

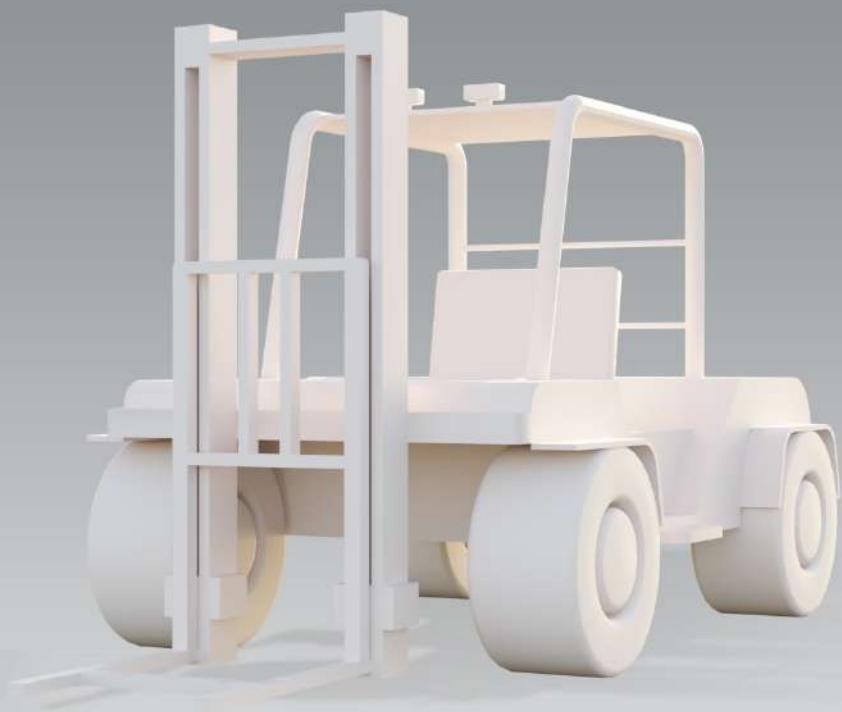
DOWELL ESS

iCube 100/215

Energy Storage System

User Manual

Document version
: 01



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Table of Contents

1 Overview	4
1.1 Main Content	5
1.2 Target Audience	5
1.3 Warning Sign Definition	6
2 Safety Instructions	7
2.1 Safety Information	8
2.2 Operator Requirements	10
2.3 Electrostatic Protection	10
3 Product Description	11
3.1 Energy Storage System Overview	12
3.2 Application Scenarios	12
3.3 Main Functions	13
3.4 Technical Parameters	13
3.5 Appearance	15
3.5.1 Product dimensions	15
3.5.2 Appearance and interface introduction	16
3.5.3 Internal introduction	17
3.6 Communication Topology Diagram	17
4 Lifting, Transportation And Storage	18
4.1 Unboxing	19
4.2 Lifting Operation	20
4.2.1 Lifting precautions	20
4.2.2 Preparation before lifting	35
4.2.3 Lifting process	21
4.3 Forklift Operation	22
4.4 Storage	24
5 Equipment Installation	25

Table of Contents

5.1 Installation Precautions	26
5.2 Preparation Before Installation	28
5.2.1 Installation environment requirements	28
5.2.2 Installation site requirements	29
5.2.3 Equipment ventilation requirements	30
5.2.4 Preparing installation tools	31
5.2.5 Installation site maintenance space requirements	31
5.3 Energy Storage System Structure Installation	33
5.3.1 Mobile installation	33
5.3.2 Fixed installation	34
5.3.3 Installation inspection	35
5.3.4 Installation tool preparation	12
5.4 Electrical Wiring	37
5.4.1 External AC cable connection and procedures	37
5.4.2 AC cable and ground cable wiring procedures	38
5.4.3 Inspection after equipment wiring	40
 <i>6 Product Operation</i>	41
6.1 Power-on Process	42
6.1.1 Check before power-on	42
6.1.2 Power-on steps	42
6.2 Normal Shutdown Procedures	44
6.3 Emergency Stop Procedures	45
6.4 Display Screen Interface Operation	46
 <i>7 Maintenance Instructions</i>	48
7.1 System Requirements	49
7.1.1 Requirements for normal system operation	49
7.1.2 Long-term unused system usage requirements	50
7.2 Maintenance Precautions	51
 <i>Appendix 1 Inspection Form</i>	

01

Overview



1.1 Main Content

This manual mainly introduces the methods of transportation and storage, mechanical installation, electrical connection, power-on and power-off, fault handling and maintenance of energy storage integrated systems.

1.2 Target Audience

This manual is applicable to personnel involved in the transportation, installation and other operations of this product. Personnel involved must meet the following requirements:

- 1. Proficient in professional knowledge such as electricity, electronics, and mechanical engineering, and proficient in understanding electrical schematics, structural drawings, etc.
- 2. Understand the products, basic knowledge, working principles, and control logic of the energy storage industry;
- 3. Have a professional electrician construction certificate and qualification recognized by the law in the area where this product is used, and be familiar with local relevant laws and regulations;
- 4. Have the ability to handle emergency incidents and handle related incidents in accordance with the laws and regulations in the area where this product is used;
- 5. Proficient in the terms and contents of this manual, have professional profession skills and a high sense of responsibility.
- The manual contains important information. Please read the manual carefully before operating and maintaining the system. Please put this manual and other materials in the product components together to ensure that operators and maintenance personnel can refer to it in time.

1.3 Warning Sign Definition

In order to protect the personal and property safety of users when using this product and improve the efficiency of users using this product, this manual details the relevant information and adds relevant symbols to strengthen the explanation. The following symbols may appear in this article, and their meanings are as follows:

Symbol	Illustrate
 Danger	Intended to warn of an imminently hazardous situation which, if not avoided, will result in death or serious injury.
 Warning	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
 Caution	Indicates a potentially hazardous situation which, if not avoided, may result in moderate or minor injury.
 Notice	Used to convey equipment or environmental safety warning information, which, if not avoided, may result in equipment damage, data loss, equipment performance degradation, or other unpredictable results. "Notice" does not involve personal injury.
	Indicates additional information in the manual, which emphasizes and supplements the content. It may also provide tips or tricks for optimizing the use of the product, which can help you solve a problem or save you time.
	This symbol means that there is dangerous high voltage inside the product and touching it may cause electric shock.
	This symbol means that there is a high temperature hazard in this part of the product. Please avoid contact to avoid personal injury.
	This symbol means that the product is protected by ground (PE) and needs to be connected to a ground wire. The connection must be firm and reliable to ensure the safety of the operator.
	This symbol means that it is forbidden to open the product here, and there will be serious dangers if you open it casually.
	This symbol means that it is forbidden to touch this part of the product. Touching it carelessly may cause equipment failure and pose a great danger.

02

Safety

Instructions



2.1 Safety Information

Please strictly abide by the safety regulations in this product manual. To avoid possible casualties and property losses during the use of this product, and to increase the service life and efficiency of this product, please read the safety regulations carefully.

- 1. Do not immerse the battery in water;
- 2. Improper use and storage of batteries may result in the risk of fire, explosion and burns. Do not disassemble, crush, incinerate, heat or throw the battery into fire;
- 3. Do not throw the battery into fire or expose it to high temperatures exceeding the temperature conditions specified in this manual for a long time, otherwise it may cause a fire;
- 4. When the battery life ends, the used battery should be disposed of in a timely manner in accordance with local recycling or waste regulations;
- 5. Do not disassemble, dismantle or repair the battery in any way without authorization;
- 6. Do not mix lithium-ion batteries of different specifications and brands;
- 7. Do not use the battery if it emits an odor, heats up, deforms, changes color or has any other abnormal phenomenon;
- 8. Do not short-circuit the positive and negative poles of the battery, otherwise the strong current and high temperature may cause personal injury or fire;
- 9. Connect the positive and negative poles of the battery strictly according to the markings and instructions. Reverse or cross-charging is prohibited;
- 10. Overcharge/over-discharge of the battery is prohibited, otherwise it may cause battery overheating and fire accidents;

- 11. When the electrolyte leaks, avoid skin and eyes from contacting the electrolyte. If contact occurs, immediately wash the contact area with plenty of clean water and seek medical help;
- 12. It is prohibited for any person or animal to swallow any battery parts or battery contents;
- 13. The battery is potentially dangerous, and appropriate protective measures must be taken during operation and maintenance. Otherwise, it may cause serious personal injury and property damage;
- 14. The customer is aware of the following potential hazards during the use and operation of the battery: The operator may be injured by chemicals, electric shock or arc during operation; although the human body reacts differently to DC and AC, DC voltages above 50V are equally harmful to the human body as AC, so the customer must take a conservative posture during operation to avoid current injury. There are chemical risks from the electrolyte in the battery. When operating the battery and selecting personal protective equipment, the customer and his employees must consider the above potential risks to prevent accidental short circuits, arc explosions or thermal runaway;
- 15. Do not throw or drop the battery. Gravity impact may damage the protective mechanism and may cause abnormal chemical reactions leading to heating or fire.
- 16. Do not pierce, hammer, stamp or any other actions that may cause the battery to deform. They may cause short circuit or fire in the battery.

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

If any of the above abnormal usage conditions occur, the device should not be used and the after-sales department of Dowell Technology Co., Ltd. should be contacted as soon as possible for further evaluation.

2.2 Operator Requirements

- 1. When operating or maintaining the energy storage system, you must wear a safety helmet, insulating gloves, insulating shoes, and goggles. It is strictly forbidden to wear metal accessories such as watches;
- 2. Only professionally qualified electricians can operate and maintain this product, and they must be equipped with complete professional electrical equipment;
- 3. Be able to evaluate the assigned tasks and identify possible dangerous events;
- 4. Be able to rescue injured people in the first place;
- 5. Understand the relevant maintenance standards of the product;
- 6. Comply with local laws, regulations, and standards.

