

**Cape Town 5MW/10MWh
Battery Energy Storage System
Liquid Cooling Product Design
Scheme**

Project background and requirements

Project in Cape Town, the PCS power is 5MW. The battery useable capacity of 8MWh and the capacity retention at the end of 10 years should at minimum 80%. The total battery cycle number is 6000 times in 10 years.

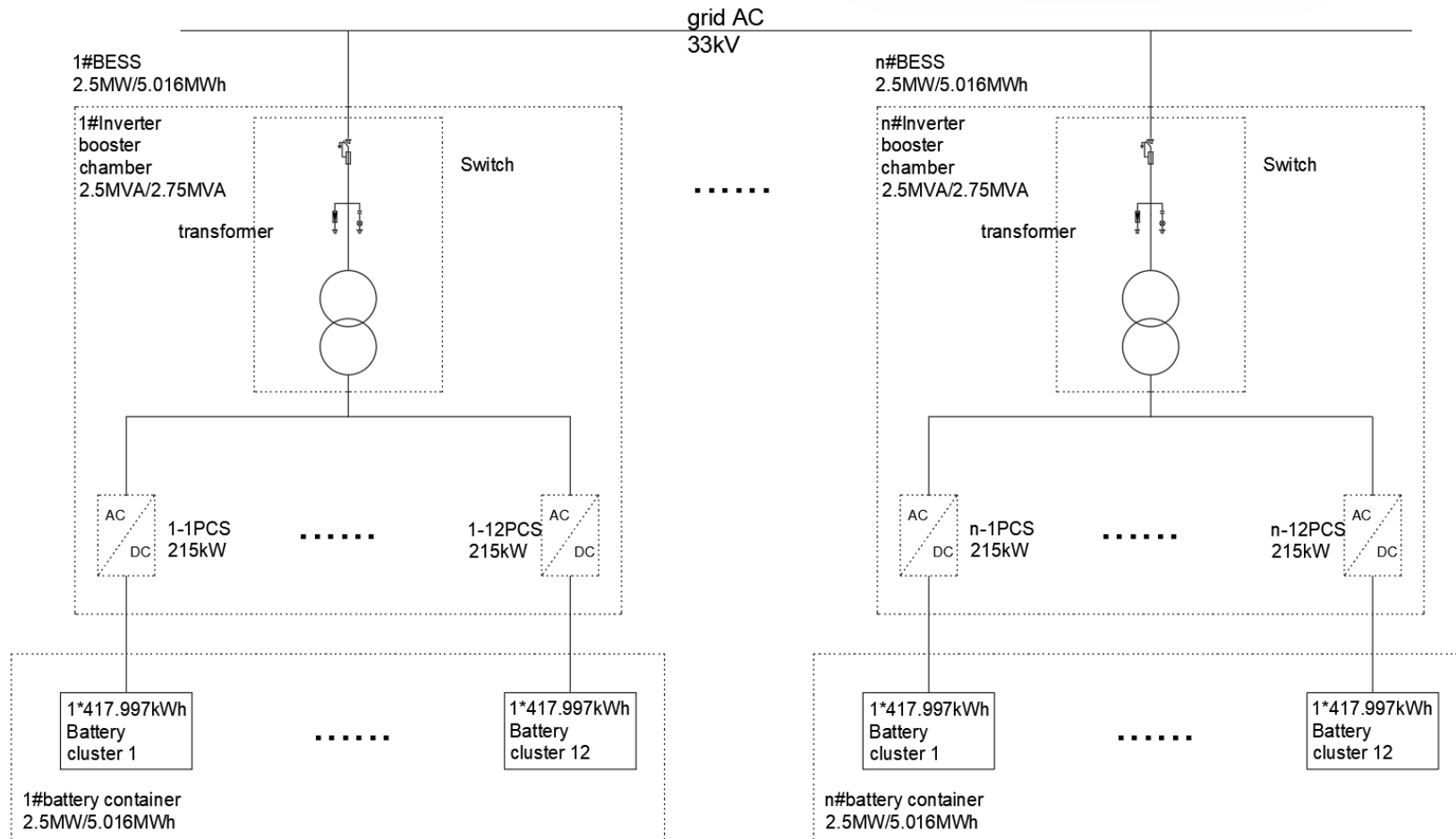
The AC connect voltage is 33kV, it will be integrated into a local PV plant.

