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|  | Guangdong Longweixin<br>Electric Technology Co.,<br>LTD | document number   |               |
|   |   | version number    | A<br>02       |
|   | 261kWh energy storage outdoor cabinet                   | availability date | 2024/9/<br>20 |

## 261kWh Energy Storage Outdoor Cabinet

### Specification

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# 1. Product Presentation

## 1.1. Overview

The 261kWh outdoor energy storage cabinet developed by our company, as a new generation of industrial and commercial energy storage solution, fully integrates advanced technologies such as "high efficiency, high safety, long life and easy expansion", forming a modular, standardized and intelligent outdoor energy storage system.

The energy storage adopts the design concept of "safe and reliable", and the components are self-developed or adopted by first-line suppliers, so as to provide customers with safe and reliable, affordable, high-quality, easy to install and expand, simple and easy to use energy storage products, so that the construction of energy storage projects is simpler, the use is more concise, and the operation and maintenance is easier.



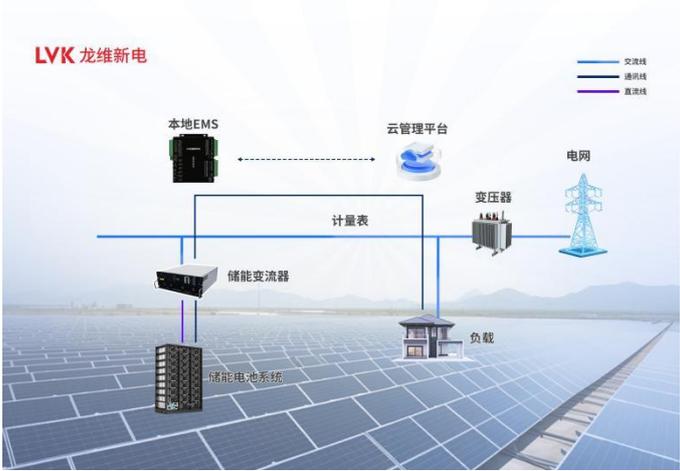
Figure 1-1 Schematic Diagram of 261kWh Outdoor Energy Storage Cabinet

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Figure 1-2: 261kWh Energy Storage Outdoor Cabinet Parallel Topology (battery-PCS-Grid-Connected Cabinet)

## 1.2 Product Application Scenario 1

|            |                                |  |
|------------|--------------------------------|--|
|            | Application scenario name      | User-side energy storage   |
| <b>场景一</b> | Schematic diagram illustration |    |
|            | Key features                   | <p>User-side energy storage systems primarily charge during off-peak or flat-rate electricity periods while discharging during peak demand periods, thereby capturing differential revenue through load leveling. These systems can also manage peak electricity demand by eliminating short-term surges, reducing users' basic electricity costs. Additionally, they provide backup</p> |

|  |  |  |
|--|--|--|
|  |  | power during peak usage periods and support dynamic capacity expansion capabilities. |
|--|--|--|

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|            |                           |  |
|------------|---------------------------|--|
| Scenario 2 | Application scenario name | Light storage and charging   |
|            | Schematic diagram display |   |
|            | Key features              | <p>Due to the significant short-term capacity expansion pressure on urban distribution networks, insufficient power supply has led to operational difficulties at some charging stations, resulting in limited revenue. In the integrated photovoltaic-storage-charging system, energy storage can absorb excess solar power or charge during off-peak electricity periods while discharging during peak demand hours. This mechanism effectively alleviates grid capacity constraints and enhances operational profitability for charging stations.</p> |
| Scenario 3 | Application scenario name | Backup power supply function (single machine 125kW/261kWh)   |
|            | Schematic diagram display |    |
|            | Key features              | <p>In industrial and commercial enterprises, STS modules can be selected</p>   |

|               |                                 |   |
|---------------|---------------------------------|---|
|               |                                 | to improve the power supply reliability in places with high requirements for power reliability. When the mains power is cut off, the power supply is switched to energy storage, and the switching time of STS is less than 20ms. |
| Scenario<br>4 | Application<br>scenario<br>name | Microgrid   |

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|                           |   |
|---------------------------|---|
| Schematic diagram display |   |
| Key features              | <p>For remote areas with unstable or no mains power access, the energy storage system can be combined with other distributed power sources to form a small micro-grid to ensure power supply.</p> |

## 1.3 Product Features

### 1.3.1 Product Capacity

The capacity of outdoor energy storage cabinet is 125kW/261kWh (0.5P). The outdoor cabinet can be freely expanded and matched according to user needs, and supports up to

Expand 10 units with capacity range of 125~ 1250kW/261kWh~ 2610kWh to meet the needs of energy storage projects of different sizes.

