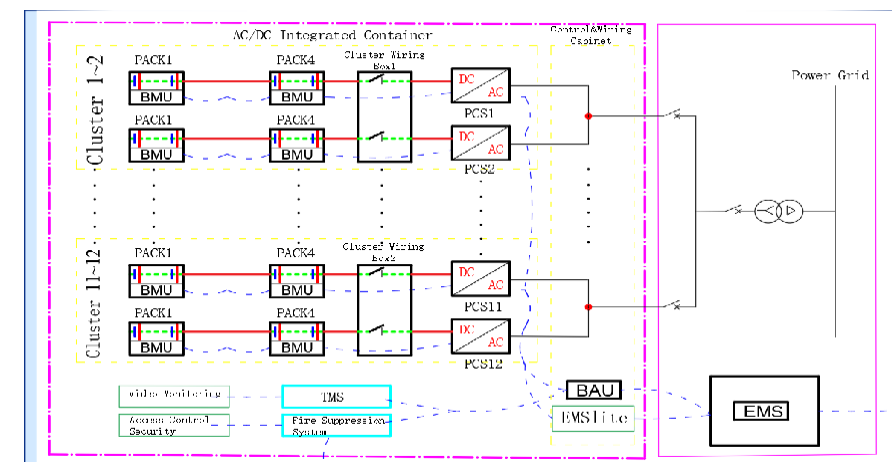


# Electric energy storage system product design scheme

Parasol Elite Power

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- ❑ **Product:** 5 MWh LFP Battery Energy Storage System (BESS)
- ❑ **Type:** All-in-one, liquid-cooled solution
- ❑ **Components Included:** Energy storage lithium-ion battery with Battery Management System (BMS), Modular type liquid-cooled Power Conversion System (PCS), Liquid cooling temperature control system, Security lighting and monitoring system, Fire suppression system, Power distribution system.
- ❑ **Battery system DC design Voltage Level :** 1500 Vdc
- ❑ **DC Rated Voltage:**  $416 \times 3.2 = 1331.2 \text{ Vdc}$
- ❑ **PCS AC Rate Voltage:** 690 VAC
- ❑ **ESS Charge-Discharge Power C-rate :** 0.5P
- ❑ **Container Specifications:** prefabricated 20-foot non-walk-in container
- ❑ **Installation Requirements:** Only basic infrastructure is required for quick setup.
- ❑ **On-site connections needed:** Power and secondary communication cables
- ❑ **Merits:** Convenient and efficient installation, Minimizes engineering effort, Reduces costs



Topology Diagram

# Energy storage battery system design scheme

| Parameters of the system                                                  |                                                                                                   |
|---------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| Cell                                                                      | 3.2V/314Ah, LFP                                                                                   |
| System battery configuration                                              | 1P416S is a cluster, a total of 12 clusters                                                       |
| Battery rated energy                                                      | 5.015MWh                                                                                          |
| Battery voltage range                                                     | 1164.8V ~ 1476.8V (Cell 2.8 ~ 3.55V)                                                              |
| Rated discharge power                                                     | 0.5P/2.5MW(12*215kW)                                                                              |
| Rated AC Voltage                                                          | AC690V(50/60Hz)                                                                                   |
| Parameters of the compartment                                             |                                                                                                   |
| Floor space size (length × width x height)                                | 6058×2438×2896mm                                                                                  |
| Maximum lifting and transportation weight and dimensions of a single unit | ≤44T, L6058*W2438*H2896mm                                                                         |
| Protection level                                                          | IP54                                                                                              |
| Operating environment temperature range                                   | -30℃ ~ 50℃                                                                                        |
| Working altitude                                                          | ≤2000m (>2000m will be customized separately)                                                     |
| Battery thermal management system                                         | liquid cooling                                                                                    |
| Fire Fighting System                                                      | Fire extinguishing system (aerosol), explosion-proof exhaust system and emergency water sprinkler |
| External system communication interface                                   | Support RS485, Ethernet, CAN                                                                      |
| External system communication protocol                                    | Support Modbus RTU, Modbus TCP, IEC104, IEC61850                                                  |

# Energy storage battery system design scheme

## 314AhCell -1500Vdc- liquid cooling, 5 MWh LFP ESS AC/DC all in one solution

| Single cabin item description                                         | Unit topology reference diagram                                                     | Rated voltage ( V ) | Rated capacity ( Ah ) | Storage energy ( kWh ) | Combination method                                                                                                                                                     |
|-----------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------------------|-----------------------|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cell                                                                  |    | 3.2                 | 314                   | 1.0048                 |                                                                                                                                                                        |
| Module<br>( including BMU )                                           |    | 332.8               | 314                   | 104.499                | 1P104S Battery Pack                                                                                                                                                    |
| Cluster<br>( including BCU )                                          |    | 1331.2              | 314                   | 417.9968               | Configuration within the Battery Cluster: 1P416S (4*1P104S)                                                                                                            |
| PCS Rack<br>(In Cluster, Including PCS and High-voltage junction box) |   | /                   | /                     | /                      | A single cluster is configured with one 215 kW PCS.<br>DC voltage range: 1000 V - 1500 V.<br>AC voltage: 690V                                                          |
| Energy storage battery compartment                                    |  | 1331.2              | 3768                  | 5015.9616              | Twelve clusters are installed in one 20-foot high container, forming an AC/DC All in One system with a power capacity of 2.508 MW and an energy capacity of 5.015 MWh. |

# Energy storage battery system design scheme-Cell

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314Ah

| NO. | Item                          | Performance                             |
|-----|-------------------------------|-----------------------------------------|
| 1   | Rated Capacity                | 314Ah, 0.5P@25°C                        |
| 2   | Rated voltage                 | 3.2V                                    |
| 3   | Charge cutoff voltage         | 3.65V                                   |
| 4   | Discharge cutoff voltage      | 2.5V                                    |
| 5   | AC internal resistance (1kHz) | ≤0.25mΩ                                 |
| 6   | Charging temperature range    | 0~55°C                                  |
| 7   | Discharge temperature range   | -20~55°C                                |
| 8   | Rated charging current        | 0.5P (25±2°C)                           |
| 9   | Rated discharge current       | 0.5P (25±2°C)                           |
| 10  | Cycle life                    | 8,000 times (25±2°C, 0.5P/0.5P, 70%EOL) |
| 11  | Cell dimensions               | 174.7*71.5*207.1±0.8                    |

# Energy storage battery system design scheme-Module

The module consists of a BMU, battery unit, connection bar, MSD, connector, liquid cooling plate, explosion-proof valve, battery module box, etc. The battery module grouping method is 1P104S, which consists of 8 set 1P13S battery units.



