

# Battery Energy Storage System



## Operation I Maintenance



Product Name : BP-ES-125kW-261kWh-B02

C&I Energy Storage System (125kW/261kWh)

Version 1.0 (November 2025)

# TABLE OF CONTENTS

- 1. Safety Information ..... 2
  - 1.1. Electrical Safety ..... 4
  - 1.2. Battery Safety ..... 5
  - 1.3. Fire Protection and Emergency Measures..... 8
  - 1.4. Environmental Requirements ..... 8
  - 1.5. Mechanical Safety ..... 9
  - 1.6. Equipment Safety ..... 9
  - 1.7. Storage Security Management ..... 10
- 2. Maintenance and Troubleshooting ..... 12
  - 2.1. General Maintenance Precautions ..... 12
  - 2.2. Personnel Requirements ..... 13
  - 2.3. System Isolation Requirements (Before Maintenance) ..... 14
  - 2.4. Periodic Maintenance Requirements ..... 14
  - 2.5. Safety Management ..... 15
  - 2.6. System Cleaning ..... 21
  - 2.7. Battery Maintenance..... 22
  - 2.8. Liquid Cooling System Maintenance ..... 24
  - 2.9. Fault Handling..... 26
  - 2.10. Accident Handling ..... 28

## 1. Safety Information

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This chapter provides essential safety information that must be carefully read and understood before transporting, storing, installing, operating, or maintaining the Energy Storage System (ESS). It is intended to ensure the personal safety of all personnel involved, prevent property damage, and guarantee reliable and compliant system operation.

All activities must be carried out in strict accordance with the instructions contained in this manual and with all safety markings and warnings displayed on the equipment. Failure to follow the safety information in this document may lead to personal injury, equipment damage, or even fatal accidents.

### Representations and General Responsibilities

Before performing any work on the equipment, the operator or service personnel must read this manual thoroughly and follow all operational and safety instructions. JA Solar accepts no liability for any damage, loss, or injury resulting from misuse, unauthorized modification, or operation that is inconsistent with the specifications or guidance provided herein.

The signal words **DANGER**, **WARNING**, **CAUTION**, and **NOTICE** (see also chapter 1.3) used throughout this manual highlight the risk levels associated with certain actions. These warnings do not cover all possible hazards. Users must also comply with all relevant international, national, and regional standards, regulations, and industry safety practices.

### Exclusions of Liability

The Company shall not be liable for any damage, injury, or loss arising from or related to the following conditions:

1. Damage to the equipment caused by **force majeure**, such as earthquakes, floods, volcanic eruptions, mudslides, lightning strikes, fires, wars, armed conflicts, typhoons, hurricanes, tornadoes, or other extreme weather events.
2. Failure to operate or maintain the product in accordance with the **operating conditions and requirements** specified in this handbook.
3. Failure to follow the **operating instructions, procedures, and safety warnings** described in this document or displayed on the product.
4. Any **unauthorized disassembly, modification, or alteration** of the product or its software.

5. Damage caused by **improper storage conditions** that do not comply with the storage requirements stated in this manual.
6. Installation or operation of the system in an environment that does not meet **applicable international, national, or regional standards**.
7. Installation, operation, or maintenance of the system by **unqualified or untrained personnel**.
8. Use of **tools, materials, or accessories** that do not meet local laws, regulations, or relevant technical standards.
9. Damage caused during **transportation** by the user or by a third-party carrier appointed by the user.
10. Damage or loss caused by **negligence, mishandling, gross error, or intent** on the part of the user or a third party.

Furthermore, the Company will not assume responsibility for any damage or malfunction caused by:

- Operation of the system outside its **design specifications** or rated conditions.
- Use of the equipment in an **environment incompatible** with its intended design, resulting in equipment malfunction, abnormal behavior, or component failure.
- Any **personal injury, property damage, or operational hazard** resulting from non-compliance with this manual or local safety standards.
- Any **reverse engineering, decompilation, or unauthorized modification** of the system's hardware or software, including the study of internal logic or performance testing without written permission.

### **Safety Compliance**

All operations, including transportation, storage, installation, commissioning, operation, and maintenance, must comply with the relevant laws, regulations, and standards applicable in the region of use.

Only personnel who have received proper technical and safety training and who hold the necessary local qualifications are permitted to carry out these tasks.

The system must always be operated within the environmental, electrical, and mechanical limits specified in this manual. Operation outside these conditions may cause malfunction, personal injury, or equipment damage, and such incidents will not be covered by the warranty.

## 1.1. Electrical Safety

Always confirm that the system and all related cables are undamaged before switching on. Damaged insulation or loose terminals may cause electric shock or fire. Follow the manufacturer's specified power-on and power-off sequence at all times. Use only insulated tools that are rated for voltages higher than the system's operating voltage.

All grounding connections must comply with the relevant national or international electrical standards, such as IEC 60364-5-54. Connect the protective earth conductor first when installing the system and remove it last when dismantling. Before working on any circuit, verify with a tester that the system is de-energized and properly grounded.

Place visible "Do Not Switch On" warning tags on all relevant switches and circuit breakers. Keep cables away from hot surfaces and sharp edges, and ensure that all entries are sealed to prevent the ingress of moisture or small animals. When handling electronic boards, use anti-static wrist straps to prevent electrostatic discharge.

After switching off, wait at least 15 to 20 minutes for internal capacitors to discharge before opening any enclosures or touching live parts.

### **WARNING**

Before making electrical connections, make sure the equipment is undamaged, otherwise electric shock or fire may result.

Unregulated and incorrect operation may cause accidents such as fire or electric shock.

During operation, foreign objects must be prevented from entering the interior of the equipment, as this may result in short-circuit failure or damage to the equipment, derating or loss of power to the load, and personal injury.

When equipment is installed, the protective earth wire must be installed first; when equipment is removed, the protective earth wire must be removed last.

When the unit is in operation, the casing is hot and there is a risk of burns, so do not touch it.

