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7.92MW/45MWh Na-ion battery energy storage system product design program

Parasol Elite Power

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Energy Storage Battery System Design Solution

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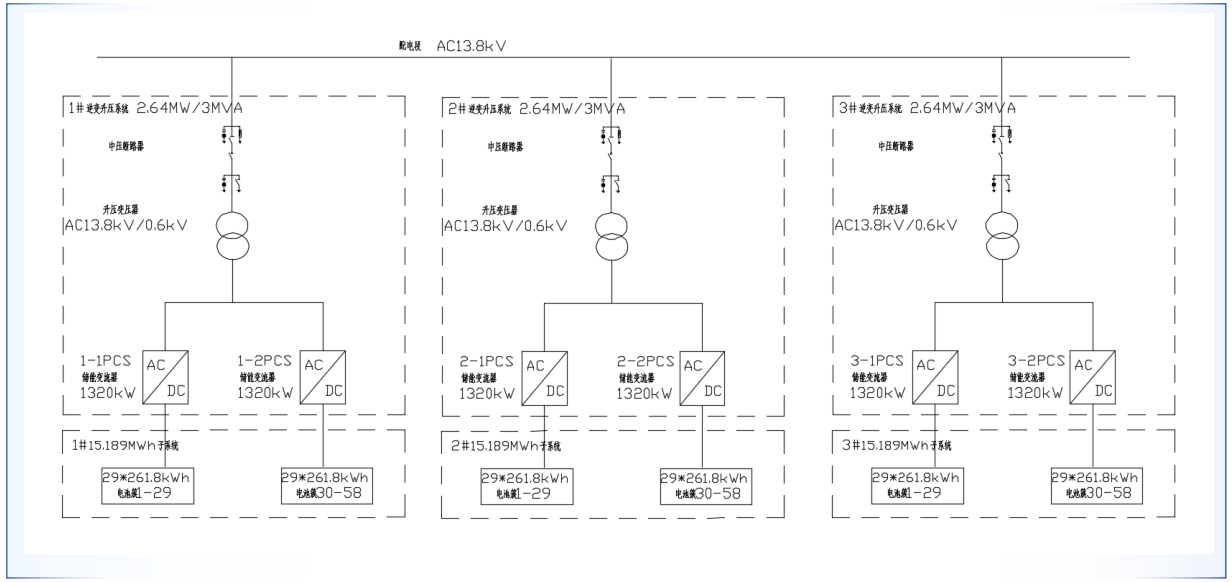
The Na-ion battery energy storage system boasts a total capacity of 7.92MW/45MWh, structured around three sets of energy storage subsystems, each providing 2.64MW/15.189MWh. Each of these subsystems includes a 2640kW PCS, a 3MVA step-up transformer, high-voltage switchgear, and a 15.189MWh battery system.

Within the 2.64MW/15.189MWh battery energy storage sub-system, two independent battery stacks are incorporated. This design enables continuous power supply even during maintenance or shutdown of one of the battery stacks, ensuring uninterrupted functionality and operational resilience.

