System Manual

For GOTION Battery Energy Storage System

Model: ESD1331-05P5015

October 2024

CONFIDENTIAL

Using This Manual

Disclaimer

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Revision History

Change Date	Section(s) Affected	Description of Revision	Version#	Author(s)
10/25/2024	/	Revised the manual based on version 1.0.	v2.1	@JG @YL @AQ
10/12/2024		Battery cabin foundation diagram Quantity of embedded steel platesincreased to 10	V2.2	ZhangQL

About This Manual

Purpose

This document describes the ESD1331-05P5015 Energy Storage System (also referred to as ESS, or Battery ESS, or BESS).

Before installing the ESS, read this document carefully to understand the safety information as well as functions and features of the ESS.

Target Audience

This document is intended for design engineers, installers, and/or operators of the ESD1331-05P5015 Battery Energy Storage System.

Symbol Conventions

Symbol	Description
⚠ DANGER	Indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.
⚠ WARNING	Indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.
⚠ CAUTION	Indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.
NOTICE	Indicates a potentially hazardous situation which, if not avoided, could result in equipment damage, data loss, performance deterioration, or unanticipated results. *NOTICE* is used to address practices not related to personal injury.
🕮 NOTE	Supplements the important information in the main text. *NOTE* is used to address information not related to personal injury, equipment damage, and environment deterioration.

Clarification of Battery Component Terminology

To standardize terminology across Gotion ESS technical documentation, we adhere to the following nomenclature hierarchy for battery components:

Cell -> **Module** -> **Pack** -> **Rack** -> **Bank** -> **Stack/Cluster** -> **Container**

The table below provides detailed definitions for each component level:

Classification	Definition
Battery cell	The smallest unit of the battery system. It consists of electrodes, electrolyte, separator, and casing.
Battery module	A module is a group of interconnected cells. These can be in a series and/or parallel configuration to achieve the desired voltage, capacity, or power levels.
Battery pack	A pack may consist of one or several connected modules, along with all the necessary electronic components to manage the cells, such as the battery management unit (BMU) of the battery management system (BMS), detectors, and often thermal management systems. Note: conceptually, the pack-level referred to here is equivalent to the module-level when it comes to UL9540A testing or certifications.
Battery rack	Racks are assemblies that house multiple battery packs. They facilitate integration into larger systems by providing structural support, electrical connections, and protective measures. Note: conceptually, the rack-level referred to here is equivalent to the unit-level for UL9540A testing.
Battery bank	A bank is a physical assembly of one or more battery racks mounted together to fit into the container. *For example, in the GRID5015 container, 2 racks, each containing 4 packs are mechanically mounted together on an assembly, herein referred to as a bank.*
Battery stack/cluster	These terms are often used interchangeably and refer to groups of racks electrically assembled together to enhance capacity or output according to specific configurations. *For example, a GRID5015 container consists of 2 stacks, which provides 2 independent DC outputs.*
Container/system	A "container" or "system" typically refers to a large, self-contained unit that houses multiple battery racks. These containers are designed to be modular and scalable, enabling easy integration into larger energy storage setups. Note: conceptually, the container/system-level in this context is equivalent to the installation-level for UL9540A testing.

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Glossary

AC	Alternating Current
AWG	American Wire Gauge
BAMU	Battery Array Management Unit (3rd-level BMS)
BCMU	Battery Cluster Management Unit (2nd - level BMS)
BESS	Battery Energy Storage System
BMS	Battery Management System. This monitors and controls all the functions and the state-of-health of the battery.
BMU	Battery Management Unit (1st -level BMS)
CCU	Central Control Unit
Cell	The smallest unit of a battery.
DC	Direct Current
DI/DO	Data Input / Data Output
DOD	Depth of Discharge
DN38	Diameter Nominal 38
DEC	Diethyl Carbonate
EMC	Ethyl Methyl Carbonate
End of Life (EoL)	The point where a battery falls below a certain failure threshold.
ESD	Electrostatic Discharge
ESS	Energy Storage System
EMS	Energy Management System
FS%	Full Scale %
ft	Feet in measurement
gpm	Gallons per Minute
GND	Ground (or Grounding)
HMI	Human Machine Interface
HVAC	Heating, Ventilation and Air Conditioning
ICP	Integrated Control Panel
IP Class	Ingress Protection Class, an international standard used to rate the degree of protection or sealing effectiveness in electrical enclosures against intrusion of objects, water, dust or accidental contact.
LEL	Lower Explosive Limit
LFL	Lower Flammability Limit
LFP	Lithium Iron Phosphate
MCB	Miniature Circuit Breaker
O&M	Operation and Maintenance
PCS	Power Conversion System
P-rate (0.5P)	The ratio of the charge/discharge power to the battery energy as measured by the system.
PPE	Personal Protective Equipment
RH (%)	Relative Humidity (%)
SoC	State of Charge

SoH	State of Health
UPS	Uninterruptible Power Supply
DT Terminal	Deutsch Terminal
OT Terminal	Open Terminal

1 Safety information

1.1 General safety

Before transporting, storing, installing, operating, using, or maintaining the equipment, it is crucial to read and strictly adhere to the instructions in this document, as well as all safety guidelines provided on the equipment itself.

For the purposes of this document, "**equipment**" encompasses the products, software, components, spare parts, and services related to this guide; "**the Company**" refers to the equipment's manufacturer, seller, or service provider; "**you**" refers to the entity handling the equipment in any of the mentioned capacities.

The safety statements—**Danger**, **Warning**, **Caution**, and **Notice**—within this document do not encapsulate all necessary safety precautions. You must also observe applicable international, national, or regional standards and industry practices.

The Company disclaims liability for any harm or loss resulting from non-compliance with safety requirements or standards in terms of equipment design, production, and usage. The equipment must operate in environments that fulfill its design specifications. Failure to do so can lead to defects, malfunctions, or damage not covered by warranty.

Furthermore, the Company is not responsible for any property loss, personal injury, or death that may occur. Ensure all activities such as transportation, storage, installation, operation, use, and maintenance comply with relevant laws, regulations, standards, and specifications.

Refrain from reverse engineering, decompiling, disassembling, adapting, embedding, or creating derivative works from the equipment software. Avoid attempting to understand the internal logic, accessing the software's source code, infringing on intellectual property rights, or disclosing any performance test results of the software.

The Company will not be held liable under the following circumstances:

- Damage to the equipment due to force majeure events such as earthquakes, floods, volcanic eruptions, landslides, lightning, fires, wars, conflicts, and severe weather conditions.
- Operation of the equipment beyond the stipulated conditions in this document.
- Installation or usage in environments that do not meet established international, national, or regional standards.
- Damage resulting from storage conditions that do not adhere to those specified in the product documentation.
- Installation or usage by unqualified personnel.
- Damage due to negligence, intentional misconduct, or improper operations by the receiving party or a third party.
- Failure to adhere to operation instructions and safety precautions provided on the product and within this document.
- Unauthorized removal or modification of the product or software code.
- Equipment damage caused by the receiving party or a third-party during transportation.
- Inadequate preparation of materials and tools that comply with local laws, regulations, and related standards.

1.2 Personal safety

DANGER

Always confirm that the power is disconnected before beginning installation. Never install or remove cables while power is on. Making contact between the cable core and any conductor while power is live can lead to electric arcs, sparks, fire, or explosions, potentially causing personal injury.

Figure 1- 1 Cable core

DANGER

Non-standard and improper operations on the energized equipment may cause fire, electric shocks, or explosion, resulting in property damage, personal injury, or even death.

DANGER

Before operations, remove conductive objects such as watches, bracelets, bangles, rings, and necklaces to prevent electric shocks.

DANGER

During operations, employ specialized insulated tools to mitigate the risk of electric shocks or short circuits. Ensure these tools meet the dielectric withstanding voltage requirements set by local laws, regulations, standards, and specifications.

WARNING

During operations, wear appropriate personal protective equipment, including protective clothing, insulated footwear, safety goggles, helmets, and gloves.

General Safety Requirements

- **Handling Protective Devices**: Never disable protective devices. Always heed the warnings and precautionary measures both in this document and on the equipment.
- **Emergency Response**: If there's a risk of personal injury or equipment damage, immediately halt operations, inform your supervisor, and implement appropriate safety measures.
- **Power Safety**: Do not activate the equipment until it has been installed and inspected by professionals.
- **Direct Contact**: Avoid direct contact with power supply equipment, especially with damp objects or conductors. Always measure voltage before touching any conductor surfaces or terminals to prevent electric shock.
- **Operational Safety**: Do not touch equipment during operation as surfaces may be hot, and avoid contact with moving parts like fans to prevent injuries.

Fire Safety Protocol

- In the event of a fire, evacuate the area immediately, activate the fire alarm, or contact emergency services. Under no circumstances should you re-enter the affected area.

Personnel Requirements

- **Qualification and Training:**
  - **Professionals**: Only those familiar with the equipment's principles, trained in operations, and aware of potential hazards are permitted to handle the equipment. These individuals must understand the extent of hazards associated with installation, operation, and maintenance.
  - **Trained Personnel**: Must be educated in technology and safety, experienced, conscious of potential operational hazards, and capable of implementing safety measures to minimize risks.
- **Special Tasks**: Personnel performing electrical tasks, working at heights, or operating special equipment must have the appropriate qualifications as required by local regulations.
- **High-Voltage Operations**: Only certified high-voltage electricians may operate medium-voltage equipment.
- **Equipment and Component Handling:**
  - **Installation and Maintenance**: Only qualified professionals or trained personnel should install, operate, and maintain the equipment.
  - **Safety Facility Removal and Inspections**: Only qualified professionals may remove safety devices and perform inspections.
  - **Component Replacement**: Only authorized professionals can replace equipment or components, including software.
  - **Access Restrictions**: Access to the equipment should be limited to personnel directly involved in working on it.

1.3 Electrical safety

DANGER

Before connecting to a power source, ensure the equipment is in good condition to avoid risks of electric shock or fire.

DANGER

Non-standard and improper operations may result in fire or electric shocks.

DANGER

Ensure that no foreign objects enter the equipment during operations, as this can lead to equipment damage, reduced load power, power failure, or personal injury.

WARNING

For equipment requiring grounding, always connect the ground cable first during installation and disconnect it last when dismantling the equipment.

CAUTION

Do not route cables near the air intake or exhaust vents of the equipment.

General Requirements

- **Compliance with Procedures**: Adhere to the specified procedures for installation, operation, and maintenance outlined in this document. Unauthorized modifications, additions, or alterations to the equipment are prohibited.
- **Utility Approval**: Secure approval from relevant national or local electric utility companies before connecting the equipment to the grid.
- **Safety Measures**: Follow all power plant safety regulations, including operation and work ticket mechanisms.
- **Restricted Access**: Erect temporary fences or warning ropes and display "No Entry" signs around operational areas to restrict access to unauthorized personnel.
- **Power Protocol**: Before handling power cables, ensure all related equipment and switches are turned off.
- **Liquid Detection**: If liquid is present inside the equipment, disconnect the power immediately and refrain from using the equipment.
- **Tool Management**: Verify tools meet operational requirements and log them before use. After operations, collect all tools to prevent them from being left inside the equipment.
- **Cable Precautions**: Prior to power cable installation, confirm cable labels are accurate and terminals are insulated.
- **Installation Accuracy**: Utilize a torque tool with the correct measurement range for tightening screws. Maintain tool alignment and ensure torque error remains within 10% of the specified value.
- **Bolt Management**: After double-checking, mark tightened bolts with blue (by installation personnel) and red (by quality inspection personnel) across the bolt edges.

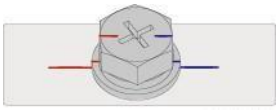


Figure 1- 2 Bolt diagram

- **Protective Measures**: After installation, confirm that all protective cases and insulation tubes are securely in place to prevent electric shocks.
- **Input Management**: Disconnect all inputs before operating the equipment.
- **Maintenance Protocol**: Before servicing downstream electrical or power distribution devices, switch off the power supply equipment's output.
- **Safety Signage**: During maintenance, place "Do not switch on" labels near all related switches or circuit breakers and display warning signs to avoid accidental power connection. Only power on the equipment after completing troubleshooting.
- **Safety Shutdown**: If troubleshooting post-power-off is required, disconnect the power, verify de-energization, install a ground cable, hang warning signs, and set up barriers.
- **Regular Checks**: Periodically inspect equipment connections to ensure all screws are securely tightened.
- **Professional Handling**: Only qualified professionals should replace damaged cables.
- **Label Integrity**: Maintain the integrity of all equipment labels and nameplates. Replace any that are worn out.

- **Cleaning Precautions**: Avoid using solvents like water, alcohol, or oil to clean electrical components.

Grounding

- **Compliance with Standards**: Ensure the grounding impedance complies with local electrical standards.
- **Reliable Grounding**: Maintain a permanent connection to the protective ground. Verify the electrical connection for reliable grounding before operation.
- **Grounding Installation**: Do not operate equipment without a properly installed ground conductor and ensure no damage occurs to the ground conductor.
- **Three-Pin Sockets**: For equipment utilizing a three-pin socket, confirm the ground terminal is connected to the protective ground point.
- **Touch Current Precautions**: If high touch current is possible, ground the protective ground terminal on the equipment enclosure before connecting to the power supply to prevent electric shock.

Cabling Requirements

- **Safety Compliance**: Select, install, and route cables according to local safety regulations.
- **Cable Handling**: Ensure cables are straight, without coiling or twisting. Avoid joining or welding cables. Use longer cables if necessary.
- **Cable Protection**: Verify all cables are correctly connected, insulated, and meet specifications. Ensure routing slots and holes are free from sharp edges, and use cushion materials where cables pass through to prevent damage.
- **Cable Arrangement**: When routing cables into a container from above, bend them into a U-shape outside before entry. Bundle same-type cables neatly and keep different types at least 30 mm apart. Immediately seal any cable holes with sealing putty when installation is paused.
- **Cable Support**: Secure buried cables with supports and clips, ensuring close ground contact in the backfill area to prevent damage.
- **Environmental Considerations**: Reassess cable suitability if external conditions change, such as layout or ambient temperature, according to standards like IEC-60364-5-52.
- **Thermal Clearance**: Maintain at least 30 mm clearance between cables and heat sources to protect insulation.
- **Cold Weather Handling**: Only install cables above 0°C and store cables at room temperature for 24 hours before laying if they have been in subzero conditions.
- **Handling Care**: Avoid dropping cables from heights as it can damage them and affect their performance.

NOTICE

Static electricity from human bodies can damage electrostatic-sensitive components, such as large-scale integrated (LSI) circuits:

- **ESD Precautions**: Always follow ESD (Electrostatic Discharge) protection regulations when handling equipment, boards, or modules with exposed circuit boards, such as application-specific integrated circuits (ASICs). Wear ESD-protective clothing and gloves, or use a well-grounded ESD wrist strap.

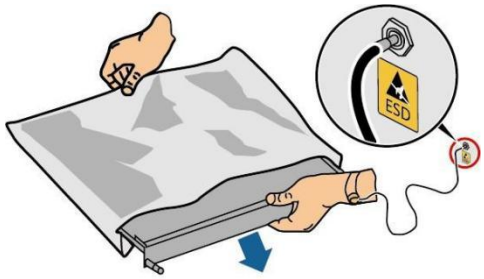


Figure 1- 3 Follow ESD protection regulations

- **Handling Components**: When picking up a board or module, grasp it by the edges without touching any of the components. Avoid direct contact with the components using bare hands.
- **Packaging for Safety**: Always use ESD-safe packaging materials to store or transport boards or modules to prevent static damage.

1.4 Mechanical safety

Hoisting Guidelines

- Only trained and qualified personnel should perform hoisting operations.
- Isolate the hoisting area with temporary warning signs or fences.
- Verify that the hoisting foundation can support the load.
- Before hoisting, ensure all tools are securely attached to a fixed object that can bear the load.
- Avoid walking or standing under the crane or hoisted objects during operations.
- Do not drag steel ropes or hoisting tools, and avoid colliding hoisted objects with hard surfaces.
- Maintain a hoisting rope angle of no more than 90 degrees to ensure stability and safety.

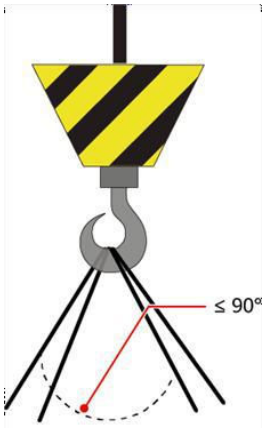


Figure 1- 4 Hoisting angle diagram

Hole Drilling Guidelines

- Secure approval from both the customer and contractor prior to drilling holes.
- Always wear safety goggles and protective gloves while drilling.
- Ensure not to drill into buried pipes or cables to prevent short circuits and other risks.
- Protect equipment from metal shavings during drilling and clean up all shavings afterward.

Working at Heights Safety Guidelines

- Operations conducted 2 meters or higher above the ground must be properly supervised.
- Only trained and qualified individuals are allowed to work at heights.
- Avoid working at heights during hazardous conditions, such as when surfaces are wet. Resume work only after the safety owner and technical personnel have inspected the equipment and confirmed safety.

- Establish restricted zones and place conspicuous signs to prevent access by unauthorized personnel.
- Install guard rails and warning signs around edges and openings to prevent falls.
- Avoid stacking scaffolding, springboards, or other objects on the ground beneath work areas. Ensure no one remains or passes underneath these areas.
- Properly carry operation machines and tools to avoid damage and injuries from falling objects.
- Do not throw objects to or from heights. Use slings, hanging baskets, highline trolleys, or cranes for transporting objects.
- Avoid simultaneous operations on upper and lower layers. If necessary, install protective shelters or take other safety measures. Keep tools and materials from accumulating on upper layers.
- Dismantle scaffolding from the top down and not simultaneously at multiple levels. Ensure stability of the structure during dismantling.
- Personnel must strictly adhere to safety regulations when working at heights. The company disclaims responsibility for accidents resulting from non-compliance.
- Exercise caution at all times when at heights and avoid resting in elevated locations.

Ladder Safety Guidelines

- Use wooden or insulated ladders for live-line work at heights.
- Opt for platform ladders with protective rails. Avoid using single ladders.
- Before using a ladder, ensure it is in good condition and verify its load-bearing capacity. Do not exceed this capacity.
- Position the ladder securely and ensure it is stable before use.

Figure 1- 5 Ensure ladder is held firm

- Maintain stability and keep your center of gravity within the ladder's side rails while climbing. Avoid reaching out too far to the sides.
- If using a step ladder, make sure the pull ropes are firmly secured.

1.5 Installation and Wiring

ESS Safety Guidelines

⚠ DANGER

Operational Precautions

- **Access Control**: Do not open container doors while the system is operational. In the event of a malfunction, avoid standing within the opening range of the container doors.
- **Emergency Protocol**: Immediately evacuate the area if the fire alarm horn or strobe is activated.

Protective Measures

- **Site Security**: Implement protective and isolation measures around the ESS, such as fences, walls, and safety warning signs, to prevent unauthorized access and mitigate risks of personal injury or property damage.

Installation Requirements

- **Compliance with Standards**: Ensure that ESS installation adheres to local fire separation distances or firewall requirements as per standards like **GB 51048-2014** "Design Code for Electrochemical Energy Storage Station" and **NFPA 855** "Standard for the Installation of Stationary Energy Storage Systems."

Maintenance and Inspection

- **Regular Fire Safety Checks**: Conduct fire safety inspections of the ESS at least monthly.
- **Power System Inspection**: When inspecting the system with power on, adhere to hazard warning signs and avoid standing at the battery container doors.
- **System Updates and Changes**: After replacing power components or modifying cable connections, manually initiate cable connection detection and topology identification to ensure system integrity.

Documentation and Record Keeping

- **Recording Procedures**: It is advisable to use a camera to document the detailed processes of equipment installation, operation, and maintenance for future reference and compliance verification.

Battery Safety Guidelines

DANGER

Handling and Connection:

- Avoid connecting the positive and negative poles of a battery directly to prevent short circuits, which can cause leakage, smoke, fire, or explosion. To avoid battery short circuits, only maintain batteries with the system powered off and de-energized.
- Ensure batteries are not exposed to high temperatures or near heat sources like sunlight or heaters, as overheating can also lead to dangerous outcomes.
- Protect batteries from mechanical damage such as vibration, falls, collisions, or punctures to prevent fires or other hazards.
- Never disassemble, alter, or insert foreign objects into batteries, and avoid touching terminals with metal objects to prevent short circuits and leakage.
- Use only the battery model recommended by the manufacturer to avoid risks of fire or explosion.

Installation and Storage:

- Install batteries in dry areas away from potential water sources like air conditioner vents or water pipes.
- Ensure batteries are stored and transported in their original packing, positioned according to the labels to prevent damage, avoid placing them upside down, vertically, on their side, or tilted. Do not stack batteries improperly.
- Before installation and operation, prepare and install firefighting facilities, such as fire sand and CO2 fire extinguishers, in compliance with local regulations.

Maintenance and Emergency Procedures:

- Wear appropriate protective gear and power down equipment immediately in the event of a battery leak or odor; evacuate the area and contact authorities.
- Tighten the screws on copper bars or cables to the specified torque. Regularly check these connections for tightness and inspect for signs of rust, corrosion, or the presence of foreign objects, cleaning as necessary. Loose connections can cause excessive voltage drops and increase the risk of fire under high current conditions.
- Recharge batteries promptly after discharge to prevent damage from overdischarge.

Chemical and Fire Safety:

- In case of a battery fire, be aware that gases produced may irritate eyes, skin, and throat; take protective measures promptly.
- Properly exhaust any flammable gases generated to prevent fire or equipment corrosion.

1.6 Operation and Maintenance

Liability Disclaimer

The Company will not be liable for damage or other consequences to the batteries under the following conditions:

- **Force Majeure**: Damage due to natural disasters such as earthquakes, floods, volcanic eruptions, or extreme weather conditions.
- **Environmental Non-compliance**: Damage resulting from an operating environment or external power parameters that do not meet the requirements for normal operation, such as inappropriate temperature or unstable power grids.
- **Improper Handling**: Damage from incorrect handling or connection, including falling, leaking, or cracking of batteries.
- **Delayed Power On**: Damage due to not powering on the batteries promptly after installation, leading to overdischarge.
- **Delayed Acceptance**: Damage because batteries were not accepted promptly as scheduled.
- **Unauthorized Changes**: Damage from relocating, reinstalling, or altering usage scenarios without notifying the Company or compliance with its requirements.
- **Additional Load Connections**: Damage from connecting extra loads to the batteries.
- **Storage and Warranty Expiration**: Damage when the storage period exceeds the upper limit or the warranty period has expired; using expired batteries poses safety risks.
- **Incorrect Settings and Mixed Usage**: Damage from setting incorrect operating parameters, using batteries of different types together, or mixing our batteries with those from other vendors or of different capacities.
- **Maintenance Failures**: Damage from improper maintenance, such as frequent overdischarge, expanding load capacity without notice, or long-term lack of full charging.
- **Neglect in Maintenance**: Damage from failing to perform regular maintenance checks on battery terminals or store batteries according to specified requirements.

General Guidance:

- Use only batteries provided by the Company to ensure safety and management accuracy. The Company is not responsible for faults in batteries not supplied by it.

Installation and Maintenance:

- Carefully read and adhere to the battery manufacturer's instructions before installing, operating, or maintaining batteries. Pay special attention to the safety precautions outlined in this document and additional instructions provided by the manufacturer.
- Charge batteries within the specified temperature range. Avoid charging when the ambient temperature is below the allowed range to prevent internal short circuits during low-temperature charging.
- Inspect packaging before unpacking. Do not use batteries if packaging is damaged and report any damage to the carrier and manufacturer immediately.

- Install batteries **within 24 hours of unpacking**. If installation is delayed, store batteries in their original packaging in a dry, indoor environment free of corrosive gases. Power on the ESS within 24 hours of installation and complete the process from unpacking to system activation **within 72 hours**. Ensure power-off time during routine maintenance does not exceed 24 hours.

Handling and Storage:

- Do not use batteries that are visibly damaged (e.g., dropped, bumped, bulged, or dented), as such damage could lead to electrolyte leakage or flammable gas release. Contact professional operations and maintenance personnel immediately for replacement or removal.
- Store damaged batteries away from other devices, flammable materials, and untrained individuals.
- Before handling batteries, ensure there is no irritating or burnt odor present.
- Keep installation tools and metal objects off the batteries during installation.
- Clean up the installation area thoroughly once setup is complete.
- Avoid installing batteries during adverse weather conditions like rain, snow, or fog, as moisture can corrode the battery packs.
- If batteries become wet, do not install them. Instead, move them to a safe location and arrange for their proper disposal.
- Before installing a battery pack, check for any deformation or damage to the enclosure.
- Ensure that the battery terminals are not unexpectedly grounded. If they are, disconnect them from the ground.
- Avoid performing welding or grinding near batteries to prevent fires from sparks or arcs.
- If batteries are not in use for extended periods, store and charge them according to specified requirements.
- Use only devices that comply with local laws and regulations for charging or discharging batteries.
- Disconnect the battery loop during installation and maintenance.
- Monitor stored batteries for any signs of smoke, flame, electrolyte leakage, or excessive heat.
- Handle batteries carefully if they show signs of fault or high surface temperature to avoid burns.
- Never stand on, lean on, or sit atop battery equipment.

Usage Restrictions:

- Do not use batteries in critical backup power scenarios that involve:
  - Life-supporting medical devices
  - Essential control equipment such as trains and elevators, where failure could result in personal injury
  - Key computer systems crucial for social and public functions
  - Proximity to sensitive medical equipment
  - Similar high-risk applications

Safety Compliance:

- Wrap exposed battery terminals with insulation tape during installation and maintenance to protect against short circuits.
- In cases of electrolyte leakage, which can corrode metal parts and damage boards, follow immediate safety protocols: evacuate the area, seek fresh air, rinse affected skin or eyes thoroughly with water, and seek medical attention for any exposure.

Emergency and Leakage Handling:

- **Short Circuit Protection:** During installation and maintenance, ensure all exposed battery terminals are covered with insulation tape to prevent short circuits.
- **Preventing Contamination**: Keep foreign objects, including conductive materials, screws, and liquids, away from batteries to avoid causing short circuits.
- **Leakage Response:** Treat electrolyte leakage seriously as it can corrode metal parts and damage boards. If exposed to electrolyte, execute the following emergency protocol:
  - **Inhalation**: If you inhale fumes from the electrolyte, leave the contaminated area immediately, seek fresh air, and obtain medical attention without delay.
  - **Eye Contact**: Rinse your eyes with water continuously for at least 15 minutes if electrolyte comes into contact with them. Avoid rubbing your eyes and seek medical attention promptly.
  - **Skin Contact**: If electrolyte contacts your skin, wash the affected area immediately with soap and water and then seek medical attention.
  - **Ingestion**: If electrolyte is ingested, seek immediate medical attention.

Recycling and Disposal:

- Regulatory Compliance: Dispose of waste batteries in accordance with local laws and regulations. Never treat batteries as ordinary household waste, as improper disposal can lead to environmental pollution or even explosions.
- Handling Leaks and Damage: If a battery is leaking or damaged, immediately contact technical support or a designated battery recycling company for proper disposal.
- End-of-Life Management: For batteries that have reached the end of their service life, arrange for disposal through a battery recycling company.
- Storage Precautions for Disposal:
- Avoid exposing waste batteries to high temperatures or direct sunlight.
- Do not store waste batteries in environments with high humidity or corrosive substances.
- Faulty Batteries: Do not use damaged or faulty batteries. Contact a battery recycling company to dispose of them promptly to prevent environmental harm.

2 Product description

2.1 Model description

The ESD1331-05P5015 Energy Storage System features an integrated, liquid-cooled battery container on the DC side, consisting of a battery system and an auxiliary control system.

Figure 2- 1 Container appearance

The battery system includes battery clusters or racks, a high-voltage box, and an integrated power distribution or control panel. The auxiliary control system comprises a liquid-cooled temperature control system and a fire suppression system.

Configuration Details:

1. The system utilizes **314Ah** Lithium-ion Phosphate (LiFePO4, or LFP) cells arranged in series to create a 1P104S liquid-cooled **battery pack**.
2. **Four** such battery packs are connected in series to configure a 1P416S **battery rack**.
3. **Six** battery racks within the cabin are linked in parallel to establish a **battery stack**.
4. **Two** such battery stacks within the container are also connected in parallel, culminating in a complete 1331.2V/5.015MWh battery energy storage system container.
5. The battery system is managed by a **three-level** Battery Management System (BMS), providing comprehensive system-level control and management.

The liquid-cooled energy storage container is a crucial platform product, incorporating advanced temperature control technology suitable for large-scale energy storage applications. This system supports factory production, testing, and the overall hoisting and transportation of energy storage containers, meeting a broad range of industrial requirements.

2.2 Label description

Label	Name	Meaning
	Electric Shock Warning	High voltage may occur after the device is powered on. Only qualified and trained electrical technicians are allowed to install and operate the device.
	Dangerous Warning	Indicates the device might cause harmful to the personnel. Only qualified and trained electrical technicians are allowed to install and operate the device.
	Explosive Warning	Indicates the device might cause explosion. Only qualified and trained electrical technicians are allowed to install and operate the device.
	Grounding Symbol	Indicates the position for connecting the ground cable.
	ADR transportation warning label - *UN3536 - Hazard Class 9*	Helps other traffic participants identify and keep away from hazardous sources in a timely manner to reduce the risk of accidents.
	Hoisting Mark	Indicates the position for hoisting the battery ESS container.
	Water Firefighting Mark	Signifies a connection point for a fire hose to be used in firefighting.
	Emergency Stop Mark	Indicate the button is only for emergency stop. It is a fail-safe control switch that when de-energized, will stop the operation of the equipment.
	Height label	The equipment is elevated. Tools like an insulated stool or a step ladder may be required for easier operation.
	Height (or mind the step) warning label	Indicates that the container height is greater than 2.6m to alert the personnel during transportation and operation.

2.3 Functions and features

Functions

The ESD1331-05P5015 BESS is designed to manage the charging and discharging of DC power, converted by the power conversion system (PCS), for applications such as power grid peak shaving and frequency regulation.

Each battery rack connects to the Third-Level BMS, which independently controls the charging and discharging to enhance capacity and system availability.

Battery Charging: The PCS interfaces with the rack controller, issuing commands to charge the batteries.

Battery Discharging: During times when grid power is insufficient, the system directs the batteries to supply power to the loads via the PCS.

The ESS features high-voltage direct current (HVDC) ports for its input and output.

This system is a prefabricated all-in-one Lithium-ion Battery Container System that consolidates a prefabricated modular structure, power supply and distribution, monitoring, environmental control, fire suppression, and an integrated cabling system into a single unit.

Features

The ESD1331-05P5015 BESS offers the following key features:

- **High Energy Density**: This system achieves high volumetric energy density and utilizes a space-saving configuration with four containers in a quad layout design.
- **Standardization**: Featuring a modular design with a logical layout for ease of maintenance, the standard containers simplify loading, unloading, transportation, and installation.
- **Ultra-high Security**: The system includes cell-level temperature monitoring and thermal barriers, along with pack-level submersion suppression. It is equipped with submerged FK-5-1-12, aerosol, or similar fire extinguishants, along with a prefabricated, comprehensive container water sprinkler system.
- **Intelligent Temperature Control Technology**: It employs modular adjustable piping to ensure excellent temperature uniformity. The integration of BMS with liquid cooling control enhances efficiency and energy savings.

2.4 Appearance

The content below shows the appearance of the BESS Container from various angles.

FIGURE 2- 2 is the schematic diagram of the main sections of BESS:

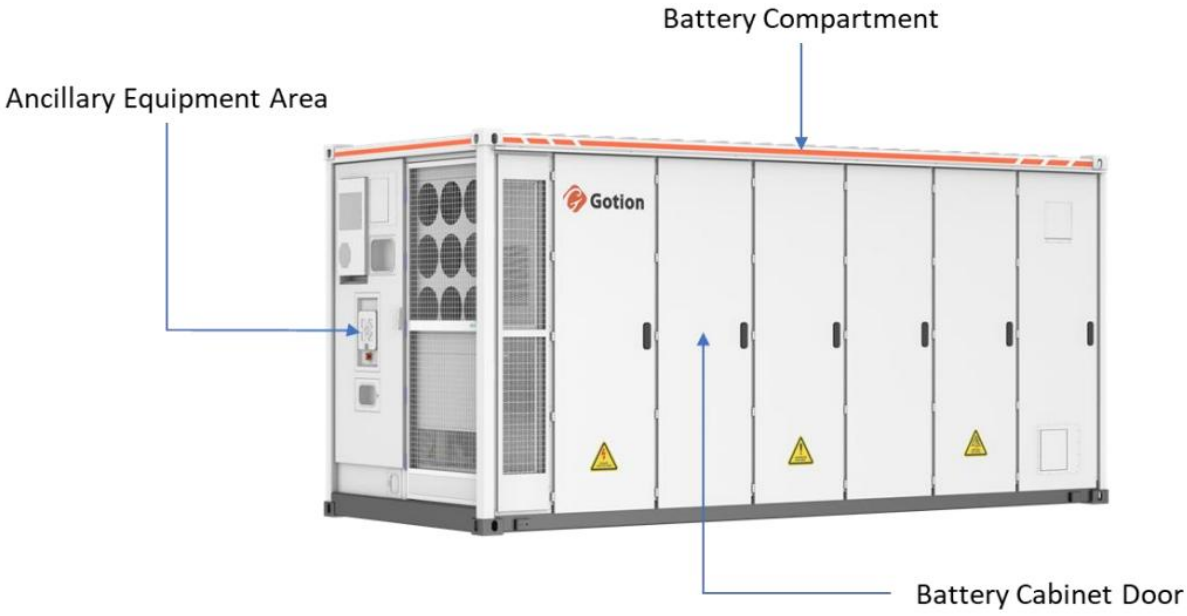


Figure 2- 2 Schematic diagram of BESS main sections

FIGURE 2- 3 is the front view of the BESS:

Figure 2- 3 BESS front view

FIGURE 2- 4 is the rear view of the BESS:

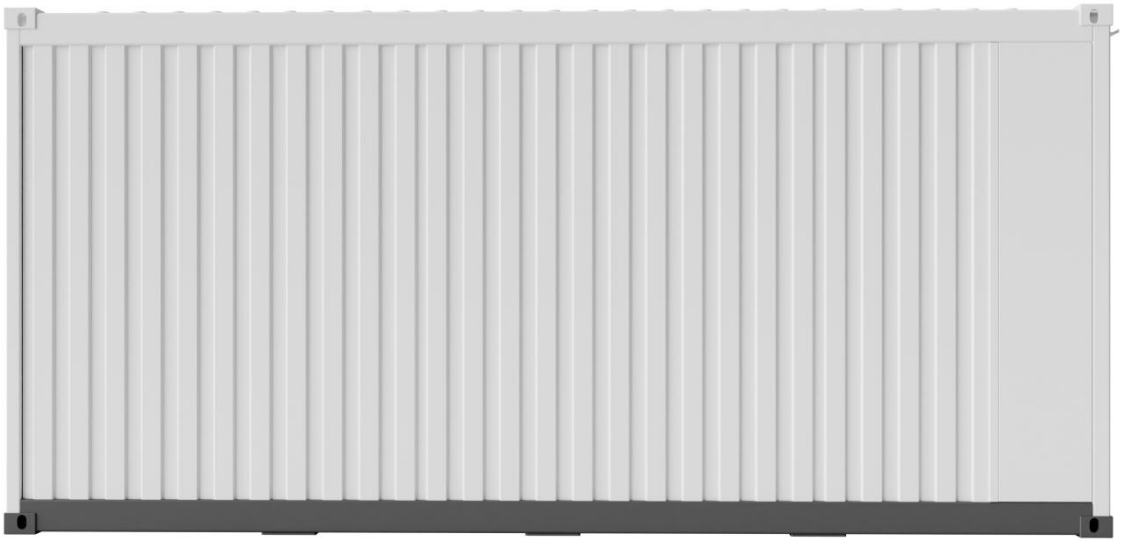


Figure 2- 4 BESS rear view

FIGURE 2- 5 is the left-side view of the BESS:

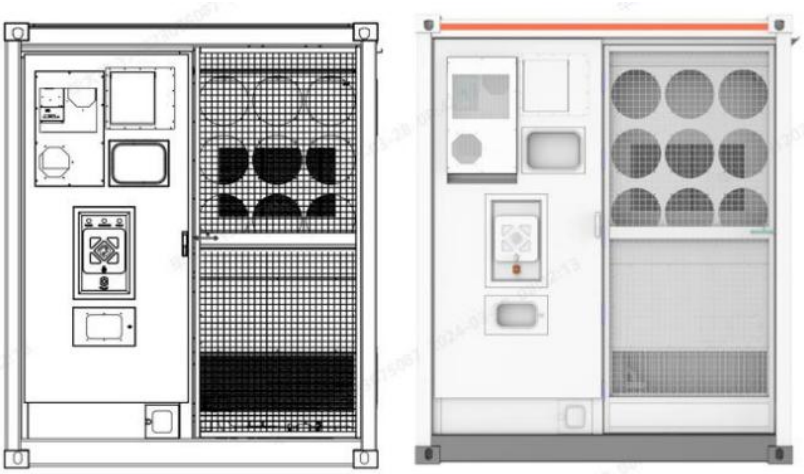


Figure 2- 5 BESS left-side view

FIGURE 2- 6 is the right-side view of the BESS:

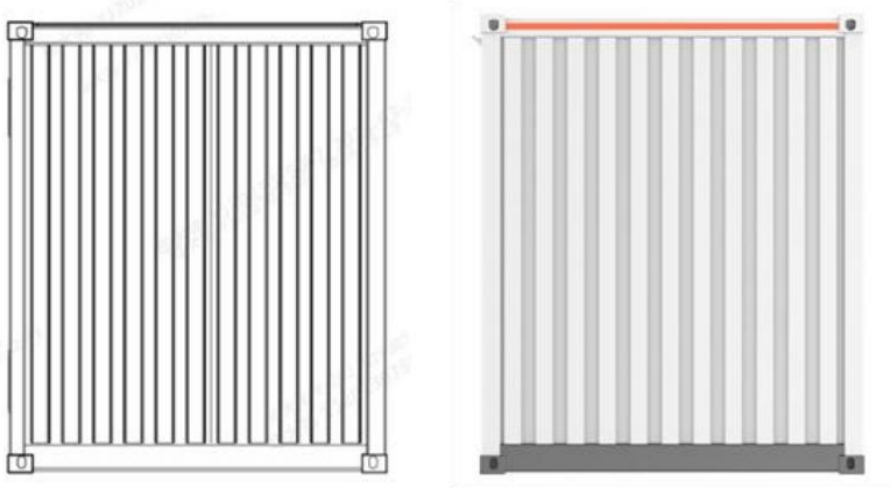


Figure 2- 6 BESS right-side view

FIGURE 2- 7 is the top view of the BESS:

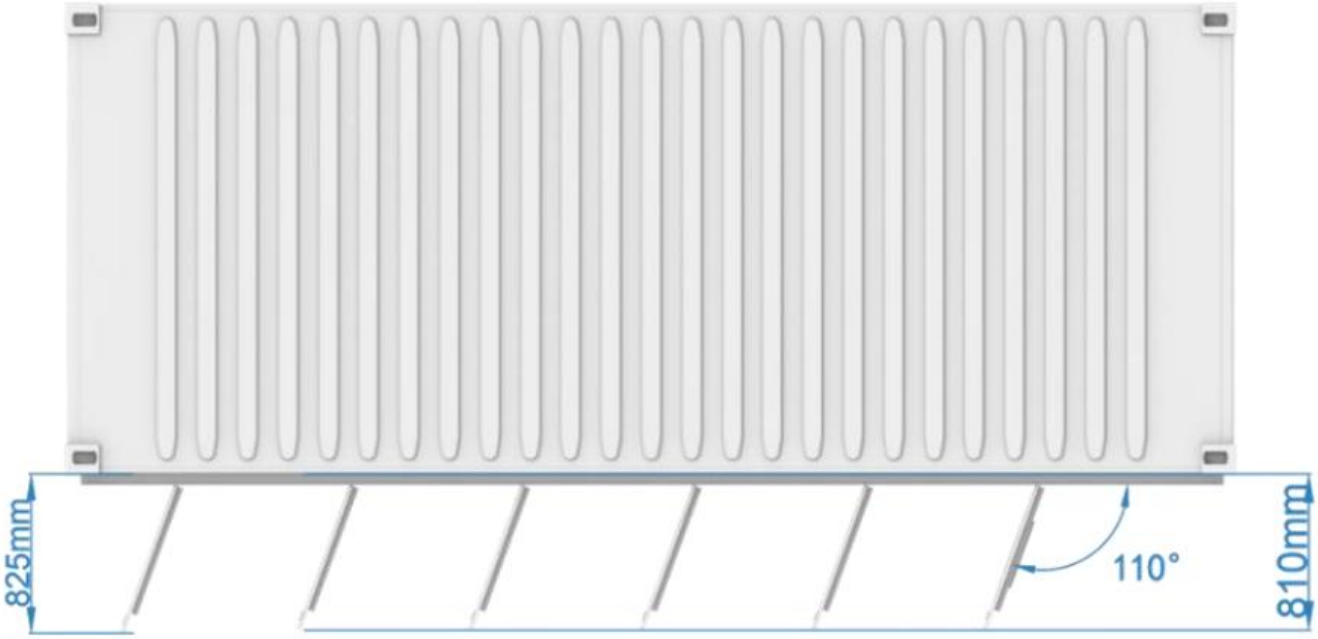


Figure 2- 7 BESS top view (cooling system)

NOTE

The site foundation should be designed by qualified technical personnel, such as those from a design institute. These professionals may refer to the foundation drawings provided by the Company. To obtain these drawings, please contact Gotion.