In the event of a fire, evacuate the building or equipment area and ring the fire alarm or call the fire alarm. Under no circumstances should you re-enter a burning building or equipment area.

**DANGER**Electrically charged measurements

High voltages are present in the equipment within the Energy Storage Integration System, and accidental touching may pose a risk of fatal electric shock. It is important to observe the following requirements when making measurements with electricity:

Take proper precautions (e.g. wear insulated gloves rubber shoes, etc.).

At least one professional must accompany you during surveying operations to ensure personal safety.

**DANGER**Full power-off operation

It must be ensured that the equipment and systems within the integrated energy storage system are completely unpowered before the integrated energy storage system is operated.

Ensure that a disconnected device cannot be accidentally repowered. Use a multi-meter to ensure that the inside of the unit is completely de-energised.

Ensure correct earthing as necessary. Ensure that escape routes are clear throughout the operation.

Ensure that the Energy Storage Integration System has been completely de-energised and confirm this by measuring with a multi-meter. Use insulating material to insulate and cover potentially electrically live parts adjacent to the operating section.

Always wait at least 20 minutes after the Energy Storage Integration System has been completely decommissioned before operating the Energy Storage Integration System.

**1.2. Battery Safety**

The battery system operates at high DC voltage and poses a severe risk of electric shock. Before any work, disconnect all battery modules and wait at least 20 minutes to ensure the system is fully discharged. Never short-circuit the positive and negative terminals, and never pierce, crush, or drop a battery module.

Batteries must be kept away from any heat source, open flame, or direct sunlight. Only use and replace batteries of the same type and specification that have been approved by the manufacturer. Regularly check and tighten the busbar and terminal screws using the torque values given in the

technical documentation. Loose or corroded connections can cause excessive heating and may lead to fire.

Do not charge or discharge the batteries outside the permitted temperature range. After each discharge, recharge the batteries promptly to avoid deep-discharge damage.

If you notice leakage, smoke, or a strong odor, isolate the affected battery, ventilate the area, and contact professional service personnel immediately. Do not touch leaking electrolyte — it is toxic and corrosive. Wear goggles, gloves, and protective clothing when handling a damaged battery.

Used or defective batteries must be disposed of or recycled in accordance with local hazardous-waste and transport regulations. They should never be discarded with household waste.

**DANGER**

This product contains high voltage! Danger of electric shock! The battery in the system generates a high voltage when connected, which can cause electric shock or even life-threatening injury if accidentally touched.

When installing, maintaining and overhauling the equipment, it is necessary to ensure that:

- All storage batteries were completely disconnected and remained disconnected for 20 minutes.
- Provide visible warning signs at the connection disconnections of the energy storage batteries to ensure that they cannot be accidentally reconnected.

**DANGER**

- Short the positive and negative terminals of the battery, otherwise it will cause a short circuit of the battery. (A short-circuited battery will instantaneously generate a high current and release a large amount of energy, causing the battery to leak, smoke, release flammable gases, runaway heat, catch fire or explode.)
- It is strictly prohibited to maintain the battery with electricity, otherwise it will cause short circuit of the battery.
- It is strictly prohibited to expose the battery to high temperature environments or around heat generating equipment, such as high temperature sunlight, fire sources, transformers, heaters, etc.. (Overheating may cause leakage, smoke, release of flammable gases, thermal runaway, fire or explosion.)

- It is strictly prohibited for the battery terminals to come into contact with other metal objects, which may cause heat generation or electrolyte leakage.
- Please obtain the battery recommended by the manufacturer's sales through proper channels. Using or replacing the battery with an incorrect model will pose a risk of fire or explosion.
- A battery is a closed system that does not release any gases under normal operating conditions. If the battery is subjected to extreme abuse, such as fire, pinprick, extrusion, lightning strike, overcharging or other severe conditions that may lead to thermal runaway of the battery, it may lead to battery breakage or abnormal chemical reaction inside the battery, which may lead to electrolyte leakage or generation of CO<sub>2</sub> or H<sub>2</sub> gases, and the site should ensure that flammable gases are discharged normally to avoid leading to combustion or corrosion of the equipment.
- In the event of a battery accident, non-professionals should stay away (electrolyte is toxic and volatile) and contact a professional immediately.
- In case of battery accident, professionals should wear goggles, rubber gloves, gas mask, protective clothing, etc., power down the equipment in time and take out the leaking battery, and contact technical engineers or after-sales service to deal with it.

#### WARNING

- Battery storage and transit, before removing the packaging need to ensure that the outer packaging box is intact without damage, in accordance with the identification of the box is placed correctly, it is strictly prohibited to inverted, sideways, vertical, tilted placement, stacked in line with the requirements of the packaging on the yardage, to avoid any impact or fall, etc. caused by the battery damage.
- Batteries should be installed in areas away from liquids, and are strictly prohibited from being installed under air conditioning outlets, vents, machine room outlet windows, water pipes and other locations prone to water leakage, in order to prevent liquids from entering the interior of the equipment and causing equipment malfunction or short-circuit.
- Tighten the fastening screws of the copper rows or cables according to the torque specified in the text, and periodically check whether they are tightened, whether there are rust, corrosion or other foreign materials, and dispose of them cleanly, otherwise the screws are falsely connected will lead to excessive connection voltage drop, and even burn the battery with a large amount of heat when the current is high.

- After discharging the battery, the battery should be recharged in a timely manner, otherwise the battery may be damaged due to over-discharge.

### 1.3. Fire Protection and Emergency Measures

In case the battery module leaks electrolyte or any other chemicals, potentially harmful gases may be generated. Therefore, avoid any contact with the discharged material when handling or operating the equipment.