2.3 Electrostatic Protection

The accumulation of static electricity may cause electric shock, fire, explosion, failure and damage of electronic devices, etc. The energy storage system contains circuit boards or other electrostatically sensitive components. In order to prevent or reduce the harm of static electricity, static protection must be done to inhibit the generation of static electricity, accelerate the leakage of static electricity, and neutralize static electricity. Its prevention methods include but are not limited to:

- 1. During the replacement of components, all uninstalled equipment and components should be kept in packaging bags with static shielding function, and temporarily removed equipment and components should be placed on foam plastic pads with anti-static function;
- 2. Do not touch welding points, pins or exposed circuits.

03

Product

Description



3.1 Energy Storage System Overview

A single 100kW 215kWh commercial liquid-cooling all in one system, consisting of 4 liquid-cooling battery packs, a high-voltage box and a 100kW PCS. Each liquid-cooling pack is composed of 60 battery cells connected in series, and the rated capacity of the battery cell is 280Ah. The high-voltage box contains a battery cluster management unit and some protection, control and other electrical components, which are used to manage and protect the operating status of the entire battery cluster. The energy storage system adopts a battery compartment and an electrical compartment design, which is convenient for installation and maintenance.

3.2 Application Scenarios

Power generation side:

It is used to reduce the impact of instantaneous changes in photovoltaic and wind power generation systems on the power grid, smooth out power fluctuations, and reduce resource waste and wind abandonment.

Grid side:

Peak shaving and valley filling, load smoothing, and rapid adjustment of grid frequency can improve the stability and reliability of grid operation.

In a microgrid, the energy storage system helps maintain the dynamic balance of the system and ensures voltage stability for critical loads.

User side:

Use electricity at off-peak hours, save on electricity bills, and enjoy the price difference between peak and trough electricity prices.

As a backup power source, it reduces peak power load.

3.3 Main Functions

- 1. The battery system can detect the battery operating status (voltage, current, temperature, SOC/SOH, etc.) and regulate battery charging and discharging and energy storage based on operating conditions and actual performance of electrical components;
- 2. The battery system has high-voltage sampling and MSD, fuse and other safety device status check functions. When a battery fails, the system will report and limit the charge and discharge current or power to protect the safety of the power system;
- 3. The battery system can control the cooling, heating and temperature setting of the water-cooling unit;
- 4. The liquid-cooling energy storage system meets the IP55 protection level and supports outdoor use.

3.4 Technical Parameters

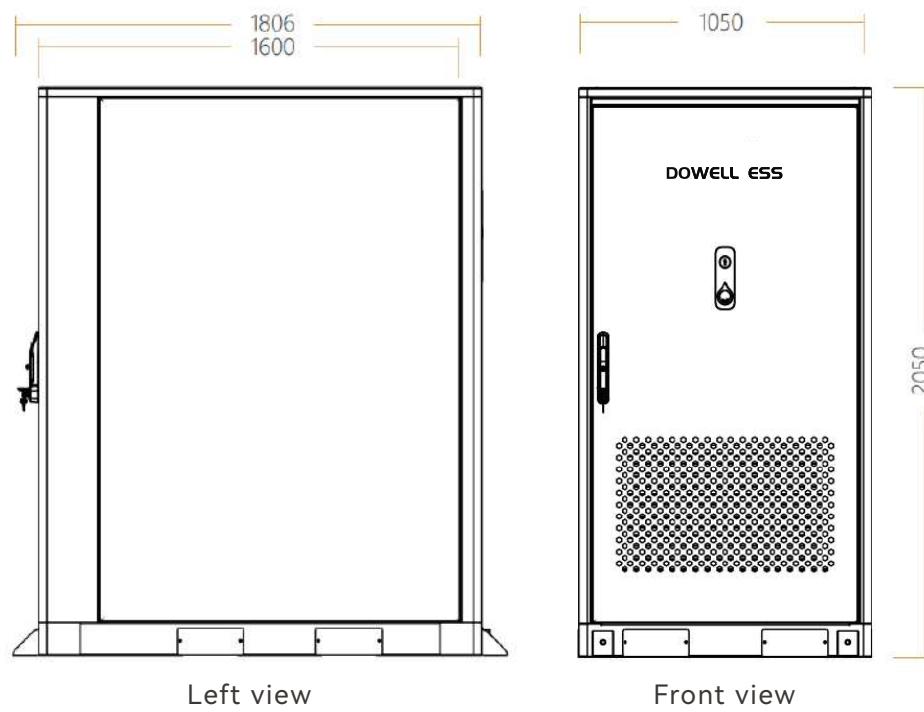
Product Model	iCube-C Series
Model Name	iCube 100/215
Cell Capacity	LFP-280Ah
C Rate	0.5P
Configuration	1P240S
Battery System Voltage	768VDC
Number of strings	1
Rated Energy Capacity	215kWh
Battery Voltage Range	672-852Vdc
BMS Communication Interface	RS485, Ethernet
BMS Communication Protocol	Modbus RTU, Modbus TCP
Certification	IEC62619

Product Model	iCube-C Series
AC Data	
Rated AC Power	100kW
Max. AC Current	160A
Rated voltage	400/230V
Grid Voltage Range	-20% - 15%
PCS Cooling	Air cooling
Frequency	50HZ/60HZ
Output THDi	<3%
PF	1 (lead) ~1 (lag)
AC Output	3W+PE / 3W+N+PE
Certification	UL1741, IEEE1547.1-2020, CSA C22.2, IEC62477, EN50549
General Data	
Dimension W/O Clearances[W*D*H]	1050*1600*2050mm
System Efficiency	95%
Degree of Protection	NEMA 3R /IP 54
Operating Temperature Range	-20~55°C
Relative Humidity	0~95% (non-condensing)
Max Working Altitude	<3000m
Cooling concept of DC hatch	Liquid-cooling

*Note: Delflagration venting is optional configuration, result in different quotation.Flexible Configuration of each cabinet in parallel, adaptive to flexible capacity layout.

