145.08KWh Energy Storage System Scheme

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1 145.08KWh Energy Storage System Scheme

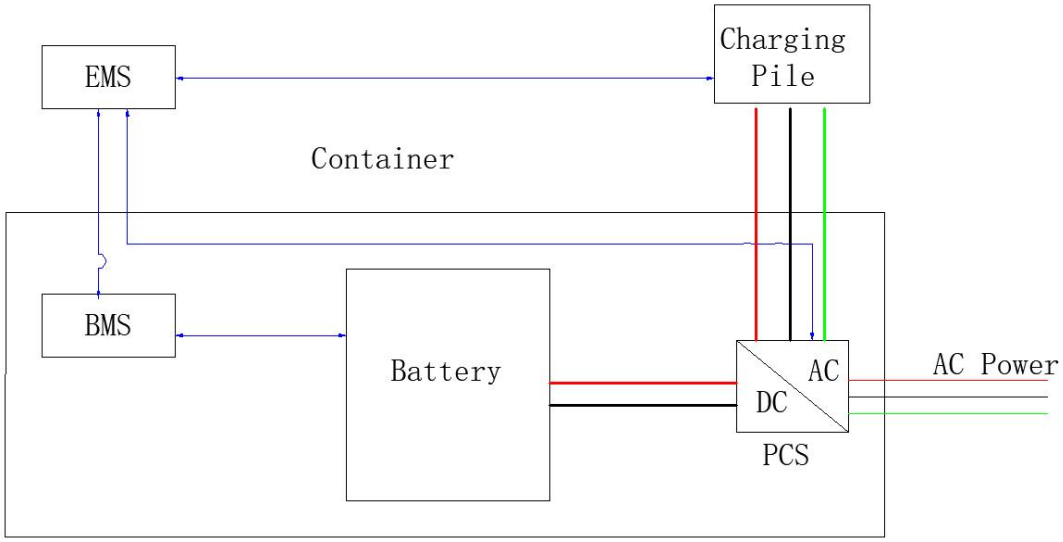
1.1 Energy storage capacity configuration Scheme

No	Item	Specification	Capacity	Voltage range(V)	Remark
1	Cell	280Ah，3.2V	280AH	2.5-3.65	
2	Battery pack	18S	16.12KWh	45V~65.7V	
3	Battery cluster	9 packs	145.08KWh	405V~591.3V	
4	Battery stack	1 clusters	145.08KWh	405V~591.3V	
5	Item	1 stacks	145.08KWh		

1.2 Overall architecture scheme of energy storage system

The energy storage system consists of a 145.08KWh battery and a main control box.

The topology of the energy storage system is shown in the following figure：



1.3 Battery system solution

1.3.1 Energy storage module scheme

1.3.1.1 Cell solution

Through investigating the products of mainstream manufacturers in the market, 280Ah square aluminum case lithium iron phosphate battery is proposed to be used in this project.
The main parameters of the battery cell are shown in the table below:

NO	Item	parameter
1	Nominal Capacity	280Ah
2	Nominal voltage	3.2V
3	Working voltage	2.5~3.65V
4	Working temperature	-20℃~+60℃
5	Storage temperature	-20℃~+35℃
6	Weight	5.6kg
7	Energy density	110Wh/Kg
8	Maximum charging current	280A
9	Maximum continuous discharge current	280A
10	Cycle life	≥6000 times