In case of inhalation or physical contact with the leaked material/s, leave the contaminated area immediately and seek medical attention

If a potential fire hazard is suspected at any time, please do as follows:

1. In case the battery pack is charging/discharging and there are potential signs of thermal runaway (e.g smoke) but no visible flames or fire, provided it is safe to do so, disconnect the main circuit breaker to shut off power.
2. As there are no open flames, a Class ABC fire extinguisher or a carbon dioxide extinguisher could be used to extinguish the event.
3. If flames are visible, DO NOT try to put out the fire, and evacuate immediately and contact the local emergency service.

**Warning:** During an event, noxious and poisonous gases could be generated which could affect those near and around the product.

4. Post event when the situation has been contained, the damaged equipment should be placed into a quarantined zone and promptly reported to JA Solar or its authorised partners for further instructions.

### 1.4. Environmental Requirements

The system must be installed and operated within the temperature and humidity limits specified by the manufacturer, usually between  $-20\text{ }^{\circ}\text{C}$  and  $55\text{ }^{\circ}\text{C}$  with relative humidity below 95 percent non-condensing. Avoid installation in areas where flammable gases, corrosive vapors, conductive dust, or strong electromagnetic fields are present.

Maintain good ventilation and never block the air inlets or exhaust openings of the cooling system. The installation site must be level, stable, and capable of supporting the full weight of the cabinet. Do not install in areas that are prone to flooding or water accumulation.

Cable entries and openings must be properly sealed with grommets or sealing putty to prevent the entry of moisture, dust, or pests. After installation, remove all packaging materials and flammable debris from the working area to reduce fire risk.

#### **CAUTION**

Do not open the Energy Storage Integrated System cabinet door in case of dust storms, thunderstorms, high winds, hail, or other inclement weather, or when the relative humidity of the surrounding environment is greater than 95%.

At the end of the severe weather, please treat your surroundings promptly.

The warning labels on the product and on the electrical equipment inside contain important information about the safe operation of the product and the equipment inside, and must not be torn off or damaged!

- Ensure that body warning signs are always legible.
- Always replace the body warning label as soon as it is damaged or obscured.

### **1.5. Mechanical Safety**

Only certified lifting tools and slings should be used when moving or positioning the cabinet. Observe local safety regulations when working at height and always wear a helmet and a safety harness attached to a stable anchor point.

Before installation, check that the cabinet is stable and that the centre of gravity is balanced. Never drill holes into the cabinet or make structural modifications, as this may damage the protective enclosure and void the IP rating. Avoid excessive tilting or shock when transporting or placing the unit.

Do not place heavy objects on top of the cabinet and never use the equipment as a step or support. Inspect all tools for damage before use and replace any that are worn or defective.

### **1.6. Equipment Safety**

Operate the energy storage system only after it has been checked and commissioned by qualified personnel. Never operate the system with open doors or removed covers.

Ensure that ventilation fans and air-cooling systems are operating normally to prevent overheating. Keep the area around the equipment clean, dry, and free from combustible materials. All safety labels and warning signs on the equipment must remain legible; replace them immediately if damaged.

Only original spare parts and manufacturer-approved software updates may be used. Unauthorized modifications can lead to equipment failure and void the warranty. Test all protective devices such as fuses, emergency stops, and residual-current detectors on a regular basis to ensure they function correctly.

### **1.7. Storage Security Management**

The storage environment should meet the requirements of local regulations and standards. Stacking of dangerous goods should be in accordance with relevant regulations. Dangerous goods stored in the same stock should meet the segregation requirements.

Dangerous goods sub-assembly, modification, opening of boxes and drums inspection should be carried out in a safe place outside the warehouse. At the end of the operation, the storage area and storage room should be inspected and confirmed to be safe before leaving.

Cleaning of dangerous goods containers should be left to qualified units.

If the battery malfunctions (carbonization, leakage, expansion, water ingress, etc.), it shall be promptly transferred to the hazardous materials warehouse for separate storage, with a distance of not less than 3m from the surrounding combustible materials, and scrapped as soon as possible for disposal.

When storing the battery, it should be placed correctly according to the identification of the packing box, and it is strictly prohibited to place it upside down, sideways or tilted, and when stacking it, it should meet the yardage requirements on the outer packaging.

When storing batteries, please store them separately, avoid mixing them with other equipment and avoid stacking them too high. When storing a large number of batteries on site, it is recommended to have fire-fighting facilities that meet the requirements, such as fire-fighting sand, fire extinguishers and so on.

The ambient air must not contain corrosive or flammable gases.

#### **Storage environment requirements:**

- Ambient temperature:  $-10^{\circ}\text{C} \sim 55^{\circ}\text{C}$ , recommended storage temperature:  $0^{\circ}\text{C} \sim 30^{\circ}\text{C}$  (6months);

- Relative humidity: 5%RH to 95%RH;
- Store in a dry, ventilated, clean room;
- Avoid contact with corrosive organic solvents, gases and other substances;
- Avoid direct sunlight;
- The distance from the heat source must not be less than two meters without a significant amount of infrared light;
- No metallic conductive type dust, etc.

During storage, relevant proof of compliance with product storage requirements, such as temperature and humidity log data, photos of the storage environment and inspection reports, need to be kept.

Battery storage must be disconnected from the outside and the circuit breaker must be in the off position.

The warehouse manager should keep monthly statistics on battery storage and regularly inform the planning link about the battery inventory. For batteries with storage time close to 15 months ( $-10^{\circ}\text{C} \sim 25^{\circ}\text{C}$ ), 9 months ( $-25^{\circ}\text{C} \sim 35^{\circ}\text{C}$ ) or 6 months ( $-35^{\circ}\text{C} \sim 55^{\circ}\text{C}$ ), timely arrangement of replenishment of electricity will be made.

When stored beyond the expiry date, they need to be inspected and tested by a professional before being put into use.

Stored batteries should be shipped on a first-in, first-out basis.

After the battery production test is completed, it needs to be replenished to a minimum of 30% SOC before storage.

#### **WARNING**

Battery replenishment before the need for battery appearance inspection, inspection of qualified batteries can be the next step in the replenishment of electricity processing, unqualified batteries scrapped.

