

280 Ah Liquid Cooling Rack

User's Manual

To protect your personal safety, please be sure to read carefully and follow the safety requirements below:

Symbols in This Document

This manual uses the following symbols to highlight important information:

 **WARNING:** Indicates a hazardous situation which, if not avoided, could result in injury or death.

 **CAUTION:** Indicates a hazardous situation which, if not avoided, could result in minor injury or damage to the equipment.

NOTE: Indicates an important step or tip that leads to best results, but is not safety or damage related.

General Information

NOTE: The maintenance workers must be required to hold the Fortress Power maintenance authorization certificate to carry out maintenance work.

 **WARNING:** It is strictly forbidden to touch both pole terminals of ESS at the same time with both hands.

 **WARNING:** Be sure to disconnect the corresponding high and low voltage switches before performing maintenance on the ESS.

 **WARNING:** Wear safety helmets, insulated gloves, insulated shoes, and goggles when operating or maintaining the ESS. Do not wear metal jewelry such as watches.

 **WARNING:** When cleaning the ESS, it is forbidden to wash the HV/LV connectors directly.

 **WARNING:** It is strictly forbidden to crush, pierce and burn artificially the batteries to damage the ESS.

 **WARNING:** The working environment of ESS should be free from corrosive, explosive, uninsulated gas or conductive gas and away from heat sources

 **WARNING:** Stepping on the top of the RACK is prohibited during use and maintenance.

 **WARNING:** If you have any questions, please contact the ESS supplier, operate without authorization is forbidden.

 **WARNING:** Use in series or parallel with other types of battery products is prohibited.

Care and Maintenance

Environmental Requirements

RACK is capable of charging and discharging within the operating temperature range specified below. At the extremes of the temperature range, RACK may limit charge or discharge power to improve battery lifespan.

For best performance, the average ambient temperature over the system's lifetime should fall within the optimum temperature range specified below:

Operating Temperature	-30°C~55°C
Optimum Temperature	-25~45°C

Care and Cleaning

If it is installed outside, keep the sides of RACK clear of leaves and other debris to maintain optimal airflow.



CAUTION: Do not lean on stack anything on top of, or hang anything from RACK or from wires or conduit leading to RACK.



CAUTION: To clean RACK use a soft, lint-free cloth. If needed, the cloth can be dampened with mild soap and water only.



CAUTION: Do not use cleaning solvents to clean RACK, or expose RACK to flammable or harsh chemicals or vapors.

Maintenance

RACK and the Gateway do not require pre-scheduled preventative maintenance. The only maintenance required by an owner is to keep the RACK unit free and clear of debris, especially around the air intake and exhaust.

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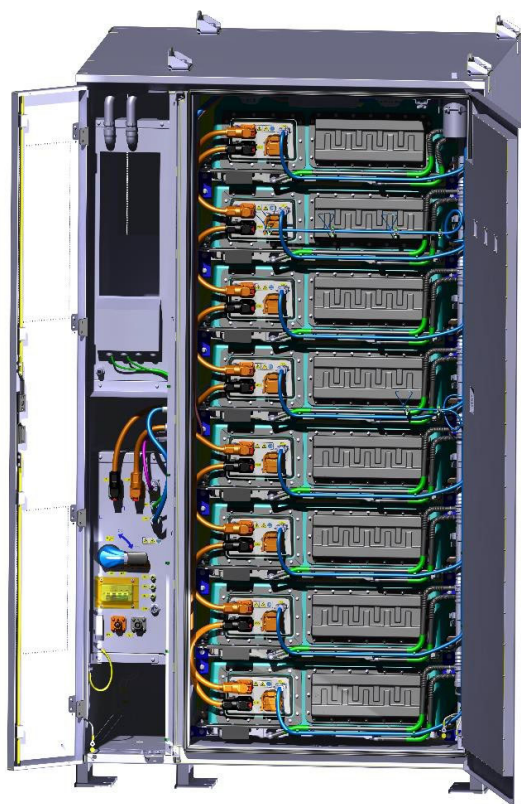
1. Product Overview

1.1 Applicable Scope

This manual is applicable to the battery racks of the following model:

O852280-E/ O852280-P

All references to “battery racks” in this manual, unless specifically indicated herein, refer to the product series mentioned above.



Weight	3500kg
Dimension	1300mm(W)*1300mm(D)*2340mm(H)

1.2 Main Feature

- The battery system can detect the battery operating status (Voltage, current, temperature, SOC/SOH/SOP estimation, etc.) , According to the current state of the battery and the actual performance of the electrical components to adjust the battery charge and discharge and energy storage
- The battery system has functions such as insulation detection, high-voltage sampling, and status check of safety devices such as MSD and fuse. When the battery fails, the system will report and limit the charge or discharge current or power, delay the opening of the contactor, and protect the safety of the power system.
- The battery system can control the cooling, heating and temperature settings of the liquid cooling unit
- The cabinet body of the Rack meets the IP56 protection grade and supports use under outdoor conditions.
- Rack equipped with Stat-X aerosol fire extinguishing system, It can detect the temperature and smoke status in the Rack in real time to prevent fire safety accidents such as accidental battery fire

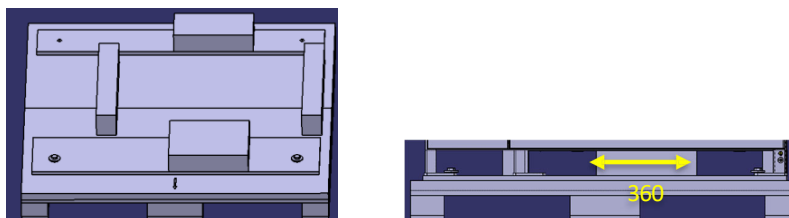
2. Transportation and Storage

2.1 Packaging

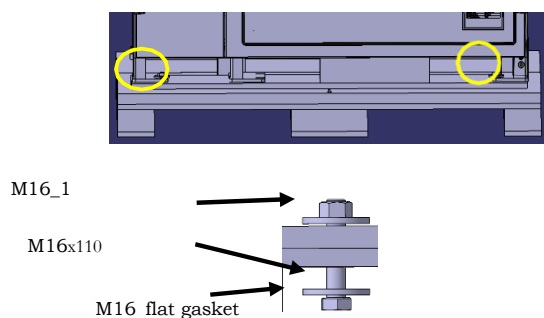
The system is packaged as a whole to ensure that the product is well protected from any harmful gases, chemical contamination, static electricity, moisture and mechanical damage during handling, transport and storage. The name of product, specification, production date, quantity and lot number have been labeled on the packaging box.

2.1.1 Rack Packing steps:

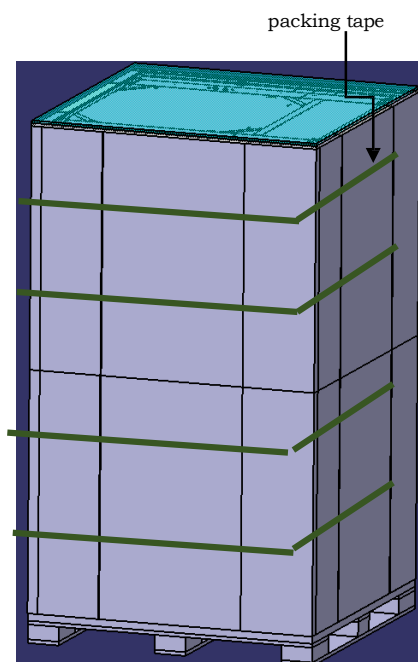
1 Lay the tray flat, hang the Rack on the tray and fix it.



2 Fix the RACK with bolts.



3 Put it into the packaging bag from one to the bottom, wrap the scotch tape around the mouth of the bag, lay the top package flat on both sides, and fix it with scotch tape.



6 Wrap the winding film from the bottom of the tray (sticking to the ground), the winding film should be no less than 3 layers

2.2 Transportation

Trucks and shipping are preferred as means of transport while shelter and sun protection should be guaranteed during transportation. Please load and unload in a civilized way. Packing boxes with products inside can be transported by any means of transport. Batteries shall be handled with care in the middle of loading and unloading. Be cautious of throwing, rolling over and heavy pressure. Avoid direct contact with rain, snow and mechanical impacts.

2.2.1 Requirements for Battery Transport Environment

Based on battery features and with the purpose of maximizing the battery performance, the transport and storage of battery packs should meet the following requirements:

Recommended storage temperature: $\leq 20^{\circ}\text{C}$; Allowable storage temperature: $-40\sim 60^{\circ}\text{C}$;

Humidity: $< 95\%$ (no condensation).

2.2.2 Requirements for Rack Transport

(1) Check before loading of battery rack into container

- 1) Before loading into container, it is necessary to check the outside and inside of the container to ensure the cleanliness of the inside, and the inside shall be equipped with hooks;
- 2) Before loading into container, check the package and external label of the cargo to ensure the integrity of external package.

