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Approval Sheet
Model No.: AT10MW20.64MWH ESS
10MW/20.64MWh Energy Storage System

Approval Sheet No.: EA22-027

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Version	Description	Date (dd/mm/yyyy)	Released by	Approved by
0	First Edition	27/5/2022	Berlinda Yeh	ALISA CHEN

Items	Descriptions	
1	User Name	NEVA A.S.
2	Installation Location	Marmara Region Central Anatolia Region
3	Environmental Conditions	Outdoor air temperature -15 ~ 40 ℃
4	Altitude	0-800M

1. Scheme of system

1.1. System Overview

This set of energy storage system is the standard configuration scheme of 10MW/20.64MWh energy storage power station.

1.2. Reference Standards

《 Design code for electrochemical energy storage station》（GB/T 51048）

《Lithium ion battery for electrical energy storage》（GB/T 36276）

《Technical standard for battery management system of electrochemical energy storage station》（GB/T 34131）

《Technical specification for power conversion system of electrochemical energy storage system》（GB/T 34120）

《Testing code for power converter of electrochemical energy storage system》（GB/T 34133）

《General technical requirements for electrochemical energy storage system in power system》（GB/T 36558）

《Technical rule for electrochemical energy storage system connected to power grid》（GB/T 36547）

《Test specification for electrochemical energy storage system connected to power grid》（GB/T 36548）

《Operation performance index and evaluation of electrochemical energy storage station》（GB/T 36549）

《Technical standard for monitoring and control system of electrochemical energy storage

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station》（NB/T 42090）
《General specification for power control system of battery energy storage system》（NB/T 31016）
《Technical specification for lithium ion batteries of electrochemical energy storage station》（NB/T 42091）
《Conductor and Appliance Selection Design Code》(DL/T5222)
《Standard for design of cables of electric power engineering》（GB 50217）
《Code for design of ac electrical installations earthing》（GB50065）
《Quality of electric energy supply. Harmonics in public supply network》（GB/T 14549）
《Power quality - Three-phase voltage unbalance》（GB/T 15543）
《Power quality - Deviation of supply voltage》（GB/T 12325）
《Power quality - Voltage fluctuation and flicker》（GB/T 12326）
《DC power supply equipment for power system》（DL/T 459）
《High frequency switching converter module in power system》（DL/T 781）
《Technical Code for Designing DC System of Power Projects 》（DL/T 5044）
《Technical code for relaying protection and security automatic equipment》（GB14285）
《Technical code for designing of electrical secondary wiring in fossil fuel power plants and substations》（DL/T 5136）
《Technical code for designing electrical measuring and energy metering device》（DL/T 5137）
《Telecontrol equipment and system》（DL/T 634）
《Installation Work for Electric Devices Code for Erection and Acceptance of Switchboard Outfit Complete Cubicle and Tie Lines of Secondary Circuit》（GB 50171）
《Insulation co-ordination》（GB311.1~311.3）
《Common specifications for high-voltage switchgear and controlgear standards》（GB/T 11022）
《Alternating-current metal-enclosed switchgear and controlgear for rated voltages above 3.6 kV and up to and including 40.5 kV》（GB3906）
《Common Specifications for High-voltage Switchgear and Controlgear Standards》（DL/T593）
《Low-voltage switchgear and controlgear》（GB14048）
《Code for design of low voltage electrical installations》(GB50054)
《Low-voltage switchgear and controlgear assemblies》（GB7251）
《Code for design of electrical measuring device of power system》（GB/T 50063）
《Guide for choice power transformers》（GB17468）
《Power transformers》（GB1094.1~1094.5）

System scheme

1) Scheme composition

The system composition of the 10MW/20.64MWh energy storage power station is shown in Table 1-1

