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AT115kW/232kWh Outdoor Liquid Cooled Integrated Energy Storage Cabinet Specification

1 Product Appearance

2 Product Description

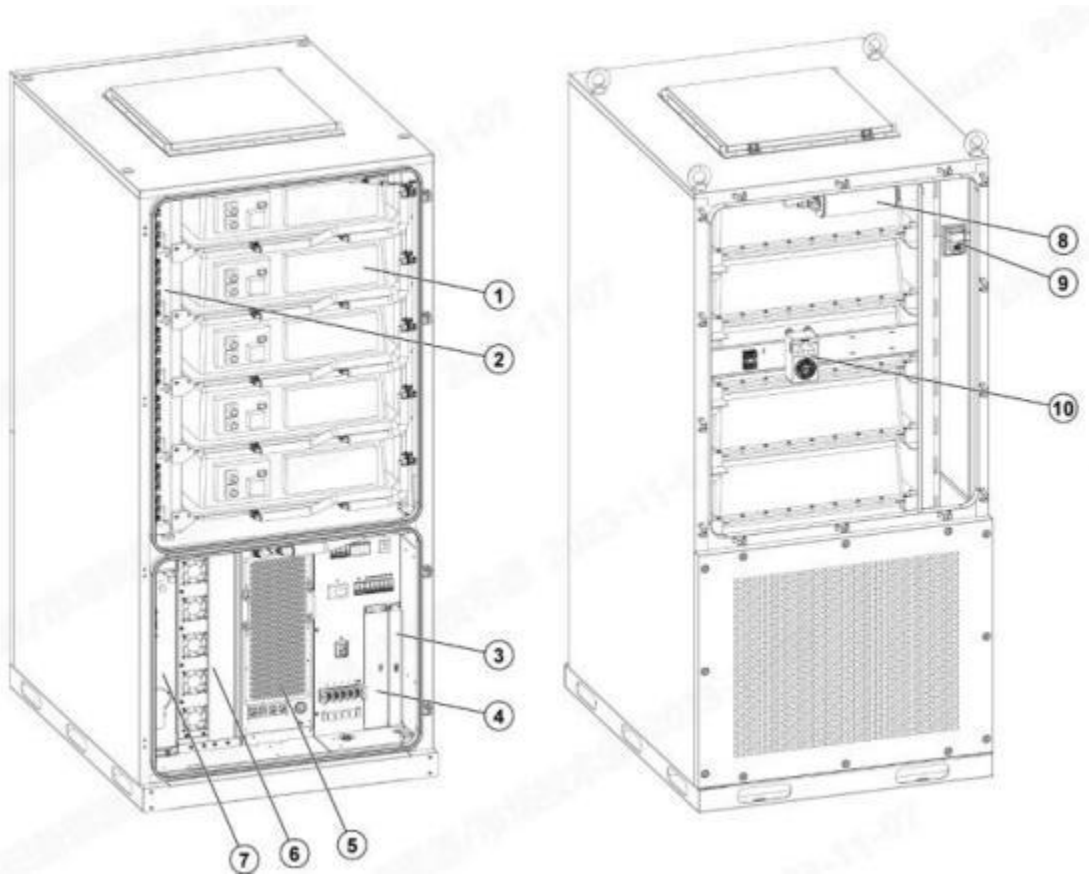
115kW/232.96kWh Outdoor Liquid Cooled Integrated Energy Storage Cabinet is a device for storing and transferring electrical energy.For the convenience of transportation and installation, the integrated cabinet covers an area of <1.6m2 and weighs <2.3t. It supports 0.4kV AC grid-connected, off-grid, and grid-connected off -grid switching functions.The system consists of liquid-cooled battery clusters and high-voltage boxes, energy storage converter, temperature control system, fire protection system, power distribution system, grounding system, EMS energy management system, security system, etc., of which the energy storage converter adopts a 3-level topology, with high conversion efficiency and common mode low interference.

Application Categorization:	Application Name
Common energy storage applications	Peak shaving and valley filling, power supply and demand adjustment, capacity/demand management, peaking adjustment , standby power, distributed photovoltaic storage integration, micro-grids, etc.
Grid-assisted applications	Improve power supply reliability, ease transmission system congestion, and improve electric energy quality

3 System Parameter

S/N	Project Description	Specification Parameters	Remark
1	**DC Side Parameters**		
1.1	Cell Type	LFP 3.2V/280Ah	
1.2	System Capacity	232.96kWh	
1.3	Rated DC Voltage	832V	
1.4	Battery Voltage Range	680Vdc~949Vdc	
1.5	DC Maximum Current	160A	
1.6	Battery Pack Configuration	1P260S	
1.7	Rated Charge/Discharge Ratio	≤0.5P	
2	**AC Side Parameters**		
2.1	Rated Output Voltage	400V AC	
2.2	Grid Voltage Range	-20%~15%	Settable
2.3	Rated Power-grid Frequency	50Hz/60Hz	
2.4	Power-grid Frequency Range	45~55Hz	Settable
2.5	Rated Output Power	115kW	
2.6	AC Input Way	3L+N/3L+N+PE	
2.7	Power Factor Adjustment Range	-1~1	
2.8	Adaptation To Power-grid Type	TT/TN	
3	**Efficiency**		
3.1	Maximum System efficiency	>90%	＜0.5P
4	**Basic parameters**		
4.1	Temperature Of Working Environment	-20℃~55℃	Automatic Derating Over 45°C
4.2	Relative Humidity Of Working	0～95%	
4.3	Maximum Working Altitude	4000m	Automatic Derating >2000m
4.4	Protective Class	IP55	
4.5	Battery Heat Dissipation Method	Intelligent Liquid Cooling	
4.6	Size（W*H*D）	1120*2350*1400mm	
4.7	Weight	<2300kg	
4.8	Fire-Fighting	Perfluorohexanone	
4.9	External Communications Interface	CAN/RS485/Ethernet/4G	
4.10	Communications Protocol	Modbus-RTU/TCP、CAN2.0B	
4.11	Display	Local Touch Screen, Remote APP	

4 Introduction of Main Components



1.Battery pack	2.Battery Pack Equalizer (Optional)	3.EMS
4.UPS	5.Water Chiller	6.PCS
7.High Voltage Distribution Box（PDU）	8.Perfluorohexanone Gas Cylinders	9.Audible And Visual Alarm
10.Dehumidifier		

4.1 Introduction Of DC Systems

4.1.1 Battery Cell

The DC side use CATL standard 280Ah Lithium Iron Phosphate (LFP) square aluminum cell, with a standard charging/discharging multiplier of 0.5P, featuring high sustained power, high cycle life, high storage life and high security.

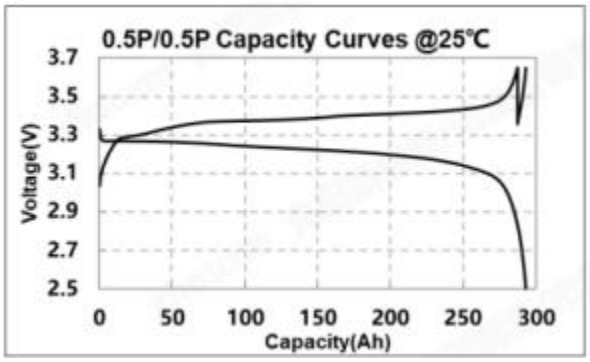
S/N	Project Title	Specification Parameters	Remark
1	Battery Type	Lithium Iron Phosphate	Aluminum Case
2	Nominal Voltage (V)	3.2	Rated Multiplier Discharge
3	Nominal Capacity (Ah)	280	25±2℃, 0.5P/0.5P Voltage Range 2.5~3.65V

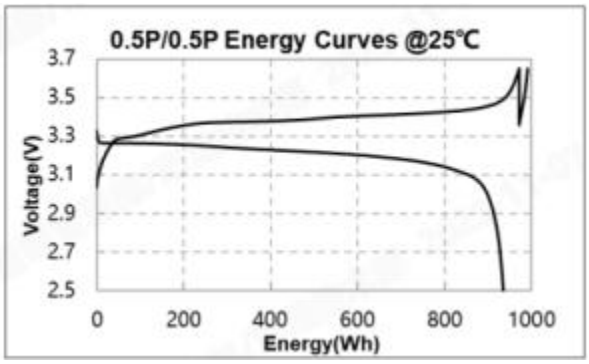
4	Standard Charging Power	0.5P	25±2℃
5	Maximum Continuous Charging Power	0.5P	

6	Standard Discharge Power	0.5P	25±2℃
7	Maximum Continuous Discharge Power	0.5P	
8	Voltage Range (V)	2.0-3.69	Limit Range
9		2.8-3.65	Recommended Range Of Use
10	Energy Efficiency	≥94%	Rated Multiplier (Discharge Energy/Discharge Ah) / (Charge Energy/Charging Ah)
11	Size（W*H*T mm）	173.93*207.2*71.65	±0.8
12	Cycle life	≥8000cycles	70%SOH，25℃、0.5C
13	Internal Resistance（mΩ）(1KHz)	0.17±0.05	New Battery Status（~30%SOC）
14	Weight（Kg）	5.4±0.3	
15	Storage Temperature Range(℃)	-30℃~+60℃	Storage Environment Humidity ≤ 85% ROH, no condensation
16	Working Temperature Range(℃）	-20~+60℃	Charging temperature range: 0~60℃, Discharging temperature range: -20~60℃
17	Application Altitude（m）	<5000	

1) Capacity & Energy Curve

Testing Procedure:(1) 25℃, 0.5P constant power charge to 3.65V; (2)Stand for 5 minutes; (3) 0.1P constant power charge to 3.65V; (4)Stand for 30 minutes; (5) 0.5P constant power discharge to 2.5V; (6) Stand for 30 minutes.