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Electric energy storage system product design scheme

Considering the impact of discharge depth, efficiency, cable loss, auxiliary power loss and other related factors, the project is equipped with 2 sets of 2.5MW/5.016MWh energy storage subsystems, and each set of energy storage subsystems includes one 20-foot 2.5MW/5.016MWh energy storage battery cabins and one 2.5MW/2.75MVA booster inverter. This project is equipped with a total of 2 sets boost inverter integrated machines and 2 sets 5.016MWh storage battery cabins:



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
Parameters of the compartment	
Floor space size (length × width)	6058×2438mm
Maximum lifting and transportation weight and dimensions of a single unit	48T, L6058*W2438*H2896mm
Protection level	IP54
Operating environment temperature range	-30°C ~ 50°C
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
List of certification standards	UL1973, UL9540, UL9540A, IEC62619, IEC62620, UN38.3

314AhCell -1500Vdc- liquid cooling, 5 MWh LFP ESS DC side 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 (including BMU)		166.4	314	52.2496	1P52S battery module
Cluster (including BCU)		1331.2	314	417.9968	1P416S , 8 battery modules and 1 main control box are connected in series to form a battery cluster
Energy storage battery compartment	 (schematic diagram)	1331.2	3768	5015.9616	12 battery clusters installed in a 20 - foot high cabinet container, 5.015MWh battery subsystem

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 is composed of BMU, battery unit, connection bar, MSD , connector, liquid cooling plate, explosion-proof valve, battery module box, etc. The battery module grouping method is 1P52S, which is composed of four 1P13S battery units .



NO.	Item	performance	Remark
1	Module model	1P52S liquid-cooled battery module	
2	Cell specifications	314Ah-LFP	
3	Group mode	1P52S	
4	Rated voltage	166.4V	
6	Rated energy KWh	52.25kWh	0.5P,25±2°C
7	Allowable operating temperature range°C	Charging: 0 ~ 55; Discharging: -20 ~ 55	
8	Dimensions (L*W*H)mm	1118*780*254 (±2mm)	
9	Weight kg	< 350	

Energy storage battery system design scheme-Cluster

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Each battery cluster consists of 8 battery modules (1P52S) and 1 high-voltage box. The grouping method is 1P416S and the energy is 417.997KWh.

NO.	Project	Performance
1	Rated voltage V	1331.2
2	Rated capacity Ah	314 @25±2°C
3	Rated energy kWh	417.997 @25±2°C
4	Rated charging and discharging power kW	209
5	Maximum charging and discharging power kW	209
6	Charge and discharge energy efficiency	≥95% (0.5P)
7	Allowable operating temperature range°C	Charging: 0 ~ 55; Discharging: -20 ~ 55
8	communication method	CAN
9	Operating voltage range V	1164.8 ~ 1476.8 (cell 2.8 ~ 3.55)
10	Balance strategy	Passive balancing
11	Weight kg	About 3100



BMS system solution

The battery management system consists of **the battery module management unit BMU, the battery cluster management system BCMU, the battery container management system BAU and the high-voltage control box HVC** . The BMS system has functions such as high-precision detection and reporting of analog signals, fault alarms, uploading and storage, battery protection, parameter settings, **balancing functions** , battery pack SOC calibration and information interaction with other equipment.



