JKE-5015K-2H-LAA
5.01MWh Liquid-cooled ESS
User Manual

Contents

Preface

Dear users, thank you for choosing our products! Please be sure to read this user manual carefully before using our product.

By carefully reading this manual, it will enable you to better understand the characteristics of this product, correctly use and maintain this product, ensure the use of safety and give full play to the best performance of this product, so as to obtain the maximum benefit from using this product.

The pictures provided in this manual are for demonstration purposes only. Detailed information varies slightly depending on relationship between the product version and market area. This manual has been prepared in accordance with the status of our energy storage systems at the time of commissioning. The product form factor and technical specifications may evolve. This manual will be revised accordingly without prior notice when the product is updated.

If the system fails due to your negligence, incorrect use or unauthorized dismantling or cracking of the control program, etc., your right to warranty will be lost; any direct or indirect warranty claims resulting from such failure will not be accepted by our after-sales service department.

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Version/Status	Modifier	Date	Remark
V1.0	Nicki Hu	2024.05.15	First Version
V1.1	Nicki Hu	2024.06.26	Update

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1.Summary

1.1 Overall Summarize

This manual mainly introduces our product, transportation, installation, operation, maintenance and troubleshooting of the 20' Standard Liquid-cooled Energy Storage System. Before using this product, please be sure to read this manual carefully and operate the energy storage system according to the methods described in this manual, otherwise may lead to equipment damage or personal injury.

1.2 Target Reader

This manual applies to personnel involved in transportation, installation and other operations related to this product, and those involved shall compliance with the following requirements:

- Proficiency in specialized knowledge of electricity, electronics and mechanical engineering, and comprehension of electrical schematics and structural drawings;
- Taking a knowledge of products, basic knowledge, working principle, control logic in the energy storage industry;
- Have the professional electrician construction certificate and qualification recognized by the local law when this product is used, and be familiar with the local relevant laws and regulations;
- Possess the ability to deal with emergency emergencies and handle related events according to the local laws and regulations when this product is used;
- Have a good understanding of the terms and conditions of this manual, with professional skills and a high sense of responsibility.

The manual contains important information, please read it carefully before operating and maintaining the system. Keep this manual and other details in the product components together to ensure timely access by operators and maintenance personnel.

1.3 Definition for Warning Sign

In order to protect the user’s personal and property safety when using this product, and to improve the using efficiency of this product, relevant information is noted in this manual, and relevant symbols are added to enhance the explanation.

The terms "Danger", "Warning", "Attention" and "Notice" in this manual do not represent all safety matters that should be followed, and you must also comply with relevant international, national or regional standards and industry practices. The company does not assume any responsibility for the violation of the safety operation requirements or the violation of the design, production and use of equipment safety standards.

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The following logos may appear in this document and the meanings they represent are listed below:

Symbol	Instruction
Danger	Aiming to warn the immediate hazardous situation, if not avoided, will lead to death or serious personal injury.
Warning	Aiming to warn the potentially hazardous situations, if not avoided, may lead to death or serious personal injury.
Caution	Aiming to warn the potentially hazardous situations, if not avoided, may lead to moderate or minor personal injury.
Note	Aiming to communicate equipment or environmental safety warnings that, if not avoided, may lead to equipment damage, loss of data, degradation of equipment performance, or other unforeseen consequences. "Caution" does not involve personal injury.
	Indicates additional information in the manual that emphasizes and complements the content, or may provide tips or tricks for optimal use of the product that can help to take you out of some trouble or save your time.
	This symbol means that there is a high voltage hazard inside the product and any touching may lead to a risk of electric shock.
	This symbol means that there is a danger of high temperatures happening on the product and any touching shall be avoided to prevent from injury.
	This symbol means that the product here for the protection of the ground (PE), it is necessary to connect the grounding wire, the link is required to be firm and reliable, in order to ensure the safety of the operator.
	This symbol means that the product is prohibited from being opened and there will be a significant risk with any accidental opening.
	This symbol means that the product shall not be touched, any touching may take the device to malfunction, which will lead to a great danger.

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1.4 Abbreviation

SN.	Item	Definition
1	Cell	Single Battery Cell
2	PACK	Liquid-cooled Battery Pack
3	Rack	Battery system consisting of multiple battery PACKs and a high voltage box
4	Integrated Cabinet	It consists of an auxiliary power supply section, a BMS management section and a DC convergence section. Its role is to provide AC power for the internal energy storage container; collect internal data and communicate with the outside; and DC converge the battery clusters.
5	BMS	Battery Management System
6	BMU	Level 1 BMS，Slave units for battery management systems
7	BCU	Level 2 BMS，Master control unit for battery management systems
8	SCU	Level 3 BMS，Master Control Unit for Battery Management Systems
9	PCS	Power Conversion System
10	UPS	Uninterruptible Power Supply
11	EMS	Energy Management System
12	Local controller	Centralized control system for overall control and management of the same local equipment groups, as well as liaison between equipment groups
13	SOC	State of Charge

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2.Safety Statement

2.1 Safety Instructions

Please strictly observe the terms of the safety regulations in this product manual. In order to avoid possible injury or death and property damage during the use of this product, and to improve the service life and efficiency of this product, please be sure to read the safety specifications carefully.

For the safe operation and maintenance of Jinko BESS units, technicians must thoroughly read and strictly adhere to all safety instructions provided in this manual. JinkoSolar disclaims liability for any malfunctions, component damage, personal injuries, property loss, or other damages that may arise under the following conditions:

- Equipment damage caused by earthquake, flood, volcanic eruption, debris flow, lightning strike, fire, war, armed conflict, typhoon, hurricane, tornado, extreme weather, force majeure;
- Improper Charging: Battery damage or capacity loss resulting from not charging the batteries as per specified requirements.
- Handling and Operational Errors: Batteries that are dropped, damaged, or leak due to improper handling or failure to follow operational guidelines.
- Over discharge: Damage caused by failing to power on the batteries in a timely manner, leading to over discharge.
- Use of Incompatible Equipment: Damage resulting from the use of non-specified equipment for charging and discharging.
- Maintenance Failures: Frequent over discharge, incorrect capacity expansion, or prolonged periods without being fully charged due to improper maintenance.
- Incorrect Parameter Settings: Damage due to improperly set battery operating parameters.
- Unsuitable Operating Environment: Battery damage because the operating conditions do not meet specified environmental requirements.
- Unauthorized Use: Any damage resulting from using the batteries in ways not specified in this manual, including but not limited to, connecting extra loads.
- Non-Compliance with Maintenance Guidelines: Damages arising from failure to maintain the batteries as per the manual's instructions.
- Exceeding Warranty: Damage occurring from continued use of batteries past their warranty period.
- Use of Defective Batteries: Using damaged, defective, or deformed batteries.
- Mixing Battery Types: Damage caused by using JinkoSolar batteries in conjunction with other battery brands or with batteries of different capacities.
- Storage and Installation Risks: Property loss or damage resulting from storing or installing batteries near flammable or explosive materials.
- Unqualified Personnel: Personal injuries or property damage resulting from battery-related operations performed by individuals who are not qualified or who are not wearing appropriate safety gear.

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➢ Unsafe Behavior: Damage caused by improper behavior such as eating, drinking, or smoking near the battery storage areas.

➢ Theft: Loss or damage due to battery theft.

➢ Adherence to these guidelines will ensure the safe and efficient operation of Jinko BESS units. Always consult the system manual for specific operational procedures and safety measures.

2.2 Operator Requirements

 **Danger**	The installation process is strictly prohibited from live operation. Do not install or remove cables with power on. Transient contact between the cable core and the conductor may generate electric arcs, sparks, or fire or explosion, which may cause fire or personal injury.
 **Danger**	When the device is powered on, improper or incorrect operations may cause fire, electric shock, or explosion, resulting in personal injury or property damage.
 **Danger**	Do not wear conductive objects such as watches, bracelets, bracelets, rings, and necklaces during operation to avoid being burned by electric shocks.
 **Danger**	Use special insulation tools to avoid electric shock or short circuit. The insulation voltage withstand level must meet the requirements of local laws, regulations, standards, and regulations.
 **Danger**	Special protective equipment must be used during the operation, such as wearing protective clothing, insulating shoes, goggles, safety hats, insulating gloves, etc.

➢ A professionally qualified electrician is required to operate and maintain this product, and a complete set of specialized electrical equipment is required;

➢ Be able to assess the assigned tasks and recognize dangerous events that may occur;

➢ Be able to rescue injured personnel in the first instance;

➢ Understand the relevant maintenance standards for the product;

➢ In special scenarios, such as electrical operations, climbing operations, and special equipment operations, the personnel must have special operation qualifications required by the local country/region.

2.2.1 Personal Protective Equipment (PPE)

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According to “Maximum Power Method” in NFPA 70E, the estimated DC arc flash incident energy at the maximum power point can be calculated, and then the hazard boundary is defined.

The PPE is determined by the incident energy which is the temperature produced (in cal/cm2) (usually eighteen inches) from an arc flash is less than 1. Therefore, the PPE requirement for battery rack operational precautions is category 1.

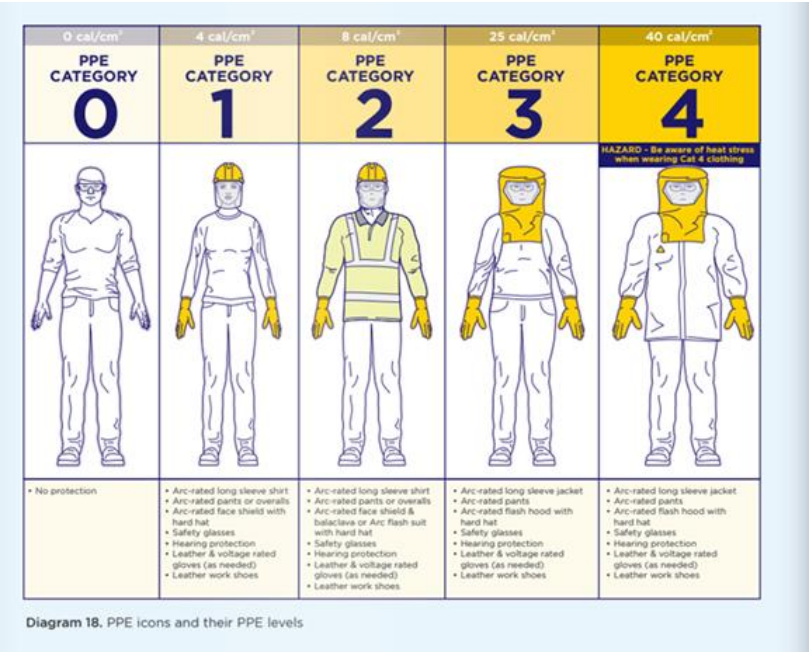

Figure 2-1-1 PPE Category

2.2.2 First Aid Measures

Contact Method and Appropriate Actions:

➢ Inhalation: Immediately move to fresh air. If breathing has stopped, perform artificial respiration and seek medical attention promptly.

➢ Skin Contact: Remove any contaminated clothing. Thoroughly wash the affected area with soap and water. If skin irritation or rash develops, seek medical attention.

➢ Eye Contact: Rinse the eyes with clean water for at least 15 minutes. If irritation persists, consult a medical professional.

➢ Ingestion: If the substance has been swallowed and the individual is conscious, administer water or milk to drink and seek medical attention immediately. Do not induce vomiting unless directed by a healthcare provider. If medical assistance is not readily available, take the individual, along with the substance container and label, to the nearest emergency medical facility. Do not give anything by mouth to an unconscious person.

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2.3 Electrical Safety

Danger	Before electrical connection, ensure that the device is not damaged; otherwise, electric shock or fire may occur.
Danger	When the device is powered on, improper or incorrect operations may cause fire, electric shock, or explosion, resulting in personal injury or property damage.
Danger	Prevent foreign bodies from entering the device. Otherwise, the device may be short-circuited or damaged, load power supply derating or power failure, and personal injury may occur.
Warning	When installing a device that needs to be grounded, install the PGND cable first. When removing a device, remove the PGND cable at the end.
Note	Do not allow cables to pass through the air inlet and air outlet of the device.

2.3.1 General Requirement

➢ The installation, operation, and maintenance must follow the sequence of steps in the manual. Do not modify, add, or change the equipment or change the installation sequence without authorization.

➢ It is necessary to obtain the permission of the power department of the country or region where it is located before it can be connected to the grid.

➢ Comply with plant safety regulations, such as operation ticket, work ticket system.

➢ Install temporary fences or warning ropes in the working area, and hang "Do not enter" signs, non-staff are strictly prohibited to enter.

➢ Before installing or removing power cables, disconnect the device and its front and rear switches.

➢ When liquid is found inside the device, turn off the power immediately and do not continue to use it.

➢ Before operating the equipment, it is necessary to carefully check that the tools used meet the requirements and register; After the operation is complete, retrieve the device by number to prevent it from being left inside the device.

➢ Before installing power cables, ensure that cable labels are correct and cable terminals are properly insulated.

➢ After installation, ensure that all protective shells and insulation tubes of electrical components are in place to avoid the risk of electric shock.

➢ If the device has multiple inputs, disconnect all inputs and perform operations on the device

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only after the device is powered off completely.

➢ When maintaining the power supply or distribution equipment at the rear of the power supply device, turn off the output switch of the power supply device.

➢ During equipment maintenance, hang "Do not close" signs on the upstream and downstream switches or circuit breakers, and post warning signs to prevent accidental connections. You can power it on again only after the fault is rectified.

➢ During fault diagnosis and troubleshooting, the following safety measures must be taken if power failure is required: power failure > Power inspection > Installation of ground cable > Hanging sign plate and installation of shield.

➢ Periodically check the screw of the device connection terminal to ensure that it is tight.

➢ If the cable is damaged, it must be replaced by a professional to avoid risk.

➢ It is strictly prohibited to alter, damage or block the logo and nameplate on the equipment, and timely replace the logo that has become unclear due to long-term use.

➢ Do not use water, alcohol, or oil to clean internal and external electrical components.

2.3.2 Electrostatic protection

Accumulation of static electricity may cause electric shocks, fires, explosions, failure and damage of electronic devices. There are circuit boards or other static-sensitive components in the energy storage system, in order to prevent or reduce the harm of static electricity, it is necessary to do a good job of static electricity protection, which in turn inhibits the generation of static electricity, accelerates the leakage of static electricity, and carries out static electricity neutralization. The prevention methods include but are not limited to:

➢ In the process of replacing components, all equipment devices that have not yet been installed should be retained in bags with anti-static shielding, and temporarily removed equipment devices should be placed on foam pads with anti-static function;

➢ Do not touch solder joints, pins, or exposed circuitry.

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2.3.3 Environment Requirement

Danger	Do not place the device in an environment with flammable or explosive gas or smoke, and do not perform any operations in such an environment.
Danger	Do not store inflammable and explosive materials in the equipment area.
Danger	Do not place the device near heat sources or fire sources, such as fireworks, candles, heaters, or other heating equipment. Heat may cause damage to the device or cause a fire.
Warning	The device should be installed in an area away from liquid. Do not install the device under the water pipe or air outlet where condensate may occur. Do not install it under the air conditioner port, air vent, or cable window of the equipment room to prevent liquid from entering the device and causing device faults or short circuits.
Warning	When the equipment is running, do not block the vent, heat dissipation system or use other items to cover the equipment to prevent high temperature damage or fire.

- Store the device in a clean, dry, well-ventilated place in an appropriate temperature and humidity environment. Keep the device away from dust and condensation.
- Do not install or operate the equipment beyond the range specified in the technical specifications; otherwise, the performance and safety of the equipment will be affected.
- Do not install, use, or operate outdoor equipment or cables (including but not limited to carrying equipment, operating equipment and cables, plugging and unplugging signal interfaces connected to outdoor, working at heights, outdoor installation, or opening doors) in bad weather such as thunder, rain, snow, or strong wind above level 6.
- Do not install the device in an environment that is exposed to dust, smoke, volatile gas, corrosive gas, infrared radiation, organic solvents, or excessive salt.
- Do not install the device in an environment with metal conductive dust or magnetic conductive dust.
- Do not install the device in an area that is prone to the breeding of fungi, molds and other microorganisms.
- Do not install the device in an area disturbed by strong vibrations, strong noise sources, or strong electromagnetic fields.
- Site selection should comply with local laws, regulations and relevant standards.
- Installation environment The ground should be solid and free of bad geology, such as rubber soil, soft soil, or easy subsidence. Low-lying areas such as water accumulation and snow are strictly prohibited. The water level of the site should be higher than the highest water level in the area.
- Do not install the device in a position that can be flooded by water.
- If the device is installed in a place with dense vegetation, in addition to routine weeding, harden the ground under the device, such as laying cement and stones.

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➢ When installing, operating, or maintaining the device, clear the water, snow, ice, or debris on the top of the device and then open the door to prevent debris from falling into the device.

➢ Ensure that the surface is strong enough to meet the load-bearing requirements.

➢ After installing the device, clear the empty packing materials, such as cartons, foam, plastic, and cable ties, from the device area.

2.4 Battery Safety Instructions

 **Danger**	Do not short-circuit the positive and negative terminals of the battery, otherwise it will cause a short circuit of the battery. A short circuit in the battery will generate a large current and release a large amount of energy, causing the battery to leak, smoke, release flammable gas, thermal runaway, fire or explosion. In order to avoid battery short circuit, the battery is not allowed to live maintenance.
 **Danger**	Do not expose the battery to high temperature environments or heat-generating devices, such as high temperature sunshine, fire sources, transformers, and heaters. Overheated batteries may cause leakage, smoke, release of flammable gases, thermal runaway, fire, or explosion.
 **Danger**	Do not expose the battery to mechanical shock, drop, collision, hard object puncture, or pressure impact; otherwise, the battery may be damaged or fire may occur.
 **Danger**	It is strictly prohibited to disassemble, modify or destroy the battery (such as inserting foreign bodies, external extrusion, immersion in water or other liquids) to avoid battery leakage, smoke, release of flammable gas, thermal runaway, fire or explosion.
 **Danger**	Do not touch battery terminals with other metal objects. This may cause heat or electrolyte leakage.
 **Danger**	Use or replace the battery model is not correct, there is a risk of fire, explosion. Use the specified battery model recommended by the manufacturer.
 **Danger**	Battery electrolyte is toxic and volatile. When there is electrolyte leakage or abnormal odor, avoid contact with the leaking liquid or gas. Non-professional personnel should not approach, please contact professional personnel immediately. Professional personnel should wear goggles, rubber gloves, gas masks, and protective clothing to power off the device, take out the leaking battery, and contact technical support engineers.
 **Danger**	The battery is a closed system that does not release any gas under normal operation. If extreme abuse, such as burning, needling, squeezing, lightning strike, overcharging, or other harsh conditions that may lead to thermal runaway of the battery, may cause damage to the battery or abnormal chemical reactions inside the battery, resulting in electrolyte leakage or CO, H2, etc., ensure that flammable gas discharge measures are normal on site to avoid burning or

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	corrosion of the device.
Danger	The gas produced by the combustion of the battery can irritate the eyes, skin and throat. Please pay attention to protection.
Warning	Do not install the battery under the air conditioner port, air vent, cable window, or water pipe in the equipment room. This prevents liquid from entering the device and causing fault or short circuit.
Warning	During battery installation and commissioning, fire fighting facilities, such as fire sand and carbon dioxide fire extinguishers, must be equipped in accordance with construction standards and specifications. Before putting into operation, it is necessary to ensure that there are fire fighting facilities that comply with local laws, regulations and regulations.
Warning	Before unpacking batteries, ensure that the outer packing cases are intact and undamaged during storage and transfer. Place them correctly according to the labels on the packing cases. Do not place them upside down, sideways, vertically, or at an Angle.
Warning	After the batteries are unpacked, place them in the required direction. Do not place them upside down, sideways, upright, tilted, or stacked to avoid battery damage or scrap caused by any impact or fall.
Warning	Tighten the screws of the copper bar or cable according to the torque specified in this document. Periodically check whether the screws are tightened and whether there is rust, corrosion, or other foreign matter, and clean the screws. Otherwise, the virtual connection of the screws will cause excessive voltage drop, and even a large amount of heat will burn the battery when the current is high.
Warning	After the battery is discharged, charge the battery in time; otherwise, the battery may be damaged due to over discharge.

2.4.1 General Requirement

	To ensure the safety of the battery and the accuracy of the battery management function, please use the battery configured by our company. The company will not be responsible for battery related failures arising from the use of batteries not configured by the Company.

➢ Read the instructions provided by the battery manufacturer and comply with the manufacturer's requirements before installing, operating, and maintaining the battery. The safety precautions in this document are only important precautions. For more safety precautions, see the battery manufacturer's manual.

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➢ Please use the battery within the specified temperature range. Do not charge the battery when the ambient temperature is lower than the operating temperature limit to avoid internal short circuit caused by low temperature charging.

➢ Before unpacking batteries, check whether the package is intact. Damaged batteries cannot be used. If damaged batteries are used, inform the carrier and manufacturer immediately.

➢ Install the batteries within 24 hours after they are unpacked. If the batteries cannot be installed in a timely manner, reinstall them in the package and place them indoors in a dry environment without corrosive gas. The energy storage system must be powered on within 24 hours after installation. Remove batteries from packaging and power on the energy storage system within 72 hours. During routine maintenance, the power-off period cannot exceed 24 hours.

