

Microgrid application plan for Nigeria hotel project

2024.05

一、Overview:

1.1 Application overview

Project location: Nigeria.

Load mode: hotel household appliances.

Usage overview:

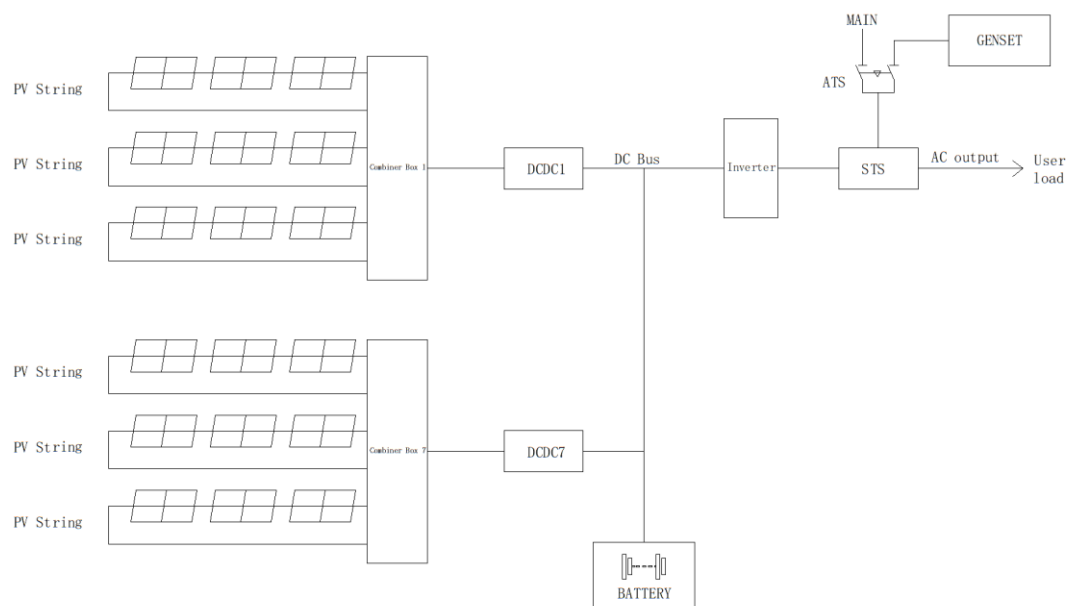
The equipment mainly supplies power to the hotel, and the total peak load is estimated to be about 200KW. There is mains power on site, which is usually carried by the mains. The photovoltaic energy storage equipment can be connected in parallel with the mains to jointly bear the load. When the mains power fails, the power supply can be seamlessly transferred to the optical storage equipment. When the optical storage equipment also fails or cannot meet the load, the ATS switch is used to switch to the LPG gas genset, and the gas genset takes the load.

1.2 Application configuration

According to the usage requirements and conditions, the configuration is as follows:

The system is equipped with a 200KW energy storage inverter system, a 210KWp photovoltaic system and a 430KWh lithium iron phosphate energy storage system. The photovoltaic system is connected in parallel with the energy

storage system through DC coupling. The mains power is run in parallel with the photovoltaic energy storage system through a 200KW STS device. At the same time, the gas genset is connected to the mains power supply system through an ATS switch. It forms a 4-power joint power supply system including mains electricity, photovoltaics, energy storage, and generator units. The primary system diagram is as shown below:



1.3 Run logic overview

The priority order of system power supply is photovoltaic – energy storage – grid – generator set. The specific work flow is as follows –

1. When photovoltaic energy is sufficient,

photovoltaic power supply will be used first. When the load demand for electricity is met, the battery will be charged if there is excess power;

2. When the photovoltaic power generation cannot meet the power demand of the load, the energy storage battery delivers energy to the load. At this time, the photovoltaic and battery power the load at the same time;

3. When photovoltaics and batteries cannot meet the load operation and the grid is normal, the grid will provide insufficient power, and the system controller can control the grid to charge the energy storage battery.