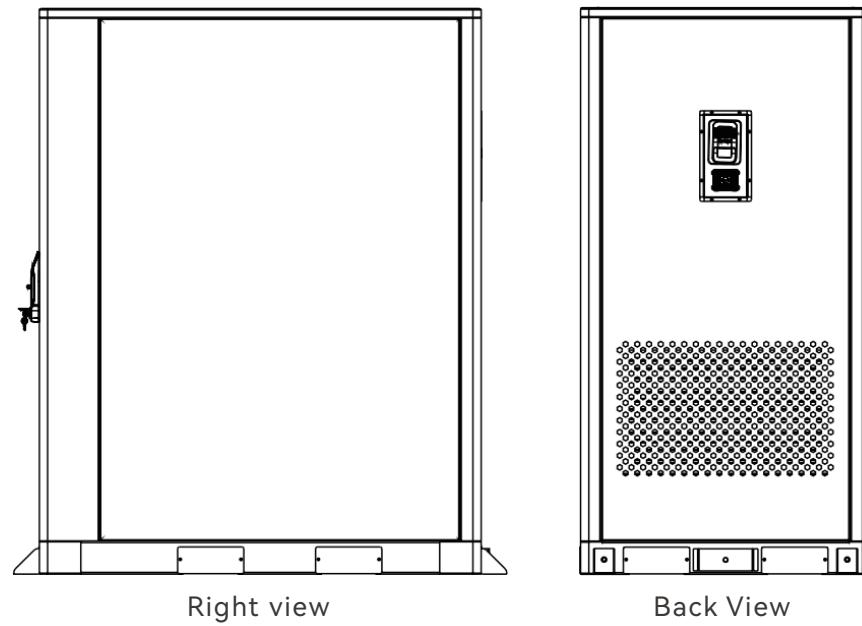
3.5 Appearance

3.5.1 Product dimensions



Left view

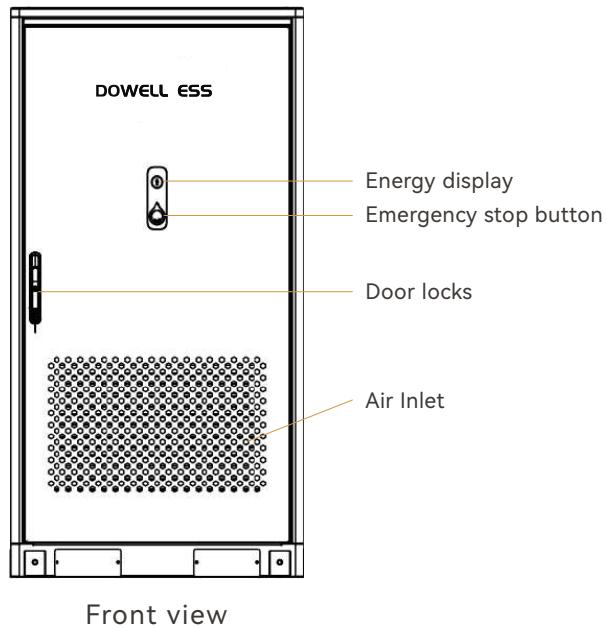
Front view



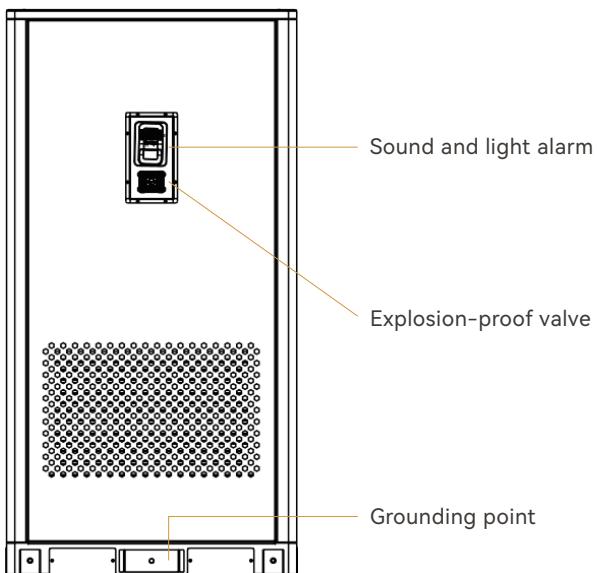
Right view

Back View

3.5.2 Appearance and interface introduction

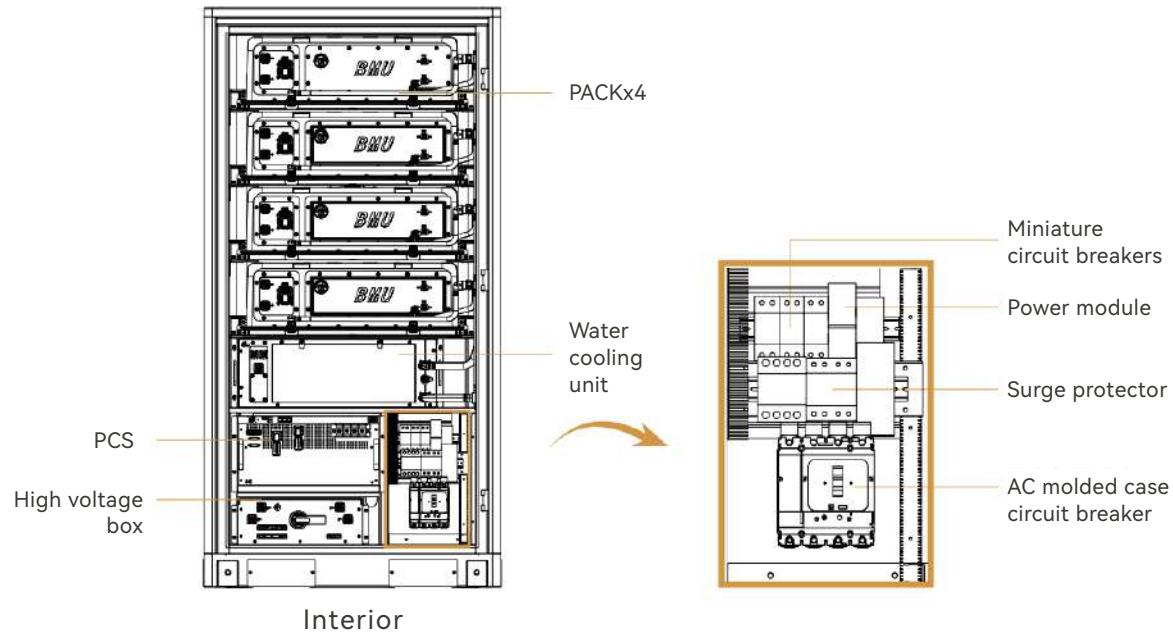


Front view

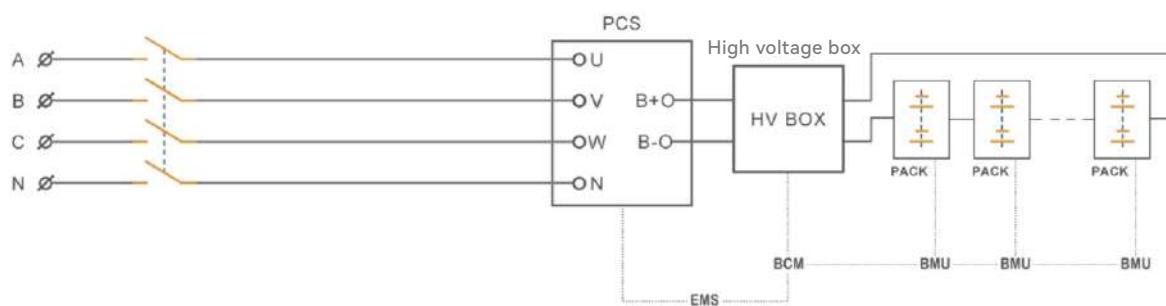


Back View

3.5.3 Internal introduction



3.6 Communication topology diagram



04

Lifting, Transportation And Storage



4.1 Unboxing

- 1. Please pay attention to the following matters when unpacking. After unpacking, please confirm whether the accessories are complete.
- 2. Please do not apply impact force to the battery when unpacking, as this may cause damage to the battery.
- 3. After unpacking, please check whether there are any scratches, deformation or other abnormalities on the appearance.
- 4. If there is any abnormality after unpacking, please contact the dealer. If you continue to use it, it may cause leakage, fire, or battery damage.

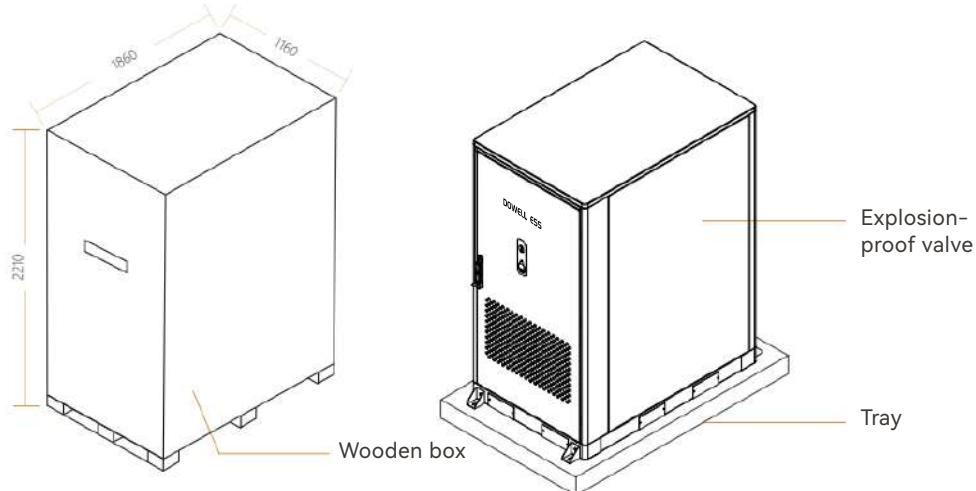


Figure 4-1 Packaging diagram

Product accessories:

Name	Use	Quantity
OT70-8 terminal	used for AC IN/OUT switch wiring	5pcs

When the product configuration does not include a DCDC module, the whole machine does not have the accessories listed in the above table.

4.2 Lifting Operation

4.2.1 Lifting precautions



Warning

- During the entire lifting process, the crane's safety operating procedures must be strictly followed;
- No one is allowed to stand within 10 meters of the operating area, especially under the crane arm and on the hoisted or moving machine. It is strictly forbidden to stand under the device to avoid casualties;
- In case of adverse weather conditions, such as heavy rain, fog, strong wind, etc., the vehicle should be stopped.

4.2.2 Preparation before lifting

- 1. Crane preparation:

The total weight of the equipment (including packaging) is about 3 tons. Please select the crane lifting tonnage according to the total weight of the equipment and site conditions. Recommended tonnage: 5~8 tons.

- 2. Preparation of lifting equipment: Wire rope, shackle, strut, etc.

4.2.3 Lifting process

- 1. When loading and unloading, a crane of appropriate tonnage must be used. When lifting, nylon lifting ropes (belts) or wire ropes can be used;
- 2. The hoisting process must be carried out in strict accordance with the hoisting diagram, see Figure 4-2 below for details;
- 3. The machine should be lifted vertically and should not be dragged on the ground or pushed on any surface;
- 4. After the cabinet is lifted 300mm off the ground, stop moving and check the connection of the lifting device. Only after that can the lifting continue;
- 5. During the entire lifting process, it should be done slowly, pay attention to the balance of the box, and do not move too fast;
- 6. During the entire lifting process, it is strictly forbidden to stand under the outdoor cabinet and the crane.

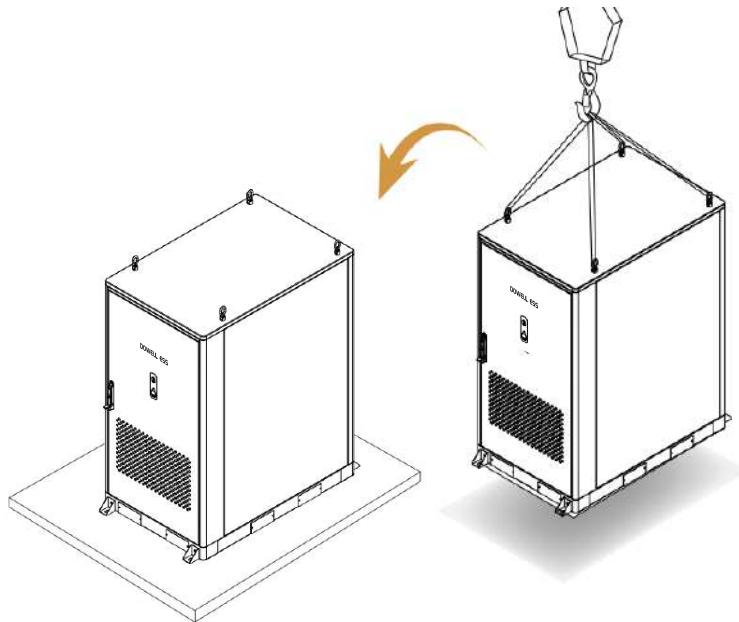


Figure 4-2 Hoisting diagram

4.3 Forklift Operation



Notice

During transportation and loading and unloading, please always keep in mind the mechanical parameters of the energy storage system:

- Packing size (L×W×H): 1160×1860×2210mm
- Weight: Approx. 2650kg

When using a forklift for forklift operations, the following conditions must be met:

- 1. The forklift used should have sufficient load-bearing capacity (at least 5 tons is recommended);
- 2. The fork of the forklift used should be inserted into the full depth of the integrated cabinet, that is, the fork length should be at least 1500mm.

The schematic diagram of the forklift hole is shown in Figure 4-3 below;

- 3. When lifting, lowering and moving the fork, it must be done slowly and steadily, and a test fork must be performed;
- 4. Considering safety factors during forklift loading, it is recommended to tie a safety belt around the equipment and connect it to the forklift beam.