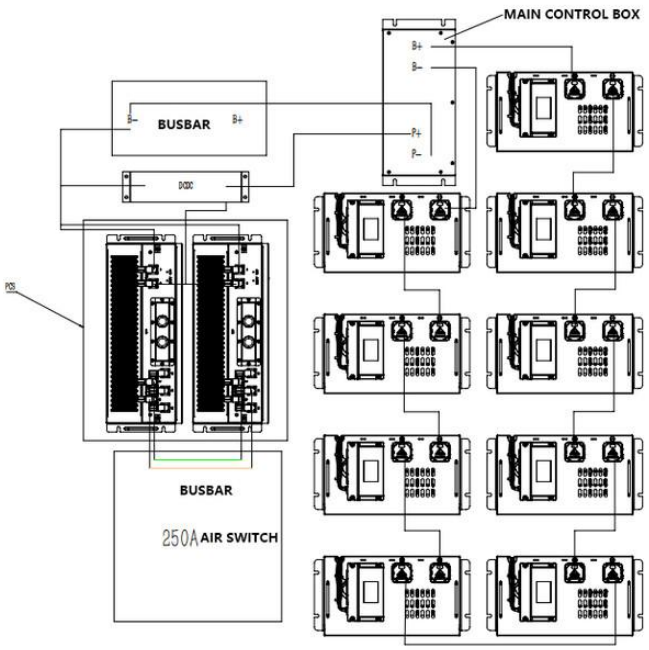
1.3.1.2 Module Scheme

The battery module is composed of 18 square aluminum shell cells with a length of 18S, and the module's pole lugs are connected by laser welding. Adopting air-cooled cooling method with BMU module.

The module reference diagram is as follows:

1.3.2 Battery cabinet solution

1.3.2.1 Outline diagram of battery cabinet (similar projects are for reference only)



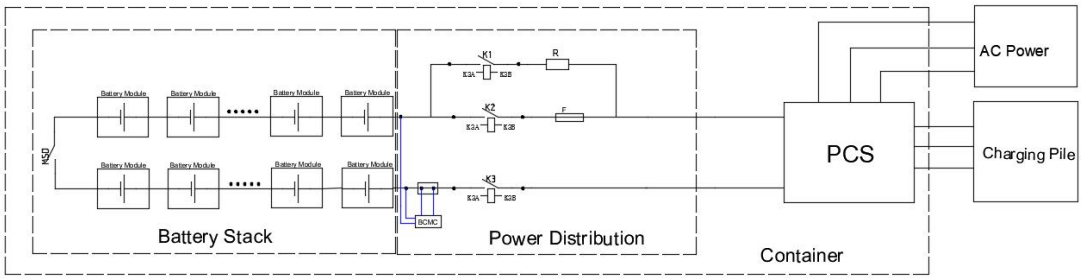
1.3.2.2 Battery cabinet parameters

The performance parameters of the energy storage battery cabinet are shown in the table below：

NO	Item	parameter	remark
1	Colour	Industrial gray	
2	Capacity	145.08KWh	
3	Voltage range	405V~591.3V	

1.3.2.3 Electrical design of energy storage cabinets

1.3.2.3.1 Primary diagram of energy storage cabinet



1.3.3 Energy Storage Battery Management System Scheme（BMS）

1.3.3.1

The energy storage lithium battery system should have a battery management system (BMS). The BMS is designed in accordance with GB/T34131-2017 to realize the overall control and protection of the energy storage battery stack and realize the communication with PCS and EMS.

1.3.3.2

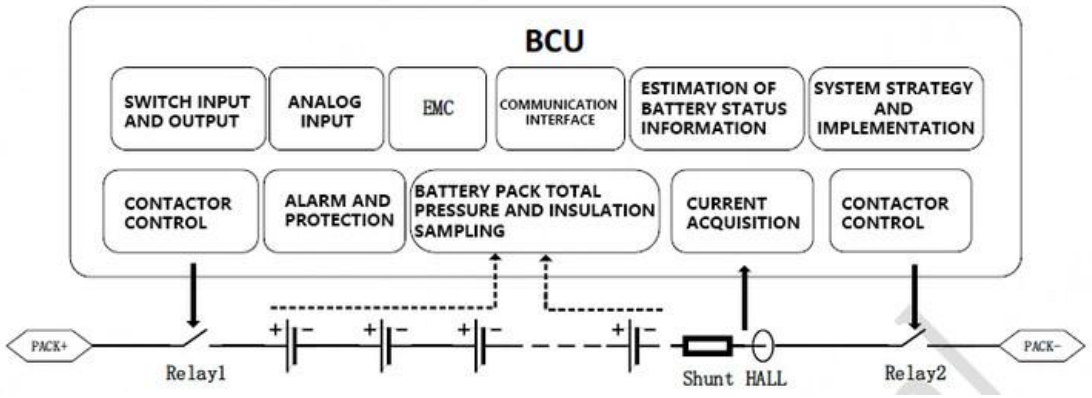
The BMS should realize the acquisition of high-precision and high-reliability battery cell voltage and temperature, and at the same time perform high-precision estimation of the state of charge (SOC) of the battery energy storage device, and realize the power balance between battery cells through the balance control circuit. In the case of abnormal battery data, fault alarm and protection are carried out.

