5MWh BESS Product Specification

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V0		Notiya	**2025-02-20**

Catalogue

1 Product Introduction

1.1 Abbreviation

5MWh	5MWh Liquid cooling BESS
BMS	Battery management system
BSMU	Battery stack management unit
BCMU	Battery cluster management unit
BMU	Battery management unit
PCS	Power conversion system
BESS	Battery energy storage system
DTU	Data transfer unit
FFS	Fire suppression system

1.2 Reference standard

- IEC 62485-1:2018-Safety requirements for secondary batteries and battery installations
- IEC 62619:2017-Secondary cells and batteries containing alkaline or other non-acid electrolytes -Safety requirements for secondary lithium cells and batteries, for use in industrial applications
- IEC 60695-1-11 - Fire hazard assessment
- NFPA 855 - Standard for the Installation of Stationary Energy Storage Systems
- IEC 62933-1 Electrical energy storage (EES) systems - Part 1: General requirements
- IEC 62933-2-1 Electrical energy storage (EES) systems - Part 2-1: Unit parameters and testing methods - General specification
- IEC 62933-3-1 Electrical energy storage (EES) systems - Part 3-1: Planning and performance assessment of electrical energy storage systems - General specification
- IEC 62933-4-1 Electrical energy storage (EES) systems - Part 4-1: Guidance on environmental issues - General specification

- IEC 62933-5-2 Electrical energy storage (EES) systems - Part 5-2: Safety requirements for grid integrated EES systems - Electrochemical based systems
- IEC 62477-1 Safety requirements for power electronic converter systems– Part 1: General requirements
- IEC 61000-2 Electromagnetic compatibility (EMC) – Part 2: Environment
- IEC 61000-4 Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques
- IEC 63056 Functional safety of electrical, electronic, and programmable electronic systems
- NFPA 69 Standard on Explosion Prevention Systems
- IEC 60445 Basic and safety principles for man-machine interface, marking and identification
- IEC 61439 Low-voltage switchgear and control gear assemblies
- IEC 61643-11 Surge protective devices – Part 11: Surge protective devices connected to low-voltage power distribution systems – Performance requirements and testing methods

1.3 Scope

This document introduces the safety and handling information, features, requirements, service, maintenance and warranty of 5MWh 20ft Liquid-cooling BESS of with the model of 5MWh (hereinafter referred to as 5MWh) in detail.

2 Product overall introduction

5MWh 20ft Liquid-cooling BESS			
Product model	5MWh		
Product type	Lithium iron phosphate battery system		
No.	**Item**		**Specification**
1	Configuration		12*（4*1P104S）
2	Rated energy		5.016MWh
3	Rated voltage		1331.2Vdc
4	Voltage scope		1164.8~1497.6Vdc
5	Rated charge		2.5MW
6	Rated discharge		2.5MW
7	Auxiliary power (voltage scope)		400V AC±5% 50Hz
8	Environmental conditions	Storage temperature	-35℃ ~+55℃
		Work temperature	-30℃~+55℃
		Application altitude	≤5000m (≥2000m derating to use)
9	Basical parameter	Dimension	6300mm(length)*2438mm(width)*2896mm(height)
		Color	RAL 9003(standard color)
		Weight	≈42t
		IP level	IP55

		Cooling method	Liquid cooling
		Communication protocol	PCS: CAN/RS485 EMS: IEC61850
		Coolant	50% glycol and water liquid

2.1 System equipment introduction

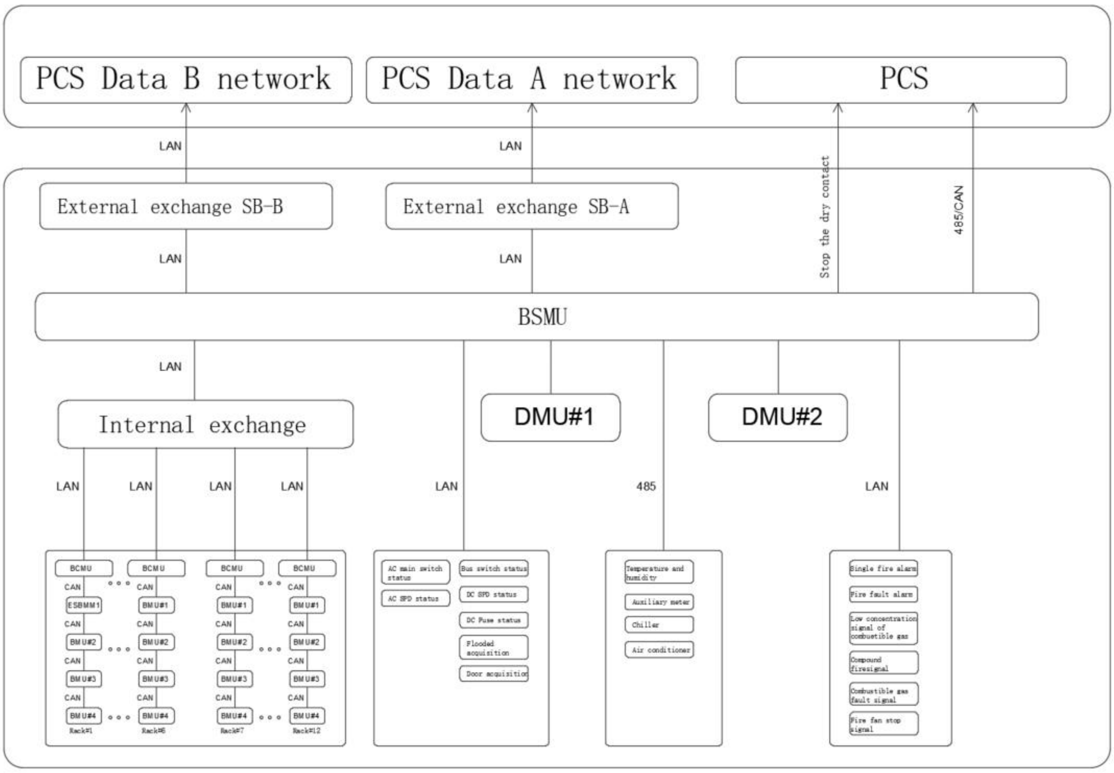
The 5MWh outdoor liquid cooling BESS is a high energy density integrated system consisting of battery cluster units, BMS, fire suppression system, lighting system, thermal management system, ventilation system, electrical system, etc.

