
Sound Pressure Level (dBA)	47	61	62	64	67	60	55	49

4.0 NOISE MODELING RESULTS

Given the battery and transformer sound pressure levels presented in Table 3 and Table 4, Veneklasen predicted the future emitting noise levels. Moreover, Veneklasen employed traffic counts supplied by the Department of Transportation of Connecticut to assess the ambient noise levels resulting from traffic contribution.

Figure 3 indicates the different receiving locations at the nearest property lines and Table 5 shows the predicted noise levels at each location. *Figure 4* presents 1/3 Octave Band Spectrum at the receptor locations. The spectrum shows that the proposed BESS facility will not produce "prominent discrete tones" (as defined by the state noise regulation) at any of the surrounding receptors.

Figure 3 – Receiving Noise Locations

Table 5– Predicted Noise Levels

Location	Type of Land Use		Predicted Equipment Noise Level at Receptor Measurement Location (Leq Day/Night), dBA	Predicted Traffic Noise Level dBA, Leq, (Day/Night)	Tonal Noise (Section 22a-69-1.2)	State Criteria dBA (Day/Night)	City Criteria dBA (Day*/Night**)	Meet Both Criteria
	Regs. Conn. Agencies §§ 22a-69-3.5 Emitter Land Use Category	Regs. Conn. Agencies §§ 22a-69-3.5 Receptor Land Use Category						
L1	Class C	Class A	47	54/51	No	61/51	66	yes
L2	Class C	Class B	44	49/46	No	66	66	yes
L3	Class C	Class A	40	60/57	No	61/51	61/51	yes
L4	Class C	Class B	48	60/57	No	66	NA***	yes
L5	Class C	Class A	40	52/49	No	61/51	61/51	yes
L6	Class C	Class B	42	53/50	No	66	NA***	yes
L7	Class C	Class C	39	53/50	No	70	66	yes

* Day = 7 a.m. to 10 p.m. on Sunday 9 a.m. to 10 p.m.

** Night= 10 p.m. to 7 a.m., Saturday 10 p.m. to 9 a.m.

*** Land designated Open Space by the City of New London is adjacent to the proposed BESS. This receptor type is not covered under the City's noise regulations. As a result, the State of CT noise requirements will be referenced for the

corresponding Receptor Measurement Location.

5.0 CONCLUSIONS

We have the following conclusions from the acoustical analysis of the proposed Hanwha QCells BESS:

- According to the noise modeling prediction results, all evaluated locations meet the noise criteria outlined in Regs. Conn. Agencies §§ 22a-69-1 through 22a-69-7.4. Consequently, no further noise mitigation measures are deemed necessary.
- As presented in Table 5, traffic noise will significantly control the ambient noise levels at all locations. Therefore, noise from the proposed QCells Battery Storage Units will be virtually inaudible at the Receptor Measurement Locations.
- Per the noise modeling prediction results, all noise assessment locations comply with the noise criteria of the City of New London noise standards. No additional noise mitigation is required.

If you have any questions or comments regarding this report, please do not hesitate to contact us.

