密级：商密 A

Classification:L1

100kW-215kWh Liquid Cooled Energy Storage System User Manual

V1

Nov 2023

Preface

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

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

The pictures provided in this manual are for demonstration purposes only, and detailed information may vary slightly depending on the product version and market region. This manual has been prepared in accordance with the status of our energy storage system at the time of its commissioning. The product form and technical specifications may evolve continuously. This manual will be revised accordingly when the product is updated, and the revised items will not be notified.

If the system fails due to your negligence, improper use or unauthorized disassembly or hacking of the control program, you will lose your warranty rights; any direct or indirect warranty claims resulting from this will not be accepted by our company after-sales service.

Table of Contents

1. Overview

1.1 Main content

This manual describes the product, transportation, installation, operation, maintenance and troubleshooting of the 215kWh 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 it may cause equipment damage or personal injury.

1.2 Target audience

This manual applies to personnel involved in the transportation, installation and other operations related to this product, and the personnel involved must meet the following requirements: Proficiency in electrical, electronic, mechanical engineering and other professional knowledge, proficiency in understanding electrical schematics, structural drawings, etc.; Understanding of the products, fundamentals, working principles, and control logic of the energy storage industry; Have a professional electrician construction certificate and qualification recognized by the law of the region where this product is used, and be familiar with the relevant laws and regulations in this region; Have the ability to deal with emergencies and handle relevant pieces according to the laws and regulations of the region where this product is used; Proficiency in the content of this manual, professional skills and a high degree of responsibility. The manual contains important information; please read it carefully before operating and maintaining the system. Please keep this manual and other information in the product components together to ensure timely access by the operator and maintenance personnel.

1.3 Manual warning flag definition

In order to protect the user's personal and property safety when using this product and to improve the user's efficiency of this product, these manual details the relevant information and adds relevant symbols to enhance the explanation. The following logos may appear in this article and represent the following:

Symbol	Description
	Used to warn of an emergency hazardous situation that, if not avoided, would result in death or serious personal injury.
	Used to warn of potentially hazardous situations that, if not avoided, could result in death or serious personal injury.
	Used to warn of potentially hazardous situations that, if not avoided, could result in moderate or minor personal injury.
	Used to communicate equipment or environmental safety warnings that, if not avoided, could result in equipment damage, data loss, reduced equipment performance, or other unpredictable results. "Caution" does not refer to personal injury.
	Indicates additional information in the manual that emphasizes or supplements the content, and may also provide tips or tricks to optimize the use of the product, help you solve a problem or save you time.
	This symbol means that the product contains high voltage hazards inside and touching it may result in electric shock hazards.
	This symbol means that the product contains a high temperature hazard and should be avoided to avoid personal injury.
	This mark means that the product is protection ground (PE), need to connect the grounding wire, please link firmly and reliably to ensure the safety of the operator.
	This mark means the product is forbidden to open here, and there is a major danger to open casually.
	This mark means the product is forbidden to touch, random touch may lead to equipment failure, there is a greater danger.

2. Safety instructions

2.1 Safety instructions

Please strictly comply with the terms of the safety regulations in this product manual. In order to avoid possible casualties 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.

1. It is prohibited to immerse the battery in water;
2. There is a risk of fire, explosion and burns if batteries are not properly used and stored. Do not decompose, crush, incinerate, heat and put the battery into the fire;
3. It is prohibited to put the battery into fire or expose it to high temperature for a long time which exceeds the temperature limitations specified in this manual, otherwise it may cause fire;
4. When batteries reach the end of their useful life, used batteries should be disposed of promptly in accordance with local recycling or waste regulations;
5. Do not disassemble, dismantle or recondition the battery in any way without authorization;
6. Do not mix different specifications, different brands of lithium-ion batteries;
7. If the battery emits a strange smell, heat, deformation, discoloration or any other abnormal phenomenon shall not be used;
8. Prohibit short-circuiting the positive and negative terminals of the battery, otherwise the strong current and high temperature may cause personal injury or fire;
9. Connect the positive and negative terminals of the battery in strict accordance with the label and instructions, and prohibit reverse or series charging;
10. Prohibit overcharging/over-discharging of the battery, otherwise it may cause overheating and fire accidents;
11. When the electrolyte leaks, avoid skin and eye contact with the electrolyte. In case of contact, wash the contact area immediately with plenty of water and seek medical help;
12. It is prohibited for any person or animal to ingest any part of the battery or substances contained in the battery;
13. Batteries are potentially hazardous and must be operated and maintained with proper precautions. Failure to do so may result in serious personal injury and property damage;
14. The Customer is aware of the following potential hazards in the use and operation of the Battery: the operator may be injured by chemicals, electric shock or arcing during operation; although the human body reacts differently to being exposed to direct current than to alternating current, direct current voltages higher than 50V are just as harmful as alternating

current, and the user must adopt a conservative posture during operation to avoid injury from the current. There is a chemical risk from the electrolyte in the battery. When handling batteries and selecting personal protective equipment, users and their employees must consider the above potential risks to prevent accidental short circuiting, arcing, explosion, or thermal runaway;

15. Throwing or dropping the battery is prohibited. Gravity impacts may damage the protective mechanism and may cause abnormal chemical reactions leading to heat or fire;
16. Prohibit pinprick, hammer, postmark and any other behavior that may cause deformation of the battery, which may cause short-circuit or fire within the battery.

Failure to comply with the above warnings can result in a variety of disasters

If any of the above abnormal use occurs, please stop usage and operation and contact JinkoSolar after-sales service as soon as possible for further evaluation.

2.2 Operator requirements

1. Safety helmet, insulated gloves, insulated shoes and goggles are required when operating or maintaining the energy storage system, and metal jewelry such as watches are strictly prohibited;
2. Only professionally qualified electricians are allowed to operate and maintain this product, and complete professional electrician equipment is required;
3. Operators are able to assess the assigned tasks and recognize dangerous events that may occur;
4. Operators are able to rescue injured personnel in the first instance;
5. Understand the relevant maintenance standards of the product;
6. Comply with local laws, regulations, ordinances and standards.

2.3 Electrostatic protection

The accumulation of static electricity may cause electric shock, fire, explosion, electronic device failure and damage, etc. Energy storage systems with circuit boards or other electrostatic sensitive components, in order to prevent or reduce the harm of static electricity, it is necessary to be well protected against static electricity, and thus inhibit the generation of static electricity, accelerate the leakage of static electricity, electrostatic neutralization. The prevention methods include, but are not limited to:

1. In the process of replacing components, all equipment devices that have not been installed should be kept in bags with anti-static shielding, and temporarily removed equipment devices placed on foam pads with anti-static features;
2. Do not touch solder points, pins or exposed circuits.

3. Product overview

3.1 215kWh liquid-cooled energy storage product system overview

Single 215kWh liquid-cooled energy storage cabinet consists of 5 liquid-cooled battery packs and a high-voltage box and a 100kW PCS and a liquid-cooled unit, each liquid-cooled pack consists of 48 cells connected in series, with a rated capacity of 280Ah of each cell. The high-voltage box contains a battery cluster management unit (BCU) and a set of protection, control, and other electrical components. The high voltage box is used for management and protection of the entire cluster of battery packs. The 215kWh liquid-cooled energy storage cabinet adopts the design of the battery compartment and the electrical compartment insulated with each other, which is safer for operation and maintenance.

