TRAIL ROAD BESS FACILITY

EMERGENCY RESPONSE PLAN (ERP)

Rev 4.0 | July 2026

Summary

This document serves as the Preliminary Emergency Response Plan (ERP) for the Trail Road energy storage facility to be located in Richmond, Ontario, Canada. This ERP will be finalized prior to commissioning.

Only an ERP with input from the local first responders can provide true guidance and pertinent information regarding the roles, responsibilities, and chain of communication and command of the System Owner / Operator, Property Owner, and other required Subject Matter Experts (SMEs) for preparing for, and safely responding to, a fire, overpressure event, or other battery-related incident requiring a public safety response at the energy storage facility.

LIFE SAFETY SHALL BE THE HIGHEST PRIORITY DURING ANY TYPE OF EVENT

Prepared For:

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EMERGENCY CONTACT INFORMATION

IN CASE OF EMERGENCY CALL 911

LOCAL FIRE DEPARTMENT

Ottawa Fire Services

Phone: (613) 232-1551 (Non-emergency)

Address: 1445 Carling Avenue
Ottawa, ON K1Z 7L9
Canada

LOCAL POLICE DEPARTMENT

Ottawa Police Service

Phone: (613) 236-1222 (Non-emergency)

Address: 211 Huntmar Drive
Stittsville, ON K2V 1E2
Canada

HOSPITAL EMERGENCY ROOM

Queensway Carleton Hospital

Phone: (613) 721-2000

Address: 3045 Baseline Road
Ottawa, ON K2H 8P4

LOCAL BURN CENTER

The Ottawa Hospital, Civic Campus

Phone: (613) 722-7000

Address: 1053 Carling Avenue
Ottawa, ON K1Y 4E9

SUBJECT MATTER EXPERT (SME)

INTERIM – FOR CONSTRUCTION PHASE ONLY

(Will be updated prior to facility operation)

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NETWORK OPERATIONS CENTER

Phone: **TBD**

SYSTEM OWNER / OPERATOR

XXXXXXXXXXXXXXXXX

Phone: (XXX) XXX-XXXX

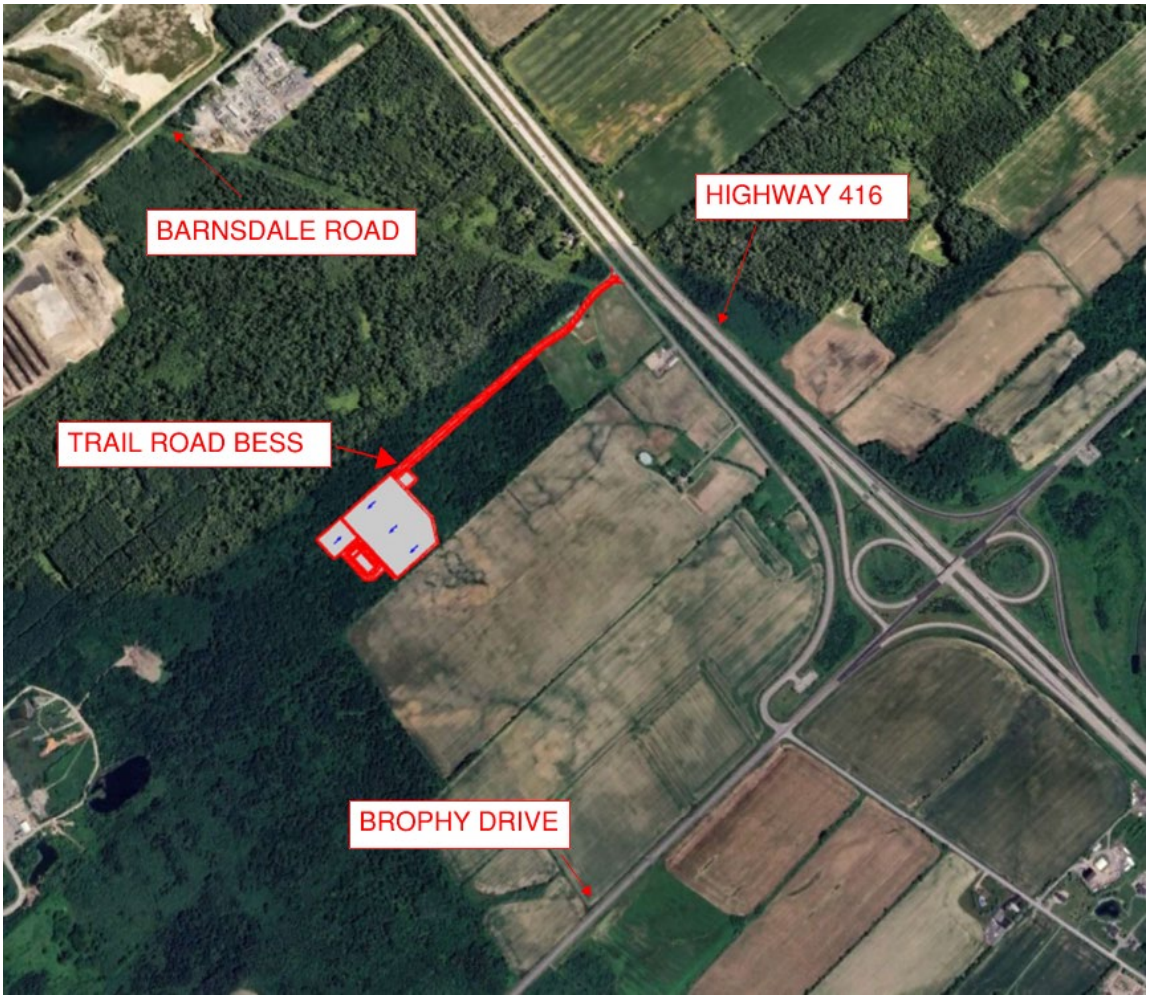
Address: XXXXXXXXXXXXX
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ENERGY STORAGE SYSTEM INFORMATION

TRAIL ROAD ENERGY STORAGE FACILITY

Site Address: 4186 William McEwen Drive
Richmond, ON K0A 2E0

GPS Coordinates: 45°12'52.11"N 75°45'1.17"W



ENERGY STORAGE SYSTEM

Make / Model: Sungrow PowerTitan 2.0

Total MW / MWh: 150MW / 600 MWh

 # Units: 156

FIRE DETECTION SYSTEMS

- Two (2) heat detectors per BESS enclosure
- Four (4) smoke detectors per BESS enclosure
- One (1) H2 gas detector per BESS enclosure
- One (1) CO gas detector per BESS enclosure
- Six (6) Deflagration Panels

EXPLOSION PROTECTION

Active exhaust ventilation system triggered by gas detectors within BESS enclosure to remove flammable gases from enclosure before explosive concentrations are able to accumulate.

WATER SUPPLY

85,000L water storage with remote hydrant system will be available on site to support fire department operations.

PROJECT INFORMATION

Project Name	**Trail Road Emergency Response Plan**
Project No.	25-20150
Prepared For	Evolugen 41 Victoria St. Gatineau, QC J8X 2A1 Canada
Revision No.	Rev 4.0
Document No.	
Date of Issue	7/3/2026

REVISION HISTORY

Revision No.	Date of Issue	Substance of Change
Rev 0.1	3/5/2025	Draft issue- G Baade
Rev 0.1a	5/2/2025	Updates as per client comments.
Rev 0.1b	5/27/2025	Updates as per client comments.
Rev 0.1d	7/7/2025	Updates as per client comments.
Rev 2.0	1/21/2026	Updates as per client comments.
Rev 3.0	1/26/2026	Updates as per client comments. Issued for permit-site plan control.
Rev 4.0	7/3/2026	Updates as per client comments.
		For a list of revisions made by the client, please see Appendix.

Note 1: *The information in this document is subject to change while in DRAFT status and may be modified in the event of modifications to equipment or other factors affecting the design of the system or site.*

Note 2: *During the operating life span of the project, it is expected that this document shall be reviewed annually, and that all pertinent information shall be appropriately updated as necessary. This ERP is compiled based upon current design and usage at the time of this writing.*

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Upon acceptance of this "as designed" interim draft, which may be made public as an "*as designed release*," ESRG shall treat this document as ready for release but shall not mark the document as "*as-built final*" until ESRG can confirm, via personnel on site, that the system, "*as-built,*" aligns with the reviewed and reported design.

The industry, related technology, and best practices are rapidly evolving and changing regularly. It has been observed that changes often occur to a project through the construction phase, be they to the battery itself or to the balance of system. As such, an "*as-designed release*" document should be considered final only if no changes are made to the system from design to construction to completion. If it is 100% accurate, it will be released unchanged. However, should ESRG encounter deviations from the design, the document will be amended accordingly per the design changes and then released as a final document.

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ACRONYMS

AR	Arc-Rated
BMS	Battery Management System
E-Stop / EPO	Emergency Stop / Emergency Power Off
ERP	Emergency Response Plan
EMS / ESMS	Emergency Management System / Energy Storage Management System
ERG	Emergency Response Guide (generic, product-level emergency response guide)
ESRG	Energy Safety Response Group
ESS / BESS	Energy Storage System / Battery Energy Storage Management System
FACP	Fire Alarm Control Panel
IC	Incident Commander
ICS	Incident Command System
kW	Kilowatt(s)
kWh	Kilowatt-hour(s)
LFL / LEL	Lower Flammability Limit / Lower Explosive Limit
LFP	Lithium Iron Phosphate
MW	Megawatt(s)
MWh	Megawatt-hour(s)
NOC	Network Operations Center
O&M	Operations and Maintenance
PCS	Power Conversion System
PPE	Personal Protective Equipment
SCBA	Self-Contained Breathing Apparatus
SDS	Safety Data Sheets
SME	Subject Matter Expert
SOC	State of Charge
UICS	Unified Incident Command System
UFL / UEL	Upper Flammability Limit / Upper Explosive Limit

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1 INTRODUCTION

1.1 Scope and Purpose

This Emergency Response Plan (ERP) is provided for the Trail Road Battery Energy Storage System (BESS) facility located at 4186 William McEwen Drive, Richmond ON, K0A 2E0, Canada. The purpose of this document is to provide guidance and pertinent information regarding the roles, responsibilities, and chain of communication and command of the System Owner / Operator, Property Owner, and other required Subject Matter Experts (SMEs) for preparing for, and safely responding to, a fire, explosion, or other battery-related incident requiring a public safety response at the energy storage facility.

A competent O&M manager will be hired and trained before the facility is operational. "On-site personnel" include all individuals on the facility property who are direct employees of the Owner / Operator or affiliated contractors. The Owner / Operator and contractors are similarly responsible for establishing and maintaining contractor-specific Emergency Response Plans and reporting procedures that will work in conjunction with the overall energy storage facility plan.

Life safety shall be the highest priority during any type of event.

1.2 Activation

This Emergency Response Plan shall be activated during any emergency response to a battery-related incident on-site.

1.3 Incident Command System (ICS)

The System Owner / Operator, Subject Matter Experts, Remote Monitoring Facility staff, and all energy storage system-related personnel shall comply with the orders of the Incident Commander (IC) and the command staff.

1.4 Operations and Maintenance (O&M)

Operations and maintenance procedures for the energy storage facility and associated equipment are outside the scope of this document. Please see Sungrow's ***Operation & Maintenance Instruction manual, PowerTitan 2.0 Series.***

Please refer to manufacturer Operations and Maintenance manuals for all associated equipment related to the site prior to beginning any work on this installation.

1.5 ERP Update Process

1.5.1 Issuance and Revisions

Dates for draft issuance, revisions, and final issuance of this ERP are provided on Page 5 of this document.

Updates to this ERP based on any major material changes to the installation are the responsibility of the System Owner / Operator and other relevant entities as required.

1.5.2 Annual Review

During the operating life span of this installation, it is expected that this document shall be reviewed annually, with all pertinent information updated as required.

1.5.3 Plan Retirement

All decommissioning procedures should be performed by trained and knowledgeable persons in alignment with the Decommissioning Plan provided for this installation. Decommissioning shall be performed under the supervision of the System Owner / Operator responsible for this installation.

Notification of decommissioning shall be provided to the Fire Department by the System Owner / Operator responsible for this installation.

1.6 Fire Department Training

Initial and recurring training will be provided to Ottawa Fire Services in accordance with the requirements set forth in NFPA 855.

The initial site training will include Ottawa Fire Services and any emergency response staff that OFS requests to attend. Attendance is at the discretion of OFS, based on who they feel should have knowledge of this facility to enhance the Fire Department's response to an incident.

The initial site training will include a site walkdown to teach staff about the site layout, including the location of the retention pond gate valve and the fire alarm control panel.

An emergency response dry run will also be completed, so the fire department can rehearse their response plan for an emergency scenario.

Recurring trainings will include yearly per the requirements of NFPA 855, and will focus on training new employees on the site, and updating all staff on changes to the facility, along with industry codes. Agendas for these trainings will be developed and circulated to OFS for comments prior to the session, to ensure they capture the needs of the Fire Department.

2 SITE OVERVIEW

2.1 Site Location

The Trail Road BESS Facility will be located on a 16.3-acre parcel of land located at 4186 William McEwen Drive, Richmond, ON, K0A 2E0, Canada. The site will consist of 156 Sungrow PowerTitan 2.0 BESS enclosures as depicted in Figure 1 below.

The site is located in a largely rural area, about 24 km south of Ottawa. It is surrounded by forest and open farmland on three sides, with the remaining side bordered by William McEwen Drive. Route 416/ Veterans Memorial Highway runs directly beside William McEwen Drive.

SITE INFORMATION		
Site Address:	4186 William McEwen Drive Richmond ON, K0A 2E0 Canada	
GPS Coordinates:	45°12'52.11"N 75°45'1.17"W	**Special Flood Zone:** No

Figure 1 – Site Layout

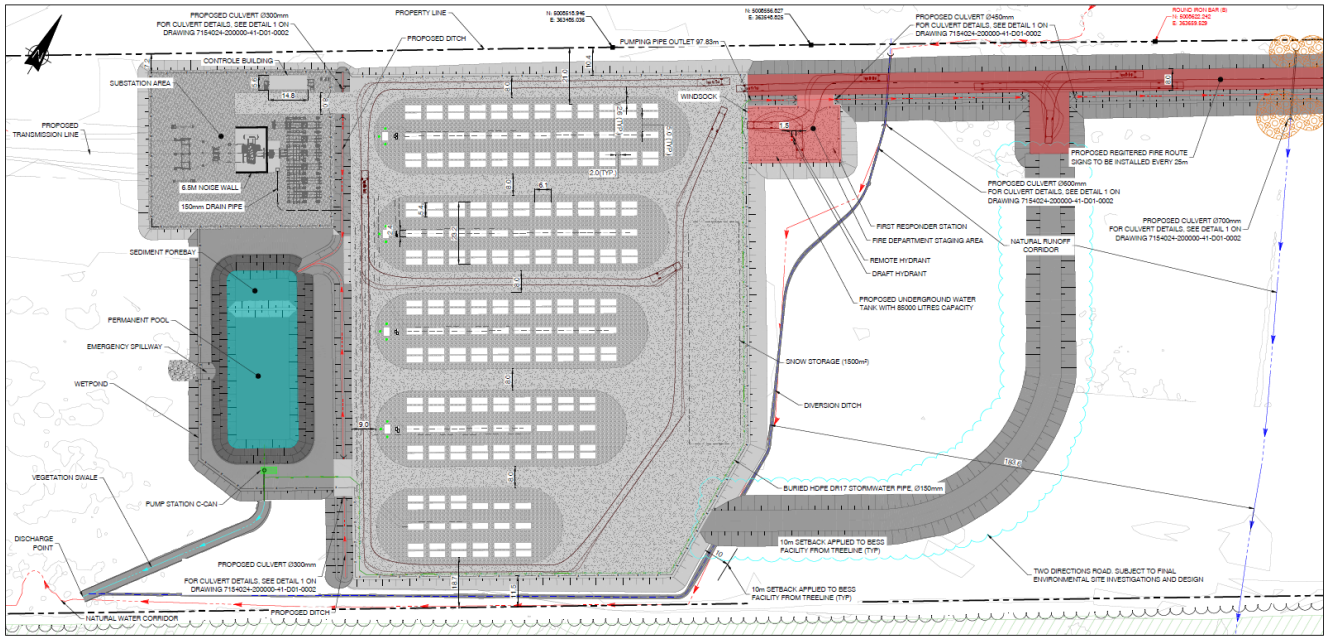


Figure 2 – Aerial View



2.2 Fire Department Staging Area

The fire department staging area and safety assembly area for any onsite personnel is located east of the BESS perimeter fence line.

It is recommended that fire department staging areas are established at angles relative to the sides of the BESS enclosures to reduce potential impact from flying projectiles or debris in the event of an explosion event.

The fire department should not attempt to enter the BESS fence line prior to incident size-up and coordination with the facility's designated SME, or as otherwise determined at the ultimate discretion of the IC.

2.3 First Responders Station

A weatherproof enclosure housing a physical copy of the Emergency Response Plan (ERP), operational permits, O&M logs, and product manuals will be located east of the BESS facility, just outside the gate in the Fire Department Staging Area. This is the

designated First Responder Station. The enclosure will be large enough to house the FACP, a small desk, chairs, and have electrical outlets for power.

2.4 Site Access

There will be an 8.0-meter-wide access road starting at the entrance off of William McEwen Drive that provides access to the northeast corner of the site and around all the BESS enclosures. A site access gate will be provided for fire department access. In addition, there will be a secondary access road loop that extends to the south and enters the facility at the southeast corner (Figure 1). As noted above, the fire department should not attempt to enter the site fence line unless there is a clear threat to life safety.

2.5 Lock Box Access

A lock box containing a physical copy of the ERP, operational permits, O&M logs, product manuals, etc., is provided at the site entrance.

2.6 Equipment Access

The Sungrow PowerTitan 2.0 BESS enclosures are only accessible for maintenance purposes via cabinet-style enclosure doors and cannot be physically entered by personnel at any time.

The Fire Department should not attempt to open the enclosure doors at any time.

2.7 Water Supply

There will be seven (7) fire hydrants on the site that will be fed by an 85,000-liter underground water tank. In addition, water from the onsite retention pond can also be utilized by responding FD personnel.

2.8 Fire Alarm Control Panel

The primary Fire Alarm Control Panel (FACP) will be located within the fire department staging area.

2.9 Water Retention

Best practice dictates not to use any water directly on an affected enclosure. However, if the IC deems fire hose streams necessary, the water runoff will be captured within the wet pond. The wet pond will be lined with an impermeable barrier that will not allow any contaminants to pass through. Upon arrival to the site, the IC shall order the control room to close the gate valve on the wet pond outlet. If the control room is unresponsive, or the control system has failed, the valve can be manually closed by responders by turning the handcrank on the valve.

The facility owner will complete soil and water testing pre-install to develop baseline soil and water compositions. After an event where the SME deems water or soil contamination is possible, the following testing schedule will be adhered to:

- Within 1 week of event
- 1 month after event
- 3 months after event
- 6 months after event
- 1 year after event
- Ongoing as needed (determined by the appointed SME)

A City of Ottawa Program Manager of Environmental Remediation will work with the proponent SME, as required, to validate the testing completion.

2.10 Nearby Exposures

The facility site is surrounded on three sides by forest and open land, and William McEwen Drive on the remaining side. Additionally;

- A private residence (4160 William McEwen Dr) is located to the north, adjacent to the roadway, about 120m from the site property line.
- A small landscaping business sits at 4236 William McEwen Drive, adjacent to the site property line and William McEwen Drive.

Figure 3 - Nearby Exposures



2.11 Associated Electrical Equipment

- **Energy Storage System:** Sungrow PowerTitan 2.0
- **Medium Voltage Transformer (MVT):** Sungrow MVS5140-LS-US
- **Inverters / PCS:** Medium Voltage Transformer (MVT): Sungrow SC210HX-US

2.12 Site Maintenance

The facility's interior access roads shall be maintained to guarantee accessibility to the site by emergency personnel, especially during inclement weather. Owner/operator or their designee shall ensure landscaping and other ongoing upkeep activities are in place prior to construction.

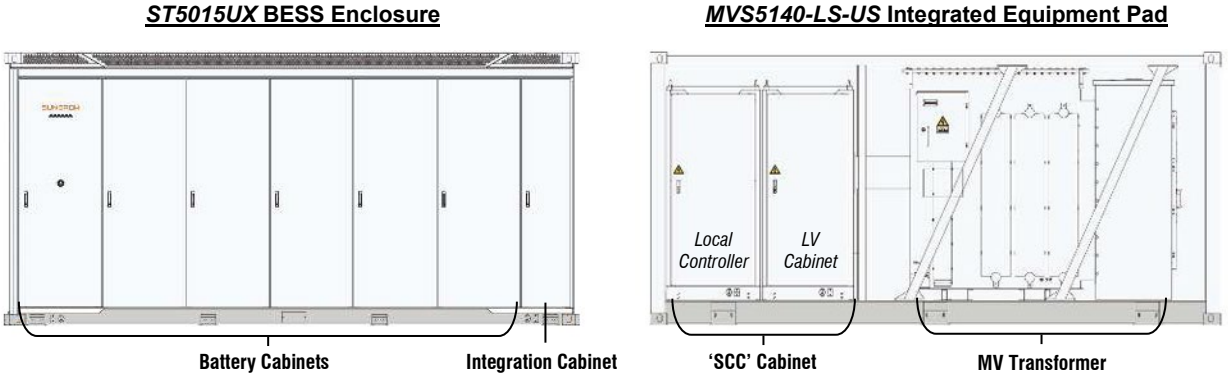
3 ENERGY STORAGE SYSTEM OVERVIEW

The Trail Road BESS facility will utilize 156 Sungrow PowerTitan 2.0 BESS enclosures, each providing approximately 5015 kWh. Each PowerTitan enclosure consists of battery modules utilizing lithium iron phosphate (LFP) battery cells.

Each PowerTitan enclosure is equipped with NFPA 68-compliant vent panels to control the release of pressure if the flammable gases released during battery failure ignite within the enclosure.

Each PowerTitan enclosure is equipped with four (4) smoke detectors, two (2) heat detectors, and two (2) gas detectors (one H2 and one CO), a battery management system (BMS), and an active NFPA 69 exhaust ventilation system for removal of flammable gases from within the enclosure in the event of a battery failure as well as deflagration panels. Additional information on fire protection systems is provided in Section 4 below.

Figure 4 -Typical Sungrow PowerTitan 2.0



4 FIRE PROTECTION SYSTEMS

4.1 Exhaust Ventilation System

The PowerTitan 2.0 is equipped with an exhaust ventilation system designed in accordance with NFPA 69: Standard on Explosion Prevention Systems to remove flammable gas from the enclosure before an explosive atmosphere is allowed to accumulate. The system consists of one exhaust fan with a rated flow rate of 750 m3/h (441 CFM). In the event that the flammable gas detector (described above) is activated, the FSS air intake equipment and FSS exhaust equipment are triggered.

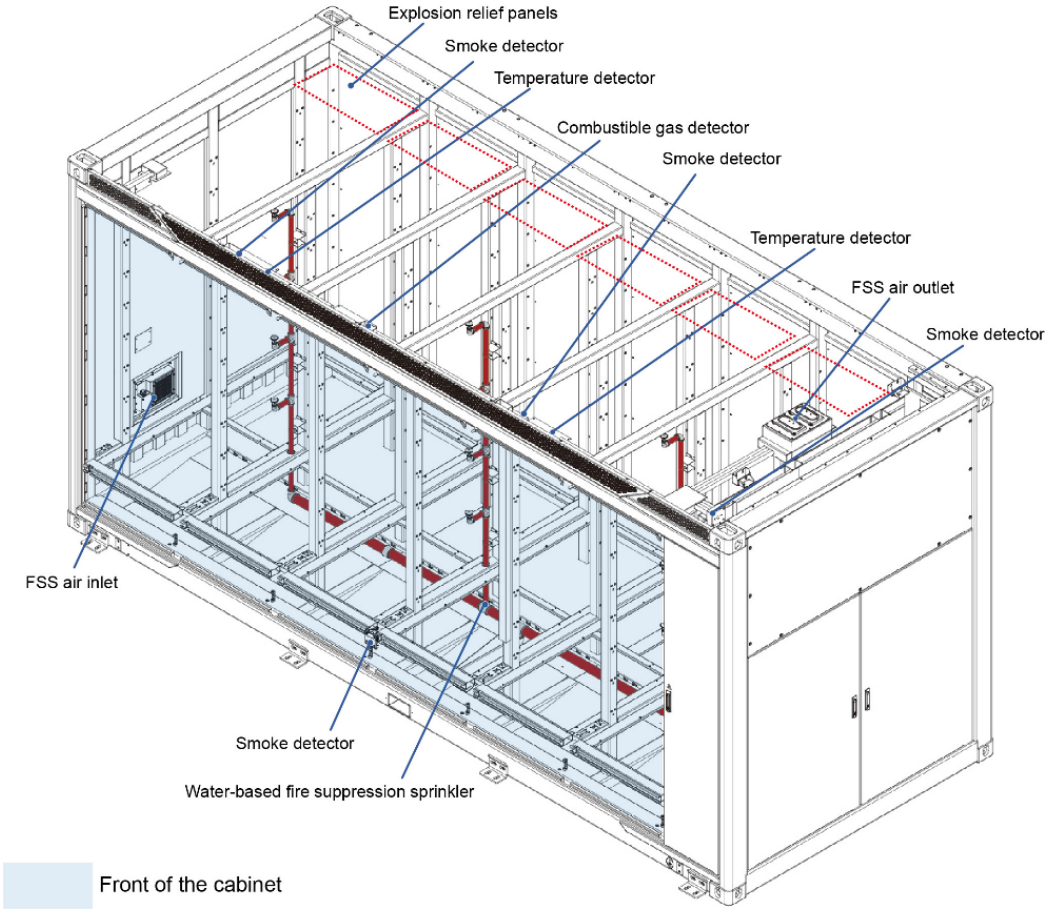
WARNING: Risk of Explosion / Deflagration	
	An explosion/deflagration / over-pressure event is a critical hazard, and any emergency on-site should always be addressed with full awareness of potential factors which may lead to such an event. **Any failure or alarm condition should result in the assumption of an explosion risk.**

WARNING: Risk of Re-ignition	
	Do **NOT** assume the fire is out as the fire event unfolds. A lithium-ion battery fire which has seemingly been extinguished may flare up again if all cells within the enclosure have not been completely consumed.

4.2 Fire Protection

Each PowerTitan enclosure comes equipped with a number of fire safety devices (referred to as the “Fire Suppression System” or FSS in Sungrow documentation). By default, each enclosure includes two (2) heat detectors, four (4) smoke detectors, a dedicated UL 864-listed Fire Alarm Control Panel (FACP), and six (6) deflagration vent panels located in the roof of the enclosure. Additional features including flammable gas detectors, sounder beacon, internal sprinkler heads, and emergency ventilation system may be requested by customers on a project-specific basis.

Figure 5 - Fire and Life Safety Layout



WARNING: Risk of Re-ignition	
	Do **NOT** assume the fire is out as the fire event unfolds. A lithium-ion battery fire which has seemingly been extinguished may flare up again if all cells within the enclosure have not been completely consumed. The risk of battery re-ignition can remain present for hours or even days after the smoke/flame is initially detected.

WARNING: Risk of Explosion / Deflagration	
	An explosion/deflagration / over-pressure event is a critical hazard, and any emergency on-site should always be addressed with full awareness of potential factors which may lead to such an event. **Any failure or alarm condition should result in the assumption of an explosion risk.**

WARNING: Electrical Shock Hazard	
	In case of flooding, stay out of the water if any part of the BESS enclosure(s) or wiring is submerged.

4.3 Emergency Shutoffs

Emergency shutoff is provided at multiple levels, though the Fire Department should not engage with E-Stops, as ESS shutdown may adversely affect the electrical grid.

The Fire Department should not engage with E-Stops, as ESS shutdown may adversely affect the electrical grid. Any interaction with E-Stops should only be initiated in coordination with the System Owner and other SMEs as is deemed necessary.

4.3.1 Site-Level E-Stop

Manual Emergency Stop (E-Stop) / Emergency Power Off (EPO) switch(es) are located within the facility. The exact location will be provided once the final layout is approved.

The Fire Department should not engage with E-Stops, as ESS shutdown may adversely affect the electrical grid. Any interaction with E-Stops should only be initiated in coordination with the System Owner and other SMEs as is deemed necessary.

4.3.2 Enclosure-Level E-Stop

Each PowerTitan enclosure is equipped with an AC circuit breaker located within the Electrical Cabinet and is to be used only by authorized maintenance or operations personnel.

In the event of a battery-related failure, the Fire Department should not approach any battery enclosures or engage with any enclosure E-Stops.

CAUTION: Risk of Stranded Energy	
	Shutting off power to the BESS enclosure(s) does not de-energize the battery and shock hazard may still be present. Always treat the batteries as Energetic Hazardous Materials, as they may maintain their State of Charge (SOC) long after the removal of power to the overall ESS.

WARNING: Risk of Fire and Explosion	
	Risk of fire or explosion may be present in the event of a battery failure. The Fire Department should not attempt to engage with any site or enclosure E-stops. Assistance in shutdown should be provided by the System Owner / Operator and any other required SMEs.

WARNING: Electrical Shock Hazard	
	In case of flooding, stay out of the water if any part of the BESS enclosure(s) or wiring is submerged.

4.4 Battery Management System (BMS)

An integrated Battery Management System (BMS) monitors key datapoints such as voltage, current, and state of charge (SOC) of battery cells, in addition to providing control of corrective and protective actions in response to any abnormal conditions. In the event of any abnormal conditions, the BMS will generally first raise an information warning, and then trigger a corresponding corrective action should certain levels be reached. Critical BMS sensing parameters include, but are not limited to:

- Over / under temperature limits
- Over / under voltage limits
- Over / under current limits
- Communications loss

BMS data is monitored by a 24/7 Network Operations Center (NOC) and is accessible to the System Owner / Operator and, based on the nature of a potential ESS failure, may provide information on the state of the batteries to corporate first responders.

5 FIRE DETECTION, ALARMING, AND NOTIFICATION

5.1 Fire Detection Systems

Each PowerTitan enclosure is equipped with four (4) smoke detectors and two (2) heat detectors to provide detection of fire or abnormally high temperatures within the enclosure.

Additionally, each PowerTitan enclosure is equipped with one (1) hydrogen gas detector, which, upon detection of flammable limits within the enclosure, activates the active exhaust ventilation system to remove flammable gases from the enclosure before explosive concentrations are allowed to accumulate. Lastly, each PowerTitan enclosure is equipped with one (1) carbon monoxide (CO) gas detector, which, upon detection of CO, activates the active exhaust ventilation system to remove CO gases from the enclosure before CO concentrations are allowed to accumulate.

Activation of smoke, heat, or gas detectors shall result in the following actions:

Actions Triggered Upon Smoke, Heat, and Gas Detection:

- Activation of any smoke or heat detector will automatically send an alarm signal to the Fire Alarm Control Panel (FACP).
- Activation of a combustible gas detector upon detection of 10% LFL will send a supervisory signal to the FACP and initiate the explosion prevention (exhaust ventilation) system.
- The master FACP reports to a Network Operations Center (NOC), which then transmits to the System Owner / Operator
- All alarms are tied into the BMS and are available to the NOC.

5.2 Central Station Monitoring

In the event of heat, smoke, or gas detection within the BESS enclosure, the site FACP shall send Alarm and Supervisory signals to the Central Station, which shall then be relayed to the local fire department to coordinate dispatch of responding units.

Table 1 – Central Station Monitoring Facility Information

Central Station Monitoring Facility Name ▪ **Phone:** TBD ▪ **Additional Information:** TBD

5.3 Remote Monitoring Facility

In addition to monitoring by the Central Station, remote monitoring of BMS operation is provided by the 24/7 Operations Center. In the event of a battery-related failure transmitted by the BMS, alarm notifications and other pertinent information on the state of the ESS shall be sent to the System Owner to inform potential emergency response procedures as needed.

Additionally, if more detailed information on the state of the Sungrow PowerTitan 2.0 BESS unit is required, the Operations Center should be contacted.

Table 2 – 24/7 Network Operations Center Information

24/7 Network Operations Center (for Emergency Use)

- **24/7 Emergency Hotline: TBD**
- **Email Support: TBD**

6 GENERAL HAZARDS ASSOCIATED WITH BATTERY ENERGY STORAGE SYSTEMS

Lithium-ion battery failures pose several major risks, as briefly described in the sections below. Specific response procedures for different incident scenarios are provided in Section 8 of this document.

6.1 Thermal Runaway

The defining characteristic of lithium-ion battery failures is a state known as thermal runaway. Thermal runaway is a chemical process where self-heating in a battery exceeds the rate of cooling, causing high internal temperatures, melting, off-gassing/venting, and in some cases, fire or explosion. Thermal, mechanical, and electrical abuse can lead to thermal runaway; internal short circuit from manufacturing defects; or the development of metallic dendrites that form an internal short over time.

Flammable and potentially explosive gases (generally white in color) typically evolve when a BESS goes into thermal runaway and may be released in large quantities from battery cells or modules. Fire and explosive incidents may result, and precautions as described in sections below should be observed.

6.2 Fire and Re-ignition

Lithium-ion battery fires burn extremely hot (upwards of 1,000 – 1,500°C) and are generally not easily extinguished. Fire growth may be slow, fast, or ultra-fast (e.g., during a deflagration event) in nature, and may last for several hours before the battery modules are completely consumed. Furthermore, even when a lithium-ion battery fire appears to be fully extinguished, re-ignition risk may still be present hours or even days after there are no visible signs of fire.

Application of water directly to affected battery modules may potentially prolong the incident, and the decision to apply water should be made in coordination with the System Owner / Operator and any other required SMEs.

WARNING: Risk of Re-ignition	
	Do **NOT** assume the fire is out as the fire event unfolds. A lithium-ion battery fire which has seemingly been extinguished may flare up again if all cells within the enclosure have not been completely consumed. The risk of battery re-ignition can remain present for hours or even days after the smoke/flame is initially detected.

NOTICE	
	Indicators which may provide insight into what is happening or about to happen during an incident may include: ▪ Smoke or flames ▪ Change in smoke color ▪ Change in velocity or volume of smoke production ▪ Sounds – popping and/or hissing ▪ Smell – sweet smell

6.3 Explosion

Lithium-ion batteries release flammable off-gases during thermal runaway which, if allowed to accumulate within the enclosure, may create an explosive atmosphere, posing serious risk to first responders and nearby exposures. These gases may accumulate within the BESS enclosure at levels above the Lower Explosive Limit (LEL). At sufficiently high accumulations, gases can also exceed their Upper Explosive Limit (UEL), at which point ventilation may bring the environment back into flammable limits, thus creating a new explosion risk.

It may be difficult to discern conditions within the enclosure if smoke and gas are not visible outside of the enclosure. Furthermore, a single battery cell may release enough flammable off-gas to generate an explosive atmosphere within the enclosure. Therefore, any failure or alarm condition should always result in the assumption of a potential explosion risk.

WARNING: Risk of Explosion / Deflagration	
	An explosion/deflagration / over-pressure event is a critical hazard, and any emergency on-site should always be addressed with full awareness of potential factors which may lead to such an event. **Any failure or alarm condition should result in the assumption of an explosion risk.**

6.4 Electric Shock

Even if a battery may look to be destroyed by fire and/or other means, there is potential that the battery still contains stranded energy and remains energized. De-energization of the system or any removal of the battery or battery component shall only be performed by a trained and competent individual with appropriate PPE.

Normal overhaul of the BESS enclosure should not be attempted by the fire department in any circumstances, as there are considerations for handling damaged batteries requiring equipment and expertise not readily available. Once the scene is secured, these actions may be undertaken by trained experts under close supervision.

WARNING: Risk of Stranded Energy	
	Always treat the batteries as Energetic Hazardous Materials, as stranded energy is likely to remain present. Traditional Fire Department overhaul should **NOT** be conducted due to the potential for stranded energy.

6.5 Arc Flash

All BESS systems and related electrical equipment shall always be treated as energized (Energetic Hazardous Material).

Arc-rated PPE and appropriately trained personnel are required when working on or accessing equipment within an Arc Flash Boundary. In general, when in direct proximity of the battery enclosure, wear a non-melting or untreated natural fiber long-sleeve shirt, long pants, safety glasses, hearing protection, and leather gloves. AR plant clothing is also acceptable. Maintain arc flash boundary until completion of any particular task.

6.6 Toxic Smoke and Gas Emission

Lithium-ion batteries may release large quantities of flammable and toxic gas when undergoing failure and pose an inhalation hazard. Chemicals consumed during a thermal runaway event will produce copious amounts of smoke.

The BESS site perimeter should not be entered during a fire or off-gassing event unless there is an imminent threat to life safety, at which time only properly trained and equipped public safety personnel may enter. This entry shall be with full firefighter protective gear to include self-contained breathing apparatus (SCBA).

A fog pattern from a handline or monitor nozzle may be an effective way to control the off-gassing event on the exterior of the battery container from migrating to unwanted areas. However, if water is used in extinguishing flames, these gases can become acids, which may cause skin irritation.

WARNING: Toxic Gases	
	Large quantities of toxic smoke and gas may be emitted from the BESS enclosure(s) during battery off-gassing or fire situations. **Proper PPE including SCBA should be worn by first responders.**

NOTICE	
	Typical composition of battery off-gassing event may include: ▪ High concentrations (>10%) of Hydrogen, Carbon Monoxide, Carbon Dioxide ▪ Lower concentration (<10%) of Methane, Ethane, or other flammable hydrocarbons

6.7 Additional Hazards and Considerations

For additional hazards associated with leaked coolant, leaked refrigerant, leaked electrolyte, or emergency considerations during storage, operation, transportation, or first aid measures, and disposal procedures, please see product-level Emergency Response Guide.

7 EMERGENCY RESPONSE CONSIDERATIONS

7.1 Emergency Contacts

A list of emergency contacts associated with this installation is provided on Page 3.

7.2 Equipment and Personnel Protective Equipment (PPE)

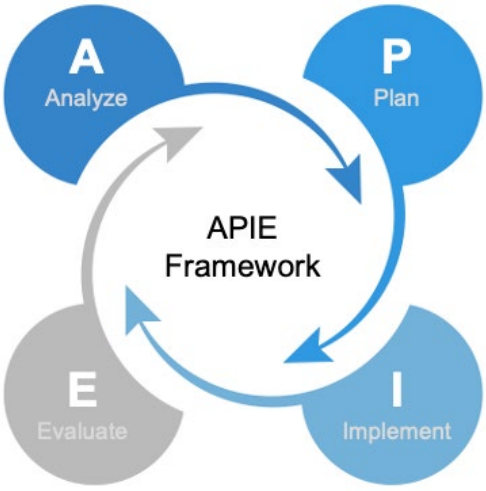
Full firefighter protective gear shall be worn in any response to a fire and/or explosion event or if there is any indication a fire may be present or likely to be present at any time during the event.