For specific forklift operation, please refer to Figure 4-4 below:

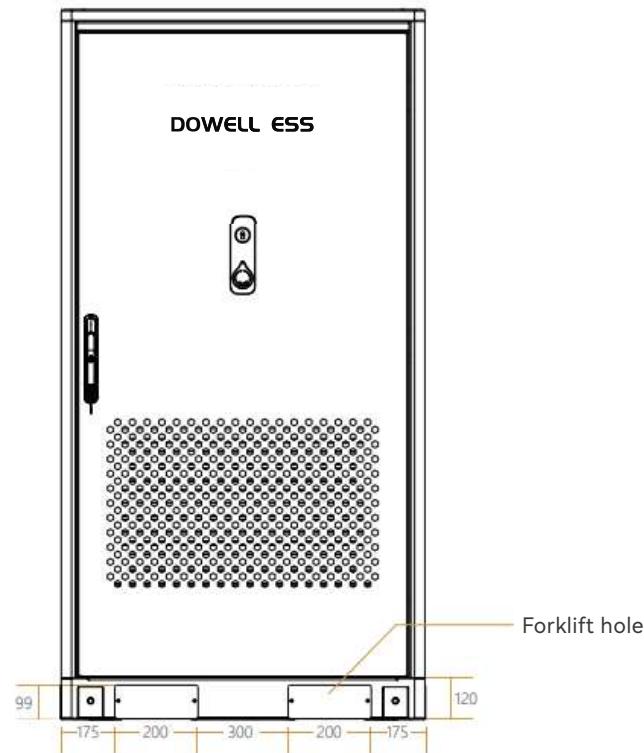


Figure 4-3 Forklift hole diagram

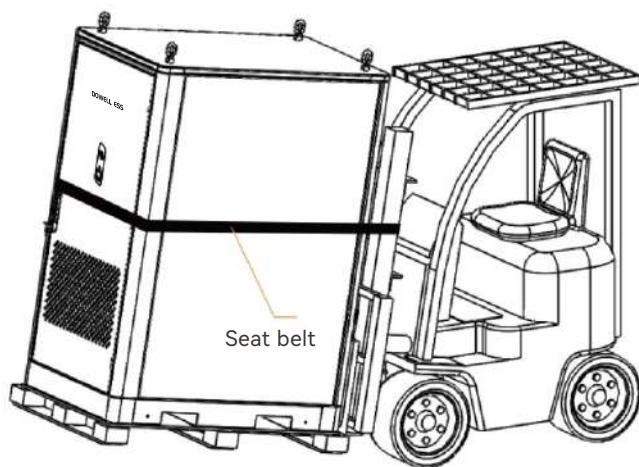


Figure 4-4 Fork mounting diagram

4.4 Storage

The liquid-cooling energy storage system should be stored in a dry warehouse and should not be exposed to the sun or rain. Toxic and harmful gases, flammable and explosive products, and corrosive chemicals are not allowed in the warehouse. Mechanical shock, heavy pressure, strong magnetic field, and direct sunlight should be avoided. The distance from heat sources should not be less than 2m, and the distance from walls, windows, or air inlets should be at least 50cm.

Project	Parameter
Average daily storage temperature	$\leq 20^{\circ}\text{C}$
Allowable storage temperature	<ul style="list-style-type: none">Short-term storage temperature range (within 1 month): $-20 \sim 45^{\circ}\text{C}$Long term storage temperature: $-20^{\circ}\text{C} \sim 35^{\circ}\text{C}$
Storage humidity	$\leq 95\%$, no condensation

Under these conditions:

It is recommended to discharge and recharge the battery every 3 months to ensure that the battery SOC is always maintained in the range of 20% to 50% SOC. Capacity verification tests and re-inspections are required every 12 months.

Warning

During the storage of the energy storage system, if the user does not comply with the storage methods and Dowell Technology Co., Ltd. does not assume any responsibility for system damage caused by failure to comply with the requirements.

05

Equipment

Installation



5.1 Installation Precautions



Danger

The energy storage system is a high-voltage device and is a dangerous item. Improper operation and use by non-professionals may cause serious consequences such as electric shock, combustion, and explosion. The installation and maintenance of the integrated energy storage battery cabinet must be performed by professional technicians, and relevant safety regulations must be strictly followed when using it.



Warning

1. Be careful not to touch the staff when the equipment is hoisted to the ground;
2. A special installation isolation area must be set up when performing installation operations;
3. During the hoisting process, it is necessary to pay attention to the equipment to be handled with care;
4. Only installers who have received high-voltage electricity treatment training can install it;
5. If the equipment is defective, cracked, or damaged, please do not install it;
6. Do not try to open, disassemble, repair, tamper with or modify the equipment during installation;
7. Do not install in bad weather such as rain, dust, etc.;
8. In order to protect the equipment and its components from damage during transportation, please operate with caution; do not hit, pull, drag or step on the equipment. Do not subject the equipment to any strong external force;
9. Do not insert foreign objects into any part of the equipment;
10. Do not expose the equipment or its components directly to flames;
11. Do not install the equipment near heating devices;
12. Do not immerse the equipment or its components in water or other liquids;
13. Please place the equipment on a level ground to ensure that it is placed stably without shaking or tilting;
14. The installation of the equipment should take into account the load-bearing and load-bearing capacity of the installation ground.

The internal devices of the energy storage system have been reliably connected and tested before leaving the factory. At the project site, it is necessary to install and fix the energy storage system, connect the external communication cables, and connect the external auxiliary power supply cables.

The detailed description of the energy storage system installation process is shown in the following table:

Installation Process	Description
Pre-installation inspection	<ol style="list-style-type: none">1. Check whether the appearance of the equipment is damaged;2. Check whether there are any components in the equipment that are damaged or fallen off;3. Confirm that all parts are intact and not missing;4. Confirm that the installation environment meets the requirements;5. Confirm whether there is other equipment installed at the project site.
Allowable storage temperature	<ol style="list-style-type: none">1. Use a crane to hoist the equipment onto the prefabricated foundation;2. Fix the equipment according to project requirements.
Storage humidity	<ol style="list-style-type: none">1. Connect the ground point;2. Connect the communication and signal cables from the equipment slave to the host.3. Connect the power cables of the equipment host and slave to the user;4. Connect the communication cable between the equipment host and the user.

5.2 Preparation Before Installation

5.2.1 Installation environment requirements

The energy storage system installation environment should meet the following requirements:

Project	Environmental requirements
Installation project site requirements	<ol style="list-style-type: none">1. Outdoors with good ventilation and high wind volume2. The air inlet and outlet must be professionally protected from rain, wind, sand and dust3. Necessary fire prevention, waterproof and rodent prevention treatment4. Surface inclination $\leq 1^\circ$, earthquake resistance >8
Foundation requirements	<ol style="list-style-type: none">1. The installation surface must be flat and dry, and no water is allowed to accumulate on the ground2. Ensure that the ground is level and can bear the weight of the energy storage equipment
Space requirements	There must be enough space in front, behind, left, right and above the equipment for ventilation, maintenance and escape
Ambient temperature	$-20^\circ\text{C} \sim +50^\circ\text{C}$
Relative humidity	$\leq 95\%$, no condensation
Altitude	$\leq 2000\text{m}$

5.2.2 Installation site requirements

Energy storage system must be installed on concrete or other non-combustible surfaces. The installation plane must be horizontal, firm, and flat, with sufficient bearing capacity, and no depression or tilt is allowed.

When building the foundation, the wiring of the equipment must be considered, and trenches or other wiring holes for wiring must be reserved.

The equipment adopts the method of wiring from the bottom, and the wiring must be routed through the trench. Therefore, a trench needs to be preset on site. The following requirements are imposed on the trench:

- 1. The trench needs to have necessary waterproof and moisture-proof design to prevent the cable from aging and short-circuiting, which will affect the normal operation of the energy storage equipment.
- 2. Since the power of the equipment is large, the required cable is thicker, and the cross-sectional area of the cable needs to be fully considered when designing the trench.
- 3. Customers can determine the number of cable brackets according to their needs, and the cable brackets need to fully consider the weight and size of the equipment.
- 4. When laying cables, communication cables, power cables, and power cables need to be laid separately. The DC circuit and AC circuit need to be laid separately, and the distance between different cables needs to be greater than 300mm.
- 5. The climate around the installation site is dry and well ventilated, and it is far away from Class A factories or flammable and explosive areas;
- 6. The foundation soil needs to have a certain degree of compactness. It is recommended that the relative density of the soil at the installation site be $\geq 98\%$. If the soil is loose, please be sure to take corresponding measures to ensure the stability of the foundation.

5.2.3 Equipment ventilation requirements

The operation of energy storage equipment will generate a lot of heat. If the temperature of the equipment is too high, the electrical parameters of the energy storage equipment will deteriorate and may cause damage to the energy storage equipment. To ensure the heat dissipation of the energy storage equipment, the installation environment must meet the following requirements:



Notice

- The equipment should be installed in a well-ventilated environment;
- The air inlet must ensure sufficient fresh air entering;
- It is recommended that the ventilation system of the equipment be separated from other ventilation systems in the control room;
- If you find that the equipment is overheating, please check that the ventilation holes are properly ventilated.

The energy storage system adopts the front air flow and rear air flow design. The positions of the air inlet and outlet are shown in the following figure:



Figure 5-1 Diagram of air outlet

5.2.4 Preparing installation tools

Tools	quantity	Instructions
Forklift	1	<ul style="list-style-type: none"> For indoor and outdoor transportation. The load-bearing capacity is greater than 5t and the fork length is greater than 1500mm The fork center distance is greater than 600mm
Crane	1	Load-bearing capacity: 5~8t
Bandage	8m	Flexible straps, wire ropes or strapping for crane transport
Sockets and wrenches	1 set	For fixing, the maximum torque should be greater than 70N·m

5.2.5 Installation site maintenance space requirements

Considering the space requirements of the energy storage equipment, the maintenance space of the front door of the equipment is required to be no less than 1.5m (if a forklift is required to replace the pack, it is recommended to reserve 2.5m), the maintenance space on the left and right sides is required to be no less than 0.1m, and the maintenance space of the rear door of the equipment is required to be no less than 0.8m. The specific installation distance shall be subject to the requirements of the local design and installation specifications.