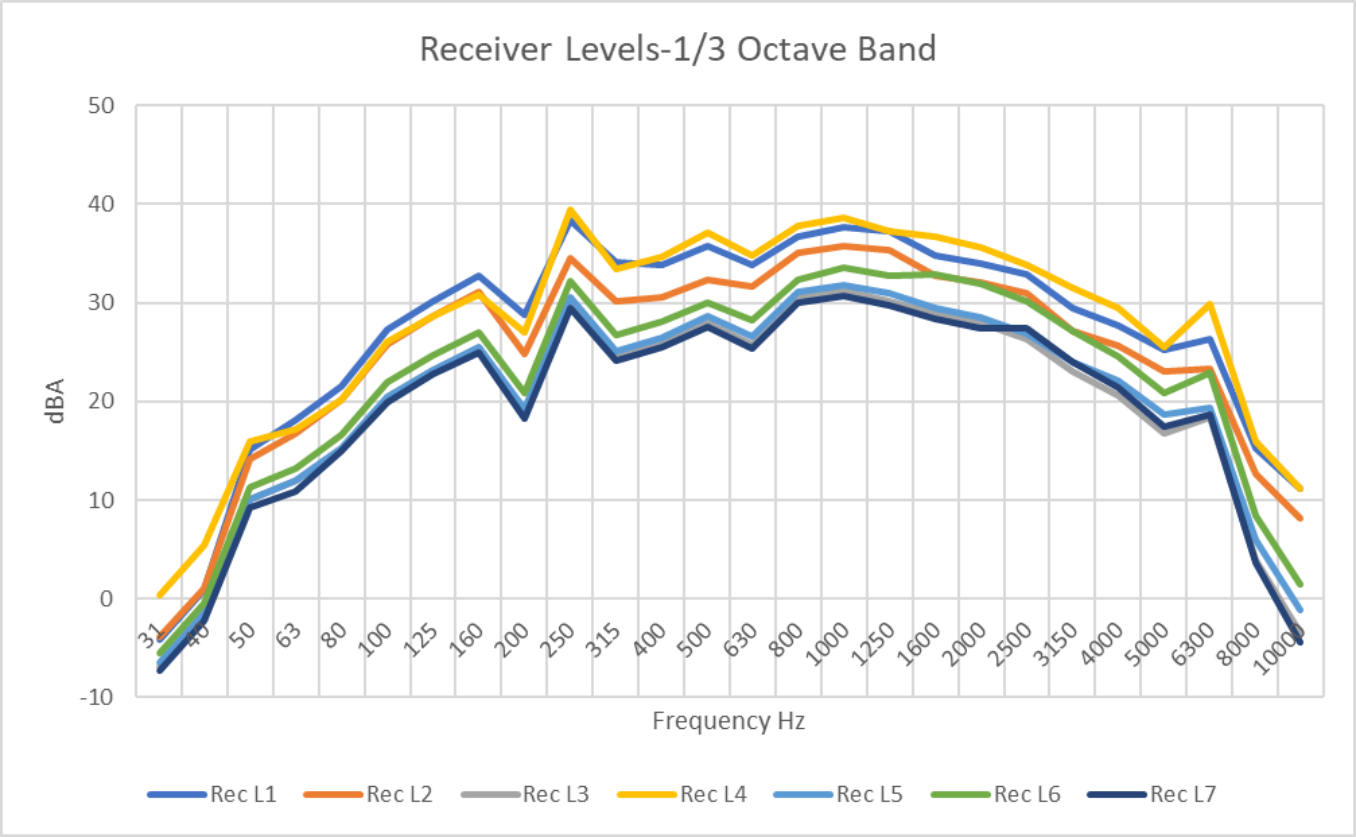
Sincerely,
Veneklasen Associates, Inc.

Pablo H. Cantero
Senior Associate

Sanath Hapuarachchi
Associate

APPENDIX I – RECEIVER NOISE LEVELS (1/3 OCTAVE BAND SPECTRUM)

Figure 4- Receiver Noise 1/3 Spectrum



APPENDIX II - GLOSSARY OF ACOUSTICAL TERMS

Term	Definition
Absorption	A property of material referring to how much sound it absorbs (as opposed to reflecting). In the context of this report, absorption refers to the total quantity of absorption within the receiving space. Absorption is measure in sabins.
A-weighting (dBA)	The sound pressure level in decibels as measured in an A-weighting filter network. The A-weighting de-emphasizes the low frequency components of the sound in a manner similar to the frequency response of the human ear and correlates well with subjective reactions to noise.
Decibel (dB)	A unit describing the amplitude of sound equivalent to 20 times the logarithm, to the base 10, of the ratio of the pressure of the sound to the reference pressure of 20 μPa. Used to quantify sound pressure levels.
Equivalent Sound Level (Leq)	The time-weighted average noise level during the stated measurement period.
Sabin	A unit used to describe absorption within a space. One sabin is equal to the absorption of a one-square-foot open window.
Sound Pressure Level (SPL)	The amplitude of sound when compared to the reference sound pressure level of 20 μPa. SPL is measured in dB.
Sound Transmission Class (STC)	A single-number metric used to describe the transmission loss performance of a material or assembly across the frequency spectrum. It is intended for use primarily when speech is the noise source.
Transmission Loss (TL)	A measure of the reduction in sound level as a sound wave passes through a material. The higher the transmission loss, the better the material's sound insulating properties.

APPENDIX III – Liquid Cooling energy Storage System

ST2752UX-US

Liquid Cooling Energy Storage System
2 - 8 hour application

Preliminary

LOW COSTS

- Highly integrated ESS for easy transportation and O&M
- All pre-assembled, no battery module handling on site
- 8 hour installation to commission, drop on a pad and make electrical connections

SAFE AND RELIABLE

- Integrated DC/DC converters actively limit fault current
- DC electric circuit safety management includes fast breaking and anti-arc protection
- Multi level battery protection layers formed by discreet standalone systems offer impeccable safety

EFFICIENT AND FLEXIBLE

- Intelligent liquid cooling ensures higher efficiency and longer battery cycle life
- Modular design supports parallel connection and easy system expansion
- IP54 outdoor cabinet and optional C5 anti-corrosion

SMART AND ROBUST

- Fast state monitoring and faults record enables pre-alarm and faults location
- Integrated battery performance monitoring and logging

SUNGROW
Clean power for all

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 ℃ (> 45 ℃ 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	SCS000UD-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	SCS000UD-MV-US
Grid Connection Data	
Max.THD 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

Power Conversion system

SC4000UD-MV-US
SC5000UD-MV-US

Power Conversion System

HIGH YIELD

- Advanced three-level technology, max. efficiency 99%
- Effective forced air cooling, no derating up to 45 °C (113 °F) (SC4000UD-US)
- Wide DC voltage operation window, full power operation at 1500 V