(2) Loading of battery rack into container

- 1) The forklift matched with the battery rack load shall be used in operation and shall pass the annual inspection. The forklift shall not move during lifting;
- 2) The weight of a battery rack is high. The container shall be stuffed with filling material and the tie belt shall be used to fix the battery rack in a container;
- 3) After being loaded into a container, the warehouse head shall recheck the tie belt and protection and then notify to release after confirmation.

(3) Battery rack transport

- 1) The high-speed driving speed of the vehicle shall not exceed the speed specified by traffic laws, and the bumpy road section shall be avoided as far as possible;
- 2) It is forbidden to brake and make sharp turns when the vehicle is driving;
- 3) Keep the car in good condition, check the carrying situation of the car frequently. If problems are

found, feedback and solve in time.

(4) Unloading of battery rack

1) Provide the packing list to the client for preparing proper unloading tools.

2.3 Storage

The system should be stored in a dry warehouse to avoid exposure and rain. No harmful gases, flammable or explosive products and corrosive chemicals are allowed in the warehouse. Keep away from mechanical impact, heavy pressure and strong magnetic field. Avoid direct sunlight and the distance to heat source should be more than 2m away. The packaging box should be at least 20cm high from floor, and at least 50cm away from the wall, windows or air inlets.

Recommended storage temperature: $\leq 20^{\circ}\text{C}$; Allowable storage temperature: $-40\sim 60^{\circ}\text{C}$;

Humidity: $<95\%$ (no condensation).

Under these conditions,

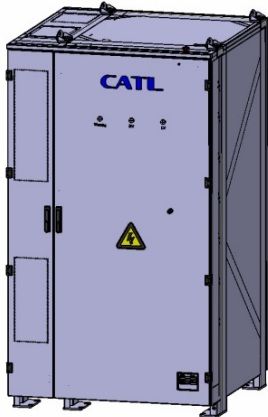
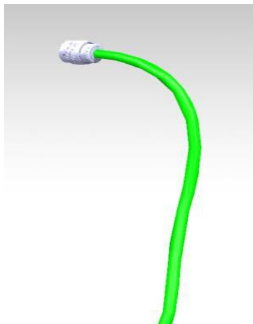
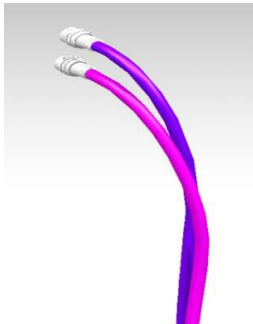
The product shall be supplemented to 50% SOC at least once within 6 months after leaving the factory. The capacity verification test and re-inspection are required every 12 months.

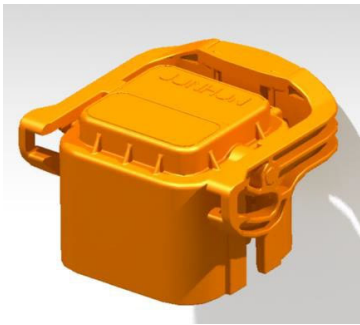
3. Installation

The battery system is a high-voltage energy storage device, which is regarded as dangerous goods; operation and use by non-professional persons or improper operation and use of it might result in severe consequences, e.g. electric shock, combustion and explosion. The battery system must be installed and maintained by professional technicians and used in strict accordance with the relevant safety provisions.

3.1 Main constituent parts for installation

Table 1. Main constituent parts for installation

Components	Diagram	Number	Unit	Remark
Rack		1	Pcs	Dimension : W*D*H(mm) 1300*1300*2280 Weight : 3500kg Voltage range : 1164.8~1497.6V DC
HV harness		1	Set	One for the positive pole and one for the negative pole on the control box.
Auxiliary power supply harness		1	Pcs	Including power supply for chiller and power supply for BMS.
Communication harness		1	Set	Building the connection between two adjoining racks, one for input and one for output.

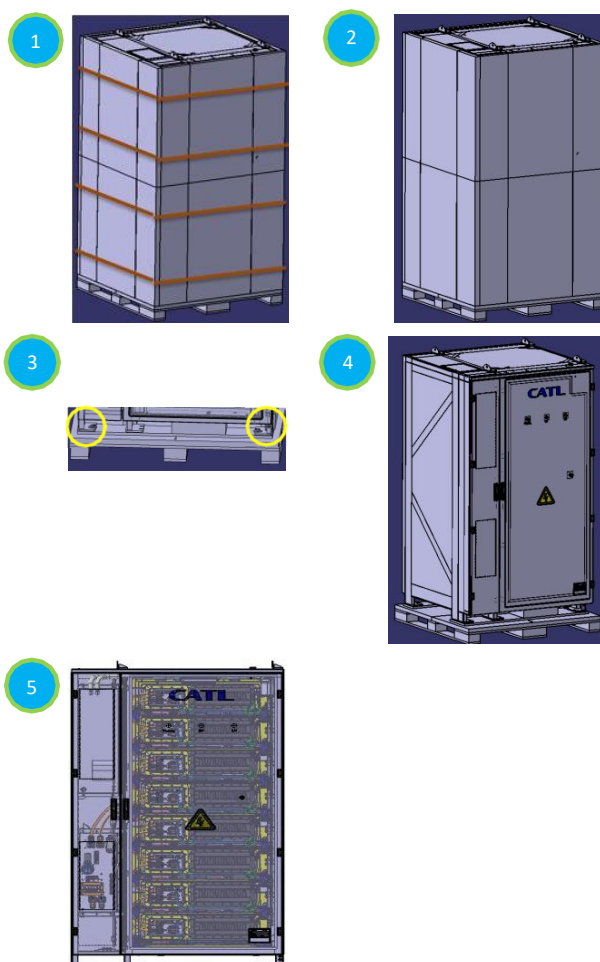
MSD		8	Pcs	Installation of MSD should be conducted after the fixation of racks and harness.
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3.2 Preparation for installation

3.2.1 Unpacking

Unpacking steps are as follow:

1. Remove the packing belt and winding film on box.
2. Remove the front and back panel from the front side and back side respectively.
Remove the right side and left side panels.
3. Unscrew four nuts on the wooden pallet, remove the bolt and washer.
4. Move the rack out of the tray.
5. Unpacking completed.



3.2.2 Description of the installation process

The installation process is mainly divided into two stages: rack installation and wiring. The main content and steps are as follows:

Table 2. Installation process

Installation steps	Specific implementation	Remark
Rack installation	A. Transfer the rack to the designated location by means of forklift transfer or hoisting.	The tool should meet the weight requirements, and the tilt angle should be smaller than 5°.
	B. Fix the bottom foot of the rack.	M16 bolt, required torque is
		150~200N.M
	C. Grounding of the rack.	M8 bolt, required torque is 10N.M, wire size $\geq 50\text{mm}^2$ (cooper) The external casing of the equipment should be well grounded
Wiring	A. Power harness	Including positive and negative poles, orange connector connects to HV+, black connector connects to HV-.
	B. Auxiliary power supply harness	Including power supply for chiller and control circuit.
	C. Communication harness	One for input and one for output.
	D. MSD	Should be conducted after the fixation and inspection of racks and harness.

3.3 Installation of the rack

3.3.1 Installation Precautions

- ⚠ **WARNING:** The tilt angle should be smaller than 5° during the hoisting.
- ⚠ **WARNING:** Do not hit the staff during landing.
- ⚠ **WARNING:** Should set an isolation area for the operation of installation.
- ⚠ **WARNING:** Move and transfer the rack in a manner way during hoisting.

- ⚠ **WARNING:** RACK installation must be carried out only by Installers who have been trained in dealing with high voltage electricity.

- ⚠ **WARNING:** Do not use or install the RACK if it is defective, appears cracked, broken, or otherwise damaged.

- ⚠ **WARNING:** Do not attempt to open, disassemble, repair, tamper with, or modify RACK.

- ⚠ **WARNING:** Do not conduct the installation under worse weather, such as rainstorm and sandstorm.

- ⚠ **WARNING:** To protect RACK and its components from damage when transporting, Handle with care. Do not impact, pull, drag, or step on RACK. Do not subject RACK to any strong force. To help prevent damage, leave RACK in its shipping packaging until it is ready to be installed.

- ⚠ **WARNING:** Do not insert foreign objects into any part of RACK.

- ⚠ **WARNING:** Do not expose RACK or its components to direct flame.

- ⚠ **WARNING:** Do not install RACK near heating equipment.

- ⚠ **WARNING:** Do not immerse RACK or its components in water or other fluids.



CAUTION: Do not use cleaning solvents to clean RACK, or expose RACK to flammable or harsh chemicals or vapors.



CAUTION: Do not use components without authority by Fortress Power.



CAUTION: The schematic diagram of transfer and hoisting as shown in the figure is for reference only, the specific tools and equipment used in actual operation shall prevail.



CAUTION: The minimum clearance between the racks should be back to back 100mm (0.5P rack) or 500mm (1P rack); 10 mm(side by side) The clearances above are for reference only, the actual clearance should comply with the local standards and regulations.