### 1.3.2 Product Formation

The outdoor energy storage cabinet integrates seven core systems, which can provide stable and reliable performance under different application scenarios and environmental conditions. The core systems are introduced as follows:

- 1) Energy storage battery system-----for the storage and release of electricity;
- 2) Battery management system BMS-----for battery data collection, status monitoring and control protection;
- 3) Energy management system EMS-----configure power management strategy, monitoring, control and power flow;
- 4) Fire safety system-----to provide effective means for fire safety protection;
- 5) Energy storage converter system PCS--two-way current conversion

between battery DC and grid AC;

6) Fluidic cooling system----provides efficient temperature control for the cell;

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7) The electrical system provides reliable power supply, lighting, grounding and other functions for the cabinet equipment.

### 1.3.3 Product Advantages

The main advantages of this series of products are as follows:

1) Using lithium iron phosphate polymer cell with high safety, high energy density and long cycle life, it can adapt to various application scenarios of 0.5P rate;

2) The high efficiency liquid cooling scheme is adopted to effectively optimize the temperature difference between batteries and improve the cycle life of batteries;

3) Adopt the active safety fire protection scheme, and configure the PACK grade D single package water injection fire extinguishing system, which can detect, alarm and put out the fire in time and effectively, so as to firmly guard the lifeline of product safety;

4) The modular and standardized design scheme makes the single outdoor cabinet have small footprint, convenient transportation and installation, and high adaptability on the installation site. The outdoor cabinet is easy to expand, with 1 to 10 units (261kWh~2610kWh) expandable per group, and can be configured with multiple outdoor cabinets according to project requirements.

5) The parallel connection scheme on the AC side can fundamentally eliminate the circulating current between batteries and further improve the battery life.

6) Adopting intelligent design ideas, it has cloud remote operation and maintenance function, full life cycle system maintenance, and can predict the impact of operating conditions on battery SOC and SOE. Continuous iterative control strategy is selected to make the system run in the best state at all times, reducing the loss of battery performance and life.

7) Adopt the active system safety design idea, 24/7 cloud real-time monitoring, predict safety risks in advance, issue safety warnings in advance, and provide timely and effective protection when faults occur.

8) The outdoor cabinet has multiple protective functions such as "anti-corrosion, fireproof, waterproof, dustproof, shockproof and uv protection", and the structural strength and space can provide favorable protection for the stable operation of the energy storage battery system.

9) Users can choose to equip the STS module according to their needs. After the optional equipment, the outdoor cabinet has the function of backup power supply, which improves the power supply capability of important places.

10) Users can choose to equip photovoltaic MPPT module according to their needs. After selection, the outdoor cabinet has photovoltaic DC coupling function, which can store photovoltaic power into the energy storage cabinet.

11) Users can choose the photovoltaic energy storage dynamic adjustm-

ent system according to their needs to maximize the value of photovoltaic power generation.

#### 1.3.4 Internal Layout

In order to improve system security, reduce the chance of equipment misoperation, reduce fire safety risks, save operating costs,

To ensure long-term stable operation of outdoor energy storage cabinets, the system consists of two compartments: the equipment compartment and the battery compartment, separated by high-grade thermal insulation and flame-retardant materials. The equipment compartment houses liquid-cooled units and PCS (Power Control System) devices, while the battery compartment primarily contains battery systems. Both compartments are categorized into three functional zones: "Temperature Control", "Fire Safety", and "Functional Operations".