Table 1-1 System composition table

No.	Name	Model No.	Unit	Q'ty	Description
1	**Battery Container (20ft)**	HY20H-2580	SET	8	Electric energy storage unit, rated capacity of each container is 2.58MWh; the total battery capacity of whole station is 20.64MWh
1.1	Battery Cluster (per container)	HY-R645	SET	4	645.12kWh per cluster, 4 cluster per container
1.2	System cabinet (per container)	HY-SC-H2000	SET	1	Bus bar and power distribution function, environmental management function, etc.
1.3	Industrial Air Conditioner (per container)		SET	1	Single unit with 20kW cooling capacity (To be fixed at final design). Including industrial air conditioners, air ducts, temperature and humidity sensors, etc.
1.4	Fire System (per container)		SET	1	Including Heptafluoropropane gas fire extinguishing, smoke temperature detection, fire alarm, etc.
1.5	Lighting system (per container)		SET	1	Lights, Emergency Lights, etc.
1.6	Container and accessories		SET	1	Container (20 HQ), cables, etc.
2	**PCS Boost cabin (20 feet)**	HYMV-2750	SET	4	2.75MW of each set; total power of the whole station is 11MW
2.1	Power Conversion System (per PCS boost cabinet)		SET	1	2750kW , energy storage inverter
2.2	Transformer -American type (per PCS boost cabinet)	SCBII Series HY-10.5/0.55kv-2750	SET	1	(Might be changed by grid requirement)
2.3	Control box (per PCS boost cabinet)		SET	1	Power distribution and communication in the box
2.4	Cabinet and accessories		SET	1	Cabinet, cables, etc.
3	**Energy Management System (EMS)**		SET	1	Power station management, power dispatch

2) Spatial layout

The 10MW/20.64MWh energy storage power system consists of 8 sets of battery containers and 4 sets of PCS booster cabins. The equipment covers an area of about 200 square meters (adjusted according to the actual layout of the site). Maintenance space need to be reserved among containers and cabinets, which can be adjusted according to specific needs. The referent layout diagram is shown in Figure 1-1.

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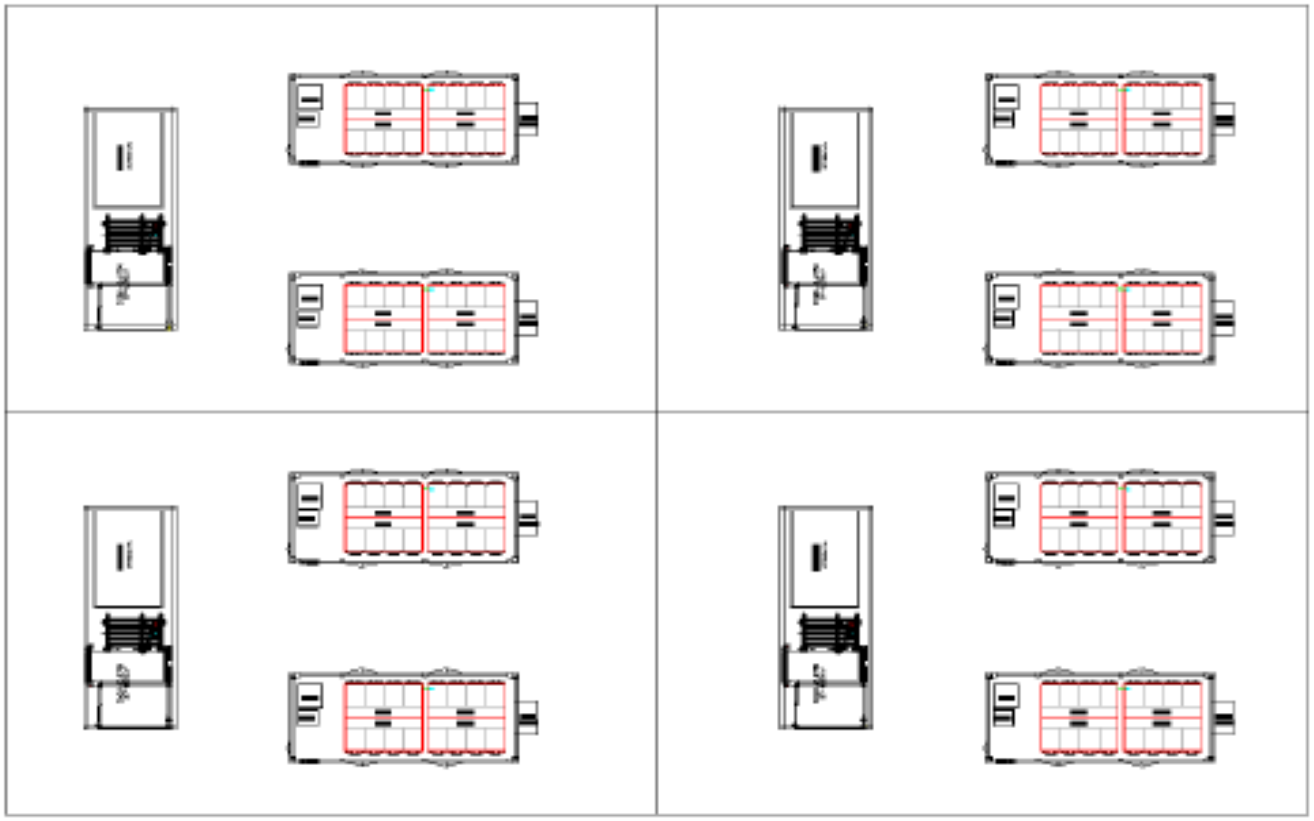