 **WARNING:** Please place the battery system on a level ground to ensure that it is placed stably without shaking or tilting;

 **WARNING:** Battery system installation should consider the load capacity of its installation ground and floor (according to the requirements of architectural drawings).

3.3.2 Site and environmental requirements

Rack foundation requirements

- Unspecified concrete grades are C30, the floor thickness is 200mm, each side protrudes 300mm from the edge of the electrical cabinet, and is equipped with three-level steel symbol 12@150.
- Reinforcement adopts HRB400 grade, after derusting treatment, anticorrosive treatment should be carried out according to relevant specifications.
- Floor board thickness 100mm, concrete strength class C15.

- The foundation bearing layer shall be undisturbed soil, and the characteristic value of bearing capacity shall not be less than 100Kpa. If the foundation support layer is weak soil, graded sandstone should be used for replacement, and the replacement depth should not be less than 500mm. The replacement soil layer must be compacted and compacted in layers, Layer thickness should not be greater than 300mm, The compaction coefficient is greater than 0.97. The edge of the replacement layer needs to exceed the base edge by 300mm, The characteristic value of bearing capacity after replacement is not less than 100Kpa, The content of particles with a particle size of less than 0.75mm at the time of refilling shall not exceed 10%.
- During the foundation construction, precipitation measures should be taken, soaking the foundation pit is strictly prohibited; safe and reliable support measures should be taken for foundation pit excavation
- Ground flatness requirement: within 2m, the flatness deviation is less than $\pm 4\text{mm}$

3.3.3 Installation steps

Attention:

- (1): Recommended transfer mode of the Rack: Top hoisting transfer
 - (2): If a forklift is used, pay attention to adding protection on the forklift arm to prevent the dirt on the forklift arm from polluting the Rack or the forklift from scratching the bottom of the Rack.
- A. Transfer the rack to the designated location by means of forklift transfer or hoisting. The lifting lug should be repainted after the installation.

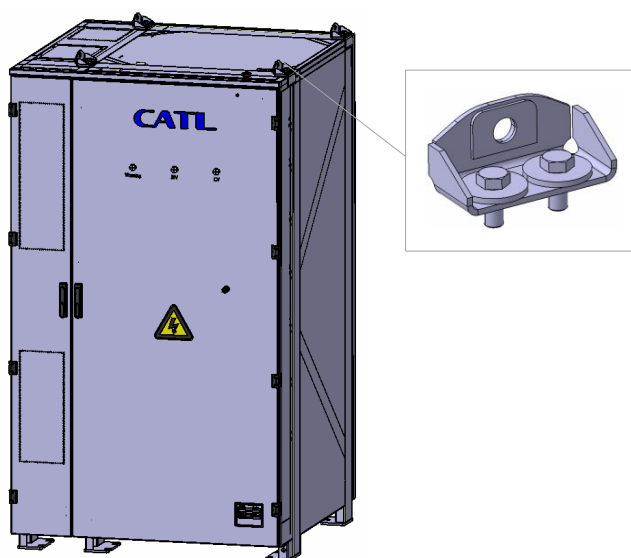
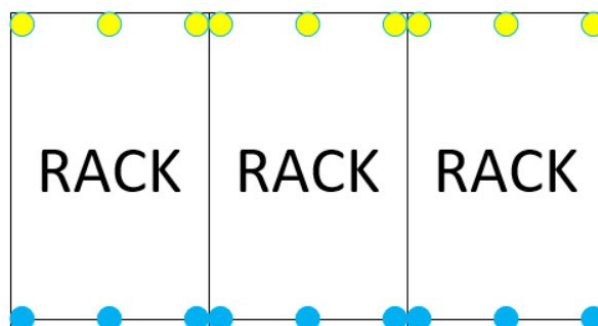


Figure 2. Lifting lug on the rack

The radius of the hole on the lifting lug is 11mm.

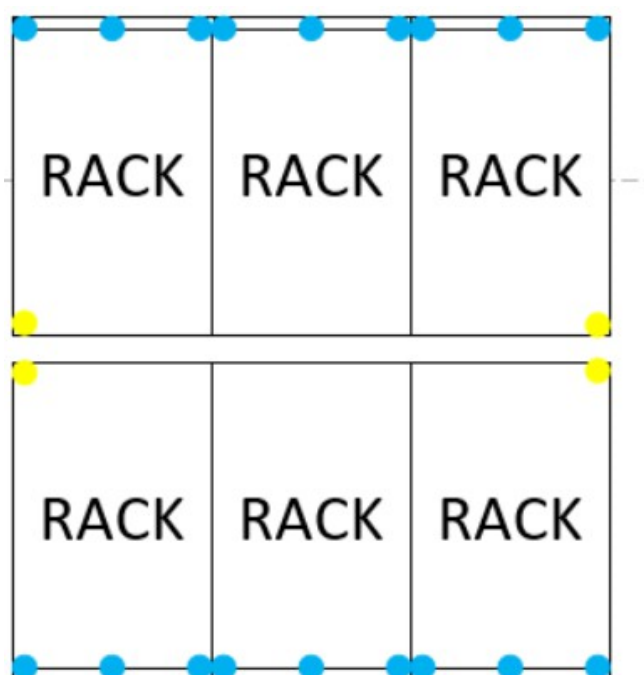
B. Fix the bottom foot of the rack

C. The bottom of each rack is fixed with M16 bolts. The torque of the torque wrenches is set to 150~200N.M.



Note: The blue spots in the figure presents that point need to be locked with two bolts. The yellow spots in the figure presents that point need to be locked with one bolt.

Different layouts of racks are shown as following figures:

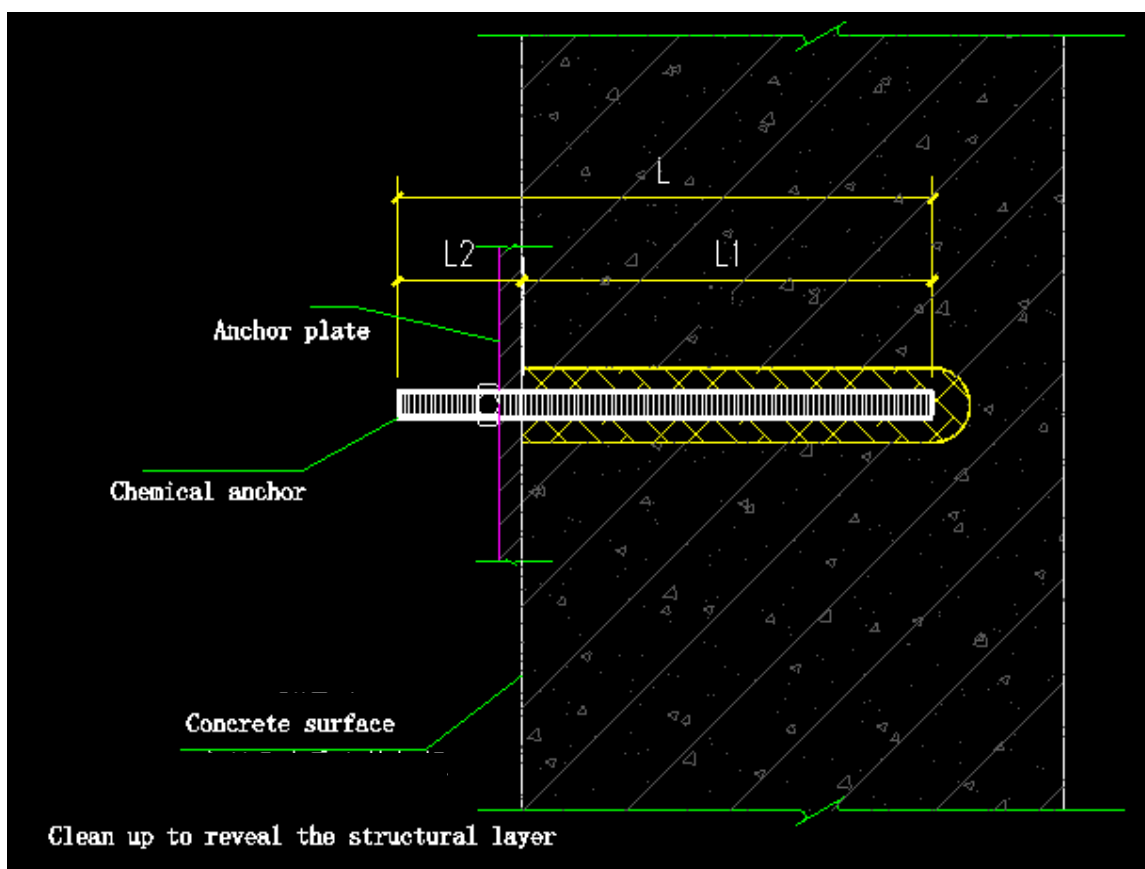


Note: The blue spots in the figure presents that point need to be locked with two bolts. The yellow spots in the figure presents that point need to be locked with one bolt.