SMART O&M

- Modular design, easy for maintenance
- High protection degree, easy for outdoor installation
- Optional C5 anti-corrosion degree, adjust to applications close to the sea

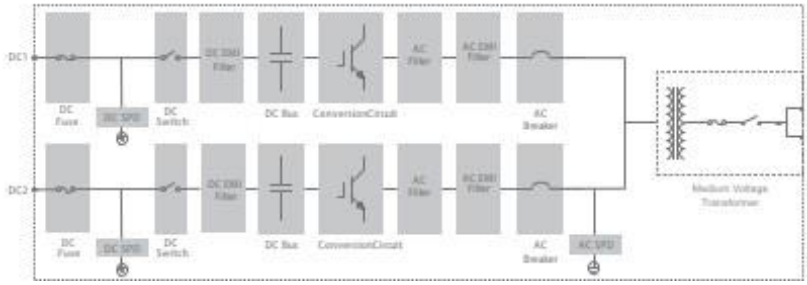
FLEXIBLE APPLICATION

- Bidirectional power conversion system with full four-quadrant operation
- Compatible with high voltage battery system, low system cost
- Battery charge & dis-charge management and black start function integrated

GRID SUPPORT

- Compliant with UL1741, IEEE1547, UL1741 SA, Rule 21 and HECO 14H
- Fast active/reactive power response
- L/HVRT, L/HFRT, soft start/stop, specified power factor control and reactive power support

CIRCUIT DIAGRAM



SUNGROW
Clean power for all

System Type	SC4000UD-MV-US	SC5000UD-MV-US
DC side		
Max. DC voltage	1500 V	
Min. DC voltage	1150 V	1370 V
DC voltage range	1150 – 1500 V	1370 – 1500 V
Max. DC current	1775 A * 2	1862 A * 2
No. of DC inputs	2	
AC side (Grid)		
AC output power	4000 kVA @ 45 ℃	5000 kVA @ 40 ℃
Nominal AC voltage	800 V	950 V
AC voltage range	704 – 880 V	836 – 1045 V
Nominal grid frequency / Grid frequency range	50 Hz / 45 – 55 Hz, 60 Hz / 55 – 65 Hz	
Harmonic (THD)	< 3 % (at nominal power)	
Power factor at nominal power / Adjustable power factor	>0.99 / 1 leading – 1 lagging	
Adjustable reactive power range	-100 % – 100 %	
Feed-in phases / AC connection	3 / 3-PE	
AC side (Off-Grid)		
Inverter port nominal AC voltage	800 V	950 V
Inverter port AC voltage range	704 – 880 V	836 – 1045 V
AC voltage distortion	< 3 % (Linear load)	
DC voltage component	< 0.5 % Un (Linear balance load)	
Unbalance load Capacity	100 %	
Nominal Voltage frequency / Voltage frequency range	50 Hz / 45 – 55 Hz, 60 Hz / 55 – 65 Hz	
Efficiency		
Inverter max. efficiency	99.00%	
Transformer		
Transformer rated power	4000 kVA	5000 kVA
Transformer max. power	4000 kVA	5000 kVA
LV / MV voltage	0.8 kV / 34.5 kV	0.95 kV / 34.5 kV
Transformer vector	Dy1 or Dy11	
Transformer cooling type	ONAN (Optional: KNAN)	
Oil type	Mineral oil (PCB free) or degradable oil on request	
Protection		
DC input protection	Load break switch + fuse	
Inverter output protection	Circuit breaker	
AC output protection	Load break switch + fuse	
Surge protection	DC Type II / AC Type II	
Grid monitoring / Ground fault monitoring	Yes / Yes	
Insulation monitoring	Yes	
Overheat protection	Yes	
General Data		
Dimensions (W*H*D)	6058*2896*2438 mm 238.5''*114.0''*96.0''	
Weight	16000 kg 35274 lbs	
Degree of protection	NEMA 4X (Electronic for Inverter) / NEMA 3R (Others)	
Operating ambient temperature range	-35 to 60 ℃ (> 45 ℃ derating) -31 to 140 ℉ (> 113 ℉ derating)	-35 to 60 ℃ (> 40 ℃ derating) -31 to 140 ℉ (> 104 ℉ derating)
Allowable relative humidity range	0 – 100 %	
Cooling method	Temperature controlled forced air cooling	
Max. operating altitude	1000 m (standard) / > 1000 m (optional) 3280.8 ft (standard) / > 3280.8 ft (optional)	
Display	LED, WEB HMI	
Communication	RS485, CAN, Ethernet	
Compliance	UL1741, UL1741 SA, IEEE 1547, Rule 21, HECO 14H, CSA C22.2 No.107.1-01	
Grid support	L/HVRT, L/HFRT, active & reactive power control and power ramp rate control, Volt-var, Volt-watt, Frequency-watt	