Figure 1-1 Layout of energy storage power system (subject to the actual layout on site)

3) Main wiring diagram of energy storage power station

The output DC voltage of the battery container is converted by the PCS booster cabin and boosted to 35kVAC (depending on the voltage level of the grid connection point, the value is optional) .The typical main wiring diagram is as follows (subject to the final access design):

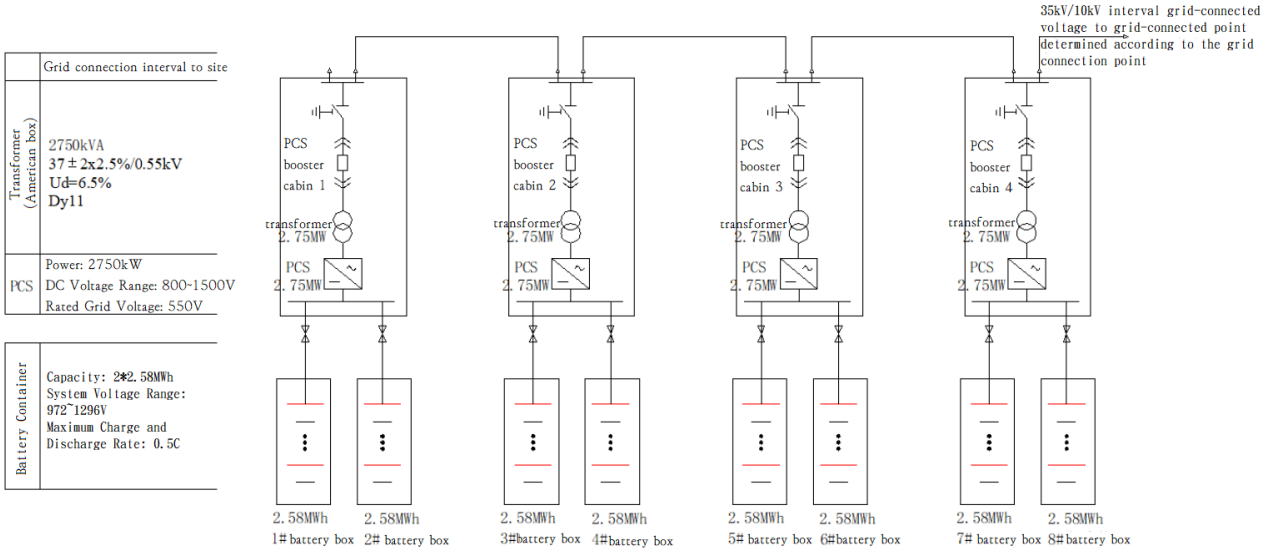

Figure 1-2 Main wiring diagram of energy storage power station

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2. Battery container

The rated capacity of a single battery container in this scheme is 2.58MWh, including battery system, air conditioner, fire system, container, etc. The layout is shown as Figure 2-1, and the key equipment composition is shown as Table 2-1.