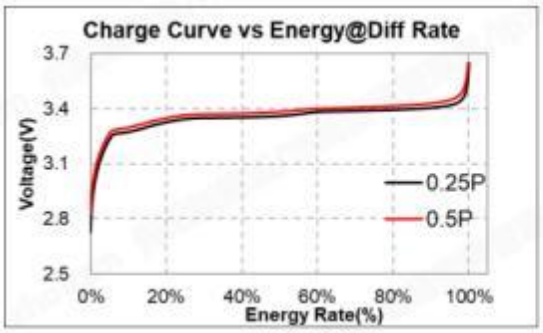


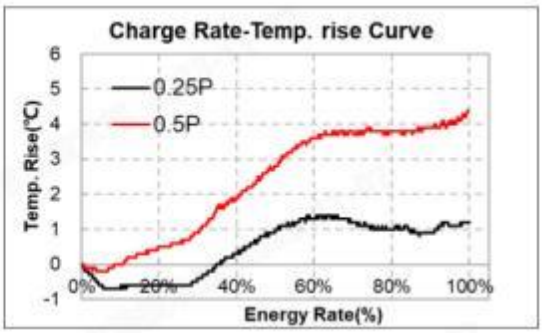


Conclusion: The minimum discharge capacity of the battery cell is 280Ah @25℃, 0.5P; the minimum discharge energy of the battery cell is 896Wh @25℃, 0.5P.

2) 25°C Charge multiplier curve

Test Procedure: (1)Stand at 25°C for 30 minutes; (2) Charge n*P at constant power to 3.65V (n=0.25,0.5); (3)Stand for 5 minutes; (4) Discharge 0.5P at constant power to 2.5V; (5) Stand for 5 minutes; (6) Repeat Steps 2 to 5 until the test is completed.





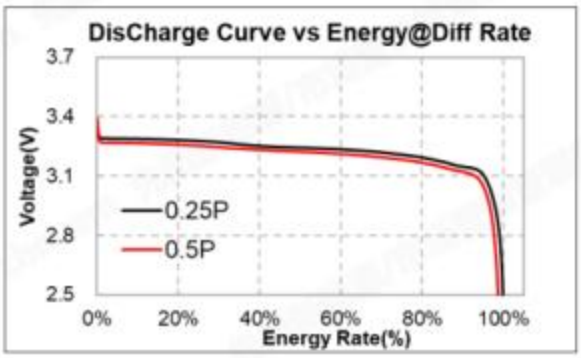
Conclusion:

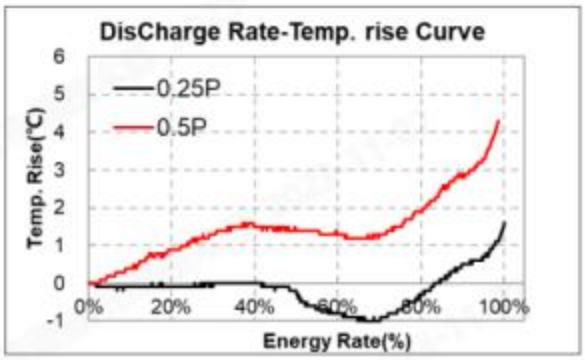
Rate DisCharge Performance		
Rate	0.25P	0.5P
Energy Rate	100.00%	99.85%
Temp. Rise(℃)	1.2	4.4

3) **25°C Discharge Multiplication Curve**

Test Procedure: (1) Stand at 25°C for 30 minutes; (2) 0.5P constant power charge to 3.65V; (3) Stand 5 minutes; (4) 0.1P constant power charge to 3.65V; (5) Stand 5 minutes; (6) n*P constant power discharge to 2.5V (n=0.167,0.25,0.5); (7) Stand 5 minutes; (8) Repeat steps 2 to 7 until the test is complete.

2.5V (n=0.167,0.25,0.5); (7) Leave for 5 minutes; (8) Repeat steps 2 through 7 until the test is complete.



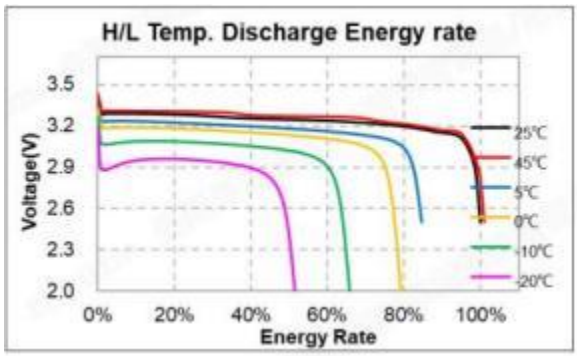


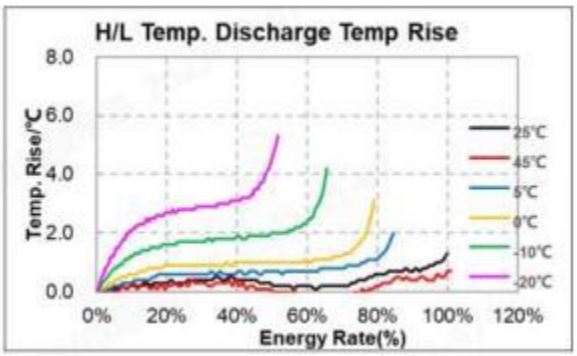
Conclusion:

Rate DisCharge Performance		
Rate	0.25P	0.5P
Energy Rate	100.00%	98.62%
Temp. Rise(℃)	1.6	4.3

4）High And Low Temperature Discharge Curve

Test Procedure: (1) 25℃, 0.25P constant power charge to 3.65V; (2) XX℃ (XX=25,45,5,0,-10,-20), 0.25P constant power charge to 2.5V; (3) Repeat steps 1 to 2 until the test completed ; (4) Stand for 5 minutes.



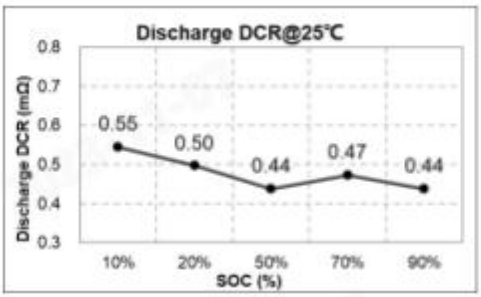


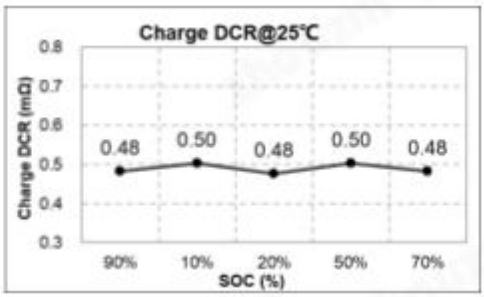
Conclusion:

High/Low Temp Discharge Performance						
Temp. (℃)	25℃	45℃	5℃	0℃	-10℃	-20℃
Energy Rate	100.0%	100.1%	86.0%	79.3%	66.5%	53.0%
Temp.Rise(℃)	1.7	1.0	3.5	3.9	5.1	6.3

5）DCR

Test procedure: (1) 25℃, 560A constant current discharge for 30 seconds, cut off voltage ≥2.5V; (2) 25℃, 420A constant current charge for 30 seconds, cut-off voltage ≤3.65V.