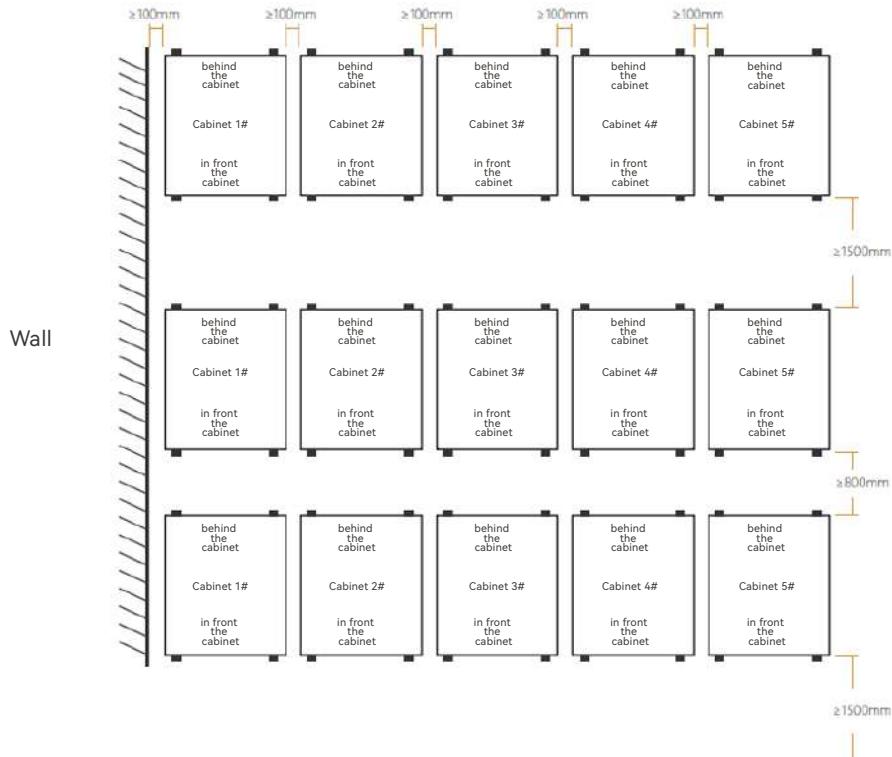


Figure 5-2 Installation and maintenance space diagram

Serial number	Inspection items
1	Check the packaging boxes to see if they are missing, damaged or damp.
2	After unpacking, please check whether the shell of each module is deformed, paint peeled, cracked, etc., and whether there is water stain inside the shell.
3	Please check the accessories inside the packaging box and count the items according to the list to ensure that they are complete (optional accessories).

5.3 Energy storage system structure installation

Considering the space requirements of the energy storage equipment, the maintenance space of the front door of the equipment is required to be no less than 1.5m (if a forklift is required to replace the pack, it is recommended to reserve 2.5m), the maintenance space on the left and right sides is required to be no less than 0.1m, and the maintenance space of the rear door of the cabinet is required to be no less than 0.8m. The specific installation distance shall be subject to the requirements of the local design and installation specifications.

5.3.1 Mobile installation

As shown in the figure below, place the equipment on a flat cement platform with sufficient support, and feed the wires through the forklift port on the front of the equipment.

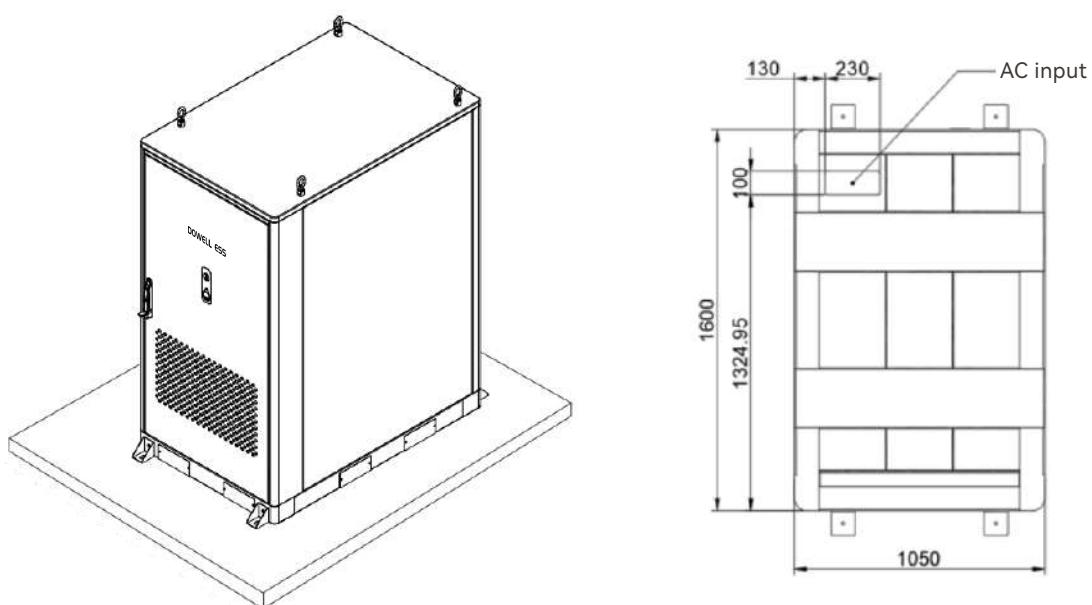


Figure 5-3 Installation line import diagram

5.3.2 Fixed installation

After the energy storage system is hoisted, use M12 (recommended torque: 40N·m) bolts to fix the equipment base according to project requirements. As shown in the following figure:

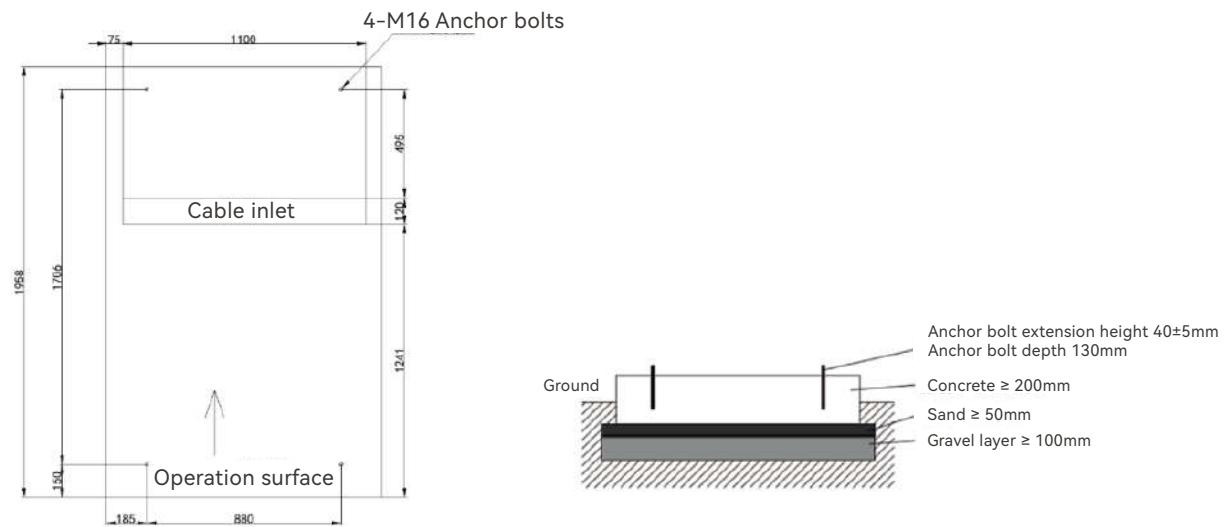


Figure 5-4 Installation piling diagram (Subject to the actual situation of the project)

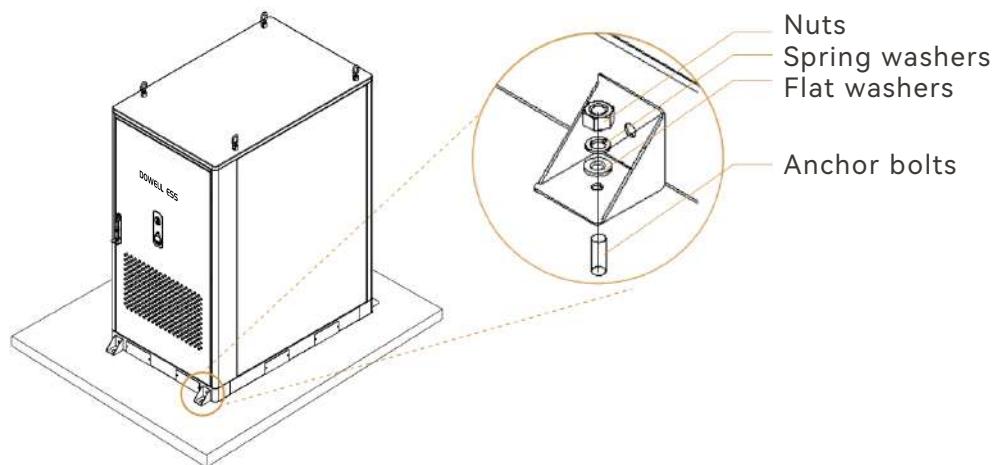
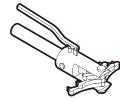


Figure 5-5 Installation and fixing diagram (subject to the actual situation of the project)

5.3.3 Installation inspection

Serial number	Inspection items	Treatment measures
1	Check whether the fasteners are tightened.	If it is loose, tighten the screws again.
2	Whether the space environment meets the installation size requirements.	If there is insufficient space, it is recommended to redesign and install.
3	Check whether the air duct is unobstructed and free of foreign matter.	If there is any foreign matter, please clean it up. If it is not smooth, eliminate the cause.

