Technical Proposal for 100kW-241kWh On-Grid Battery Energy Storage System

BATTLINK

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Abbreviations

AC	Alternating Current
BESS	Battery Energy Storage System
BMS	Battery Management System
DC	Direct Current
BOL	Beginning of life
DOD	Depth of Discharge
EMS	Energy Management System
EOL	End of Life
FSS	Fire Suppression System
HVAC	Heating, Ventilation and Air Conditioning
LFP	Lithium iron phosphate
PCS	Power Conversion System
SOC	State of Charge
SOH	State of Health

1 Recommended Programme

1.1 Design Conditions

1	Project Location	-
2	Desired Power	100kW
3	Desired Battery Energy Capacity	241kWh
4	Desired Battery Energy Capacity Term(at Beginning of Life (BOL) or at End of Life (EOL))	BOL
5	Use Case (Primary)	Energy Arbitrage/ Energy Shifting/ Peak Load Shifting
6	Design Life Mode	10 Years

1.2 Solution Introduction

This solution adopts the modularized energy storage cabinet design scheme, and the configuration capacity of a single energy storage cabinet is 100kW/241kWh.Product model is BATT-CI-100/241.

1.2.1 ESS features and characteristics

This system has the following functional features:

● It can solve the problem of customers' difficulty in increasing capacity and improve the convenience of electricity consumption.

● It can replace the use of diesel generators, reduce the waste of diesel, and reduce noise pollution.

● It can be used in conjunction with new energy sources such as photovoltaic to smooth the curve of photovoltaic power generation.

● It can be used as a backup energy source to ensure the stability of power supply to the load when the power grid loses power.

The system scheme has the following characteristics:

● Single cabinet design, high integration, small volume, moderate weight, low requirements for transportation vehicles and roads, can be forklift; equipment foundation is simple and easy to make.

● Adoption of lithium iron phosphate battery cells, intelligent analysis of battery cells, effectively improving safety.

● Distributed air-conditioning to ensure temperature balance and reduce the temperature difference between battery packs.

● Standardized design, simple expansion, plug-and-play, small unit capacity, flexible phasing scheme.

1.2.2 Product parameters

Product Parameters	
Nominal power	100kW
Nominal energy	241kWh
Nominal voltage	768V
Operating voltage range	696V~852V
Nominal capacity	314Ah
Nominal grid voltage	380V/400V
Nominal grid frequency	50Hz/60Hz
Protection class	IP55
Cooling method	Air cooling
Fire protection system	Perfluorohexanone
Communication method	CAN/RS485
Operating humidity range	0%~90%(non-condensing)
Ambient temperature	-30℃~60℃
Dimensions (L×W×H)	1520*1480*2000mm
Weight	2.6T

1.3 Electrical SLD of BESS

The ESS system will be AC 380Vconnected to the substation, the SLD shown as below:

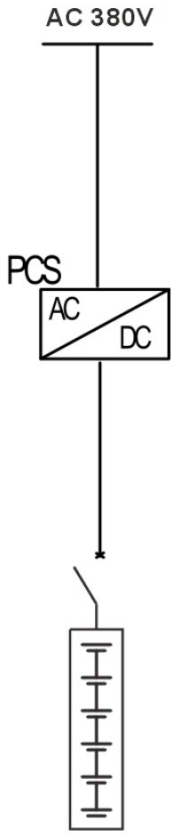


Fig. The SLD of BESS solution

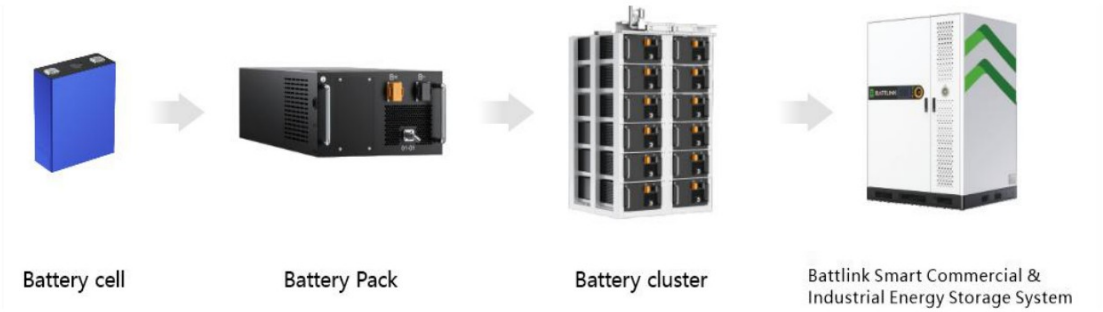
1.4 Configuration List

No	Item	Specification/Model	Quantity	
1	Cabinet and Accessories	1520*1480*2000mm（L*W*H）,IP55,Including other accessories in the cabinet.	1	PCS
2	Battery system	Capacity of 241kWh, including high-voltage box, BMS, wiring harness, etc.	1	PCS
3	PCS	Nominal power 100kW, AC grid voltage 380V/400V.	1	PCS
4	FSS	Perfluorohexanone,Detectors and controller, pipes and alarms.	1	PCS
5	Thermal Management System	5KW industrial air conditioning.	1	PCS

