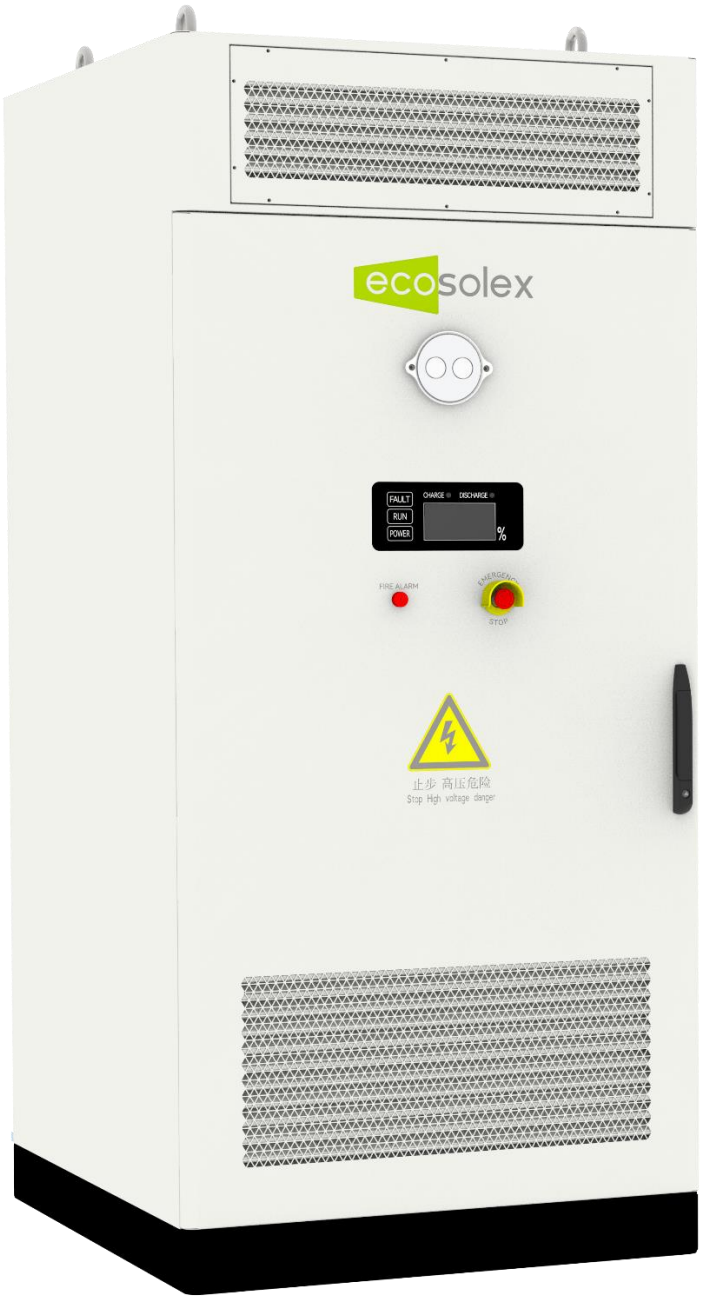

TB215KWH-2H-Y Liquid-cooled Energy Storage All-in-one Machine User Manual

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1. About this manual

1.1 Summarize

This manual describes the installation, electrical connection, debugging, function introduction, troubleshooting and routine maintenance of the TB215KWH-2H-Y Liquid-Cooled Energy Storage All-in-One (hereafter referred to as the Energy Storage System). Please read this manual carefully to understand the precautions and familiarize yourself with the functions and features of the energy storage system before transporting, installing, debugging, using and maintaining the energy storage system.

1.2 Applicable product

TB215KWH-2H-Y liquid-cooled energy storage all-in-one machine.

1.3 Applicable person

This manual applies to persons who perform transportation, installation, and other operations on this energy storage system.

1.4 Description of symbol

Sign	Explanation
 Dangerous	Indicates hazards with a high level of risk that may result in death or serious injury if not avoided.
Warning	Indicates hazards with a medium level of risk that may result in death or serious injury if not avoided.
 Attention	Indicates hazards with a low level of risk that may result in minor or moderate injury if not avoided.
 Prompt	Indicates hazard with a low level of risk that may result in minor or moderate injury if not avoided. "prompt" does not involve personal injury.
 Notice	"Notice" is additional information in a manual that emphasizes or supplements the content, helps you solve a problem or saves you time. " Notice " are not safety warnings and do not involve personal, equipment, or environmental injuries.

1.5 Relevant abbreviation

Complete name	Abbreviation
Electrical Energy Storage System	EESS
Battery PACK	PACK
Power Conversion System	PCS
Energy Management System	EMS
Battery Management System	BMS
State of charge	SOC
Fire Suppression System	FSS
Liquid Cooling System	LCS

2. Safety Precautions

2.1 Personnel requirements

- Professionals: Personnel who should be familiar with the structure, principle and electrical design of the energy storage system, who can be clear about the various sources of hazards in the process of safety, operation, debugging, troubleshooting and maintenance of the energy storage system, and who have experience in operating and training the equipment.
- Trained and qualified personnel: personnel who understand the structure and principle of the energy storage system, who are aware of the danger that may be posed when carrying out an operation, and who have the ability to respond in an emergency to dangers or emergencies that may arise during installation and operation.
- Only Professionals and trained personnel are allowed to installation, operate and maintain the energy storage system.
- Only Professionals are allowed to debugging and troubleshoot the energy storage system.
- Except for the personnel who operate the energy storage system, other personnel are not allowed to approach the energy storage system.
- Should be familiar with the contents described in this manual.

2.2 Electrical safety

2.2.1 General safety

The "Danger", "Warning", "Attention", " Prompt" and "Notice" in the manual do not represent all safety matters that should be followed. Relevant international, national or regional standards and industry practices must also be followed. The company does not assume any responsibility for any violation of safety operation requirements or violation of design, production and use equipment safety standards.

The energy storage system should be used in an environment that meets the design specifications. Reverse engineering, decompiling, disassembling, adapting, implanting or other derivative operations on the equipment software are prohibited. Otherwise, the possible equipment failure, equipment malfunction and component damage are not within the scope of the equipment quality assurance. Otherwise, the company shall not be liable for compensation for personal injury, property loss, etc.

2.2.2 Personnel security

 Dangerous	■ The installation process is strictly prohibited to operate with electricity. It is prohibited to install or remove cables with electricity. The moment the cable touches the conductor, arcs, sparks or fire and explosion may occur, which may cause fire or personal injury. ■ When equipment is powered, unregulated and incorrect operation may produce a fire, electric shock or explosion, resulting in injury, death or property damage. ■ It is strictly prohibited to wear watches, bracelets, bangles, rings, necklaces and other easily conductive objects during operation to avoid being burned by electric shock.
Warning	■ The use of specialized protective gear is recommended during operation, such as wearing protective clothing, insulated shoes, goggles, helmets and insulated gloves. ■ When the unit is in operation, the housing is hot and there is a danger of burns, so do not touch it.

2.2.3 Battery safety

Herald

The company is not responsible for battery damage and other structure caused by the following reasons:

- Battery damage caused by earthquake, flood, volcanic eruption, mudslide, lightning strike, fire, war, armed conflict, typhoons, hurricane, tornados, extreme weather or force majeure.
- Loss of capacity or irreversible damage to the battery due to the customer's failure to charge the battery over a period of time, etc.
- Battery damage, dropping, liquid leakage, rupture, etc. caused by improper handling by the customer or failure to connect the battery as required.
- Frequent over-discharge of battery due to improper maintenance by the customer, expansion of capacity at the customer's site or failure to fully charge for a long period of time.
- Direct damage to the battery caused by the site operating environment not meeting the environmental requirements for normal operation.
- Battery damage caused by the customer's failure to follow storage requirements (e.g., storage in humid, rain-prone environments, etc.).
- Damage to the product or other property caused by the customer storing or installing the battery with flammable or explosive materials.
- Changing the battery usage scenarios by the customer, including but not limited to connecting additional loads to the battery by themselves.
- Damage to the product caused by the customer's continued use of batteries that have exceeded the warranty period.