Electrical topology diagram of 7.92MW/45MWh energy storage system



Energy Storage Battery System Design Solution

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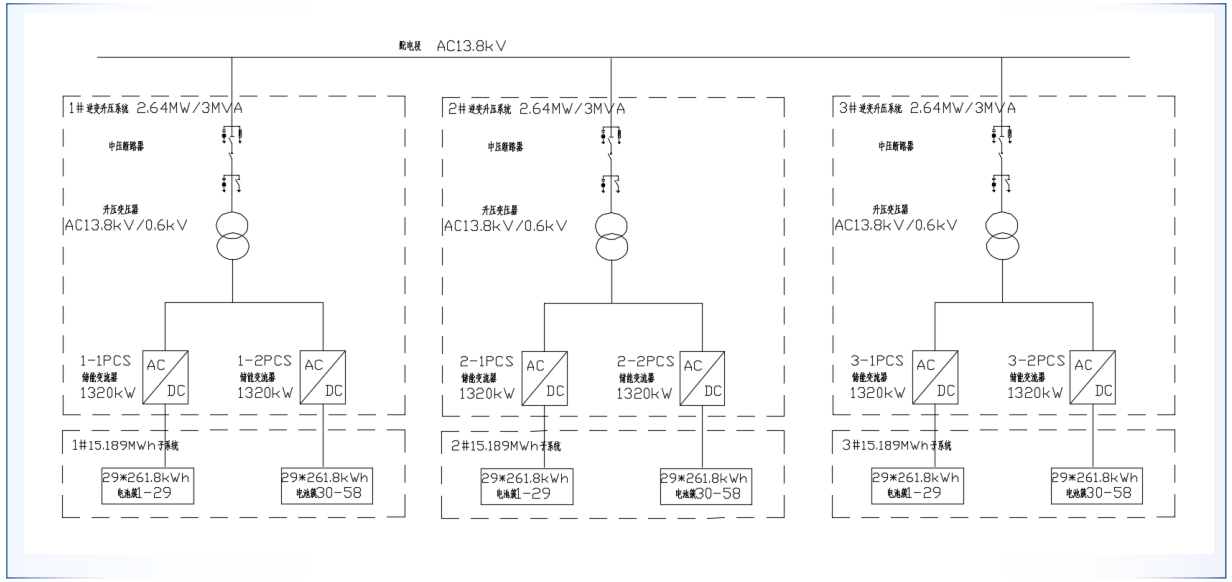
Na-ion batteries are connected in both series and parallel configurations to create a battery cluster. The DC output, falling within a specific voltage range, undergoes inversion to 600V AC through the energy storage converter. Subsequently, the energy storage system is elevated to a 13.8kV bus level by the step-up transformer.

The DC side configuration of the energy storage battery system comprises the Na-ion battery, connecting cables, automatic gas fire extinguishing system, liquid cooling unit, video monitoring equipment, communication system, and lighting and power distribution components within the energy storage system. These elements are strategically arranged indoors to optimize functionality and space utilization.

Electrical topology diagram of 7.92MW/45MWh energy storage system



Energy Storage Battery System Design Solution

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220AhCell-1500Vdc-liquid-cooled, contains 3 sets of 2.64MW-15.189MWh cell subsystems, product design solution:

Item Description	Unit Topology Reference Diagram	Rated Voltage (V)	Rated Capacity (Ah)	Electricity Storage (kWh)	Composition	Finished Solution
Cell		3.1	220	0.682		**1 set of 2640kW PCS (consisting of 2 sets of 1320kW PCS);** **1 set of energy storage subsystem; 2.64MW-15.189MWh** Including: battery system, battery management system, monitoring system, automatic fire-fighting system, liquid cooling unit, lighting system, etc., to ensure the safe and stable operation of the energy storage system.
Battery box ((incl. BMU)		148.8	220	32.736	1P48S Battery Module	
Battery Cluster (incl. BCU)		1190.4	220	261.888	1P384S, 8 battery boxes and 1 master box in series to form a battery cluster	
Energy Storage Battery Subsystem		1190.4	12760	15189	58 cell clusters 15.189 MWh battery subsystems	

Energy Storage Battery System Design Solution - Cell Selection

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220Ah

Nominal capacity	220Ah (0.5C@25±3℃)
Nominal Voltage	3.1V
Nominal Charge/Discharge Current	110A
Maximum Continuous Charge/Discharge Current	220
Operating Voltage	1.5-3.95V (extreme range) 2.0-3.9V (recommended range)
Battery Internal Resistance@1kHz	≤0.05mΩ
Weight	≤4.4±0.2Kg
Storage Temperature Range	-20~40℃
Maximum Continuous Discharge Rate	Charging 5~45℃; Discharging -20~60℃
Humidity	≤85
Battery Size	173.6×71.25×203.7mm