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Table 1-1: Outdoor Cabinet Functional Division Description

| Name of cabin       | Major installations                       | fire safety  | Functioning  | temperature control                 |
|---------------------|---|--|--|-------------------------------------|
| equipment bay       | Name: PCS, liquid cooling unit            | External configuration water injection system                            | On-site operation, fault maintenance               | Liquid cooling, natural air cooling |
| Battery compartment | Name: Battery pack, high voltage box, EMS | Active fire fighting, PACK grade aerosol + water injection fire fighting | System control, local operation, fault maintenance | liquid cooling                      |

## 1.4 Product Configuration List

The main equipment configuration of a single energy storage outdoor cabinet is as follows:

| order number | systematic name           | Name of main equipment   |   | unit       | quantity |
|--------------|---------------------------|--------------------------|---|------------|----------|
| 1            | Battery system            | 52kWh battery pack       | Using 3.2V/314Ah lithium iron phosphate cell  | individual | 5        |
| 2            | Battery management system | Control module           | Each battery pack is configured with one slave control  | individual | 5        |
| 3            |                           | Master Module            | One main controller is configured for every five battery packs                                  | individual | 1        |
| 4            | Electrical box            | high-voltage compartment | Each outdoor cabinet is equipped with one high voltage box                                      | individual | 1        |
| 6            | AC/DC converter system    | PCS                      |   | cover      | 1        |
| 7            | energy management system  | EMS                      | Supports peak and valley filling, demand control and other functions, which are only configured | cover      | 1        |

|    |                            |                            |  |       |   |
|----|----------------------------|----------------------------|--|-------|---|
|    |                            |                            | red in the main cabinet.   |       |   |
| 8  | fire extinguisher system   | /                          | PACK Classed water injection fire or aerosol fire suppression system | cover | 1 |
| 9  | Fluid cooling system       | Refrigeration capacity 8kW | Cold plate, liquid cooling and so on                                 | cover | 1 |
| 10 | Electrical support systems | /                          | Low voltage electrical appliances, DC, grounding, lines and so on    | tower | 1 |
| 11 | Cabinet                    | /                          | Cabinet sheet metal structure and its installation accessories.      | cover | 1 |
| 12 | Photovoltaic MPMT module   | 120kW                      | Select the configuration according to the actual situation           |       |   |
| 13 | Photovoltaic inverter      | Power self-distribution    | Select the configuration according to the actual situation           |       |   |

Note: The equipment name/specification and corresponding quantity are subject to the actual supply.

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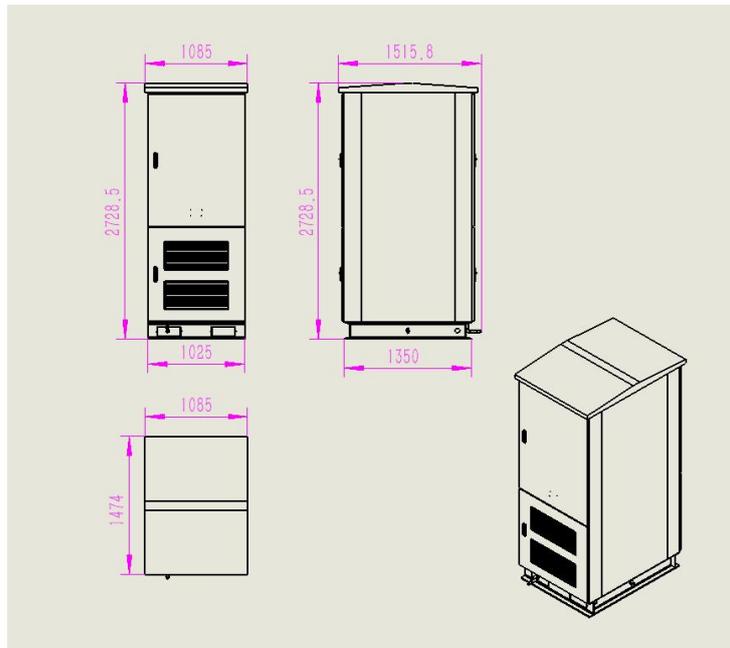
## 1.5 Product Specifications