4. When the power grid fails, photovoltaics and energy storage give priority to powering the load. When photovoltaics and batteries cannot meet the load operation, the control system controls the generator to start, and controls the ATS to connect the generator to the power supply line, and the generator provides insufficient power, at the same time, the system controller can control the power grid to charge the energy storage battery to improve generator utilization.

5. During the power supply process of the generator

a: When the photovoltaic or energy storage power

meets the load power and the mains power has not been restored, the system controller controls to disconnect the generator power supply and switch to photovoltaic and battery power supply;

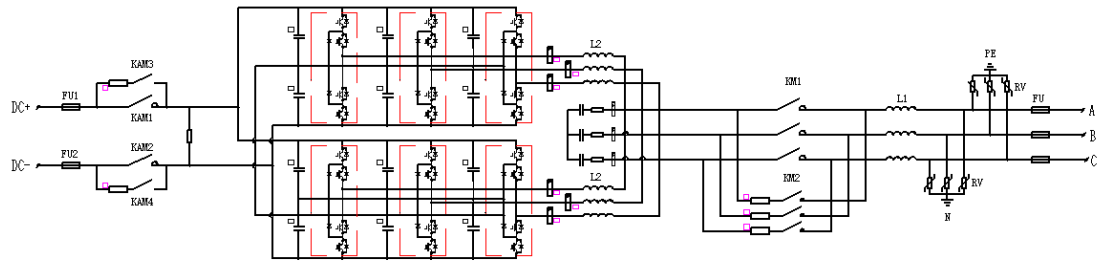
b: When the mains power is restored, the system controller controls to disconnect the generator power supply and stop the generator, and switches to the mains power supply, continuing the power supply logic of items 1, 2, and 3 above;

c: After the generator starts, the control system controls the PCS to charge the battery, always keeping the generator working at maximum efficiency (settable) output, and improving the overall utilization of the system.

6. The photovoltaic energy storage system adopts a seamless switching method during the switching operation with the mains or generator to avoid economic losses caused by power outages.

二、Equipment technical data

2.1 Energy storage converter data



Schematic diagram of energy storage converter module

Features:

- Interleaved three-level topology, high equivalent switching frequency, small ripple, and more stable system;
- Staggered magnetic integrated inductors have lower losses and an overall conversion rate of up to 98%;
- With PQ, VF, SVG and other functions;
- Energy interaction with the power grid according to EMS instructions;
- Wide temperature operating capability and wider adaptability;

Datasheet:

Table 1 Parameter list of energy storage modules (for reference)

AC-side parameters	
Rated output power (kW)	100
Wires connection	Three-phase four-wire system, IT system
Output overload capacity (times)	1.1@longterm; 1.2@1min
AC rated voltage (A)	150A @ 45℃
Allowed grid voltage (Vac)	400V±15%
Allowed grid frequency (Hz)	50/60 (-2.5~1.5)
Total harmonic distortion	≤3% (rated power)
Rated power factor	>0.99
Output voltage distortion	≤3% (Linear rated power load)
DC—side parameters	
Maximum DC power (kW)	160@45℃
DC Voltage range (Vdc)	550~850
Maximum current (A)	213@45℃
Short-circuit inrush current on DC side	50kA@2ms
Communication interface	
Communication interface	CAN2.0、RS485
Communication protocol	Modbus RTU、CAN2.0
BMS access	Equipped (passive dry contact)
Protection	
Protection of AC side	Overcurrent, Overvoltage, Frequency

Protection of DC side	Overcurrent, Overvoltage, short circuit, anti-reverse connection
overtemperature protection	Equipped
AC phase sequence adaptive	Equipped
Power Module (IGBT) Protection	Equipped
Communication Fault Protection	Equipped
Cooling system fault protection	Equipped
System parameters	
Module Main Circuit Topology	Tri-level
Operating method	Constant power, constant voltage, and constant current control
Number of parallels	2-8
Other functions	PQ、VF、SVG、VSG
Maximum system efficiency	$\geq 98\%$
Charge/discharge conversion time (ms)	$\leq 50\text{ms}$
Noise (dB)	< 75
Protection level	IP20
Permissible ambient temperature ($^{\circ}\text{C}$)	$-20\sim 50$
Cooling	Forced air cooling
Permissible humidity	$0\sim 95\%$ (non-condensation)
Permissible altitude	No derating below 2000 meters altitude,

	2000m~4000m derating operation
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This system is equipped with a 200kW PCS, which is composed of 2 PCS modules.