Energy Storage Battery System Design Solution -Battery Module

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The battery module adopts a 1P48S configuration, featuring a capacity of 32.736kWh (0.5C, 25±2℃) and a nominal voltage of 148.8 V. Integrated within the battery module is an acquisition module, known as BMU, responsible for collecting essential parameters such as module voltage and temperature. Additionally, the BMU is equipped with functions including equalization and intelligent temperature control.
The battery pack employs a laser-welded structure for its battery cells, ensuring a high level of safety and reliability in operation.

No.	Project	Specification	Comment
1	Combination Mode	1P48S	
2	Rated Capacity (Ah)	220	
3	Rated Energy (kWh)	32.736	
4	Nominal Voltage (V)	148.8	
5	Operating Voltage Range (V)	96～184.8(2.0V～3.85V)	
6	Rated Charge and Discharge Current	110A	0.5C
7	Dimension (W×D×H) mm	1118*780*255（±2）	
8	Weight (kg)	282±2	
9	Allowable Operating Ambient Temperature	5℃～45℃	
10	Temperature Difference Within Pack	≤3℃	
11	BMU Capture Line Out Method	Front outlet	
12	Insulation Standard	Battery box insulation resistance ≥1GΩ	Excluding wet weather
13	Voltage Resistance Standard	4000VDC, no breakdown phenomenon	Leakage current <10mA

Energy Storage Battery System Design Solution -Battery Cluster

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The battery cluster comprises 8 battery modules and 1 high-voltage box, featuring a nominal voltage of 1190.4 V, a capacity of 220 Ah, and a total electric capacity of 261.894 kWh. The arrangement of the battery cluster is back-to-back, allowing for top-side air intake and heat dissipation. Positioned at the bottom left of the battery cluster, the high-voltage box is strategically placed for ease of operation and maintenance. This modular design enables the parallel connection of multiple clusters to create energy storage systems with varying sizes and capacities.

No.	Project	Specification	Comment
1	Combination Mode	1P384S	@8 battery modules
2	Rated Capacity (Ah)	220	
3	Rated Energy (kWh)	261.894kWh	
4	Nominal Voltage (V)	1190.4	
5	Operating Voltage Range (V)	768 V～1478.4 V（Cell 2.0 V～3.85 V）	
6	Rated Charge and Discharge Current(A)	110	0.5C
7	Dimension (W×D×H) mm	1120×830×2400mm	
8	Weight (kg)	≤2560	
9	Temperature Difference Within Pack	≤5℃	
10	Composition	Battery Racks, Battery Insertion Boxes, BMS High Voltage Boxes	
11	Allowable Operating Ambient Temperature	5℃～45℃	
12	IP Level	IP20	
13	Insulation Standard	Meet the requirements of GB36558-2018	
14	Voltage Resistance Standard	4000VDC, no breakdown phenomenon	Leakage current <20mA

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02

Product Design Solutions for Power Energy Storage

Power Conversion System (PCS)

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Centralized solutions

The PCS and transformer are integrated with a ring cabinet to form the inverter-booster system. The system is equipped with 2640kW PCS, each set of 2640kW PCS contains 2 sets of 1500kW (downsized to 1320kW for use) Power Conversion System (PCS), 1 set of 3MVA step-up transformer, 1 ring network cabinet and 1 side of the power communication cabinet. Every 29 battery clusters in the energy storage system are converged and connected to the DC side of the corresponding 1 1320kW PCS, and the AC side of the PCS is boosted to 13.8kV by the step-up transformer. Circuit breaker + disconnecting switch or load switch + fuse solutions are available and can be selected by the customer.