|  |  |
|--|--|
| System parameter                               |  |
| Single outdoor cabinet capacity                | 125kW/261kWh   |
| Maximum number of parallel machines per group  | 10 tower   |
| Maximum parallel processing capacity per group | 1250kW/2610kWh   |
| Discharge operating temperature                | -15°C~45°C   |
| Stable charging                                | 0°C~45°C   |
| Storage temperature (°C)                       | Within one month: -20°C ~45°C  |
|  | Within six months: 0°C~35°C  |
| noise  | <75db  |
| Cooling-down method                            | Liquid cooling   |
| Cycle index                                    | 8,000 times @25°C,0.5P, 70%EOL   |
|  | 4200 times @25°C,0.5P, 80%EOL  |
| Fire extinguisher system                       | Active fire prevention: Pack-level aerosol fire suppression with water injection |
| Sensor type                                    | Temperature sensing, combustible gas   |
| Reference dimensions (width*depth*height mm)   | 1085*1515.8*2708.5mm   |
| Weight ( T )                                   | 2.5  |
| Corrosion resistance                           | C3/C4/C5 (optional)  |
| Levels of protection                           | Battery compartment: IP54  |
|  | Equipment compartment: IP54  |
| Allow relative humidity                        | 0~95%  |
| Allow altitude                                 | ≤4000m (over 2000m, reduced capacity)  |
| System effectiveness                           | 85%  |
| Communicating protocol                         | Modbus TCP/RTU   |
| System operation mode                          | Peak shaving and valley filling  |
|  | Demand control   |
|  | Dynamic expansion  |
|  | Photovoltaic storage   |
|  | Anti-Backflow  |



|            |  |                   |               |
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|                                      |                               |
|--------------------------------------|-------------------------------|
| attestation                          | <b>Battery: GB/T 36276</b>    |
|                                      | BMS:GB/T 34131                |
|                                      | PCS:GB/T 34120                |
| <b>Communication side parameters</b> |                               |
| Rated AC power (KVA)                 | 125                           |
| AC overloads (KVA)                   | 137.5                         |
| mode of connection                   | <b>Three phase four wire</b>  |
| Allowable grid voltage range (V. ac) | 400 (-5%~5%)                  |
| Allowable grid frequency range (Hz)  | 50/60 (-2.5~2.5)              |
| power factor                         | -0.99~0.99                    |
| Maximum conversion efficiency        | ≥98%                          |
| cooling-down method                  | <b>liqukd cooling</b>         |
| Unbalanced load capacity             | 100%                          |
| <b>DC side parameters</b>            |                               |
| Battery type                         | <b>lithium iron phosphate</b> |
| compound mode                        | 1P260S                        |
| Rated capacity (Ah)                  | 314                           |
| Rated energy (kWh)                   | 261                           |
| rated voltage ( V )                  | 832                           |
| Rated charge/discharge ratio         | 0.5P                          |
| Operating voltage range (V)          | 676~936                       |



Outdoor Cabinet Size Diagram

|   |   |                   |               |
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## 2. Core System Introduction

### 2.1 Energy storage battery system

The grouping of the energy storage battery system in the prefabricated cabin is as follows:

Table 2-1 Battery System Grouping

| order number | top class                          | 261kwh energy storage outdoor cabinet |
|--------------|------------------------------------|---------------------------------------|
| 1            | Connected in parallel groups       | 1P260S                                |
| 2            | Number of cells (pieces)           | 260                                   |
| 3            | Number of battery packs (pcs)      | 5                                     |
| 4            | Number of battery clusters (pcs)   | 1                                     |
| 5            | Number of high-voltage boxes (pcs) | 1                                     |

Note: In the group form, "S" represents series and "P" represents parallel.

#### 2.1.1 Energy storage cells

This product utilizes a long-life 3.2V/314Ah lithium iron phosphate polymer cell, featuring high safety, high energy density, and extended cycle life at low cost. The cell has passed third-party certification testing conducted by authoritative institutions in accordance with the GB/T 36276-2018 standard. The basic parameters of the battery and core components are as follows:

Table 2-2 Basic Parameters of 314Ah Cell

| order number | **                  | specifications | remarks                            |
|--------------|---------------------|----------------|------------------------------------|
| 1            | Type of cell        | LF<br>P        | L<br>F<br>P                        |
| 2            | Cell weight (kg)    | 5.6 ±<br>0.15  | After the Blue Band                |
| 3            | rated capacity (Ah) | 314            | 25°C Standard charge and discharge |
| 4            | Nominal energy (Wh) | 1004.8Wh       |                                    |

|   |                                 |      |  |
|---|---------------------------------|------|--|
| 5 | rated voltage<br>( V )          | 3.2  |  |
| 6 | Charging limit volt-<br>age (V) | 3.6  |  |
| 7 | Release limit volt-<br>age (V)  | 2.6  |  |
| 8 | Rated charging<br>power         | 0.5P |  |