5.3.4 Installation tool preparation

Serial number	Tool Name	legend
1	Insulating gloves	
2	Protective glasses	
3	Insulated shoes	
4	Face mask	
5	Hydraulic pliers	

Serial number	Tool Name	legend
6	Screwdriver	
7	Wire strippers	
8	Diagonal pliers	
9	Impact drill	
10	Torque wrench	
11	Ruler	
12	Tape measure	
13	Marker pen	

5.4 Electrical Wiring

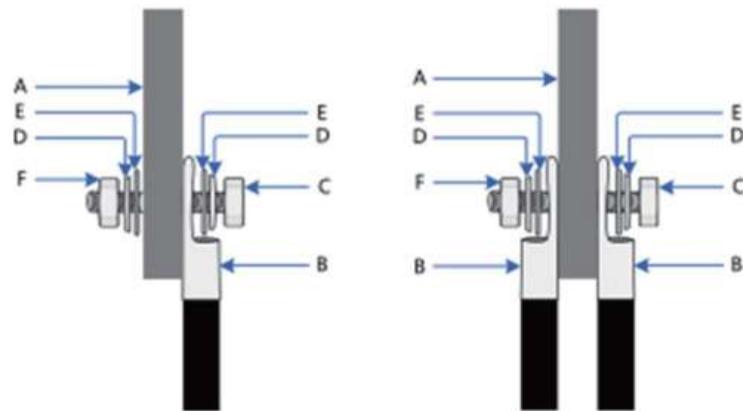
5.4.1 External AC cable connection and procedures

Cable and terminal model recommendations

The recommended terminal models for AC cables and grounding wires are shown in the following table:

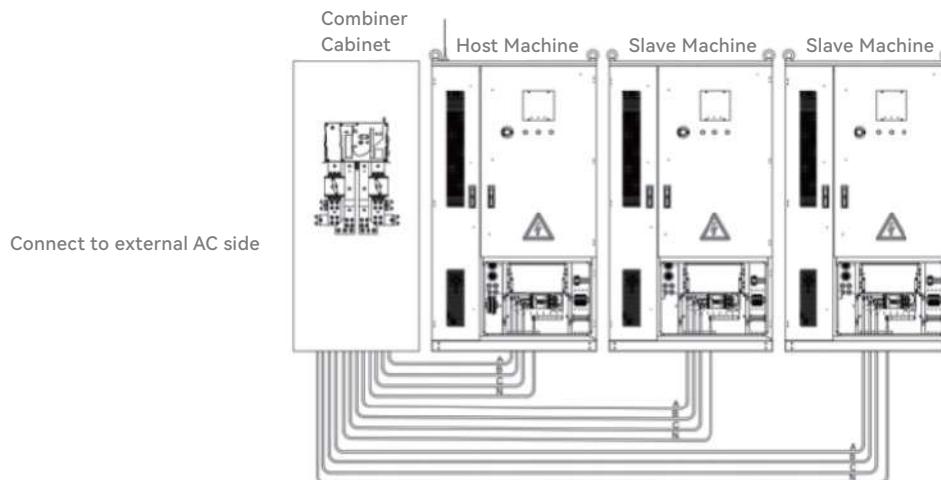
Serial number	Project	Description
1	AC cable wiring	4*70+35 power cables are inserted into the bottom of the cabinet and connected to the AC terminal block, neutral copper bar and ground bar of the host or slave of the liquid-cooled energy storage battery integrated cabinet. Five M10×25 combination screws with performance level 8.8 are required to lock the terminal and copper bar, and use a No. 17 socket wrench to tighten. The recommended tightening torque is: 40N·m
2	Terminal block model	<ul style="list-style-type: none">• Copper tube terminal: wire diameter 70, M10 fixing hole• Copper tube terminal: wire diameter 35, M10 fixing hole

The connection specifications of cables and copper bars are shown in the figure below:



A	B	C	D	E	F
Copper busbar	Copper terminal	Screws	Dish washer	Flat washer	Nut

5.4.2 AC cable and ground cable wiring procedures



- Step 1: Confirm that the output switches of the energy storage equipment and the front and rear stages of the high-voltage distribution box are in the disconnected state;
- Step 2: Strip off the insulation at the end of the cable. The length of the insulation stripped off at the end of the cable should be the depth of the wire crimping hole of the wiring copper nose plus about 5mm;
- Step 3: According to the selected cable specifications, equip the appropriate wiring copper nose for crimping;
 - (1) Place the exposed copper core of the stripped wire into the crimping hole of the wiring copper nose
 - (2) Use a terminal crimping machine to crimp the wiring copper nose. The number of crimps should be more than two.
- Step 4: Install the heat shrink tubing
 - (1) Select a heat shrink tubing that matches the cable size. The length of the heat shrink tubing should be about 2cm longer than the crimping tube of the wiring copper nose.
 - (2) Put the heat shrink tubing on the wiring copper nose to completely cover the crimping hole of the wiring copper nose.
 - (3) Use a hot air gun to heat the heat shrink tubing to shrink it.
- Step 5: Wiring
 - Select screws, spring washers, flat washers and nuts that match the wiring copper nose to connect and fix them to the wiring junction box/grid cabinet junction copper busbar, and tighten them according to the recommended torque of 40N·m.

5.4.3 Inspection after equipment wiring

After installation, the following items must be checked and measured again to avoid equipment damage and property loss.

Serial number	Description
1	Before measurement, disconnect the switches on the battery side and the grid side to ensure that the DC and AC sides of the energy storage device are not energized.
2	The positive and negative poles of the battery and the energy storage equipment are connected correctly and the AC phase sequence is correct and has been tightened. Measure the resistance between the three phases, which should be in the megohm level. If it is K level or smaller, check the circuit.
3	The external control cables, grounding cables, and communication cables are fastened.
4	The grounding wire resistance is less than 0.1Ω , and the cable is intact without damage or cracks
5	Clean the installation area and make sure no tools or foreign objects are left in the installation area.
6	Use fireproof mud to seal the gaps between cables to prevent small animals from entering.

06

Product

Operation



6.1 Power-on Process

6.1.1 Check before power-on

- 1. Check whether the circuit breaker in the electrical compartment of the energy storage equipment is in the disconnected state;
- 2. Check whether the power cables in series between the battery packs and between the battery packs and the high-voltage box are reliably connected;
- 3. Check whether the connection terminals of all communication and power cables are reliably connected;
- 4. Check whether the communication, power supply harness and power cables on the high-voltage box panel are correctly connected;
- 5. Check whether there are any problems with the connection of all network cables on the switch in the energy storage equipment and the three-level display control.

6.1.2 Power-on steps

- Step 1: Close the AC circuit breaker of the equipment, measure and confirm that the voltage is 380V, close QF, and sequentially close the auxiliary power micro-breakers QF1, QF2, QF3, QF4, and QF5 on the high-voltage distribution box in the energy storage equipment, close the DC isolation switch with handle in the high-voltage box, and observe the status of the indicator light on the cabinet;

Serial number	Code	Name
1	A	High voltage box auxiliary power interface
2	B	High voltage box RS485 network port

- Step 2: Start the liquid cooling unit and observe whether the power supply is normal;
- Step 3: Close the main control box isolation switch QS1 and send the battery power-on command through the host computer; after the battery cabinet is pre-charged, the high-voltage relay will automatically close, and DC high voltage will be generated at both ends of the positive and negative output poles of the battery cabinet;
- Step 4: Close the PCS incoming line circuit breaker F101. After completing the above operations, the whole system enters a state where it can be charged and discharged;

 **Notice**

Before closing the internal switch of the energy storage system auxiliary power supply, check whether the AC auxiliary power supply voltage is within the normal voltage range (220V±10%).

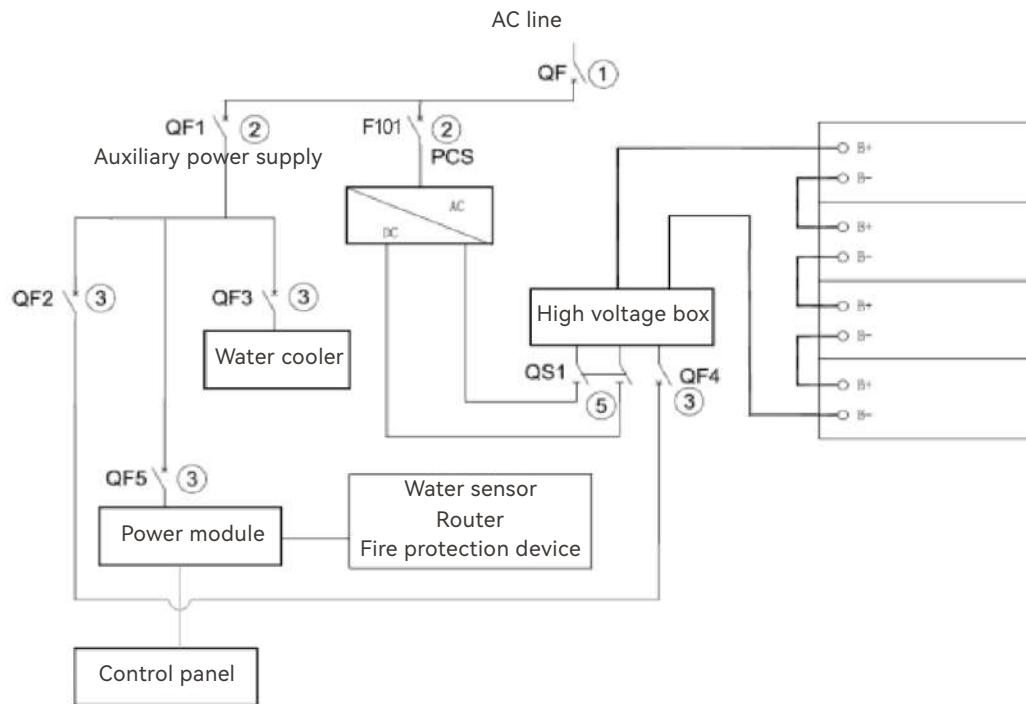


Figure 6-1 Power-on process diagram

6.2 Normal Shutdown Procedures

The specific operation steps are as follows:

Send the "stop" command through the control mode of the display control SCU, the AC and DC measurement switches of the energy storage equipment is automatically disconnected, and the energy storage system stops running.