No	Equipment	Technical requirement	Qty	Unit	Remark
1	Battery container	20 HQ liquid cooling battery container with the capacity of 5.016MWh	1	pcs	Including1.1~1.4
1.1	Chiller cabin	Chiller with the cooling capacity of 60kW	1	set	
1.2	Electrical cabin	The interior includes the bus system, the control system and the power distribution system	1	set	
1.2.1	Bus system	The system has two arrays, the switch is 1250A	2	pcs	
1.2.2	Power distribution system	Including auxiliary power distribution, power distribution of the liquid cooling unit, UPS power supply, etc.	1	set	
1.2.3	Communication system	The array level management systems,	1	set	

		switches for BMS			
1.2.4	Fire protection system	Smoke sensor, fire extinguishing control panel and accessories	1	set	
1.2.5	Air conditioner	The cooling of the components in the electrical cabin requires air conditioner with a cooling capacity of 2kW	1	set	
1.2.6	Cable	Internal cables and accessories	1	set	
1.3	Battery cabin	Battery array	1	set	
1.3.1	Battery cluster	Includes 4*1P104S Pack, BMU, cluster control box and BCMU	12	set	
1.3.2	Lighting system	Battery cabin lighting	1	set	
1.3.3	Fire Suppression system	Including aerosol fire agent, smoke sensors, heat sensors, combustible gas sensors, sound and light alarm system, and reserved dry water pipe	1	set	
1.3.4	Exhaust system	Air inlet louver, exhaust fan, air duct	1	set	
1.3.5	Cable	Internal cables and accessories	1	set	
1.4		Enclosure:	1	set	

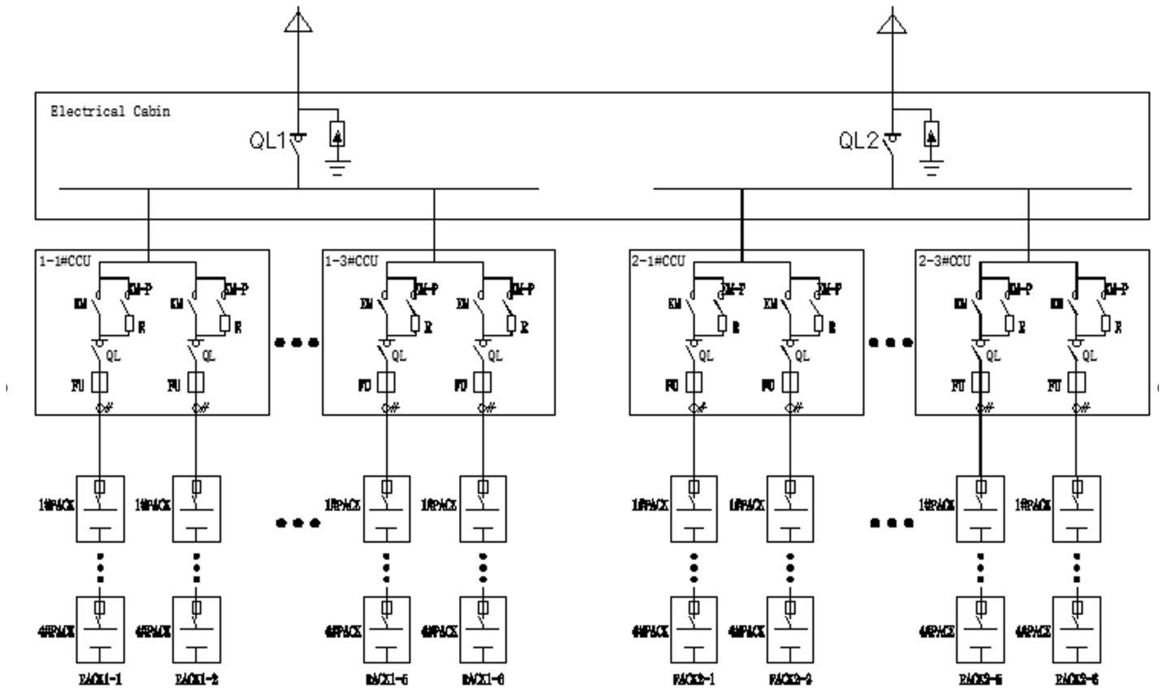
	Others	6300*2438*2896mm, internal cable of battery container.			

2.2 Communication topology



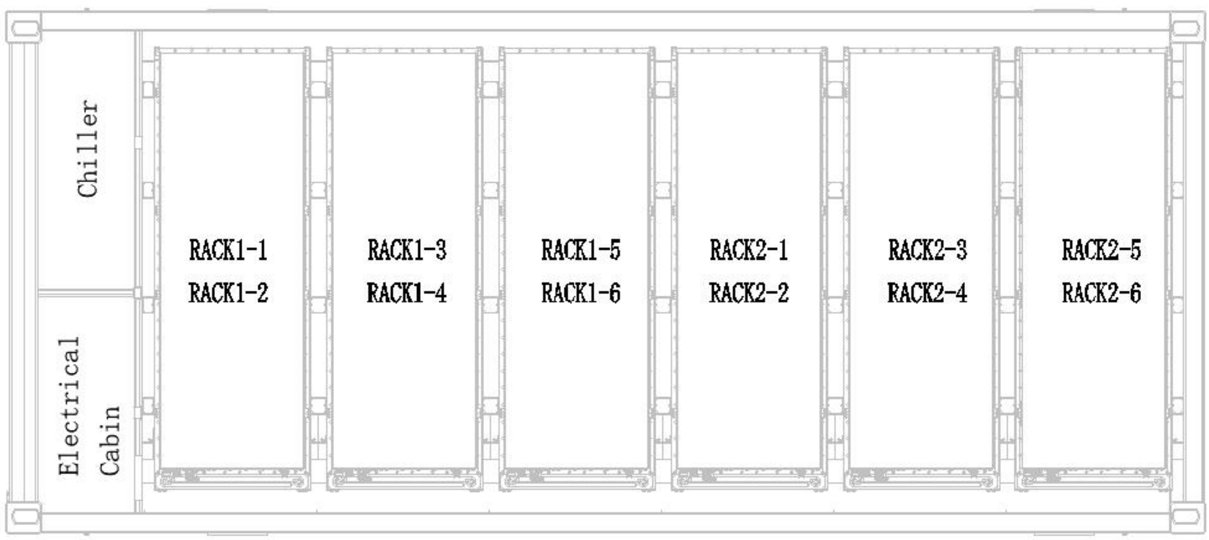
2.3 Primary schematic diagram

The total capacity of the battery container is 5.016MWh, which integrates the battery system, BMS, fire suppression system, chiller, and environmental monitoring in the container, compatible with the 2h system and 4h system. Primary schematic diagram is shown as below