➢ Do not use damaged batteries (such as drops, collisions, bulge, or indentations in the case), which may result in leakage or release of flammable gases. If the battery is damaged, such as leakage or structural deformation, contact the installation provider or professional operation and maintenance personnel to remove and replace the battery. Do not store damaged batteries near other equipment or combustible materials, and non-professionals should not go near damaged batteries.

➢ Before operating the battery, ensure that there is no irritation or burning odor around the battery.

➢ Do not place installation tools, metal parts, or foreign objects on the battery during battery installation. After the installation is complete, clean the battery and the items around the battery.

➢ Do not install battery packs in rain, snow, or fog to prevent battery packs from being eroded by water vapor and rain.

➢ If the battery is accidentally flooded, do not continue to install, transported to the safety isolation point and scrapped in time.

➢ Before installing a battery pack, check that the battery pack cover is not deformed or damaged.

➢ Check whether the positive and negative battery poles are accidentally grounded. If the battery is grounded unexpectedly, disconnect the battery terminal from the ground.

➢ Do not weld or grind near the battery. Otherwise, electric sparks and electric arcs may cause fire.

➢ If the battery is not used for a long time, store and recharge the battery according to the battery requirements.

➢ Do not charge or discharge devices that do not comply with local laws, regulations and regulations.

➢ Keep the battery loop disconnected during installation and maintenance.

➢ The damaged battery should be monitored during storage to ensure that there are no signs of smoke, flame, electrolyte leakage or heat.

➢ When the battery is faulty, the surface temperature may be too high. Avoid touching the battery to avoid burns.

➢ Do not stand, lean or sit on the equipment.

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2.4.2 Short-circuit protection

➢ When installing and maintaining batteries, wrap exposed cable terminals on batteries with insulation tape.

➢ Avoid foreign objects (such as conductive objects, screws, and liquids) entering the battery and causing short circuit.

2.4.3 Liquid Leakage protection

	Electrolyte overflow may cause potential damage to the device. The electrolyte overflow may corrode metal objects and boards, causing board damage.

The electrolyte is corrosive and contact may cause skin irritation and chemical burns. If you come into contact with battery electrolyte, take the following measures.

➢ Inhalation: Evacuate the contaminated area, get fresh air immediately, and seek medical help immediately.

➢ Eye contact: Immediately rinse eyes with plenty of water for at least 15 minutes without rubbing and seek immediate medical help.

➢ Skin contact: Wash contact areas immediately with plenty of water and soap, and seek medical help immediately.

➢ Ingestion: Seek medical help immediately

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3. Product Introduction

3.1 Overview for Energy Storage System

Our Suntera G2 is a 5.01MWh (nominal energy) energy storage system .According to the requirement of 0.5P charging/discharging ratio of energy storage system, this design adopts high-safety and high-reliability lithium iron phosphate battery cell for the system design .

This product is a 20-foot container energy storage system, including 12 battery clusters and 1 integrated cabinet .Each battery cluster is composed of 4 lithium iron phosphate battery boxes and 1 high voltage box in series, and is managed by a set of battery management system .Each battery box is grouped by 104 314Ah cells in 1P104S mode and managed by 2 BMUs battery monitoring units .The high-voltage DC bus of 12 subunits converges on 1 integrated cabinet, which controls two circuits (one with six), integrates the man-machine interface (SCU) of battery management system, provides Ethernet communication main interface for each battery cabinet, and also uploads battery data and information to the power station energy management system .The management and monitoring system is equipped with UPS, which can maintain the monitoring operation of the system for a certain period of time when the power grid is cut off.

3.2 Technical Parameters for the Energy Storage System

3.2.1 Container design scheme

The energy storage system of this product adopts integrated design, which integrates the energy storage battery cluster and battery management system into a 20-foot container, which contains the battery cluster, integrated cabinet, automatic fire fighting system, liquid-cooled system and other equipment.

The container has its own independent power supply system, temperature control system, heat insulation system, flame retardant system, fire alarm system, firefighting system, emergency system and other automatic control and safety guarantee systems .The container size is designed according to the standard 20-foot high container, which is convenient for stacking.

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Table1 Parameters of Liquid-cooled System

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No.	Item	Specification	Remark
1	Type of Cell	LFP	
2	Auxiliary power supply	400V AC, 50/60Hz	
3	Cell Parameter	3.2V/314Ah	
4	Maximum charging/ discharging power	0.5P	
5	Configuration of system	1P416S×12	
6	Rated Capacity	5.01 MWh	
7	Rated voltage	1331.2V	
8	Voltage range	1164.8~1497.6V	
9	Cooling method	Liquid-cooled	
10	BMU Communication	CAN	
11	Operating temperature	-30～ 50℃	
12	Humidity	≤95%RH，no condensation	
13	Altitude	< 3000m, derating above 2000m	
14	Noise level	≤80dB(A)	@1m/75dB
15	IP grade	IP55	
16	Storage temperature	-20~45℃（For 1M）0~35℃（For 6M）	
17	Fire protection	Temperature sensor + Smoke detector + Combustible gas detector + Deflagration venting +Fire extinguishing gas + Water sprinkler	
18	Corrosion-proof grade	C4,C3/C5（optional）	
19	Earthquake grade	Level 7	
20	External communication interface	Ethernet/CAN/RS485	
21	Dimension (L×W×H)	6058×2438×2896mm	
22	Weight	42T	
23	Design Life	20 years	

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3.3 Exterior Design for the Energy Storage Systems

3.3.1 Enclosure aesthetics

The container structure design mainly includes shape, steel structure selection, shell protection, container inlet and outlet lines, etc. The specific design is as follows:

Overall dimensions of container: 20-foot standard high container with overall dimensions of 6058×2438×2896mm (20HQ);

The container has functions such as good corrosion prevention, fire prevention, waterproofing, dust prevention (sandstorm prevention), anti-vibration, ultraviolet protection and theft prevention, so as to ensure that the container will not fail due to corrosion, fire prevention, waterproofing, dust prevention (sandstorm prevention), anti-vibration, ultraviolet protection and other factors.

Fire prevention function: ensure that the container shell structure, thermal insulation materials, internal and external decorative materials are all made of flame retardant materials;

The overall protection level of the container is IP55. The parts of the container door panel that connect the outside are protected by sealing strips to prevent dust or rain from entering the container when it encounters sandstorm or rainy weather outdoors .Ensure that there is no water, water seepage and water leakage at the top of the container body, no rain on the side of the container body and no water leakage at the bottom of the container body;

Dust-proof (sand-proof) function: ensure that standard ventilation filter screens which can be easily replaced are installed at the air inlet and air outlet of the container and the air inlet of the equipment, which can effectively prevent dust from entering the container under gale, dust and sand weather conditions;

Anti-earthquake design: ensure that the mechanical strength of the container and its internal equipment meets the requirements under transportation and earthquake conditions, and there will be no deformation, abnormal function, non-operation after vibration, etc.

Anti-ultraviolet function: ensure that the properties of materials inside and outside the container will not deteriorate due to ultraviolet radiation, and will not absorb ultraviolet heat;

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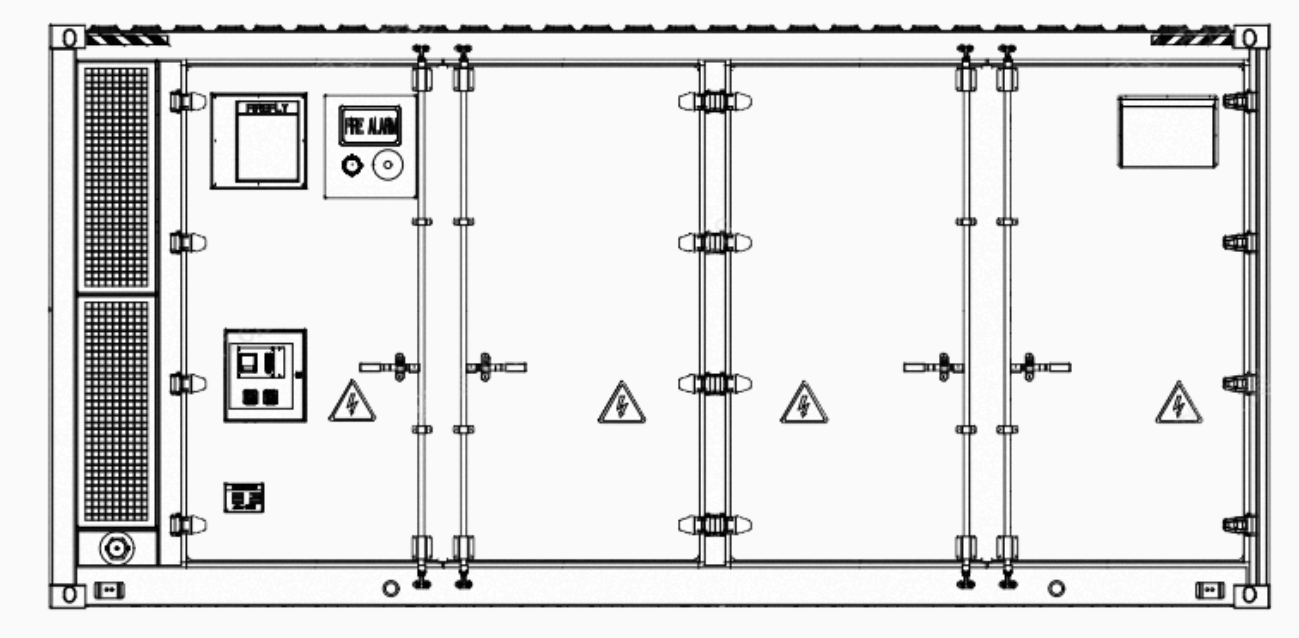
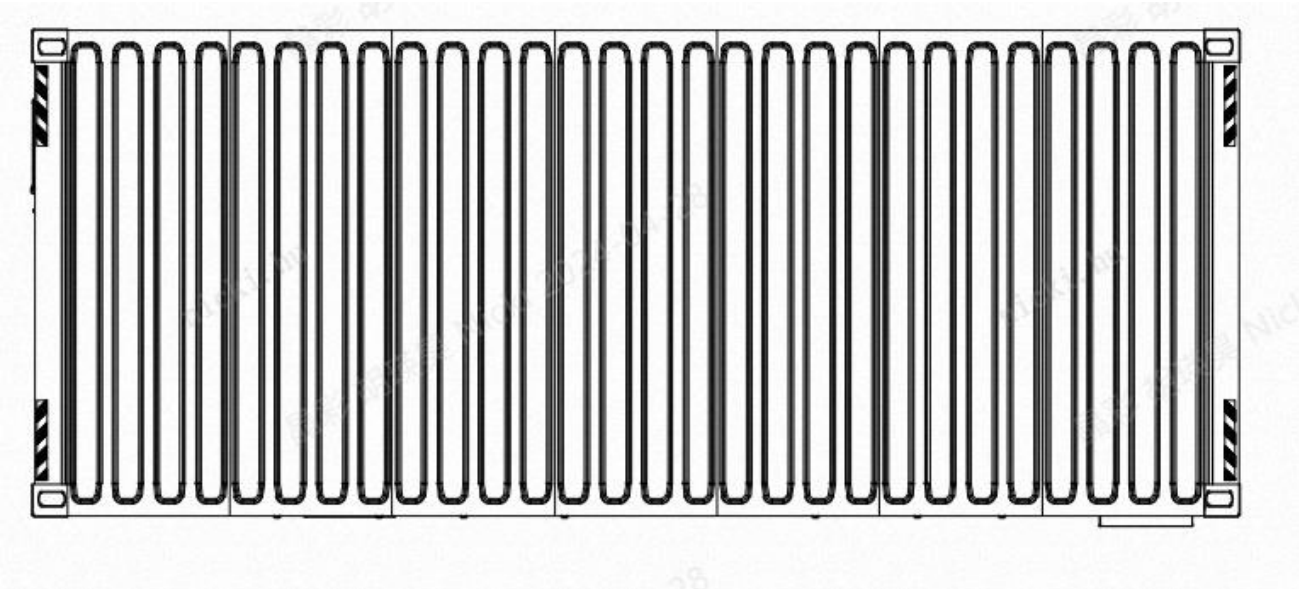
The enclosure aesthetics with dimensions of the container are shown in the figure:



Front View



Top View

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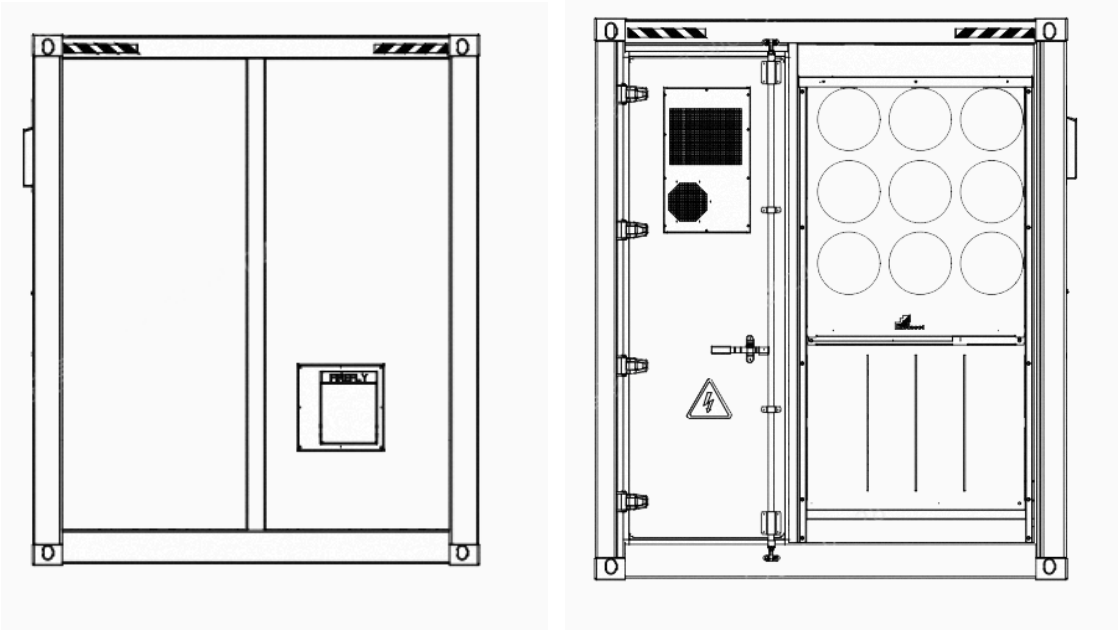
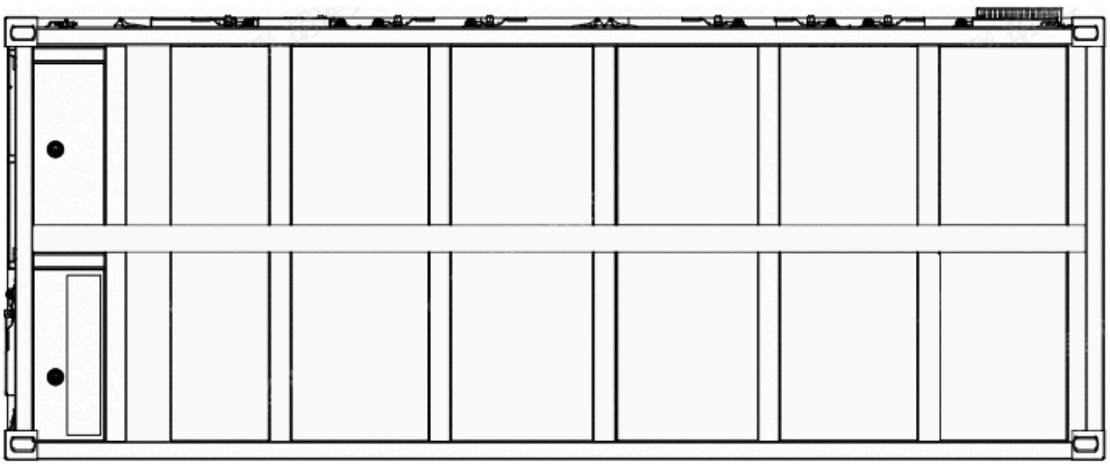


Side View



Bottom View

Figure 3-3-1 Schematic diagram of 20-foot container layout

*Please note: The image provided is for illustrative purposes only. The actual product may vary.

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3.3.2 Ventilation Design

Containers are designed with a "bottom-in, top-out" ventilation scheme, as shown in the figure below:

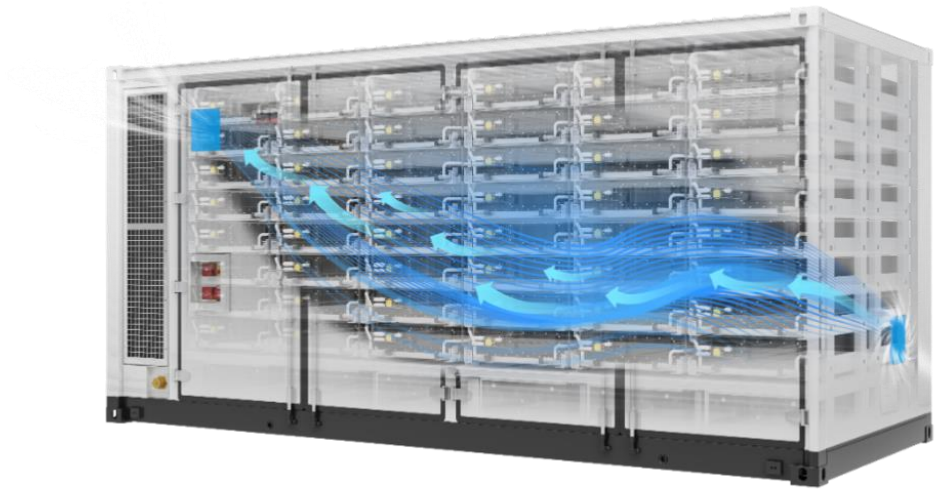

Figure 3-3-2 Schematic diagram of container ventilation

* Please note: The image provided is for illustrative purposes only. The actual product may vary.

3.4 Internal Design for the Energy Storage Systems

3.4.1 Composition of Internal Equipment

The 5.01MWh system consists of 12 sets of 418KWh battery clusters, which are integrated and installed in a 20-foot container, containing a total of 12 battery clusters, an integrated cabinet, a set of firefighting system, a set of liquid-cooled system, etc. The layout of the container is shown in the figure below:

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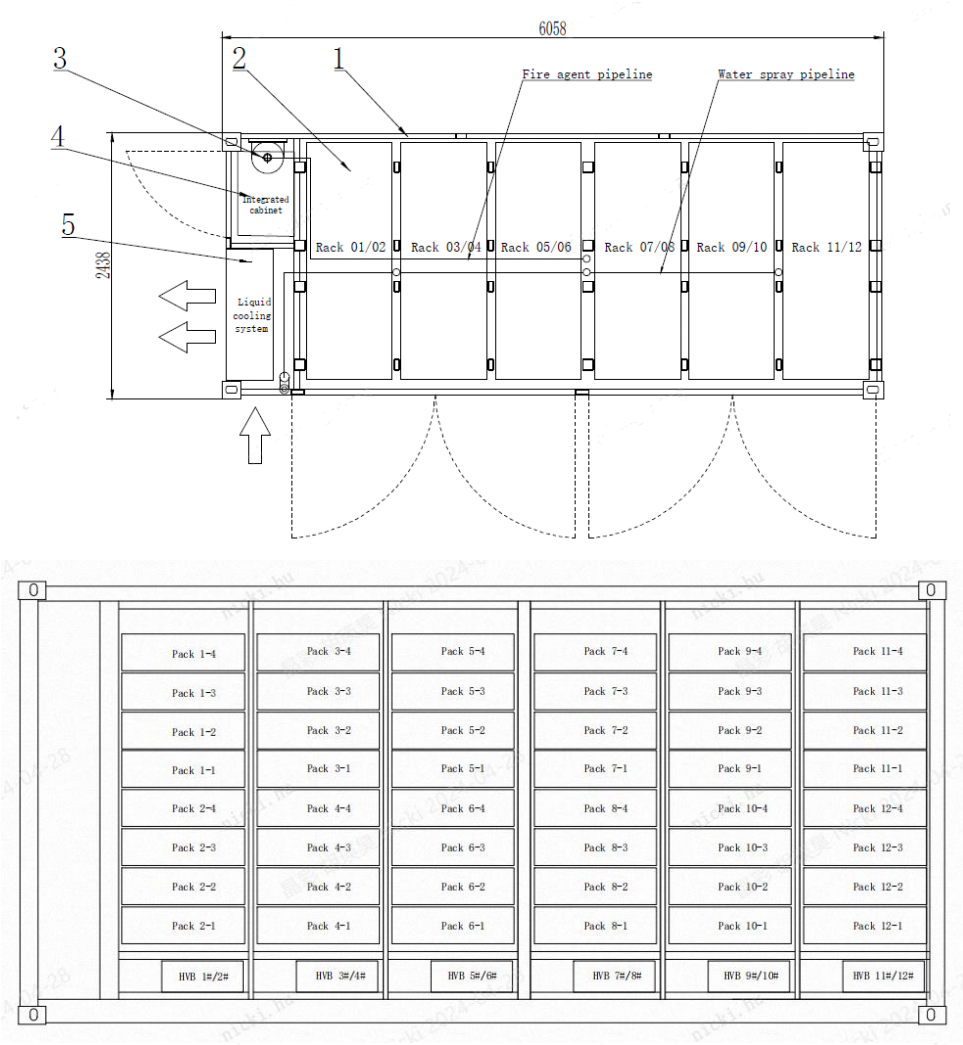

No.	Name	Specifications	Unit	Quantity	Remark
6	Accessory		set	1	1100kg
5	Liquid cooling system	1200*440*2400mm	pcs	1	500kg
4	Integrated cabinet	800*400*1500mm	pcs	1	500kg
3	Fire cylinder		set	1	500kg
2	Battery cluster	930*2175*2450mm	pcs	12	32400kg
1	Container	6058*2438*2896mm	pcs	1	7000kg

Figure 3-4-1 Schematic diagram of container interior

3.4.2 High Voltage Box

High-voltage box is a kind of high-voltage power circuit management unit designed for energy storage system, which is an intermediate unit connecting battery cluster and energy storage converter. High-voltage box has the functions of battery cluster voltage, battery cluster current collection, battery cluster circuit contactor control and protection, summarizing the data uploaded by the first-level BMS (BMU), and realizing the information communication with the third-level BMS (SCU), and so on. The high-voltage control box contains circuit breakers, contactors, fuses, loop current control circuits, current sensors, battery cluster control management module (BCU),

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switching power supply and other components. The high-voltage control box has been designed with full consideration of the electrical characteristics of each component, heat dissipation performance, safety performance and operability and maintainability, with reasonable space layout, featuring compact structure, flexible configuration, safety and reliability.