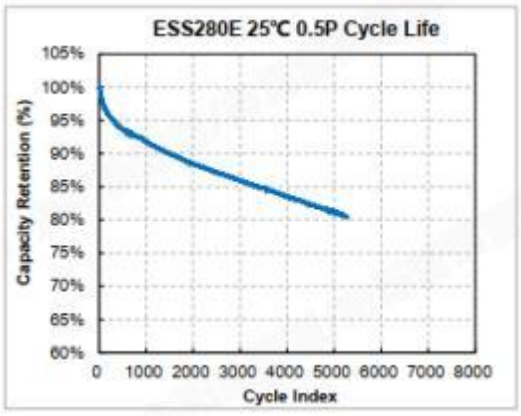


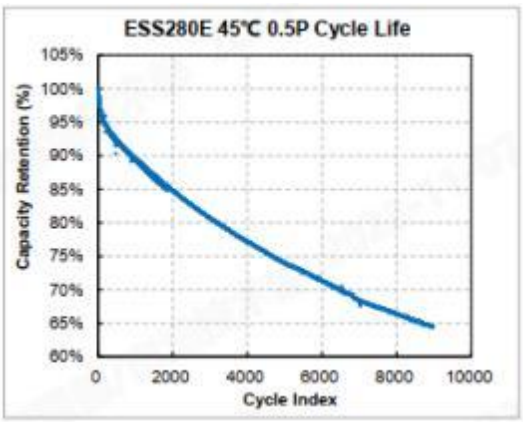
Conclusion:

SOC	10%	20%	50%	70%	90%
DischargeDCR mΩ	0.55	0.50	0.44	0.47	0.44
ChargeDCR mΩ	0.48	0.50	0.48	0.50	0.448

6) Cycle Life Curve

Test procedure: (1) 25℃, 2.5V~3.65V(100%DOD), 0.5P charging/0.5P discharging cycle; (2) 45℃, 2.5V~3.65V(100%DOD), 0.5P charging/0.5P discharging cycle.。





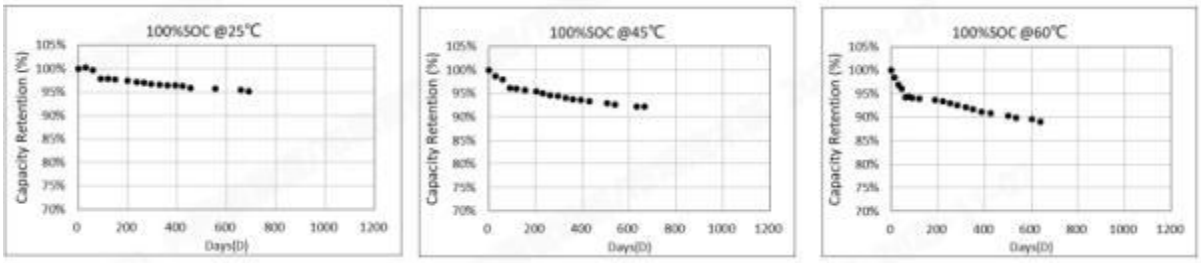
Conclusion:

The ambient temperature is 25℃, the multiplication rate is 0.5P, after predicted and analyzed, when the capacity retention rate of the battery cell is 80%, the number of 0.5P cycles is about 5200 times.

Ambient temperature 45℃, multiplication rate 0.5P, after predicted and analyzed, when the capacity retention rate of the battery cell is 80%, the number of 0.5P cycles is about 3100 times.

7) Storage Life

Test Procedure: (1) 25℃, 100% SOC storage, and monitor the reversible capacity retention rate; (2) 45℃, 100% SOC storage, and monitor the reversible capacity retention rate; (3) 60℃, 100% SOC storage, and monitor the reversible capacity retention rate.



Conclusion:

~95% reversible capacity retention @ 25 ℃ ~650days

~92% reversible capacity retention @ 45 ℃ ~650days

~89% reversible capacity retention @ 60 ℃ ~650days

4.1.2 Battery Box

Inside the battery box contains 52 of battery cells and 1 CSC, a battery box contains 8 NTC temperature sampling, the CSC is responsible for collecting the voltage, current and temperature of the cells inside the battery box.

The detailed parameters are shown in the table below:

S/N	Project Title	Specification parameters	Remark
1	**Basic Parameters**		
1.1	Battery Rated Energy Storage Capacity	46.592kWh	
1.2	Number of Battery cell	52	
1.3	Voltage Range	145.6~187.2V DC	CELL:2.8~3.6V
1.4	Rated Voltage	166.4VDC	
1.5	Rated Charge Multiplier	0.5P/1P	
1.6	Discharge Multiplier	0.5P/1P	
1.7	Maximum Continuous Current	140A/280A	
1.8	Passive Equilibrium	Full operating conditions, 24hours start-up	

		equalization	
2	Working environment		
2.1	Working Temperature Range Of The Battery Box	Charge： 0~+55℃ Discharge： -30~+55℃	
2.2	Storage Temperature	-30~+60℃	
2.3	Recommended Working Temperature	21±3℃，average21℃	Optimum Working Temperature 20~40℃
2.4	Battery Box IP Protective Level	IP66	
3	**Auxiliary Power**		
3.1	Control Loop-voltage Range	20~26V DC	
3.2	Control Loop-power (CSC power)	2W	
4	Common Parameter		
4.1	Dimension(W*D*H)(mm)	810(W)*1152(D)*243.4(H)	
4.2	Weight	320±10kg	
4.3	IP Protective Level	IP66	
4.4	Cooling Method	Liquid Cooling	
4.5	Communication Method	CAN	

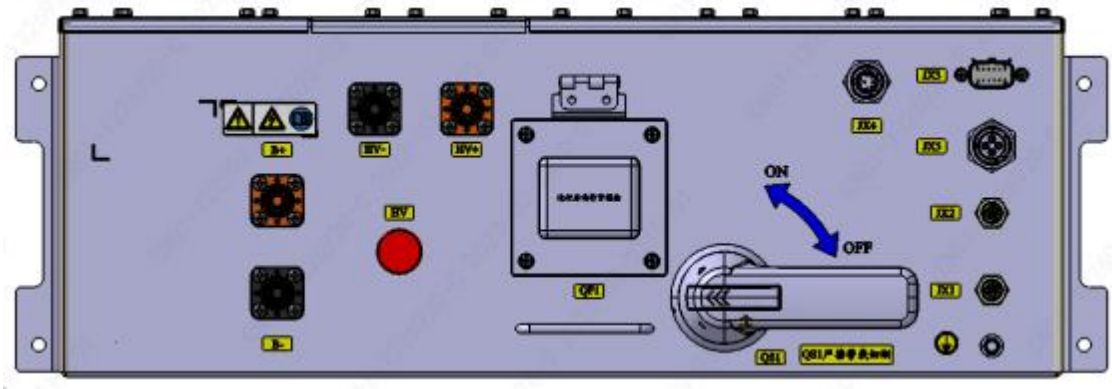
4.1.3 Battery Cluster

The battery cluster consists of 5 packs, connected in series with each other in the form of 1P260S. The battery modules are arranged from top to bottom in the storage cabinet and are connected via special connectors on the front panel.

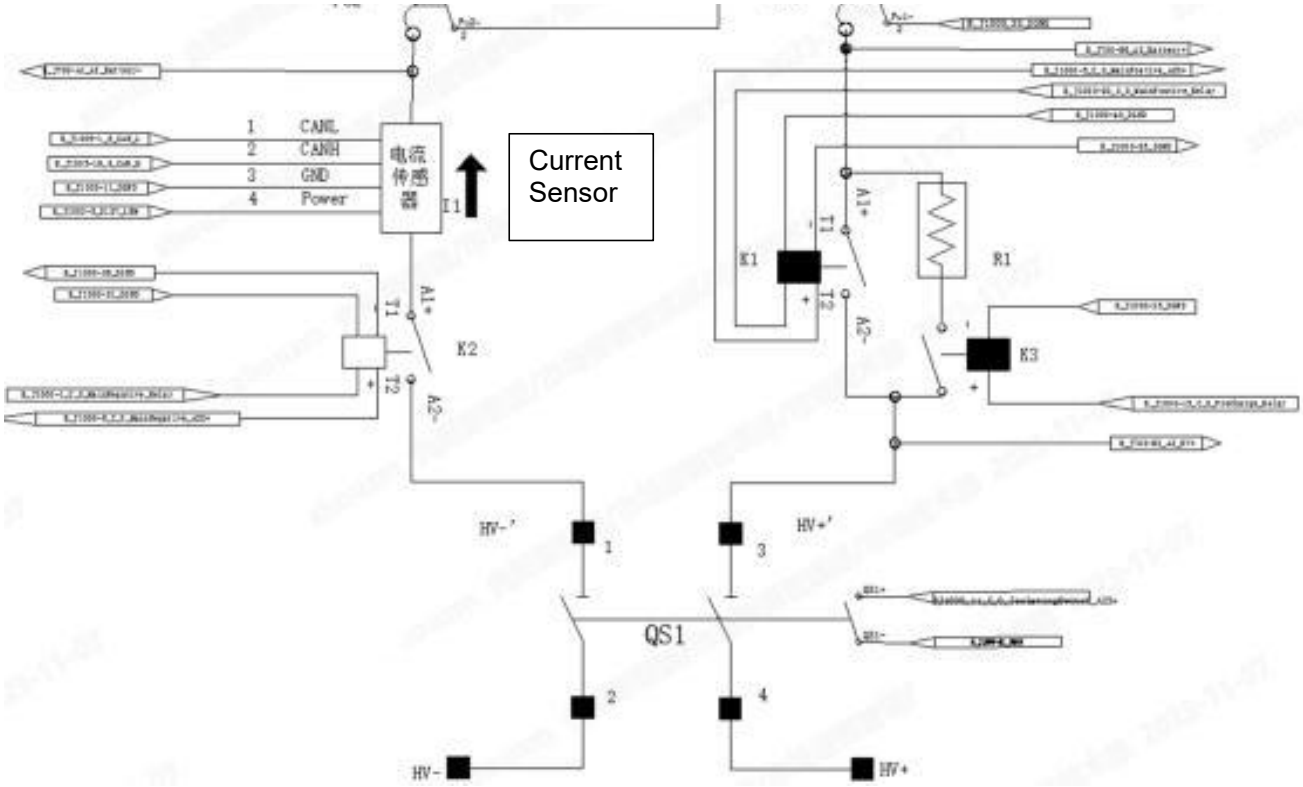
S/N	Project Title	Specification Parameters	Remark
1	Nominal capacity	280Ah	
2	Nominal Voltage	832V	
3	Voltage Range	728V~949V	Calculate according to 2.8~3.65V
4	Energy Storage	232.96kWh	
5	Structural dimensions	836mm*1084mm*1315mm	W*D*H
6	Weight parameters	1750kg	

4.1.4 High Voltage Box

The high voltage box is responsible for the connection between the battery string and PCS, monitoring the voltage, temperature, current and insulation of the battery string in real time, and collecting signals such as flooding and emergency stop button. The SBMU controls the start and stop of the electric water chiller according to the temperature of the battery cells, and uploads the information of the battery string to the EMS and PCS, and the high-voltage box is equipped with the protection functions of over-current, under-voltage, over-temperature, over-charging and discharging, etc.