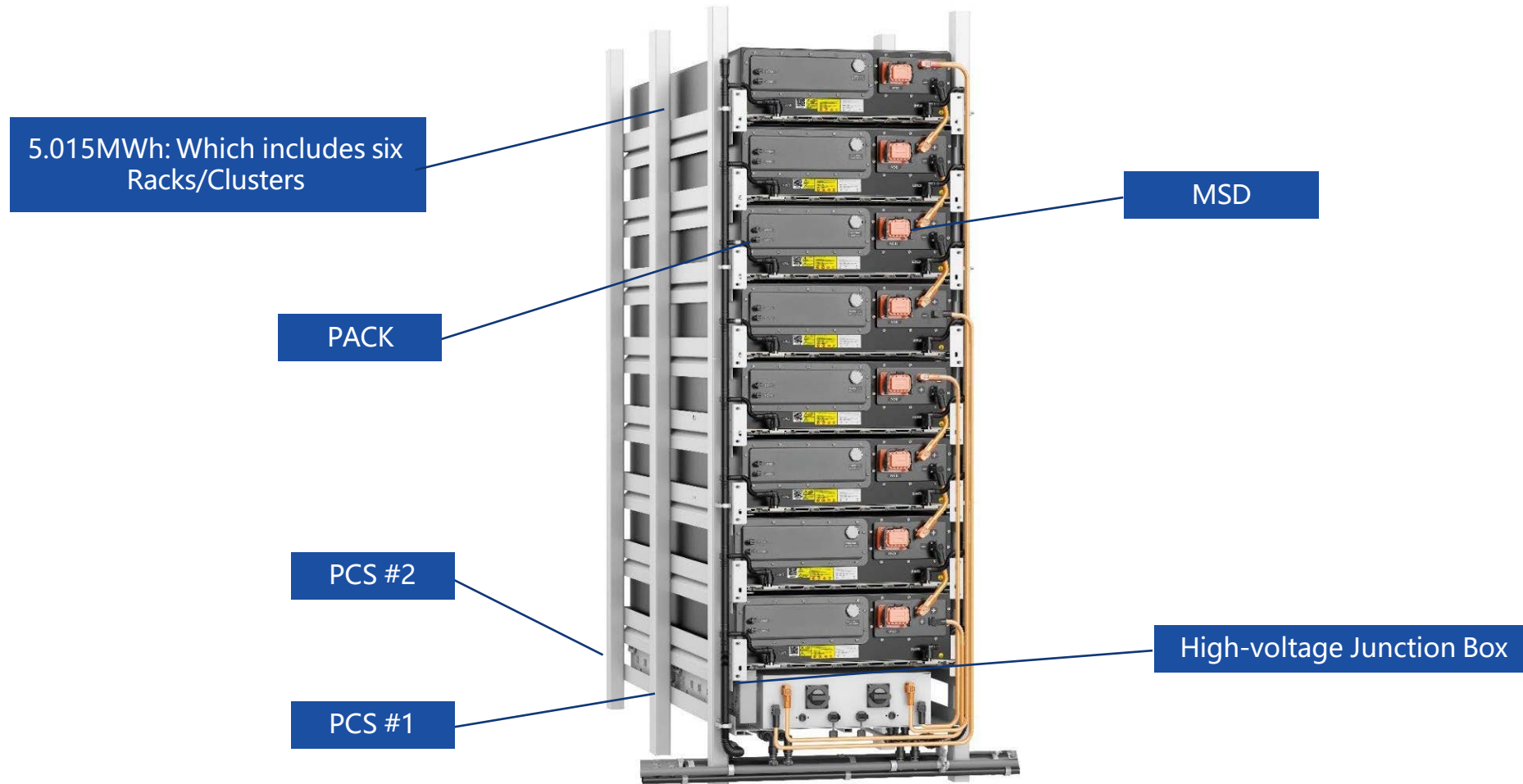
| NO. | Item                                    | performance                             | Remark      |
|-----|-----------------------------------------|-----------------------------------------|-------------|
| 1   | Module model                            | 1P104S liquid-cooled battery module     |             |
| 2   | Cell specifications                     | 314Ah-LFP                               |             |
| 3   | Group mode                              | 1P104S                                  |             |
| 4   | Rated voltage                           | 332.8V                                  |             |
| 6   | Rated energy KWh                        | 104.49kWh                               | 0.5P,25±2°C |
| 7   | Allowable operating temperature range°C | Charging: 0 ~ 55; Discharging: -20 ~ 55 |             |
| 8   | Dimensions (L*W*H)mm                    | 2187*790*251.3 mm                       |             |
| 9   | Weight kg                               | < 700kg                                 |             |

# Energy storage battery system design scheme-Cluster

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Four Packs (including a Battery Management Unit—BMU) are connected in series to a Junction Box and one modular PCS (the Power Conversion System includes a Battery Control Unit—BCU) to form a Cluster. There are two Clusters in one Rack.



# Energy storage battery system design scheme-Cluster

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The battery cluster is composed of 4 battery modules connected in series. A single rack contains 2 battery clusters. The 4 PACKs on the upper layer of the cluster rack form a battery cluster, and the 4 PACKs on the lower layer form a battery cluster. The two battery clusters are connected to two PCSs respectively , and the AC side of the PCS outputs three-phase AC power.



| Item                                 | Specifcations                                 |
|--------------------------------------|-----------------------------------------------|
| DC Side Parameters (one cluster)     |                                               |
| Rated Voltage                        | 1331.2V                                       |
| Voltage Range                        | 1144 ~ 1497.6VDC                              |
| Rated Capacity                       | 314Ah @25 ± 2 °C                              |
| Rated Energy                         | 417.997 kWh @25 ± 2 °C                        |
| AC Side Parameters (one cluster)     |                                               |
| Rated Charge And Discharge Power     | 209 kW                                        |
| Maximum Charge And Discharge Power   | 209 kW                                        |
| Rated Grid-connected Voltage         | 690VAC                                        |
| Grid-connected Voltage Range         | 586VAC ~ 759VAC                               |
| Grid Connection Frequency            | 50Hz /60Hz                                    |
| Charge And Discharge Conversion Time | ≤ 20 ms ( grid-connected )                    |
| Current Total Harmonic Distortion    | < 3%                                          |
| Power Factor                         | -1 to 1                                       |
| System Parameters                    |                                               |
| Working Temperature                  | Charge: 0 ~ 55°C; .<br>Discharge: -20 ~ 55°C; |
| Balanced Method                      | Active balancing / passive balancing          |
| weight                               | ≤ 6100 kg                                     |

# Battery Management System ( BMS )

## BMS System Structure

The battery management system (BMS) consists of a three-level architecture : battery module management unit BMU, battery cluster management system BCU, and battery stack management system BAU.