If there is no risk of fire or explosion present, arc-rated (AR) protective clothing to protect against arc flash and electrical shock shall be worn. Jewelry, such as necklaces, shall be removed to avoid contact with any electrical hazard.

Proper PPE shall include use of Self-Contained Breathing Apparatus (SCBA).

7.3 APIE (Analyze, Plan, Implement, and Evaluate) Framework

APIE is a framework commonly used for emergency incident preparation and development of appropriate response protocol(s). The four elements of the framework are Analyze, Plan, Implement, and Evaluate. An example APIE framework with simplified sample details pertaining to an emergency incident is as follows:



Analyze: Provide signs and monitoring signals that indicate incident escalation (e.g., fire or explosion) may take place, which first responders should be aware of

Plan: Delineate the danger zone to mitigate risk to first responders and bystanders (pedestrians, vehicular traffic, etc.)

Implement: Once a plan is developed and proper resources and equipment installed, implement respective safety actions as deemed necessary.

Evaluate: Provide continuous monitoring and feedback of the incident and adjust accordingly to ensure ongoing safety of any bystander or responder in the impact area.

7.4 General Emergency Response Recommendations

Initiation of emergency response shall be activated per current protocol.

Table 3 - General Emergency Response Recommendations

General Emergency Response Recommendations:

1. **If there is any threat or potential threat to life or safety, 911 shall be called immediately to summon the aid of public safety responders.**
2. **An initial scene assessment shall be conducted from all sides** (360-degree scene size-up) if possible, and a clear, concise assessment shall be given to incoming responders. Hazards and facility safety concerns such as high voltage areas or other electrical concerns shall be announced to all responders. The scene assessment shall include the following in plain language (no code or terms):
    - Where the incident is located
    - What has happened
    - What is occurring
    - Any injuries or unaccounted for individuals
    - What needs or other resources should be requested
3. **An Incident Command System (ICS) shall be established immediately and shall include designation of roles.** The primary command post location shall be located at the Fire Department Staging Area at the front of the site. If Public Safety is summoned to the incident, the ICS shall be a Unified Incident Command System (UICS).
4. **On-site staff (if applicable) shall immediately go to a designated muster point,** which will be the command post location unless designated differently by the Incident Commander.
5. **Incident Command shall designate the individual in charge of accountability.** Accountability shall be reported as soon as possible. If available, another individual shall control any traffic and guide first responders to the scene.

Notes:

- At the same time as these activities are occurring, the System Owner / Operator or other designated SME shall immediately contact the 24/7 Network Operations Center to establish available data from the BMS and communicate this to the Incident Commander or other appropriate individual.
- It is recommended that a safe perimeter is set up and maintained around the site to keep any persons or personnel a safe distance from the incident.

WARNING: Risk of Explosion / Deflagration	
	An explosion/deflagration / over-pressure event is a critical hazard, and any emergency on-site should always be addressed with full awareness of potential factors which may lead to such an event. **Any failure or alarm condition should result in the assumption of an explosion risk.**

WARNING: Toxic Gases	
	Large quantities of toxic smoke and gas may be emitted from the ESS during battery off-gassing or fire situations. **Proper PPE including SCBA should be worn by first responders.**

7.5 Determine Fire Protection Approach

Caution should be exercised if water is applied directly to the exterior of an affected BESS enclosure, as this will not stop a thermal runaway event and may potentially delay eventual combustion of the entire ESS product. Defensive firefighting tactics are generally recommended, with water being applied to nearby exposures for cooling, as necessary. Any hoseline operations should be limited to hose and master stream application from outside of the construction perimeter as far back as hose and stream ranges allow. The decision to provide thermal cooling via hoselines should be made in coordination with System Owner / Operator and any other required SMEs.

A fog pattern from a handline or monitor nozzle may potentially be utilized to control smoke and gases released from the affected enclosure and prevent them from migrating to unwanted areas.

In all instances, power shutdown and isolation involving any high voltage feeder lines must be confirmed before any defensive measures are taken involving application of water to the site.

WARNING: Risk of Re-ignition	
	Do **NOT** assume the fire is out as the fire event unfolds. A lithium-ion battery fire which has seemingly been extinguished may flare up again if all cells within the enclosure have not been completely consumed. The risk of battery re-ignition can remain present for hours or even days after the smoke/flame is initially detected.

7.6 Incident Monitoring and Evaluation:

Continuous monitoring and feedback on the incident should be provided as the situation evolves. Consultation with the System Owner / Operator and any other required SMEs should be held to guide incident response and determine appropriate next steps.

If available, real-time BMS data from the 24/7 Network Operations Center should be utilized (e.g., temperature, voltage, or other critical measurements) to monitor the spread of failure and assess the health of adjacent BESS enclosures to help guide response procedures as the event unfolds.

8 INCIDENT SCENARIOS AND RESPONSE PROCEDURES

8.1 Explosion Incident

Lithium-ion batteries release flammable off-gases during thermal runaway, which, if allowed to accumulate within the enclosure, may create an explosive atmosphere, posing serious risk to first responders and nearby exposures. Furthermore, it may be difficult to discern conditions within the enclosure if smoke and gas are not visible outside of the unit.

In case of fire or thermal runaway event, an explosive or deflagration event may occur, potentially subjecting personnel to overpressure and projectile hazards. An initial exclusion area should be established, based on the discretion of the Incident Commander, to guard against any blast overpressure. Fire Department staging or operations should not be in direct alignment with the BESS enclosures and should be established at angles relative to the sides of the enclosures if possible. If available, shielding via the built environment should be utilized to protect against high temperatures, overpressure events, or projectile hazards.

A safe stand-off distance of at least 30m shall be maintained between individuals and the BESS enclosure(s) exhibiting fire conditions. Staging of personnel and equipment shall be on the angles of the BESS enclosure to stay out of the potential blast radius of any enclosure doors or other possible projectiles.

WARNING: Risk of Explosion / Deflagration	
	An explosion/deflagration / over-pressure event is a critical hazard, and any emergency on-site should always be addressed with full awareness of potential factors which may lead to such an event. **Any failure or alarm condition should result in the assumption of an explosion risk.**

8.2 Fire Incident

Upon detection of fire or excessive heat emanating from an affected BESS enclosure by the heat or smoke detectors, an audible and visual alarm shall be signaled at the Annunciator Panel. Smoke and flames may be visible from the outside of the BESS enclosure. Fire growth may be slow, fast, or ultra-fast (e.g., during a deflagration event) in nature.

A safe stand-off distance of at least 30m shall be maintained between individuals and the BESS enclosure(s) exhibiting fire conditions. Staging of personnel and equipment shall be on the angles of the BESS enclosure to stay out of the potential blast radius of any enclosure doors or other possible projectiles. Attempt to extinguish the fire only if an imminent threat to life safety exists.

If there is no immediate threat to life safety:

1. Allow the BESS to burn in a controlled fashion until all fuel sources inside are depleted.
2. A defensive approach should be considered utilizing water to cool and protect adjacent exposures and mitigate the spread of fire to areas outside of the fenced installation. Manage the fire incident utilizing the reach of the hose stream to protect exposures and control the off-gassing and smoke from the enclosure.
3. Remember that even after the BESS enclosure is isolated from the electric grid, there may still be considerable stored energy in the batteries that poses a potential electric shock hazard to anyone in the nearby vicinity.

Additionally, chemicals released during a fire or explosion event will be in a gaseous form and primarily pose an inhalation hazard. A fog pattern from a handline or monitor nozzle may provide an effective means of controlling an off-gassing event on the exterior of the battery enclosure from migrating to unwanted areas such as public muster points, emergency responders, building intakes, etc.

Hose streams may also be applied to adjacent exposures for cooling purposes based on consultation with System Owner / Operator and other required SMEs. BMS data available via the 24/7 Network Operations Center should be closely monitored for the adjacent system(s) for any indicators of heat impact or water damage to any adjacent BESS enclosures and relayed to the appropriate individual within the Incident Command System.

Following partial or complete consumption of the system by fire, batteries may continue to emit flammable gases and toxic gases for an extended period of time. Continuous monitoring of gas levels in and around the incident location is recommended. Full firefighter PPE and SCBA shall be utilized until gas levels are confirmed to be at a safe level. A Firewatch shall be provided to ensure the continued safety of the site after the situation appears stable.

WARNING: Risk of Re-ignition	
	Do **NOT** assume the fire is out as the fire event unfolds. A lithium-ion battery fire which has seemingly been extinguished may flare up again if all cells within the enclosure have not been completely consumed. The risk of battery re-ignition can remain present for hours or even days after the smoke/flame is initially detected.

8.3 Thermal Runaway or Off-Gassing Incident

A thermal runaway incident, as described in Section 6.1, is the characteristic failure mode of lithium-ion batteries. A thermal runaway event may begin suddenly, and the nature of the situation may evolve rapidly depending on a number of different factors. Combustion of flammable gases may result in fire or explosion, and considerations in Section 8.1 and Section 8.2 above should be observed based on the nature of the event as it unfolds.

A thermal runaway event may result in large quantities of smoke and gas being released, which may or may not be visible outside of the BESS enclosure itself; therefore, it is critical that any failure or alarm condition result in the assumption of an explosion or fire risk.

In the event of a thermal runaway or suspected off-gassing event, the following actions should be taken:

1. Evacuate the area to a safe location a sufficient distance from the troubled enclosure
2. If the alarm system has not already signaled the Fire Department, immediately call 911
3. Call any required Subject Matter Experts designated for the site
4. Call the 24/7 Network Operations Center listed on Page 3 & Page 22
5. Establish a safety perimeter around all sides of the BESS facility and remain outside the fenced area. Do not allow personnel other than firefighters in proper PPE to enter the safety perimeter and stay upwind of any smoke or off-gassing. (Note: the safety perimeter may extend beyond the boundary of the fenced area).
6. As the incident evolves, a fire or explosion event may occur, and procedures outlined in Section 8.1 and Section 8.2 above should be followed based on the situation as it progresses.

WARNING: Risk of Explosion / Deflagration	
	An explosion/deflagration / over-pressure event is a critical hazard, and any emergency on-site should always be addressed with full awareness of potential factors which may lead to such an event. **Any failure or alarm condition should result in the assumption of an explosion risk.**

WARNING: Risk of Re-ignition	
	Do **NOT** assume the fire is out as the fire event unfolds. A lithium-ion battery fire which has seemingly been extinguished may flare up again if all cells within the enclosure have not been completely consumed. The risk of battery re-ignition can remain present for hours or even days after the smoke/flame is initially detected.

WARNING: Toxic Gases	
	Large quantities of toxic smoke and gas may be emitted from the BESS enclosure(s) during battery off-gassing or fire situations. **Proper PPE, including SCBA, should be worn by first responders.**

NOTICE	
	Indicators which may provide insight into what is happening or about to happen during an incident may include: ▪ Smoke or flames ▪ Change in smoke color ▪ Change in velocity or volume of smoke production ▪ Sounds – popping and/or hissing ▪ Smell – sweet smell

8.4 Alarm Incident

In the event of an alarm activation, the following actions should be taken:

1. Evacuate the area to a safe location a sufficient distance from the troubled enclosure
2. If the alarm system has not already signaled the Fire Department, immediately call 911
3. Call any required Subject Matter Experts designated for the site
4. Call the 24/7 Network Operations Center listed on Page 3 & Page 24
5. Establish a safety perimeter around all sides of the BESS facility and remain outside the fenced area. Do not allow personnel other than firefighters in proper PPE to enter the safety perimeter and stay upwind of any smoke or off-gassing. (Note: the safety perimeter may extend beyond the boundary of the fenced area).

8.5 External Fire / Thermal Exposure Incident

For any type of external heat source or fire impingement (i.e., not stemming from the battery system itself), the Incident Commander should be advised to look at the state of health information from the BMS data (e.g., increasing temperature in target BESS enclosures) available from the 24/7 Network Operations Center to evaluate severity of the incident and treat as an ESS emergency. All precautions previously noted for fire and explosion incidents should be observed.

8.6 External Impact Incident

In the event that an enclosure is severely impacted, causing crushing or puncturing of the outer shell of the enclosure, treat this as an emergency - notify 911 and other required parties.

9 POST INCIDENT / HANDOFF PROCEDURES

9.1 Handoff Procedures

When an energy storage site is deemed safe, upon determination by the Incident Commander (IC), the Subject Matter Expert (SME) shall ensure that the site is safeguarded until the damaged system is removed, repaired, or replaced based on the approved Decommissioning Plan filed with this installation.

9.2 Activation of Decommissioning Plan

Decommissioning of the system shall take place in accordance with the approved Decommissioning Plan filed with this installation. Deactivation, de-energizing, dismantling, and removal of the system shall be conducted by trained and knowledgeable persons in accordance with manufacturer's specifications.

APPENDICES

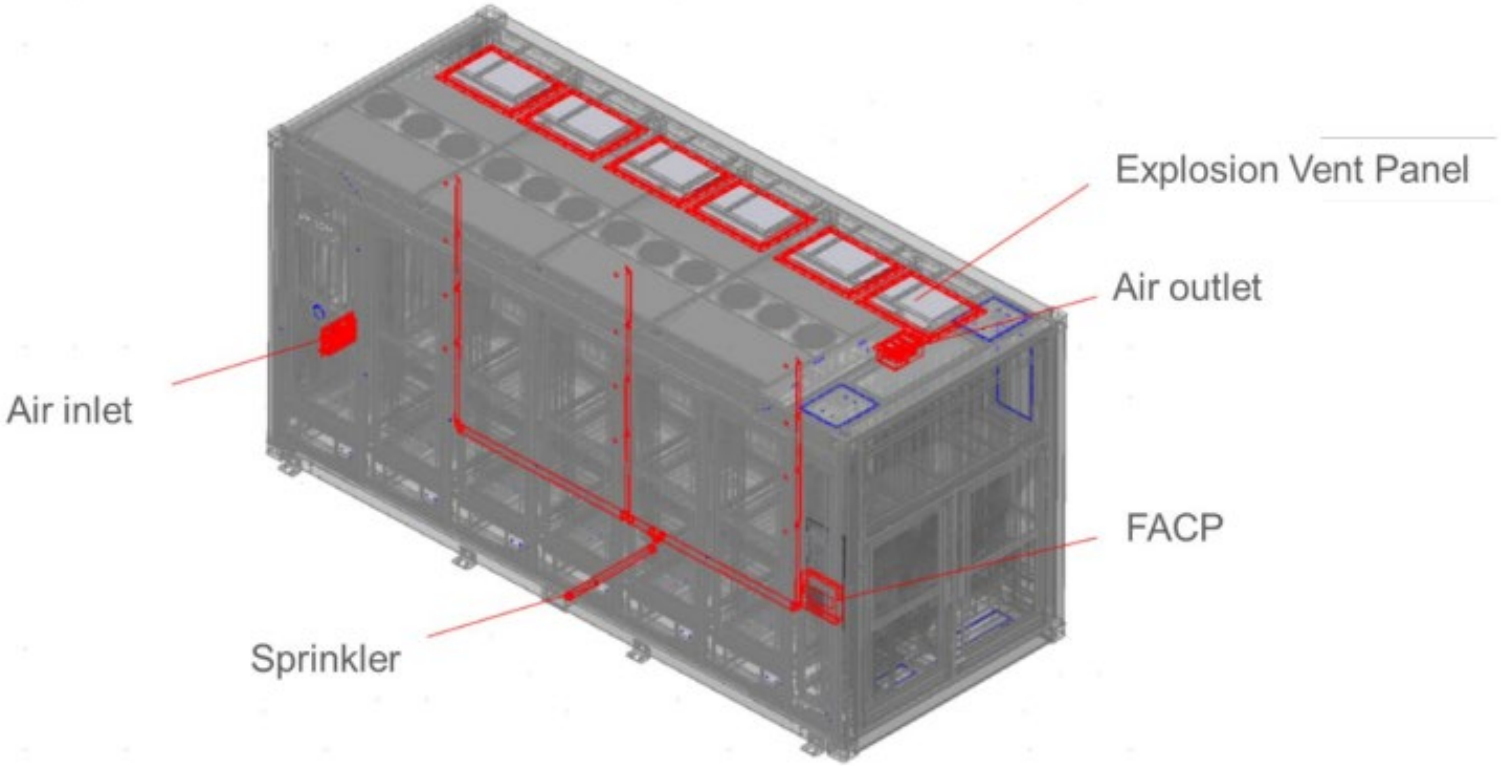
APPENDIX A – Additional Site Photos

Final site photos to be added prior to facility operation.

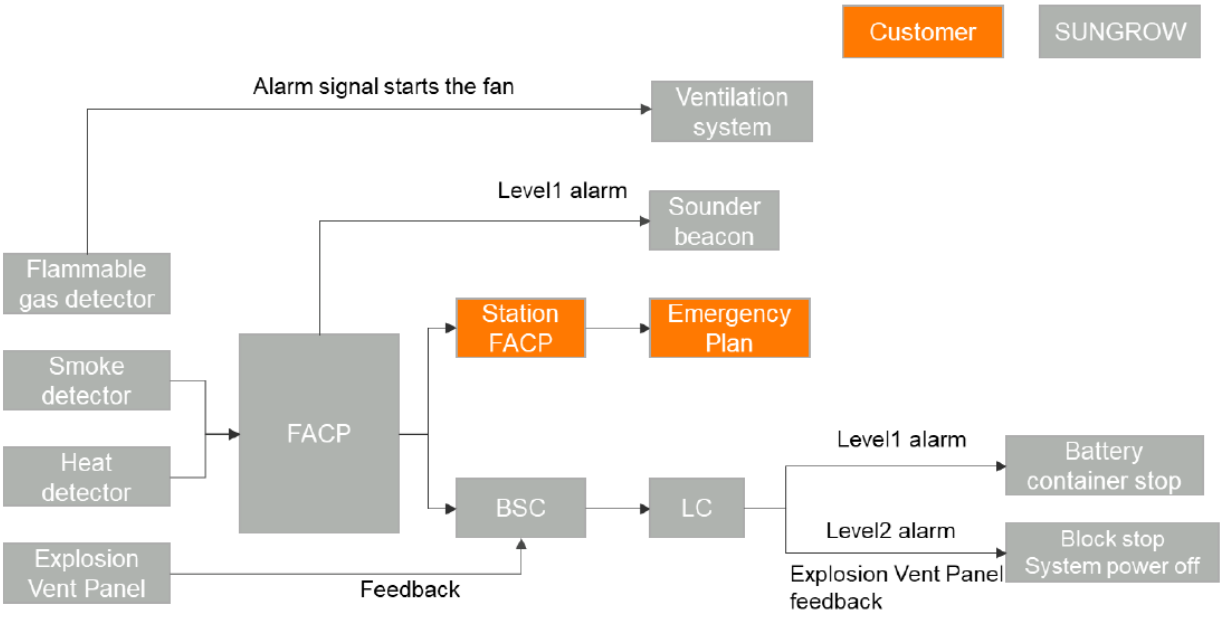


APPENDIX B – Additional Information

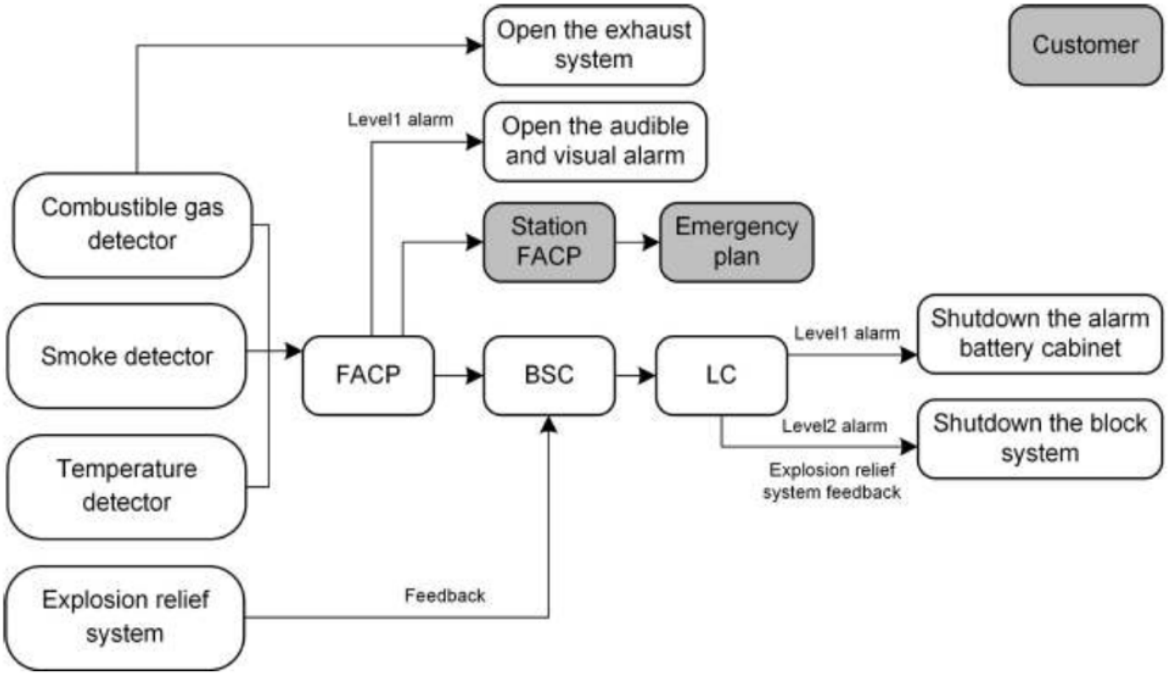




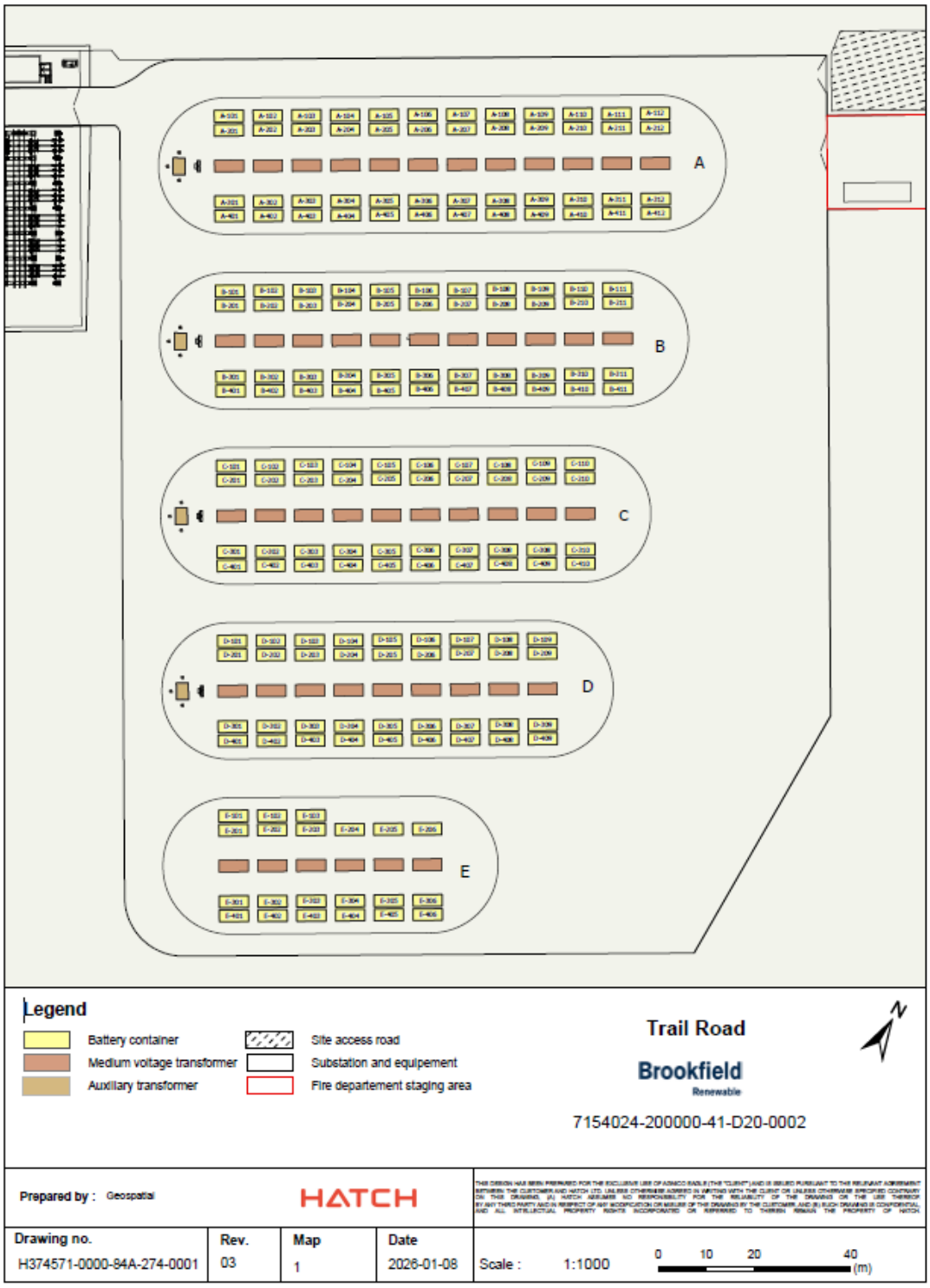
Fire Signal control logic (Optional Version) – *Sungrow FSS Design document*



Control Logic of Exhaust System – *Sungrow US Systems manual*



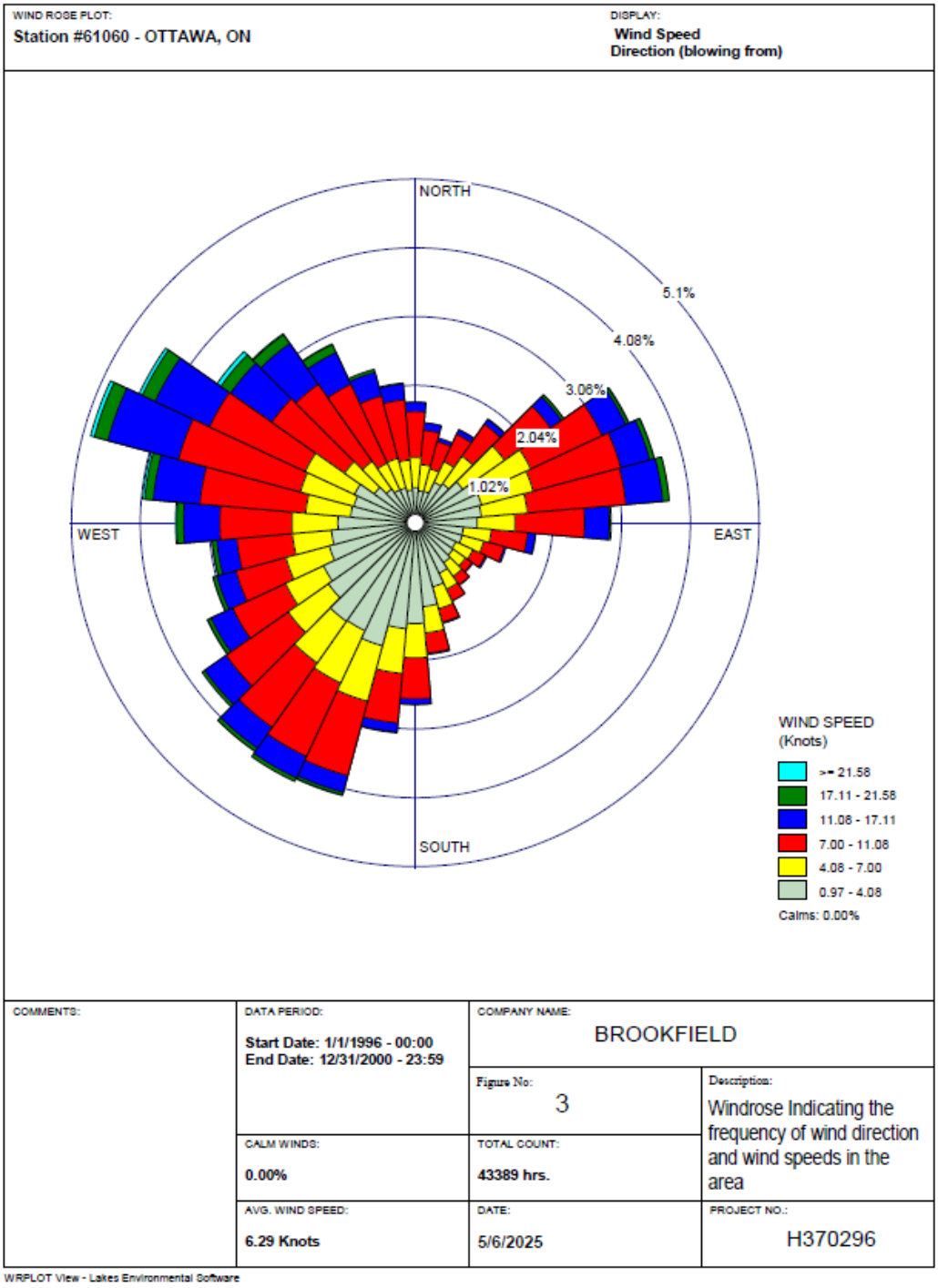
Additional BESS Site Layout



APPENDIX C - Revision History (Client)

Revision No.	Date of Issue	Substance of Change
Rev 0.1c	7/3/2025	Edits based on OFS comments
Rev 0.1e	10/2/2025	Updated for ZBLA Application

APPENDIX D – Windrose



APPENDIX E - Sungrow PowerTitan 2.0 Operation & Maintenance Instruction

Operation & Maintenance Instruction

PowerTitan 2.0 Series



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About This Manual

This manual describes the commissioning, troubleshooting, and maintenance of the energy storage system.

Target Group

This manual is for operators of the power storage plant and qualified technical personnel.

The ESS must and can only be installed by professional technicians who meet the following requirements:

- Has been trained
- Read this manual thoroughly and understand the safety instructions related to operations
- Be familiar with local standards and relevant safety regulations of electrical systems

How to Use This Manual

Please read this manual carefully before using the product and keep it properly at a place for easy access.

In order to provide customers with the best usage experience, the products and product manuals are always in the process of improvement and upgrade. If the manual received is slightly inconsistent with the product, it may be a result of product version upgrade, and the actual product shall prevail.

Contents of the manual may be updated and amended continuously, so it is possible that there may be some errors or slight inconsistency with the actual product. Please refer to the actual product purchased, and the latest manual can be obtained from **support.sungrowpower.com** or sales channels.

The figures in this manual are for reference only. The actual product received may differ.

Symbol Explanations

To ensure the safety of the users and their properties when they use the product and to make sure that the product is used in an optimal and efficient manner, this manual provides users with the relevant safety information highlighted by the following symbols.

Below is a list of symbols that are used in this manual. Review them carefully to make better use of this manual.

⚠ DANGER

Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING

Indicates a moderately hazardous situation which, if not avoided, will result in death or serious injury.

⚠ CAUTION

Indicates a slightly hazardous situation which, if not avoided, may result in minor or moderate injury.

NOTICE

Indicates a potential hazard which, if not avoided, will result in device malfunction or property damage.

"NOTE" indicates additional information, emphasized contents or tips that may be helpful, e.g., to help you solve problems or save time.

Symbol on Products

Always note hazard warnings on the machine body, including:

Marks	Explanation
	High voltage inside! Risk of electric shock by touching it!
	This symbol indicates a protective ground terminal which needs to be firmly grounded to ensure the safety of operators.
	Read the instructions before performing any operation on the product.
	Live parts! Do not touch them until 5 minutes after disconnection from the power sources.
	Pay attention to the danger. Do not operate this product in the live status!
	Pay attention to heavy objects. Lifting of heavy objects may lead to back injuries. Please lift heavy objects with appropriate tools.
	Pay attention to explosion.
	Pay attention to corrosion.
	Do not dispose of this product as household waste.
	No fire.
	There should be a medical center nearby.
	In case of contact with eyes, rinse the eyes immediately with running water or normal saline; and seek medical help in time.

Marks	Explanation
	It is required to wear goggles.
	This symbol indicates that the product can be recycled.
 Li-ION	This symbol indicates that lithium batteries can be recycled.

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1 System Description

1.1 System Introduction

The following will introduce the standard liquid-cooled energy storage system. A typical functional block diagram of the energy storage system is shown as below. The core equipment mainly comprises of a power conversion system (PCS), battery collection panel (BCP), battery supply panel (BSP), battery, battery management system (BMS), energy management system (EMS), transformer, smart control cabinet (SCC), and local controller (LC). The auxiliary system mainly includes a liquid cooling system (LCS), fire suppression system (FSS), and lighting system.

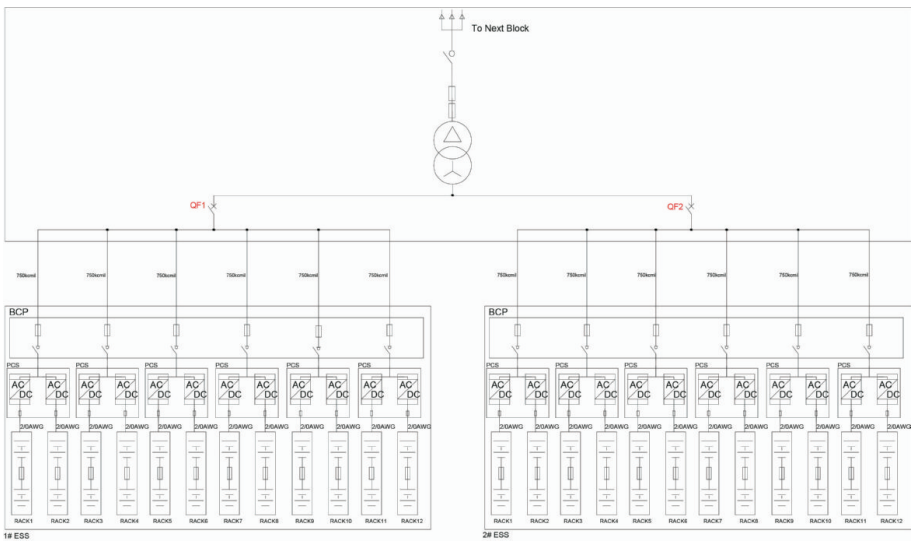


figure 1-1 Functional Block Diagram of Energy Storage System

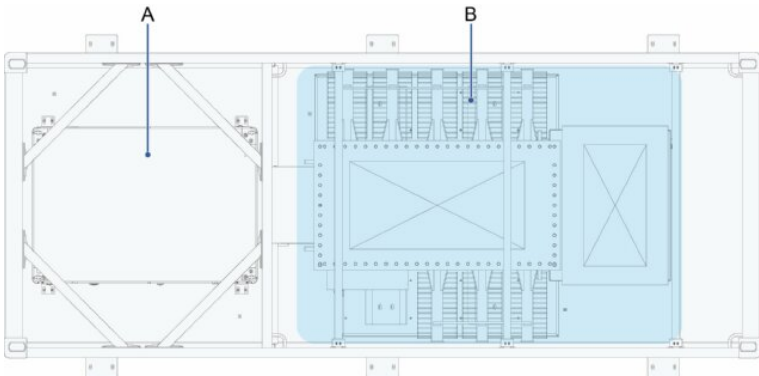
*The above pictures are for reference only, please refer to the actual product received!

1.2 System Configuration

This guide is based on the 0.5C standard system capacity: 5 MW / 10 MWh, with the configuration list as below.

Model	No./Pcs	Notes
MVS5140-LS-US	1	1 * SCC5140+1 * Transformer
ST5015UX-2H-US	2	416S12P LFP battery + 12*SC210HX + BSP + BCP + FSS + Temperature control system

The main electrical equipment for the medium voltage substation (MVS) is shown in the schematic diagram below.

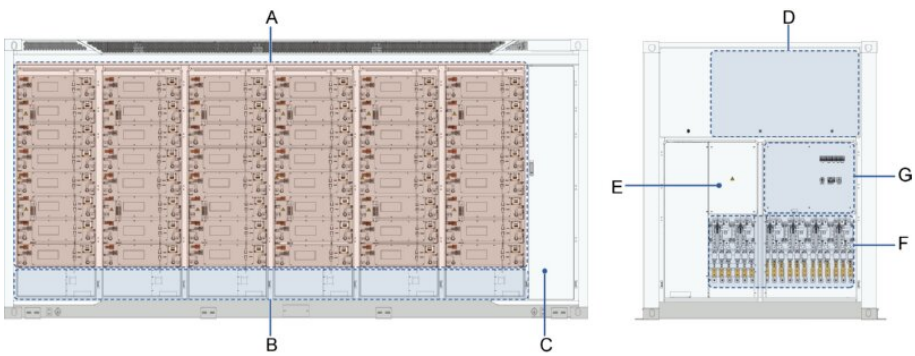


*The above image is for reference only. Please refer to the actual product you received!

table 1-1 Description of Internal Equipment

No.	Name	Description
A	Smart control cabinet	• Convergence on the low-voltage side; • Provides auxiliary power for the energy storage cabinet and supplies power for firefighting.
B	Transformer	Converts low-voltage electricity to medium-voltage electricity compatible with the grid.

The main electrical equipment in the energy storage system (ESS) is shown in the schematic diagram below.



*The above image is for reference only. Please refer to the actual product you received!

table 1-2 Description of Internal Equipment

No.	Name
A	Rack
B	Terminal box & Power conversion system (TB & PCS)

No.	Name
C	Integrated compartment
D	Liquid cooling system (LCS)
E	LCS control box
F	Battery collection panel (BCP)
G	Battery supply panel (BSP)

The physical diagram of the MVS is shown below.



*The above image is for reference only. Please refer to the actual product you received!

The physical diagram of the ESS is shown below.



*The above image is for reference only. Please refer to the actual product you received!

1.3 Communication Architecture

The system mainly consists of EMS, LC, BSC, PCS, CMU, and MVS.

- BSC can collect fire alarm and firefighting system fault signals via dry contact signals, and upload them to LC or EMS for shutdown protection of the battery system. Meanwhile, it associates with the firefighting main terminal to turn on the exhaust fan to reduce the combustible gas concentration.
- LC collects MVS fault signals via dry contact signals so as to implement shutdown protection for MVS faults.

- BSC and LC collect information about the liquid cooling unit, combustible gas detector, electricity meter, HVAC, and the status indicator light of the control system via RS485 communication.
- CMU collects the battery information and interchange data with PCS and BSC via CAN communication.
- LC collects signals from BSC and PCS via the Ethernet and performs the control and information upload functions.