2.4 Product layout

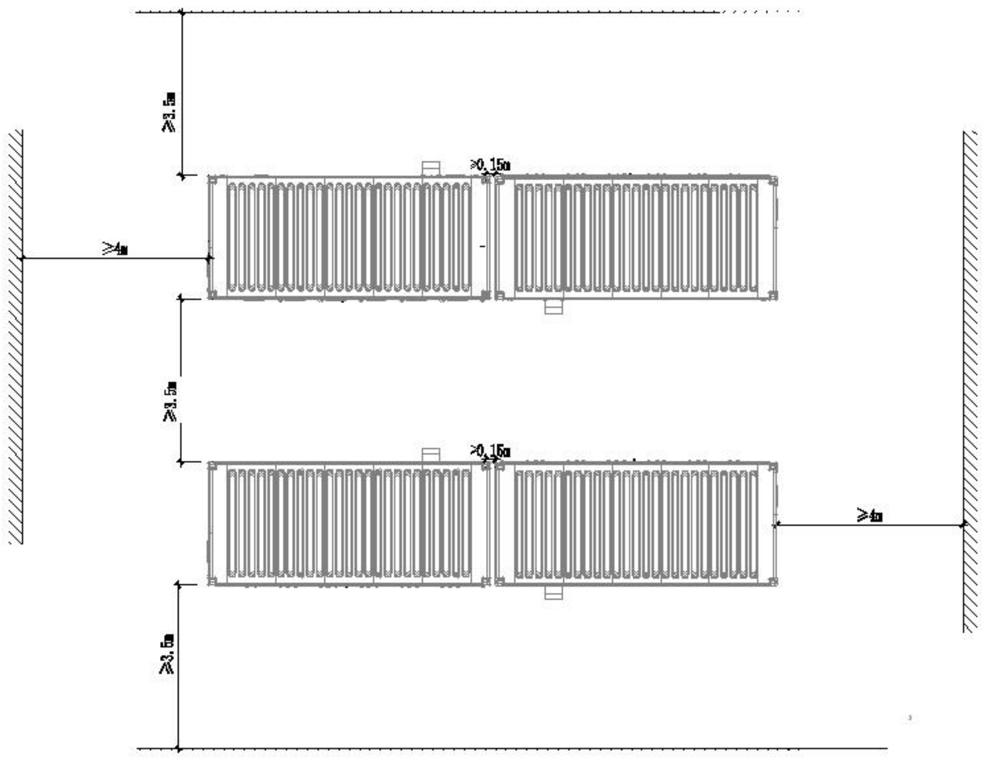
2.4.1 Interior layout diagram of single container



2.4.2 Power station layout

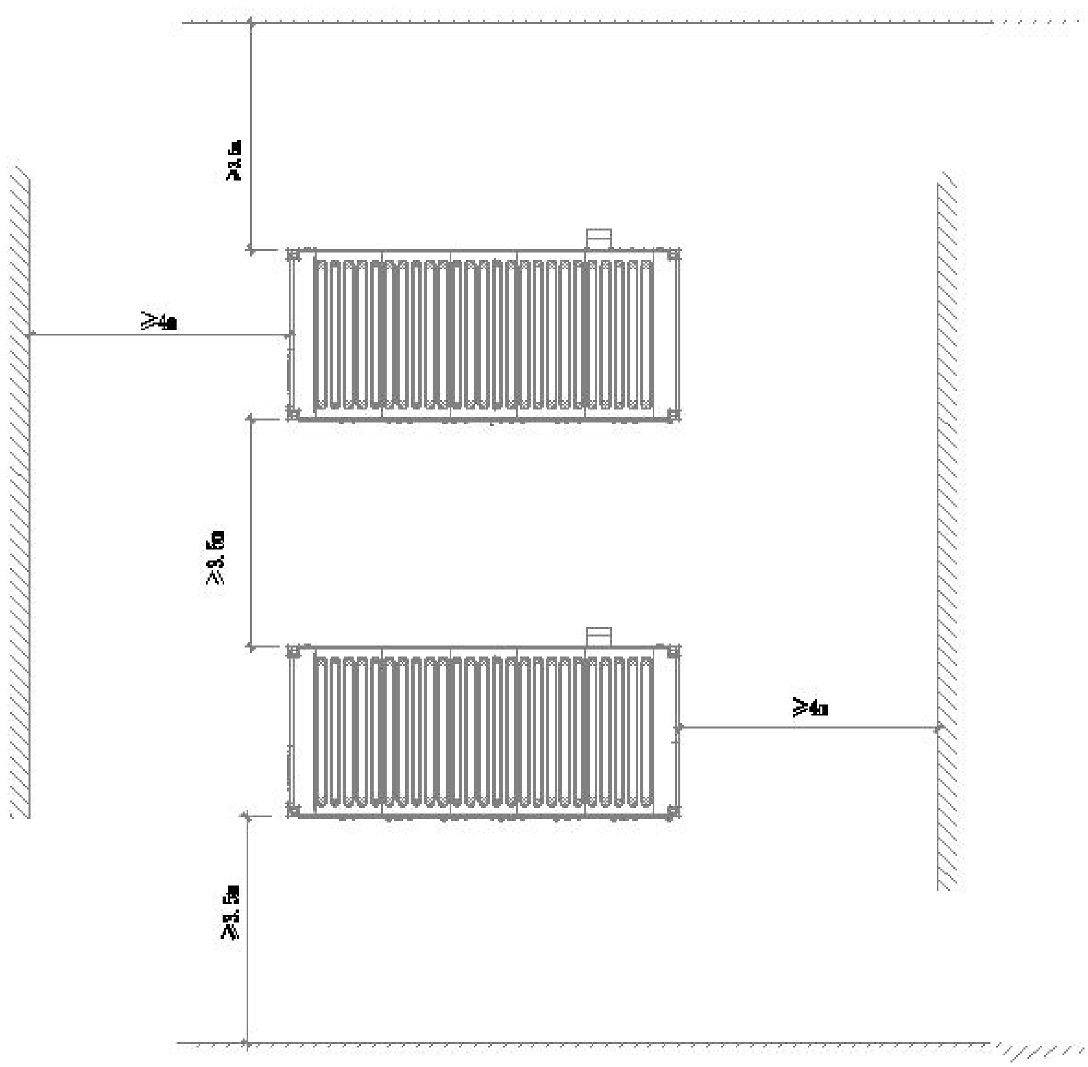
The distance between the long side of the battery container is not less than 3.5 m, and the distance between the short side is not less than 4m.

