Version 01

User Manual

CESS-105K215AL

Smart Energy,

Sustainable Solutions

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1 Safety Instructions

1.1 Explanation of Safety Symbols

Before installing, operating, or maintaining the equipment, please read this manual thoroughly and follow all safety precautions identified on the equipment and in the manual. To ensure better use of this product and to safeguard personal and property safety, pay close attention to the following symbols:

Table 1-1 Meaning of the Identity

Symbol	Description
DANGER	"DANGER" indicates a high potential hazard that, if not avoided, could result in death or serious injury.
WARNING	"WARNING" indicates a moderate potential hazard that, if not avoided, may lead to death or serious injury.
CAUTION	"CAUTION" indicates a low potential hazard that, if not avoided, could result in moderate or minor injury.
NOTE	"NOTE" emphasizes content and may also provide tips for optimizing product use.

1.2 General Safety

NOTE

This equipment should be used in an environment that meets the design specifications. Otherwise, equipment failure might occur, leading to abnormal device function or damage, personal safety accidents, or property loss, which are not covered under the equipment's warranty. Installation, operation, and maintenance of the equipment should comply with local laws, regulations, and standards. The safety precautions in this manual are intended to supplement, not replace, local laws, regulations, and standards. The company assumes no responsibility in the following situations:

- Installation and usage environments exceed the provisions of relevant international, national, or regional standards.
- Operation outside the conditions described in this manual.
- Unauthorized disassembly, alteration of the product, or modification of software codes.
- Failure to follow the operational instructions and safety warnings provided in the product documentation.
- Damage caused by abnormal natural environments (force majeure, such as earthquakes, fires, storms, floods, landslides, etc.).

● Damage due to failure to comply with transportation and installation requirements.

● Damage due to storage conditions that do not meet product documentation requirements.

● Damage to the equipment's hardware or data caused by the customer's negligence, improper operation, or intentional damage.

● System damage caused by third parties or customer reasons, including relocation and installation systems that do not meet the requirements of this manual, as well as adjustments, changes, or removal of identification marks that do not comply with this manual.

DANGER

The equipment operates at high voltage. Improper handling could lead to electric shock or fire, resulting in death, severe personal injury, or significant property damage. Please follow the operational sequence and safety precautions outlined in this manual and other relevant documents to ensure proper operation:

● Inspect the equipment for securely fastened pre-installed cable connections. Check for any damage to the equipment, such as holes, dents, or other signs of potential internal damage. Ensure internal components have not shifted and do not unauthorizedly alter the structure or installation sequence of the equipment.

● Do not use water to clean the internal electrical components of the equipment. If liquid enters the equipment, immediately press the emergency stop switch and notify the site management personnel.

● Avoid performing installation, wiring, maintenance, or replacement operations while the equipment is powered. Before touching any conductive surface or terminal, measure the voltage at the contact point and ensure that the equipment or parts to be serviced are properly grounded to avoid the risk of electric shock.

● Except for personnel operating the equipment, keep others away. Do not power up the equipment until it has been fully installed or checked by a professional. When powering up for the first time or conducting operations with the main circuit energized, ensure at least two people are present on-site.

NOTE

● The user's actions and tools used during transportation, handling, installation, wiring, and maintenance must comply with the laws, regulations, and relevant standards of the country or region.

● Before opening the cabinet doors, clean off any accumulated water, ice, snow, or other debris from the top of the cabinet to prevent foreign objects from falling inside.

● Reverse engineering, decompiling, disassembling, adapting, embedding, or other derivative operations on the equipment's software are prohibited. It is not allowed to study the internal implementation of the equipment, obtain the software source code, steal intellectual property, or disclose any results of the equipment software performance tests in any manner.

1.3 Electrical Safety

➢ *1.3.1 Wiring Requirements*

● Select cables that comply with local laws and regulations. Cables of the same type should be bundled together, while cables of different types should be laid separately, avoiding entanglement or cross-laying.

● If leaving the wiring temporarily unfinished or during the wiring process, immediately seal the cable entries and close the cabinet doors to prevent small animals from entering.

● Cables used in energy storage systems must be securely connected, well-insulated, and meet the required specifications. Protective measures must be taken where cables pass through conduits or holes to prevent damage from sharp edges or burrs.

● After wiring, cables should be securely fixed using cable supports and clamps. In areas where soil is backfilled, ensure cables are closely adhered to the ground to prevent deformation or damage from the backfilling pressure.

● Using cables in high-temperature environments may lead to insulation aging and damage. The distance between cables and heating devices or heat sources should be at least 30mm.

● To ensure construction safety, all cables should be laid and installed at temperatures above 0° C. Handle cables gently, especially in cold weather conditions, to avoid damage.

➢ *1.3.2 Grounding Requirements*

● Do not damage the grounding conductor. The equipment's grounding system should be permanently connected to the protective grounding network. Before operating the equipment, check the electrical connections to ensure the equipment is properly grounded.

● The equipment grounding impedance must meet the national standard GB 50054 and local electrical standards.

● Do not operate equipment without installing the grounding conductor. Equipment requiring grounding must have the protective ground wire installed first during installation and removed last during disassembly.

➢ *1.3.3 Maintenance Requirements*

● Before connecting or disconnecting cables, first switch off the protective circuit breaker for the corresponding circuit.

● Use a multimeter suitable for the voltage level to check for live circuits, ensuring the equipment is completely powered off.

● If there are live parts nearby, use insulation boards or insulation tape for covering or wrapping.

● After reliably connecting the circuit to be maintained with the ground circuit using a grounding wire, proceed with maintenance and operation.

NOTE

● Before connecting cables, ensure the cable labels are correctly identified.

● If the equipment has multiple inputs, disconnect all inputs and wait for the equipment to be fully powered down before operating.

● After maintenance, disconnect the grounding wire between the maintenance circuit and the ground circuit.

1.4 Mechanical Safety

CAUTION

● When not using a wooden box for fork-lifting, the bottom surround must be removed. Handle with care during lifting to avoid impact or vibration.

● During transportation, the center of gravity of the box should be positioned between the two forks of the forklift. Long-distance carrying, inversion, or tilting is prohibited.

● When transporting equipment, the large size of the equipment may obstruct the operator's view; it is necessary to arrange for auxiliary personnel to assist in the operation.

1.5 Battery Safety

Description

The company is not responsible for damage to the batteries provided due to the following reasons：

● Damage, capacity loss, or irreversible damage due to the customer's failure to charge or accept the battery in a timely manner, resulting in over-storage.

● Mechanical damage, leakage, rupture, etc., caused by improper operation or failure to connect the battery as required.

● The customer or a third party changing the battery usage scenario without informing the company. This includes, but is not limited to: connecting additional loads to the battery, mixing with batteries of other brands, or using batteries of different rated capacities together.

● Direct damage to the battery due to the operating environment of the on-site equipment or external electrical parameters not meeting the environmental requirements for normal operation. This includes the actual operating temperature of the battery being too high or too low, poor electrical grid conditions, frequent power outages, etc.

● Frequent over-discharge of the battery caused by the customer not correctly setting the battery operation management parameters or improper maintenance, expansion at the customer's site, or long-term inability to fully charge.

● Theft or loss of the battery.

● Batteries that have exceeded their warranty period.

DANGER

● Do not expose the battery to high temperature environments or near heating devices such as sunlight, fire sources, transformers, heaters, etc. Overheating of the battery may cause fire or explosion.

● Do not disassemble, modify, or destroy the battery (such as inserting foreign objects, immersing in water or other liquids, etc.) to avoid battery leakage, overheating, fire, or explosion.

● Thermal runaway of the battery can produce flammable gases, as well as harmful gases such as CO, HF, etc. The accumulation of flammable gases from thermal runaway poses a risk of deflagration and explosion, potentially causing personal injury and property loss.

● When installing or maintaining a battery, use insulating tape to wrap the exposed cable terminals on the battery. Also, avoid foreign objects (such as conductive objects, screws, liquids, etc.) entering the battery interior causing a short circuit.

WARNING

● Use the battery within the temperature range specified in this manual. Do not charge the battery when the environmental temperature is below the lower limit of the operating temperature, to avoid internal short circuits caused by crystallization during low-temperature charging.

● Dispose of used batteries in accordance with local laws and regulations, and do not treat batteries as household waste.

● If more than 8 months have passed since the last charge, the battery needs to be recharged. Failure to recharge as required may affect the battery's performance and service life.

Abnormal Battery Handling Measures

DANGER

● In the event of electrolyte leakage or abnormal odor, avoid contact with the leaked liquid or gas. Non-professionals should not approach; contact professionals immediately for handling.

● The electrolyte is corrosive, and contact may cause skin irritation and chemical burns. If contact with battery electrolyte occurs, immediately wash the affected area with plenty of water and soap, and seek medical help immediately.

● In the event of a battery drop resulting in obvious odor, damage, smoke, or fire, evacuate personnel immediately and report to the authorities promptly. Professional personnel should extinguish the fire using firefighting equipment, ensuring safety.

1.6 Maintenance and Replacement

WARNING

● Do not open the cabinet doors in weather conditions such as rain, snow, thunder, sandstorms, or heavy fog.

● Before removing components from the cabinet, please ensure that other parts on the cabinet have not become loose.

● During equipment maintenance, insulating materials should be used to cover nearby live parts.

● Do not allow any objects to come into contact with the fan while it is operating (such as fingers, components, screws, etc.) before the fan is powered off and has stopped rotating.

● Do not power up the equipment before troubleshooting.

● When performing a live inspection of the system, pay attention to the hazardous warning signs on the equipment and avoid standing at the cabinet door.

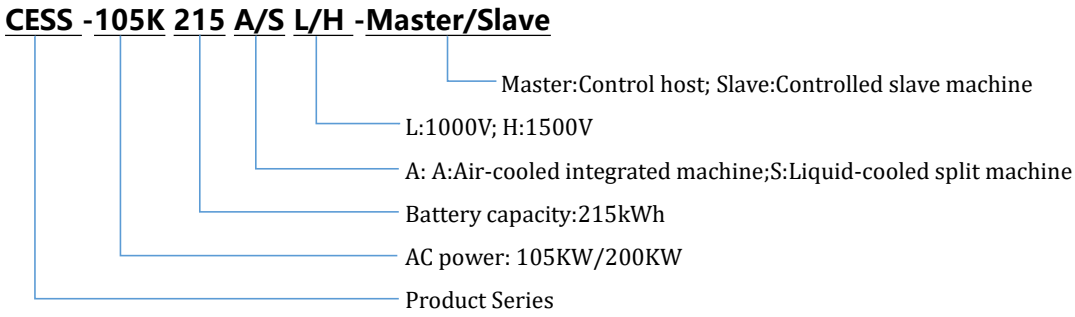
● Except for the battery module, wait for 15 minutes after powering down the equipment to ensure it is de-energized before operating on the equipment.

● After replacing power components of the energy storage system or changing the wiring, manual wiring inspection is required to avoid abnormal system operation.

● After completing maintenance and replacement operations, the cabinet doors should be locked promptly, and the keys should be properly stored.

2 Product Description

2.1 Description of models



Note: Isolation transformer (external), rated output power and battery capacity can be flexibly configured according to project requirements.

2.2 Product Features

The CESS series outdoor energy storage cabinet integrates an energy storage battery, battery management monitoring system, distribution system, environmental control system, and fire control system. The outdoor cabinet adopts a modular design, facilitating maintenance and expansion, and employs front maintenance to reduce the footprint and maintenance passage. It is characterized by safety and reliability, rapid deployment, low cost, high energy efficiency, and intelligent management.

In common application scenarios, the operational strategy of the energy storage system is as follows：

Peak Shaving and Valley Filling: During off-peak times with lower electricity rates, the energy storage cabinet automatically charges and then stands by when full. During peak times with higher electricity rates, the storage cabinet automatically discharges to realize price arbitrage, improving the economic benefits of the photovoltaic storage charging system.

Dynamic Capacity Addition: Charges the battery when the load is light and discharges it when the load is heavy, increasing load capacity during peak times and expanding the distribution system's capacity.

Microgrid: Integrates with photovoltaic systems, charging systems, diesel generation systems, etc., to coordinate energy balance, improve renewable energy consumption, and dynamic capacity addition, thereby enhancing the economic benefits of the microgrid system.

2.3 Electrical Wiring Diagrams

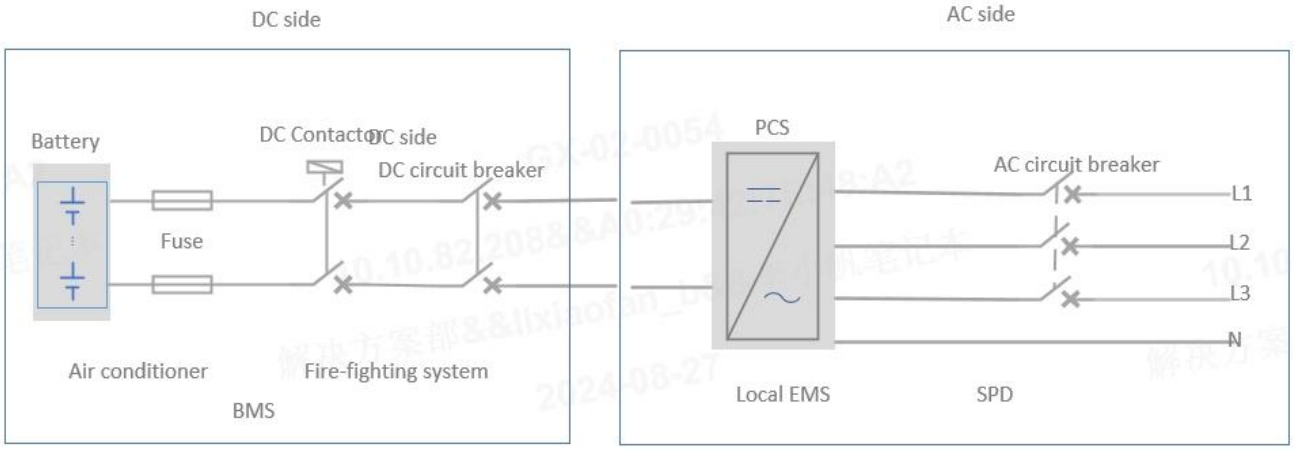


Figure 2-1 Electrical Primary Diagram

2.4 Product Characteristics

● Systematization: Integrates an energy storage battery, battery management monitoring system, distribution system, environmental control system, and fire control system, fully controlling the system's operational status and risks;

● High Safety: Utilizes lithium iron phosphate cells for stable and safe performance, with high-standard reinforced structural design, multiple levels of safety warnings, and protection, ensuring safety and reliability from the cell to the system.

● Excellent Thermal Insulation Design: The system uses an industrial liquid cooling unit combined with advanced thermal insulation design to efficiently and stably ensure that the energy storage system operates at an appropriate temperature.

● Supports Multiple Units in Parallel: Covers a wide power range of 50kW to 1MW, with multiple configuration options ranging from 2 to 5 hours.

● The system adopts an outdoor cabinet form, offering flexible and straightforward configuration while keeping each cabinet relatively independent and unaffected by others.

● Protection level of IP54, perfectly coping with various types of outdoor weather; the outdoor cabinet has a small footprint, facilitating transportation.

2.5 Product Specifications

The following are the typical configuration parameters for the CESS series outdoor cabinet-type energy storage systems. The actual supply will be in accordance with the technical agreement.

Table 2-1 Outdoor Cabinet System Parameters Table

Model	CESS-105K215AL-Master/Slave
DC Side	
Battery Rated Energy Storage Capacity	215kWh
System Rated Voltage	768V
System Voltage Range	648V~876V
Battery Type	Lithium Iron Phosphate Battery (LFP)
Battery Module Series-Parallel Connection Mode	1P*16S*15S
Maximum Charge/Discharge Current	140A
Pulse charge current	171A(t≤60s)
Pulse discharge current	171A(t≤60s)
AC Side	
Rated AC power	105kW
Rated alternating current	150A
Rated AC voltage	400V，3W+PE
Rated ac frequency	50/60Hz
Current total harmonic distortion rate THDI	<3% (Rated)
Voltage total harmonic distortion rate THDU	<3%
Conventional Parameters	
Ingress Protection Level	IP54
Relative Humidity	0~95% (No Condensation)
Display	8.4 inch all-in-one touch controller (including 4G)
Noise	≤78dB
Charging Temperature	0℃~50℃
Discharging Temperature	-20℃~50℃
Working Temperature	-30℃~50℃
Cooling Method	Air cooling 3.2kW
Altitude	3000m (Derating above 2000m)
BMS Communication	Ethernet/RS485/CAN
EMS Communication	Ethernet/RS485/CAN
Dimensions (W*D*H)	(1500±5)mm * (1490±5)mm * (2348±5)mm
Weight (approx.)	2500±10kg

Note: Actual parameters are set before leaving the factory according to customer requirements.

2.6 Component Introduction

➢ *2.6.1 Battery System*

● The energy storage module specification is 1P16S, with a rated voltage of 51.2V and an energy capacity of 14336Wh.