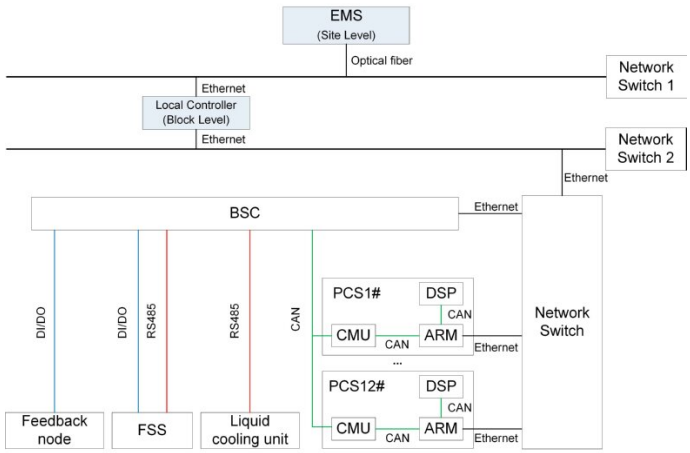


figure 1-2 Communication Architecture Diagram

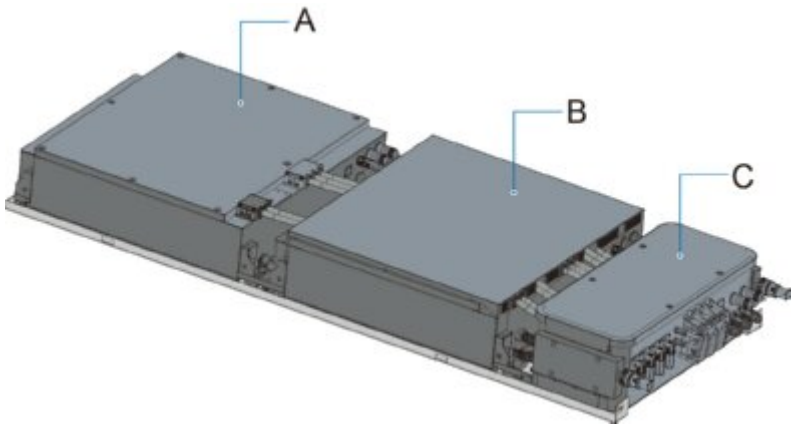
*The above image is for reference only. Please refer to the actual product you received!

2 Introduction to System Subunits

2.1 Power Conversion System & Terminal Box

Two SC210HX and one junction box are integrated inside each power conversion system (PCS) and terminal box (TB). The RACK core control unit CMU is integrated inside the PCS, and the PCS also contains key devices such as inverter modules, fuses, lightning protectors, DC contactors, shunts, and copper bars.

Description of Module Appearance



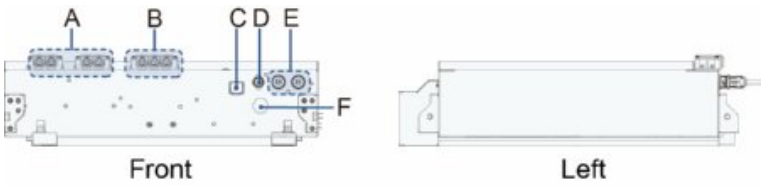
*The above image is for reference only. Please refer to the actual product you received.

No.	Name	Description
A	2# PCS	Converts DC power from the storage battery to AC power that meets the requirements for grid connection.
B	1# PCS	
C	TB	Enables product communication, accesses to the DC power from the batteries, and feeds the AC power to the next-level equipment or the public grid.

2.1.1 SC210HX-US(PCS)

The ESS has 12 built-in SC210HX-US for monitoring, energy transfer and signaling interactions of the battery clusters.

The SC210HX-US appearance is shown in the picture.



* The figure is for reference only. The product received may differ.

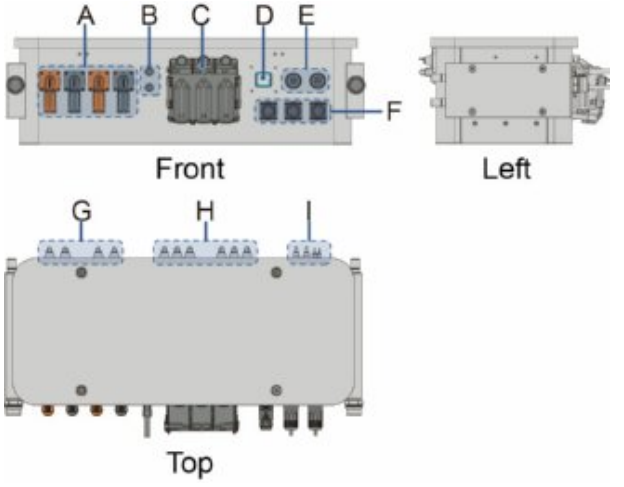
table 2-1 Panel Description

No.	Description
A	DC terminals
B	AC terminals
C	Indicator light
D	Communication plugs
E	Network port
F	Ventilation valve

2.1.2 Terminal Box (TB)

The ESS contains 6 terminal boxes for connecting the battery clusters to the PCS, and internal fuses to protect the battery clusters etc.

The TB appearance is shown in the picture.



* The figure is for reference only. The product received may differ.

table 2-2 Panel Description

No.	Description
A	DC terminals
B	MC4
C	AC terminals
D	Indicator light

No.	Description
E	Network ports
F	Communication terminals
G	DC Bulkheads
H	AC Bulkheads
I	Communication Bulkheads

2.2 Battery

Standardized and unitized battery modules are developed based on lithium iron phosphate cells. Battery modules are connected in series to form a battery cluster. The battery clusters are connected to the supporting power conversion system (PCS) to form energy storage systems(ESS) and store and release electric energy.

Battery Module

table 2-3 LFP battery parameters

LFP battery module	Parameter	Value
	Model	P1044AL-ACA
	Size (W*H*D (without terminals, spigots))*	(790 ± 3) mm * (240 ± 3) mm * (2214 ± 5) mm
	Multiplying power	≤0.5 C
	Cell type	Prismatic aluminum shell LFP
	Combination	1P104S
	Rated capacity	314 Ah
	Weight (without coolant)*	（650 ± 15） kg
	Degree of protection	IP67

*Indicates that the parameter values are for reference only, please refer to the actual project!

Battery Cluster

The battery cluster is composed of PACKs, PCS, fuse, etc.

Battery cluster parameters are shown as follows:

table 2-4 Battery cluster parameters

Parameter	Value*	Parameter	Value*
Model	R0417BL-ACAA	Combination	1P416S
Key components	4 PACKs, 1 PCS	Rated capacity	314 Ah
Nominal voltage	1331.2 V	Voltage range	1123.2 V ~ 1497.6 V

*Indicates that the parameter values are for reference only, please refer to the actual project!

2.3 Battery System Controller (BSC)

It mainly collects node signals such as energy storage system core temperature, fire protection, UPS, etc. The BSC is fixed in the BSP cabinet.

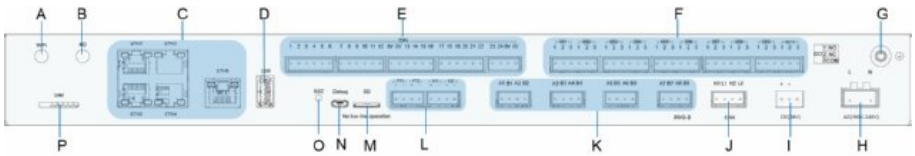


figure 2-1 Wiring Port Schematic

*The figure is for reference only and the actual product shall prevail!

Item	Remark	Name	Description
A	WIFI	WIFI communication port	Reserved function
B	4G	4G communication port	Reserved function
C	ETH1~ET-H5	Ethernet port	The ports can be connected to the master station in the background via devices such as the switch and router, and can be used for devices downstream (it can be configured to connect the PV inverter, the PCS, or the like)
D	USB	USB port	Software upgrade port
E	DIN	Digital input	Dry contact input port
F	DO1~DO10	Digital output	Relay output ports (relay specification: 250Vac/3A or 30Vdc/3A)
G	⏚	Grounding port	Used for grounding
H	AC (110V~240-V)	AC power supply port	Connected to 110~240Vac power supply (50/60Hz), and current ≤ 0.5A
I	DC(24V)	DC24V power supply port	The current is ≤ 2.0A, and the insulation of the switch power supply used for this port needs to be reinforced
J	CAN	CAN communication port	Reserved function
K	A1B1~A8-B8	RS485 communication port	Support 8 inputs of RS485, or can be connected to the slave station devices or the background

Item	Remark	Name	Description
L	PT1、PT2、AI1、AI2	Analog input	Reserved function
M	SD	SD card port	Reserved function
N	Debug	Debugging port	Used to debug the controller
O	RST	Reset port	Used for hardware reset of the controller
P	SIM	SIM card port	Reserved function

2.4 Smart Controller Cabinet (SCC)

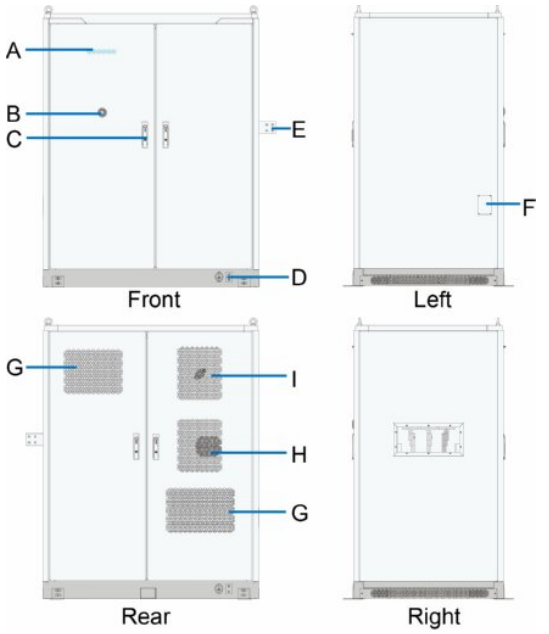
The smart control cabinet SCC is integrated in the MVS, the SCC cabinet integrates the functions of low voltage convergence, communication and auxiliary power supply of the system.

Functional description

- Monitor PCS and battery system information.
- Monitor states of liquid cooling system, fire suppression system, and other external nodes.
- Manage system states such as running, fault and alarm.
- Battery balance management of energy storage system.
- Provide data acquisition and control interface of energy storage system to EMS.
- Provide ESS auxiliary power supply and fire suppression system supply.

Appearance

The SCC appearance is shown in the picture.



* The figure is for reference only. The product received may differ.

table 2-5 Panel Description

No.	Description
A	Indicator light
B	Emergency stop button
C	Door lock
D	Grounding point
E	AC copper (connected to transformer)
F	Nameplate
G	Air inlet for fan
H	Air inlet for HVAC
I	Air outlet for HVAC

2.5 Local Controller (LC)

LC mainly realizes the response to the upper computer scheduling, monitors the system faults and alarms, collects the data of the sub-devices to ensure that the system can be operated safely and normally, and at the same time manages and schedules the sub-devices, such as the PCS, batteries, and medium-voltage modules.

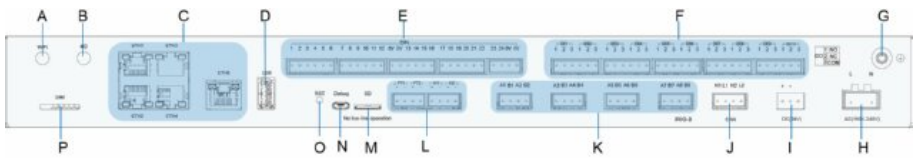


figure 2-2 Wiring Port Schematic

*The figure is for reference only and the actual product shall prevail!

Item	Remark	Name	Description
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B	4G	4G communication port	Reserved function
C	ETH1~ET-H5	Ethernet port	The ports can be connected to the master station in the background via devices such as the switch and router, and can be used for devices downstream (it can be configured to connect the PV inverter, the PCS, or the like)
D	USB	USB port	Software upgrade port
E	DIN	Digital input	Dry contact input port
F	DO1~DO10	Digital output	Relay output ports (relay specification: 250Vac/3A or 30Vdc/3A)
G	⏚	Grounding port	Used for grounding
H	AC (110V~240-V)	AC power supply port	Connected to 110~240Vac power supply (50/60Hz), and current ≤ 0.5A
I	DC(24V)	DC24V power supply port	The current is ≤ 2.0A, and the insulation of the switch power supply used for this port needs to be reinforced
J	CAN	CAN communication port	Reserved function
K	A1B1~A8-B8	RS485 communication port	Support 8 inputs of RS485, or can be connected to the slave station devices or the background
L	PT1、PT2、AI1、AI2	Analog input	Reserved function
M	SD	SD card port	Reserved function

Item	Remark	Name	Description
N	Debug	Debugging port	Used to debug the controller
O	RST	Reset port	Used for hardware reset of the controller
P	SIM	SIM card port	Reserved function

2.6 Liquid Cooling System (LCS)

The liquid cooling system consists of a liquid cooling unit, a disturbing fan, a top cooling fan, and a control unit. The liquid cooling unit and the eight-way valve are located on the upper-right side of the integrated compartment of the energy storage cabinet, while the control box for the liquid cooling unit is on the lower-left of the integrated compartment. Specifically, the heat-generating power devices of the PCS, such as the IGBT modules and reactors, are liquid-cooled, while other devices dissipate heat into the external air through the internal turbulence.

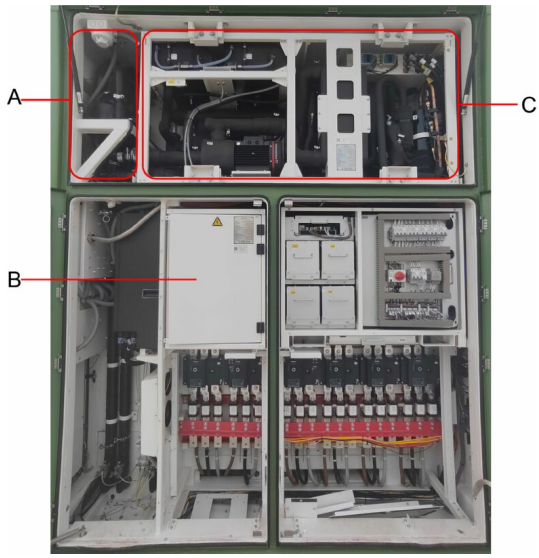


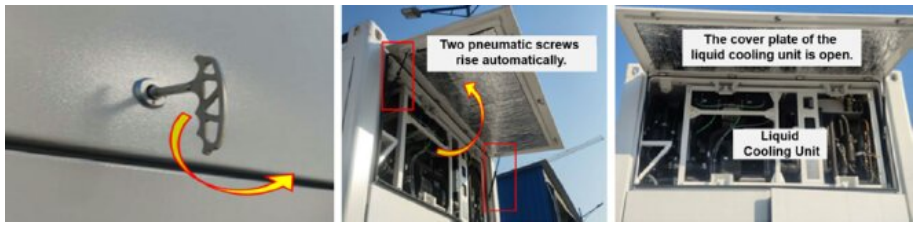
figure 2-3 Schematic Diagram of Integrated Compartment

*The above image is for reference only. Please refer to the actual product you received!

No.	Name
A	Eight-way Valve
B	Liquid Cooling Unit Control Box
C	Liquid Cooling Unit

How to open the cover plate of the liquid cooling unit

Open the door lock with the key, lift the door gently, and the pneumatic screws on both sides will rise up to open the cover plate of the liquid cooling unit. Then you can see the liquid cooling unit.



*The above image is for reference only. Please refer to the actual product you received!

2.7 Fire Suppression System (FSS)

The ESS is equipped with an automatic fire alarm and linkage control system, an explosion relief system, a combustible gas detection and alarm system and an exhaust system (-optional), a water-based fire suppression system (optional). It is equipped with combustible gas detectors (optional), smoke detectors, and temperature detectors. If any abnormality is detected, BSC connects to LC via Ethernet for alarm signaling, control of the ESS shutdown, and control of the system for corresponding logic control.

NOTICE

To ensure the detection accuracy of the combustible gas detectors, perform a functional validation test at least twice a year. If the detector fails the test, check and if necessary, calibrate the detector.

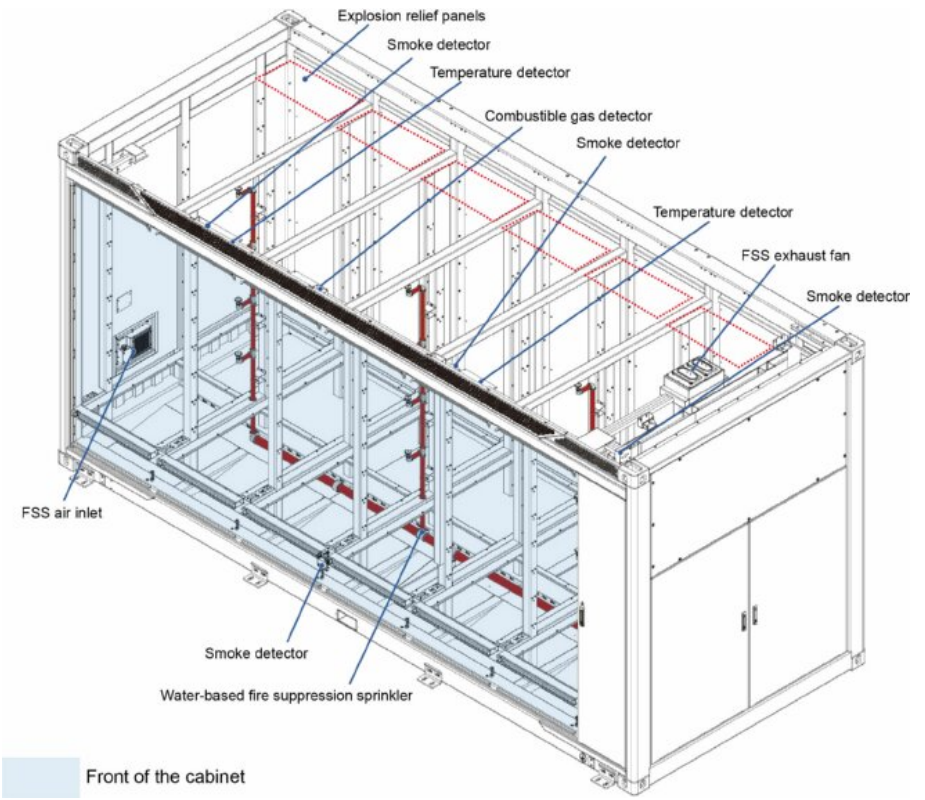


figure 2-4 Diagram of fire fighting system composition

* The figure is for reference only. The product received may differ.

table 2-6 Major Firefighting Components

No.	Name	Description
1	Automatic fire alarm system	Each battery compartment is equipped with smoke and temperature detectors to provide feedback on the alarm and fault signals. Two smoke sensors and two temperature sensors are evenly arranged in each battery compartment, and one smoke sensor is arranged at the top of the integrated compartment and one at the center of the PCS compartment. An optional audible and visual alarm on the outside the battery compartment will be activated when either of the smoke sensor or the temperature sensor triggers an alarm.
2	Explosion venting system	Explosion venting plates are installed in the battery compartment to vent explosions and provide feedback on the status of the venting plates. The explosion venting plates are evenly located on top of the energy storage cabinet. When the pressure reaches 0.01 Mpa, the explosion venting plates will open and feedback their status.

No.	Name	Description
3	Gas detection and emergency ventilation systems	A combustible gas detector in linkage control with the firefighting ventilation device is arranged in the battery compartment to provide feedback on fault and alarm information. A combustible gas detector, an air inlet unit, and a ventilation unit are arranged in the battery compartment. When the combustible gas concentration reaches 10% LEL, the gas detector will work and control the emergency ventilation system to turn on.
4	Water firefighting system	The system reserves multi-layer firefighting water pipelines and is equipped with 93 ℃ upward spraying sealed sprinkler heads. The external valves of the pipelines are provided by the client. In the battery compartment, there are 12 sprinkler heads, which are arranged in three groups between the batteries or walls for optimal fire suppression. A DN50 interface is reserved at the bottom of the battery compartment, and customers must connect external pipelines for the automatic sprinkler system, and design the pipelines by themselves.

3 Commissioning

3.1 Check Before Power-up

Personnel requirements

- Personnel engaged in on-site commissioning must have no severe physical or sensory defects and must possess a certificate recognized by the relevant national labor safety inspection authority after undergoing training, examination, and qualification evaluation conducted by the relevant authorities before performing electrical operations.
- They must be proficient in first aid for electric shock.
- The on-site commissioning personnel should be focused and should always consider all lines as "live" before confirming that they are neutral with a multimeter. They should not touch the lines with their bare hands.
- Before commissioning, the personnel should carefully check whether the tools they use are safe and reliable and wear necessary PPE in order to avoid accidents during work.

Checking energy storage cabinet

- Check that the positive and negative wires of the battery RACK, the PCS&TB, BCP and RACK fuses, and the AC power busbar in the SCC are wired correctly.
- Check that the battery RACK, PCS&TB, BCP, the RACK fuse, MSD, and the AC power busbar in the SCC are not loose.
- Check that there is no short circuit between the three phases of the converging branches in the BCP and SCC, and check whether insulating barriers are installed between the three phases of the load switch.
- Check that the battery RACK, PCS&TB, BCP, SCC, liquid cooling unit control box, BSP auxiliary power supply and communication wiring are reliably connected.

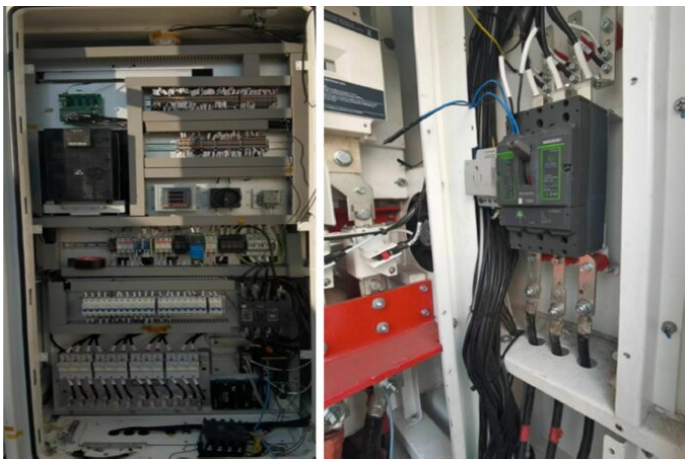


figure 3-1 SCC and BSP Auxiliary Power Supply

- Check that the battery RACK, BCP, BSP, liquid cooling unit control box, and SCC are reliably grounded.
- Check the battery PACK, the multi-way valve, and the cooling pipes for coolant leakage.
- Based on the electrical drawings, check the external cables of BCP are connected to the three AC phases of SCC correspondingly, and avoid BCP and SCC wiring crossover errors.
- The load switch on the BCP and the circuit breakers SWITCH1 & SWITCH2 in the SCC should be in the open state.
- The MSD has an integrated internal fuse module to provide overcurrent or short-circuit protection for individual PACKs. Check that MSD has been inserted into all PACKs as required.



figure 3-2 MSD

Checking PCS & TB

- Check the electrical drawings to confirm that the DC positive and negative connections outside the PCS & TB are correctly and firmly connected, and the AC three-phase outgoing lines are correctly and firmly connected so as to avoid reversely connected cables. The DC-side wiring order can be tested within the LC Web interface with the system self-checking function.



figure 3-3 SCC and BSP Auxiliary Power Supply

- Check whether the communication lines are normal and firmly connected according to the communication diagram.

3.2 Powering on Steps

Before powering up, the equipment must be comprehensively and meticulously inspected to ensure that all indicators are in line with the requirements before powering up.

Step 1 Power on the MVS.

1 Close the self power supply switch QS1 (AC BRANCH SWITCH 1#) (skip this step if external power supply is selected);

2 Close the isolation module power switch QS2 (AC BRANCH SWITCH 2#) (skip this step if external power supply is selected);

3 Close the main power control switch of 1~2# battery cabinet QF1~QF2 (ESC MAIN POWER SWITCH 1~2#);

4 Close the 480Vac power switch QF3 (AUX POWER SWITCH 1#);

5 Close the transformer branch switch QS3 (AC BRANCH SWITCH 3#);

6 Close the power supply switch of the maintenance socket Q2 (SOCKET SWITCH);

7 Close the 230Vac power switch Q1 (AUX POWER SWITCH 2#);

8 Close the fan power switch Q3 (FAN SWITCH);

9 Close the HVAC power supply switch Q4 (HVAC SWITCH);

10 Close the UPS power supply switch Q5 (UPS SWITCH);

NOTICE

When powering up for the first time, if the temperature is lower than -20℃, it is necessary to start the HVAC heating function first, so that the temperature inside the cabinet > -20℃ before starting the UPS.

11 Close the uninterruptible power supply switch of the FSS accident ventilation Q6 (-RESERVED) (skip this step if the UPS of SCC supply uninterruptible power for the FSS accident ventilation);

12 Close the battery cabinet auxiliary power supply switch Q7 ~ Q8 (FSS FAN SWITCH 1~2#);

13 Close the 24Vdc power switch Q11 (24V SMPS SWITCH);

14 Finish powering on the MVS.

Step 2 Power on the auxiliary power supply.

1 Close the main control switch of the 480Vac power QF1 (AC MAIN SWITCH);

2 Close the power switch of the LCS Q1 (LCS);

3 Close the LCS fan and PCS cooling air tray power switch Q2 (BATT FAN);

4 Close the branch circuit breaker of the transformer Q3 (POWER TRANSFORMER);

5 Close the power supply switch of the maintenance socket Q4 (MAINTAIN SOCKET);

6 Close the 24Vdc power switch Q5 (DC 24V) for indicator lights, dehumidifiers, etc;

7 Close the power supply switch Q6 (AC FAN) for the integrated cabin fans, spoiler fans, etc;

8 Close the power supply switch of FACP Q7 (FIRE ALARM);

9 Close the FSS auxiliary power switch Q8 (FSS FAN);

10 Close the DC load switch QS11 (SMPS DC SUPPLY);

NOTICE

- **Check the status of circuit breakers in the liquid cooling unit. If any circuit breaker is not closed, close it;**
- **If the battery cabinet is equipped with a fire engine and a combustible gas engine, check the state of the ship type switch in the engine. If any ship type switch is in the off position, move it to the on position.**

Step 3 Power on the main power circuit:

Turn the AC SWITCH QS1~QS6 on the BCP to "ON".

- - End

⚠ WARNING

If one circuit breaker trips during power-on process, suspend closing other circuit breakers and immediately check whether a short circuit occurs to downstream loads of the tripped circuit breaker.

3.3 Pre-run Preparation

- Check and repair the faults displayed by the system after powering up.
- Verify whether the software version is correct.
- Go to the web interface of BSC and LC respectively, and check whether the parameter configuration files are correct. Never modify the configuration parameters.
- When the system is stored in a low-temperature environment for a long period of time without power, and the temperature of the battery cell is below the charging/discharging

starting conditions, the energy storage system cannot be started directly. Before starting the system, connect the auxiliary power supply, and switch on the liquid cooling unit to warm up the battery cells. The warm-up time depends on the original temperature of the cells. In case of extreme low temperature (e.g. the cell temperature is -30 °C), it may be necessary to switch on the liquid cooling unit two days in advance to warm up the battery cells.

3.4 Commissioning

3.4.1 Commissioning of Communication Functions

Step 1 Reassign the sub-device addresses according to the address assignment requirements on site.

It is recommended to modify the IP address with which the LC is connected to the EMS according to the customer's requirements, while the default IP addresses of other sub-devices should not be modified.

Step 2 The data of LC devices and sub-devices should be readable on the background monitoring (EMS) interface.

Step 3 The system stop/start commands and charging/discharging power commands issued through the backend monitoring (EMS) interface should be able to realize the corresponding functions.

Step 4 Modifying control parameters on the background monitoring (EMS) interface should result in the corresponding functions.

- - End

3.4.2 Commissioning of Start/Stop and Charging/Discharging Functions

Before starting the system, click the system self-checking settings on the LC Web screen. If an error occurs, check the wiring order of the power cables and whether the communication IP addresses of the PCS and the BSC are matched.

Step 1 Control the system to start through the background monitoring interface. When the PCS start command is sent, the PCS should be able to start normally. When the PCS stop command is sent, the PCS should be able to stop normally.

Step 2 Increase the PCS power to the actual maximum available discharging power in the step of 100 kW through the background monitoring interface. After running for 10 minutes, the BSC should be able to distribute the power to 24 PCSs normally. Observe the voltage, current, temperature, and other parameters of the battery RACK in the two energy storage cabinets and observe the voltage, current, and device temperature rise in all PCSs, which should be normal. Observe whether the liquid cooling unit can control the running temperature normally, and then set the PCS power to 0 kW.

Step 3 Increase the PCS power to the actual maximum available charging power in the step of 100 kW through the background monitoring interface. After running for 10 minutes, the BSC should be able to distribute the power to 24 PCSs normally. Observe the voltage, current, temperature, and other parameters of the battery RACK in the two energy storage cabinets and observe the voltage, current, and device temperature rise in all PCSs, which should be normal. Observe whether the liquid cooling unit can control the running temperature normally, and then set the PCS power to 0 kW.

Step 4 Set a battery SOC upper limit value, and charge the battery at the power of the actual maximum rechargeable power. Observe whether the PCS corresponding to the RACK is in a hot standby state when the set SOC upper limit value is reached.

Step 5 Set a battery SOC lower limit value, and discharge the battery at the power of the actual maximum discharging power. Observe whether the PCS corresponding to the RACK is in a hot standby state when the set SOC lower limit value is reached.

Step 6 When you disconnect the communication between the control backend and the PCS, the PCS should be able to stop.

- - End

For the upper/lower limit values set in Steps 4 and 5, select values that can be reached within a short time based on the actual charge state of the battery RACK, and change the parameters back to the original set values after the test.

3.4.3 Charge/Discharge Cycle Commissioning

Step 1 The background monitor performs a full charge-discharge cycle based on the actual charge/discharge status of the battery RACK in the battery container, and calibrates the battery SOC to ensure balanced SOC.

Step 2 Observe the voltage, current, temperature and other parameters of battery RACK and single cells, which should be normal during charging and discharging.

Step 3 Observe the PCS voltage, current, and temperature data, which should be normal.

Step 4 Observe whether there is a large deviation in the cell voltage difference, temperature difference and SOC of the RACK.

- - End

4 Routine Maintenance

4.1 Precautions Before Maintenance

WARNING

- **Do not open the door to maintain the device in rainy, humid or windy days. SUNGROW shall not be held liable for any damage caused by violation of the warning.**
- **Avoid opening the container door when the humidity is high in rain, snow or fog, and make sure that the seals around the container door do not curl when the door is closed.**
- **Before performing maintenance on a Rack, make sure that all MSDs in that Rack have been properly disconnected.**
- **When performing maintenance on the Pack, ensure that the locking structure of the aviation plug is in the unlocked state before unplugging the power cord to avoid damage to the Pack caused by strong unplugging.**

WARNING

- **To avoid electric shock, do not perform any other maintenance operations beyond this manual.**
- **If necessary, contact SUNGROW customer service for maintenance.**

NOTICE

In the event of heavy snowfall at the project site, please clear the snow from the top of the equipment and the surrounding area in a timely manner.

In fair weather, it is recommended to open the container door to dehumidify the equipment.

4.2 Maintenance Item and Interval

- This section is the recommended maintenance cycle. The actual maintenance cycle should be adjusted according to the specific installation environment of this product.
- The power station scale, installation location and on-site environment affect the maintenance cycle of this product. In sandy or dusty environments, it is necessary to shorten the maintenance cycle and increase the frequency of maintenance.

4.2.1 Maintenance (Initial grid connection)

Item	Check method
Electrical Connection Specifications	Check the following items and correct them immediately if they do not meet the requirements: • Examine the input and output cable materials and specifications. • Terminal materials, specifications and their installation direction. • Bolt size and its gasket mounting direction.

4.2.2 Maintenance (Every month)

Item	Check method
Cabinet	• Check whether there is any damage, flaking paint or sign of oxidization on the enclosure. • Check whether there is any damage or deformation of the cabinet and internal devices. • Check whether there are flammable objects on the top of the cabinet. • Check whether the welding points between the cabinet and the foundation steel plate are firm and whether there is corrosion. • Check whether the lock of the cabinet door can be unlocked flexibly. • Check whether the sealing strip is fixed properly. • Check whether there are foreign objects, dust, dirt, and condensed water inside the integrated energy storage system.
Air inlet and outlet	Check to see if the outdoor cabinet air inlet and outlet are blocked.
Cables	Check all cables for breakage

Item	Check method
System status	• Check if there is abnormal noise during operation of internal devices. • Check whether the temperature in the container is excessively high. • Check whether the humidity and the amount of dust inside the cabinet are within the normal range. Clean the equipment if necessary.
Software data	• Read the data in the LC300 WEB. • Save run data, parameters, and logs to the relevant files. • Check the various parameter settings. • Update the software.

4.2.3 Maintenance (Every half a year)

Item	Check method
Safety function	• Check whether the emergency stop button work normally. • Simulate shutdown. • Check the warning marks and other device marks, and replace them timely when they are fuzzy or damaged.
Internal components inspection	• Check the cleanness of the circuit board and other elements and components. • Check to see if the fan is operating normally and if there is any abnormal noise. • Check the temperature of the radiator and the amount of dust accumulated. Clean heat-dissipation modules with a vacuum cleaner if necessary. • Replace the air filter screen when necessary.

Item	Check method
Device maintenance	• Carry out regular inspection for corrosion of all metal components (once per half a year). • Check the contactors (auxiliary switches and micro-switches) annually to ensure the good mechanical operation. • Check the running parameters (especially voltage and insulation). • Troubleshoot for unoperated UPSs, which need to be recharged once every six months.
Transformer	• Check for oil leakage from the transformer. • Check the oil level gauge for normal operation. • Check whether the operating temperature is normal. • Check whether the operating noise is normal. • Check for external corrosion. • Check the main components of the transformer.

4.2.4 Maintenance (Once a year)

Item	Check method
Ground of the shielded layer of cables	Check whether the cable shielding layer is in good contact with the insulation sleeve and whether the copper bus bar is firmly fixed.
Surge protection device and fuse	Check whether the SPD and fuse are properly fastened.
Wiring and cable layout	• Check whether the cable layout is normal and whether there is a short circuit. For any non-conformances found during inspection, correct them immediately. • Check whether all cable entry are well sealed. • Check whether the power cables are loose, and fasten them again by the torque specified previously. • Check whether the power cables and control cables are damaged, especially if the surface contacting the metal surface is cut. • Check whether the insulation tapes on the power cable terminals fall off.

Item	Check method
Ground connection and equipotential connection	• Check whether the ground connection is correct and the grounding resistance shall be no more than 4Ω. • Check whether the equipotential connection inside the integrated system is correct.
Transformer inspection	• If water enters, dry it with a dry cloth or dry it with drying equipment; if water accumulates in the charged part, it needs to be dried and experimented. • Check gasket and replace if deteriorated. • Check for loose torque markings, tighten and re-torque markings.

4.3 Container Maintenance

4.3.1 Painting Make-up Measures

Check the exterior damage and choose the applicable program based on the different levels of damage.

Case 1：Dirt on surface caused by water spots and dusts can be cleaned.

Case 2：Surface dirt and damaged finish, which cannot be cleaned.

Case 3：Primer is damaged, and the base material is exposed.

Check whether the protective paint sprayed on casing of the product is fallen off or peeled off, if so, repair it timely.

Spray a special protective paint to the exterior of the product every 3 ~ 5 years.

Maintenance Steps for Case 1:

Material:

No.	Name	Source
1	Cleaning cloth	Not included in the scope of supply
2	Water	
3	Alcohol or other non-corrosive detergent	

1 Wet the cleaning cloth (or other scrubbing tools) with water, and scrub the dirty parts on surface.

2 If the dirt cannot be cleaned with water, scrub with 97% alcohol till the surface is acceptable. (Or try to use non-corrosive detergents that are generally used locally)

Maintenance Steps for Case 2:

Material:

No.	Name	Source
1	Abrasive paper	Not included in the scope of supply
2	Cleaning cloth	
3	Water	
4	Alcohol	
5	Brush	
6	Paint	

1 Polish the paint surface with blistering or scratches with an abrasive paper for a smooth surface.

2 Wet the cleaning cloth with water or 97% alcohol, and scrub the damaged parts to remove surface stains.

3 Perform paint repair for the scratched parts with a soft brush after the surface is dried, brush the paint as uniform as possible.



Maintenance Steps for Case 3:

Material:

No.	Name	Source
1	Abrasive paper	Not included in the scope of supply
2	Cleaning cloth	
3	Water	
4	Alcohol	
5	Zinc primer	
6	Brush	
7	Paint	

1 Polish the damaged parts with an abrasive paper to remove rust and other burrs for a smooth surface.

2 Wet the cleaning cloth with water or 97% alcohol, and scrub the damaged parts to remove surface stains and dust.

3 Spray the parts with base material exposed with zinc primer for protection after drying of the surface. Ensure to spray to cover the bare base material completely.

4 Perform paint repair for the damaged parts with soft brush after the primer is dried, and brush the paint uniformly.



4.3.2 Checking Door Locks and Hinges

Check whether the door locks and hinges of the container can be used normally after cleaning. Lubricate the door lock holes and hinges properly when necessary.

4.3.3 Checking Sealing Strips

If the sealing strip is in good condition, it can effectively prevent water seepage inside the container. Therefore, carefully check the sealing strip and replace it immediately if there is any damage.

4.4 Battery Maintenance

4.4.1 Regular Maintenance and Maintenance Cycle

Below is the recommended maintenance cycle. The actual maintenance cycle should be adjusted according to the specific installation environment of this product.

The power station scale, installation location and on-site environment affect the maintenance cycle of this product. In sandy or dusty environments, it is necessary to shorten the maintenance cycle and increase the frequency of maintenance.

⚠ WARNING

Do not leave the product in a low voltage or low SOC condition for a long period of time. Loss of capacity due to the following conditions is not covered by the warranty.

- **Battery discharge cell voltage is below 2.7V for 120 consecutive hours.**
- **Any cell cluster SOC is 0% for 120 consecutive hours.**
- **Battery discharge cell voltage ≤2V.**

⚠ WARNING

Over or under voltage fault & alarm (detailed information can be found in the "Communication protocol→BSC300 Info-3x table→CMU level 1 fault and CMU level 2/3 alarm").

- **Fault: "Cell over voltage fault", "Cell under voltage fault", "Total over voltage fault", "Total under voltage fault".**
- **Alarm: "Cell over voltage alarm", "Cell under voltage alarm", "Total over voltage alarm", "Total under voltage alarm".**

End users must assign a high priority to above listed faults and alarms reported by the Sungrow local controller. When an alarm or fault is triggered, the user interface should prominently highlight these issues. Furthermore, end users should promptly contact Sungrow for timely resolution to prevent battery warranty loss due to over-discharge or overcharge.