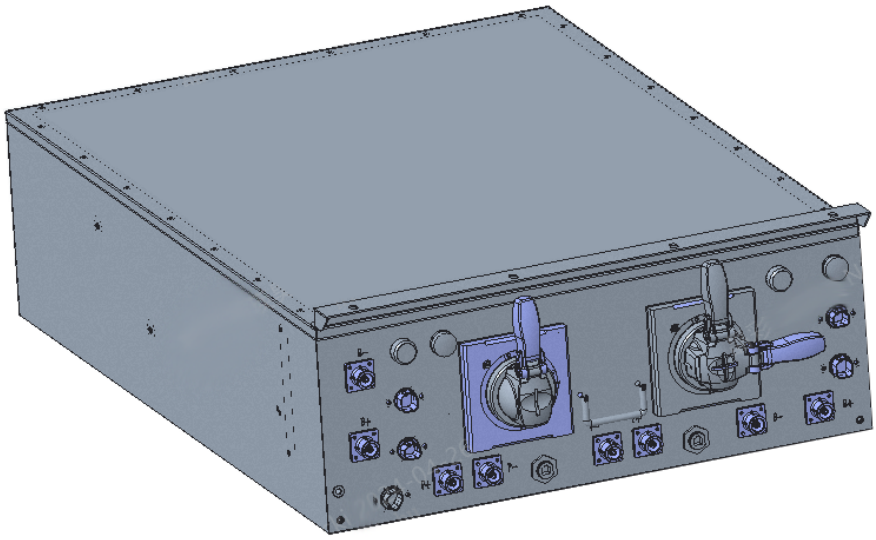

Figure 3-4-2 Outline Schematic Diagram for High Voltage Box

The main parameters of the high voltage box are listed below:

SN.	Parameter	Value	Remark
1	DC Rated voltage	1500V	
2	DC Rated current	275A	
3	Power supply	AC230V，50Hz/60Hz，0.7A	
4	Protection level	IP54	
5	Working Temperature	-30℃~55℃	
6	Working Humidity	≤95%RH，no condensation	
7	Working Altitude	≤3000m	
8	Dimension (W*D*H)	930×680×276mm	
9	Weight	~65kg	

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3.4.3 Cell

This design scheme adopts the mainstream 314Ah Ferrous lithium phosphate (LFP) square aluminum shell battery, and the parameters of the cell are as follows:

Table Parameters for Cell: 3.2V 314Ah

SN.	Parameter	Value
1	Rated capacity	314Ah
2	Rated voltage	3.2V
3	Battery energy	1004.8Wh
4	Max.charge/ discharge power	0.5P
5	Voltage range	2.8V ~ 3.6V
6	Operating temperature	Charging:0℃~60℃ Discharging:-30℃~60℃
7	Storage temperature	-30°C~60°C
8	Weight	5.6±0.30kg
9	Cell dimention（W*D*H）	(173.7±0.5)×(207.2±0.5)×(71.70±0.5)mm

Figure 3-4-3 schematic diagram of cell appearance

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3.4.4 Battery PACK

The design of battery PACK is to design batteries in series. According to the size of the battery PACK and the selected cell, the electrical box is connected in series with 104 cells. After series connection, the battery PACK is of 1P104S and the voltage is 332.8V. The specific parameters are as follows:

Table Parameters for Battery PACK:

SN.	Parameter	Value
1	Cell	314Ah,LFP
2	Configuration of PACK	1P104S
3	Rated voltage	332.8V
4	Voltage range	291.2V~374.4V
5	Rated capacity	104kWh
6	Max.charge/ discharge power	0.5P
7	Operating temperature	-30℃~50℃
8	Weight	~650kg
9	Dimension (W*D*H)	785x2190x240mm
10	Humidity	≤95% RH, no condensation
11	Cooling method	Liquid-cooled
12	IP grade	IP67

Figure 3-4-4 Schematic diagram of battery PACK

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3.4.5 Battery RACK

Battery cluster is mainly used to install battery PACK, high-voltage box and supporting wires and cables. The high-voltage box includes BCU, high-voltage and low-voltage electrical protection parts, etc .The design of battery cluster adopts a layered design, and the appearance of cabinet adopts maintenance-free technology .The battery cluster of this project is mainly equipped with 4 battery PACKs and 1 high-voltage box. The battery cluster has complete installation and connection materials and can complete the wiring of battery output terminals .The parameters of a standard battery cluster are as follows:

Table 3-4-5 Battery Cluster Parameters

SN.	Parameter	Value
1	Configuration of RACK	1P416S
2	Rated voltage	1331.2V
3	Rated capacity	314Ah
4	Voltage range	1164.8~1497.6V
5	Rated capacity	418kWh
6	Battery PACK	4pcs
7	High voltage box	1pc
8	Weight	About 5.3KG (including 2 clusters)
9	Dimension (W*D*H)	805x2192x2664mm(including 2 clusters)
10	Humidity	≤95% RH, no condensation
11	Cooling method	Liquid-cooled

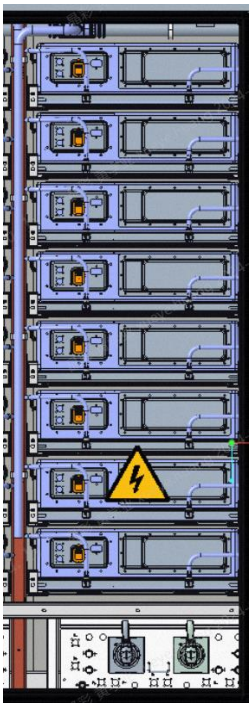

Figure 3-4-5 Schematic diagram of battery cabinet structure

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3.4.6 Integrated Cabinet

1) The integrated cabinet provides high-voltage DC bus parallel convergence for 12 418kWh battery clusters, and is equipped with lightning protection devices;
2) The integrated cabinet provides system emergency exit switch and function for 12 battery clusters and battery management system;
3) The integrated cabinet provides the CAN bus convergence to 12 battery cabinets, integrates them into a battery management system, and converts the information of each battery cluster into Ethernet protocol through SCU and sends it to EMS, and can independently complete the remote monitoring of the battery system;
4) The integrated cabinet provides a communication interface with PCS;
5) The SCU in the integrated cabinet has the function of network time synchronization;
6) In the standby state, it sends commands to the energy storage unit through EMS, which can complete the system scheduling function.

The schematic diagram of the appearance of the integrated cabinet is as follows:

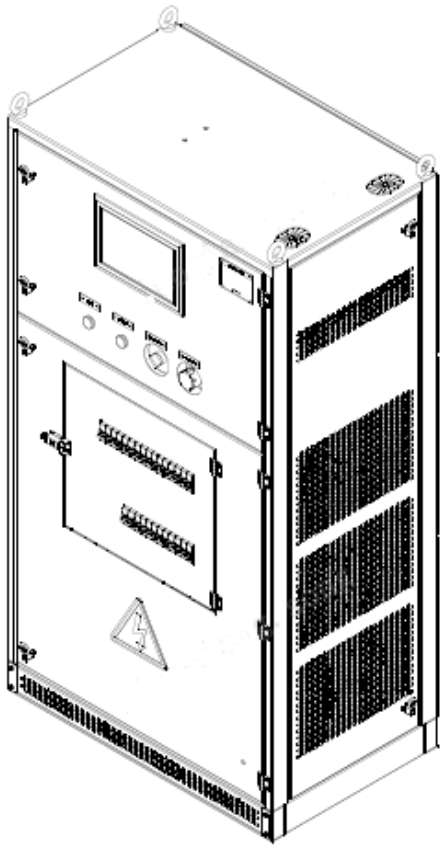

Figure 3-4-6 Schematic diagram of integrated cabinet

*The above pictures are only for reference, please refer to the final received goods!

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Wiring design of integrated cabinet

1) The installation and wiring of components in the integrated cabinet are neat and reliable, their layout is reasonable, and their electrical insulation meets the relevant standards.
2) The distribution of DC circuits in the integrated cabinet is reasonable and clear, and the incoming and outgoing lines adopt well-known brand terminals, with isolation protection between the terminals; The design of the terminal blocks in the main control box is reasonable, for convenience of maintenance and debugging;
3) The integrated cabinet is designed with a circuit breaker to ensure that the system can be disconnected step by step during overhaul;
4) DC positive and negative wires adopt different color codes;
5) The high and low voltage wires and signal wires are separated in different wire troughs, and the incoming and outgoing wires adopt the lead wire and connecting wire mode of inlet down and outlet down;
6) The strong and weak secondary circuits are laid separately, and each terminal is connected to only one wire. The current terminal and the voltage terminal are clearly distinguished;
7) The position number and serial number of the components in the cabinet are consistent with those in the drawings, and all operable components are marked. The internal wiring is based on the wiring diagram and serial number, and all equipment installed on the panel is marked with planar identification marks.

3.4.7 Thermal management design of the container

The thermal management system in this scheme is divided into two parts: battery compartment thermal management system and electrical room thermal management system.

The thermal management system of battery compartment adopts liquid-cooled system, which consists of liquid-cooled unit, liquid return pipeline and battery liquid-cooled plate (Pack body part). In addition, it adopts multi-mode and refined thermal management control logic to ensure system temperature and temperature difference, and improve system consistency and service life.

The liquid-cooled unit and battery compartment are arranged in a completely independent structure, which improves the safety of the system .The rated refrigerating capacity of liquid-cooled unit is 60kW .The liquid-cooled pipeline adopts a three-stage pipeline scheme, and all pipelines adopt nylon hoses, which have the functions of heat preservation, condensation prevention and exhaust .Based on the simulation analysis of heat flow in the internal flow channel of battery liquid-cooled plate under all working conditions, the non-uniform flow channel design is adopted to ensure the uniform distribution of flow field and no fluid dead zone .According to the criterion of temperature and temperature difference at all levels, the system performs subdivided temperature zoning control and intelligently switches operation modes, which reduces auxiliary power consumption and improves system efficiency on the basis of ensuring system temperature and temperature difference .Based on the testing result, under the design working condition, the

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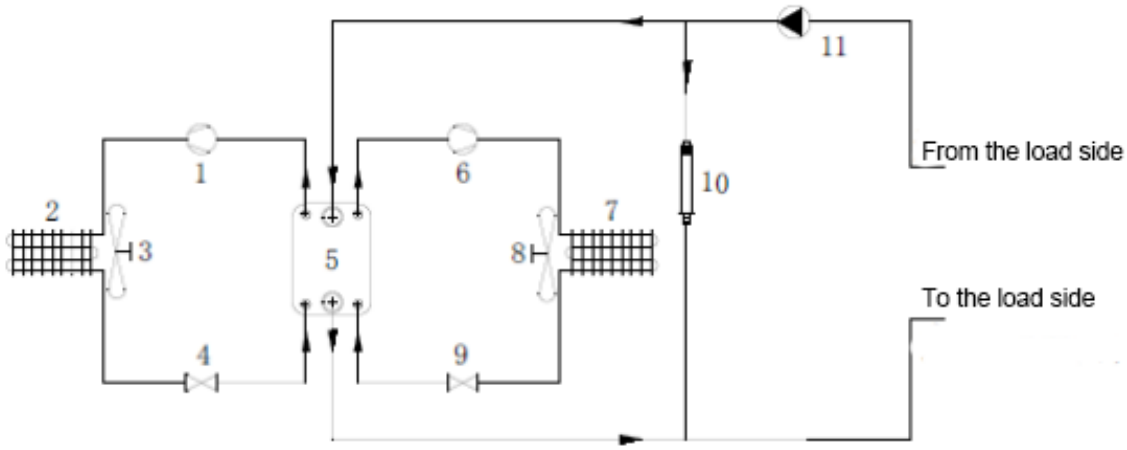
maximum battery temperature of this product is ≤35℃, and the temperature difference is ≤4℃.

The thermal management system of electrical room mainly adopts door-mounted industrial air conditioner (rated refrigeration capacity of 1.5kW) for air cooling circulation, which provides a working environment with reasonable temperature and humidity for indoor electrical components.

3.4.7.1 Liquid-cooled system

The liquid-cooling unit consists of refrigeration circulation system and coolant circulation system, and the system principle is shown in the following figure.



1:1# compressor 2: 1# condenser: 3: 1# condenser fan 4:1# throttling element

5: Plate heat exchanger 6: 2# compressor 7: 2# condenser: 8: 2# condenser fan

9: 2# throttling element 10: Electric heater 11:1# circulating water pump

The working process of the liquid-cooled unit is as follows:

1) After the discharge temperature reaches the refrigeration set point, the compressor is started to compress the gaseous refrigerant.

2) The air cooled chiller's control system adjusts the speed of the compressor motor according to the discharge temperature or the requirements issued by the upper computer, so as to control the power and discharge temperature of the whole machine.

3) The condenser condenses the high-temperature gaseous refrigerant.

4) The gaseous refrigerant is condensed into liquid, and the heat is exhausted to the air in the surrounding environment by the fan through the surface of the condenser.

5) The electronic expansion valve throttles and depressurizes the condensed refrigerant, which is then injected into the plate heat exchanger.

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6) The refrigerant is evaporated in the plate heat exchanger and absorbs the heat of the coolant.

7) The circulating water pump sends the coolant to the plate heat exchanger for heat exchange with the refrigerant, and sends the cooled coolant to the container to cool the battery pack.

No.	Parameter name	Parameter value
1	Operating voltage range	400V±15%,3~, 50/60 ±3Hz
2	Operating environment temperature range	-30°C ~ +55°C
3	Operating relative humidity range	5% ~ 95%
4	Storage environment temperature range	-40°C ~ +70°C
5	Storage environment humidity range	5% ~ 95%
6	Transport performance	Can meet the requirements of land transportation, air transportation and sea transportation, etc.
7	External dimensions (W×D×H)	1200mm×440mm×2400mm
8	Protection level of electrical control box	IPX5
9	Coolant operating temperature range	-30°C~50°C
10	Coolant operating pressure range	0.25bar~3.0bar

3.4.7.2 Liquid-cooled Pipeline

The liquid-cooled pipe is a three-stage pipe system: all pipes are made of nylon hose, PA12 material, crimping process, and connected by quick-insert joints. The pipes are flexibly connected by bellows. The third-stage line and PACK link have a two-way stop valve design to ensure that there is no coolant leakage when removing and servicing the PACK.

The piping system has an automatic exhaust function to discharge the air in the liquid-cooled system in time and reduce the influence of gas on heat exchange and coolant stability.

The piping system is equipped with a convenient replacement filter to ensure the cleanliness of the cooling medium.

The external piping parts of the liquid-cooled system are required to be insulated without condensation.

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3.4.7.3 Leakage Monitoring and Response

Reduce the risk of fluid leakage

1) The lower box and liquid-cooled plate are integrated and designed, no joints and leaks inside the PACK;

2) The nylon hose used in the primary pipeline can effectively absorb the assembly tolerance, and the sealing form is changed from stainless steel chuck to quick insertion form with lower risk of vibration resistance and impact leakage;

3) The number of pipe joints is small, and high sealing fittings, valves, etc. are used;

4) Pipe fittings, valves, etc. are mainly arranged in the liquid-cooled unit compartment, which reduces the leakage risk points inside the battery compartment.

Leakage monitoring and alarming

1) Adopting the coupling judgment of differential pressure and coolant level to detect system leakage or blockage in advance. In addition, an optional flow meter can be used so as to further increase the sensitivity of the leakage detection.

2) Automatic replenishment system coolant level variance and automatic replenishment number of alarms, system leakage of high warning;

3) Coolant Leak Response Program

4) After the system monitors the abnormality, it will predict the risk of leakage/clogging according to the degree of leakage and stop the system operation in time to avoid the abnormality from expanding.

5) Equipped with a stable liquid leakage collection and discharge facility, which can not only minimize the diffusion of leaking coolant, but also slow down the uncontrolled spread of combustible gases released by thermal runaway of the cell.

3.4.8 Battery Management System BMS

3.4.8.1 Product Description

This design scheme adopts the mainstream battery management system scheme in the industry, and the main chip adopts a high-performance automotive chip .It includes two functions: energy storage system monitoring and battery management system. Each system includes slave units for battery management system (BMU), main units for battery management system (BCU), stack control unit (SCU), high voltage control unit and battery display control unit .This management system is used to detect the voltage and temperature of cell and total current of single cluster, calculate the SOC of battery cluster, and store the manufacturing information, version information and necessary operation history data of related battery cabinets. Each unit of the battery management system communicates in real time through CAN bus, and the main control unit transmits the operation status and alarm information of battery cluster to the stack control unit, while receiving the operation instructions issued by the stack control unit in real time .The management system can automatically

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manage the high voltage and heat, coordinate the automatic battery balance function of the whole energy storage system, and automatically calibrate the SOC according to the calculation when necessary .The block diagram of the battery management system is shown below.

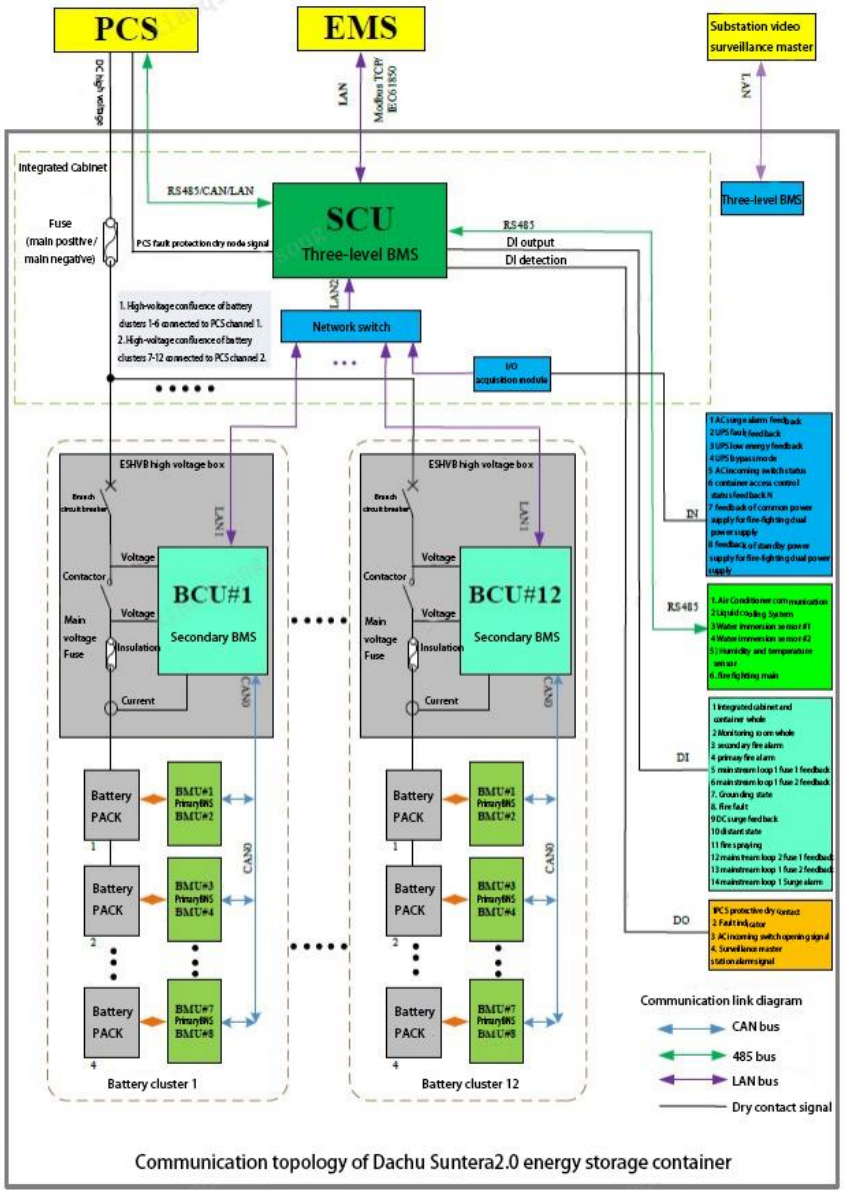

Figure 3-4-8-1 Block diagram of battery management system

SCU(Level 3 BMS), is a kind of control and management host for energy storage battery management system, which carries out numerical calculation, performance analysis, alarm processing and record storage of real-time battery data uploaded by BCU (Level 2 BMS) and BMU (Level 1 BMS), and also realizes linkage control with PCS mainframe and energy storage management system (EMS), optimizes the load control strategy according to the output power requirement and SOC state of each cluster of batteries, and keep the battery system with safe, stable and high-efficiency operation.