2.5 Components

The Battery ESS comprises the following essential components:

- **Battery Container Enclosure and Battery Racks (or Battery Clusters)**
- **Fire Suppression System:** Includes a water spray pipeline, smoke detector, heat detector, aerosol or FK-5-1-12 fire extinguisher, auxiliary control panel, and exhaust system.
- **High-Voltage Box**
- **Integrated Control Panel**
- **Environmental Control System:** Features a liquid cooling unit and air conditioner.
- **Monitoring System:** Displays key information on the LCD screen located on the front panel of the integrated control panel.

FIGURE 2- 8 is an overview of BESS key components.

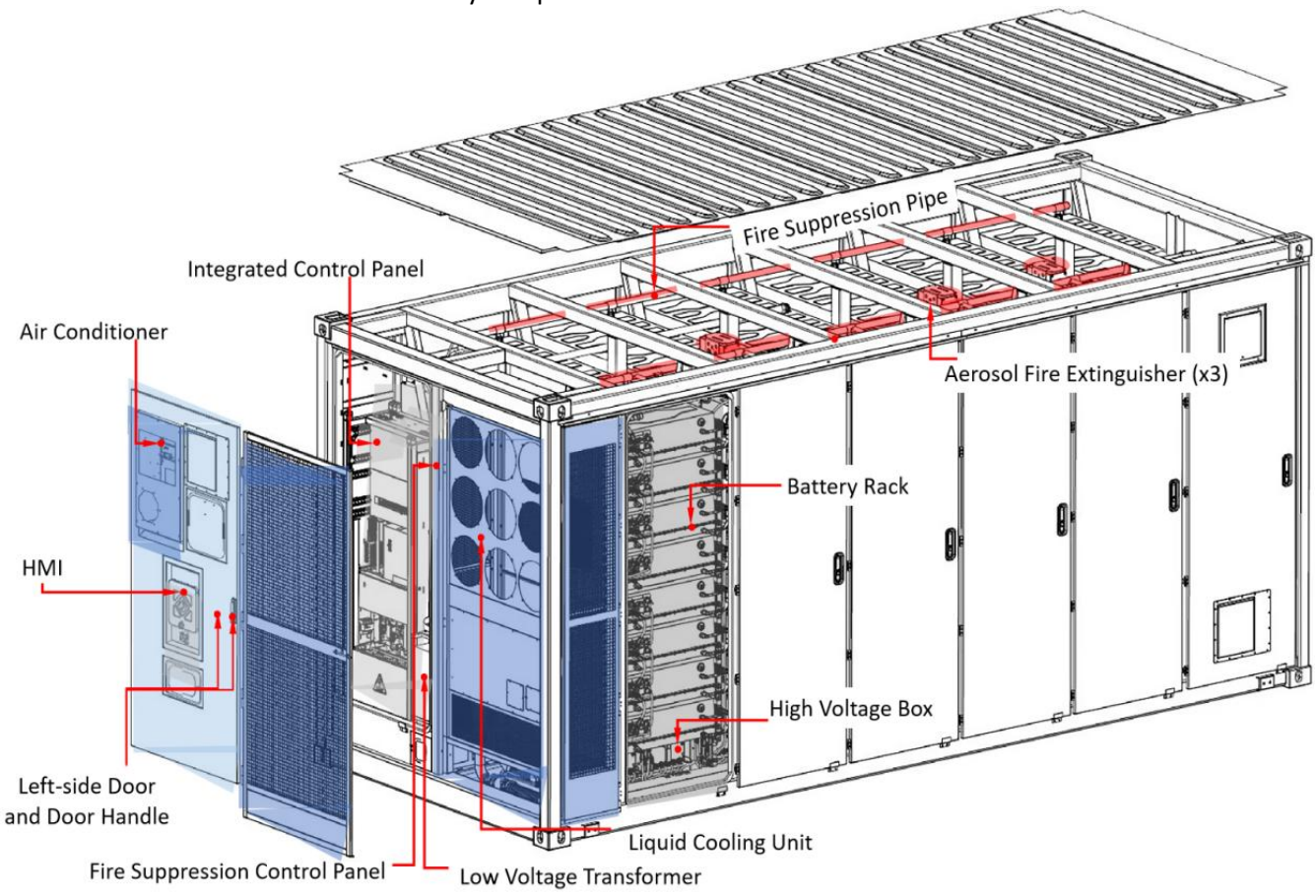


Figure 2- 8 BESS key components

2.5.1 Battery system

The battery ESS consists of several key components, beginning with individual battery cells that are grouped together to form battery packs. These packs are subsequently arranged into battery racks.

2.5.1.1 Battery cell

The battery cell employed is a Lithium Iron Phosphate (LiFePO4 or LFP) prismatic cell.

Figure 2- 9 Cell appearance

The table below shows the basic parameters of battery cells.

No.	Item Name	Technical Parameters	Notes
1	Model number	IFP72175207-314Ah	
2	Rated capacity	314Ah	LiFePO4
3	Dimensions (W×D×H)	(174.8±0.5) mm × (71.95±0.5) mm × (207.1±0.5) mm	Contains height of poles
4	DC internal resistance	0.3mΩ < R < 0.5mΩ	25°C±2°C, 50% SoC@3C(30s)
5	Nominal voltage	3.2V	
6	Nominal Capacity	1004.8V	3.2×314
7	Voltage range	2.5V ~ 3.65V	100% DOD, T > 0°C
8	Weight	5.63±0.2kg	
9	Operating temperature	32°F ~ 131°F / 0°C ~ 55°C	Charging temperature
		-22°F ~ 140°F/ -30 ~ 60°C	Discharge temperature
10	Storage temperature	-22°F ~ 140°F/ -30 ~ 60°C	30% ~ 50% SoC
11	Cycle life	≥10000	25±2°C, 0.5P/0.5P 90%DOD, 70%EOL

*DoD: Depth of Discharge
*SoC: State-of-Charge

2.5.1.2 Battery pack

The battery pack is composed of four 1P26S sub-modules linked in series to create a 1P104S configuration, with a rated specification of 332.8V/314Ah. At the pack level, voltage and temperature data from individual cells are collected and cell balancing is managed by the first-level BMS.

Figure 2- 10 Pack appearance

The table below shows the pack parameters.

No.	Item Name	Technical Parameters	Notes
1	Model number	EPD332-05P104	
2	Cell capacity	314Ah	
3	Configuration	1P104S	
4	Nominal energy	104.4kWh	0.5P, 100%DOD, 25±2°C
5	Nominal voltage	332.8V	3.2×104
6	Rated Capacity	314Ah	0.5P, 100%DOD, 25±2°C
7	Recommended operating voltage range	291.2V ~ 374.4V	(2.8~3.6V) × 104
8	Charge and discharge rate	≤0.5P	
9	Maximum Charge/Discharge Power	52.2kW	
10	Operating temperature	0 ~ 55°C	Charging temperature
		-30 ~ 60°C	Discharge temperature
11	Working humidity	5% ~ 95%	
12	Thermal management method	Liquid cooling	
13	Dimensions (W×D×H)	(785±1.5)mm×(2192±1.5)mm×(240±1.5)mm	
14	Weight	680±10kg	
15	Key components	104 cells, 2 BMS, and 1 fuse	

2.5.1.3 Battery rack

Each battery bank[1] is composed of two electrical racks, each containing four battery packs connected in series, and the high-voltage box for each rack is located at the bottom of the mechanical structure as a rack-level control module.

Figure 2- 11 Battery bank appearance (2 racks)

The table below shows the rack parameters.

No.	Item Name	Technical Parameters	Notes
1	Model number	ERD1331-05P418	
2	Cell capacity	314Ah	
3	Rack configuration	1P416S	
4	Nominal energy	418kWh	0.5P, 100%DOD, 25±2°C
5	Nominal voltage	1331.2V	3.2×416
6	Rated capacity	314Ah	0.5P, 100%DOD, 25±2°C
7	Recommended operating voltage range	1164.8 ~ 1497.6V	(2.8~3.6V) × 416
8	Charge and discharge rate	≤0.5P	100%DOD, 25°C
9	Maximum Charge/Discharge Power	208.9kW	0.5P, 25±2°C
10	Working temperature	0 ~ 55°C	Charging temperature
		-30 ~ 60°C	Discharge temperature
11	Working environment humidity	5% ~ 95%	
12	Thermal management method	Liquid cooling	

[1] A bank is a collection of battery racks physically mounted together to fit into the container. In the GRID5015 container, 2 racks are mounted together which is called a bank.

2.5.1.4 Battery container

The battery cabin includes battery racks and high-voltage boxes, each with dedicated fuse protection. The standard container configuration comprises 12 racks and 12 high-voltage boxes, though a varying number of rack options can be flexibly selected based on customer requirements for system capacity.

Figure 2- 3 BESS front view from page 14

The table below shows the container parameters.

No.	Items	Specification	Note
1	Product number	ESD1331-05P5015	
2	Product configuration	2 Stack ×6 Rack ×4 Pack ×1P104S	
3	Cell capacity	314Ah	0.5P, 100%DOD, 25±2℃
4	Nominal energy	5015.9kWh	0.5P, 100%DOD, 25±2℃
5	Nominal voltage	1331.2Vdc	
6	Recommended operating voltage range	1164.8Vdc ~ 1497.6Vdc	Corresponding voltage range 2.8V ~ 3.6V
7	Charge and discharge rate	≤0.5P	
8	Auxiliary power	AC400V, 50Hz, Three-phase four-wire system	
9	Storage temperature	-30°C ~ 60°C	
10	Working temperature	-30°C ~ 45°C	
11	Working environment humidity	0 ~ 95%	
12	Protection level	IP55 (Battery room)/IP55 (Electrical room)	
13	Applied altitude	<2000m (3000m upgrade option available)	
14	Weight	≈44t	
15	Dimensions (W×D×H)	6058mm×2438mm×2896mm	

2.5.2 High-voltage box

The high-voltage box is a rack-level control unit specifically designed by Gotion for the liquid-cooled energy storage battery system. It serves as an intermediary unit between the battery pack and the Integrated Control Panel, housing key components such as isolation switches, relays, fuses, secondary BMS, and switching power supplies. The BESS contains a total of 12 high-voltage boxes.

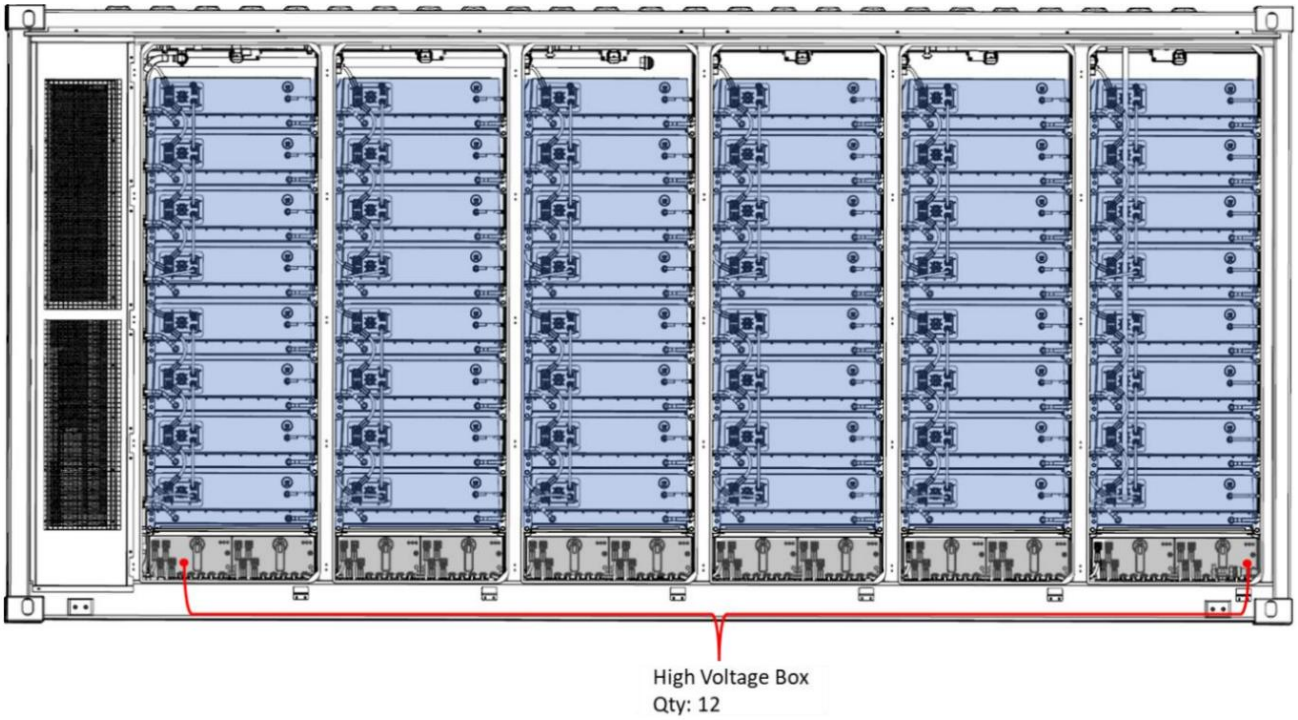
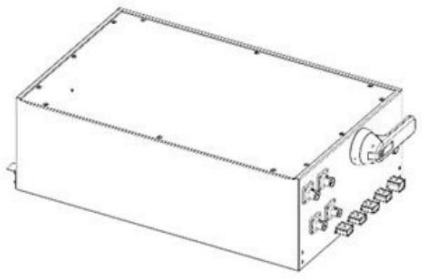


Figure 2- 12 Schematic diagram of high-voltage box location

In the design of the high-voltage box, careful consideration has been given to electrical characteristics, heat dissipation, waterproofing, safety, operability, and maintainability. Its space layout is optimized for a compact structure, flexible configuration, and enhanced safety and reliability.

The high-voltage box is equipped with a DC24V power supply interface and a CAN communication interface, enabling data communication, control, and protection of the battery management system.

The table below provides key parameters of the high-voltage box:

Item	Parameter
Appearance	
Dimension (W x H x D)	390mm x 614mm x 200mm
Weight	27 kg
Voltage range	≤1500V
Nominal current	250A
Working temperature range	- 10 ℃ ~ + 40 ℃

Altitude	≤2000m
Communication protocol	CAN

Function description:

- Supports AC 230V (single-phase 480V/400V) power supply.
- Compatible with CAN communication protocol.
- Enables electric opening control and condition monitoring of circuit breakers for reliable breakpoint maintenance.
- Features power, operation, and fault indicators for clear product status visualization.
- Equipped with high-voltage quick-connect plug-ins for fast, safe, and reliable connections.
- Available in standardized dimensions: 390×614×200mm (Width x Height x Depth).

Key component descriptions:

Item	Component	Descriptions	Qty	Unit
1	Isolating switch	NDG3VH-250，1500V	1	pc
2	DC contractor	DC1500V(max)/350A，No Polarity	2	pc
3	Fuse	DC 1500V/315A	2	pc
4	Current detector	Range±300A	1	pc
5	Positive pole socket	DC1500V/250A，Orange Color	2	pc
6	Negative pole socket	DC1500V/250A，Black Color	2	pc
7	BMS master unit	Developed by Gotion	1	pc

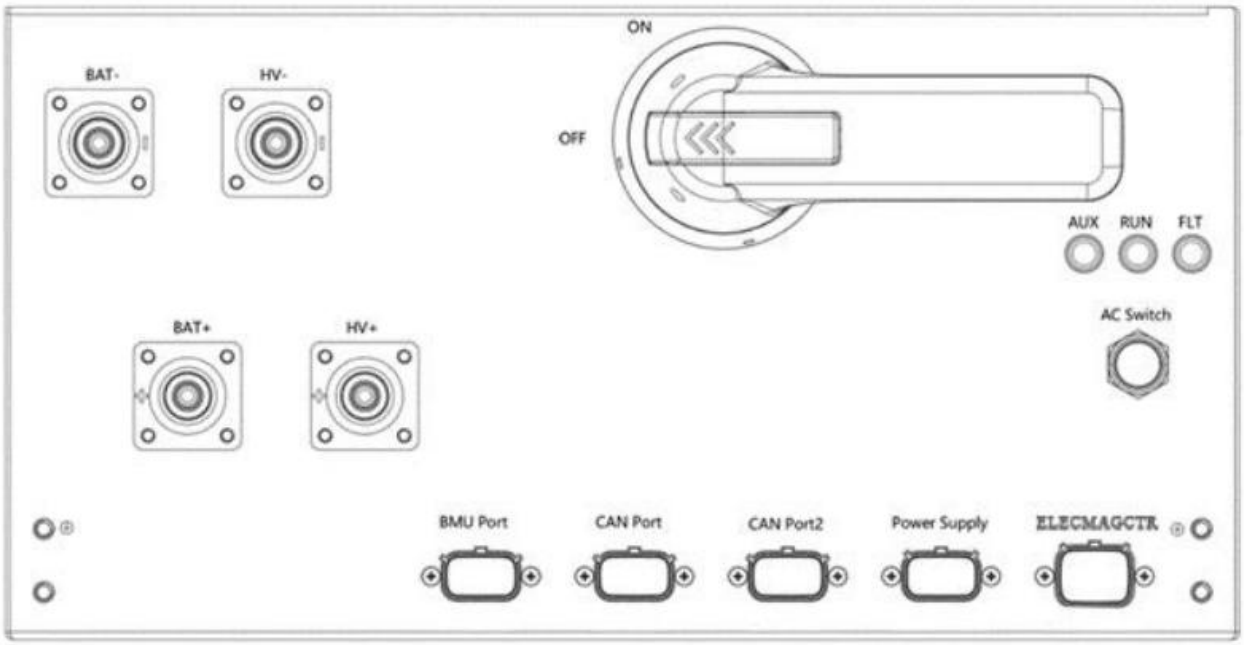


Figure 2- 13 High-voltage box external front panel

The external front panel of the high-voltage box is shown in the figure above, with the main interfaces detailed in the Interface Definition Table below.

Item	Silk-print ports on BESS	Main function	Note
1	BAT+	PACK Positive pole connector	
2	BAT-	PACK Negative pole connector	
3	HV+	External output positive connector	
4	HV-	External output negative connector	
5	AUX	Auxiliary power LED	The green light is always ON, indicating the power supply is normal
6	RUN	Running LED	A solid green light indicates that the main output relay in the high-voltage box is closed. the light is off when the relay is off.
7	FLT	Fault LED	A solid red light indicates that the system has fault
8	ELECMAGCTR	Solenoid valve control interface	Connect to the solenoid valve on the battery pack
9	CAN Port	Cascaded CAN communication interface	CAN bus, hand-in-hand
10	BMU port	BMU (1st Level BMS) communication interface	
11	Power supply	Power supply for high voltage box	AC230V Input
12	GND	Installation grounding point	Symbol: ⏚
13	ON/OFF	ON/OFF status for circuit breaker	

2.5.3 Integrated control panel

2.5.3.1 About the integrated control panel

The Integrated Control Panel (also called confluence cabinet) is specifically designed for our standard liquid-cooled battery energy storage container. It serves as the intermediary unit connecting the high-voltage box and the energy storage converter.

The panel includes battery system isolation switches, fuses, a three-level BMS, and an Uninterruptible Power Supply (UPS) power supplies. The design carefully considers the electrical characteristics, heat dissipation, safety, operability, and maintainability of each component. With a compact structure, flexible configuration, and a well-organized space layout, the Integrated Control Panel offers enhanced safety and reliability.

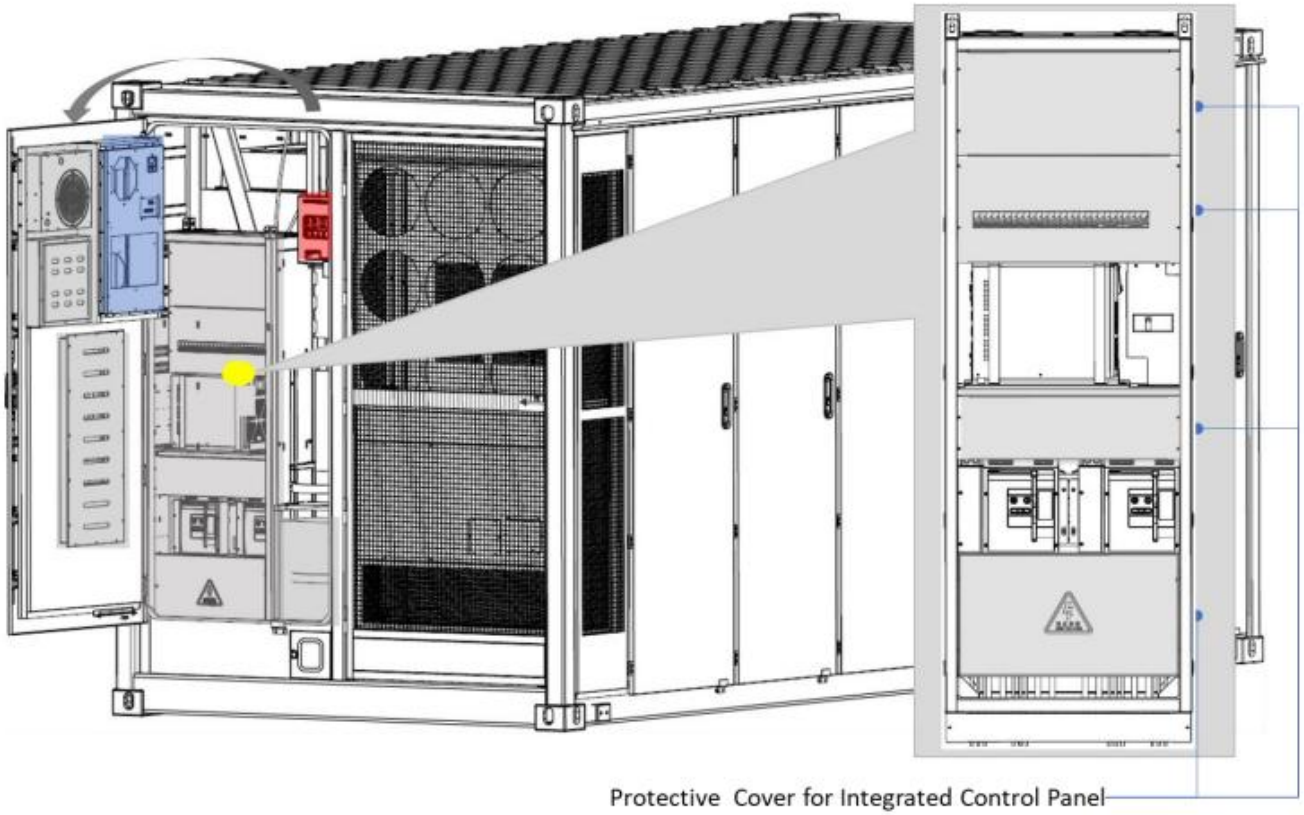


Figure 2- 14 BESS's integrated control panel

The 3rd-Level BMS installed in the Integrated Control Panel features CAN, RS-485, and RJ45 Ethernet communication interfaces, enabling communication with the high-voltage box, PCS, or Energy Management System (EMS). It facilitates data communication, control, and protection of the energy storage system.

Function description:

- Operates on AC400V power supply.
- Supports AC230V power supply for the Rack-level high-voltage control box.
- Provides CAN communication for the Battery Rack's high-voltage control box, allowing for BMS monitoring and management.
- Supports communication with EMS, PCS, and other external devices for information exchange.
- Supports backbone node control with CAN, RS-485, and RJ45 Ethernet communication protocols.

- Supports digital signal input detection for monitoring switch statuses, fire alarms, and other signals.
- The DC Main Bus uses a “bottom-in and bottom-out” configuration, with a removable bottom plate.
- Includes an emergency stop control function.

Key component descriptions:

Item	Component	Descriptions	Qty	Unit
1	DC circuit breaker	1500VDC1600A	2	pc
2	Fuse	1500VDC1800A	4	pc
3	3rd-Level BMS	Developed by Gotion	2	set
4	UPS	3KVA w/ Backup Power for 30min	1	pc
5	Switch power supply	240W (output power)	1	pc

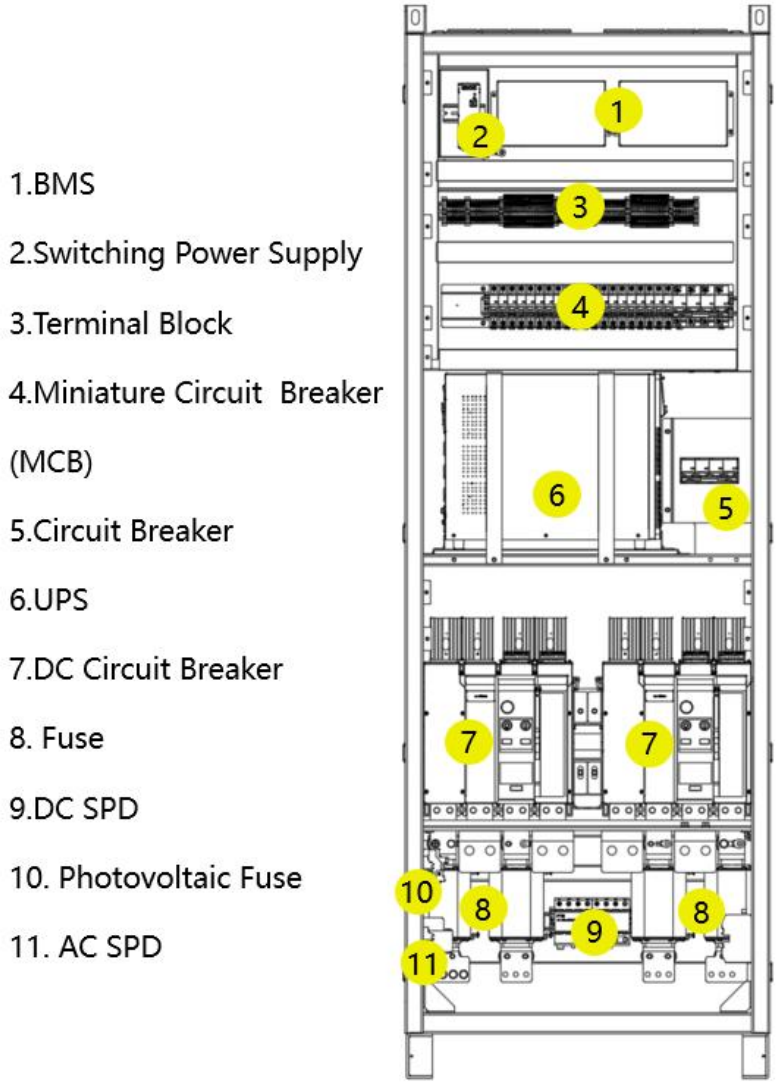


Figure 2- 15 Integrated control panel key components

2.5.3.2 Grounding the integrated control panel cabinet

As shown in the diagram below, the grounding point of the Integrated Control Panel is connected to the cabin housing. This ensures proper grounding of the Integrated Control Panel through the grounding of the cabin housing.

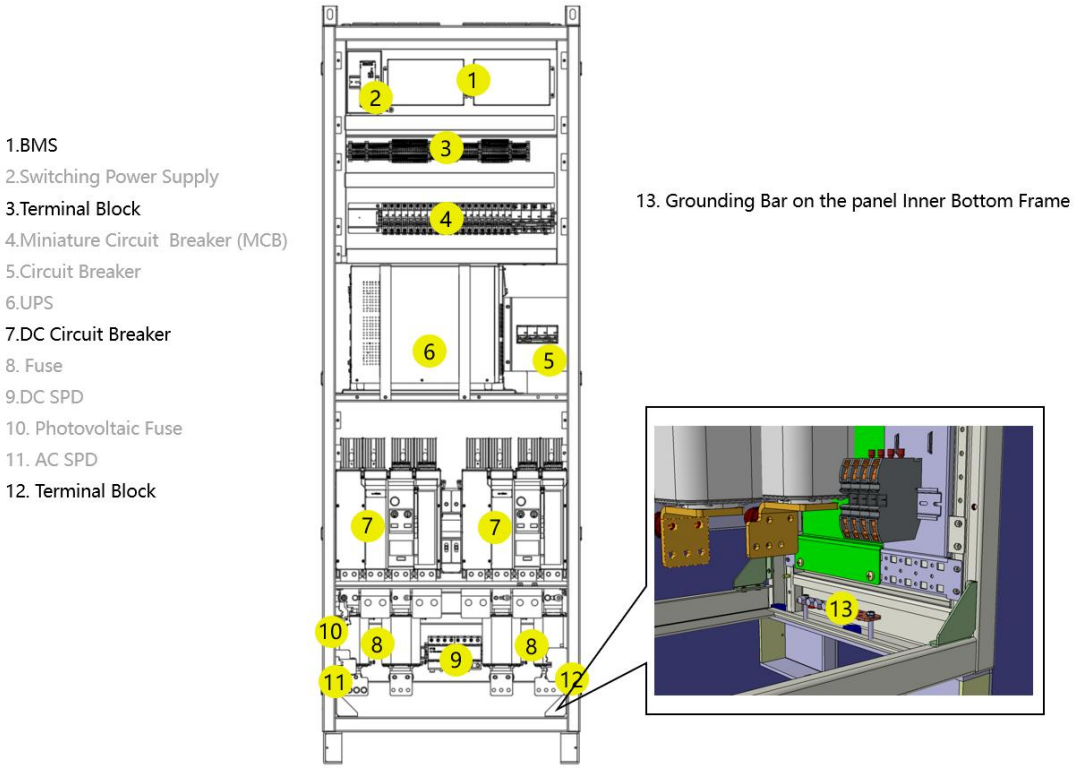


Figure 2- 16 Diagram of the integrated control panel's grounding tab

NOTICE

- The Battery Rack is welded to the Battery Container, ensuring a secure connection between the two. For more details, refer to section 5.5.2 on grounding the ESS.
- The grounding connection of the busbar control cabinet is pre-connected at the factory. The customer only needs to verify that the grounding wire is properly connected.

2.5.4 Monitoring system (HMI)

The monitoring system provides real-time operation information for the air conditioning, fire protection, liquid cooling unit, and other equipment through the human-machine interface (HMI). It also fully displays various battery data, including current, temperature, voltage, and more.

Appearance of the Monitoring System:

The monitoring system is mounted on the left side of the container, as shown in the image below.

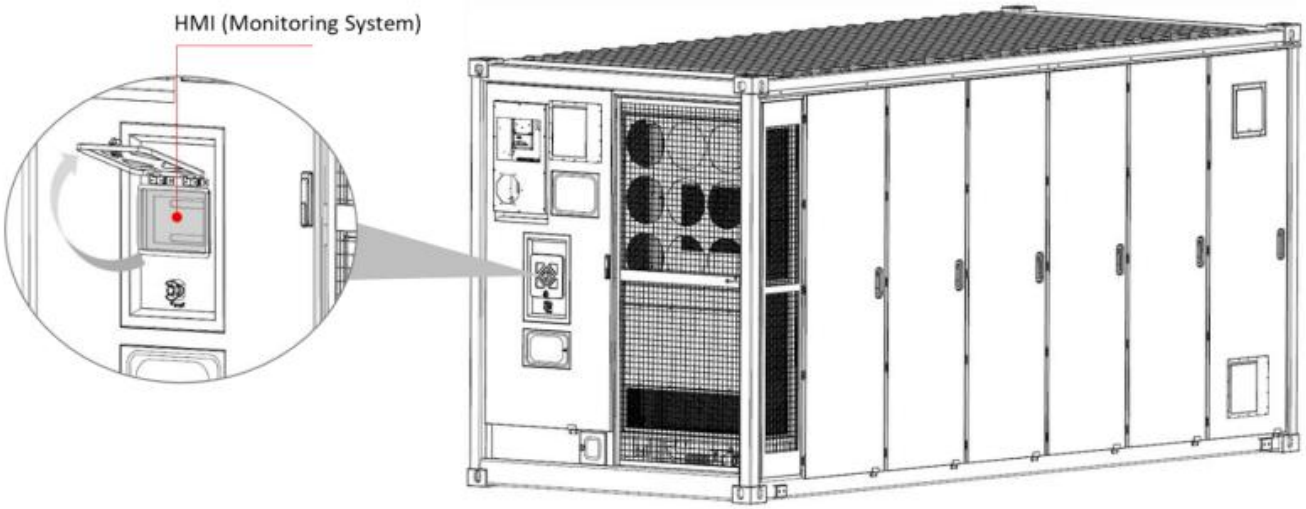
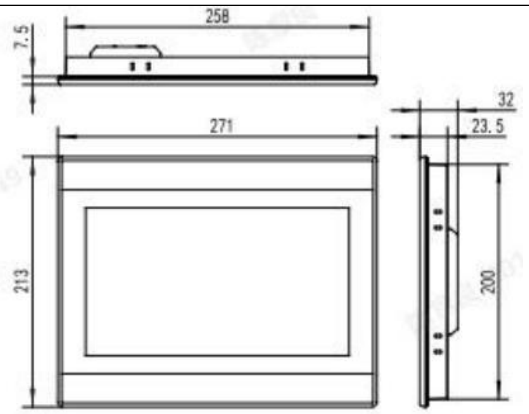


Figure 2- 17 HMI location on the BESS

Details are provided in the table below.

Item	Appearance
Front appearance	
Back plate	

Installation dimensions (mm)	

Key functions of the monitoring system:

- Monitors battery information within the Battery ESS.
- Tracks the status of liquid cooling units, the fire suppression system, and other external nodes.
- Manages system operation, faults, alarms, and other statuses.
- Monitors the charge and discharge status of the battery.
- Monitors the input and output port statuses of the 3rd-level BMS.
- Monitors the communication status of the 1st-level and 2nd-level BMS.

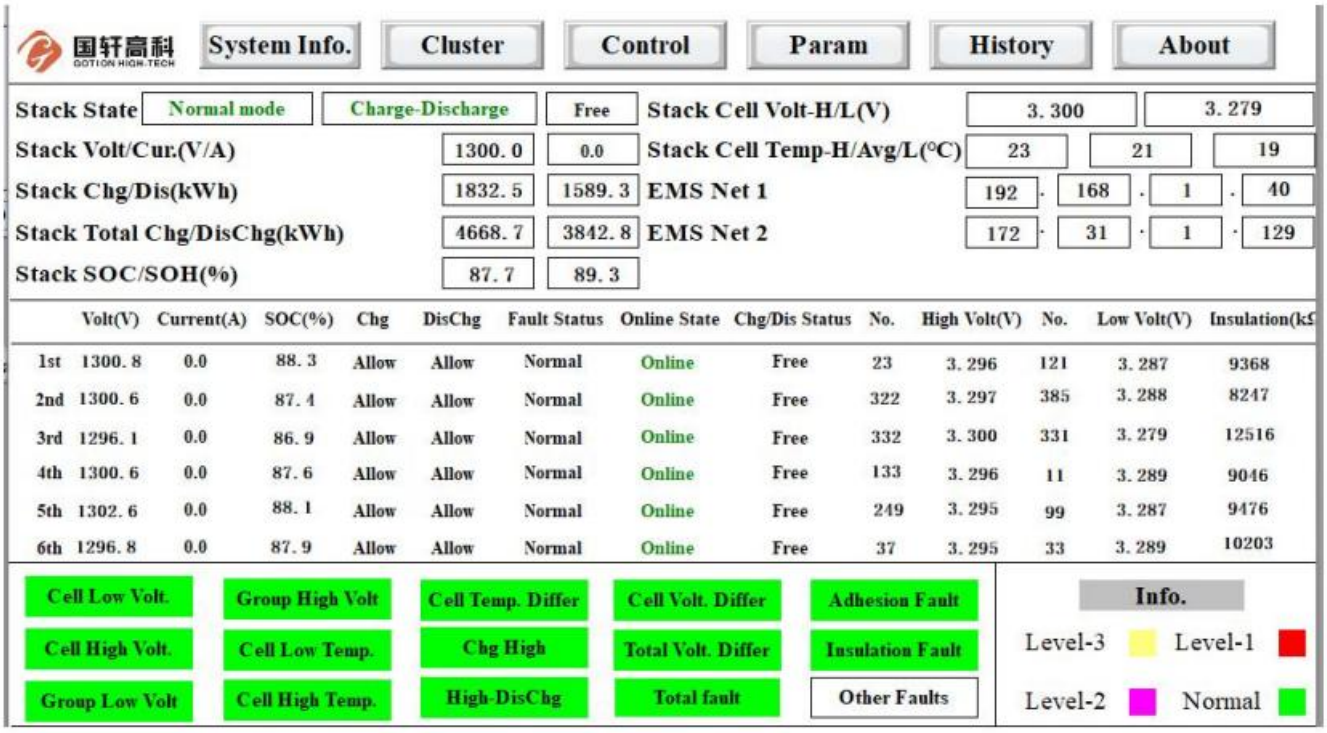


Figure 2- 18 HMI example

2.5.5 BMS

The BMS in the Battery ESS uses a three-level hierarchical architecture to perform the following functions:

- Real-time monitoring of battery voltage, temperature, total battery cluster voltage, current, and insulation.
- Insulation resistance detection.
- Fault diagnosis, alarm notifications, fault protection, and recording of battery system events.
- Self-testing capabilities.
- Protection against overcharge, over-discharge, and over-current in the battery system.
- Anti-circulation control between Battery Racks.
- SoC and SoH estimation.
- Battery equalization.
- Timing synchronization.
- Setting battery operating parameters, alarms, and protection values locally or remotely.
- Event recording, data storage, and display.
- Communication with PCS, EMS, and ancillary equipment.