● 280Ah, 0.5C battery cells, battery module, the system parameter table is as follows：

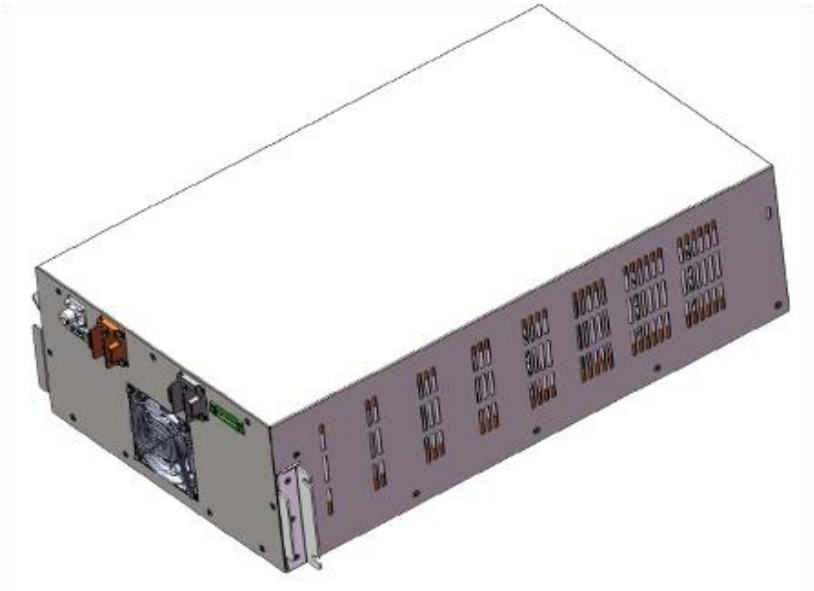


Figure 2-2 Module Schematic Diagram

Table 2-2 Battery System Parameters

No.	Name	Specification Parameters	Remarks
1	**Cell Parameters**		
1.1	Battery Type	Lithium Iron Phosphate Battery (LFP)	
1.2	Dimensions	(173.84±0.3) x (204.6±0.5) x (71.41±0.3)，Without Terminal Posts (173.84±0.3) x (207.15±0.4) x (71.41±0.3)，With Terminal Posts	Thickness Dimension Measurement Conditions: 20%SOC, 300±20 kgf
1.3	Battery Weight/kg	5.42±0.16	
1.4	Cell Nominal Voltage	3.2V	
1.5	Cell Voltage Range	2.5V~3.65V	Prohibited from exceeding use, using beyond the specified range will damage the battery and poses safety risks
1.6	Cycle Count	≥9000time	25±2℃, 0.5P, 2.8V-3.55V, Degraded to 224Ah

1.7	Nominal Capacity	280Ah@0.5C, 25℃	
1.8	Maximum Continuous Charge Rate	0.5C@25℃	
1.9	Maximum Continuous Discharge Rate	0.5C@25℃	
2	**Module Parameters**		
2.1	Dimensions	445±5mm(W)*750±5mm(D)*228±3mm(H)	
2.2	Nominal Capacity	280Ah@0.5C,25℃	Test Capacity≥98%, qualified
2.3	Nominal Voltage	51.2V (16cells)	Shipping Capacity 30%-40% SOC
2.4	Voltage Range	43.2~58.4V	Prohibited from exceeding use, using beyond the specified range will damage the battery and poses safety risks
2.5	Maximum Continuous Charge Rate	0.5C@25℃	Not to exceed 140A
2.6	Maximum Continuous Discharge Rate	0.5C@25℃	Not to exceed 140A
2.7	Nominal Weight	110kg	±2.5kg
2.8	Nominal Energy	14.336kWh	25℃@1C rated
2.9	*Insulation Standard	Battery Box Insulation Resistance>1GΩ(1000VDC)	Refer to GB36276-2018
2.10	*Pressure Resistance Standard	3110VDC，No breakdown or flashover phenomenon	Refer to GB36276-2018
2.11	Maximum Charge Voltage per Cell	3.65V	Any single cell, prohibited from exceeding use, using beyond the specified range will damage the battery and poses safety risks
2.12	Minimum Discharge Voltage per Cell	2.5V	Any single cell, prohibited from exceeding use, using beyond the specified range will damage the battery and poses safety risks
2.13	Charge High-Temperature Protection	50℃	Battery Module Temperature
2.14	Discharge High-Temperature Protection	50℃	Battery Module Temperature

2.15	Charge Low-Temperature Protection	0℃	Battery Module Temperature
2.16	Discharge Low-Temperature Protection	-20℃	Battery Module Temperature
2.17	Usage Environment	Indoor, dry, constant temperature	
2.18	Ingress protection	IP21	
2.19	Operating Temperature Range (℃)	0~50	Any single cell, prohibited from exceeding use, using beyond the specified range will damage the battery and poses safety risks
2.20	Storage Temperature Range (℃)	-30~55	Prohibited from exceeding use, using beyond the specified range will damage the battery and poses safety risks
2.21	Storage Environment Humidity (RH)	5%~95%	Prohibited from exceeding use, using beyond the specified range will damage the battery and poses safety risks
2.22	Operating Environment Humidity (RH)	≤85%	Prohibited from exceeding use, using beyond the specified range will damage the battery and poses safety risks
2.23	Operating Efficiency	≥92%	25℃±2℃ 1C charge/discharge @90%DOD
3	**System (Cluster) Parameters**		
3.1	System Rated Energy Storage Capacity	215kWh	
3.2	System Rated Voltage	768V	
3.3	Working Voltage Range	648V~876V	
3.4	Series and Parallel Connection Method	1P*240S	
3.5	Number of Included Battery Boxes	15	

➢ *2.6.2 BMS (Battery Management System)*

2.6.2.1 Composition of BMS

Primary BMS (BMU)——Located within the battery module, the Battery Management Unit (BMU) is responsible for monitoring internal battery information such as individual cell voltage, temperature, and the total voltage of each module, as well as performing passive balancing functions. Each BMU collects data from one battery module and uploads this data to the BCMU via CAN BUS, while also balancing the cells within the battery module based on commands received from the BCMU.

Secondary BMS (BCMU)——Located inside the high-voltage box, the Battery Cluster Management Unit (BCMU) is in charge of managing the battery cluster. It receives detailed data uploaded from the BMUs within the battery rack and samples the total voltage and current of the battery cluster to calculate and correct SOC (State of Charge) and SOH (State of Health). It manages the pre-charging and charging/discharging of the battery module by controlling relay switches and uploads relevant data to the BAMS (Battery Area Management System) via CAN BUS.

2.6.2.2 BMS Functional Overview

1) High Precision Monitoring and Reporting of Battery Analog Quantities

This includes real-time voltage detection of the battery cluster, detection of charging and discharging current of the battery cluster, detection of individual cell terminal voltage, multi-point temperature detection of the battery module, and insulation monitoring of the battery cluster.

2) Battery System Operation Alarm, Local Display, and Reporting Function

This includes alarms for battery system over-voltage, under-voltage, over-current, high temperature, low temperature, leakage, communication abnormalities in the battery management system, and internal anomalies of the battery management system.

3) Battery System Protection Function

The Battery Management System will take the battery out of operation in the event of analog quantities like voltage, current, and temperature exceeding safety protection thresholds, simultaneously reporting protection information and displaying it locally.

The BMS has three levels of software protection functions, detailed in the following table:

Table 2-3 Software Protection Functions

First Level Alarm (Request Power Reduction)	Second Level Alarm (PCS Standby)	Third Level Protection (Relay Cut-off)
Single Cell Overcharge/Overdischarge Warning Large Voltage Difference Warning for Single Cells High/Low Temperature Warning for Single Cell Charging/Discharging Large Temperature Difference Warning High/Low Total Voltage Warning High Charging/Discharging Current Warning Low Insulation Warning	Single Cell Overcharge/Overdischarge Large Voltage Difference for Single Cells High/Low Temperature for Single Cell Charging/Discharging Large Temperature Difference High/Low Total Voltage High Charging/Discharging Current Low Insulation	Single Cell Overcharge/Overdischarge Large Voltage Difference for Single Cells High/Low Temperature Protection for Single Cell Charging/Discharging Large Temperature Difference Protection Overvoltage/Undervoltage of Total Voltage Overcurrent during Charging/Discharging Low Insulation BMU Communication Timeout BCU Communication Timeout Communication Timeout with EMS or PCS Cell Fault NTC Fault

4) Self-Diagnostic Function

The Battery Management System is equipped with a self-diagnostic capability, which allows it to report communication interruption alarms when internal communication within the battery management system or external communication encounters a disruption. Furthermore, the system has the functionality for fault self-diagnosis, local display, and reporting to the local monitoring system for other anomalies, such as abnormal analog quantity collection.

5) Balancing Function

The Battery Management System employs a passive balancing strategy to effectively maintain the uniformity of the battery module.

6) Operating Parameter Setting Function

The Battery Management System provides the capability to locally modify various operating parameters of the battery management system. The parameters that can be set include：

- Upper limit voltage for individual cell charging
- Lower limit voltage for individual cell discharging
- Maximum operating temperature for the battery
- Minimum operating temperature for the battery
- Overcurrent threshold for the battery

7) The Battery Management System can locally display various operating statuses of the battery system, including:

- System operation status display
- Individual cell voltage/temperature inquiry and display
- Battery module voltage/temperature inquiry and display
- Battery cluster current/SOC/SOH inquiry and display
- Alarm information display
- Display of other abnormal information

The Battery Management System can perform a full charge and discharge of the battery module in conjunction with the PCS (Power Conversion System), completing the battery system capacity calibration as well as SOC (State of Charge) calibration function.

8) External Communication

Table 2-4 BMS Communication

Sequence Number	Communication Equipment	Communication Method	Remarks
1	BMS-PCS	485	
2	BMS-PCS	Dry Contact	Normally closed, open in case of failure
3	BMS-EMS	Ethernet	

Note: In the absence of a technical agreement from the customer, it is provided by the supplier. Any modifications later on require business coordination.

2.6.2.3 BMS Parameters

Table 2-5 BMS Technical Parameters

No.	project	parameters
1	BMS Operating Voltage Range	24V
2	Low Voltage System Power Consumption	≤2.5W@24V (Single board power consumption, excluding BMU, BCU, and relay control power consumption)
3	BMS Static Current	≤0.1mA
4	BMS Operating Temperature Range	-40~85℃
5	BMS Storage Temperature Range	-40~85℃
6	BMS Storage Humidity Range	10% to 90% (Non-condensing)
7	Single Cell Voltage Detection Range	0~5V
8	Single Cell Voltage Detection Resolution	1mV

9	Single Battery Voltage Detection Accuracy	≤±5mV
10	Single Battery Voltage Detection Frequency	<200ms
11	Total Voltage Detection Channel Number	1
12	Total Voltage Measurement Range	0V~1500V
13	Total Voltage Detection Resolution	100mV
14	Total Voltage Detection Accuracy	<0.5% FSR (Full Scale Range)
15	Temperature Measurement Range	-40~125℃
16	Temperature Detection Resolution	1℃
17	Temperature Detection Accuracy	-40~75℃≤±1℃ 75~125℃≤±2℃
18	Number of BMU Voltage Detections	52S
19	Number of Slave Board Temperature Detections	52
20	Total Current Detection Range	-300A~300A
21	Current Detection Accuracy	<0.2%FSR (Full Scale Range)
22	Current Detection Cycle	50mS
23	Current Detection Channel Number	1
24	Insulation Monitoring	Three levels of insulation fault detection: 0: No fault (>500Ω/V), 1: General fault (250~500Ω/V), 2: Severe fault (<100Ω/V)
25	Insulation Detection Accuracy	<10% (Compared to the actual insulation value, deviation not exceeding 10%)
26	SOC Estimation Accuracy	SOC <8% (Charge-discharge calibration performed once a month)
27	SOC Calibration	Yes
28	Balancing Mode	Passive Balancing
29	Passive Balancing Current	Not less than 80mA
30	Supported Communication Interfaces	CAN, RS485, Ethernet
31	Number of BCU Relay Control Channels	6 channels
32	BCU Relay Control Current	- Rated at 1A, peak 5A (for 1s)
33	Number of BMU Relay Control	2 channels

	Channels	
34	BMU Relay Control Current	Rated at 1A, peak 5A (for 1s)
35	Fault Data Recording	Equipped with an integrated real-time clock module, providing large capacity memory to record battery data detected during the operation of the battery management system and the time of occurrence, for system diagnosis and performance optimization.
36	Relay Adhesion Detection	Yes
37	Power-on Self-test	Yes

2.6.2.4 Operating Strategy

When the battery is fully charged, a "fully charged" status should be sent, maintaining this status to notify the PCS (Power Conversion System) to stand by and prohibit charging (although discharging is allowed). The prohibition on charging can only be lifted when the average cell voltage drops below 3.265V, and a discharge current of more than 5A is simultaneously detected.

After the battery has been fully discharged, a "fully discharged" status should be sent, maintaining this status to notify the PCS to stand by and prohibit discharging (requiring timely charging). It is forbidden to draw power from the DC side while the PCS is in standby mode until the prohibition on discharging can be lifted, which is allowed only when the average cell voltage is above 3.2V, and a charging current of more than 5A is simultaneously detected.

Note: The charging and discharging strategy should use the battery voltage as a reference. If the battery's State of Charge (SOC) value is used as a reference for the charging and discharging strategy, it must be confirmed with our company in advance. If not confirmed with our company, we will not bear any responsibility!

2.6.2.5 Alarm Threshold Table and Treatment Measures

These thresholds are factory default values, and should be adjusted based on actual site application conditions.

Table 2-6 Fault Threshold Table

Fault name	Fault level	Failure value	Latency	Release value	Latency	Treatment program
High Total Voltage	Level 1	828	3S	804	5S	Alarm, operation at reduced power of 50%.
	Level 2	840	3S	788	5S	Request PCS to standby, prohibit charging, allow discharging.
	Level 3	864	3S			Request PCS shutdown and provide dry contact output, delay 3 seconds before cutting off all contactors, restore upon restart.
Low Total Voltage	Level 1	744	3S	768	5S	Alarm, operation at reduced power of 50%.

during Discharge	Level 2	720	3S	780	5S	Request PCS to standby, prohibit discharging, allow charging.
	Level 3	672	3S			Request PCS shutdown and provide dry contact output, delay 3 seconds before cutting off all contactors, restore upon restart.
High Single Cell	Level 1	3.50V	3S	3.35V	5S	Reduce power by 50%.
	Level 2	3.55V	3S	3.28V	5S	Request PCS to standby, prohibit charging, allow discharging.
	Level 3	3.65V	3S			Request PCS shutdown and provide dry contact output, delay 3 seconds before cutting off all contactors, restore upon restart.
Low Single Cell	Level 1	3.0V	3S	3.1V	5S	Reduce power by 50%.
	Level 2	2.8V	3S	3.25V	5S	Request PCS to standby, prohibit discharging, allow charging.
	Level 3	2.5V	3S			Request PCS shutdown and provide dry contact output, delay 3 seconds before cutting off all contactors, restore upon restart.
Single Cell Voltage Difference	Level 1	0.4V	5S	0.2V	5S	Alarm, operation at reduced power of 50%.
	Level 2	0.6V	5S	0.3V	5S	Request PCS to standby, prohibit both charging and discharging.
	Level 3	0.8V	5S			Request PCS shutdown and provide dry contact output, delay 3 seconds before cutting off all contactors, restore upon restart.
High Temperature during Charging	Level 1	45℃	5S	40℃	5S	Alarm, operation at reduced power of 50%.
	Level 2	50℃	5S	45℃	5S	Request PCS to standby, prohibit both charging and discharging.
	Level 3	55℃	5S			Request PCS shutdown and provide dry contact output, delay 3 seconds before cutting off all contactors, restore upon restart.
High Temperature during Discharge	Level 1	45℃	5S	40℃	5S	Alarm, operation at reduced power of 50%.
	Level 2	50℃	5S	45℃	5S	Request PCS to standby, prohibit charging and discharging.

	Level 3	55℃	5S			Request PCS shutdown and provide dry contact output, delay 3 seconds before cutting off all contactors, restore upon restart.
Low Temperature during Discharge	Level 1	0℃	5S	5℃	5S	Alarm, operation at reduced power of 50%.
	Level 2	-10℃	5S	0℃	5S	Request PCS to standby, prohibit charging and discharging.
	Level 3	-20℃	5S			Request PCS shutdown and provide dry contact output, delay 3 seconds before cutting off all contactors, restore upon restart.
Low Temperature during Charging	Level 1	5	5S	10℃	5S	Alarm, operation at reduced power of 50%.
	Level 2	0℃	5S	5℃	5S	Request PCS to standby, prohibit charging and discharging.
	Level 3	-5℃	5S			Request PCS shutdown and provide dry contact output, delay 3 seconds before cutting off all contactors, restore upon restart.
Temperature Difference	Level 1	10℃	5S	8℃	6S	Alarm, operation at reduced power of 50%.
	Level 2	15℃	5S	13℃	6S	Request PCS to standby, prohibit charging and discharging.
	Level 3	20℃	5S			Request PCS shutdown and provide dry contact output, delay 3 seconds before cutting off all contactors, restore upon restart.
Overcurrent during Charging	Level 1	130A	5S	110A	5S	Alarm, operation at reduced power of 50%.
	Level 2	150A	5S	130A	5S	Request PCS to standby, prohibit charging.
	Level 3	170A	3S		5S	Request PCS shutdown and provide dry contact output, delay 3 seconds before cutting off all contactors, restore upon restart.
Overcurrent during Discharge	Level 1	130A	5S	110A	5S	Alarm, operation at reduced power of 50%.
	Level 2	150A	5S	130A	5S	Request PCS to standby, prohibit discharging.

	Level 3	170A	3S			Request PCS shutdown and provide dry contact output, delay 3 seconds before cutting off all contactors, restore upon restart.
Low SOC	Level 1	10%	5S	15%	5S	Alarm only, no action taken.
	Level 2	5%	5S	10%	5S	Alarm only, no action taken.
	Level 3	/	/	/	/	
High SOC	Level 1	95%	5S	90%	5S	Alarm only, no action taken.
	Level 2	100%	5S	95%	5S	Alarm only, no action taken.
	Level 3	/	/	/	/	
Insulation Leakage	Level 1	1000 Ω/V	5S	1200Ω/V	5S	Alarm, operation at reduced power of 50%.
	Level 2	500Ω/V	5S	600Ω/V	5S	Request PCS to standby, prohibit charging and discharging.
	Level 3	100Ω/V	5S	200Ω/V	5S	Request PCS shutdown and provide dry contact output, delay 3 seconds before cutting off all contactors, restore upon restart.
Cell Fault	/		1S			Request PCS shutdown and provide dry contact output, delay 3 seconds before cutting off all contactors, restore upon restart.
NTC Fault	/		1S			Request PCS shutdown and provide dry contact output, delay 3 seconds before cutting off all contactors, restore upon restart.
BCU and BMU Communication Fault	/	/	5S	/	/	Request PCS shutdown and provide dry contact output, delay 3 seconds before cutting off all contactors, restore upon restart.
BAU and BCU Communication Fault	/	/	5S			Request PCS shutdown and provide dry contact output, delay 3 seconds before cutting off all contactors, restore upon restart.
EMS (PCS) Communication Fault			5S			Request PCS shutdown and provide dry contact output, delay 3 seconds before cutting off all contactors, restore upon restart.

Note:

1) The parameter alarm value is fine-tuned according to the actual project. The above parameters are for reference only.

2) The dry contact of BMS-PCS is normally closed and opens in case of a fault.

Explanation

BCU, BMU, BAU are terms used by some battery manufacturers for the three levels of BMS, and different manufacturers may have different terminologies.