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3.4.8.2 SCU layout

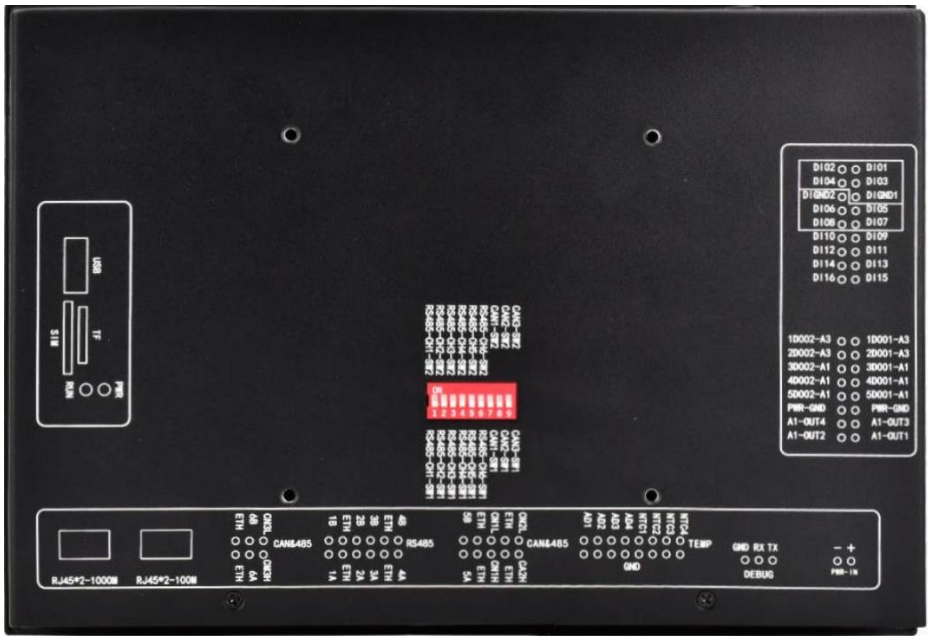

Figure 3-4-8-2 SCU front & back layout

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3.4.8.3 SCU Port Definition and Pin Order

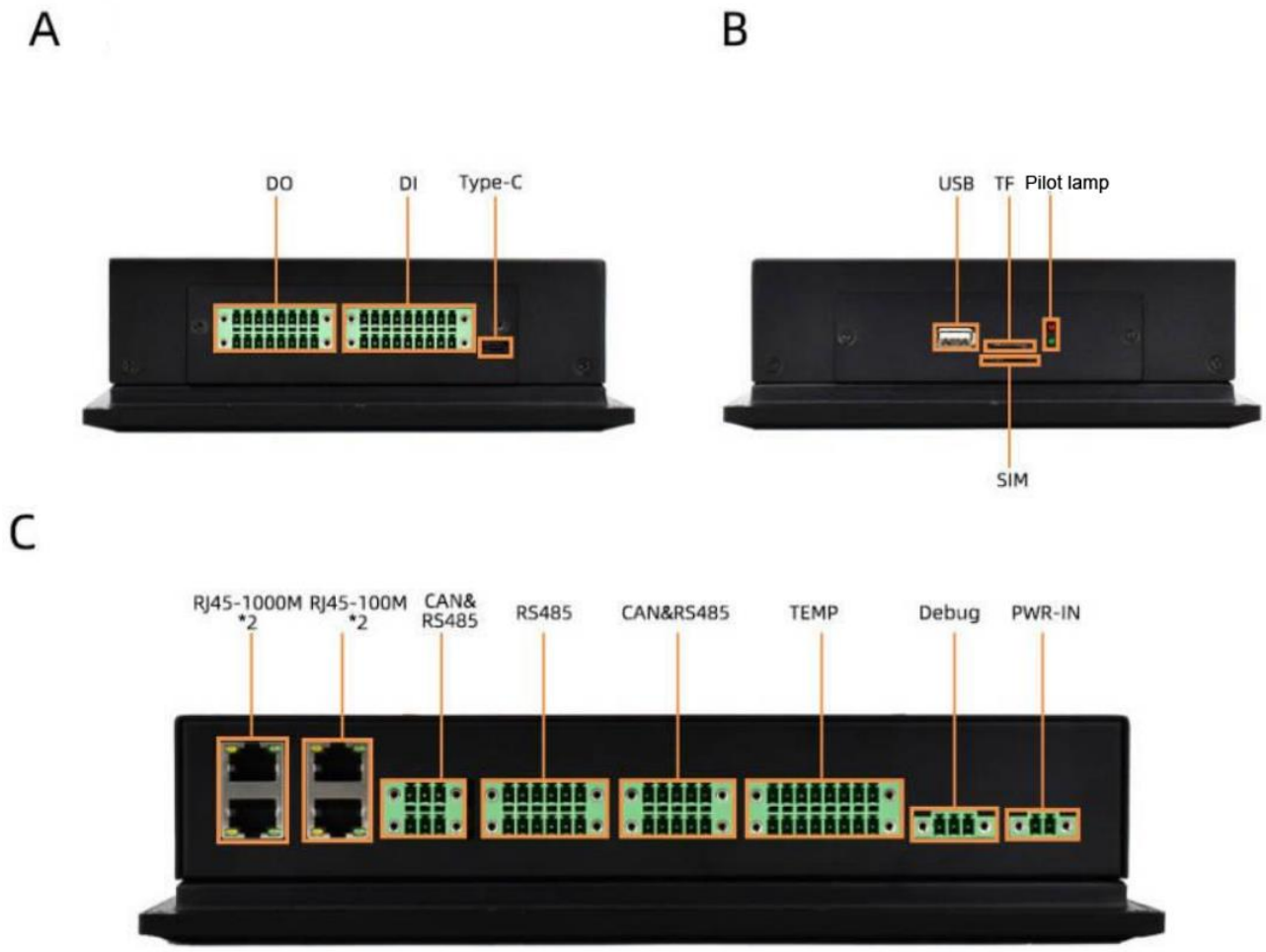

Figure 3-4-8-3 Schematic diagram of SCU interface

* Please note: The image provided is for illustrative purposes only.

1) RS485 PORT J12

(EDG-3.81MM Spaced double row 12Pin connector)

SN	Function
1	RS485_CH4_A
2	RS485_CH4_B
3	SHELL_EARTH
4	SHELL_EARTH
5	RS485_CH3_A
6	RS485_CH3_B
7	RS485_CH2_A

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8	RS485_CH2_B
9	SHELL_EARTH
10	SHELL_EARTH
11	RS485_CH1_A
12	RS485_CH1_B

2) RS485&CAN PORT J13

(EDG-3.81MM Spaced double row 10Pin connector)

PIN No.	Signal Name
1	CAN2_H
2	CAN2_L
3	SHELL_EARTH
4	SHELL_EARTH
5	CAN1_H
6	CAN1_L
7	SHELL_EARTH
8	SHELL_EARTH
9	RS485_CH5_A
10	RS485_CH5_B

3) RS485&CAN PORT J21

(EDG-3.81MM Spaced double row 6pin connector)

PIN No.	Signal Name
1	CAN3_H
2	CAN3_L
3	RS485_CH6_A
4	RS485_CH6_B
5	SHELL_EARTH
6	SHELL_EARTH

4) 4.2.4TEMP PORT J16

(EDG-3.81MM Spaced double row 16Pin connector)

PIN No.	Signal Name
1	GND
2	TEMP_NTC4
3	GND
4	TEMP_NTC3

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5	GND
6	TEMP_NTC2
7	GND
8	TEMP_NTC1
9	GND
10	ADC4
11	GND
12	ADC3
13	GND
14	ADC2
15	GND
16	ADC1

5) 4.2.4RS232 Debugging serial port J10
(EDG-3.81MM spaced 3Pin connector)

PIN No.	Signal Name
1	DBG_TXD
2	DBG_RXD
3	GND

6) 4.2.5PWR-IN PORT J2
(EDG-3.81MM Spaced single row 2Pin connector)

PIN No.	Signal Name
1	PWR_IN
2	GND_PWR_IN

7) 4.2.6DO PORT J15
(EDG-3.81MM Spaced double row 16Pin connector)

PIN No.	Signal Name
1	REPLAY1_OUT1
2	REPLAY1_OUT2
3	REPLAY2_OUT1
4	REPLAY2_OUT2
5	REPLAY3_OUT1
6	REPLAY3_OUT2
7	REPLAY4_OUT1
8	REPLAY4_OUT2
9	REPLAY5_OUT1

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10	REPLAY5_OUT2
11	GND_PWR_IN
12	GND_PWR_IN
13	VCC_1A_OUT3
14	VCC_1A_OUT2
15	VCC_1A_OUT1
16	VCC_1A_OUT0

8) 4.2.7DI PORT J18

(EDG-3.81MM Spaced double row 18Pin connector)

PIN No.	Signal Name	PIN No.	Signal Name
1	DIN_01	2	DIN_02
3	DIN_03	4	DIN_04
5	GND_DIN_1	6	GND_DIN_2
7	DIN_05	8	DIN_06
9	DIN_07	10	DIN_08
11	DIN_09	12	DIN_10
13	DIN_11	14	DIN_12
15	DIN_13	16	DIN_14
17	DIN_15	18	DIN_16

3.4.9 Ethernet Switches

3.4.9.1 Basic Introduction for Ethernet Switches

The EDS-2018-ML series Industrial Ethernet switches are equipped with 16 10/100M electrical ports and two 10/100/1000BaseT(X) or 100/1000BaseSFP combo ports, making them ideal for high-bandwidth data fusion applications. In addition, to provide versatility to meet applications in different industries, the EDS-2018-ML series allows users to enable or disable QoS features, broadcast storm protection and port interrupt alarm functions via DIP switches on the external panel.

The EDS-2018-ML series supports 12/24/48 VDC redundant dual power inputs, rail mounting and high EMI/EMC levels. In addition to its compact size, the EDS-2018-ML series has passed 100% burn test to ensure reliable operation in the field. The EDS-2018-ML series supports standard temperatures from -10 to 60°C, and wide temperature models from -40 to 75°C are also available.

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Figure 3-4-9-1 EDS-2018-ML diagram

3.4.9.2 Switch Features and Benefits

- Two Gigabit Ethernet ports are used for the uplink and flexible interface design for high-bandwidth data transmission
- Supports QoS and processes critical data in high-traffic transmission
- Relay output warning for power failure and port interruption
- IP30 protection
- 12/24/48 Redundant VDC dual power input
- Support -40 to 75°C operating temperature (-T model)

3.4.10 UPS

3.4.10.1 Basic Introduction for UPS

An UPS(Uninterruptible Power Supply) is a device that includes an energy storage system, primarily used to provide a stable power supply to equipment that requires high reliability.

Under normal grid condition, the UPS will keep grid voltage stable and give supply to the load, at this time the UPS is an AC voltage regulator, at the same time it is also charging from the battery to the machine; when the grid is lost(accidental blackout), the UPS will immediately transfer the battery's DC energy through the inverter switching method to the load with supplying 220V alternating current. So as to enable the load to maintain the normal work and protect the load software and hardware from being damaged. Generally, UPS equipment can both provide protection against over-voltage or under-voltage.

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3.4.10.2 Interfaces and Functions for UPS

The interface of UPS is shown as below:

Figure 3-4-10-2 Schematic diagram for UPS interface

SN.	Name	Instruction
1	Graphic LCD display	- Clear display of information about the UPS status and measured values - Enhanced Configuration Features
2	Front Panel	Panel for battery replacement (hot swap function)
3	Slot for management card	Netpack models come with a network card as standard
4	Output	8 x IEC 10A + 2 x IEC 16A function with energy metering (including 2 programmable groups)
5	UPS port	USB port; 1 Serial Port; Dry contact output; Remote Power Off and Relay Outputs
6	External Battery Connector	Bridging for connecting Batteries to Devices

3.4.11 Air Conditioner inside the Integrated Cabinet

EC series air conditioner products belong to temperature control products which are developed for outdoor cabinet cooling occasions, mainly used to provide a suitable temperature environment and ensure the service life of the equipment inside the cabinet. The installation schematic diagram of the air conditioner is shown below:

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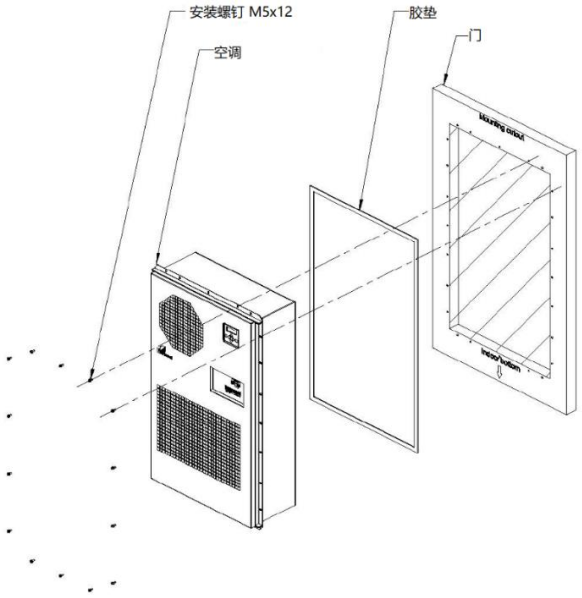

Figure 3-4-11 Schematic diagram for Air Conditioner Installation on the energy storage system

3.4.12 Design of Video Surveillance System (Optional)

The video surveillance system is mainly responsible for all-weather routine video monitoring of main electrical equipment and installation sites, and can be linked with other subsystems for alarm to meet the requirements of operation management for safety and patrol inspection.

In this scheme, a high-definition monitoring camera is installed in the container, and the system diagram of the monitoring scheme is as follows:

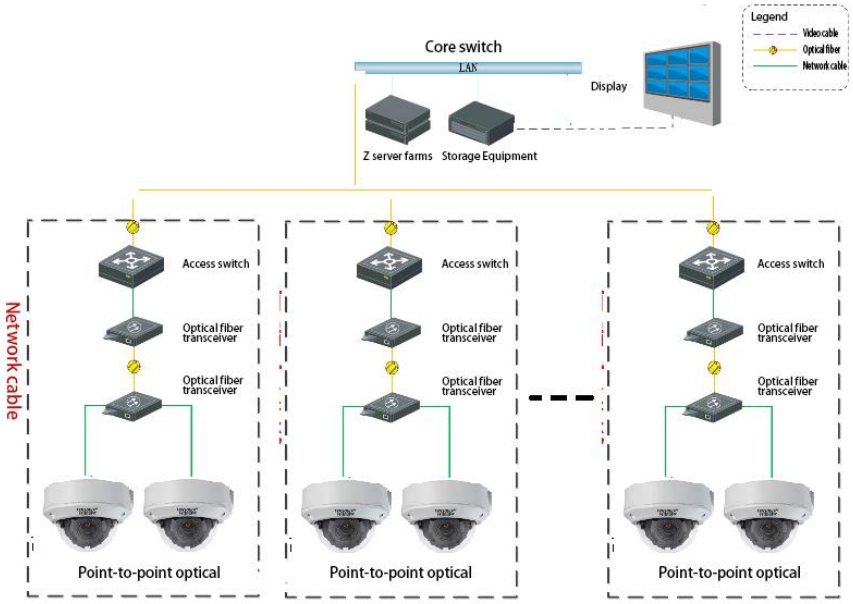

Figure 3-4-12 (1) Schematic diagram of monitoring scheme system

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In this scheme, two high-definition cameras are arranged in the container, and the power supply in thecontainer is used to ensure that the equipment is on-line 24 hours a day, and the network signals of the cameras are converted into optical signals with multi-port optical fiber transceivers for long-distance transmission.

Figure 3-4-12 (2) Schematic diagram of camera appearance

3.5 Primary Diagram for the Energy Storage System

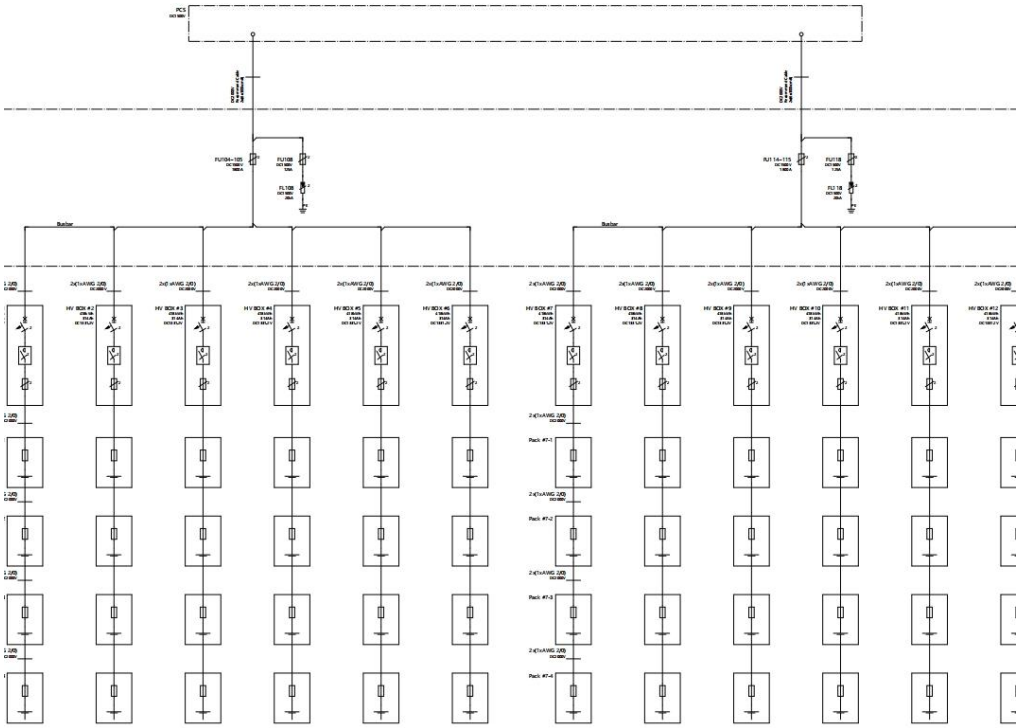

Figure 3-5 Primary schematic diagram for the energy storage system

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4. Lifting, Transportation and Storage

4.1 Lifting Operation

4.1.1 Precautions for Lifting

Warning	➢ In the process of lifting, it is necessary to operate in strict accordance with the safety regulations of the crane. ➢ It is strictly prohibited to keep people stand there within 10 meters of the operation area, especially under the lifting arm and under the lifting or moving machine, to avoid accidents. ➢ In case of bad weather conditions, such as heavy rain, fog, strong winds, etc., lifting should be stopped.

4.1.2 Preparation for Lifting

1) Crane preparation:

The total weight of the equipment is about 42 tons, please select the crane according to the total weight, recommended model: 80 tons to 120 tons.

2) Spreader preparation:

Wire rope, unloading buckle, spreader bar, etc.