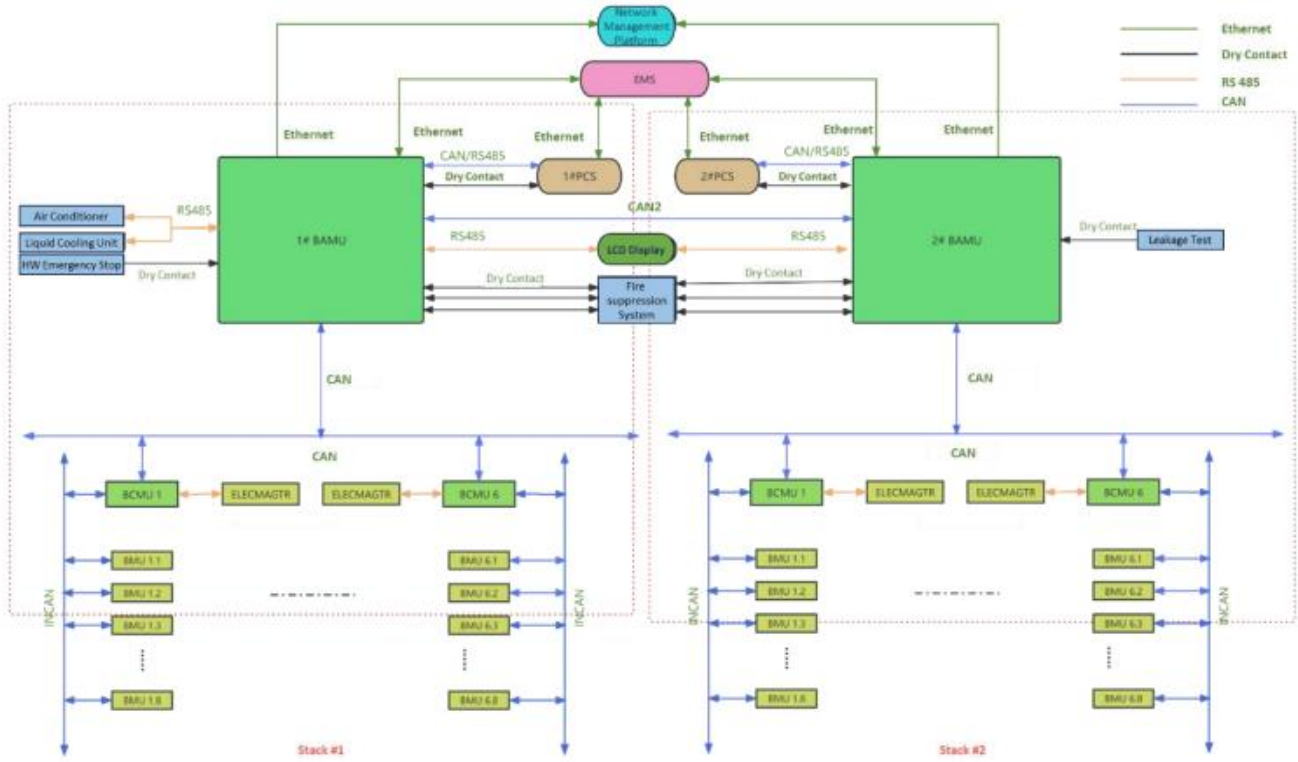


Figure 2- 19 Battery racks connecting to 2 PCS

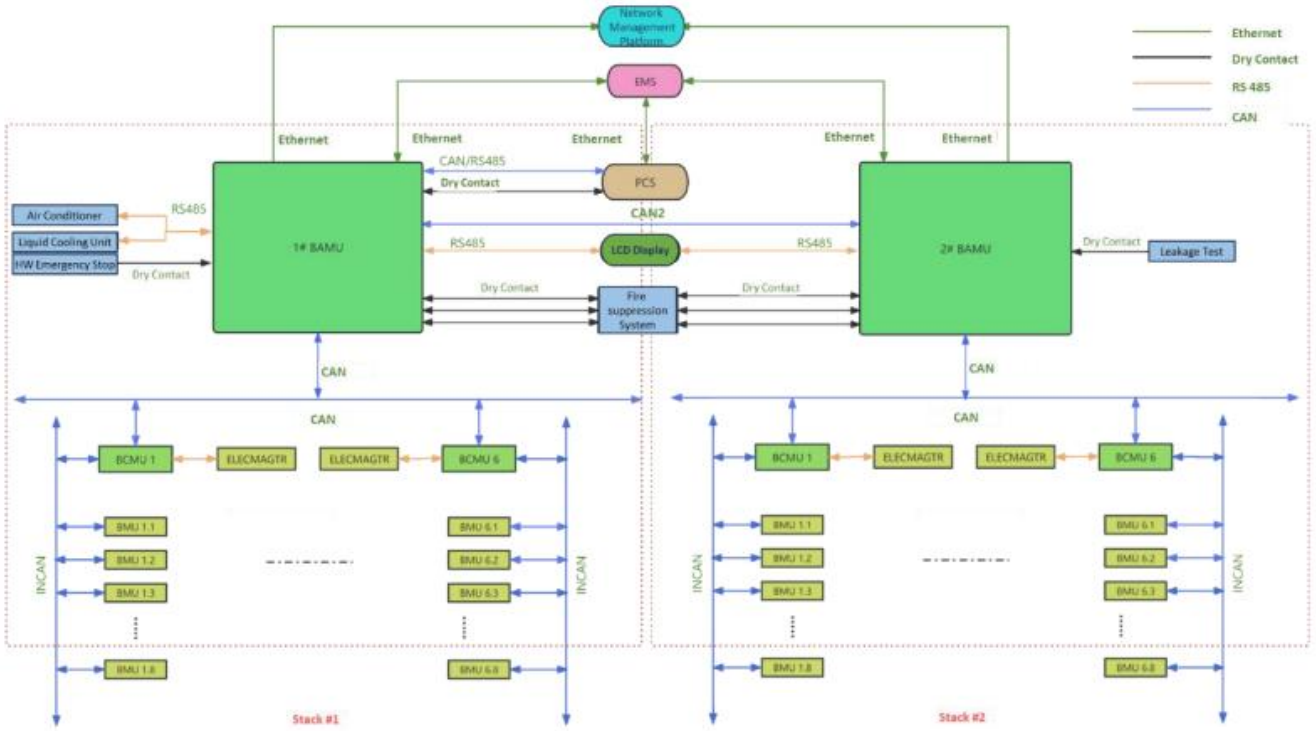


Figure 2- 20 Battery racks connecting to 1 PCS

2.5.5.1 First-level BMS (BMU)

The First-level 54S BMS, also called Battery Management Unit (BMU), is a slave control unit with an integrated passive balancing function, designed for lithium battery management systems:

- Supports voltage monitoring for 54 individual cells.
- Supports 30 channels of NTC (10K) temperature monitoring.
- Enables passive balancing with an equalization current ≥ 100mA.
- Supports thermal management, allowing fan speed adjustment based on different temperature levels.
- Supports Bootloader upgrades, allowing firmware updates online via CAN.
- Provides alarm functions for overvoltage, undervoltage, temperature (overtemperature), communication, and more.
- Supports detection of voltage drops in wiring harnesses.

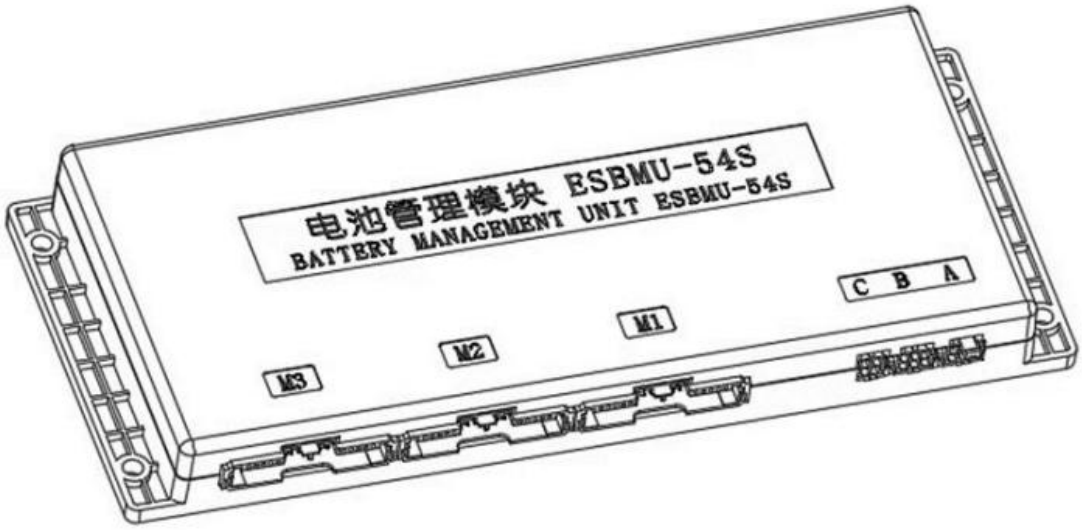


Figure 2- 21 BMU appearance

The BMU has overall dimensions of 260 mm × 110 mm × 23.5 mm and features hardware interfaces including A-port, B-port, C-port, M1 port, M2 port, and M3 port.

The first-level BMS specifications are shown in the following table:

Item	Description		Parameter				Note
			Minimum	Typical	Maximum	Unit	
1	Working Power	Nominal Voltage	9	-	32	Vdc	
		Nominal Power Consumption	-	-	1	W	DI/DO not connected

2	Data Acquisition – Single Cell Voltage Data	Channels	3	-	54		Voltage for battery modules should be above (>) 6V
		Range	1.5	-	4.5		
		Accuracy	≤±0.1%FS, Voltage≤5mV				
3	Data Acquisition - Temperature	Channels	-	-	30	Channel	
		Range	-40 (-40)	-	257 (125)	°F (℃)	
		Accuracy	-	±1.8 (1)	-	°F (℃)	±1.8°F@-13°F ~ 149°F (±1℃@-25℃ ~ 65℃), ±3.6°F@-40°F ~ -13°F, or 149°F ~ 257°F (±2℃@-40℃ ~ -25℃, or 65℃ ~ 125℃)
4	DO	Channels	-	-	1	Channel	
		Output Current (A)	-	-	1	A	Peak Current 5A@100ms
5	DI	Channels	-	-	1	Channel	
		High level	9	24	32	Vdc	

2.5.5.2 Second-level BMS (BCMU)

The Second-level BMS, known as the Battery Cluster Management Unit (BCMU), operates at the Battery Rack level. Its primary responsibilities include:

- Real-time monitoring of the total voltage, current, insulation resistance, and switching status of the Battery Rack.
- Estimating the SoC, SoH, and other battery states, while determining balancing strategies by analyzing voltage and temperature data of individual cells provided by the First-level BMS.
- Supporting fault diagnosis of the battery system and enabling safety control functions for protection equipment such as circuit breakers and relays.
- Communicating with the upper-level battery array management system (Third-level BMS) to automatically respond based on predefined strategies, ensuring the safe, stable, and reliable operation of the Battery ESS.

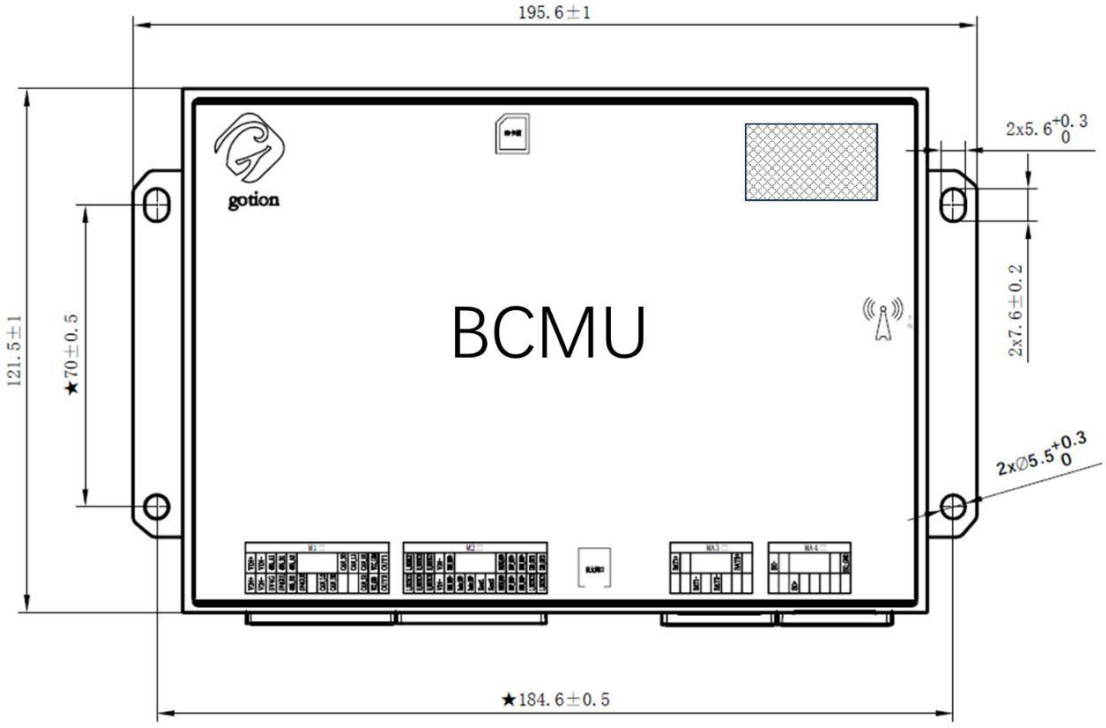


Figure 2- 22 BCMU appearance

The second-level BMS specifications are shown in the following table:

Item	Description	Specification
1	Dimension	7.7in x 4.7in x 0.8in (195mm x 120mm x 20.8mm)
2	Weight	1.8lb (800g)
3	Material	Sheet metal with ordinary spray paint
4	Insulation resistance	> 10MΩ 1000VDC
5	Withstand voltage	3280V AC @ 50Hz
6	Power supply voltage	24V DC

7	Power consumption	< 3W
8	Slave BMS can be connected	Max. 64 Slave BMS
9	Communication protocol	2 x Insulated CAN / 2 x Insulated 485 / 1 x Ethernet / 1 X 4G (reserved)
10	Baud rate	250kbps / CAN; 9600Kbps/RS485
11	Total voltage acquisition accuracy (rack level)	≤ ±0.5%FS, maximum error ≤ 5V
12	Current acquisition accuracy (rack level)	≤ ±0.5%FS, maximum error ≤ 3A
13	Insulation resistance acquisition accuracy (rack level)	Relative error ≤ 20% when nominal total voltage ≥ 400V; Relative error≤30% when nominal total voltage<400V;
14	Operating environment	Temperature: 14°F ~ 131°F (-10°C ~ 55℃) Humidity: < 95% (RH, no condensing) Magnetic Field: < 400A/m Corrosive, flammable, and explosive gases are not allowed around

2.5.5.3 Third-level BMS (BAMS)

The Third-Level BMS, also known as the Battery Array Management System (BAMS), serves as the control host for the battery management system in energy storage power stations. Its key functions include:

- Communicating with the Second-level BMS to obtain real-time data from the battery rack, such as voltage, current, temperature, and SoC.
- Monitoring the operation status of air conditioners, fire-fighting equipment, circuit breakers, and other devices through network communication.
- Performing data analysis, alarm processing, parameter setting and adjustments, and time-based data storage.
- Collaborating with the PCS host and EMS to optimize control strategies based on actual power output needs and the SoC of each battery group.
- Automatically adjusting and enabling coordinated control to ensure the safe and stable operation of the power station, while promoting extended battery life.

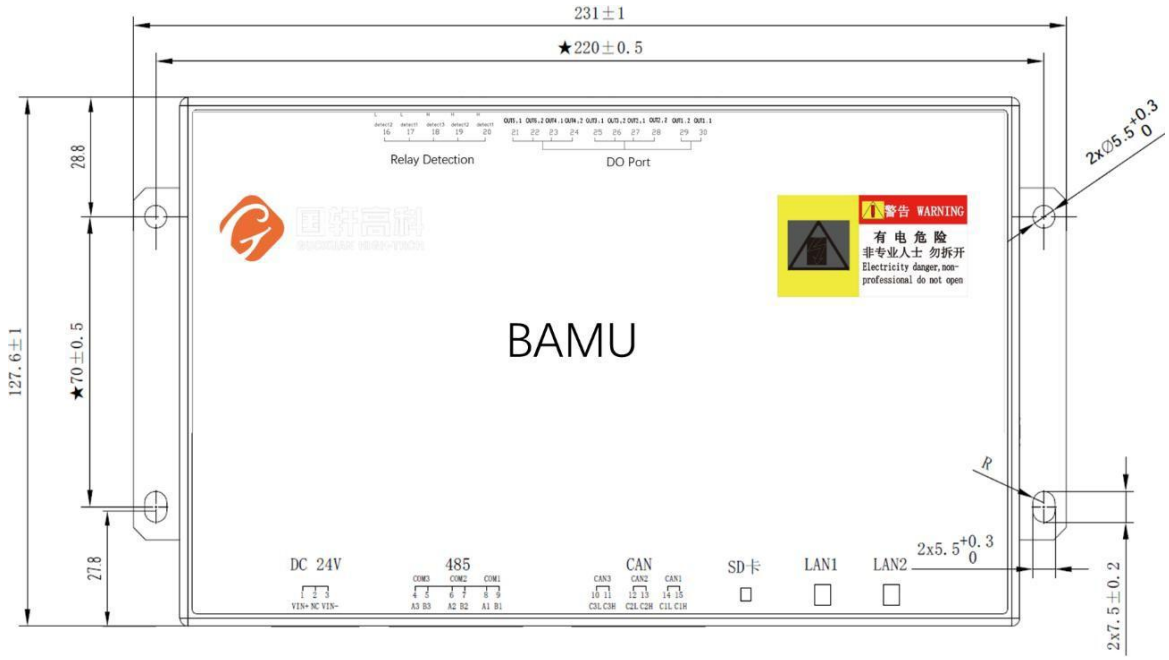


Figure 2- 23 BAMU appearance

The third-level BMS specifications are shown in the following table:

Item	Description	Specification
1	Dimension	9.1in x 4.9in x 0.8in (231mm x 125mm x 20.8mm)
2	Weight	4lb (1800g)
3	Material	Sheet metal with ordinary spray paint
4	Insulation resistance	>10MΩ 1000VDC
5	Withstand voltage	4380V AC @ 50Hz

6	Power supply voltage	24V DC
7	Power consumption	< 5W
8	Communication port	2x10/100M LAN(RJ45), 3 x isolated CAN, 3 x isolated RS485
9	Baud rate	9600bps/RS485, 250kbps / CAN, 100Mbps/LAN
10	Data logging interval	≤ 60 seconds
11	Event log database	> 5000 events, including exception class, occurrence time, protection action
12	Query method	On-site panel inquiry, remote computer queries.
13	Alarm mode	Light alarm, and display alarm prompt
14	Display	10.2” TFT LCD Screen, resolution (1024 x 600)
15	Operating environment	Temperature: 14°F ~ 131° F (-10°C ~ 55℃) Humidity: < 95% (RH, no condensing) Magnetic Field: < 400A/m Corrosive, flammable and explosive gases are not allowed around

2.5.6 Thermal management system

At the ESS container level, the system's temperature is managed through a combination of air conditioning and a liquid cooling temperature control system.

The liquid cooling system comprises the liquid cooling unit, piping system, and battery pack cooling system to regulate the temperature of the battery packs.

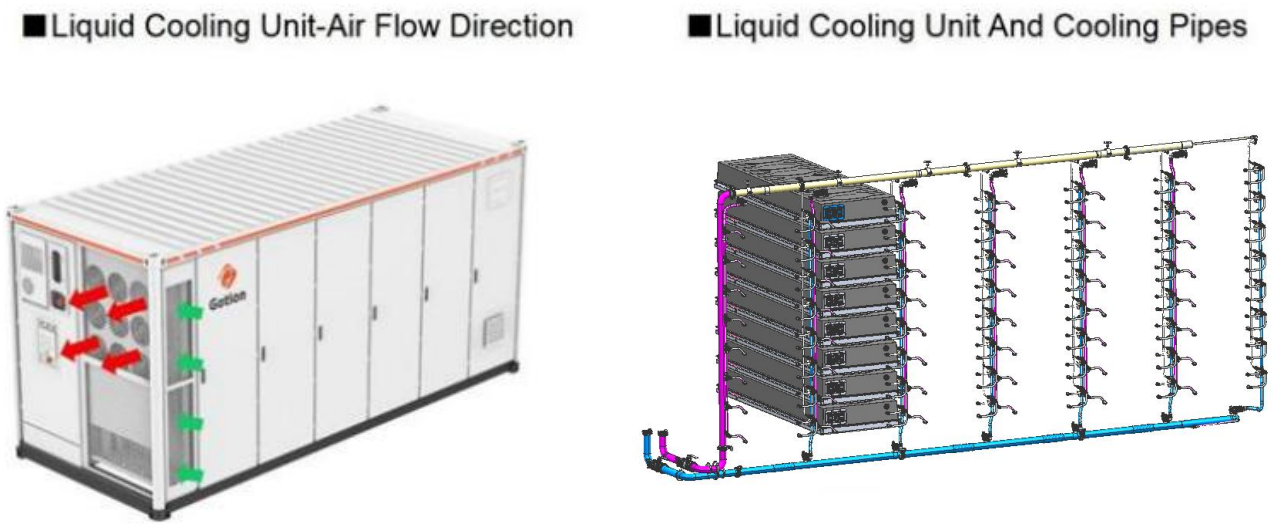


Figure 2- 24 Liquid cooling system

At the Battery Pack level, the second generation of Gotion's energy storage liquid-cooled standard box is used. It integrates liquid cooling channels into the bottom plate of the box, improving heat conduction efficiency and reducing system temperature variation.

At the Battery Rack level, the liquid cooling pipes are connected in parallel between the Battery Packs that make up the Rack. This ensures consistent inlet water temperature across the Battery Packs and minimizes temperature differences within a single Rack.

At the ESS container level, the liquid-cooled systems of all the Racks are connected in parallel. By utilizing a customized refrigeration unit, the flow rate is evenly distributed across each Battery Pack, ensuring consistent cooling and minimizing temperature variations between Battery Packs inside the container.

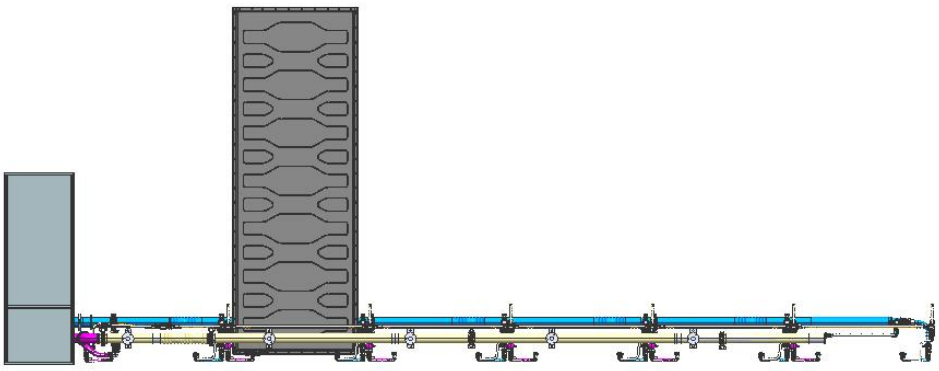


Figure 2- 25 Top view of the liquid-cooling system

Figure 2- 26 Front view of the liquid-cooling system

2.5.6.1 Air conditioner

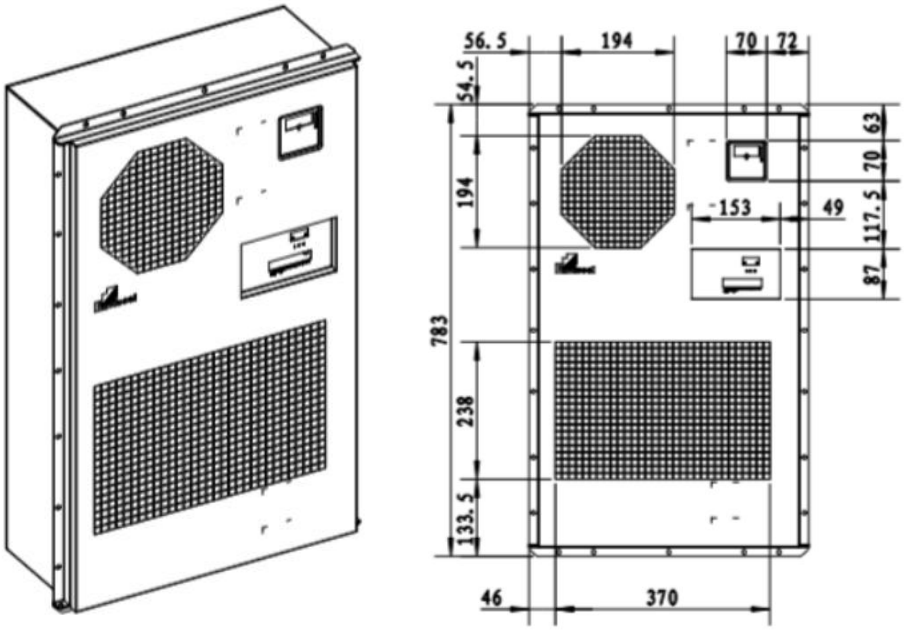


Figure 2- 27 Air conditioner appearance

The table below provides the key parameters of air conditioner.

Item	Parameters
Dimension (W*D*H)	483*200*783 mm
Weight	35 kg
installation	Outdoor
Operating temperature	-40°F ~ 131°F (-40℃ ~ 55℃)
Sound Level (indoor side)	65 dB(A)
IP Class	IP55
RoHS2 compliance	Yes
Energy Consumption -Input Power	850 W
Energy Consumption – Input Current	3.80A
Air Flow Volume	650 m3/h
Maximum Operation Current	6.5A
Voltage Range	220 V±15%, 50/60 Hz
Nominal Voltage – Controller	220 V, 50 Hz
Nominal Voltage – Cooling/Heating System	220 V, 50 Hz

2.5.6.2 Liquid cooling unit

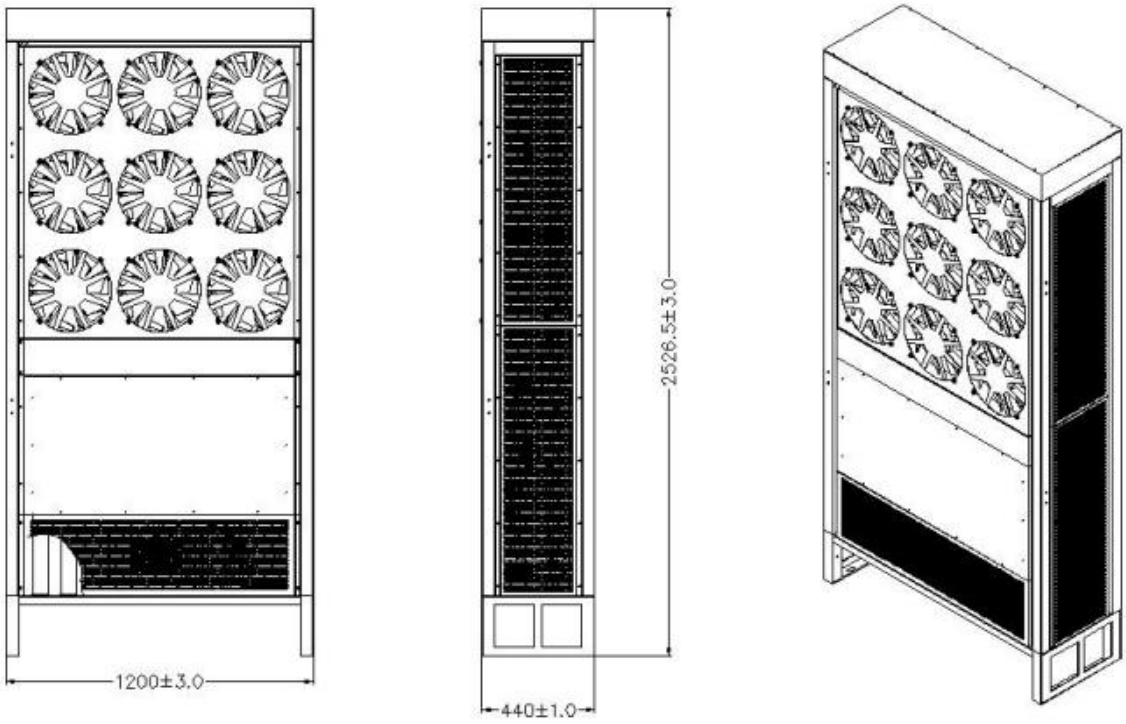


Figure 2- 28 Liquid cooling unit appearance and dimensions

The table below provides the key parameters of liquid cooling unit.

Item	Parameters
Voltage (V)	380 Vac±15%
Frequency (Hz)	50 Hz ±2%
W18/L45/ cooling capacity (kW)	60 kW
Heating volume (kW)	12 kW
Rated cooling power (kW) W18/L45	28 kW
Self-circulating power (kW)	3.6 kW
Maximum operating current (A)	64 A
Rated liquid rate	500L/min@15m
Nosie(dB)	≤85 dB
Coolant	50% ethylene glycol aqueous solution
Working temperature (℃)	-22°F ~ 131°F (-30 ℃ ~ 55 ℃)
Storage humidity	5 ~ 95%

Working altitude	0 ~ 4000m, greater than 2000m, performance decreases by 3% for every 1000m increase in altitude
Liquid supply and recycle	Bottom supply and return liquid
Installation method	Floor mounted installation
Weight	390kg
Outlet size (W*D*H)	1200*440*2530mm

2.5.7 Fire suppression system

The role of the fire suppression system in a battery energy storage system (BESS) is to ensure the safety and protection of the system in case of fire or thermal events.

The fire suppression system's auxiliary control panel is mounted on the right side of the ESS container, while the gas ventilation system, primarily composed of the electric louvers and exhaust fan, is located on the left and front sides of the container.

The fire extinguishing system, including detectors, sprinklers, and pipelines, is rack-mounted and pre-integrated into the battery ESS container.

Please note that two types of fire extinguishers are offered, tailored to meet specific requirements and comply with the authority having jurisdiction (AHJ):

- **FK-5-1-12 clean agent fire extinguishing system:**

  Perfluorohexanone, marketed under the brand name FK-5-1-12, is used as a fire extinguisher offering several advantages: high firefighting efficiency, no watermarks, non-corrosive, low toxicity, excellent insulation properties, environmentally friendly and safe, with easy storage and transport due to its low evaporative pressure.

- **Aerosol fire extinguishing system:**

  The other optional extinguishant used in fire extinguishing system is Powdered Aerosol A (SFE), known for its high insulation properties, environmental friendliness, and rapid-fire extinguishing and cooling capabilities.

  The Aerosol system generates a powdered aerosol in situ through a chemical reaction within a non-pressurized container, releasing fine dry powder particles (1-5 microns) suspended in inert gases.

The fire suppression system operates in two modes: **automatic and electrical manual**. Each protected area is equipped with two independent detection loops, consisting of a detection circuit, the clean agent or Aerosol fire extinguishing system, and a water fire extinguishing system. More information about the two modes can be found in chapter 9. Fire extinguishing system.

The detection circuit is made up of components such as the fire extinguishing controller, Li-ion tamer detectors, heat detectors, smoke detectors, emergency stop button, and alarm bell.

The water-based fire extinguishing system consists of a fire hydrant interface, fire water pipeline (dry pipe), and water sprinklers.

2.5.7.1 Key components of the fire suppression system

Key components of the fire suppression system include the FSS Control Panel, extinguishant abort switch, Li-ion tamer with interface module, ventilation system intelligent control module, manual non-coded pull station, sound and light alarm, emergency stop button, etc.

The figure below provides an overview of the key components within the BESS container.

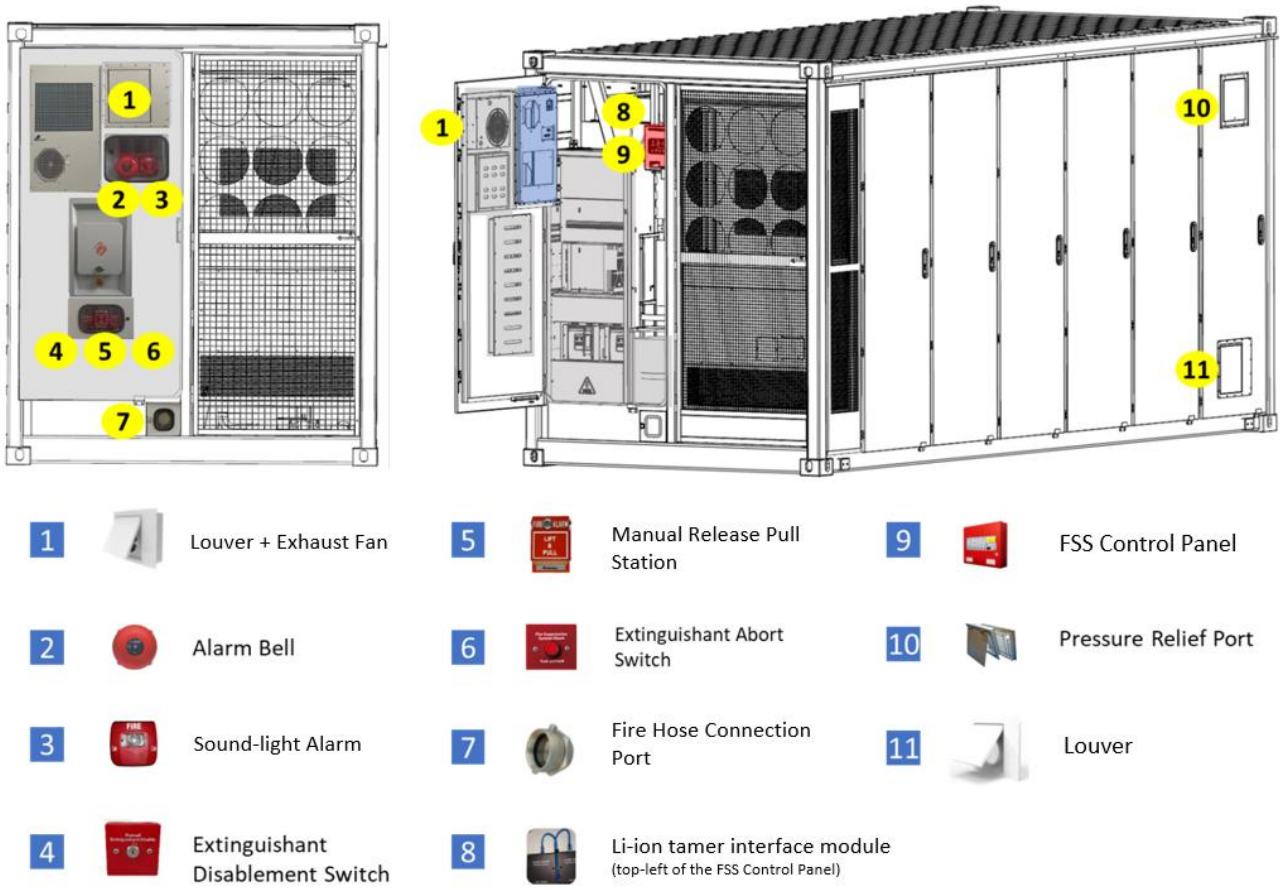


Figure 2- 29 BESS key components overview

2.5.7.1.1 FSS control panel

The FSS Control Panel manages fire alarms and automatic fire extinguishing functions.

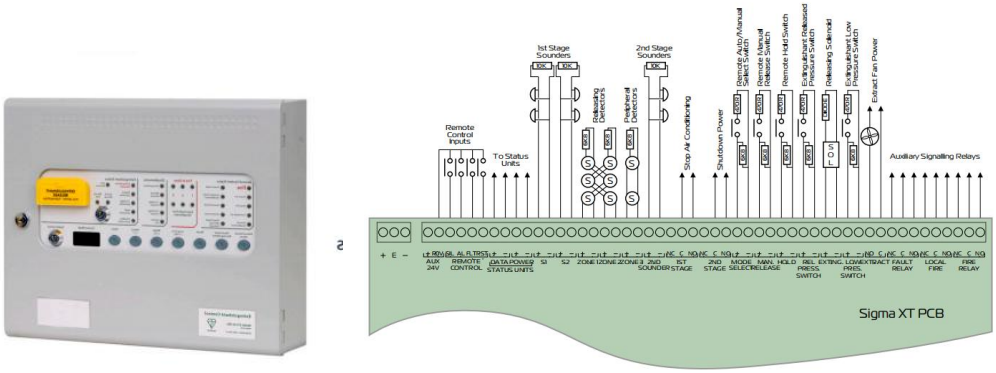


Figure 2- 30 FSS control panel

Item	Parameters
Dimension (W*D*H)	310*90*385mm
Enclosure material	1.2mm mild sheet steel
Operating voltage	230V AC Battery: two 12V 7Ah sealed lead acid in series
Capacity	Number of initiating circuits: 3 Number of detectors per zone: ≤ 32
Operating temperature	-5℃ ~ 40℃±2℃)
Humidity	≤ 95% (no condensing)
IP Rating	IP 30

2.5.7.1.2 Alarm bell

The alarm bell emits loud, resonant tones, operates on 24VDC, and is motor-driven.

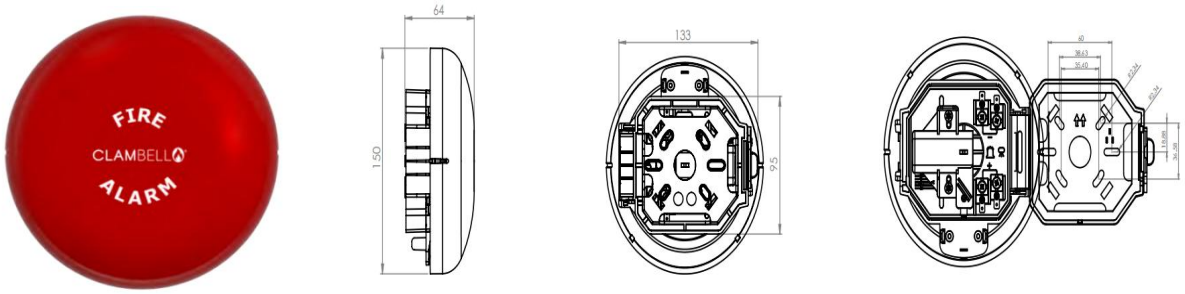


Figure 2- 31 Alarm bell

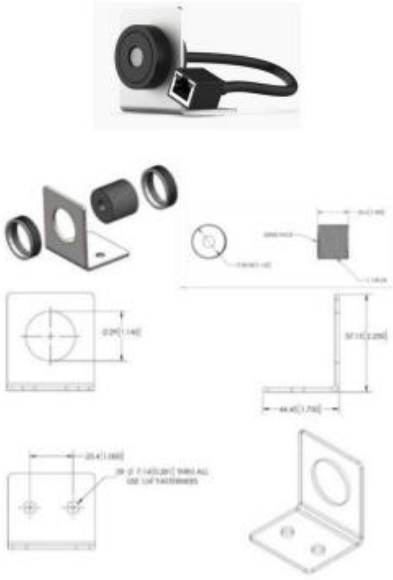
Item	Parameters
Dimension (W*D*H)	150*64*150mm
Nominal voltage	Regulated 24V DC/FWR (full wave rectified)
Operating voltage range	20.4-27.6V
Sound Output	96dBA
Standard operating temperature	-10℃-+50℃

2.5.7.1.3 Li-ion tamer rack monitoring module and detector

The Li-ion Tamer (also known as Lithium-ion detector) interface module is located on the right side of the Battery ESS Container, in the top left area of the Fire Suppression System's Auxiliary Control Panel.