Front view of high voltage box



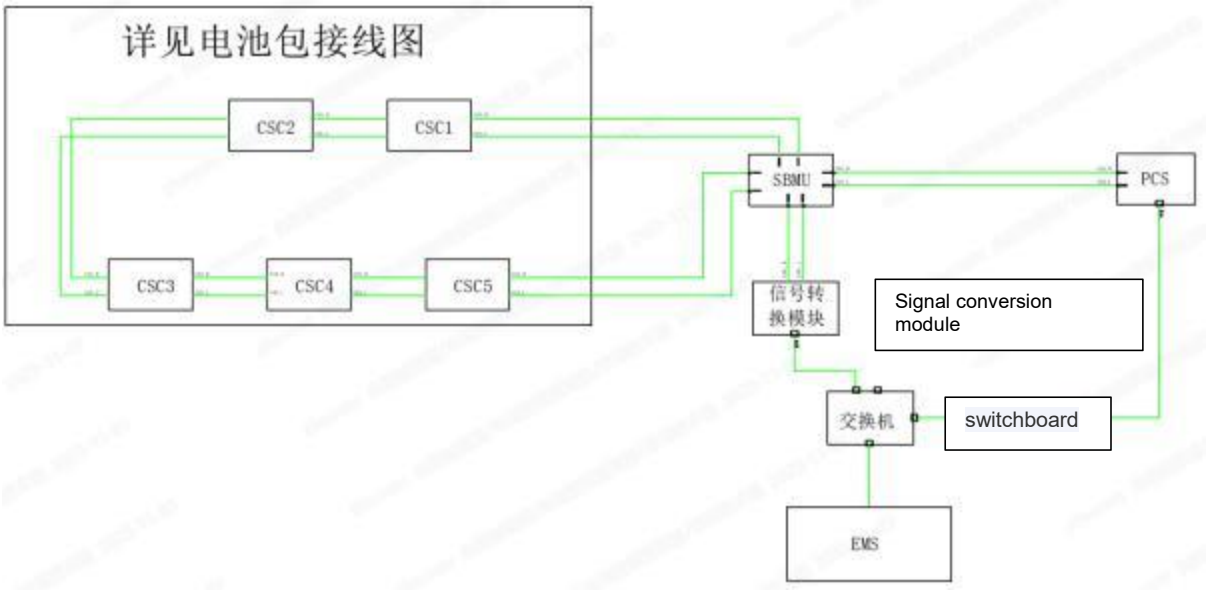
Typical framework diagram

High voltage box specification parameters:

S/N	Project Title	Specification Parameters	Remark
1	Dimensions	150.1*670*680.5	
2	Weight	60kg	
3	Allowable Voltage Range	800~1500V	
4	Allowable Current Range	0~320A	
5	Allowable Environment Temperature	-30~55℃	
6	Allowable relative humidity	95%RH	
7	Allowable Altitude	4000m	
8	Cooling Method	Air Cooling	
9	Protection Class	IP66	
10	External Communication Methods	CAN Bus Communication	

4.1.5 Battery Management System（BMS）

The BMS adopts a 2-stage architecture, with each Battery Module Management Unit CSC collecting parameters such as cell voltage and temperature from the battery module to the SBMU (Battery Cluster Management Unit) via the CAN bus, and the SBMU combining the other data collected (including fire alarm signals, water cooler status and other series of parameters such as battery status) to take equalization measures for the batteries and power control for the converter PCS. The SBMU, in combination with the other data collected (including fire action signals, water cooler status, battery status, and other series of parameters), takes measures to equalize the batteries and controls the power of the converter PCS.



Typical System Diagram

BMS Performance Parameters：

S/N	Performance Classification	Project	Performance Target
1	Basic Requirement	Operating Temperature Range	-30~+65℃
2		Storage Temperature Range	-40℃~+85℃
3	Battery condition monitoring accuracy and range	Individual Voltage Sampling Accuracy	±5mV@0~+60℃
4		Total voltage sampling accuracy	≤0.5% FSR
5		Total voltage detection range	0V～1500V
6		Current Sampling Accuracy	≤0.5% FSR
7		Current detection range	-500A～500A (Subject to actual conditions)
8		Temperature sampling accuracy	±1℃（-20℃~65℃;)
9		Temperature Sampling Range	-40～85℃
10	Battery status analysis accuracy	SOC Estimation Accuracy	≤5%@SOC≤30% or SOC≥80%,8 %@80%＞

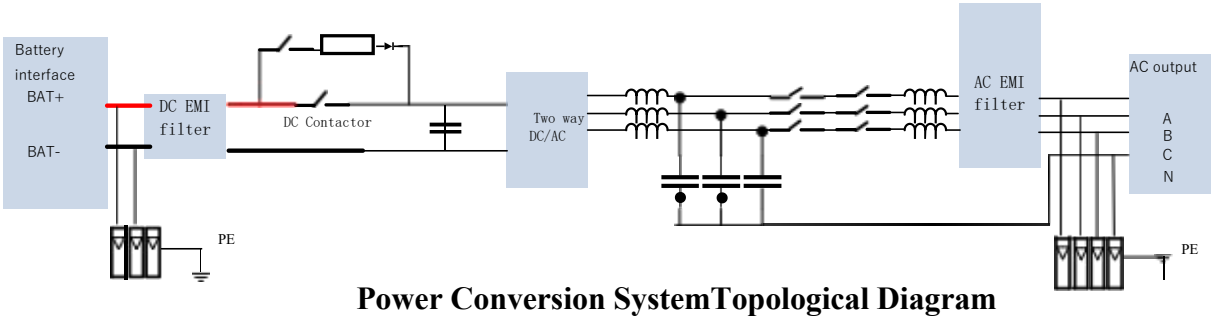
			SOC >30%

4.2 Power Conversion System(PCS)

Power Conversion System (PCS) plays an executive role in the energy storage system. Its main function is to control the charging and discharging process of the energy storage battery pack, and to perform the conversion of AC and DC, which consists of a DC/AC bi-directional converter, a control unit, an auxiliary power supply, and a temperature control system.

PCS

By communicating with BMS and EMS, PCS can realize active and reactive power adjustment, battery charging or discharging management, obtaining battery status information, and protecting battery charging and discharging.



Power Conversion SystemTopological Diagram

1) PCS Specification Parameters:

S/N	Project Title		Specification Parameters	Remark
1	Rated power		125kW	
2	D.C. Input	Input power	125kW	
3		Voltage range	650Vdc-950Vdc	
4		Rated current	208A	
5		Maximum current	229A	
6		DC Slow Start Function	Possess	
7	Grid-connection parameters	Rated power	125kW	
8		Maximum power	137kW	
9		Rated voltage	400Vac	
10		Allowable Voltage Range	-20%~15% Rated voltage (settable)	
11		Rated frequency	50Hz/60Hz	
12		Allowable grid frequency	45~55Hz（settable）	

13		Rated current（RMS）	181A	
14		Maximum current（RMS）	199A	
15		THDi	<3%	
16		Power factor adjustable range	-1~+1	
17		Overload capacity	110%	
18	Off-grid parameters	Rated power	125kW	
19		Maximum power	137kW	
20		Rated Voltage	400Vac	
21		Rated frequency	50Hz或60Hz	
22		Output Voltage Accuracy	1%	
23	System	Maximum inverter efficiency	99%	
24		Voltage Scale	three-phase, four-wire	
25		Insulation resistance	≥1MΩ	
26		Communication method	RS485、Ethernet、CAN	
27		Display	LED	
28		Protection class	IP65	
29		Size (W×D×H）	998*800*265mm	
30		Weight	72kg	
31		Operating temperature	-40℃~60℃	Automatic derating when >45℃
32		Relative Humidity	0~100%（No condensation）	
33		Altitude	4000m	Automatic derating when >2000m
34		Cooling method	Intelligent air cooling	
35		Installation Methods	Rack-mounted/Wall-mounted	
36		Access to the grid	Automatic synchronization	
37		Maintenance methods	Pre-maintenance	

2) **PCS operating states and their transitions**

The operating states of the PCS include: down state, standby state, and running state.