Typical layout 1: The overall the path of overall DC cables will be shortest, adapted to the rectangular power station. Picture of typical layout1 as below.



Typical layout 2: Single box, suitable for square site, covers a slightly larger area, DC cable is longer. Picture of typical layout 2 as below.

Conclusion: The above two layouts are selected according to the size of the owner's site.



2.5 Product features

① Cost decreasing and benefit increasing

Less space occupied.

High-efficiency temperature control system, which can control the temperature difference between batteries in pack level within 2 ℃, and in system-level within 5 ℃. And it also can improve the battery life about 15%.

② Safe and reliable

The isolated design of electric cabin and battery cabin, which can maximally ensure the safety of system, the intelligent management of batteries health, advance warning pathological batteries.

③ Flexibility and efficiency

Strong environmental adaptation, support various extreme environment application.

The efficiency of heat dissipation, battery life, and DOD are improved simultaneously.

3 Product introduction

3.1 Battery Pack

The battery pack consists of 104 cells and 1 BMU (Battery Management Unit). Each battery pack includes 64 NTC temperature sampling points and 104 cell voltage sampling points. The BMU is responsible for measuring cell voltage, total module voltage, and cell ambient temperature. It supports optional active/passive balancing functions and can actively report real-time monitoring data to the BCMU (Battery Control and Management Unit) via the CAN 2.0 communication bus. It also executes temperature control and balancing strategies issued by the BCMU.

Table 3.1-1 Battery Pack Parameters

No.	Item	Parameter	Reference Diagram
1	Cell	3.2V, LFP	
2	Configuration	1P104S	
3	Rated Capacity	314Ah	
4	Rated Voltage	332.8V	
5	Rated Energy	104.498kWh	
6	Rated Charge/Discharge Rate	0.5CP	
7	Dimensions (WHD)	7702462220mm	
8	Weight	680±10kg	
9	Cooling Method	Intelligent Liquid Cooled	

No.	Item	Parameter	Reference Diagram
10	Communication	CAN	
11	Protection Level	IP67	
12	Optimal Operating Temperature	15℃~35℃	
13	Storage Temperature	-30℃～55℃	
14	Maximum Temperature Difference in Pack	<2℃ (Aluminum Busbar Temperature)	

Notes for battery pack:

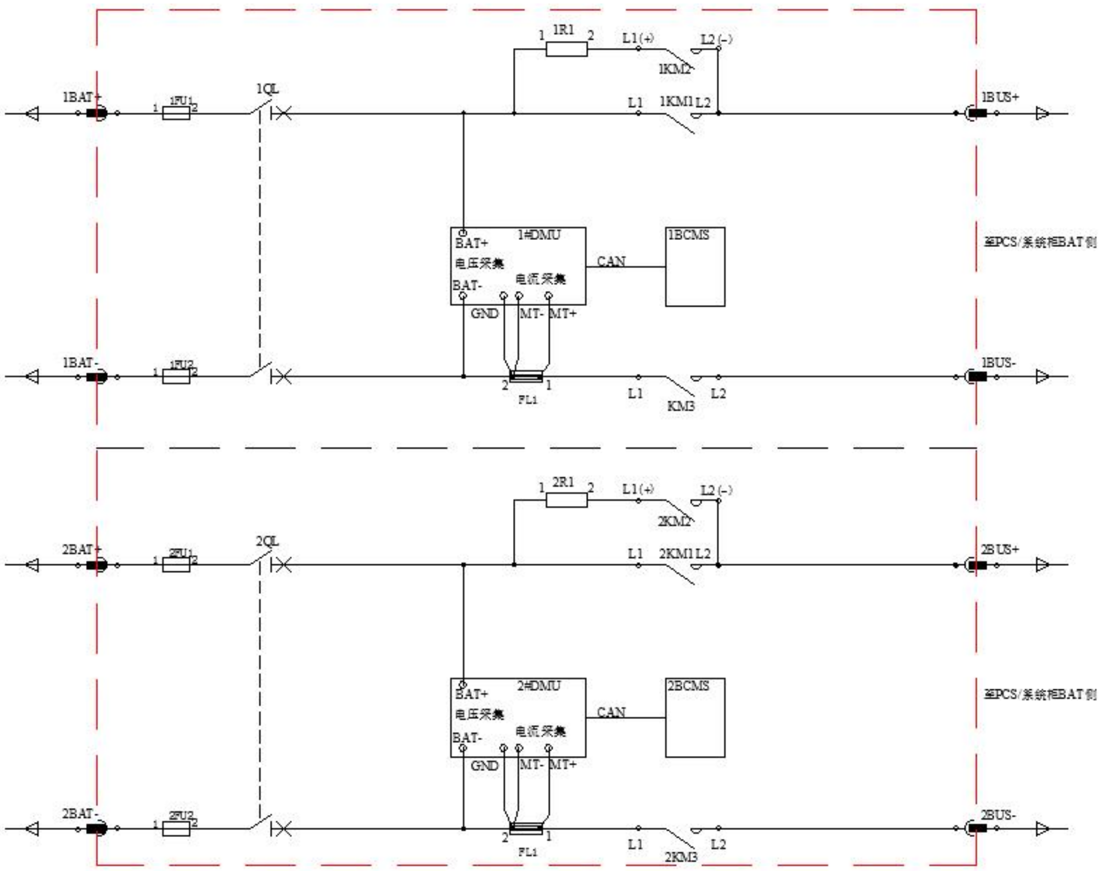
- Unless otherwise specified, all tests are conducted at an ambient temperature of 25℃.
- The battery pack is charged at a constant power of 52.25kW until any single cell reaches the termination voltage (3.6V) or the module reaches the charging termination voltage (374.4V). Then, it is discharged at a constant power of 26.12kW until any single cell reaches the termination voltage (2.75V) or the module reaches the discharge termination voltage (286V). After each charge and discharge cycle, the battery pack should rest for at least 30 minutes.