A Three-Tier Architecture (BMU→BCU→BAU) for hierarchical management, Mainly Including Monitoring, Protection, and Balancing Modules.

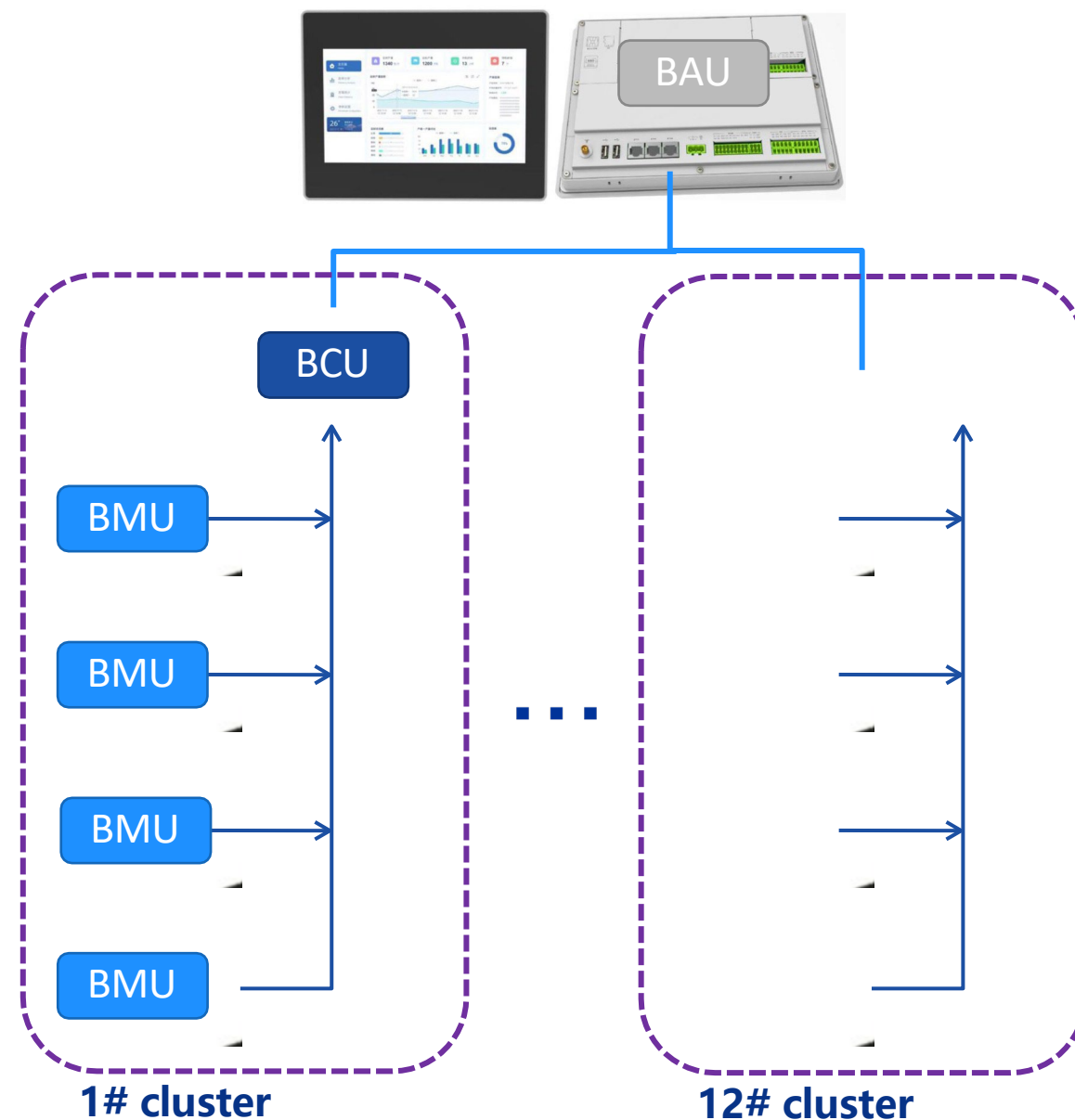
BMU : Mainly responsible for collecting single cell voltage and temperature;

BCU : Mainly responsible for insulation monitoring, processing single cell voltage / temperature, and calculating the current battery SOC\SOH .

BAU : Mainly responsible for communicating with dynamic environment equipment, processing real-time data uploaded by BCU , and performing data aggregation and display functions.

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# PD Control & Wiring Cabinet

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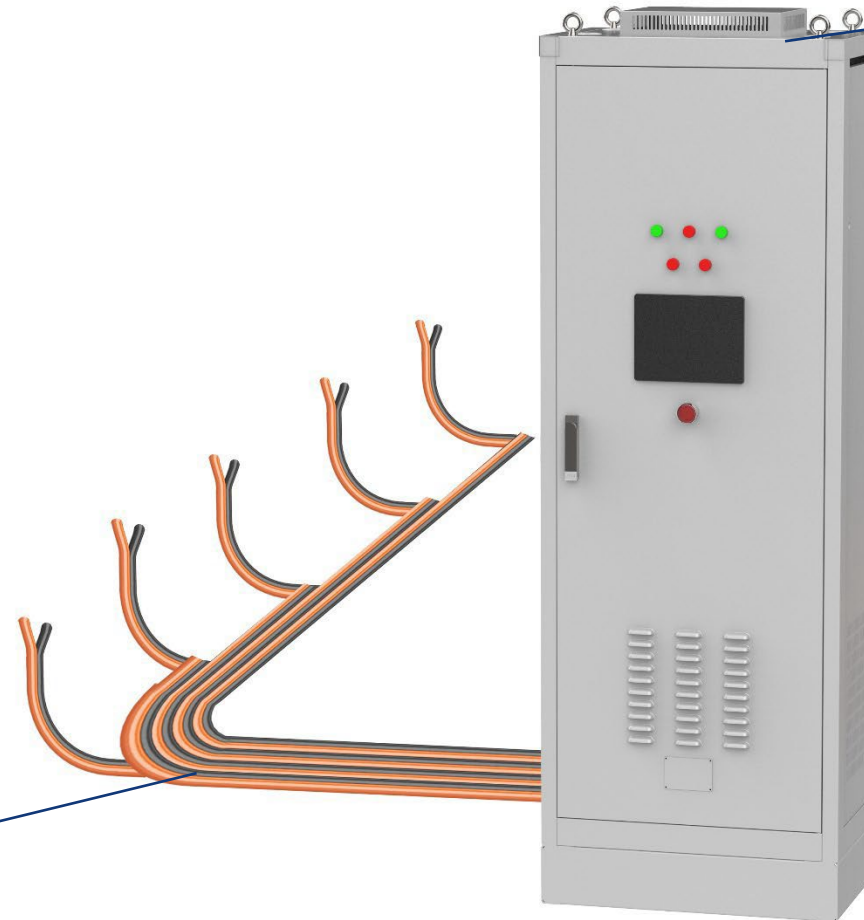
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## PDU & Wiring Cabinet:

Manage container DC&AC system

Transfer HV AC cables

Supply system auxiliary power



HV AC harness (from PCS)

PDU Control & Wiring Cabinet

# Thermal management system

The thermal management system can cool, heat, and dehumidify the internal environment of the container system, including that of the battery and PCS.

## ❑ Dry system:

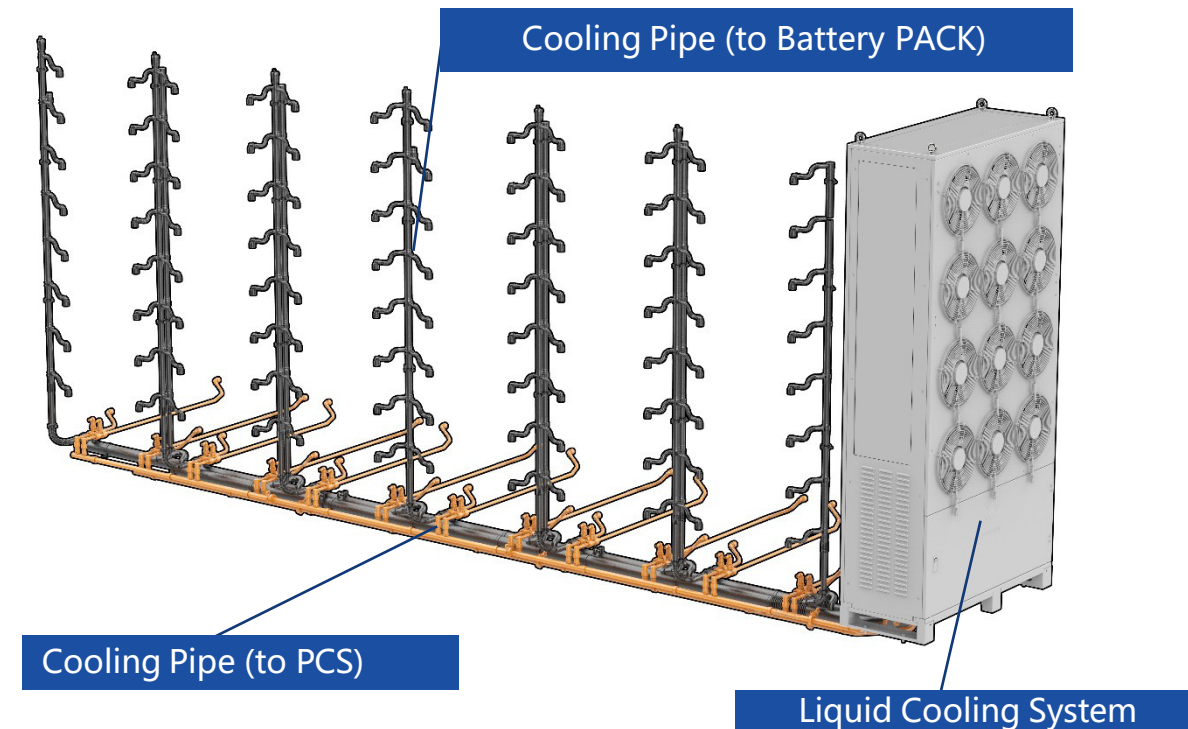
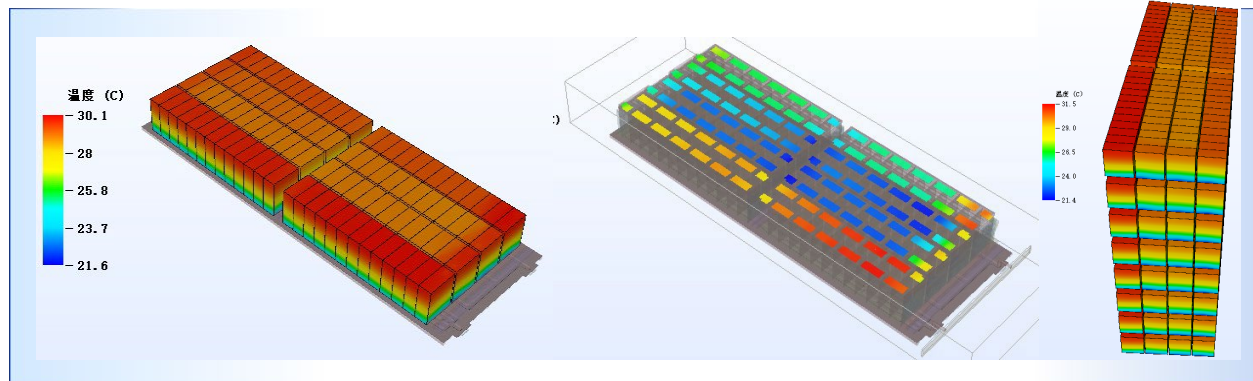
Dehumidify inside the environment

## ❑ Dual-circuit Compressor

Dual liquid cooling circuits with separate thermal management for the battery and PCS.

## ❑ Cooling Pipe System:

Support coolant circulating



# Fire Fighting System

The Fire Suppression System Can Detect Fires, Conduct Firefighting Operations (Including Ventilation And Water - Sprinkling), And Issue Warnings To Comply With NFPA 69.