Item	Parameter
Li-ion tamer interface module 	• Dimension (W*D*H): 85mm * 32.8mm * 140mm • Input voltage: 24V (Range: 15 ~ 32V DC) • Relay output: Fault indication, Alarm Indication • Communication protocol: CAN Bus Operating Temperature: -10°C to 60°C • Ambient humidity: 5 ~ 95% RH (non-condensing)

Monitoring detectors are installed at the battery racks and are highly sensitive to lithium-ion battery off-gassing compounds, providing early warnings of battery failures. These detectors require no calibration and deliver reliable output signals.

Item	Parameter
Li-ion tamer detector 	• Dimension: Φ28.6 x 25.4mm • Input power: 3-16VDC • Power consumption: 250mW (@5VDC, 25℃) • Target gas: Battery electrolyte vapor components (such as diethyl carbonate, dimethyl carbonate, EMC, DEC, etc.), Volatile organic compounds, CO, H2 • Min. probe threshold: < 1ppm/sec • Response time: 5 seconds • Operating temperature: -10 ~ +80℃ • Ambient humidity: 10 ~ 95% RH (non-condensing) • Max. temperature change: 8.6℃/minute • Target application lifetime: > 15 years

2.5.7.1.4 Extinguishant disablement and abort switch

The Disablement Switch is key-removable in either position, mechanically disabling both sides of the solenoid circuit during activation, with an illuminated indicator on the panel when activated.

The Abort switch is connected to the Abort terminals of the releasing panel, providing open and short circuit supervision.

Figure 2- 32 Extinguishant disablement switch

2.5.7.1.5 Manual automatic switching with emergency start

The manual automatic transfer switch should be kept in automatic mode, that is, the fire protection system should operate automatically.
When personnel need to maintain the energy storage system, the manual/automatic transfer switch should be switched to manual mode to prevent accidental action of the fire protection system and the release of fire extinguishing agents.
In case of emergency, personnel can manually release the fire extinguishing agent through the emergency start button.

Figure 2- 33 Front and view of the manual automatic transfer switch

2.5.7.1.6 Temperature and smoke detector

The heat detector measures and monitors the environment temperature.

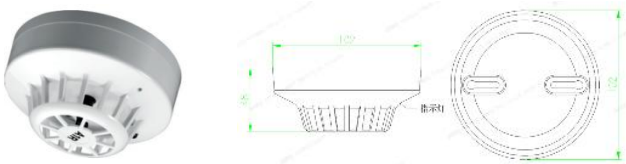


Figure 2- 34 Heat detector appearance

Item	Color	Status	Description
Heat detector	Red	Steady on	The detector activates into alarm mode.
		Blinking	The detector switches to monitoring mode.

The smoke detector monitors the environment for smoke concentration.

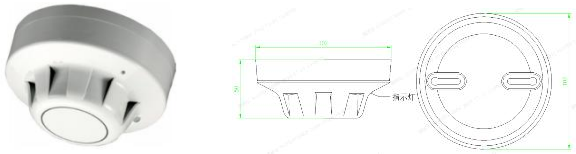


Figure 2- 35 Smoke detector appearance

Item	Color	Status	Description
Smoke detector	Red	Steady on	The detector activates into alarm mode.
		Blinking	The detector switches to monitoring mode.

More parameters of the smoke detector are shown in the table below.

Item	Parameter
Dimension (D*H)	100mm * 42mm
Operating voltage	24 V (9–33 V DC)
Quiescent current	30 – 50μA
Alarm current	52 mA
Operating temperature	–4°F to +140°F (–20°C to +60°C)
Ambient humidity	0% ~ 95% RH (non-condensing or icing)

2.5.7.1.7 Fire extinguishing agent

FK-5-1-12 Clean Agent Fire Extinguishing System

The fire extinguishing agent storage cylinder is used to store the fire extinguishing agent, and, along with components such as solenoid valves, pressure gauges, and pipelines, forms the complete fire extinguishing system.

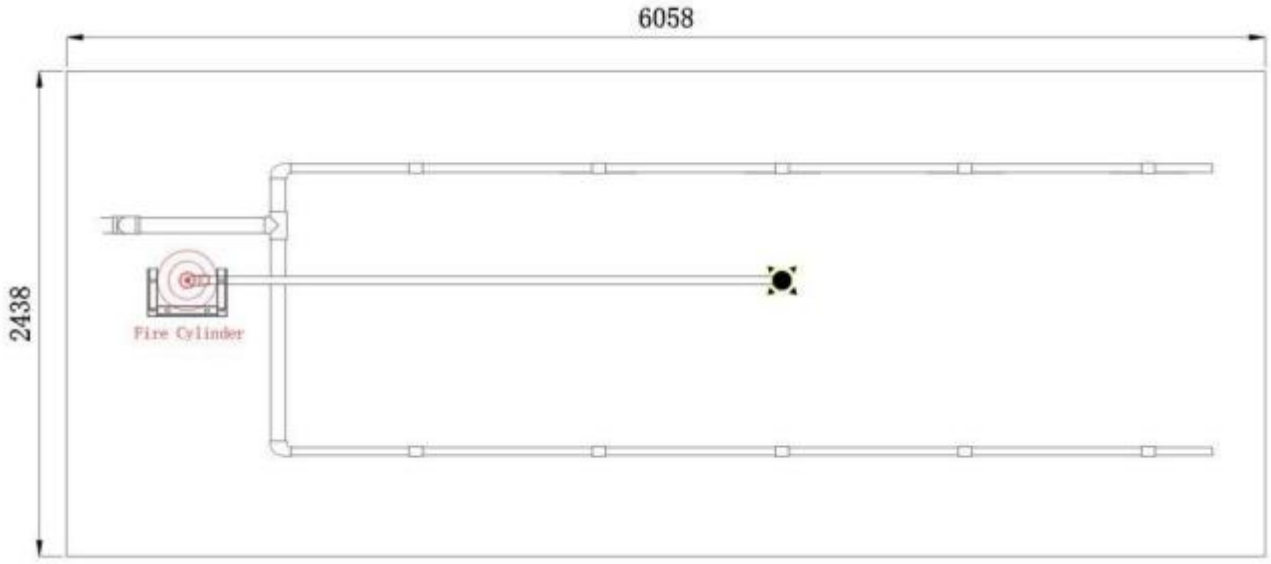


Figure 2- 36 Top view of clean agent fire extinguishing system

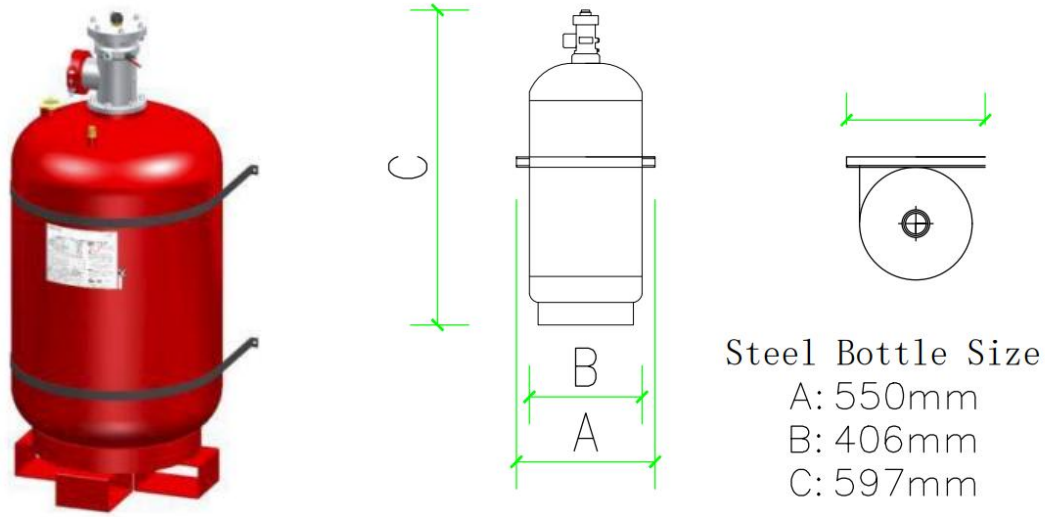


Figure 2- 37 Appearance of a fire cylinder

Key parameters of fire cylinder are shown in the table below.

Item	Specification
Part number	SPS030-MS-052-DT
Cylinder height (mm / in)	748mm (29.45in) / 600mm (23.6in)

Outer diameter (mm / in)	406mm (15.98in)
Hose diameter	DN38
Storage pressure (at 20°c / 68°f)	25 bar
Maximum operating pressure (at 50°c / 122°f)	42 bar
Operating temperature (°c / °f)	-10°C to +60°C (14°F to 140°F)
Startup mode	Electrical & Manual Actuator
Electromagnetic startup voltage/current	24VDC / 0.5A
Gas release time (seconds)	6s ≤ t ≤ 10s
Extinguishing chemical	Perfluorohexanone (FK 5-1-12)
Nominal capacity (l / gal)	52L (13.74 gal)

NOTICE

Fire cylinders must be shielded from direct sunlight.

Aerosol Fire Extinguishing System

The Aerosol Fire Extinguisher utilizes GreenSol© A1000, based on environmentally friendly SFE Powdered Aerosol technology, which is listed on the USEPA Halon Alternatives SNAP list as Powdered Aerosol A.

The A1000 is designed to extinguish Class A (solid fuel), Class B (liquid and gas fuel), and Class C (electrical) fires in enclosed spaces. It produces large quantities of powdered aerosol, designed to extinguish fires in a 10.0m³ enclosed volume.

The system is compatible with standard detection and control systems and can be installed inside or outside the protected volume.

Figure 2- 38 Appearance of the Aerosol fire extinguisher

Item	Parameter
Model	A1000
Dimensions (W*D*H)	120mm*320mm*120mm
Fire extinguishing capacity	10m³ (100g/m³)
Start-up mode	Electric start

Powdered Aerosol color	White / light grey
Discharge time	46 seconds
Temperature range	-40°C (-40°F) to 54°C (130°F)
Toxicity	None
SFE weight	1000g / 35.27oz
SFE specific gravity	1.2~1.5 g/cm³
SFE combustion velocity	1.1-1.2 mm/sec
Total weight	12.5 kg
Resistance	0.85~1.85 Ohm (±0.2)
Power supply	1.35A
Ignition	Electrical match SPEX (1a – 1w) type
Ozone Depletion Potential	None
Global Warming Potential	None

Three GreenSol© A1000 Aerosol Fire Extinguishers are mounted on the top roof of the container, as shown in the top view image below.

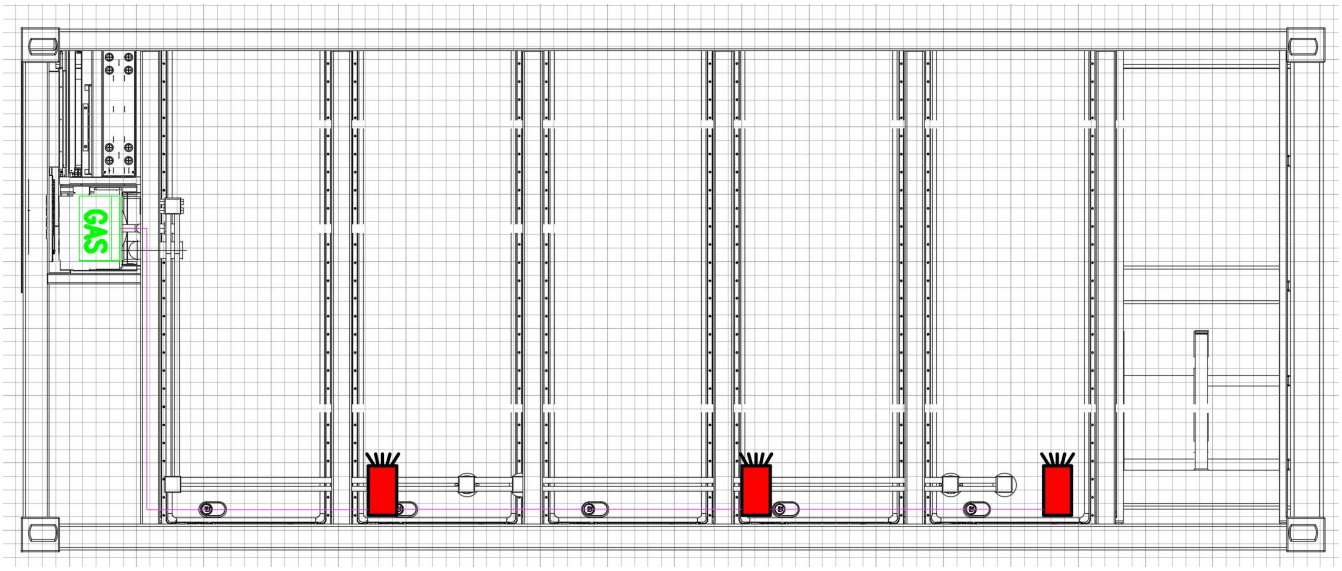


Figure 2- 39 Top view of Aerosol fire extinguishers (x3) and fire suppression pipes in the BESS container

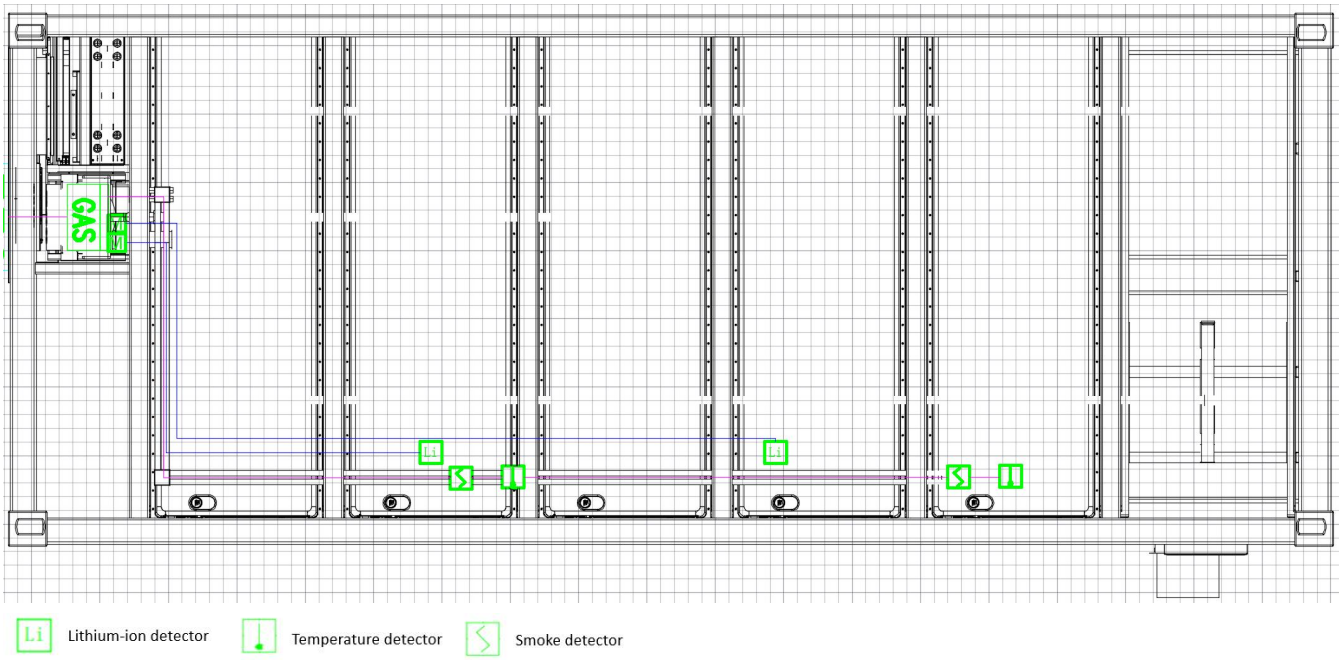


Figure 2- 40 Top view of smoke and heat detectors in the BESS container

2.5.7.1.8 Gas ventilation system

The gas ventilation system consists of an air-intake electric louver and an air-exhaust louver with an exhaust fan, all mounted on the wall of the BESS container.

Figure 2- 41 Exhaust device

Figure 2- 42 Louvers

The technical parameters of the exhaust fan and louver are as follows:

Parameters	Exhaust louver	Air-intake louver
Dimension (W*D*H)	350mm*110mm*400mm	350mm*52mm*400mm
Rated voltage	230Vac@50Hz	24Vdc
Frequency	50Hz	/
Rated power	120W	30W
Maximum air volume	820 CFM	/
Operating temperature	-4°F~131°F / -20℃~55℃, 85%RH	-4°F~131°F / -20℃~55℃, 85%RH
Storage temperature	-40°F~149°F / -40℃~65℃, 95%RH	-40°F~149°F/ -40℃~65℃, 95%RH
IP rating	IP55	IP55
Material	Galvanized Steel	Galvanized Steel
Anti-corrosion rating	C4 or C5	C4 or C5
Explosion-proof rating	Exd II CT4	Exd II CT4

2.5.7.1.9 Automatic pressure relief device

The automatic pressure relief device is a key component of the gas fire extinguishing system, typically remaining in a "CLOSED" state. When the gas fire extinguishing system is activated, excess pressure may build up in the protected area. The automatic pressure relief device will release this overpressure, protecting the area. Once the pressure decreases, the device closes again to maintain the airtightness of the protected area and ensure effective fire extinguishing.

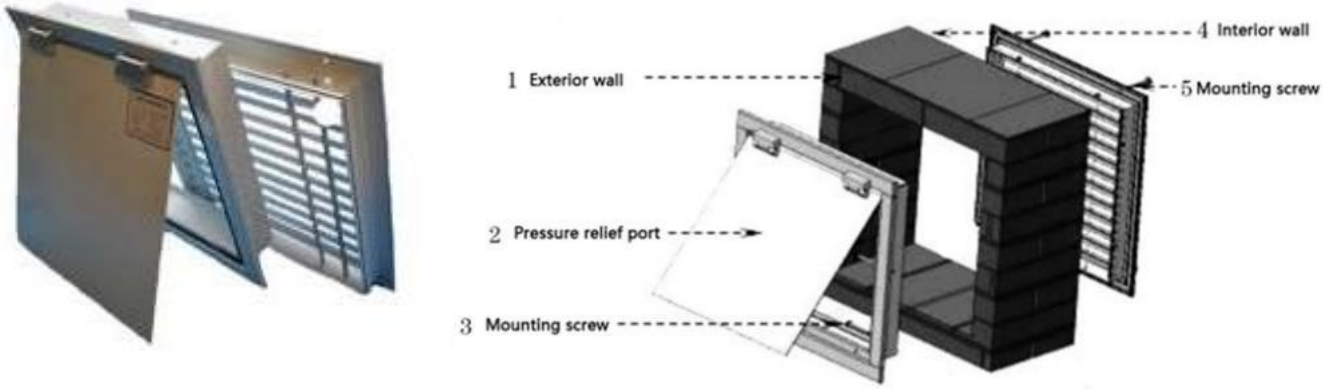


Figure 2- 43 Pressure relief device

The technical parameters of the pressure relief device are as follows:

Item	Parameter
Dimension (W*D*H)	375mm * 80mm* 375 mm
Cut-out size (W*H)	300mm*300mm
Opening Pressure	1100±50Pa
Pressure relief area	0-0.07m^2

2.6 Battery ESS working principle

2.6.1 Main circuit diagram

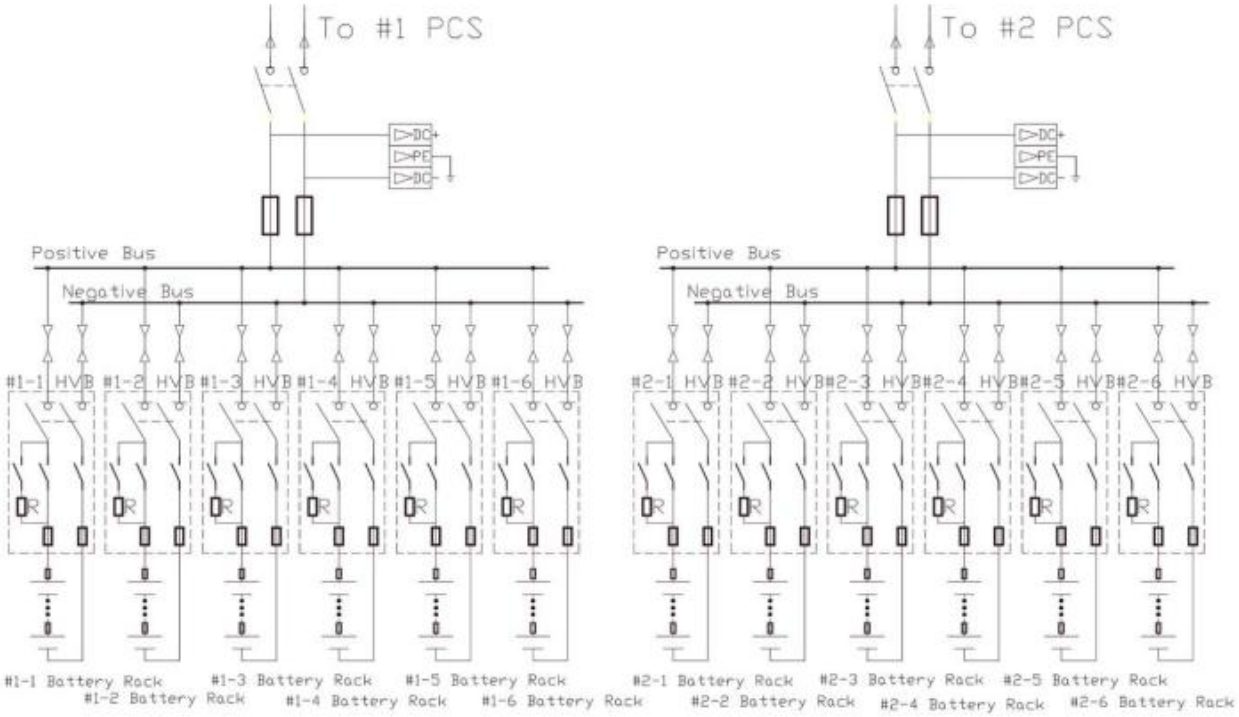


Figure 2- 44 Primary single line diagram with 2 PCS outputs

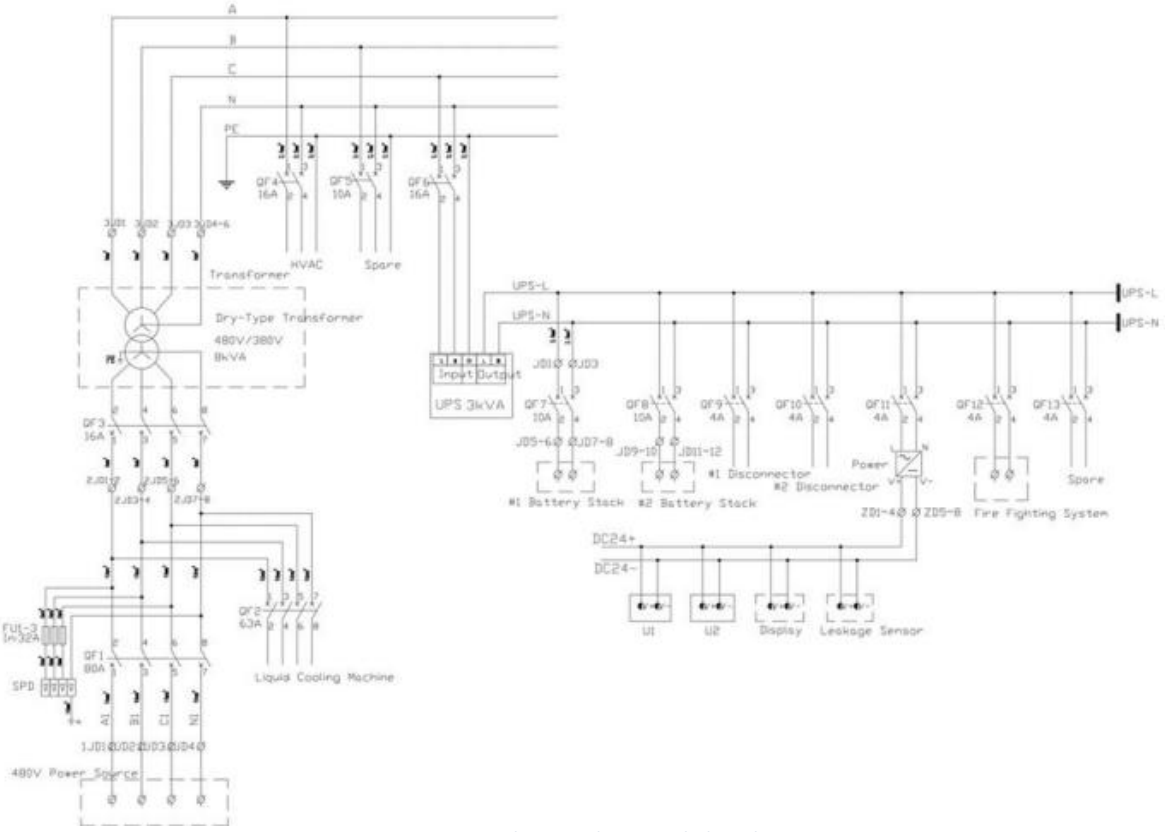


Figure 2- 45 Secondary auxiliary single line diagram

2.6.2 Working modes

The Battery ESS operates in four modes: Charging, Discharging, Idle, and Fault.

Working mode description	Reference image
In **Charging** mode, the Battery ESS charges the battery system and automatically stops when fully charged.	
In **Discharging** mode, the Battery ESS supplies power to the load and stops when the discharge cut-off voltage is reached.	

In **Idle** mode, the Battery ESS remains inactive.	
In **Fault** mode, the Battery ESS has encountered a fault, which can be reviewed on the display screen.	

2.7 Typical application scenario

From a system-wide perspective, energy storage applications can be categorized into three scenarios: power generation side energy storage, transmission and distribution side energy storage, and user side energy storage. These scenarios can be further classified into energy-based and power-based demands.

Energy-based demands typically require long discharge times, such as energy time-shifting, with no need for rapid response. In contrast, power-based demands prioritize fast response times, though the discharge duration is generally short, such as in system frequency regulation.

In practical applications, energy storage technologies must be evaluated based on the specific requirements of each scenario to determine the most suitable solution.

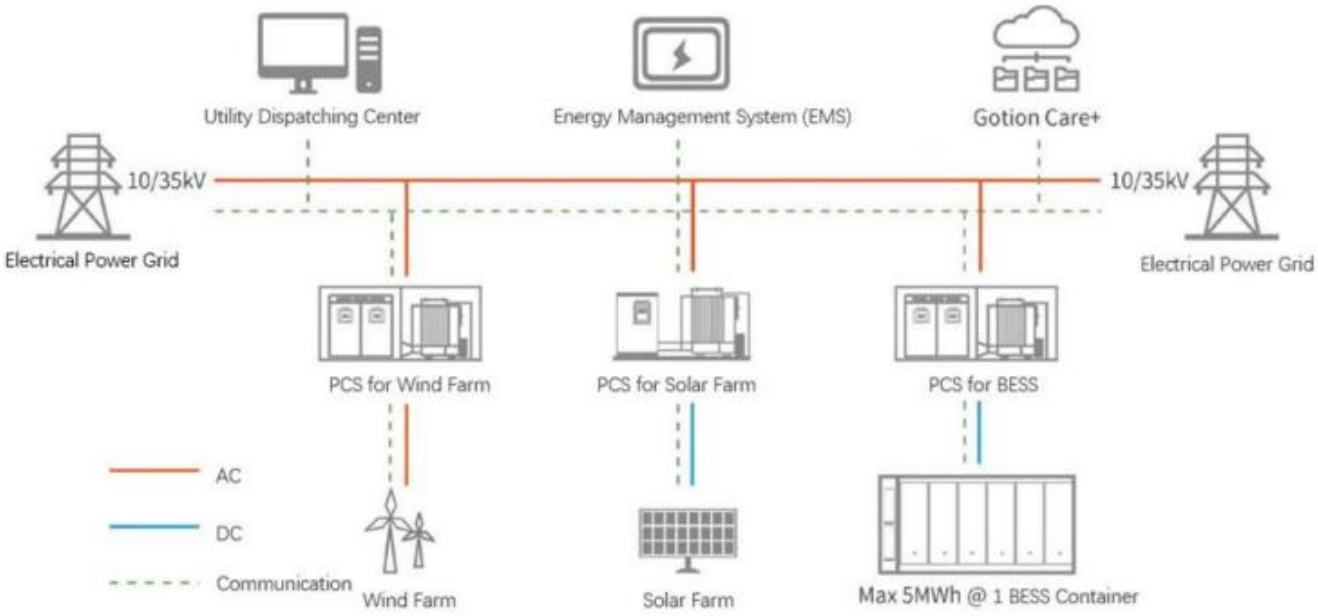


Figure 2- 46 Schematic of energy flow and communication in the system

3 Transportation requirement

DANGER

Load or unload batteries with caution. Otherwise, the batteries may be short- circuited or damaged (such as leakage and crack), catch fire, or explode.

WARNING

Do not move a battery by holding its terminals, bolts, or cables. Otherwise, the battery may be damaged.

Keep batteries in the correct direction during transportation. They must not be placed upside down or tilted, and must be protected against falling down, mechanical impact, rains, snows, and falling into water during transportation.

General Requirements for Transporting Batteries:

- **Certifications and Classification:**
  - Batteries have obtained UN38.3 and UN3536 certifications.
  - Classified as Class 9 dangerous goods.
- **Transportation Provider:**
  - Must be qualified to transport dangerous goods.
  - Open truck transportation is prohibited.
- **Delivery and Compliance:**
  - Batteries should be delivered directly to the site via road or sea, complying with international dangerous goods transport regulations.
  - Ensure compliance with regulations of departure, route, and destination countries.
- **Transportation Methods:**
  - Prefer sea or road transportation; avoid railway or air transport.
  - Adhere to the *International Maritime Dangerous Goods Code (IMDG Code)* for maritime transport.
  - Follow the Agreement Concerning the *International Carriage of Dangerous Goods by Road (ADR)* or *JT/T 617* for road transport.
  - Avoid tilting or jolting during transportation.

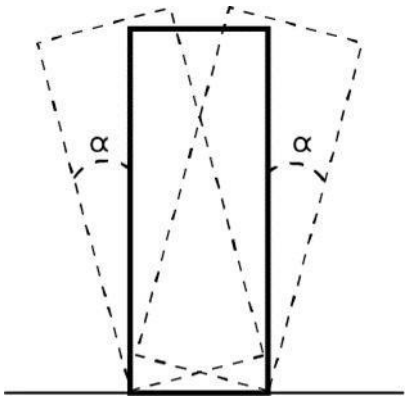


Figure 3- 1 Diagram showing proper angles for safe navigation

- **Pre-Transport Checks:**
  - Inspect battery packages for integrity, odor, leakage, smoke, or signs of burning.
  - Ensure all container doors are locked.
  - Select appropriate cranes or hoisting equipment based on site conditions.
  - Use tools with sufficient load-bearing capacity, arm length, and rotation radius.
  - Remove potential obstacles like trees and cables.
  - Transport equipment in good weather conditions.
  - Set up warning signs or belts to prevent unauthorized entry into the hoist area.
  - Secure equipment to the transport vehicle with ropes to prevent excessive tilting.

- **Packaging and Handling:**
  - Secure the packing case during transport.
  - Handle with care during loading and unloading; take moisture-proof measures.
  - Vehicles must meet load-bearing capacity requirements.
  - Road transport speed limit: 80km/h (50 mph) on flat roads, 60km/h (37 mph) on rough roads, or follow local traffic regulations.

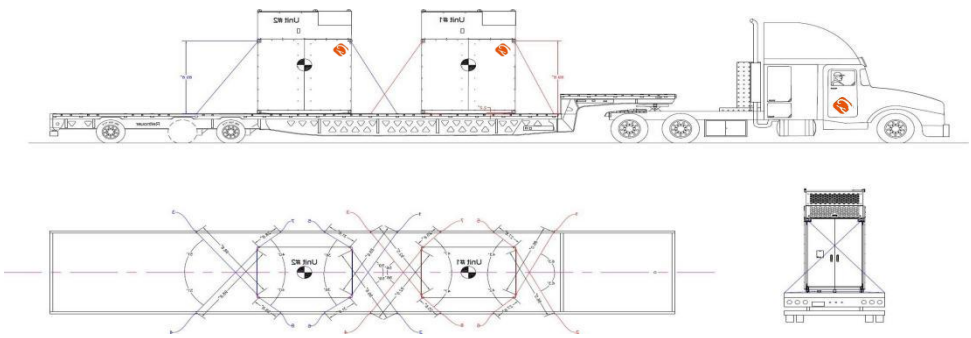


Figure 3- 2 Road transport diagram

- **Safety Precautions:**
  - Exercise caution to prevent bumps and ensure personal safety.
  - Do not mix dangerous goods with food, medicine, animal feed, or their additives.
  - Separate dangerous goods from ordinary goods using spacers or maintaining a distance of at least 0.8 meters.

- **Faulty Battery Transport:**
  - Insulate terminals, pack, and place faulty batteries in an explosion-proof box.
  - Record site name, address, time, and fault symptom on the box.
  - Avoid transporting faulty batteries near flammable materials, residential areas, or densely populated places.

- **Moving Heavy Objects:**
  - Plan manpower and work division for equal weight distribution.

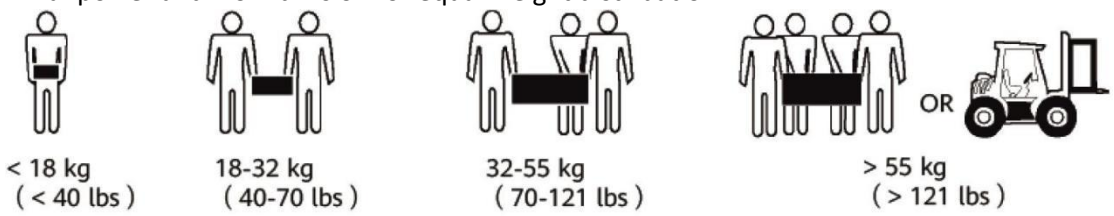


Figure 3- 3 Lifting diagram

  - Ensure synchronized lifting and landing with supervision.
  - Wear protective gear such as gloves and shoes.
  - Use legs to lift objects gently and stably; avoid using your back.
  - Hold equipment handles or lower edges; avoid module handles.
  - Lift objects to waist height, adjust grip, and lift.
  - Move heavy objects stably and slowly to prevent damage.
  - Be cautious of workbenches, slopes, stairs, and slippery places.
  - Ensure door width allows safe movement through it.
  - Move feet to change direction; avoid twisting your waist.
  - Secure equipment to forklift trucks and assign personnel for care.
  - Prevent collisions or falls during movement.

4 Storage requirement

4.1 General requirements

NOTE

- Proof that the product is stored according to the requirements must be available, such as temperature and humidity log data, storage environment photos, and inspection reports.
- Do not store battery packs for extended periods. Long-term storage of lithium batteries may cause capacity loss. Generally, the irreversible capacity loss is 3% to 5% after the lithium batteries are stored at the recommended storage temperature range for 12 months.
- The storage environment must be clean and dry. The product must be protected against rain and water.
- The air must not contain corrosive or flammable gases.
- Do not tilt the product or place it upside down.
- If equipment except battery packs has been stored for more than two years, it must be checked and tested by professionals before use.

4.2 ESS storage (excluding battery packs)

- Do not unpack an ESS if it will be stored for a long time.
- Do not stack the ESSs.
- Ensure that the ground surface is flat (for long-term or temporary storage).
- Close the Container door.
- Storage temperature: -22°F to 140°F / -30°C to 60°C (without UPS); relative humidity: 5%–95%.

4.3 Battery pack storage and single battery pack charge

4.3.1 Material delivery check

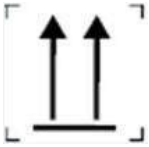
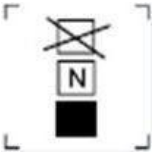
⚠ WARNING

- Ensure that batteries are stored in a dry, clean, and well-ventilated indoor environment, free from sources of strong infrared or other radiation, organic solvents, corrosive gases, and conductive metal dust. Avoid exposure to direct sunlight, rain, and keep batteries away from heat and ignition sources.
- If a battery is faulty (showing signs of scorch, leakage, bulge, or water intrusion), relocate it to a designated dangerous goods warehouse for separate storage. Ensure the battery is at least 3 meters away from any combustible materials and arrange for its disposal as soon as possible.
- Store batteries correctly according to the markings on the packing case. Avoid placing batteries upside down, laying them on one side, or tilting them. Stack batteries in accordance with the specified stacking requirements on the packing cases.
- Store batteries separately from other devices. Do not stack batteries too high. Ensure the storage site is equipped with qualified firefighting facilities, such as fire sand and fire extinguishers.
- After batteries are powered off, static power consumption and self-discharge loss may occur in internal modules, potentially leading to battery damage due to overdischarge. Avoid storing batteries in a low SoC and charge them in a timely manner. Permanent battery faults caused by delayed charging are not covered by the warranty. Scenarios leading to low SoC storage include but are not limited to:
- Disconnected power or signal cables.
- Inability to charge batteries due to a system fault after discharge.
- Incorrect system configurations preventing battery charging.
- Long-term mains power failure preventing battery charging.

⚠ CAUTION

It is recommended to use batteries promptly after deployment onsite. Batteries stored for an extended period should be periodically charged (recommended SoC for storage is 30%-50%, with charging intervals every 3 months if not in use) to prevent damage.

4.3.2 Packaging label descriptions

Label	Description
	**This way up**: The package shall be vertically oriented during transport and storage.
	**Fragile**: The package contains fragile objects and shall be handled with care.
	**Keep dry**: The package shall be kept away from rain.
	**Stacking limit by number**: The packages shall not be vertically stacked beyond the specified number. The actual label may vary.

4.3.3 Battery storage protocol

- Storage environment requirements are as follows:
  - **Ambient temperature**: -22°F to 140°F / -30°C to 60°C (Recommended: 32°F to 86°F / 0°C to 30°C. Extended storage at temperatures above 104°F / 40°C may degrade battery performance and shorten service life.)
  - **Relative humidity**: 5%–95% (Recommended: approximately 45%)
  - **Conditions**: Keep in a dry, clean, and well-ventilated area; avoid exposure to corrosive organic solvents, gases, and direct sunlight
  - **Proximity**: Maintain a distance of at least 2 meters from heat sources
- **Disconnection:** Ensure batteries in storage are disconnected from external devices. All indicators on the batteries should be off.
- **Charging Intervals:** For batteries stored in a low SoC, charge within the maximum interval corresponding to the SoC when powered off to avoid overdischarge damage.
- **Qualified Personnel:** Only trained and qualified personnel should charge batteries. Use insulated gloves and dedicated insulated tools.
- **Monitoring:** Observe the batteries during charging and promptly address any issues.
- **Handling Abnormalities:** If a battery bulges or smokes during charging, stop immediately and dispose of the battery properly.