3.2 Technical parameters of the energy storage system

Table 3-1 215kWh liquid-cooled energy storage cabinet technical parameter table

No.	Item	Parameters
Battery Parameters		
1	Battery type	LFP
3	Cell specifications	3.2V/280Ah
4	Maximum charge/discharge power	0.5C
5	Grouping method	1P240S
6	Rated energy	215kWh
7	Rated voltage	768V
8	Voltage range	672～864V
10	Cooling method	Liquid cooling
AC Side Parameters		
11	Rated AC power	100kW
12	Rated voltage	400Vac
13	AC access method	Three-phase four-wire
14	Rated frequency	50Hz/60Hz±2.5Hz
15	Total harmonic distortion rate of current	≤3%
16	Cooling method	Forced air cooling
System Parameters		
12	Operating environment temperature	-20～50℃,>45℃ derating
13	Operating environment humidity	≤95% Relative humidity, non-condensing

14	Altitude	≤2000m
16	IP level	IP55（battery compartment)
18	Fire fighting agent	Aerosol
19	Corrosion-proof grade	C3/C5(optional)
25	Communication	LAN
26	Dimension (L×W×H)	1300×1300×2300mm
27	Weight	About 2800kg

3.3 Structure graph of 215kWh liquid-cooled energy storage cabinet

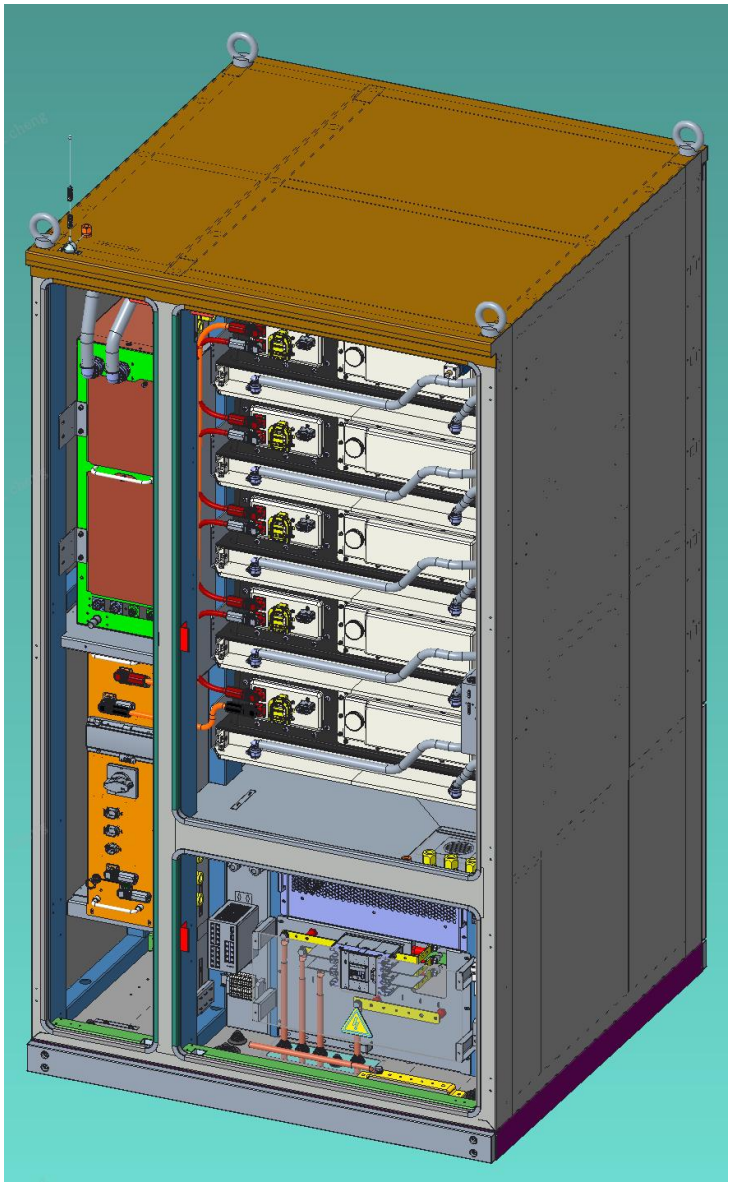


Figure 3-1 liquid-cooled outdoor battery cabinet (specifics based on the actual product)