1.3.3.3

The topology configuration of the BMS should match and coordinate with the topology of the PCS and the grouping of batteries, and optimize the control and overall management of the battery operating status. The specific implementation level of each function in the BMS functional requirements is determined by the topology configuration of the BMS, and it should be implemented layered and local. The slave control BMU is responsible for the collection of battery voltage and temperature. Each battery box is equipped with 1 BMU to collect the voltage of 18 strings of battery cells, 10 channels of battery temperature, and 2 channels of battery B+/B- pole temperature; the external communication interface of BMU must be CAN physical interface, powered by 24VDC, and needs to support CAN bus upgrade. The

main control BCU is placed in the high-voltage box, and communicates CAN interactively with the slave BMU. It is responsible for collecting the bus current, bus voltage and pre-charging voltage, controlling the on-off of each high-voltage relay, and performing core algorithm estimation such as SOC/SOH/SOP and insulation resistance.

The main control unit BCU is the control core of the battery management system. It realizes the detection of battery cell voltage, temperature, etc. through communication with the slave control unit, and detects the external characteristic parameters such as the total voltage of the battery pack, charge and discharge current, and ground insulation resistance. , Estimate and monitor the internal state of the battery (capacity, SOC, SOH, etc.) according to an appropriate algorithm, and on this basis realize the charge and discharge management, thermal management, insulation detection, monomer balance management and fault alarm of the battery pack; It can realize data exchange with PCS, EMS, human-machine interface and other devices through the communication bus, and realize communication with BMU through the daisy chain. The schematic diagram of the main control application is shown in the figure below:



1.3.3.4

The BMS system adopts distributed power supply, which is powered by AC220V. Each high-voltage box has a built-in AC/DC power conversion, and the unit is a cluster.

1.3.3.5

BMS Technical parameter

Name	Quantity	Description	Min	Typical	Max	unit	instruction
Auxiliary voltage	1	Working voltage	9	24	32	V	DC 24V or battery, no external load
		Working current	-	80	-	mA	
Total voltage	1	Voltage	50	-	1500	V	Total voltage, precharge

sampling		range					
		Sampling accuracy	-	-	1	%	
Shunt Current Sampling	1	Current range	-500	-	500	A	Sampling range and sampling accuracy are affected by shunt selection
		Sampling accuracy	-	-	0.5	%	
Hall current sampling	3	Sensor supply voltage 1	-	5±1%	-	V	Respectively support voltage type Hall, CAN Hall, current type Hall, 3 types of Hall current sampling, among which current type Hall is optional; Hall supply voltage 2 needs a power supply greater than 12V to output normally
			-	-	80	mA	
		Sensor supply voltage 2	-	12±3%	-	V	
			-	-	200	mA	
Analog input	8	Voltage range	0	-	3.3	V	6-way for temperature (NTC) sampling, 2-way voltage Hall sampling input
		Temperature Sampling Accuracy	-	-	±2	℃	
Digital input and output	7	VIL	0	-	0.5	V	8-way IO input and output states can be flexibly configured by software DIO output has no drive capability
		VIH	3	-	PWR+	V	
		VOL	0	0.04		V	
		VOH	-	2.98	3.3	V	
Address allocation	1		-				Isolation Master Address Assignment
High side switch output	8	Current	-	1	4A@100mS	A	Maximum Simultaneous Output Current 6A
High voltage relay status detection	2	-	-	-	-		
SOC	-	SOC	-	-	5	%	

		calculation error					
	-	Capacity display range	0	-	1000	Ah	
Isolated CAN communication	2	Baud rate	-	-	500	Kbps	
Isolated 485 communication	3	Baud rate	-	-	57600	bps	
Environment	-	Working temperature range	-25	-	65	℃	
	-	Working humidity	-	-	95	%	
	-	Working Altitude	-	-	4000	m	

1.3.4 Important functional schemes for energy storage systems

1.3.4.1 Energy storage system balancing scheme

1.3.4.1.1 Passive equilibrium scheme

Passive equalization parameters:

NO	Item	parameter	remark
1	Number of balanced paths	18	
2	Equalizing current	100mA	
3	MOS configuration method	External MOS	
4	Balanced interface protection	Equipped with TVS protection	

The external MOS balancing scheme, compared to the built-in MOS scheme, can better protect the FAE interface and prevent FAE from being damaged by static electricity, hot swapping impact, and other methods.