1.Shutdown status

The shutdown state is the state in which the PCS unit blocks the pulse and disconnects the contactors on the DC and AC sides simultaneously. It can be categorized into normal shutdown, emergency shutdown, and severe fault shutdown.

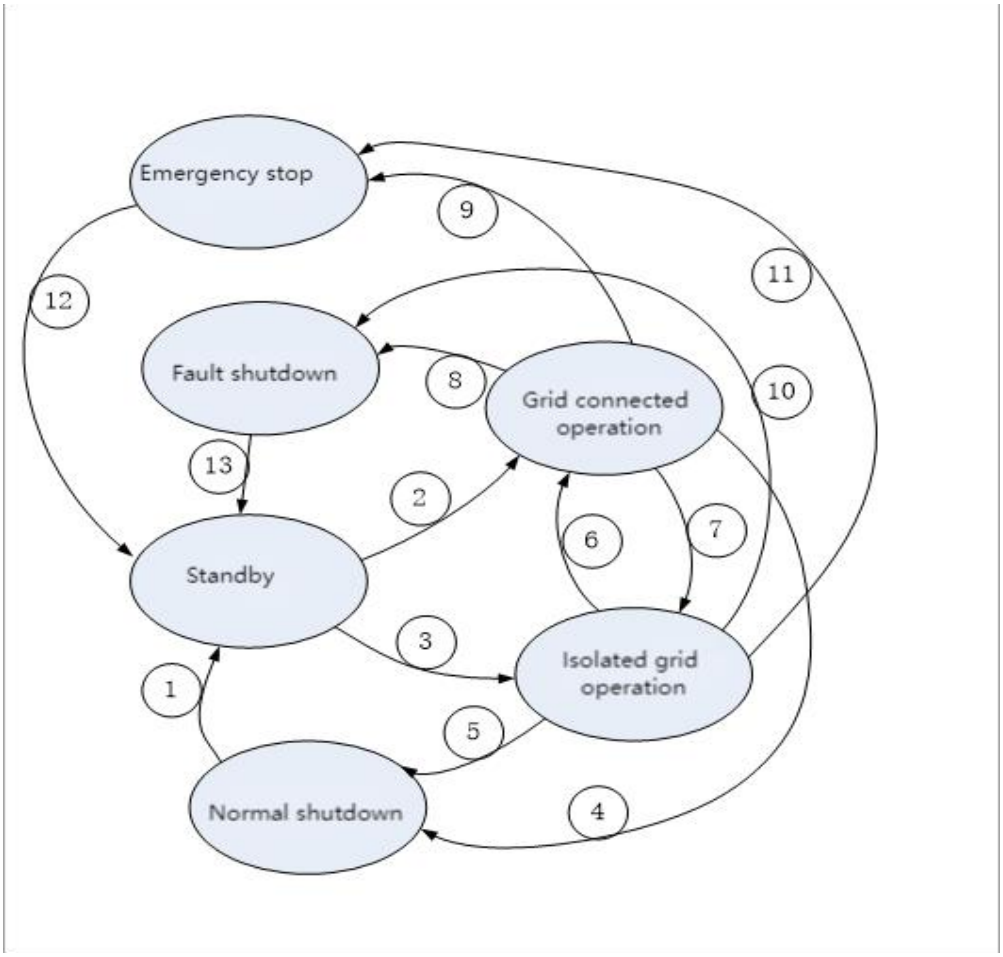
2. Standby state

The standby state refers to the hot standby state of the PCS device when it is ready to enter the working state or when a certain working state is completed. At initial power-up, when both the DC and AC sides are detected to be ready and the battery system reaches the working condition, the PCS unit enters the standby state and prepares to receive the operation mode and working state control commands.

3. **Operational status**

The operation status is categorized into grid-connected and isolated grid operation status.

4. State transitions



PCS state transition diagram

Each state transition condition of PCS is as follows:

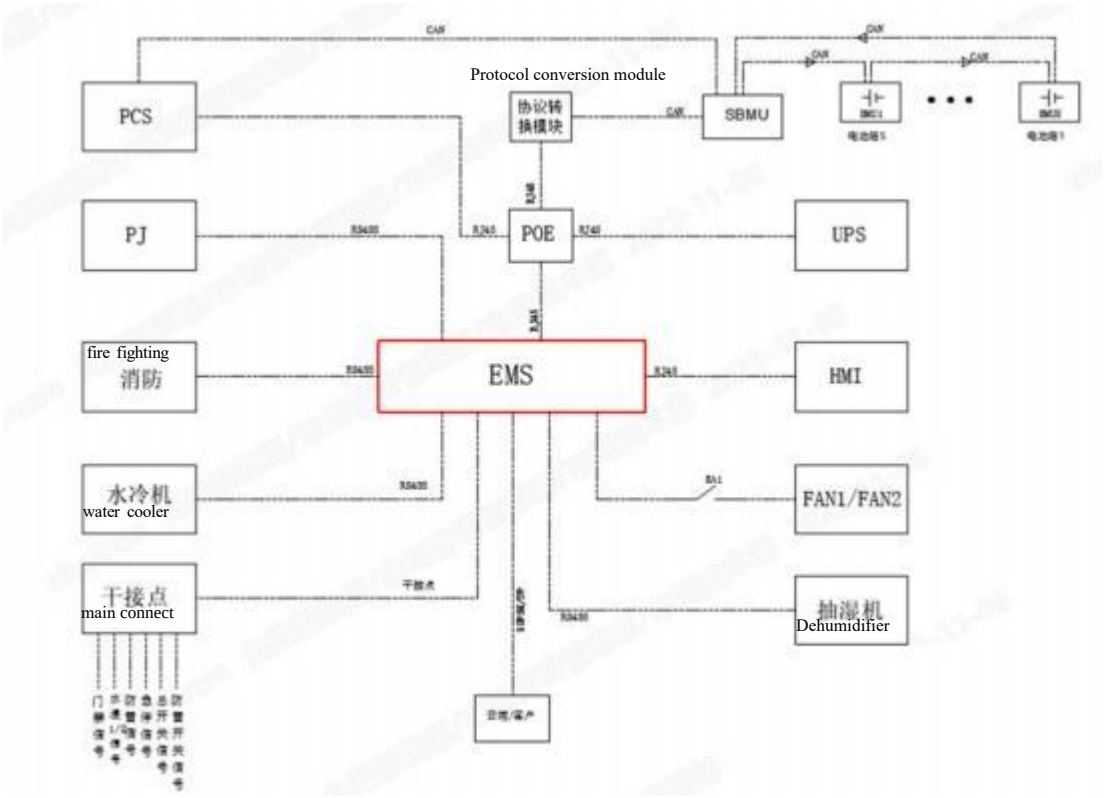
S/N	Instructions
1	PCS receives a standby command from the monitoring system
2	PCS receives a grid-connected operation command from the monitoring system.
3	PCS receives a command to run the isolated grid from the monitoring system
4、5	PCS receives a shutdown command from the monitoring system
6	PCS receives a grid-connected operation command from the monitoring system.
7	PCS receives an isolated grid command from the monitor
8	PCS detects an internal or external fault
9	PCS receives an emergency stop command from the monitoring system
10	PCS detects an internal or external fault
11	PCS receives an emergency stop command from the monitoring system
12	PCS receives a standby command from the monitoring system
13	Receive standby command from monitoring system after fault elimination

4.3 Monitoring System

The monitoring system mainly manages the metering meters of the distribution access system, the collection meters of the user load bus and the components of the energy storage system, and carries out adjustment and control and collection of relevant operating parameters.

Product Appearance

The integrated cabinet energy storage monitoring system consists of an energy management system (EMS) controller and related communication accessories. It can interact with the energy storage converter and BMS to control the charging or discharging of the energy storage system. Through RS485 or main contact , water cooler, fire fighting, access control, flooding, security and other auxiliary systems work status.



EMS Communication Topology

1) EMS is divided into equipment layer, communication layer and application layer.

Device layer: energy collection and conversion (PCS, BMS) is needed to support;

Communication layer: mainly includes links, protocols, transmission and so on;

Information layer: mainly includes cache middleware, database and server, of which the database system is responsible for data processing and data storage, recording real-time data and important historical data, and providing historical information query;

Application layer: the forms of expression include APP, Web, etc., providing visualized monitoring and operation interface for management personnel, with specific functions covering energy conversion decision-making, energy data transmission and collection, real-time monitoring and control, operation and maintenance management and analysis, visual analysis of power/electricity, and remote real-time control.