➢ *2.6.3 Environmental Control System*

The energy storage system is equipped with smoke detectors, temperature detectors, water immersion sensors, limit sensors, emergency stop buttons, and fire suppression units among other environmental control elements, allowing for comprehensive monitoring of the system's operational status. Schematic of the environmental control system：

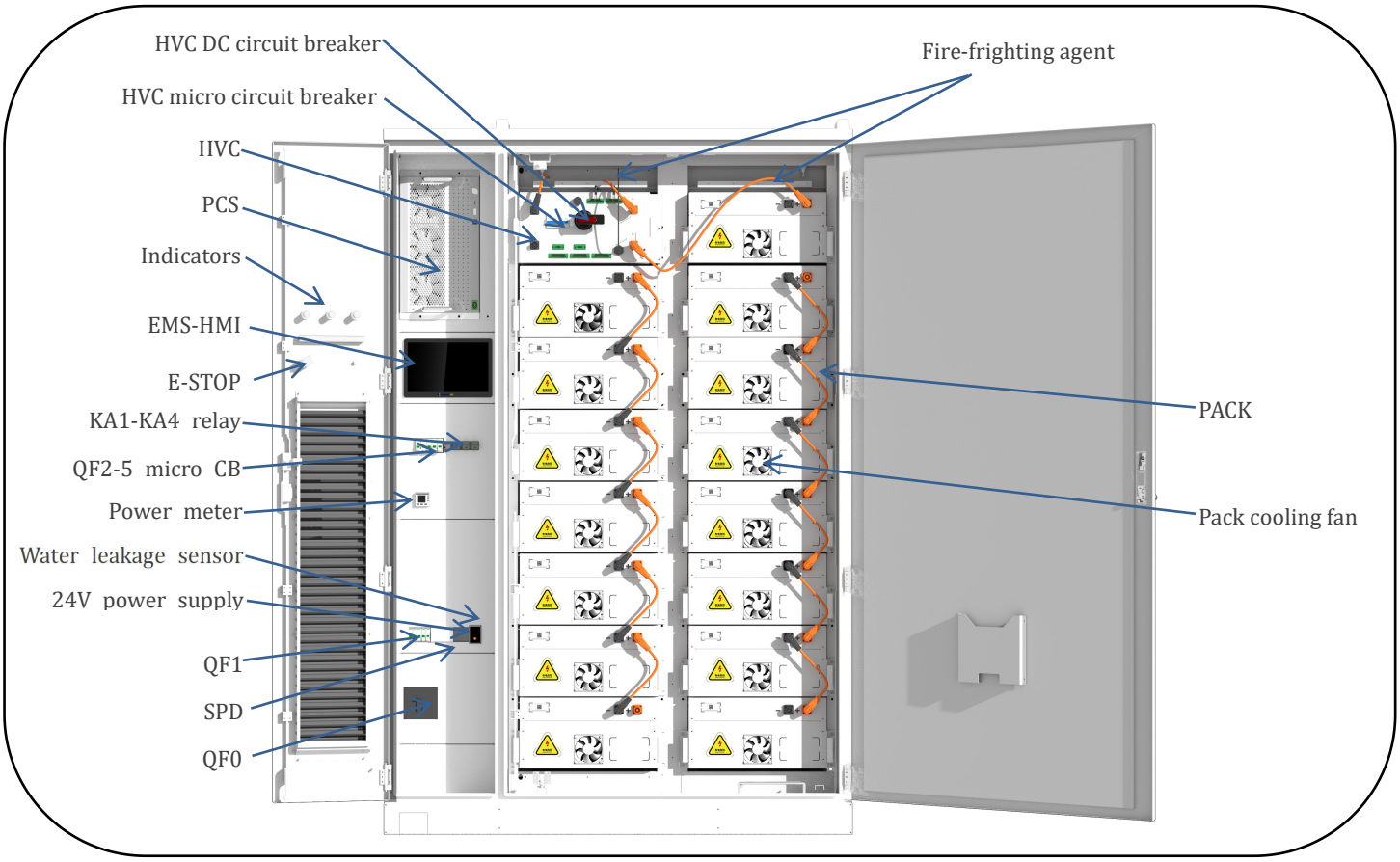


Figure 2-3 Cabinet Interior Structure Diagram

2.6.3.1 Precision Air-conditioning Parameters

Table 2-7 Precision air-conditioning Parameters

Item	Unit	Value
Model	Pcs	ECA-32HR-09ACSZ-1237C
Air Conditioner Type		Wall-mounted industrial air conditioner
Working environment	℃	-30~50

Temperature control range	℃	20~50
Power Supply	Vac	1/PE AC 220V 50Hz
Cooling capacity	KW	3.2
Heat capacity	KW	1
Cooling input power	KW	1.6
Heating input power	KW	1.2
Maximum operating current	A	9.5
Refrigerant	kg	R134a
Dimensions (W * D * H)	mm	545×255×1332
Net weight	Kg	About 75
Color		RAL7035
Internal circulation air volume	m3/h	1300
Controller type Remote communication		telecommunication
Anticorrosive		C3
Noise	dB(A)	70
Power connection		Plugless connection
IP		IP55
Return air mode Internal circulation		Internal circulation: upper side back, lower side out
Mounting mode		Wall-mounted
Condensate management		Collect to the water tray and discharge through the drain pipe
Special requirement		1With the dehumidification function

2.6.3.2 Access Switches

Microswitches detect the device's open door status and lighting linkage.

Table 2-8 Microswitch Parameters

Name	Parameters
Rated Voltage	AC-15: 220V DC-13: 220V
Rated Current	AC-15: 0.79A DC-13: 0.15A
Protection Level	IP52
Standard	GB/T 14048.5, IEC/EN 6094705-1
Switch Characteristics	One set of normally open, one set of normally closed
Operating Environment	Temperature: -5°C to +40°C Relative Humidity: <90% RH (no condensation)

2.6.3.3 Smoke and Temperature Detector

Smoke detectors are used to detect the smoke concentration and temperature range of the current environment.

Table 2-9 Parameters of Water Immersion Sensor

Name	Parameters
Operating voltage	DC24V（Allowable range 9V~30V）
Working current	Monitoring state: <1mA@DC12V Alarm state: <30mA@DC12V
Relay output	Normally open， Contact capacity 1A 30VDC
Use environment	Temp：-10℃~+65℃ Relative humidity<95% RH(No condensation)

2.6.3.4 Water Immersion Detection Device

The water immersion detection device checks whether there is any leakage in the energy storage system.

Table 2-10 Parameters of Water Immersion Sensor

Name	Parameters
Working Voltage	DC24V (permissible range 10V~30V)
Working Current	≤0.1A
Detection Channel	1 channel, 2-core leak detection cable
Response Time	<2s
Relay Output	Normally open, contact capacity 1A 30VDC
Operating Environment	Temperature: -10°C~+65°C Relative Humidity: <95% RH (no condensation)

➢ *2.6.4 Firefighting System*

The outdoor cabinet firefighting system adopts a perfluorohexanone fire extinguishing system. The YF2.0Q-HS perfluorohexanone extinguishing agent has high efficiency and low extinguishing concentration, capable of extinguishing Class A, B, C, and E fires. It is non-conductive, volatile, and leaves no residue, making it suitable for protecting high-value equipment and storage areas. Its use causes no damage to equipment and goods, making it a true clean extinguishing agent. It can be used to extinguish fires in energy storage cabinets, computer rooms, CNC centers, aviation, ships, vehicles, oil extraction, natural gas production, and usage areas.

2.6.4.1 Program Advantage

No external power supply is required and the device works independently.

The use of perfluorhexanone fire extinguishing agent has obvious cooling effect, and has no damage to live

equipment and precision equipment (volatile, no residue, strong insulation and no conduction).

No pressure storage at room temperature, high reliability.

2.6.4.2 System Device Composition

1) Equipment parameter introduction

Figure2-4 Physical Display

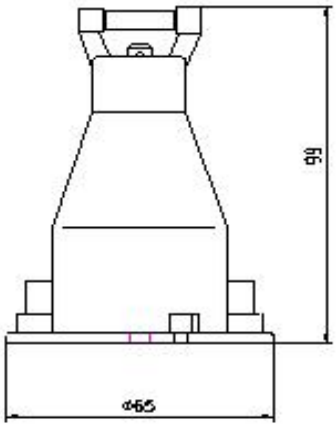
The non-pressure-storage type perfluorohexanone fire extinguishing device features innovative structure, reliable performance, and flexible installation. The device uses perfluorohexanone extinguishing agent, which rapidly transforms into a colorless and non-toxic gas after injection, leaving no residue and causing no harm to people and equipment. There are various detection and triggering methods, including thermal initiator, temperature-sensitive magnetic power generation component, or temperature/smoke detector connected to the fire alarm control host. The device can be installed inside and outside the protection space, and fixed by screws or 3M double-sided adhesive.

Table 2-11 Technical Parameters

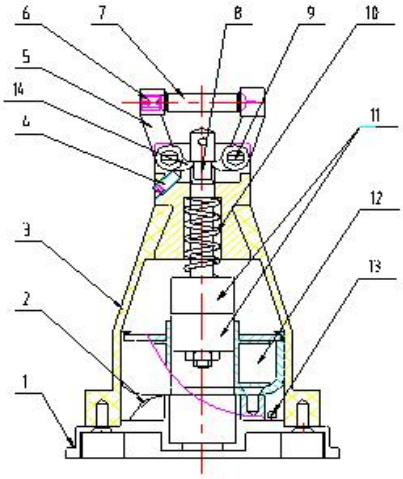
Type	QFF-0.5/1.2-QY
Overall dimension	60mm*60mm*390mm
Storage pressure	0Mpa
Starting mode	Electric start/hot start
Starting voltage/current	DC5~24V/2A
Hot start temperature	170℃±10℃
Extinguishing agent capacity	500mL
Protective volume	0.9m^3~1.373m^3
Start-up time	≤1S
Injection time	≤8S
Injection starting pressure	1.2Mpa
Installation mode	Paste installation/bracket installation
Operating temperature range	-40℃~+75℃
Signal feedback	Passive switching signal feedback
Class of protection	IP67

The JR11 thermal magnetic generator assembly is a start control device for non-pressure storage perfluorohexanone fire extinguishing, operating without external power supply by utilizing electromagnetic induction to generate start current from its own preset potential energy. The detection unit offers temperature models at 57°C, 68°C, 79°C, 93°C, 141°C, 182°C, and 260°C for various applications. This device combines detection and start functions in a simple and reliable structure that is easy to install and use. Additionally, it can provide output control signals to shut down electrical equipment or activate alarm devices.

External dimensions(mm)



Structural diagram



No.	Component	No.	Component
1	Base	8	Magnet Pull Rod
2	Rectifier	9	Hinge
3	Shell	10	Pressure Spring
4	Safety Screw	11	Magnet
5	Glass Ball Bracket	12	Coil
6	Adjustment Screw	13	Magnetic Switch
7	Glass Ball	14	Bracket Stud

2) Operating principle

The thermal glass ball detects fire and triggers a series of actions, including bracket rotation, magnet movement, induction current generation, rectification into DC current, and electric ignition head activation.

Table 2-12 Technical Parameters

Item	Value
Output voltage	≥20V 5ms
Output current (peak)	≥1.5A

Control contact allowable current	500mA
Feedback output	Always open dry contact
Service life	10Years

➢ *2.6.5 Configuration Lists*

In summary, the overall configuration list of the energy storage system in a typical configuration is as follows:

Table 2-13 Outdoor Cabinet Energy Storage System Overall Configuration List

Name	Model	unit	number	Remarks
Battery System	280Ah, 215kWh	cover	1	With control box
PCS	105kW	cover	1	modularization
Distribution system	Plastic case, micro break, lightning protection, socket, indicator light	cover	1	
Air Conditioning System	AC3200 220±15%VAC~50Hz	cover	1	Precision air conditioning
Firefighting System	Temperature sensor, smoke sensor, Perfluorohexanone device	cover	1	Thermally activated type
Auxiliary System	Leak sensor, limit switch, emergency stop button, lighting	cover	1	Auxiliary support equipment
Management system	HC-ES-CCU	cover	1	Touch all-in-one machine, switch

The actual supply configuration shall prevail.

3 Installation and Wiring

3.1 Transportation and Handling

➢ *3.1.1 Product Transportation*

● To ensure the equipment is in a good protective state, it is recommended to transport it with packaging.

● Equipment transportation must follow the requirements indicated on the packaging to prevent personal injury and equipment damage.

● It is not recommended to transport energy storage batteries by rail or air. Speed limits for land transportation: 80 km/h on flat roads and 60 km/h on rugged roads. In case of any conflict, local traffic regulations should prevail.

➢ *3.1.2 Product Handling*

● When using a forklift for moving, ensure the forklift has sufficient load capacity and that the center of gravity of the equipment is between the forks to prevent personal injury and equipment damage.

● For transportation with batteries, the forklift's load capacity needs to be ≥5t; for transportation without batteries, the forklift's load capacity needs to be ≥1.5t.

● The recommended fork blade length is ≥1.5m, width between 80cm to 160cm, and thickness between 25cm to 70cm.

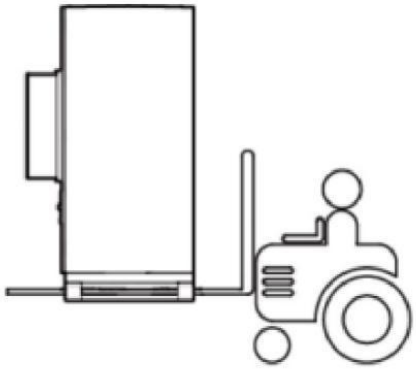


Figure3-1Handing Diagram

3.2 Packaging and Storage

➢ *3.2.1 Product Packaging*

To keep the product in a good protective state during transportation, specific wooden crate packaging is used. The equipment packaging has the following basic parameters (including but not limited to), which need to be carefully verified according to project requirements.

Table 3-1 Packaging Parameters

Parameters	Description
Model	Product Model
Dimensions	Dimensions after packaging
Weight	Total weight after packaging
Label	Instructions such as "This side up", "Handle with care", and "Center of gravity location"

➢ *3.2.2 Product Storage*

If the product is not to be immediately transported or installed for use, it must be stored indoors, and the storage location must meet the following conditions：

Table 3-2 Requirements for Product Storage Conditions

Parameters	Requirements
Storage Temperature (excluding battery)	-25°C to +60°C
Battery	20°C to 30°C
Storage Relative Humidity	<95% (no condensation)
Altitude	<3000m

NOTE

Long-term storage of batteries is not recommended. Long-term storage of lithium batteries can lead to capacity loss, with an irreversible capacity loss of 3% to 10% after 12 months of storage at the recommended storage temperature. The total storage and transportation time of the battery module should not exceed 8 months (starting from the time of dispatch). If exceeding 8 months, recharging and SOC calibration are required, with at least 50% SOC needed. Failure to recharge as required may affect the battery's performance and service life.

3.3 Installation Environment Requirements

The layout for the installation of energy storage systems must meet the local standards for fire protection distances or firewall requirements, including but not limited to the "GB 51048-2014 Electrochemical Energy Storage Station Design Specification" and the "NFPA 855 Standard for the Installation of Stationary Energy Storage Systems." Energy storage systems are only suitable for outdoor scenarios and require outdoor arrangements; indoor arrangements are not supported. The general requirements for site selection are as follows：

● The installation site should be above the highest historical water level of the area. The distance from airports, buried garbage disposal sites, riverbanks, or dams should be ≥2km.

● Choose a location with good ventilation. During equipment operation, do not block the ventilation ports and cooling systems to prevent overheating and fire. Ensure sufficient installation space to prevent nearby equipment from being affected by the heat generated by the product; ensure there is enough external wiring space at the installation site. The location should have convenient transportation conditions and reliable fire suppression system equipment.

● The installation site should be away from sources of fire, and flammable or explosive materials should not be placed around the equipment. If the equipment is installed in areas with dense vegetation, in addition to routine weeding, the ground below the equipment should be hardened to prevent weed overgrowth.

● Do not install energy storage systems outdoors in salt-damaged areas to prevent equipment corrosion and potential fire hazards. Salt-damaged areas refer to regions within 2km of the coast or areas affected by sea breeze.

● Energy storage systems must have protective measures such as fences or walls, with safety warning signs erected for isolation, to prevent unauthorized personnel from entering during the operation of the equipment, thereby avoiding personal injury or property damage.

● Equipment should be installed away from liquids, not under locations prone to condensation, such as water pipes and air vents; it should not be installed under air conditioning vents, ventilation ducts, or windows where equipment exits rooms, to prevent liquid from entering and causing short circuits in the equipment.

Description

When the safety distance of the selected site cannot meet the relevant national standards, it is recommended to reconsider the site selection. The site selection should avoid scenarios not recommended by industry standards and regulations, including but not limited to the following areas and places：

● Areas with strong vibrations, noise sources, and strong electromagnetic field interference.

● Places that produce or contain dust, cooking fumes, harmful gases, corrosive gases, etc.

● Places that produce or store corrosive, flammable, or explosive materials. Within the danger range of blasting.

● Locations with existing underground facilities. Places with dense populations, high-rise buildings, or underground constructions.

● Areas with adverse geological conditions such as rubbery soil, weak soil layers, prone to water accumulation and subsidence.

● Within the boundaries of mining collapse (fault displacement) areas. Areas that could be flooded after the breach of dams or levees.

● Seismic faults and earthquake zones with a design intensity of more than 9 degrees. Areas directly endangered by mudslides, landslides, quicksand, karst caves, etc.

● Important water source sanitation protection areas.

● Historical and cultural heritage protection areas.

If no more suitable site is available, it is recommended to install a firewall with a fire resistance of not less than 3 hours for safety protection, while also considering the space requirements for equipment transportation, installation, and maintenance. It is recommended to refer to T/CEC 373-2020: The length and height of the firewall should exceed the outer contour of the energy storage cabinet by 1m each.

3.4 Preparation Before Installation

1) Before installing the product, check whether the product is intact. If any damage is found, please retain evidence and contact Jiangsu Nantong Energy Technology Co., Ltd.
2) If the product is confirmed to be normal, please check against the delivery list to see if all accessories are complete.

Table 3-3 Requirements for Product Storage Conditions

No.	Name	Quantity	Remarks
1	Outdoor Cabinet Energy Storage System	1 set	Includes cabinet door keys
2	User Manual	1 copy	
3	Certificate of Conformity	1 piece	
4	Factory Inspection Report	1 piece	

3) Before installation, users are required to prepare relevant installation tools.

Table 3-4 List of Installation Tools

No.	Name	Quantity	Remarks
1	Screwdriver Set	1 set	
2	Socket Set	1 set	
3	Multimeter	1 unit	
4	Forklift	1 unit	
5	Screws, Nuts, Washers	Several	

3.5 Mechanical Installation

After confirming that the product is normal and all accessories are complete, the following suggestions for mechanical installation can be considered:

● Choose the equipment installation location based on the product dimensions in advance, and make proper positioning and fixing; the foundation is recommended as shown in Figure 3-2.

● Considering the product weight, the selected installation location needs to have sufficient load-bearing strength.

● Ensure a reliable grounding point, with a ground resistance of less than 4Ω.

● To prevent rainwater from entering, it is recommended to install the product on a cement pedestal, with a recommended height of 300-400mm.