NOTICE

- **In order to avoid triggering the warranty expiration condition, when the "Cell Under-voltage Fault" or "Cell Over-voltage Fault" is triggered, the user must contact the local team of Sungrow within 24 hours and follow the requirements of Sungrow to carry out the next operation.**
- **If the system is configured with the "Active power up" function, Sungrow will enable this function by default when the device is shipped from the factory. When the SOC is too low, the system will charge the battery with a low current until the SOC reaches a safe threshold (the safe threshold can be set) automatically. In order to minimize the risk of under-voltage of the battery that may void the warranty, Sungrow recommends that users do not turn off the "Active power up" function.**

NOTICE

- **If the system will not be in operation for an extended period (7 days or more), it's recommended to increase the SOC lower limit protection value to above 10% SOC. Additionally, it is important to regularly monitor the system's SOC to avoid the risk of over discharge which will cause warranty expiration.**
- **During maintenance or shutdown, if the SOC of any battery cluster is 0%, the SOC needs to be charged to 15% and above within 120 hours.**
- **If the SOC of any battery cluster is 0% during operation, the SOC needs to be charged to 5% and above within 2 hours. Or when the SOC reaches 0%, a command can be issued by the host computer EMS to change the system mode to recharge mode.**

Maintenance performed once two years

Inspection item	Inspection method
Battery cluster status and cleanliness	Check the following items. In case of nonconformity, take corrective actions immediately: • Check the battery cluster and internal devices for damage or deformation. • Check the internal devices for abnormal noise during operation. • Check whether the temperature inside the battery cluster is too high. • Check whether the internal humidity and dust of the battery cluster are within the normal ranges. If necessary, clean the battery cluster.
Warning sign	Check whether the warning sign and label are legible and dirty. If necessary, replace them.
Wire and cable	Check whether the TB and battery module are connected correctly and whether the battery modules are also connected correctly.
Corrosion	Check the battery cluster for internal oxidation or rust.

Maintenance performed once a year

Inspection item	Inspection method
TB and battery module box	Check the following items. In case of nonconformity, take corrective actions immediately: • Check whether there are flammable objects at the top of the battery cluster. • Check whether the battery cluster is secured at the fixing point on the foundation plate and whether there is rust. • Check the box for damage, paint peeling, oxidation, etc. • Check whether there are foreign objects, dust, dirt and condensate inside the battery cluster.
Wire and cable layout	The inspection must not be carried out until all internal devices of the battery cluster are powered off! In case of nonconformity found in inspection, take corrective actions immediately: • Check the cable layout for short circuit and compliance with the specifications. If case of any abnormality, take corrective actions immediately. • Check whether all wire inlets and outlets of the battery cluster are sealed properly. • Check the battery cluster for internal seepage of water. • Check whether the power cables and copper busbars are loose, and tighten them according to the aforesaid torque. • Check the power cable and communication cable for damage, especially cut marks on the surface exposed to the metal surface.
Grounding	Check whether the grounding is correct. The grounding resistance should not be greater than 4Ω.
Fan	• Check the fan for faults (e. g. locked rotor and stalling). • Check the fan for abnormal noise during operation.
Screw	Check whether screws inside the battery cluster fall off or are rusted.

Maintenance performed once every six to twelve months

Inspection item	Inspection method
Ambient temperature and humidity inspection	• Check whether the temperature in the ambient temperature record is within the operating range. • Check whether the humidity in the ambient humidity record is within the operating range.
Function inspection	• Check the operating status of the DC contactor: Send the Start/Stop command in the power-off status and check whether the system works properly. • Measure whether the 24V output voltage is within the range in the specification. • Check whether the current, voltage and temperature in the operation record of the battery cluster are within the operating ranges.

4.4.2 Maintenance Precautions

For safe and efficient maintenance of the system, maintenance personnel must carefully read and observe the following safety requirements:

1 Have the electrician certificate issued by the Work Safety Supervision Bureau, and receive professional training before assuming their work.

2 Follow relevant safety precautions, use necessary tools, and wear personal protective equipment.

3 Do not wear metal accessories such as jewelry or watches.

4 Never touch the high-voltage positive and negative electrodes of the energy storage system by both hands at the same time under all circumstances.

5 Prior to the maintenance of the energy storage system, disconnect all high-voltage and low-voltage switches.

6 Do not clean this product directly with water. If necessary, use the vacuum cleaner to clean it.

7 Plug and remove cables in accordance with the specifications, without brute force or violent operation.

8 After maintenance is completed, clean tools and materials in time and check whether there are metal objects left inside or at the top of the product.

9 In case of any doubt on operation and maintenance of this product, contact the Customer Service Center of SUNGROW instead of operation without permission.

4.4.3 Maintenance

1 Operating temperature: The working temperature should be kept between -30℃–50℃. The temperature charging and discharging should be 15℃–30℃ and typically 25℃.

2 The RACK should not be charged or discharged with high magnifying power. The continuous charging and discharging current of a single rack should not exceed the rated current.

3 When the energy storage system is not used in a long time, it should be charged once every six months, until its SOC is 30%–40%.

4 When the system is used after long-term storage, it should be fully charged at least once to restore the best performance of the battery.

5 Regularly check whether the air duct of the cooling system is blocked and clean the system. In particular, clean the air inlet and outlet of the fan and use a vacuum cleaner if necessary, to maintain free air circulation inside the cabinet. Before dust removal, the power supply must be cut off. It is forbidden to rinse the system with water.

6 Regularly check whether the fastening bolts of the high-voltage cables and connecting busbars of the energy storage system are loose, whether the contacts are in good conditions, and whether the terminal surfaces are severely corroded or oxidized.

7 Regularly check the protective covers of high-voltage positive and negative electrodes of the PACK for ageing, damage and missing.

8 Regularly check cables for loosening, ageing, damage and fracture and inspect whether the insulation is in good conditions.

9 Regularly check the battery cabinet for pungent odor and high-voltage connections for burning odor.

10 Regularly check whether the voltage, temperature and other data of the monitoring upper computer are correct and whether there are fault alarms in the alarm column.

11 Regularly check whether the status and alarm indicators of the energy storage system are in good conditions and whether they work properly.

12 Regularly check whether the emergency stop button of the energy storage system can be used, in order to quickly shut down the system in an emergency.

13 Regularly check whether the fire extinguishers are in good conditions and within the validity period.

14 Never use different types of battery modules in series or parallel.

⚠ WARNING

- **The battery is potentially dangerous, so appropriate protective measures must be taken during operation and maintenance!**
- **Incorrect operation may cause severe personal injury and property damage!**
- **Use the appropriate tools and protective equipment during battery operation.**
- **Battery maintenance must be performed by those who have battery expertise and received safety training.**

4.5 Maintenance of Liquid Cooling System

The following provides the recommended maintenance periods. The actual maintenance period shall be adjusted reasonably in consideration of the specific installation environment of the product.

Factors like the power plant scale, the location, and the site environment can affect the maintenance period of the product. It is necessary to shorten the maintenance period and increase the maintenance frequency in the event of heavy sandstorm or dust in the operation environment.

Item	Content	Check method	Maintenance tools
Fan	Check whether the fan blades cannot rotate or are damaged. If so, replace the fan.	• The fan blade rotates smoothly without abnormal noise. • No damage to fan blade. Note: Check this item at least half a year. Blade damage inspection is not mandatory.	Screwdriver with long handle
Water pump	• Check whether over 5% of the cooling air inlet hole of the water pump is blocked. If so, clear it with a brush. • Visually inspect the pump body (not the joint parts) and check whether there is obvious water dripping (-except condensate). If so, replace the sealing ring of the pump.	• The water pump runs smoothly without abnormal noise. • There is no obvious dripping on the pump body (except condensate).	Brush
Water system	• Check whether the high pressure of the water system is ≥3 bar and whether there is an alarm of too high pressure of water out of the condensing side through the software of the upper computer. – Check whether the filter of the water system is dirty and blocked. – Check for malfunctioning multi-way valves. – Check the tank level and fill it for overfilling. • Check the tank level, if the tank level is lower than the lowest level in the sight glass, it needs to be replenished.	• Water system high pressure <3 bar. • The tank level is in the normal range of the sight glass.	PC, network cable, slotted screwdriver, Phillips screwdriver, water pump, water pipe, clamp.

⚠ WARNING

If the ESS has a "communication failure or failure of the liquid-cooled unit", please contact the after-sales service personnel in time to ensure the functional integrity of the system.

4.6 FSS Equipment Maintenance and Repair

The fire suppression system should be inspected and maintained on a regular basis by a full-time staff member who has been specially trained and qualified by examination. The fire extinguishing system shall be inspected as stipulated in the inspection category and inspection records shall be kept. Problems found during inspection should be dealt with promptly.

4.6.1 Automatic Fire Alarm System

System check

table 4-1 Objects, items and quantities of monthly and quarterly system inspections

No.	Inspection objects	Inspection items	Inspection frequency
1	Fire detectors	Fire alarm function	It should be ensured that each detector is checked for fire alarm function at least once a year.
2	Input/Output modules	Output module startup function	It should be ensured that a start-up function check is carried out for each module at least once a year.
3	Combustible gas alarm controllers	Combustible gas alarm function	Monthly check of the alarm function of each combustible gas alarm controller.
4	Combustible gas detectors	Combustible gas alarm function	It should be ensured that the combustible gas alarm function is checked at least once a year for each detector.
5	Combustible gas concentration display (if any)	Combustible gas concentration display function	Monthly check of the display function of each combustible gas concentration display screen.
6	Fire alarms	Fire alarm function	It should be ensured that each fire alarm is checked for fire alarm function at least once a year.

No.	Inspection objects	Inspection items	Inspection frequency
7	Emergency start-stop button	On-site emergency start and stop function	It should be ensured that the start and stop function of each on-site start/stop button is checked at least once a year.
8	Automatic fire-fighting system	Integral linkage control function	It should be ensured that the linkage control function is checked at least once a year for each alarm zone.

System maintenance

- Wiring terminal

  Check the wiring terminals of detectors and bases, controllers, manual parts buttons, fire hydrant buttons, fire electrical control devices and all other products in the system, and re-tighten and connect the loosely connected terminals; replace the screws, terminal spacers, and other wiring parts that have traces of corrosion; and remove the corroded ends of the wires and reconnect them after hot tinning.

- Smoke detector

  Clean the sensing components and circuit boards with specialized process equipment and calibrate the detector response thresholds after cleaning.

- Temperature detector

  Clean temperature-sensitive parts and circuit boards with specialized process equipment, and calibrate the detector response time after cleaning.

- Combustible gas detector

  Combustible gas detectors need to be functionally tested every six months. If the detector fails to pass the test, please check and calibrate the detector if necessary, and the gas-sensitive element should be replaced in time after it reaches the life span specified by the manufacturer.

  Use a standard gas to test the alarm function of the combustible gas detector. If the requirements are not met, the alarm threshold should be adjusted or the gas-sensitive element should be replaced in accordance with the product specification, and then the sensor alarm threshold should be calibrated to the detector's factory-set value.

- Controller products and fire-fighting electrical controls

  Use compressed air, brush, etc. to remove dust at the circuit board and terminals; use vacuum cleaner, damp soft cloth, etc. to remove dust inside the cabinet. If the air is humid, desiccant can be placed inside the cabinet. Measure the power supply voltage of the terminal detector or module of the controller bus circuit with a multimeter, and replace

the circuit board or adjust the line if the voltage value is less than the value specified in the manual.

4.6.2 Accident Ventilation System

table 4-2 Maintenance objects, items and frequency

No.	Inspection objects	Inspection items and frequency
1	FSS air inlet	It is recommended that this be done every six months.
2	FSS air outlet	You can control the fan on and off through the BSC software or fan manual control switch, and observe whether the louvers and fan operate normally without abnormal noise, and whether the BSC software has fault signal feedback.

5 Common Maintenance Operations

5.1 Safety Instructions

⚠ WARNING

- **Do not install or remove power cord with power on. Turn off the power switch before installing and removing the power cord.**
- **Perform the maintenance only after the power is off and do not switch on the power during operation. For certain operations required when the system is running (e.g., the liquid cooling unit is running), make sure that the equipment has been wired correctly before switching on the power.**
- **The voltage may be generated on the battery side or the grid side. Always use a standard voltmeter to confirm that there is no voltage before touching.**
- **If you disconnect the DC power supply of the ESS, the battery will not power off immediately. Wait for 10 minutes and ensure that the device is not powered on before operation.**

⚠ WARNING

- **Personal protective equipment (PPE) is required for maintenance, troubleshooting and other tasks. The maintenance personnel must wear safety goggles, helmets, insulated shoes, and gloves.**
- **Place conspicuous warning signs around the equipment to prevent accidents caused by false switching. Set up warning signs or safety warning tapes in the vicinity of equipment.**

⚠ WARNING

- **The coolant is toxic, so avoid oral intake or long-term skin contact. If you get the coolant into the eyes due to accidentally, please flush your eyes with clean water immediately, and go to the hospital for treatment promptly.**
- **The coolant and its package must not be discarded at will, but should be disposed of as per the relevant local laws and regulations.**
- **Protective equipment such as goggles are required when working with coolant (glycol solution) or performing maintenance on the liquid cooling pipes.**

NOTICE

- **Operators should have certain expertise on electronics, electrical wiring, and mechanics and be familiar with electrical and mechanical schematics. And they should be familiar with the composition and working principle of ESS and its front-end and back-end devices.**
- **Operators should have received specialized training on the installation and commissioning of electrical equipment.**
- **Operators should be able to respond to hazardous or emergency situations during installation or commissioning.**
- **Operators should be familiar with the relevant standards and codes of the country/region where the project is located.**

NOTICE

- **The lifting, transportation, installation, wiring, operation, and maintenance of equipment must comply with the relevant laws and regulations of the region where the project is located.**
- **If you need to walk on top of the equipment, please follow the procedures for working at heights.**

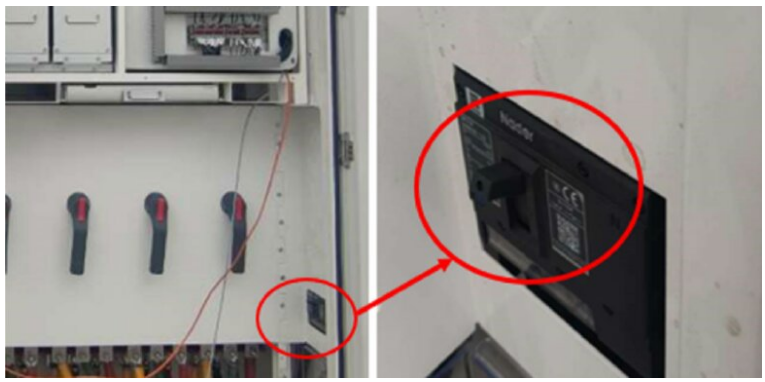
5.2 Coolant Filling and Drainage Operations

5.2.1 Coolant Change Intervals

Object	Standard	Period	Tools
Coolant	1. The coolant has obvious impurities; 2. The coolant color is significantly darker; 3. The coolant PH value is below 7.3.	5–6 years	Water pump, hose, hose clamp, slotted screwdriver Note: Please contact Sungrow Customer Service to replace hardware facilities

Operating Instructions for Coolant PH Testing

Step 1 System power-off: Open the BCP cabinet door of the integrated compartment from the side of the energy storage cabinet, and disconnect the auxiliary power supply circuit breaker to power off the system.



Step 2 Open the integrated compartment door in the front and open the water cooling unit cabinet door.

Step 3 Remove the sealing screw of any filler.

Step 4 Slowly open the valve by gently screw it (not fully open) and release about 10 mL coolant.



Step 5 Test the coolant sample with the PH test paper or PH meter to obtain the current coolant PH value. When the value is below 7.3, it is required to change the coolant (drain and refill the system).

- - End

5.2.2 Safety Precautions

⚠ WARNING

Normally coolant is not a health hazard, excessive exposure may cause irritation to the eyes, skin and breathing.

Personal protection

Wear personal protective equipment (PPE) when changing coolant. PPE should comply with relevant national standards, including but not limited to the following protective equipment.

Protective parts	Protective equipment
Respiratory protection	Under normal conditions of use, it is generally not necessary to wear respiratory protection equipment. If the engineering control facility does not maintain the air concentration at a level sufficient to protect the health of personnel, choose respiratory protection equipment suitable for the conditions of use and in compliance with relevant legal requirements. If you need to wear a safety filter mask, please choose a suitable mask and filter combination. Choose a filter suitable for a mixture of particulate/organic gas and vapor [boiling point >65 ℃ (149 ℉)].
Hands protection	Use oil-resistant, chemical-resistant protective gloves.
Eyes protection	Please use protective goggles.
Skin and body protection	Use non-permeable protective clothing and safety shoes.

Disposal considerations

Waste types	Disposal measures
Coolant	Discharges are made in accordance with local regulations and are not disposed of haphazardly.
Rubbish remnant	Separate and recycle, and if it meets the relevant regulations, it can be burned or reused.
Containers	Dispose of in accordance with all applicable local and national regulations. Use recovery/recycling where feasible, otherwise incineration is the recommended method of disposal. Empty containers may contain hazardous residues. Do not cut, puncture or weld on or near to the container. Labels should not be removed from containers until they have been cleaned. Contaminated containers must not be treated as household waste. Containers should be cleaned by appropriate methods and then re-used or disposed of by landfill or incineration as appropriate. Do not incinerate closed containers.

Accidental release measures

When a coolant leak occurs, refer to the following measures to deal with it.

- Immediately contact a professional to have uninvolved persons evacuated quickly to safety.

- Cut off the source of the spill as far as possible and prevent it from entering spaces such as sewers, drains and bodies of water.
- When cleaning up spilled liquids, wear protective equipment to protect your body from contact with the spilled or released material.
- Use sand, mud or other materials that can be used as barriers to set up barriers to prevent diffusion. Recover liquid directly or store in absorbent. Clean the contaminated area with detergent, water and a hard broom. Put the collected liquid in a disposable container.

First aid measures

Contact method	Measures
Inhalation	Move to fresh air. If breathing has stopped, give artificial respiration first aid. Seek medical attention.
Skin contact	Take off contaminated clothing. Rinse the skin thoroughly with soap and water. Seek medical attention if skin inflammation or rash occurs.
Eyes contact	Flush eyes with plenty of water for at least 15 minutes. Seek medical attention.
Ingestion	If ingested, but conscious, water or milk to drink and actively seek medical help, do not induce vomiting unless instructed by healthcare patients. If you cannot get help from a doctor, please send the patient and the container and label to the nearest medical emergency center or hospital. Do not give any food to unconscious patients.

5.2.3 Tooling Introduction

The filling-draining kit includes a handle, a pressure gauge, a drain valve, a pump working switch, a power indicator, a pump working indicator, a power supply storage compartment, and a pipeline storage compartment.

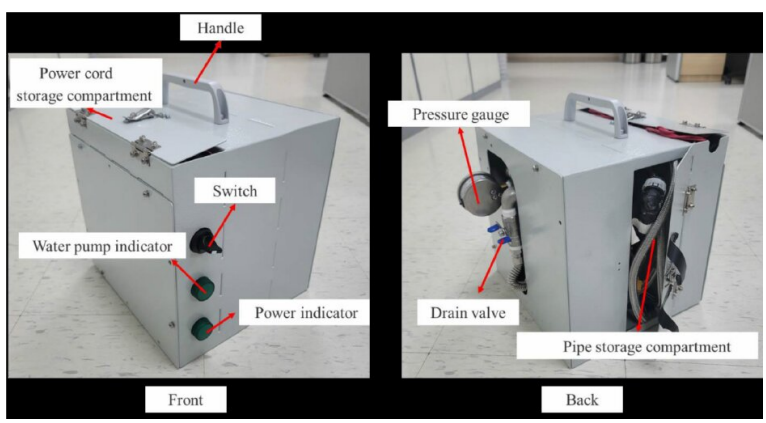


figure 5-1 Filling-draining Kit

The power cord storage compartment contains a 5 m-long power cord (which is longer than the distance between the distribution cabinet and the main pipe filler port), and the pipeline

storage compartment contains a refilling pipe and a liquid suction pipe. At one end of the refilling pipe, there is a quick plug connector matching the main pipe filler port and a ball valve V5.

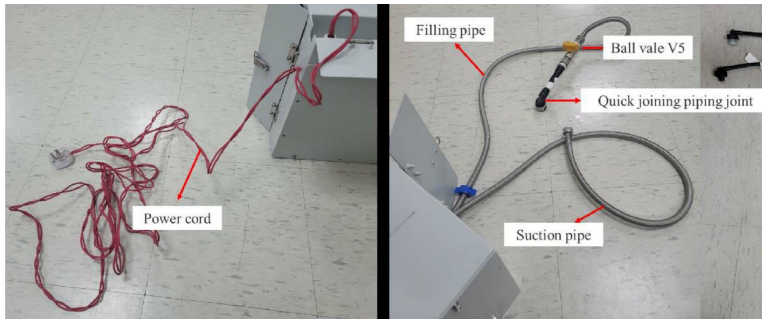


figure 5-2 Power Cord and Pipeline

The technical parameters of the filling-draining kit are shown in the table below.

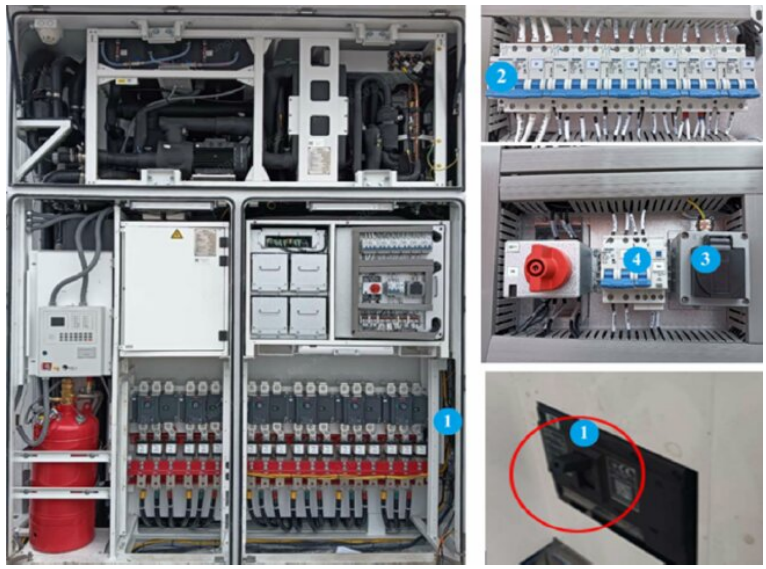
table 5-1 Technical Parameters of Filling-draining Kit

No.	Parameter Name	Parameter Value
1	Dimensions	270 mm*300 mm*300 mm
2	Weight	≤10 kg
3	Rated Voltage	220 V AC
4	Load Current	≤4 A
5	Power	≤96 W
6	Flow Rate	12 L/min
7	Headlift	2.5 Bar
8	Other Functions	Non-return

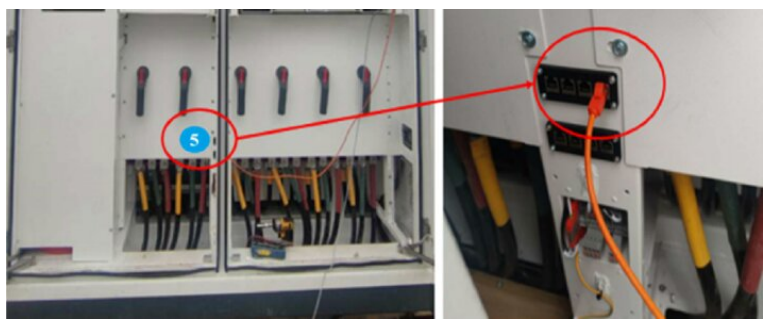
In PT2.0, the pipeline system is upgraded, so you don't need to drain the coolant for PACK and PCS maintenance, but only simply disconnecting the self-sealing connector at the maintenance location.

5.2.4 System Drainage

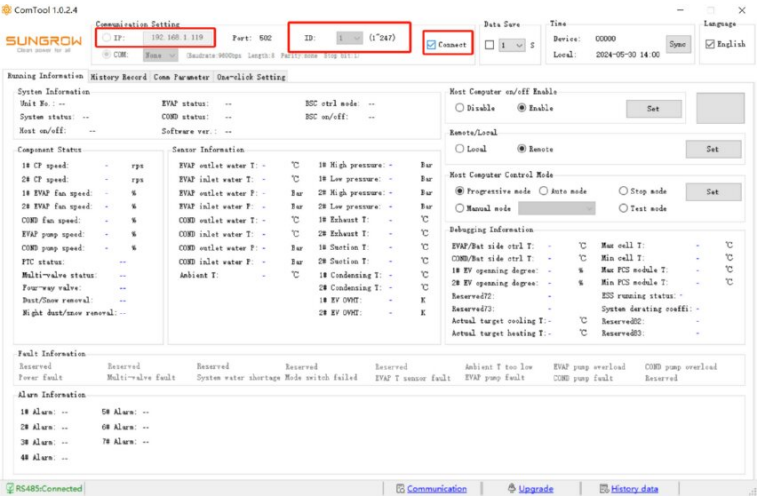
Step 1 Open the integrated compartment door on the right side of the energy storage cabinet, and confirm that the auxiliary power supply of the system on the lower-right side and the power supply switch for the liquid cooling unit on the upper-right side are connected in the order shown below.



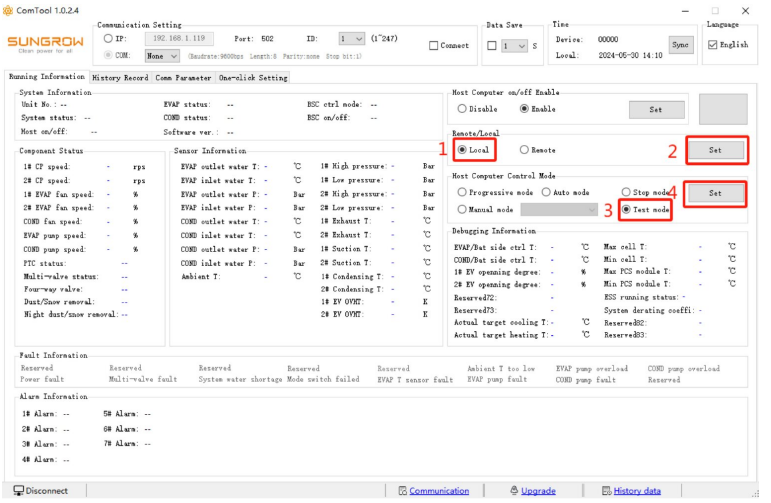
Step 2 Connect the signal network interface of the liquid cooling unit through the network cable and open the temperature control system app ComTool.



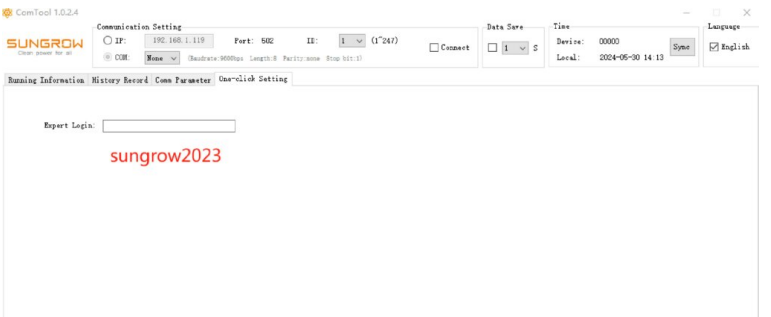
Step 3 Open ComTool, enter liquid cooling unit IP address **192.168.1.119** in **IP**, set **ID** to 1, and check □**Connect**. Then the connection between the host computer and the liquid cooling unit is established.



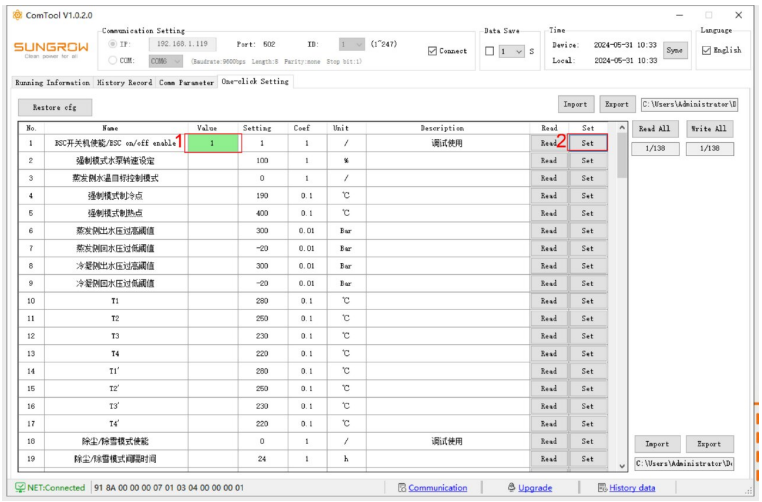
Step 4 Tap on"**Local→Set**" , "**Test mode→Set**"in sequence to enter the debug mode.

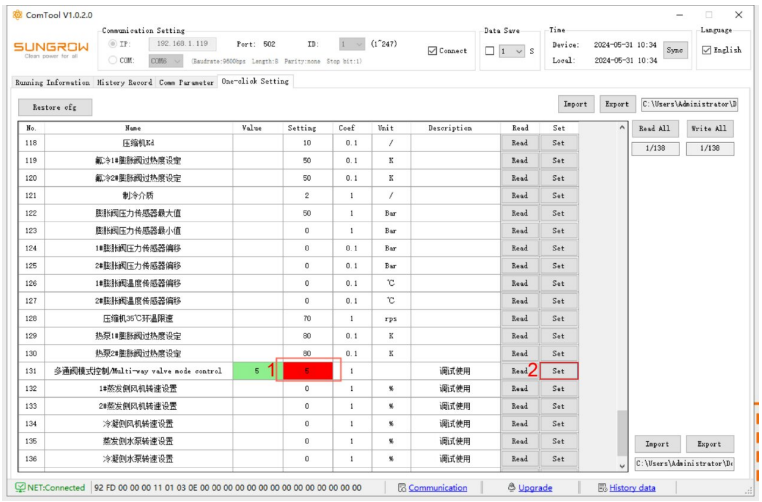


Step 5 Tap on the **One-click Setting** button, and enter Expert Login: **sungrow2023**, and go to the configuration interface.

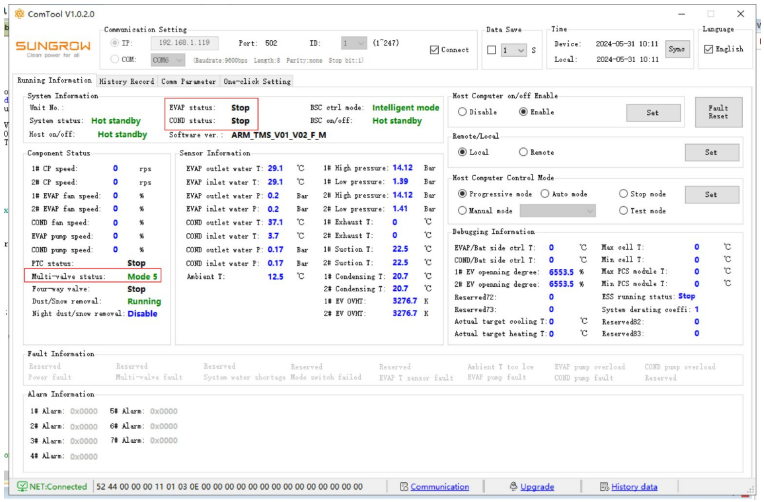


Step 6 In the configuration interface, set BSC on/off enable to 1 and Multi-way walve mode control to 5.



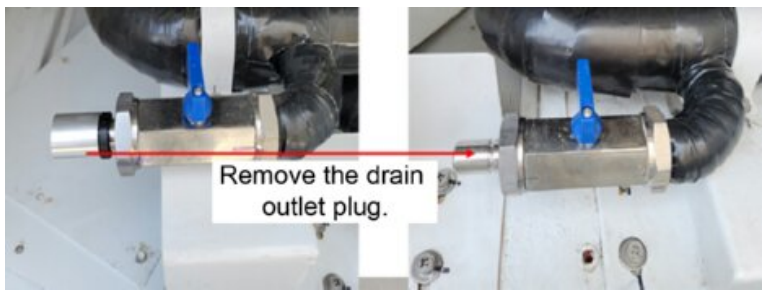


Step 7 Enter the Running Info interface and confirm that Multi-valve status is Mode 5, and the setting is successful. Confirm that the unit is in the stop status.

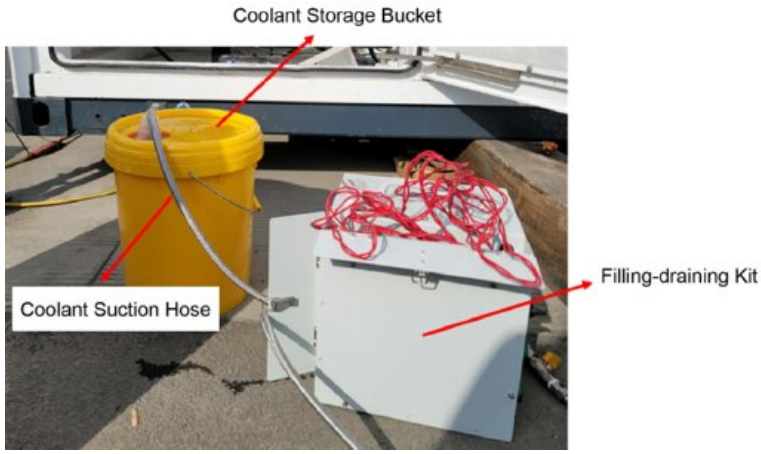


Step 8 After the multi-way valve mode is successfully set, open the integrated compartment door from the front of the energy storage cabinet.

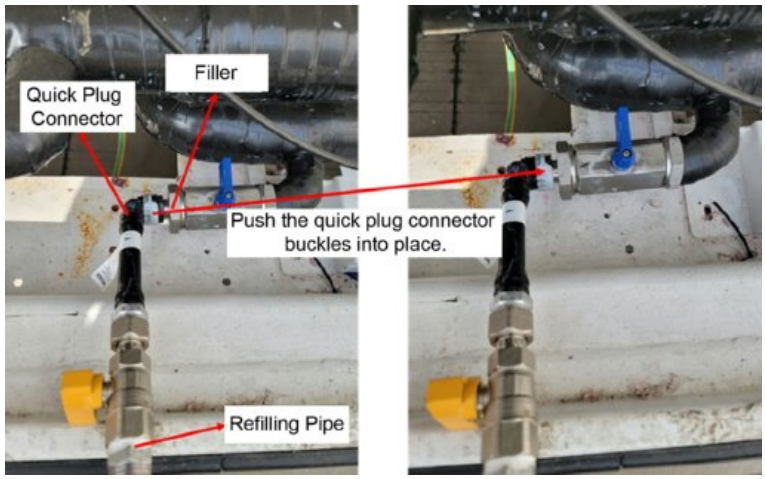
Step 9 Remove the plug from the system drain outlet.



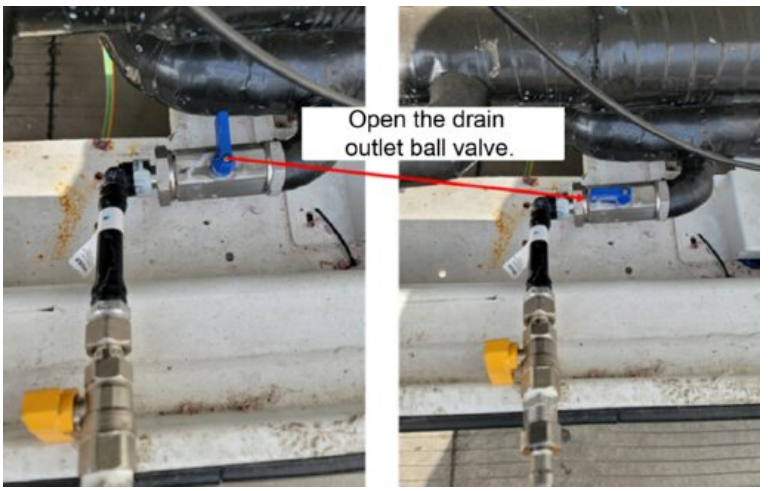
Step 10 Prepare the coolant storage bucket, take out the coolant suction hose from the filling-draining Kit storage compartment and put it into the bucket. This picture shows the 18 kg small bucket. The liquid discharge volume of the 2.0 system is approximately 200 kg. It is recommended to prepare 11 small buckets, or one large bucket with sufficient capacity.



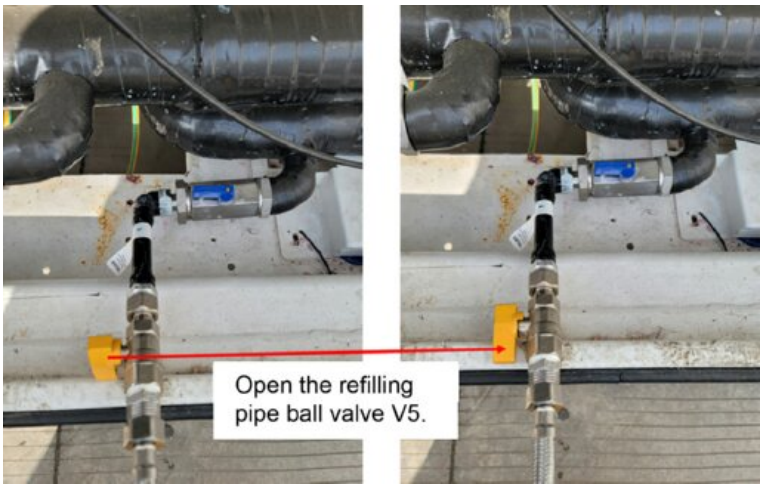
Step 11 Take out the refilling hose from the filling-draining Kit storage compartment, insert the quick plug connector into any of the system's drainage ports, and push the buckle of the quick plug connector into place.



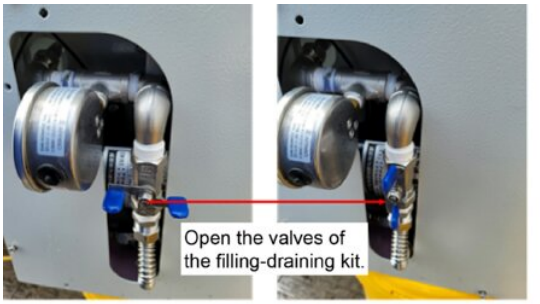
Step 12 Open the system drain port ball valve.



Step 13 Open the ball valve V5 of the filling hose in the filling-draining kit.



Step 14 Open the drain valve of the filling-draining kit, and coolant will flow out at this point.





Overall Layout

Step 15 If no liquid flows from the suction hose for 30 seconds, it will be considered that the system drainage is completed.

Step 16 After pipe maintenance is complete, change the coolant, and refill coolant into the system.

- - End

5.2.5 System Refilling

Step 1 Open the integrated compartment cabinet door on the right side of the energy storage cabinet and confirm that the system auxiliary power supply in the lower right and the power supply switch for the liquid cooling unit in upper right are connected.

Step 2 Open the door of the integrated compartment cabinet on the side of the energy storage cabinet, connect the signal network port of the liquid cooling unit through the network cable, and open the liquid cooling system software ComTool.

Step 3 Open ComTool, enter liquid cooling unit IP address **192.168.1.119** in **IP**, set **ID** to 1, and check □**Connect**. Then the connection between the host computer and the liquid cooling unit is established.

Step 4 Tap on"**Local→Set**" , "**Test mode→Set**"in sequence to enter the debug mode.

Step 5 Tap the **One-click Setting** button and enter Expert Login: **sungrow2023** to go to the configuration interface.