3.2 Cluster Control Box

The cluster control box primarily includes detection devices, protection devices, and an AC/DC power module. It is equipped with a built-in Battery Cluster Management Unit (BCMU), which enables battery cluster control, protection, data acquisition, and power distribution functions.This product adopts a design with 2 inputs and 2 outputs.

Table 3.2-1 Cluster control box parameters

No.	Item	Parameter
1	Rated Voltage	1500V
2	Rated Current	250A
3	Breaking Capacity	150kA
4	Protection Level	IP20
5	Dimensions (W*H*D)	780*1550*250mm



Cluster Control Box Electrical Schematic Diagram

3.3 Temperature Control System

3.3.1 System Overview

The product utilizes a liquid cooling method for temperature control. The temperature control system consists of a liquid cooling unit, pipelines, and coolant. The pipelines are divided into three levels based on their location:

- **Primary Pipeline**: The main pipeline connected to the inlet and outlet of the chiller.
- **Secondary Pipeline**: The cluster-level main pipeline, corresponding to the number of clusters.
- **Tertiary Pipeline**: The module-level pipeline connected to the inlet and outlet of the module's liquid cooling plate.

The liquid cooled system is equipped with a circulation pump based on the resistance of the water circuit and battery packs to ensure that the liquid flow through each liquid-cooled battery pack is approximately equal, meeting the uniform temperature requirements for all batteries in the system.

3.3.2 System Functions

The system adopts a "dual-cycle" structure for heat dissipation, with dual energy efficiency control and multi-level distribution of liquid cooling pipelines. The temperature difference within any PACK is controlled within 2℃.

The unit features PC monitoring functionality, with communication between the chiller and the host achieved via RS485. The control mode can be set to either automatic mode or cell temperature control mode. Each branch is equipped with a flow meter and regulating valve for independent flow monitoring and control.

The system includes a dual power supply system, backup power, leakage protection, solid-state relays, and emergency stop switches for multiple layers of protection. It provides real-time feedback on coolant leakage signals to prevent safety incidents. Operational status is monitored in real-time, with immediate feedback on any faults.

3.3.3 Temperature Control Performance

(1)Cell Temperature Control:

The temperature of individual cells is controlled within 20~40℃.

(2)Temperature Difference Control:

The temperature difference between cells within a module is controlled within 2℃.

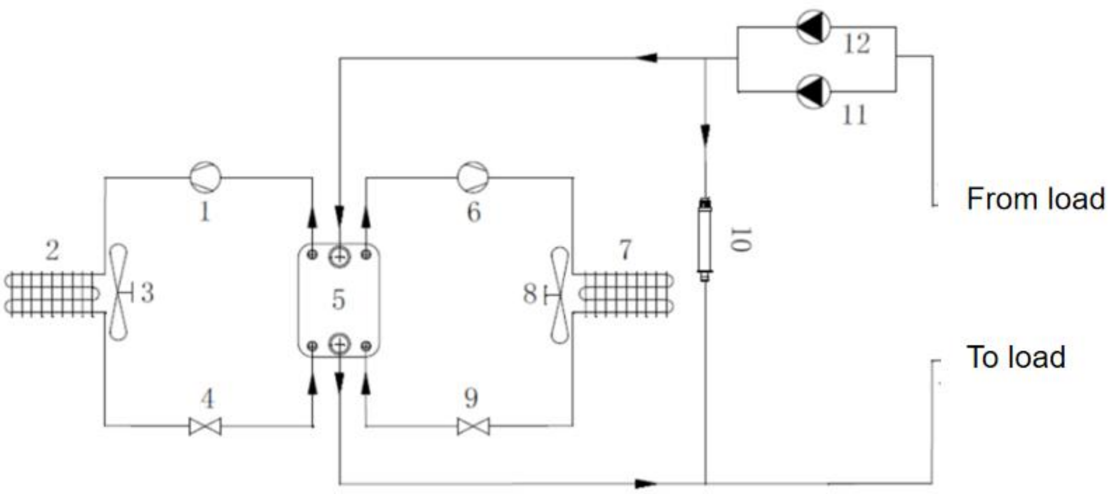
(3)Extreme Condition Temperature Control:

Under external environmental conditions of 20~45℃, the system ensures that the internal temperature, cell temperature, and temperature differences within the system remain within the specified range, ensuring smooth operation of the energy storage system.

The system adjusts the operating state (standby, cooling, or heating) based on real-time battery cell temperature, achieving the highest energy efficiency ratio.

3.3.4 System Principle

The air-cooled chiller unit consists of a refrigeration cycle system and a coolant circulation system. The system principle is illustrated in the diagram below.