If the energy storage equipment is in the external power supply mode, all circuit breakers and external power supplies of the machine must be disconnected.



Notice

- Before removing the protective baffle, make sure that the energy storage equipment is in a power-free state (after the PCS is powered off, it must be left to stand for at least 5 minutes).
- Under normal circumstances, please use the normal shutdown procedure to shut down the energy storage equipment.
- In an emergency, you must use emergency shutdown to ensure rapid response and protect the energy storage equipment and peripherals

6.3 Emergency Stop Procedures

In case of emergency, please follow the steps below:

- 1. Press the emergency stop switch on the outside of the cabinet door, the energy storage equipment automatically disconnects the AC and DC measurement switches, and the energy storage equipment stops running.
- 2. If the energy storage equipment is in external power supply mode, all circuit breakers and external power supplies of the device must be disconnected.



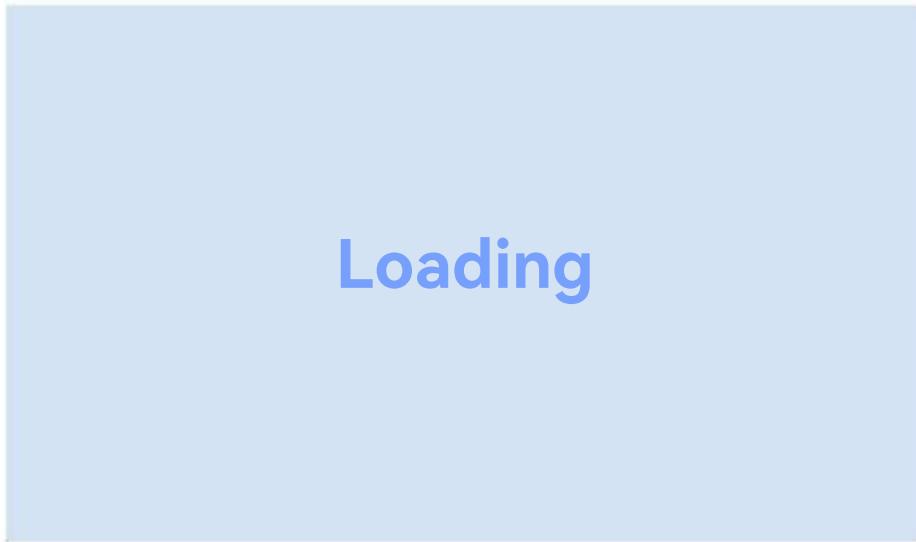
Notice

- There must be a warning sign at the disconnect switch to prevent others from mistakenly turning on the power and endangering personal and property safety.
- When the energy storage equipment is reactivated, it is necessary to ensure that the related faults of the energy storage equipment have been eliminated.

6.4 Display Screen Interface Operation

1. Startup

- After the equipment is turned on, it automatically enters the startup loading page, as shown below.
- Click the screen or wait for 3 seconds to enter the system overview page.



2. System Overview

- Start the configuration screen device or click the “System Overview” menu at the bottom to enter this page, as shown in the figure below.
- The page displays the system wiring diagram, including the real-time data changes of the system’s main operating equipment and its key indicators.



- Description of some key indicators

a)SOC (State of Charge): Displays the real-time percentage of remaining battery power;

b)Active power (kW): Displays the real-time active power of the device;

c)Reactive power (kVar): Displays the real-time reactive power of the equipment;

d)Operating status: The operating status of the energy storage system includes four types: operation, standby, shutdown, and fault. The indicator light corresponding to the real-time operating status is green, and the rests are gray;

e)Communication status: The communication status with the third party, green is normal, and gray is communication interruption.

07

Maintenance

Instructions



Explanation of professional terms:

Serial number	Code	Description
1	Normal operation	Refers to the system that works every day
2	Interval operation	Refers to a system that does not run on a fixed monthly basis and cannot be guaranteed to work every day
3	Long time no use	Refers to a system that has not been started for more than 3 months

7.1 System Requirements

7.1.1 Requirements for normal system operation

- 1. Perform battery maintenance on the system every 12 months to prevent battery damage.
- 2. Carry out inspections on the system every 12 months (refer to Appendix 1) and keep inspection records.

7.1.2 Long-term unused system usage requirements

The SOC range for storage of battery system is 20% to 50%. Avoid long-term storage of battery system below 15% SOC. If the battery is not used for a long time, power-consuming devices need to be disconnected in time.

- 1. Carry out an inspection of the energy storage system every three months (refer to Appendix 1) and keep inspection records;
- 2. Perform battery maintenance on the energy storage system every three months to prevent battery damage;
- 3. Before using the long-discharge system for the first time, the battery must be fully charged at least once to activate it and restore the battery performance to its best condition.



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

7.2 Maintenance Precautions

Before performing maintenance and repair work on the system, relevant personnel must first disconnect the DC circuit breaker switch on the high-voltage box panel to ensure that the DC circuit breaker switch is in the OFF state and the fire protection is in the manual state. After the maintenance and repair work is completed, it is necessary to ensure that the DC circuit breaker switch is in the ON state and the fire protection is in the automatic state.

This energy storage equipment has a high protection level and can be used outdoors, but long-term operation in harsh environments will still cause aging of the energy storage equipment or damage to the internal equipment. Regular maintenance and inspection of the energy storage equipment and replacement of aging and damaged parts will effectively extend its service life and improve the performance of the internal equipment.

The maintenance cycles given in this section are reference values, and the actual maintenance cycle should be reasonably determined in combination with the actual environmental conditions of the project site. If the operating environment of the energy storage equipment is relatively harsh, such as in desert areas, the corresponding maintenance cycle should be shortened. In particular, internal and external cleaning, anti-corrosion and anti-rust work, etc. should be more frequent. For example, if the energy storage equipment is installed in a desert area, it is recommended that the internal and external parts of the energy storage equipment should be carefully inspected and thoroughly cleaned after each sandstorm.

Check the following items, if they do not meet the requirements, please correct them immediately:

Annual Inspection

Maintenance type	Inspection items	Test Method
Cabinet and structural parts	System status and cleaning	<p>Check the following items. If they do not meet the requirements, please correct them immediately:</p> <ul style="list-style-type: none"> • Check whether the cabinet and internal equipment are damaged or deformed • Check whether the internal equipment makes abnormal noise during operation • Check whether the temperature inside the cabinet is too high • Check whether the humidity and grayscale inside the cabinet are within the normal range. If necessary, clean it in time • Check whether the air inlet and outlet of the cabinet are blocked
	Warning signs	Check that warning signs and labels are clearly visible and not damaged. If damaged, replace them.
	Cable shield grounding	Check whether the cable shielding layer is in good contact with the insulation sleeve; Check whether the grounding copper bar is fixed in place.
	Lightning protection equipment and fuses	Check whether the lightning protection equipment and fuses are well tightened.
	Corrosion	Check whether there is oxidation or rust inside the cabinet
Cabinet exterior		<p>Check the following items. If they do not meet the requirements, please correct them immediately:</p> <ul style="list-style-type: none"> • Check whether there are flammable objects on the top of the cabinet • Check whether the welding points between the cabinet and the foundation steel plate are firm and whether there is rust (if the rust level reaches the rust level C of the ISO 8501-1 standard, repair work is required) • Check whether the cabinet shell is damaged, paint peeling, oxidation, etc. • Check whether the cabinet door lock can be opened flexibly • Check whether the sealing strip is well fixed and whether it is aging and broken

Cabinet and structural parts	Inside the cabinet	<ul style="list-style-type: none"> 1) Check whether there are foreign objects, dust, dirt and condensed water inside the energy storage system 2) Check whether the external outlet is completely sealed
	Air inlet and outlet	Check whether the air inlet and outlet louvers and filters are clean. If necessary, use a vacuum cleaner to remove dust and clean them. Replace the filters regularly according to the conditions of use.
	Wiring and cable routing	<p>Wait until the internal equipment of the energy storage system is completely powered off for 3 minutes before starting the inspection! During the inspection, if any non-conformity is found, please correct it immediately.</p> <ul style="list-style-type: none"> Check whether the cable arrangement is standardized and whether there is a short circuit. If there is any abnormality, it must be corrected immediately Check whether all the inlet and outlet holes of the cabinet are well sealed Check whether there is water seepage inside the cabinet Check whether the power cable connection is loose and tighten it according to the previously specified torque Check whether the power cable and control cable are damaged, especially whether there are cuts on the surface in contact with the metal surface Check whether the insulation wrapping tape of the power cable terminal has fallen off
	Grounding and equipotential bonding	<ul style="list-style-type: none"> Check whether the grounding connection is correct Check whether the equipotential connection inside the energy storage system is correct
	Fan	<ul style="list-style-type: none"> Check the fan's operating status Check if the fan is blocked Check if there is any abnormal noise during fan operation
	Screws	Check whether there are any screws dropped inside the cabinet.