## ❑ Fire Detecting:

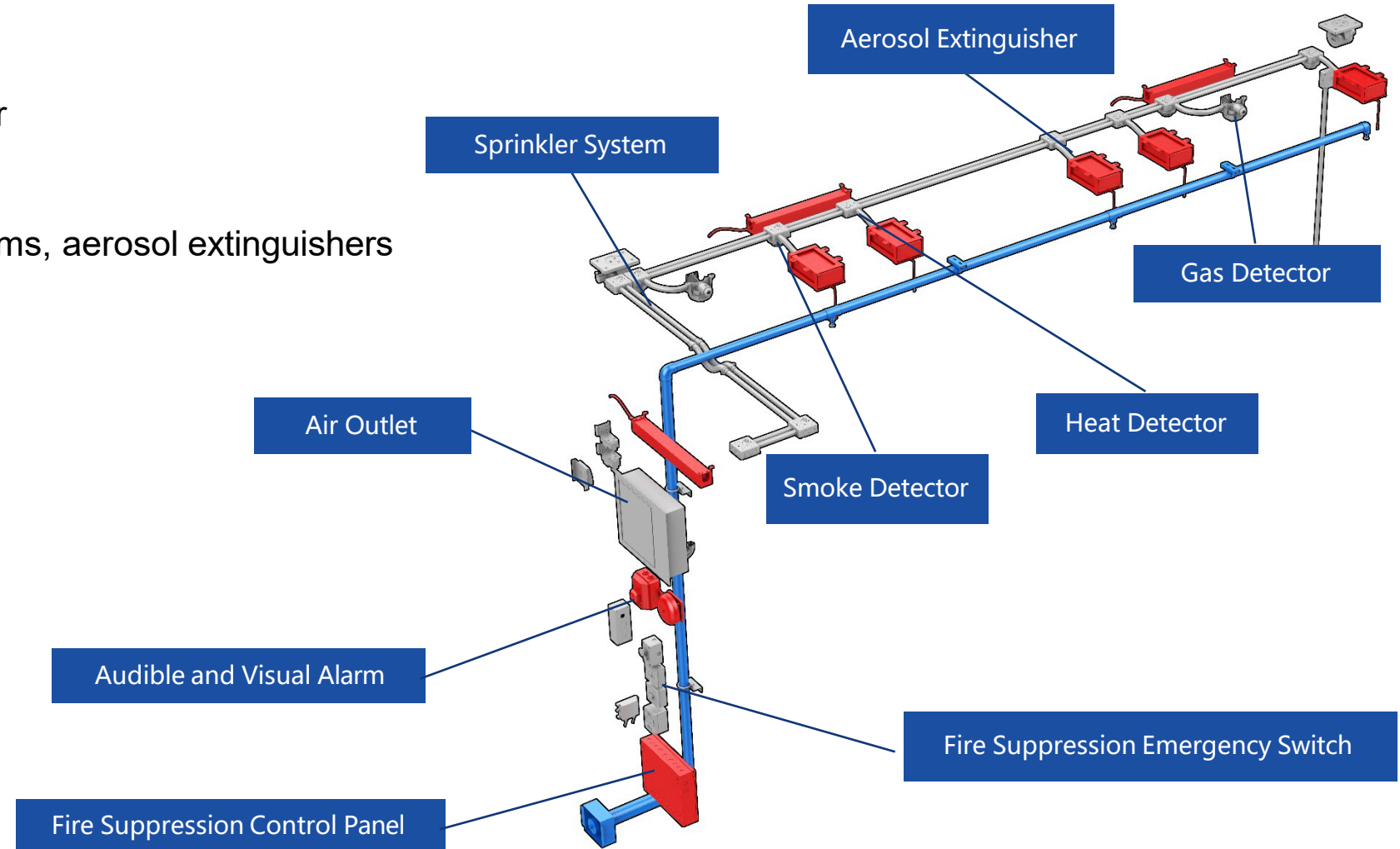
Smoke, gas, heat detector

## ❑ Fire Suppression:

Ventilators, sprinkler systems, aerosol extinguishers

## ❑ Fire alarm:

Audible and Visual Alarm



# Fire Fighting System

## 2. Explosion-proof exhaust system

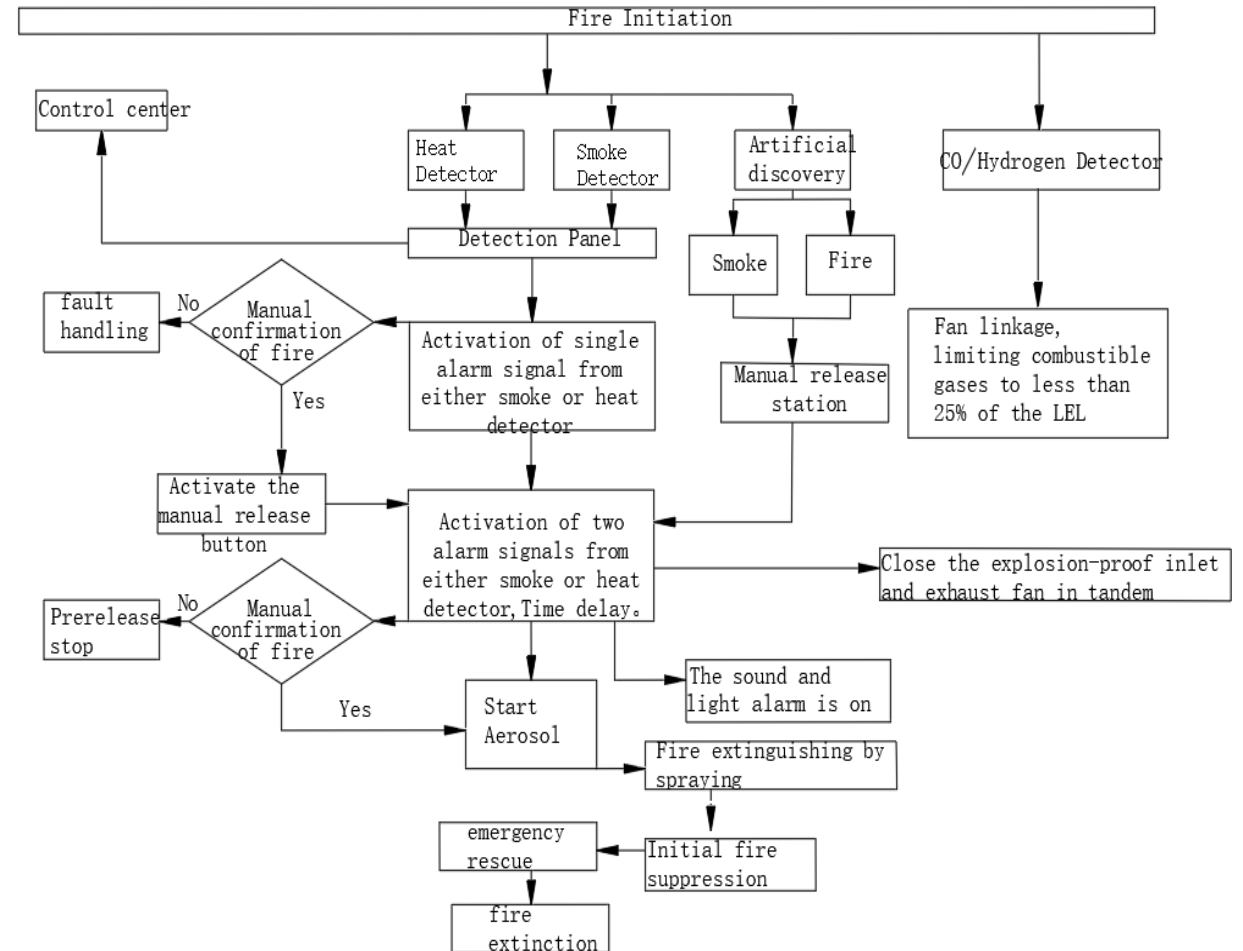
The layout plan of the explosion-proof exhaust system is shown in the figure below, using a bottom-in and top-out layout. The air intake system is installed at the bottom of the side of the container, and the exhaust system is installed at the top of the other side of the container.