If the battery does not appear battery deformation, battery shell broken, battery leakage, it is judged to be the appearance of the inspection pass.

Overdue storage judgement conditions:

- Batteries that are deformed, broken, or leaking are directly scrapped, regardless of storage time.

- The storage time is calculated from the latest charging time marked on the supplemental power label on the outer package of the battery, and after the battery has been qualified for supplemental power, the latest charging time of the supplemental label and the next charging time will be refreshed (the next charging time = the latest charging time + supplemental power cycle).
- The maximum permissible period and number of storage replenishments is 3 years or 3 times, e.g. 1 replenishment every 8 months, maximum 3 times permitted; 1 replenishment every 12 months, maximum 3 times permitted.
- Exceeding the maximum permissible period and number of times is recommended to scrap the battery.
- There is capacity loss in long-term storage of lithium batteries, and lithium batteries generally have an irreversible capacity loss of 3% to 10% after 12 months of storage at the recommended storage temperature.
- If the customer performs the discharge test acceptance in accordance with the specification, there is a risk of failing a battery whose capacity after storage is less than 100 percent of the rated capacity.

#### **WARNING**

When the battery SOC is reduced to 0% or when it automatically shuts down, it needs to be recharged in time within 7 days. Permanent battery failure due to overdue recharge for customer reasons.

## **2. Maintenance and Troubleshooting**

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### **2.1. General Maintenance Precautions**

#### **Scope of Application**

This chapter defines the operation and maintenance (O&M) requirements for the Battery Energy Storage Systems (BESS). It specifies site and personnel requirements, service standards, safety management rules, emergency response procedures, record management, and expectations for continuous improvement.

#### **Basic O&M Requirements**

- All O&M work must comply with national laws, regulations, and applicable technical standards.
- A complete O&M management system and formal safety procedures must be established.
- Roles, responsibilities, workflows, and Standard Operating Procedures (SOPs) must be clearly defined and documented.

### **Equipment Requirements**

- All system infrastructure must meet relevant national and industry standards.
- Designated and qualified personnel must be responsible for equipment operation and maintenance.
- Routine inspections shall be conducted at defined intervals: weekly, monthly, quarterly, and annually.
- Equipment surfaces must remain clean, free from rust, dust, and contamination.
- Prohibited: Storing flammable, explosive, corrosive, or polluting materials near electrical equipment.

## **2.2. Personnel Requirements**

All ESS operations must be performed by trained and authorized personnel only.

- Minimum of two qualified persons must be present on site during operation or maintenance.
- Personnel must complete safety training and pass competency assessments prior to assignment.
- All activities shall strictly follow SOPs and relevant safety regulations.
- Professional conduct and clear communication are mandatory at all times.

### **Personnel Responsibilities**

- Monitor system operating status and respond to system alarms or faults.
- Maintain key components and perform scheduled inspections.
- Implement site-specific safety rules and participate in safety inspections.
- Report hazards and unsafe conditions immediately.

### **Skills Requirements**

Personnel must be able to:

- Understand ESS working principles, common faults, and emergency procedures.

- Apply national and industry safety regulations correctly.
- Demonstrate electrical safety skills and emergency response competence.

### 2.3. System Isolation Requirements (Before Maintenance)

Before performing any maintenance activity, the system must be fully isolated from all electrical sources.

#### **DANGER**

##### **Isolation Steps**

1. Disconnect the **DC isolation switch** of the PCS to separate it from the batteries.
2. Open the **PDU circuit breakers** to isolate the high-voltage cabinet from the battery cabinet.
3. Verify correct grounding of the system.
4. Ensure complete isolation from all **AC and DC sources**.
5. Wait **at least 20 minutes** for discharge before checking voltage levels with a voltmeter.

#### **Important:**

**Even when a cabinet is not in operation, treat all battery cabinets as live.**

### 2.4. Periodic Maintenance Requirements

Environmental conditions influence the required maintenance frequency.

- In harsh environments (e.g., deserts, high dust levels), shorten all inspection cycles.
- After sandstorms or similar events, perform full internal and external cleaning.

#### **General Rules for Periodic Maintenance**

- Maintenance work may only begin **after the ESS has been fully powered down and isolated**.
- Record all non-conformities and correct them immediately.
- Use only approved tools, PPE, and procedures during inspections.

## 2.5. Safety Management

### Organizational Requirements

- Establish a clear safety management structure with designated safety officers.
- Personnel must remain within authorized operating areas.
- PPE—such as safety shoes, protective clothing, and insulated gloves—must be worn at all times.
- Hazards must be reported and mitigated without delay.

### Equipment Safety

- Maintain safe electrical operating conditions at all times.
- Faulty equipment must not be used; replace or repair immediately.
- Disconnect the power supply before performing maintenance.
- Inspect safety labels and signage regularly; replace if damaged.

### Inspection Requirements

- Perform unannounced safety spot inspections.
- Correct any unsafe condition immediately.

### Fire Safety

- Adhere to all fire protection laws and standards.
- Ensure all fire suppression systems are functional and clearly marked.
- Conduct **monthly fire safety inspections**.
- Perform at least **two fire/emergency drills per year**.
- Keep evacuation routes permanently unobstructed.

### Tools and Spare Parts Management

- Maintain a documented inventory of tools, spare parts, and PPE.
- Record all procurement and usage of spare parts.
- Ensure critical spare parts and maintenance equipment are available at all times.