- 1) Before chemical bar planting, the brush layer of bar planting flour needs to be cleaned out, and then the next step after cleaning
- 2) The concrete strength grade is C25, and the chemical planting reinforcement needs to do the pull-out test
- 3) It is required that the tensile strength of the planted chemical anchor bolt is not less than twice the design value of the bearing capacity
- 4) Chemical anchors are recommended to use Hilti HVA chemical anchors. For specific design values, please refer to the table below

Chemical anchor	Design value of tensile bearing capacity (KN)	Design value of shear capacity (KN)	L1	L2	L
R-M16	34.7	34.6	125	38	163

- 5) The construction of chemical anchors should comply with JGJ 145-2013 《Technical specification for anchorage behind concrete structure》
- 6) If there is welding, measures should be taken to avoid overheating of the anchoring area and lead to the failure of the rebar glue
- 7) Adhesives for load-bearing structures must be tested for bond shear strength. During the inspection, the standard value of the bonding strength shall be determined according to the requirements of the confidence level of 0.9 and the guaranteed rate of 95%



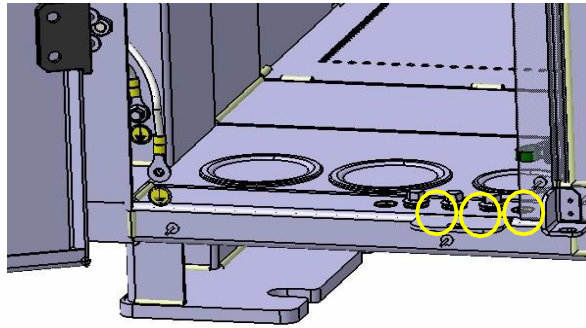


Figure 5. Grounding of the rack

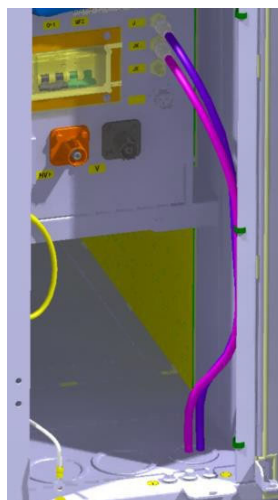
3.4 Electrical interface

3.4.1 Wiring

1 Installation of communication harness

- Install the corresponding communication harness on JX2 and JX3:
- In the first rack, JX2 is connected to the JX3 of the next rack, and JX3 is connected to MBMU.
- In the middle rack, JX2 is connected to the JX3 of the next rack, and JX3 is connected to JX2 of the last rack.
- In the terminal rack, JX3 is connected to JX2 of the last rack, and JX2 is connected to the terminal resistor connector.

Figure 6. Communication harness



2 Installation of auxiliary power supply harness

- Install the auxiliary power supply harness (including the harness for chiller and BMS power supply) on JXH1.

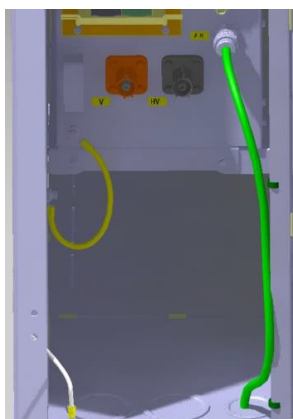


Figure 7. Auxiliary power supply harness

3 Installation of power harness

- Isolation switch QS1 and breakers QF1, QF2 should be in OFF state.
- Orange connector connects to HV+, black connector connects to HV-.
- Push the plug of the HV connector into the receptacle during installation. When you can feel obvious resistance, press the secondary lock(the disassembly method is opposite);
- If the second lock cannot be push in, it indicates that the HV connector is not be installed correctly.

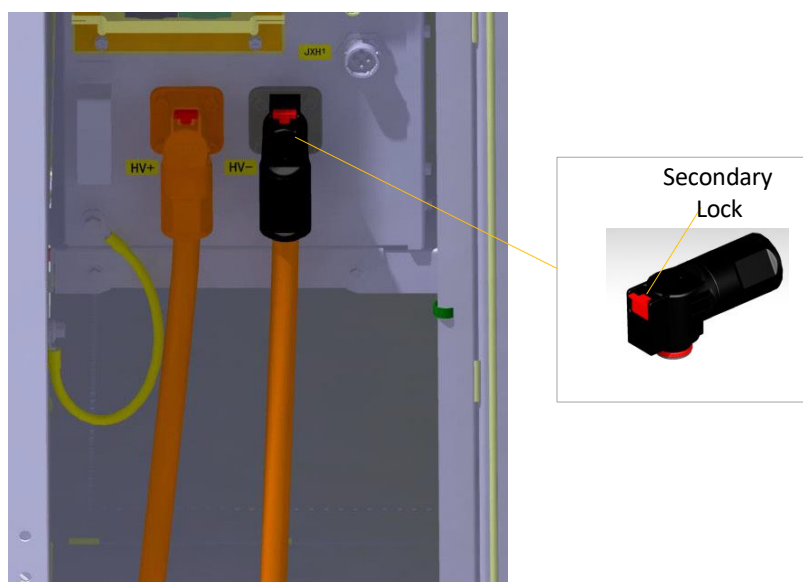


Figure 8. Power harness

4 The diagrams of installation and disassembly of HV connector are as follow:

➤ Original state

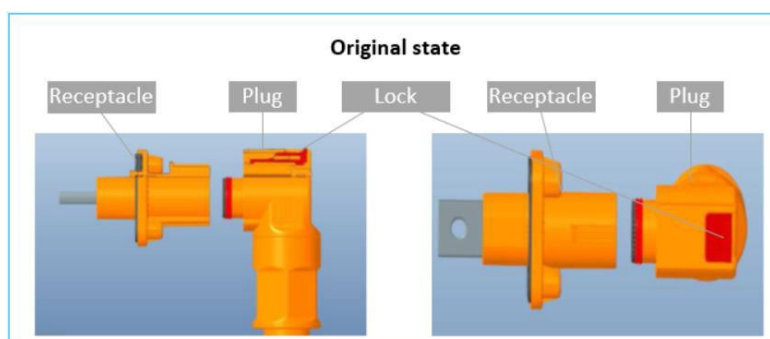


Figure 9. Original state of HV connector

➤ Diagram of installation and disassembly

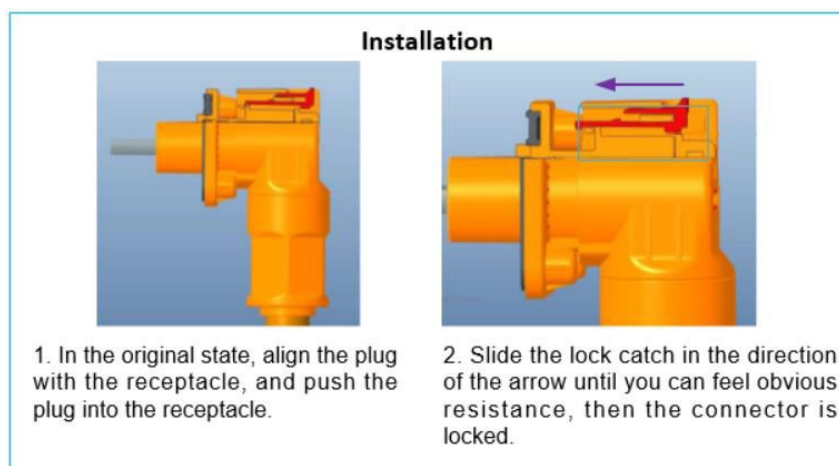


Figure 10. Installation of HV connector

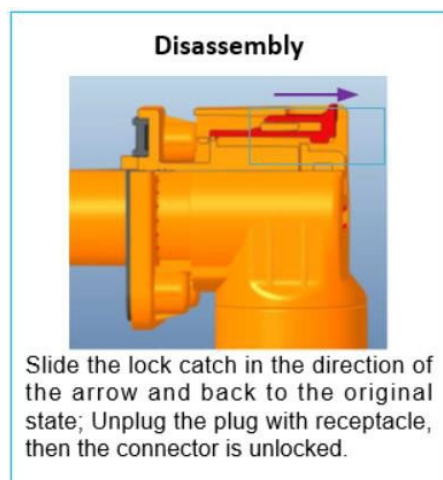


Figure 11. Disassembly of HV connector

5 After confirming that the above installation is correct, install the MSD.

- Isolation switch QS1 and breakers QF1, QF2 should be in OFF state.
- Open the battery compartment door.



Figure 12. Installation of MSD

- 6 Install eight MSD upper cover on the panel of each module box.
- Put the handle in the vertical state and align the cover of the maintenance switch with the receptacle.