(1) **Components List:**

No.	Item
1	1# Compressor
2	1# Condenser

No.	Item
3	1# Condenser Fan
4	1# Throttle Element
5	Plate Heat Exchanger
6	2# Compressor
7	2# Condenser
8	2# Condenser Fan
9	2# Throttle Element
10	Electric Heater
11	1# Circulation Pump
12	2# Circulation Pump

(2) **Component Functions:**

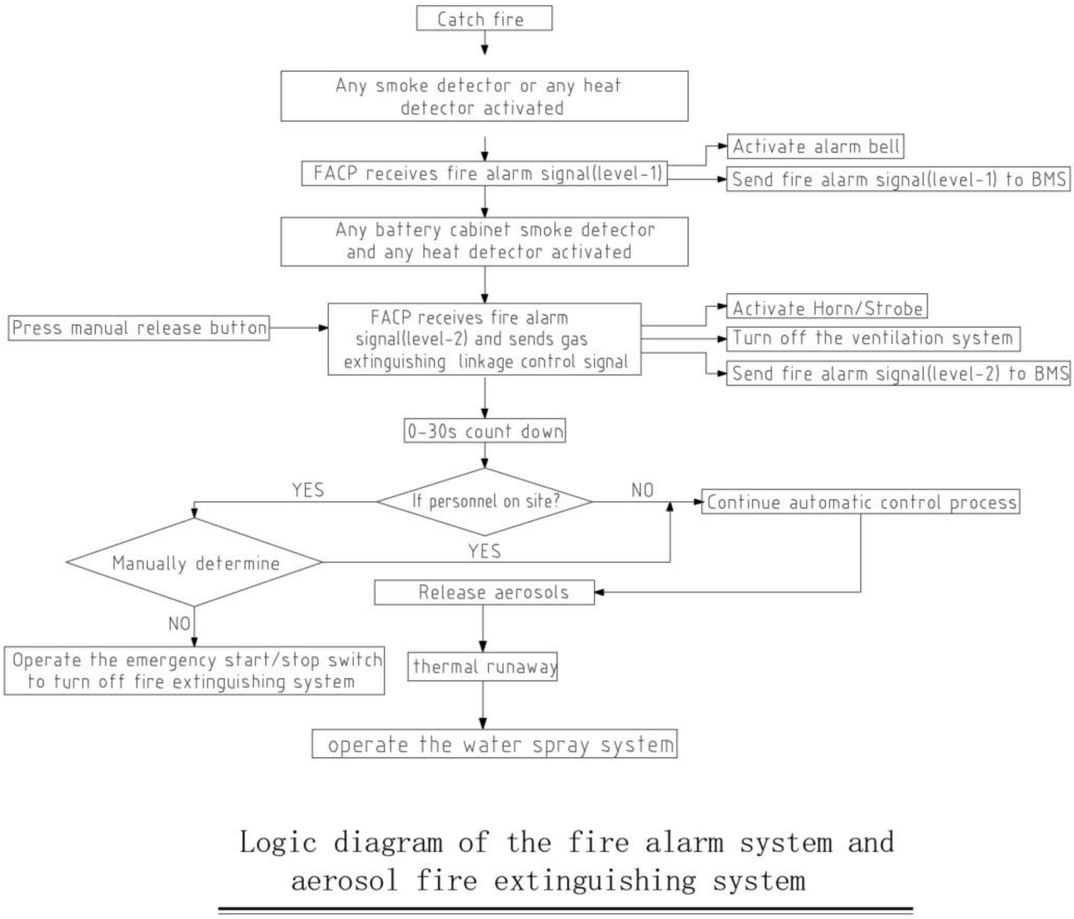
- **Compressor**: Compresses the refrigerant to provide power for the refrigeration system.
- **Condenser**: Designed with finned tube heat exchangers for high heat exchange efficiency. The refrigerant releases heat in the condenser.
- **Fan**: Uses a centrifugal fan to expel heat released by the refrigerant in the condenser to the outside.
- **Electronic Expansion Valve**: Controls the refrigerant flow by adjusting its opening.
- **Plate Heat Exchanger**: The intersection of the refrigeration cycle system and the coolant circulation system, responsible for heat exchange between the refrigerant and coolant.
- **Electric Heater**: Heats the coolant.
- **Circulation Pump**: Transports the coolant, providing power for the coolant circulation system.

3.4 Fire Protection System

The energy storage fire protection system includes a gas fire suppression system, ventilation system, and water sprinkler system. When thermal runaway in batteries leads to the leakage of flammable or toxic gases, the ventilation system responds promptly to exhaust and ventilate. In the event of a fire, the fire suppression system quickly intervenes to detect, alarm, and extinguish the fire. If the fire spreads or reignites, and the fire suppression system cannot control it, the water sprinkler system can be activated to prevent severe consequences such as explosions or large-scale fires.

3.4.1 Gas Fire Suppression Control System

The gas fire suppression control system consists of 1 gas fire suppression controller, 3 smoke detectors, 2 temperature detectors, 1 emergency start button, 1 emergency stop button, 1 alarm bell, 1 sound and light alarm, 1 gas release indicator, and 8 sets of aerosol fire suppression devices. The control logic diagram for the automatic fire alarm and gas fire suppression system is as follows:



Logic Diagram

(1) Automatic Control Strategy: When the system is in automatic control mode and any smoke detector or temperature detector in the container is triggered, the fire alarm controller receives a first-level fire signal, activates the alarm bell, and outputs a first-level fire signal to the battery management system.

When both a smoke detector and a temperature detector in the battery compartment are triggered simultaneously, the gas fire suppression controller receives a second-level fire signal, sends a control signal to shut down the ventilation equipment, and outputs a second-level fire signal to the battery management system. Upon receiving the second-level fire signal, the gas fire suppression controller initiates a 30-second delay for the aerosol fire suppression system. After the delay, the sound and light alarm and gas release indicator are activated, and the gas fire suppression controller outputs a fire suppression command to release the aerosol fire suppression agent.