6	EMS	Including data collection,communication, local display, and strategy control.	1	PCS

2 System Specification of Battery System

The product model is BATT-CI-100/241 integrated cabinet consists of 1 cluster of 768V314Ah storage batteries , 1 set of fire suppression system ,1 set of 5kW industrial air-conditioning, 1 set of 100kWpower conversion system and 1 set of EMS.



2.1 Battery Cell

The energy storage system adopts 3.2V314Ah single cell, the battery cell adopts square aluminium shell design, which avoids the possibility of the surface of the battery cell being damaged by machinery and resulting in the internal damage of the battery cell, and improves the safety performance of the product.

Item		Parameter
	**Battery Chemistry**	LFP
	Nominal capacity	314Ah
	Nominal voltage	3.2V
	Voltage range	2.5V~3.65V
	Nominal Energy	1004.8Wh
	Charging temperature	0℃~60℃
	Discharge temperature	-30℃~60℃

2.2 Battery Standard Box

The module adopts 20pcs of 3.2V 314Ah single LFP cells,the pack also integrates the battery management unit.

Item		Parameter
	**Standard box composition mode**	20S1P
	Nominal energy of standard box	20.096kWh
	Nominal voltage	64V

	Operating voltage range	58V~71V
	Nominal capacity	314Ah

2.3 Battery Cluster

The 768V314Ah battery cluster consists of 12 64V314Ah standard battery boxes and 1 main control box.

Item		Parameter
	**Battery cluster composition method**	240S1P
	Nominal energy of battery clusters	241.15kWh
	Nominal voltage	768V
	Operating voltage range	696V~852V
	Charging temperature	0℃~60℃
	Discharge temperature	-30℃~60℃

2.4 Battery Management System

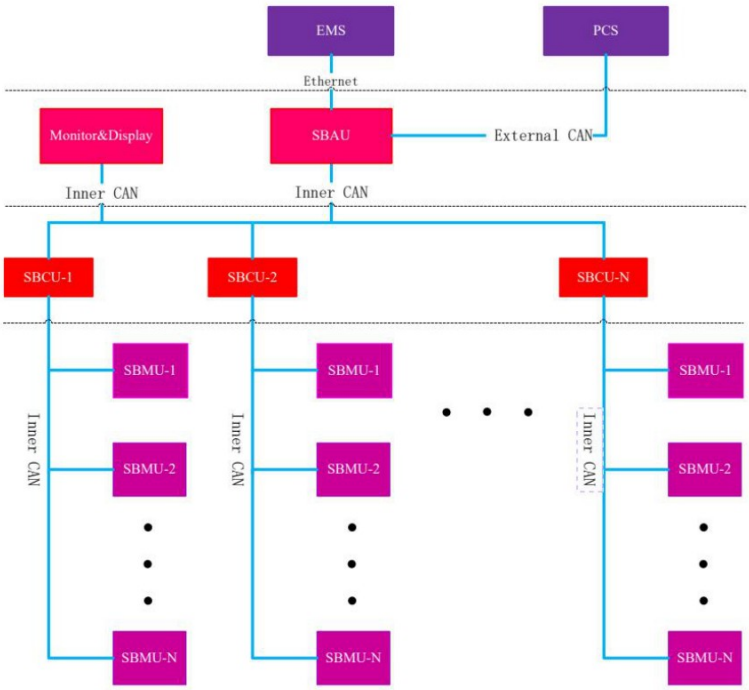


Fig:BMS connection block diagram

● BMU is the slave control module of battery management system, which monitors the working status of the batteries in the battery box in real time when the battery box is charging and discharging, and detects and reports the status of total voltage, total current, cell voltage, battery temperature, etc. of the battery box in real time, as well as alarms for over-voltage, under-voltage,

over-temperature and under-temperature.

● BCU is the cluster control module of the battery management system, connected to the BMU, it can authenticate and interact with the BMU information of the battery box on the CAN network, obtain the battery voltage, temperature and other information of the battery box, and process and report accordingly according to the established protection strategy. BCU is also responsible for the functions of battery current sampling, insulation detection, and the related alarms and protection measures.