**Record Keeping**

- Document all faults, inspections, maintenance activities, and spare-parts replacements.
- Retain:
  - **Paper records** for at least **3 years**
  - **Digital records** for at least **5 years**

<b>ONCE A MONTH</b>	
Fire Protection	<ul style="list-style-type: none"> <li>• Inspect and record the operational status of the gas fire extinguishing storage device room and on-site equipment.</li> <li>• All system components, including the extinguishing agent storage container, container valve, check valve, connecting pipe, collecting pipe, safety relief device, selection valve, valve drive device, nozzle, signal feedback device, leak detection device, and pressure reducing device, should be free from collision deformation and other mechanical damage.</li> <li>• The pressure gauge pointer in the extinguishing agent and driving gas storage containers should be within the effective range.</li> </ul>
<b>EVERY THREE MONTH</b>	
Energy Storage System Inspection	<ul style="list-style-type: none"> <li>• Check if the appearance of the energy storage system has any damage, deformation, or rust.</li> <li>• Listen for any abnormal sounds while the energy storage system is operating.</li> <li>• Observe various parameters during operation through BAU<sup>1</sup>.</li> <li>• If available, use thermal imaging cameras and other tools to detect system overheating.</li> <li>• Check for any electrolyte leakage from the battery box exterior.</li> <li>• Inspect whether the ventilation, environmental temperature, humidity, and dust around the energy storage meet the requirements.</li> </ul>
Duct Cleaning	<ul style="list-style-type: none"> <li>• Check for dust in the duct.</li> <li>• Listen for any abnormal vibrations when the fan is running.</li> </ul>

<sup>1</sup> BAU = Battery Auxiliary Unit

	<ul style="list-style-type: none"> <li>• Use tools for cleaning.</li> </ul>
<p>Fire Protection</p>	<ul style="list-style-type: none"> <li>• The types and distribution of combustible materials, as well as the openings in the protection area, should meet design requirements.</li> <li>• The equipment in the storage device room, the fire extinguishing agent delivery pipelines, and the supports and hangers should be securely fixed without looseness.</li> <li>• The connecting pipes should be free of deformation, cracks, and aging. If necessary, send them to a legally recognized quality inspection agency for testing or replacement.</li> <li>• Each nozzle opening should be free of blockages.</li> <li>• When there are damages and blockages in the fire extinguishing agent delivery pipeline, a tightness test and flushing should be conducted again.</li> </ul>
<p>Battery Appearance Structure Inspection</p>	<ul style="list-style-type: none"> <li>• Visually check if the casing is clean; if there are stains, they should be wiped clean, and the area should be kept ventilated and dry;</li> <li>• Visually check if the casing has any leaks or deformations; if so, it should be replaced in a timely manner;</li> <li>• Refer to the records and actually measure whether the ambient temperature is normal.</li> </ul>
<p>With instruction of JA Service Team (at commissioning): Voltage and Internal Resistance (conductance) Measurement.</p>	<p>Voltage measurement: Use a multimeter or DC voltmeter to measure the terminal voltage of the battery and the total voltage of the battery pack, record the results and make a judgment.</p> <p>Internal resistance (conductance) measurement: Use an internal resistance meter (or conductance meter) to measure the internal resistance (conductance) of individual battery cells and compare them with each other.</p> <p>If there are individual batteries with higher internal resistance, focus on checking the following items:</p> <ul style="list-style-type: none"> <li>• Whether the operating mode of the battery is correct;</li> <li>• Whether the battery voltage and temperature are within the specified range;</li> <li>• Whether the battery has been subjected to long-term overcharging or undercharging;</li> </ul>

	<ul style="list-style-type: none"> <li>• Has the operating life exceeded the manufacturer's recommended lifespan?</li> <li>• Battery connection inspection</li> </ul>
Battery Connection Inspection	<ul style="list-style-type: none"> <li>• Confirm that all battery connection points are secured, with no loose bolts or overheating at the connections.</li> </ul>
<b>EVERY 6 MONTHS</b>	
Safety Features	<ul style="list-style-type: none"> <li>• Check the emergency stop button and the stop function of the LCD.</li> <li>• Simulate a shutdown.</li> <li>• Check the body warning labels and other equipment labels; if any are unclear or damaged, please replace them promptly.</li> </ul>
Device Maintenance	<ul style="list-style-type: none"> <li>• Conduct regular inspections of rust conditions on all metal components.</li> <li>• Annual inspection of contactors (auxiliary switches and micro switches) to ensure their mechanical operation is good.</li> <li>• Check operating parameters (especially voltage and insulation, etc.).</li> <li>• Check if all circuit breakers are malfunctioning.</li> <li>• Check if the circuit breaker or load switch is damaged.</li> <li>• Check the cleanliness of the circuit board and components.</li> <li>• Check the temperature of the heat sink and the presence of dust. If necessary, use a vacuum cleaner to clean the heat module or replace the filter.</li> </ul>
Door Lock and Hinge Inspection	<ul style="list-style-type: none"> <li>• After the cleaning work is completed, the door locks and hinges of the energy storage integrated system should be checked to ensure they are functioning properly and in good condition.</li> <li>• If necessary, appropriate lubrication should be applied to the door lock keyholes and hinges.</li> </ul>
Seal Strip Inspection	<ul style="list-style-type: none"> <li>• A well-sealed sealing strip is an important guarantee to effectively prevent water leakage inside the energy storage integrated system. It should be carefully checked, and if damaged, please replace it immediately.</li> </ul>
Fan	<ul style="list-style-type: none"> <li>• Check the operating status of the fan.</li> </ul>