Step 6 In the configuration interface, set BSC on/off enable to 1 and Multi-way walve mode control to 5.

Step 7 Enter the Running Info interface and confirm that Multi-walve status is Mode 5, and the setting is successful. Confirm that the unit is in the stop status.

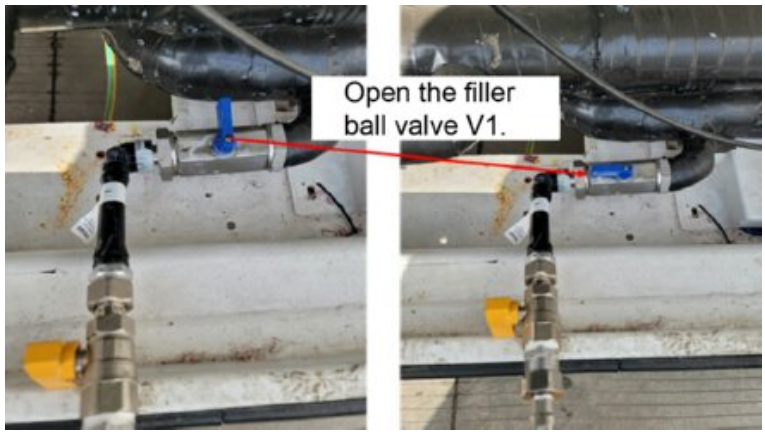
Step 8 After the multi-way valve mode is successfully set, open the integrated compartment door from the front of the energy storage cabinet.

Step 9 Remove the plug from the any filler port of the system.

Step 10 Prepare the coolant, take out the coolant suction hose from the filling-draining kit hose storage compartment and insert it into the bucket.

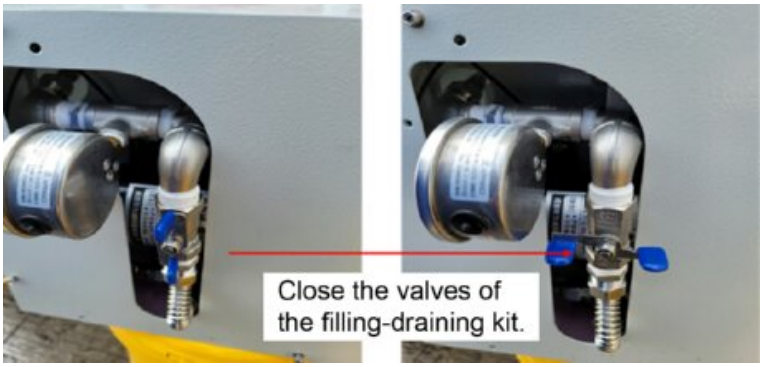
Step 11 Take out the coolant filling hose from the filling-draining kit hose storage compartment, insert the quick plug connector into any filler port of the system, and push the buckle of the quick plug connector into place.

Step 12 Open the system filler port ball valve V1.

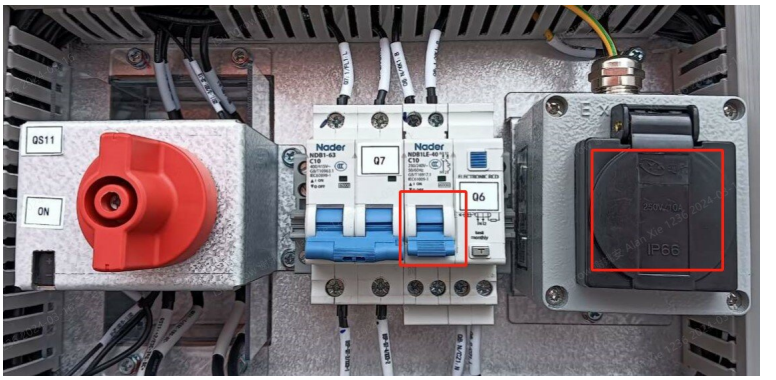


Step 13 Open the ball valve V5 of the filling hose in the filling-draining kit.

Step 14 Close the drain valve of the filling-draining kit.



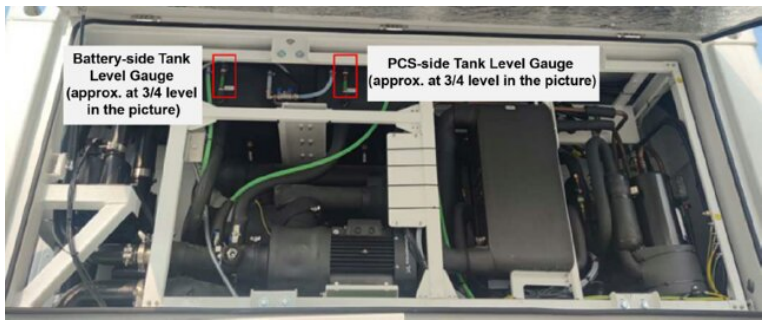
Step 15 Connect the electrical plug of the filling-draining kit to the 220 V power supply socket of the integrated compartment and turn on the power supply switch.

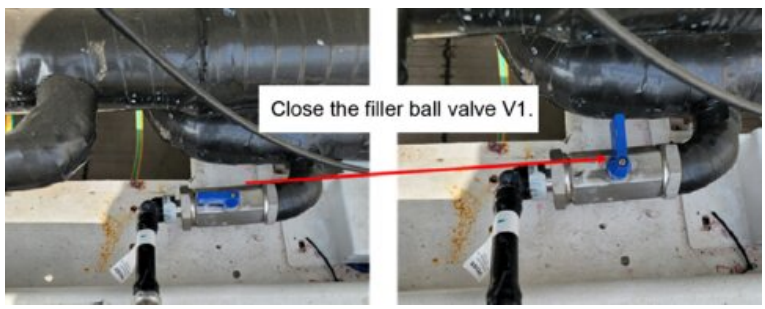


Step 16 Turn on the filling-draining kit switch. The pump working indicator of the filling-draining kit will come on, and the pump starts to fill coolant.



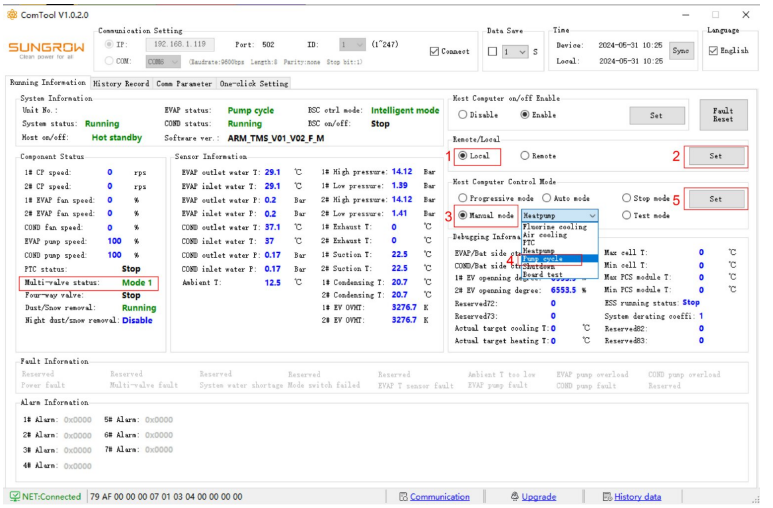
Step 17 Observe the level of the glass tube in the sightglass on the battery side and PCS side of the liquid-cooled main machine. When the level of any coolant tank reaches the 3/4 of the glass tube level gauge, stop filling coolant immediately and close the ball valve of the filling hose. The maintenance personnel need to observe the residual coolant quantity in the barrel. After the coolant is used up, close the switch of the filling-draining kit first, and then fill the coolant. It is estimated that about 11 barrels of coolant (18 kg) are needed to refill the system after drainage.



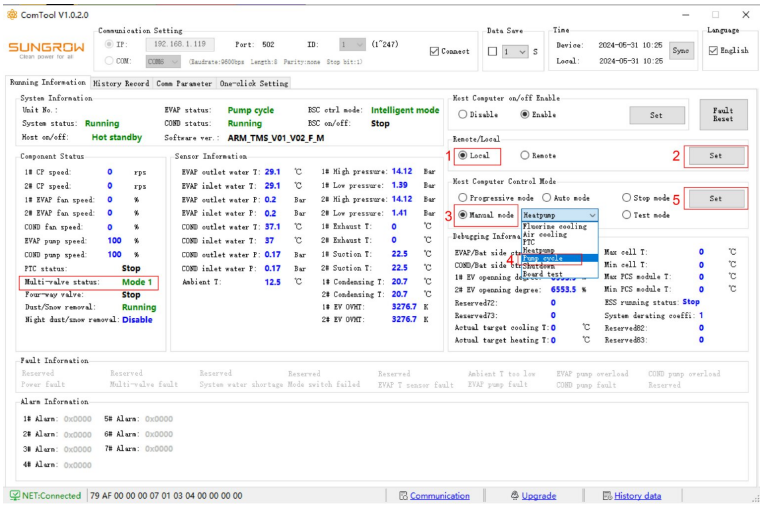


Step 18 Adjust the liquid cooling unit to the low-speed pump circulation mode and allow it to run for 10 minutes. In the Configuration interface, set BSC on/off enable to 1, Multi-way walve mode control to 1, and Maximum pump speed to 45.

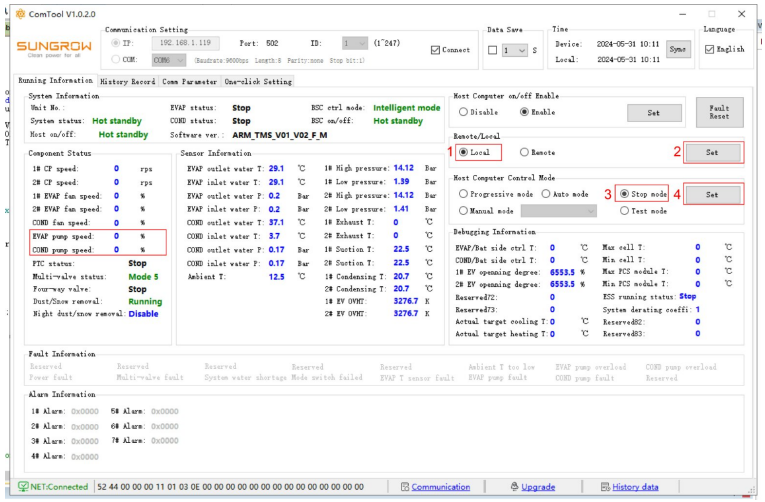
Step 19 Select **Local** in the Remote/Local mode on the Running Info interface and tap the **Set** button. In Host Computer Control Mode, select“**Manual mode→Pump cycle**”, and tap the **Set** button. At this point the liquid cooling unit starts to run.



Step 20 Set the liquid cooling unit to the high-speed pump circulation mode and allow it to run for 20 minutes. In the Configuration interface, set the BSC ON/OFF Enable to 1, the multi-way valve mode control to 1, and the Maximum pump speed to **100**. On the Running Info interface, select **Local** in the Remote/Local mode. Tap the **Set** button. In Host Computer Control Mode, select“**Manual mode→Pump cycle**”, and then tap the **Set** button. At this point the liquid cooling unit starts to run.



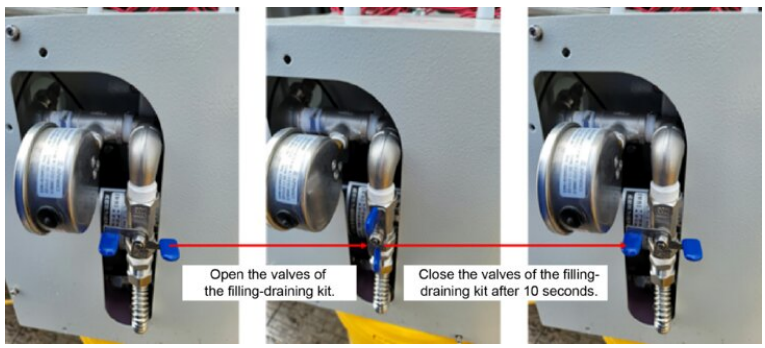
Step 21 When the pump is running, check the pipe connectors and valves for leakage. If any, stop the pump and drain the coolant, and then replace the leaking component. Stopping the liquid cooling unit: Under **Local** in the Running interface, select **Stop mode**, and tap the **Set** button. Then the liquid cooling unit will stop, and the speed of the coolant pump should become 0.



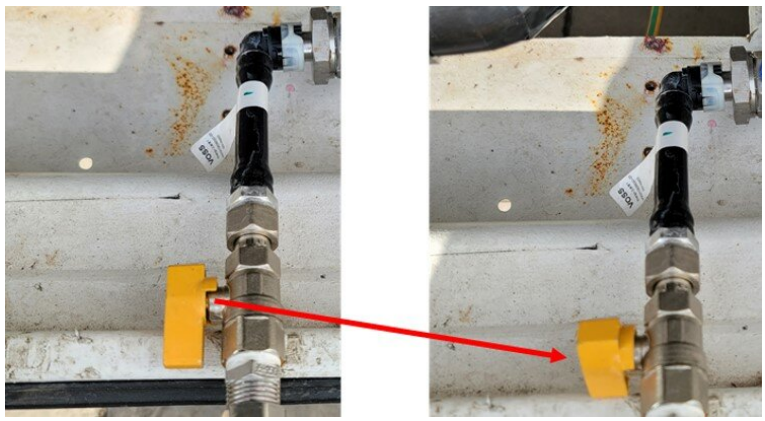
Step 22 If there is no leakage, set the liquid cooling unit mode to low-speed pump circulation mode, start the unit, allow it to tun for 30 minutes, and then stop it.

Step 23 In the stop state, when the liquid levels of the glass tubes on the two coolant tanks of the liquid cooling unit are both at 3/4 of the level gauge, the filling is complete. If the liquid level of one water tank is below the middle line, connect the filler port of the filling device to the corresponding inlet pipe filler port (that is, if the level of the coolant tank on the battery side is lower, the filler port on that side will be used for filling, which is same for the PCS side). Open the filling port valve to start filling coolant, and stop filling when the level is about 3/4. Close the filling port ball valve. Run for another 30 minutes until the levels of both tanks is at 3/4 of the glass tube in the stop state.

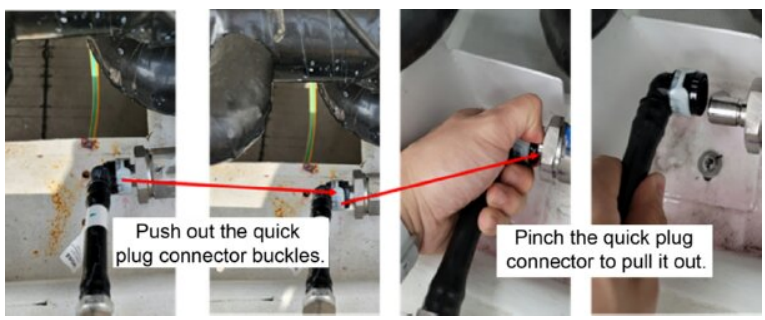
Step 24 Open the drain valve of the filling-draining kit and close it after 10 seconds.



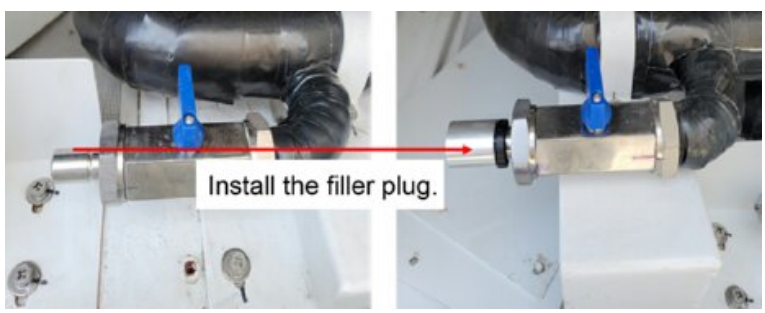
Step 25 Close the ball valve V5 on the filling hose of the filling-draining kit.



Step 26 Push out the buckle of the filling hose quick plug connector and pinch the quick plug connector to pull it out.



Step 27 Plug the system filler port.



Step 28 Set the liquid-cooling unit parameters to the factory mode. In the configuration interface, set the maximum pump speed to 100. Tap the Read button to read the current value and confirm whether the setting is successful.

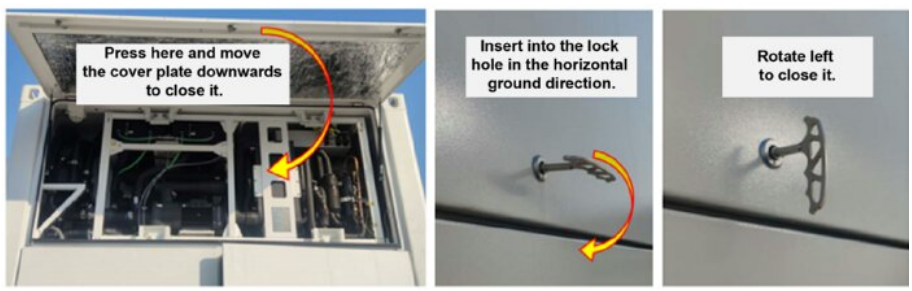
Step 29 Under **Local** in the running interface, select **Stop mode**, and tap the **Set** button. Then the liquid cooling unit should stop. Observe whether the coolant pump speed changes to 0.

Step 30 Remove the power supply plug of the filling-draining kit and the computer network cable, and store the pipes and power cable in the corresponding storage compartments of the kit.



Step 31 Use a rag to clean any coolant left inside the container.

Step 32 Close the liquid cooling unit upper cover plate and integrated compartment door.



- - End

5.2.6 Coolant Replenishment Operation of Condenser/Evaporator

In the PT2.0 system, the condensation side corresponds to the PCS side, while the evaporation side to the battery side.

Step 1 Open the integrated compartment and the cover plate of the liquid cooling unit to observe the coolant tank level in the condenser.

Step 2 Take out the filling pipe from the filling-draining kit pipeline storage compartment, and insert the quick connector into the PCS-side filler during coolant replenishment. During coolant replenishment for the evaporator, insert the quick connector into the battery-side filler and push the buckle of the quick connector into place.

Step 3 Open the filler ball valve of the system.

Step 4 Open the ball valve V5 of the filling hose in the filling-draining kit.

Step 5 Close the drain valve of the filling-draining kit.

Step 6 Connect the electrical plug of the filling-draining kit to the 220 V power supply socket of the integrated compartment and turn on the power supply switch.

Step 7 Turn on the filling-draining kit switch. The pump working indicator of the filling-draining kit will come on, and the pump starts to fill coolant.

Step 8 Observe the level of the glass tube in the sightglass on the battery side and PCS side of the liquid-cooling unit, and stop filling when the level reaches 3/4 of the level gauge.

Step 9 Close the filler ball valve.

Step 10 Run the liquid cooling unit at low speed for 5 minutes and then at high speed for 10 minutes, and observe whether there is liquid leakage at pipe joints and valves in the whole process. If any, it is necessary to drain the coolant after shutting down the machine, and then replace leaking components.

Step 11 No leakage is found and the liquid level of both water tanks is at 3/4 in the shutdown status. This indicates the coolant replenishment is complete. Switch the liquid cooling unit to the factory mode and shut it down.

Step 12 Finally, store the filling-draining kit properly.

- - End

5.3 Battery Module Replacement

5.3.1 Tooling Introduction

5.3.1.1 Liquid-cooled PACK/PCS Maintenance Tooling

The PACK/PCS maintenance tooling used for PowerTitan2.0 is shown below.

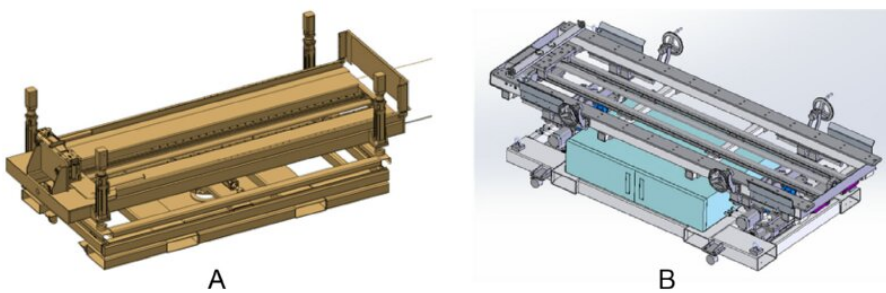


figure 5-3 Maintenance Tooling

*The figure is for reference only. The actual tooling may be different.

Maintenance tooling is available in A/B form, please refer to the actual project. This manual introduces the maintenance tooling in A form, please refer to A form for the operation procedure of B form.

The technical data of the maintenance tooling are listed in the table below.

table 5-2 Technical Data of Maintenance Tooling

Parameter	Description	Parameter	Description
Machine code	A0SJ0084	Rated load	700 kg
Overall weight	1000 kg	Platform guide rail height	500~600 mm
Operating voltage	AC 110 V~230 V	Push motor power	1000 W
Leveling travel	0~100 mm	Platform size	2250*793 mm
Side shift travel	0~±100 mm	Push rate	1000 mm/min
Horizontal adjustment angle	±20°	Transit mode	Forklift or crane

The components of the maintenance tooling are shown in the figure below.

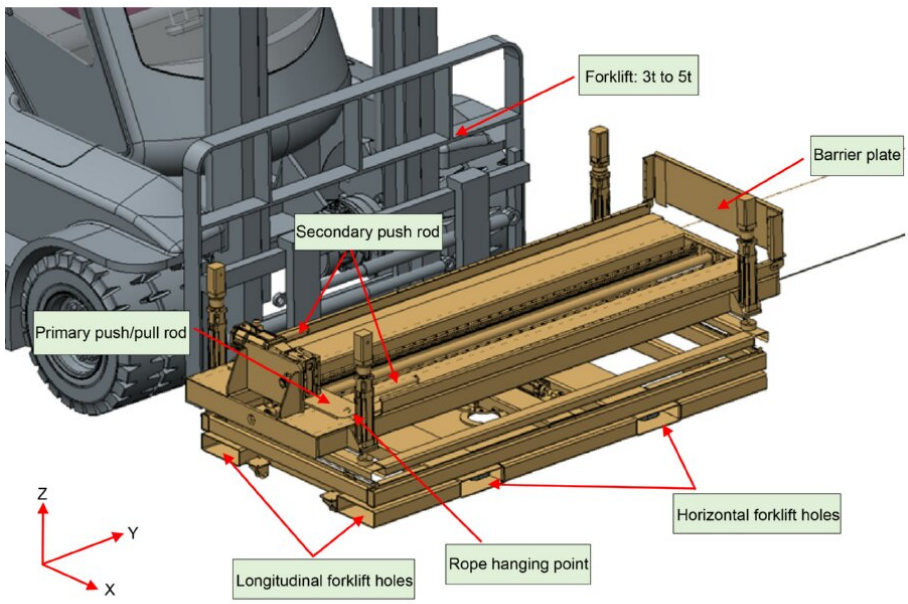


figure 5-4 Components of Maintenance Tooling

*The figure is for reference only. The actual tooling may be different.

5.3.1.2 Transport Tooling

The maintenance tooling should be used in conjunction with the transport tooling. The transport tooling is shown below, the machine code is B0J00152.

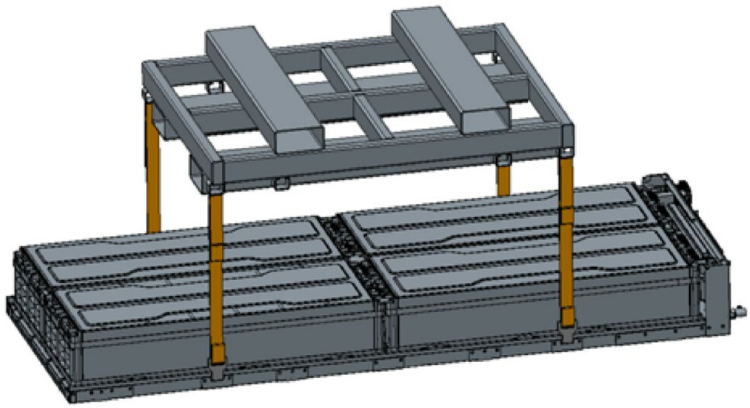


figure 5-5 Transport Tooling

*The figure is for reference only. The actual tooling may be different.

NOTICE

The height of the PACK must not exceed the height of the ground by 1.5 m to prevent the risk of falling.

Use transport tooling with a forklift as shown below.

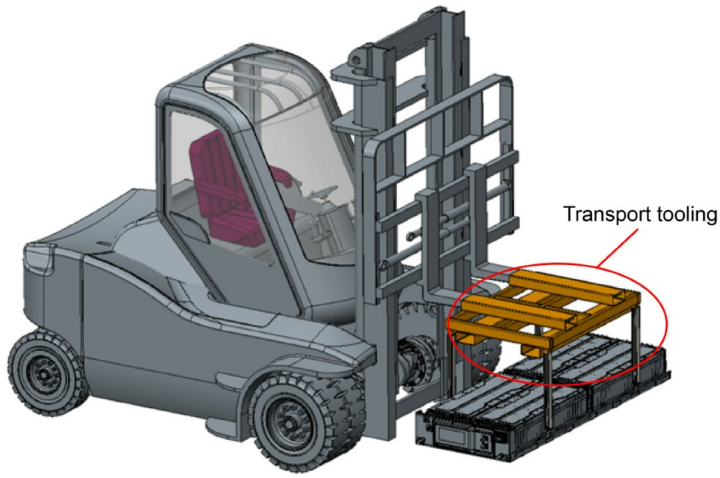


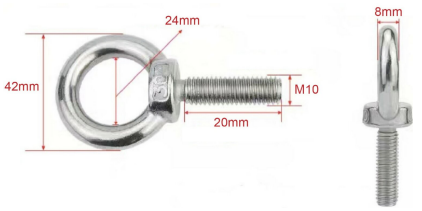
figure 5-6 Transport tooling with forklift schematic

*The figure is for reference only. The actual tooling may be different.

5.3.1.3 Other Tools

It is suggested to prepare the appropriate tools, including but not limited to those listed below, to ensure the maintenance work can be completed smoothly.

Tools	Description
 Forklift	• A 5t forklift that runs on oil is recommended; • For dirt and gravel roads that are prone to collapsing, it is recommended that off-road tire forklifts or pre-paved steel plates be used based on an assessment of the strength of the road surface to prevent the tires from sinking into the road surface, making it difficult to move forward with maintenance work.
 Herringbone ladder	A herringbone ladder with a height of 3m is recommended (the guide rail for the top PACK sits at a height of 2276 mm. You may select the ladder according to the height of the foundation on site).
 Safety harness for working at height	-

Tools	Description
 Safety helmet for working at height	-
 Eye bolt	• M10*20 eye bolt (4 pcs); • Included in the maintenance tooling configuration.
 M10 socket	An electric M10 socket is recommended (torque adjustable).
 Two-hook rope	• It is recommended to use a two-hook rope that has a length of 1m and a diameter of 14mm to pull the PACK out. • Load capacity ≥0.6t; • Breaking load ≥2.5t. • Included in the maintenance tooling configuration.
 Allen wrench	It is recommended to use an allen wrench set.

*The figures are for illustration only.

5.3.2 Replace PACK

5.3.2.1 Precautions

DANGER

High voltages! Danger of electric shock!

- **Do not touch any live part!**
- **Before installation, make sure the outdoor cabinet and its internal components are all voltage-free.**
- **Do not place the product on the surface of flammables.**

WARNING

During maintenance, do not step on the lead screw assembly of the tooling, to avoid getting it damaged.

WARNING

- **Do not open the door and maintain the system on rainy, humid, or windy days. SUNGROW shall not be held liable for any possible outcome arising from failure to observe this instruction.**
- **Avoid opening the cabinet door on days with rain, snow, heavy fog, or high humidity. Besides, after closing the cabinet door, make sure the sealing strip around the door does not curl.**
- **To avoid accidents, maintenance work is not recommended in snow or rain, as the ground may be slippery and tires may easily get stuck.**

WARNING

- **The maintenance work must only be performed by qualified engineers, Please comply with the requirements in "Safety Precautions" in this manual. SUNGROW shall not be held liable for any personal injury or property damage arising from failure to follow the safety instructions.**
- **To ensure the safety of maintenance personnel and the smooth completion of maintenance work, follow strictly the instructions provided in this manual throughout the whole process.**

NOTICE

Do not carry people on the tooling, and after the maintenance work is completed, the tooling should be well protected by the matching protective cover.

5.3.2.2 Site Requirements

NOTICE

- **Cables should be pre-buried below the ground surface with cable trench covers with a bearing capacity of not less than 50kN.**
- **The upper surface of the cable trench cover should be at the same height as the ground to ensure ease of passage for forklifts.**
- **The design layout of the site within the power station should take into account the passage of forklift trucks, and the strength should meet the requirements of forklift trucks (with a total weight of 50kN) to ensure that the forklift trucks are able to drive into any cabinet between the cabinets.**
- **If steps need to be arranged, for liquid-cooled 2.0 projects, the spacing of the cabinets should not be less than 3.5m, and the total depth of the steps on one side should not exceed 0.6m.**

5.3.2.3 General Procedure

The maintenance tooling is used for the replacement or maintenance of liquid-cooled PACKs and PCSs. This manual mainly gives instructions on how to replace a PACK using the tooling, but the steps apply to PCS replacement as well.

The procedure to replace the liquid-cooled PACK can be divided into four parts: preparation work, tooling setup, PACK mounting, and follow-up work.



figure 5-7 Liquid-cooled PACK Replacement Procedure

5.3.2.4 Preparation

5.3.2.4.1 System Power-off

Power off the whole system before replacing the PACK.

Preparation: Log in to the LC interface, turn off the system via the control software (you may press the emergency stop button on the cabinet in case of an emergency or other special situation).

Step 1 Power off the main power circuit.

Turn the load switch on the BCP to "OFF".

Step 2 Power off the auxiliary power supply.

1 Disconnect DC load switch QS11 on the BSP (power module DC supply).

2 Disconnect other miniature circuit breaker switches on the BSP.

- - End

NOTICE

- **Perform maintenance only after the power is off, and ensure the system will not be powered again during the maintenance operation. For some operations that need to be performed with power on, ensure that the wiring has been completed properly before powering on.**
- **Protective measures must be taken during electrical maintenance, such as wearing insulated gloves or insulated shoes.**

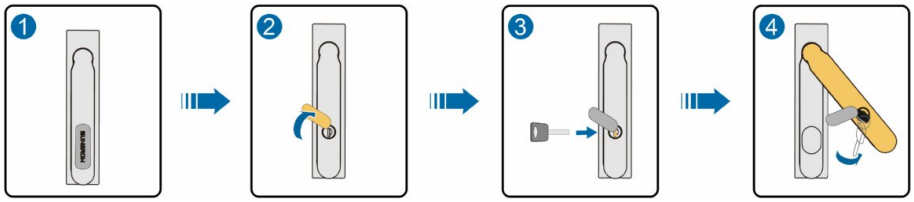
5.3.2.4.2 Open Cabinet Door

Step 1 Open the cabinet door.

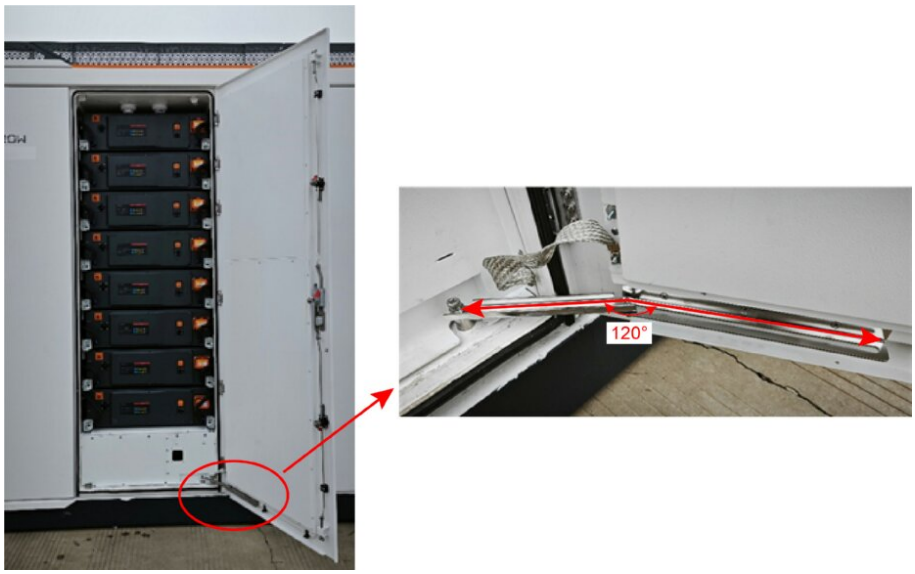
1 Toggle the protective cover on the handle clockwise to expose the keyhole.

2 Insert the door key and turn it clockwise.

3 Rotate the handle counterclockwise to open the front door.



Step 2 Open the door to the full, at an angle of 120°.



*The figure is for reference only.

- - End

5.3.2.4.3 Remove MSD Plugs

When stopping the product for maintenance or disconnecting the power for troubleshooting, pull out the MSD plug to cut off the electrical circuit for safety.

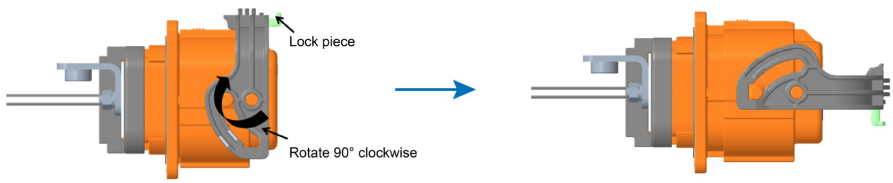
WARNING

Prohibit unplugging the MSD under load!

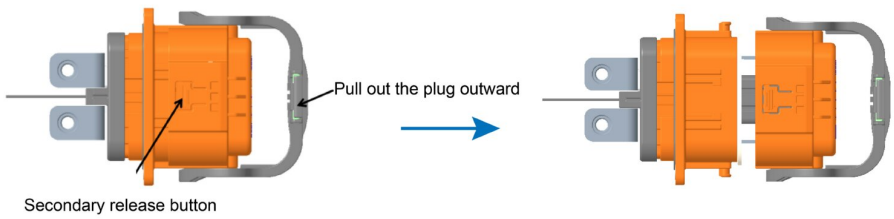
NOTICE

Before pulling out the MSD, you need to unplug the R1-4-BAT+ aerial plug of the battery cluster, and then pull out the MSD on the PACK to be maintained.

Step 1 Pull out the lock piece, and turn the handle around 90° clockwise.



Step 2 Press and hold the secondary lock release button, and pull the plug out.



Do not lose the MSD after pulling it out, and store it properly to avoid dropping and moisture.

- - End

5.3.2.4.4 Remove Bidirectional Shut-off Valve

Step 1 Fix the hook of the safety harness.

The operator, who wears a safety helmet and safety harness properly, climbs up the ladder and attaches the hook to the corner fitting on the top PACK.

NOTICE

- **You may decide whether to use a ladder based on the height of the foundation and the position of the PACK requiring maintenance.**
- **The point to which the safety harness is fixed must always be higher than the height at which the operator is working.**



figure 5-8 Point to Attach the Hook

*The figure is for reference only.

Step 2 Pull out the male connector of the bidirectional shut-off valve and remove it from the liquid cooling pipe. Then, put the pipe on the inside of the guide rail, to avoid collision when moving the PACK.

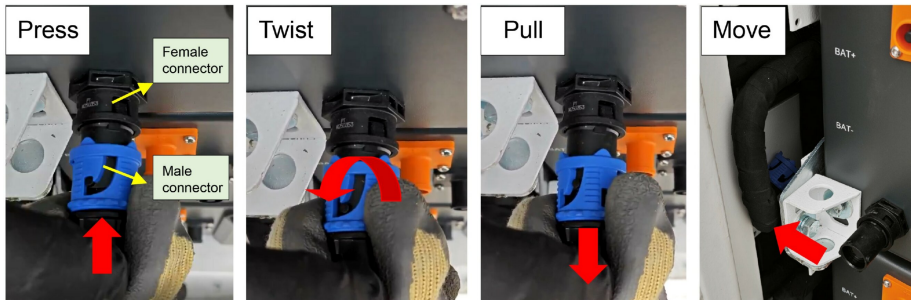


figure 5-9 Remove Bidirectional Shut-off Valve (Left Side)

*The picture is for reference only.

NOTICE

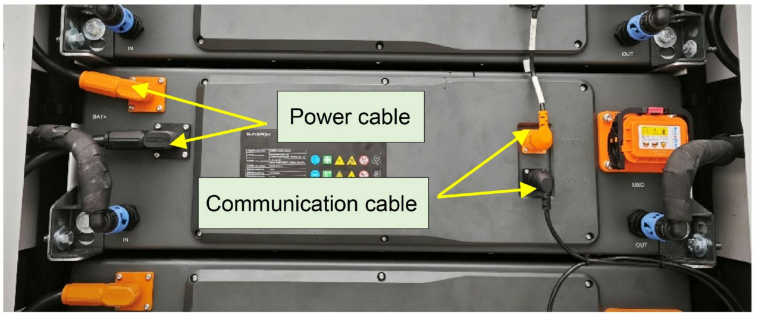
In the whole process of pressing, twisting, and pulling, hold the male connector of the shut-off valve with one hand, to prevent the connection between the valve's female connector and the PACK from getting loose due to overly high torque.

- The steps to remove the bidirectional shut-off valve on the right side are the same.
- The bidirectional shut-off valve will have a little leakage (about 0.3ml) during dismantling and pulling out, which is a normal phenomenon.

- - End

5.3.2.4.5 Remove Cables

The picture below shows the positions of the power cables and communication cables on the PACK.



*The figure is for reference only.

NOTICE

Keep the power cables and communication cables properly after removing them.

Step 1 Press the key on the positive and negative connector of the power cable, and pull the cable out.



figure 5-10 Remove Power Cable

*The figure is for reference only.

Step 2 Rotate the positive and negative connectors of the communication cable, and pull the cable out.

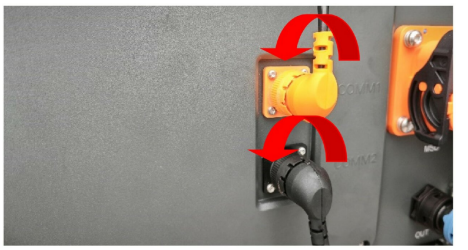


figure 5-11 Remove Communication Cable

*The figure is for reference only.

- - End

5.3.2.4.6 Remove Fuse

If the PACK to be removed is in layer 2, 3, 6, or 7, you need to remove the fuse between the RACKs.

Fuses between RACKs are shown in the figure below.