DC Side Parameters	
DC voltage range	800-1500V
Maximum DC current	1870A
Quantity of battery branch circuits	1
AC Low Voltage Side Parameters	
Rated output power	1500kW
Maximum AC power	1650kW
Rated grid voltage	600V
Output THDi	＜3%
Grid-connected power factor	-1~+1
Communication Methods	
Display method	LCD touch screen
Upper computer communication method	ModbusTCP/IP, IEC61850, etc.

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03

Product Design Solutions for Power Energy Storage

- Energy Storage Battery System Design Solution
- Power Conversion System (PCS)
- **Battery Management System (BMS)**
- Energy Management System (EMS)
- Auxiliary System
- System Configuration Table

Battery Management System (BMS)

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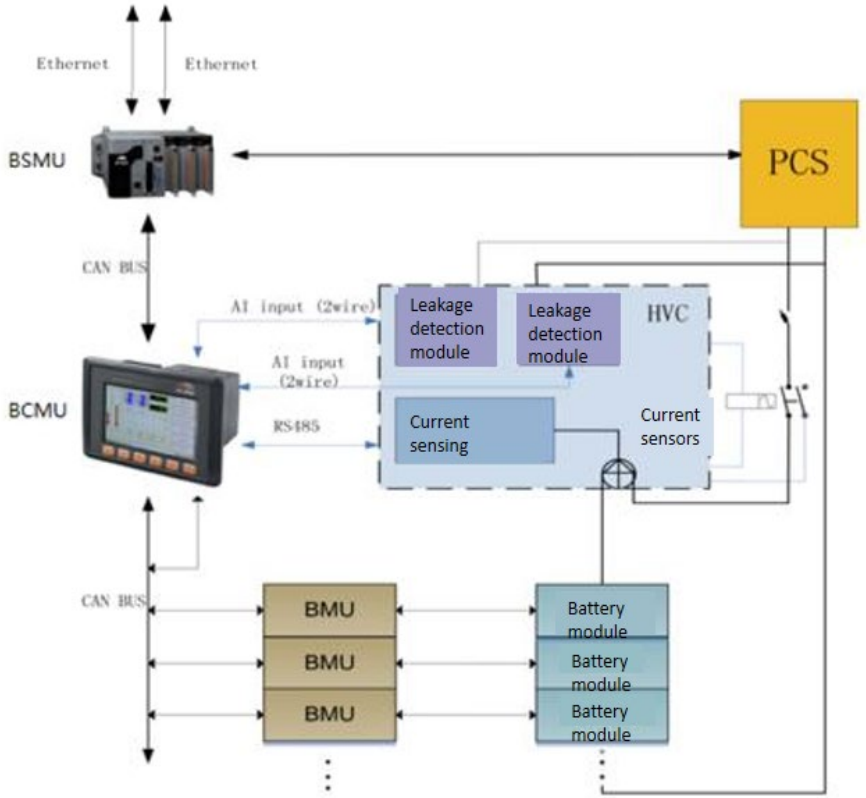
BMS three-level topology



BMS Main Parameter

No.	Project name	Technical parameters and indicators
1	Operating power supply	9~32V
2	Cell acquisition range	1.5~4.5V
3	Cell voltage acquisition error	≤±5mV
4	Current acquisition range	≤300A
5	Current acquisition accuracy	≤±0.5%
6	Temperature acquisition error	±1℃
7	Voltage acquisition cycle	100ms
8	Current acquisition cycle	≤50ms
9	Temperature acquisition cycle	≤1s
10	Equalization method	Passive equilibrium
11	SOC estimate	≤8%
12	Protection	Overcharge, over-discharge, over-temperature and other protections, and the protection value can be set
13	Communication with PCS	CAN/RS485
14	Communication method with background monitoring	TCP/IP
15	Event record storage	≥10000 messages
16	Historical data storage	≥30 Days

Battery Management System (BMS)