 Dangerous	■ The battery is strictly prohibited from being subjected to mechanical vibration, falling, collision, puncture by hard objects or pressure shock, otherwise it may cause battery damage or fire. ■ Do not expose the battery to high-temperature

	environments or around heat-generating equipment, such as high-temperature sunlight, fire source, transformers, heater, etc. Overheating of the battery may cause leakage, smoke, release of flammable gases, thermal runaway, fire or explosion. ■ It is strictly prohibited to disassemble, modify or damage the battery (e.g. inserting foreign objects, extruding with external force, immersing in water or other liquids), which may cause battery leakage, smoke, release of flammable gases, thermal runaway, fire or explosion. ■ It is strictly prohibited for the battery terminals to come into contact with other metal objects, which may cause heat generation or electrolyte leakage. ■ Battery electrolyte is toxic and volatile. When electrolyte leakage occurs or there is an abnormal odor, avoid contact with the leaking liquid or gas. Non-professionals should stay away, pay attention to protection, and contact professionals immediately to deal with the situation.
 Warning	■ After discharging the battery, the battery should be recharged in a timely manner, otherwise the battery may be damaged due to over-discharge. ■ Batteries should be installed in areas away from liquids, and are strictly prohibited to be installed under air conditioning outlets, vents, machine room outlet windows or water pipes and other locations prone to water leakage, in order to prevent liquids from entering the interior of the energy storage system and causing malfunctions or short circuits.

2.2.4 Equipment security

 Dangerous	■ Before making electrical connections, make sure that the energy storage system is undamaged, otherwise electric shock or fire may result. ■ During operation, foreign objects should be prevented from entering the interior of the equipment, which could result in short circuit failure or damage to the equipment, load supply derating, power loss and personal injury. ■ Do not allow finger, part, screw or tool to touch the running fan to avoid injury to hands or damage to the unit.
Warning	■ When installing equipment that requires grounding, the protective ground wire must be installed first; when removing equipment, the protective ground wire must be removed last. ■ Before installing and removing the power cables, the energy storage system itself and its front and rear stage switches must be disconnected. ■ All equipment transportation, installation and wiring, operation and maintenance must comply with the relevant codes and regulations of the region where the project is located.
 Attention	■ No cables are allowed to pass through the inlet or outlet of the energy storage system. ■ Do not deactivate equipment protection devices and ignore warnings, cautions and precautions on manuals and energy storage systems. ■ Do not power on the equipment without completing the installation of the energy storage system or without confirmation from professionals.

2.3 Environmental requirements

 Dangerous	■ Site selection should be in accordance with local laws and regulations and relevant standard requirements. ■ It is strictly forbidden to place the energy storage system in or near flammable, explosive gas or smoke environment, and it is prohibited any operation in such an environment. ■ It is strictly prohibited to install the energy storage system in an environment with dust, fumes, volatile gases, corrosive gases, infrared and other radiation, organic solvents or excessive salt. ■ It is strictly prohibited to install the energy storage system in the area of strong vibration, strong noise sources and strong electromagnetic field interference. ■ The ground of the installation environment should be solid, without rubber soil, soft soil or poor geological conditions such as easy sinking. It is strictly forbidden to choose low-lying areas or areas prone to water accumulation. The site level should be higher than the historical highest water level in the area.
Warning	■ When the energy storage system is installed, the protective ground wire must be installed first; when the equipment is removed, the protective ground wire must be removed last. ■ Before installing or removing power cables, the energy storage system and its front and rear switches should be disconnected.
 Attention	■ Fences or warning ropes must be added to the energy storage system operation area, and "No Entry" signs must be hung. Non-staff members are strictly prohibited from entering.
 Prompt	■ It is strictly prohibited to artificially alter, damage or obscure the signs and nameplates on the equipment, signs that become unclear due to long-term use should be replaced in a timely manner.

2.4 Mechanical safety

 Dangerous	■ Arc welding, cutting and other operations on the energy storage system are prohibited without evaluation by the company. ■ Installation of other equipment on top of the energy storage system is prohibited without evaluation by the Company. ■ Drilling holes in the energy storage system is strictly prohibited. Drilling holes will damage its sealing, electromagnetic shielding performance, internal devices or cables, and metal shavings from drilling holes into the device will cause short circuit on circuit board.
Warning	■ Before installing the energy storage system, you should first make sure it is securely fixed to prevent the cabinet from tilting and collapsing due to an unstable center of gravity, causing problems such as injuries to installer and damage to equipment. ■ Tools need to be prepared and qualified by professional organizations, prohibit the use of scarred and unqualified or beyond the inspection of the validity of the tool, to ensure that the tool is solid, not overloaded.
 Attention	■ Please check the energy storage system connection terminal screws periodically to make sure they are tight and not loose.
 Notice	■ When installing the equipment, use a torque tool with the appropriate range to tight the screws. When tightening with a wrench, make sure that the wrench is not skewed.

2.5 Emergency response plan

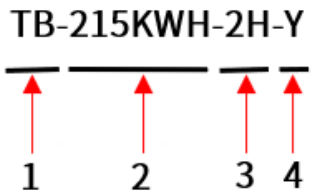
 Dangerous	If the battery is dropped or hit hard: ■ If the battery has obvious odor, breakage, smoke, fire, etc., immediately evacuate and call the police in time, and the professional personnel will use fire-fighting facilities to extinguish fires while ensuring safety.

	■ When the battery temperature is too high, it will cause deformation, damage, electrolyte overflow and leak toxic gas. Wear respiratory protection equipment and stay away from it to avoid skin irritation and chemical burns. In case of fire: ■ When safety is ensured, the system should be powered off and the energy storage system door should not be opened. ■ Immediately evacuate the building or equipment area and ring the fire alarm, or call the fire alarm, and do not re-enter the burning building or energy storage system area. ■ After the firefighters arrive at the scene, provide them with relevant product information, including but not limited to: battery pack type, energy storage system capacity, battery pack location distribution, user manual, etc. ■ Firefighters need to be prompted to avoid contact with high- voltage components in extinguishing fires, as this may result in the risk of electric shock. In case of flooding: ■ Power off the system while ensuring safety. ■ If any part of the battery is submerged in water, do not touch the battery to avoid possible electric shock. ■ Do not use batteries that have been flooded and contact a battery recycling company for disposal. If exhaust starting: ■ Do not allow personnel to face the exhaust port. ■ Contact one of our professionals for an estimate after you finish. If the sound and light alarm sound: ■ Turn off the power supply when safety is ensured, leave immediately, and do not open the door.

3. Products Introduction

3.1 Model description

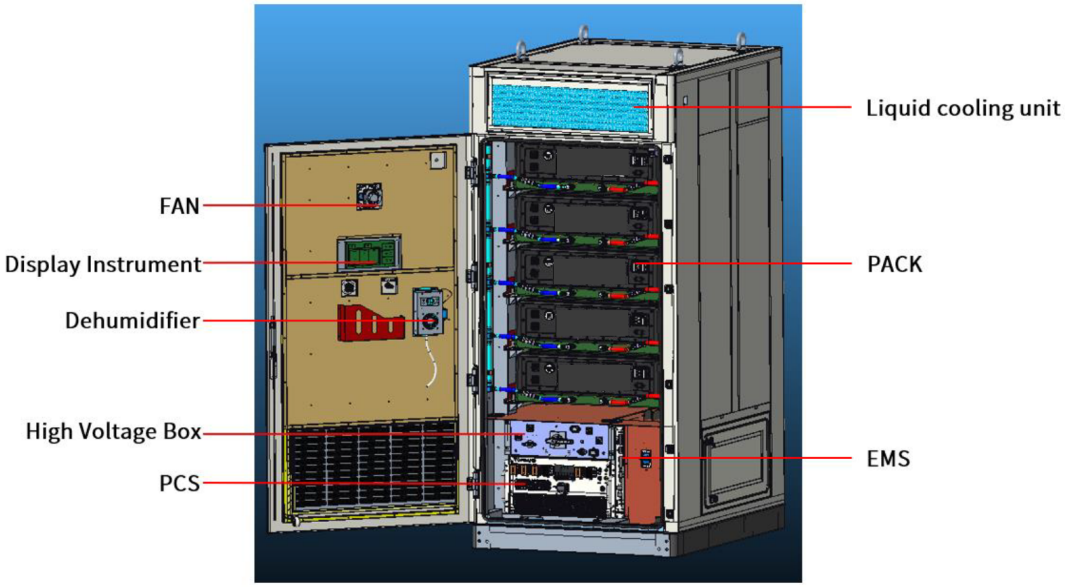
This manual mainly covers the following product models:



Signs	Meaning	Retrieve a value
1	Company name	Topband
2	Energy level	215KWH: Energy of 215 kWh
3	Electricity backup signs	2H: for ⩾ 2 hours of power backup time scenarios
4	Thermal signs	Y: Liquid Cooling

3.2 Appearance introduction

The visual appearance of the energy storage system is shown below:



3.3 Parameter introduction

The main parameter of the energy storage system are shown in the following table:

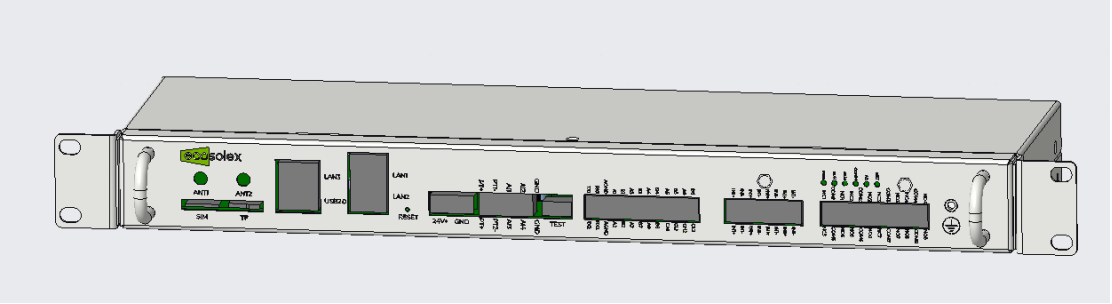
Name	Technical Parameter
Rated output power	100kW
Rated grid voltage	400V,3W+N+PE

Rated grid frequency	50Hz
Rated current	150A
Total harmonic distortion	＜3%
Maximum system conversion efficiency	⩾90%
Power factor	Continuous, -1~+1
Wiring method	Three-phase four-wire +PE
Battery Type	LFP-280Ah
Rated electrical energy	215kWh
Battery voltage range	648V~864V
Charge/discharge ratio	0.5C
Number of cycles	⩾6000,@25℃,0.5C
Cooling method	Liquid cooling
Fire protection system	Aerosol
Dimensions (without rings)	2350mm（H）*1050（W）*1300（D）
Weight	2.7t

3.4 Components introduction

3.4.1 EMS

The energy storage system adopts high-performance self-developed EMS_A01, built-in ARM cortex series quad-core processor, with rich peripheral resources, stable and reliable operation, fast response speed, comprehensive functions, real-time scheduling and remote control, which can be widely used in energy storage products, and the actual picture is shown below:



The main technical parameter of EMS is shown in the table below:

Project Name	Parameter
Operating voltage	DC24V
Current	<2A

Communication interfaces	8 RS485, 2 RS232, 2 CAN, 3 Ethernet, 1 4G
Other interfaces	SIM card, SD card, Reset, Wireless antenna
Switching, analog	8 Channel DO/DI, 6 Channel AI
Communication protocol	Ethernet: MODBUS TCP, IEC61850 MMS CAN, RS485: Modbus RTU
Protection class	IP20
installation	Rack and wall mounted

3.4.2 PCS

The PCS utilizes the TB125K-B3P model with the following functions and features:

- In the grid-connected system, PCS can realize peak shaving and valley filling, peak and frequency regulation, dynamic capacity increase and reactive power support to the grid, and also support various charging modes such as constant voltage, constant current and constant power.
- In grid-disconnected system, the PCS operates primarily in voltage source mode to provide backup power to AC loads.
- It has the function of storing system information such as operation data and fault data.
- Individualized parameter configurations to meet the best operating performance under a wide range of needs.
- Charge/discharge control of the PACK and response to grid scheduling demands are realized through relevant communication protocols.
- It is equipped with protection functions such as DC reverse connection protection, AC short-circuit protection, AC over-current protection, AC over-voltage protection, islanding protection, leakage current protection, surge protection and insulation impedance detection.

The actual picture is shown below:

The main technical parameter of PCS is shown in the table below:

Technical Parameter		TB125K-B3P
DC Side parameter	Maximum DC power	140kW
	Maximum DC voltage	1000V
	Maximum DC current	233.3A
	DC operating voltage range	600V~1000V
AC Side parameter	Rated output power	125kW
	Maximum output active power	137.5kW
	Maximum output apparent power	137.5kVA
	Rated output voltage	380V, 3L/N or 3L
	AC voltage range	340V~440V
	Output voltage frequency	50/60Hz
	Rated output current	189.9A
	Maximum output current	208.9A
	Power factor	Continuous,-1～+1
	Total current harmonic distortion	⩽3%
Efficiency	Maximum efficiency	98.50%
	Rated efficiency	97.3%
	Human-computer interaction	LED+APP

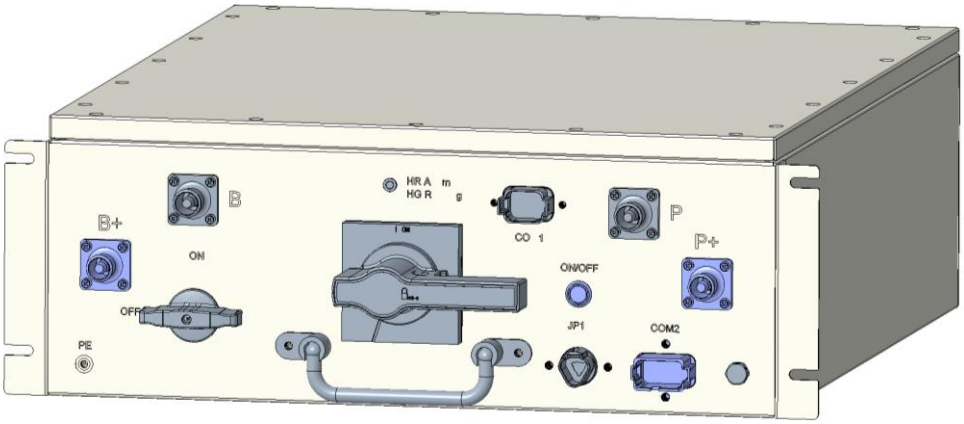
Communica-tion	Monitoring Method	RS485
General parameter	Standby power con-sumption	＜10W
	Topological structure	Non-isolated
	Cooling method	Intelligent air-cooled
	Protection class	IP20
	Weights	90kg
	Sizes	515mm×280mm×740mm

3.4.3 High voltage box

The energy storage system uses a high-performance high-voltage control box with the following functions and features:

- Supports manual and electric opening and closing control functions of DC circuit breaker.
- It has accurate battery cluster voltage detection, group terminal current detection and battery cluster insulation status detection functions.
- Supports temperature detection of copper row and power connector in the high- voltage box to ensure the safety of system operation.
- The external interface and box structure adopt waterproof option and de-sign, the whole machine can reach IP65 protection level.
- Adopting multiple redundant protection measures, it has high reliability, high stability and high anti-interference performance.
- Supports CAN communication or daisy chain communication function with the battery management slave control module and master control module of the energy storage system.

The actual picture is shown below:



The main technical parameters of the high-voltage box are shown in the table below:

Name	Parameter
Control unit	DC1500V
Molded case circuit breakers	DC1500V
DC contactor	DC1500V /250A
Fuse	DC1500 V /315A
Pre-charge resistance	200W/50Ω
Diverter	300A/0.2%
Switching mode power supply	200W/ Output DC24V
Communication socket	3-pin, 8- pin, 12-pin
Protection class	IP65
Weight	⩽40kg

3.4.4 Battery

The battery module consists of four 1P12S modules connected in series to form 153.6V 280AH with an energy of 43.008kWh, and the energy storage system uses five battery modules connected in series with a total energy of 215.04kWh.