	<ul style="list-style-type: none"> <li>• Check if the fan is blocked. During operation, is there any abnormal noise?</li> </ul>
Supplementary Liquid	<p>Conduct tests every six months, and when the return liquid pressure is below 0.8 Bar, use the supplementary liquid pump to inject coolant for pressurization.</p> <ul style="list-style-type: none"> <li>• Remove the maintenance panel located at the bottom front of the chiller unit and close the ball valve after the liquid discharge port.</li> <li>• Open the automatic air vent valve/manual valve at the highest point of the connecting pipeline.</li> <li>• Connect the outlet of the replenishment pump to the inlet of the chiller unit using a pipe, and connect the inlet to the external storage tank.</li> <li>• After connecting the power supply line of the replenishment pump to the corresponding terminal, power on the chiller unit.</li> <li>• Start the replenishment pump to inject the coolant.</li> <li>• Stop the injection when the return liquid pressure stabilizes between 0.8 Bar and 1 Bar.</li> <li>• After the injection is completed, close the automatic exhaust valve/manual valve at the highest point of the connecting pipeline, and close the ball valve after the replenishment port.</li> <li>• Then remove the replenishment pump and reinstall the maintenance panel below the unit.</li> </ul>
<b>EVERY 12 MONTHS</b>	
Fire Protection	<ul style="list-style-type: none"> <li>• Conduct one simulated startup test and, if conditions permit, perform one simulated jet test on the gas fire extinguishing system</li> </ul>
Cable Shield Grounding	<ul style="list-style-type: none"> <li>• Check if the cable shield is in good contact with the insulating sleeve; ensure the grounding copper busbar is securely fixed.</li> </ul>
Lightning Protection Devices and Fuses	<ul style="list-style-type: none"> <li>• Check if the lightning protection devices and fuses are properly secured.</li> </ul>
Cabinet exterior	<ul style="list-style-type: none"> <li>• Check if there are any screws fallen inside the energy storage integration system.</li> </ul>

	<ul style="list-style-type: none"> <li>• Check if there is any oxidation or rust inside the energy storage integration system.</li> <li>• Check if the battery compartment door of the energy storage product can be opened normally.</li> <li>• Check whether the internal and external environment of the energy storage product is clean, tidy, and free of clutter.</li> <li>• Check whether the exterior of the energy storage product has any corrosion or peeling.</li> <li>• Check whether the grounding of the energy storage product is normal.</li> <li>• Check whether the safety warning labels on the exterior of the product are intact.</li> <li>• Are the internal battery group and control cabinet fixed securely?</li> <li>• Is the sealing at the entry and exit points of the cable intact?</li> <li>• Check the cable trench to prevent damage to the cable, ensuring that the brackets are grounded and that heat dissipation in the trench is good.</li> </ul>
<p>Inside the Cabinet</p>	<ul style="list-style-type: none"> <li>• Check for foreign objects, dust, dirt, and condensation inside the energy storage integration system.</li> <li>• Inspect the inlet and outlet of the energy storage integration system, check the temperature of the radiator and for dust. If necessary, a vacuum cleaner can be used to clean the heat dissipation module and other components.</li> </ul>
<p>Wiring and Cable Arrangement</p>	<ul style="list-style-type: none"> <li>• Check if the cable arrangement is standard and if there are any short circuits or other issues. If any abnormalities are found, they must be corrected immediately.</li> <li>• Check whether all the entry and exit holes of the energy storage integration system are well sealed.</li> <li>• Check for any signs of water leakage or dampness inside the energy storage integration system.</li> <li>• Check if the power cable connections are loose and retighten them according to the previously specified torque.</li> </ul>

	<ul style="list-style-type: none"> <li>• Inspect the power cables and control cables for any damage, especially looking for signs of cuts on the insulation where they contact metal surfaces.</li> <li>• Check whether the insulation tape of the power cable terminal is falling off.</li> <li>• Check if the grounding connection is correct; the grounding resistance value must not exceed 0.1Ω.</li> <li>• Check if the equipotential connections inside the energy storage integrated system are correct.</li> </ul>
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## 2.6. System Cleaning

The cleaning of the surroundings and interior of the energy storage integration system is an important aspect of maintenance work. Due to the influence of environmental factors such as temperature, humidity, dust, and internal equipment vibrations, dust can accumulate inside, blocking air inlets and outlets or entering internal equipment, which may lead to potential failures, shorten the lifespan of the equipment, or reduce power generation.

During normal operation of the equipment, regular inspections and cleaning should be conducted to ensure that the internal equipment is in a relatively good operating environment.

Cleaning Cycle	The cleaning cycle of the energy storage integration system should be reasonably determined based on its operating environment, such as climatic conditions, to ensure that both the external and internal cleanliness of the energy storage integration system is maintained. If the operating environment is harsh, such as in desert areas, the maintenance cycle should be shortened.
Internal cleaning of energy storage	For dust inside the energy storage integrated system, it is not recommended to use a broom for direct sweeping, as this may cause dust to become airborne. It is advisable to use a vacuum cleaner to absorb the dust.
Internal cleaning of the foundation	Users should regularly enter the foundation to check the cleanliness inside. If necessary, please use a vacuum cleaner for cleaning.

**WARNING**

- The ventilation of the air intake must be checked. Otherwise, if the module cannot be effectively cooled, it may fail due to overheating.
- The above is only a recommended routine maintenance cycle for the product; the actual maintenance cycle should be reasonably determined based on the specific installation environment of the product. Factors such as the scale of the power station, its location, and the on-site environment can all affect the maintenance cycle of the product.
- If the operating environment has a lot of wind-blown sand or thick dust, it is very necessary to shorten the maintenance cycle and increase the maintenance frequency.

**2.7. Battery Maintenance**

**WARNING**

- Batteries pose potential hazards, and appropriate protective measures must be taken during operation and maintenance!
- Incorrect operation may result in serious personal injury and property damage.
- The correct tools and protective equipment must be used when operating the battery.
- Battery maintenance must be performed by personnel with battery expertise and safety training.