3.4 Single line diagram

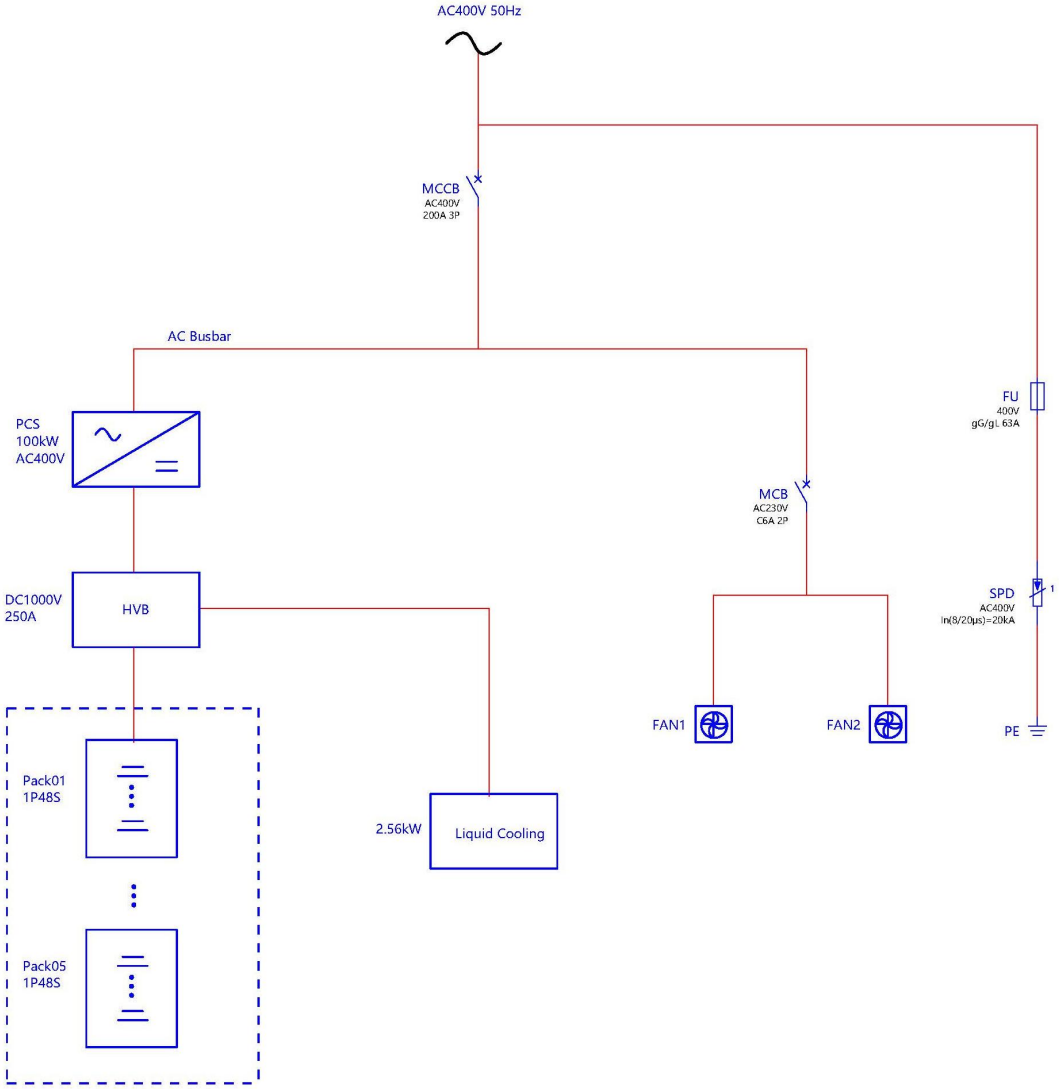


Figure 3-2 215kWh liquid-cooled energy storage system single line diagram

3.5 Communications topology

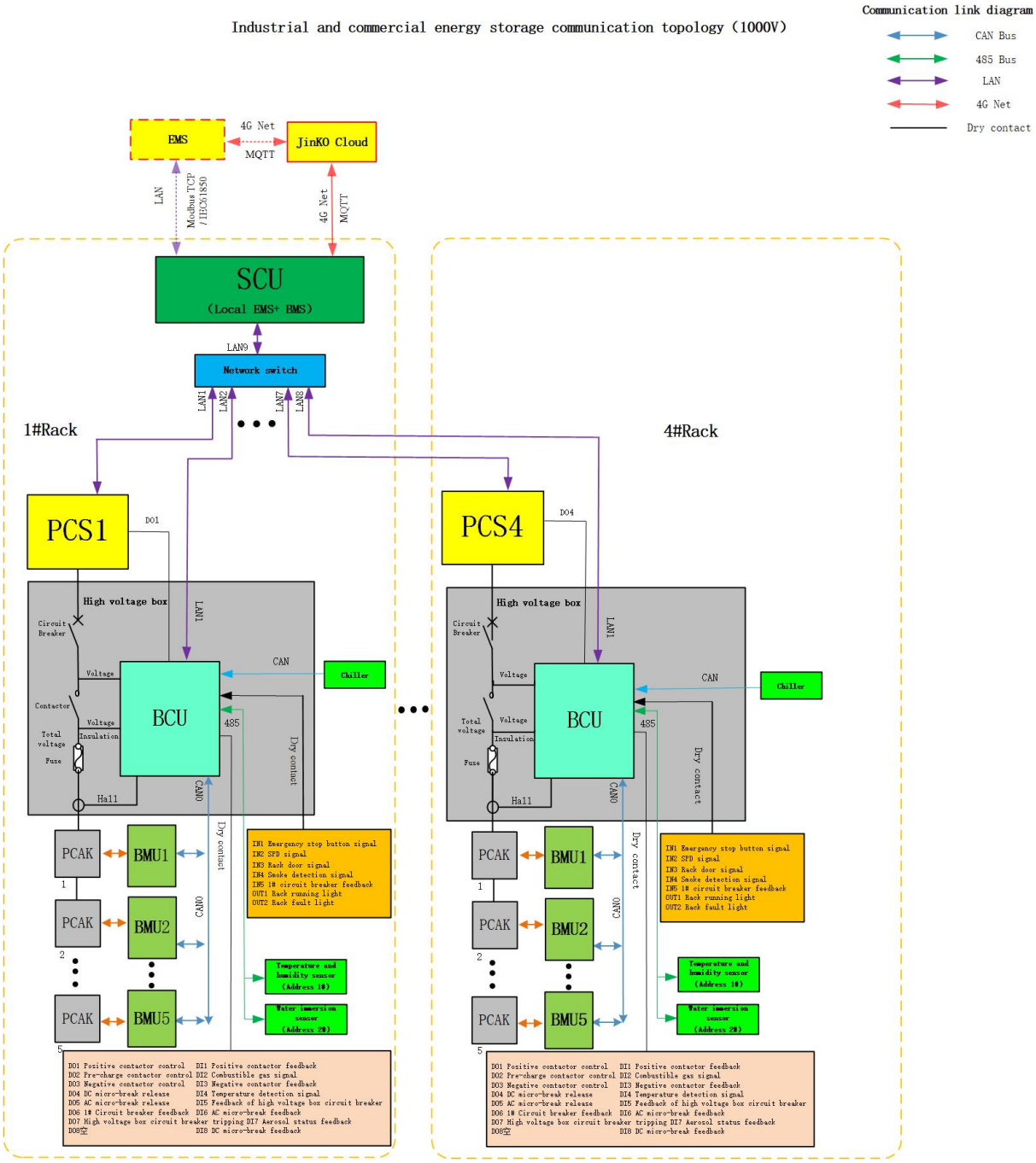


Figure 3-3 Communication topology of battery management system

4. Lifting, transportation and storage

4.1 Lifting operation

4.1.1 Lifting precautions

Warning	**Warning:** 1) In the whole process of lifting, it is necessary to operate in strict accordance with the safety operation procedures of the crane; 2) No one is allowed to stand within 10 meters of the operation area, especially under the lifting arm and under the lifting or moving machine to avoid casualties.; 3) In case of bad weather conditions, such as heavy rain, fog, strong wind, etc., lifting should be stopped.

4.1.2 Preparation before lifting

Crane preparation

The total weight of the equipment is about 3.0 tons, please select the crane according to the total weight, recommended model: 8 tons to 12 tons.

Spreader preparation

Wire rope, hooks, rings, etc.

4.1.3 Lifting process

1. When loading and unloading, a crane of suitable tonnage must be used; when lifting, nylon slings (straps) or wire ropes can be used;
2. The lifting process should be carried out with strict reference to the lifting diagram, see Figure 4-1 below for details;
3. The cabinet shall be lifted vertically and shall not drag on the ground and shall not be dragged and pushed on any surface;
4. After lifting 300mm, pause and check the connection of the spreader, and continue lifting only after the connection is firmly established;
5. The whole lifting process should be carried out slowly, pay attention to the balance state of the box, do not move too fast;
6. In the entire lifting process, standing below 215kWh liquid-cooled energy storage cabinet and cranes are strictly prohibited.

4.1.4 Lifting schematic of 215kWh liquid-cooled energy storage cabinet

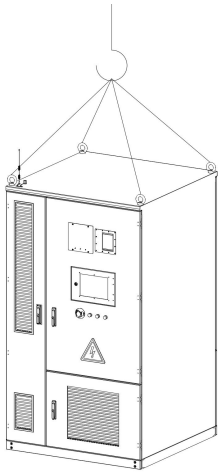


Figure 4-1 lifting diagram of 215kWh liquid-cooled energy storage cabinet

4.2 Forklift operation

When forklifts are use in this lifting process, the following conditions must be met:

- The forklift used should have sufficient load capacity (at least 8 tons is recommended);
- The forks of the forklift used should be inserted into the full depth of the outdoor cabinet. The depth of insertion should be at least 1500mm;
- A test fork must be performed to ensure that the fork is raised, lowered and moved slowly and smoothly;
- Considering the safety issue during forklift process, it is recommended to bundle a safety belt around the 215kWh liquid-cooled energy storage cabinet attached to the forklift beam. Specific forklift operation can be referred to as shown in Figure 4-2 below:

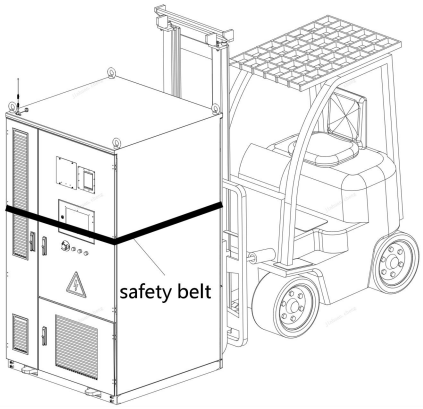


Figure 4-2 Schematic of slot location

4.3 Transportation

The 215kWh liquid-cooled energy storage cabinet is suitable for land and sea transportation. Dangerous goods vehicles and shelter & sun protection measures should be applied in the transportation. In the loading and unloading process, 215kWh liquid-cooled energy storage cabinet should be gently moved and placed, to prevent dropping, tumbling and heavy pressure. Avoid the rain, snow, and mechanical impact during transportation and shipment.

4.3.1 Transportation environment requirements

According to the battery characteristics, the 215kWh liquid-cooled energy storage cabinet should meet the following requirements during storage and transportation in order to maximize the protection of the battery performance: Average daily storage temperature: ≤20℃; Allowable storage temperature: -20 to 45℃; Humidity: ≤95%, non-condensing.

4.3.2 215kWh liquid-cooled energy storage system factory preparation

1) Before the equipment leaves the factory, the 215kWh liquid-cooled energy storage cabinet is protected by white EPE wrapping, the top four edges are protected by wooden corner guards, the vertical four edges are protected by paper corner guards, and the outermost side is protected by PE wrapping film, as shown in the following Figure 4-3:

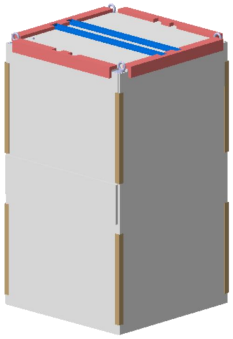


Figure 4-3 Packing solution

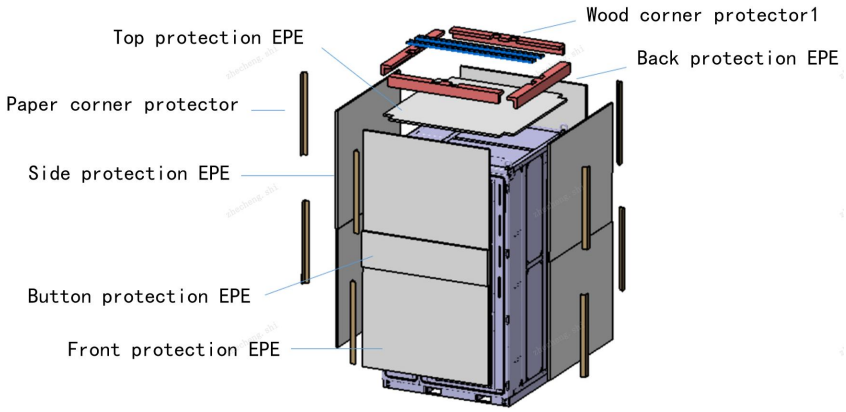


Figure 4-4 Exploded diagram of packing solution

2) After packing, the corresponding labels are pasted on the outside of the PE film: company logo, before and after marking, center of gravity marking, 9 types of dangerous goods marking, four-proof marking, and finished product labeling;
3) For sea transportation, MSDS certification is to be met and UN marking is to be affixed;
4) The equipment needs to be reinforced as necessary during transportation to prevent shifting and tipping.