4.3.4 Other precautions

⚠ CAUTION

- AC mains input voltage requirements for charging:
  - 230 V (three-phase 260–530 V AC or single-phase 176–300 V AC)
  - 110 V (three-phase 130–265 V AC or single-phase 90–175 V AC)
  - AC input power cables used for charging in the warehouse must have a through-current capacity greater than 63 A.
- If batteries have been stored for longer than allowed, promptly report the event to the person in charge.
- Ensure that batteries are delivered based on the "first in, first out" rule.
- Handle batteries with caution to avoid damage.

Conditions for Determining Overdue Storage of Battery Packs

- Avoid storing batteries for extended periods.
- If batteries exceed the allowed storage time, report to the responsible person promptly.
- Dispose of any deformed, damaged, or leaking batteries immediately, regardless of storage duration.

Preparing Charging Devices

- Multimeter
- Clamp meter
- Insulated torque socket wrench
- Charger

Inspection Before Charging

1. Visual Check: Inspect the battery's appearance before charging. Only charge batteries that are free from defects.
2. Qualification Criteria: Ensure the battery has no:
   - Deformation
   - Shell damage
   - Leakage
3. Accessory Check: Verify that all accessories are complete based on the packing list provided with the charger.

Full Charge Strategy

- Ambient Temperature: Charge within 59°F to 104°F / 15°C to 40°C (Recommended: 77°F±3.6°F / 25°C ± 2°C).

Charge and discharge current	Charging duration (excluding equalization)
12.5 amps	24 hours* (fully discharge the battery and then charge the battery to 50% SoC)
25 amps	12 hours* (fully discharge the battery and then charge the battery to 50% SoC)

*The suggested times may vary based on actual needs. The maximum charge/discharge current should not exceed 150 amperes.

5 Installation

5.1 Site requirements

5.1.1 Site selection

NOTICE

Refer to the NFPA855, Standard for the Installation of Stationary Energy Storage Systems, and applicable local laws and regulations.

5.1.1.1 General requirements

Site Requirements:

- The installation site must be at least 300mm above the highest historical water level of the area and should not be located in low-lying land.
- The distance between the ESS and residential buildings must be at least 12m, and the distance from densely populated buildings (schools, hospitals) must be greater than 30.5m. If these distances cannot be met, fire walls must be installed between the ESS and the buildings.
- The ESS and site must be in environments free from explosion risks.
- The site must have convenient transportation access and reliable fire suppression facilities.

Fire Safety:

- Ensure at least two gas fire extinguishers are near each unit during installation, commissioning, and operation.
- Reserve sockets for the water fire suppression system at the ESS site.
- The site must be spacious enough to accommodate capacity expansion.
- The ESS should be installed more than 30m away from third-party wireless communication facilities.
- Select a dry and well-ventilated location for the site.

Prohibited Site Conditions:

- Avoid areas with strong vibration, loud noises, and strong electromagnetic interference.
- Avoid areas with dust, oil fumes, harmful gases, and corrosive gases.
- Avoid areas with corrosive, flammable, and explosive materials.
- Avoid areas with existing underground facilities.
- Avoid areas with adverse geological conditions such as rubbery soil, soft soil layers, waterlogging, and land subsidence.
- Do not place under reservoirs, water landscapes, or water rooms.

Notes for Waterlogging Areas:

- If prone to waterlogging, install water-blocking and drainage facilities or raise the ground.
- Do not use cable trenches for drainage.
- Implement fire retardant sealing at cable holes.

Seismic and Hazard-Prone Areas:

- Avoid areas prone to earthquakes (seismic fortification intensity > 9), debris flow, landslides, quicksand, karst caves, mining land subsidence, blasting hazards, flood due to dam or levee failure, important water supply sources, historic relics, populated areas, high-rise buildings, and underground buildings.
- Avoid intersections and busy roads of urban main roads.

Flood and Waterlogging Prevention:

- Large-scale systems (power ≥ 100 MW): Site elevation must be higher than the flood level with a 1% probability or the highest historical waterlogging level.
- Medium- or small-scale systems (power < 100 MW): Site elevation must be higher than the flood level with a 2% probability or the highest historical waterlogging level.
- If elevation requirements cannot be met, change the site location or implement appropriate flood prevention measures.
- For sites prone to wind and waves from rivers, lakes, and seas, consider the wind and wave height with a 2% probability plus an additional 0.5m safety height.
- Build side ditches or drainage ditches to manage catchment water.

Foundation Construction:

- Investigate site conditions (location, environment, climate) in detail before constructing the foundation for the Battery ESS.
- Ensure maintenance access to the battery pack and other equipment by hardening the side road of the container with cement or asphalt.

5.1.1.2 Outdoor site requirements

General Requirements for Selecting an Outdoor ESS Site:

- **Vegetation:** Ensure no vegetation, especially flammable plants, within 3m of the ESS to prevent potential fires. Exceptions include single specimens of trees, shrubbery, or cultivated ground cover (such as grass, ivy, succulents) that do not readily transmit fire.
- **Obstacles:** No obstacles should be above the ESS. The ESS must not be installed under structures like parking sheds, and PV modules must not be installed on top of the ESS.
- **Safety Distances:** The distance between the ESS and production buildings must comply with local fire protection regulations:
  - The ESS must be at least 10 ft (3.048 m) away from lot lines, public ways, buildings, combustible materials, hazardous materials, high-piled stock, parking spaces, and other exposure hazards.
  - If either of the following conditions is met, the distance can be reduced to 3 ft (0.914 m):
    - Presence of 1-hour freestanding firewalls extending 5 ft (1.5m) above and beyond the ESS installation boundary.
    - Non-combustible exterior walls with no openings or combustible overhangs, with a 2-hour fire resistance rating as per ASTM E119 or UL 263.
- **Exhaust Device:** The distance between the exhaust device of the ESS and any heating and ventilation vents, air intake vents of air conditioners, windows, doors, unloading platforms, and fire sources of other buildings or facilities must be greater than 15 ft (4.6m).
- **Airflow Considerations:** Ensure the air inlet and outlet of the battery container are correctly oriented and do not affect the heat dissipation of other equipment.

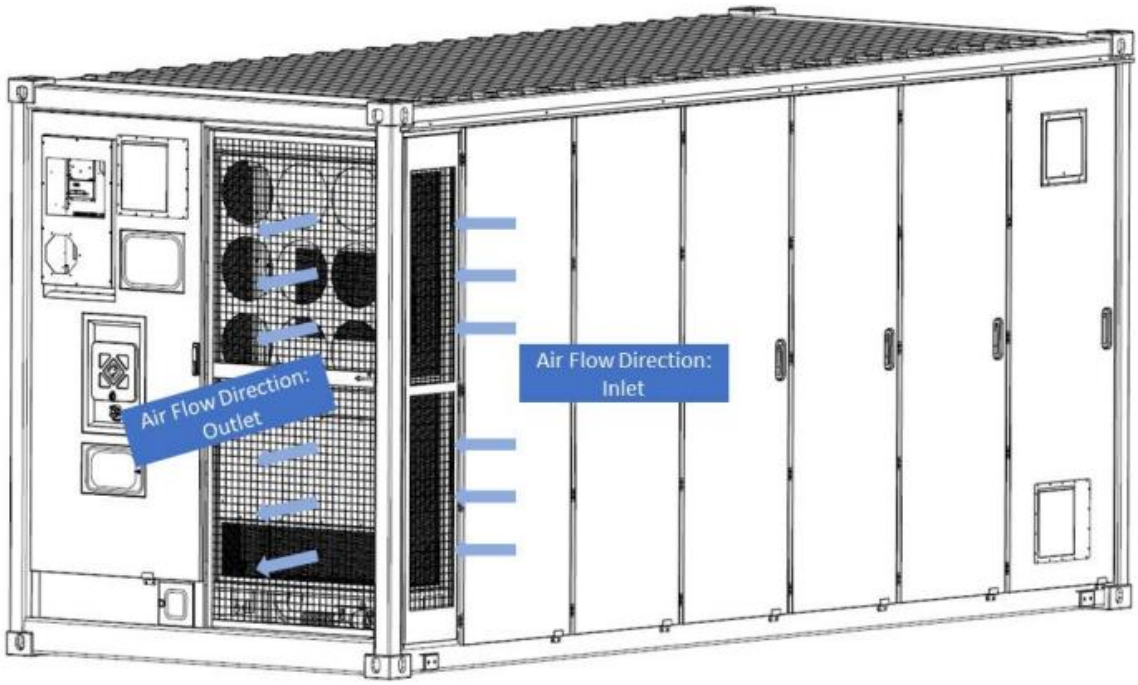


Figure 5- 1 The direction of airflow is indicated by the arrows

Environmental conditions:

- Corrosion Prevention: The ESS must not be installed in salt-affected or polluted areas. Suitable environments include:
  - Outdoor locations more than 1.2 mile (2000m) from the coast. Avoid areas 0.3 mile (500m) to 1.2 mile (2000m) from the coast unless confirmed with the vendor or company's engineers. Outdoor deployment is not allowed within 0.3 mile (500m) of the coast; indoor installation as per *section 5.1.1.3* is required.
  - Locations more than 1 - 2 mile (1500–3000m) from heavy pollution sources (e.g., smelteries, coal mines, thermal power plants).
  - Locations more than 0.6 - 1.2 mile (1000–2000m) from medium pollution sources (e.g., chemical, rubber, electroplating industries).
  - Locations more than 0.3 - 0.6 mile (500–1000m) from light pollution sources (e.g., packing houses, tanneries, boiler rooms, slaughterhouses, landfill sites, sewage treatment plants).

5.1.1.3 Indoor building requirements

The fire safety of ESS dedicated-use buildings or structures must comply with local laws and regulations, referencing standards such as NFPA 855. The following requirements must be met:

General Building Requirements:

- **Dedicated-Use Building/Structure:**
  - Must have a 2-hour fire resistance rating for walls and store a maximum of 600 kWh lithium batteries per fire protection unit.
  - Solely for the operation of ESS equipment.
  - Occupants limited to professional personnel for operating, maintaining, servicing, testing, and repairing the ESS and other energy systems.
  - No other occupancy types permitted.
- **Safety Distances:**
  - Must be at least 3 m from lot lines, stored combustible materials, hazardous materials, high-piled stock, electrical infrastructure, public ways, buildings, and parking spaces.
- **Internal Layout:**
  - Comply with local fire protection laws and standards, considering safe distances and layout of buildings and materials.
- **Combustible Materials:**
  - Not stored in the ESS building. Must be at least 3 m away from the building.
- **Fire Extinguishers:**
  - Equipped with halogenated agents, FM-200, FK-5-1-12, carbon dioxide, or dry powder. At least two extinguishers per fire protection unit, checked and replaced periodically.
- **Smoke Detectors:**
  - Room-level smoke detectors, at least two of each type, with an enabled automatic fire alarm system.
- **Ventilation Devices:**
  - Independent ventilation devices interacting with the fire alarm system, limiting flammable gas concentration below 25% of the lower flammability limit (LFL). Ventilation rate: ≥ 1 $ft^3/min/ft^2$ (5.1 $L/sec/m^2$).
- **Flammable Gas Detection:**
  - Rooms protected by a continuous gas detection system that activates the mechanical exhaust ventilation system at 25% LFL and remains on until the gas level is below 25% LFL. Minimum 2 hours of standby power.
  - System failure should trigger a trouble signal at the monitoring center.
- **Fire Suppression Facilities:**
  - Equipped with water spray or sprinkler systems, with water supply for over 2 hours at designed flow rate and continuous supply for 12 hours post-fire. Sprinkler design density: 0.3 gpm/ft^2 (12.2 mm/min) over the room area or 2500 ft^2 (230 m^2), whichever is smaller.

- **Pressure Relief:**
  - Equipped with pressure relief explosion-proof devices or equivalent channels. Protective fences or walls must be installed if side pressure relief is used, maintaining at least 3 m distance from the relief wall.
- **Ambient Temperature:**
  - Inside the building should be below 55°C during ESS operation.
- **Ceiling Height:**
  - At least 4.5 m, with 2 m clearance above the ESS for pressure relief. No flammable materials above the ESS.
- **Maintenance Clearances:**
  - Doors must accommodate forklift installation. The indoor area should meet clearance requirements for ESS maintenance and forklift operations.
- **Exits and Aisles:**
  - Safety exits and aisles as per local building codes, with emergency lighting for all exit doors and aisles, and all exit doors opening toward the exit direction.

Exemption Conditions:

- **Fire Department Approval:**
  - Installation requirements must align with local fire department approvals. Water sprinkler systems, smoke detection, flammable gas detection, and explosion-proof requirements can be exempted if approval is obtained, but mechanical exhaust ventilation, pressure relief clearance, heat dissipation, and maintenance clearances must still be met.
- **Distance-Based Exemptions:**
  - Fire control and suppression systems, size and separation requirements, and water supply can be omitted for ESS buildings located more than 100 ft (30.5 m) from buildings, lot lines, public ways, stored combustible materials, hazardous materials, high-piled stock, and other exposure hazards.

Offshore Indoor Applications:

- **Proximity to Coast:**
  - If within 500 m of the coast, the ESS must be in a dedicated indoor environment with controllable temperature and humidity. Indoor environment must meet C4 or higher levels as specified in ISO 12944/ISO 9223. Site selection requirements for indoor applications must be met.
- **Anti-Salt Fog Measures:**
  - Outdoor air conditioners and ventilation devices must have anti-salt fog measures. Anti-salt fog filters must be installed at air intake and exhaust vents, or anti-salt fog devices used, maintained, and replaced periodically.

5.2 Unpacking and acceptance procedures

- Securing and Moving Equipment:
  - Before moving, secure the equipment to a pallet truck or forklift with ropes to prevent it from tipping over. Handle the equipment carefully to avoid any bumps or falls that could cause damage.

- Pre-Unpacking Check:
  - Inspect the packaging to ensure it is intact before unpacking the batteries. Do not use batteries with damaged packaging. If any damage is detected, immediately inform the carrier and the manufacturer.

- Unpacking Process:
  - Once the equipment is in the installation position, unpack it carefully to avoid scratches. Ensure the equipment remains stable during the unpacking process.
  - If the installation environment is not ideal, take precautions against dust and condensation (e.g., using a dust cover, plastic film, or fabric cloth) after unpacking the batteries to prevent potential corrosion.

- Post-Unpacking Inspection:
  - Verify that all deliverables are present and match the packing list.
  - Confirm that the received container matches the ordered model.
  - Inspect the BESS and internal components for any signs of damage.
  - Check that all fastening and removable components are secure. If any components are loose, promptly notify the carrier and manufacturer.

5.3 Installation preparations

⚠ WARNING

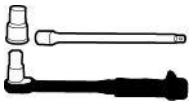
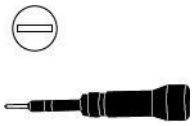
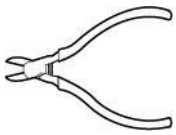
- Ensure the power circuit breaker is turned OFF before beginning battery installation.
- During battery installation, avoid placing tools, metal parts, or other items on the batteries.
- After completing the installation, clean the batteries and the surrounding area to remove any objects.
- When moving batteries, do not remove protective components, such as protective covers or waterproof caps, from the battery terminals.
- Avoid standing or working under the forklift tines.
- Operate the battery pack installation kit only after the forklift has come to a complete stop.

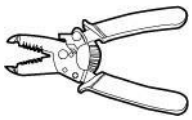
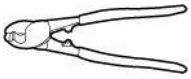
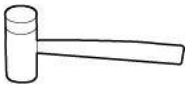
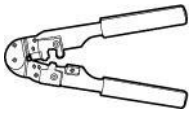
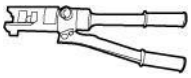
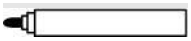
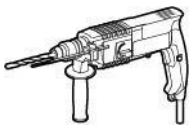
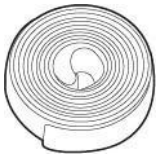
5.3.1 Preparing tools

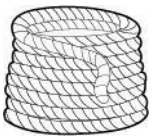
NOTE

- The tool images are for reference only.
- The tool tables may not include all the tools needed onsite. Installation personnel and the customer should prepare additional tools based on the specific site requirements.

Here are the installation tools you might need:

 Phillips insulated torque screwdriver	 Insulated torque socket wrench (including an extension bar) • Socket specifications: 7–19 mm • Socket depth ≥ 32 mm • The socket connector matches the torque wrench. • Torque range: 1.2–45 N·m	 Flat head insulated torque screwdriver	 Diagonal pliers

 Wire stripper	 Cable cutter	 Rubber mallet	 Utility knife
 RJ45 crimping tool	 Hydraulic pliers	 Multimeter (DC voltage measurement range ≥ 1500 V DC)	 Marker
 Steel measuring tape	 Level	 Vacuum cleaner	 Hammer drill
 Hammer drill bit Φ16 mm	 Heat shrink tubing	 Heat gun	 Cable tie

 Insulated ladder	 Crane	 Lifting rope Rope length ≥ 1845mm x 4	 Electric forklift
 Pallet truck	-	-	-

5.3.2 Personal Protective Equipment (PPE)

Here is the PPE you might need:

 Insulated gloves	 Protective gloves	 Goggles	 Dust mask
 Insulated shoes	 Reflective vest	 Safety helmet	 Safety harness

5.4 Installing the ESS

5.4.1 Installation environment check

Before starting the installation, carefully verify that all site requirements are met. Installation should only proceed once these conditions are satisfied. The company is not responsible for any issues arising from installations conducted in non-compliant environments.

NOTE

- Establish a safe zone by using red caution belts to clearly define the area.
- Remove any obstacles within the safe zone.
- Place construction and warning signs in prominent, visible locations.

5.4.2 Determining the installation position of the ESS

Prerequisites:

- Ensure that all site requirements are fulfilled.
- Verify and adjust the height of the concrete platforms, making sure the height difference between the upper surfaces of all platforms does not exceed 5mm.

NOTE

- Confirm that the concrete platforms adhere to the necessary specifications.
- Determine the installation position and orientation of the ESS based on the specific site conditions.

Procedure:

1. Identify the reference points for installing the ESS on the concrete platforms and mark them with a marker.
2. Based on the reference points, use an ink fountain and a long, flexible measuring tape to mark the mounting positions for the four corner fittings of the ESS.

NOTE

When marking the positions for the corner fittings, ensure that the four lines form a rectangle.

5.4.3 Foundation requirements

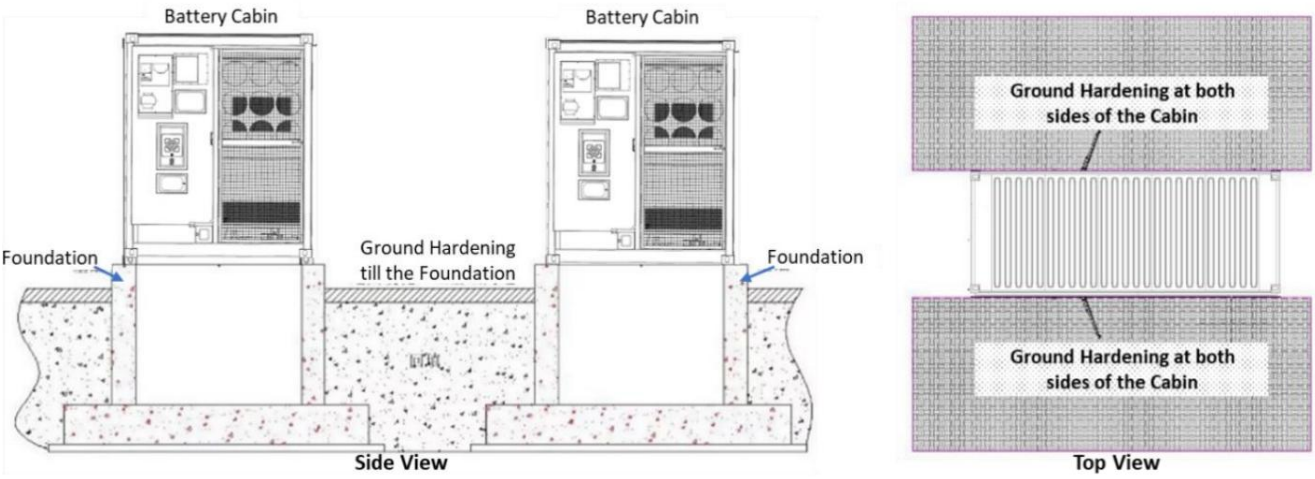


Figure 5- 2 Foundation diagram

Foundation Design Requirements:

- **Installation Surface:** The ESS must be installed on concrete or another non-combustible surface that is horizontal, secure, and flat, with sufficient load-bearing capacity. Subsidence or slopes are not permitted.
- **Load-Bearing Capacity:** The foundation must support the total weight of the equipment. If the foundation's load-bearing capacity does not meet the required standards, a review is necessary.
- **Foundation Preparation:** The bottom of the excavated foundation must be compacted and level.
- **Water Prevention:** After excavation, ensure that water does not enter the foundation. If water does enter, the affected areas must be excavated and refilled.
- **Level Tolerance:** The tolerance between the foundation and the Container's contact surface must be less than or equal to 3 mm.
- **Elevation:** The foundation must be above the highest recorded local water level and at least 300 mm above ground level.
- **Drainage Facilities:** Construct drainage systems according to local geological conditions and municipal requirements to prevent water accumulation at the equipment foundation. The foundation must be capable of handling the maximum historical rainfall. All drained water must be disposed of in compliance with local laws and regulations.
- **Cable Inlets and Trenches:** Reserve trenches or cable inlets for the ESS during foundation construction. Ensure that reserved holes on the foundation and cable inlets at the bottom of the equipment are sealed.
- **Foundation Diagram:** The provided foundation diagram is for reference only and should not be used as the final construction drawing. The design specifications of the ESS foundation must be reviewed and adjusted according to the installation environment, geological characteristics, and seismic requirements of the project site.

5.4.4 Hoisting operation

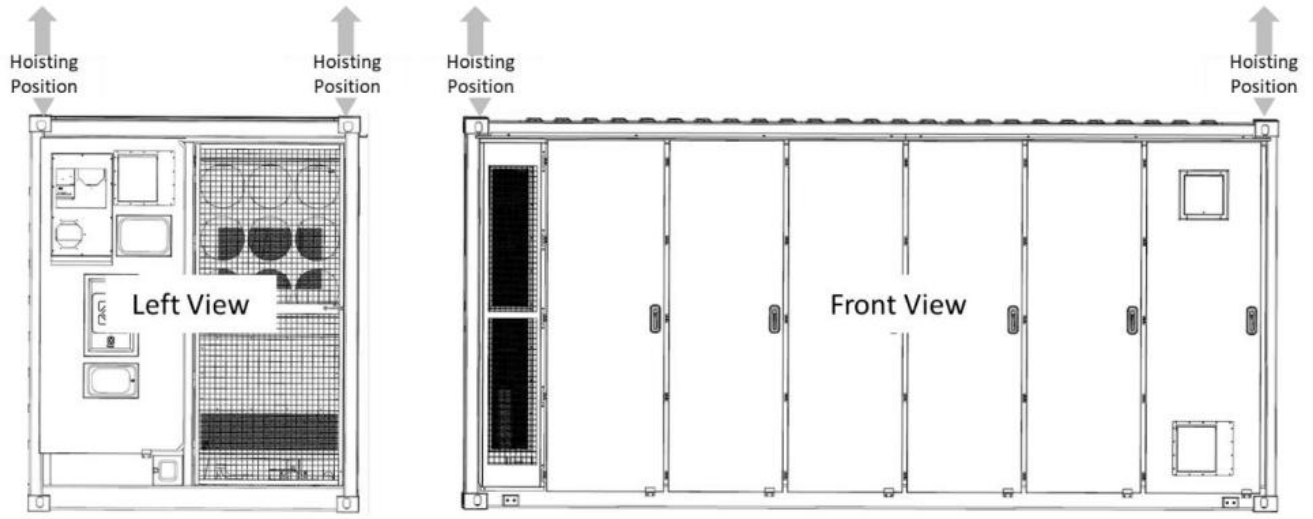


Figure 5- 3 Hoisting diagram (left and front view)

Hoisting Prerequisites:

- **Pre-Installation Inspection:** Before installing the equipment, thoroughly inspect the ESS for any signs of damage, such as holes or cracks, and verify that the equipment model is correct. If any abnormalities are found or the model is incorrect, contact the dealer immediately.
- **Hoisting Equipment Verification:** Ensure that the crane and hoisting ropes meet the required load-bearing specifications. Use steel hoisting ropes as needed, and select an appropriate crane based on the crane company's standards, with onsite assessment by professionals.
- **ESS Preparation:** Confirm that all doors of the ESS are securely closed before hoisting. It is advisable to conduct hoisting operations outdoors during clear, wind-free weather conditions.
- **Handling During Installation:** When installing or removing the hoisting equipment, avoid dragging it on the ESS to prevent scratches.
- **Safety Precaution:** Do not attempt to hoist or move the ESS after the battery packs have been installed.

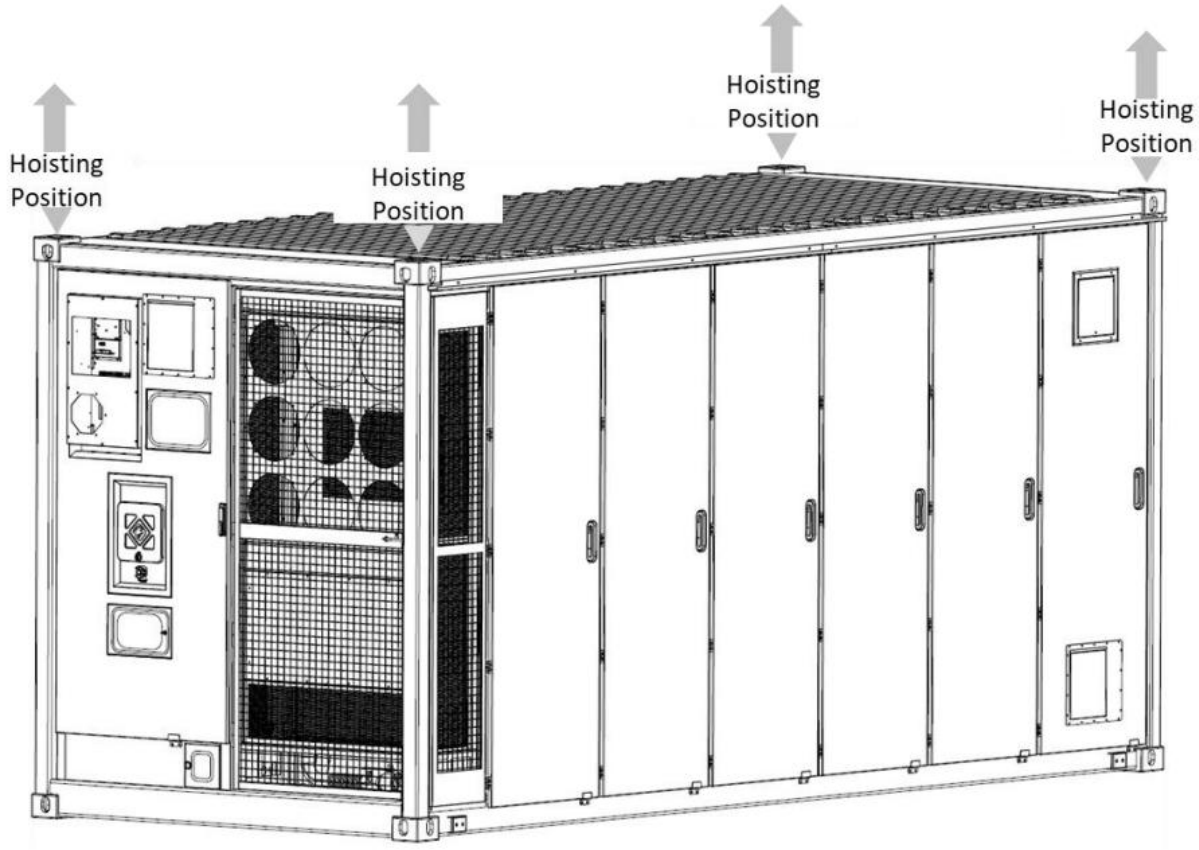


Figure 5- 4 Hoisting diagram (stereo view)

Detailed operation instructions can be found below:

Stage	Precautions
Before hoisting	Crane hoisting capacity ≥ 40 t, working radius ≥ 10 m (These are suggested information for reference only). If the onsite environment does not meet the required working conditions, ask a professional to assess the conditions.
	Only trained and qualified personnel are allowed to perform hoisting operations.
	Check that hoisting tools are complete and in good condition.
	Ensure that the hoisting tools are secured to a load-bearing object or wall.
	When the equipment is used outdoors, it is recommended that you hoist the equipment when the weather is good and there is no wind.
	Ensure that the crane and steel ropes meet the requirements before the hoisting.
	All doors of the equipment are closed and locked.

	Ensure that the steel hoisting ropes are securely connected.
	It is recommended that the equipment be hoisted from left to right or from right to left.

Stage	Precautions
During hoisting	Do not allow any unauthorized person to enter the hoisting areas and do not stand under the crane arm.
	Ensure that the crane is properly located and avoid long- distance hoisting.
	Keep the Cabinet stable and horizontal during hoisting, and ensure that the diagonal gradient of the Cabinet is less than or equal to 5 degrees.
	Ensure that the angle between two ropes is less than or equal to 90 degrees.
	Hoist and land the Cabinet slowly to prevent shock to equipment inside it.
	Remove the ropes after ensuring that the Cabinet is placed evenly on the Cabinet base.
	Do not drag steel ropes or hoisting appliances. Do not collide with the equipment.
	Secure the Cabinet you have hoisted before hoisting another Cabinet.

5.4.5 Forklift operation

NOTE

Do not move the ESS once the battery packs are installed.

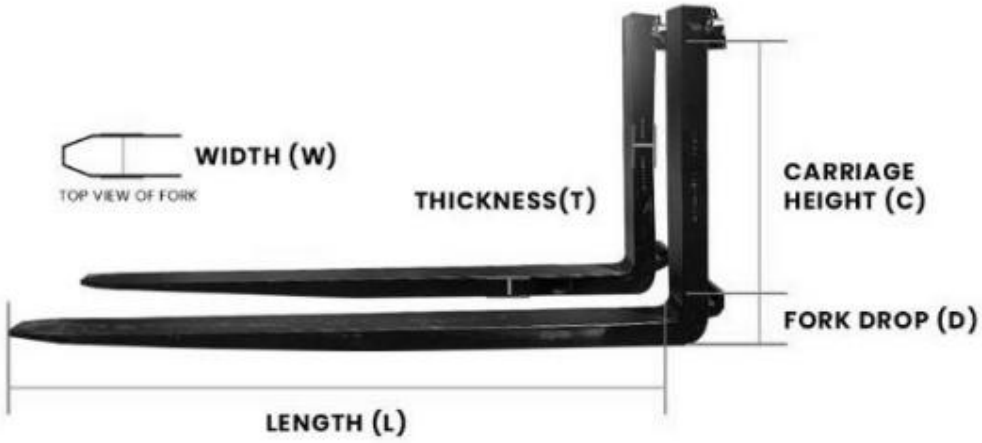


Figure 5- 5 Forklift tynes specifications diagram

- **Avoid Moving After Installation:** Do not move the ESS once the battery packs are installed.
- **Forklift Requirements:**
  - Ensure the forklift has a load-bearing capacity of at least 2 tons.
  - It is recommended that the tynes are at least 1.2 meters in length, with a width between 80 mm and 160 mm, and a thickness between 25 mm and 70 mm.
- **Lifting Height Guidelines:**
  - For foundations 0.3 meters or lower, the forklift lifting height should be at least 2 meters.
  - If the foundation is higher than 0.3 meters, the lifting height should be adjusted accordingly.

5.4.6 Clearance requirement

NOTICE

The figure below illustrates the minimum clearance requirements for installation and O&M. Additionally, the equipment clearances must comply with the site selection criteria outlined in Section 5.1.1 (Site Selection Requirements).

To ensure adequate space for maintenance and vehicle access, the following clearance guidelines should be observed:

- **Minimum:** 5 ft (1524mm) clearance on the short side (confluence cabinet side) and 10 ft (3048mm) on the long side.
- **Recommended:** A 13.1 ft (4000mm) clearance around the 4-container matrix is strongly recommended for optimal maintenance and access.

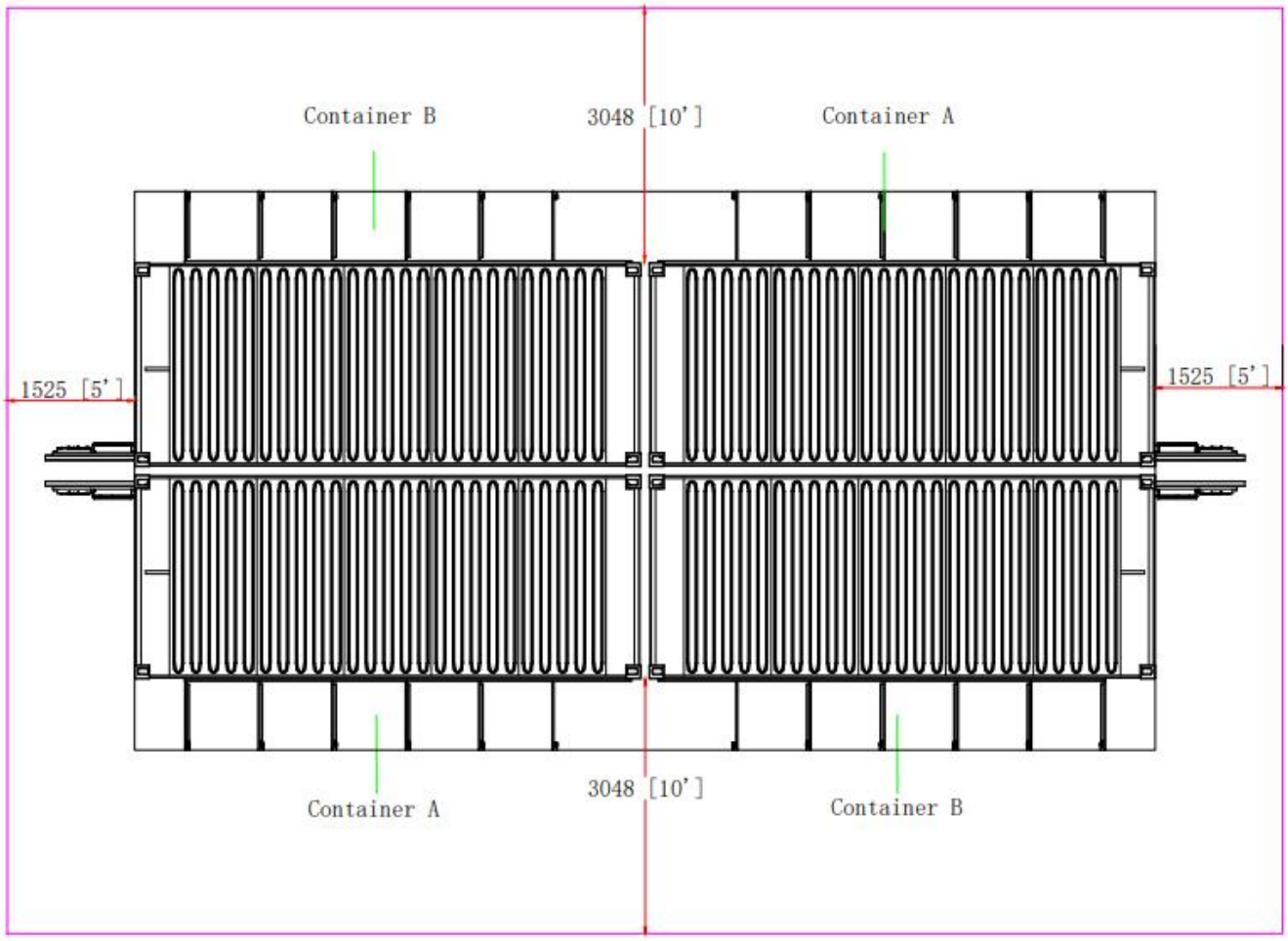


Figure 5- 6 Minimum quad configuration clearance (top view)

Notes: All units in mm unless otherwise specified

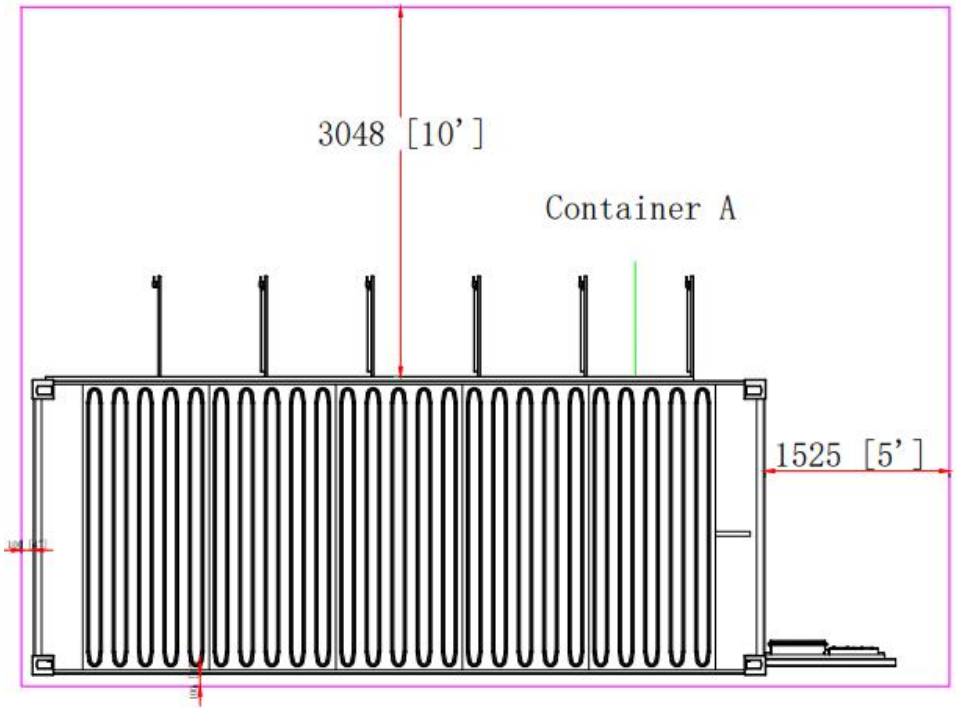


Figure 5- 7 Minimum single configuration clearance (top view)

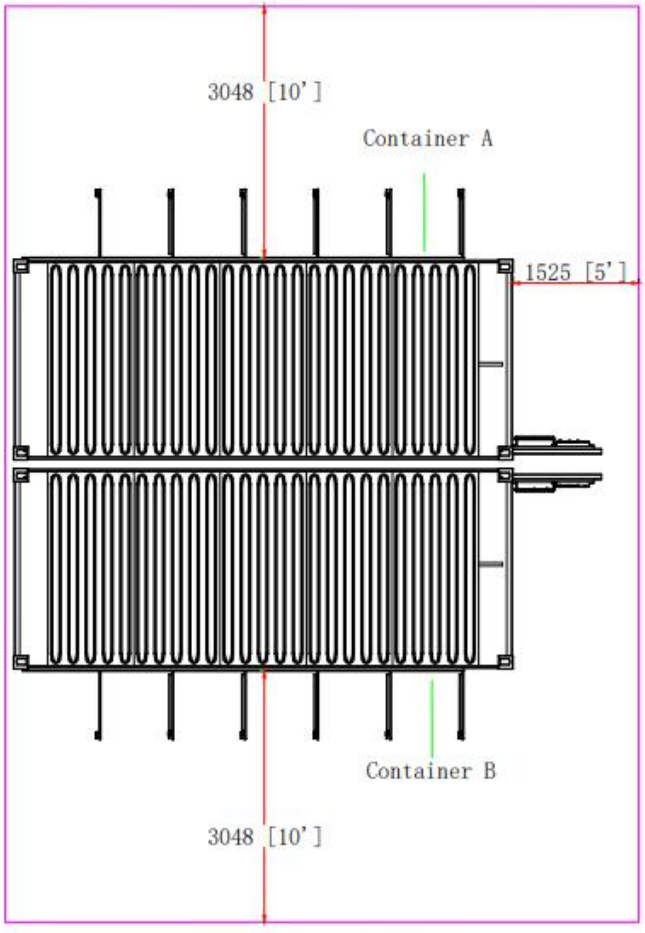


Figure 5- 8 Minimum dual configuration clearance (top view)

5.5 Connecting a ground cable for the ESS

5.5.1 Bottom fixation of the ESS

The bottom of the Battery ESS Container is secured to the foundation through welding. After the welding is complete, the welded areas are treated with anti-corrosion measures to ensure durability.