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| order<br>number | 项目   | specificat-<br>ions | rem-<br>arks               |
|-----------------|--|---------------------|----------------------------|
| 9               | Maximum charging po-<br>wer                    | <sup>0.5</sup><br>P |                            |
| 10              | Rated discharge po-<br>wer                     | <sup>0.5</sup><br>P |                            |
| 11              | Maximum discharge po-<br>wer                   | <sup>0.5</sup><br>P |                            |
| 12              | cycle index                                    | ≥8,000<br>times     | @25℃,0.5P/0.5P, EOL<br>70% |
| 13              | Internal resistance of co-<br>mmunication (mΩ) | ≤<br>0.18           |                            |

### 2.1.2 battery pack

The liquid-cooled battery pack used in this product is independently developed, designed and manufactured by our company. Its internal components are mainly composed of cells, copper connecting bars, box liquid cooling plates, collection communication wire bundles, BMS and other components.

Each battery pack is arranged with 52 voltage collection points and 28 temperature collection points inside, which are connected to the BMU through the wire harness. The outdoor cabinet can accurately evaluate the state of the cell, and reduce the probability of safety accidents by the temperature difference in the battery pack.

#### 1) Battery pack parameter table

Table 2-4 Battery Pack Parameters

| order nu-<br>mber | 项目                           | param-<br>eter | rema-<br>rks                     |
|-------------------|------------------------------|----------------|----------------------------------|
| 1                 | burst<br>mode                | 1P52S          |                                  |
| 2                 | Rated energy<br>(kWh)        | 5<br>2         |                                  |
| 3                 | rated voltage<br>(V)         | 166            |                                  |
| 4                 | Working voltage range<br>(V) | 135~1187       | Single cell voltage<br>2.6 ~ 3.6 |
| 5                 | power rating                 | 5              |                                  |

|    |                                    |                        |  |
|----|------------------------------------|------------------------|--|
|    | ( kW )                             | z                      |  |
| 6  | Charging temperature range (°C)    | 0<br>~<br>4<br>5       |  |
| 7  | Discharge temperature range (°C)   | -<br>15~<br>45         |  |
| 8  | Recommended temperature range (°C) | 28<br>±3               |  |
| 9  | levels of protection               | IP<br>67               |  |
| 10 | Heat management methods            | liquid cooling         |  |
| 11 | communication mode                 | C<br>A<br>N            |  |
| 12 | Size (W*D*H, mm)                   | 1085*1515.8*<br>2708.5 |  |

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### 2.1.3 Battery clusters

The battery cluster is mainly composed of battery pack and high voltage box. Each battery pack is installed in the outdoor cabinet, and the modules are connected through DC power cable and BMU communication wire harness

The high-voltage box serves as the input and output window of the battery cluster's energy flow and information flow. It contains BMU main control, contactors, electrical appliances, fuses, pre-charging resistors, switching power supplies and other components, which can be configured and modified according to project requirements.

Each energy storage outdoor cabinet is arranged with 5 battery boxes and 1 high-voltage box in the battery compartment to form a battery cluster. The basic parameters of the battery cluster are as follows:

Table 2-5 Battery Cluster Parameters in the Battery Compartment

| order number | 项目                              | parameter                           |
|--------------|---------------------------------|-------------------------------------|
| 1            | Cell selection                  | 3. 2V/314AH                         |
| 2            | burst mode                      | 1P52S*5                             |
| 3            | rated voltage ( V )             | 832                                 |
| 4            | Working voltage range (V)       | 676~936                             |
| 5            | Rated energy (kWh)              | 261                                 |
| 6            | Rated charge/discharge ratio    | 0. 5P/0. 5P @25℃                    |
| 7            | Heat management methods         | liqukd cooling                      |
| 8            | Best cycle temperature (°C)     | 25                                  |
| 9            | Temperature control range (°C)  | ±3                                  |
| 10           | guard mode                      | Fuses, contactors, circuit breakers |
| 11           | BMS configure                   | BCU: 1                              |
|              |                                 | BMU: 5                              |
| 12           | High pressure box configuration | 1 tower                             |

## 2.2 Battery Management System

Battery management system is an important basis for the stable

operation of energy storage batteries. It has a variety of functions such as data collection, status monitoring, control and protection, which can realize comprehensive perception of battery state, early warning and accurate control.

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### 2.2.1 BMS Equipment Composition

The BMS of this product adopts a two-level architecture scheme, which has the characteristics of wide functional coverage, small size, strong anti-interference performance, safety and reliability. Each battery pack has one BMU (slave unit) built in, and each battery is equipped with one main control unit (BCU).