Note: Before packing begins, place the user manual and other information in a self-sealing bag in an easily accessible location inside the cabinet door.

4.3.3 Transportation

1) Obeying traffic rules;
2) Drivers shall comply with the regulations of the relevant authorities concerning the routes, time and speed of transportation of dangerous goods. Route stops should be guarded and kept away from construction facilities and populated areas, and no stops should be made at locations with no permit;
3) It is strictly prohibited for vehicles transporting dangerous goods in violation of the relevant national regulations, for example overload, exceed the limit or exceed the speed limit. Dangerous goods transportation vehicles are not allowed to carry other ordinary goods or other flammable or explosive substance. Vehicle drivers shall carry with the road transportation permit and the qualification certificate for transportation of Dangerous Goods
4) Vehicles must be equipped with a locator system and be equipped with security and anti-theft devices;
5) Transportation employees must be familiar with the relevant safety regulations, technical standards, production safety rules and regulations, and safety operation procedures. They need to understand the nature of the dangerous transported goods and their hazardous characteristics, and the measures in the event of an accident. They must operate in accordance with the rules for the Transportation of Dangerous Good, and must not operate in contravention of the regulations;
6) When an accident occurs in which dangerous goods are burned or stolen or lost in the course of transportation, the driver and escort shall report the accident to the leadership, the local public security and traffic police immediately, explaining the circumstances of the accident, the name of the dangerous goods. and They should take all possible warning and emergency measures at the scene, and cooperating with the relevant departments actively;
7) 215kWh liquid-cooled energy storage cabinet is equipped with batteries inside, speeding is prohibited. On highway with flat asphalt, speed limit is 70km/h. The speed limit at curves is

50km/h; the speed limit in city is 40km/h. Always avoid emergency starting and braking;

8) Please drive with extreme caution on any road surface such as non-flat tarmac and with a speed limit of 50km/h;
9) Transportation over rough and bumpy roads is prohibited;
10) Check the bundling of the 215kWh liquid-cooled energy storage cabinet before departs to ensure that it is securely bundled; check the bundling of the 215kWh liquid-cooled energy storage cabinet every 4 hours during transportation.

Caution	Please always keep in mind the mechanical parameters of the energy storage system during transportation and handling; Size(L×W×H): 1380×1380×2400mm; Weight：about 3000kg;

4.4 Storage

The system should be stored in a dry warehouse and should not expose to the sun and rain. No harmful gas, flammable, explosive products and corrosive chemicals are allowed in the warehouse. The mechanical shock, heavy pressure and strong magnetic field should be avoided. And the product should avoid direct sunlight and stay away from heat source not less than 2m and at least 50cm from wall, window or air inlet.

No.	Item	Parameter
1	Average daily storage temperature	≤20℃
2	Allowable storage temperature	Short-term storage (within 1 month): -20～45℃
		Long-term storage: -20℃～35℃
3	Storage humidity	≤95%, non-condensing

Under the conditions set forth herein:

It is recommended that the battery should be discharged and charged every 3 months to ensure that the battery SOC remains within the range of 20 to 50% SOC; And capacity verification tests and re-tests are required every 12 months.

Warning	During the storage process of 215kWh liquid-cooled energy storage cabinet , JinkoSolar shall not be liable for any damage of the system caused by the user's failure to comply with the storage methods and requirements specified in this manual.

5. Foundation construction

When siting foundations, please follow the following principles:

1. The climatic environment, soil and geological conditions (such as stress wave emission situation, groundwater level) and other characteristics of installation site should be fully considered;
2. The surrounding environment should be dry, well ventilated and away from flammable and explosive areas;
3. 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 should be ≥98%. If the soil is loose, please take measures to ensure the foundation is stable.

6. Equipment installation

6.1 Installation instructions

Danger	The 215kWh liquid-cooled energy storage cabinet is a high-voltage energy storage equipment, belonging to the dangerous goods. Non-professional and improper operation and use may cause electric shock, combustion, explosion and other serious consequences. Installation and maintenance of the battery system must be operated by professional and technical personnel. The use of the battery system must strictly comply with the relevant safety regulations.
Warning	1. Be careful not to touch the staff when the cabinet is lifted to the ground; 2. Specialized isolation areas are required for installation operations; 3. The cabinets need to be held and placed lightly and gently; 4. Installation should only be carried out by installers specialized in the handling of high voltage electricity; 5. Do not install the cabinet if it is defective, cracked or damaged; 6. Do not attempt to open, disassemble, repair, or modify the the 215kWh liquid-cooled energy storage cabinet during installation; 7. Do not install in inclement weather such as rain, sand, etc; 8. To protect the product and its components from damage during transportation, please handle with care; Do not hit, pull, drag or step on the cabinet. Do not subject the cabinet to any strong external forces 9. Do not insert foreign objects into any part of the cabinet; 10. Do not expose the energy storage outdoor cabinet or its components to direct flame; 11. Do not install the energy storage outdoor cabinet near heating equipment; 12. Do not immerse the cabinet or its components into water or other liquids; 13. Please place the cabinet on a level floor, making sure it is placed smoothly without shaking or tilting; 14. The installation of the cabinet should consider the bearing and loading capacity of the ground.

The internal equipment of the energy storage outdoor cabinet has been reliably connected and tested before leaving the factory. It is necessary to install and fix the outdoor cabinet box and connect external power cables, external signal cables, and the outdoor cabinet grounding at the project site. The installation process is shown below in figure6-1:

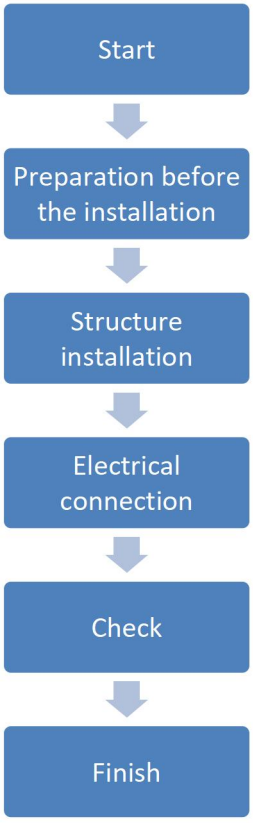


Figure 6-1 Installation process of liquid-cooled energy storage system

The installation process of the energy storage outdoor cabinet is described in detail as shown in Table 6-1:

Table 6-1 Detailed description of the installation process

Installation process	Description
Pre-installation preparation	1. Check the appearance of the energy storage outdoor cabinet; 2. Inspect the outdoor cabinet for damage or dislodgement of devices; 3. Verify that all parts are intact and not missing; 4. Confirm that the installation environment meets the requirements; 5. Confirm the availability of equipment for lifting outdoor cabinets at the project site.
Structural installation	1. Use a crane to move the energy storage outdoor cabinet to the prefabricated foundation;

	2. Fix the energy storage outdoor cabinet according to project requirements.
Electrical connection	1. Connecting the grounding wire; 2. Connecting DC cables; 3. Connecting external auxiliary power, communication and signal cables.

6.2 Pre-installation

6.2.1 Installation environmental requirements

Installation environment should meet the following requirements:

Table 6-2 Environmental requirements for installation of energy storage outdoor cabinet

Item	Requirements
Installation site	Surface inclination ≤ 1° Seismic resistance > 8 level
Ambient temperature	-30~+55℃
Relative humidity	≤95%, no condensation
Altitude	≤2000m

6.2.2 Installation & Maintenance space requirements

For the space requirements of the cabinet, the maintenance space of the front door is required to be not less than 1.5m (if a forklift truck is needed to replace the pack, it is recommended to reserve 2.5m) and the maintenance space of the left and right sides is required to be not less than 0.1m, and the maintenance space of the rear door is required to be not less than 0.8m.