4.1.3 Lifting Steps

1) When loading or unloading goods, a crane of suitable tonnage must be used. When lifting, nylon sling (belt) or steel wire rope can be used;

2) The lifting process should strictly refer to the lifting diagram for lifting, see the attached diagram below for details;

3) In the process of lifting, the container should be kept stable and the tilt angle is ≤5°;

4) The whole lifting process should be carried out slowly, pay attention to the observation of the balance of the box state, do not move too fast;

5) When moving horizontally, the tilt angle should not exceed 15°;

6) During the whole lifting process, anyone is not allowed to stand under the container and crane;

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4.1.4 Schematic Diagram on Lifting and Installation for Liquid-cooled Energy Storage System

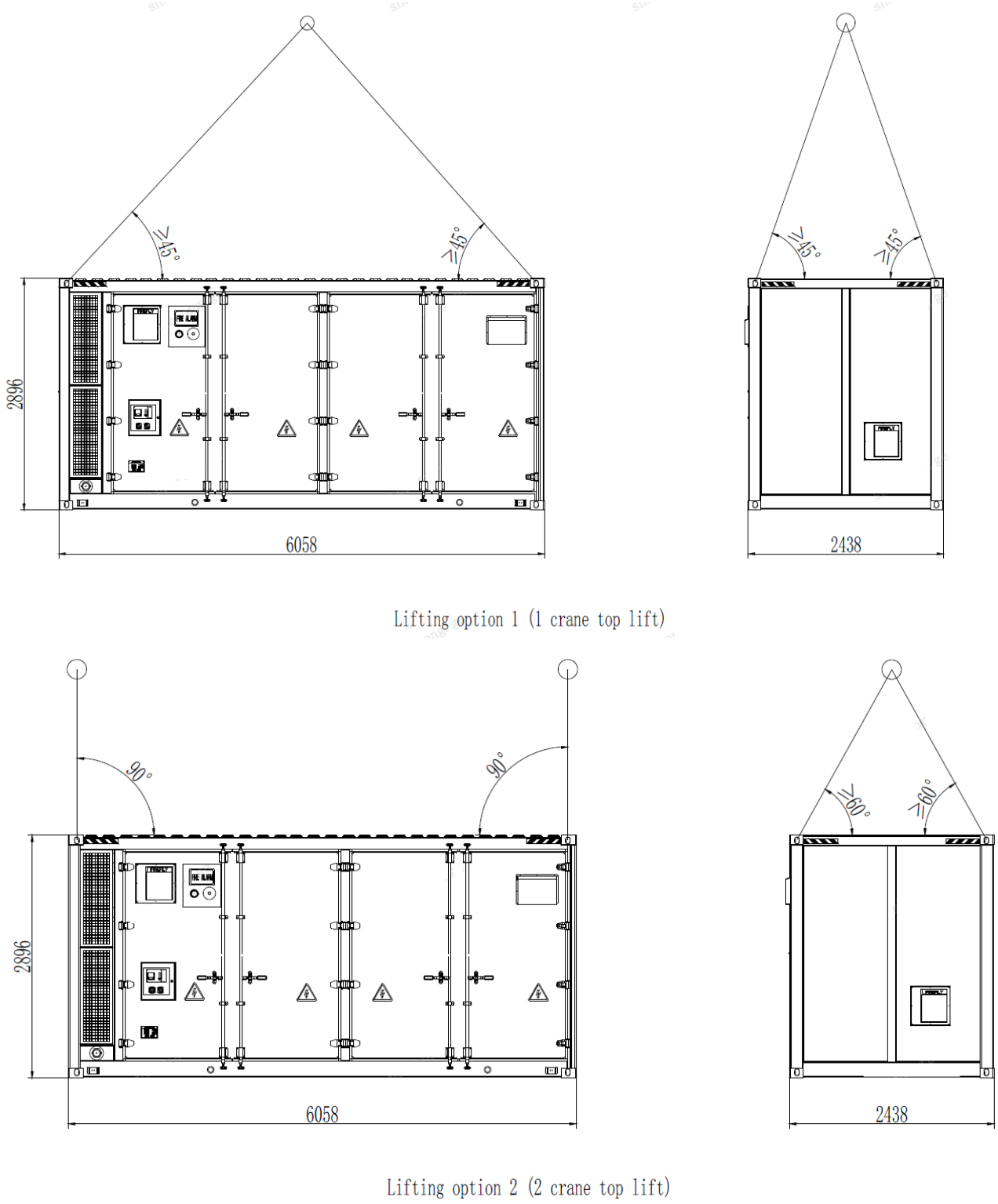

Figure 4-1 Schematic Diagram on Lifting for Liquid-cooled energy storage system

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4.2 Transportation

Liquid-cooled energy storage system containers are suitable for land and sea transportation, and should be sheltered and sun-protected during transportation, civilized loading and unloading, and direct rain, snow and mechanical impact should be avoided during transportation.

4.2.1 Environmental Requirements for Transportation

According to the characteristics of the battery, the battery pack should follow the below requirements during storage and transportation to maximize the protection of battery performance:

Average daily storage temperature: ≤20℃.

Humidity: ≤95%, no condensation.

4.2.2 Preparation before Leaving the Factory for Liquid-cooled Energy Storage System

1) The container outside the gap in the place before shipment must be sealed with a sealing plate, sealing tape to ensure that the internal equipment is not affected during transportation;

Figure 4-2 Schematic diagram of sealing board blocking

2) At the same time, in order to avoid bumping in transportation, to prevent the paint film from being scratched and other issues, according to the customer's choice, each container can be equipped with an optional rainproof canvas cover to strengthen the protection of the box;

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Figure 4-3 Packaging Schematic on Tarpaulin

3) For sea transportation, it is necessary to add the relevant markings certified by the classification society: box master code, box number, weight and other relevant markings;

4) For ocean shipments, meet MSDS certification and affix a Class 9 Dangerous Goods label;

4.2.3 Road Transportation

1) Obey the traffic rules;

2) Because the container equipment is equipped with batteries inside, speeding is prohibited. On flat asphalt road, highway speed limit is 70km/h, slow down at curves and speed limit is 50km/h; town road speed limit is 40km/h, avoid emergency starting and emergency braking;

3) Please drive with special care on any road surface such as non-flat asphalt road and the speed limit is 50km/h;

4) Prohibit transportation on the surface of bad bumpy road;

5) The goods are firmly tied; before departure, check the tying situation once; during transportation, check the tying situation once every 4 hours;

Note	Please always keep in mind the mechanical parameters of the energy storage system during transportation and loading/unloading: Dimensions (L×W×H): 6058×2438×2896mm (20HQ) Weight: 42 tons

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4.3 Storage

Considering storage，system should be placed in a dry warehouse, shall not be exposed to sunlight and rain. Harmful gases, flammable, explosive products and corrosive chemicals are not allowed in the warehouse, avoid mechanical shock, heavy pressure and strong magnetic field effect, avoid direct sunlight, no less than 2m away from the heat source, and at least 50cm away from the wall, window or air inlet.

Average daily storage temperature: ≤20℃;

Allowable storage temperature: short-term storage temperature range (within 1 month): -20~45℃; long-term storage temperature: 0℃～35℃;

Storage humidity: ≤95%, no condensation;

Under the conditions set forth herein:

It is recommended that the battery should be discharged and recharged every 3 months to ensure that the SOC of the battery remains within the range from 15 to 40%;

A capacity check test and re-inspection is required every 12 months.

Warning	During the storage of the liquid-cooled energy storage system, JinkoSolar Co., Ltd. shall not be liable for any damage to the system caused by the user's failure to comply with the storage methods and requirements set forth in this manual.

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5. Foundation Building

When selecting the site for the foundation, please follow the principles below:

Climatic environment, soil and geological conditions (e.g. stress wave emission, underground water level) and other characteristics of the place where this liquid-cooled energy storage system is installed should be fully considered.

The surrounding environment should be dry, well ventilated and away from flammable and explosive areas.

The foundation soil needs to have a certain degree of compactness. It is recommended that the relative compactness of the soil at the installation site is ≥98%. If the soil is loose, please make sure to take measures to ensure the foundation is stable.

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6. Equipment Installation

6.1 Installation Instructions

The internal equipment of the Liquid-cooled energy storage system has been reliably connected and tested before leaving the factory, and it is necessary to install and fix the container box, connect the power cables to the DC side of the PCS, do connection on the external signal cables, do connection on the external auxiliary power supply cables, and connect the container to the ground on the project site. The installation steps is shown as Figure 6-1:

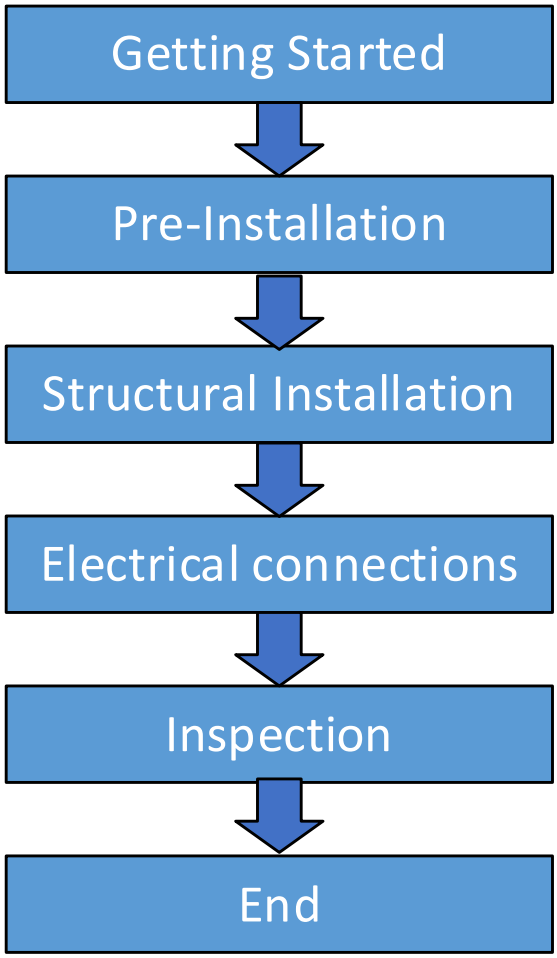

Figure 6-1 Installation Steps on Liquid-cooled Energy Storage System

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The installation steps on liquid-cooled energy storage system is described in detail as Table 6-1 shown:

Table6-1 Detailed description of the installation steps

Installation protocol	Installation steps
Pre-installation	➢ Check containers and functional cabinets for cosmetic damage. ➢ Check the container and functional cabinets for damage or detached components. ➢ Verify that all components are intact and not missing ➢ Confirm that the installation environment meets the requirements. ➢ Confirm the availability of equipment for lifting containers at the project site.
Structural installation	➢ Moving liquid-cooled energy storage system containers to prefabricated foundations using cranes. ➢ Securing the container according to project requirements.
Electrical connection	➢ Connecting Ground Points. ➢ Connecting DC side cables on PCS. ➢ Connecting external communication and power cables.

6.2 Pre-Installation

6.2.1 Inspection for Delivering

Compare the equipment delivery list to determine if the quantity of equipment matches the list.

6.2.2 Inspection for Equipment

Check whether the final equipment received will match the model of the equipment ordered.

Check whether the inside and outside of the equipment are intact and undamaged.

If there is any instruction material in the packing box, please keep it in safe.

Warning	Guarantee that the installed equipment is the same model as the final ordered equipment. Guarantee that the installed equipment is free from any damage.

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6.2.3 Environment Requirements for Installation

The box of liquid-cooled energy storage system on installation environment should follow the below requirements:

Table6-2 Requirements for installation environment on box of Liquid-cooled energy storage system

Projects	Requirement
Installed Location	Land Surface Inclination≤1° Seismic Resistance＞Level 8
Environment Temperature	-30~+50℃
Relative Humidity	≤95%, no condensation
Altitude	＜3000m

6.2.4 Installation Procedure for Liquid-cooled Container

6.2.4.1 Fixing Connections for Cabinet of Liquid-cooled Container

Use crane (recommended lifting capacity: 80-120 tons) to slowly lift the whole liquid-cooled energy storage system onto the prefabricated foundation, please refer to the lifting operation content in chapter 6.1 of this manual for specific lifting method;

The container shall be installed and fixed according to the site conditions. There must be a concrete foundation with sufficient strength at the bottom of the container. When the container is installed, there must be sufficient supports at the four corners of the container and the bottom side beams.

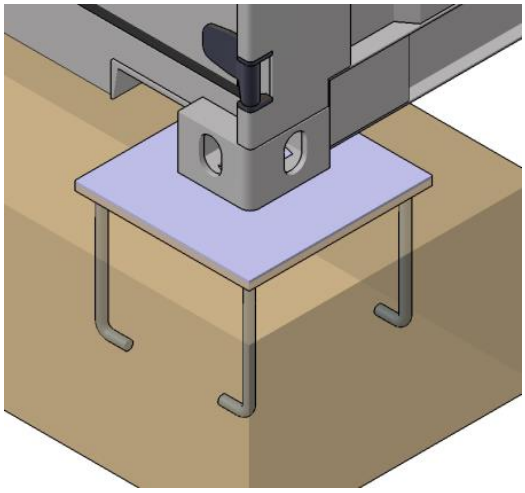

Figure 6-2-4- 1 (1) Schematic diagram of container welding and fixing.

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Bolt connection is to connect the four corner pieces at the bottom of the container with the embedded support with a set of T-bolt groups, and the fixing method is as follows:

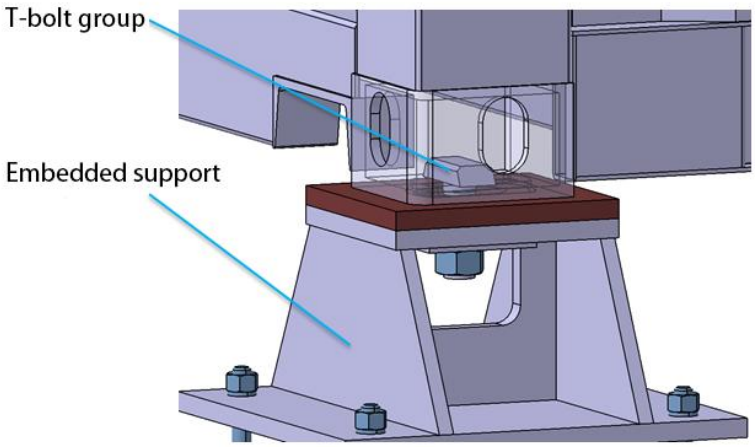

Figure 6-2-4-1 (2) Schematic diagram of container fixing by bolt connection

6.2.4.2 Ground Connection for Liquid-cooled Container

The bolt fixing point of the container is reliably connected with the non-functional conductor of the whole container. In addition, the container provides two box grounding points and two equipment grounding points in the form of grounding bars, and the grounding points provided to users must form reliable equipotential connection with the non-functional conductor of the whole container. The effective cross-sectional area in the grounding system is not less than 250mm² Grounding resistance ≤4Ω and connection impedance ≤0.1Ω.

There is a grounding bar inside the container, and the ground wires of battery cabinet and integrated cabinet are connected to the internal grounding bar, which is led out to external grounding equipment.

The top of the container is equipped with a high-quality lightning protection system with reliable connection. The lightning protection system is connected to the main grounding network at two different points through grounding flat steel or grounding round steel, and the effective cross-sectional area of the conductor in the grounding system is determined when the subsequent drawings are confirmed.

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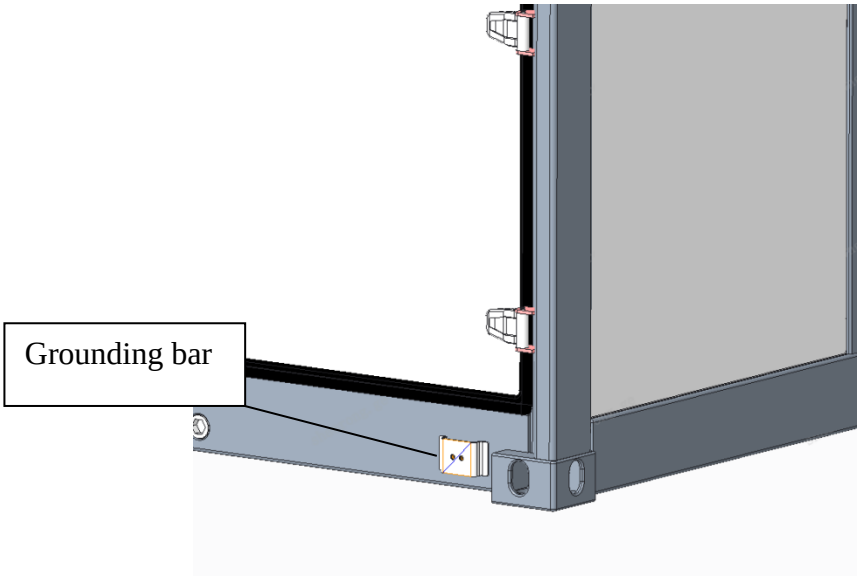

Figure 6-2-4-2 schematic diagram of container grounding bar position、

6.3 Electrical Connections

6.3.1 Precautions for Electrical Safety

Danger	High voltage danger! Danger of electric shock! ➢ Do not touch energized parts! ➢ Make sure that the AC and DC sides are not energized before installation. ➢ Do not place the device on flammable surfaces.
Warning	The entry of wind and sand and moisture may damage the electrical equipment within the energy storage system or affect the operational performance of the equipment! ➢ Avoid electrical connection work during the sandy season or when the relative humidity in the surrounding environment is greater than 95%. ➢ Start the connections when there is no sand and the weather is clear and dry.
Warning	➢ Before wiring, it is necessary to check the polarity of all input cables to ensure that each input polarity is correct. ➢ During electrical installation, do not pull on cables or wires as this may lead to damage on insulation. ➢ Take the necessary auxiliary measures to reduce the stress on the cables or wires. After each step of the cable connection, it is necessary to ensure that the wiring is correct and secure.

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Warning	When an external short-circuit occurs in the RACK circuit and the high-voltage box fuse generates a protective action, the fuse in the high-voltage box must be replaced.

6.3.2 Preparation before Cable Connection

6.3.2.1 Preparation for Installation Tools

No.	Tool	Legends
1	Insulated gloves	
2	Safety goggles	
3	Insulated shoes	
4	Working clothes	
5	Safety Helmets	
6	Screwdrivers	

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7	Wire Strippers	
8	Hydraulic Clamp	
9	Heat guns	
10	Multimeters	
11	Torque wrenches	
12	Marker pens	

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6.3.2.2 Preparation for Cable

The cable selected must follow the below conditions:

➢ Have adequate current-carrying ability. The current-carrying ability of the conductor includes, but is not limited to, the following factors:

- Environment conditions
- Type of conductor insulation
- The way to lay the cable
- Cable material and cross-sectional area

➢ The cable diameter must be selected for the maximum current carrying ability and the length must be allowed for.

➢ All DC input cables should be of the same specification and material.

➢ All DC input cables should be of the same size and material. 3-phase AC output cables should be of the same size and material.

➢ Flame-retardant cables must be selected.

Note	The cables used should comply with the local laws and regulations. The cable colors shown in the illustrations in this manual are for reference only, please select cables according to local cable standards.

6.3.3 Container wiring design

1) The installation of battery cabinets in the container and wiring between cabinets are neat and reliable, their layout is reasonable, and their electrical insulation meets the relevant standards.

2) The wiring of the power cable of the electric cabinet in the container is placed separately from the secondary control wire and communication wire, which is beautiful and orderly and avoids interference.

3) The power cable of the container's electric cabinet goes out from the bottom of the battery cabinet and is connected to the DC circuit breaker of the integrated cabinet through the trough at the bottom of the container .See the following figure.

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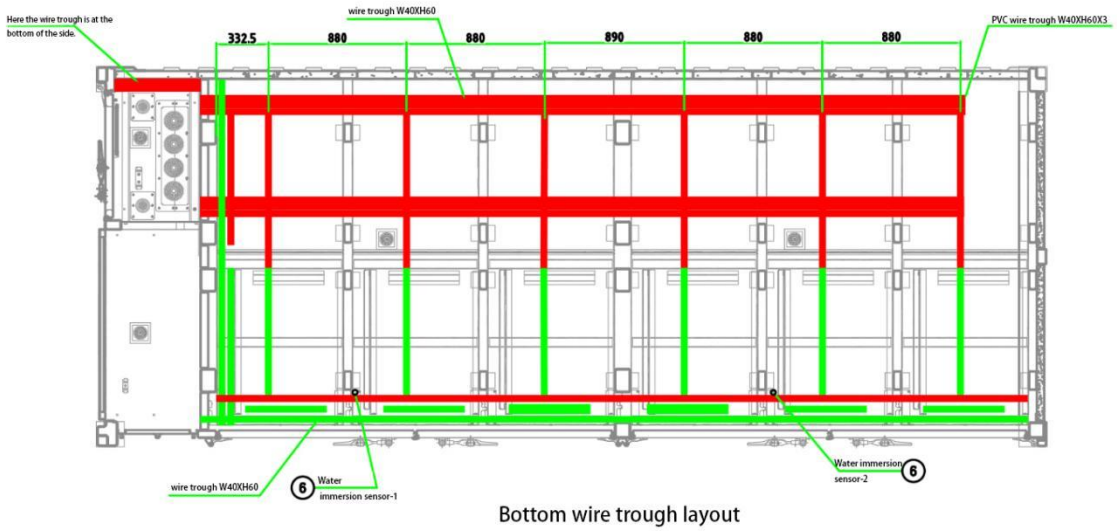

Figure 6-3-3 Schematic diagram of the layout of power lines and signal lines in the container.