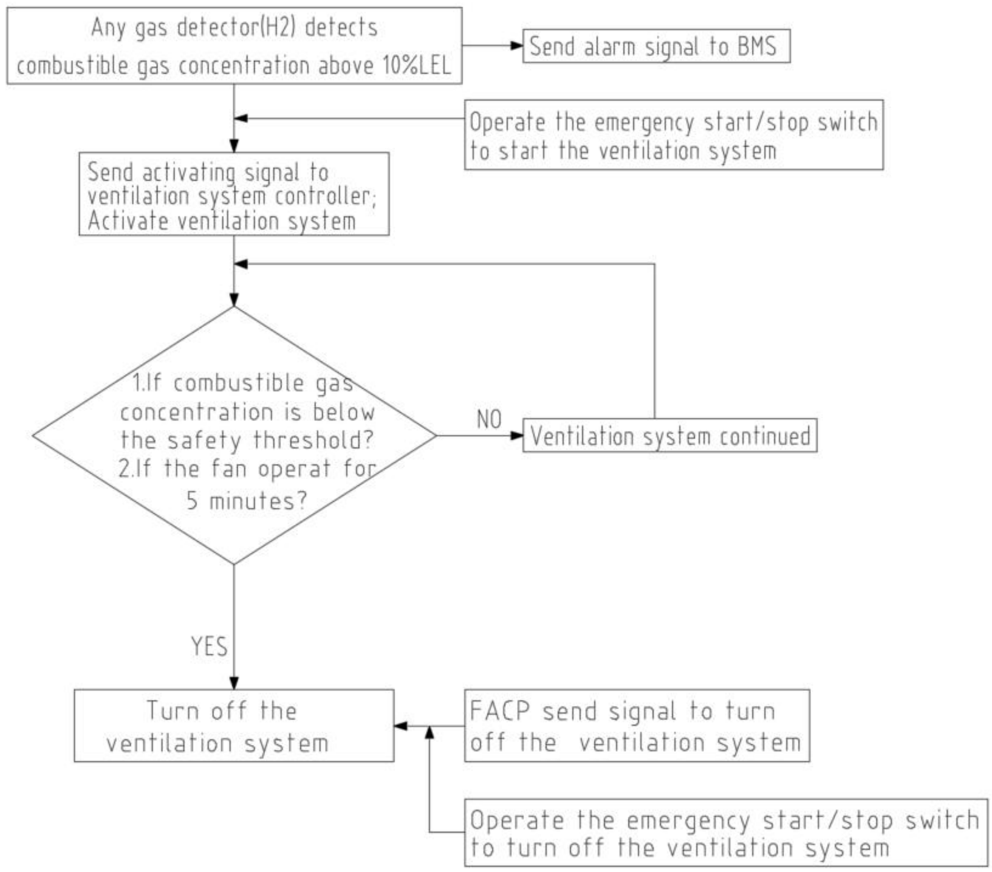
(2) Manual Start Control Strategy: When the system is in manual control mode and on-site personnel detect a fire, they should assess whether to activate the aerosol fire suppression system. If necessary, they should immediately press the emergency start button. The gas fire suppression controller will then initiate a 30-second delay for the aerosol fire suppression system. During the delay, the emergency stop button for the ventilation system should be pressed to close the vents and stop the ventilation system. After the delay, the gas fire suppression controller will output a fire suppression command, activate the sound and light alarm and gas release indicator, and release the aerosol fire suppression agent.

(3) Emergency Stop Strategy: When the system is in automatic control mode and the gas fire suppression controller receives a second-level fire signal, it immediately initiates a 30-second delay for the aerosol fire suppression system. If on-site personnel determine that the aerosol fire suppression system should not be activated, they can press the emergency stop button to pause the automatic activation process. When the emergency stop button is released, the countdown resumes with 10 seconds remaining, and the automatic activation process continues.

3.4.2 Ventilation System

The ventilation system consists of 2 hydrogen gas detectors ($H2$), 1 exhaust fan, and 1 electric intake louver. The system uses a one-in, one-out layout, with the exhaust fan and electric louver installed diagonally. The intake system draws external air into the container from the bottom, while the exhaust system extracts and expels air from the bottom and upper layers.

The control logic diagram for the ventilation system is as follows:



Logic diagram of the ventilation system

(1) Automatic Control Strategy: When any hydrogen gas detector detects a gas concentration reaching the first alarm threshold (10% LEL), it sends a first-level alarm signal to the battery management system and outputs a control signal to start the ventilation system. When the gas concentration at all monitoring points falls below the first alarm threshold, the gas fire suppression controller outputs a control signal to stop the ventilation system after 5 minutes of operation.

When the ventilation system control box receives a gas fire suppression control signal from the gas fire suppression controller, it immediately shuts down the electric louver and exhaust fan, regardless of the gas detector's alarm status.

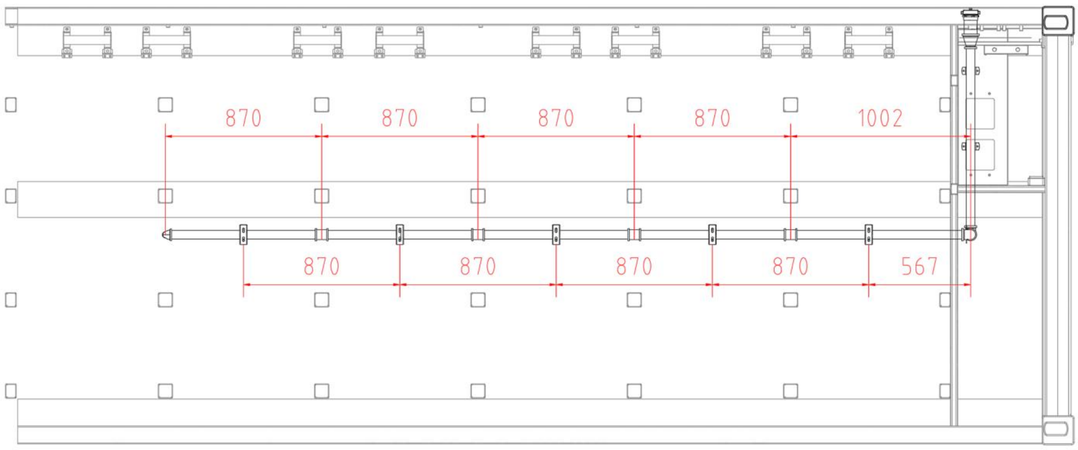
(2) Manual Control Strategy: When a gas detector triggers a first-level alarm signal and the ventilation system does not start, on-site personnel should

immediately press the emergency start switch to force the ventilation system to operate. If the gas alarm signal persists, the ventilation system should remain running, and the emergency stop switch should not be pressed.

3.4.3 Fire Water Sprinkler System

Each compartment should be equipped with a compartment-level water sprinkler network. In the event of a fire, the fire water pipe can be connected to a standard quick connector to supply water to the container.