2.2 PV DC/DC converter

Table 2 Parameter list of PV modules (for reference)

Parameters of high voltage side	
Rated power (KW)	30
Voltage range (V)	500-1000
Maximum current (A)	50
Parameters of low voltage side	
Rated power (KW)	30
Voltage range (V)	200-650
Maximum current (A)	80
Other parameters	
PV MPPT operating voltage (V)	low voltage:100-550V;high voltage: 400-900V
Battery equalization voltage (V)	Programmable
Battery float voltage (V)	Programmable
Voltage accuracy	≤1%
Current accuracy	≤1%
fault protection	Over-voltage, over-current, over-temperature, etc.
Communication interface	RS485、CAN
Cooling	Air cooling

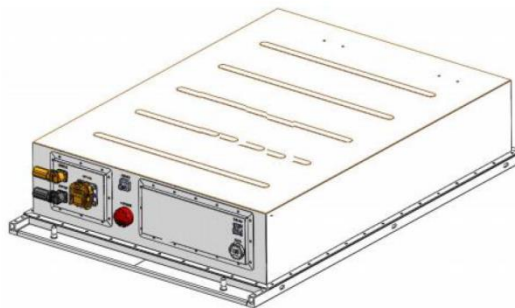
2.3 Parameters of Energy Storage Battery

Parameters of cell:



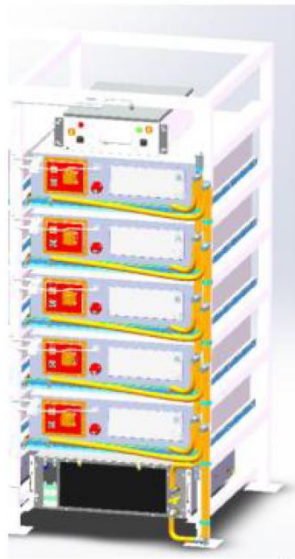
Electrochemical Systems	LFP/C
Rated capacity (Ah)	280
C-rate	<1C
Energy density	≥ 162.9
Application areas	BEV/ESS
Dimension (L*W*Hmm) ± 0.8	174.2*71*207.1
GB Certification	GB/T 36276-2018

Parameters of PACK:



Maximum C-rate	$\leq 0.5C$
Series parallel circuits	1P48S
Nominal capacity	280Ah
Nominal energy	43.008KWh
Nominal voltage	153.6V
Operating Voltage Range	129.6-172.8V
Operating Temperature Range	discharge: -20-55°C, charge: 0-55°C

Parameters of battery cluster:



Maximum C-rate	$\leq 0.5C$
Series parallel circuits	1P240S
Nominal capacity	280Ah
Nominal energy	215.04KWh
Nominal voltage	768V
Operating Voltage Range	648-876V
Operating Temperature Range	discharge: $-20-55^{\circ}\text{C}$, charge: $0-55^{\circ}\text{C}$

This system uses two clusters of 215 KWh to form a 430 KWh energy storage system.

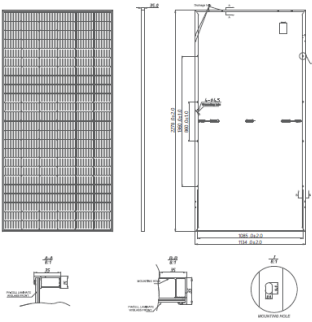
2.4 Parameters of PV panel:

The PV system uses a total of 385 PV panels of 540Wp to form a PV array, and the capacity of the PV system is $385 \times 540\text{Wp} = 207.9\text{KWp}$. The parameters of a single photovoltaic panel

are as follows:

MECHANICAL SPECIFICATIONS

Cell Type	Monocrystalline
Cell Dimensions	182*182mm
Cell Arrangement	144 (6*24)
Weight	27kg
Module Dimensions	2278*1134*35mm (89.69*44.65*1.38inches)
Cable Length	Portrait 300mm/Landscape 1200mm/Customized
Cable Cross Section Size	TUV: 4mm2 (0.006inches2)/UL: 12AWG
Front Glass	3.2mm (0.13inches) AR Coating Tempered Glass
No. of Bypass Diodes	3/6
Packing Configuration (1)	31pcs/carton, 620pcs/40hq
Frame	Anodized Aluminium Alloy
Junction Box	IP68



ELECTRICAL SPECIFICATIONS

Module Type	540		545		550		555		560	
Testing Condition	STC	NMOT	STC	NMOT	STC	NMOT	STC	NMOT	STC	NMOT
Rated output (Pmp/Wp)	540	402	545	405	550	409	555	413	560	417
Maximum Power Voltage(Vmpp/V)	41.9	39.0	42.0	39.1	42.1	39.2	42.2	39.3	42.3	39.4
Maximum Power Current(Imp/A)	12.89	10.30	12.98	10.37	13.07	10.44	13.16	10.51	13.25	10.58
Open Circuit Voltage(Voc/V)	49.7	46.5	49.8	46.6	49.9	46.7	50.0	46.8	50.1	46.9
Short Circuit Current(Isc/A)	13.62	10.98	13.71	11.05	13.80	11.12	13.89	11.19	13.98	11.26
Module efficiency(%)	20.9%		21.1%		21.3%		21.5%		21.7%	
Power Tolerance (W)	0~+5		0~+5		0~+5		0~+5		0~+5	

STC: Irradiance 1000W/m2, Cell Temperature 25°C, Air Mass AM1.5 NMOT: Irradiance at 800W/m2, Ambient Temperature 20°C, Air Mass AM1.5, Wind Speed 1m/s

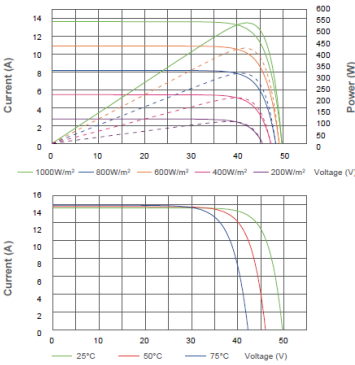
MAXIMUM RATINGS

Maximum System Voltage	1000V/1500V DC (IEC)
Operating Temperature	-40°C ~ +85°C
Maximun Series Fuse	25A
Static Loading	Snow Loading: 5400Pa/ Wind Loading: 2400Pa
Conductivity at Ground	≤0.1Ω
Safety Class	II
Resistance	≥100MΩ
Connector	T01/LJQ-3-CSY/MC4/MC4-EVO2

TEMPERATURE CHARACTERISTICS

NMOT Temperature	43°C±2°C
Temprature Coefficient (Pmax)	-0.36%/°C
Temperature Coefficient (Voc)	-0.26%/°C
Temperature Coefficient (Isc)	0.043%/°C

CURVE & TEMPERATURE DEPENDENCE



2.5 Parameters of generator set



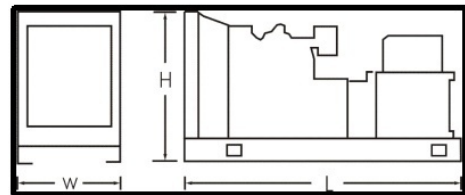
Specification of genset

Model: SSF275

Main parameters

- Prime power: 200kW/250kVA
- Standby power: 220kW/275kVA
- Frequency: 50Hz
- Rated speed: 1500r/min
- Rated Voltage: 380/400/415V
- Factor: 0.8
- Start mode: DC24V/electrical start

Size and Weight



Size
L×W×H (mm)

Weight
(Kg)

- Open type: 3400×1160×1830 3300
- Silent type: 4800×1500×2240 4170

Operation conditions

- Operation temp: $\leq 40^{\circ}\text{C}$
- altitude: ≤ 1000 米
- Humidity: $\leq 60\%$

Note:

1. When the ambient temperature is higher than 40°C or the altitude is higher than 1000 meters, the power decreases, which needs to be corrected.
2. Excessive humidity requires corresponding measures.