6.3.3.1 Schematic Diagram for the Hole at the Bottom of the Liquid-cooled Container

The bottom of the energy storage container is equipped with a DC power cable inlet on the PCS side, an external communication line port, and an external auxiliary power supply port, with detailed hole locations and hole sizes shown in Figure 6-3:

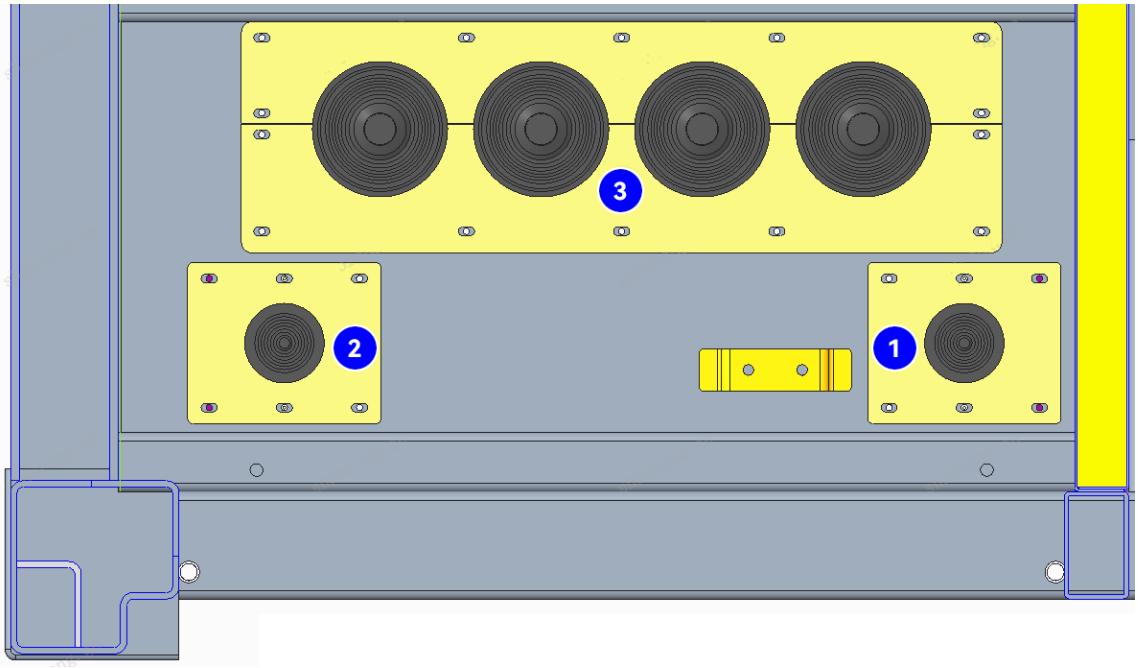

Figure 6-3-3-1 Schematic diagram of the hole at the bottom of the liquid-cooled container

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NO.	Name	Quantity	Remark
1	External auxiliary power cable port	1	Hole diameter: 60mm
2	Communication cable port	1	Hole diameter: 60mm
3	DC power cable port on PCS side	4	Hole diameter: 120mm

6.3.4 Interface Diagram for Integrated Cabinet

1) Power interface

A power connection port connected to PCS is reserved in the container, which is located at the terminal of the integrated cabinet .See the following figure:

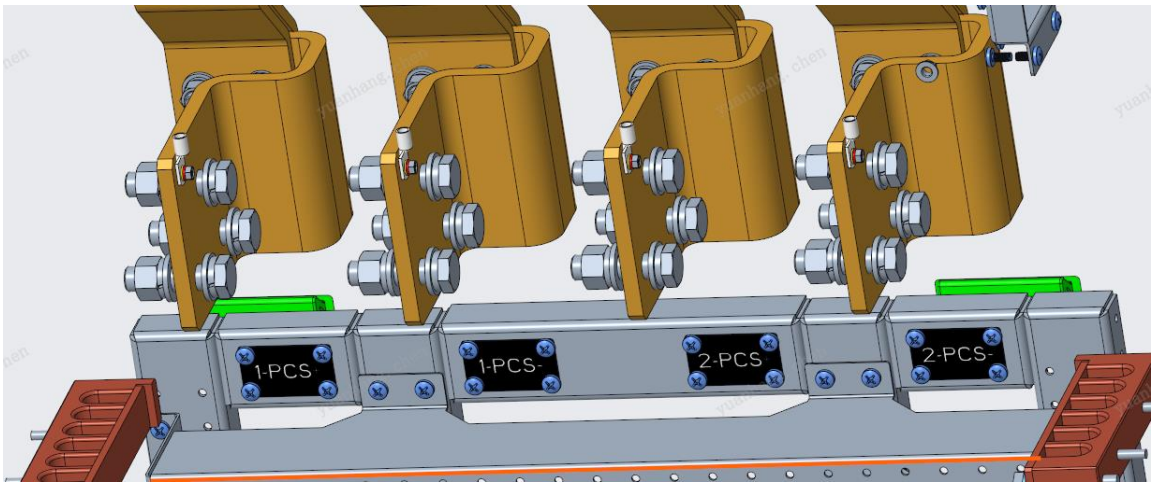

Figure 6-3-4 External power connection port of confluence cabinet

2) Communication interface

The container is externally designed with a unified communication interface and external communication. The external communication interface includes RS485 and CAN communication interfaces, as shown in the table below.

No.	Communication equipment	Communication interface	Communication protocol	Remarks
1	External monitoring (EMS) by the battery monitoring system	LAN	MODBUS	
2	BMS to PCS	CAN RS485 LAN	CAN2.0B Modbus	

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The internal wiring of the liquid-cooled energy storage system cabinet has been completed before shipment, and users only need to connect the external wiring. The external interfaces of the integrated cabinet include DC side cable wiring holes, external auxiliary power supply interface and external communication ports, and the specific cable connection port instructions are shown as Table 6-3-4：

Table 6-3-4 Instructions for Cable Connection Port on Integrated Cabinet

No.	Name	Recommended Model	Remark
1	DC output cable	**UL**: Copper cable,, 24 pieces 300kcmil AWG/DC 2000V **IEC**: Copper cable,, 24 pieces 150mm^2/DC1500V	2 DC outputs，Positive and negative poles for 6 each
2	External communication lines (RS485, CAN)	**UL**: 2*18AWG（Shielded twisted pair cable） **IEC**: 2*1mm^2 （Shielded twisted pair cable）	a certain number or amount
	External signal wire (dry contact)	**UL**: 2*2*16AWG **IEC**: 2*2*1.5mm^2	2 dry contact signal point，a certain number or amount
	External network port	Ultra 5 network cable	a certain number or amount
3	Power supply port for Auxiliary	**UL**: 5*2AWG，Three-phase five line，400VAC **IEC**: 5*50mm2，Three-phase five line，400VAC	a certain number or amount

6.3.4.1 Interface Port for DC Cable

The location and size of the DC cable connections are shown as Figure 6-3-4-1:

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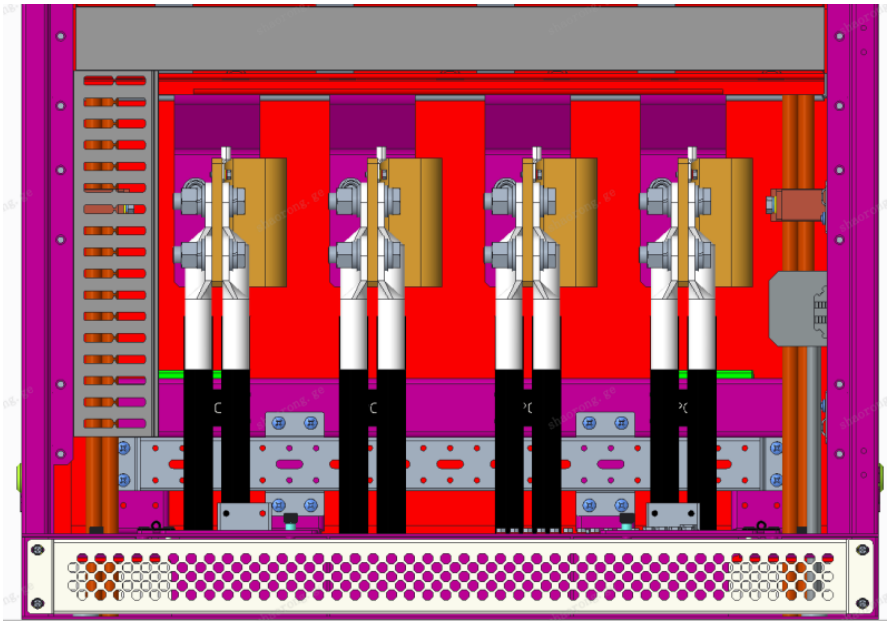

Figure 6-3-4-1 (1) Interface Port Schematic diagram of DC cable on integrated cabinet

Recommended terminal block models for DC cables are shown as Table 6-4:

Table 6-4 Recommended Terminal Block Models for DC Cable

NO.	Item	Description
1	DC Cable Connection	**UL**: 24 pcs of 1* 300kcmil AWG copper core power cables, **IEC**: 24 pcs of 1* 150mm^2 copper core power cables, 2 DC outputs, 6 pcs of which are connected to DC+ copper row, 6 pcs of which are connected to DC- copper row, a total of 6 M16X50 bolts with performance grade 8.8, spring washers, flat washers and M16 hexagonal nuts with performance grade 8 are used to lock the terminals and the copper rows, and a No. 24 socket wrench is used to fasten them, and the recommended value of the fastening torque is: 119~140N-m.
2	Type for Terminal block	**UL**: DTM-150 **IEC**:DTM-150

Where the cable is connected to the copper row specification, is shown as Figure 6-3-4-1（2）：

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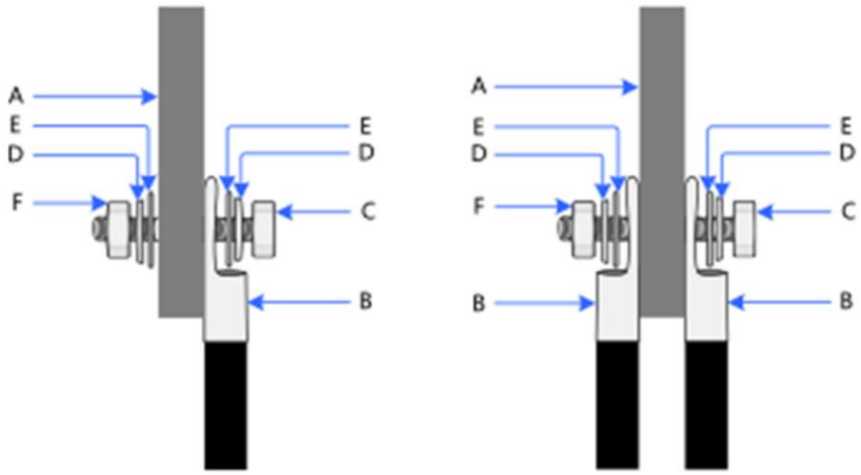

Figure 6-3-4-1(2)Standardized Graph for Connection between Cable and Copper

A	B	C	D	E	F
Copper Bar	Copper nose	Screws	Spring washer	Flat washer	Nut

6.3.4.2 Connection Steps for DC Cable

Step 1: Confirm that each output switch in the front and rear stages of the integrated cabinet is disconnected;

Step 2: Strip off the insulating skin at the end of the cable, the length of the insulating skin stripped off at the end of the cable should be the depth of the crimping hole of the wiring copper nose plus about 5mm;

Step 3: According to the selected cable specifications, equipped with the appropriate wiring copper nose crimping;

1) Be stripped of the exposed copper core part of the wire into the crimp hole of the copper nose of the wire.

2) Crimp the wiring copper nose with terminal crimping machine, the number of crimps should be in more than two channels.

Step 4: Installation of heat shrink tubing;

1) Select and cable size in line with the heat shrink tubing, heat shrink tubing length should be beyond the wiring copper nose crimp tube about 2cm or so

2) The heat shrink tubing in the wiring copper nose, to completely cover the wiring copper nose pressure line hole is appropriate

3) Heat the heat shrinkable tube with the heat gun making it shrink by heat.

Step 5: Cable connection

Match the wiring copper nose with screws, spring washers, flat washers and nuts to connect and fix with the wiring copper row, and lock it according to the recommended torque.

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6.3.4.3 Interface Port for AC Cable（Auxiliary Power Supply）

Integrated cabinet provides external auxiliary power supply interface, location for cable connection is shown as Figure 6-3-4-3, the site needs to be according to the electrical wiring diagram for the corresponding wiring work.

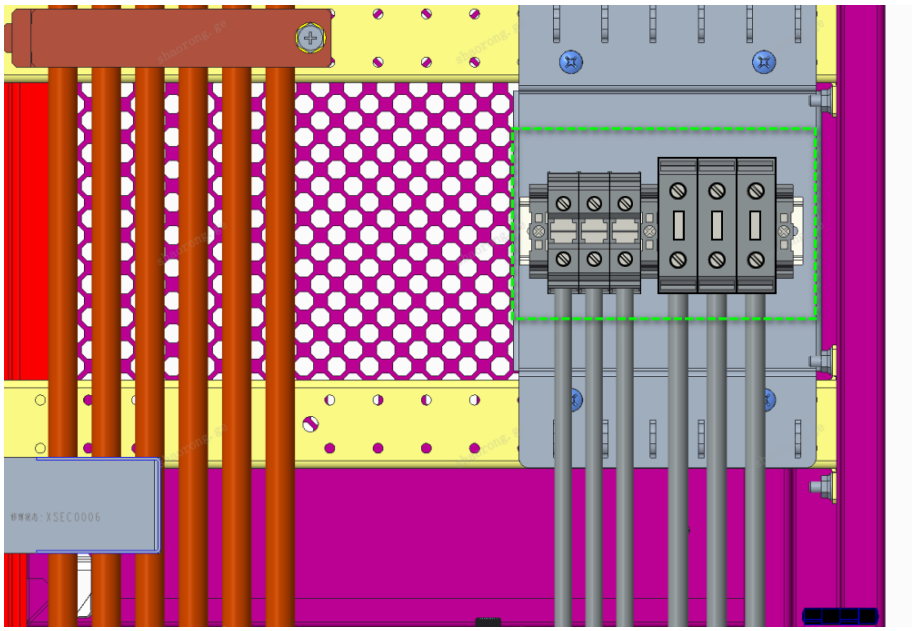

Figure 6-3-4-3 External Interface for Auxiliary Power Supply on Integrated Cabinet

6.3.4.4 External Interface for Communication

There provides an interface with external communication in the Integrated cabinet, the location of which is shown as Figure 6-3-4-4, corresponding cable connection needs to be carried out on site as per the electrical connection diagram.

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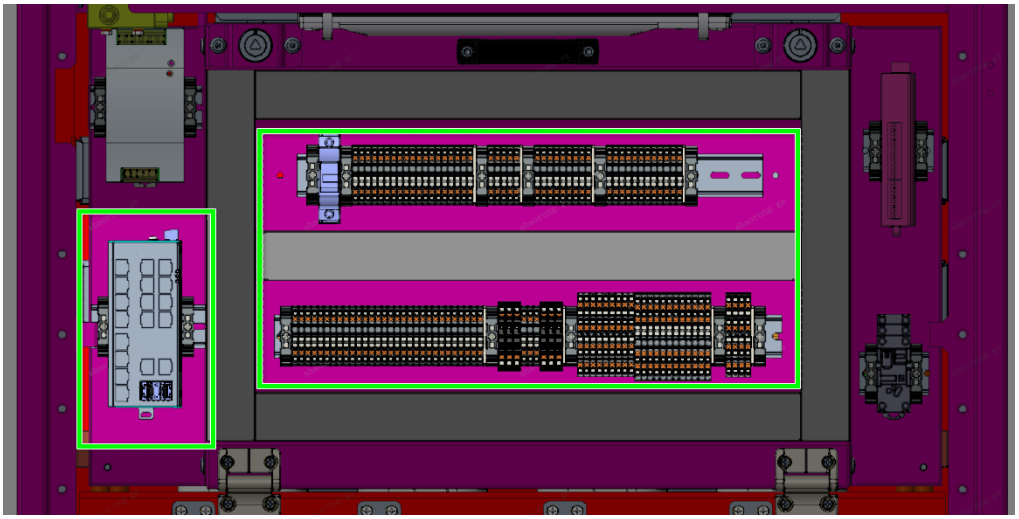

Figure 6-3-4-4 Interface for Communication Control and with the northbound communication fiber optic interface between Integrated cabinet and external PCS

6.3.4.5 Procedure for Cable Connection between External Cable on Auxiliary Power Supply and Communication

Step 1: Pass the external cable for auxiliary power supply through the threading hole at the bottom of the container, use a screwdriver to connect it with the terminals reserved on the left side of the bottom of the integrated cabinet, and confirm that the connection is finished, and then fix the cable on the corresponding cable tie bracket with a cable tie (nylon);

Step 2: Connect the communication control interface of the external PCS to the X7/X8 terminals inside the integrated cabinet with twisted shielded cable;

Step 3: Connect the station-level EMS to the network switch fiber optic interface in the integrated cabinet with fiber optics.

6.3.5 Check for Cable Connection

1) Before officially powering on, check the cables connected to the whole system to make sure that the cables are connected reliably and there is no aging and breaking as well as insulation damage;

2) Check whether the positive and negative DC power cables of the integrated cabinet are connected;

3) Check whether the AC power supply cable of the integrated cabinet is connected in the correct phase sequence;

4) Check whether all communication cables are connected and reliably to the connection terminals.

6.3.6 Operation after Cable Connection

After all electrical cables are connected, the following actions should be took:

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- Please do comprehensive inspection on all cables connected to ensure that there is no leakage and looseness.
- Tightly seal the holes and gaps around the integrated cabinet with fireproof and waterproof materials.
- Restore the protective cover firmly.

Check container to ensure that no any tools or equipment are left in the container.

 **Warning**	Failure to seal properly may result in ingress of moisture and sand. Failure to seal properly may result in the entry of rodents.

Lock the door of cabinet and container

Step 1 : Reinstall the removed wiring zone guards in the reverse order of removal.

Step 2: Once the wiring zone guards have been installed, lock the door of integrated cabinet, remove the key and keep it in store.

Step 3: Finally, lock the door of the electrical compartment, remove the key and keep it in store.

 **Note**	Ensure that the sealing strips around the cabinet and box doors are not broken or torn. Ensure that the sealing strips around cabinet and box doors are not curled when the doors are closed.

6.4 Cable Connection between Battery

6.4.1 Precautions

6.4.1.1 Hazard for Electric Shock

- It is not allowed to operate the equipment under status of power on;
- Ensure that neither the AC nor DC side of the equipment is energized before installation;
- Ensure that the necessary protective equipment has been worn during installation.

6.4.1.2 Impacts for Environment

- It is not allowed to do connection on device in environments where the ambient humidity is greater than 95%;
- It is not allowed to do connection on device in environments with high wind and sand;
- It is not allowed to do connection on device in environments with corrosive and flammable

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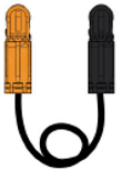
gases.

6.4.1.3 Requirements for Cable Connection

- Please connect the primary and secondary connected cables to the equipment then do confirm on following the connection schematic;
- Ensure the correct polarity of the cables when connecting to prevent short-circuit and other dangerous situations;
- During connection of the equipment, do not pull the cable with force, so as not to lead damage to the terminals and cable insulation layer;
- After each step for cable connection is done, it is necessary to check for proper and secure connection.

6.4.2 Cable Connection

Preparation for tools

NO.	Tool	Legends
1	Insulated gloves	
2	Protective mask	
3	Insulated shoes	
4	Working clothes	
5	Power cable	

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6	Communication cable	

Step1： It is necessary to wear protective equipment such as insulated gloves and insulated shoes before connecting power cables;

Step2：Open the door of battery compartment and prepare each cluster of cables for connection. Turn the DC circuit breaker of high voltage box to the OFF position before connecting the power and communication cables between the PACKs and between the PACKs and the high voltage box;

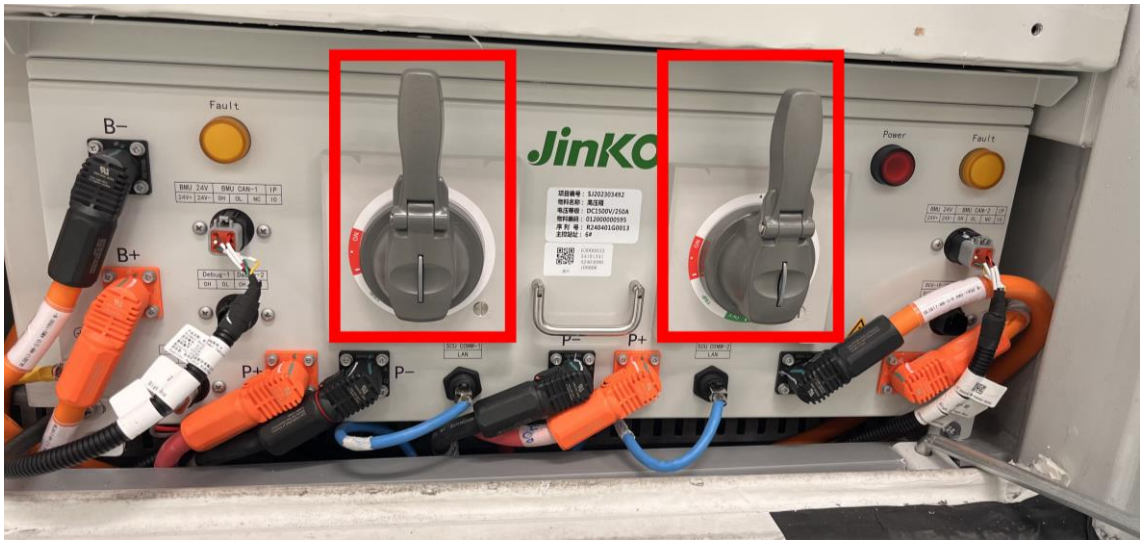

Figure 6-4-2 (1) Image of DC circuit breaker for high voltage box

Step3： Connect the communication cables between PACKs and high voltage box with a Rack as example:

1) Insert the connector of communication cable into the COMM interface on communication cable of battery PACK1~PACK4 respectively;

Figure 6-4-2 (2) Image of communication cable connector on HV BOX

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2) Plug the communication cable connector into the slave connector of the high voltage box;

Figure 6-4-2 (3) Image of communication cable connector on HV BOX

Step4：Connect the power cables between PACKs and the high voltage box, with a RACK as example:

1) Connect the positive terminal B+ of PACK1 to the negative terminal B- of PACK2;
2) Connect the positive terminal B+ of PACK2 to the negative terminal B- of PACK3;
3) Connect the positive terminal B+ of PACK3 to the negative terminal B- of PACK4;
4) Connect the positive terminal B+ of PACK4 to B+ of the high voltage box;
5) Connect the negative terminal B- of PACK1 to B- of the high voltage box;

Step5：After the cable connection, it is necessary to check for ensure that the wiring is correct and solid.