2) EMS Specification parameters

Command		Description
Power supply		Input Voltage AC220V
		Power Dissipation＜19W
10 Channel		8-channelinputs supporting active (12V) and passive inputs, 4-channel outputs
Button		1 FUN button for restoring the default IP address
Peripheral interface		1 USB HOST,1 SD card slot
Communication serial port		6 fully isolated RS485, using three levels of protection, support GB/T 17626.5-2008 standard 4KV protection
		2 fully isolated RS232
Network interface		1 x 100M/10M Ethernet interface
		Support embedded WEB, no need to install any software that can browse the monitoring data
Wireless Configurable	WIFI	Compatible standard 802,11a/b/g, RF type DSSS/CCK/OFDM
	4G Full Netcom	Quad-band TDD-LTE, Tri-band FDD-LTE
	GPRS	Quad-band 850/900/1800/1900, Classl~12 available
Computing resource	CPU	6000MHZ,Cortes-A8 Processor
	Memory,FLASH	Default memory 256M, FLASH 256M, other capacity can be configured
Working environment	Working	-10°C~50°C
	Working humidity	10%~90%RH, no condensation
	Storage	-30°C~+70°C
	Atmospheric	70~106kpa
Appearance Structure	Structure	High quality aluminum alloy
	Product	440mm*280mm*44mm(L*W*H)
	Installation	Front or rear panel rack mounting

1) Mobile APP Interface：

3) Web Interface：

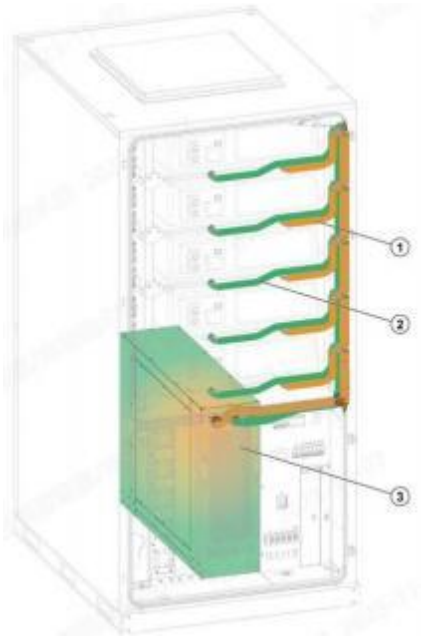
4.4 Thermal management systems

The liquid cooling system of the battery pack adopts the design of zone cooling, dividing the battery module into several independent cooling zones, each zone has its own cooling circuit, so as to better control the cooling effect of each zone, ensure the uniformity of the overall temperature of the battery pack, and effectively improve the comprehensive efficiency of the Pack.

The temperature control system consists of a variable frequency liquid cooling system and its piping system to adjust the temperature of the cores in the energy storage system.

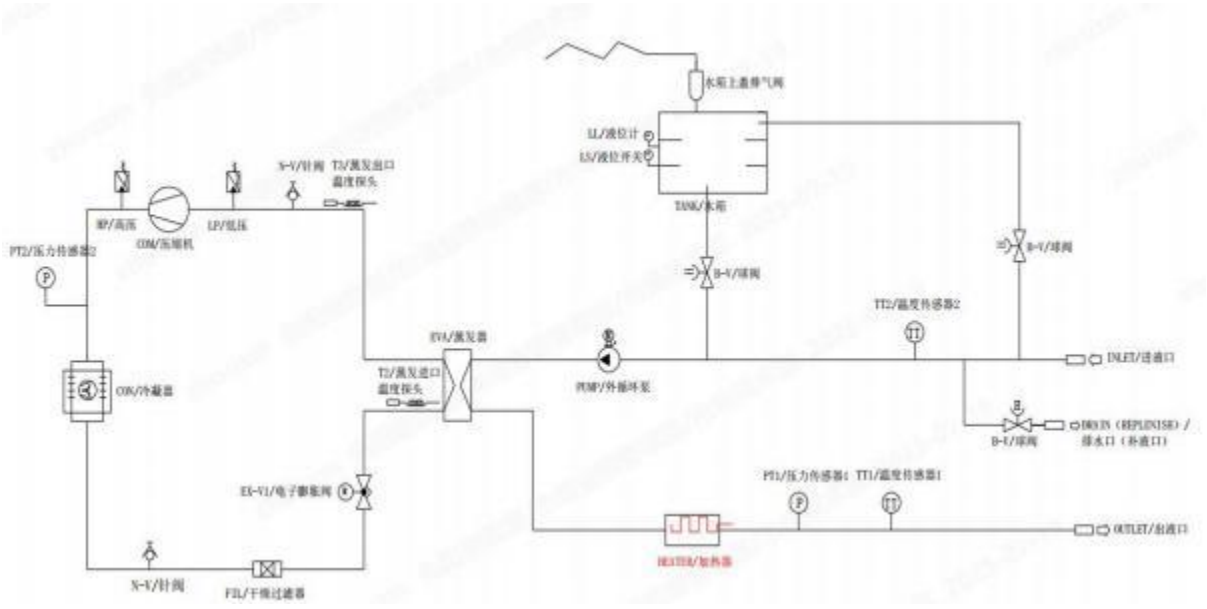
When the temperature of the battery cell is too high, the liquid cooling system delivers lower temperature heat transfer medium to the battery box to take away the excess heat to reduce the temperature of the battery cell; on the contrary, when the temperature of the battery cell is too low, the liquid cooling system delivers higher temperature heat transfer medium to the battery box to increase the temperature of the battery cell.In this way, the battery cells always work within the appropriate temperature range to maintain the optimal working condition of the system.

The thermal management system can control the core temperature within 35℃, and the temperature difference between the cores in the cluster does not exceed 3℃.



Schematic diagram of temperature control system

1. Liquid return piping	2. Liquid outlet piping	3.Water Chiller



Schematic diagram of liquid cooler operation

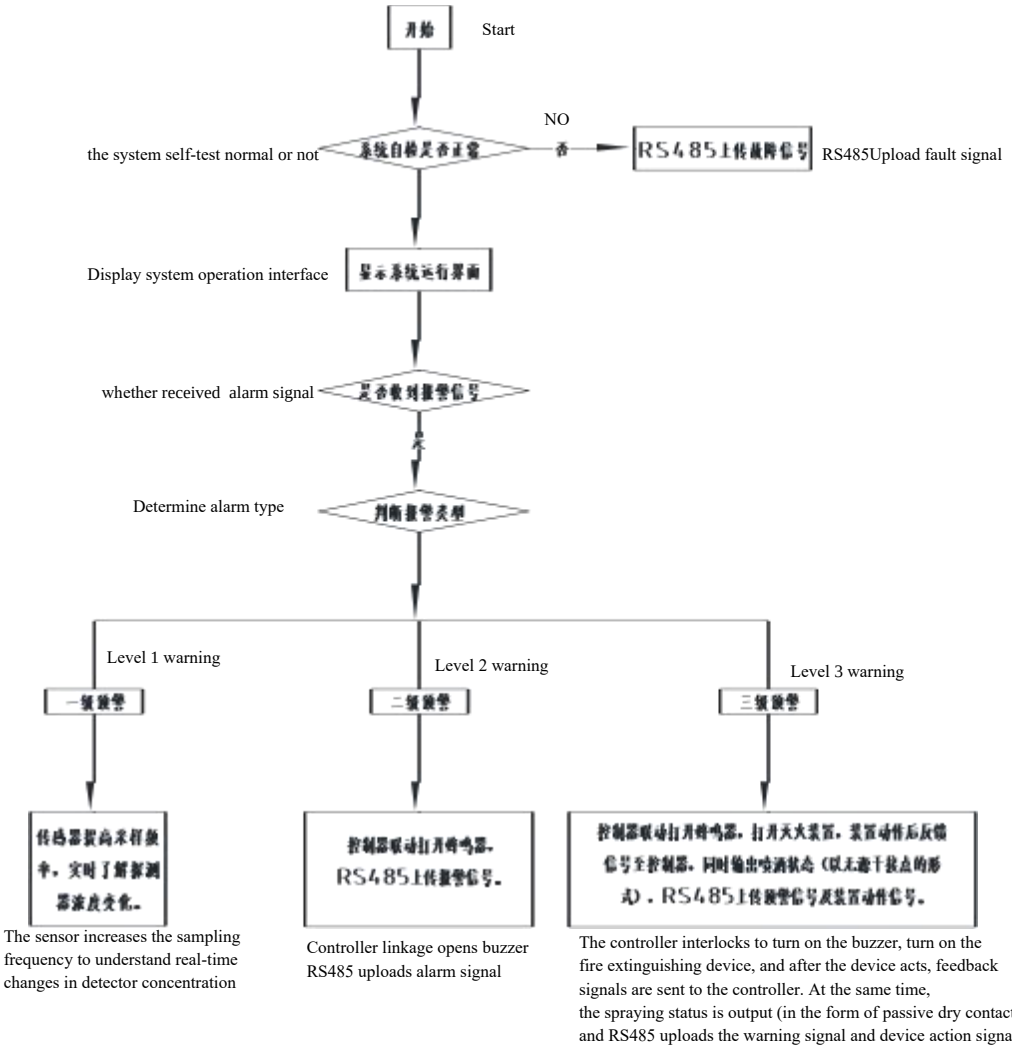
4.5 Fire Protection System

The energy storage cabinet perfluorohexanone fire extinguishing system consists of composite fire detectors, non-pressure storage perfluorohexanone fire extinguishing devices (including controllers), spray nozzles and piping fittings.