● SBAU is the stack control module of the battery management system, connected to the SBCU, it can authenticate and interact with the group controller SBCU on the CAN network, obtain the voltage and temperature of all the battery clusters and the information of each cluster system, etc., and carry out the corresponding processing according to the established protection strategy.SBAU is also responsible for interacting with the PCS and the backstage, and according to the information, carry out the corresponding strategy control and parameter SBAU is also responsible for interacting with PCS and the backend to control the strategy and Parameter according to the information situation.

2.5 Outline Drawing of ESS

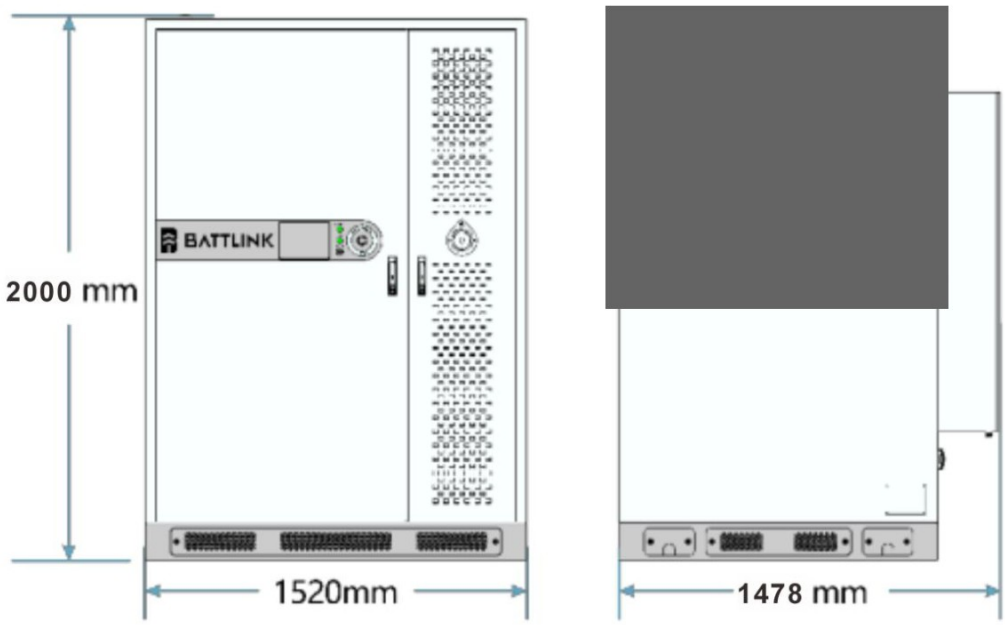


Fig. Outline Drawing of ESS

3 Power Conversion System

Fig. The pic of PCS

3.1 Product Features

● Multiple working modes including PQ, VF, VR, VSG, etc.
● Three-level control technology, high efficiency and high power quality;
● It can accept grid dispatching, including RS485, CAN, Ethernet and other communication modes;
● 105% rated output power can be operated for a long time;
● The modular system design improves the diversity of the connection between the battery pack and the energy storage PCS system;
● The system can be used independently or in parallel to meet the needs of energy storage projects of various scales.

3.2 Operating Mode

(1) Grid-connected operation function (PQ)
PCS has comprehensive grid-connected operation function, which can flexibly adapt to the charging and discharging control of different batteries. The specific grid-connected operation modes are as follows:
Active islanding detection, active and reactive power scheduling, constant voltage mode (DC), constant current mode (DC), low-voltage ride-through, intelligent charging and discharging modes, etc., which can be operated according to the charging and discharging commands issued by the backend. The grid-connected operation mode can be well adapted to various application scenarios, such as peak shaving and valley filling, frequency regulation, peak shifting, voltage regulation and so on.Grid-connected operation mode can be well adapted to various application scenarios, such as peak and frequency regulation, peak shaving and valley filling, and new energy smooth grid connection.
(2) Off-grid operation function (VF)
PCS provides powerful voltage and frequency support for PCS off-grid operation through the standalone inverter function with fast enough dynamic performance to track load power fluctuations. Voltage and frequency commands for the standalone inverter are issued from the backend. The standalone inverter function can provide voltage source support for remote areas, distributed microgrids and other application scenarios to maintain system stability, and can also be used as a backup power source to achieve reliable power supply for sensitive loads.

3.3 Technical Parameter

AC Grid Parameter	
Nominal power	100kW
Maximum output power	110kW
Allowable converter voltage	400Vac (-15%~10%)
Permissible frequency of the converter	50/60HZ
current harmonic distortion rate	<3%
Power factor	0.9 ahead ~0.9 behind
AC standard	3W+N+PE
Battery Parameter	
Operating voltage range	650~900V
Maximum power	100kW
System Parameter	
Cooling method	Forced air cooling
Relative humidity	<95% (no condensation)
Maximum working altitude	2000m (2000m~4000m derating)
Communications interface	RS485 / Ethernet/CAN
Environmental temperature	-30℃~55℃

4 Fire Suppression System

BATTLINK battery container is equipped with a complete fire protection system, including combustible gas detectors, smoke and temperature fire alarm systems, and a fire protection host, as well as a perfluorohexane automatic fire extinguishing system. The fire host of the energy storage system simultaneously connects the signal to the fire alarm system.