Figure 6-4-2 (4) Image of communication and power cables between PACKs inside the Rack

Figure 6-4-2 (5) Image of the communication and power cables between the PACK and the high voltage box inside the Rack.

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Figure 6-4-2 (6) Image of communication and power cables in Rack

Warning	•The color of Positive plug is orange, for negative plug is black. •The positive terminal of the plug needs to be inserted into the positive connector and the negative terminal of plug needs to be inserted into the negative connector. •When the plug is tightly inserted, The sound of "click" will be heard, which means that it is firmly connected.

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7. Product Operation

7.1 Liquid-cooled Energy Storage System Power-up Process

7.1.1 Pre-power-up Check

1）Check that the DC circuit breaker on the high voltage box panel is in the disconnected state;

Figure 7-1-1 (1) HV BOX circuit breaker

2）Check that the series power cables are connected reliably between the battery PACKs of each rack and between the battery PACKs and the high voltage box;

Figure 7-1-1 (2) Power cable connections

3）Check that all communication and power supply cable connection terminals are securely connected;

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4）Check that the communication and power harnesses as well as the power cables are properly connected on the high voltage box;

5）Check the LAN port connections in the integrated cabinet for problems.

Figure 7-1-1 (3) LAN port

7.1.2 Liquid-cooled Energy Storage System Power-up Procedure

Note: For all the switch details, please refer to the below table.

Step 1：

1) Close the AC side main circuit breaker in the integrated cabinet QF207；

2) Close the liquid-cooled system switch QF209；

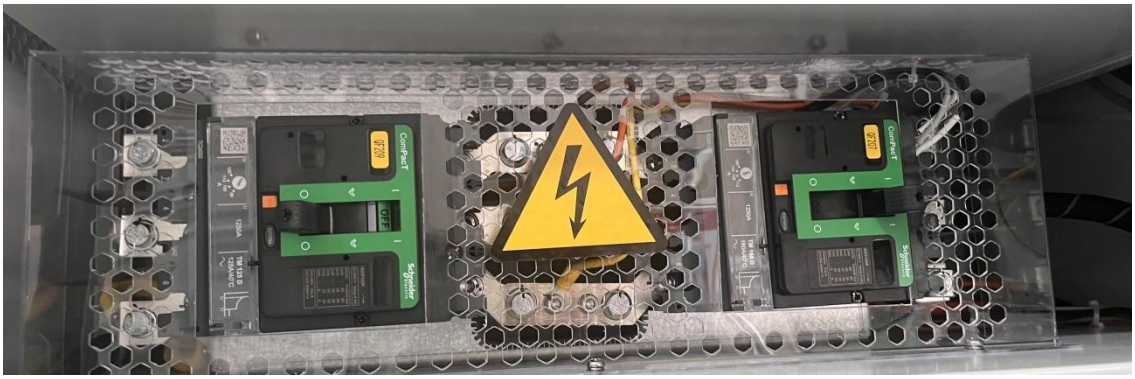

Figure 7-1-2 (1) QF207&QF209

3) Close the UPS switch QF221；

4) Close the fire main switch QF223；

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5) Close operation control system switch QF227;

6) Close the BMS I/O switch power switch QF224;

7) Close the video surveillance system switch QF221.1;

8) Close the fire ventilation system switch QF222;

9) Close the high voltage box power supply switch QF227.1;

10) Close the HVAC power switch QF216;

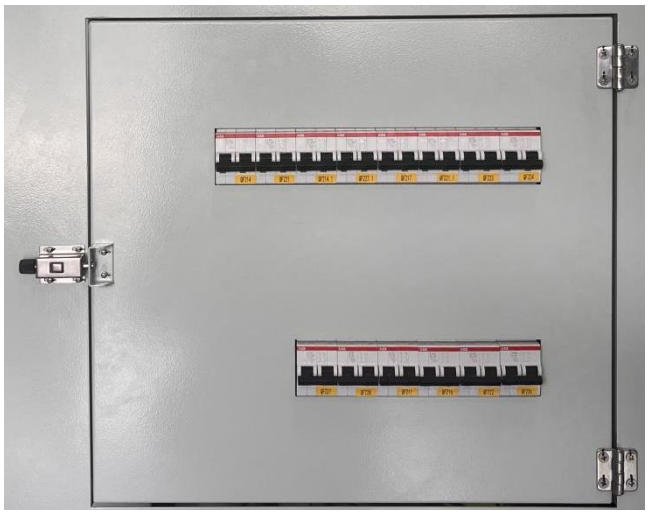

Figure 7-1-2 (2) Control Panel with switches of integrated cabinet

11) Starting the UPS power supply;

Long press for 3 seconds to light up the screen, and observe the screen to ensure that the UPS is working in main mode;

Figure 7-1-2 (3) UPS screen

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No.	Name	Function
1	QF207	AC side main Circuit breaker
2	QF209	liquid-cooled system switch
3	QF221	UPS switch
4	QF223	Fire main switch
5	QF227	Control system switch
6	QF224	BMS I/O switch power switch
7	QF221.1	video surveillance system switch
8	QF222	fire ventilation system switch
9	QF227.1	high voltage box power supply switch
10	QF216	HVAC power switch
11	UPS	UPS Screen

Step 2： Close the DC isolation switch of each high voltage box; then close the 220VAC power supply switch of each high voltage box, and observe the status of the indicator lights on the high voltage box;

No.	Name	Status	Instruction
1	Power indicator	Light up	Power supply to the high voltage box is normal
2	Fault indicator	Light up	System failure, including hardware failure, internal communication failure, battery failure, etc.

Figure 7-1-2 (4) HV BOX-DC 1500V power on

Step 3： After the battery cluster power-up is completed, the level 3 BMS automatically sends a close relay command to the level 2 BMS in the high voltage box, and the level 2 BMS will close the main positive and main negative DC relays after the self-test is completed, and the power-up of this cluster is completed;

Step 4： After confirming that there are no faults in the Level 3 BMS and completing the above operations, the system enters the charging and discharging state.

***Note:** The corresponding device numbers may vary for different items, depending on the actual schematic diagram.

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7.1.3 Liquid-cooled Energy Storage System Power-down Procedure

Step 1: Disconnect the DC circuit breakers from each rack high voltage box;

Step 2:

1) Turn off the UPS power;
2) Disconnect the HVAC power switch;
3) Disconnect the high voltage box power supply switch;
4) Disconnect fire ventilation system switch;
5) Disconnect the video surveillance system switch;
6) Disconnect the BMS I/O switch power switch;
7) Disconnect the operator control system switch;
8) Disconnect the fire main switch;
9) Disconnect the UPS switch;
10) Disconnect the liquid-cooled system switch;
11) Disconnect the AC main circuit breaker in the integrated cabinet;

Note: For all the switch details, please refer to the below table.

No.	Name	Function
1	UPS	UPS Screen
2	QF216	HVAC power switch
3	QF227.1	high voltage box power supply switch
4	QF222	fire ventilation system switch
5	QF221.1	video surveillance system switch
6	QF224	BMS I/O switch power switch
7	QF227	Control system switch
8	QF223	Fire main switch
9	QF221	UPS switch
10	QF209	liquid-cooled system switch
11	QF207	AC side main Circuit breaker

***Note:** The corresponding device numbers may vary for different items, depending on the actual schematic diagram.

Unplanned (Emergency) Power-down:

Fire incident: immediately contact local fire department professionals for emergency assistance.

Unplanned Outage (Shutdown Due to Faults): For any faults leading to an unplanned shutdown, promptly contact JinkoSolar support services.

In an emergency, immediately press the emergency stop button on the BESS to halt the system's operation. Be aware that even after activating the emergency stop button, the auxiliary AC power supply of the BESS will remain live and carry voltage. Avoid contact with it!

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7.2 List of Commissioning for Energy Storage System

No.	Test Item	Description	Results
1	Exterior Inspection	Box shell flat and the color is uniform	OK■
2		Clear marking, complete and correct silk-screening	OK■
3	Check Screws	Check screws for looseness, slipped teeth, damage, etc.	OK■
4	Confirmation of high-voltage connection circuit	Check that the positive and negative power cables in series between each cluster of battery packs and between the battery packs and the high-voltage box are correctly connected and not reversed.	OK■
5	Activation system	Close the DC circuit breaker of the high voltage box and the 220VAC power supply micro switch, and observe whether the power indicator on the high voltage box lights up.	OK■
6	system self-test	Check the system self-test for alarms	OK■
7	Software Version Confirmation	Verification system software version	OK■
8	System High Voltage Closure	Close all high-voltage box, high-voltage relays and corresponding circuit breaker; measure whether the busbar voltage is normal or not.	OK■
		Measure voltage with equipment：XXX V	OK■
9	System High Voltage Calibration	Close all high voltage relays of the high voltage box, then the host computer calibrates the voltage	OK■
10	System communication with PCS	Can PCS control the power up and down of the product	OK■
11	Charge and Discharge Inspection	Small current charging and discharging of products via PCS	OK■

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8.Fire Fighting Instructions

Warning	The energy storage system is equipped with an automatic fire extinguishing system, and the fire switch shall not be triggered arbitrarily in non-emergency situations.

8.1 General Provision

Please comply with the fire codes and regulations of the country/region where the project is located.

Regularly inspect and maintain fire protection equipment to ensure that all functional indicators are normal.

8.2 Fire fighting system design

The fire fighting system of this project consists of fire alarm controller/gas extinguishing control panel, compound detector (involving combustible gas detection, smoke detection and temperature detection), audible and visual alarm, alarm bell, deflation indicator lamp, manual emergency start/stop button, container fire extinguishing device (including fire extinguishing agent storage cylinder, electromagnetic drive device and pressure annunciator), business box accessories (nozzle and high-pressure hose) and power supply box fire extinguishing device (including fire extinguishing agent storage cylinder, electromagnetic drive device and pressure annunciator).

Note	To ensure the accuracy of gas detectors, combustible gas detectors need to be functionally tested and calibrated every 1 year.

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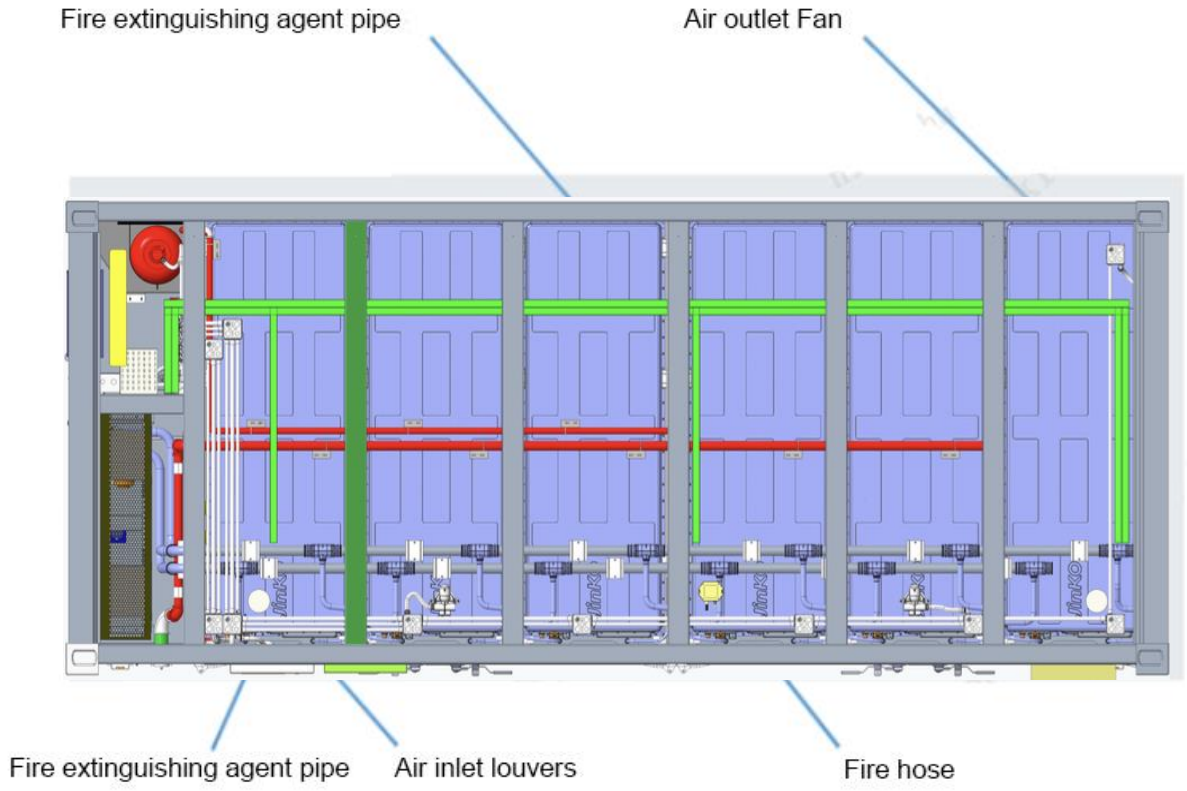
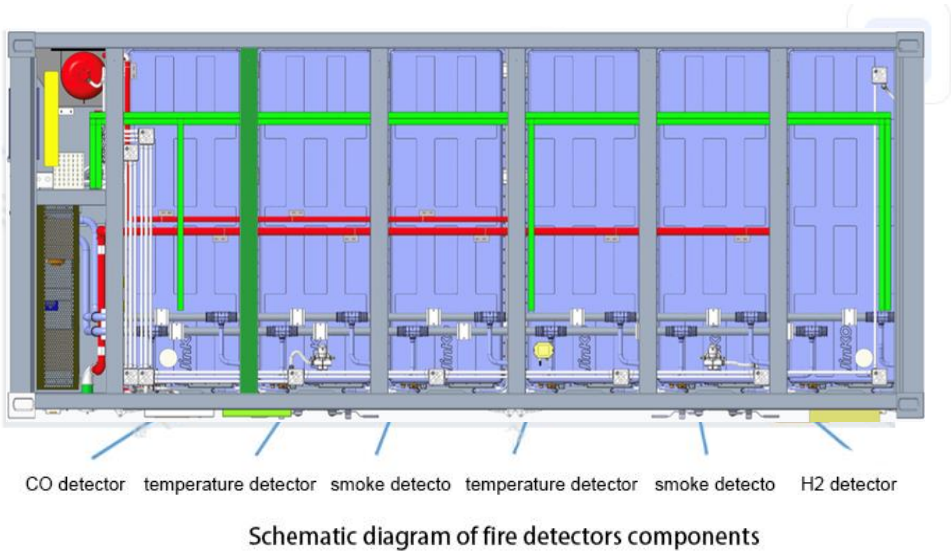


Schematic diagram of fire protection system components

Figure 8-2 (1) Schematic diagram of fire protection system components



Schematic diagram of fire detectors components

Figure 8-2 (2) Schematic diagram of fire detectors components

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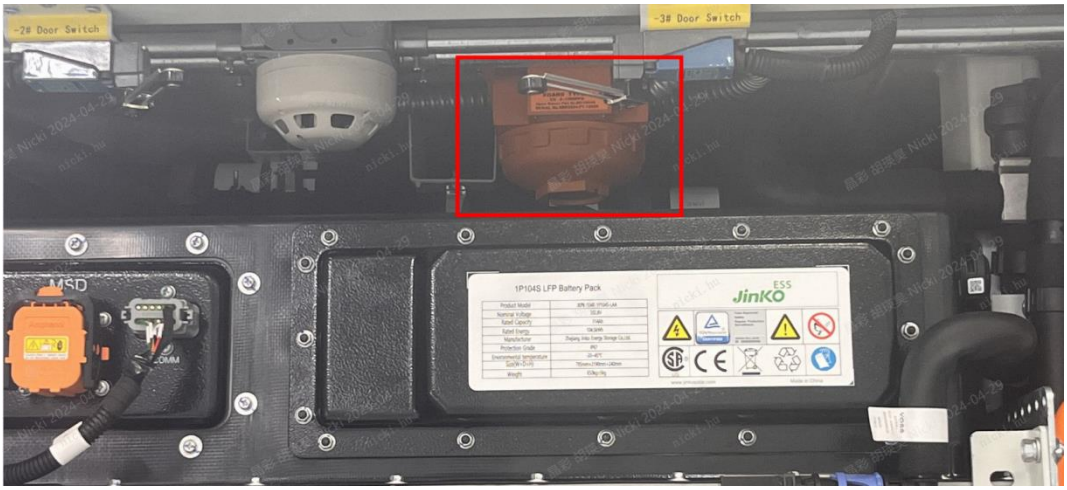

Figure 8-2 (3) Image of combustible gas detector

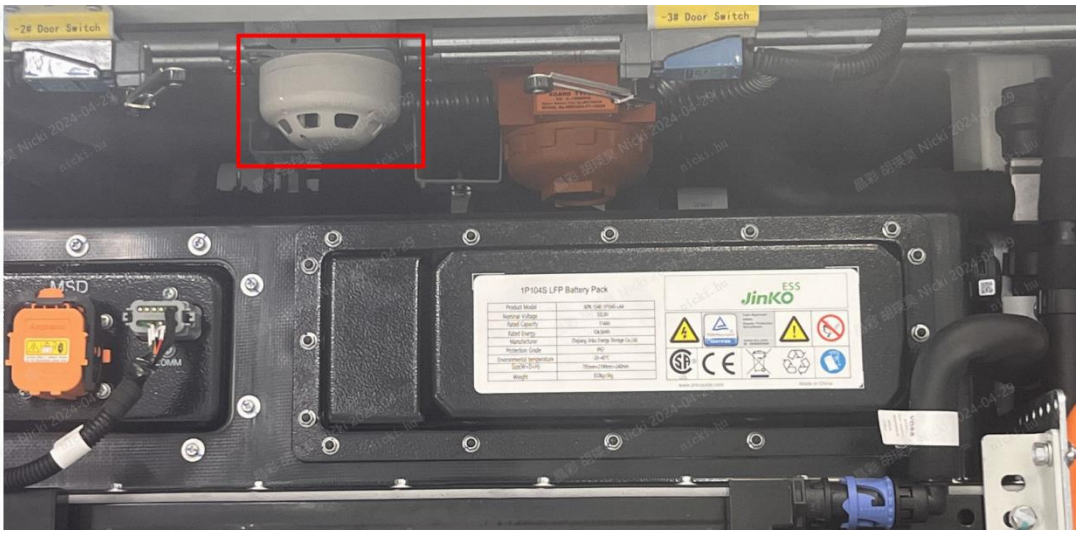

Figure 8-2 (4) Image of temperature detector

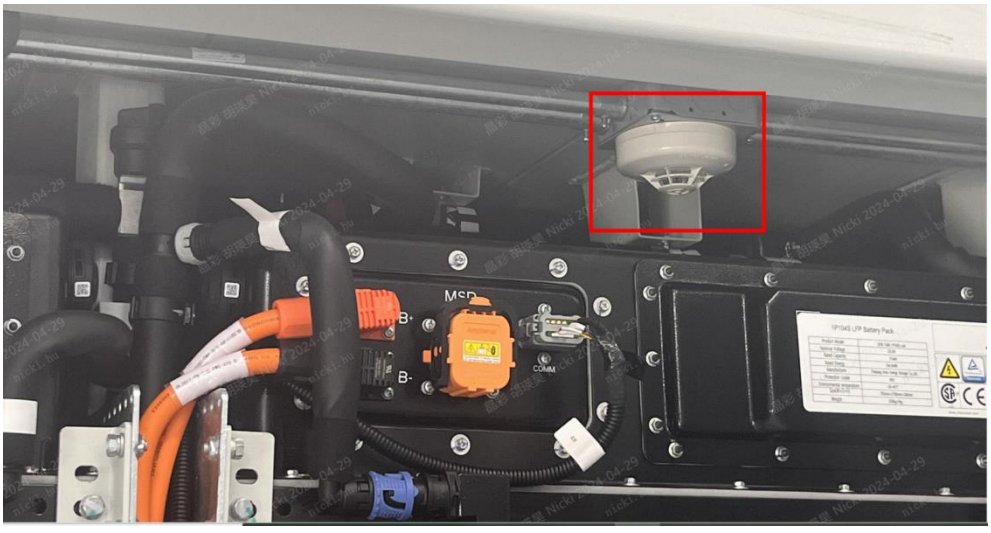

Figure 8-2 (5) Image of smoke detector

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Figure 8-2 (6) Image of fire control panel and gas cylinde

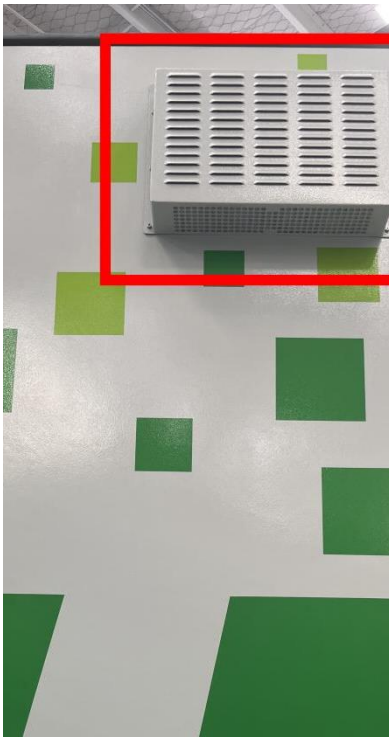

Figure 8-2 (7) Image of pressure relief port

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Figure 8-2 (8) Image of air inlet

Figure 8-2 (9) Image of air outlet

Figure 8-2 (10) Image of external DN65 water supply port for water fire fighting

* Please note: The image provided is for illustrative purposes only. The actual product may vary.