BMU



BCM



BAU



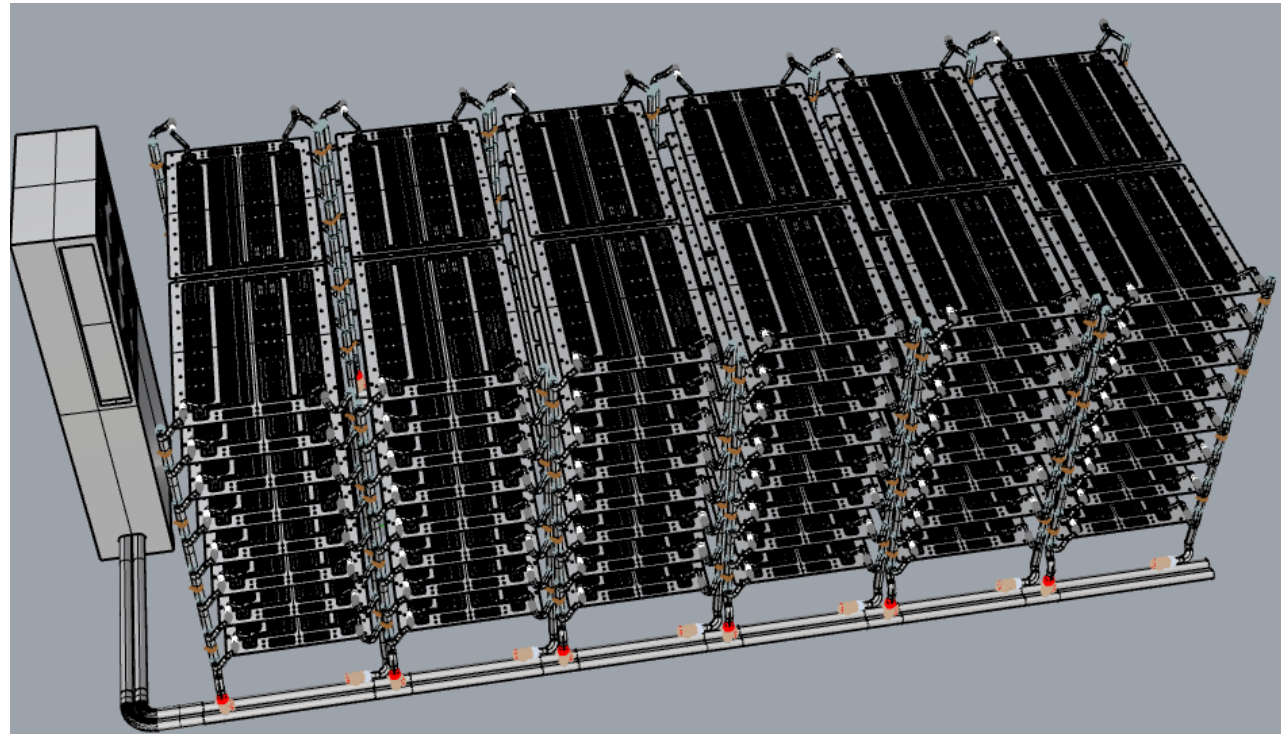
Main features of BMS

The intelligent battery management system can carry out real-time monitoring, charging and discharging, balancing, inspection, temperature monitoring, etc., for single and whole batteries. It has three levels of protection, such as voltage balance control, over-temperature protection, temperature rate, voltage rate, insulation detection, voltage protection, current protection, and communication failure, and can manage multiple groups of batteries. It is a powerful battery management system with perfect technical indicators to detect the voltage of all individual batteries, the total current of battery packs, and the multi-channel ambient temperature in each group.

Thermal management system

Due to the temperature characteristics of lithium batteries, the thermal management effect directly affects the cycle life, charge and discharge efficiency, output power, environmental application range, etc. of the system. This solution adopts the thermal management form of liquid cooling and liquid heating, through the precise design of the module cold plate, Passive flow balance design of three-stage pipeline system and the uniform air supply and dehumidification design of the dehumidification air duct throughout the cabin ensure that the temperature differences of battery cells within modules, within clusters, and within container meet the temperature differences of 2 °C, 3 °C, and 5 °C respectively, with small overall temperature rise and well balanced temperature that extend the service life of the battery system.