The battery module adopts modularized design, featuring high energy density, wide temperature range, long life, light weight and high safety performance, and actual picture is shown below:

The main technical parameter of a single battery module is shown in the table below:

Name		Parameter
Cell	Cell type	LFP
	Nominal capacity	280Ah
	Nominal energy	896Wh
	Nominal voltage	3.2V
Module	Grouping method	1P48S
	Nominal l capacity	280Ah
	Nominal energy	43.008kWh
	Nominal voltage	153.6V
	Operating voltage	120 V ~175.2V
	Energy density	139Wh/kg
	Maximum charge/discharge ratio	1P
	Rated charge/discharge ratio	0.5P
	Cooling method	Liquid cooling
	Coolant	0.7L
	Protection class	IP67
	Sizes	1092mm×820mm×245mm
	Weights	310kg

3.4.5 Liquid cooling unit

The energy storage system utilizes a highly energy-efficient and adaptable liquid cooled unit with the following features:

- Making full use of the natural cooling source, variable frequency design, high efficiency and energy saving, energy efficiency ratio up to 4.62/year.
- Closed-loop circulation system, automatic replenishment system to ensure stable coolant performance.
- The condenser adopts the steel tube fin method with high corrosion resistance.
- 365 days/year uninterrupted operation, the whole machine life>10 years, high reliability.
- Supports remote communication and provides a variety of alarm

and protection functions.

The actual picture is shown below:

The main technical parameter of the liquid-cooled unit are shown in the table below:

Name	Parameter
Rated working voltage	AC220V ~AC240V 50/60Hz
Maximum operating current	19.2A
Rated circulating water flow	46.5L/min
Rated external circulation head	60Kpa
Refrigerant	R134a
Coolant	50% Ethylene glycol aqueous solution
Sizes	245mm×700mm×900mm
Weight	75kg
Installation	Drawer-type
Inlet and outlet pipe form	DN20 quick coupling
Liquid temperature setting range	10℃～35℃(heating point ≤ cooling point)
Default cooling setpoint	18℃
Default heating	15℃

setpoint	

3.4.6 Dehumidifier

The energy storage system uses an intelligent semiconductor dehumidifier with the following functions and features:

- The dehumidification air duct actively induces condensation and exhausts gas to heat and dehumidify, effectively achieving comprehensive management of moisture-proof and dehumidification of the enclosed space in the cabinet.
- The dehumidification process, which results in a simultaneous decrease in relative and absolute humidity, hardly raises the temperature and does not produce the negative effects of temperature differences.
- The dehumidification condensation pipeline can discharge the condensed water out of the cabinet, and can also use liquid storage bags to collect the condensed water outside the cabinet.
- Specialized moisture-proof components are used to ensure normal operation in humid environments.

The actual picture is shown below:

The main technical parameter of the dehumidifier is shown in the table below:

Name	Parameter
Operating voltage	DC24V
Dehumidification power	60W
Communication method	RS485
Humidity detection range	25℃～95℃

Temperature detection range	20%RH～95%RH
Dehumidification start-up value	45%RH～95%RH
Humidity measure-ment accuracy	±3%RH
Temperature meas-urement accuracy	±1℃
Overall sizes	236mm×129mm×66mm
Guide water pipe	Silicone D12mm、L2m
Net weight	1.2kg

3.4.7 Fire fighting

The energy storage system utilizes composite fire detectors with the following features:

- which can detect hydrogen, carbon monoxide, VOC, smoke concentrations and temperature changes resulting from thermal runaway of batteries in real time. And report it immediately.
- Can be used with electrically activated aerosol automatic fire extinguishing devices.

The actual picture is shown below:

The main technical parameter of the composite fire detector is shown in the table below:

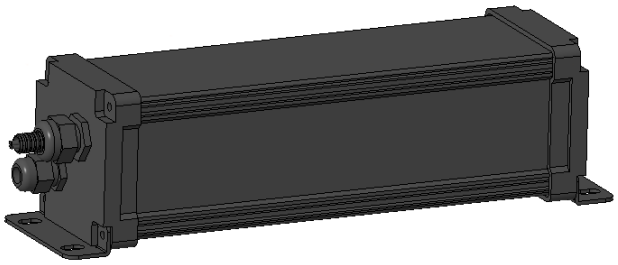
Name	Parameter
Operating voltage	DC9 V ~24V
Starting current	24V/2A
Communication method	CAN

Power wastage	＜5W
Net weight	110g
Smoke Alarm threshold	Level 1 alarm: 0.13dB/m, Level 2 alarm: 0.25dB/m Threshold can be set
CO gas alarm threshold	Level 1 alarm: 200ppm, Level 2 alarm: 500ppm Threshold can be set
Ambient temperature alarm threshold	Level 1 alarm: 70°C, Level 2 alarm: 80°C, Level 3 alarm: 90°C.Thresholds can be set

The energy storage system utilizes an automatic aerosol fire extinguisher with the following features:

- Through high temperature, high pressure and other special conditions will be fire extinguishing agent in the form of aerosol spray, to achieve rapid and effective fire extinguishing effect.
- Wide range of application, suitable for confined spaces, small size, light weight, non-toxic and non-destructive of the atmospheric ozone layer.
- Easy maintenance, atmospheric pressure storage, long life.

The actual picture is shown below:



The main parameter of the aerosol fire extinguisher is shown in the table below:

Name	Parameter
Starting mode	Electric or hot start
Starting current	⩾700mA
Starting temperature	⩾170°C
Shell color	Black
Feedback signal	Passive switching signals
Spraying time	⩽15s
Protection of space	$3m^3$
Oxidant name and content	Potassium nitrate, strontium nitrate 50% ~ 58%

Sizes	247mm×67mm×66mm
Net weight	1145g±30g

4. Transportation and storage

4.1 Type of transportation

Energy storage systems can be transported by land and sea.

4.2 Transportation requirements

Energy storage system transportation needs to meet the following requirements:

- The doors of each cabinet of the equipment are locked and checked to make sure that the batteries are intact and that there is no odor or leakage.
- Please pack the equipment strictly before transportation by vehicle, and take moisture-proof measures for long-distance transportation.
- Land transportation shall comply with ADR or JT/T 617 transportation requirements.
- Land transportation should be as far as possible to choose a better road condition under the route of the equipment for the transportation of mobile, transport process to reduce the bump and tilt.
- When transporting by land, be sure to use a rope to secure the top ring of the equipment to the transport vehicle so that the equipment is not tilted too far during transportation.
- Comply with international dangerous goods transportation rules and meet the regulatory requirements of the transportation regulatory authorities of the country of origin, country of transit and country of destination.
- Sea transportation should comply with the transportation requirements of the International Maritime Dangerous Goods Code.

4.3 Transportation precautions

 Dangerous	■ Rough loading and unloading is prohibited, as this may result in short-circuit, damage (leakage, rupture, etc.), fire or explosion of the battery. ■ It is strictly prohibited to transport equipment or items that may affect or damage the energy storage equipment together in a mixed load.

	■ Stacking is prohibited for transportation in ports and on ships.
Warning	■ When using forklift to move short distance, the forklift should be forked in the center position to prevent tipping over. Before moving, please use the rope to fasten the equipment on the forklift; when moving, professional personnel should be on the side to watch and direct.

4.4 Storage requirements

Energy storage system storage needs to meet the following requirements:

- It should be stored in an environment that is waterproof, dustproof, and free of corrosive and flammable gases.
- It should be stored under the condition of ambient temperature 0℃～35℃ and relative humidity not more than 80%.
- Battery module SOC should be maintained at 20% to 50%.