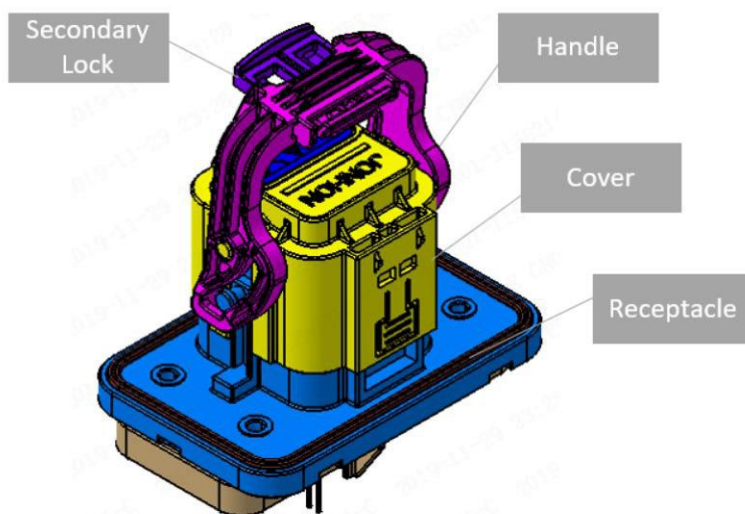


Figure 13. MSD diagram

- Push it in and rotate the handle.

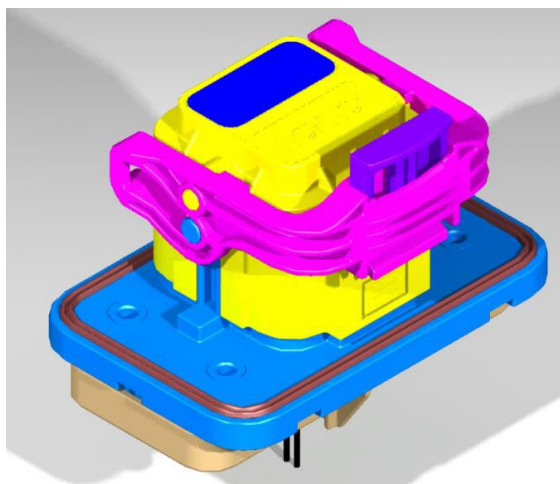


Figure 14. MSD diagram-state 1

- When you can hear the “da da” sound, push in the secondary lock (the disassembly method is opposite), and the installation is completed.

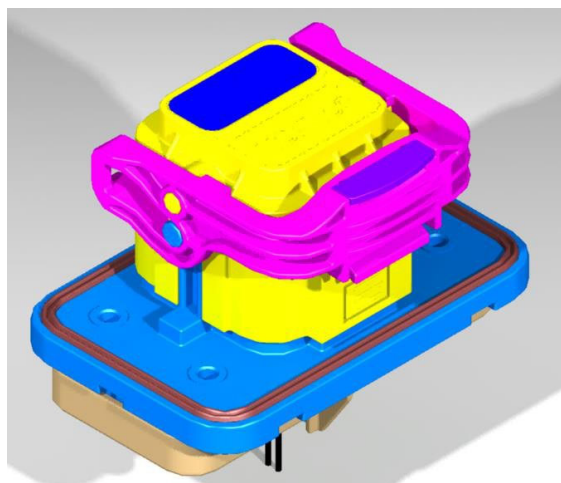


Figure 15. MSD diagram-state 2

3.4.2 Precautions in wiring



CAUTION: JX1 is a debugging interface, which needs to be kept in a sealed state.



CAUTION: The connector need to be tighten during the installation of JX2 and JX3.



WARNING: The power supply harness for the chiller is different from the BMS, and no errors are allowed to occur during wiring. Besides, JXH1-1 and JXH1-2 need be connected to UPS.



WARNING: To ensure the high voltage connector is locked.



WARNING: To ensure the MSD is locked.



WARNING: The positive and negative poles on the DC combiner cabinet cannot be reversed during wiring.



WARNING: Strictly prevent any form of short circuit during the connection process.



WARNING: It is strictly forbidden for the operator to operate without training.



WARNING: It is strictly forbidden for the operator to operate freehand without wearing protective equipment.



WARNING: All connections must be made under explicit guidance, and any form of guessing and vague trial operation methods are strictly prohibited.



WARNING: The key points of the connection are: ensure the connection is correct, reliable (will not be loosened), good contact, no short circuit.



CAUTION: After the connection is completed, it must be measured and confirmed point by point.

⚠ WARNING: Before wiring, make sure the rack is in OFF state by setting QF1, QF2 and QS1 in off state.

⚠ CAUTION: If there are other uncertain factors, need to be confirmed by professionals before implementation.

4. Commission check list

NO.	Test items	Specific description		Consequent	
1	Exterior	Flat shell, uniform color		OK■	NG□
		Clear logo, complete and correct silk screen		OK■	NG□
2	Check the screws	Check whether the screws are loose, slippery, damaged, etc.		OK■	NG□
3	Confirm the high voltage connection circuit	Check whether the high-voltage positive and negative poles of 1#1 system junction cabinet and electric cabinet are correct and whether they are connected reversely		OK■	NG□
		Check whether the high-voltage positive and negative poles of 1#2 system junction cabinet and electric cabinet are correct and whether they are connected reversely		OK■	NG□
4	Start the system	Close the QF1 and QF2 switches of the main control box, and see if the low-voltage indicator light is on or the water-cooling unit is turned on.			
		1#1 system electric cabinet 1-1 ~ 1-6 RACK 1#2 system electric cabinet 2-1 ~ 2-6 RACK		OK■ OK■	NG□ NG□
5	System parameter check	1#1	Maximum temperature value: ____ Minimum temperature value: ____ Whether $\leq 5^{\circ}\text{C}$ Maximum voltage value: ____ Minimum voltage value: ____ Whether $\leq 20\text{mV}$ Whether the cell voltage, the number of temperature	OK■ OK■ OK■	NG□ NG□ NG□

			samples and the fan are running normally		
		1#2	Maximum temperature value: ____ Minimum temperature value: ____Whether $\leq 5^{\circ}\text{C}$ ____ Maximum voltage value: ____ Minimum voltage value: ____Whether $\leq 20\text{mV}$ Whether the cell voltage, the number of temperature samples and the fan are running normally	OK■ OK■ OK■	NG□ NG□ NG□
6	System high pressure closure	Close all high-voltage relays and corresponding circuit breakers of the RACK. Measure whether the bus voltage is normal. Multimeter measured voltage: XXX V		OK■	NG□
7	System high pressure calibration	Close all high voltage relays of the electric cabinet, and the upper computer calibrates the voltage of the electric cabinet		OK■	NG□
8	Software version confirmation	Confirm the system software version		OK■	NG□
9	RACK and PCS communication	Can PCS control the power on and off of the product		OK■	NG□
10	Charge and discharge check	Charge and discharge the product with low current through PCS		OK■	NG□

5. Operating Instructions

In order to ensure the long-term safe and reliable operation of your energy storage system, please read and follow the instructions below:

[Note] Fortress Power will not be liable for any damage caused by failure to use the battery system in accordance with the specified requirements or beyond the specified range and other losses arising out of such damage.

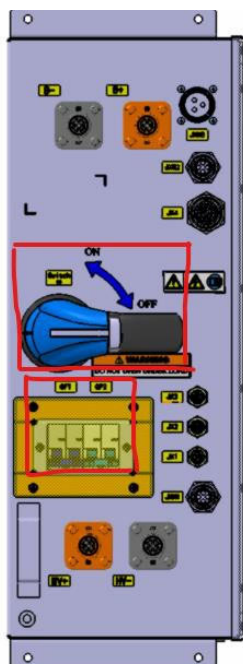
5.1 Rack Temperature Characteristics

- Operating ambient temperature:-20°C~55°C (discharge) / 0°C~55°C (charge)
- Safe storage ambient temperature:-30°C~60°C
- Recommended storage environment temperature: average temperature ≤ 25 °C
- Optimum operating ambient temperature:20°C~40°C

5.2 Cable Connection Confirmation

- Before power on, check the connection cable of the whole system, and make sure that the cable connection is reliable without aging fracture and insulation damage.
- Check whether the positive and negative poles of the DC output power cable in the battery rack are connected correctly;
- Check whether the power connection of the battery cupboard is correct;
- Check whether all communication wires and cables and sub connections at the connection end are tight and reliable;

5.3 Status Checking of Equipment Switch



- Close the QF1 and QF2 isolation switch on the battery rack (red frame in above figure).

5.4 Power up the Secondary Circuit

After connecting AC power supply, the indicator lights of every battery rack is as follows:

System status	Indicator light for the secondary circuit ●	Indicator Light for the primary circuit ●	Alarm indicator light ●
Power ON	Green light is ON	Red light is OFF	Yellow light is OFF

- If the combination of the lights on and off is inconsistent with the above list, it means that the system is not normally started up. Repeat the steps.

- If the system fails to start up after repeating the steps for 5 times, please conduct preliminary troubleshooting of system failure according to the **“Failure and Alarm Handling and Countermeasures in chapter 8”**;
- If the problem cannot be solved, please contact the manufacturer for system troubleshooting.