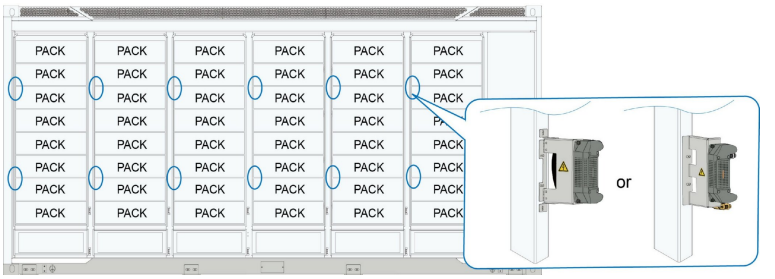


figure 5-12 Positions of Fuses

*The figure is for reference only.

NOTICE
Keep the fuse properly after removing it.

Step 1 Remove the screws from the fuse mounting hole locations.

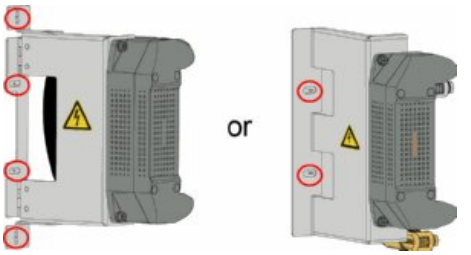


figure 5-13 Fuse mounting holes

Step 2 Remove the cable between the fuse and the PACK, and then take the fuse down.

- - End

5.3.2.4.7 Remove PACK Corner Fittings

Step 1 Remove the M10 screws from the corner fittings of the PACK using the M10 socket.



figure 5-14 Positions of M10 Screws

*The picture is for reference only.

Step 2 Take down the corner fittings and keep them properly for later use.

Step 3 Install the M10 eyebolt screws (2pcs, included in the tooling configuration) in the original holes of the PACK.

- - End

5.3.3 Tooling Setup

5.3.3.1 Initial Setup

Put the tooling in place first, for further adjustment and calibration.
The setup work should be completed in the proper order of Y-axis, X-axis, and then Z-axis.

Step 1 Y-axis.

Use a forklift to move the tooling to the place where the PACK to be replaced is located. Keep the tooling around 200 mm away from the cabinet door to avoid collision. You can remove the door restrictor if necessary.

Step 2 X-axis.

Drive the forklift backward and forward slowly, until the tooling is almost aligned with the center of the battery compartment where the PACK to be maintained is located.

Step 3 Z-axis.

Lift or lower the forklift forks, until the guide rail of the maintenance tooling is in a horizontal plane approximately 10 mm lower than the guide rail in the cabinet, then unfold the barrier plate.

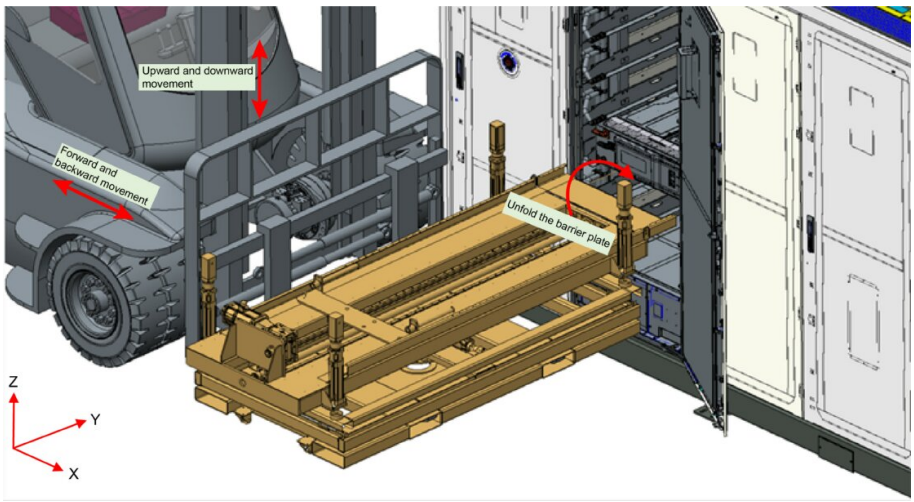


figure 5-15 Maintenance Tooling Setup

*The figure is for reference only.

- - End

5.3.3.2 Tooling Adjustment

Make small adjustments to the tooling so that the PACK can be put into the cabinet smoothly.

Adjustments should be made first on the Z-axis and then the X-axis.

Step 1 Connect the workhorse power cord to the cabinet BSP maintain socket or to the mains (-voltage is configured differently for different areas).

Step 2 Z-axis.

1 Rotate the tooling around the Z-axis to ensure that the maintenance tooling is approximately perpendicular to the cabinet (this action is an automated adjustment; if the automated precision is insufficient, it can be adjusted manually).

2 Using the Z-axis fine-tuning hydraulic rod in "figure 5-16 Maintenance tooling adjustment schematic", fine-tune the height of the four corners of the tooling, so that the tooling guide rail and the PACK rail to be maintained at the same level (leveling action for automated adjustment, such as automated precision is insufficient, can be manually adjusted).

Step 3 X-axis.

Using the X-axis fine-tuning hydraulic lever in "figure 5-16 Maintenance tooling adjustment schematic", fine-tune the left and right offset travel of the tooling so that the tooling screw is centered and aligned with the PACK to be maintained.

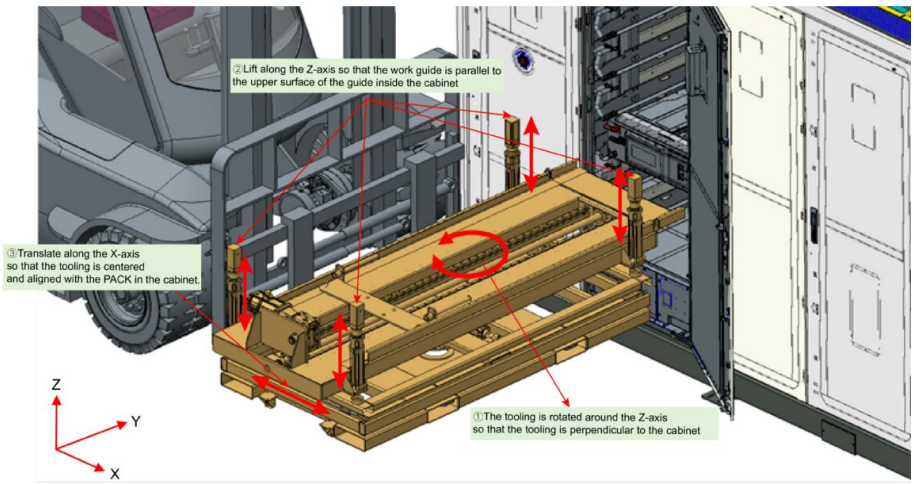


figure 5-16 Maintenance tooling adjustment schematic

*The figure is for reference only.

- - End

5.3.4 PACK Mounting

5.3.4.1 Remove Old PACK

Step 1 Pull the PACK out of the cabinet.

1 Push the primary push / pull rod positively along the Y-axis to the end.

2 Connect the PACK eye bolt to the wire rope hanging point of the tooling with the tooling supporting wire rope (two ropes in total, 1 each of 1.5m and 3m, 3m wire rope is used here).

3 Recover the primary push / pull rod and pull the PACK out of the cabinet about 500mm.

NOTICE

This process should be carried out slowly to avoid bumping into the PACK nozzle. Meanwhile, always pay attention to the connection between the rollers under the PACK and the guide rails of the tooling.

4 Slowly raise the tooling so that the bottom rollers on the front of the PACK lap on the tooling, thereby stressing the tooling guide rails.

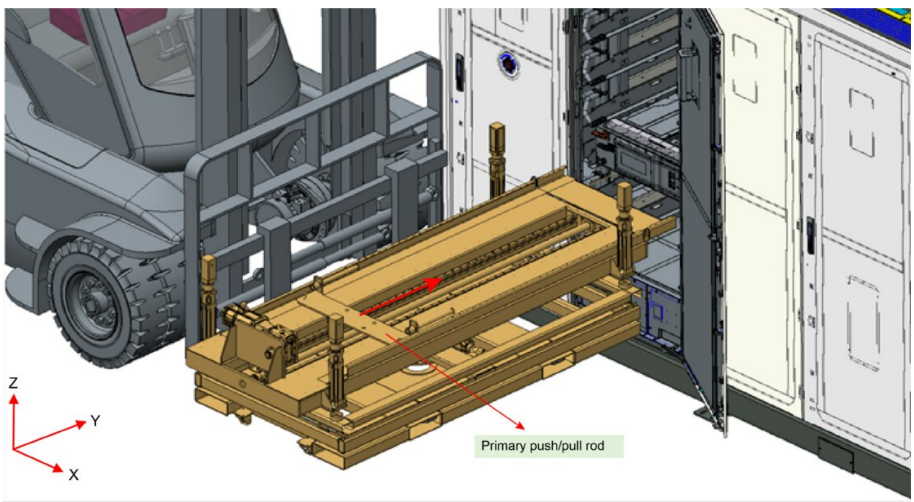


figure 5-17 Schematic diagram of PACK out of the cabinet 1

*The figure is for reference only.

Step 2 When the PACK travel reaches about 500 mm in front of the negative end of the Y-axis, slowly raise the tooling again.

NOTICE

At this time, most of the weight of the PACK has been borne by the tooling, the tooling because of the forklift tires have elasticity and parts and components with other reasons, it will be downward displacement of 5 ~ 10mm, in order to avoid the PACK all pulled out of the sudden fall, at this time you need to slowly raise the tooling again. So that all the weight of the PACK is borne by the tooling, and the cabinet rail is no longer under force (the bottom roller of the back end of the PACK leaves the upper surface of the cabinet rail 1~2mm).

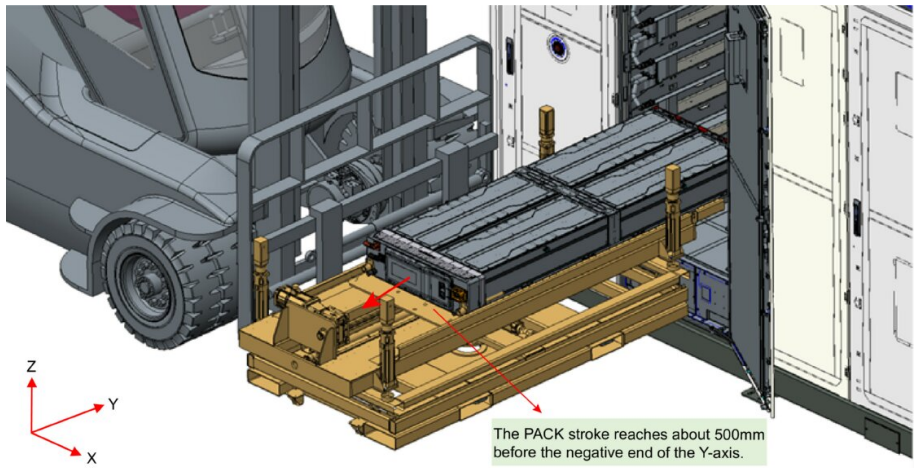


figure 5-18 Schematic diagram of PACK out of the cabinet 2

*The figure is for reference only.

Step 3 The primary push / pull rod is pushed positively along the Y-axis to the overlap with the PACK, and the 1.5m wire rope is replaced. Retract the primary push / pull rod in the negative direction along the Y-axis to complete the last 500mm of travel.

Step 4 After the barrier plate is up and secured, disconnect the tooling from power. Remove the wire rope and eyebolt from the front of the PACK and lower the forklift tines until the tooling hits the ground.

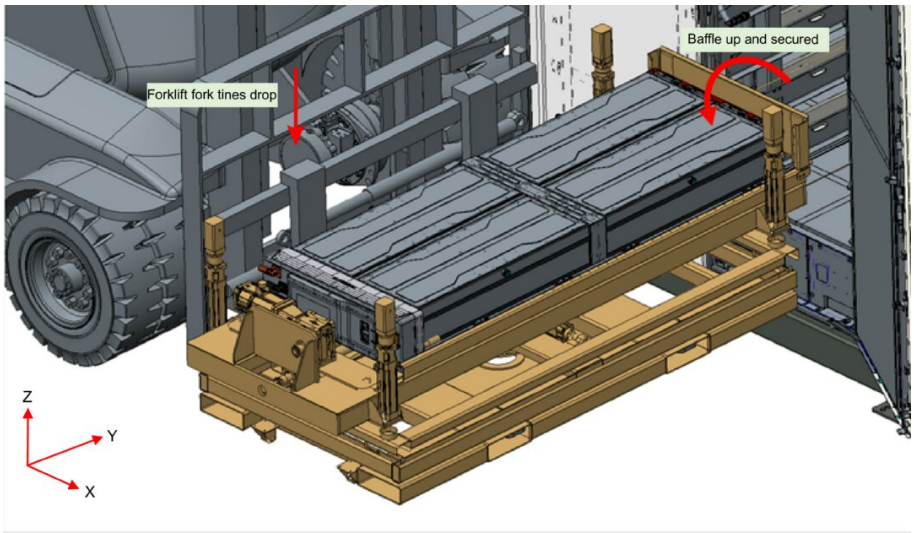


figure 5-19 Schematic diagram of PACK out of the cabinet 3

*The figure is for reference only.

Step 5 Forklift trucks and PACK transport tooling are used to transfer used PACKs to pre-arranged locations.

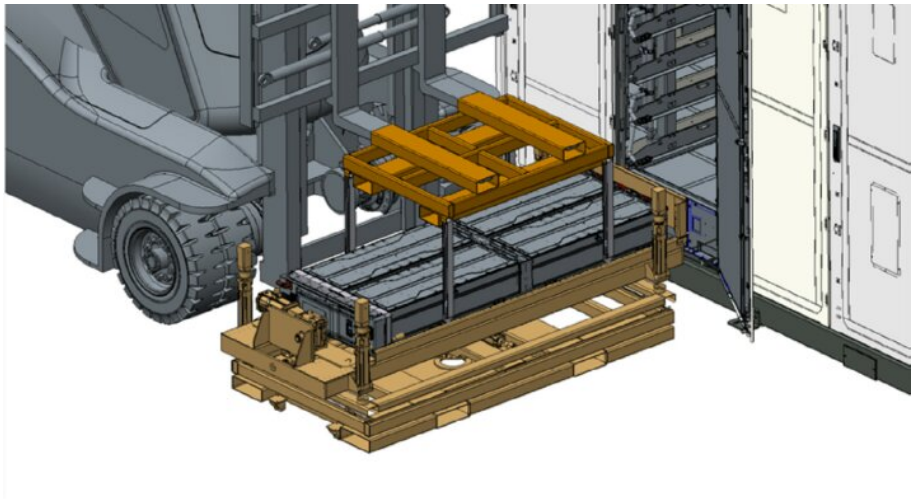


figure 5-20 Schematic diagram of transport tooling to replace PACK

*The figure is for reference only.

- - End

5.3.4.2 Mount New PACK

Step 1 Use forklift and PACK transport tooling to transfer new PACKs to the PACK maintenance tooling.

Step 2 Raise the maintenance tooling to the point where the upper surface of the tooling guide rail is slightly higher than the position of the guide rail inside the cabinet (3~5mm is appropriate, if the forklift precision is insufficient, the tooling will be used to complete the refinement of the action after the tooling is powered up). Subsequently, connect the power cord of the tooling to the BSP maintenance socket or the mains, and after calibrating and adjusting the tooling (refer to "5.3.3.2 Tooling Adjustment" for the adjustment procedure), unfold the barrier plate.

Step 3 The primary push / pull rod moves forward slowly along the Y-axis by about 500mm, and when the bottom roller of the PACK is about to lap on the cabinet guide rail, lower the tooling to the point where the upper surface of the tooling guide rail is at the same level as the upper surface of the cabinet guide rail.

NOTICE

This should be done slowly to avoid bumping the PACK spout.

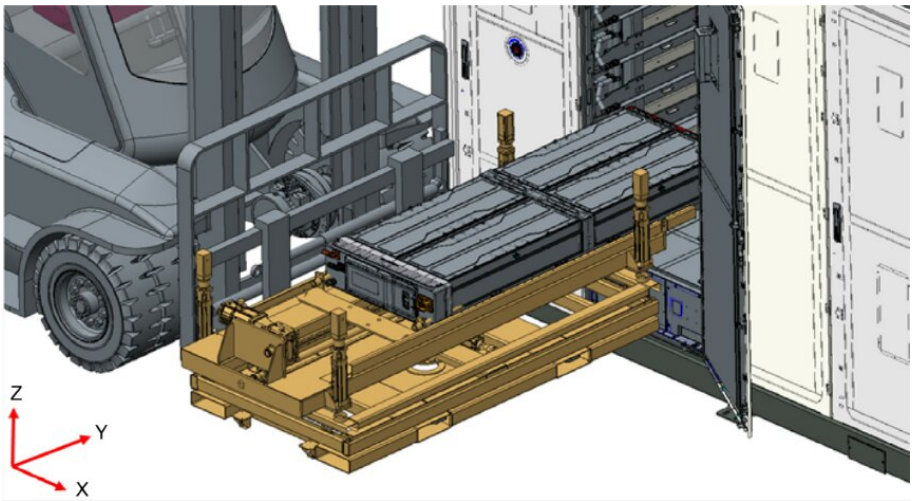


figure 5-21 Schematic diagram of PACK-in-cabinet action 1

*The figure is for reference only.

Step 4 Push the PACK positively along the Y-axis to the position where the front end of the PACK is about 300mm away from the surface of the cabinet, and then lower the tooling as a whole by about 5mm, so that the roller at the bottom of the front end of the PACK hangs in the air, and there is no contact between the roller and the tooling guide rail. Subsequently, the primary actuator along the Y axis negative return about 600mm, manually extend the secondary actuator and rotate fixed.

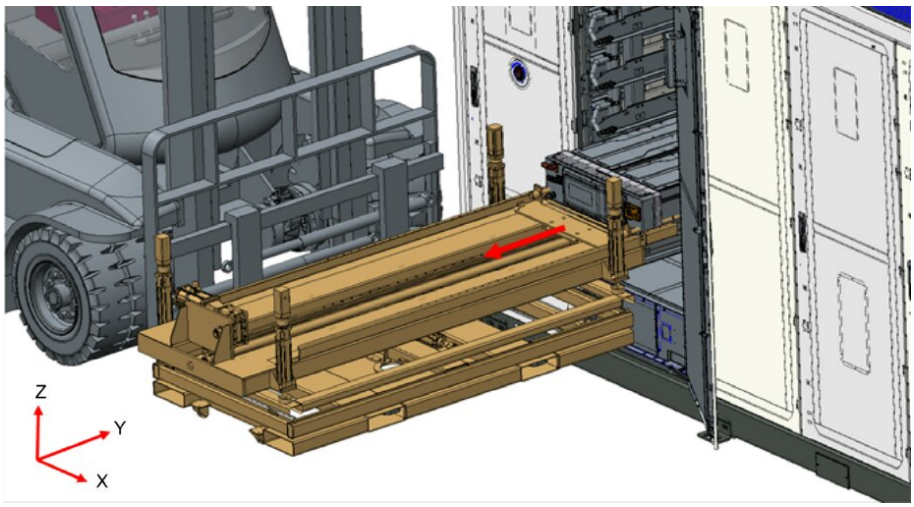


figure 5-22 Schematic diagram of PACK-in-cabinet action 2

*The figure is for reference only.

Step 5 The primary push / pull rod pushes forward along the Y-axis, driving the second stage pusher to move, completing the last section of travel before the PACK is put into the cabinet. After that, the primary push / pull rod is recovered 600mm, the end plate of the tooling is upturned, the power supply of the tooling is disconnected, and the tooling is transported away from the site by forklift truck.

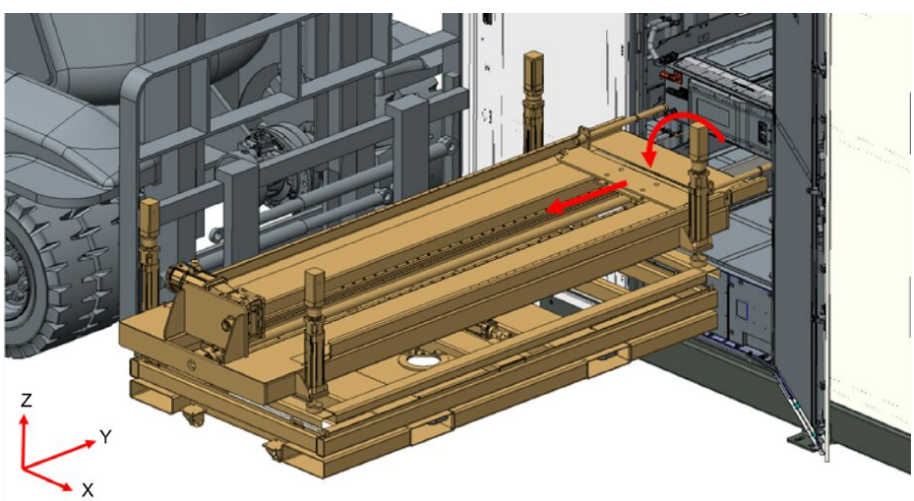


figure 5-23 Schematic diagram of PACK-in-cabinet action 3

*The figure is for reference only.

- - End

5.3.5 Follow-up Work

5.3.5.1 Fix PACK Corner Fittings

Step 1 Secure the corner fittings in the corresponding positions on the PACK.

Step 2 Fix M10 screws on the corner fittings.



figure 5-24 Positions of M10 Screws

*The picture is for reference only.

- - End

5.3.5.2 Install Fuse

Fuses between RACKs are shown in the figure below.

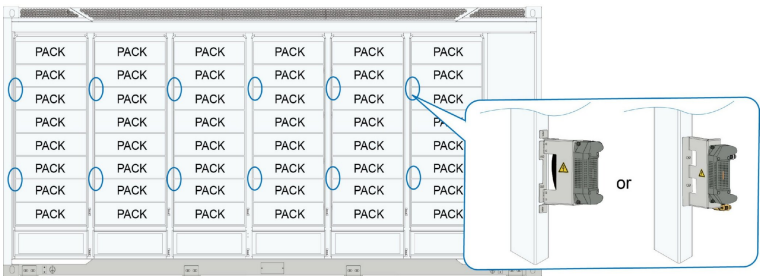
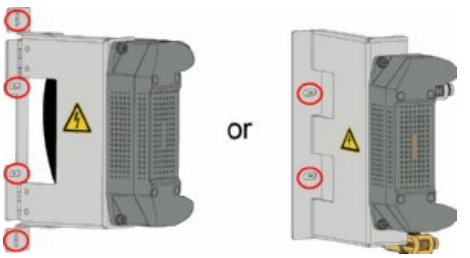


figure 5-25 Positions of Fuses

*The figure is for reference only.

Step 1 Fit the M6 screws on the fuse, but do not tighten them now.



Step 2 Insert the plugs that come with the fuse into the PACK bases properly.

WARNING

When the aviation plug is connected in place, you will hear a "click". Please make sure the connection is secure.

- Insert the positive aviation plug into the positive on the PACK base, and the negative plug into the negative on the base. Orange indicates positive, and black indicates negative. When the aviation plug is connected in place, you will hear a "click".
- When connecting the power cable, you can adjust the position of the fuse properly.

Step 3 After the connection is completed, tighten the screws that are fit in Step 1.

- - End

5.3.5.3 Connect Cables

Step 1 Connect the power cables between the PACKs.

WARNING

When the aviation plug is connected in place, you will hear a "click". Please make sure the connection is secure.

Insert the positive aviation plug into the positive on the PACK base, and the negative plug into the negative on the base. Orange indicates positive, and black indicates negative.

Step 2 Connect the communication cables between the PACKs.

- - End

5.3.5.4 Install Bidirectional Shut-off Valve

Prepare for installation:

- Check the installation torque at the connection between the PACK and the female end of the bidirectional shut-off valve. If the torque value is lower than 3.4N·m, increase the torque value to 3.4N·m.
- Check whether there is any foreign debris at the interfaces of the female and male connectors of the bidirectional shut-off valve. If any debris is found, clean it using pure water.
- Check whether there is any damage to the sealing ring at the interfaces of the female and male connectors of the bidirectional shut-off valve. If any damage is found, replace

the corresponding male connector or the tertiary piping assembly where the female connector is located.

Step 1 Take out the cooling pipe from the inside of the guide rail.

Step 2 Put the male connector of the bidirectional shut-off valve onto the female connector.

Step 3 Twist the male connector until the female connector firmly fits into it.

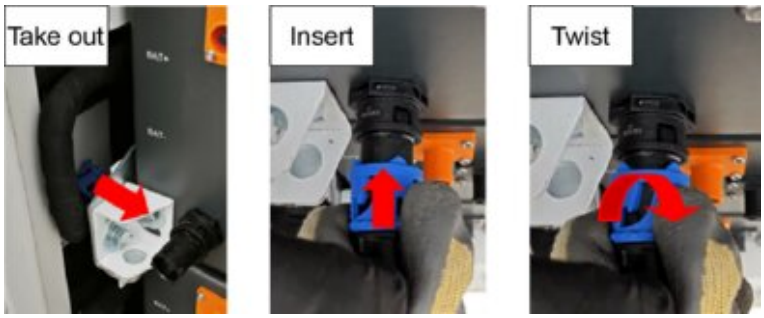


figure 5-26 Installation of Bidirectional Shut-off Valve (Left Side)

*The figure is for reference only.

The steps to install the bidirectional shut-off valve on the right side are the same.

- - End

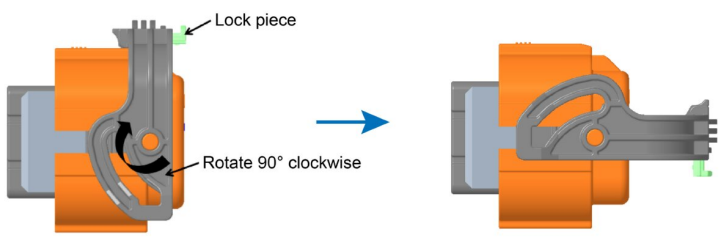
5.3.5.5 Fit MSD Plugs

The MSD is fused to protect against short circuit conditions outside the PACK.

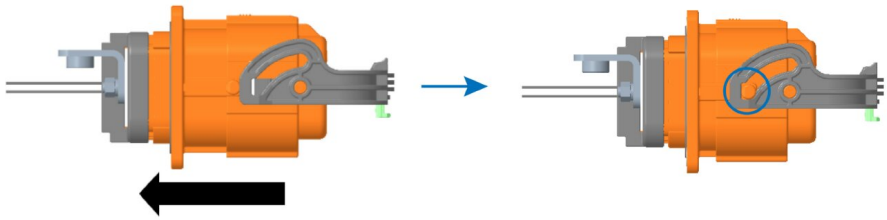
NOTICE

- **The MSD installation on each Pack needs to be completed before power-on, and the MSD on each Rack is installed in the order of Pack1~Pack4.**
- **Before installing the MSD, it is necessary to unplug the R1-4-BAT+ aerial plug of the battery cluster, and then restore the R1-4-BAT + aerial plug of the battery cluster after the MSD installation is completed.**

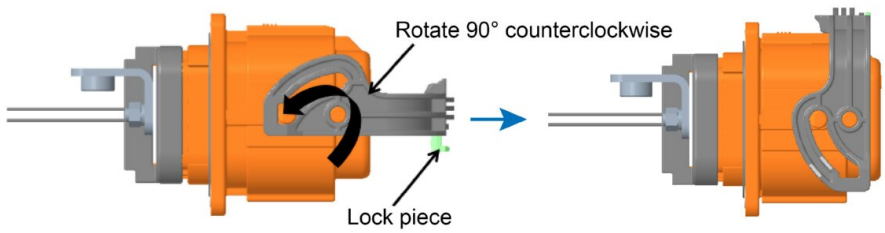
Step 1 Pull out the lock piece, and turn the handle around 90° clockwise.



Step 2 Put the MSD plug into the socket. Normally, the curved slot on the handle will grip the peg on the socket.



Step 3 Turn the handle 90° counterclockwise to snap them together, and push in the lock piece.



- - End

5.3.5.6 System Power-on

After the PACK replacement operation is complete, perform a system power-up.

Preparation: Before powering up, it is necessary to carry out a comprehensive and detailed inspection of the equipment to ensure that all indicators are in line with the requirements before powering up.

Step 1 Power on the auxiliary power supply.

1 Close the miniature circuit breaker switch on the BSP.

2 Close the DC load switch QS11 (SMPS DC SUPPLY) on the BSP.

Step 2 Power on the main power circuit.

Turn the AC SWITCH QS1~QS6 to "ON".

Step 3 Log in to the LC interface, turn on the system via the control software.

- - End

> ⚠ WARNING
>
> **If one circuit breaker trips during power-on process, suspend closing other circuit breakers and immediately check whether a short circuit occurs to downstream loads of the tripped circuit breaker.**

5.3.5.7 Close Cabinet Door

Inspect the wirings thoroughly and carefully after all works have been completed. In addition, make sure you:

- Lock the door of the outdoor cabinet. Then, remove the key and keep it in a safe place.
- Confirm that there is no obstruction or blockage by foreign objects at the air inlets and outlets.

WARNING

- **Moisture may get in if the product is not properly sealed.**
- **Rodents may get in if the product is not properly sealed.**

5.4 PCS Maintenance

The maintenance tooling can be used for the replacement or maintenance of liquid-cooled PACKs and PCSs. This manual mainly gives instructions on how to replace the PACK using the tooling, but the steps apply to the PCS replacement as well.

Step 1 Power off the system.

Step 2 Remove the door restrictor and the grounding bolt on the door frame.

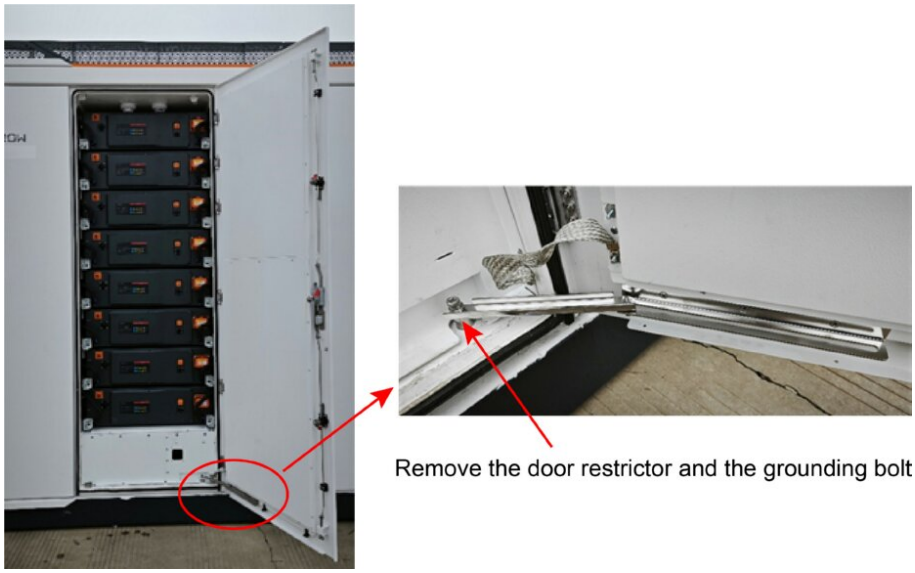


figure 5-27 Position of Door Restrictor

*The figure is for reference only.

Step 3 Remove the right sealing plate of the PCS compartment.



figure 5-28 Right Sealing Plate

*The figure is for reference only.

Step 4 Remove the bidirectional shut-off valves, cable, and drain pipe from the fan coil.

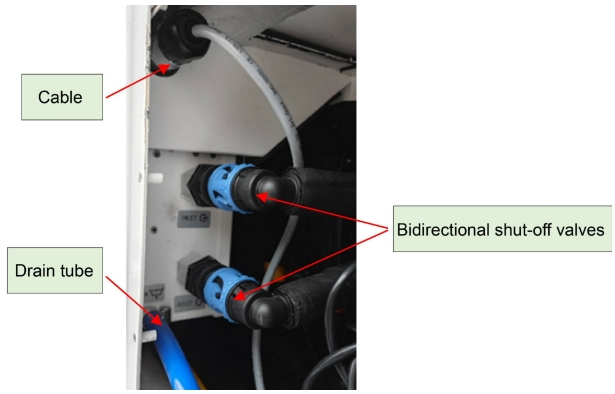


figure 5-29 Positions of Bidirectional Shut-off Valves, Cable, and Drain Pipe

*The figure is for reference only.

Step 5 Remove the lock holder and the left sealing plate of the PCS compartment.

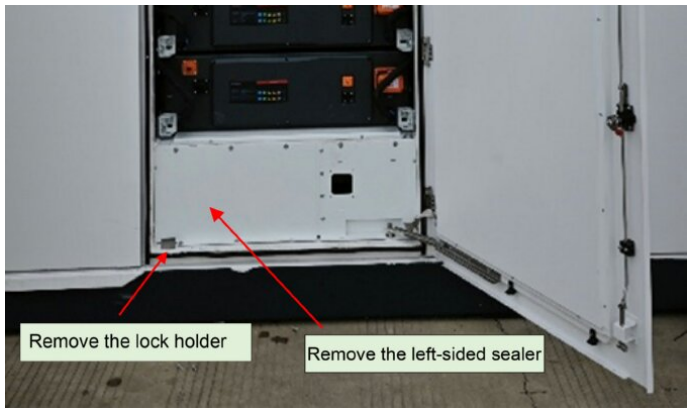


figure 5-30 Positions of Lock Holder and Left Sealing Plate

*The figure is for reference only.

Step 6 Remove the power cables and communication cables on the junction box.

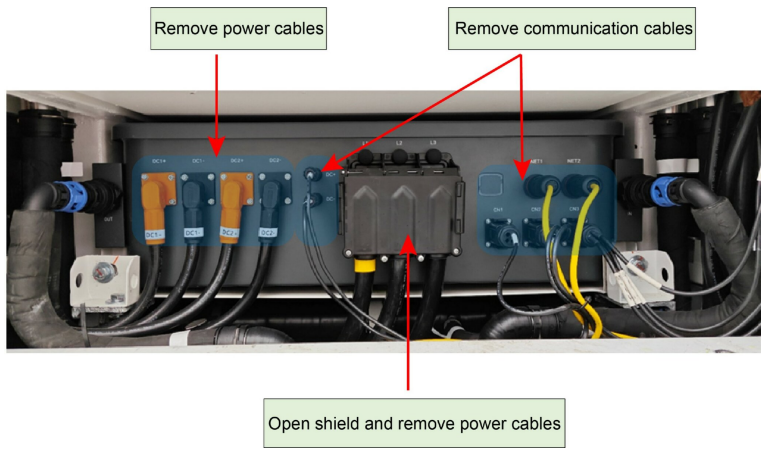


figure 5-31 Positions of Power Cables and Communication Cables

*The figure is for reference only.

NOTICE

Put the cables and pipes under the tray and on both sides of the guide rail properly, to avoid damaging the cable or pipes when pulling the tray out.

- **Cable connectors should be wrapped in clean insulating material to prevent contamination by foreign matter.**
- **Pipe connectors need to be protected with a clean sleeve to prevent foreign objects from entering.**

Step 7 Remove the corner fittings on the tray and the bidirectional shut-off valves.

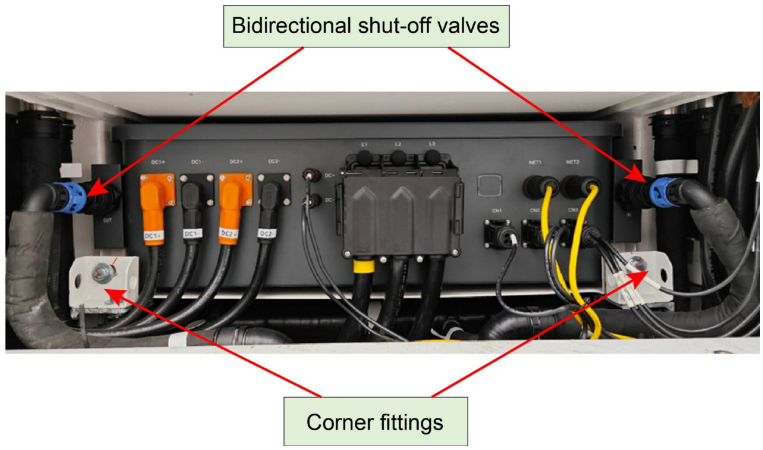


figure 5-32 Positions of Corner Fittings and Bidirectional Shut-off Valves

*The figure is for reference only.

Step 8 Install the M10 eyebolt screws (2pcs, included in the tooling configuration) in the original holes of the tray.

Step 9 Tooling setup. Refer to "5.3.3 Tooling Setup".

Step 10 PCS mounting. Refer to "5.3.4 PACK Mounting".

Step 11 Follow-up work. Fit back the cables, pipes, fasteners, and sealing plates, etc., by completing the steps for removing them in the reverse order.

- - End

5.5 Replacing BMU

NOTICE

- **Disconnect the corresponding MSD maintenance switch before maintaining the PACK to ensure safe maintenance of the PACK.**
- **Check the wiring order on the DC side after the maintenance by means of the system self-check function on the LC Web interface.**

5.5.1 Remove BMU Box and Top Cover

Preparation: Prepare a M4 Allen key, and wear PPE and non-slip protective gloves.

Step 1 Use an M4 Allen key to remove the 6 hexagon socket head screws that fix the BMU box in place.



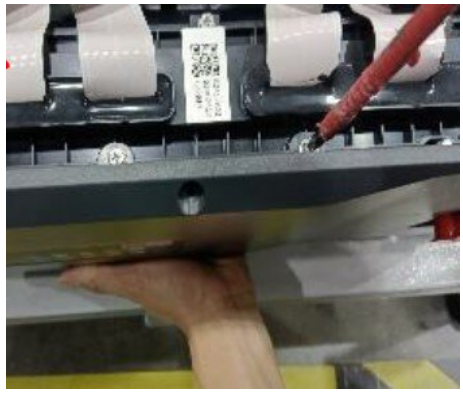
Step 2 After removing the screws fixing the BMU box, hold the BMU box from underneath and gently pull it outwards slowly with both hands.



NOTICE

Carefully hold the BMU box when removing it to prevent the BMU from dragging and pulling the FFC. Do not use excessive force when pulling the BMU box outward.

Step 3 Hold the BMU box with your left hand and use a Phillips screwdriver to remove the screws fixing the BMU box in place.



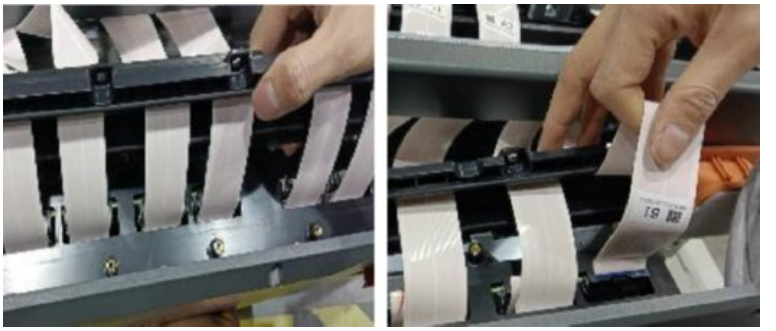
Step 4 Hold the BMU box with your left hand, pinch both sides of the BMU top cover with your right thumb and forefinger, and then gently remove the BMU with firm force. Since the flexible flat cable (FFC) is partially connected to the BMU box, do not pull it outwards with excessive force.