The thermal management system consists of liquid cooling units, pipelines, modular liquid cooling plates, modular liquid cooling pipelines, dehumidification systems, temperature and humidity sensors, etc.



The energy storage fire protection linkage system can be divided into fire extinguishing system (aerosol), explosion-proof exhaust system and emergency water spray . When the battery thermal runaway causes flammable gas to leak, the explosion-proof exhaust system responds in time to exhaust and ventilate. ; When a fire occurs, the fire extinguishing system quickly intervenes to carry out detection, alarm, fire extinguishing and other actions; if the fire spreads or re-ignition occurs and the fire extinguishing system cannot control the fire, emergency water sprinklers can be connected for emergency Disposal to prevent deflagration, fire and other serious consequences.

1. Fire extinguishing system

When the smoke or heat detector in the protection area alarms, the fire sound and light alarm outside the protection area will be activated immediately to remind personnel to respond; when the smoke and heat detectors detect fire at the same time or when the manual release pull is started, the fire audible and visual alarm and the alarm bell will sound to prompt the evacuation of personnel on site. The gas fire extinguishing controller will delay for 30 seconds (adjustable) and then send a 24V electrical signal to the fire extinguishing device. The fire extinguishing device will be activated to implement fire extinguishing. , and give feedback signals. If the emergency stop button at the door is pressed during the 30-second delay period, the gas spray operation will be canceled and the system will be reset . If the fire spreads or re-ignites and the fire extinguishing system cannot control the fire, emergency water sprinklers can be connected for emergency treatment to prevent deflagration, fire and other serious consequences.