External MOS is also more conducive to heat dissipation, reducing the risk of FAE heating, improving FAE stability, and also improving balance efficiency.

1.3.4.2 Temperature control scheme for energy storage system

The energy storage cabinet is equipped with industrial air-conditioning for heat dissipation, and the unique air duct design realizes precise heat dissipation. The battery room is equipped with a cooling capacity industrial air conditioner with multiple operating modes to meet different application scenarios; large air volume design to meet the small temperature difference requirements for battery heat dissipation; self-starting on incoming power, with multiple protection functions, high reliability and open communication protocol; equipped with RS485 communication interface, realize remote monitoring function of the host computer according to project requirements; easy installation, no need to connect pipelines; 24 hours of uninterrupted operation.

1.3.4.3 Energy storage system fire protection scheme

The fire protection system of this energy storage project includes the following systems：

a) Heptafluoropropane fire extinguishing system

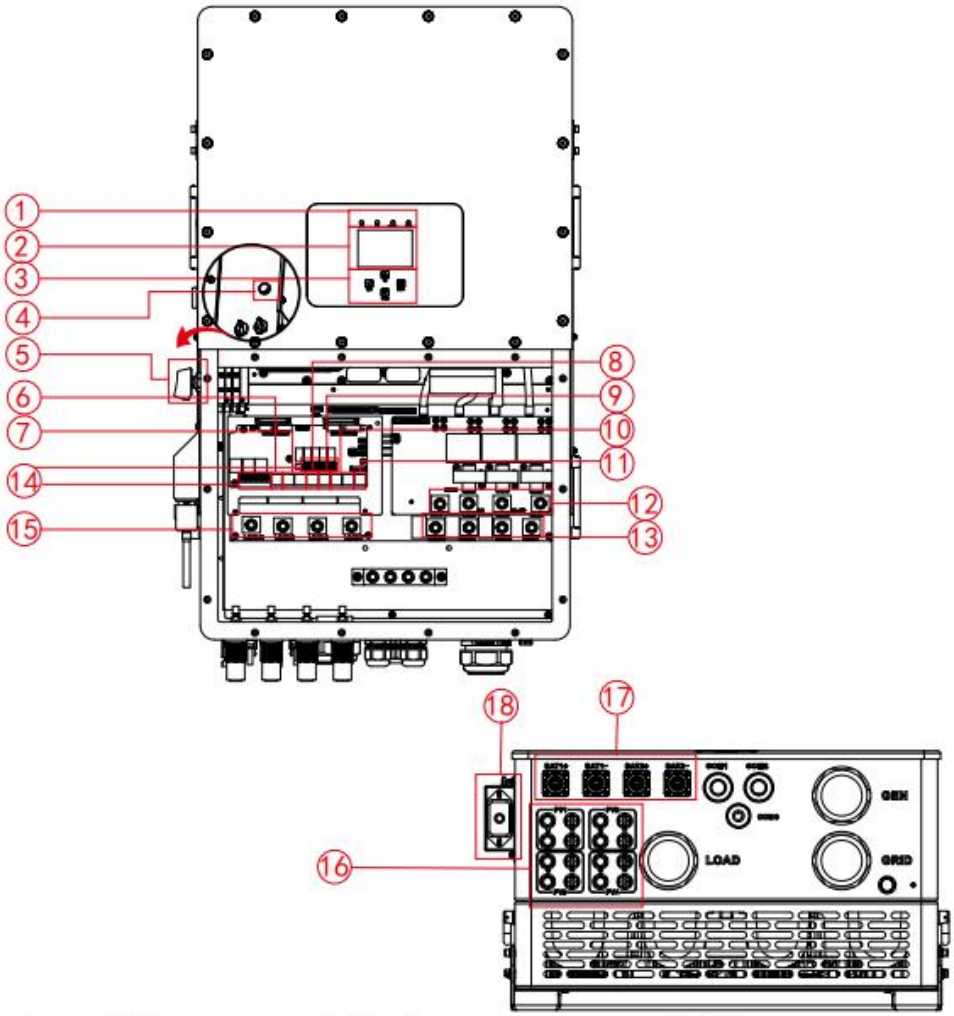
For electrical fires. The cabinet-type heptafluoropropane gas fire extinguishing system is integrated inside the battery container (the entire gas fire extinguishing system has three start-up methods: automatic control, manual control and mechanical emergency operation.)