4.5 Storage precautions

 Dangerous	■ Tilting or inverted storage is prohibited. ■ Avoid mechanical presses, heavy pressure, strong electric fields and strong magnetic fields.
Warning	■ Battery is recommended to be used in a timely manner. For battery that have been stored for a long period of time, please recharge regularly, otherwise the battery may be damaged. ■ The recharging process should be performed by professional and trained and qualified personnel. If the battery swell, smoke, or otherwise becomes abnormal, charging should be stopped immediately.
 Attention	■ Regular inspections should be made to check whether the cabinet and the internal equipment are intact, and the cycle should be once every 15 to 30 days.

5. Unboxing and Installation

5.1 Unboxing acceptance

Before unboxing and accepting the energy storage system, you need to pay attention to the following aspects:

- Before unpacking the equipment, check the outer packaging for visible signs of damage.
- It is necessary to keep the energy storage equipment stable during the unpacking process, and the packaging should be removed carefully to avoid scratching the equipment.
- Please check whether the delivery items are complete according to the attached packing list.
- Chack that the energy storage equipment is in good condition, without damage, rust and paint loss.
- The nameplate information should be checked for consistency with the product ordered.
- The relevant warning signs of the energy storage equipment should be checked for damage, scratches or blurring.
- If the environment for dismantling is poor, after dismantling the package, please do a good job of preventing dust and condensation or wait until a suitable environment is selected before dismantling the package.

5.2 Equipment installation

5.2.1 Installation environmental requirements

Item	Requirement
Installation site requirement	■ When selecting the installation site, due consideration should be given to the characteristics of the climatic environment and geological conditions (e.g., stress wave emission, groundwater level). ■ The surroundings of the site are dry and well ventilated. ■ Ensure that there are no objects in the vicinity of the installation location that could tip over and damage the energy storage system. ■ Keep away from flammable, explosive and corrosive materials.
Installation ground requirement	■ The energy storage system is to be installed on concrete or other non-combustible surfaces, provided that the installation is level, solid, and flat, with adequate long-term capacity.

	■ If a foundation is required, it must be designed and constructed in advance in accordance with the requirements of the energy storage system and the national, regional or local standards of the installation area, and should at least meet the following requirements: a) The bottom of the pit where the foundation is to be built must be compacted and filled. b) The cabinet should be elevated to prevent rain from eroding the base of the cabinet as well as the interior. c) Drainage measures need to be constructed to take into account local geological conditions. d) Consider cable routing and reserve trenches or cable entry holes. e) After connecting all cables, cable inlets and outlets as well as connectors should be sealed with fire-resistant mud or other suitable material to prevent rodent entry.
Installation space requirement	■ Sufficient space should be left in front, back, left, right and above the energy storage system for heat dissipation, maintenance and escape.

5.2.2 Auxiliary equipment installation

You should pay attention to the following aspects when installing with a forklift:

- It should be ensured that the pins are inserted into the forked sockets of the energy storage device and that the length of the pins meets the requirements of the device.
- It should be ensured that it is moved and lowered slowly and steadily, and the angle of inclination should be as small as possible to avoid shocks and vibrations.
- Professional installers need to be arranged to guide and guide the driver.

You should pay attention to the following aspects when installing with a crane:

- It should be ensured that the sling connections are safe and reliable, and the strength of the slings should be sufficient to bear the weight of the

equipment.

- When lifting must ensure the site safety, the site should be a professional command.
- The equipment should be lifted vertically, not skewed, and when the equipment is in place, it should be placed gently and landed steadily.
- It is strictly prohibited for unrelated persons to enter the lifting area, and it is prohibited to stand under the lifting arm.

5.2.3 Installation process

For details of the equipment installation process, please refer to the Liquid Cooled Energy Storage All-in-One -Equipment Installation Manual.

5.3 Check after installation

After the equipment is installed, you need to confirm that the following meet the requirements:

- The energy storage system is mounted on fixed points in accordance with the specified design and is stable and reliable;
- The space for the installation meets the specified requirements.

6. Electrical connection

6.1 Electrical preparations

 Dangerous	■ Before making electrical connections, make sure that all switches on the energy storage system are in the OFF position and that the AC and DC sides are not energized. ■ Smoking or the use of open flame near electrical connections is prohibited. ■ Before touching any conductive surface or terminal, measure the voltage at the contact point.
Warning	■ Only trained and qualified personnel may perform operations related to electrical connection. ■ When making cables, be sure to stay away from the equipment to avoid cable debris from accidentally entering the equipment and causing ignition resulting in personal injury and equipment damage. ■ It is recommended to wear insulated gloves and use insulated tools to avoid electric shock injury or short circuit

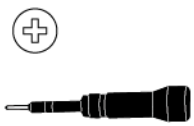
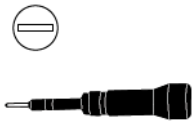
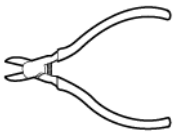
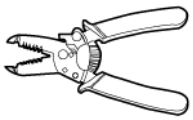
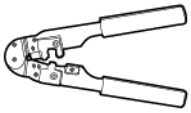
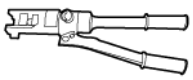
	failure. ■ It is recommended to have fire-fighting facilities that meet the requirements on site, such as fire sand, fire extinguishers, etc. ■ After each step of the wiring operation, it is necessary to carefully check to ensure that the wiring is correct and solid. ■ Ensure that all electrical component protective casings, insulating sleeves and other devices are in place after the installation is complete to avoid the risk of electric shock.
Notice	■ During connection, do not pull the cable hard enough to damage its insulation. ■ All cables and wires should have sufficient space for bending.

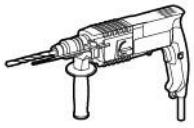
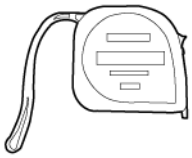
6.2 Wiring preparations

6.2.1 Preparations of tools and consumables

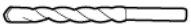
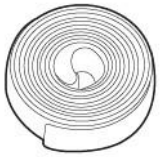
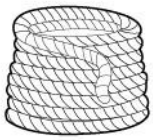
Use the appropriate tools for the electrical wiring, and do not use mismatched tools for the electrical connection, which may result in damage to the device or the nut.

Recommended installation tools include, but are not limited to, the following have:

 Phillips Insulated screw drive	 Flat head screw driver	 Diagonal plier	 Wire stripper
 Cord cutter	 Pipe crimping plier	 Hydraulic plier	 Wrench

 Impact drill	 Hot air gun	 Multimeter	 Inner hexagon set
 Insulated ladder	 Measuring tape	 Rubber hammer	

Recommended consumables are:

 Impact drill bit	 Load-bearing tie	 Heat shrink tube	 Cord

Recommended personal protective tools are:

 Insulated gloves	 Protective gloves	 Insulated shoes	 Protective suit
 Safety helmet	 Safety glasses	 Reflective vest	 Dust mask

6.2.2 Cable preparations and requirements

For grid (off-grid) phase A, phase B, phase C and phase N, the cable for each phase input should be prepared with 50~95mm^2 conductors.

For grid (on-grid) phase A, phase B, phase C and phase N, the cable for each phase input should be prepared with 120~150mm^2 conductors.

Cable selection should meet the following requirements:

- It should be ensured that the conductor has sufficient current-carrying

capacity (the load current must be less than the allowable current-carrying capacity). Factors affecting the current-carrying capacity of the conductor include, but are not limited to, environmental conditions, the type of conductor insulation, the method of laying the cable, and the material and cross-sectional area of the cable.

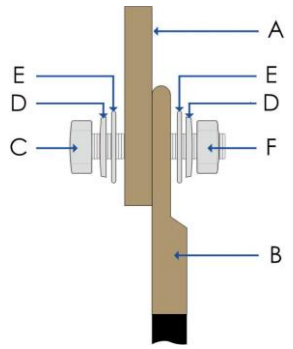
- The cross-sectional area of the distribution cable should be selected according to the heat-generating conditions and the maximum current-carrying capacity, and the length must leave a margin.
- The specifications and materials of three-phase AC input and output cables should be the same, and flame-retardant cables should be selected.
- In domestic power distribution cables, the color selection of three-phase AC phase wires shall be yellow, green, red or brown, grey and black, and the color of phase wires of foreign power distribution cables shall follow the standard requirements of local countries or regions.