The air inlet system inputs outside air into the container from the bottom, stirs and transports the internal gas to the upper layer of the container, and the exhaust system directly extracts the gas sent from the bottom and the gas in the upper layer out of the container.

## 3. Water sprinkler fire extinguishing system

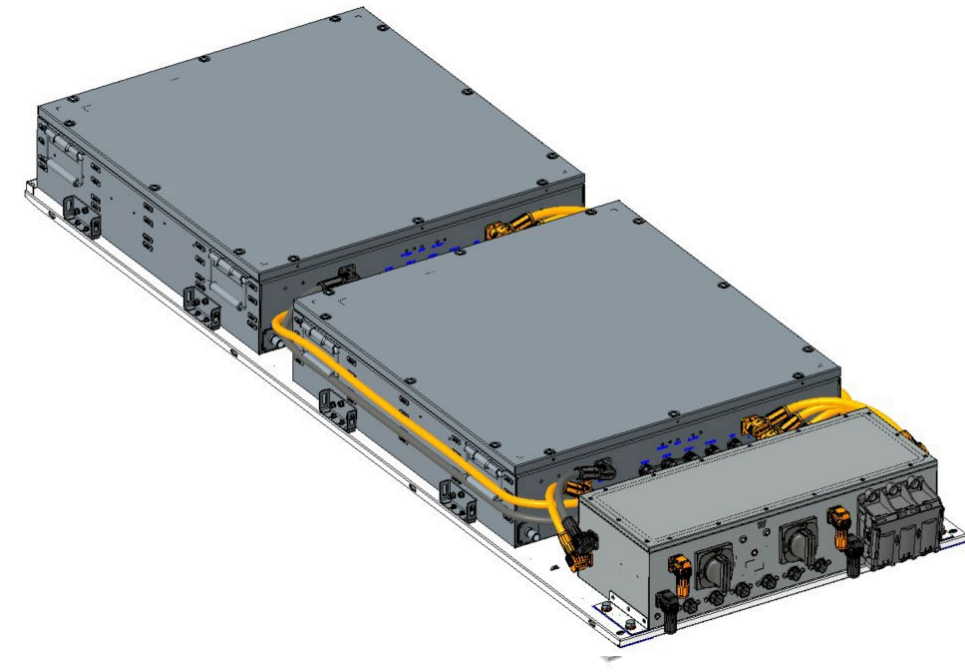
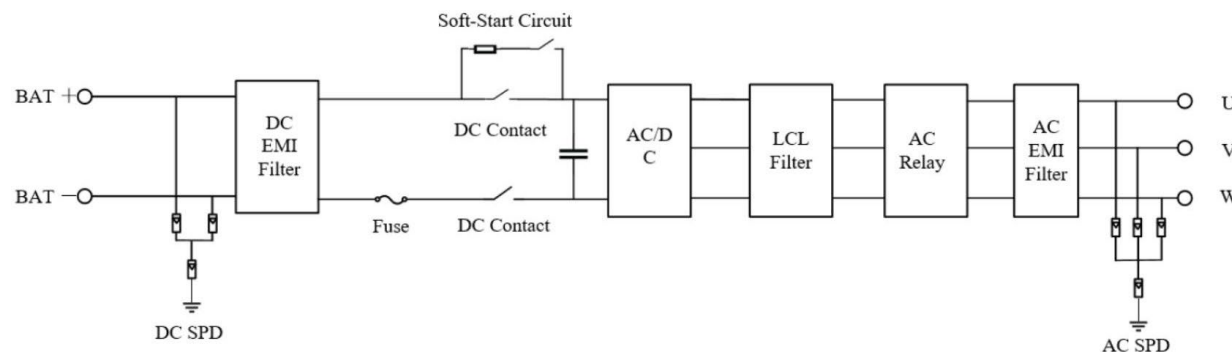
Each subdivision should be equipped with a cabin-level water spray pipe network. When a fire occurs, the fire water pipes can be connected to standard quick connectors to supply water to the container.

The water fire protection interface DN65 pipe + KM type snap-on 65 pipe tooth interface is reserved on the top of the container. The main transportation pipeline should be galvanized steel pipe and connected through threads or fire clamps.



The PCS tray integrates two 215kW PCS units with a high-voltage junction box to enhance performance and safety. It supports pre-charging and protective functions while monitoring battery temperature, voltage, and circuit current. This system manages commands for pre-charging and discharge contactors, ensuring optimal battery circuit control. Designed for electrical characteristics, thermal safety, and easy maintenance, it boasts a flexible configuration and high reliability.

- ① Detection of battery cluster parameters, including terminal voltage, current, insulation, and temperature.
- ② External Auxiliary Power Supply: AC 220V power input and DC 24V power output.
- ③ Automatic addressing function for BMU communication.
- ④ Communication function with the Battery Management Unit (BMU) for 4 CAN.
- ⑤ Remote automatic switching control function for circuit breakers or contractors.
- ⑥ Digital signal input detection, capable of monitoring switch status signals.
- ⑦ Supports dual-channel DC input and dual-channel three-phase three-wire AC output.



# PCS introduce

- ❑ Integrated DC high-voltage box and Battery Control Unit (BCU) to lower costs and reduce debugging time.
- ❑ Liquid cooling design allows operation at 58°C without derating. - Modular single-cluster design eliminates single points of failure.
- ❑ A single cluster manages all batteries, resolving barrel effect and circulation issues.
- ❑ AC coupling reduces the risk of high-power DC arcing.
- ❑ Features IP66 protection, optional C5 anti-corrosion, and operates up to 3000 meters without derating.
- ❑ Supports mixing old and new batteries to prolong battery life.