- - End

5.5.2 Removing Connection Cables

Step 1 Pull the top cover of BMU 5–7 cm upward and pull out the FFC from the BMU box one after another.



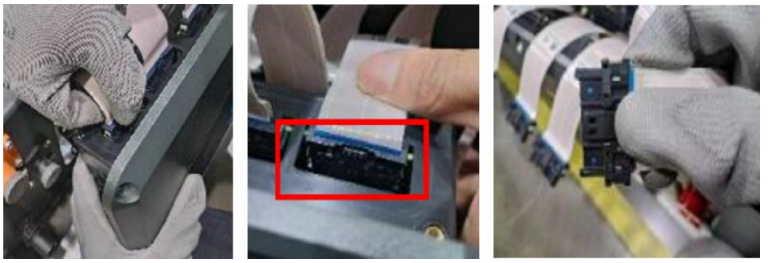
NOTICE

When removing the top cover, hold the BMU box. Do not lift the cover with excessive force.

Step 2 Always pull out the FFC in a sequence from the orange main positive terminal to the MSD.



Step 3 Press the buckle tail of the FFC terminal until the front section of the buckle rises, and then gently pull out the FFC terminal.



Step 4 Once the FFC is pulled out, the terminal must be well protected.



NOTICE

Do not use excessive force when pulling out the FFC terminals, and the FFC plugs pulled out should be protected.

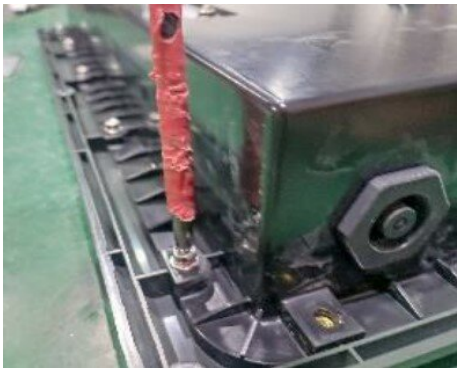
Step 5 Remove the high-voltage interlock wire connecting the MSD to the BMU panel.



- - End

5.5.3 Remove BMU Panels

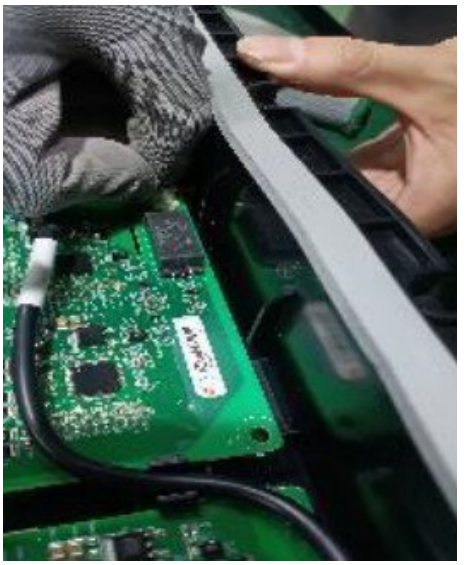
Step 1 Remove the screws that secure the BMU box to the front panel.



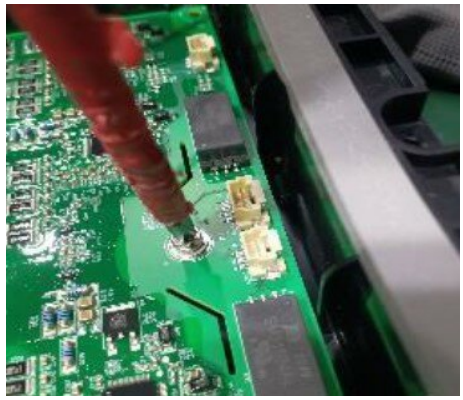
NOTICE

When removing the top cover, hold the BMU box. Do not lift the cover with excessive force.

Step 2 Once the BMU box is disassembled, press the buckles on the communication harness terminal post and gently pull the terminal post out.



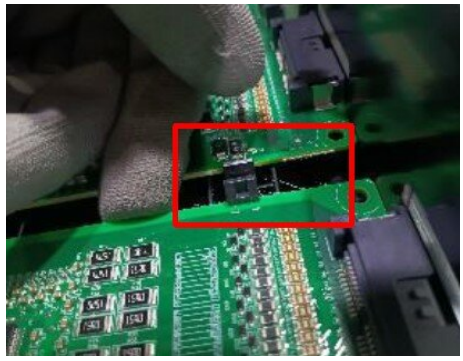
Step 3 Remove the grounding bolt from the BMU panel.



NOTICE

Do not use excessive force when pulling out the acquisition harness, and the harness terminals pulled out should be protected.

Step 4 When removing the BMU panel, press the buckles that secure the BMU panel outward by hand.



Step 5 After removing the BMU panel under the buckles, pull the BMU panel out over the buckle.



- - End

5.6 Replacing Fuse

Please refer to "5.3.5.2 Install Fuse" and "5.3.2.4.6 Remove Fuse".

5.7 Cleaning and Maintaining Air Cooler

5.7.1 Notes

NOTICE

- **During the maintenance of air cooler, never step on the top cover and the fan of the air cooler to avoid damage to the fan.**
- **Maintenance is not recommended when the top of the energy storage cabinet is wet and slippery in rain or snow.**
- **For the safety of maintenance personnel and successful maintenance, the maintenance process must be in strict compliance with the safety regulations.**

5.7.2 Tool Preparation

It is recommended to prepare the tools including, but not limited to, those below to ensure smooth maintenance.

Tool	Description
 High-pressure water washer	If it is convenient to get water on site, the water washing method is recommended, that is, use a convenient high-pressure water gun with power supplied by an outdoor cabinet.
 Push-pull blower	If it is inconvenient to get water on site, it is recommended to use the hand-held push-pull blower with original detachable lithium battery.

Tool	Description
 Step ladder	It is recommended to use a 3-meter step ladder (the container is 2,896 mm high, and the ladder can be reasonably configured based on the foundation height on site).
 Safety rope	-
 Helmet	-
 Eyebolt	M10*20 eyebolt (1 pcs).

Tool	Description
 Phillips screwdriver	Electric models are recommended for efficiency.
 Screen brush	-

5.7.3 Operational Preparation

Step 1 Place the herringbone ladder at a flat position beside the energy storage cabinet, 5–10 cm to the cabinet.

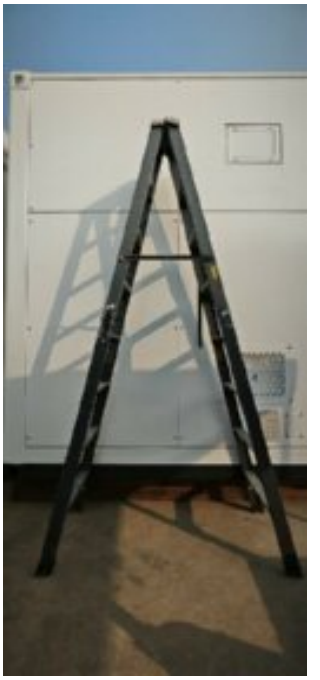


figure 5-33 Schematic Picture for Placing Herringbone Ladder

Step 2 Once the ladder is securely placed, another worker is required to hold the ladder. The worker who is going to climb must wear a helmet and a safety rope correctly, and then climb to the top of the energy storage cabinet via a Herringbone ladder.

Step 3 Install the eye bolt to the preformed hole on the air cooler to be cleaned, and attach the safety rope buckle to the installed eyebolt.



figure 5-34 Schematic Diagram of Connecting Safety Buckle

- - End

5.7.4 Sand Accumulation Maintenance

Step 1 Use a Phillips screwdriver to remove the top cover of the air cooler fan of the unit to be maintained, and expose the rubber seal plug of the quick maintenance window.

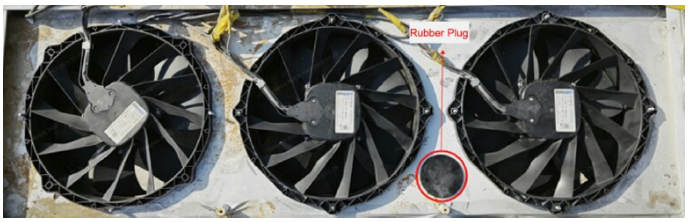


figure 5-35 Schematic Diagram of Rubber Plug

Step 2 Remove the rubber plug and expose the quick maintenance window.

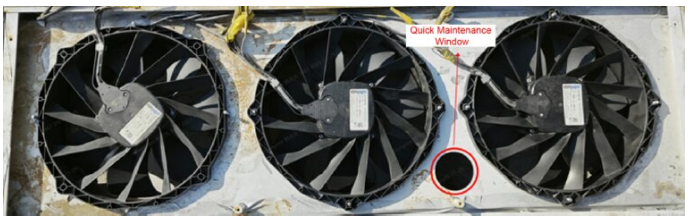


figure 5-36 Schematic Diagram of Quick Maintenance Window

Step 3 The window is about 70 mm in diameter. You can put the water gun head or the nozzle of a vacuum cleaner suction hose inside the air cooler to rinse or suck sand and dust.



figure 5-37 Schematic Diagram of Maintenance Process with Push-pull Blower



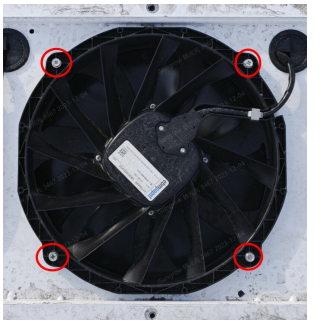
figure 5-38 Schematic Diagram of Maintenance Process with High-pressure Water Gun

Step 4 After cleaning and maintenance, install the rubber plugs and the top cover for the air cooler fan, and then conduct maintenance on the next air cooler.

- - End

5.7.5 Fan Maintenance

Step 1 If the fan needs to be replaced for maintenance, remove the 4 screws shown below.



Step 2 Unplug the wiring terminal.



Step 3 Remove the fan to be maintained and replace it with a new one.

- - End

5.7.6 Heat Exchanger Maintenance

During the heat exchanger maintenance, it is unnecessary to unplug the fan terminals.

Step 1 Remove the fan and place it at the perimeter of the air outlet (the fan cable must be kept free of stress when the fan is removed).



figure 5-39 Schematic Diagram of Maintenance Process with Push-Pull Blower

Step 2 Clean the sand and dust on the surface of the heat exchanger with water gun or push-pull blower, so as to improve the heat transfer efficiency of the heat exchanger.

- - End

5.7.7 Inlet Filter Screen Maintenance

If the inlet filter screen is blocked by debris such as floccule or dust, maintenance is required.

NOTICE

When maintaining the inlet filter screen, the operator should wear a safety rope, hang the safety rope to the installation point of the lifting ring, and conduct maintenance and cleaning with the help of a ladder.

Step 1 Remove some of the sand, dust, and floccule from the filter surface with a water gun or a push-pull blower.

Step 2 Use a screen brush to clean screens at different locations on the cabinet.

Step 3 For screens on the top of the cabinet, the operator can climb to the top with the help of a ladder to perform the maintenance. The maintenance procedures are similar to those for sand accumulation maintenance.

- - End

6 Troubleshooting

6.1 Overview

When an abnormal change occurs in the ESS, it is recommended that preliminary troubleshooting be performed first through the troubleshooting.

If problems cannot be resolved according to this manual, please contact us. We need the following information in order to provide you with better assistance.

- The SN, the manufacture date, and the software version of the device
- The manufacturers, the models, and the configuration information of the devices connected to this device
- Brief fault description
- Pictures of the fault site

⚠ WARNING

The ground cable must be grounded well, otherwise, fatal electric shock may occur to the operators!

6.2 List of Common Faults

Category	No.	Fault Name
PCS Fault Diagnosis	1	DC Under Voltage
	2	DC Over Voltage
	3	AC Under Voltage
	4	AC Over Voltage
	5	AC Under Frequency
	6	AC Over Frequency
	7	AC Relay Fault
	8	Anti-Islanding Protection
	9	10MIN Grid Over Voltage
	10	Module Over-temperature
	11	Leakage Current Protection
	12	Overload Protection
	13	DC Over Current
	14	AC Over Current
	15	Ambient Temperature Exception

Category	No.	Fault Name
	16	Hardware Fault
	17	Battery Over Voltage
	18	Battery Under Voltage
	19	Insulation Impedance
	20	AC SPD Fault
	21	Analog Offset Exception
	22	Battery Polarity Reversed
	23	AC Current Imbalance
	24	DC Relay Fault
	25	DC SPD Fault
	26	DC Soft Start Fault
	27	DC Component Fault
	28	Device Code Repeat Fault
	29	Parallel Operation Communication Fault
	30	AC Voltage Imbalance Fault
	31	Inverter-side Relay Soft Start Fault
	32	Busbar Voltage Imbalance Fault
	33	Carrier Synchronization Fault
Battery Fault Diagnosis	1	Cell Over Voltage Fault
	2	PACK Over Voltage Fault
	3	Total Over Voltage Fault
	4	Cell Under Voltage Fault
	5	PACK Under Voltage Fault
	6	Total Under Voltage Fault
	7	Cell Low Temperature Fault
	8	Cell Over Temperature Fault
	9	Over Current Fault
	10	Voltage Sample Fault
	11	Temperature Sample Fault
	12	Current Sample Fault
	13	CMU-BMU Communication Fault
	14	CMU-BSC Communication Fault
	15	Fuse Fault
	16	Total Voltage Difference Fault
	17	Cell Over Voltage Alarm
	18	PACK Over Voltage Alarm
	19	Total Over Voltage Alarm

Category	No.	Fault Name
	20	Cell Under Voltage Alarm
	21	PACK Under Voltage Alarm
	22	Total Under Voltage Alarm
	23	Cell Voltage Difference Alarm
	24	PACK Voltage Difference Alarm
	25	Cell Temperature Difference Alarm
	26	Cell Low Temperature Alarm
	27	Cell Over Temperature Alarm
	28	Over Current Alarm
BSC Fault Diagnosis	1	Node Fault (System Fault Status)
	2	BSC-LC Communication Fault (System Fault Status)
	3	Firefighting Fire Alarm (System Fault Status)
	4	Emergency Stop (System Fault Status)
	5	Unit Fault (System Fault Status)
	6	Firefighting System Fault (System Fault Status)
	7	Analog Sampling Fault (System Fault Status)
	8	Auxiliary Sub-device Fault (System Fault Status)
	9	Firefighting Dry Node Alarm (Firefighting System Fire Alarm)
	10	High Combustible Gas Concentration Alarm (-Firefighting System Fire Alarm)
	11	Combustible Gas Detecting Device Communication Fault (Firefighting System Fire Alarm)
	12	Combustible Gas Detecting Device Fault (Firefighting System Fire Alarm)
	13	Firefighting Dry Node Fault (Firefighting System Fire Alarm)
	14	Fire Extinguishing Gas Not Released (Firefighting System Fire Alarm)
	15	All CMU fault (Unit Fault)
	16	Node Fault (Unit Fault)
	17	BSC-CMU Communication Fault (Unit Fault)
	18	Node Alarm (System Alarm Status)
	19	Anti-loss Alarm (System Alarm Status)
	20	Auxiliary Sub-device Alarm (System Alarm Status)
	21	Unit Alarm (System Alarm Status)
LC Fault Diagnosis	1	PCS Fault (System Fault Status)

Category	No.	Fault Name
	2	LC-PCS Communication Fault (System Fault Status)
	3	BSC Fault (System Fault Status)
	4	LC-BSC Communication Fault (System Fault Status)
	5	Host Computer Communication Fault (System Fault Status)
	6	Node Fault (System Fault Status)
	7	System Not Ready Fault (System Fault Status)
	8	Emergency Stop (System Fault Status)
	9	Analog Sampling Fault (System Fault Status)
	10	Power Line Abnormal Fault (System Fault Status)
	11	AC Insulation Detector Board Communication Alarm (-Auxiliary Sub-device Alarm)
	12	AC Insulation Detector Board Fault (Auxiliary Sub-device Alarm)
	13	PCS Unit Fault (System Alarm Status)
	14	PCS Unit Alarm (System Alarm Status)
	15	LC-PCS Communication Alarm (System Alarm Status)
	16	BSC Unit Fault (System Alarm Status)
	17	BSC Unit Alarm (System Alarm Status)
	18	LC-BSC Communication Alarm (System Alarm Status)
	19	Node Alarm (System Alarm Status)
	20	SOC Upper Limit 1 Alarm (System Alarm Status)
	21	SOC Upper Limit 2 Alarm (System Alarm Status)
	22	SOC Lower Limit 1 Alarm (System Alarm Status)
	23	SOC Lower Limit 2 Alarm (System Alarm Status)
	24	Zero Power Operation Timeout Alarm (System Alarm Status)
	25	HVAC Communication Alarm (Auxiliary Sub-device Alarm)
	26	HVAC Alarm (Auxiliary Sub-device Alarm)
	27	Breathing Light Communication Alarm (Auxiliary Sub-device Alarm)
	28	Ammeter Communication Alarm (Auxiliary Sub-device Alarm)
	29	Node Expansion Board Communication Alarm (-Auxiliary Sub-device Alarm)

Category	No.	Fault Name
	30	AC Insulation Detector Board Alarm (Auxiliary Sub-device Alarm)
	31	Transformer Oil Temperature Fault (Auxiliary Sub-device Alarm)
	32	Transformer Oil Temperature Communication Alarm (-Auxiliary Sub-device Alarm)
Firefighting Fault Diagnosis	1	Invalid Module Response
	2	Duplicate Module Address Codes
	3	Low Detector Threshold Value
	4	Detector Exception
	5	Controller Hardware Mismatch
	6	External Power-down Exception
	7	Module Open Circuit
	8	Manual/Auto Switching and Starting Device Communication Exception
Fault Diagnosis for Liquid Cooling System	1	Low Ambient Temperature
	2	Evaporator/Condenser Pump Overload
	3	Evaporator/Condenser Pump Fault
	4	Power Supply Fault
	5	Multi-way Valve Fault
	6	System Water Shortage Fault
	7	Mode Switching Fault
	8	Evaporator Temperature Sensor Fault
	9	Temperature/Pressure Sensor Fault
	10	High Evaporator Outlet Water Temperature
	11	Too High Condenser Outlet/Return Water
	12	High Evaporator/Condenser Outlet Water Pressure
	13	Low Evaporator/Condenser Inlet Water Pressure
	14	Low Level in Evaporator/Condenser
	15	Thermal Relay Overload
	16	High-voltage Switch Disconnection Alarm
	17	Low-voltage Switch Disconnection Alarm
	18	Compressor Overload
	19	Compressor Fault
	20	Compressor Lockout Alarm
	21	Expansion Valve Controller Alarm
	22	Fan Fault

Category	No.	Fault Name
	23	BSC Offline
Medium-voltage Box-type Substation Fault Diagnosis	1	Oil Temperature Alarm
	2	Oil Temperature Trip
	3	Low Oil Level Trip
	4	Oil Pressure Trip
	5	SCC Door Open
	6	SCC Smoke Sensor Action
	7	Abnormal Main Circuit Lightning Protector
	8	SCC Main Circuit QF1 Disconnected
	9	SCC Main Circuit QF2 Disconnected

6.3 ESS Faults and Corrective Measures

6.3.1 PCS Fault Diagnosis

Log in to the LC Web interface, and in the navigation bar, click "**Running info→PCS info**" to view Fault status or Alarm running status.

Fault Name	Trigger	Recovery Condition	Handling Method
DC under voltage	1. Under the running status with non-open-loop and short-circuit loop control strategy, the busbar voltage is below the minimum value of battery voltage, i.e., (980 V - 30 V) * 0.9 - 150 V (1 ms fast protection). 2. In grid-connected charging mode (DC current below 10 A), 1-second under voltage protection when the busbar voltage is below the larger value of the set minimum busbar voltage and the peak grid busbar voltage plus or minus 20 V. 3. In the grid-connected charging mode, when the busbar voltage is below the peak grid busbar voltage plus 8 V, when the charging power exceeds 0.7 times the active rated power, or when the bus charging current falls below its lower limit, a fault will be reported within 1 second.	The battery voltage is above the set lower limit of the busbar voltage plus 5 V or the peak grid line voltage plus 2 V for 1 minute, the fault will be cleared.	1. Generally, the PCS will resume operation when the DC voltage returns to normal. 2. Check whether the battery voltage is normal. If it is below the minimum permissible voltage, the battery voltage is low, and you need to charge the battery. 3. Check that the LC interface parameters are set correctly. 4. Check the DC voltage sampling channel.

Fault Name	Trigger	Recovery Condition	Handling Method
	4. In non-grid-connected charging mode, the busbar voltage is below the minimum value (975 V), a fault will be reported within 1 second. 5. After the SVG switch is closed, the busbar voltage is below 1,380 V for 2 minutes.		
DC over voltage	1. When the busbar voltage exceeds the set over voltage value (1,550 V), 1-millisecond quick protection will be implemented. 2. When the busbar voltage is above the set over voltage value (1,550 V) for more than 50 milliseconds.	When the busbar voltage falls below the set upper limit of the voltage protection threshold minus 20 V (1,530 V) and keeps running for 30 seconds.	1. Generally the machine will resume operation when the DC voltage returns to normal. 2. In the event of a fault stop of the PCS due to a busbar voltage over 1,650 V, the input side switch will be locked, and you need to power it off manually, check it and reset the switch. 3. Check whether the battery voltage is normal. If it exceeds the maximum allowable value, the battery is faulty. 4. Check that the LC interface parameters are set correctly.

Fault Name	Trigger	Recovery Condition	Handling Method
			5. Check the DC voltage sampling channel.
AC under voltage	1. The minimum value of the grid three-phase voltage is below the Level 1-5 under voltage value, and the duration exceeds the protection time of the corresponding level. 2. A timeout occurs when low voltage ride through is enabled.	1. The machine stops due to fault and is in off-grid or VSG mode, and the PCS will automatically clears the fault after 30 seconds. 2. When the grid three-phase wire voltage extreme values are within the over/under voltage recovery range, and the running time under this condition exceeds the set grid recovery time, the PCS will automatically clear the fault. 3. The PCS will clear the islanding fault automatically. 4. By setting the PCS working mode or switching the rated frequency value of the grid, the PCS will automatically clear the fault.	1. Generally, the PCS will resume operation when the grid voltage returns to normal. 2. Measure the actual grid voltage. If it is lower than the set value of the protection parameter, notify the customer to contact the power company for further action. 3. If the actual grid voltage is normal, check if the AC wiring is secure. 4. Check that the LC interface parameters are set correctly. 5. Check the grid voltage sampling channel. 6. In the off-grid mode, the fault will be recovered automatically 30 seconds after the protection is switched off.
AC over voltage	1. In VF mode, when the grid exists in the	1. The machine stops due to fault	1. Generally, the PCS will resume operation

Fault Name	Trigger	Recovery Condition	Handling Method
	starting state, the grid exists for more than one minute. 2. The maximum value of the grid three-phase voltage exceeds the Level 1-5 over voltage value, and the time exceeds the protection time of the corresponding level. 3. A timeout occurs when high voltage ride through is enabled. 4. The instantaneous grid line voltage exceeds 1.45 times the rated value for 1 millisecond.	and is in off-grid or VSG mode, and the PCS will automatically clears the fault after 30 seconds. 2. When the grid three-phase wire voltage extreme values are within the over/under voltage recovery range, and the running time under this condition exceeds the set grid recovery time, the PCS will automatically clear the fault. 3. The PCS will clear the islanding fault automatically. 4. By setting the PCS working mode or switching the rated frequency value of the grid, the PCS will automatically clear the fault.	when the grid voltage returns to normal. 2. Measure the actual grid voltage. If it is above the set value of the protection parameter, notify the customer to contact the power company for further action. 3. If the actual grid voltage is normal, check if the AC wiring is secure. 4. Check that the LC interface parameters are set correctly. 5. Check the grid voltage sampling channel. 6. In the off-grid mode, the fault will be recovered automatically 30 seconds after the protection is switched off.
AC under frequency	1. The frequency ride through time has exceeded the limit. 2. The sliding window frequency is below -7.5 Hz (for 60 ms) or the grid frequency	1. Grid under frequency faults will be cleared directly when the grid reports an islanding fault. 2. When the grid frequency is within	1. Generally, the PCS will resume operation when the grid frequency returns to normal. 2. Measure the actual grid frequency. If it is below the set value of

Fault Name	Trigger	Recovery Condition	Handling Method
	hopping is below -1.2 Hz (for 80 ms). 3. The grid frequency is below the Level 1-5 protection value, and the duration exceeds the set under frequency protection time of the corresponding level. 4. The 300-millisecond sliding window frequency is below -0.3 Hz.	the grid under frequency recovery range and the grid under frequency recovery time exceeds the set frequency recovery time, the PCS will automatically clear the fault. 3. If the machine is in the VF or VSG mode in a non-fault stop status, the PCS will automatically clear the fault after 30 seconds. 4. If the working mode of the PCS changes or the rated frequency of the grid changes, the PCS will clear the low grid frequency fault.	the protection parameter, notify the customer to contact the power company for further action. 3. Check that the LC interface parameters are set correctly. 4. In the off-grid mode, the fault will be recovered automatically 30 seconds after the protection is switched off.
AC over frequency	1. The frequency ride through time has exceeded the limit. 2. Sliding window frequency is above 7.5 Hz (lasting 60 ms) or grid frequency jump is above 1.2 Hz (lasting 80 ms). 3. The grid frequency is above the protection value of level 1-5, and the time exceeds the setting time of the	1. Grid over frequency faults are cleared directly when the grid reports an islanding fault. 2. When the grid frequency is within the range of the grid over frequency recovery value and the grid over frequency recovery value time exceeds	1. Generally, the PCS will resume operation when the grid frequency returns to normal. 2. Measure the actual grid frequency. If it is above the set value of the protection parameter, notify the customer to contact the power company for further action.

Fault Name	Trigger	Recovery Condition	Handling Method
	under-frequency protection of the corresponding level. 4. The 300-millisecond frequency sliding window is above 0.3 Hz.	the set frequency recovery time, the PCS will automatically clear the fault. 3. If the machine is in the VF or VSG mode in a non-fault stop status, the PCS will automatically clear the fault after 30 seconds. 4. If the working mode of the PCS changes or the rated frequency of the grid changes, the PCS will clear the low grid frequency fault.	3. Check that the LC interface parameters are set correctly. 4. In the off-grid mode, the fault will be recovered automatically 30 seconds after the protection is switched off.
AC relay fault	1. Self-check of the AC-side relay in the on-grid mode fails more than three times. 2. Self-check of the AC-side relay in the VF mode fails more than three times.	In the fault stop status, the PCS with an AC relay fault for 3 minutes will automatically clear the AC relay fault (up to 4 times) and then must be powered down.	1. Power off and restart the machine. 2. Check whether the AC relay power supply is normal. 3. Check the control circuit for exception. 4. Check the relay for damage.

Fault Name	Trigger	Recovery Condition	Handling Method
Anti-islanding protection	1. The frequency difference under active anti-islanding protection is above the set value, and the fault is triggered after 500 milliseconds as per the Japanese standard, otherwise the fault will be triggered directly. 2. In the non-off-grid status, the grid voltage is below 25% of the rated voltage of the grid or the grid phase jump fault protection flag is on for more than 5 seconds. 3. The machine is in on-grid mode under fault stop status, and the grid voltage is below 20% of the rated voltage of the grid for more than 5 seconds.	1. The machine is in VF or VSG mode under the fault stop status for more than 30 seconds, and the PCS will clear the fault automatically. 2. The PCS will automatically clear the fault when the PCS working mode or the rated frequency of the power grid is changed. 3. If PCS reports an islanding fault and the operating time is above the grid protection recovery time, the PCS will automatically clear the fault.	1. Check whether the power supply from the grid is normal. 2. Check whether the AC wiring is correct. 3. Check whether the AC wiring is secure. 4. Check whether the AC circuit breaker is closed. 5. Check the grid voltage sampling channel.
Minute grid over voltage	The average value of the sliding window voltage is above the set value (759 V).	When the grid three-phase wire voltage extreme values are within the over/under voltage recovery range, and the running time under this condition exceeds the set grid recovery time, the PCS will automatically clear the fault.	1. Generally, the PCS will resume operation when the grid voltage returns to normal. 2. Measure the actual grid voltage changes. If the grid voltage is abnormal, notify the customer to contact the power company for further action.

Fault Name	Trigger	Recovery Condition	Handling Method
			3. Check that the LC interface parameters are set correctly. 4. Export the fault records to analyze the grid voltage parameters.
Module over-temperature	The max temperature of the IGBT module is above the set max temperature (95 °C) for more than 100 milliseconds.	If the max temperature of the IGBT module is below 70 °C for 5 seconds, the PCS will automatically clear the fault.	1. Generally, the PCS will resume operation after the module temperature returns to normal. 2. Check whether the ambient temperature of the PCS is too high and whether it is under direct sunlight. Shade it appropriately if so. 3. Check the ventilation conditions of the environment where the PCS is installed. 4. Check whether the cooling air duct is normal, for example, whether the air outlet is blocked by foreign objects. 5. Check the PA board, the driver FFC, the driver board, and the power module. 6. Check whether the PCS fan is running normally. If not, please refer to Fan 1

Fault Name	Trigger	Recovery Condition	Handling Method
			troubleshooting method for next steps.
Leakage current protection	1. When the leakage current RMS is above 90% of the leakage current protection value for 240 milliseconds, a fault will be triggered. 2. The machine is running in the PQ mode with RCD enabled, and the leakage current change value is below the set value. 3. During the leakage current self-check, the leakage current RMS is beyond the fixed range (0.185, 0.252).	When the PCS has a fault and the leakage current is below 90% of the leakage current protection threshold for more than 30 seconds, the PCS will clear the fault automatically.	1. Check whether the battery pack is in a rainy and humid environment. If it is rainy and humid weather, don't worry and just keep observing. 2. Check the battery pack and AC/DC wiring for poor contact. 3. Check that the LC interface parameters are set correctly. 4. Check the leakage current sensor, the sampling line and the sampling board.
Overload protection	1. When the AC power or maximum phase current RMS is over 130% of the rated value for more than 10 minutes, the PCS will report an overload fault. 2. If the max phase current RMS of the three-phase current is over 130% of the rated current for more than 200 milliseconds, the PCS will report an overload fault.	The PCS will automatically clear the overload fault when the fault stop status lasts for more than 3 minutes.	1. Check for power output with a schedule over 1.15 Pn. 2. Check for short circuits on the AC and DC sides. 3. Check the power module and driver board for exception.

Fault Name	Trigger	Recovery Condition	Handling Method
DC over current	When the DC side current of the PCS is above 130% of the max discharge current or below 130% of the maximum charge current (110% at 127 kW) for more than 200 minutes, the PCS will report a DC over current fault.	When the PCS stops due to fault, the DC current is not above 10 A and the DC over current fault lasts for 3 minutes, the PCS will clear the DC over current fault.	1. Measure the DC current of the master/ slave standalone units of the PCS. 2. Check that the LC interface parameters are set correctly. 3. Check the DC current sampling channel. 4. After a key stop command is issued and lasts for 10 seconds, the fault can be restored.
AC over current	If the max AC current is above the max over current protection value or the min AC current is below the min over current protection value (the max and min over current protection values are 500 A and -500 A respectively) for 400 milliseconds, an AC over current fault will be triggered within 1 millisecond.	If the PCS has a fault stop, the min three-phase current RMS is not above 10 A and an AC over current fault is reported for more than 3 minutes, PCS will clear the AC over current fault.	1. Check whether the wiring on the AC side is secure, and whether there is broken skin or short-circuit grounding. 2. Check the power module for any exception. 3. Check the AC current sampling channel.

Fault Name	Trigger	Recovery Condition	Handling Method
Ambient temperature exception	If the ambient temperature is above 85 °C, the DC-side capacitor temperature is above 88 °C, the temperature of the three-phase filter capacitors and the three-phase relay is above 113 °C, the max temperature of the IGBT power module is above 95 °C, and the temperature difference between the inlet and outlet water is above 5 °C, the PCS will report an ambient temperature fault within 20 milliseconds.	If the ambient temperature and DC-side capacitor temperature are below 70 °C, the three-phase filter capacitor temperature, the three-phase relay temperature and the max temperature of the IGBT power module are below 90 °C, the temperature difference between the inlet and outlet water is below 5 °C, and the fault lasts for more than 10 seconds, the PCS will clear the ambient temperature exception fault.	1. Generally, the PCS will resume operation when the internal temperature returns to normal. 2. Check whether the ambient temperature of the PCS is too high and whether it is under direct sunlight. Shade it appropriately if so. 3. Check the ventilation conditions of the environment where the PCS is installed. 4. Check whether the cooling air duct is normal, for example, whether the air outlet is blocked by foreign objects. 5. Check whether the PCS fan is running normally. If not, please refer to Fan 1 troubleshooting method for next steps.
Hardware fault	1. In the running state of the machine, if the hardware fault lasts for 10 milliseconds, the CPLD will trigger the hardware fault and the SVG switch will not be enabled.	1. The PCS will automatically clear the hardware fault when the CPLD has no hardware fault triggered, the SVG is enabled, and the machine is not running.	1. Check the DC current sampling channel, and check whether the DC current sampling line is broken and whether the connection is firm. If necessary, replace the sampling line for

Fault Name	Trigger	Recovery Condition	Handling Method
	2. Open-loop voltage phase sequence detection: In open-loop running mode and the three-phase inverter voltage RMS is not below 100 V, the negative sequence inverter phase voltage peak squared value is above 50% of the positive sequence for 5 seconds, a hardware fault will be triggered.	2. The PCS will automatically clear the hardware fault when the machine stops and the fault lasts for more than 3 minutes.	troubleshooting (the sensor may have zero drift). 2. Measure the DC voltage and check whether there is short circuit on the DC side inside the system.
Battery over voltage	1. The AC active power is below 2% of the rated active power and the absolute value of the difference between the battery voltage and the upper limit of the battery charging voltage is not above 5 V for 5 seconds. 2. If the average value of DC busbar voltage is above the upper limit value of busbar voltage protection for 2 seconds, the battery over voltage fault will be triggered. 3. When the DC voltage is above the upper limit value of the battery charging voltage (-2 V), if the	If the battery voltage is below the upper limit value of battery charging voltage (-5 V), or the constant current mode & constant current reference value is above 0, or the constant AC power mode & AC power reference value is above 0, or the constant voltage mode & battery voltage is below the upper limit value of charging voltage, the battery over voltage fault will be cleared after 30 seconds.	1. Check the possibility of a false alarm by measuring whether the actual voltage on the battery side is the same as the displayed value. 2. Export the battery side operation record, analyze the operation conditions, and check whether the battery is overcharged. 3. Check whether an unreasonable charging voltage protection value is set on the battery side. 4. Check the over voltage position on the battery side. If a single cell frequently exhibits over voltage, it may

Fault Name	Trigger	Recovery Condition	Handling Method
	battery charging power is very small or the battery is in the discharging state and the AC active power is above 5% of the AC active power reference value in the constant AC power mode, and the average value of the DC current is above 5% of the constant current reference value for 3 minutes in the constant current charging mode, the battery over voltage fault will be triggered.		have exceptions and needs to be replaced.
Battery under voltage	1. The AC active power is below 2% of the rated active power and the absolute value of the difference between the battery voltage and the lower limit of the battery discharge voltage does not exceed 5 V for 5 seconds. 2. If the average value of the DC busbar voltage is below the lower limit value of busbar voltage protection for 2 seconds, the battery	The conditions are contrary to those for clearing the battery over voltage fault, and the battery under voltage fault will be cleared after 30 seconds.	1. Check the possibility of a false alarm by measuring whether the actual voltage on the battery side is the same as the displayed value. 2. Export the battery side operation record, analyze the operation conditions, and check whether there is over-discharge on the battery side. 3. Check whether an unreasonable discharge voltage protection value is set on the battery side.

Fault Name	Trigger	Recovery Condition	Handling Method
	under voltage fault will be triggered. 3. When the DC voltage is below the lower limit value of the battery charging voltage (+2 V), which is contrary to the battery over voltage, the battery under voltage fault will be triggered if this condition persists for 3 minutes.		4. Check the under voltage position on the battery side. If a single cell frequently exhibits under voltage, it may have exceptions and needs to be replaced.
Insulation impedance	If the ISO check fails for more than three times, an ISO fault will be reported.	In the fault stop status, if the PCS reports that the ISO check failure fault for more than 3 minutes, the PCS will automatically clear the fault.	1. Generally, the machine will be re-connected to the grid after the system detects that the insulation impedance results has returned to normal. 2. Check whether the ISO impedance protection value set by the PCS is too high, and confirm whether the setting value meets the requirements. 3. Check whether the battery container is in a rainy and humid environment, and measure whether the grounding insulation impedance value of the positive and negative terminals of

Fault Name	Trigger	Recovery Condition	Handling Method
			the battery container is too low.
AC SPD fault	In the non-initial standby state, the AC fault protection time exceeds 200 milliseconds.	The fault will be cleared automatically after lasting for 30 seconds.	1. After the AC SPD node signal recovers and lasts for 10 seconds, the fault will be recovered. 2. Check for loose wiring in the AC SPD. 3. Check the AC SPD for damage.
Analog offset exception	1. In the initial standby state, the ADC sampling value exceeds the upper limit value (2,150) or falls below the lower limit value (1,945). 2. In the non-starting-and-running status, if the maximum value of DC current, inductor current, and grid current is 15% above the corresponding rated value, the fault will be triggered after 5 seconds.	The fault needs to be reset and cleared.	1. Reboot the PCS. 2. Check for loose internal wiring.

Fault Name	Trigger	Recovery Condition	Handling Method
Battery polarity reversed	In the non-running status, if the voltage sampling on the battery side is less than -100 V for 500 milliseconds, a battery polarity reversal fault is triggered.	Power down and rewire to clear the fault.	1. In the non-running status of the PCS, if the battery side voltage sample value returns to normal and lasts for 10 seconds, the fault will be recovered. 2. Check whether the battery is wired correctly.
AC current imbalance	During grid-connected operation or high/low voltage ride through, if the deviation between the max and min values of the three-phase current RMS is above 15% of the rated current for 700 milliseconds, the PCS will report a current imbalance fault.	If the deviation between the max and min three-phase RMS values is below 5% of the rated current for 20 seconds, the fault will be cleared automatically.	1. Check the grid for exception. 2. Check the AC current sampling channel. 3. The fault will automatically recover (up to 5 times) after the fault trigger disappears for 20 seconds. If the faults occurs for more than 5 times, the fault will become non-recoverable, the machine will enter the fault stop status, and you need to manually power it down for troubleshooting.