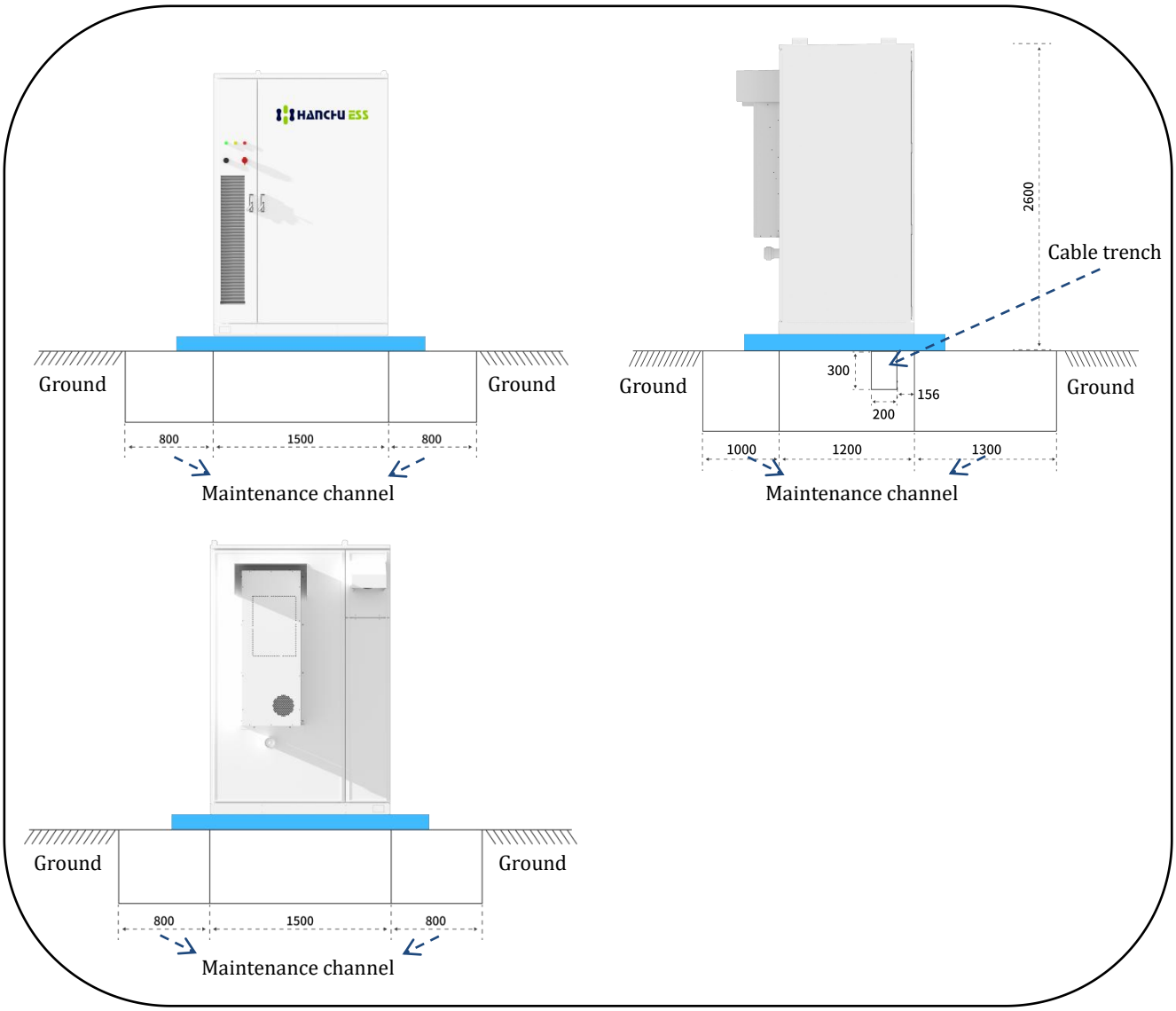


Figure 3-2 Equipment Installation in Place

3.6 Electrical Cable Installation

This product uses an integrated structure, with the DC side internally wired, requiring only the AC side and external communication for electrical cable installation on-site. The company provides wiring references as per Table 3.5, based on the product power and cable specifications. The selection of cable diameter should comply with local cable standards. Factors affecting cable selection include rated current, cable type, laying method, environmental temperature, and maximum acceptable line loss.

Table 3-5 Cable Diameter Comparison

Model Capacity	AC Cable	Neutral Line	Ground Wire	Positive and Negative DC Input (busbar level)
105kW	≥3*50mm²	≥50mm²	≥50mm²	Single module ≥50mm2

DANGER

When performing electrical installations, the following suggestions may be considered：

1) Before wiring, check that all switches within the equipment are in the off position, ensuring the equipment is de-energized.
2) Disconnect the power grid switch before wiring, ensuring the cables are de-energized.
3) Ensure correct cable phase sequence, which can be differentiated with different colored insulation sleeves or markings such as yellow, green, red, and black, to prevent phase sequence errors.
4) Cable wiring terminals and busbar connections must be tightened, and screw length should be appropriate to avoid affecting insulation and fastening.
5) Communication wires and power cables should be laid separately as much as possible, ensuring the cable insulation is not damaged during laying.
6) Grounding cables must be reliably connected to the grounding busbar, and the cable cross-sectional area must meet design requirements.
7) All AC cables should enter and exit the equipment through the bottom holes and then be connected to the corresponding phase sequence.
8) After wiring is completed, use fireproof putty to seal the wiring crevices to prevent external rodents from entering and damaging the equipment or cables.

To prevent contact resistance increase and heating due to loosened terminal connections from force, ensure the bolts fastening the terminals meet the torque requirements listed in Table 3-6：

Table 3-6 WiringTorque Rrequirements

Screw Size	M4	M5	M6	M8	M10	M12	M14	M16
Torque (N*m)	1.8~2.4	4~4.8	7~8	22~29	44~58	76~102	121~162	189~252

The entry and exit method of the energy storage system's cables is from the bottom. After removing the switch baffle, the power output terminals can be seen and wired in sequence.

- When using copper-core cables or copper-clad aluminum cables, please use copper connection terminals.
- When using aluminum alloy cables, please use copper-aluminum transition terminals or aluminum

terminals with copper-aluminum transition pads.

3.7 Communication Cable Installation

When installing external communication wires, ensure they are laid separately from power cables. When communication wires are laid parallel to power cables, it is recommended to maintain a distance of no less than 300mm. When communication wires must cross power cables, try to ensure a 90° angle between the two types of cables to minimize electromagnetic interference from power cables. Communication wires should be supported close to the ground as much as possible, such as through wire ducts, metal rails, etc. If support is not available, zip ties can be used for basic fixation.

The system's back-end communication can use RS485 or Ethernet, with system communication protocols using Modbus RTU or TCP; double-foot shielded wire or industrial Ethernet cable for wiring.

4 Power on and Commissioning

4.1 Pre-Startup Inspection

Before operating the product, ensure it has been installed according to specifications and perform a comprehensive and detailed inspection of the machine. Only after ensuring all indicators meet the requirements can the machine be started.

1) Exterior Inspection：
   a. The equipment's exterior is intact, without damage, rust, or paint loss. If there is paint loss, carry out repainting operations；
   b. Equipment labels are clear and visible; damaged labels should be replaced in time.
2) Grounding Inspection: The cabinet has a grounding point, and the grounding is secure; the grounding conductor inside the cabinet is reliably connected to the cabinet's grounding busbar.
3) Cable Inspection：
   a. The cable protective layer is intact without obvious damage.
   b. Terminals are made according to specifications, and connections are secure and reliable.
   c. Labels at both ends of each cable are clear and precise, the routing complies with the principle of separation between high and low voltage, with slack left at bends, without being pulled tight.
   d. Cable installation bolts are tightened, and cables do not loosen when pulled; sealing of cable through holes is complete.
4) Busbar Inspection: Busbars have no obvious cracks or deformation, screws at joints are tightened, marking lines are correctly positioned, and there are no foreign objects on the busbars.
5) Component Inspection: Referencing Figure 4-1, all circuit breakers are in the open position; surge protector indicators are green.

4.2 Startup Operation

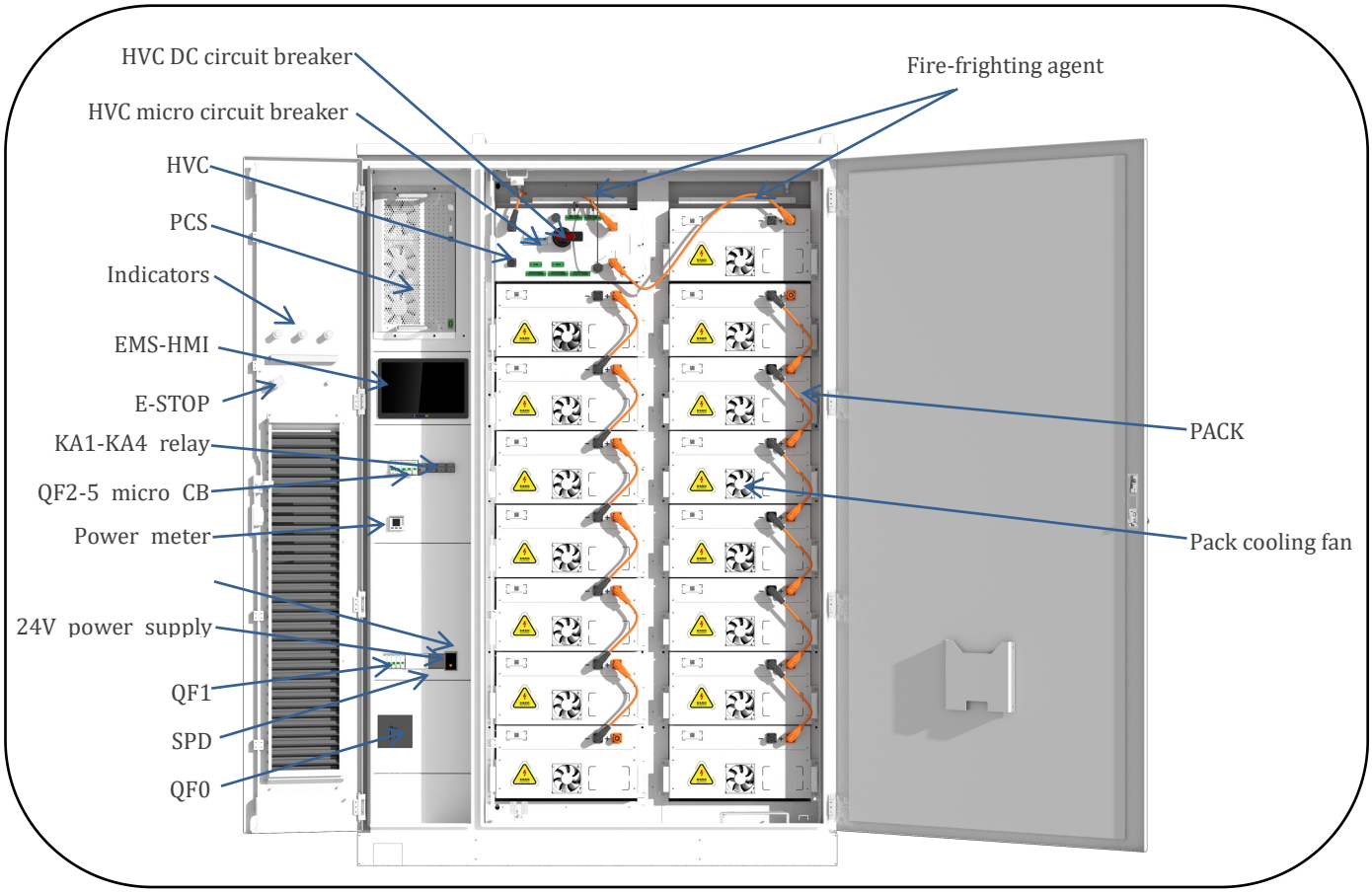


Figure 4-1 Distribution Switch Location Diagram

The operation process for starting the product (AC side startup) is as follows：

1) After powering up the AC side system, use a multimeter to confirm that the grid voltage is within the preset range (400V±10%), the three-phase sequence is correct, and the AC power has been normally delivered to each outdoor cabinet.

   Also, check whether the AC live indicator light on the outdoor cabinet is working.

2) Refer to Figure 4-1, close the QF0 DC molded case circuit breaker；

   Close the QF1-QF5 microswitch.

   Closing high pressure box micro switch and main circuit breaker.

3) Wait for the BMS to complete its self-check without any faults, automatically closing the high-voltage cabinet's internal contactor.

   At the same time, check whether the AC live indicator light on the outdoor cabinet is working.

4) Confirm that the display is normal, there are no fault alarms, and confirm that the fault indicator light on the outdoor cabinet is off.

5) Start the PCS through the AC side software system, set the grid-tied mode, constant power charging mode, and issue charging and discharging power (positive values for discharging, negative values for

charging).

The system begins operating (if a peak-valley plan curve is set, it will run automatically according to the set periods).

4.3 Trial Run

After all electrical structure installation of the equipment meets the starting conditions, in order to ensure the reliable and stable operation of the energy storage system, the initial operation must be powered on by professional electrical engineering technicians and set the operation mode and related parameters according to the project requirements:

1) Set the device control mode as "manual mode", and set the active power to 5% of the rated power for charging.
2) Observe the parameters of the screen PCS, battery and air conditioner during operation, and timely stop the machine if there is any abnormality.
3) Run for 0.5 hours.
4) Set the active power to 5% of the rated power for discharge, and the battery is discharged according to 5% of the rated power of the system.
5) Observe the parameters of the screen PCS, battery and air conditioner during operation, and timely stop the machine if there is any abnormality.
6) Run for 0.5 hours.
7) After 1 hour of trial operation without abnormality, close the system in the "switch" interface.
8) According to the project background and requirements, select the local manual power control mode, automatic peak-shaving mode or spontaneous self-use mode to be put into operation formally, and click "automatic" in the system interface.

4.4 Shutdown Operation

When the product requires routine maintenance and needs to be shut down, the normal shutdown operation is as follows：

1) First, shut down through the EMS system on the software, ensuring the inverter is turned off, then disconnect the combiner box's DC and AC side power switches, including the AC auxiliary power switch and the UPS power switch.
2) Refer to Figure 4-1, open QF1-QF5 microswitch.
3) Open the main AC circuit breaker.
4) Open the system's high-voltage cabinet DC main switch.
5) Wait for the busbar to finish discharging, confirm that all the AC and DC indicator lights on the outdoor cabinet door panel are off, and the equipment is shut down.

4.5 Emergency Shutdown

In the event of a fault or emergency situation requiring an emergency shutdown, the following emergency shutdown operation can be performed：

1) Press the emergency shutdown button "EPO"; the molded case circuit breaker will automatically trip, the PCS will shut down, and the high-voltage cabinet's contactor will be disconnected.
2) Refer to Figure 4-1, break the QF1-QF5 switch of the system, break the DC switch of the high voltage box and the micro-break of the high pressure box.
3) After the fault or danger is resolved and operation needs to be resumed, reset the EPO button.

NOTE

After pressing the "EPO" emergency shutdown button, wait for 10 minutes before starting up again!

4.6 System Lock

1) When an emergency stop of the energy storage system is manually triggered, the system automatically stops and undergoes a power cut. After manually resetting the emergency stop button, the system needs to be manually restarted.
2) When a fire alarm occurs in the energy storage system, the system automatically shuts down and cuts off the power. After the fire alarm disappears, the system needs to be manually restarted.
3) When a water intrusion alarm occurs in the energy storage system, the system automatically shuts down and cuts off the power. After the water intrusion alarm disappears, the system needs to be manually restarted.
4) When a communication loss alarm of important devices such as BMS occurs in the energy storage system, the system automatically shuts down. After the problem is resolved, the system needs to be manually restarted.
5) When a third-level alarm of the BMS of the energy storage system occurs (for example, excessive cell voltage, excessive low cell voltage, high battery discharge temperature, etc. exceed the set threshold of the third-level alarm, causing a BMS third-level alarm), the system automatically goes through a shutdown process. The faults and alarms need to be manually reset, and then the system is restarted.

5 Equipment Operation

The chapter primarily introduces the display interface and operation control of touch all-in-one machines through the man-machine interface, allowing users to conveniently execute various commands, browse operation parameters and data for DC, AC, and system operations, promptly obtain current equipment status and real-time alarm information for reliable fault diagnosis.

5.1 System Operation

➢ *5.1.1 Main Screen*

After successful power-on, the main window displays, allowing you to query the status, topology, meter information curve, and alarm information of each system in the multi-reactor system.

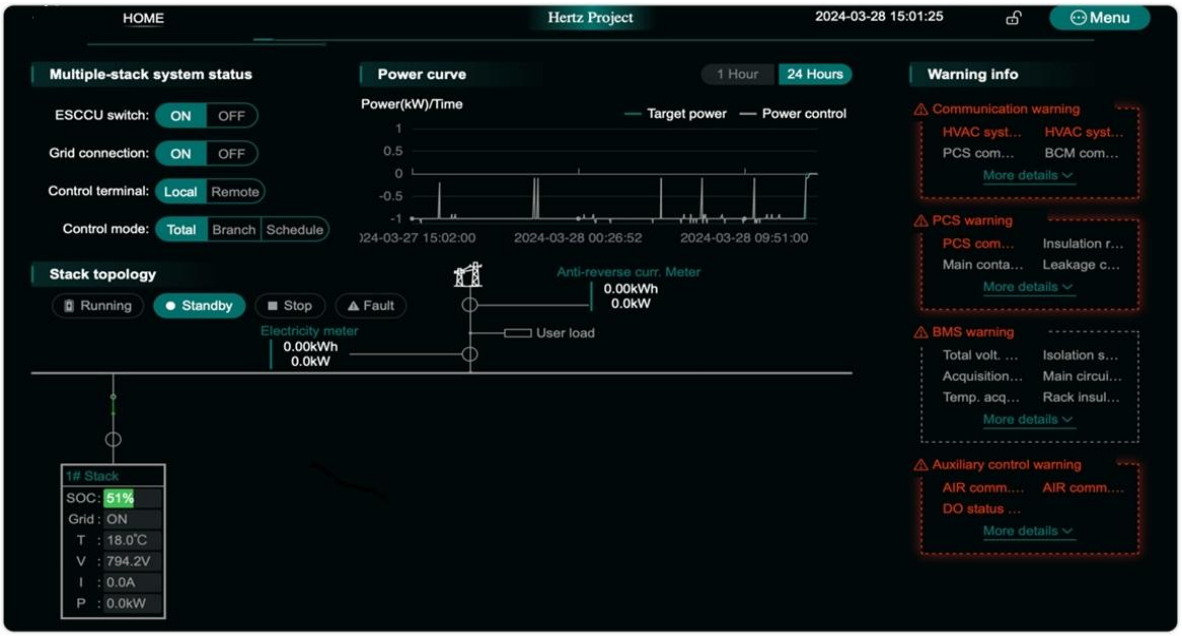


Figure 5-1 Operation Monitoring Main Interface

➢ *5.1.2 Multi-Rack System State*

1) Centralized control switch: Realize the opening and closing of centralized control function.
2) Off-grid/ grid-connected state: to achieve grid-connected and off-grid state switch.
3) Control source: local and remote control.
4) Control mode: achieve total power, subsystem and manual mode Settings

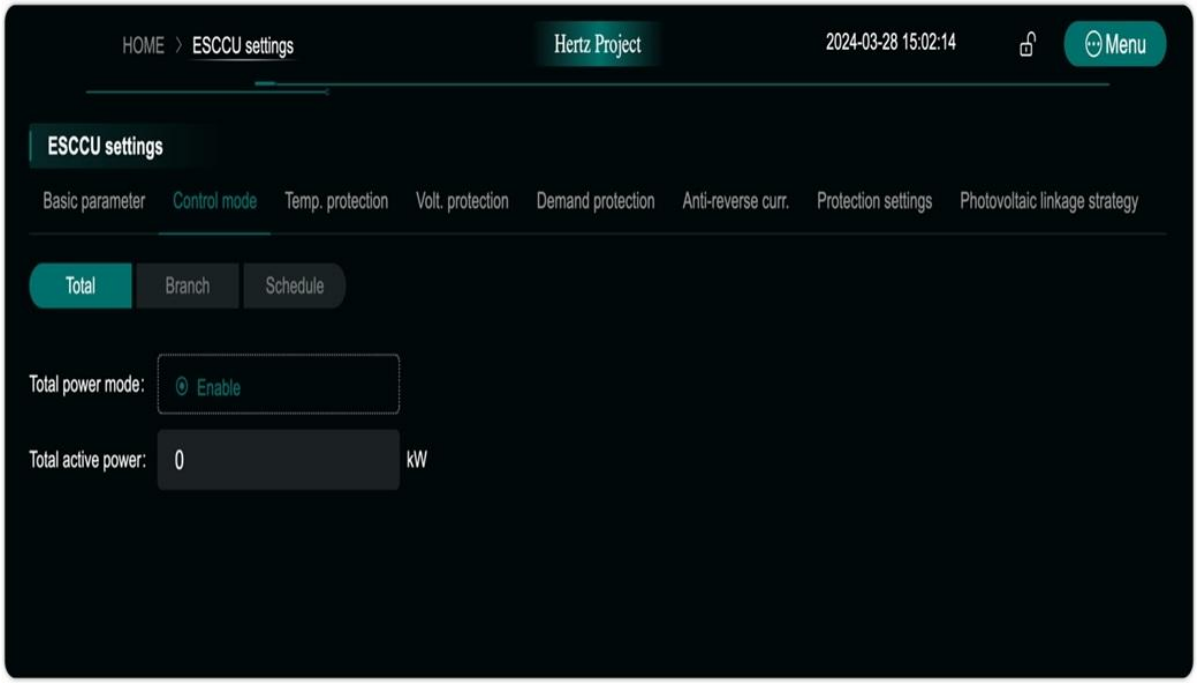


Figure 5-2 Multi-reactor System Control Mode

Revised sentence: Configure the total power mode by setting its start and stop parameters, and regulate the average distribution of PCS power within the system.