The foundation and mounting diagrams below are for your reference.

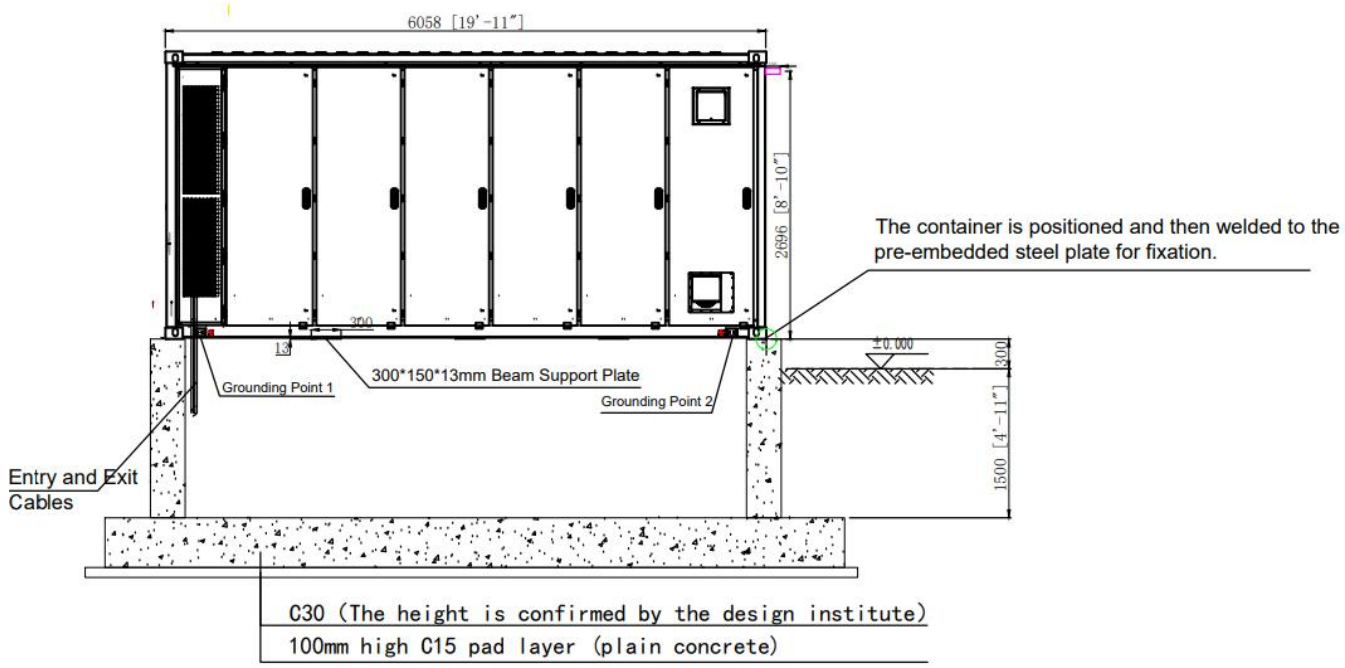


Figure 5- 9 Foundation&mounting front view

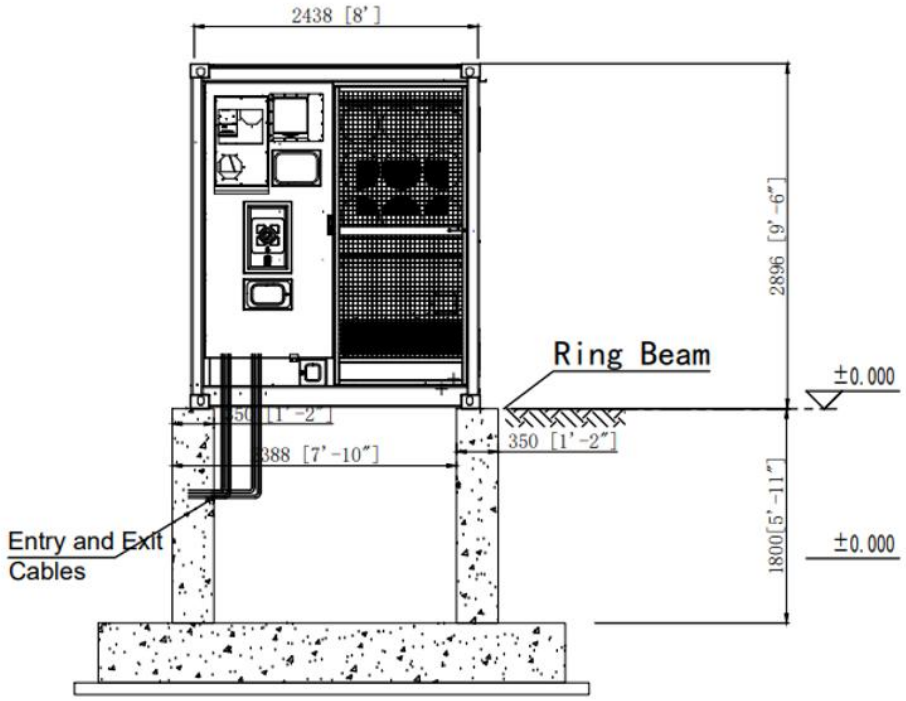
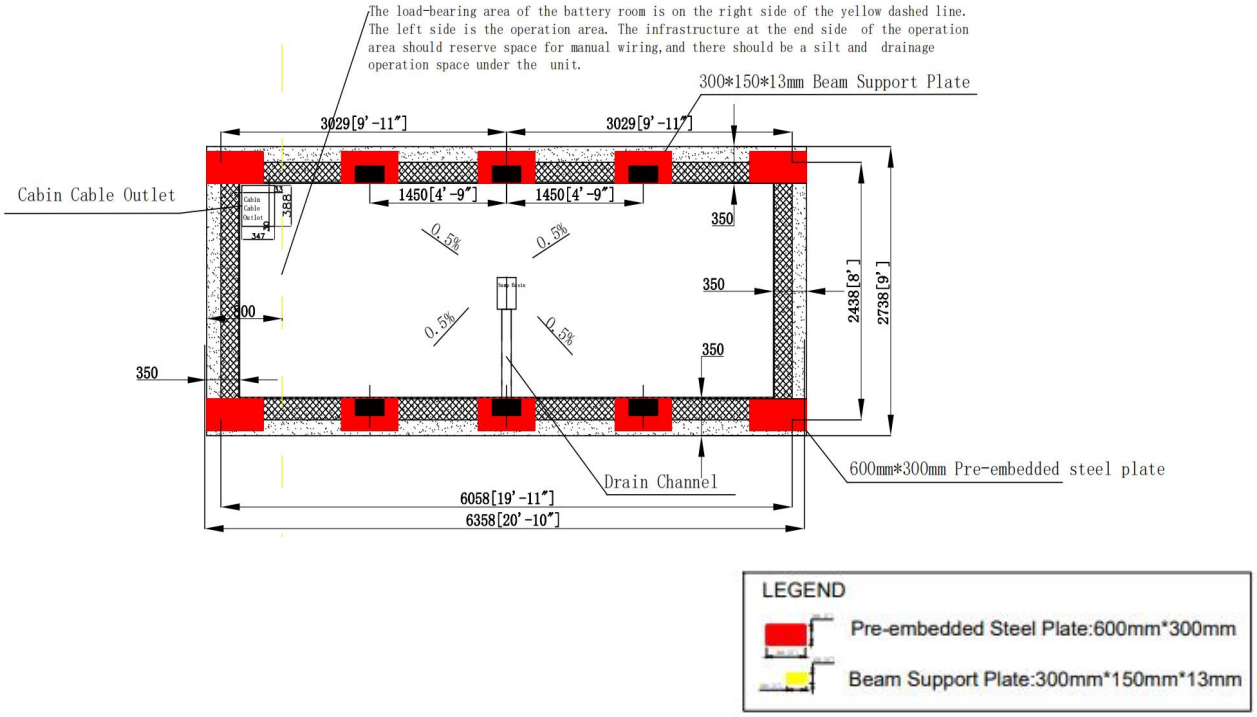


Figure 5- 10 Foundation&mounting left view



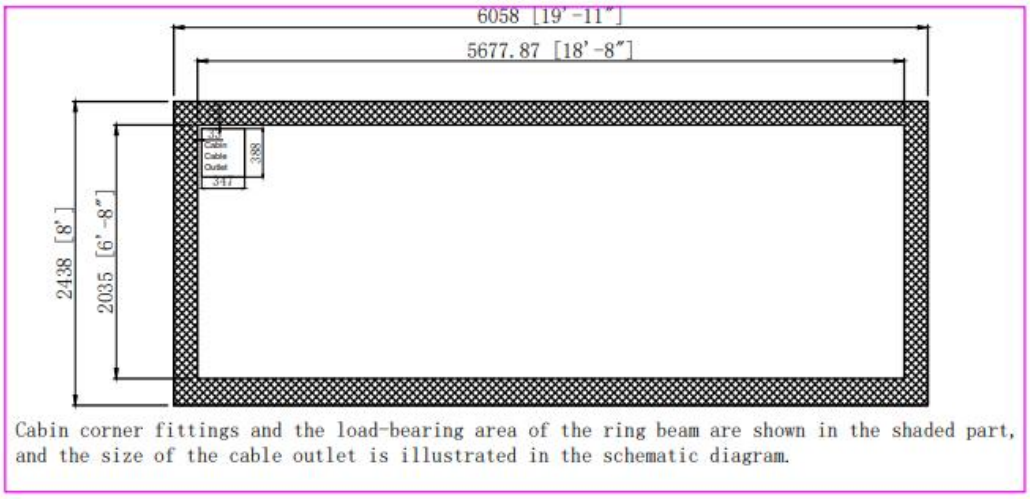


Figure 5- 11 Foundation&mounting bottom view

NOTICE

1. The megawatt-level BESS container is installed on a concrete foundation.
2. The foundation is elevated approximately 300mm above the ground, with its thickness determined by the civil engineer.
3. The upper surface of the container foundation must be level, with a height deviation of no more than 5mm.
4. Steel plates are pre-embedded at the four corners of the concrete foundation, ensuring they are secure and reliable.
5. After positioning the container on the foundation piers, the container base is welded to the embedded steel plates and treated with anti-rust protection.

6. The middle section of the container should be supported by steel plates, with at least three support points evenly distributed on each side to prevent deformation from localized sinking.
7. Grounding flat steel should be reserved in the foundation, and the container's grounding system must be securely installed with at least two connection points.
8. Both ends of all embedded pipes should be temporarily sealed to prevent debris from entering and to facilitate later cable installation.
9. The foundation diagram provided is a proposed design; the final design should be confirmed by a professional design institute.
10. The total weight of the battery system container is approximately 43 tons.

5.5.2 Grounding the ESS

Grounding Instructions:

- The Battery ESS Container is equipped with four reserved grounding copper bars, which are connected to the grounding points welded onto the channel beam (or U-bar) of the container using M10 bolts.
- The customer is required to connect at least two grounding points. It is recommended to use hand arc welding if feasible.

The schematic diagram below shows the on-site grounding of the Battery ESS Container:

Figure 5- 12 On-site grounding of the ESS container

5.6 Installation of the rain eaves

The rain eaves are shipped together with the container.

Step 1:
Unpack the package and remove the rain eaves. Each system cabin comes with 2 sets of rain eaves, and each set consists of symmetrical parts.

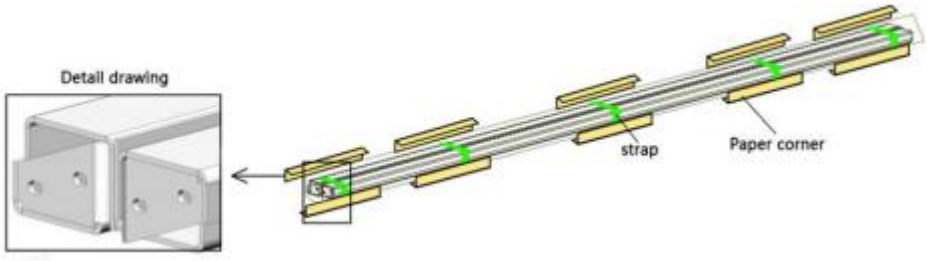


Figure 5- 13 Rain eave parts

Step 2:
Connect the left and right symmetrical parts to form a complete eave using M5×16 combination bolts and M5 nuts.

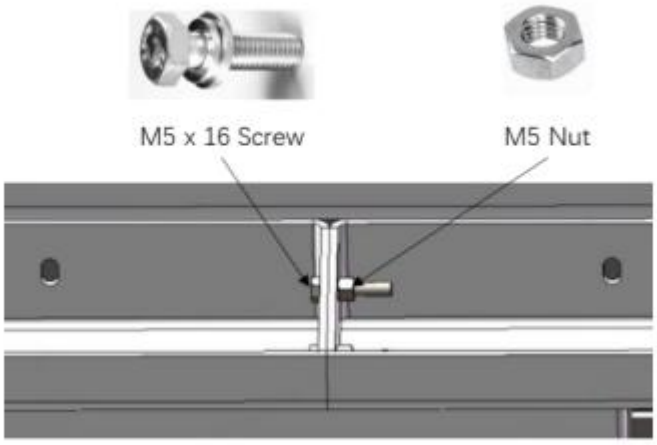


Figure 5- 14 Assembly of M5 x 16 screw and M5 nut for fastening

Step 3:
Align the holes on the rain eaves with the corresponding holes on the container and secure them using M6×16 combination bolts.

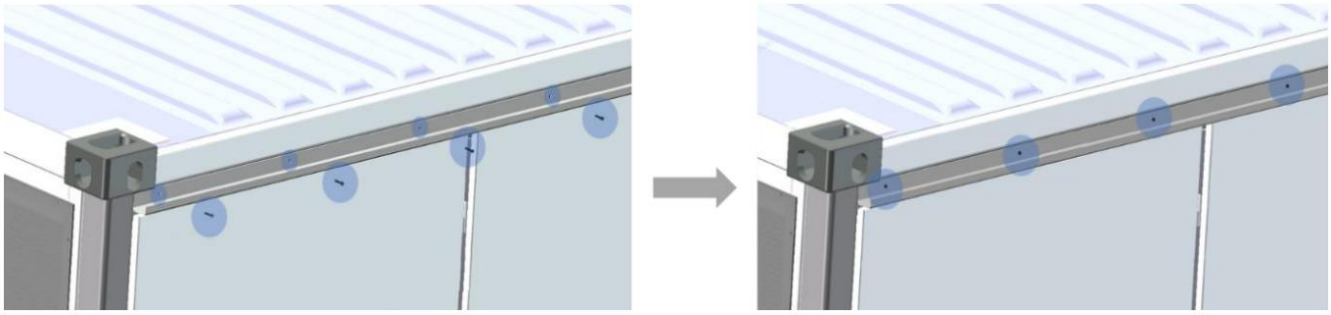


Figure 5- 15 Aligning the rain eaves with the container holes

Step 4:

Once installation is complete, seal the joints evenly to prevent rainwater from seeping through the gaps. Repeat the process on the other side of the container to install the second set of rain eaves.

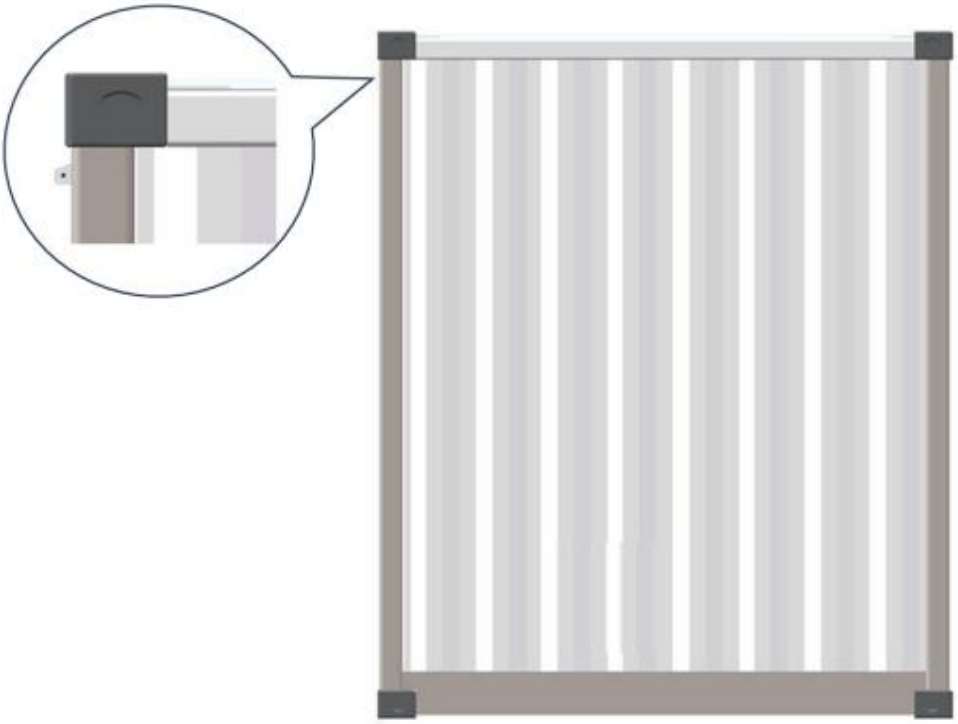


Figure 5- 16 Sealing the joints evenly

6 Battery connection

6.1 Precautions

The safety instructions in this manual must be strictly adhered to at all times.

To prevent potential injuries, property damage, and to maximize the product's lifespan, it is crucial to carefully read and follow the safety instructions.

Improper use or operation may pose risks including:

- Threatening the life and safety of the operator or others.
- Damaging the battery energy storage system or other property belonging to the operator or third parties.

⚠ CAUTION

- The safety precautions in this manual do not cover all necessary specifications, and all procedures should be adapted to the actual on-site conditions.
- Gotion will not be responsible for any losses incurred due to non-compliance with the safety precautions outlined in this manual.

⚠ WARNING

- When installing equipment with hazardous voltages, be sure to follow the relevant codes and local installation safety guidelines.
- Please follow the rules regarding the proper use of tools and personal protective equipment.
- All connections must be made under clear guidance, and any form of speculation and fuzzy attempts is strictly prohibited.
- Use tools equipped with an insulating protective layer.

- The connecting cable shall meet the requirements of voltage and current.
- Each connected connector must be safe and reliable to ensure that there will be no loose or false contact problems. The joints or connectors must be corrosion-resistant, wear-resistant, and shock-resistant.

- All kinds of connections must meet the requirements of relevant national standards, and all forms of arc discharge must be strictly complied with and followed.
- The connection between the internal batteries must have an anti-vibration pad and anti-loosening device, and the connection of temperature, voltage and current detectors must also be safe and reliable to prevent loosening, aging and extrusion.
- It is strictly forbidden to expose any metal to any induction line.
- Any form of short circuit during connection is strictly prohibited.
- It is strictly forbidden for operators to operate without wearing protective devices.
- Connect key points: Make sure the connection is correct, reliable (not loose), in good contact, and free of short circuits.
- Once the connection is complete, it must be measured and confirmed point by point.
- All connection points must be made in such a way that they do not come into contact with the outer box or other components, or short circuit.
- If there is any other uncertain point, it should be confirmed by consulting Gotion technical personnel before implementation.

6.2 Connecting the cable

6.2.1 Tools preparation

Here are the tools you might need:

 Safety helmet	 Insulation gloves	 Insulation shoes
 Reflective vest	 Insulated safety tools	 High-voltage cables
 Communication cables	/	/

6.2.2 Connection steps

Step 1: Checking the DC Circuit Breaker and Switch Status

Before connecting the cables, put on insulated clothing. Then follow these steps:

1. Have a professional open the door of the Integrated Control Panel.
2. Verify that the following switches and circuit breakers are set to the "OFF" position (locations are indicated in Figure 6- 1):
   - QS1, DC Circuit Breaker
   - QF1, Miniature Circuit Breaker (MCB) for Main Power
   - QF2 to QF13
3. Check if the isolation switch of the high-voltage box is disconnected. If not, turn it off before proceeding. Ensure all switches are in the "OFF" position before wiring.

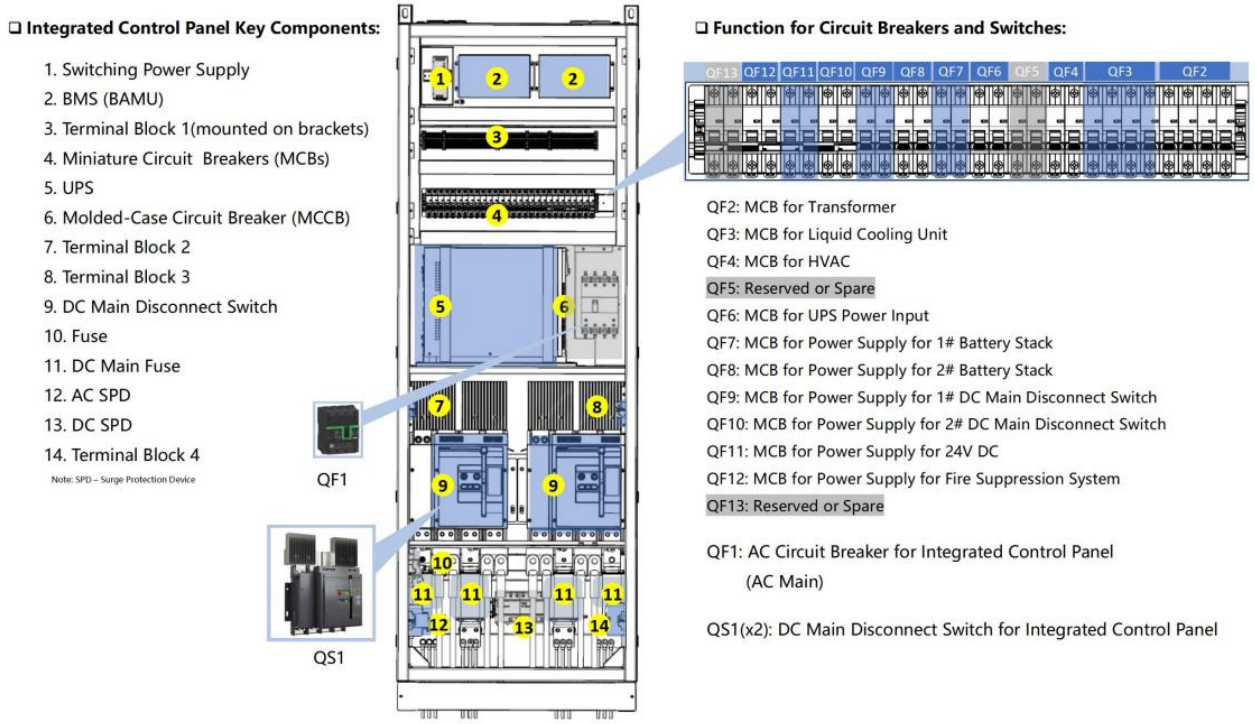


Figure 6- 1 Location of the DC circuit breaker and AC circuit breakers

Step 2: Connecting the High-Voltage cable

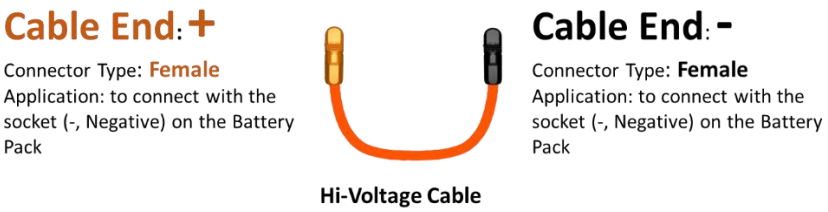


Figure 6- 2 High-voltage cable diagram

- Inspect the cable to ensure it is in good condition and the label is intact.
- If the cable and label are satisfactory, proceed with connecting the power sockets of adjacent battery packs:
  a. Align the **orange end** of the cable with the **orange socket** of an adjacent battery pack and insert it to the **Lock position** until a "click" sound is heard.
  b. Similarly, align the **black end** of the cable with the **black socket** of another adjacent battery pack and insert it to the **Lock position** until a "click" sound is heard.
- Repeat steps *a* and *b* to connect the high voltage side of the battery rack.

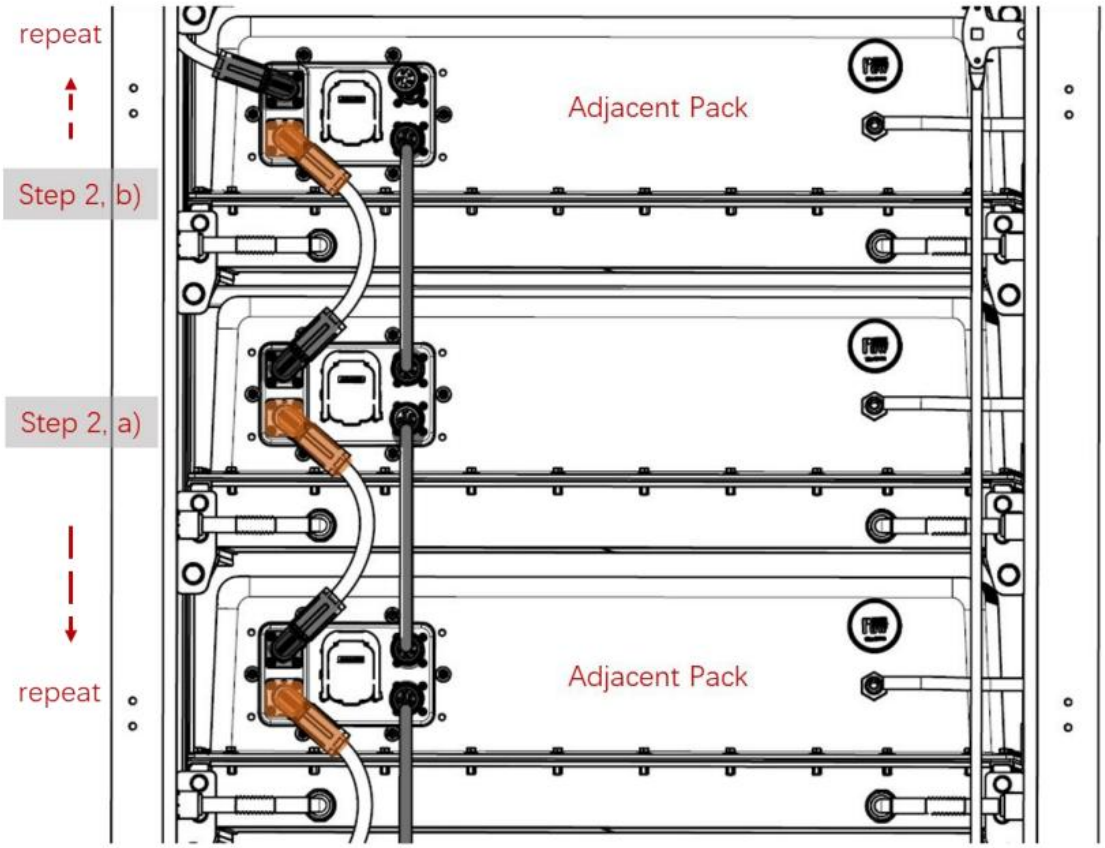


Figure 6- 3 Battery packs diagram for Step 2

Step 3: Connecting the battery communication cable

Before connecting the communication cable:

- Check whether the cable is in good condition and whether the label is complete.

Figure 6- 4 Communication cable diagram

Use the communication series cable to manually connect the battery packs within the rack in series.

a. Connect one end of the communication cable to communication port 2 of an adjacent battery pack and insert it to the **Lock position**; you will hear a "click" sound, then turn the connector clockwise until it stops.

b. Connect the other end to the communication 1 socket of another adjacent battery pack, following the same procedure as in step *a*.

Repeat steps *a* and *b* to ensure all communication terminals of the battery rack are connected.

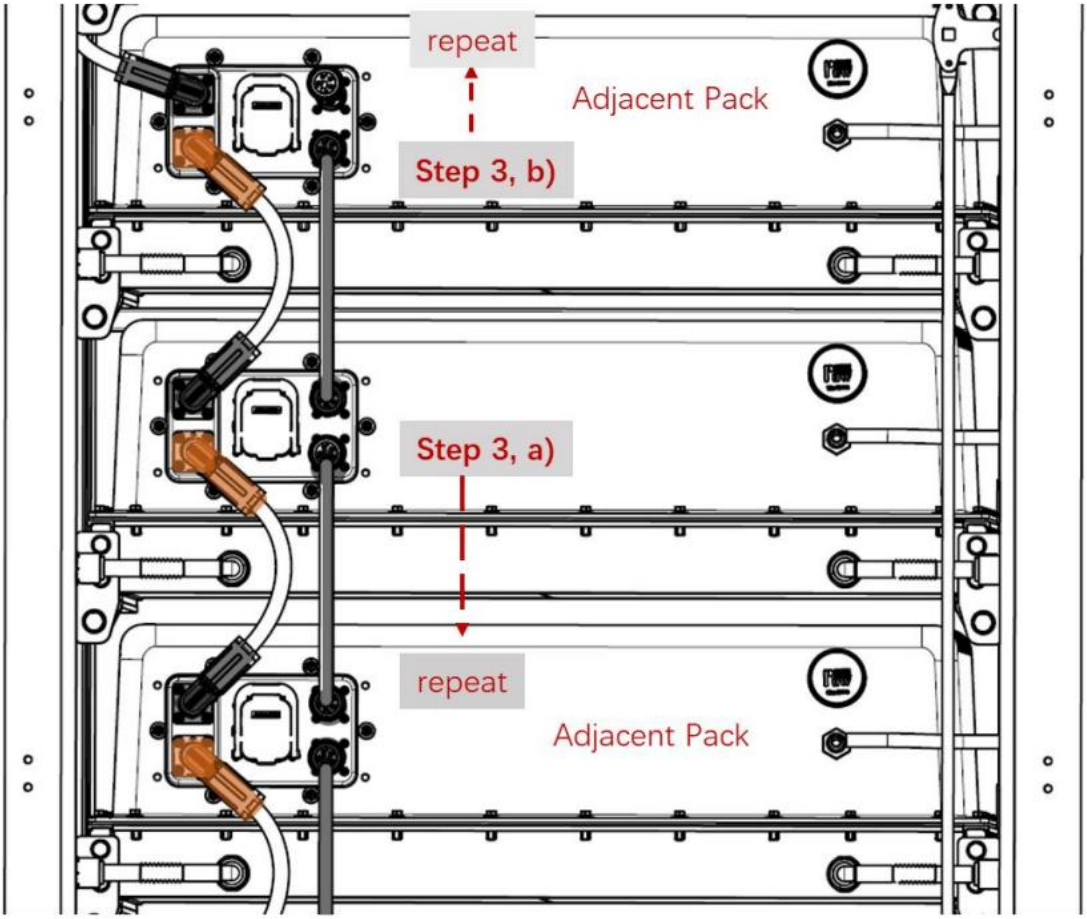


Figure 6- 5 Battery packs diagram for Step 3

Figure 6- 6 Adjacent battery packs after connecting the high-voltage cables and communication cables

7 Electrical cable connection

The company's products feature a foolproof design. The cables included with the product are labeled with text indicating the function of each port, and the interfaces of electrical components are clearly marked.

7.1 ESS container electrical wiring overview

The schematic diagram of the energy storage battery container wiring is illustrated in the figure below:

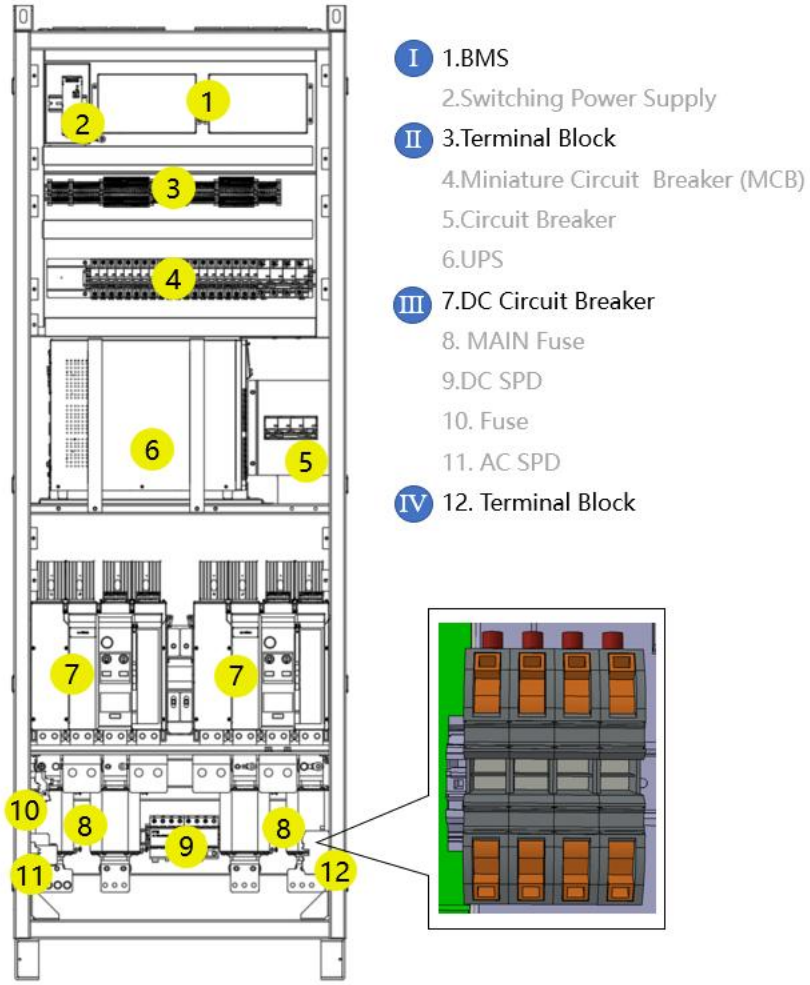


Figure 7- 1 Wiring schematic diagram of the energy storage battery container-1

Descriptions of the ports are provided in the table below.

Item	Description	Recommended model
I	Network Port	CAT5e shielded network cable
II	Communication Port	Shielded twisted pair 2×1.0mm²
III	DC Output	Port ZR-YJY23-DC1500V-1×185 mm
IV	External auxiliary power input Port	ZR-RVV-4×25 mm²

7.2 Preparation before electrical cable connection

7.2.1 Tools preparation

Here are the tools you might need:

 Safety helmet	 Insulation gloves	 Insulation shoes
 Reflective vest	 Insulated safety tools	

7.2.2 Open the container door and panel door

Step 1: Open the ESS container door

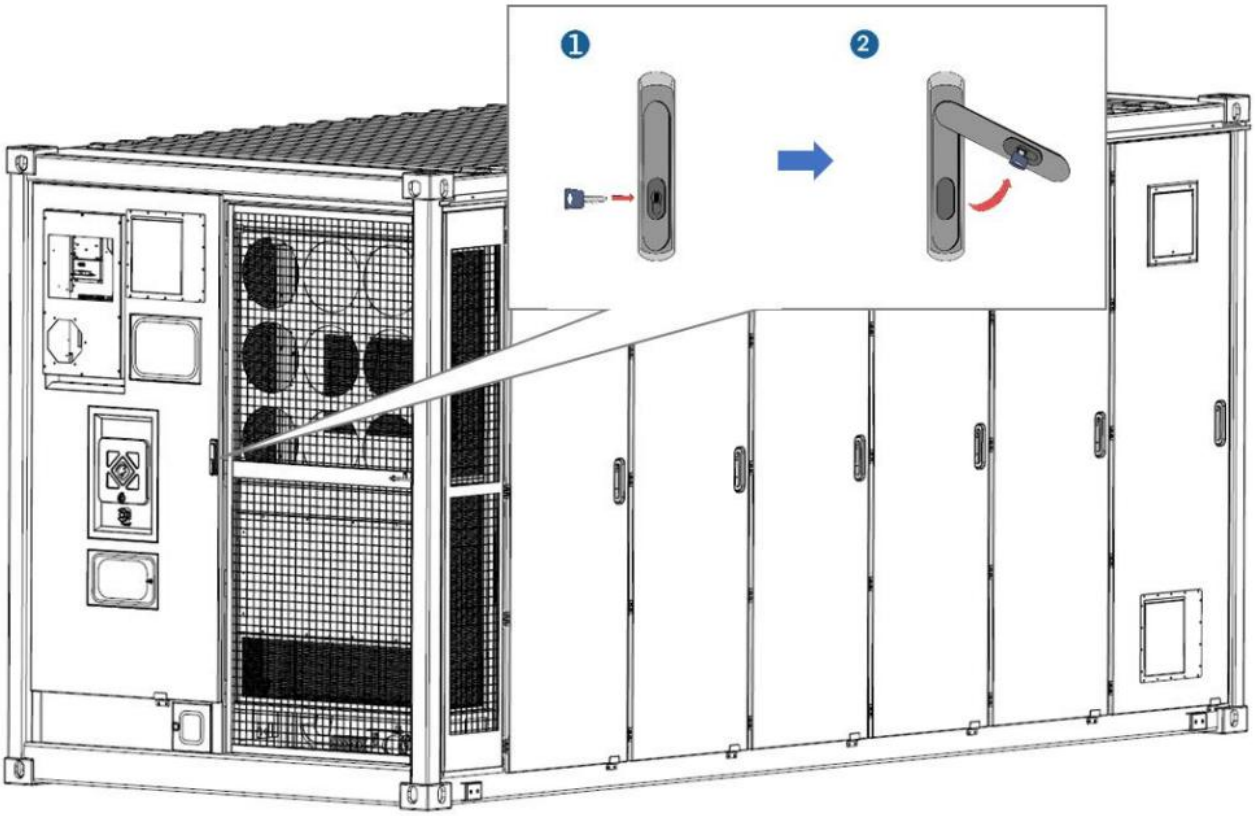


Figure 7- 2 ESS container door

Step 2: Remove the protective covers on the Integrated Control Panel.