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8.3 Gas Fire Extinguishers

1) The fire extinguishing system has three starting modes: automatic control, manual control and mechanical emergency operation.

2) The fire extinguishing system can automatically detect a fire, give an alarm, automatically start, operate the related equipment interlocked with the system, and release the fire extinguishing agent.

3) The fire extinguishing system is equipped with automatic and manual operation change-over switch, which can change automatic operation into manual operation .The change-over switch and manual control of the system should be located in a place convenient for operation in each protection zone, and manual operation mode should be able to achieve all the operations of system startup in at least one place.

4) The fire extinguishing system is equipped with an independent emergency manual operation mechanism for emergency release of gaseous fire extinguishing agents when other operation modes fail. The emergency manual operation mechanism is mechanical and can achieve all operations of releasing fire extinguishing agents in one place.

5) The system has a self-checking system, which can automatically perform patrol inspection regularly, monitor faults and give fault alarms.

6) The battery prefabrication compartment is equipped with a fire control main .The fire control main should support various communication modes, can upload the working and early-warning status of detectors in the station, and can also communicate with BMS, EMS, PCS and other equipment in the station to provide a basis for the linkage of energy storage system; The fire detector sends an early warning signal to BMS, which sends the signal to the converter control loop. When a fault occurs, it can identify and inform the user while controlling the PCS to stop running.

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8.4 Water Fire Fighting System

As the last protective barrier of the fire fighting system, the water firefighting system is an artificially controllable independent fire protection system, with standard fire protection water interface (DN65) reserved outside the battery compartment, and the fire protection water pipeline inside the battery compartment is designed with variable-diameter steel pipe. The pipeline arrangement and the number of water sprinkler nozzles (3 nozzles) satisfy the NFPA 13 installation standard for sprinkler systems.

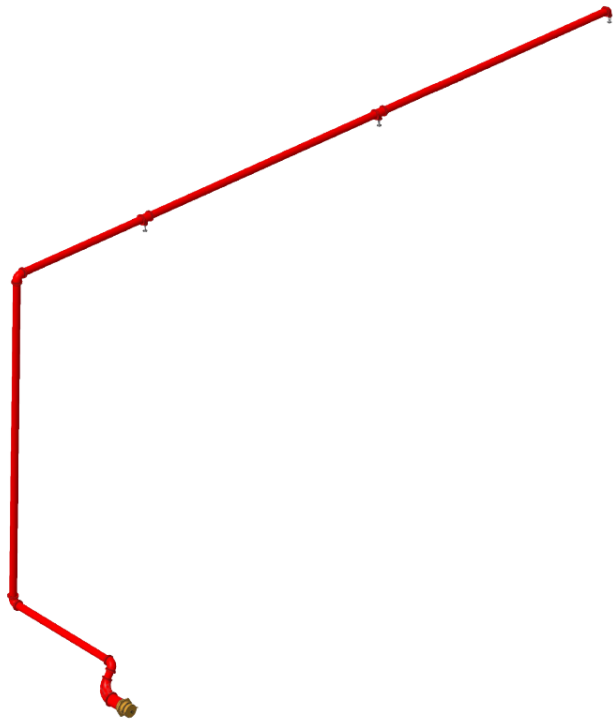

Figure 8-4 Schematic Diagram for Piping of Water Fire Fighting System

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8.5 Temperature Sensors

The Series DCD-190 Temperature Sensors utilize a dual thermistor network which provides a voltage output proportional to the outside air temperature.

Figure 8-5 Schematic diagram for temperature sensors on energy storage systems

8.6 Photoelectric Smoke Sensors

Series SOC-24V photoelectric smoke sensors utilize the light scattering principle to detect thermal runaway scenarios such as slow burning or smothering.

Figure 8-6 Schematic diagram for smoke sensors on energy storage system

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9. SOC Calibration instructions

With the long time operation of the energy storage system, due to the self-discharge of the battery, process differences and current collection accuracy will lead to SOC error and it is constantly getting bigger. If the energy storage system has been working for a long time but not fully charged or discharged. In order to reduce the SOC error, it is recommended to carry out SOC calibration.

SOC calibration period: 3-6 months is recommended for peak shaving and valley filling energy storage systems, and 1-3 months is recommended for frequency modulation energy storage projects;

SOC calibration process: it is necessary to carry out a standard full-charging and full-discharging process test, and the software will be calibrated automatically; if it is not possible to conduct the standard full-discharging test, the software will calibrate automatically; if it is not possible to conduct the standard full-charging test, the software will calibrate automatically; if it is not possible to conduct the standard discharging test, discharging as low as possible to 20% or less, and let it sit for more than one hour, and calibrate it through the software settings.

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10. Battery System Maintenance Instructions

Explanation of terms

No.	Term	Description
1	Normal operation	Refers to systems that work on a daily basis
2	Intermittent operation	Refers to a system that operates at a variable frequency per month and cannot be guaranteed to work on a daily basis
3	Unused for a long time	Battery systems that have not been started up and working for more than 3 consecutive months

10.1 Pre-maintenance instructions

 **Warning**	➢ Do not open the door of the battery container for maintenance in rainy, damp or windy weather. JinkoSolar will not be liable for any damages caused if you fail to do so. ➢ Avoid opening the container door under rain, snow or foggy days with high humidity. Please confirm that the sealing strip around the container door is not curled up while closing the container door.
 **Warning**	➢ To minimize the risk of electric shock, do not perform any other maintenance or overhaul operations beyond those in this manual. ➢ If necessary, contact JinkoSolar customer service personnel for maintenance and overhaul.
	In fair weather, it is recommended to open the container door to ventilate and dehumidify the equipment.

10.2 Requirements for the use of the system

10.2.1 Uptime system usage requirements

- ➢ Do battery maintenance on the system once every 12 months to prevent damage to the battery, refer to section 10.4 for specific maintenance instructions.
- ➢ Perform an inspection of the system every twelve months (refer to 12.1 Inspection Items) and keep a record of the inspection.

10.2.2 Requirements for the use of interval operation systems

- ➢ Requirements for use are the same as for a normal operating system

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10.2.3 Requirements for use of systems that haven't been used for a long time

- SOC range of storage battery: 15%~40%, avoid long-term storage of battery cells below 15% SOC, and cut off power consuming equipment in time when the battery is not used for a long time.
- Perform an inspection of the energy storage system every 3 months (refer to 12.1 Inspection Items) and keep a record of the inspection.
- Perform battery maintenance on the system every three months to prevent battery damage.
- Before the first use of the system, at least one full charge is required to activate the battery system in order to restore the performance of the battery to its optimal state.

	Leaving the energy storage system unused for a long time can cause irreversible damage to the battery, so be sure to perform regular maintenance.

10.3 Maintenance Precautions

Before the relevant personnel carry out maintenance and repair operations on the system, they must first disconnect the DC circuit breaker on the high-voltage box panel to ensure that the DC circuit breaker is in the OFF state and the firefighting is in the manual state, and after the maintenance and repair operations are completed, they need to ensure that the DC circuit breaker is in the ON state and the firefighting is in the automatic state.

10.4 Battery Maintenance

In order to ensure the long-term safe and reliable operation of the Liquid -cooled energy storage system, please read and comply with the following instructions for use：

Maintenance Procedure:

When the battery needs to be stored for a long time, the battery should be charged to 15-40% SOC and stored in a special site, and the storage conditions should meet the requirements of 4.3.

It is recommended that the battery be discharged and recharged once every 3 months during the long storage period to ensure that the battery SOC remains within the range of 15-40% SOC. It is recommended to check the specific situation of the battery in the system through BMS every 3 months, and the data can be shared to our company to help judge the battery status, with the maximum storage time not exceeding 6 months. Before the system is finally connected to the grid, if the ambient temperature is lower than 10℃, it is necessary to turn on the system to adjust the battery to normal temperature (25℃±3℃), and after resting for ≥10h, use 0.2C multiplier current to fully charge the battery cell once, and then charge and discharge the product under actual working conditions.

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	Check to make sure the environment is safe, the system is safe, and there are no alarms or malfunctions before performing battery maintenance operations

10.5 Liquid -cooled System Maintenance

10.5.1 Electrical System Maintenance

The maintenance information of the Liquid-cooled electronic control system is shown in Table 10-1：

Table 10-1 Maintenance for Liquid-cooled Electrical System

Maintenance Projects	Maintenance Standards	Maintenance Period	Detection method	Exception handling method
Reliability of wiring panel power cable and signal cable	No loose electrical cables and signal cables	6 Months	Visual Inspection	Tighten loose cables with a screwdriver after 10 minutes of power failure
	Electrical cable and signal cable without aging, damage, abnormal heat and other abnormalities	6 Months	Visual Inspection	Replace the power cable and signal cable after 10 minutes of power failure
	No dust at the wiring panel	6 Months	Visual Inspection	Clean the dust with a brush after 10 minutes of power failure
Maintaining the air switch in proper working order	Automatic clutching in case of circuit abnormalities (e.g. short circuit)	6 Months	Visual Inspection	Replace the maintenance air switch after 10 minutes of power failure. The maintenance air switch is located in the electrical control box
	The above maintenance intervals are only recommended values and can be adjusted according to actual planning.			

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10.5.2 Cabinet Outlook Maintenance

The maintenance information for the appearance of the Liquid-cooled units is shown in Table 10-2：：

Table 10-2 Appearance maintenance of Liquid-cooled units

Maintenance Projects	Maintenance Standards	Maintenance Period	Detection method	Exception handling method
Appearance of the unit	The unit is clean and free of dust and dirt	6 Months	Visual Inspection	Use a brush or cotton cloth to remove dust and dirt from the unit after 10 minutes of power failure.
	The above maintenance intervals are only recommended values and can be adjusted according to actual planning.			

10.5.3 Fan maintenance

The maintenance information for the liquid-cooled system fans is shown in Table 10-3：

Table 10-3 Liquid-cooled Unit Fan Maintenance

Maintenance Projects	Maintenance Standards	Maintenance Period	Detection method	Exception handling method
Reliability of Fan Operation	No dust in the fan, no foreign body blockage at the air outlet	6 Months	Visual Inspection	After 10 minutes of power failure, use a brush to clean the dust of the fan and clean the foreign matter at the air outlet
	Fan blades are not broken, turning the fan smoothly without strange noise	6 Months	Visual Inspection	Fasten the fan after 10 minutes of power failure, check if there are internal cables and other interference with the rotation of the fan, if the fan fails, please replace it.
	The above maintenance intervals are only recommended values and can be adjusted according to actual planning.			

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10.5.4 Condenser Maintenance

The condenser maintenance information for Liquid-cooled systems is shown in Table 10-4：

Table 10-4 Condenser maintenance for Liquid-cooled systems

Maintenance Projects	Maintenance Standards	Maintenance Period	Detection method	Exception handling method
Condenser cleaning	Condenser free of dust and foreign matter blockage	6 Months	Visual Inspection	Clean the condenser with compressed air or a vacuum cleaner with a brush head after 10 minutes of power failure.
	The above maintenance intervals are only recommended values and can be adjusted according to actual planning.			

10.5.5 Cooling Medium Maintenance

The maintenance information for the cooling media of the liquid-cooled system is shown in Table 10-5：

Table 10-5 Cooling media maintenance for Liquid-cooled systems

Maintenance Projects	Maintenance Standards	Maintenance Period	Detection method	Exception handling method
Cooling Media	The concentration is in accordance with the range, PH and electrolyte concentration are required to meet the requirements, no fouling, precipitation and algae, etc.	6 Months	Coolant tester visual inspection	Replace the coolant after 10 minutes of power failure.
	The above maintenance intervals are only recommended values and can be adjusted by the user according to the actual performance of the coolant. The maintenance interval of the coolant with better stability can be relatively longer. The procedure for replacing the cooling medium in the liquid-cooled unit is as follows. 1) Disconnect the power and wait at least 10 minutes. 2) Drain the fluid from the cooling system through the drain port. 3) Replenish the coolant and check the PH value and electrolyte			

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	concentration of the coolant.
⚠ Notice	Ethylene glycol is a substance that pollutes groundwater, so the equipment operator must comply with national and local regulations and must not .

10.6 Maintenance for Fire Suppression System

Only regular fire system inspection can ensure the normal operation of the fire suppression system, and fire system maintenance content is shown in Table10-6：

Table 10-6 Fire protection system maintenance content

Maintenance interval	Person type	Maintenance content
Weekly	Client	1) Protected are a Daily cleaning 2) Visual inspection of the condition of pipes and nozzles 3) Cylinders Checking the pressure condition
Monthly	Client	1) Protected areas (visual inspection) - Daily cleaning - Condition of pipes and nozzles - Ensure protected areas are unaltered - Inspection of blocking of doors or duct valves 2) equipment (visual inspection) - Cylinders (gauges, supports, damage) - Detectors (cleanliness) - Hand pull starter (not blocked) - Nozzles (not clogged) 3) Detection equipment (visual inspection) - Make sure they are mounted in the correct position - Make sure they are not damaged - Make sure they are clean and not covered with grease, dust paint or any other spoils. 4) Hand pull starters - Make sure they have not been tampered with - Ensure that the wiring to the pull starter is not obstructed. 5) alarm equipment

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		- Check for dust buildup - Check for corrosion - Check for damage 6) pipe network - Ensure that the distribution network is securely installed. - Ensure nozzles are installed in the correct position - Make sure that the nozzle is not covered with dust, grease, or paint and that the spraying is not obstructed 7) all parts - Look for signs of damage - Look for disconnected parts and reconnect to the system - Look for loose connections and tighten them - Look for corrosion - Look for twisted or dented parts 8) Cylinder head valve pressure gauge - Check cylinder pressure and make sure it is within the operating pressure range. 9) cylinders - Make sure all cylinders are securely mounted in the rack. - Check for corrosion. - Check for damage. - Check for damage. Check for missing parts. 10) Starter - Check that the starter is mounted in the correct position - Check all starter lines - Check that lines are not altered or disconnected 11) pressure switches - Ensure all pressure switches are installed - Ensure all pressure switches are installed and in the correct "non-start" position. 12) control panel - Visually check that the control panel and dispenser are functioning correctly (green light on during operation). - If there is a fault (yellow light on), contact

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		JinkoSolar After Sales Service.
Every 3 months	Maintenance personnel	Monthly inspection program plus performance testing of all valve actuator components, performance testing of all electrical equipment.
Every 6 months	Maintenance personnel	Maintenance program every 3 months plus check medication doses.
Every 12 months	Maintenance personnel	-Maintenance program every 6 months plus visual inspections - All start-up and release hoses - Protected area (sealing test)

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11. Diagnosis of Common Abnormal Problems

11.1 System Alarm Handling

11.1.1 Liquid-cooled Unit Failure

11.1.1.1 Fan failure

Failure phenomenon	Possible causes	Inspection and maintenance
External circulation fan does not operate	Liquid-cooled unit not powered up	Check if there is power at the power input of the liquid-cooled unit.
	Have suffered a lightning strike, the circuit breaker tripped	Check if the circuit breaker inside the liquid-cooled unit is closed.
	Abnormal power input to the liquid-cooled unit (such as over- or under-voltage of the power supply)	Verify that the liquid-cooled unit has the appropriate alarms.
	The liquid-cooled unit is in standby mode	Normal scenario. The liquid-cooled unit is powered up and after 30s of standby, it enters the automatic control logic.
	Fan jamming	Check for foreign objects stuck in the fan.
	Loose terminal	Check if the fan plug is loose.
	Control board failure	Replace the control board
	Fan failure	Fan replacement
External circulation fan noise	Wind turbine bearing wear	Fan replacement
	Fan blades scrape other objects	Check if there are cables, etc. interfering with the fan blades.

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11.1.1.2 Refrigeration System Failure

Failure phenomenon	Possible causes	Inspection and maintenance
Compressor not started	Not powered on (standby)	Check the main power switch and check the operation display to see if the power is on.
	Loose circuit connection	Tighten circuit connector.
	Circuit open or short circuit	Check the circuit open or short circuit and repair the main power supply.
	Inverter failure	Inverter replacement
	Control board damage	Replace the control board
	Compressor motor failure	Replace the compressor.
Compressor does not work	No cooling requirement	Check the output status of the compressor for the discharge temperature on the display screen. Check that the operation interface is in the cooling state.
	Downtime delay	The compressor has a minimum stop time under normal conditions, and if the temperature rises to the on point during this time, the compressor will still turn on with a delay.
High exhaust pressure	Dirty condenser blockage	Clean the condenser with compressed air or a vacuum cleaner equipped with a brush head.

11.1.1.3 Cooling Media Circulation System Failure

Fault phenomenon	Possible causes	Inspection and repair
Internal circulation water ring pump does not start	Not powered on (standby)	Check the main power switch and check the operation display to make sure it is turned on.
	Loose circuit connection	Fasten the circuit connectors.
	Water pump inverter failure	Replace the pump inverter.
	Pump body failure	Replace the circulating water pump.

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		See "10.4 Replacing the electric heater and circulating water pump" for details.
Electric heater does not work	No heating requirement	Check whether the water outlet temperature and heating set point are set reasonably.
	Loose circuit connection	Fasten the circuit connectors.
	Electric heating overheating protection	Wait for a period of time and restart the electric heating, and observe whether the electric heating is working normally.
	Pipe electric heating failure	Replace the electric heater. See "10.4 Replacing the electric heater and circulation pump" for details.

11.2 Methods of handling emergencies

11.2.1 Fire Damage

Step 1: Evacuate the scene to a safe area, set aside a safe isolation zone, and call the police according to the scene.

Step 2: Under the condition of ensuring personal safety, conditionally carry out the following operations.

- If the wire harness smoke fire, use carbon dioxide or dry powder extinguisher to extinguish the fire.
- If you accidentally inhale smoke, please move and seek medical attention as soon as possible.

Step 3: Notify the system manufacturer for further processing advice.

	If the fire is caused by charging or discharging abnormality, make sure to turn off the power at the first time, and then execute the firefighting action.

11.2.2 Flood Damage

Step 1: Evacuate the site to a safe area and set aside a safety quarantine area, regardless of whether the system is powered on or not.

Step 2: Notify the system supplier and wait for the water to fade before overhauling.

Step 3: Prohibit starting the system until the system manufacturer gives the result of the system safety determination.

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11.2.3 Battery drop/impact

- In case of obvious odour, damage, smoke, fire, etc., evacuate personnel immediately, call the police in time, and contact professionals, who will use firefighting facilities to extinguish the fire while ensuring safety.
- If the appearance is not obviously deformed or damaged, and there is no obvious odour, smoke, or fire, perform the operation under the premise of safety:

1) Warehouse: To evacuate personnel, professional personnel will use mechanical tools to transfer the battery to an open and safe place, and contact the company's service engineers, standing for 1h and monitoring the battery temperature within the range of room temperature ±10℃ after processing.

2) Energy storage system site: Evacuate personnel, close the door of the energy storage system, and let professional personnel use mechanical tools to transfer the battery to an open and safe place, and contact the service engineer of the company for 1h post-processing.

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12.Appendix

12.1 Inspection Program

Inspection items	Inspection method	Yes/No	Abnormal records
Whether the fire extinguishing system is complete	Visual		
Whether the fire extinguishing system is within the validity period	Visual		
Whether the heat dissipation system is complete	Visual		
Whether the air duct of the heat dissipation system is blocked	Visual		
Whether the appearance of the electric cabinet is deformed	Visual		
Whether the appearance of the electric cabinet is rusted and broken	Visual		
Whether there is water vapor inside the cabinet	Visual		
Is the low-voltage wire harness loose or broken	Visual		
Is the high voltage harness loose or broken	Visual		
Whether the wire harness interferes with structural parts	Visual		
Whether the high voltage connection is corroded	Visual		
Is the structure fixing bolt loose or	Visual		

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missing			
Is the maintenance switch (MSD) complete and reliably installed?	Visual		
Is the water cooling pipe broken	Visual		
Is there any bad odor in the battery room?	Olfaction		
Is there any irritating odor in the cabinet?	Olfaction		
Is there a burnt smell in the high voltage connection area?	Olfaction		
Is the summary data complete?	Monitoring Upper Unit		
Is the individual voltage data complete	Monitoring Upper Unit		
Is the monomer temperature data complete	Monitoring Upper Unit		
Alarm bar with or without abnormal alarm	Monitoring Upper Unit		
Note: If you find any abnormalities during the inspection process, please give feedback in time and contact the relevant personnel to arrange for processing!			

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