Fire fighting	Maintenance items every 6 months plus inspection of fire containers	<ol style="list-style-type: none">1. Look for signs of structural problems<ul style="list-style-type: none">• Surface wear• Cuts• Weathering2. Make sure they are properly connected3. Check the fire container pressure and make sure the pressure is within the operating pressure range4. Check the sensor for tight wiring and contaminants
Electrical parts	Device maintenance	<p>Maintenance of circuit breakers/isolators and contactors</p> <ul style="list-style-type: none">• Perform regular inspections of all metal components for corrosion• Annual inspections of circuit breakers/isolators and contactors (auxiliary switches and micro switches) to ensure good mechanical operation• Check operating parameters (especially voltage and insulation)• Maintenance of surge protector circuits (it is recommended to perform surge protection every six months, depending on the actual environment. If it is a multi-zone, it is recommended to increase the maintenance frequency appropriately)• Use a multimeter to measure whether the front fuse is intact• Check the appearance of the surge protector for cracks, deformation or other physical damage, check whether the wiring part is intact, confirm that the cable connector and terminal are not oxidized, check whether the grounding wire is firm, and confirm whether the installation surface is clean and free of dust, oil stains and other dirt UPS maintenance (if any)• Keep the surrounding area clean and dust-free• Under normal use, replace the battery at least every 4 years to ensure that the equipment operates at maximum efficiency

Half-year Inspection

Maintenance type	Inspection items	Test Method
Cabinet and structural parts	Security Features	<ul style="list-style-type: none"> Check the warning labels on the machine and other equipment labels. If they are blurred or damaged, please replace them in time Check the emergency stop button to see if it stops Simulate a shutdown
	Internal component inspection	<ul style="list-style-type: none"> Check the cleanliness of the components Check the heat sink temperature and dust. If necessary, clean the heat sink module, etc. with a vacuum cleaner Replace the air filter if necessary <p>Note! The ventilation of the air inlet must be checked. Otherwise, if the module cannot be cooled effectively, it will malfunction due to overheating.</p>
Fire fighting	Device maintenance	Regularly inspect all metal components for corrosion (every six months)
Liquid Cooling unit	Maintenance items every 3 months plus inspection of fire containers	Check the fire container pressure and make sure the pressure is within the operating pressure range
	Reliability of power cables and signal cables in wiring panels	<ul style="list-style-type: none"> Reliability of power cables and signal cables in the wiring panel Electrical cables and signal cables are free of aging, damage, abnormal heating and other abnormalities No dust on the wiring panel

Maintenance type	Inspection items	Test Method
BMS	Appearance of the unit	The unit is clean and free of dust and dirt.
	Fan operation reliability	<ul style="list-style-type: none"> The fan is dust-free, and there is no foreign matter blocking the air outlet The fan blades are not damaged, and the fan rotates smoothly without abnormal noise
	Condenser cleaning	The condenser is free of dust and foreign matter.
	Liquid cooling pipeline inspection	Check the connection of the liquid cooling pipe and whether there is seepage or leakage in the liquid cooling pipe.
	Coolant condition (visual inspection and reagent inspection)	<ul style="list-style-type: none"> 1. Open the valve and take 10~50ml of coolant from the system; 2. Observe the state of the coolant to see if there are any abnormalities such as discoloration/impurities; 3. Check the pH value of the coolant to see if it is lower than pH7.3; 4. If the above abnormalities exist, drain the original system liquid according to the filling and drainage process and refill the coolant.
	Primary BMS module	<ul style="list-style-type: none"> 1. Before each power-on, make sure that the connectors are well connected and not loose; 2. Before each power-on, check and confirm that the voltage of the power supply is within the specification range; 3. For battery packs that have not been working for a long time (more than 1 month), check whether the voltage of the single cell and group terminals is within the normal range before powering on the module; 4. When it is necessary to connect the CAN card for software operation, before powering on, confirm that the resistance of the channels CANH and CANL corresponding to the CAN card connection module is 60Ω, and insert the USB cable before powering on.

Maintenance type	Inspection items	Test Method
	Secondary BMS module	<ul style="list-style-type: none"> 1. Before each power-on, make sure that the connectors are well connected and not loose; 2. Before each power-on, check and confirm that the voltage of the power supply is within the specification range; 3. Before each power-on, check whether the contactor and fuse (if any) are normal; 4. When it is necessary to connect the CAN card for software operation, before powering on, confirm that the resistance of the channels CANH and CANL corresponding to the CAN card connection module is 60Ω, and insert the USB cable before powering on.
	Tertiary BMS module	<ul style="list-style-type: none"> 1. It is recommended to keep the screen clean at all times and prevent it from being bumped; 2. During long-distance transportation, it is recommended to disassemble and install it in a paper box with foam protection and restore it on site.
	Current sensors	If the current sensor (shunt or Hall) has not been used for a long time (more than 1 month), you need to check to make sure that the sensor is not rusted or dusty.
	Wiring	If the wiring harness has not been used for a long time (more than 1 month), you need to recheck to make sure that the wires and connectors are not damaged, pins are broken, or rusted.
	Module Replacement	When replacing or repairing parts, timely and sufficient communication with professionals is required.
	Software Maintenance	View the configurable parameters of the Web.
Battery	The state of charge (SOC, capacity state) should be maintained at 15%~40%	For long-term storage (more than 6 months), a standard charge and discharge cycle should be performed every 6 months.

Quarterly Inspection

Maintenance type	Inspection items	Test Method
	Check protected areas	<ul style="list-style-type: none"> 1. Daily cleaning 2. Pipe and nozzle condition 3. Ensure the protected area has not been changed
	Check the equipment	<ul style="list-style-type: none"> 1. Fire container (pressure gauge, bracket, damage) 2. Detector (cleanliness) 3. Nozzle (no blockage)
	Check detection equipment	<ul style="list-style-type: none"> 1. Make sure they are installed in the correct position 2. Make sure they are not damaged 3. Make sure they are clean and not covered with grease, dust, paint or any other dirt 4. Test the sensitivity of each detector according to the detector manufacturer's instructions
	Check all alarm devices	<ul style="list-style-type: none"> 1. Check for dust accumulation 2. Check for corrosion 3. Check for damage 4. After each test, reset the alarm circuit
	Check the pipe wire net	<ul style="list-style-type: none"> 1. Make sure the nozzle is installed in the correct position 2. Make sure the nozzle is not covered with dust, grease, paint, and the spraying is not blocked
	Check all parts	<ul style="list-style-type: none"> 1. Look for signs of damage 2. Look for disconnected components and reconnect them to the system 3. Look for loose connections and tighten them 4. Look for corrosion 5. Look for twisted or dented components
	Check the fire container pressure gauge	Check the pressure and make sure it is within the operating pressure range.

Maintenance type	Inspection items	Test Method
PCS	Check the condition of fire container	<ul style="list-style-type: none"> 1. Check if the fire container is securely installed 2. Check for corrosion 3. Check for damage 4. Check for missing parts 5. Check the pressure gauge
	Electrical and fixed connection inspection	<ul style="list-style-type: none"> 1. Ground connection 2. Module ground connection 3. Electrical connection for DC input 4. Electrical connection for AC input 5. Connection for communication cable 6. Fan
	Cleaning	<ul style="list-style-type: none"> 1. Clean copper bars, terminals, mesh 2. Clean ventilation baffles 3. Clean air ducts and ventilation ducts 4. Check if the fan is abnormal and if the fan is blocked by dust or foreign matter
	Appearance inspection	<ul style="list-style-type: none"> 1. Check labels 2. Check latches, door stops, and hinges
Battery	SOC calibration (maintenance frequency varies according to actual application scenarios. It is recommended to fully charge and discharge the battery once every three months. If full charge and discharge cannot be achieved every day, it is recommended to do it once every month)	<ul style="list-style-type: none"> 1. A standard full charge and full discharge process experiment is required, and the software will automatically calibrate 2. If it cannot be met, a standard full discharge experiment can be conducted, and the software will automatically calibrate 3. If it cannot be met, a standard full charge experiment can be conducted, and the software will automatically calibrate 4. If it cannot be met, a standard discharge experiment can be conducted, try to discharge to less than 20%, let it stand for more than 1 hour, and calibrate through the software settings

Monthly Inspection

Maintenance type	Inspection items	Test Method
Battery	SOC calibration (maintenance frequency varies according to actual application scenarios. It is recommended to fully charge and discharge the battery once every three months. If full charge and discharge cannot be achieved every day, it is recommended to do it once every month)	<ul style="list-style-type: none"> 1. A standard full charge and full discharge process experiment is required, and the software will automatically calibrate 2. If it cannot be met, a standard full discharge experiment can be conducted, and the software will automatically calibrate 3. If it cannot be met, a standard full charge experiment can be conducted, and the software will automatically calibrate 4. If it cannot be met, a standard discharge experiment can be conducted, try to discharge to less than 20%, let it stand for more than 1 hour, and calibrate through the software settings
BMS	System alarm and troubleshooting	View system alarm information and troubleshoot corresponding faults through the SCU display screen



The above maintenance cycle is only a recommended value and can be adjusted according to actual planning.

Appendix 1 Inspection Form:

Inspection items	Inspection method	Yes/No	Abnormal records
Is the fire extinguishing system complete?	• Visual inspection		
Is the fire extinguishing system within the validity period?	• Visual inspection		
Is the cooling system complete?	• Visual inspection		
Is the cooling system air duct blocked?	• Visual inspection		
Is the appearance of the integrated cabinet deformed?	• Visual inspection		
Is the appearance of the integrated cabinet rusty or damaged?	• Visual inspection		
Is there any moisture inside the integrated cabinet?	• Visual inspection		
Is the low voltage wiring harness loose or damaged?	• Visual inspection		
Is the high-voltage wiring harness loose or damaged?	• Visual inspection		
Does the wiring harness interfere with the structural parts?	• Visual inspection		
Is the high voltage connection burned?	• Visual inspection		
Are the structural fixing bolts loose or missing?	• Visual inspection		
Is the maintenance switch (MSD) complete and installed reliably?	• Visual inspection		
Is the liquid cooling pipe damaged?	• Visual inspection		

Inspection items	Inspection method	Yes/No	Abnormal records
Is there any bad smell in the integrated cabinet?	Nose		
Is there any irritating smell in the integrated cabinet?	Nose		
Is there a burning smell at the high-voltage connection?	Nose		
Is the summary data complete?	Monitoring host computer		
Is the single cell voltage data complete?	Monitoring host computer		
Is the monomer temperature data complete?	Monitoring host computer		
Check if there is any abnormal alarm in the alarm column	Monitoring host computer		

 **Notice**

Note: If you find any abnormalities during the inspection, please provide feedback in time and contact relevant personnel to handle it!