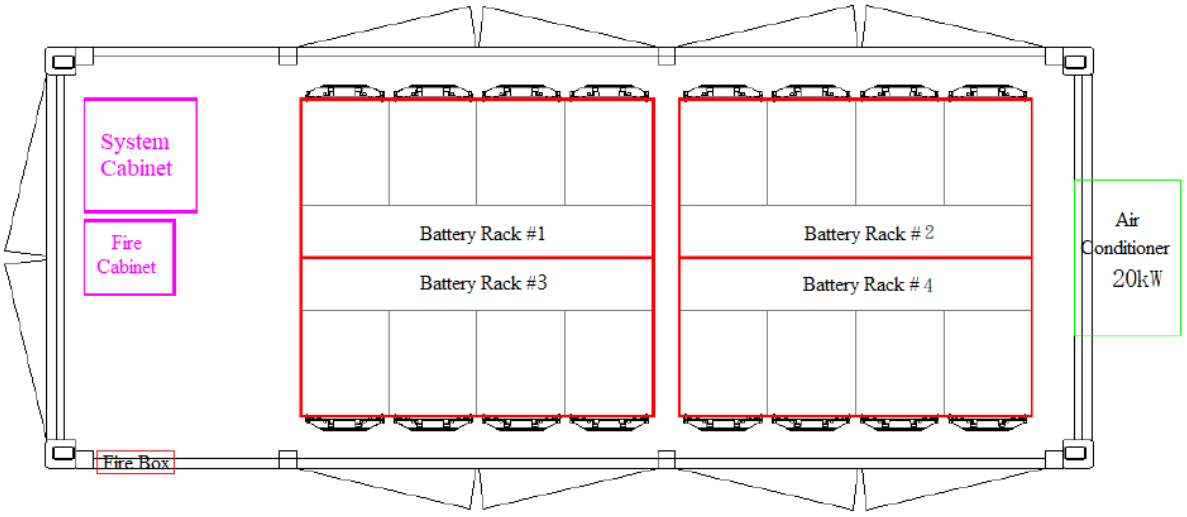


Figure 2-1 Layout of the battery container

Table 2-1 Composition of key equipment of battery container

No.	Name	Unit	Q'ty	Description
1	Battery Container (20ft)	SET	1	Dimension (L*W*H)：6058*2438*2896(mm)
2	Battery Cluster	SET	4	645.12kWh per cluster
3	System Cabinet	SET	1	Bus bar and power distribution function, environmental management function, etc.
4	Industrial Air Conditioner	SET	1	Single unit with 20kW cooling capacity (To be fixed at final design)
5	Fire System	SET	1	Heptafluoropropane Gas Extinguishing System
6	Lighting system	SET	1	Lights, Emergency Lights, etc.

The battery container mainly integrates the battery part and supporting systems, and the technical parameters are shown in Table 2-2.

Table 2-2 Technical parameters of battery container

No.	Item	Parameters	Remark
1	Capacity (MWh)	2.58	
2	Rated DC Voltage(V)	1152	
3	DC voltage range (V)	972~1296	
4	Communication	Ethernet, CAN 2.0, RS485	
5	Ingress Protection level	IP54	
6	Operating ambient temperature (℃)	-15 ~ 40 ℃	Ambient temperature outside the container
7	Cooling	Industrial air conditioner	
8	Maximum allowable altitude (m)	≤5000	Over 2000m, de-rating operation
9	Fire System	Gas extinguishing system	
10	Weight (T)	25	estimated
11	Container Dimension (mm)	6058*2438*2896	L*W*H

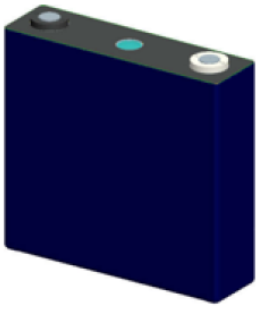
2.1. Lithium battery cell

The lithium iron phosphate battery (LFP) selected in this solution has the advantages of high specific energy, long cycle life, low cost, high cost performance, high current charge and discharge, high temperature resistance, high energy density, no memory, safety and no pollution. It has been widely used in energy storage systems.