Each storage cabinet is used as a protection zone, and a 5-in-1 composite detector is placed in each battery cabinet as a detection device to detect gas concentration (H2, CO, VOC,), smoke, and temperature. The compound detector, controller and non-storage pressure perfluorohexanone fire extinguishing device are connected electrically. The outlet of the non-storage pressure perfluorohexanone fire extinguishing device is connected to the gas nozzle through high-pressure hose and quick-connect fittings. When the detector transmits the alarm signal to the controller, the device will be opened after receiving the activation signal from the detector and controller, and the extinguishing agent will be sprayed out through the pipeline and the nozzle to inhibit the fire in the battery cabinet.

Schematic diagram of fire-fighting system

1.Pipeline nozzle	2.Composite Fire Detector	3. Non-pressurized perfluorohexanone fire extinguishing equipment

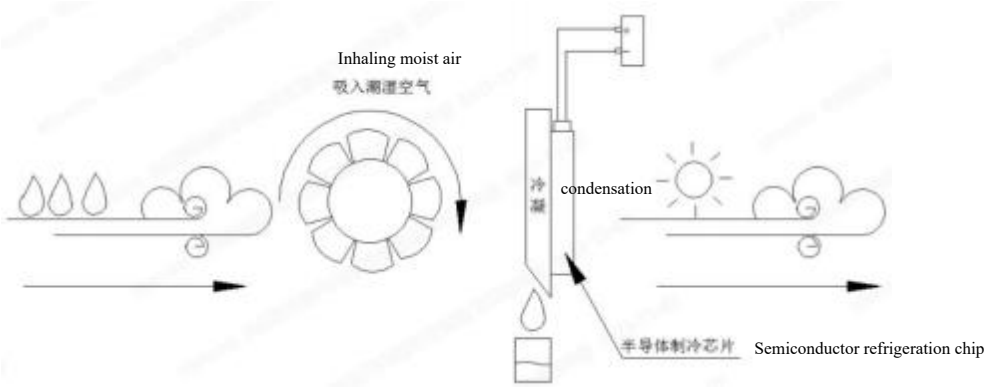


Fire protection system action flow diagram

4.6 Dehumidification system

For the power equipment such as mechanism box, terminal box, move-open and center-mounted switchgear, the inside of the cabinet is prone to creepage, flashover and accidents caused by condensation. The causes of these accidents mainly include humid climate, long-term idling and so on. Therefore, the power system has a rigid demand for moisture-proof and condensation-proof cabinets.

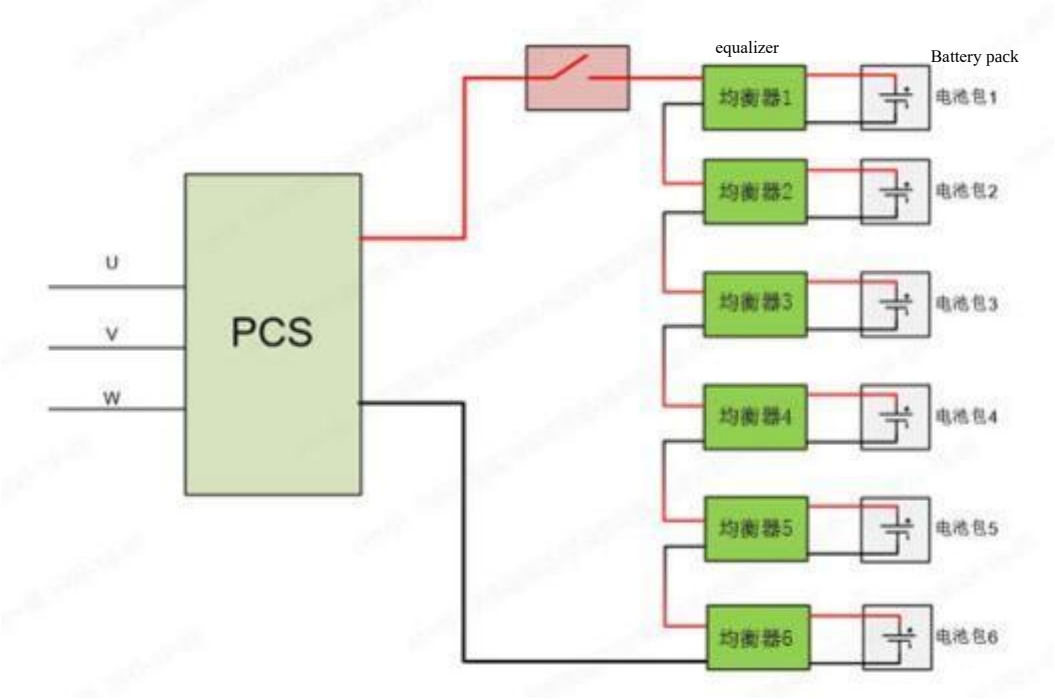
Intelligent dehumidifier can automatically draw the humid air in the confined space into the dehumidification duct through the fan, and the water vapor in the air condenses into water after passing through the semiconductor refrigeration components, and then discharged out of the cabinet through the conduit pipe, so as to make the small environment inside the cabinet to achieve good dehumidification effect. By actively guiding condensation, the device can effectively prevent the aging of the equipment inside the cabinet, the reduction of insulating strength, the breakdown of the secondary terminals, the mold and mildew of the materials and the corrosion of the steel structural parts and other safety hazards, so as to ensure the safe operation of the electrical circuits inside the cabinet.



How dehumidifiers work

4.7 Battery pack intelligent equalizer (optional)

The three-phase power is output from the PCS to the high voltage DC, and several battery packs are connected in series, each with a battery pack intelligent equalizer. The following figure only lists 6 battery packs in series, the actual number of battery packs varies according to the system configuration, 8 or even more, each battery pack with an equalizer.

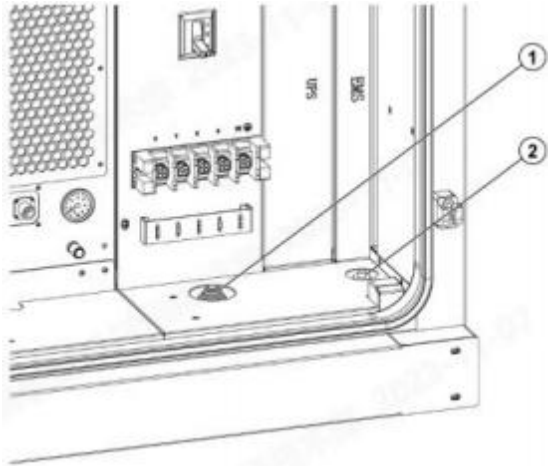


System schematic block diagram

Under normal circumstances, the Battery Pack Intelligent Equalizer is used in conjunction with the PCS. The Battery Pack Intelligent Equalizer is between the PCS and the battery packs, and can intelligently adjust the current through each battery pack according to the battery pack capacity, so that the battery packs can be charged and discharged differently, and the capacity of each battery pack can be balanced. Extends the life of the system with an estimated 10% increase in discharge over the life of the system.

5 Product External Interfaces

The integrated cabinet is delivered with all cables between the devices inside the cabinet connected. External cables and communication cables can enter the cabinet through the access holes in the bottom of the cabinet.



All-in-one cabinet in and out of the line control schematic

S/N	Instruction	Dimension
1	External cable pass in and out holes	Pass coil inner diameter 54mm
2	Communication cable pass in and out holes	Pass coil inner diameter 35mm

6 Optional system configurations

The parameters in this specification are introduced for 115KW/232.96KWh liquid-cooled integrated cabinet, which is the standard cabinet configuration. Customers can make flexible choices and configurations according to the actual capacity demand situation, supporting up to 10 parallel all-in-one cabinets.

List of product configurations:

S/N	Configuration	Specification parameters	Standard/Optional	Remark
	All-in-one cabinet			
1	Battery clusters (with high voltage box)	832Vdc/232.96kWh	Standard	
2	Constitute String Type converter	115kW	Standard	
3	Water Chiller	Cooling capacity 3kW	Standard	
4	Dehumidifying device	Dehumidification capacity ＞230ml/24h，Applicable space<3m³	Standard	

5	Perfluorohexanone Fire Extinguishing Systems	Gas Cylinder1.5L， Dosage Of Drugs2.4kg	Standard	
6	Energy Management System		Standard	
7	UPS	1kVA	Standard	
8	Cabinets and their structural components	W*D*H:1120*1400*2350mm	Standard	Including water-cooling piping, grounding system, battery racks, etc.
9	Battery Pack Intelligent Equalizer Confluence Cabinet	1 per battery pack	Optional	
10	Current Convergence Cabinet	Size:W*D*H:800*744*2350 mm	Optional	Configuration for 2 or more parallel all-in-one cabinets

7 System Maintenance

7.1 Maintenance Considerations:

When performing maintenance or overhaul of the energy storage system, the following procedures must be observed to ensure the safety of the operator:

1.Strictly observe the regulations in the maintenance manual, and do not operate with electricity.