Inspection content	Inspection method
Function Check	<ul style="list-style-type: none"> <li>• Check the operating status of the DC contactor: In a shutdown state, send open/close commands and check if the operation is normal.</li> <li>• Measure whether the 24V output voltage is within the specified range.</li> <li>• Check the battery cluster operation records to see if the current, voltage, and temperature are within the usage range.</li> </ul>
Environmental Temperature and Humidity Check	<ul style="list-style-type: none"> <li>• Check the environmental temperature records to ensure the temperature is within the usable range.</li> <li>• Check the environmental humidity records to ensure the humidity is within the usable range.</li> </ul>
Switch box (if applicable) and battery module housing	<ul style="list-style-type: none"> <li>• Check the following items, and if they do not meet the requirements, please correct them immediately:</li> </ul>

	<ul style="list-style-type: none"> <li>• Check if there are any flammable objects on top of the battery cluster.</li> <li>• Check if the fixing points of the battery cluster to the foundation steel plate are secure and if there is any rust.</li> <li>• Check if there are any foreign objects, dust, dirt, or condensation inside the battery cluster.</li> </ul>
Ground Connection	<ul style="list-style-type: none"> <li>• Check whether the ground connection is correct; the ground resistance value must not exceed 0.1Ω.</li> </ul>
Wiring and Cable Arrangement	<ul style="list-style-type: none"> <li>• Check for foreign objects, dust, dirt, and condensation inside the battery cluster. The wiring and cable arrangement should only be inspected after the internal equipment of the battery cluster is completely powered off! If any non-compliance is found during the inspection, please correct it immediately.</li> <li>• Check whether the cable arrangement is standard and if there are any short circuits or other issues. If any abnormalities are found, they must be corrected immediately.</li> <li>• Check whether all the inlet and outlet holes of the battery cluster are well sealed.</li> <li>• Check for any water ingress inside the battery cluster.</li> <li>• Check if the power cables and busbar connections are loose, and re-tighten them according to the previously specified torque.</li> <li>• Check for any damage to the power cables and communication cables.</li> </ul>
Screw	<ul style="list-style-type: none"> <li>• Check for any screws that may have fallen off or are rusted inside the battery pack.</li> </ul>

**Operating Rules**

- Recommended operating temperature: 0 °C to 45 °C (optimal 25 °C).
- High-rate charging/discharging is prohibited.
- If unused > 6 months, recharge/discharge to maintain SOC 30–40%.
- For long-idle systems: fully charge once before use.
- Check battery parameters daily.

- Monthly: check alarms, E-stop function, fire system.
- Every 6 months: check HV cables, busbar torque, insulation aging.
- Yearly: clean cooling ducts.
- Do not mix battery module types; packs are not interchangeable.

**2.8. Liquid Cooling System Maintenance**

The following are the recommended maintenance cycles; the actual maintenance cycle should be adjusted based on the specific installation environment of the product, such as the scale of the power station, installation location, and on-site conditions.

Component	Check Items	Method	Cycle	Tools
Fan	<ul style="list-style-type: none"> <li>• Check whether the fan blades rotate normally and whether the blades are damaged. If they cannot rotate or are damaged, the fan needs to be replaced.</li> </ul>	<ul style="list-style-type: none"> <li>• The fan blades rotate smoothly and without abnormal noise;</li> <li>• The fan blades are undamaged. Note: The shortest inspection period is six months; damage inspection is not mandatory.</li> </ul>	6 months	--
Water Pump	<ul style="list-style-type: none"> <li>• Check if the area of the water pump's heat dissipation air intake is blocked by more than 5%. If so, it needs to be cleaned with a brush;</li> <li>• Visually inspect the water pump body (excluding the pipeline connection) for any obvious dripping (excluding condensate). If there is obvious dripping, the water</li> </ul>	<ul style="list-style-type: none"> <li>• The water pump operates smoothly and without abnormal noise;</li> <li>• There is no obvious dripping from the pump body (excluding condensate).</li> </ul>	6 months	Brush

	pump sealing ring needs to be replaced.			
Cooling System	<ul style="list-style-type: none"> <li>Check HMI alarms</li> <li>Check low tank level warnings</li> </ul>	<ul style="list-style-type: none"> <li>Has the unit reported the 'water tank liquid level'? When low warning received fluid replacement is needed a</li> </ul>	As needed	Screwdrivers, pump, hoses
Coolant Quality	<ul style="list-style-type: none"> <li>Check if discoloured or contaminated</li> </ul>	<ul style="list-style-type: none"> <li>Replace coolant</li> </ul>	6 months	Pump, hose, clamp

Factors can affect the maintenance cycle of the product. If the operating environment has a lot of wind and sand or is heavily dusty, it is necessary to shorten the maintenance cycle and increase the maintenance frequency.

**Waste Disposal**

- Dispose coolant per local regulations.
- Recycle uncontaminated containers; dispose contaminated ones accordingly.

**Leak Emergency Response**

- Evacuate personnel, stop leak source, prevent drainage contamination, absorb or pump out liquid.
- Wear full protective equipment.

**First Aid**

- Inhalation: move to fresh air; provide oxygen.
- Skin/eye contact: rinse with water ≥ 15 min; seek medical attention.
- Ingestion: seek medical assistance immediately.

## 2.9. Fault Handling

### General Safety Warning

Under fault conditions, **lethal high voltage may still be present** inside the energy storage system (ESS).

All troubleshooting must be performed **only by qualified and authorized technicians** who have received professional training on the specific equipment.

Follow **all applicable safety regulations**, lockout/tagout procedures, and the instructions in this manual.

### Initial Fault Checks

If the ESS fails to charge or discharge as expected, displays a fire alarm, or the air-conditioning system stops operating, perform the following checks:

#### 1. BAU Status

- Verify that the BAU (Battery Auxiliary Unit) displays fault information.
- Confirm that the BAU is powered and functioning normally.

#### 2. Communication Status

- Check the communication link between the ESS and the BAU.
- Confirm whether the fire-protection system's power supply and communication interfaces are operating correctly.
- Verify that the air-conditioning system has normal power supply and communication.

If faults persist after the above checks, refer to the **Alarm List and Handling Methods**. For any unlisted faults, contact the manufacturer's after-sales service team immediately.

### System Fault Handling and Emergency Plan

#### 1. Fault Cause Identification

Operation and maintenance (O&M) personnel shall identify the type and severity of the fault using system messages, alarms, backend data, or SOE (Sequence of Events) logs.