5.5 Power up of Primary Circuit of Battery Rack

- After the secondary circuit is electrified, charge the primary circuit for the battery rack. At this moment, the positive and negative output ends of the battery rack will generate about 1372.8V (50%SOC) DC high voltage. After electrification, the light combination will correspond to the following state:

System status	Indicator light for the secondary circuit ●	Indicator Light for the primary circuit ●	Alarm indicator light ●
Power ON	Green light is ON	Red light is ON	Yellow light is OFF

- If the combination of the lights on and off is inconsistent with the above list, it means that the system is not properly powered on. Repeat the steps.
- If the system fails to be powered on after repeating the steps for 5 times, please conduct preliminary troubleshooting of system failure according to the **“Failure and Alarm Handling and Countermeasures in chapter 8”**; If the problem cannot be solved, please contact the manufacturer for system troubleshooting.

5.6 Charging of Battery Rack

- After powering on the primary circuit, if BMS detects the charging current, the battery rack will enter the charging state for charging. At this time, corresponding states of indicator lights are as follows:

System state	Indicator light for the secondary circuit ●	Indicator Light for the primary circuit ●	Alarm indicator light ●
Power ON	Green light is ON	Red light is ON	Yellow light is OFF

5.7 Discharging of Battery Rack

- After powering on the primary circuit, if BMS detects the discharging current, the battery rack will enter the discharging state for discharging. At this time, corresponding states of indicator lights are as follows:

System state	Indicator light for the secondary circuit ●	Indicator Light for the primary circuit ●	Alarm indicator light ●
Power ON	Green light is ON	Red light is on	Yellow light is OFF

5.8 Power Down of Primary Circuit of Battery Rack

- During power down of primary circuit, the main circuit of the battery rack is disconnected and there is no high voltage at both ends of the positive and negative output poles, and the combination of lights on and off will correspond to the following state:

System state	Indicator light for the secondary circuit ●	Indicator Light for the primary circuit ●	Alarm indicator light ●
Power ON	Green light is ON	Red light is OFF	Yellow light is OFF

Note: When there is charging and discharging flow in the main circuit of the battery system, the system will not be able to carry out the power down operation. Only when the charging and discharging flow is less than 5A can the power down operation be carried out.

5.9 Secondary Circuit Power Down

- The primary circuit indicator light is OFF. After disconnecting the AC power supply, corresponding states of indicator lights are as follows:

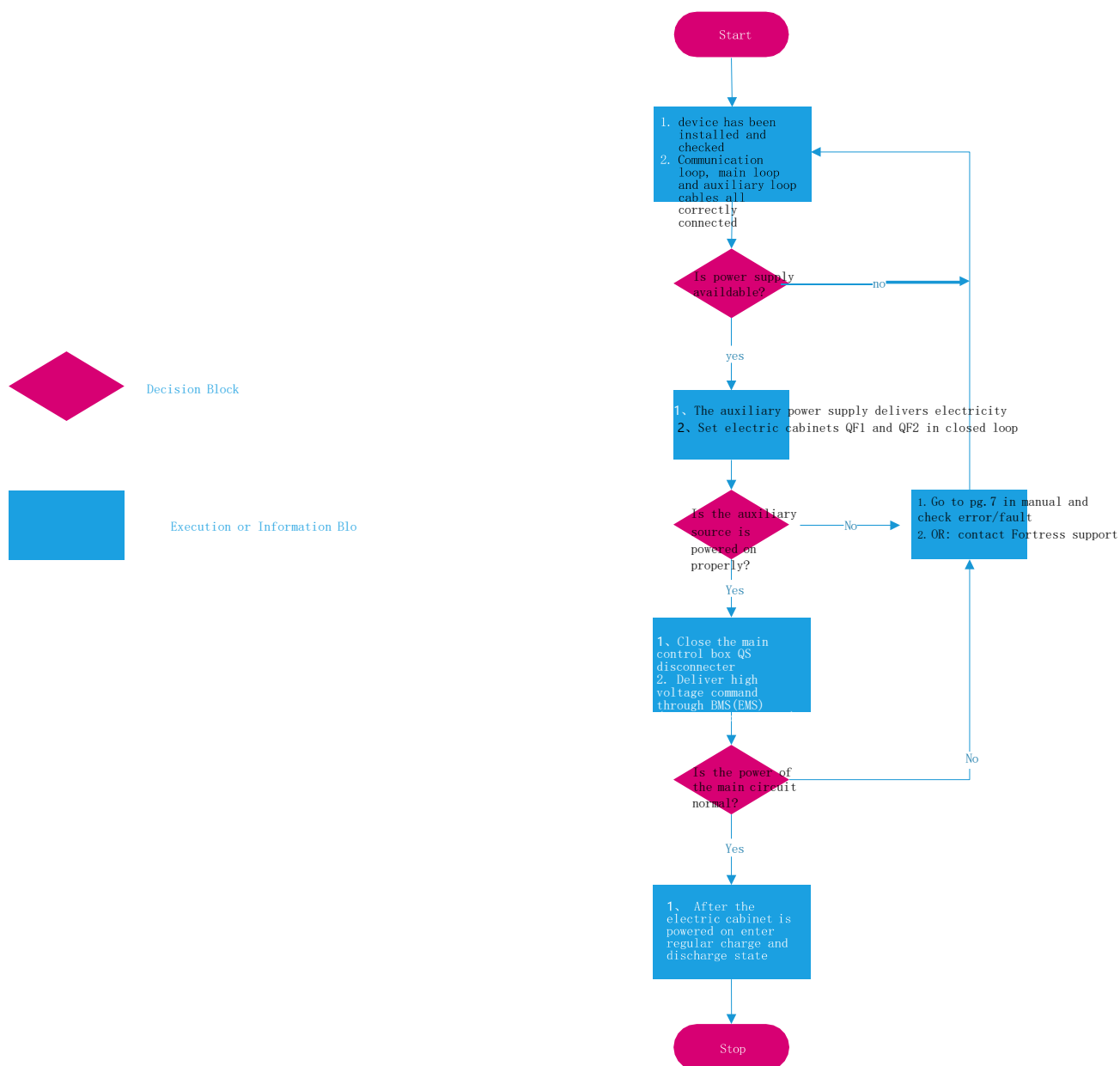
System state	Indicator light for the secondary circuit ●	Indicator Light for the primary circuit ●	Alarm indicator light ●
Power OFF	Green light is OFF	Red light is OFF	Yellow light goes out

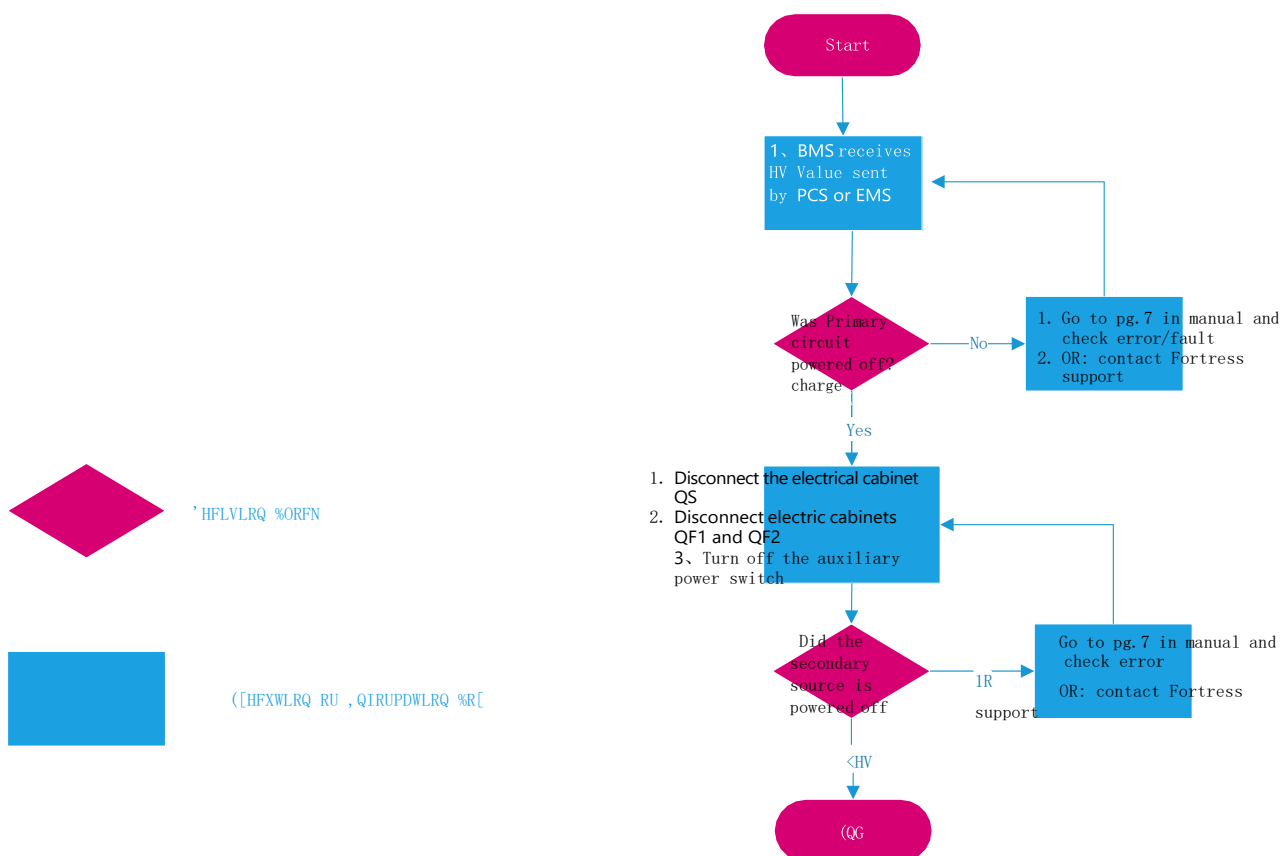
- If the combination of the lights on and off is inconsistent with the above list, it means that the system is not shut down normally. Repeat the steps.
- If the system fails to shut down after repeating the steps for 5 times, please conduct preliminary troubleshooting of system failure according to the **“Failure and Alarm Handling and Countermeasures in chapter 8”**; If the problem cannot be solved, please contact the manufacturer for system troubleshooting.