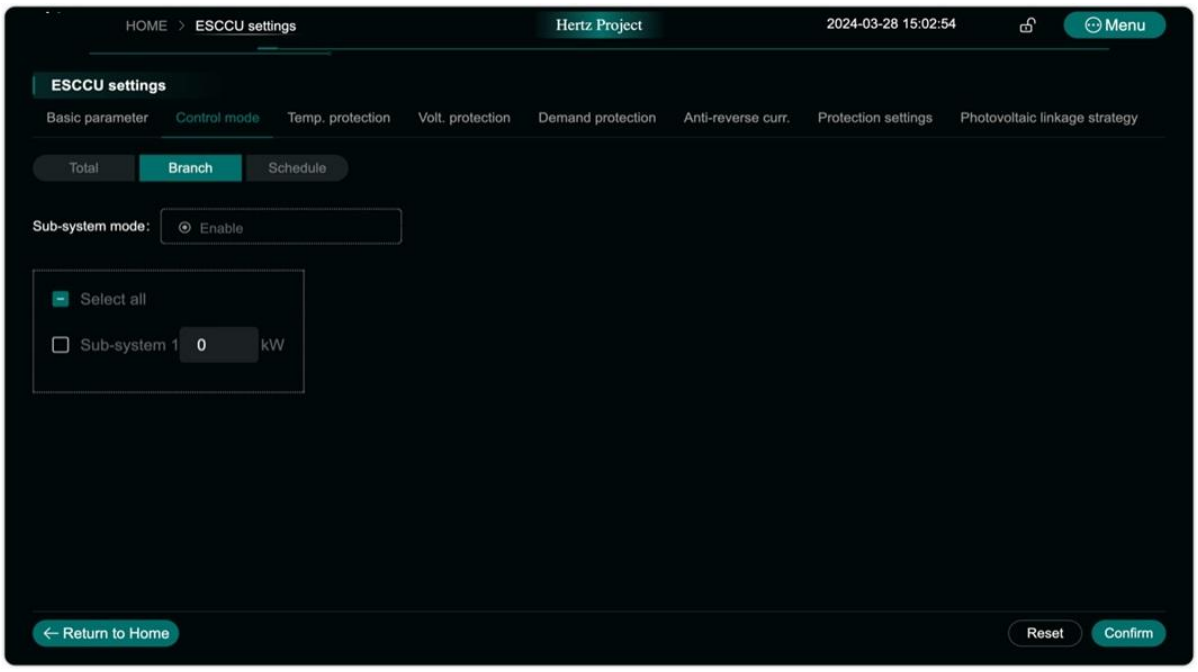


Figure 5-3 Subsystem Control Mode

The subsystem mode in the given diagram can be configured to initiate and terminate the system, while each subsystem's active power is individually set. Once the selected subsystem is determined, its mode of operation is controlled.

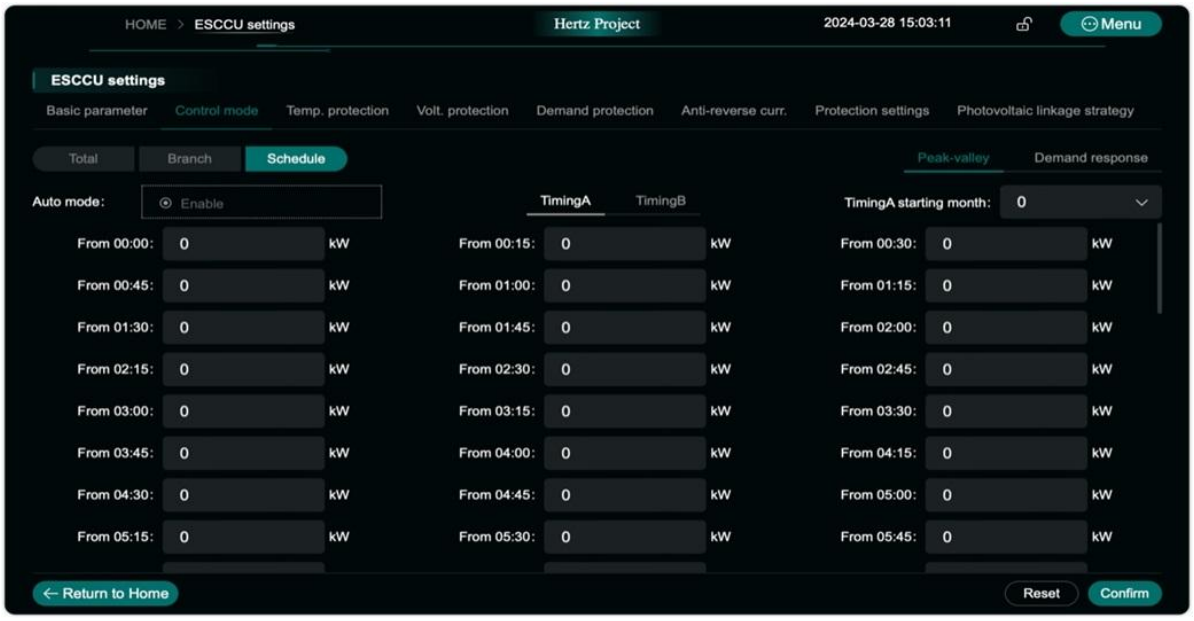


Figure 5-4 Automatic Control Mode

The automatic mode can be planned in the figure above, allowing for setting start and stop times. Additionally, different seasons can be added to various months for PCS power control.

➢ *5.1.3 Multi-Rack System Topological Graph*

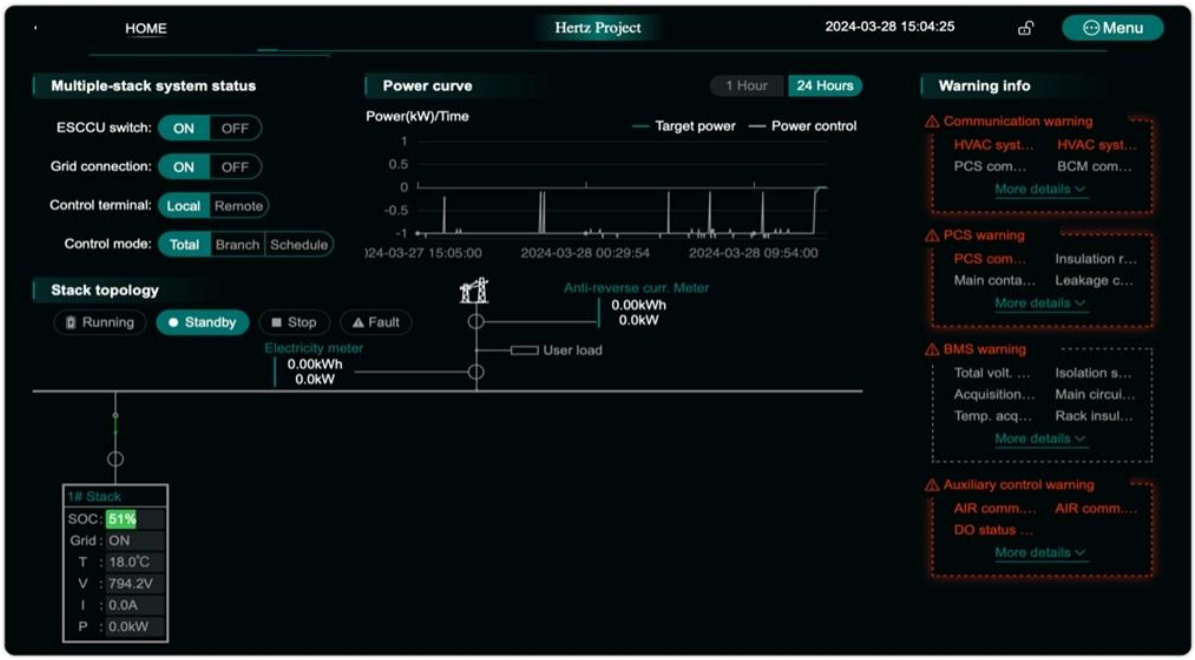


Figure 5-5 Multi-Rack System Topological Graph

1) Display system status: show the charging, discharging, and standby status of the system.
2) Metering data: click on "Metering" in the EMS management system's main page to view voltage, current, active and reactive power metering data, as well as statistical power consumption data for the system (refer to Figure 5-6).

3) Backflow preventer data: click on "Backflow preventer" in the EMS management system's main page to view voltage, current, active and reactive power backflow preventer data, as well as statistical power consumption data for the system (refer to Figure 5-7).

4) Multi-Rack data view: click on each heap's data frame to access detailed parameters for each corresponding heap (refer to Figure 5-9).

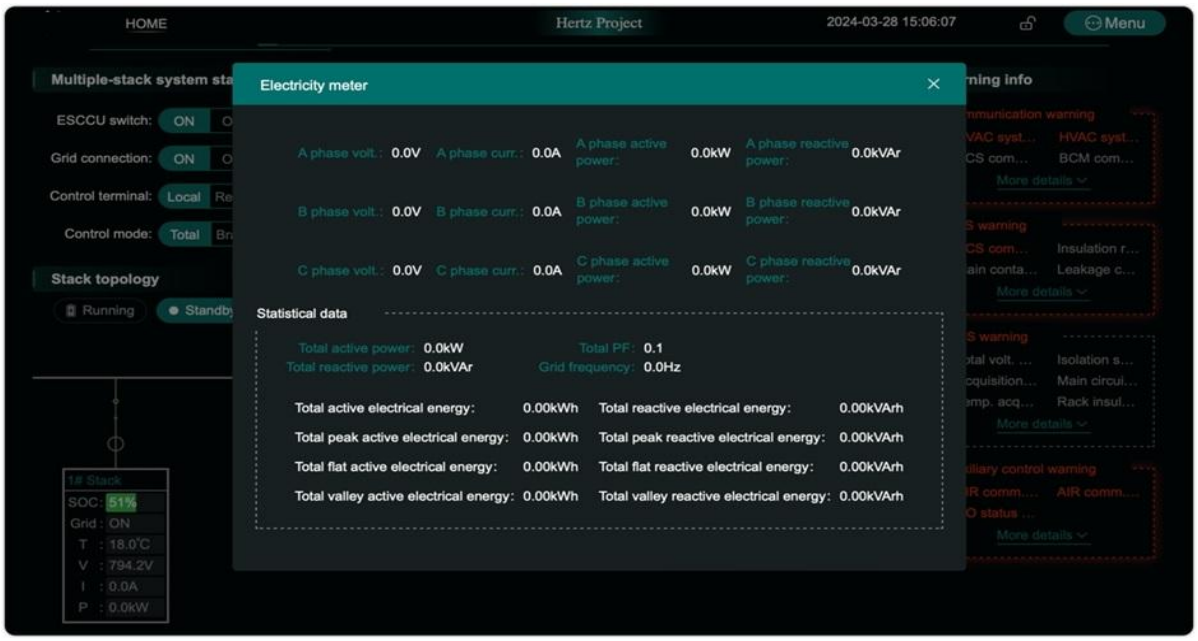


Figure 5-6 Metering Meter Data Interface

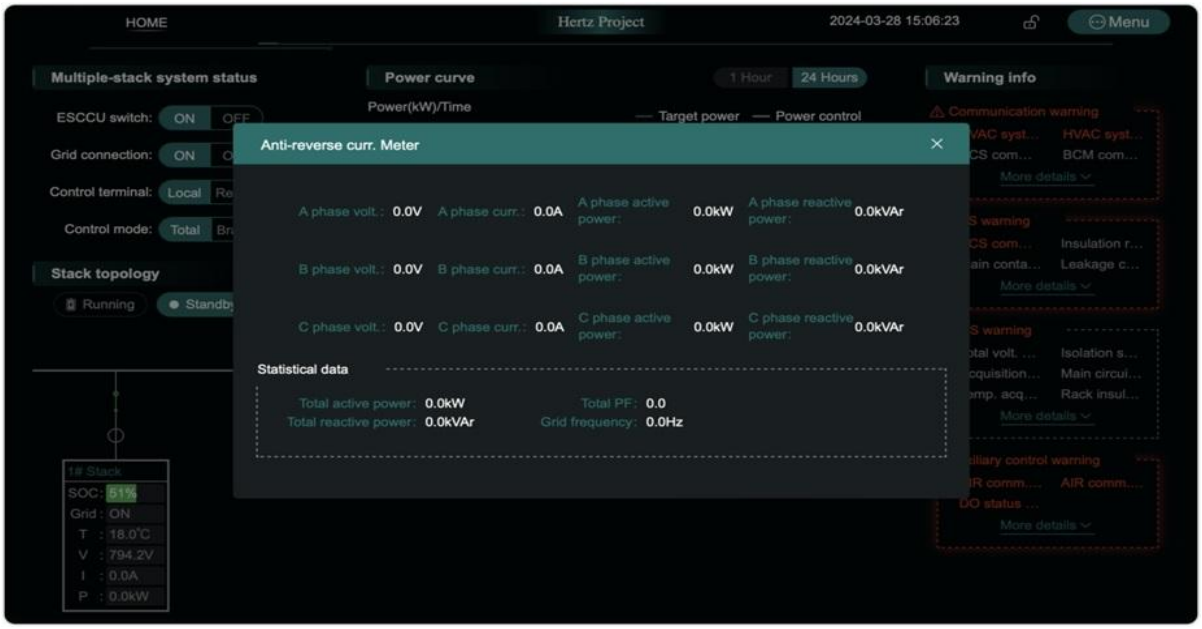


Figure 5-7 Anti-countercurrent Meter Interface

➢ *5.1.4 Power Curve*

The data is divided into two time periods, namely 1 hour and 24 hours, to achieve complete power and control over the graph.

➢ *5.1.5 Alarm Information*

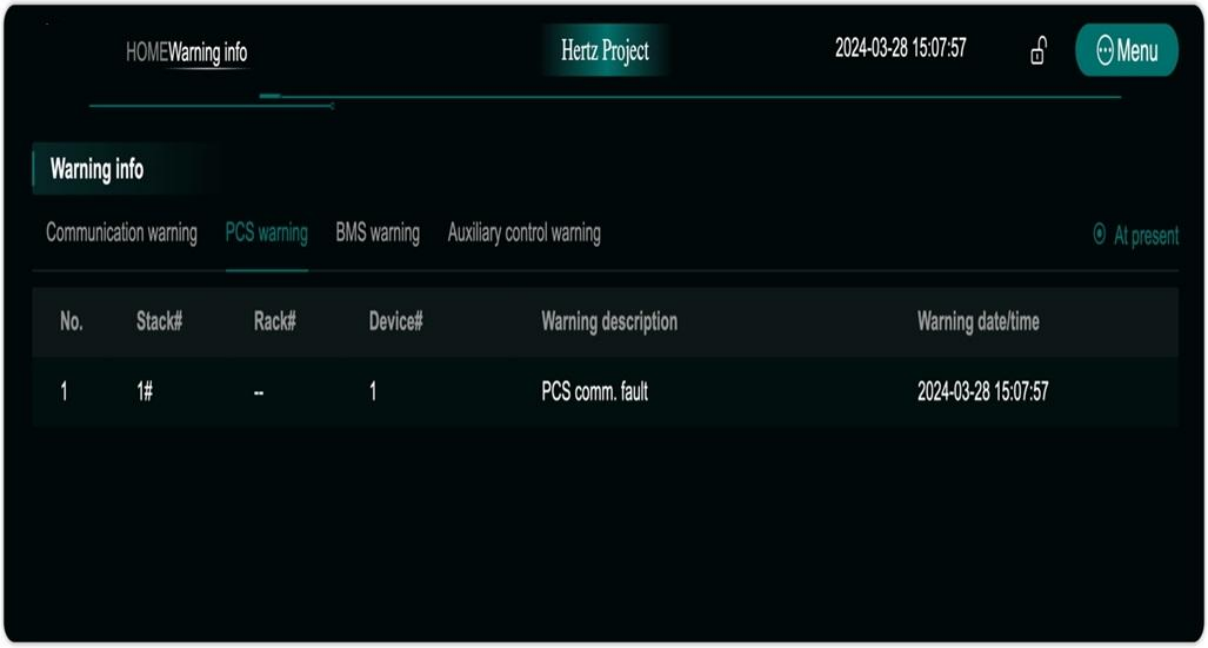


Figure 5-8 Alarm Information

If the communication between any PCS, BMS, fire protection, or air conditioning device in the system is disconnected, a red alarm is displayed in the alarm bar. Click any item of [More Details] on the home page of "Alarm Information" to view the detailed alarm information of communication status alarms, PCS alarms, BMS alarms and environmental control (fire, air conditioning, temperature and humidity meter, DI collection) alarms. If there is more alarm data on this page, scroll down to view the full content of current alarm information.