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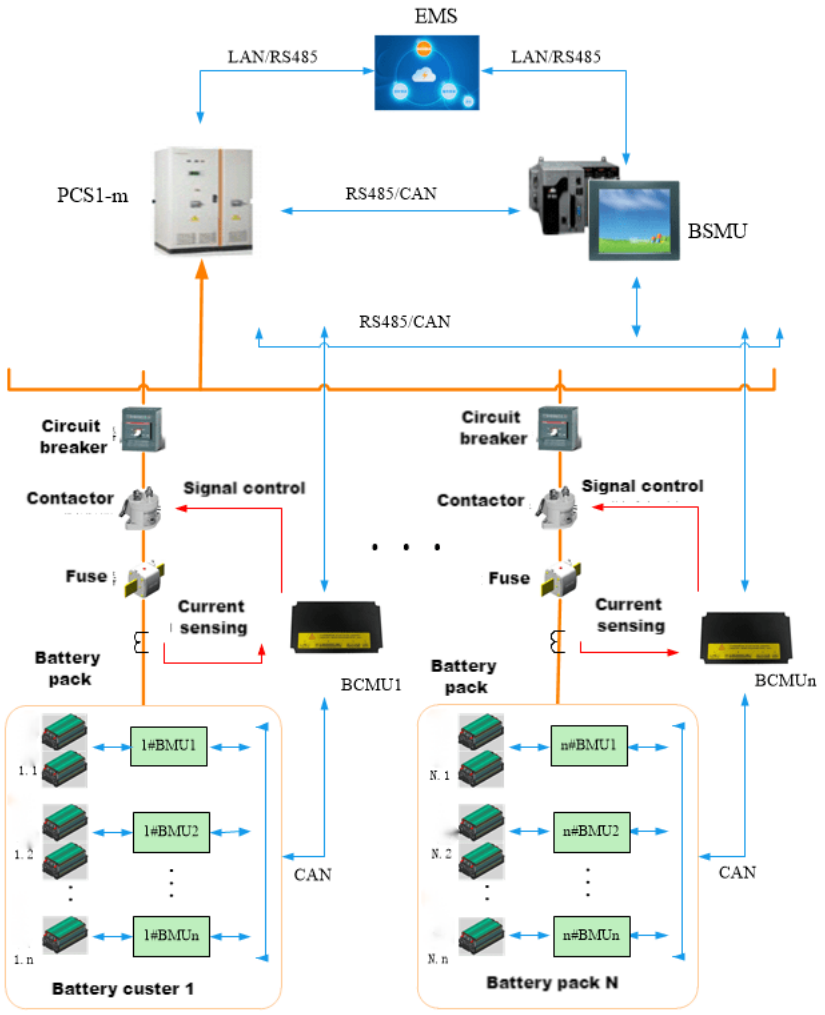
Function: Battery management system consists of BMU (battery management unit), BCU (battery cluster management unit), BAU (battery array unit) and high-voltage control box. The BMS system uses analog signal high-precision detection and reporting, fault alarm, uploading and storing, battery protection, parameter setting, passive equalization, SOC calibration of battery packs, and information interaction with other equipment in the system.

- Analog Measurement
- Passive equalization
- Battery system operation alarms
- Battery system protection
- Self-diagnostic function
- Setting of operating parameters
- Local operation status
- display
- Event and historical data logging
- Communication functions



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Product Design Solutions for Power Energy Storage