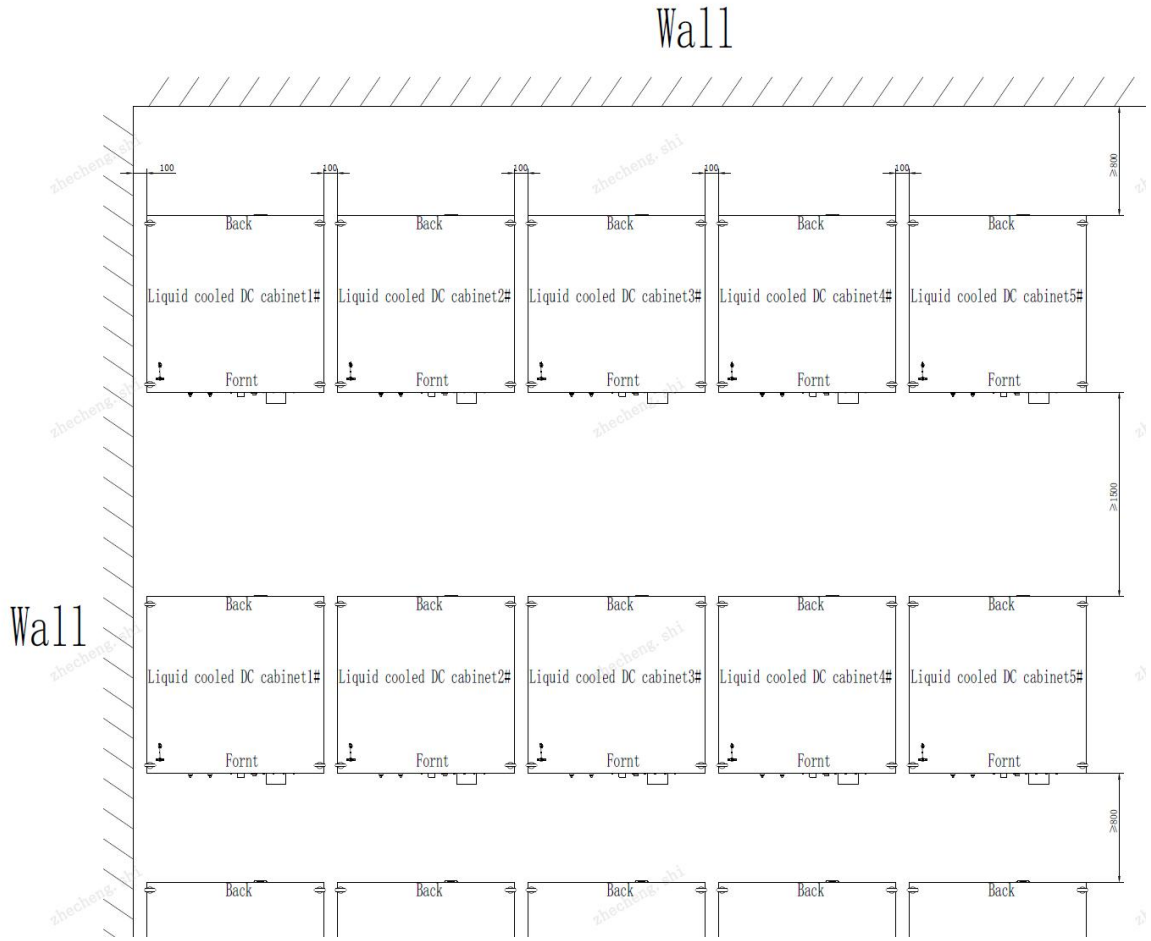


Figure 6-2 installation & Maintenance space

6.2.3 Installation steps

6.2.3.1 Fixation connection

(1) Use a crane (recommended lifting capacity: 8 tons - 12 tons) (or forklift, recommended forklift capacity of 8 tons or more) to slowly lift (or forklift) the whole liquid-cooled energy storage system to the prefabricated foundation, please refer to chapter 4.1 of this manual for the specific operation method of loading operation;

(2) After the lifting of the energy storage system is completed, the outdoor cabinet base is fixed with M12 (recommended torque: 75N·m) bolts according to the project requirements;

(3) The welds need to be protected from corrosion after welding is completed.

6.2.3.2 Ground connection

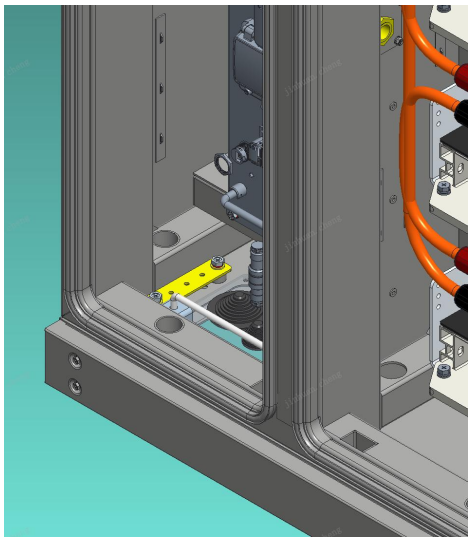
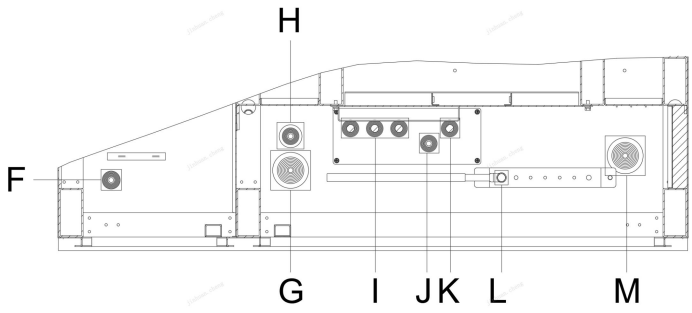


Figure 6-3 215kWh liquid-cooled energy storage cabinet ground connection diagram

6.2.3.3 Interface connection description

The 215kWh liquid-cooled energy storage cabinet integrated cabinet is equipped with a PCS AC cable port, an external communication cable port, and a grounding strip, with detailed locations and functional descriptions shown in Figure 6-4 and Table 6-4:



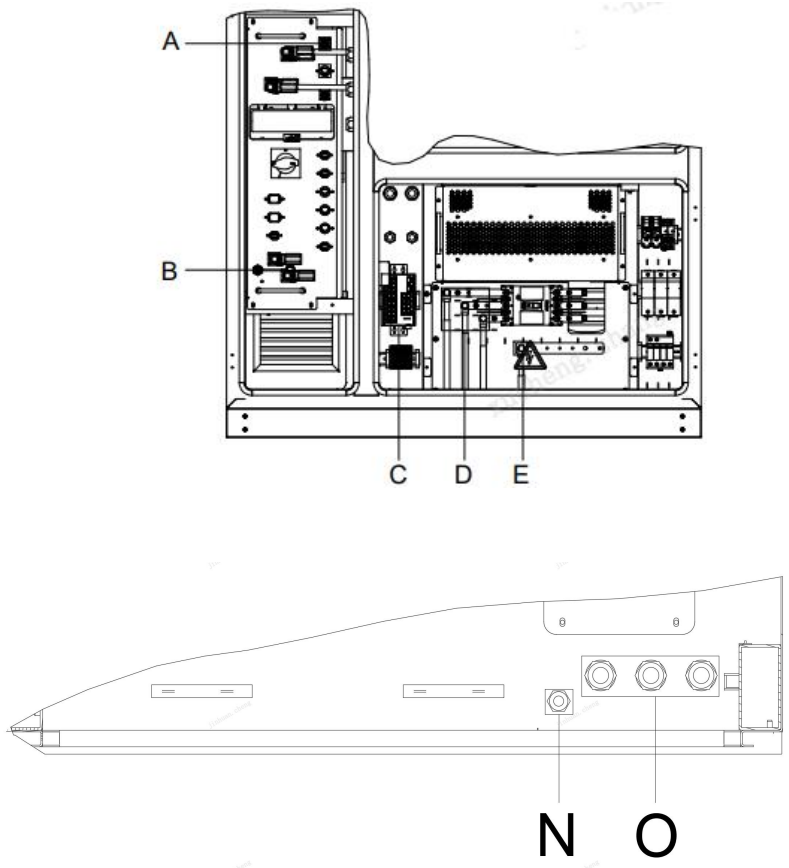


Figure 6-4 Schematic diagram of 215kWh liquid-cooled energy storage cabinet interface location

Table 6-3 Functional descriptions of interface connection

No.	Code	Name	Remark
1	A	High voltage box auxiliary power interface	
2	B	High voltage box RJ45 network interface	
3	C	Network switch	
4	D	AC side wiring copper bar interface	Connection with M10 bolts
5	E	N-phase wiring copper bar interface	Connection with M10 bolts