Table 2-6 Battery Management System Configuration Table

| order number | device name | Configuration notes                                     | function declaration  | installation site            |
|--------------|-------------|---|---|------------------------------|
| 1            | BMU         | From the control unit, each battery pack has 1 built in | Mainly responsible for the state parameter collection and monitoring of battery pack  | Inside the battery pack      |
| 2            | BCU         | Master control unit, one battery cluster is configured  | Mainly responsible for data monitoring, status calculation, charge and discharge management of single cluster battery system, and communication with other devices to realize system strategy | Inside the high pressure box |

### 2.2.2 Introduction to Main Functions of BMS

| order number | Function name  | order number | Function name                        |
|--------------|--|--------------|--------------------------------------|
| 1            | Battery voltage and temperature measurement function | 7            | Operation parameter setting function |
| 2            | Online SOC diagnosis                                 | 8            | Active equilibrium function          |
| 3            | Battery system protection function                   | 9            | memory function                      |
| 4            | Communication func-                                  | 10           | Battery state est-                   |

|   | tions   |    | imate                        |
|---|---|----|------------------------------|
| 5   | Thermal management functions                    | 11 | Time-sensitive functionality |
| 6   | Self-diagnostic and fault-tolerant capabilities | 12 | Fault trace function         |
| ... For more functional requirements, please contact us |   |    |                              |
|   |   |    |                              |

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### 2.2.3 BMS Communication Architecture

The communication architecture between BMS devices in this product is as follows:

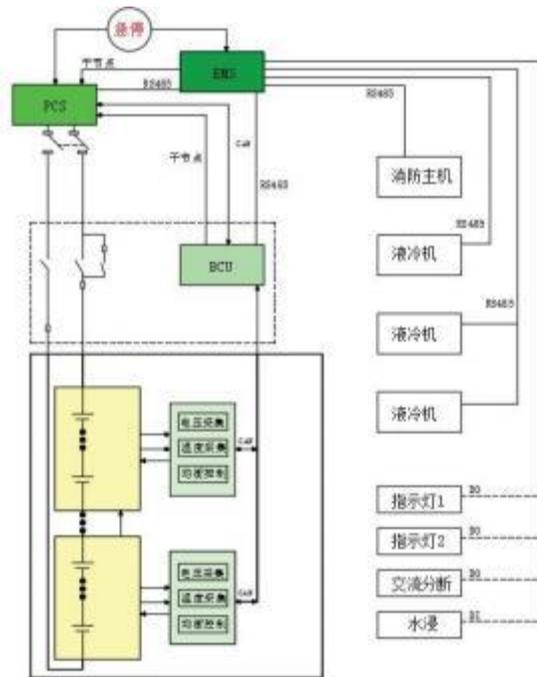


Figure 2-3 Schematic Diagram of BMS Communication Architecture

### 2.2.4 BMS Parameter

Table 2-6 BMS Parameter Table

| order number | device name                      | 项目                                 | parameter           |
|--------------|----------------------------------|------------------------------------|---------------------|
| 1            | B<br>M<br>U<br>Control unit      | Working voltage range              | 9~32<br>V           |
| 2            |                                  | Number of battery management units | 64 bunch<br>( Max ) |
| 3            |                                  | Balanced approach                  | Active equilibrium  |
| 4            |                                  | Voltage acquisition range          | 0~5<br>V            |
| 5            |                                  | Number of temperature measurements | -40~<br>125℃        |
| 6            | B<br>C<br>U<br>main control unit | Working voltage range              | 9~32<br>V           |
| 7            |                                  | SOC accuracy                       | ±<br>5%             |
| 8            |                                  | SOH accuracy                       | ±                   |

|    |  |                              |            |
|----|--|------------------------------|------------|
|    |  | Accuracy                     | 8%         |
| 9  |  | Voltage acquisition range    | 0~1000 V   |
| 10 |  | Current acquisition range    | -261~261 A |
| 11 |  | Temperature collection range | -40~125°C  |
| 12 |  | Communication interface type | CAN\RS485  |

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## 2.3 energy management system

The Energy Management System (EMS) is designed to monitor, control, and optimize energy flow and consumption within power systems. By leveraging data acquisition, analysis, and decision support technologies, it enables real-time monitoring of equipment performance, energy usage patterns, and environmental conditions, thereby achieving efficient energy management and operational optimization.