6.3 Wiring component requirements

M8 wiring noses should be prepared for each cable line of the A-phase, B-phase, C- phase and N-phase inputs to the grid.

6.3.1 Copper wire access

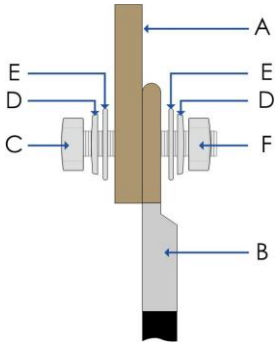
If copper wire access is selected, the wiring components should be connected in the order shown below.



Serial number	Name	Serial number	Name
A	Copper row	D	Gasket
B	Copper terminal	E	Flat mat
C	Bolt	F	Nut

6.3.2 Aluminum wire access

If aluminum wire access is selected, a copper-aluminum transition terminal is required and the wiring components should be connected in the order shown below.



Serial number	Name	Serial number	Name
A	Copper row	D	Gasket
B	Copper-aluminum transition terminal	E	Flat mat
C	Bolt	F	Nut

6.4 Ground connection

The method and requirements for ground connections are as follows:

- One method of grounding is to use the grounding flat steel welding fixed, the other is to use the grounding cable fixed.
- The grounding cable of the energy storage system should use 35~50mm^2 copper grounding cable with M8 wiring copper nose, refer to the requirements for wiring components to reliably connect the grounding point to the cabinet grounding point and permanently to the protective ground.
- The grounding resistance shall be measured after the grounding connection and the impedance shall meet the requirements of local electrical standards.

6.5 AC side wiring

When connecting to the AC grid, the upper-level AC circuit breaker must be disconnected to ensure that there is no voltage on the contact terminals. When connecting to the grid, permission must be obtained from relevant departments and all grid-related safety requirements and specifications must be complied with.

The specific wiring steps are as follows:

a) Disconnect the upper-level AC circuit breaker and measure with a multimeter to ensure that there is no voltage at the terminal.

b) Bring the cable into the inlet hole and into the AC wiring area of the energy storage system cabinet.

c) Ensure that the AC cables are connected in the correct order.

d) Use wire stripper to strip the protective layer of the cable to expose the copper core.

e) Refer to 6.3.1 and use terminal crimping.

f) Using M8 bolts, secure the terminals to the wiring holes and tighten.

g) When wiring is complete, gently tug on the cable to ensure that margin is left.

h) The alignment across the energy storage system is protected by flexible bellows and the bellows are fixed and installed using special fixing clips.

7. System power-up and debugging

7.1 Check before power on

Serial number	Checklist	Inspection criteria
1	Cable	■ The cable protection layer is well wrapped with no visible damage. ■ The cable hose is intact. ■ The cable installation bolts have been tightened and are not loose when pulled.
2	Battery	■ The copper bars of the battery pack a not deformed and the plastic coating is not damaged. ■ There is no damage to the exterior of each battery pack.
3	Breaker	■ All circuit breakers of the energy storage system are OFF.
4	Emergency stop button	■ The emergency stop button is in the pressed state.
5	Lightning protector	■ The lightning protector status indication is green.
6	Grounding	■ Check to make sure the unit is reliably grounded.
7	Liquid Cooling Unit	■ Liquid cooling lines and connections are not loose.
8	Heat	■ Check that all air inlets and outlets are not

	dissipation	obstructed or blocked.
9	Baffle area	■ The baffles in the power distribution area should not have cracks, dents, scratches, cracks or looseness.
10	Foreign matter	■ Check to make sure the cabinet is free of foreign objects, such as tools or leftover materials.

7.2 System power-on

The following steps should be followed for the first power-up or system power-up of the energy storage system:

a) Release the emergency stop button (required for first power-up only).
b) Open the three-phase AC main switch QF1.
c) Switch on the lightning protector switch QF12 and the contactor control switch QF11.
d) Turn on QF3, QF4, QF5, QF6 and QF8 circuit breaker switches in sequence.
e) Turn on QF7, QF9, and QF10 circuit breaker switches in sequence.
f) Open the PCS AC protective switch - QF2 circuit breaker.
g) Turn on the main switch of the high voltage box.

Warning	■ During the system power-on process, if any abnormalities are found, the emergency stop button should be pressed immediately to power off and shut down the system urgently. Wait for professional technicians to resolve and confirm that there are no problems before resuming system power-on.

7.3 System debugging

System debugging of the energy storage system should be performed by following the steps below:

a) Verify that everything is OK with the energy storage system powering on.
b) Connect the network port of the EMS to the tuning computer with a network cable.
c) Open the relevant debugging software to check whether there are abnormal alarms in each submodule.
d) If there are alarms, they need to be solved one by one according to the content of the alarm and the suggested solutions in 9.2 of the reference manual.

e) If there are no alarms or if the alarms that exist are resolved, it is time to begin configuring the relevant parameter of the energy storage system, including but not limited to EMS parameter, PCS parameter, dehumidifier parameter, etc.

f) The All-in-One is in an available state, waiting for the cloud platform to start up or locally.

g) The energy storage system is started for trial operation and the equipment communication parameter are observed to be normal.

Warning	■ Operations related to the debugging of the system are restricted to professional personnel only. ■ When debugging, a fence or cordon should be set up to prohibit unrelated personnel from entering the site area. ■ During the debugging of the energy storage system, if an unexpected abnormal situation occurs, the emergency stop button should be pressed immediately.

7.4 System power off

The energy storage system should be powered off or shut down for maintenance in the following order:

a) Turn off the main switch of the high voltage box.

b) Open the three-phase AC main switch QF1.

c) Close the lightning protector switch QF12 and the contactor control switch QF11.

d) Turn off the QF3, QF4, QF5, QF6 and QF8 circuit breaker switches in sequence.

e) Turn off the QF7, QF9 and QF10 circuit breaker switches in sequence.

f) Closing the PCS AC protective switch - QF2 circuit breaker.

g) Press the emergency stop button.

8. Function introduction

8.1 Safety monitoring

8.1.1 Battery monitoring

The energy storage system can dynamically adjust and control the cooling and heating functions according to the current maximum single cell temperature, average battery temperature and ambient temperature and humidity, so that the battery

temperature is always maintained between 15 and 30°C and the relative humidity is maintained at less than 75%.

8.1.2 Emergency stop monitoring

The energy storage system can monitor the emergency stop status at any time. When the emergency stop is triggered, the energy storage system immediately exits the operation mode, stops charging and discharging and alarms.

8.1.3 Fire monitoring

The energy storage system can monitor hydrogen, carbon monoxide, VOC, smoke concentration and temperature changes in real time based on the composite fire detector. If the concentration and temperature changes in the cabinet exceed the specified level one limit, the energy storage system will trigger the fan and explosion-proof breather valve to perform exhaust work; when the concentration and temperature changes exceed the level two or three limits, the energy storage system will trigger an additional Fire extinguishing agent in aerosol form to extinguish fire quickly.

8.1.4 Flood monitoring

The energy storage system can monitor whether water enters into the cabinet, when the water enters into the cabinet and reaches the limiting height, the energy storage system immediately exits the operation mode, stops charging and discharging and alarms.

8.1.5 Door monitoring

The energy storage system has a built-in door switch sensing device. When the door is monitored to be open during use, the energy storage system immediately exits the operation mode, stops charging and discharging and alarms.

8.1.6 Fault monitoring

The energy storage system can monitor the failure of all the equipment in the cabinet in real time, when any equipment in the cabinet has a hardware and software failure or communication failure, the energy storage system immediately exits the operation mode, stops charging and discharging and alarms.

8.2 Cloud platform

Relying on the latest architecture server, the cloud platform of energy storage system has low network latency, excellent stability, high scalability, perfect monitoring system and multiple security protection measures. The cloud platform integrates one-stop management of scheduling control and configuration, charging and discharging capacity, revenue analysis, monitoring, alarm, operation and

maintenance, and project distribution, which improves friendly and smooth interactive experience for users.