6	F	High voltage box auxiliary power feedthrough hole	
7	G	Network feedthrough hole	
8	H	Reserved interface	
9	I	AC side power cable feedthrough	
10	J	Grounding cable feedthrough hole	
11	K	N-phase cable feedthrough hole	
12	L	Grounding cable terminal hole	
13	M	Dry contact signal cable feedthrough hole	
14	N	Dry contact signal cable standby gland	
15	O	Dry contact signal cable gland	

6.2.3.4 PCS interface description

PCS is a conversion device between the grid and the battery that charge and discharge the battery. It can invert the DC power from the battery into AC power that can be connected to the grid, and it can rectify the AC power from the grid into DC power that can be charged into the battery. The PCS can be used in grid-connected mode. The location of the wiring ports of the PCS and the function description of each interface are shown in Figure 6-5 and Table 6-4 below:

Figure 6-5 Interface location diagram for PCS module

Table 6-4 PCS module interface function description table

No.	Name	Remark
1	Clip ears	
2	Wiring copper terminals	AC A/B/C + DC positive/negative
3	EPO terminals	
4	Indicator lamp	
5	Communication network interface	
6	Handles	Removable for front or side panel mounting

6.2.3.5 SCU position and interface description

The SCU is installed on the battery compartment door panel of the 215kWh liquid-cooled energy storage cabinet, and its location and interface function are described as shown in Figure 6-5 and Table 6-4 below:

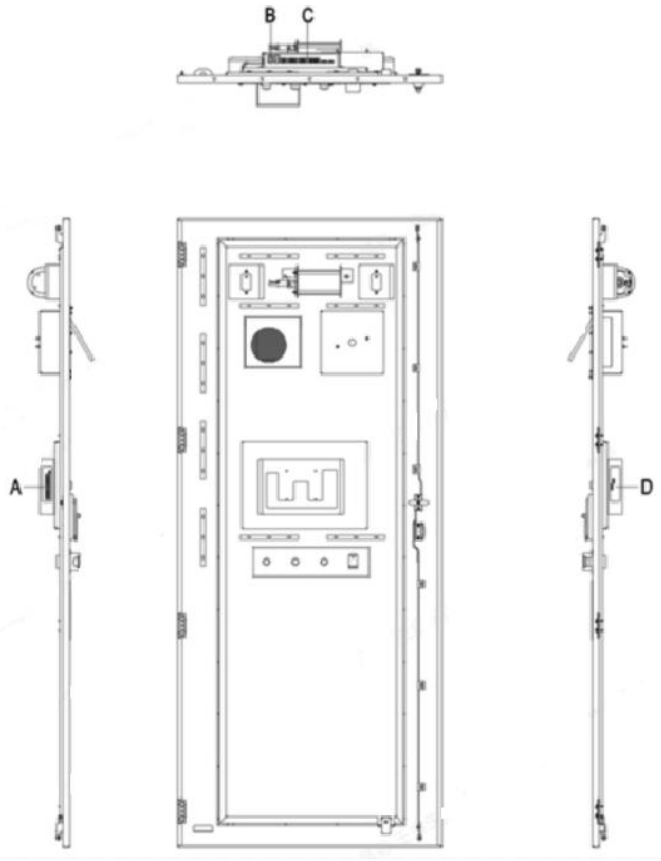


Figure 6-6 SCU interface location diagram for the 215kWh liquid-cooled energy storage cabinet

Table 6-5 SCU interface function description table for the 215kWh liquid-cooled energy storage cabinet

No.	Code	Name	Remark
1	A	Dry contact	
2	B	SCU communication ethernet port	
3	C	CAN&RS485 Communication port\Power supply port	
4	D	SCU USB port\SIM	

6.3 Electrical connections

6.3.1 External AC cable connection and procedure

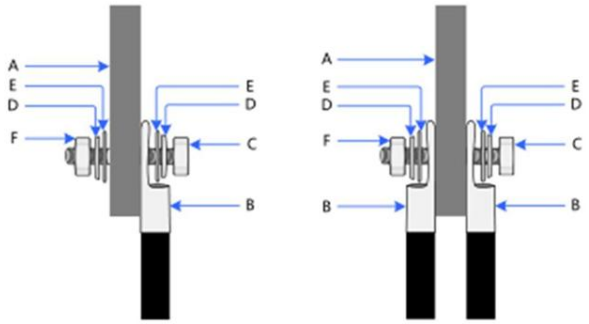
6.3.1.1 Cable and terminal block model recommendations

Recommended terminal block model types for AC cables and grounding wires are shown in Table 6-6 below:

Table 6-6 Recommended terminal block models for AC cable and grounding wires

No.	Item	Description
1	AC cable wiring	24*70mm²+35mm² (4*95mm²+50mm²) (depending on the cable laying method) power cables, through the bottom of the cabinet to the liquid-cooled energy storage cabinet AC terminal block, the middle copper row and ground row, you need to use five performance level 8.8 M10 × 25 combination of screws to lock the terminals and copper rows, and the use of No. 17 socket wrenches for tightening, tightening torque recommended value: 40N·m.
2	Terminal block model type	Copper pipe terminal: wire diameter 70mm^2(95mm²) M10 fixing hole Copper pipe terminal: wire diameter 35mm^2(50mm²) M10 fixing hole

The cable and copper row connection specifications, as shown in Figure 6-7 below:



A	B	C
Copper Bar	Copper	Terminal Screw
D	**E**	**F**
Dish gasket	Flat gasket	Nut

Figure 6-7 The cable and copper row connection diagram

6.3.1.2 AC cable and ground cable wiring procedure

Step 1: Confirm that the output switches of the liquid-cooled energy storage cabinet, the high-voltage distribution box, and the front and rear stages are all in the disconnected state;

Step 2: Strip off the insulation at the end of the cable, the length of the insulation at the end of the cable should be peeled off for the wiring copper nose pressure hole depth plus about 5mm;

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

(1) The stripped wire exposed copper core part of the wire into the copper nose of the crimp hole

(2) Use the terminal crimping machine to connect the copper nose pressure, crimping the number should be 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 pipe about 2cm;

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

(3) Use the heat gun to heat the heat shrinkable tube to make it shrink by heat.

Step 5: Wiring.

Select the screws, spring washers, flat washers and nuts that match the copper noses of the wiring to be connected to the wiring harness and fasten them according to the recommended torque.

6.3.2 Auxiliary and communication cable connections and steps between cabinets (if any)

The communication and signal wiring between liquid-cooled energy storage cabinet host and slave, the site needs to be according to the electrical wiring diagram to carry out the corresponding wiring work.

Step 1: Connect the liquid-cooled energy storage cabinet 1.5mm2 cable to the EPO terminal of PCS, and connect the cable to the corresponding terminal of liquid-cooled energy storage cabinet BCU;

Step 2: Connect two super category 6 shielded network cables to the corresponding network ports of the high voltage box and PCS of the all-in-one cabinet slave, pass them through the threading holes of the liquid-cooled energy storage all-in-one cabinet slave and all-in-one cabinet mainframe, respectively, and connect the two network cables to the corresponding network ports of the switch of the all-in-one cabinet mainframe.

6.3.3 External communication cable wiring

Liquid-cooled energy storage cabinet host three-level display and control provides a communication interface, the site needs to be based on the electrical wiring diagram, the use of ultra-six network cable, the liquid-cooled energy storage cabinet three-level display and control of the communication port to connect to the back office or other communications equipment.

7. Operations

7.1 Pre-power-up checks

(1) Check that the circuit breaker in the electrical compartment in the liquid-cooled energy storage cabinet is in the disconnected state;

(2) Check whether the series power cables are connected reliably between the battery packs and between the battery packs and the high voltage box;

(3) Check that the connection terminals of all communication and power supply cables are connected reliably;

(4) Check that the communication and power supply cables and the power cables on the high voltage box panel are connected correctly;

(5) Check whether there are problems with all the network cable connections on the switch and the three-level display and control in the liquid-cooled energy storage cabinet (run after the parameter configuration is completed).

7.2 Power-up procedure

Step 1: Close the auxiliary power micro-break on the high-voltage distribution box in the liquid-cooled energy storage cabinet, close the high voltage box with handle DC circuit breaker, and observe the status of the indicator light on the high-voltage distribution 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.

Step 2: Turn on the liquid-cooled unit and observe whether the power supply is normal;

Step 3: After the liquid-cooled energy storage cabinet is powered up, the three-stage BMS automatically sends a command to the two-stage BMS in the high-voltage distribution box to close the relay, and the two-stage BMS will absorb the main positive and negative relays after the self-test is completed, which is a bunch of power-up is completed;

Step 4: Close the PCS compartment inlet circuit breaker, after completing the above operation the system enters the state that can be charged and discharged.