1.4 Energy storage converter solution（PCS）

The energy storage system of this project uses two rated power 30kW energy storage converters to realize bidirectional energy conversion between the energy storage battery and the AC grid, including AC/DC bidirectional converter power modules, controllers, and electrical protection devices.The energy storage bidirectional converter has the function of parallel and off-grid operation, which can guarantee the continuous power supply of important loads; it can cooperate with the monitoring system to realize the advanced application of the power system. The main parameters of PCS are as follows:

1.4.1 PCS main parameters

Model	SUN-29.9K-SG01HP3-EU-BM3	SUN-30K-SG01HP3-EU-BM3	SUN-35K-SG01HP3-EU-BM3	SUN-40K-SG01HP3-EU-BM4	SUN-50K-SG01HP3-EU-BM4
Battery Input Date					
Battery Type	Li-Ion				
Battery Voltage Range(V)	160~800				
Max. Charging Current(A)	50+50				
Max. Discharging Current(A)	50+50				
Max. Charging/Discharging Power(W)	29900	33000	38500	44000	55000
Number of battery input	2				
Charging Strategy for Li-Ion Battery	Self-adaption to BMS				
PV String Input Data					
Max. DC Input Power(W)	38870	39000	45500	52000	65000
Max. DC Input Voltage (V)	1000				
Start-up Voltage(V)	180				
MPPT Range(V)	150-850				
Full Load DC Voltage Range (V)	360-850	360-850	420-850	360-850	450-850
Rated DC Input Voltage (V)	600				
PV Input Current(A)	36+36+36			36+36+36+36	
Max.PV Isc(A)	55+55+55			55+55+55+55	
No. of MPPT Trackers	3			4	
No. of Strings Per MPPT Tracker	2+2+2			2+2+2+2	
AC Output Data					
Rated AC Output and UPS Power(W)	29900	30000	35000	40000	50000
Max. AC Output Power(W)	29900	33000	38500	44000	55000
Peak Power(off grid)	1.5 time of rated power, 10 S				
AC Output Rated Current(A)	45.4/43.4	45.5/43.5	53.1/50.8	60.7/58.0	75.8/72.5
Max. AC Current(A)	45.4/43.4	50/47.9	58.4/55.8	66.7/63.8	83.4/79.8
Max. Three-phase Unbalanced Output Current（A）	60	60	60	70	83.3
Max. Continuous AC Passthrough(A)	200				
Power Factor	0.8 leading to 0.8 lagging				
Output Frequency and Voltage	50/60Hz; 3L/N/PE 220/380, 230/400Vac				
Grid Type	Three Phase				
Total Harmonic Distortion (THD)	<3% (of nominal power)				
DC current injection	<0.5% In				
Efficiency					
Max. Efficiency	97.60%				
Euro Efficiency	97.00%				
MPPT Efficiency	>99%				



1: Inverter indicators	7: Parallel port	13: Grid
2: LCD display	8: CAN port	14: Function port
3: Function buttons	9: DRM port	15: Load
4: Power on/off button	10: BMS port	16: PV input
5: DC switch	11: RS485 port	17: Battery input
6: Meter port	12: Generator input	18: WiFi Interface

2 Main equipment list

The main equipment list is as follows：

Equipment	Quantity	unit	remark
Lithium battery module	9	Set	
Main control box	1	Set	
BMS monitoring system	1	Set	
Thermal Management Air Conditioning System	1	Set	
Heptafluoropropane automatic monitoring fire extinguishing system	1	Set	
Connection cable	1	Set	bus cable, communication cable
PCS	1	Set	50kW
Energy storage battery cabinet	1	Set	W*D*H=2265×1850×1050mm