### 2.3.1 Energy scheduling and control strategy

The energy storage outdoor cabinet energy management system has peak shaving and valley filling, demand control, dynamic expansion, light storage and charging application, storage and charging application, anti-flow control and other control strategies.

### 2.3.2 Major Function

(1) Data monitoring and collection: The energy management system can monitor the generation, storage and consumption of energy in outdoor cabinets in real time; in addition, it can collect data from BMS, PCS, power environment system and other equipment, including battery charge and discharge status, temperature, voltage, current, etc.

(2) Data Analysis and Optimization: Energy management systems utilize advanced data analytics to process and analyze collected system data, enabling comprehensive understanding of operational status and performance metrics. Through systematic data analysis, potential issues within the energy system can be identified, allowing for optimization recommendations such as adjusting charging/discharging strategies and improving energy utilization efficiency.

(3) Energy Scheduling and Control: The Energy Management System intelligently coordinates energy distribution based on real-time demand and system status. By analyzing demand forecasts, electricity pricing trends, grid load patterns, solar PV output levels, and charging station availability, it optimally manages the charging/discharging cycles of energy storage facilities.

(4) Fault Detection and Safety Protection: The energy management system promptly identifies and alerts for faults in energy storage facilities, such as battery overloads, overcharging, or abnormal temperatures, ensuring safe operation. Additionally, it integrates with the power distribution network to enable remote monitoring and protection of these systems.

(5) Cloud remote operation and maintenance: The energy management system will collect the operation and fault data of the equipment and upload it to the cloud, which can accurately predict and locate faults remotely, greatly reducing the operation and maintenance work of engineers.

(6) Operation benefit display: The energy management system can display the energy storage benefits and electricity information.

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### 2.3.3 EMS Communication Architecture Diagram



Figure 2-4 EMS Communication Architecture Diagram

## 2.4 Energy Storage Converter System

The outdoor energy storage cabinet is equipped with two 125kW Power Conversion Systems (PCS). These PCS units, designed to connect battery systems with the grid (and/or loads), enable bidirectional energy conversion by controlling battery charging/discharging cycles and performing AC/DC conversion. Featuring a three-phase four-bridge topology, the system provides single-phase and three-phase active/reactive power control capabilities, effectively addressing three-phase imbalance issues with precision.

### 2.4.1 Control Function

PCS can be combined with EMS to achieve peak and valley filling, demand control and other control functions.

### 2.4.2 Defensive Function

PCS can carry out real-time fault protection according to the voltage and frequency of the grid side and its own operating state. The protection functions include: power grid over/under voltage, power grid frequency over/under frequency, DC over/under voltage, AC overcurrent, DC overcurrent,

phase loss, anti-islanding and other protection functions.

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## 2.5 Fire safety system

This series of products employs an active fire safety strategy to disconnect high-voltage circuits before thermal runaway occurs, with real-time monitoring of cell temperature, voltage signals, and electrical circuits. Each outdoor energy storage cabinet operates as a protected zone with dual-layer protection: pack-level and cabinet-level safeguards. The pack-level protection system uses integrated dual-sensor detectors installed within each battery pack to monitor combustible gas concentrations and temperatures. Each battery pack is equipped with an electromagnetic valve and a pack-level nozzle. These integrated sensors are electrically connected to the cabinet's non-pressure-based fire suppression system, which relays control commands to the electromagnetic valves. The fire suppression system's outlet connects to the electromagnetic valves via high-pressure hoses and quick-connect fittings. When thermal runaway occurs in a battery pack, the integrated sensors transmit alarm signals to the system, activating its water injection or aerosol suppression mechanisms. Water or mist extinguishing agents are then directly delivered to the affected battery pack through quick-connect pipelines and nozzle arrays.

The cabinet-level protection system employs passive fire suppression technology, integrating a non-pressurized water injection system with temperature-sensing magnetically activated components. When the internal cabinet temperature exceeds the activation threshold of the magnetically activated components, the system initiates pulse currents to activate either the non-pressurized water injection system or aerosol fire suppression equipment. This provides full immersion protection for energy storage cabinets while simultaneously transmitting activation signals to the cabinet-mounted non-pressurized fire suppression system.

### 2.5.1 Major Equipment

#### (1) Composite fire detector

**Function:** It integrates carbon monoxide and temperature into one set, and monitors and analyzes the thermal runaway characteristics of batteries in energy storage cabinets.