Fault Name	Trigger	Recovery Condition	Handling Method
DC relay fault	1. The DC relay detects that K0, K1 and K3 do not meet the switching-on conditions or are sticking. 2. The difference between the battery voltage and the busbar voltage in the charging/discharging status is above 50 V for 100 milliseconds. 3. The absolute value of the difference between the battery voltage and the busbar voltage is above 15 V for 2 minutes.	The PCS will automatically clear the fault after it lasts for 3 minutes in the shutdown status.	1. Power off and restart the machine. 2. Check whether the AC relay power supply is normal. 3. Check the control circuit for exception. 4. Check the relay for damage.
DC SPD fault	The DC fault protection lasts for more than 200 milliseconds in non-initial standby status.	The fault will be cleared automatically after lasting for 30 seconds.	1. The fault will be recovered after the DC SPD node signal recovers and lasts for 10 seconds. 2. Check for loose wiring on the DC SPD board. 3. Check the DC SPD board for damage.

Fault Name	Trigger	Recovery Condition	Handling Method
DC soft start fault	The difference between the battery voltage and the busbar voltage is above 30 V for 2 minutes.	The fault will be cleared automatically after lasting for 30 seconds, and will be no longer executed after the fault are cleared for 3 times.	1. Attempt to power down and restart the PCS. 2. Check the sampling channel and drive FFC of the PCS. 3. Without other faults, the fault will be recovered 10 minutes after the fault triggering conditions disappear.
DC component fault	With the DC component fault protection disabled or not in the high/low voltage ride through mode, if the three-phase output current DC component sample value exceeds the DC component protection range and its duration exceeds the DC component fault protection time, the PCS will trigger a DC component fault.	The fault will be cleared automatically after lasting for 10 seconds.	1. The PCS will restart automatically after a fault stop. 2. The Zero Power Standby can be set to Enabled. 3. Export the PCS fault records and analyze the data to find solutions.

Fault Name	Trigger	Recovery Condition	Handling Method
Device code repeat fault	1. Set the parallel operation address. 2. A device code repeat fault will be reported when the slave addresses are duplicated for 1 second.	1. The device code repeat fault will be cleared if the parallel operation is disabled. 2. The DSP and ARM data exchange is not completed, and the device code repeat fault will be cleared automatically.	1. The PCS will restart after a fault stop. 2. Check whether the parallel operation address is set correctly. 3. Check whether the parallel operation function of the machine is set to Enabled.
Parallel operation communicati-on fault	The communication between the parallel machines has exceptions, failing 10 times (100 ms) in the running status and 3,000 times (30 s) in the non-running status.	1. Parallel Operation Enable is turned off or the parallel running mode is switched to the host mode. 2. The parallel operation communication returns to normal and lasts for 30 seconds (the communication fails for no more than 4 times).	1. Attempt to power down and restart the PCS. 2. Check whether the parallel operation communication wire of the PCS is loose. 3. Check whether the settings for the DSP board dip switch are normal. If there is any exception, reset it after powering down the PCS. 4. Check the power supply of the system to see whether each PCB is normally powered.

Fault Name	Trigger	Recovery Condition	Handling Method
AC voltage imbalance fault	If the maximum difference in the RMS values of the grid three-phase line voltage exceeds the grid voltage imbalance protection value with the grid voltage protection disabled and the grid voltage imbalance enabled in non-islanding mode, and the running time in this status exceeds the corresponding protection time, the PCS will trigger an AC voltage imbalance fault.	1. The PCS will automatically clear the fault if the working mode of the PCS or the rated operating frequency of the grid changes. 2. If the operating state is Off-grid or in the VSG mode with a fault stop, and the PCS is in the grid imbalance status for more than 30 seconds, the PCS will automatically clear the fault. 3. If the maximum difference between the RMS values of the grid three-phase line voltage is below the grid voltage imbalance recovery value, and the machine running time exceeds the recovery time of the grid, the PCS will automatically clear the grid imbalance fault. 4. If the machine is running in the island mode or grid imbalance protection is disabled.	1. Generally, the PCS will resume operation when the grid returns to normal. 2. Measure the actual grid voltage. If the actual value of the grid voltage imbalance is above the protection value set by the PCS, please inform the customer to contact the power company to deal with it. 3. Check that the LC interface parameters are set correctly.

Fault Name	Trigger	Recovery Condition	Handling Method
		5. The PCS automatically clears faults.	
Inverter-side relay soft start fault	If the inverter-side relay soft start time exceeds 30 seconds in the starting status, the PCS will report a relay soft start fault.	In the fault stop status, if the PCS is in the inverter-side soft start fault status for more than 3 minutes, the PCS will automatically clear the fault (up to 5 times).	1. Generally, the fault will be cleared automatically 2 minutes after it occurs. 2. Check whether the AC relay power supply is normal. 3. Check the control circuit for exception. 4. Check the relay for damage.
Busbar voltage imbalance fault	Either the positive or negative half-busbar voltage is above the upper limit value of half-busbar voltage (900 V), or the absolute value of positive or negative half-busbar voltage difference is above the limit value of half-busbar voltage difference for 1 second or 5 milliseconds (-imbalance fast protection), the PCS will trigger the busbar voltage imbalance fault.	If the positive or negative half-busbar voltage is below the upper limit of half-busbar voltage (900 V) and the absolute value of the difference between the positive and negative half-busbar voltage is below the limit of the difference between the half-busbar voltage for more than 30 seconds, the PCS will automatically clear the fault.	1. Attempt to power down and restart the PCS. 2. Measure the positive and negative busbar voltages to check whether the DC voltage sample is abnormal. 3. Check the battery side voltage for exception.
Carrier synchronizati-on fault	1. When the machine is running, the carrier synchronization status	1. When the parallel operation is disabled or the machine is in the non-parallel	1. Attempt to power down and restart the PCS.

Fault Name	Trigger	Recovery Condition	Handling Method
	is abnormal (low level) for 200 milliseconds. 2. The machine is in non-running status and the busbar voltage is above 200 V, and the carrier synchronization status is abnormal (low level). The machine runs continuously for 200 milliseconds in such a state, and then runs continuously for 10 minutes.	mode, the PCS will automatically clear the fault. 2. The fault lasts for 10 seconds and the carrier synchronization returns to normal.	2. Check whether the dip switch settings on the DSP board are normal. 3. Check for loose carrier synchronization wires.

*If the fault persists after the above operations, contact Sungrow.

6.3.2 Battery Fault Diagnosis

Fault Name	Trigger	Handling Method
Cell over voltage fault	The voltage of a single cell continuously exceeds the set fault threshold.	1. Check whether the BSC parameters are set correctly. 2. Check the cell voltage for exception. 3. Check the voltage sampling line for exception.
PACK over voltage fault	The voltage of PACK continuously exceeds the set fault threshold.	1. Check whether the BSC parameters are set correctly. 2. Check the cell voltage for exception. 3. Check the voltage sampling line for exception.
Total over voltage fault	The total voltage of PACK continuously exceeds the set fault threshold.	1. Check whether the BSC parameters are set correctly. 2. Check the cell voltage for exception. 3. Check the voltage sampling line for exception.

Fault Name	Trigger	Handling Method
Cell under voltage fault	The voltage of a single cell continuously falls below the set fault threshold.	1. Check whether the BSC parameters are set correctly. 2. Check the cell voltage for exception. 3. Check the voltage sampling line for exception.
PACK under voltage fault	The voltage of PACK continuously falls below the set fault threshold.	1. Check whether the BSC parameters are set correctly. 2. Check the cell voltage for exception.
Total under voltage fault	The RACK voltage continuously falls below the set fault threshold.	1. Check whether the BSC parameters are set correctly. 2. Check the cell voltage for exception. 3. Check whether there is any exception in the high-voltage acquisition circuit and hardware of the CMU mainboard.
Cell low temperature fault	The cell is continuously charged or discharged at low temperatures (below the set fault threshold).	1. Check whether heat production is enabled for the liquid cooling unit. 2. Check whether the battery compartment is well sealed. 3. Check the cell temperature sensor connection for exception.
Cell over temperature fault	The temperature of the cell continuously exceeds the set fault threshold.	1. Check whether cooling is enabled for the liquid cooling unit. 2. Check whether the battery compartment is well sealed. 3. Check whether the battery power terminal bar is in good condition. 4. Check for inveracious soldering of the cells in the PACK. 5. Check the cell temperature sensor connection for exception.
Over current fault	The current continuously exceeds the set fault threshold.	1. Check whether the BSC parameters are set correctly. 2. Check whether the power cable of the system is properly connected.

Fault Name	Trigger	Handling Method
Voltage sample fault	Abnormal voltage sample, disconnected sampling line, and BMU hardware fault.	1. Check whether the BMU is damaged and replace it if so. 2. Check whether the voltage sampling line is disconnected.
Temperature sample fault	Abnormal temperature sample, disconnected sampling line, and BMU hardware fault.	1. Check whether the BMU is damaged and replace it if so. 2. Check whether the temperature sampling line is disconnected. 3. Check whether the temperature sensor fails.
Current sample fault	Abnormal temperature sample, disconnected sampling line, and CMU fault.	Check whether the current sampling line is disconnected.
CMU-BMU communication fault	The communication line is disconnected or the BMU is damaged.	1. Check whether the communication lines are connected normally and in a correct sequence. 2. Check whether the first BMU without communication is damaged (the communication line connection skips this module). 3. Check whether CMU is damaged.
CMU-BSC communication fault	The communication line is disconnected, the BSC is damaged, or the CAN-matched resistor is not connected.	1. Check whether the communication lines are connected normally. 2. Check whether the CAN-matched resistor is installed. 3. Check whether CMU or the container BSC is damaged.
Fuse fault	Short circuit or long-term overload, loose feedback line, fuse quality problem, or CMU fault.	1. Measure the fuse for an open circuit and replace it in case of any exception. 2. Check whether the line is disconnected or loose.

Fault Name	Trigger	Handling Method
Total voltage difference fault	The difference between the cumulative total voltage and the sample total voltage exceeds the set fault threshold, or there is an exception in the total voltage sampling loop, indicating a CMU fault.	1. Troubleshoot other system faults such as communication fault and voltage sampling fault. 2. Check whether the total voltage sampling line is loose.
Cell over voltage alarm	The voltage of a single cell continuously exceeds the set alarm threshold.	1. When charging has stopped for 5 minutes (or the system starts discharging), check whether the alarm is automatically released. 2. Check whether the BSC parameters are set correctly. 3. Check the cell voltage for exception. 4. Check the voltage sampling line for exception.
PACK over voltage alarm	The voltage of PACK continuously exceeds the set alarm threshold.	1. When charging has stopped for 5 minutes (or the system starts discharging), check whether the alarm is automatically released. 2. Check whether the BSC parameters are set correctly. 3. Check the cell voltage for exception.
Total over voltage alarm	The total voltage of RACK continuously exceeds the set alarm threshold.	1. When charging has stopped for 5 minutes (or the system starts discharging), check whether the alarm is automatically released. 2. Check whether the BSC parameters are set correctly. 3. Check the cell voltage for exception.

Fault Name	Trigger	Handling Method
Cell under voltage alarm	The voltage of a single cell continuously falls below the set alarm threshold.	1. When discharging has stopped for 5 minutes (or the system starts charging), check whether the alarm is automatically released. 2. Check whether the BSC parameters are set correctly. 3. Check the cell voltage for exception. 4. Check the voltage sampling line for exception.
PACK under voltage alarm	The voltage of PACK continuously falls below the set alarm threshold.	1. When discharging has stopped for 5 minutes (or the system starts charging), check whether the alarm is automatically released. 2. Check whether the BSC parameters are set correctly. 3. Check the cell voltage for exception.
Total under voltage alarm	The total voltage of RACK continuously falls below the set alarm threshold.	1. When discharging has stopped for 5 minutes (or the system starts charging), check whether the alarm is automatically released. 2. Check whether the BSC parameters are set correctly. 3. Check the cell voltage for exception.
Cell voltage difference alarm	The difference between the max cell voltage and the min cell voltage collected from the RACK continuously exceeds the set alarm threshold.	1. Check whether the system power level is too low, and the alarm will be automatically released when the power level is restored. 2. Check for cell imbalance (refer to Sungrow Maintenance Manual for imbalance). 3. Check BMU for exception (replace it if so). 4. Check the cell voltage for exception. 5. Check whether the voltage sampling flat cable is disconnected.

Fault Name	Trigger	Handling Method
Pack voltage difference alarm	The difference between the highest PACK voltage and the lowest PACK voltage continuously exceeds the set alarm threshold.	1. Check the PACK cells for over-discharge and over-charge. 2. Check BMU for exception (replace it if so).
Cell temperature difference alarm	The difference between the max cell temperature and the min cell temperature collected from the RACK continuously exceeds the set alarm threshold.	1. After the PCS operating power drops, check whether the alarm is released automatically. 2. Check the liquid cooling unit is turned on normally. 3. Check for loose power connection bars. 4. Check for inveracious soldering of the cells in the PACK.
Cell low temperature alarm	The cell is continuously charged or discharged at low temperatures (below the set alarm threshold).	1. Judge whether the container system has not been fully started, and check the alarm is released automatically when the system is started. 2. Check whether heat production is enabled for the liquid cooling unit. 3. Check the temperature sensor for exception. 4. Check whether the battery compartment is well sealed.

Fault Name	Trigger	Handling Method
Cell over temperature alarm	The temperature of the cell continuously exceeds the set alarm threshold.	1. After the PCS operating power drops, check whether the alarm is released automatically. 2. Check whether cooling is enabled for the liquid cooling unit. 3. Check the temperature sensor for exception. 4. Check whether the battery compartment is well sealed. 5. Check whether the battery power terminal bar is in good condition. 6. Check for inveracious soldering of the cells in the PACK.
Over current alarm	The current is continuously over the set alarm threshold.	1. Whether the RACK is unbalanced. If the first installation is unbalanced, the system should be on standby for ≥24 hours. 2. Whether the alarm occurs in the case of low discharge SOC and disappears automatically when SOC is restored. It is recommended to reduce the depth of discharge. 3. Test whether the system power connection bar is normal, whether the battery system has a large temperature difference, and whether there is any exception in the liquid cooling unit.

*If the fault persists after the above operations, contact Sungrow.

6.3.3 BSC Fault Diagnosis

Fault Name	Trigger	Handling Method
Node fault	All branch-level nodes have node faults or the system level nodes have faults.	1. Check against the Node Fault Alarm List. 2. Check the status of the signal line connection as per the Operation Manual.
BSC-LC communication fault	Communication fault between BSC and LC.	1. Check the LC is powered up and is working properly. 2. Follow the Operation Manual to check the communication line between BSC and LC, and verify if the LC and BSC networks under the system are within the same LAN. 3. Follow the Operation Manual to test whether the IP address of the BSC configured on the LC matches the actual device.
Firefighting system fire alarm	Dry nodes related to firefighting trigger the fire alarm, or the fault that the firefighting gas is not released is triggered.	1. Check whether the smoke sensor and temperature sensor work. 2. Check the fire alarm node feedback signal cables and terminals for damage. 3. Check the firefighting controller for exception. 4. Check whether the BSC fire alarm node status is configured correctly. 5. Check the smoke and temperature sensors for exception, and conduct a replacement test for verification.
Emergency stop	An emergency stop fault is triggered.	1. Check whether the emergency stop signal wiring is normal. 2. Check whether the emergency stop button for the battery container is pressed.
Unit fault	Battery unit fault detected.	1. Check the battery unit fault code. 2. Locate the faulty battery, then check the battery parameters at the fault point and confirm the fault. 3. Refer to the battery-side troubleshooting methods.

Fault Name	Trigger	Handling Method
Firefighting system fault	There is a fault in the firefighting system. See the definition of firefighting system fault for details.	1. Check the firefighting fault node feedback signal cables and terminals for damage. 2. Check the firefighting controller for exception. 3. Check whether the BSC firefighting fault node status is configured correctly. 4. Check the devices of the firefighting system one by one.
Analog sampling fault	There is a fault with the analog sampling device.	1. Check whether the firefighting analog sampling node feedback signal cables and terminals for damage. 2. Check the firefighting controller for exception. 3. Check whether the BSC firefighting analog sampling node status is configured correctly. 4. Check the firefighting system analog sampling.
Auxiliary sub-device fault	There is a fault with the external 485 communication sub-device connected to the BSC.	1. Check for open circuit in the communication line between the BSC and the sub-device. 2. Check the BSC for exception. 3. Check the sub-device for exception. 4. Check whether the communication addresses of the BSC and the sub-device are configured correctly.

Fault Name	Trigger	Handling Method
Firefighting dry node alarm	Level 1 fire alarm, Level 2 fire alarm, gas release, PCS aerosol, or explosion venting panel node trigger fault.	1. Check whether the smoke and temperature sensing node feedback signals are consistent with the actual situation; otherwise it is a false alarm, and you should reset the node fault. 2. Check whether the firefighting gas node feedback signal is consistent with the actual situation; otherwise it is a false alarm, and you should reset the node fault. 3. Check whether the aerosol node feedback signal is consistent with the actual situation; otherwise it is a false alarm, and you should reset the node fault.
High combustible gas concentration alarm	The combustible gas detecting device reports Concentration Level 1 and 2 alarms.	1. Check whether the concentration reported by the gas detector is within the normal range. 2. Check whether the protection threshold is set correctly. 3. Check the batteries in the battery compartment for exception. 4. If it is a false alarm, calibrate the gas detector for higher precision.
Combustible gas detecting device communication fault	The communication between the BSC and the combustible gas detecting device is disconnected.	1. Check the communication line for open-circuit points. 2. Check whether the communication address of the gas detecting device is set correctly. 3. Check whether the communication address of the gas detecting device configured in BSC is set correctly.
Combustible gas detecting device fault	There is a fault with the combustible gas detecting device.	1. Check whether the power supply to the gas detecting device is normal. 2. Check the BSC for exception. 3. Check the combustible gas detecting device for exception.

Fault Name	Trigger	Handling Method
Firefighting dry node fault	Dry node triggers the firefighting system fault.	1. Check whether the firefighting system dry node software is configured correctly. 2. Check for open circuit in the dry node line. 3. Check the firefighting controller for exception.
Firefighting gas not released	No gas release signal is received 60 seconds after the Level 2 fire alarm was triggered.	1. Check whether the firefighting gas cylinders spray and release gas. 2. Check the pressure switch for exception. 3. Check for open circuit in the pressure switch feedback signal line. 4. Check the controller for exception.
All CMU fault	There is a fault with all CMUs within the battery unit.	1. Check the CMU fault records. 2. Check the RACK fault records. 3. Check the cell fault records.
Node fault	There is a fault with the branch node or system-level node corresponding to this battery unit.	1. Check whether the software of the branch node or system-level node corresponding to the battery unit is configured correctly. 2. Check whether the branch node or system-level node corresponding to the battery unit is open-circuit. 3. Check the BSC for exception.
BSC-CMU communication fault	Communication fault between the BSC and any CMU.	1. Check whether the power supply to the CMU is normal. 2. Check the communication line connection based on the Operation Manual. 3. Check whether the CMU address is configured correctly within the BSC.
Node alarm	A branch-level node triggers a fault or any node triggers an alarm.	1. Check against the Node Fault Alarm List. 2. Check the status of the signal line connection as per the Operation Manual.

Fault Name	Trigger	Handling Method
Anti-loss alarm	The AC side of the system is disconnected, and the min cell voltage of the power supply RACK is below the set value to trigger the under voltage alarm, or any rack voltage triggers the under voltage alarm.	1. Check whether the AC power is disconnected, and restore it if so. 2. Check whether the RACK is under voltage, and charge it if so.
Auxiliary sub-device alarm	There is an alarm with the external 485 communication sub-device connected to the BSC.	1. Check for open circuit in the communication line between the BSC and the sub-device. 2. Check the BSC for exception. 3. Check the sub-device for exception. 4. Check whether the communication addresses of the BSC and the sub-device are configured correctly.
Unit alarm	There is an alarm with any of the battery unit in the BSC group.	1. Check the battery unit fault code. 2. Locate the faulty battery, then check the battery parameters at the fault point and confirm the fault. 3. Refer to the battery-side troubleshooting methods.

*If the fault persists after the above operations, contact Sungrow.

6.3.4 LC Troubleshooting

Login LC Web, click  on the interface to view the fault alarm information.

Name	Type	Reason	Troubleshooting advice
PCS fault	System fault	All PCS failures under the system.	Check whether each PCS under the system has faults, and handle PCS faults according to PCS manual.

Name	Type	Reason	Troubleshooting advice
LC-PCS comm fault		Abnormal communication between all PCS and LC under the system. • PCS is not powered on. • The communication line is loosely connected or disconnected. • Communication error of the PCS address in LC. • The equipment works abnormally.	• Check whether the PCS is normally started. • Check the communication lines between LC and all PCS under the system, and check whether the LC and PCS networks under the system are in the same local area network. • According to the operation manual, check whether the IP address of PCS configured in LC is consistent with that of the actual equipment.
BSC fault		All BSC failures under the system.	Check whether each BSC under the system has faults, and handle BSC faults according to BSC fault alarm description.
LC-BSC comm fault		Abnormal communication between all BSC and LC under the system. • BSC is not powered on. • The communication line is loosely connected or disconnected. • Communication error of the BSC address in LC. • The equipment works abnormally.	• Check whether the 24V auxiliary power supply is normal. • Check the communication lines between LC and all BSC under the system, and check whether the LC and BSC networks under the system are in the same local area network. • According to the operation manual, check whether the IP address of BSC configured in LC is consistent with that of the actual equipment.

Name	Type	Reason	Troubleshooting advice
Host computer comm fault		There is a malfunction in the communication between LC and the host computer.	• Check that the system's lower LC and upper network are on a local area network. • Check the communication lines between the system's lower LC and all host computers. • Check if the LC configuration IP address matches the actual device.
Node fault		Node input signal alarm is triggered. • A fault occurs and the node signal is triggered. • The node detection signal line is loose.	• Check according to Node Fault Alarm List. • Check the connection status of signal lines according to the operation manual.
System not ready fault		The system has no fault but cannot be started. • The grouping and wiring of BSC units and PCS units are inconsistent.	Check whether the grouping of BSC units is consistent with that of the actual wiring.
Emergency stop		The emergency stop button of LC is pressed.	• Check whether the emergency stop signal circuit is normally connected. • Check whether the emergency stop button on the battery cabinet is pressed.
Analog sampling fault		The temperature, current, and voltage of the corresponding equipment exceed the preset fault threshold.	• Check whether the analog sampling device has faults. • Check whether the sampled data is abnormal.

Name	Type	Reason	Troubleshooting advice
Power line abnormal fault	System alarm	During system operation, continuously check whether the power of the PCS unit and the battery unit is the same, if the power is not the same, it will trigger an abnormal fault in the power line.	Manually click the power line check button, the fault is restored after the check is passed.
AC insulation detector board comm fault		Communication between LC and the AC insulation detector board remains disconnected. • Auxiliary power supply abnormal. • The 485 communication cables are loosely connected or disconnected. • AC insulation detector board communication parameters are wrongly configured.	• Check the auxiliary power supply. • Check the wiring of the signal cable.
AC insulation detector board fault		The AC insulation detector board reports a fault.	Troubleshoot according to the AC insulation detector board manual.
PCS unit fault		Faults of one or more PCS units.	Check whether there is fault information in PCS subunit, and take targeted measures according to the PCS manual to clear the fault.
PCS unit alarm		Alarms of one or more PCS units.	Check whether there is alarm information in PCS subunits, and take targeted measures according to the PCS manual to clear the alarm.

Name	Type	Reason	Troubleshooting advice
LC-PCS comm alarm		Communication abnormality of one or more PCS of the system with LC. • PCS is not powered on. • The communication line is loosely connected or disconnected. • Configuration error of PCS address in LC. • The equipment works abnormally.	• Check whether the PCS is normally started, and check whether LC and PCS networks under the system are in the same local area network. • Check the communication lines between LC and all PCS under the system. • Check whether the IP address of PCS configured in LC is consistent with the actual equipment according to the operation manual.
BSC unit fault		One or more BSC faults.	Check BSC fault points, and handle BSC faults according to BSC fault points.
BSC unit alarm		One or more BSC alarms.	Check BSC alarm points, and handle BSC faults according to BSC alarm points.
LC-BSC comm alarm		Communication abnormality of one or more BSC of the system with LC. • BSC is not powered on. • The communication line is loosely connected or disconnected. • Configuration error of BSC address in LC. • The equipment works abnormally.	• Check whether the 24V auxiliary power of the battery container is normal, and check whether the LC and BSC networks under the system are in the same LAN. • Check the communication lines between LC and all BSC under the system. • Check whether the IP address of BSC configured by LC is consistent with the actual equipment according to the operation manual.
Node alarm		Node alarm signal is triggered. • A fault occurs and the node signal is triggered. • The node detection signal line is loose.	• Troubleshoot according to the "Node Fault Alarm List". • Check the wiring of the signal cable.

Name	Type	Reason	Troubleshooting advice
SOC upper limit 1 alarm		SOC level-1 upper limit protection is triggered for one or more BSC of the system	• Check whether the SOC value corresponding to BSC exceeds the level-1 upper limit. • Discharge the battery to reduce SOC or stop charging. • Modify the SOC level-1 upper limit on LC.
SOC upper limit2 alarm		SOC level-2 upper limit protection is triggered for one or more BSC of the system	• Check whether the SOC value corresponding to BSC exceeds the level-2 upper limit. • Discharge the battery to reduce SOC or stop charging. • Modify the SOC level-2 upper limit on LC.
SOC lower limit 1 alarm		SOC level-1 lower limit protection is triggered for one or more BSC of the system.	• Check whether the SOC value corresponding to BSC is lower than level-1 lower limit. • Charge the battery to lift SOC or stop discharging. • Modify the SOC level-1 lower limit on LC.
SOC lower limit 2 alarm		SOC level-2 lower limit protection is triggered for one or more BSC of the system.	• Check whether the SOC value corresponding to BSC is lower than level-2 lower limit. • Charge the battery to lift SOC or stop discharging. • Modify the SOC level-2 lower limit on LC.
Zero power operation time-out alarm		System runs at zero power for longer than the set time.	System exits zero power operation, or shutdown.

Name	Type	Reason	Troubleshooting advice
HVAC comm alarm	Auxiliary sub-device alarm	Communication between LC and HVAC remains disconnected • Auxiliary power supply abnormal. • The RS485 communication cables are loosely connected or disconnected. • HVAC communication parameters are wrongly configured.	• Check the auxiliary power supply. • Check the wiring of the signal cable.
HVAC alarm		HVAC reports an alarm.	Troubleshoot according to the HVAC manual.
Breathing light comm alarm		There is a communication failure between the LC and the breathing light sub-device	• Check the auxiliary power supply. • Check that the controller is connected to the breathing light communication cable.
Ammeter comm alarm		Communication between LC and ammeter remains disconnected. • Auxiliary power supply abnormal. • The 485 communication cables are loosely connected or disconnected. • Ammeter communication parameters are wrongly configured.	• Check the auxiliary power supply. • Check the wiring of the signal cable.

Name	Type	Reason	Troubleshooting advice
Node expansion board comm alarm		Communication between LC and the node expansion board remains disconnected. • Auxiliary power supply abnormal. • The 485 communication cables are loosely connected or disconnected. • Node expansion board communication parameters are wrongly configured.	• Check the auxiliary power supply. • Check the wiring of the signal cable.
AC insulation detector board alarm		The AC insulation detector board reports an alarm.	Troubleshoot according to the AC insulation detector board manual.
Transformer oil temperature fault		Faulty transformer temperature control sub-equipment.	Check for abnormal device temperatures inside the transformer room.
Transformer oil temperature comm alarm		Communication between LC and the transformer temperature sensor remains disconnected. • Auxiliary power supply abnormal. • The 485 communication cables are loosely connected or disconnected. • Transformer temperature sensor communication parameters are wrongly configured.	• Check the auxiliary power supply. • Check the wiring of the signal cable.

*If the fault is not cleared after the operation above, please contact SUNGROW.

6.3.5 Firefighting Fault Diagnosis

Fault Name	Trigger	Handling Method
Invalid module response	Modules or detectors do not respond, or these devices are not working or are not properly connected.	Check whether the detector is working and correctly connected and addressed on the signal circuit line.
Duplicate module address codes	Multiple detectors or modules of the same type are set with the same address.	Modify the incorrect address.
Low detector threshold value	The detector reading inside the chamber is too low for the detector to work properly.	Replace the detector with a new one.
Detector exception	The detector is dirty and needs to be cleaned.	Clean the detector.
Hardware mismatch	In the controller database, the programming for the device at the specified address and the type of this device do not match up correctly.	Correct the programming, or change the field device.
External power down	The external power supply to the control module is powered down.	Check for disconnected DC power supply or incorrect power wiring.
Module open circuit	The module is open-circuit.	Check the 47 k resistor.
Communication exception of fire extinguishing control panel	When the FACP and sub-devices are re-powered after a power outage over 24 hours, communication may fail to connect occasionally. Meanwhile, all indicators of the fire extinguishing control panel blink, the FACP reports a fault, and the display shows FU1.	You need to manually to reset the FACP to restore normal communication. The firefighting system will work continuously once the energy storage system is put into operation, and prolonged power outage is not allowed.

6.3.6 Fault Diagnosis for Liquid Cooling System

Fault Name	Trigger	Handling Method
Low ambient temperature	The outdoor ambient temperature is below the operating temperature specified in the specification.	1. Measure and confirm the actual ambient temperature and report it to the customer to verify the running scenario. 2. Wait for the ambient temperature to rise to the standard before starting to run. 3. When the ambient temperature is 2 ℃ above the set threshold, the equipment can resume running automatically.
Evaporator/ condenser pump overload	The line is short-circuited.	Check the power supply line and manually close the circuit breaker if there is no exception.
Evaporator/ condenser pump fault	Pump VFD fault.	1. Check whether there is anything abnormal with the pump VFD. 2. Check the control panel in the control cabinet of the liquid cooling unit for burn marks or other abnormal signs. 3. Check the appearance of the pump for exception. 4. Export the running data and fault records. 5. Contact the supplier.
Power supply fault	Exceptions such as incorrect phase sequence, over voltage, under voltage, and phase imbalance.	1. Check the circuits and circuit breakers. 2. Check whether the phase sequence of the power supply is correct. 3. Measure whether the power supply voltage is within the running voltage range. 4. Measure the power supply for phase imbalance.

Fault Name	Trigger	Handling Method
Multi-way valve fault	The multi-way valve is blocked, or the electrical line short-circuited, open-circuited or offline.	1. Check the multi-way valve power supply line for disconnection. 2. Check the multi-way valve control line for disconnection. 3. Check whether the controller command can be sent to the multi-way valve. 4. Check whether the coolant line of the multi-way valve is blocked by foreign objects. 5. Replace the multi-way valve.
System water shortage fault	The coolant is severely insufficient in the liquid cooling unit.	1. Check if the liquid level indicator of the liquid cooling unit shows a low liquid level. 2. Check whether there is coolant leakage in the battery compartment, and if any, take prompt action to address it. 3. Replenish the coolant in time.
Mode switching fault	Switching the multi-way valve failed.	1. Check the multi-way valve control line for disconnection. 2. Check whether the controller command can be sent to the multi-way valve. 3. Replace the multi-way valve.
Evaporator temperature sensor fault	There is a fault with both evaporator outlet and inlet water temperature sensors.	1. Check the connection between the sensor and the controller terminal. 2. Check whether the sensor wiring is broken. 3. Replace the sensor.
Temperature/ pressure sensor fault	The sensor returns a fault signal.	1. Check whether the sensor is connected to the controller terminal and whether the sensor terminal is loose. 2. Check for broken and shorted sensor lines. 3. The sensor may be damaged, so replace it.

Fault Name	Trigger	Handling Method
High evaporator outlet water temperature	The evaporator outlet water temperature is higher than the protection threshold.	1. Check whether the compressor fault is reported at the same time. 2. Check whether the air cooler is dirty and clogged, and clean it in time if so. 3. Check whether the fan can run normally, and replace it in time in case of any exception.
Too high condenser outlet/inlet water temperature	The condenser outlet/inlet water temperature is above the protection threshold.	1. Check whether the air cooler is dirty and clogged, and clean it in time if so. 2. Check whether the fan can run normally, and replace it in time in case of any exception.
High evaporator/ condenser outlet water pressure	The evaporator/ condenser outlet water pressure is above the protection threshold.	1. The multi-way valve angle sensor is offset. Replace the multi-way valve. 2. The back pressure of the system is too high. Vent the system.
Low evaporator/ condenser inlet water pressure	The coolant in the liquid cooling unit is insufficient, and the inlet water pressure of the evaporator or condenser is below the protection threshold.	Replenish the coolant to the liquid cooling unit in time.
Low level in evaporator/ condenser	The coolant in the liquid cooling unit is insufficient.	1. Check for coolant leakage in the battery compartment. 2. Replenish the coolant to the liquid cooling unit in time.
Thermal relay overload	The thermal relay returns an overload signal.	1. The system has unremoved gas, resulting in dry heating of the liquid cooling unit. Vent the system. 2. Insufficient coolant. Replenish the coolant to the liquid cooling unit in time. 3. The thermal protection switch has tripped. Check the thermal relay for exception.

Fault Name	Trigger	Handling Method
High-voltage switch disconnection alarm	The high-voltage switch returns a disconnection signal.	1. Check whether the ambient temperature is too high. 2. The air cooler is clogged, leading to insufficient heat dissipation. Check whether the air cooler is dirty and clogged, and clean it up in time. 3. Check whether the fan can run normally, and replace it in time in case of any exception.
Low-voltage switch disconnection alarm	The low-voltage switch returns a disconnection signal.	1. Check whether the refrigeration system is leaking refrigerant. 2. Contact the manufacturer to solve the problem.
Compressor overload	The compressor returns an overload signal.	1. Check the power supply line for disconnection. 2. Check whether the power supply terminals are loose.
Compressor fault	The compressor feeds back a fault signal.	1. Check the power supply line for disconnection. 2. Check the compressor for abnormality or damage. 3. Contact the manufacturer.
Compressor lockout alarm	The compressor returns a lockout alarm signal.	1. Reset the alarm or the host computer by clicking the Fault Reset button. 2. Contact the manufacturer.
Expansion valve controller alarm	The expansion valve controller returns an alarm signal.	1. Check the power supply line for disconnection. 2. Contact the manufacturer.

Fault Name	Trigger	Handling Method
Fan fault	The fan runs abnormally and returns a fault signal.	1. Check for loose connection terminals at the controller end. 2. Check for loose fan terminals of the air cooler. 3. Replace the damaged fan in time.
BSC offline	Communication between the liquid cooling controller and the BSC is lost.	1. Check whether the communication line between the liquid cooling unit and the BSC is normal. 2. Check whether the BSC does not transmit the data of the battery cells.

6.4 MVS Troubleshooting

Login LC Web, click "**Running info→Node info**" to view the status information of each node.

Node name	Node state	Troubleshooting advice
Oil temperature alarm	Alarm	• Go through the LC interface to view the transformer oil temperature. • Check the transformer for prolonged overload operation. • Check for pressure relief valve operation and internal transformer failure. • Check to see if the oil temperature continues to rise, if it exceeds 105℃ then you will need to shut down and troubleshoot.
Oil temperature trip	Fault	• Shutdown inspection. • Go through the LC interface to view the transformer oil temperature. • Check the transformer for prolonged overload operation. • Check for pressure relief valve operation and internal transformer failure.

Node name	Node state	Troubleshooting advice
Low oil level trip	Fault	• Check that the transformer oil level gauge is normal. • Check for oil leaks around the transformer. • Check pressure relief valve for oil injection. • Check whether the signal line is shorted, broken, there is no abnormal signal interference.
Oil pressure trip	Fault	• Check that the transformer oil pressure gauge is normal. • Transformer oil sample testing. • Check whether the signal line is shorted, broken, there is no abnormal signal interference.
SCC door open	Alarm	• Check that the SCC door is open. • Check the SCC door travel switch for abnormality.
SCC smoke sensor action	Fault	• Check for fire or smoke inside the cabinet. • Check that the smoke sensor is not malfunctioning due to high wind and sand. • Check for abnormal temperatures of electrical components in the cabinet. • Check that the smoke sensor wiring is disconnected.
Abnormal main circuit lightning protector	Fault	Check whether the lightning protector is loose or damaged, if damaged, please replace the lightning protector.
SCC main circuit QF1 disconnected	Fault	• If the fault is reported as a normal tap, no troubleshooting is required. • If it is an abnormal trip then it needs to be investigated.
SCC main circuit QF2 disconnected	Fault	• If the fault is reported as a normal tap, no troubleshooting is required. • If it is an abnormal trip then it needs to be investigated.

7 Appendix

7.1 Abbreviations

Abbreviations	Complete designation
B	
BESS	Battery Energy Storage System
BCP	Battery Connection Panel
BSP	Battery Supply Panel
BM	Battery Module
BC	Battery Cluster
BMS	Battery Management System
BSC	Battery System Controller
E	
ESS	Energy Storage System
ESC	Energy Storage Cabinet
EMS	Energy Management System
F	
FSS	Fire Suppression System
FTB	Fiber Terminal Box
FACP	Fire Host Alarm Control Panel
FFC	Flexible Flat Cable
H	
HVAC	Heating, Ventilating and Air Conditioning
L	
LCS	Liquid Cooling System
LC	Local Controller
M	
MVS	Medium Voltage System
MSD	Manual Service Disconnect
P	
PCS	Power Conversion System
S	
SCC	Smart Control Cabinet
SMPS	Switching Mode Power Supply
SOC	State Of Charge
STP	Shielded Twisted Pair
SCADA System	SCADA (Supervisory Control And Data Acquisition) System

Abbreviations	Complete designation
T	
TB	Terminal Box

7.2 Quality Assurance

When product faults occur during the warranty period, SUNGROW will provide free service or replace the product with a new one.

Evidence

During the warranty period, the customer shall provide the product purchase invoice and date. In addition, the trademark on the product shall be undamaged and legible. Otherwise, SUNGROW has the right to refuse to honor the quality guarantee.

Conditions

- After replacement, unqualified products shall be processed by SUNGROW.
- The customer shall give SUNGROW a reasonable period to repair the faulty device.

Exclusion of Liability

In the following circumstances, SUNGROW has the right to refuse to honor the quality guarantee:

- The free warranty period for the whole machine/components has expired.
- The device is damaged during transport.
- The device is incorrectly installed, refitted, or used.
- The device operates in harsh conditions beyond those described in this manual.
- The fault or damage is caused by installation, repairs, modification, or disassembly performed by a service provider or personnel not from SUNGROW.
- The fault or damage is caused by the use of non-standard or non-SUNGROW components or software.
- The installation and use range are beyond stipulations of relevant international standards.
- The damage is caused by unexpected natural factors.

For faulty products in any of above cases, if the customer requests maintenance, paid maintenance service may be provided based on the judgment of SUNGROW.

Product data such as product dimensions are subject to change without prior notice. The latest documentation from SUNGROW should take precedence in case of any deviation.

7.3 Contact Information

In case of questions about this product, please contact us.

We need the following information to provide you the best assistance:

- Model of the device
- Serial number of the device
- Fault code/name
- Brief description of the problem

For detailed contact information, please visit: **https://en.sungrowpower.com/contactUS**

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