## Parasol Elite Power

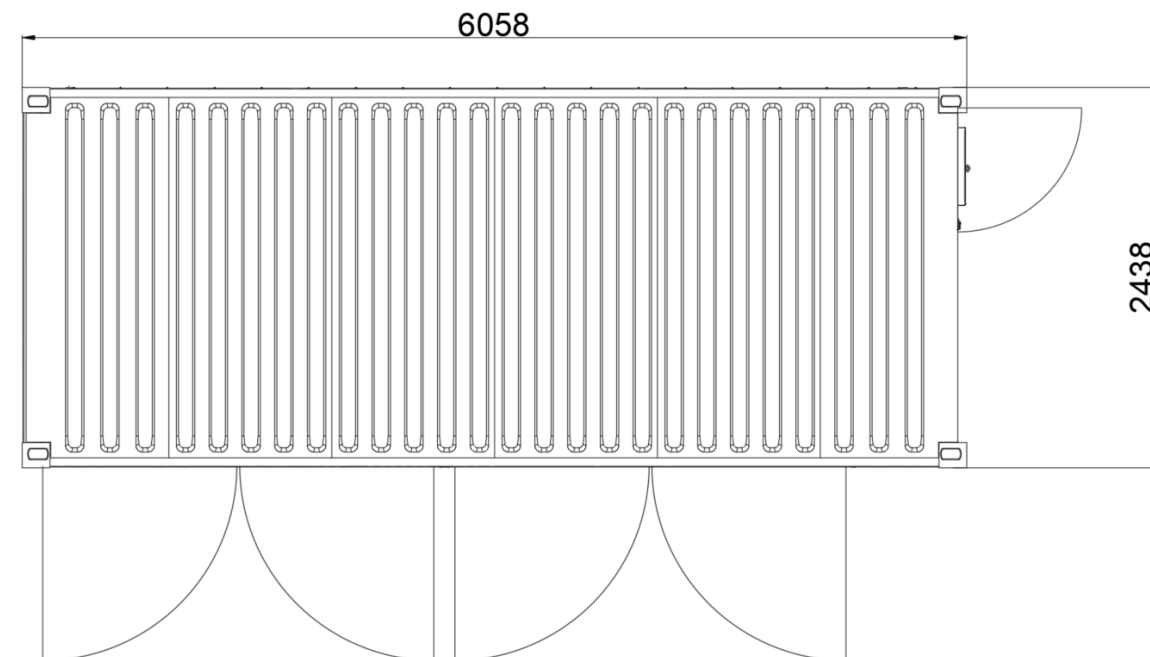
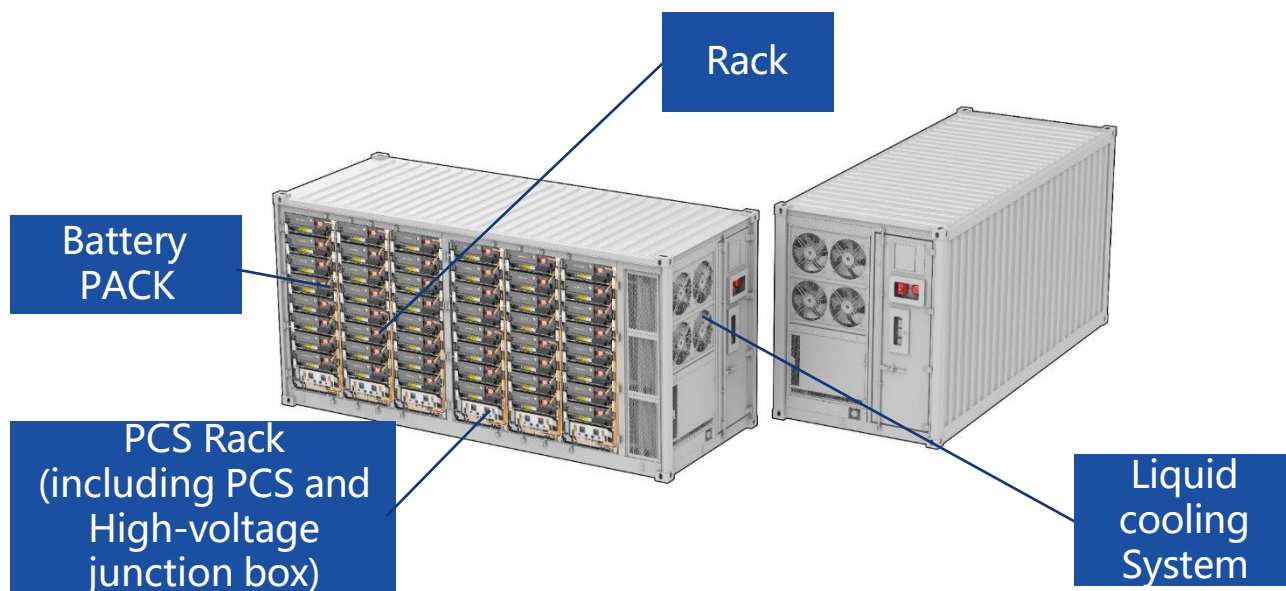
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| No. | Item                             | Performance                         |
|-----|----------------------------------|-------------------------------------|
| 1   | DC Side Parameters               |                                     |
| 2   | DC Voltage Range                 | 1000V ~ 1500V                       |
| 3   | Maximum DC Current               | 236A                                |
| 4   | AC Side Parameters               |                                     |
| 5   | Rated Power                      | 215kW                               |
| 6   | Maximum Output Power             | 237kW                               |
| 7   | AC Connection                    | 3W+PE                               |
| 8   | Isolation Method                 | Non-isolated                        |
| 9   | Rated Grid Voltage               | AC690V                              |
| 10  | Allowed Grid Voltage             | 586V ~ 759V                         |
| 12  | Rated Grid Frequency             | 50/60Hz                             |
| 13  | Allowed Grid Frequency           | 47Hz ~ 53Hz / 57Hz ~ 63Hz           |
| 14  | Total Harmonic Distortion (THD)  | < 3% (at rated power)               |
| 15  | Charge/Discharge Transition Time | <20ms                               |
| 16  | Maximum Efficiency               | 99%                                 |
| 17  | System Parameters                |                                     |
| 18  | Allowed Ambient Temperature      | -40°C ~ +60°C (derating above 45°C) |
| 19  | Cooling Method                   | Liquid Cooling                      |
| 20  | Protection Level                 | IP66                                |
| 21  | Communication Protocol           | Modbus TCP/RTU                      |
| 22  | Weight                           | ≤100kg (Net Weight)                 |