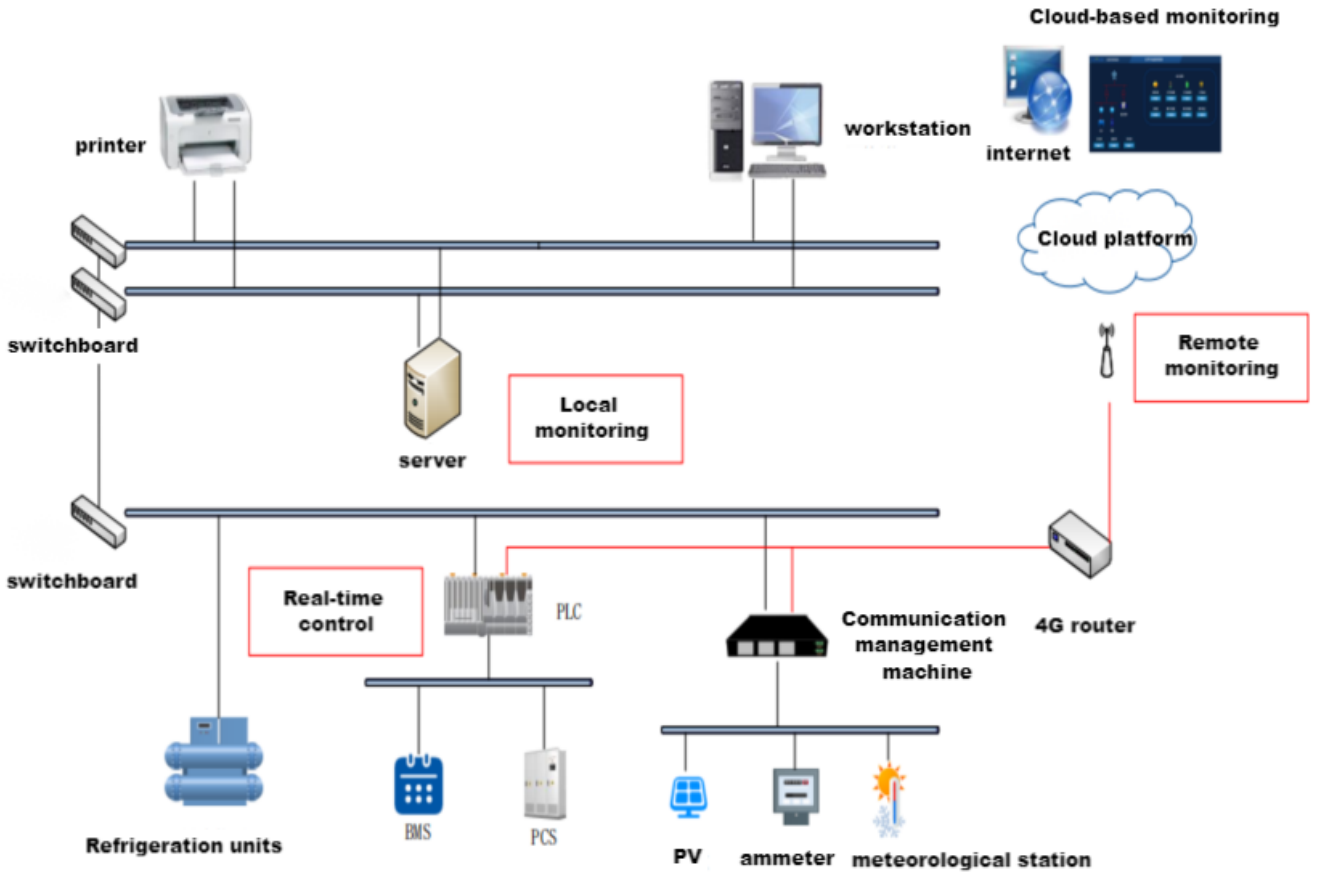
Energy Management System (EMS)

The EMS (Energy Management System) employs a unified network configuration where the EMS controller establishes seamless communication with various components within the energy storage unit, such as PCS, BMS, dynamic loop system, PV inverter, and instrumentation. Data generated from these components is transmitted to the cloud platform via a wireless network, facilitating cohesive data monitoring.

Our energy management system is designed with a service-oriented software architecture, ensuring a high level of openness to effectively meet system requirements. Utilizing middleware technology, the system adeptly shields the differences among heterogeneous systems, catering to cross-platform needs, and providing support for various operating systems, including Unix, Linux, and Windows.