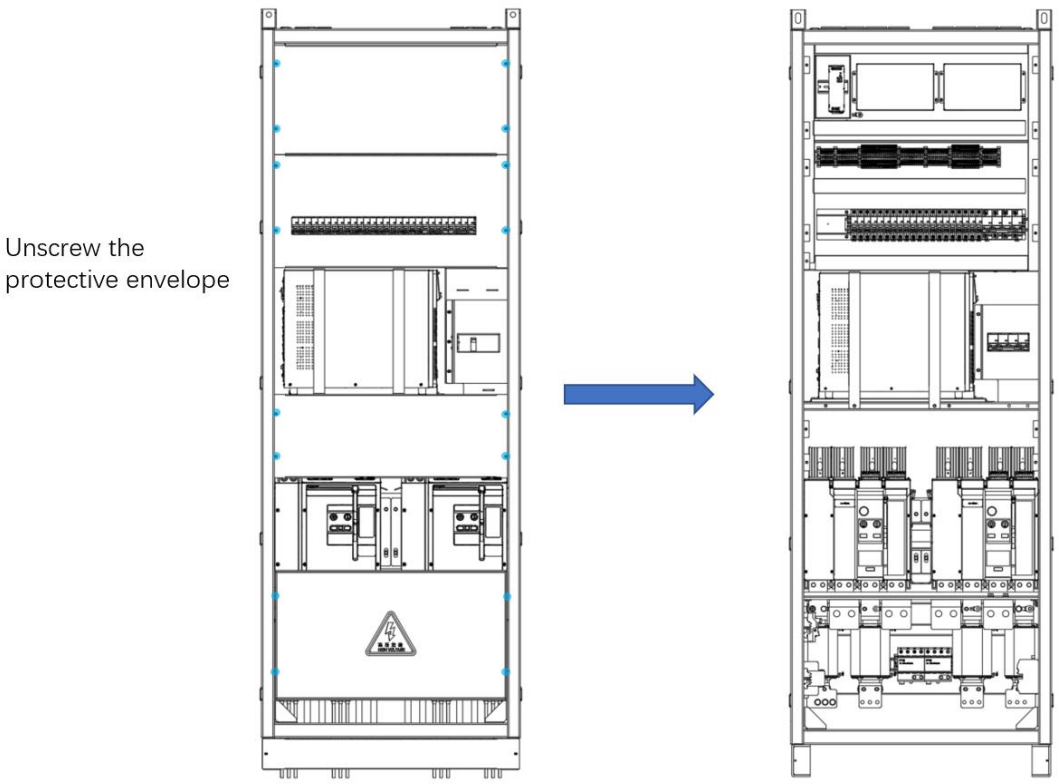


Figure 7- 3 Protective cover on the Integrated Control Panel

NOTICE

The images above are for reference only; please refer to the actual product for accuracy.

7.2.3 Cable selection

1. Cable selection criteria:
   - Ensure the selected cable meets the following conditions:
     - Adequate current-carrying capacity, influenced by factors such as:
       - Environmental conditions
       - Conductor insulation material
       - Cable routing
       - Cable material and cross-sectional area
   - Select cable diameter based on maximum current carrying capacity and optimize cable length.

2. Standardization of DC input cables:
   - All DC input cables must be of uniform size and material.

3. Consistency in three-phase AC output cables:
   - Ensure consistency in specifications and materials of three-phase AC output cables.

4. Safety precaution:
   - Choose flame-retardant cables to enhance safety.

⚠ CAUTION

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

7.3 DC cable wiring

The internal wiring of the Battery ESS Container is pre-installed at the factory. Users only need to connect the external wiring.

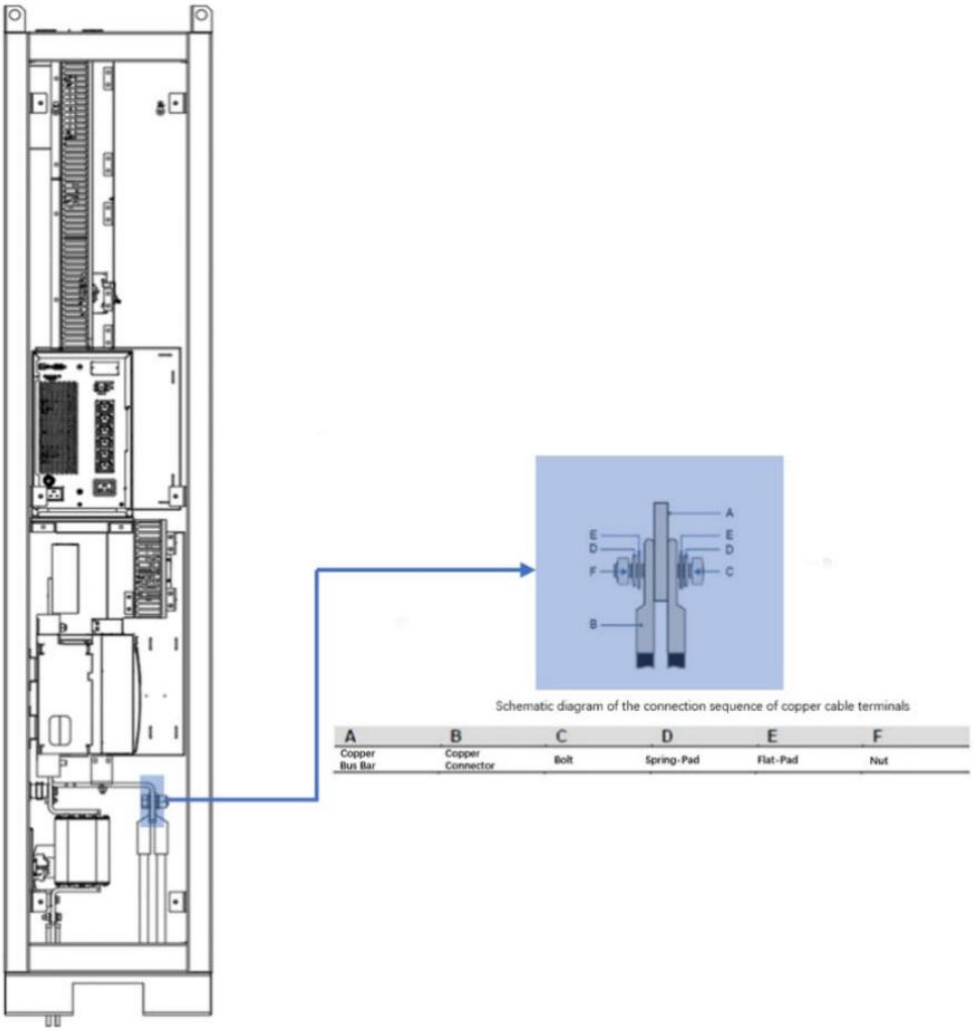


Figure 7- 4 Schematic of the connection sequence for copper cable terminals

Wiring descriptions are as follows:

Item	Description	Qty	Recommended model
1	DC+ DC wiring	8	1×185mm² Copper conductor power cables
2	DC- DC wiring	8	1×185mm² Copper conductor power cables
3	Connector	/	DT185

DC cable wiring steps:

Step 1:
Ensure the output switches of both the parent and subordinate circuits in the Integrated Control Panel are in the OFF position.

Step 2:

Strip the insulation layer from the cable end. The stripped length should be approximately 0.2in/5mm longer than the depth of the crimping hole in the copper lug, as shown in the figure below.

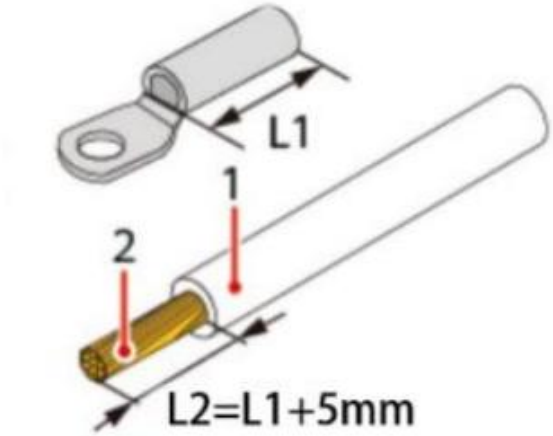


Figure 7- 5 Stripped insulation layer length diagram

Step 3:
Crimp the copper lug:
1. Choose the appropriate copper lug based on the cable size.
2. Insert the exposed copper core into the crimping hole of the copper lug.
3. Use a crimping tool to securely crimp the copper lug. Perform at least two crimpings for a secure connection.

Step 4:
Install the heat shrink tubing:
1. Select a heat shrink sleeve that closely matches the cable size, ensuring it extends about 2cm beyond the copper lug.
2. Place the heat shrink sleeve over the copper lug, completely covering the crimping hole.
3. Use a heat gun to shrink the sleeve for a tight fit.

Step 5:
Wiring:
1. Use an M16 bolt that matches the copper lug size.
2. Secure the copper lug onto the DC busbar, following the sequence shown in FIGURE 7- 4.

7.4 External power supply and communication interface

The Integrated Control Panel includes communication ports and external auxiliary power supply ports. The locations of these ports are illustrated in the figure below. During installation, ensure wiring is done according to the terminal labels.

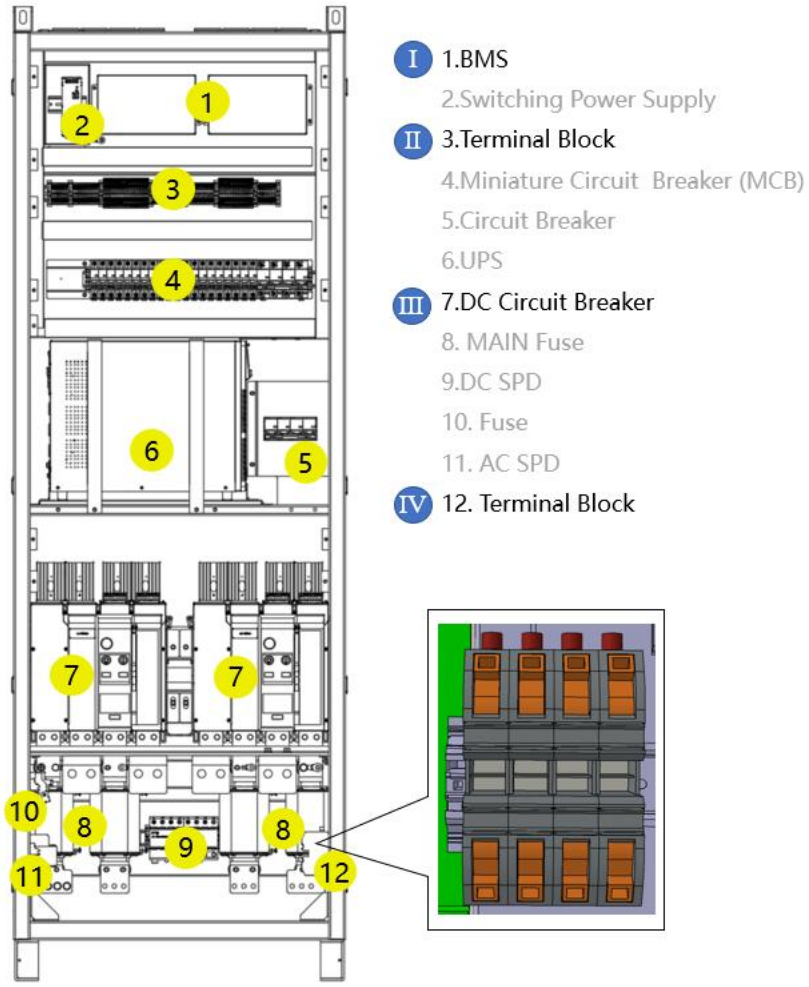


Figure 7- 6 Wiring schematic diagram of the energy storage battery container-2

Descriptions of the wiring are provided in the table below.

Item	Location	Description	Qty	Recommended model
I	BMS	External network port	1	CAT5e shielded network cable
II	Terminal block	External communication line (Backbone Node, RS485, CAN)	2	Shielded twisted pair 2×1.0mm²
III	Terminal block (mounted on lower right panel wall)	External power supply (3-phase 4-lines, 400VAC/50Hz)	4	4×25mm²

7.5 Operation after electrical cable connection

After all electrical connections have been completed, the wiring should be thoroughly and carefully inspected.

At the same time, the following procedure shall be carried out:

- Check that all the air inlets and outlets are free of foreign objects or blockages.
- The Battery ESS and BMS outlet holes and the surrounding gaps are tightly sealed and plugged with fireproof and waterproof materials.

⚠ WARNING

- Failure to seal properly can lead to moisture ingress.
- Failure to seal properly can lead to rodent entry.

Lock the Cabinet door

Close the cabinet door, lock it, pull out the key, and keep it safe.

⚠ CAUTION

Make sure the sealing strip around the door doesn't curl when the door is closed.

8 Power-on and power-off procedure

8.1 Power-on

WARNING

The battery ESS cabinet may only be operated after approval by a qualified professional and authorization from the local power authority.

WARNING

If the battery ESS has been inactive for an extended period, a thorough and detailed inspection must be conducted prior to powering on, ensuring that all parameters meet the necessary requirements.

8.1.1 Power-on inspection

Before powering on, carefully verify the following items to ensure everything is correct:

- Inspect the battery container for foreign objects (e.g., small animals, tools).
- Ensure all switches and circuit breakers in the Integrated Control Panel are set to OFF.
- Confirm that the Isolation Switch on the high-voltage box front panel is in the OFF position.
- Verify that the air conditioning system is properly connected and its switch is OFF.
- Check that the positive and negative terminals of the DC power cable in the Integrated Control Panel are connected correctly.
- Inspect the connecting cables within the Battery ESS Container for any signs of damage or insulation deterioration.
- Ensure that the communication and power supply cable terminals inside the Battery ESS Container are secure and not loose.
- Check for any unusual or irritating odors inside the Battery ESS Container.
- Confirm that both the PCS AC and DC side switches are in the OFF position.
- Clean the installation area, ensuring it is free of debris, flammable, or explosive materials.

8.1.2 Overview of power-on procedures

The reference table below provides a summary of the Power-On procedures.

Step	Item		Remarks
1	Power-on the AC auxiliary power	Switch on the 400V AC power supply.	1 in FIGURE 8- 1
2		Switch on the liquid cooling unit.	2 in FIGURE 8- 1
3		Switch on the HVAC.	3 in FIGURE 8- 1
4		Switch on the UPS Supply Power.	4 in FIGURE 8- 1
5		Turn on the UPS.	5 in FIGURE 8- 1
6		Switch on the high voltage box of #1 battery stack power supply.	6 in FIGURE 8- 1
7		Switch on the high voltage box of #2 battery stack power supply.	7 in FIGURE 8- 1
8		Switch on #1 DC Main Switch power supply.	8 in FIGURE 8- 1
9		Switch on #2 DC Main Switch power supply.	9 in FIGURE 8- 1
10		Switch on the 24V DC power supply.	10 in FIGURE 8- 1
11		Switch on the fire suppression system.	11 in FIGURE 8- 1
12		Check that each module works properly.	12 in FIGURE 8- 1
13	Power-on the DC power	Switch on the high voltage box, as shown in FIGURE 8- 2.	13 in FIGURE 8- 1
14		Use the BMS to turn on the high-voltage box relay, as shown in FIGURE 8- 3.	14 in FIGURE 8- 1 and FIGURE 8- 3
15		Use the BMS to turn on the battery side of the DC power by clicking the “M Breaker (close)” button on the LCD Display, as shown in FIGURE 8- 3.	15 in FIGURE 8- 1 and FIGURE 8- 3

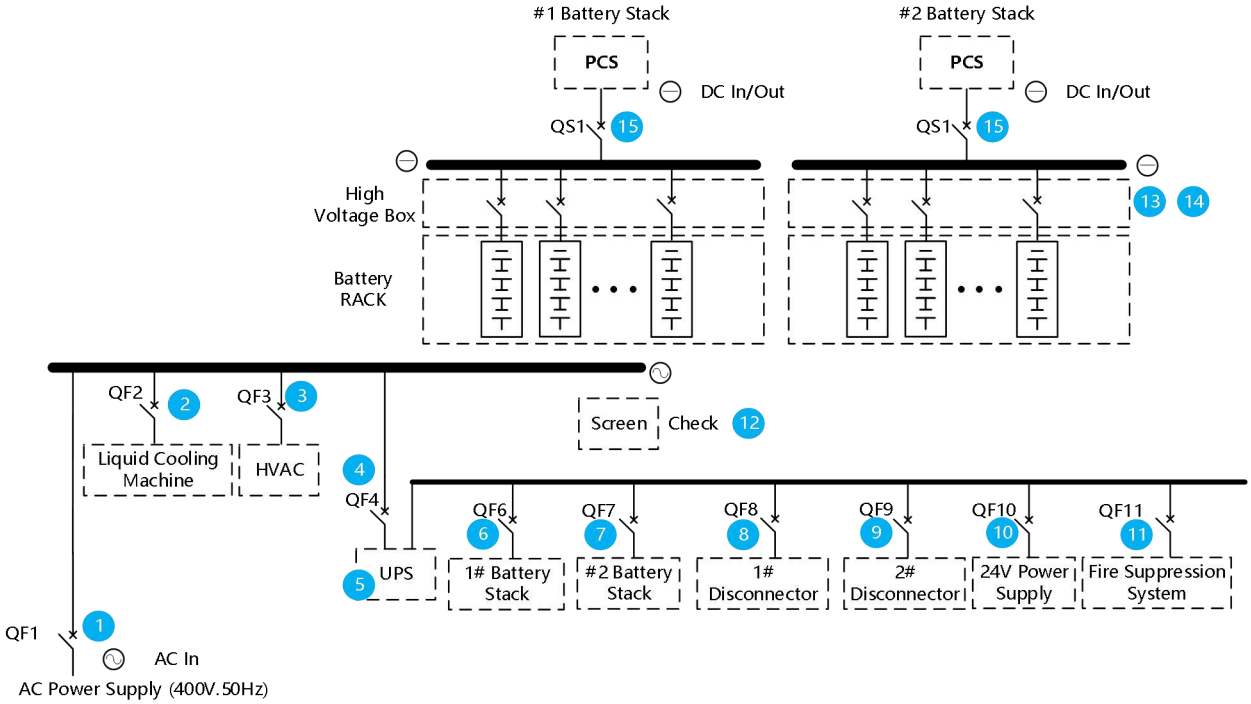


Figure 8- 1 Circuit diagram of power-on procedure

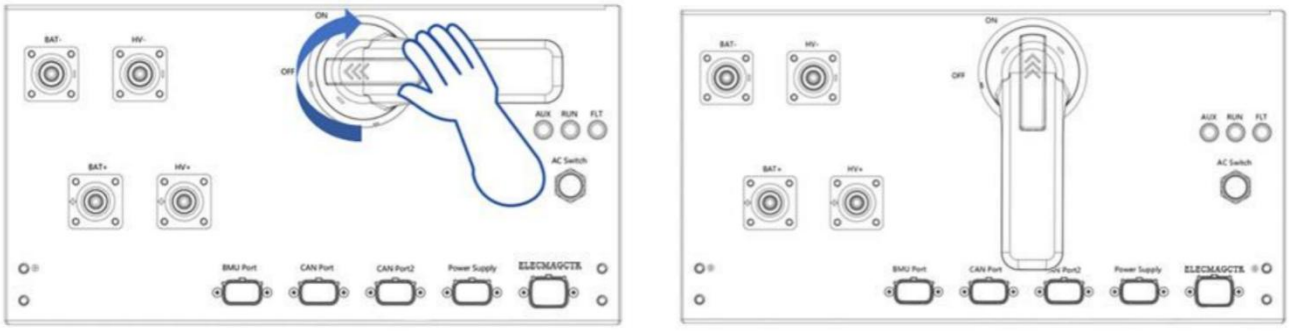


Figure 8- 2 Manually switch on high-voltage box

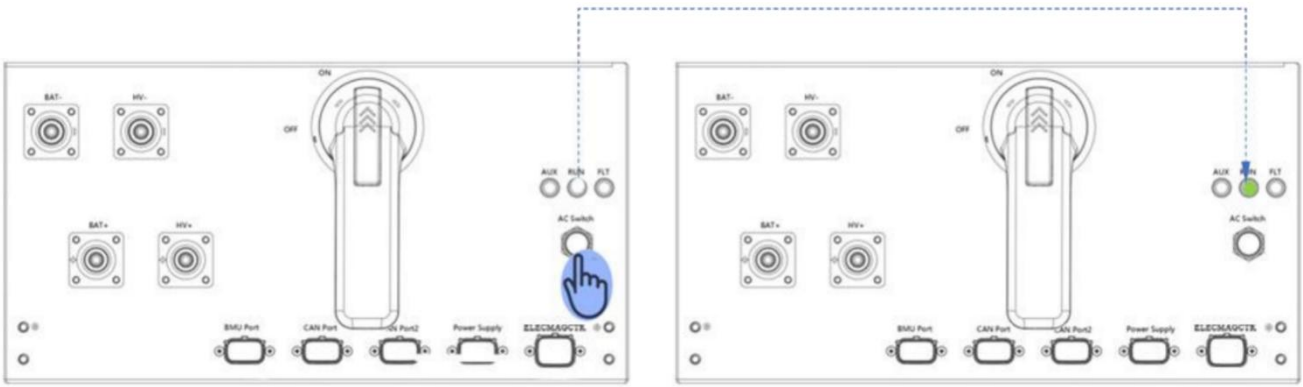


Figure 8- 3 Turn on AC switch on high-voltage box

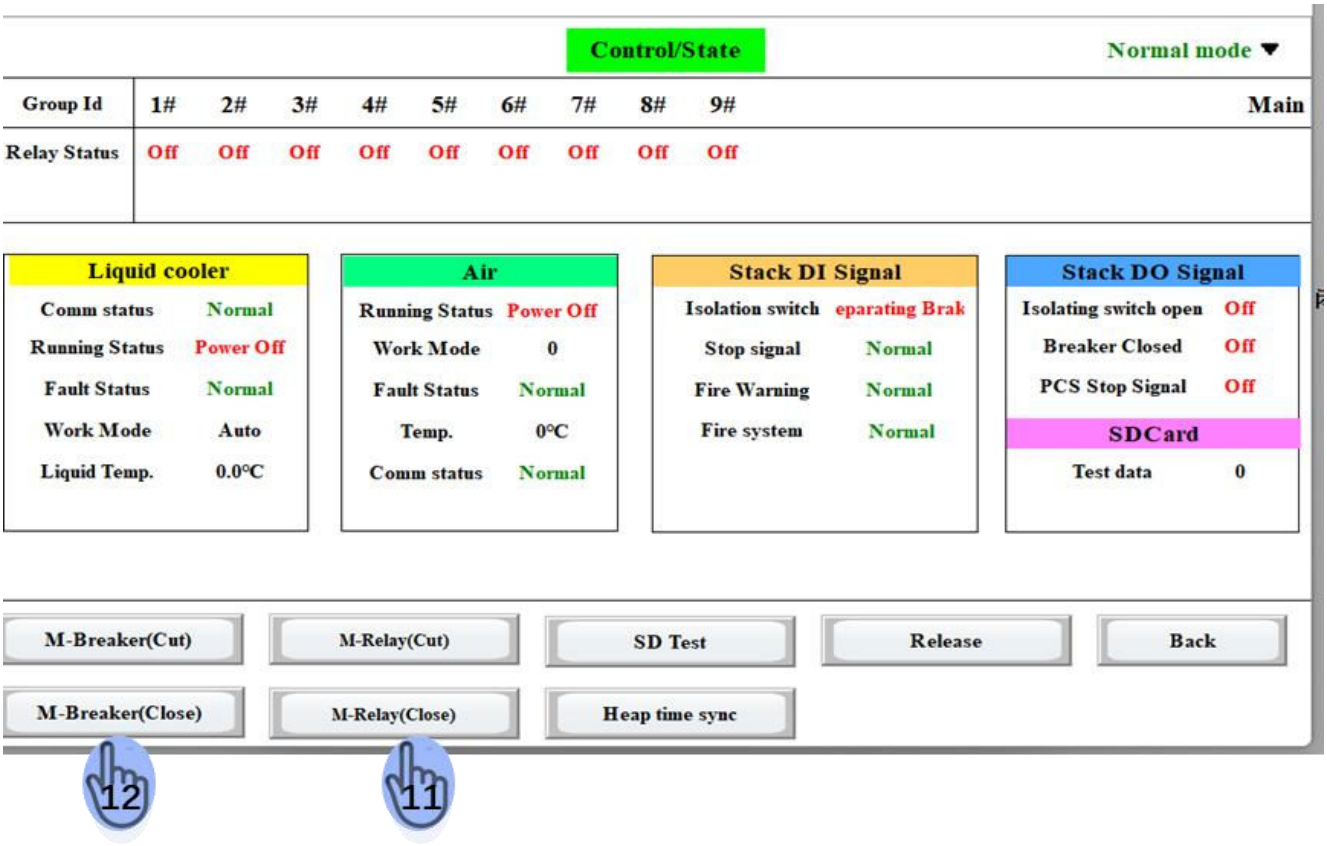


Figure 8- 4 Use the BMS to turn on the high-voltage box

8.1.3 Detailed power-on steps

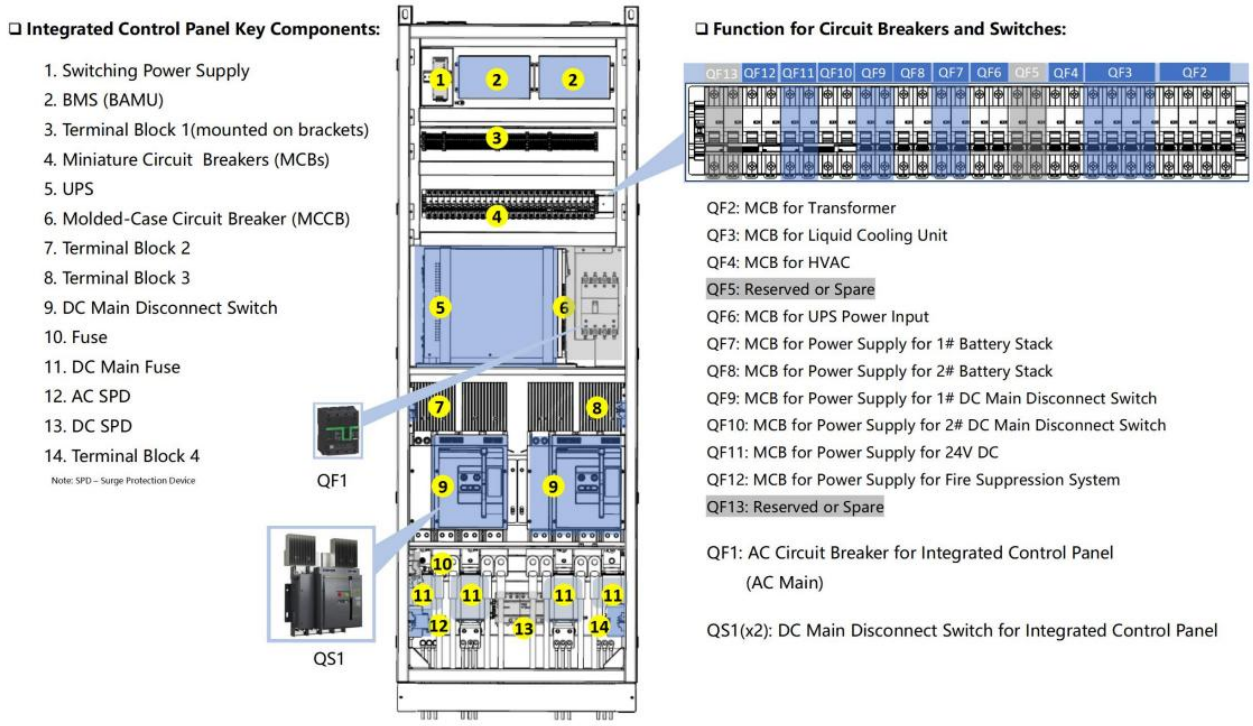


Figure 6- 1 Location of the DC circuit breaker and AC circuit breakers from page 95

Step 1:
Turn ON the external auxiliary power supply switch (QF1), followed by switching ON the miniature circuit breakers (MCBs) for the liquid cooling unit, air conditioning system, and UPS power:

- Switch ON the power supply switch (QF2) for the liquid-cooled unit.
- Switch ON the transformer switch (QF3).
- Switch ON the air conditioning unit power supply switch (QF4).
- Switch ON the UPS input power switch (QF6).
- Turn ON the UPS power.
- Switch ON the high-voltage box power supply switch (QF7) for Battery Stack #1.
- Switch ON the high-voltage box power supply switch (QF8) for Battery Stack #2.
- Switch ON the DC main switch (QF9) for Battery Stack #1.
- Switch ON the DC main switch (QF10) for Battery Stack #2.
- Switch ON the 24V DC power supply switch (QF11).
- Switch ON the power supply switch (QF12) for the fire suppression system.

Step 2:
Once Step 1 is complete, turn on the display screen on the Integrated Control Panel. Check the LCD display to confirm that the liquid cooling unit, air conditioner, fire suppression system, and other modules are operating normally.

Step 3:

- Ensure all modules are functioning correctly.
- Manually switch ON the isolation switch for each high-voltage box cluster (hold the handle of the high-voltage box, rotate it 90 degrees clockwise from OFF to ON, as shown in Figure 8- 2 Manually switch on high-voltage box).

- Turn ON the 230V-AC power supply switch for each high-voltage box cluster (locate the AC switch button on the high-voltage box and press it, as shown in Figure 8- 3 Turn on AC switch on high-voltage box).
- Return to the display panel on the Integrated Control Panel and press the main relay closure button on the screen to complete the relay closure for each high-voltage box cluster.
- Observe the indicator lights on the high-voltage box:
  - **AUX**: Power indicator (green light indicates normal power supply).
  - **RUN**: Running indicator (green light indicates the total output relay in the high-voltage box is ON; light is OFF when the box is disconnected).
  - **FLT**: Fault indicator (red light indicates system faults, such as hardware failures, internal communication issues, or battery failures).

Step 4:

Turn ON the main DC Circuit Breaker switch (QS1) in the Integrated Control Panel by pressing the button on the display screen.

Step 5:

- After the battery rack is powered on, the third-level BMS (BAMS) will automatically send a relay closure command to the second-level BMS (BCMS), engaging the second-level BMS and activating the main positive and negative relays, successfully powering on the DC bus of the 6-rack battery system.
- The third-level BMS monitoring display will turn GREEN (as shown in Figure 8- 5 Third-level BMS monitoring display below), indicating "Normal" status, completing the power-on process and allowing the system to enter charging and discharging mode.

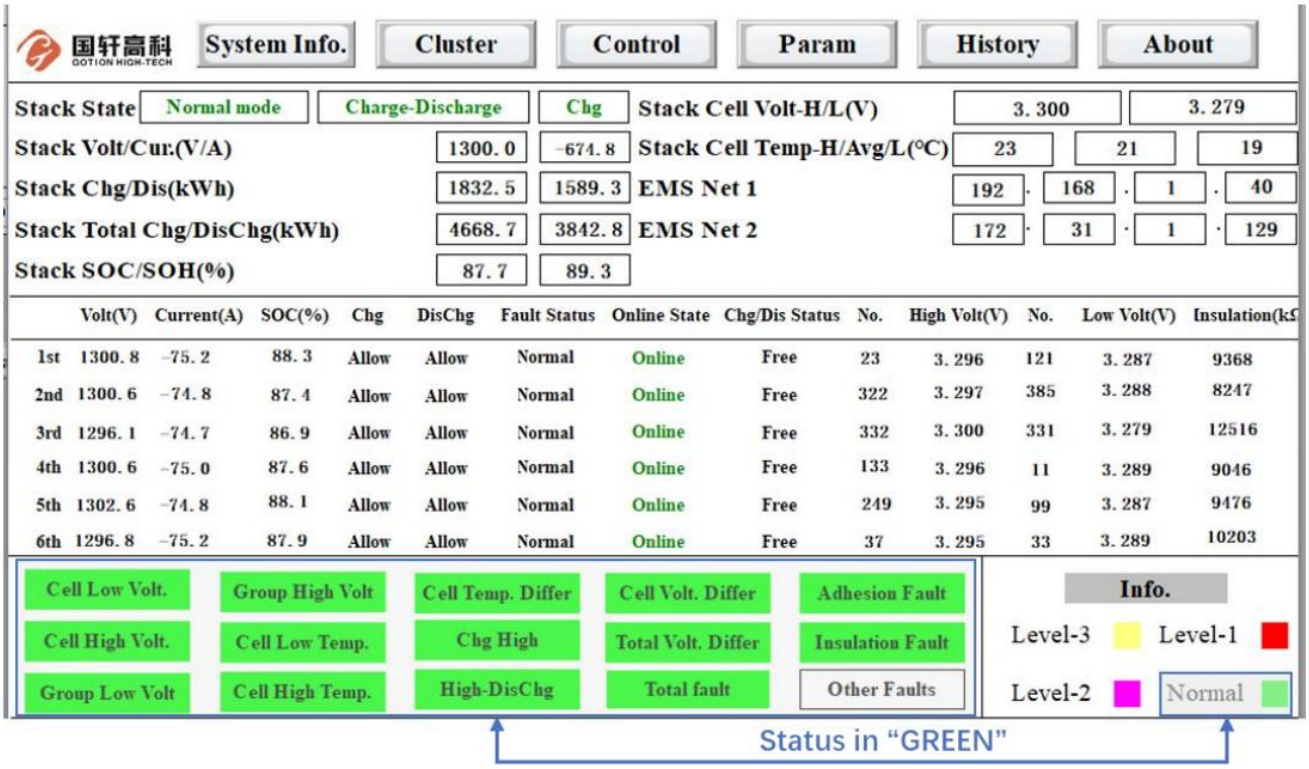


Figure 8- 5 Third-level BMS monitoring display

If a circuit breaker trips during the power-on process, stop closing other circuit breakers and immediately check for a short circuit in the load of the affected circuit.

8.2 Planned power-off

WARNING

Ensure that the DC main connection to the BESS on the PCS side has been turned off.

8.2.1 Overview of power-off procedures

The reference table below provides a summary of the Power-Off procedures.