2.Wear static electricity clothing, electrician's shoes, protective gloves, and insulated tools to protect yourself.

3.In the maintenance process, is strictly prohibited to wear metal rings, watches, earrings, and other metal equipment;

4, When maintenance work, contact with the wiring plug must use quality-qualified insulated tools, and take safety measures

7.2 Cabinet Maintenance

S/N	Checking content	Checking method	Maintenance Cycle
Maintenance matters			
1	System cleaning	Check the cleanliness of the cabinets and clean them.	1 time per year
2	Earth	Check for loose or rusted screws in the grounding copper drain.	Every 6 months to 1 year (depending on the environment of use)
3	Appearance	Check for paint loss on all parts of the cabinet, if any repainting is required.	1 time per year

4	Protection	Check for water leaks and conduct occasional inspections during the rainy season; Check the sealing of cavities to prevent the entry of small animals.	Once or more every six months
Maintenance matters			
1	Air Filters	Check the cabinet air filter and replace it if it is damaged, dusty, or dirty.	1 time per quarter
2	Earth	Replacement of corroded and broken screws and floor drains.	

7.3 Battery Cluster Maintenance

S/N	Checking content	Checking method	Maintenance Cycle
Maintenance			
1	Temperature	Temperature sampling of the battery box observed through the monitoring system	Everyday
2	Voltage	The voltage sampling of the battery box is observed by the monitoring system.	Everyday
3	Box Appearance	The surface is not stained, cracked, etc., battery box, High-voltage box parameter labels are clear, no peeling off phenomenon, whether the fasteners are loosened.	1 time per quarter
4	Earth	Check the battery box, high voltage box and battery rack for good grounding, loose or corroded ground rows and bolts.	once per every 6 months to 1 year
5	Cable	Check whether the power cable and communication cable connecting plugs are loose or burned. loose, detached, burned phenomenon, cable skin is cable skin is broken, burned site	once per every 6 months
6	Liquid cooling	Check the liquid-cooling plate and liquid-cooling piping for corrosion, damage and leakage.	1 time per quarter
Repair			
1	Battery box, high voltage box	Discover battery cell, BMS failure, fuses, contactors, circuit breakers and other devices are damaged or burned. Fuses, contactors, circuit breakers and other devices are damaged or burned, liquid cooling panels are damaged or corroded. The battery box/high-voltage box is replaced in its entirety. Replace the battery box/high-voltage box as a whole	
2	Cable	Replacement of the entire cable for problems found during the inspection	
3	Tag	On-site production of paper labels, cable tags, etc.	
4	Software Failures/Program Upgrades	On-site troubleshooting and upgrading programs	
5	SOC Calibration	Cycle at least once with a full charge	Quarterly (depending on operating conditions), EMS Automatic control of deep charging and discharging EMS automatically controls deep charging and discharging

7.4 PCS Maintenance

S/N	Checking Content	Checking Method	Maintenance Cycle
Maintenance			
1	Saving software data	Read data from the monitoring background software Save operation data, parameters and logs to the relevant Saving operation data, parameters and logs to relevant files Check parameter settings	Once a month
2	System Operational Status and Environment	Observe whether the PCS is damaged or deformed, and listen to the PCS for abnormal sounds; Check the variables while the system is running; Check whether the main components are normal; Check whether the PCS shell temperature is normal, use the thermal imaging cameras to monitoring system temperature; Observe whether the inlet and outlet air is normal; Check the humidity and dust in the environment around the PCS; Caution! The ventilation of the air inlet must be checked, otherwise, if the module can not be cooled, it will be malfaction due to overheating.	1 time every 6 months
3	PCS Cleanliness	Check the cleanliness of the circuit boards as well as the components. Check the appearance of the heat sinks and dust, if necessary, use compressed air and turn on the fan to clean the module.	1 time every 6 months to 1 year (depending on the dust content of the operating environment)
4	Cable	Check the power cable connections for looseness, detachment, and tightening; and Check the power cables and control cables for damage, especially the skin in contact with metal surfaces. Whether there are traces of cuts; and Check whether the insulation tape of the power cable terminals has been detached.	Half a year after the first commissioning year after the first commissioning, and every six months to one year thereafter every six months to one year thereafter

5	Terminals, rows of wire connections	Check the control terminal screws for looseness and tighten them with a screwdriver; Check main circuit terminals for poor contact and screw locations for signs of overheating; Check whether there is any color change in the wiring copper rows or screws, or terminals; Visually check the connections of the equipment terminals and the distribution of the wiring.	Once a year
6	Cooling Fans	Check the fan blades for cracks. Listen to whether there is abnormal vibration sound when the fan is running If the fan has abnormal conditions, it should be replaced in time.	Once a year
7	Safety function	Simulate a shutdown and check the shutdown signal communication. Check the warning labels and other equipment markings on the machine and replace them if they are obscured or damaged.	Once every six months to one year
8	Software Maintenance	Software upgrade Check parameter settings	Once every six months to one year
Repair			
1	Cable	Replace the whole cable	
2	PCS	Damage to case, power modules, boards, etc., overall PCS replacement	
3	Draught fan	Overall replacement	
4	software	Site survey, software upgrades.	

7.5 Gas Firefighting Maintenance

S/N	Checking content	Checking Method	Maintenance Cycle
Maintenance			
1	Composite Fire Detector	Turn off the tank, check that the green light on the detector is flashing properly, and use a heat gun or smoke (not both) to see if the control box produces the appropriate alarm.	1 time every 6 months
2	Audible and visual alarms	Check whether the audible and visual alarms are activated when an alarm signal occurs.	1 time every 6 months
3	Fire-fighting tank	Check that the fire tank pressure gauge pointer is in the normal range (green range).	1 time every 6 months
4	Fire protection pipeline network	Check for corroded lines and clogged nozzles.	1 time every 6 months
Repair			
1	Composite Fire Detector	Overall replacement	
2	Audible and visual alarms	Overall replacement	
3	Fire-fighting tank	Overall replacement	
4	Fire protection pipeline network	Overall replacement	

7.6 UPS Maintenance

S/N	Checking content	Checking Method	Maintenance Cycle
Maintenance			
1	Cable	Check for secure wiring, abnormal, Check that the wiring is secure, that there is no abnormal heat or temperature buildup, that the skin is not damaged, that the insulation sheath is not damaged, and that the terminals are not damage, insulation sheath damage, terminal corrosion, heat Rust, heat phenomenon	1 time per quarter
2	Tag	Whether the handwriting is clear, whether the label identification is complete	1 time per quarter

3	UPS Host	Whether Panel, indicator lights are normal, the chassis whether there is a strange smell, noise, whether there is dust accumulation phenomenon; Check whether the system by pass mode is correct; Check the battery capacity and whether the backup time meets the requirements; Check whether the voltage, current and other protection parameters are set incorrectly.	1 time per quarter
4	Earth	Check ground cable for tightness	1 time a year
5	Battery	Check whether the connecting parts are firm and free of corrosion, and whether the shell is deformed and free of leakage. Investigate the cause of abnormal battery operating temperature	1 time per quarter
Repair			
1	Cable	Replace the whole cable	
2	UPS Host	Damaged inverter module, rectifier module, static switch, batteries, etc. Replace the UPS.	
3	Circuit breakers, sockets	Overall replacement	

7.7 Water Cooler Maintenance

S/N	Checking content	Checking Method	Maintenance Cycle
Maintenance			
1	Appearance of the unit	Check the appearance of the unit for dirt, paint loss and corrosion, and clean and repaint the unit in time.	1 time per quarter
2	Cable	Check the cable for looseness, aging, damage, abnormal heat and other abnormalities, and the terminals for whether there are traces of oxidization, overheating	1 time per quarter

3	Air switch	Check whether there is any dirt on the shell, whether there is any strange odor, whether the operating handle can open/close the gate properly. odor, the operating handle can be normal opening/closing, connecting wire terminals are corrosion, traces of overheating	1 time per quarter
4	Draught fan	Check the fan is free of dust and the air outlet is free of foreign matter. Use a brush to clean the dust of the fan. Clean foreign matter at the air outlet. Check that the fan blades are not damaged and that the fan rotates smoothly without abnormal noise.	1 time per year
5	Condenser	Condenser free of dust and foreign matter blockage, use air gun Flush the condenser against the direction of air flow No serious bending and deformation of fins	1 time per quarter
6	Coolant Liquid	Use a coolant tester to check that: Concentration is within range, PH and electrolyte concentrations meet requirements. No dirt, deposits, algae, etc.	1 time every 6 months

Repair			
1	Cable	Replace the whole cable	
2	Air switch	Overall replacement	
3	Draught fan	Overall replacement	
4	Condenser	Fin deformation is corrected with a tool such as a fin comb.	
5	Coolant Liquid	Replace	