➢ *5.1.6 Parameter Settings on The Home Screen*

All parameters are power-off hold parameters. After a restart, you only need to set them once.

5.1.6.1 Basic settings

The "Parameter Settings" interface can be accessed by selecting the "More Operations" button on the right, providing detailed information.

1) Time setting: - Specifies the year, month, day, hour, second, and time zone. - NTP Settings: The NTP server can be set as National Time Center with server IP: 114.118.7.163; ServerPort: 123; Timing period: 30s; Time Zone (Beijing): UTC+8.
2) System parameters: - Allows setting of the total number of parallel subsystems and remote Modbus address. After configuration, system restart is required for saving changes.
3) Cloud service configuration: - Enables ID setup for Internet of Things and remote operation and maintenance services.

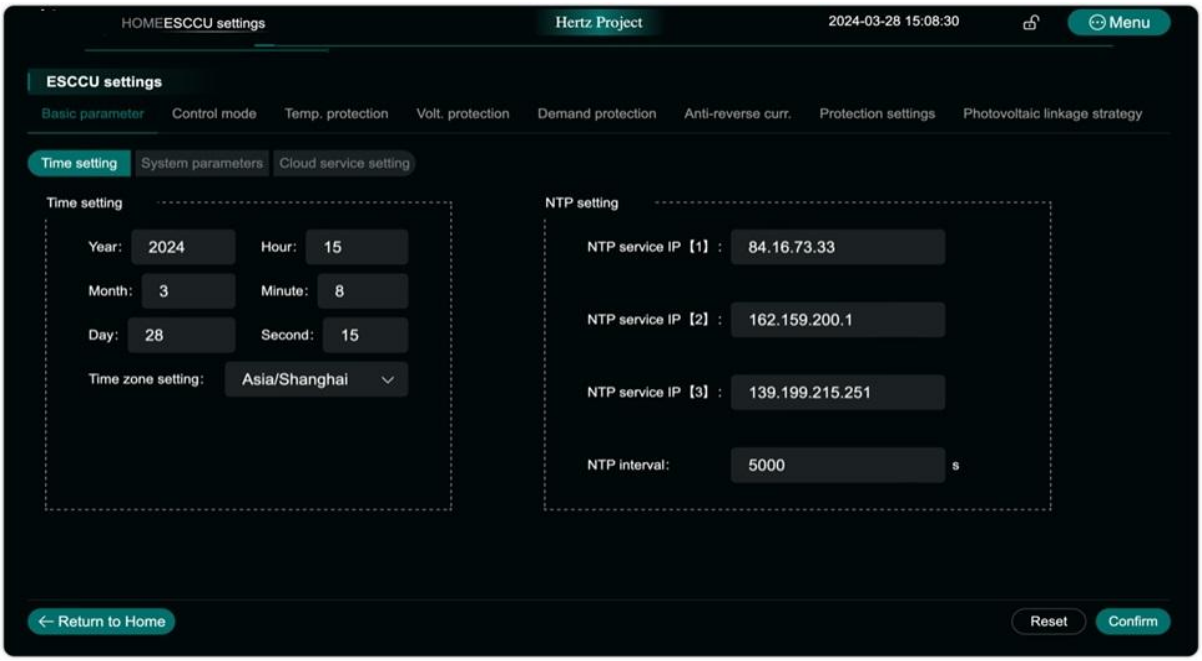


Figure 5-9 Basic Setting

5.1.6.2 Temperature-limited Power

The Temperature Limit Enable function facilitates temperature limit power control and power retention time. Maximum Temperature Limit Power and Minimum Temperature Limit Power can be individually configured, with pre-set values that are adjustable as needed. For instance, a range of 0-20C with a minimum allowable discharge of 100W and a maximum allowable charge of -100W (equivalent to 100W). By configuring the "Stop the air conditioner Function when the temperature difference is too large" parameter, you can enable or disable the air conditioner.

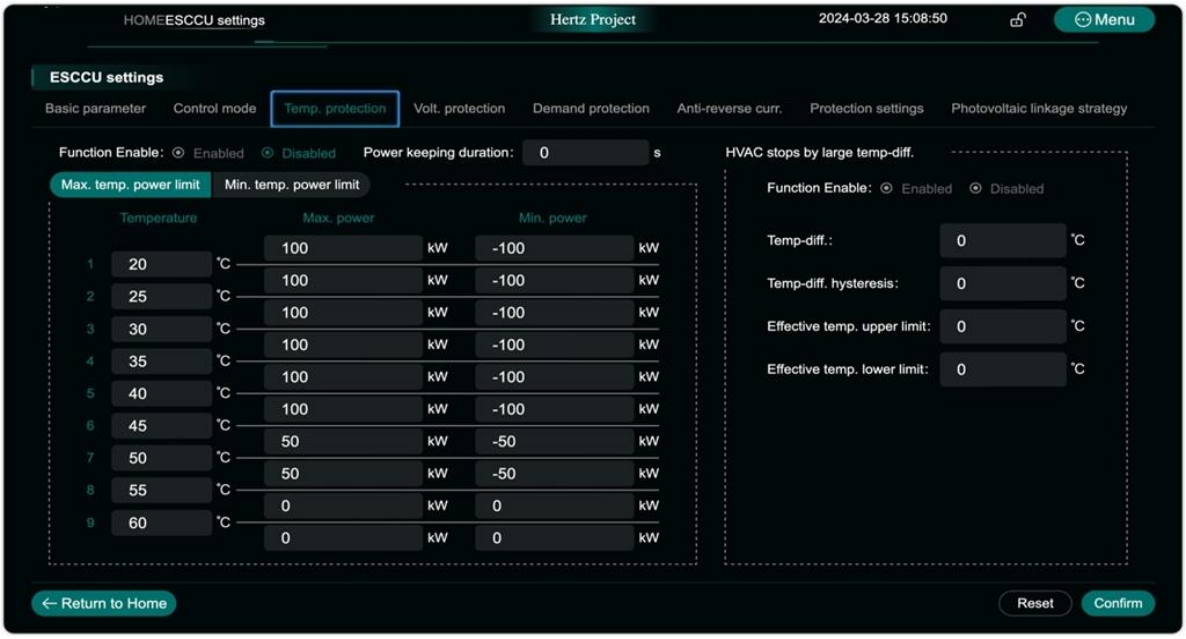


Figure 5-10 Emperature-limited Power

5.1.6.3 Voltage Limit Power

The single voltage limit enable is activated for voltage control. It enables mode control for cell voltage point control, which limits the discharge or charging power of the cell when its voltage is too high or too low.

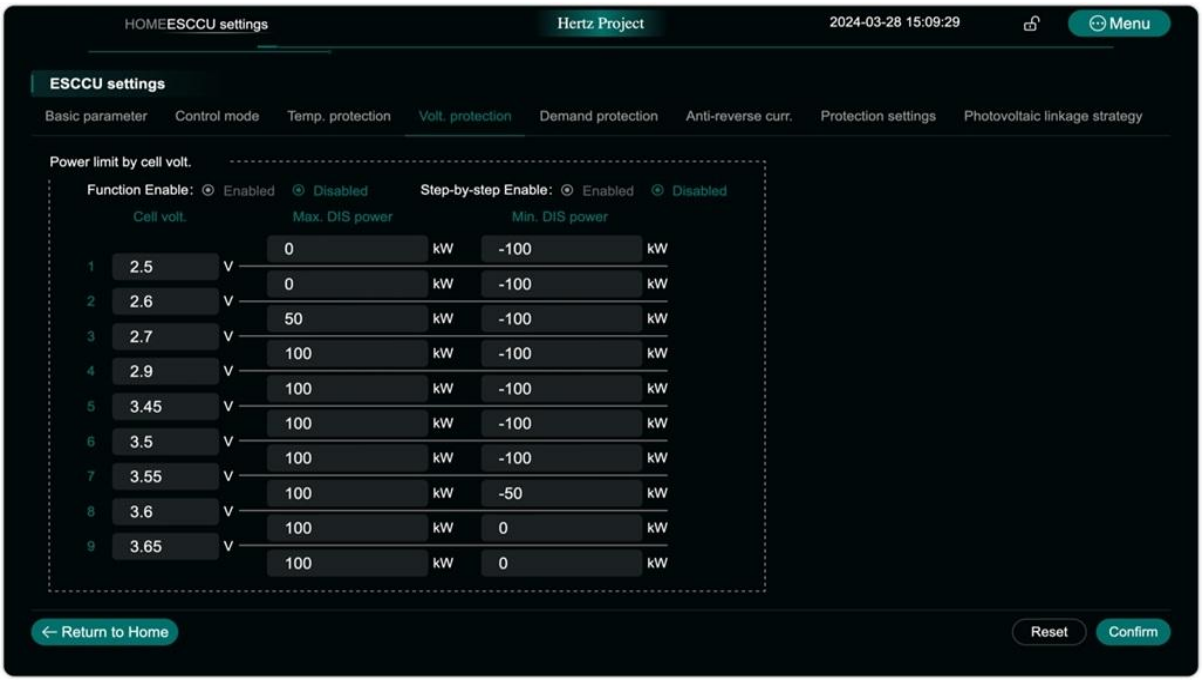


Figure 5-11 Voltage Limit Power

5.1.6.4 Required Limited Power

In order to ensure the maximum limit value of the power of the grid connected side, the demand limit enable is opened for the demand limit power control.

The main parameters are: (internal calculation algorithm of the software, change carefully, and set the password later)

1) Power selection: single-phase/three-phase total power limit
2) Feedforward coefficient
3) Power adjustment step
4) Backlash threshold adjustment step
5) Power backlash value
6) Adjust time step
7) The demand limit power value of 12 months, set the demand limit power value according to the month.

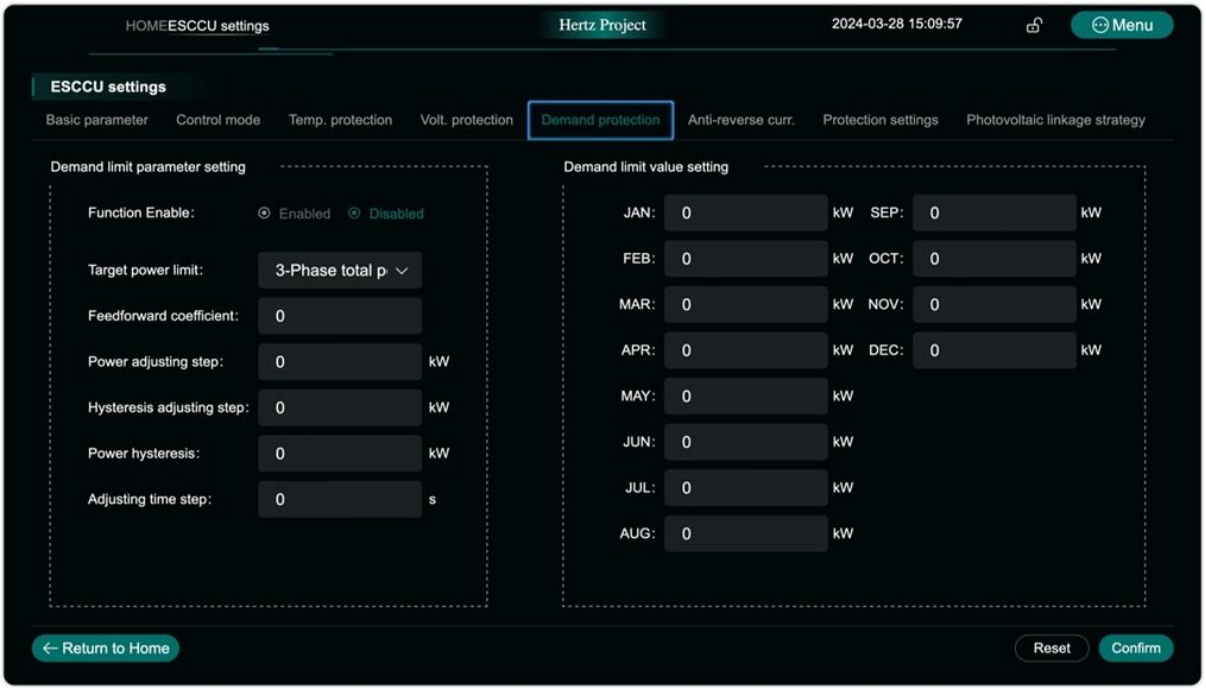


Figure 5-12 Required Limited Power

5.1.6.5 Anti-Reflux Settings

To ensure that the system does not send power to the grid; Anti-counter-current limit Enable enables the anti-counter-current limit power control.

The main parameters are: (software internal calculation algorithm, careful change, and password Settings)

1) Power selection: single-phase/three-phase total power anti-reflux
2) Feedforward coefficient
3) Critical value
4) Power adjustment step length
5) Power back difference value
6) Power return difference adjustment step
7) Adjust the time stepSetting of protection parameters

PCS power setting limit enabled for PCS power control;

1) PCS power upper limit is set as the maximum PCS power upper limit
2) PCS power lower limit is set as the maximum PCS power lower limit

The cell voltage setting limit function is enabled to control the cell voltage.

1) Monomer voltage upper limit (stop charging), monomer voltage exceeds this value, stop charging.
2) Stop charging monomer voltage return difference value, after stopping charging, the monomer voltage exceeds the return difference value, and start charging again.
3) Lower limit of monomer voltage (stop), monomer voltage exceeds this value, stop discharging.
4) Parking duration.

5) The voltage return difference of the parked monomer. After parking, the voltage of the monomer exceeds the return difference and starts discharging again.

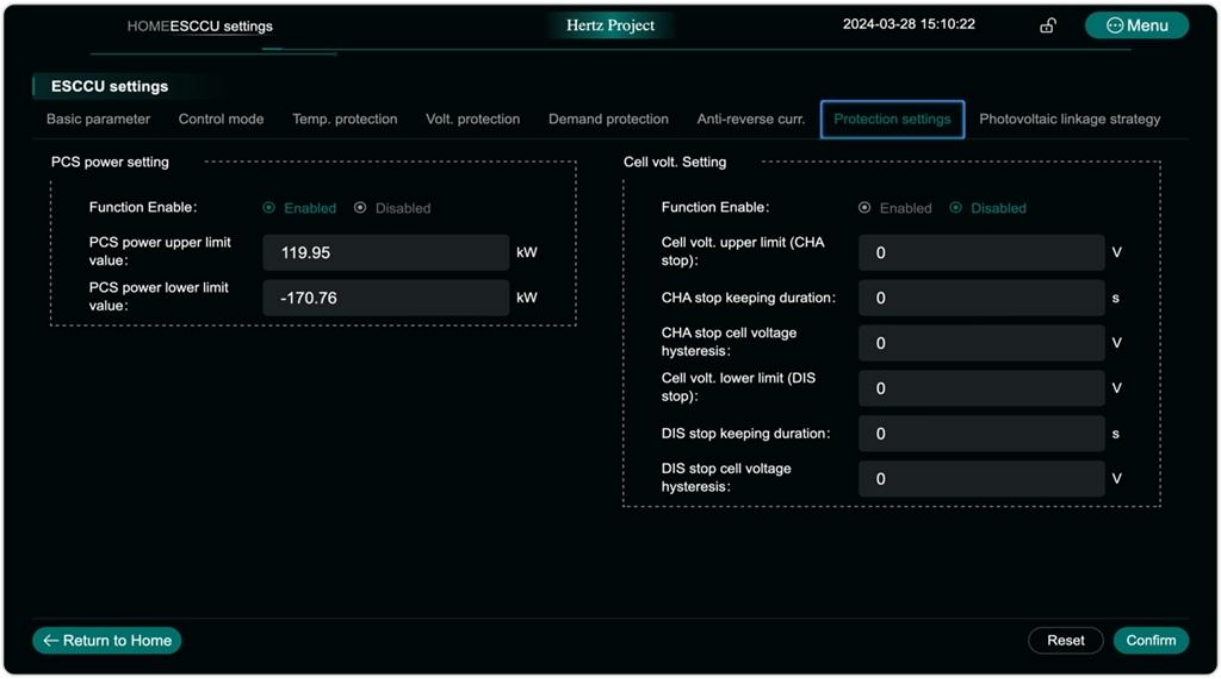


Figure 5-13 Protection Parameter Setting

5.1.6.6 Battery Stack System

From the system topology view of the main screen, click the battery block diagram of any stack-rack (1#) to enter the detailed screen of the corresponding stack-rack (1#) subsystem.

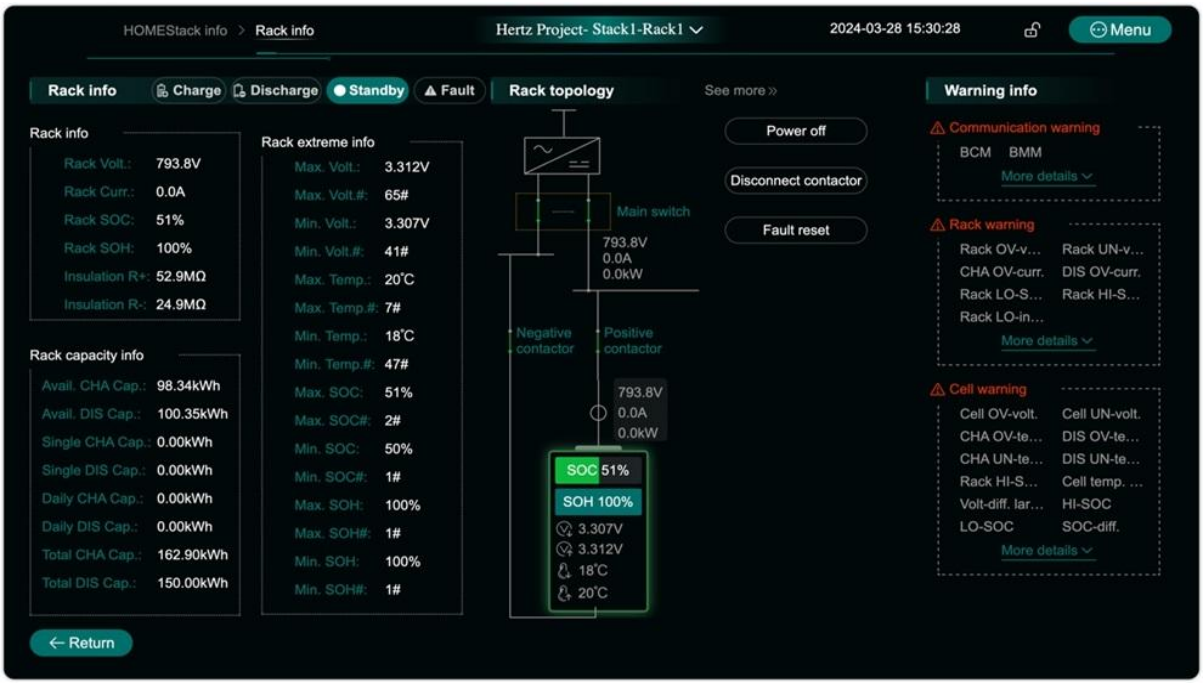


Figure 5-14 Battery Stack Subsystem Interface

In the above figure, real-time information of the subsystem is displayed, including PCS information, dynamic ring information, BMS information (battery information), corresponding heap topology, and alarm

information of the subsystem.