Remark

- Prime Power(PRP): Refers to the unit can run continuously for 24 hours under variable load, allowing 10% overload every 12 hours for 1 hour.
- Standby power (ESP) : at an average load rate of 80%, for no more than 500 hours a year. No overload is allowed.
- Each unit has passed the load test of 0%, 25%, 50%, 75%, 100%, 110% and static, transient response capacity, all protection devices and control systems have passed strict inspection before the factory qualified

2

Specification of engine

Model: SC15GT420D2

Engine parameters

- Manufacturer: SDEC
- Aspiration: Turbocharged
- Cooling: Water-cooling
- No. of cylinder/arrangement: 6/in-line
- Bore: 135mm
- Stroke: 165mm
- Displacement: 14.2L
- Compression Ratio: 9.75:1
- Rated speed: 1500r/min
- Prime power: 281kW/305kW
- Dry weight: 1250kg
- Governor: Electronic

Lubrication system

- Oil capacity Low / High: 33/41L
- Oil consumption: 0.2g/kw.h

Gas system

- Gas consumption : 49.2kg/h
- Gas inlet pressure range : 6bar~8bar
- Rated point gas intake temperature: -25~30℃

Exhaust system

- Max. exhaust back pressure: 8kPa
- Max. exhaust temperature: 680℃

Air Induction system

- Air intake restriction clean filter: $\leq 3\text{kPa}$
- Air intake restriction dirty filter: $\leq 6\text{kPa}$
- Recommended air flow @ PRP: 26.7m³/min

Cooling system

- Coolant flow: 450L/min
- Thermostat opening temperature: 77 / 90℃
- Coolant capacity of the engine: 25.5L

3

Specification of alternator

Model: FD4MS

Alternator parameters

- Manufacturer: FARADAY
- Rated voltage: 380/400/415V
- Rated frequency: 50Hz
- Power factor: 0.8
- Rated power: 235kW/294kVA
- Insulation class: H
- Temp. Rise class: H
- Protection: IP23
- Ambient temperature: 40°C
- Altitude: ≤1000m
- Overspeed: ≤2250rpm

Features

- Phases: 3
- Winding pitch: 2/3
- No. of Bearing: 1
- Connection type: Star
- Poles: 4
- Waveform Distors. (THD): <5%
- Telephone Interference (THF): <2%

4

SWT control system—standard for single unit



Note: the picture is for reference only. The specific model is subject to the formal quotation

Please refer to "SWT parallel system" if synchronising units are required.

Features

- LCD Screen, keys operation
- Multilingual display
- Control and protection functions
- Engine and alternator parameter detection
- Local and remote start
- Reasonable keys layout, friendly interface
- Multiple communication interfaces available
- Event logs
- IP65 overall

三、III. Configuration list and quote

No.	Name	Specification/Model	Unit	Qty	Note
1	Photovoltaic energy storage micro-grid system				
1.1	hybrid photovoltaic and storage converter	200KW, Including PV controller	set	1	
1.2	STS switching cabinet	Equipped with on/off grid switching function, including STS fast switching and isolation transformer	set	1	
1.3	Energy storage battery	430KWh, liquid cooling	sets	1	
1.4	Multifunctional power distribution cabinet	Including PV interface, load interface, etc.	set	1	
1.5	EMS System energy management system control cabinet	Includes control module, control software	set	1	
1.6	Containerized	20 feet, including liquid-cooled refrigerating machine, single-package fire extinguishing and cabin fire fighting system, lighting, liquid-cooled piping, exhaust device, etc.	set	1	
2	PV module	200KWp	sets	1	
3	LPG gas generator sets	SSF275, 200kW, AC400V	set	1	