# Battery cabin - layout

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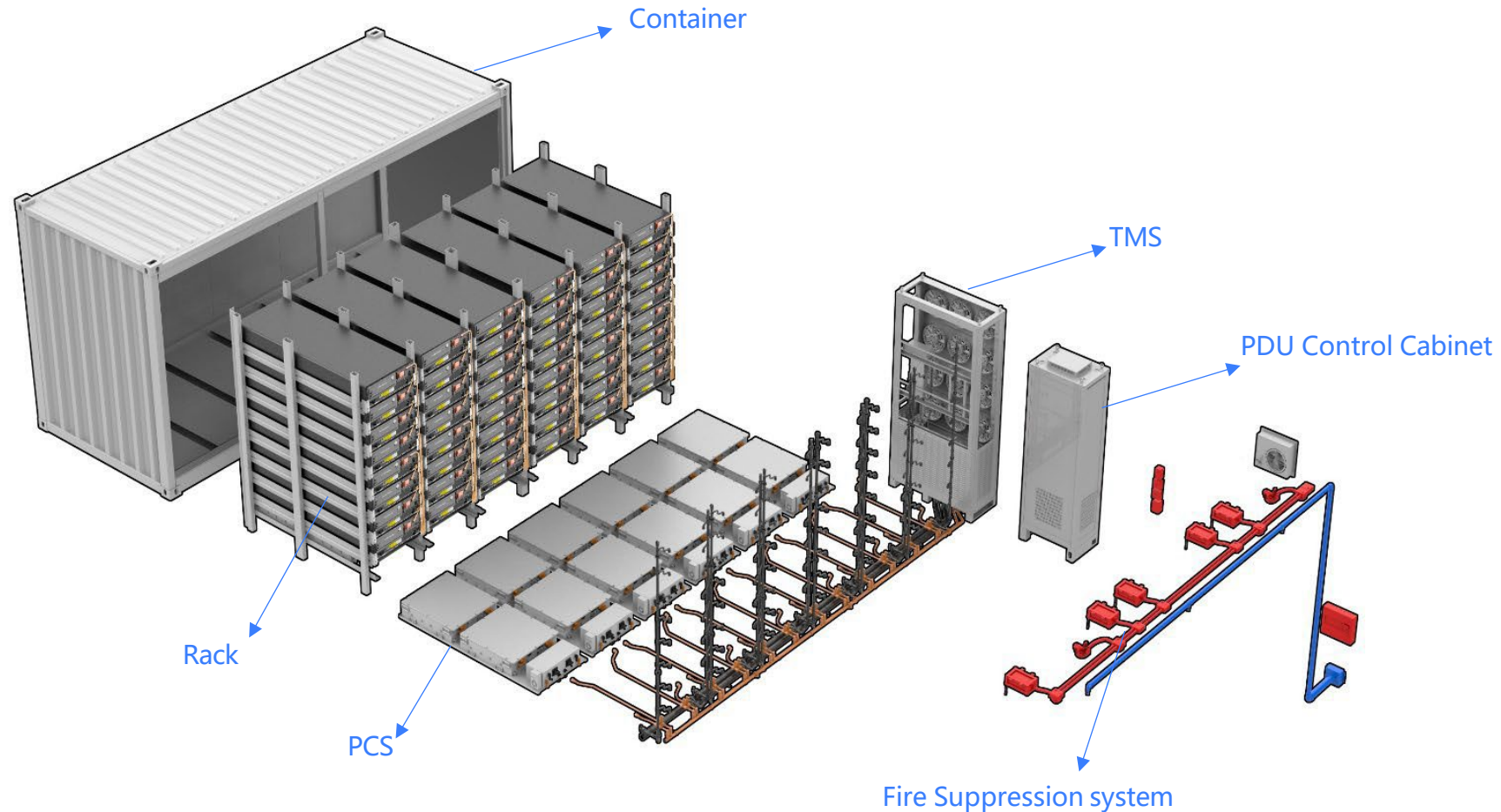


# Battery cabin - Assembly Breakdown

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The system mainly consists of a Rack, PCS, Thermal Management System(TMS), PDU, Fire Suppression system and Container cabinet.



It is required to have good anti-corrosion, fireproof, waterproof, dustproof (anti wind and sand), shockproof, anti-UV, anti-theft and other functions. The container will not fail due to corrosion, fire, water, dust and UV within 20 years.



| Items                                     | Parameter                       | Remark                                                    |
|-------------------------------------------|---------------------------------|-----------------------------------------------------------|
| Dimensions (length × width × height) (mm) | 6058×2438×2896mm                |                                                           |
| Power distribution System                 | 380V AC, 50Hz                   |                                                           |
| Anti-corrosion level                      | C3 ~ C5                         | Determine the level based on the actual project location  |
| Protection level                          | IP54                            |                                                           |
| Cabinet logo                              | Standard                        | LOGO can be customized according to customer requirements |
| Cabinet color                             | RAL7035                         |                                                           |
| Main material of battery compartment body | SPA-H (weather-resistant steel) | The steel profiles used are not lower than Q235B          |
| Rock wool thickness                       | 50mm                            |                                                           |
| Line entry and exit methods               | Bottom in and bottom out        |                                                           |

# Design scheme of booster system

The project is equipped with a 5MW/5MVA booster container for two sets of 20-foot energy storage integrate system. Each booster container mainly includes low voltage cabinet, auxiliary system and one 5000kVA oil transformer.



| AC low voltage side parameters  |                              |
|---------------------------------|------------------------------|
| Rated output power              | 5000kW                       |
| AC max power                    | 5500kW                       |
| Rated grid voltage              | 690V                         |
| Converter allowed frequency     | 50Hz/60Hz                    |
| Output THDi                     | ≤3%                          |
| On Grid power factor            | -1~+1                        |
| AC high voltage side parameters |                              |
| Transformer rating power        | 5000kVA                      |
| Transformer maximum power       | 5500kVA                      |
| Voltage ratio                   | 0.69/11~33kV(optional)       |
| System parameters               |                              |
| Size (W*H*D)                    | 6058*2896*2438mm             |
| Weight                          | ≤20t                         |
| Cooling method                  | ONAN                         |
| Temperature range               | -25℃~60℃                     |
| Protection level                | IP54                         |
| Humidity range                  | 0~95% (without condensation) |
| Communication method            |                              |
| Communication interface         | RS485                        |