8.2.1 Big data screen

The data screen of the cloud platform adopts a flat design, with clear division of modules such as total revenue, social benefits and energy storage overview, and the design of visualized data such as green power usage rate and power analysis enables users to quickly and deeply understand the required information and benefits, and the sense of experience is greatly improved. The big screen of cloud platform data is shown in the figure below.

8.2.2 Operation monitoring

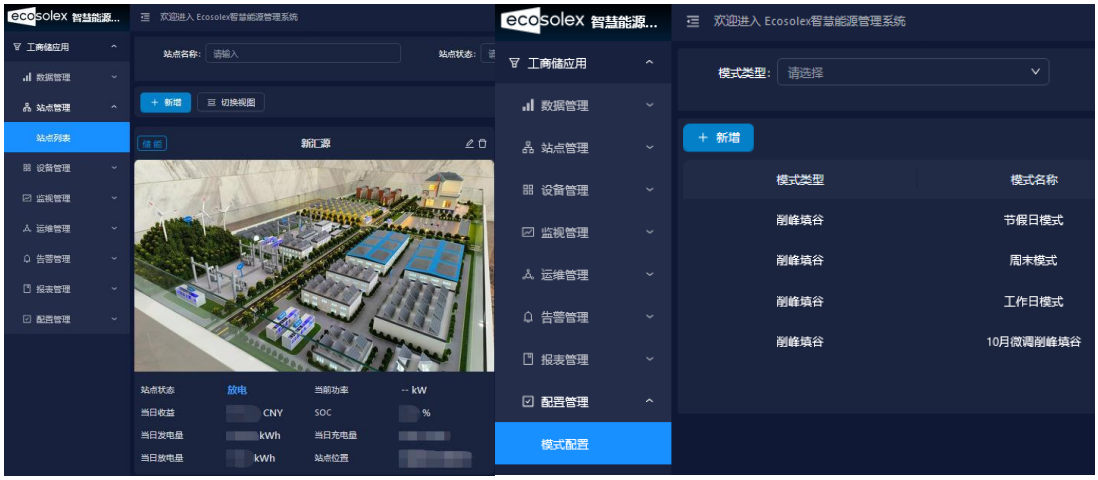
The operation topology monitoring page of the cloud platform can monitor and collect the overall and internal operation status of the energy storage system in real time, including but not limited to transformer, voltage and PCS, EMS, BMS, liquid cooling unit, Fire-fighting system, real-time temperature, etc., and provide real-time feedback and diagnosis to ensure that every possible hidden danger can be monitored, so as to give users peace of mind.

The Run operation monitoring page is shown below:

8.2.3 Site and configuration management

For energy storage system projects under construction, in operation or out of service, the cloud platform makes a clear module division, so that users can precisely layout and control the process of each project. At the same time, the cloud platform also supports remote configuration management and configuration functions, containing a variety of peak shaving and valley filling benefit models and configuration lists, so that users or professionals can use the energy storage system more quickly and reasonably.

The Site and Configuration Management pages are shown below:

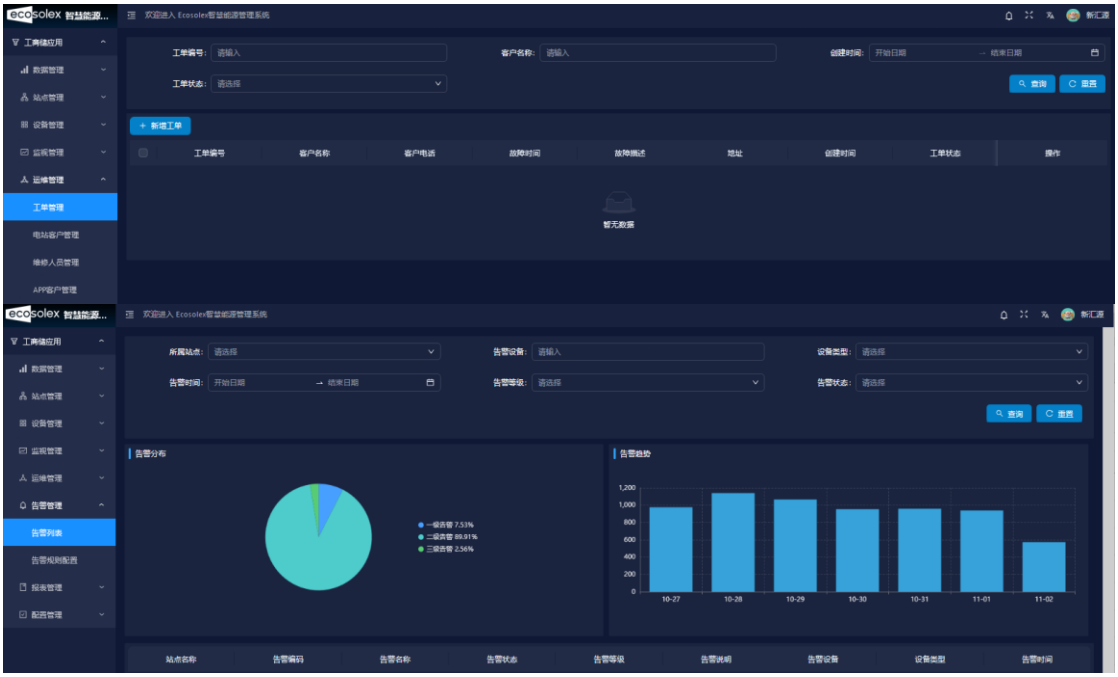


8.2.4 Alarm and maintenance management

The cloud platform adopts rapid response mechanism and intelligent operation and maintenance mode to quickly locate the site information and alarm causes, and complete the transformation of work orders, realize full automation from fault to order dispatch. Intelligent dispatching system and rationalized management of maintenance personnel greatly improve the efficiency and guarantee of after-sales service.

The cloud platform system records the process of troubleshooting or maintenance, which facilitates the subsequent more targeted after-sales service, and contains a list of alarms and faults, which makes it easier to clarify the alarm level and the required recommended operation. Encrypted data storage and transmission, multiple backup mechanisms to ensure information security, logging system to ensure traceability of system operations.

The alarm maintenance management pages are shown in the following figure:



8.3 Grid-connected and grid disconnected switching

The energy storage system supports the function of grid-connected and grid disconnected switching:

When the PCS detects the loss of power from the grid, it will send a disconnect command, and at the same time, the PCS will immediately complete the automatic switching from the " grid-connected " mode to the " grid-disconnected " mode, switching to the energy storage system to supply power to the load side, and the whole switching time is less than 2S.

When the PCS detects power coming from the grid, it will send a connect command. After receiving the connect completion signal, it will track the grid phase and amplitude. After the grid phase and amplitude are synchronized, the PCS will cut back to the grid-connected operation mode, realizing the switching from the " grid-disconnected " mode to the "grid-connected" mode, and the whole switching time is less than 2S.

8.4 Anti-reverse flow

The energy storage system has an anti-reverse flow function, which dynamically adjusts the charging and discharging power by detecting the set reverse current power, preventing the electricity from the energy storage system from entering into the grid.

8.5 Peak shaving and valley filling

The energy storage system can be set to the time mode (operating according to the power at the time) or the period mode (operating according to the power at the period) according to user needs, and the corresponding power can be set. Energy is stored during the low load or low electricity price period, and the stored energy is released during the peak load or high electricity price period. It can not only make profits through the peak-valley price difference and reduce electricity bills, but also make the power generation and consumption of the power grid more balanced, reducing the burden and loss of the power grid.

8.6 Dynamic capacity increase

The energy storage system can dynamically output differential power according to the output power of the transformer on line in the grid area where the user is located, supplementing the capacity of the transformer in a short period of time to better meet the requirements of grid scheduling.

8.7 Black start

The energy storage system supports the black start function. After the power grid system stops operating due to a fault and all power is power off, the electric energy stored in the energy storage system can be released when needed to provide the power required to start the generator set, drive the generator set that cannot start on its own, gradually expand the recovery range of the power system, and ultimately achieve the recovery of the entire power system.