5.10 List of Rack Status

System state	Indicator light for the secondary circuit ●	Indicator Light for the primary circuit ●	Alarm indicator light ●
Power OFF	Yellow light is OFF	Red light is OFF	Yellow light is OFF
Failure	Green light is ON	Red light is OFF	Yellow light is ON
Power ON	Green light is ON	Red light is OFF	Yellow light is OFF
Power up of Primary Circuit	Green light is ON	Red light is ON	Yellow light is OFF
Charge/Discharge	Green light is ON	Red light is ON	Yellow light is OFF

5.11 Flowchart for powering on the cabinet





6. Product Maintenance

6.1 Terms Explanation

- Normal operating: Refers to the system that works every day.
- Intermittent operating: Refers to a system that does not have a fixed monthly running frequency and cannot guarantee daily work.
- Long-time unused: The battery system that has not started working for more than 3 months (the battery system needs to be charged to 40% SOC before being suspended).

6.2 Operating Instructions for Normal Operating System

- Perform battery maintenance on the system every twelve months to prevent battery damage. Refer to *Section 6.6* for specific maintenance operating method.
- Conduct an inspection of ESS every twelve months (refer to *Appendix 1*) and make inspection record.

6.3 Operating Instructions for Intermittent Operating System

- The operating instructions are the same as those of normal operating system.

6.4 Operating Instructions for Long-time Unused System

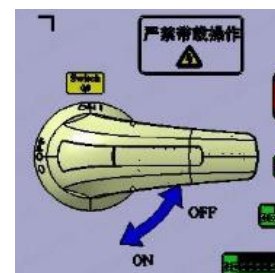
- SOC range of battery storage: 30%~50%., avoid long-term storage of batteries below 15% SOC. If the battery is not used for a long time, it is necessary to cut off the power-consuming equipment in time
- Conduct an inspection of ESS every three months (refer to *Appendix 1*) and make inspection record.
- Perform battery maintenance on the system every three months to prevent battery damage. Refer to *Section 6.6* for specific maintenance operating method.
- Before the first usage of long-time unused system, the battery system must be fully charged at least once to activate the battery system in order to recover the battery performance to the best condition.

Tips

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

6.5 Function of Isolating Switch

- The isolating switch is an electrical component used to manually cut off the high voltage circuit for safety protection (pictured, right).
- Before the maintenance work is performed on the system, the relevant personnel must disconnect the isolating switch. After the maintenance work is completed, ensure that the isolating switch is in the ON state.



6.6 Operating Method of Battery Maintenance

In order to ensure the long-term safe and reliable operation of your energy storage system, please read and follow the instructions below:

Maintenance process:

Plan 1 This plan is applicable when SOC of the battery system is low

- 1 Discharge the battery system to the cut-off condition (Average cell voltage < 3.1V or the lowest voltage < 2.8V), then stop discharging, standing for 1 hour.
- 2 Full charging automatically to the battery system (The highest voltage > 3.65V), after charging, standing for 1 hour.
- 3 Discharge the battery system to 40% and stop

Plan 2 This plan is applicable when SOC of the battery system is high

- 1 Full charging automatically to the battery system (The highest voltage > 3.65V), after charging, standing for 1 hour.
- 2 Discharge the battery system to the cut-off condition (Average cell voltage < 3.1V or the lowest voltage < 2.8V), then stop discharging, standing for 1 hour.
- 3 Charge the battery system to 40% and stop

Tips

- 1 Check to ensure environmental safety, system safety, no alarm, no fault before performing maintenance operations.
- 2 After the battery maintenance of ESS is completed, you can notify our after-sales engineer to perform data analysis for free.

6.7 Maintenance Requirements for Liquid Cooling System

- In case of liquid leakage inside the electric cabinet, please stop the machine in time and contact Fortress Power for maintenance.
- The coolant shall be BASF GLYSANTIN G30 and Sinopec OEVC electric vehicle thermal-35 recommended by Fortress Power. Once every five years. If the coolant deteriorates to the following level, it needs to be replaced.
- PH value < 6.5 or PH value > 9.5
- Chloride concentration > 60ppm
- Appearance: turbid coolant with impurities
- The energy storage water cooling pipeline uses a liquid level alarm. If the liquid level sensor prompts an alarm, the liquid needs to be added.
- If you purchase the coolant by yourself, you need to choose the coolant with the ice point lower than the local minimum temperature. It is recommended that the concentration of 40% ~ 50% glycol is good for aluminum corrosion resistance, and the maintenance should be carried out according to the requirements of the coolant supplier. It is recommended to increase the maintenance frequency. Any damage to the relevant parts of the electric cabinet caused by the use of other coolants not recommended by Fortress Power is not covered by the warranty.
- The water cooling pipeline is observed during annual maintenance, and if it is damaged, it needs to be replaced immediately. For the specific replacement operation method, see Appendix 2
- For the maintenance of water cooling chiller, please refer to appendix the user manual of water cooling chiller.

6.8 Fire Protection System Maintenance

- The service life of the aerosol is 10 years, and replacement are required every 10 years.
- Check the temperature sensor and smoke sensor every 12 months:
- Open the rack door, the rack is powered by low voltage, and observe that the sensor indicator flashes once every few seconds, which is the normal working state.
- Dust regularly: to ensure the free circulation of air in the cabinet, clean the system every 6 months. Especially for dusty application scenarios, especially the air inlet and outlet of the fan、 Floor drain, and use a vacuum cleaner when necessary. Power must be cut off before dust removal; do not rinse with water.
- The catkins need to be maintained and cleaned at least once a week during the catkin season to prevent the mesh from being blocked.

7. Diagnosis of common abnormal problems

7.1 The system alarm is divided into level alarm and non-level alarm.

Non-level alarm means that when an alarm occurs, certain equipment has been damaged or malfunctioned.

There is no need to distinguish the severity with alarm level. 0 means normal, and 1 means that the corresponding equipment has malfunctioned.

Treatment measures of failure at different levels:

Level alarm	Non-level alarm
Monomer over-voltage	Pre-charge timeout

Monomer under-voltage	Short circuit of pre-charge
	load
Monomer over-temperature	Adhesion (main positive, main negative)
Monomer low-temperature	Open circuit (main positive, main negative)
Charging over-current	Coil abnormality (continuous monitoring)
Discharge over-current	Larger temperature difference
Higher SOC	Over voltage of system
Lower SOC	Lower system voltage
	Larger voltage difference
	Voltage invalidation
	Temperature invalidation - module single-point
	Temperature invalidation - module double-point
	Current invalidation
	Equalization anomaly
	Inner and cumulative sum voltage difference
	Open circuit of high voltage circuit
	CCAN communication
	SCAN communication
	CSC power supply

	Precharged relay power supply
	Abnormal power supply of SBMU
	Power supply of current sensor
	Abnormal FUSE state of main control cabinet
	Abnormal MSD state of battery rack
	Higher relay cut-off current

7.2 Countermeasures of system alarm

When you enable the battery rack, if it cannot work normally, please do not hastily determine that the battery rack is out-of-order, please refer to Table 8-2 for possible reasons. At the same time, pay attention to check whether it is caused by external environment, such as temperature, noncompliant humidity or load overload. If the maintenance or replacement of spare parts is involved, the after-sales user's manual shall prevail. Meanwhile, the disassembly and installation are not allowed without authorization.

This chapter contains only a few simple failure diagnosis procedures. If the answer to the diagnosis is not very unequivocal, or the information obtained is not sufficient to settle the problem, please contact the local office or distributor of the Fortress Power.