8. Maintenance instructions

Explanation of terms:

NO.	Terminology	Description
1	Normal operation	Battery systems that work daily
2	Interval operation	Battery systems that operate at a variable frequency per month and cannot be guaranteed to work daily
3	Long-term resting	Battery systems that have not been started up and working for more than 3 consecutive months

8.1 System usage requirements

8.1.1 Normal operation requirements

Do battery maintenance on the system every twelve months to prevent causing battery damage, refer to section 8.3 for specific maintenance operations. Conducting inspections of the system every twelve months (refer to Appendix 1) and keeps records of the inspections.

8.1.2 Interval operation

Use the same requirements as a normal operating system.

8.1.3 Leave it for a long time without use

SOC range of energy storage battery storage: 20%~50%, to avoid long-term storage of batteries below 15% SOC, and the battery needs to cut off the power-consuming equipment in time if it is not used for a long time.

Conduct an inspection of the energy storage system every three months (refer to Appendix 1), and make inspection records.

Battery maintenance of the system every three months to prevent battery damage.

Before the first use of the long-term discharge system, it is necessary to do at least one full charge to activate the battery system to restore the performance of the battery to the best state.

	If the energy storage system is not used for a long time, it will cause irreversible damage to the battery, so please be sure to carry out regular maintenance.

8.2 Maintenance considerations

Before the relevant personnel doing maintenance and repair operations, it is required to disconnect the isolation switch on the high-voltage box. Make ensure that the isolation switch is in the OFF state, the fire-fighting system is in the manual mode. When maintenance and repair operations are completed, make sure the isolation switch is ON and the fire is in the automatic mode.

8.3 Battery maintenance

In order to ensure the long-term safe and reliable operation of the liquid cooling energy storage system, please read carefully and follow the following instructions for use:

Long-time storage maintenance process:

When the battery needs to be stored for a long time, the battery needs to be charged to 20-50% SOC and placed in a special site for storage, and the storage conditions need to meet the requirements of 4.4

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 20-50% 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, and the maximum storage time should not exceed 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 0.25C rate to fully charge the 215kWh liquid-cooled energy storage cabinet once, and then charge and discharge the product under actual working conditions.

	Check to ensure a safe environment, safe system, no alarms, and no malfunctions before performing battery maintenance operations.

8.4 Liquid cooling system maintenance

The maintenance information of the electronic control system of the liquid cooling unit is shown in Table 8-1:

Table 8-1 Liquid cooling unit electric control system maintenance

Maintenance projects	Maintenance Standards	Maintenance cycle	Detection method	Exception handling method
Reliability of wiring panel power cables and signal cables	No loosening of electrical cables and signal cables	6 Months	Visual assessment	Tighten loose cables with a screwdriver after 10 minutes of power failure.
	Electrical cables and signal cables without aging, damage, abnormal heat and other abnormalities	6 Months	Visual assessment	Replace the power cable and signal cable after 10 minutes of power failure.
	No dust at the wiring panel	6 Months	Visual assessment	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 assessment	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.			

8.4.1 Unit appearance maintenance

The maintenance information for the appearance of the liquid cooling units is shown in Table 8-2:

Table 8-2 Appearance maintenance of liquid cooling units

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

8.4.2 Filter maintenance

The maintenance information for the liquid cooling unit filters is shown in Table 8-3:

Table 8-3 Liquid cooling unit filter maintenance

Maintenance items	Maintenance standards	Maintenance cycle	Detection method	Exception Handling
Filter cleaning	No clogging of the filter with dust and foreign matter	6 Months	Visual assessment	After 10 minutes of power off, remove the front panel, remove the filter and clean the filter with compressed air or a vacuum cleaner equipped with a brush head.
	The above maintenance intervals are only recommended values and can be adjusted according to actual planning.			

8.4.3 Fan maintenance

The maintenance information for the liquid cooling unit fans is shown in Table 8-4:

Table 8-4 Liquid cooling unit fan maintenance

Maintenance items	Maintenance standards	Maintenance cycle	Detection method	Exception handling
Reliability of blower operation	No dust in the fan, no foreign matter blockage at the air outlet	6 Months	Visual assessment	After 10 minutes of power off, 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 noise	6 Months	Visual assessment	Fasten the fan after 10 minutes of power off, check if there are internal cables and other interference with the fan rotation, if the fan fails, please replace it.
	The above maintenance intervals are only recommended values and can be adjusted according to actual planning.			

8.4.4 Condenser maintenance

The condenser maintenance information for liquid cooling units is shown in Table 8-5:

Table 8-5 Liquid cooling unit condenser maintenance

Maintenance items	Maintenance standards	Maintenance cycle	Detection method	Exception handling
Condenser cleaning	No dust and foreign matter blocking the condenser	6 Months	Visual assessment	Clean the condenser with compressed air or a vacuum cleaner with a brush head after 10 minutes of power off.
	The above maintenance intervals are only recommended values and can be adjusted according to actual planning.			

8.4.5 Cooling media maintenance

The maintenance information for the cooling media of liquid cooling units is shown in Table 8-6:

Table 8-6 liquid cooling unit cooling media maintenance

Maintenance items	Maintenance standards	Maintenance cycle	Detection method	Exception handling
Cooling media	The concentration is in accordance with the range, and the PH and electrolyte concentration are required to meet the requirements. No fouling, sedimentation, algae, etc.	6 months	Coolant tester visual assessment	Replace the coolant after 10 minutes of power off.
	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 cooling unit is as follows: 1. Wait at least 10 minutes after disconnecting the power; 2. Drain the liquid in the cooling system through the drain port; 3. Replenish the coolant and check the PH value and electrolyte 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 discharge it at will.			

8.5 Fire protection system maintenance

8.5.1 Routine inspection

The user should check the entire system once a month. The inspection should include:

- System: Perform a visual inspection of the system to confirm that it is not damaged;
- Detectors/sensors: Verify that fire detectors are in place, neat, unobstructed, and functioning

properly;

- Fire detection system: Ensure that the current identification lamps are functioning properly and that all alarm lights are off;
- Aerosol generators: Ensure that the generators are securely fastened. Each generator cover is uncovered and intact;
- Installation area: Ensure that there have been no changes to the protected area that would prevent the system from functioning properly (addition or removal of walls, windows, ventilation shafts, etc.).

8.5.2 Periodic inspection (every 6 months)

- A complete inspection of the entire fire suppression system should be performed every six months. The inspection includes:
- Check for changes in protective areas, e.g., at openings, installed bulkheads;
- Visually inspect the system for signs of wear or corrosion or alteration;
- Check the functionality of the fire detection system according to the manufacturer's specifications;
- Check that the powdered aerosol generator is correctly seated and not interfered with by any obstructions.

8.5.3 Maintenance

- The thermal aerosol release system shall be tested by a qualified person in accordance with the manufacturer's test and maintenance procedures at least once a year. During periodic inspections of the hot aerosol generator and aerosol electrical system, the following components shall be checked:
- Electrical wiring;
- Terminals of the electronic igniter;
- Electrical contacts (are they clamped securely);
- Mounting bolts (are they tight);
- Maintenance reports and recommendations should be filed with the owner;
- Generator replacement after 15 years.

8.5.4 Aerosol leakage

If a thermal aerosol system results in agent leakage from the protected containment area, the leakage should be sealed immediately. The sealing method used should result in the restoration of the initial fire-fighting rating of the protected area.

8.5.5 Inspection of thermal aerosol generators

Only qualified personnel shall be permitted to inspect the thermal aerosol generator and the results of the inspection shall be documented in the following two documents:

- Permanently affixed to each thermal aerosol generator;
- Inspection Reports;
- A copy of the complete inspection report shall be delivered to the owner or jurisdictional authority of the system (or both, as required); records shall be retained by the owner/user throughout the life of the thermal aerosol system;
- If an external visual inspection reveals that the thermal aerosol generator cabinet or the generator itself has been damaged, the unit should be replaced.

8.5.6 Training

All personnel who may be involved in the inspection, testing, maintenance, or operation of hot aerosol generator systems should receive comprehensive training and ongoing comprehensive training for the duties they are expected to perform.

Personnel working in protected containment areas of hot aerosol fire protection systems should be trained in the safety of the agents involved.