In terms of hardware, we employ advanced and mature equipment, with a particular emphasis on key components featuring a redundant configuration. This strategy aims to establish a secure, reliable, standardized, and open master system, promoting resource-sharing and facilitating seamless integration. The system is deliberately crafted to be compatible with domestic hardware, operating systems, and databases.

The functionalities and topology of the EMS are flexible and customizable, allowing us to tailor them according to the specific requirements of our valued customers. This ensures that our energy management system not only meets industry standards but also aligns perfectly with the unique needs of each client.



User-side topography

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Product Design Solutions for Power Energy Storage

Auxiliary System

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Ancillary system include lighting system and power distribution and grounding system.

Lighting System:

For the lighting system, we recommend the utilization of explosion-proof lamps designed to operate effectively within a temperature range of -60 °C to 50 °C. The lighting system is engineered for straightforward installation and maintenance, emphasizing user-friendly features. With a service life exceeding 10 years based on periodic replacements, the lighting system ensures long-term reliability. Additionally, to guarantee the safe evacuation of personnel during emergencies, the system includes dedicated emergency lighting equipment.

Grounding System and Auxiliary Power Distribution

In a scenario where individual components such as the power distribution cabinet, monitoring cabinet, battery rack, and PCS maintain their dedicated grounding, a unified grounding network connects all equipment to ensure continuous grounding throughout the entire system. The collective resistance of the complete grounding system to the ground is limited to a maximum of 1 Ω. Additionally, the auxiliary power distribution unit serves as a power distribution branch for various subsystems including the temperature control system of the energy storage system, monitoring cabinet, fire protection, lighting, backup lighting, and sockets.

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Product Design Solutions for Power Energy Storage

System Configuration Table

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No.	Product name	Specification	QTY.	Unit	Manufacturer	Comment
	Na ion-electric energy storage system	**7.92MW/45.568MWh energy storage system**	**1**	**SET**	**Parasol Elite Power Group**	Sub-items include 1-5
1	**Energy storage subsystem**	**2.64MW/15.189MWh battery subsystem**	**3**	**SET**	**Parasol Elite Power Group**	
1.1	Cluster	1190.4V, 261.888kWh, including battery rack, 8 battery modules, 1 control box, power and communication power harness	58	SET	**Parasol Elite Power Group**	
1.2	Battery Management System (BMS)	Battery system matching, three-level topology	2	SET	**Parasol Elite Power Group**	
1.3	DC converging system	It includes 1 combiner cabinet and three-level BMS (including 10.1-inch display screen), including emergency stop, external interface, network switch, UPS, etc	2	SET	**Parasol Elite Power Group**	
1.4	Cooling control system	Including liquid cooling units and accessories, etc	2	SET	**Envicool**	
1.5	Ancillary materials	Contains auxiliary materials for the internal equipment of the battery energy storage system	1	SET	**Parasol Elite Power Group**	
1.6	Fire protection system	Adapt according to the actual needs of the site	1	SET	matching	Self-configuration by customer on site
1.7	Power distribution system	Lighting (including exterior) and power distribution, etc.	1	SET	matching	Self-configuration by customer on site
2	**Power Conversion System（PCS）**	**2640kW (consisting of 2 PCSs of 1320kW), AC600V**	**3**	**SET**	**Kehua**	
3	**Step-up transformers**	**SCB11-3MVA 13.8kV/0.6kV**	**3**	**SET**	**matching**	We recommend that customers configure their own on-site
4	**Medium-voltage switchgear**	**Including medium voltage circuit breaker, transformer, comprehensive protection device, etc**	**3**	**SET**	**matching**	We recommend that customers configure their own on-site
5	**Energy Management System (EMS)**	**It includes EMS control cabinet, coordination controller, touch storage all-in-one machine, switch, workstation, customized EMS software, etc**	**1**	**SET**	**matching**	We recommend that customers configure their own on-site