1) PCS information:

-Output P: PCS actual active power output

-Output Q: actual reactive power output of PCS

-Set P: ESCCU management sets the active power output of PCS

-Set P: ESCCU management sets the output reactive power of PCS

2) BMS information

-Maximum cell voltage and cell number

-Maximum cell temperature and cell number

-Rechargeable capacity

-Discharge capacity

-Accumulated charge capacity

-Accumulated discharge capacity

3) Dynamic ring information

-Air condition

-Ambient temperature and humidity

-The sensor status and so on

4) Topology view

-Main gate: indicates the circuit breaker status of the cabinet

-Main positive relay: Indicates the status of the main positive relay of the BMS

-Group terminal voltage

-End current

-End power

-Group end SOH

-End-group SOC

5) Alarm information

-Communication status alarm: The communication has been disconnected between the PCS, BMS, fire fighting, and air conditioning equipment in the cabinet, resulting in a red alarm being displayed.

- PCS alarm: Click on any item to display specific details of each alarm for detailed information regarding the PCS alarms in the cabinet.

-BMS alarm: Click on any item to display specific details related to each PCS alarm for detailed information regarding the BMS alarms in the cabinet.

-Environmental alarm: Click here to view collected alarm information from the fire control unit, air conditioner, temperature and humidity meter, as well as DI unit.

5.1.6.7 BMS System

The block diagram of the battery stack (1#) above can be clicked to access the BMS battery management system. In this page, you will be able to view comprehensive information about the stack, including cumulative charge and discharge capacity, individual charge and discharge capacity, pile voltage, current, power, SOC, as well as detailed telemetry and remote message data related to the battery stack.

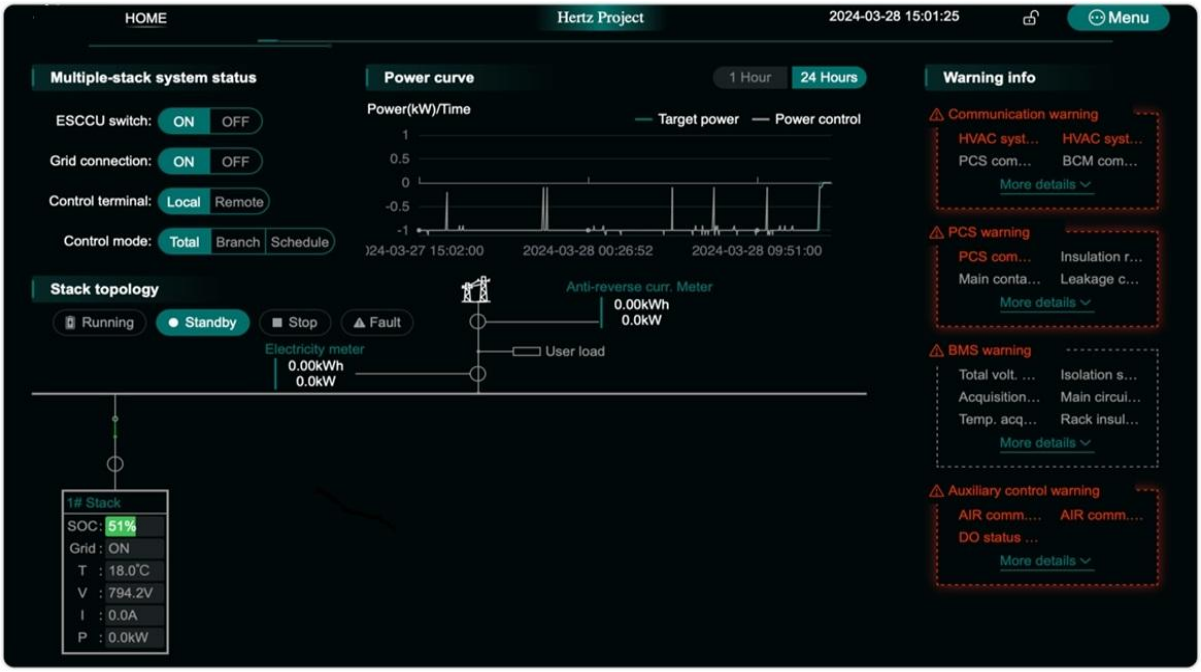


Figure 5-15 BMS Interface

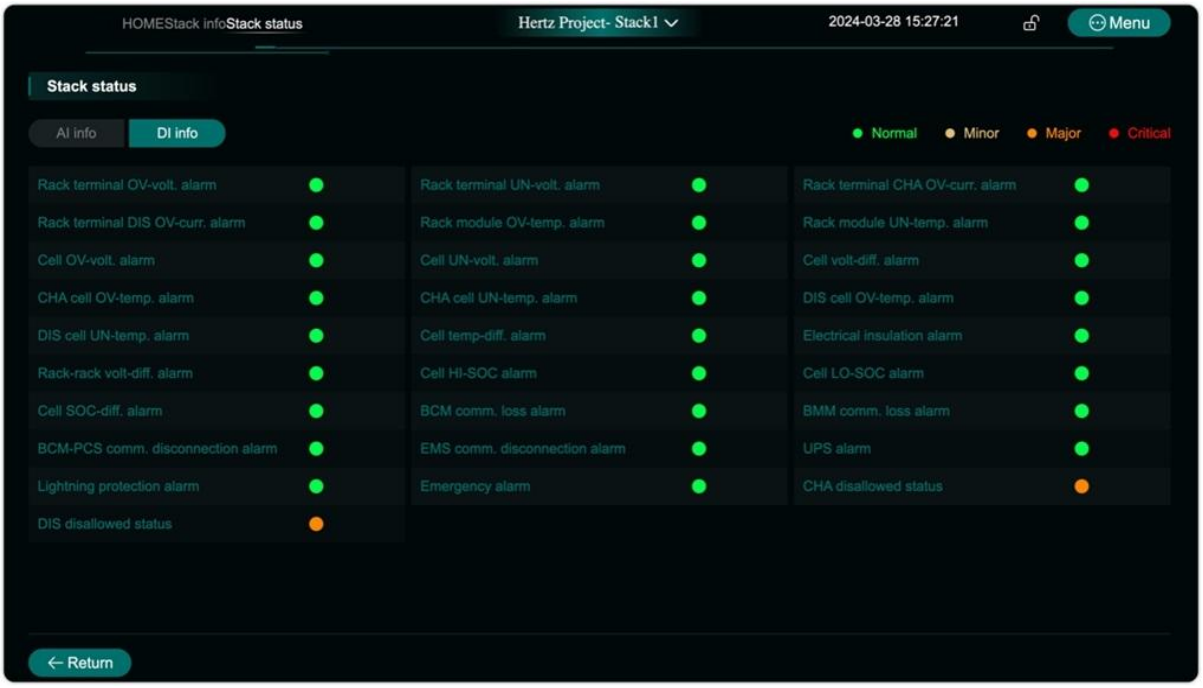


Figure 5-16 Battery Stack Remote Mmessage Interface

5.1.6.8 Battery Cluster System

Click "N# Cluster >>" in the "Real-time Information of Battery Cluster" interface above to access the detailed

information interface for the current cluster. This interface provides real-time display of cluster status (charging, discharging, or standby), summary information (voltage, current, SOC, SOH, insulation resistance), power information (single charge/discharge power, accumulated charge/discharge power), extreme value information, etc. It also displays the contactor status and current alarm status of the battery cluster in the middle of the page and various alarm information on the right.

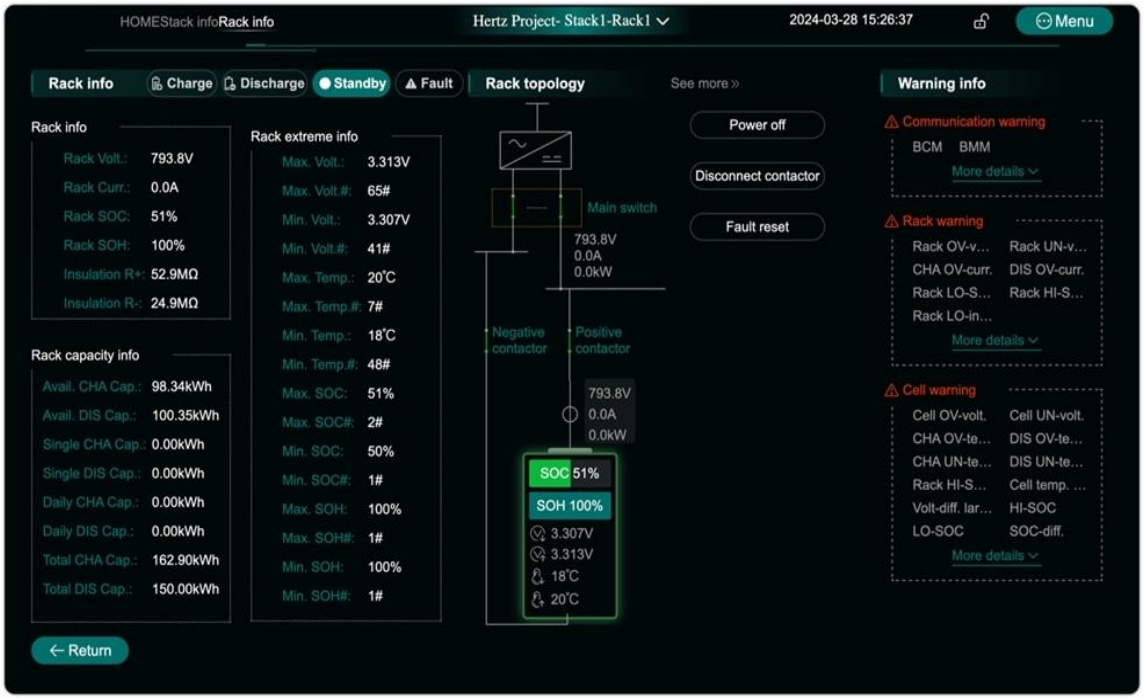


Figure 5-17 Battery Cluster Information Interface

Click the Cluster summary box (cluster 1) to query the details of the cluster unit.

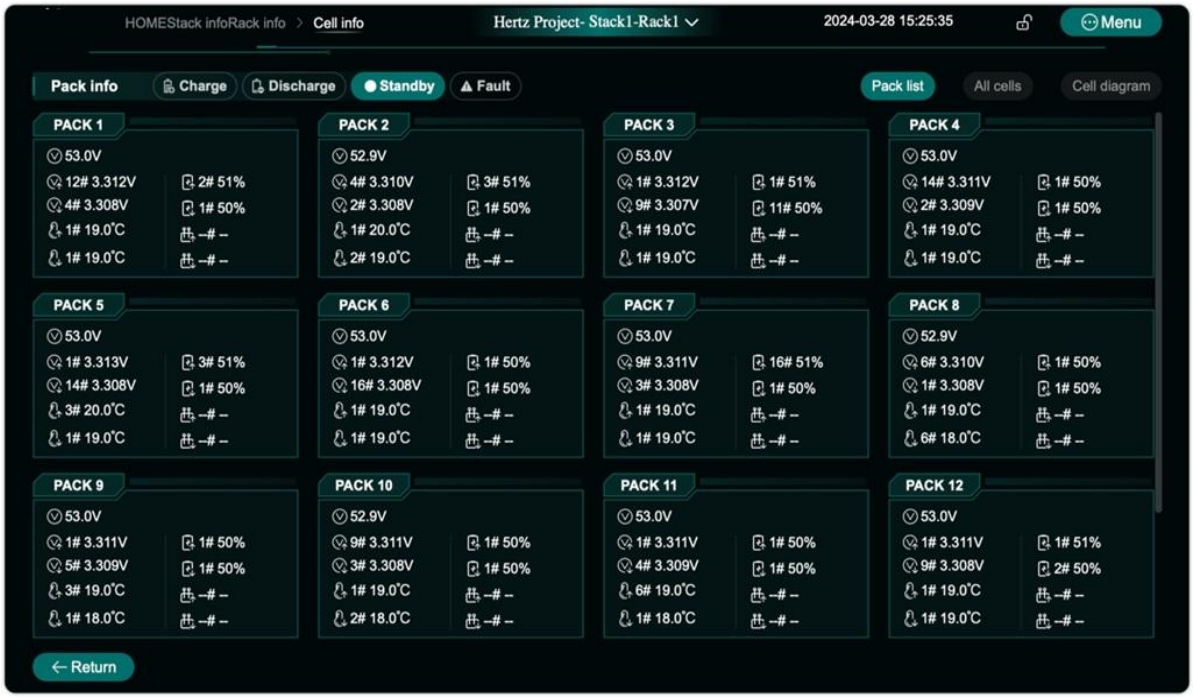


Figure 5-18 Battery Information Interface

The cluster page allows for sorting individual voltage, temperature, SOC, and SOH under respective categories to facilitate real-time comparison of different monitoring information based on specific requirements. Additionally, users can click on the "Monomer chart" in the upper right corner or select a specific monomer row to access real-time column charts and curves for that particular cell. Users can navigate through the page to view voltage, SOC, and temperature information for any given cell.

5.1.6.9 Real-time Alarms Are Generated for Battery Clusters

The real-time alarm bar on the right of Figure 5-9 displays the real-time alarms of BMS communication status, battery stack, battery cluster, and battery cell. Click "More Details" to query the specific alarm type, description, and start time of the alarm.

Click or select the content of communication status, heap alarm, cluster alarm, and single alarm under the "Alarm Information" column. You can also click the "Operation Monitoring" button on the main interface of the BMS battery management system to view the "real-time alarm" information.

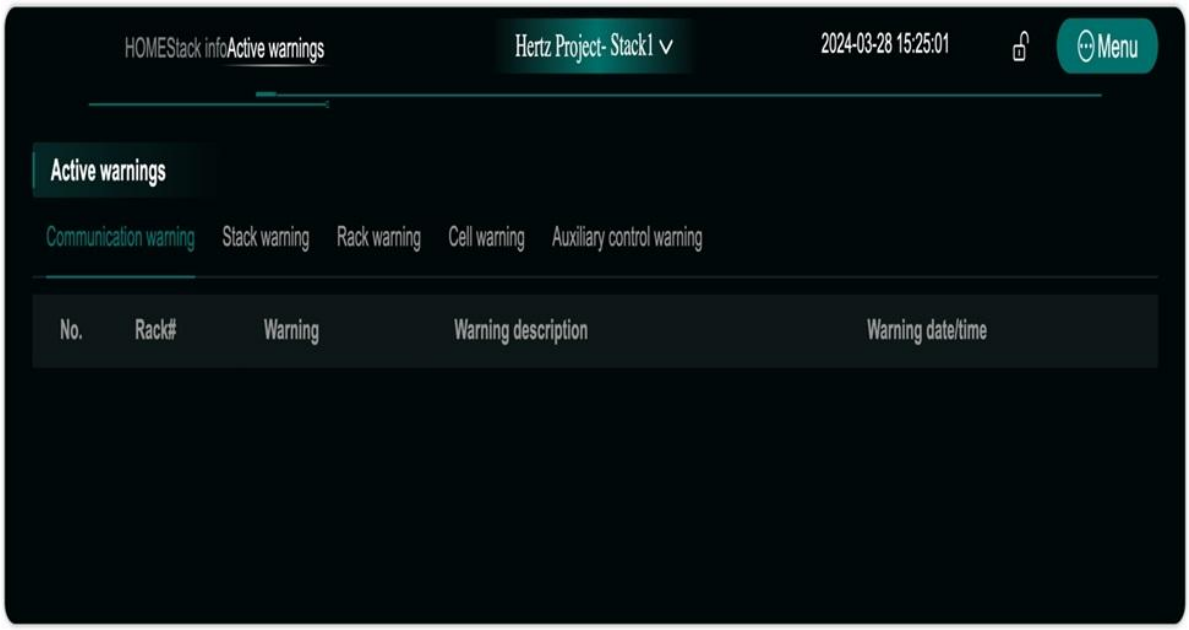


Figure 5-19 Warning Information Interface

5.1.6.10 Querying Historical Data

Click the button on the right of Figure 5-7 and select the menu of "Historical Data" to query historical data and download functions such as extreme value, alarm, event and data download, which can be queried by event segment according to different device categories. If the alarm information exceeds this page, click "<" in the lower right corner. "..." Turn the page to see all the information.

Figure 5-20 Historical Data Interface

Click "Alarms" and "Events" on the right to query historical data. You can also export and download historical alarm and event data.

5.1.6.11 Parameter Settings

Click "More" on the right to slide down the "Parameter Settings" menu, you can set the parameters of the communication interface and each battery cluster system.

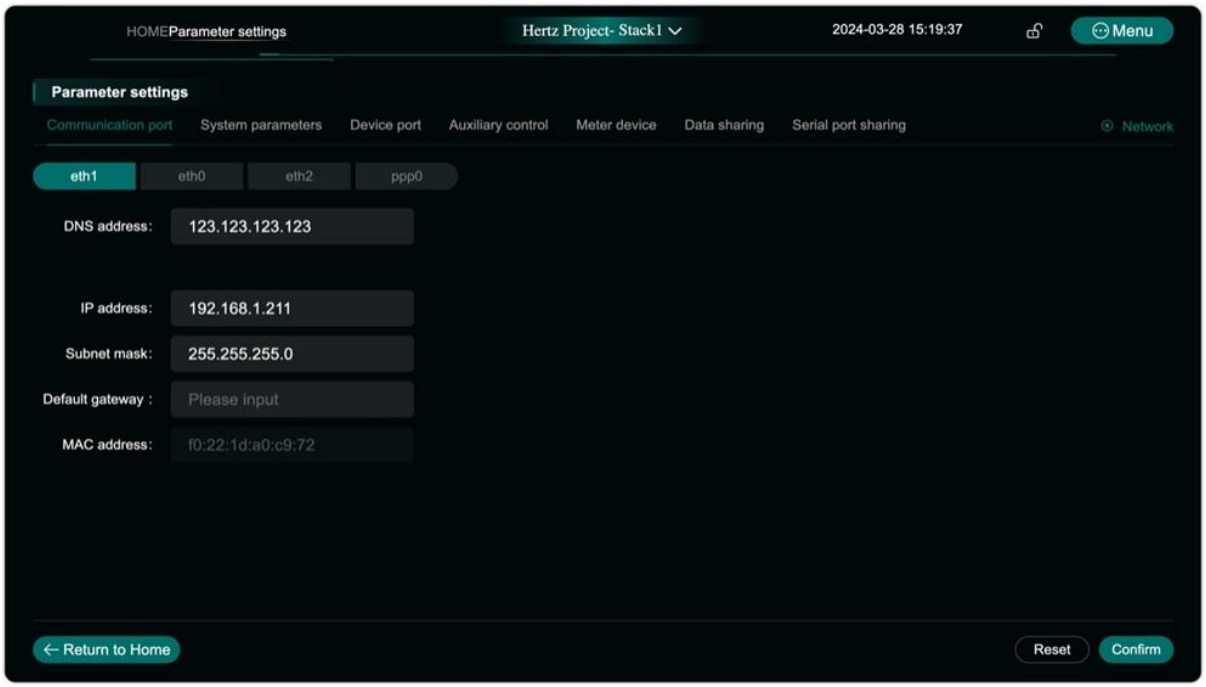


Figure 5-21 Interface Parameter Setting Interface

Select the setting interface of "Protection Parameters" in "System Parameters" to set basic parameters of

each cluster and basic protection parameters of a single battery. Click "Confirm" first to set basic parameters of multiple clusters and parameters of a single battery in the cluster at the same time.