Step	Item		Remarks
1	Power-off the DC power	Turn off the battery side of the DC power (via BAMS), by clicking the "M Breaker (cut)" button on the LCD Display, as shown in FIGURE 8- 7.	1 in FIGURE 8- 6
2		Turn off the high voltage box relay (via BAMS), by clicking the "M-Relay (cut)" button on the LCD Display, as shown in FIGURE 8- 7	2 in FIGURE 8- 6
3		Switch off the high voltage box, as shown in FIGURE 8- 8 and FIGURE 8- 9.	3 in FIGURE 8- 6
4	Power-off the AC auxiliary power	Switch off the fire suppression system.	4 in FIGURE 8- 6
5		Switch off the 24V DC power supply.	5 in FIGURE 8- 6
6		Switch off #2 DC Main Switch power supply.	6 in FIGURE 8- 6
7		Switch off #1 DC Main Switch power supply.	7 in FIGURE 8- 6
8		Switch off the high voltage box of #2 battery stack power supply.	8 in FIGURE 8- 6
9		Switch off the high voltage box of #1 battery stack power supply.	9 in FIGURE 8- 6
10		Turn off the UPS.	10 in FIGURE 8- 6
11		Switch off the UPS input power supply.	11 in FIGURE 8- 6
12		Switch off the air conditioner power supply.	12 in FIGURE 8- 6
13		Switch off the liquid cooling unit.	13 in FIGURE 8- 6
14		Switch off the 4 0 0V AC power supply.	14 in FIGURE 8- 6

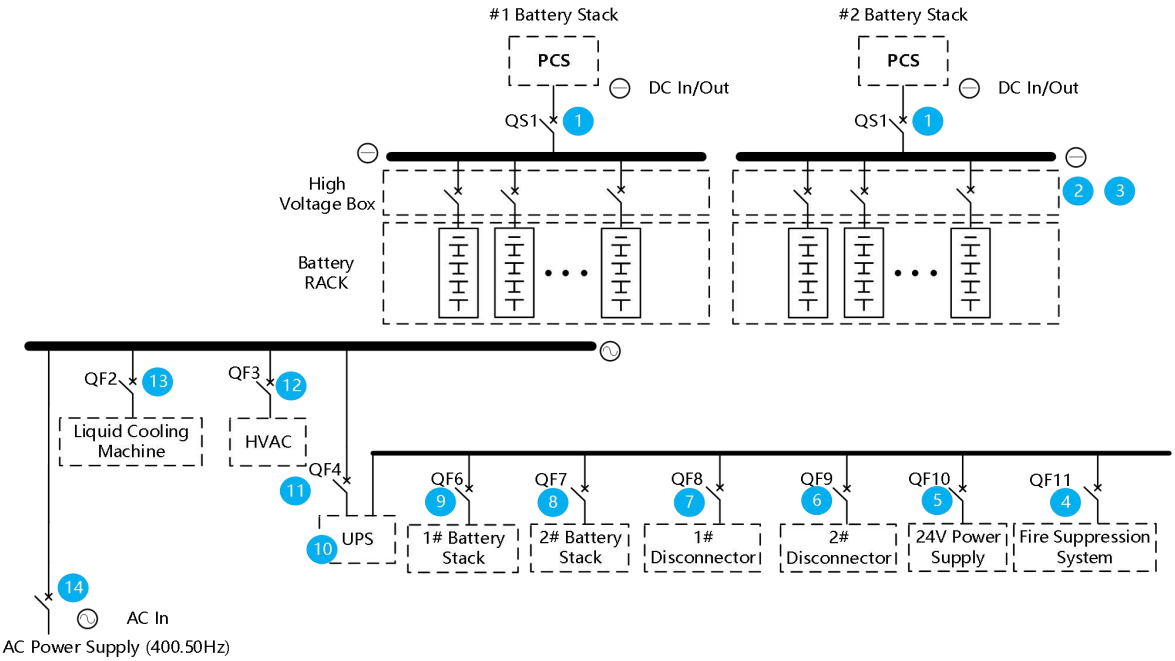


Figure 8- 6 Circuit diagram of power-off procedure

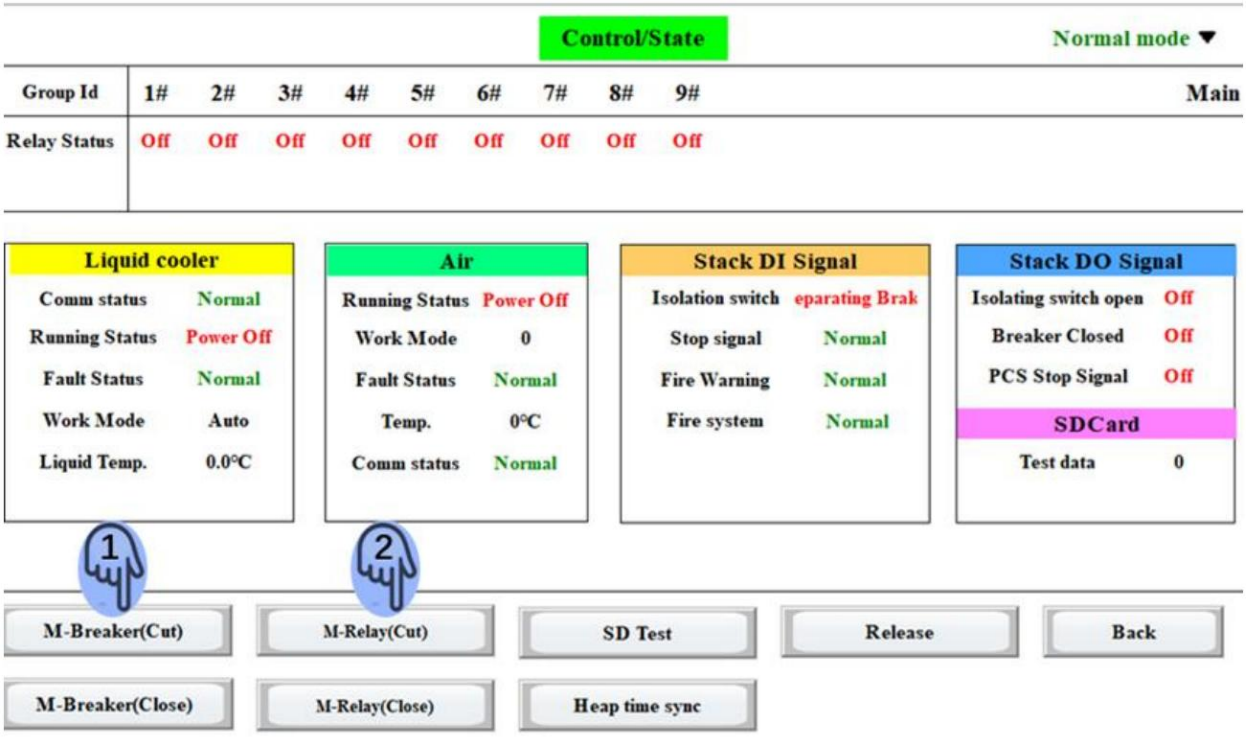


Figure 8- 7 Use BMS powering off high-voltage box

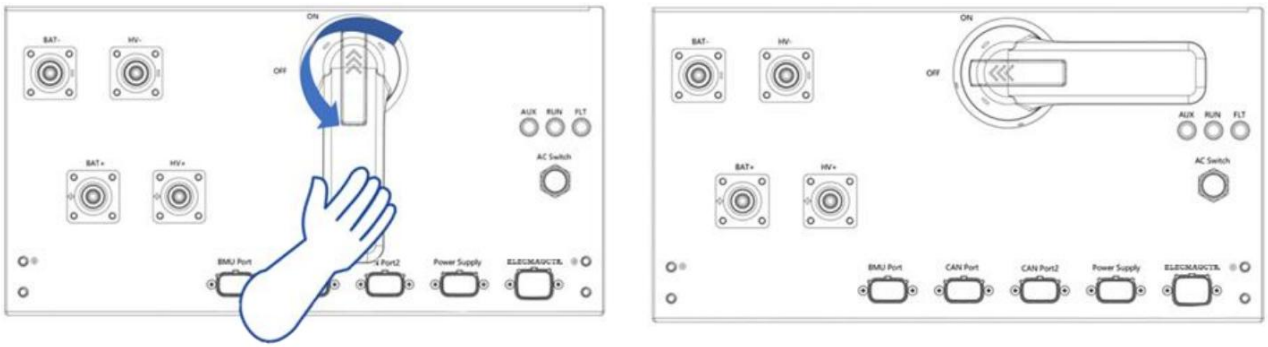


Figure 8- 8 Manually switch off high-voltage box

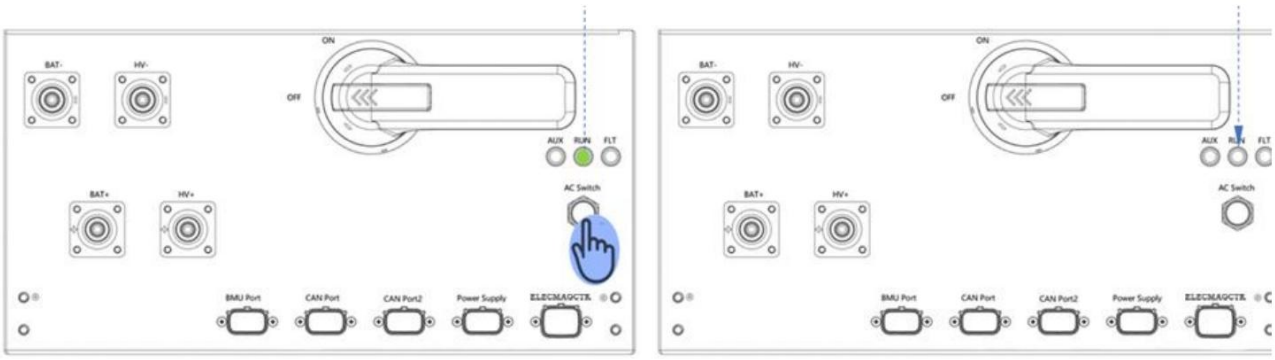


Figure 8- 9 Disconnect 230V-AC power supply switch

8.2.2 Detailed power-off steps

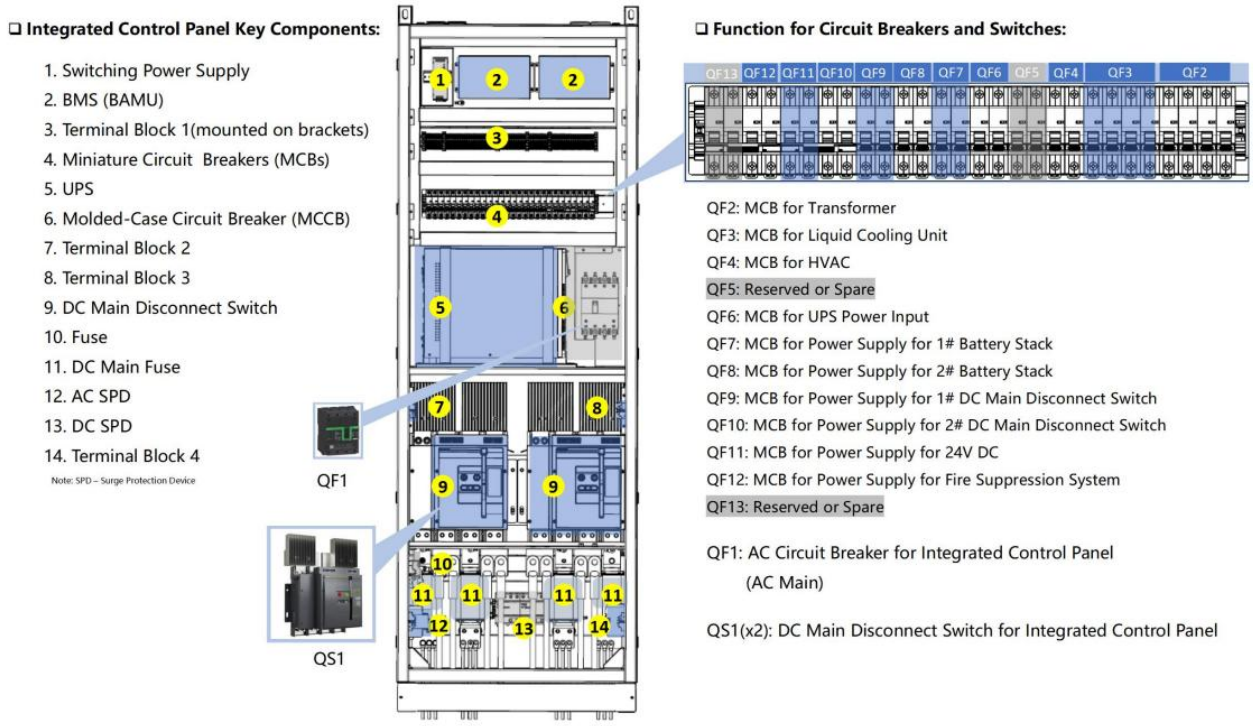


Figure 6- 1 Location of the DC circuit breaker and AC circuit breakers from page 95

Step 1:
Ensure the PCS or EMS side has turned OFF the AC and DC power to the Battery ESS. For example, use the PCS LCD panel or the EMS control system to click the stop button, disconnect the AC and DC side switches after the PCS is withdrawn, and enter shutdown mode.

Step 2:
Switch OFF the DC Circuit Breaker (QS1) in the Integrated Control Panel.

Step 3:

- On the Integrated Control Panel screen (as shown in Figure 8- 7 Use BMS powering off high-voltage box), issue the battery cluster relay disconnection command to the third-level BMS, so that each cluster of high-voltage boxes is disconnected (via the relays in the high-voltage box).
- Manually disconnect the isolation switch for each high-voltage box cluster by holding the handle, rotating it 90 degrees counterclockwise from ON to OFF, as shown in Figure 8- 8 Manually switch off high-voltage box.
- Disconnect the 230V-AC power supply switch for each high-voltage box cluster (locate the AC Switch button on the high-voltage box and press it, as shown in Figure 8- 9 Disconnect 230V-AC power supply switch).

Step 4:
Switch OFF the air conditioning system, fire protection system, UPS, and other components:

- Turn OFF the fire suppression system power supply switch (QF12).
- Turn OFF the 24V DC power supply switch (QF11).
- Turn OFF the #2 DC Main Switch (QF10).
- Turn OFF the #1 DC Main Switch (QF9).

- Turn OFF the high-voltage box power supply switch for Battery Stack #2 (QF8).
- Turn OFF the high-voltage box power supply switch for Battery Stack #1 (QF7).
- Turn OFF the UPS.
- Turn OFF the UPS power supply switch (QF6).
- Turn OFF the air conditioning unit power supply switch (QF4).
- Turn OFF the transformer power supply switch (QF3).
- Turn OFF the liquid cooling unit power supply switch (QF2).

Step 5:
Switch OFF the AC auxiliary power supply (QF1) in the Integrated Control Panel.

8.3 Unplanned power-off (outage)

1. **Fire Accidents:**
IMMEDIATELY contact your local fire department for professional assistance.

2. **Unplanned Outages (caused by failures):**
Promptly contact Gotion for support.

9 Fire extinguishing system

WARNING

Please adhere to the fire laws and regulations of the country or region where the project is located. Regularly inspect and maintain fire safety equipment to ensure all functions operate correctly.

WARNING

The battery container features an automatic fire extinguishing system. The fire extinguishing switch should not be activated unless there is an emergency.

WARNING

All fire-related components in the BESS products sold by GOTION in the UL area, including combustible gas detectors, smoke detectors, heat detectors, input and output modules, and aerosols (if applicable), comply with UL standards. For additional certifications or to meet other fire safety requirements specific to the project location, please contact Gotion.

9.1 System description

The Battery ESS Container is equipped with a water-based firefighting system, an FK-5-1-12 or Aerosol fire extinguishing system, an automatic fire alarm and control system, a combustible gas detection and alarm system, and a ventilation system.

This integrated fire extinguishing system efficiently detects fires using devices such as gas detectors, smoke detectors, and heat detectors.

When an abnormality is detected, a signal is sent to the station-level alarm system (Battery ESS Site Station Level) to trigger the fire alarm and control battery system operations through corresponding logic controls.

9.2 Fire suppression control logic

The system operates in two modes: **Automatic Control Mode** and **Electrical Manual Control Mode**.

Automatic Control Mode:

- When the protection area is unoccupied, set the control mode on the automatic fire extinguishing controller to "Automatic," putting the system into automatic control.
- When the first detector in the protection area detects a fire, an alarm will be triggered, indicating the fire's location and alerting staff.

Electrical Manual Control Mode:

- When personnel are working or present in the protection area, switch the control mode on the automatic fire extinguishing controller to "Manual," placing the system in manual control.
- In the event of a fire, you can press the manual start button on the controller or activate the emergency start button located outside the protection area to initiate the fire suppression process.
- Even in Automatic Control Mode, manual control can still be activated. Before engaging manual control, all personnel must evacuate the protection area.

For further details, please refer to the GRID5015 FSS Design document.

Below is a fire suppression system flow chart. Adjustments can be made according to customers' requirements.

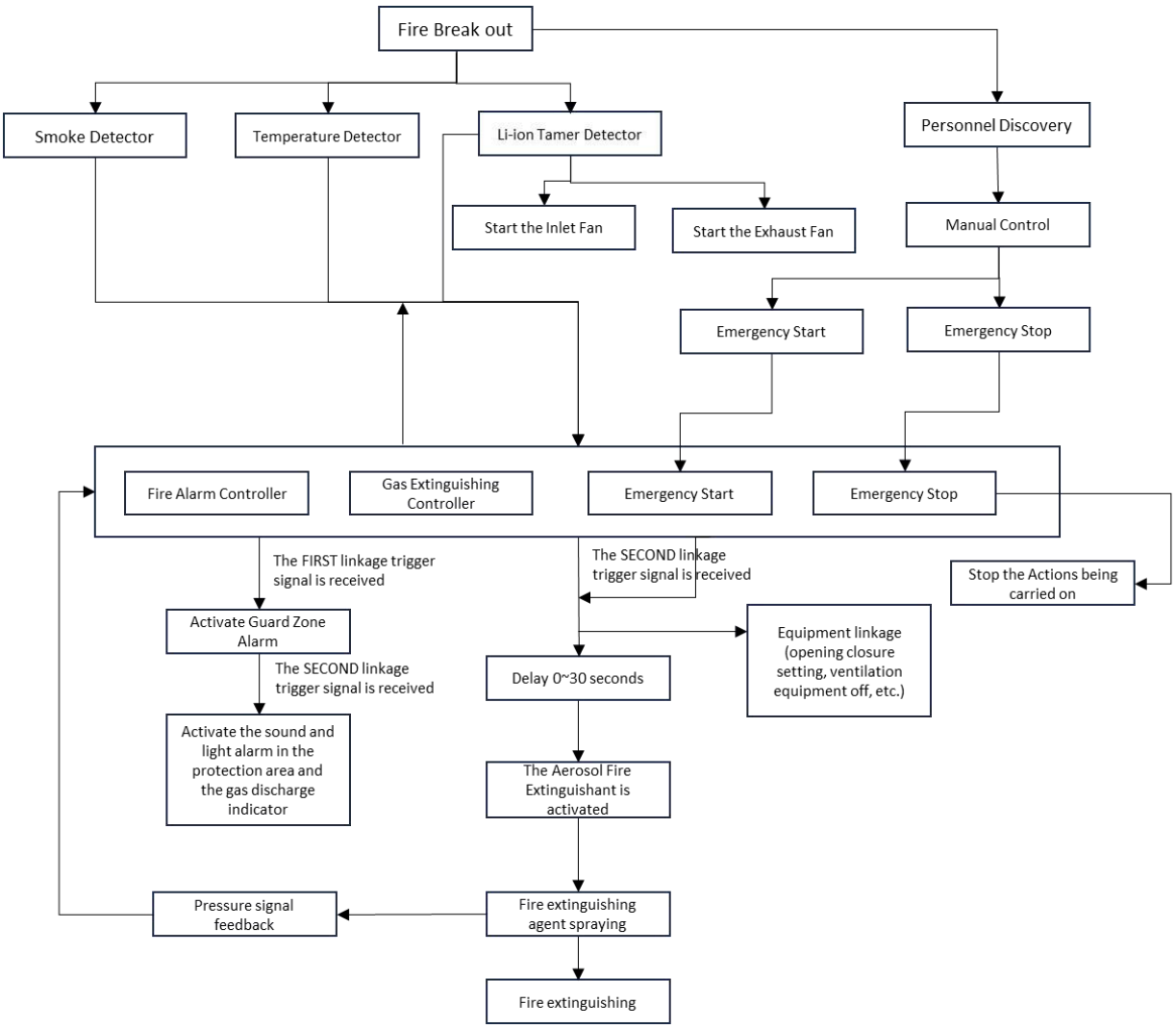


Figure 9- 1 Fire suppression system flow chart

9.3 Exhaust system

Combustible gas detection equipment is installed in the battery cabinet. When the detected gas reaches 10% Lower Explosive Limit (LEL), the system sends a signal to the station-level alarm host via the fire control panel, triggering a fire warning and activating the exhaust system.

The battery container is equipped with an air intake electric louver (referred to as "inlet" in the diagram below) and an electric louver with an exhaust fan (also called the ventilation louver, referred to as "outlet" below).

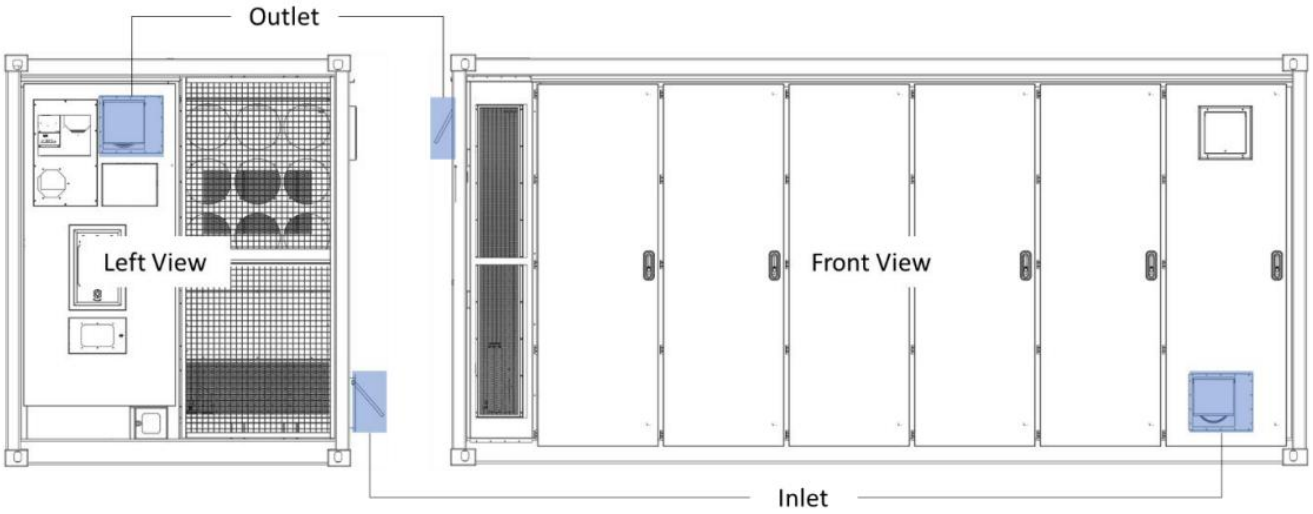


Figure 9- 2 Inlet and outlet position

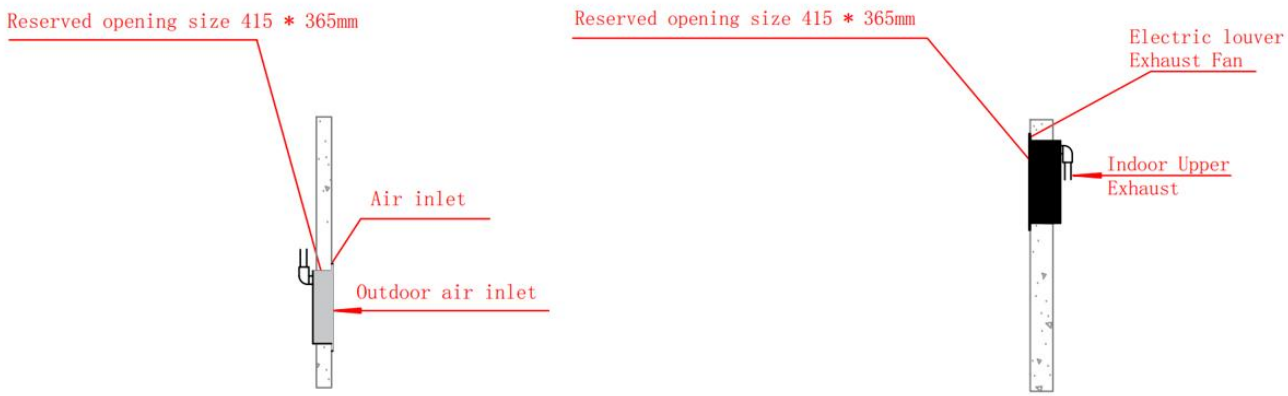


Figure 9- 3 Air inlet installation and exhaust fan installation diagram

Under normal conditions, the electric louvers remain closed. When the system's controller receives an alarm signal from the gas detector, it activates the ventilation and exhaust system. If the concentration of combustible gas exceeds 10% LEL, the air intake louver opens to allow fresh air in, while the ventilation louver opens and the exhaust fan engages to expel the gas from the energy storage container. Once the process is complete, the main controller automatically shuts down the exhaust system.

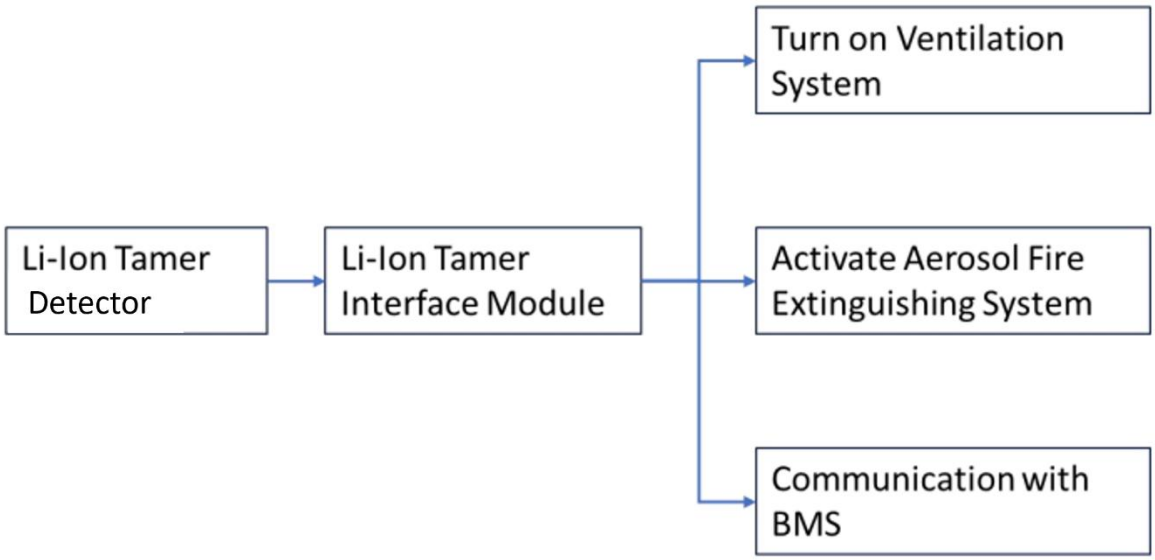


Figure 9- 4 Li-Ion tamer detector system workflow for ventilation and fire extinguishing activation

9.4 FK-5-1-12/Aerosol fire extinguishing system

We offer two types of fire extinguishing systems, designed to meet specific requirements and comply with the authority having jurisdiction (AHJ): the FK-5-1-12 fire extinguishing system and the Aerosol fire extinguishing system.

9.4.1 FK-5-1-12 clean agent fire extinguishing system

The clean agent fire extinguishing system utilizes FK-5-1-12 perfluorohexanone as the extinguishing agent.

This agent is a clear, colorless, and odorless clean gas. Stored in liquid form within the cylinder, FK-5-1-12 rapidly vaporizes upon discharge, fully flooding the protected area and absorbing heat more effectively than water.

Once released, the agent evaporates quickly without causing damage to valuable assets. When integrated with the control panel, the clean agent extinguishing system detects fires at an early stage and effectively suppresses them.

9.4.2 Aerosol fire extinguishing system

The Aerosol Fire Extinguisher utilizes the GreenSol©A1000, an eco-friendly extinguisher based on SFE Powdered Aerosol technology, which is listed as Powdered Aerosol A on the USEPA Halon Alternatives SNAP list.

The A1000 is designed to combat Class A (solid fuel), Class B (liquid and gas fuel), and Class C (electrical) fires within enclosed areas. The extinguishing agent is a powdered aerosol, generated in-situ by a chemical reaction within a non-pressurized container. This reaction produces fine dry powder particles (1-5 microns) suspended in inert gases.

SFE (Powdered Aerosol A) extinguishes fires through multiple mechanisms. It combines the heat absorption properties of traditional dry powder agents with the chemical disruption abilities of Halon agents. The SFE aerosol produces active species—solid particles—that interfere with the fire by heterogeneous reactions on the particle surfaces or homogeneous reactions in the gas phase. These reactions disrupt the fire chain precursors (OH, H), preventing recombination and halting the combustion process.

Paired with the control panel, the Aerosol extinguishing system detects and extinguishes fires in their early stages.

For detailed FSS design, you can contact Gotion for more details.

9.5 Water-based fire extinguishing system

The BESS is equipped with a water-based fire suppression system designed for effective fire extinguishing. This system features prefabricated sprinkler pipes and nozzles, which can be activated either automatically or manually. If an automatic sprinkler system is required, additional construction is necessary to connect external water supply pipes and equipment to the BESS sprinkler connections, based on the specific project requirements. The system uses upright nozzles to ensure full water coverage in all areas of the container.

Each protection zone has two independent detection loops:

- Upon receiving the first fire signal, an alarm is triggered, indicating the fire location and alerting personnel.
- If a second fire signal is detected, the automatic fire extinguishing controller enters a delay stage (adjustable between 0-30 seconds). After the delay, a fire suppression command is sent to the starting bottle that controls the relevant protection zone. The solenoid valve opens, activating the aerosol fire extinguishant to suppress the fire.

Simultaneously, the alarm controller receives feedback from the pressure signal, and the control panel activates the spray indicator light. When the alarm controller is in manual mode, it only triggers the alarm without issuing an action signal. After personnel confirm the fire, they can press the emergency start button on the alarm control panel or at the entrance of the protection area to activate the system and release the fire extinguishing agent.

10 Troubleshooting

If the issue or fault cannot be resolved using this manual, please contact GOTION for assistance. To ensure prompt and efficient service, please provide the following information:

- Device serial number, manufacturing date, and software version
- Details about the external device connected, including manufacturer, model, and configuration
- Fault information along with a brief description
- Photos of the failure site (if possible)

11 Routine maintenance

The following recommended maintenance cycle should be adjusted based on the specific installation environment of the product. Factors such as the size of the power plant, installation location, and site environment will influence the maintenance cycle. For example, if the operating environment is windy and sandy, leading to significant dust accumulation, the maintenance interval should be shortened, and the frequency of maintenance increased.

⚠ CAUTION

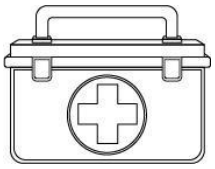
Safety requirements for maintenance and repair:

- Before connecting or disconnecting cables, turn off the protection switch for the corresponding circuit.
- Place a warning sign indicating that the switch must not be turned on at the switch location.
- Verify the appropriate voltage level by checking for any live equipment and ensure the equipment is fully powered off.
- If live parts are found nearby, block or cover them with insulating plates or insulating tape.
- Before starting maintenance or repairs, securely connect the circuit to be serviced to the main ground loop using a grounding cable.
- After completing maintenance or repairs, remove the grounding cable between the serviced circuit and the main ground loop.

11.1 Pre-maintenance preparation

NOTE

This section lists only PPE. For detailed information on the tools required for replacement, refer to the specific parts replacement section.

 Insulated gloves	 Protective gloves	 Goggles	 Dust mask
 Insulated shoes	 Reflective vest	 Safety helmet	 Safety harness
 Medical kit	-	-	-

11.2 Maintenance precautions

To safely and effectively maintain the system, maintenance personnel must carefully read and adhere to the following safety guidelines:

- Must possess a valid electrician certificate and have completed professional training.
- Follow all relevant safety precautions, use appropriate tools, and wear personal protective equipment.
- Wearing metal accessories such as jewelry or watches is strictly prohibited.
- Under no circumstances should both hands touch the high-voltage positive and negative terminals of the energy storage system simultaneously.
- Disconnect all high-voltage and low-voltage switches before performing any maintenance on the battery energy storage system.
- Avoid cleaning with water; if necessary, use a vacuum cleaner for cleaning.
- When plugging or unplugging cables, follow proper procedures—do not use excessive force or perform violent operations.
- After maintenance, ensure all tools and materials are cleaned up and check for any metal objects left inside or on top of the equipment.
- If you have any questions regarding operation or maintenance, contact Gotion’s customer service center. Unauthorized operation is strictly prohibited.

11.3 Equipment maintenance guidelines

To ensure the safe and efficient operation of the battery energy storage system, the following comprehensive maintenance guidelines outline key procedures for regular inspection, cleaning, and system calibration.

1. **Regular Dust Removal:** Clean the system regularly, paying special attention to the fan's air inlet and outlet. Use a vacuum cleaner if necessary to ensure proper air circulation in the container. Before dust removal, cut off the power supply, and never use water for cleaning.
2. **Cable Inspection:** Regularly check the cable connection terminals for looseness, rust, or oxidation, ensuring good contact.
3. **Cable Condition:** Regularly inspect cables for signs of aging, damage, or poor insulation.
4. **Indicator Lights:** Regularly check if the indicator lights are functioning correctly and whether all system functions are normal.
5. **System Charging:** Charge the system every 3 months to maintain a SOC of at least 80%.
6. **SOC Calibration:** The BMS estimates SOC based on parameters like current and time, which can result in cumulative errors due to factors such as charge/discharge rates, temperature, and self-discharge. To correct these errors, the BMS supports full charge (100%) and full discharge (0%) calibration functions.
7. **System Inspection (Every 2 Years):** Conduct a comprehensive on-site inspection of the battery system every two years to ensure normal system function and battery status.
8. **System Upgrade:** If you notice a significant reduction in battery power supply time or frequent system failures, contact Gotion for professional diagnosis and maintenance.
9. **System Status and Alarm Check:** Regularly check the status of the battery energy storage system and alarm indicators to ensure proper functionality.
10. **Emergency Stop Button:** Regularly verify the effectiveness of the battery energy storage system’s emergency stop button to ensure quick system shutdown in emergencies.
11. **Fire Protection System:** Regularly inspect the fire protection system to ensure it is in good condition and within its validity period.
12. **Battery Modules:** Do not use different types of battery modules in series or parallel.

11.4 Routine system maintenance operations

11.4.1 Alarm check

Review the Event History to check for any major or minor alarms.

Figure 11- 1 Screenshot example of checking event history -1

Figure 11- 2 Screenshot example of checking event history -2

NOTE

You can refer to the GRID5015 O&M Manual for more details.

11.4.2 Quarterly maintenance

The table below outlines the quarterly maintenance checklist.

Maintenance category	Maintenance action	Expected result	System power off or not
Container	Conduct a visual inspection: • Appearance • Rust condition • Door locks • Vents • Temperature • Noise	• No peeling or scratched coating. • No noticeable paint peeling or rust. • Door locks are intact and undamaged. • Vents are free from dust. • No presence of insects, rodents, snakes, or other animals. • No damaged or deformed equipment inside the container. • No abnormal noise during equipment operation. • No areas of excessive temperature within the battery racks. • No oxidation or rust inside the battery racks.	No
Air conditioner[1]	• Check the appearance • Clean the filter[2]	• No obvious damage to the appearance. • No obvious paint peeling or rust. • The screws are secured. • The fans rotate properly without abnormal sound. • The filter is clean and free from blockage.	No
Integrated control panel	Check the UPS battery	The UPS battery status is normal (100% SOC)	No
Power distribution area	Check whether there are foreign objects in the power distribution area.	The area is clean and free from foreign objects.	No
Pressure relief window[3]	Conduct a visual inspection: • Appearance • Rust condition • Foreign objects, ice or snow	• No obvious paint peeling or rust. • Pressure relief windows are not damaged. • No foreign object, ice, or snow on the top.	No
Warning signs	Conduct a visual inspection: • Appearance	• No obvious paint peeling, rust, or defacement (otherwise, change if necessary).	No

Note:

1. Monthly maintenance is recommended in high-temperature environments (≥ 35°C) or low-temperature environments (≤ 0°C).
2. In sandstorm-prone areas, it is recommended to clean the filter after each sandstorm and before summer. In other areas, clean the filter as needed, ensuring the filter or condenser is not blocked. A high-pressure water gun is the suggested cleaning tool.
3. In regions with severe sandstorms or heavy ice/snow, perform maintenance as needed. Ensure there are no foreign objects, ice, or snow on the pressure relief windows. Clean these areas to prevent damage to the pressure relief devices caused by improper operation.

11.4.3 Semi-annual maintenance

The table below outlines the semi-annual maintenance checklist.

Maintenance category	Maintenance action	Expected result	System power off or not
Air conditioner	Conduct a visual inspection: • Appearance • Rust condition • Screws • Fans • Filter	• No obvious damage to the appearance. • No obvious paint peeling or rust. • The screws are secured. • The fans rotate properly without abnormal sound. • The filter is clean and free from blockage.	No
Air conditioner external fan	Clean the air filter of the external fan[1]	The filter is clean and free from blockage.	No
Ambient temperature and humidity check	Conduct a visual inspection on records	The ambient temperature and humidity records are within the operating range.	No
Smoke detector and Temperature and humidity (T/H) detector	Spot check the smoke detector and T/H detector with smoke or heat generated by using dedicated devices[2].	The smoke detector light is solid red, and the T/H detector displays temperature changes on the LCD screen.	Yes
Fire suppression module	Conduct a visual inspection and do the cleaning in necessary.	• The pressure gauge pointer of the module is in the green area. • Cables are not damaged, loose, or disconnected. • The display is normal. • The module is clean and free from dust. • Cables are intact and securely connected.	Yes
Function check	Conduct a visual inspection on event records, and do measurement using multimeter.	• Verify the operational status of the total positive and total negative relays in the high-voltage box by sending open/close commands and confirming normal operation. • Measure the 24V output voltage to ensure it falls within the specified range. • Review the operation records of the battery racks to confirm that current, voltage, and temperature are within acceptable limits. • Ensure the UPS status on the Integrated Control Panel is functioning normally.[3]	Yes

Note:
1. In areas prone to sandstorms, it is recommended to clean the filter after each sandstorm and before the summer season. In other regions, clean the filter as needed, ensuring the filter or condenser is not obstructed. A high-pressure water gun is the suggested cleaning tool.
2.Disconnect the cables from the solenoid valve before testing to avoid releasing the extinguishing agent.
3.If the UPS is not used for an extended period, charge it at least every 6 months. The battery's state of charge (SOC) will reach 90% within 3 hours. After long-term storage, it is recommended to charge the UPS for 48 hours.

11.4.4 Annual maintenance

The table below outlines the annual maintenance checklist.

Maintenance category	Maintenance action	Expected result	System power off or not
Battery pack and high-voltage box	Conduct a visual inspection: • Appearance • Rust condition • Screws • Fans • Front panel vent	• No obvious damage to the appearance. • No noticeable paint peeling or rust. • The screws are secured. • The fans rotate properly without abnormal sound. • The front panel vent is clean and free from blockage. • No flammable object on top of the battery racks. • The mounting points between the battery rack and the foundation steel plate in the container are secure, with no signs of corrosion. • No coolant leakage.	Yes
Cabling and wiring connections	Conduct a visual inspection.	• Ensure the cable layout and wiring are correct, with no damaged cables, proper connector placement, and no overlap or short circuits. Any abnormalities should be corrected immediately. • Verify that all inlet and outlet openings on the battery racks are properly sealed. • Inspect the battery racks for any signs of water seepage. • Check if the DC cable and copper bar connections are loose. • Inspect the power and communication cables for any damage, paying particular attention to areas where the cable insulation may be in contact with metal surfaces for signs of cuts or wear.	Yes
Grounding	Conduct a visual inspection and take measurements using a multimeter.	Check whether the grounding connection is correct, and the grounding resistance value should not be greater than 4Ω.	Yes

Appendix

Appendix I: Emergency handling

If an accident occurs onsite (including but not limited to the scenarios below), prioritize the safety of onsite personnel and contact the Company's service engineers.

Battery falling or strong impact:

- If the battery shows obvious damage, or if there is an abnormal odor, smoke, or fire, evacuate personnel immediately, call emergency services, and contact professionals. Professionals should use fire extinguishing facilities with safety protection to extinguish the fire.
- If there is no deformation or visible damage, and no abnormal odor, smoke, or fire, ensure safety and proceed as follows:
    - Warehouse: Evacuate personnel, have professionals using mechanical tools transfer the battery to a safe, open area, and contact the Company's service engineers. Leave the battery for an hour and ensure its temperature is within the room temperature range (±10°C) before handling.
    - ESS Onsite: Evacuate personnel, close the ESS doors, have professionals using mechanical tools transfer the battery to a safe, open area, and contact the Company's service engineers. Leave the battery for an hour before handling.

Flood:

- Power off the system if safe.
- Avoid touching any submerged batteries to prevent electric shock.
- Do not use water-soaked batteries. Contact a battery recycling company for disposal.

Fire:

- If a fire occurs, power off the system if safe.
- Use carbon dioxide, FM-200, or ABC dry powder fire extinguishers to extinguish the fire.
- Advise firefighters to avoid contact with high-voltage components to prevent electric shock.
- Overheating can lead to battery deformation, malfunctions, and the release of corrosive electrolytes or toxic gases. To avoid skin irritation and chemical burns, use respiratory protective equipment and maintain a safe distance from the batteries.

Fire alarm horn/strobe:

- When the alarm indicator blinks or buzzes, do not approach, open doors, or stay nearby.
- Cut off the power supply remotely only when your safety is ensured.

Gas exhaust:

- Onsite personal protection: Avoid direct exposure to exhaust vents.
- Post-disaster product maintenance: Contact the Company's service engineers for evaluation.

Extinguishant release or fire:

- **Onsite O&M personnel suggestions:**

  a. In the event of a fire, evacuate the building or equipment area, activate the fire alarm, and

call the fire emergency service. Provide professional firefighters with relevant product information.

b. Do not enter the affected area under any circumstances or open the ESS doors. Isolate and monitor the site and keep unauthorized personnel away.

c. After alerting the fire service, remotely power off the system while ensuring your own safety.

d. Provide professional firefighters with all relevant product information upon their arrival.

e. After the fire is extinguished, have professionals manage the site according to local laws. Do not open ESS doors without permission.

f. Post-disaster product maintenance: Contact the Company's service engineers for evaluation.

- **Professional firefighters suggestions:**

a. Refer to product information provided by O&M personnel.

b. Do not open ESS doors until it is deemed safe by professionals.

c. Adhere to local firefighting regulations.

For further details, refer to Gotion’s Emergency Response Plan.

Appendix II: References

1. **Internal Standards:**

- QB/GX, "Regulations on Hoisting and Transportation of Prefabricated Cabin Energy Storage Power Stations (Updated Version)," effective from May 20, 2019.

2. **Internal Document:**

- "Liquid-cooled Energy Storage System Station-Level Layout Guidance," November 2023, Version 1.0.

3. **Industry Standards:**

- GB/T 36276, "Lithium-ion Battery for Electrical Energy Storage."
- NFPA 70, "National Electric Code."
- NFPA 885, "Standard for the Installation of Stationary Energy Storage Systems."
- NFPA 70E, "Standard for Electrical Safety Requirements for Employee Workplace."
- NFPA 72, "National Fire Alarm and Signaling Code."
- NFPA 2001, "Standard on Clean Agent Fire Extinguishing Systems."

Note: The above standards are provided for quick reference. For a comprehensive list of references, please consult with Gotion.