S/N	Failure or alarm phenomena	Possible cause of failure	Troubleshooting scheme
1	The low voltage indicator light of the battery rack is not on	1. Poor contact of wiring harness	Check indicator light wiring harness
		2. SBMU failure	Replacement of SBMU
		3. Breakdown of indicator	Replacement of indicator light
2	The high voltage indicator light of the battery rack is not on	1. Poor contact of wiring harness	Replacement of relay
		2. SBMU failure	Replacement of SBMU
		3. Breakdown of indicator	Replacement of indicator light
3	Precharged relay cannot be closed	1. Poor connection of relay wiring harness	Check wiring harness connection
		2. Relay failure	Replacement of precharged relay
		3. SBMU failure	Replacement of SBMU
4	Main positive relay cannot be closed	1. Poor connection of main positive relay wiring harness	Check wiring harness connection
		2. Main relay failure	Replacement of main negative relay
		3. SBMU failure	Replacement of SBMU
5	Main negative relay cannot be closed	1. Poor connection of main negative relay wiring harness	Check wiring harness connection
		2. Main negative relay failure	Replacement of main negative relay
		3. SBMU failure	Replacement of SBMU
6	Adhesion of main positive relay	1. Damage of main positive relay	Replacement of main positive relay
7	Adhesion of main negative relay	1. Damage of main negative relay	Replacement of main negative relay

8	Abnormal monomer voltage detection	1. Poor connection of voltage detection wiring harness	Check wiring harness connection
		2. CSC failure	Replacement of CSC
9	Abnormal monomer temperature detection	1. Poor connection of temperature detection wiring harness	Check wiring harness connection
		2. Temperature sensor failure	Replacement of temperature sensor
		3. CSC failure	Replacement of CSC
10	Abnormal total voltage detection	1. Poor connection of total voltage detection wiring harness	Check wiring harness connection
		2. SBMU failure	Replacement of SBMU
11	Ferroelectric memory failure	1. SBMU ferroelectric memory failure	Replacement of SBMU
12	Internal communication abnormal	1. Poor connection of internal CAN wire	Unplug and check CAN cable
13	System parameters are not configured	1. The battery system parameters are not configured	Configure system parameters
14	Temperature extreme	1. The battery temperature exceeds the normal working range	Stop charging and discharging
15	Voltage extreme	1. Single cell voltage exceeds the normal allowable threshold	Stop charging and discharging
16	CSU 5V power supply is abnormal	1. Bad wiring of 5V power supply harness	Check the wiring harness
		2. SBMU abnormal power generation	Replace SBMU
17	CSC 12V power supply is abnormal	1. Poor wiring of 12V power supply harness	Check the wiring harness
		2. CSC power generation abnormal	Replace CSC
18	SBMU automatic shutdown	1. MBMU wake-up signal wire is	Check the wiring harness

		badly wired	
		2. MBMU wake-up signal output failure	Replace SBMU
19	Smoke sensor is abnormal	1. Bad sensor wiring	Check the wiring harness connection
		2. Smoke sensor malfunction	Replace the smoke sensor
20	Temperature sensor abnormal	1. Bad sensor wiring	Check the wiring harness connection
		2. Temperature sensor failure	Replace temperature sensor
21	Monomer over-voltage alarm	1. Poor equalization	Stop charging and standby equalization
		2. System over-discharge	Stop charging
22	Monomer under-voltage alarm	1. Poor equalization	Stop discharge and standby equalization
		2. System over-discharge	Stop discharge
23	Monomer over-temperature alarm	1. Excessive temperature of individual cores	Check whether the air conditioner is in operation
		2. Excessive charging-discharge current	Appropriately reduce charging and discharge current
24	Monomer under-temperature alarm	1. Lower temperature of individual cores	Check whether the heating function is on (if the equipment cabinet has heating function)
		2. Lower ambient temperature	No charging
25	Cabinet overpressure alarm	1. System overcharge	Stop charging
26	Cabinet under voltage alarm	1. System over discharge	Stop discharge
27	Cabinet over temperature alarm	1. The RACK temperature is too high	Check if the air conditioner is running
		2. Temperature sensor failure	Replace temperature sensor
28	RACK low temperature alarm	1. RACK temperature is too low	Check whether the air conditioning heating function is turned on
		2. The ambient temperature is too low	No charging

29	Charging over-current alarm	1. Excessive current of system charging	Reduce charging power
30	Discharge over-current alarm	1. Excessive current of system discharge	Reduce system load
31	The unit does not run without display	The chiller is not powered on	Check if there is electricity at the power input of the chiller
		Suffered a lightning strike and the fuse burned	Check whether the fuse of the water-cooled unit is burned out, and replace it after burning
32	External circulation fan does not run	The power input of the air conditioner is abnormal, such as overvoltage or undervoltage.	Check the unit display, determine whether there is a corresponding alarm in the chiller, and correct it
		Air conditioner is on standby	Normal phenomenon, when the chiller is powered on, it enters the automatic control logic after 30s standby
		Fan stuck	Check if there are foreign objects stuck in the fan
		Loose terminal	Check whether the fan docking terminal is loose
		The compressor does not start	The external fan starts after the compressor starts
33	Abnormal noise of external circulation fan	Fan bearing wear	Replace the fan
		Fan blades scrape other objects	Check if there are cables or other interference with the fan blades
34	The compressor does not start	Power off (standby)	Check the main power switch, and check whether the operation display interface has been turned on
		Loose circuit connection	Forbidden circuit connector

		Compressor motor burned out	Check the motor and replace it immediately if any defect is found
35	Compressor not working	No cooling requirements	Check the indoor return air temperature display and the output status of the compressor in the operation interface
		Stop delay	The compressor has the shortest stop time under normal conditions. If the temperature rises to the opening point again during this period, the compressor will still start with a delay
36	High exhaust pressure	Dirty condenser	Check if the condenser is dirty and clean the condenser
		External circulation fan does not work	Refer to the description of the external fan not running
37	The internal circulation pump does not start	Power off (standby)	Check the main power switch, and check whether the operation display interface has been turned on
		Loose circuit connection	Fasten the circuit connector
		The pump body is burned out	Check the water pump, if it is found to be burned out, replace it immediately
		There is air or no cooling medium in the cooling medium, which causes the pump to protect itself	Check whether there is air or no cooling medium in the system. If there is air or no cooling medium in the system, it needs to be evacuated or supplemented with cooling medium
38	Electric heating tube does not work	No cooling requirements	Check whether the outlet water

			temperature and heating set point are set properly
		Loose circuit connection	Fasten the circuit connector
		Electric heating tube burned out	Check the electric heating tube, if it is found to be burned out, replace it immediately

7.3 Emergency Treatment Method



(Scenario 1) Fire

Step 1: Evacuate people to safe area, delimit the safety isolation zone and call the police according to the situation.

Step 2: If possible, proceed as follows in the case of personal safety:

- 1) If the wiring harness is smoking or on fire, use carbon dioxide or dry powder fire extinguisher to extinguish the fire.
- 2) If the batteries are on fire, use a high pressure water gun to extinguish the fire at a distance.
- 3) If you accidentally inhale smoke, please transfer and seek medical attention as soon as possible.

Step 3: Notify the manufacturer to obtain further handling suggestions.

Tips

If the fire is caused by abnormal charging or discharging, be sure to turn off the power first and then extinguish the fire.



(Scenario 2) Flooding

Step 1: Regardless of whether the system is powered on, evacuate people to safe area and delimit the safety isolation zone.

Step 2: Notify the supplier to perform an overhaul after the flood faded.

Step 3: It is forbidden to start the system until the manufacturer provides the safety results of the system.

8. Requirements for Maintenance Personnel

According to the after-sales user manual, the maintenance personnel shall be authorized by Fortress Power before carrying out maintenance based on the maintenance document.

Authorization of specific maintainers will be discussed during the implementation phase of the project, and Fortress Power will provide training and guidance accordingly.

Appendix 1

Inspection project	Method	Yes-√ No- × Not applicable-O	Abnormal record
Is the fire extinguishing system	Visual inspection		
Whether the fire extinguishing system is within the validity period	Visual inspection		
Is the cooling system complete	Visual inspection		
Is the cooling system air duct blocked	Visual inspection		
Whether the appearance of the electric cabinet is deformed	Visual inspection		
Whether the appearance of the electric cabinet is rusted or damaged	Visual inspection		
Is there water vapor inside the electric cabinet	Visual inspection		
Whether the LV harness is loose or damaged	Visual inspection		
Whether the HV harness is loose or damaged	Visual inspection		
Whether the wiring harness interferes with the structural parts	Visual inspection		
Whether the high voltage connection is ablated	Visual inspection		
Whether the fixing bolt of structural parts is loose or missing	Visual inspection		
Is MSD complete and reliable	Visual inspection		

Whether the water cooling pipe is damaged	Visual inspection		
Is there a foul smell in the battery compartment	Sniffing		
Is there a pungent smell in the electric cabinet	Sniffing		
Whether HV connection part has burnt smell	Sniffing		
Is the summary data complete	Monitor master computer		
Is the cell voltage data complete	Monitor master computer		
Is the cell temperature data complete	Monitor master computer		
Whether there is an abnormal alarm in the alarm bar	Monitor master computer		
Note: If any abnormalities are found during the inspection, please feedback in time, and contact the relevant personnel for processing.			