Determine whether the issue is a **critical emergency fault**, including but not limited to:

- Fire alarm

- Insulation fault
- BMS trip
- Overcurrent protection
- PCS trip or protection alarm

If a critical emergency fault is identified:

- O&M personnel must **immediately go to the site** for verification and safe handling.
- If the issue cannot be resolved quickly, arrange for personnel from the nearest service unit to confirm system and site safety.

## 2. On-Site Inspection and PCS Handling

After arriving on-site and completing a safety inspection:

- If the fault is general and has been eliminated, **restart the PCS**.
- If the fault **cannot be eliminated**, promptly contact the responsible O&M engineer for escalation.

## 3. Remote Assistance and Escalation

If on-site troubleshooting does not resolve the issue:

- The technical support team will provide **remote diagnostic assistance**.
- If the fault remains unresolved, the manufacturer will dispatch qualified service personnel to the site to perform further repairs.

## 4. Fault Nature Confirmation

When a malfunction occurs and the system behaves abnormally, the first task is to identify the fault category using:

- Backend monitoring data
- SOE event logs

- System alarm history

Typical fault categories include:

- BMS failure
- PCS failure
- Local controller failure

If the issue is confirmed as a **BMS-related fault**, proceed with the standard BMS troubleshooting procedures provided in the following sections.

## 2.10. Accident Handling

### General Emergency Response Requirements

- The **Operations and Maintenance (O&M) Center** is responsible for overall command during any emergency. O&M personnel shall execute instructions and maintain clear and reliable communication throughout the process.
- All emergency measures must be carried out by **qualified O&M personnel** to ensure the effectiveness and safety of the response.
- **Emergency response trainings** shall be conducted at least **every six months**. Lessons learned from drills must be incorporated into continuous improvement of the emergency plan.
- In the event of any anomaly or accident, the system must take **prompt, effective corrective measures** to prevent further damage, escalation, or loss.

### Specific Accident Scenarios and Response Measures

#### 1. Overheating

**Condition:** Battery pack temperature exceeds the safe operating limit.

**Response:**

- The system management unit will issue an overheating alarm.
- **Immediately stop system operation.**
- Notify qualified technical personnel to perform a full inspection.

- Do **not** resume operation until the root cause has been identified and resolved.

## 2. Electric Leakage

**Condition:** Indications of electrical leakage or abnormal insulation levels.

**Response:**

- Immediately **evacuate all personnel** from the affected area.
- Notify qualified technicians to inspect and eliminate the fault.
- Do not operate or attempt to restart the system until troubleshooting is completed.
- **It is strictly prohibited** to operate the system while insulation faults persist.

## 3. Short Circuit

**Response:**

- Evacuate all non-essential personnel from the area.
- Disconnect associated power supplies and electrical equipment if safe to do so.
- **Isolate the battery system** by disconnecting the battery from the affected circuit.
- Notify qualified technical service personnel for on-site troubleshooting.
- Components damaged by short circuit must be **tested and evaluated by the manufacturer** before reuse can be approved.

## 4. Mechanical Collision / External Damage

**Condition:** Impact, deformation, penetration, or other physical damage.

**Response:**

- Immediately disconnect system power.
- Notify professional technical personnel to assess the damage.
- If hazardous conditions exist, only personnel with appropriate **personal protective equipment (PPE)** may handle the equipment.

- No disassembly may occur until the area has been assessed and secured.

## 5. Fire

### Step 1 — Personnel Safety

- Evacuate all personnel to a safe distance.
- Establish a safety isolation zone.
- Call the appropriate emergency services based on the situation.

### Step 2 — Firefighting Measures (Only if personal safety is ensured):

1. If wiring harnesses are smoking or burning, use a **CO<sub>2</sub> or dry powder extinguisher**.
2. If the battery module itself is burning, extinguish from a distance using a **high-pressure water jet**.
3. If smoke is inhaled, evacuate immediately and seek medical assistance.

### Step 3 — Manufacturer Notification

- Notify the system manufacturer for further guidance and post-incident evaluation.

## 6. Water Flooding

### Response:

- Evacuate personnel and establish a safety isolation zone, regardless of whether the system is powered.
- Inform the system supplier.
- Maintenance may only begin **after water has receded** and the supplier has performed a risk assessment.
- Do not restart the system until the manufacturer confirms safe operating conditions.

## 7. Server Downtime

### Response:

- Verify that the ESS and associated equipment are in a safe operating state.
- Contact the server manufacturer's maintenance team to determine the recovery time.
- If recovery is not possible within **one hour**, escalate to the responsible manager for further decision-making.

## 8. Power System Outage

### Response:

- O&M personnel must go to the site immediately.
- Turn off the equipment's main power switch and record the state of the PCS emergency stop.
- Contact the electrical supervisor to confirm the outage cause and estimated restoration time.
- Report the situation to management.
- After power restoration, re-energize equipment following the approved **startup sequence** and verify normal operation.

## 9. Personnel Electric Shock

### Response:

- Ensure **your own safety first**.
- Cut off the power supply to the affected equipment.
- Assess the condition of the electrocuted person and call emergency services immediately.
- Provide first aid only if trained and only in accordance with safety regulations to avoid causing secondary injury.
- Keep the injured person stable until emergency personnel arrive.

## 10. Other Accidents

### Response:

For any unlisted accident requiring intervention or equipment removal:

- First disconnect the battery circuit to eliminate electric shock risk.
- Conduct disassembly and handling with measures that prevent short circuits, mechanical impacts, falling, or inversion of components.
- Prevent all forms of secondary damage or personnel injury.

### **DANGER**

- If any issues are found that may affect the battery or energy storage system, please contact after-sales personnel and do not attempt to disassemble it privately.
- If the copper wire inside the conductive wire is exposed, do not touch it. There is a high voltage danger. Please contact after-sales personnel and do not disassemble it privately.
- In case of any other emergencies, please contact after-sales personnel immediately. Operate under the guidance of after-sales personnel or wait for them to operate on-site.