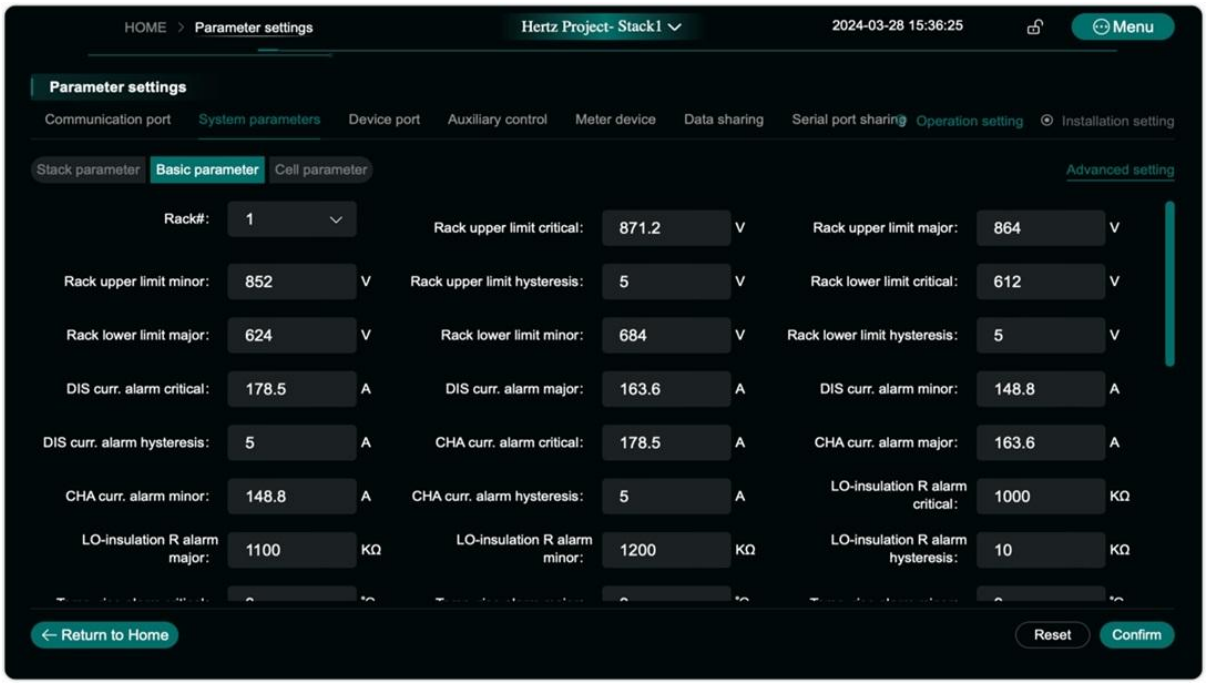


Figure 5-22 Set Multiple Battery Cluster Parameters

Select the "System parameters " menu on the right to set the project information related to the battery stack and battery cluster.

Select the "Advanced Settings " option on the right to enable and disable the balance control function.

Note:

The above parameters are read from the BMS master device by default, or can be set separately as an administrator. It is recommended to keep the parameters consistent with the BMS master device.Equipment management

Click More Operation to select the "Device settings" menu on the right, you can set and change the local device (software and hardware restart), password management (password change), etc.

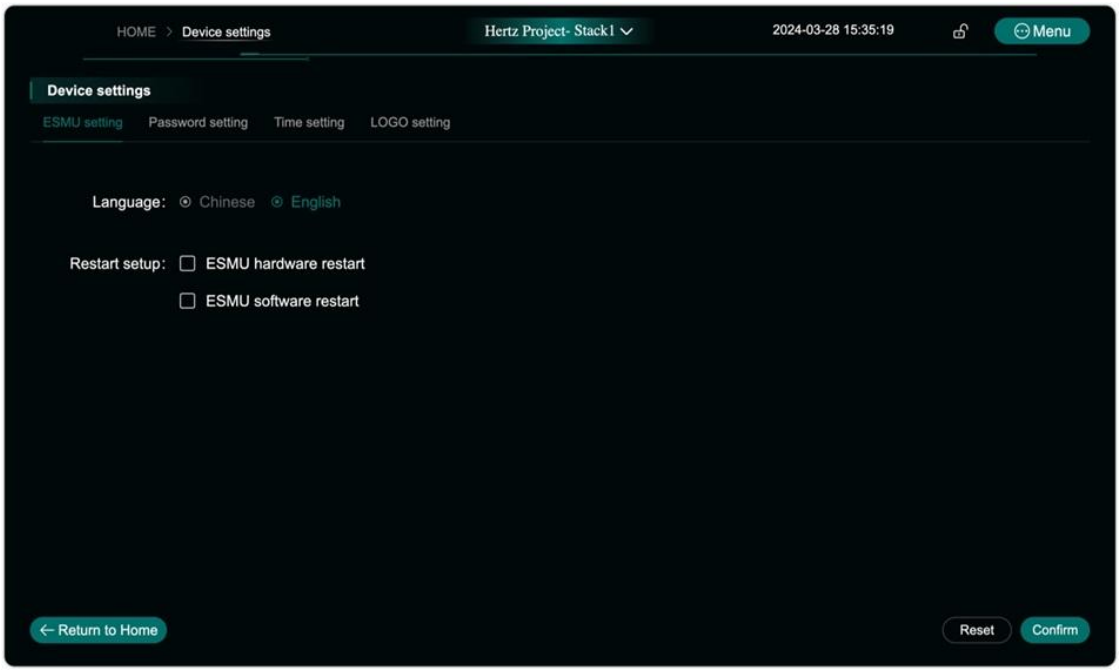


Figure 5-23 Device Settings Interface

5.1.6.12 About The System (including upgrades）

Click the "About System" menu on the right side of Figure 7 to query and manage basic device information, version upgrade, and upgrade logs.

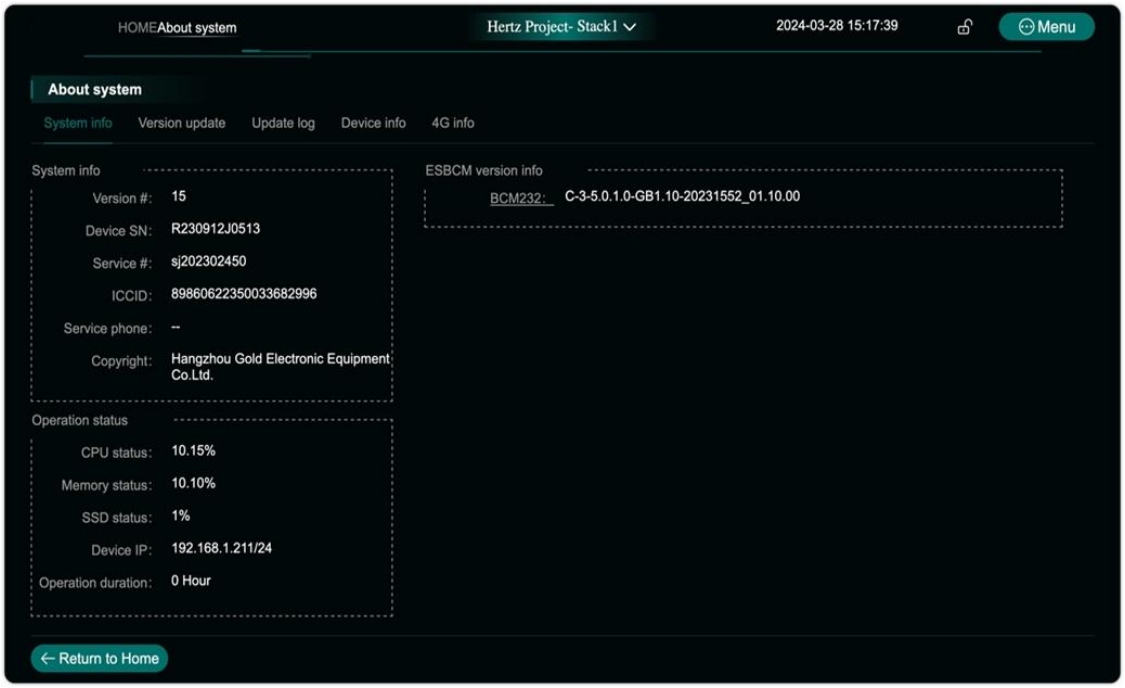


Figure 5-24 System Information Interface

System upgrade operation description: Support remote and local upgrade. Upgrade file format: Click "Local Upload" to select the file you want to upgrade, and then click "Next" or "2 Device Upgrade" System upgrade operation description: Support remote and local upgrade. Upgrade file format: Click "Local Upload" to select the file you want to upgrade, and then click "Next" or "2 Device Upgrade"

6 Alarm and Maintenance

Alarm severities are defined as follows:

Fault: The device fails and the system stops running (charging/discharging).

Alarm: The output power of the device decreases or some functions fail due to external factors, but the charge and discharge functions of the system are not affected.

6.1 Alarm Handling

Table 6-1 Troubleshooting Methods for Fault Alarms

Alarm/Fault	Component involved	Problem	Treatment method
Water flooding	Battery holder	The cabinet is flooded	1. Check whether there is accumulated water inside the cabinet. 2. Check whether the outdoor cabinet is leaking and whether the equipment in the cabinet is intact.
Limit alarm	Battery holder	The energy storage cabinet door opens	1. Check whether the cabinet door is completely closed. 2. Check whether the cable to the limit switch is disconnected. 3. Check whether the position of the limit switch is offset.
Fire failure	Battery holder	Battery overheats or catches fire	1. Press the EPO button immediately, and quickly away from the energy storage cabinet; 2. Observe at a safe distance for 30 minutes. If there is smoke, fire phenomenon, please call the fire alarm

			telephone; If no, manually clear the active alarm and contact the vendor
Compressor alarm	Air conditioner	1. Cables are loose 2. The compressor is damaged	1. Turn off the power distribution switch, open the terminal box of the air conditioner, and check whether cables are loose. 2. Observe whether the appearance of the compressor is obviously damaged, whether there is a burning taste, if so, contact the manufacturer.
Outdoor fan alarm	Air conditioner	1. Cables are loose 2. The compressor is damaged	1. Turn off the power distribution switch, open the terminal box of the air conditioner, and check whether cables are loose. 2. Observe whether the fan has obvious damage, whether there is burning taste, if so, please contact the service hotline.
Indoor fan alarm	Air conditioner	1. Cables are loose 2. The compressor is damaged	1. Turn off the power distribution switch, open the terminal box of the air conditioner, and check whether cables are loose. 2. Observe whether the fan has obvious damage, whether there is burning taste, if so, please contact the service hotline.

Power grid overvoltage/undervoltage	Power grid/oil machine	The voltage on the grid-connected side is abnormal	Check whether the grid-connected side voltage is abnormal;
Power grid overfrequency/underfrequency	Power grid/oil machine	The frequency on the grid-connected side is abnormal	Check whether the grid-connected frequency is abnormal;
Island protection fault	Power grid/oil machine	The voltage on the grid-connected side is abnormal	Check whether the grid-connected side voltage is abnormal;
High/low voltage crossing alarm	Power grid/oil machine	The voltage on the grid-connected side is abnormal	Check whether the grid-connected side voltage is abnormal;
Power grid voltage unbalance fault alarm	Power grid/oil machine	The voltage on the grid-connected side is abnormal	Check whether the grid-connected side voltage is abnormal;
Power grid phase fault alarm	Power grid/oil machine	The phase sequence on the grid-connected side is wrong	Switch any two cables in ABC wire
High/low DC voltage fault alarm	Battery	Abnormal battery voltage	Check whether the DC input voltage is abnormal;
Bus overvoltage fault	Energy storage converter	1. The load is unbalanced 2. The software is abnormal	1. Check whether the DC cable is loose or abnormal. 2. Contact the manufacturer
Bus half-voltage unbalance fault	Energy storage converter	1. The load is unbalanced 2. The software is abnormal	1. Check whether the load is abnormal. 2. Contact the manufacturer
Overtemperature derating alarm	Energy storage converter	Excessive internal temperature	1. Check whether the inlet and outlet of the electrical warehouse are blocked; 2. Check whether the internal fan works properly.

			3. Contact the manufacturer
Power tube overheated alarm	Energy storage converter	Excessive internal temperature	1. Check whether the inlet and outlet of the electrical warehouse are blocked; 2. Check whether the internal fan works properly. 3. Contact the manufacturer
Balance bridge overtemperature alarm	Energy storage converter	Excessive internal temperature	1. Check whether the inlet and outlet of the electrical warehouse are blocked; 2. Check whether the internal fan works properly. 3. Contact the manufacturer
The DC overcurrent alarm	Energy storage converter	Excess dc current	1. Check whether a short circuit exists on the DC side or the circuit is damaged. 2. Replace the Energy storage converter or contact the manufacturer.
Balance bridge overcurrent fault	Energy storage converter	Excess of internal current	1. Check whether the off-network load is excessive. 2. Replace the Energy storage converter or contact the manufacturer.
Output overload/ Output overcurrent alarm	Energy storage converter	The AC power/current exceeds the threshold	1. Check whether the power grid voltage is normal; 2. Check whether a short circuit exists on the DC side or the circuit is damaged. 3. Check whether the off-network load is excessive. 4. Replace the Energy storage converter or contact the manufacturer.

Per-wave current limiting fault	Energy storage converter	The current on the AC side is excessive	1. Check whether the power grid voltage is normal; 2. Check whether the off-network load is excessive. 3. Replace the Energy storage converter or contact the manufacturer.
Communication interruption	Energy storage converter/ Local controller	Communication interruption	1. Check whether the network cable between the modules is loose. 2. Check whether the network cable of the local controller is loose.
The parallel/synchronization fault occurs	Energy storage converter	Parallel/synchronous Signal interruption	1. Check whether the parallel cable is loose or abnormal. 2. Check whether the parallel Settings are abnormal. 3. The hardware circuit is damaged.
Relay open/short circuit fault	Energy storage converter	1. The internal relay is abnormal 2. The software is abnormal	1. Replace the Energy storage converter 2. Contact the manufacturer to replace the internal panels
Fan 1/2/3 Alarm	Energy storage converter	Internal fan exception	1. Replace the Energy storage converter 2. Contact the manufacturer to replace the internal fan
Leakage current fault	Energy storage converter	1. Excess leakage current 2. The software is abnormal	1. Check whether cables to the hall of leakage current are loose or abnormal. 2. Check whether the ground cable is disconnected.
Insulation impedance anomaly alarm	Energy storage converter/Battery	1. Low ground insulation	1. Check whether the AC/DC cable is damaged or short-

		2. The software is abnormal	circuits to the ground. 2. Check whether the battery circuit is damaged or short-circuited to the ground.
Module loss alarm	Energy storage converter	The communication between the module and the screen is interrupted	Check whether the communication network cables between modules are loose.
Dc low voltage alarm	Energy storage converter	Battery not on	Check whether the battery is on

WARNING

The preceding alarms and faults are common alarms or faults. If faults other than those listed in Table 6-1 occur, contact the manufacturer directly.

6.2 Routine Maintenance

Due to the influence of environmental temperature, humidity, dust, vibration, and the aging of internal components of the inverter, the system may encounter some potential problems during operation. To ensure the energy storage system can operate long-term and stably, it is necessary to arrange for maintenance personnel to conduct regular inspections according to Table 6-2, to promptly identify and address issues. It is recommended that the system installed in areas with severe dust, high salt spray, and heavy industry parks be maintained once every quarter. It is recommended that the system installed in a good climate area be maintained once every quarter.

Table 6-2 Routine Maintenance Tasks

Maintenance Object	Actions	Reference Standards
Cabinet	Inspect the overall appearance of the machine Check the ventilation ports Examine the condition of door locks	No obvious peeling of the coating, scratches, or corrosion No apparent signs of water leakage No accumulation of dust in the ventilation ports No damage to the door locks
Air Conditioning	Check for noise and vibration Clean the filter	Fans and compressors rotate normally, with no sticking or abnormal noises

		The surface of the filter is clean, with no blockages
Electrical	Inspect the surge protector Check the contact surfaces of the cable busbars	Surge protector functioning normally No looseness or detachment in screw sockets and connection lines No corrosion, discoloration, or dust accumulation on busbars and contact surfaces
Battery Module	Check for noise and vibration Check the contact surfaces of the cable busbars	Battery module fans rotate without sticking or abnormal noises The surface of the front panel ventilation port is clean, with no blockages No looseness or detachment in screw sockets and connection lines No corrosion, discoloration, or dust accumulation on busbars and contact surfaces

6.3 Warranty Service

➢ *6.3.1 Warranty Period*

The warranty period shall be in accordance with the commercial contract, provided the product is used correctly.

➢ *6.3.2 Warranty Scope*

Within the warranty period, for faults caused by the product's own quality issues, the company will repair or replace the product for the customer free of charge. Customers should allow reasonable response time for the company to make repairs, and the replaced products will be handled by the company. Customers must present related proof of purchase and ensure the product brand is clearly visible, otherwise, the company reserves the right to refuse warranty service.

➢ *6.3.2 Disclaimer*

The company reserves the right not to provide a quality guarantee, but may still offer paid repair services under the following conditions.

- The warranty period has expired.

- Unable to provide related proof of product purchase.
- Damage caused during transportation or loading and unloading.
- Damage caused by incorrect installation, modification, or repairs by unauthorized personnel.
- Damage caused by operating under abnormal conditions or environments.
- Machine failure or damage caused by using non-Hanchu parts or software.
- Faults caused by force majeure factors such as fire, earthquake, flood, etc.

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