Grading according to different severity of battery thermal runaway, electrolyte leakage, early stage of electrical fire, battery heat spread, etc., to realize multi-level warning and facilitate O&M operation.

The fire protection system of the energy storage power station implements a hierarchical warning mechanism and adopts multi-level fire treatment control, which can effectively reduce the risk of widespread fire in the energy storage system, and can effectively protect the safety of the energy storage system.

- The system is capable of automatic fire detection, automatic alarm and automatic activation of the fire extinguishing system.
- Three types of activation: automatic control, manual control and mechanical emergency operation.

- Independent emergency manual operation mechanism.
- Equipped with fire and extinguishing agent release alarms and audible and visual alarms.
- Self-test system, regular automatic inspection, monitoring of faults and fault alarms.

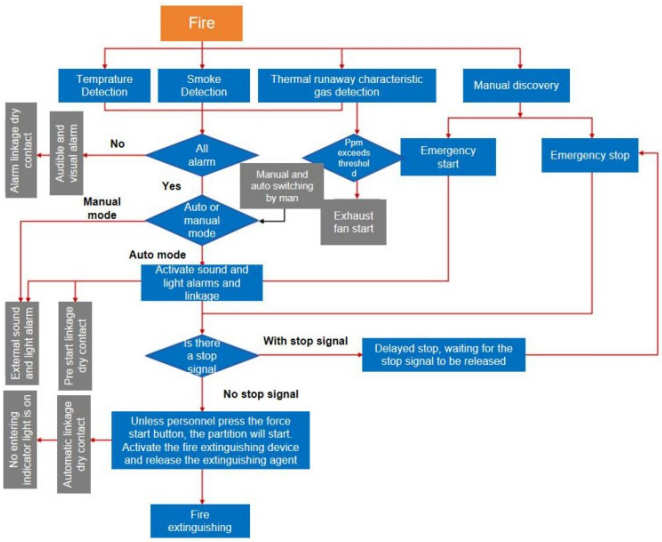


Fig. The layout of FSS components

5 Thermal Management System

Fig. Industrial Air Conditioning

The energy storage system is designed for constant temperature and humidity, and the built-in industrial air-conditioning cooling and heating system is designed for distributed temperature control. Door air conditioners are used instead of traditional centralised air conditioners for maintaining the temperature inside the system. Cold air is blown from the top and circulated inside the container to prevent dust from entering the container. The cool air blown from the air conditioner flows along the top panel to the back of the battery racks on both sides, where it is then sucked in by the fans in the battery packs, while the hot air is discharged through the air conditioner vents at the bottom. This keeps the temperature in the system within a range of 23±5℃, ensuring that the batteries are in optimum working condition.

5.1 Product Characterization

- Integrated wall-mounted design
- Cooling, heating, dehumidification, multiple operating modes
- Online monitoring, control, diagnostics and upgrades

5.2 Technical Parameter

Item	Parameter
Total cooling capacity	5.0kW
Air volume	1500m³/h
Refrigerants	R410a
Noise level	75dB(A)
Fan type	AC
Protection class	IP55
Power supply type	400Vac/50HZ
Installation	Hanging
Application environment	-15℃~45℃
Mass (in physics)	105kg

6 Energy Management System

EMS energy management system can realize integrated energy management for regulation and control of lithium battery storage power station, real-time monitoring, diagnosis and early warning, panoramic analysis, advanced control and other functions, to meet the demand for comprehensive operation monitoring, intelligent safety analysis and dynamic panoramic analysis, and to ensure the safe, reliable and stable operation of energy storage power station.

The energy management system adopts a hierarchical and distributed network architecture, consisting of the energy layer, communication layer, and acquisition layer, interconnected by communication networks:

The energy control layer consists of energy management system workstations, providing the human-computer interface for system operation, management control of on-site control layer equipment, forming a comprehensive system monitoring and management center.

The communication layer consists of grid controllers and protocol conversion devices, responsible for the coordinated control of the grid system and the conversion of communication protocols for communication with external vendor equipment.

The acquisition layer consists of distributed power combiner boxes, DC/DC controllers, Energy Storage Battery Management System (BMS), protective measurement and control devices for outgoing lines, and diesel generator control cabinets.

Fig. Operator interface for real-world application cases