9. Alarm processing

9.1 Summarize

The alarm function provides real-time feedback on the operating status of the energy storage system, and uploads the alarm information of each submodule and system to the EMS system to provide support for subsequent alarm analysis and processing.

 Warning	■ When diagnosing and troubleshooting faults, signs must be hung and barriers installed to prevent irrelevant personnel from entering. ■ During the troubleshooting and repair process, if you find any abnormalities in the energy storage system, the emergency stop button must be pressed immediately. ■ After troubleshooting, the cabinet should be checked for leftover tools, etc., or the unit may be damaged.

9.2 Alarm item list

Alarm name		Recommendations for handling
Communication 1	■ EMS and PCS communication interruption ■ EMS and BMS communication interruption ■ EMS and liquid-cooled unit communication interruption ■ EMS and fire sensor communication interruption ■ EMS and meter communication interruption ■ EMS and dehumidifier communication interruption ■ LAN1 interface communication interruption ■ LAN2 interface communication interruption	a) Check if the system power supply is normal b) Check if the communication line connection is normal c) Check if the communication port is damaged
Communication 2	■ EMS and cloud platform communication interruption	a) Check if the system power supply is normal b) Check if the 4G module SIM card has traffic c) Check the 4G signal

		strength d) Check the operation of the cloud platform server
Emergency stop switch	■ Emergency stop button pressed	a) Check that the emergency stop is pressed b) Check that the emergency stop button is working properly c) Check system power supply
Fire detection	■ Fire activation	a) Check if the external environment triggers the fire start b) Check if the fire sensor is working properly c) Check if the fire host is working properly
Water intrusion	■ Water intrusion Alarm	■ Check if there is water accumulation in the cabinet ■ Check if the water sensor is working properly ■ Check the connection of the water sensor ■ Check the system power supply
Door	■ The door was opened.	a) Check that the cabinet door is fully closed b) Check that the door

		limit switch is not offset c) Check limit sensor wiring d) Check system power supply
PCS	■ PCS internal fault	a) It is recommended to contact professional after-sales personnel to solve the problem
BMS	■ BMS internal fault	a) It is recommended to contact professional after-sales personnel to solve the problem
Liquid Cooling Unit	■ High water temperature fault ■ Low water temperature fault ■ Water temperature sensing fault ■ Return water temperature sensing fault ■ Inverter communication fault ■ System low voltage lock ■ Inverter over-current lock ■ Inverter over-temperature lock ■ Inverter overvoltage lock ■ Inverter low voltage lock ■ Inverter phase loss lock ■ Inverter other fault lock ■ Maximum current fault level ■ Water Replenishment fault ■ High water pressure fault	a) It is recommended to contact professional after-sales personnel to solve the problem
Dehumidifier	■ External temperature sensor fault ■ Cold surface temperature	a) It is recommended to contact professional after-sales personnel

	sensor fault ■ Hot surface temperature Sensor fault ■ High external ambient temperature	to solve the problem
Composite fire detectors	■ Sensor module 3.3V fault ■ Sensor module GND fault ■ Faulty sensor module detachment fault ■ Puncture valve fault ■ Smoke sensor fault ■ NTC Fault ■ CO sensor fault ■ H2 Sensor fault ■ VOC Sensor fault ■ VDD 5V fault ■ Flash fault ■ Smoke not zeroed fault	a) It is recommended to contact professional after-sales personnel to solve the problem

10. Routine maintenance

10.1 Summarize

Due to the influence of ambient temperature, humidity, dust or vibration, etc., the internal devices of the energy storage system will undergo different degrees of aging and wear and tear, etc., which will lead to the occurrence of potential failures within the equipment. Therefore, it is necessary to regularly maintain the energy storage system to ensure its normal operation and service life.

10.2 Maintenance precautions

 Dangerous	■ Before maintenance inspection, ensure that the AC circuit breaker on the upper level of the energy storage is completely disconnected. ■ After stopping the machine, please wait at least 15 minutes before opening the cabinet door, and make sure that the inside of the energy storage system has been completely uncharged before the maintenance inspection.

	■ After the power supply is disconnected, it is necessary to hang the relevant warning and prompting signs at the disconnection place to prevent the maintenance and inspection process will not be accidentally electrified.
Warning	■ Do not open the door of the outdoor energy storage system for maintenance in windy weather, and it is prohibited to open the cabinet door of the indoor or outdoor energy storage system in an environment with relative humidity greater than 95%. ■ Only professional or trained personnel should perform maintenance on the energy storage system. ■ During equipment maintenance, guardrails and other facilities should be set up around the equipment to prevent irrelevant personnel from performing operations that may affect related maintenance.
 Prompt	■ During the maintenance process, please complete the maintenance items of "checking" (no need to power off the power) first. After the required viewing items are confirmed, proceed with the maintenance items of " inspection or testing" (completely power off the power) to finally solve the problem together.

10.3 Maintenance project list and cycle

10.3.1 Maintenance work (thunderstorm season)

Project List	Inspection method
Lightning protector	■ It is recommended to inspect whether the visible window of the lightning arrester is green before each thunderstorm season. If it turns red, the module needs to be replaced.

10.3.2 Maintenance work (once every half year)

Project List	Inspection method
Liquid cooling unit-filter	■ Check that the filter is free of dust buildup, foreign matter clogging, and breakage
Liquid cooling unit-FAN	■ Check that the fan is free of dust and that there is no foreign matter blocking the air opening. ■ Check that the fan blades are not broken, and turn the fan smoothly without abnormal noise.
Liquid cooling unit - pipe	■ Check the appearance for damage, deformation and corrosion. ■ Inspect that pipe fixings and connecting joints are not loose. ■ Inspect that the valves are not damaged by failure.
Liquid cooling unit - condenser	■ Inspect that the condenser is free of dust and foreign matter. ■ Inspect that the fins have no serious bending or deformation.
Liquid cooling units- coolant	■ Inspect that the coolant is free from dirt, deposits, algae, etc. ■ Test the coolant concentration for compliance with range requirement. ■ Test the PH of the coolant and the concentration of each electrolyte meet the requirement.

10.3.3 Maintenance work (once a year)

Project List	Inspection method
Cabinet	■ Check to see if cabinet door latches, etc. can be opened flexibly. ■ Check that seals etc. are well fixed.
Bolt	■ Check that warning signs and labels, etc. are clearly visible and not defaced. Replace if necessary.
Corrosion	■ Check the interior of the cabinet for oxidation or rust, etc. Touch up paint if necessary.
	■ Inspect the cabinet for foreign objects, dust, dirt and water seepage.

The whole cabinet	■ Inspect that all inlet and outlet holes in the cabinet are well sealed. ■ Inspect whether the cables are damaged and whether the terminals are loose. ■ Inspect whether the equipotential connection inside the energy storage system is correct.
Fuse	■ Inspect that the resistance of the fuse is close to or equal to 0. If not, the fuse needs to be replaced.
Grounding	■ Inspect whether the ground connection is correct and the ground resistance should be less than 4Ω.

10.3.4 Maintenance work (every two years)

Project List	Inspection method
State of the energy storage system	■ Check whether the outdoor cabinet and internal equipment are damaged or deformed. ■ Check the internal equipment for abnormal noise during operation. ■ Check whether if the gray level in the cabinet is within normal limits. Clean if necessary. ■ Check whether the air inlet and outlet in the cabinet are blocked
Warning label	■ Check that warning signs and labels, etc. are clearly visible and not defaced.
Corrosion	■ Look for oxidation or rust, etc., on the outside of the cabinet. If necessary, more touch-up paint is required.
Cable Shield Grounding	■ Check whether the cable shield and insulation sleeve are in good contact; whether the grounding copper row is fixed in place.

11. Contact us

If you have any questions about this product, please get in touch with us. In order to provide you with better and faster
services, we need your assistance in providing the following information:

- Equipment Model
- Location of equipment installation
- Fault Code/Name
- Brief description of the fault phenomenon

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