2. Explosion-proof exhaust system

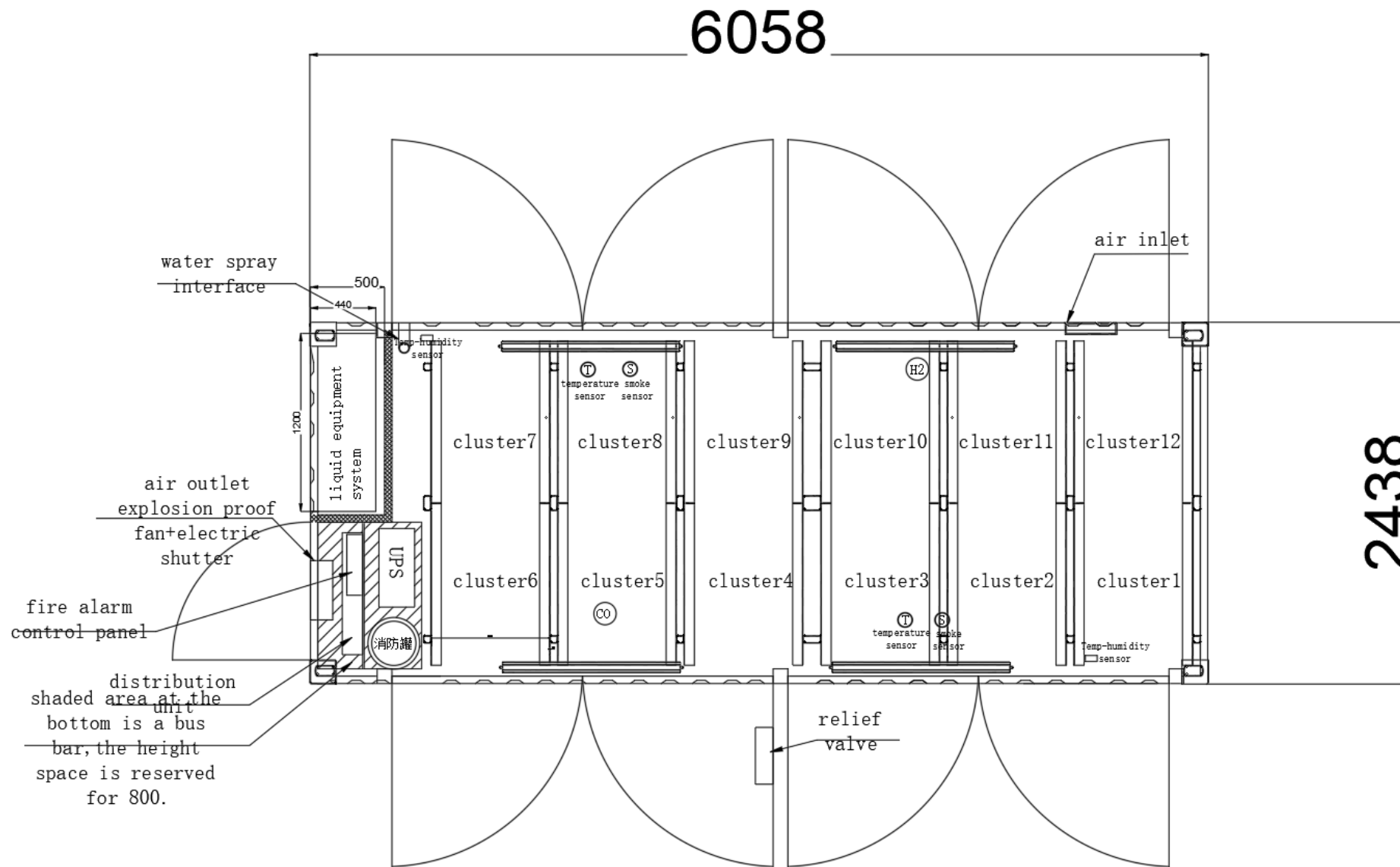
The layout plan of the explosion-proof exhaust system is shown in the figure below, using a bottom-in and top-out layout. The air intake system is installed at the bottom of the side of the container, and the exhaust system is installed at the top of the other side of the container.

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.

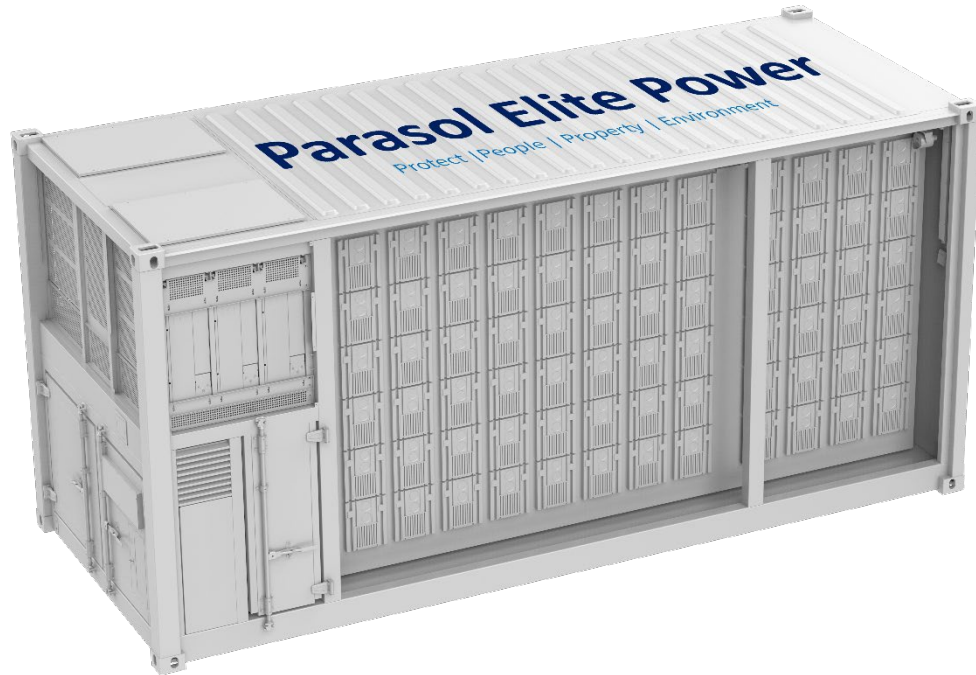
3. Water sprinkler fire extinguishing system

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.