8.5.7 Safety

Follow safety procedures when installing, servicing, maintaining, testing, and managing thermal aerosol generator systems. Comply with local and national inspection and maintenance requirements.

8.5.8 Residue removal

Solid aerosol generators are activated and transformed into rapidly expanding aerosols, which are formed from solid particles suspended in the gas phase. The size of such particles is a few micro-meters.

The composition of the thermal aerosol is a potassium compound, which is non-corrosive, non-conductive and does not cause any damage to sensitive protected equipment, nor does it react on electronic components or metals.

The solid aerosol generator SFE does not contain any halogen compounds that react with the flame; therefore, the thermal aerosol does not produce corrosive halogenated acid by-products when reacting with the flame.

The concentration of solid particles of thermal aerosol suspended in the aerosol phase is a few milligrams per cubic meter. These particles are in the anhydrous phase and after a period of time are deposited as a fine dust at the bottom of the protected area. The dust is easily removed

by washing before it absorbs moisture.

After the fire is extinguished, the thermal aerosol by-products consist mainly of very low concentrations of KOH in the anhydrous phase (which is rapidly converted in K2CO3), and the by-products are in the form of thermal aerosol particles. When maintaining and recommissioning an aerosol generator system, the following procedures must be performed in the correct order.

1. Remain in this state for at least 10 minutes after release;
2. Do not enter the protected area and prohibit unauthorized personnel from entering;
3. Turn off electronic equipment;
4. Ensure that doors and windows are closed;
5. Contact the local rescue company;
6. Ensure that the protected area is secure before entering the area;
7. Dispose of the discarded generator in accordance with applicable federal, state, and local regulations;
8. Contact an aerosol distributor immediately for a rep.

Aerosol has conducted cold-release testing of aerosol generators on a wide range of materials, including structures, composites and materials commonly used in electronic equipment. In all cases, it has been shown that the aerosol generators are not detrimental to the operational capability of the equipment.

The ultrafine size of thermal aerosol particles and the particle generation process determines that these particles have considerable floating power and are easily suspended in the gas/air mixture in the protected area. Due to this "floating" effect, the aerosols do not "settle" over a long period of time (up to one hour). The particles deposited on the equipment have a particle size of less than ≤ 5 μm and do not form a continuous layer; therefore, a thorough inspection and cleaning of the site after a cold release is an important precaution. The aerosol itself is clean, but the effect on the environment must also be considered. Relative humidity must be reduced to less than 40% to ensure less damage to electronic equipment.

When a fire occurs, unknown, hazardous, by-products of the fire pose the greatest risk to sensitive equipment. Due to the potential presence of unknown products from the fire itself, or unwanted environmental conditions, we recommend that the area be thoroughly cleaned to ensure that it is free of undesirable products. During the release process, dust in the protected area will spread around, creating deposits of undesirable residue throughout the area. The orientation, position of the equipment may have been altered, resulting in the release of the agent directly onto the wall or surface of the equipment. This can all result in the deposition of small, localized, highly concentrated agglomerated particles on surfaces. If left untreated, the

agglomerated material may absorb moisture and may cause non-progressive discoloration (copper, bronze) of unprotected metal surfaces. Therefore, the need for a professional rescue company to clean up the agglomerated particles is of paramount importance.

8.5.9 Guidelines for cleaning thermal aerosol residues

- Clean up residue as soon as possible after release (within a few hours at most);
- Wipe dry residue off floors and metal surfaces with a damp cloth or brush;
- Remove residue from electrical components with a fan/blower;
- Clean residue from electrical components with special sprays;
- After a fire, hot aerosol particles should be cleaned off before they absorb moisture and mix with combustion residue in the atmosphere, Otherwise the mixture may react with or affect electronic components, metals, etc;
- If hot aerosol particles (dust) remain for a long time, they absorb moisture. The moisture can react with metals (especially uncoated metals) and cause them to oxidize.

8.5.10 Removal of thermal aerosol generator

The following steps should be completed when the thermal aerosol generator must be removed:

- Disconnect power to the fire detection system and ensure that it cannot be turned on;
- Disconnect the hot aerosol generator and ensure that it cannot be switched on;
- Ensure personnel are standing still and follow the rules for working at height. (Working Conditions Act);
- Unscrew the bolts and nuts securing the hot aerosol generator and remove it;
- Carefully remove the hot aerosol generator from the stand and place it on a stable surface;
- After removing the hot aerosol generator, put the fire detection and alarm device back into operation as required by the competent authority;
- If the aerosol generator has been activated and is still hot, wear heat-resistant gloves.

8.5.11 Waste and the environment

Activated thermal aerosol generators that have been removed may be disposed of as ordinary waste.

If a thermal aerosol generator is removed but not activated and still contains a solid aerosol generator, the generator should be returned to the local distributor for proper disposal.

9. Diagnosis of common abnormal problems

9.1 System alarm handling solutions

9.1.1 Liquid-cooled unit failure

9.1.1.1 Fan failure

Failure phenomenon	Possible causes	Inspection and maintenance
External circulation fan does not operate	Liquid cooling unit not powered up	Check if there is power at the power input of the liquid cooling unit.
	Have suffered a lightning strike, the circuit breaker Tripped	Check if the circuit breaker inside the liquid cooling unit is closed.
	Abnormal power input to the liquid cooling unit (such as over- or under-voltage of the power supply)	Verify that the liquid cooling unit has the appropriate alarms.
	The liquid cooling unit is in standby mode	Normal scenario. The liquid cooling 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.

9.1.1.2 Cooling system failure

Failure phenomenon	Possible causes	Inspection and maintenance
Compressor 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.
	Open circuit 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 liquid discharge temperature compressor on the display screen. Check that the operating 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.

9.1.1.3 Cooling media circulation system failure

Failure phenomenon	Possible causes	Inspection and maintenance
Internal circulation water pump does not start	Not powered on (standby)	Check the main power switch, and check the operation display interface, whether it has been turned on.
	Loose circuit connection	Fasten the circuit connectors.
	Water pump inverter failure	Replace the pump inverter.

	Pump body failure	Replace the circulation pump. Replacing the electric heater and circulating water pump.
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. For details, see "10.4 Replacing the electric heater and circulating water pump".

9.2 Emergency handling methods

9.2.1 Fire

Step1: Evacuate the site to a safe area, set aside a safe isolation zone, and call the police according to the site conditions;

Step2: Under the condition of ensuring personal safety, the following operations are conditionally carried out: If the wiring harness is smoking and on fire, use carbon dioxide or dry powder extinguishers to put out the fire If you accidentally inhale smoke, please move and seek medical attention as soon as possible;

Step3: 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 as soon as possible, and then execute the firefighting action.

9.2.2 Flooding

Step 1: Emergency evacuation of site personnel to a safe area, regardless of whether the system is powered on or not, and delineate a safe isolation zone;

Step 2: Notify the system provider and have it serviced after the water has receded;

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

Appendix I

Inspection items	Inspection method	Yes/No	Abnormal logging
Is the fire extinguishing system complete?	Visual assessment		
Whether the fire extinguishing system is within the validity period	Visual assessment		
Is the heat dissipation system complete	Visual assessment		
Whether the air duct of the cooling system is clogged	Visual assessment		
Whether the appearance of the electric cabinet is deformed	Visual assessment		
Whether the appearance of the electric cabinet is rusty and damaged	Visual assessment		
Whether there is moisture inside the electric cabinet	Visual assessment		
Whether Low-voltage wiring harness is loose or broken	Visual assessment		
Is the high voltage harness loose or broken	Visual assessment		
Does the wire harness interfere with structural components	Visual assessment		
Whether high-voltage connections are corroded	Visual assessment		
Structural member fixing bolts are loose or missing.	Visual assessment		
Whether maintenance switch (MSD) is complete and securely installed	Visual assessment		
Whether cooling water pipeline is broken	Visual assessment		
Is there is stink in the battery compartment	Nasal sniffing		
Any irritating odours in the electrical cabinet	Nasal sniffing		
Whether there is a burning smell in the high-voltage connection area	Nasal sniffing		

Is the summary data complete	Monitor the upper computer		
Is cell voltage data complete	Monitor the upper computer		
Is cell temperature data complete	Monitor the upper computer		
Does alarm bar have abnormal alarm	Monitor the upper computer		
Note: If any abnormality is found during the inspection, please provide timely feedback and contact to arrange for the relevant personnel to deal with it.			