**Installation location:** one composite fire detector is arranged in each battery pack, which is connected to the cabinet-type energy storage non-

storage pressure fire extinguishing device by CAN bus communication

(2) Cabinet energy storage non-pressure fire extinguishing device

Function: Control and fire extinguishing integrated design, is the data processing center and fire suppression main body of the entire fire extinguishing system. On the one hand, it communicates with fire detectors through CAN communication; on the other hand, it has built-in fire extinguishing agent bottles. At the same time, the controller in the device also has functions such as fire detector fault detection and alarm signal output.

Installation position: in the outdoor energy storage cabinet.

3) Packaging grade water injection system or aerosol nozzle

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A pack-level water injection system nozzle is arranged on each battery pack (installation holes need to be reserved in advance on the battery pack), and connected to the solenoid valve through TFEE hose and quick connector, and then connected to the agent outlet of the cabinet-type energy storage non-storage pressure fire extinguishing device.

( 4 ) electromagnetic valve

Function: Receive the command of the control host, open the detector, and realize the single package injection of fire extinguishing agent for the thermal runaway battery pack

Installation position: one solenoid valve is arranged on the outer side panel of each battery pack.

## 2.5.2 Program Logic Control

(1) Level 1 alarm:

The concentration of carbon dioxide is 190ppm

Execution action: The detector increases the sampling frequency and focuses on monitoring the battery pack with high gas concentration.

(2) Level II alert

-When the carbon monoxide concentration is greater than or equal to 890ppm or the temperature rise is greater than or equal to 1°C/s for 10 seconds, the controller uploads the secondary alarm information through RS 485.

( 3) Level 3 alert

When the carbon monoxide exceeds 1261ppm and (temperature  $\geq 65^{\circ}\text{C}$  or temperature rise greater than 1°C/8 for 10 seconds), the controller opens the fire extinguishing agent bottle, and the fire extinguishing agent is applied to the battery pack through the pipeline and nozzle. The controller performs the action: RS485 upload the three-level alarm information.

## 2.6 Fluid cooling system

### 2.6.1 Fluid Cooling System

The liquid cooling system is composed of a liquid cooling unit and supporting pipelines. When the temperature of the cell is too high or too low, the heat exchange between the coolant circulation and the battery system is used to achieve the optimal working temperature condition of the battery pack.

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## 2.7 Electrical System

The outdoor energy storage cabinet provides a unified primary and secondary interface, which can realize the standardization of power grid connection, communication and debugging work, improve the efficiency of electrical construction of products and reduce the risk of construction.

The outdoor energy storage cabinet is powered by mains power and DC power. The mains power mainly supplies power to non-important loads in the cabin, such as chiller, cooling fan, etc.; the DC power mainly supplies power to important equipment in the cabin, such as BMS, fire protection, EMS, etc.

## 2.8 Circulation System

The outdoor energy storage cabinet is equipped with temperature and humidity sensors as well as water intrusion sensors inside. When high humidity is detected in the cabinet, it will activate to maintain low humidity levels in the battery compartment. When abnormal temperature or water intrusion is detected, alarm signals will be generated to promptly notify maintenance personnel for handling.

# 3. Matters Need Attention

- (1) Do not immerse the product in water.
- (2), The product is not used and stored correctly, there are risks of fire, explosion and burn, do not disassemble, crush, burn and heat the product.
- (3) Do not put the product in fire or expose it to high temperature conditions exceeding those specified in this specification for a long time, otherwise it may cause fire.
- (4) Keep the product out of reach of children, do not remove the original packaging before use, and dispose of used products in accordance with local recycling or waste regulations.
- (5) Do not disassemble, remove or repair the product in any way without authorization.
- (6) Do not mix products of different brands.
- (7) If the product is emitting odor, heat, deformation, discoloration or any other abnormal phenomenon, do not use it and move it to a safe place.
- (8), It is strictly prohibited to use plastic for electrical connection. Incorrect electrical connection may cause overheating of the product during use.

(9) The product must be protected during use from mechanical vibrations, impacts, and pressure shocks to prevent internal short circuits that could cause high temperatures and fires. As the product carries potential hazards, proper safety measures must be implemented during operation and maintenance. Failure to comply may result in serious personal injury or property damage. Non-compliance with these warnings could lead to multiple catastrophic consequences.