The container's bottom is reserved with a DN65 North American standard threaded water fire interface (with a plug), compatible with North American fire water interfaces. The main supply pipeline should use galvanized steel pipes connected by threads. The sprinkler heads are pendant-type open sprinklers, with 5 units installed. The water sprinkler layout is as follows:



3.5 Battery Management System (BMS)

The Battery Management System (BMS) consists of three main components: Battery Stack Management Unit (BSMU), Battery Cluster Management Unit

(BCMU), and Battery Management Unit (BMU). Each component plays a critical role in monitoring, managing, and protecting the battery system.

3.5.1 Components and Functions

(1) Battery Stack Management Unit (BSMU)

- Collects and processes data such as voltage, current, and temperature from the battery stack, clusters, and modules.
- Calculates key parameters including State of Charge (SOC), State of Health (SOH), available charge/discharge capacity, and system alarm/protection status.
- Executes scheduling strategies, temperature control strategies, and balancing schemes based on collected data and calculations.
- Logs important operations, alarms, and protection events.Records real-time operational information of the battery stack during system operation.
- Communicates with the Energy Management System (EMS) and uploads data to cloud platforms or ESS management platforms.

(2) **Battery Cluster Management Unit (BCMU)**

- Collects and processes data such as voltage, current, and temperature from the battery cluster and its modules.
- Calculates cluster-level parameters including SOC, SOH, available charge/discharge capacity, and cluster alarm/protection status.
- Sends collected data and calculation results to the BSMU.
- Logs important operations, alarms, and protection events.Records real-time operational information of the battery cluster during system operation.
- Executes scheduling and control commands issued by the BSMU

(3) **Battery Management Unit (BMU)**

- Collects data such as cell voltage, temperature, balancing voltage, balancing current, total string voltage, pressure data, and fan speed.
- Calculates battery characteristics, alarm status, and protection status.
- Logs important operational data and events during the battery pack's operation.
- Executes temperature control and balancing strategies issued by the BCMU (Battery Cluster Management System).
- Reports battery-related data to the BCMU.

The communication topology of the BMS is illustrated in **Figure 3.6-1**. The hierarchical structure ensures efficient data flow and control between the BMU, BCMU, and BSMU, as well as external systems such as the EMS and cloud platforms

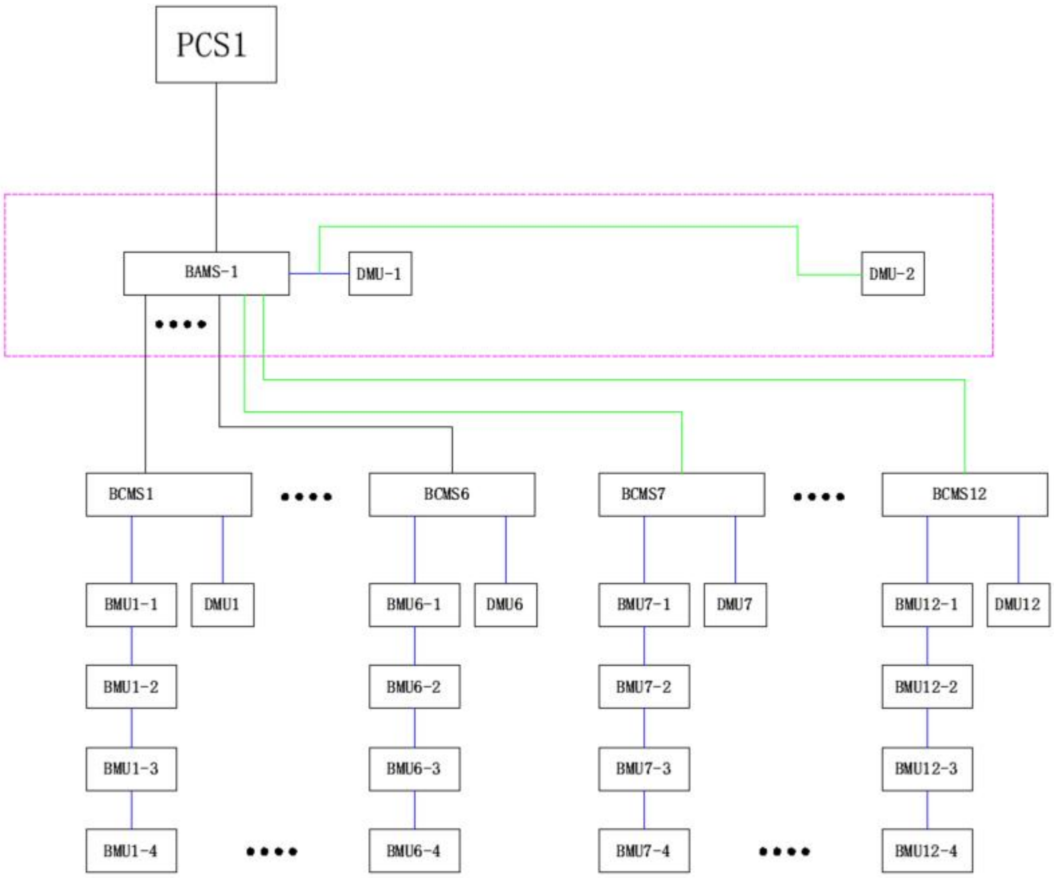


Figure 3.6-1 The communication topology of the BMS

4 Product maintenance

1.In order to ensure the safety of maintenance or over haul personnel, before maintenance or overhaul, it is necessary to ensure that the system is shut down, the power supply of all parts has been disconnected, and the necessary short circuit and grounding are carried out, and the necessary maintenance signs are placed to avoid other personnel to power on the system during maintenance

2.In order to ensure the continuous normal operation of the energy storage equipment and the service life of the equipment, it is necessary to frequently maintain the equipment.

(1) The installation and storage of the internal components of the container should avoid highly corrosive and dusty environments, and stay away from flammable and explosive gases.

(2) Regularly check Whether the wiring and terminals are aging, and whether the connection points are tight and safe.

(3) Clean the fan regularly and check Whether the fan can operate normally.

(4) Before maintenance, the power supply should be completely cut off before operation.

(5) When disassembling the operation, attention should be paid to the operation after the battery discharge is completed.

(6)Regularly maintain the liquid cooling system and replenish the coolant periodically

Note: Refer to the Operations and Maintenance manual for more details.