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 (cospowers)	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 PCS booster system-1500V

Centralized scheme

PCS and transformer adopt integrated design, and then integrate the HV chamber and other equipment to form the inverter voltage boost system, which has the advantages of low loss, high efficiency, low cost, small footprint, easy maintenance and so on.

The project is equipped with a 2.5MW/2.75MVA booster converter. Each booster converter mainly includes twelve 215kW energy storage converters (PCS), one 2750kVA oil transformer.



DC side parameters	
DC voltage range	1000~1500V
Max DC current	241A
Number of battery branches	12
Voltage regulation accuracy	≤±2%
AC low voltage side parameters	
Rated output power	2500kW
AC max power	2750kW
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	2500kVA
Voltage ratio	0.69/33kV
System parameters	
Size (W*H*D)	6058*2896*2438mm
Cooling method	natural
Temperature range	-40°C~60°C(De-rating over 45°C)
Protection level	IP54
Humidity range	0~95% (without condensation)
Communication method	
Communication interface	RS485、Ethernet、CAN
BMS access	Yes

System configuration table

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S/N	Product name	Specification	Qty	Unit	Remarks
	LFP energy storage system	5MW/10MWh Energy storage system	1	Set	Items include I, II
I	LFP energy storage subsystem	2.5MW/5.016MWh energy storage subsystem	2	Set	Items include 1、 2
1	Energy storage battery cabin	2.5MW/5.016MWh battery system	1	Set	Items include 1.1-1.7
1.1	20-FT high container	6058*2438*2896mm、 Including prefabricated cabin body, safety passage, nameplate and indication sign, lighting (including exterior) and power distribution, etc.	1	Set	
1.2	Battery cluster	1331.2V, 417.997kWh, Includes battery rack, 8 battery modules, 1 control box, power and communication harness	12	Set	
1.3	BMS	Battery system supporting, with 3-level topology	1	Set	
1.4	DC bus system	Including 1 bus cabinet, bus cable, circuit breaker, three-level BMS (including 10.1 inch display screen), emergency stop, external interface, communication management machine, network switch, UPS, etc.	1	Set	
1.5	Temperature and humidity control system	Including liquid cooling unit, liquid cooling temperature control	1	Set	
1.6	Fire-fighting system	Fire extinguishing system (aerosol), explosion-proof exhaust system and emergency water spray	1	Set	
1.7	Auxiliary materials	It contains auxiliary materials for container interior installation	1	Set	

System configuration table

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S/N	Product name	Specification	Unit	Qty	Remarks
2	Energy storage inverter booster chamber	2.5MW/2.75MVA inverter booster system	Set	1	Items include 2.1-2.6
2.1	Container	20 feet non-standard container, including prefabricated cabin body, safe passage, nameplate and indication sign, lighting and power distribution, etc.	Set	1	
2.2	Power conversion system (PCS)	215kW, AC690V	Set	12	
2.3	Transformer	2500kVA-33kV/0.69kV	Set	1	
2.4	High voltage chamber	Including 33kV high voltage load switch and fuse	Set	1	
2.5	Low voltage power communication cabinet	Includes low voltage power distribution and communication management	Set	1	
2.6	Auxiliary material	It contains auxiliary materials for container interior installation	Set	1	
II	EMS	Meet the 5MW/10MWh energy storage system access, monitoring and control battery system, PCS system, fire system, etc., participate in the dispatch of local power grid company.	Set	1	