The lithium battery cell has a nominal voltage of 3.2V and a nominal capacity of 280Ah. Other specific specifications are shown in Table 2-3.

Table 2-3 Specifications and parameters of battery cells

No.	Item	Specification	Remark
1	Battery Type	LFP	Hard pack
	Manufacture Name	HiTHIUM	LFP71173207/280Ah
		CALB	L173F280A
2	Nominal Voltage (V)	3.2	
3	Nominal capacity (Ah)	280	
4	Nominal charging current (A)	140	
5	Max. continuous charging current (A)	280	
6	Nominal discharge current (A)	140	
7	Max. continuous discharge current (A)	280	
8	Voltage range (V)	2.5~3.65	Limited range
		2.7～3.6	Recommended range
9	Storage temperature range (℃)	-10 ~+45	
10	Operating temperature range (℃)	0~+45	
11	Operating humidity (%)	≤95%	

12	Referent outlook diagram	

2.2. Battery Module

The battery module is composed of 24 pcs of 280Ah/3.2V lithium iron phosphate batteries and one battery management unit (BMU). The batteries module are assembled as 12 cells in series and 2 string in parallel. The BMU ,battery management unit is the fundamental unit of the battery management system. The BMU is composed of a power supply module, a cell data sampling module, a temperature sampling module, a channel switch module, a balance control module, a communication module, a CPU and its peripheral circuits. It measures the single cell in real time. Battery voltage, total battery string voltage, external working power supply voltage, battery ambient temperature, balanced voltage (overvoltage and under-voltage protection), balanced current (charge/discharge), and can actively report real-time monitoring data to the Battery Cluster Management System(BCMS) through the CAN2.0 communication BUS and follow control command from BAMS.

Table 2-4 Specifications and parameters of battery modules

No.	Specification	Parameter
1	Battery	3.2V 280Ah LFP Cell
2	Series and Parallel Circuits	2P12S
3	Rated Capacity	560Ah
4	Rated Voltage	38.4V
5	Rated Energy	21.504kWh
6	Standard charging conditions	Constant Power (CP), Constant Current (CC), Constant Voltage (CV)
		Power: 10.752kW (0.5CP)
		Termination voltage: 32.4V
7	Standard discharge conditions	Constant Power (CP), Constant Current (CC)
		Power: 10.752kW (0.5CP)
		Termination voltage: 32.4V
8	Max. discharge power	21.504kW（1CP）
9	Cycle Life	≥6000 times @25℃, 0.5C charge and discharge, Cell decays to 80% of the initial capacity under 90% DOD operation
10	System Voltage	≤1500V
11	Operating Temperature Range	-15 ~ 40 ℃

12	Storage Temperature	-15 ~ 40 ℃, **the SOC should be kept at 30%～50%, and not exceed 6 months.**
13	Humidity	≤85% RH (non-condensing)
14	Weight	150kg
15	Dimension	982*450*238mm（D*W*H）
16	Referent outlook diagram	

2.3. Battery Cluster

The battery cluster is with 30 packs of battery modules ,in 4 columns and 9 layers , one cluster control box, and 3 sets of maintenance switch device; total of 4 clusters are installed in the entire 20-foot container. The design comprehensively considers on thermal management of the battery container is to keep the temperature within the entire container as consistent as possible. The basic parameters of the battery cluster are shown in Table 2-5.

Table 2-5. Basic parameters of battery cluster

No.	Specification	Parameter	Remark
1	Number of battery modules	30	
2	Number of control boxes	1	
3	Maintenance switch device(MSD)	3	
4	Battery Module Series Circuits	30S	
5	Battery Cluster Rated Energy (kWh)	645.12	
6	Rated DC Voltage (V)	1152	
7	Rated Capacity (Ah)	560	
8	Dimension (mm) （W*D*H）	2040*996*2325	
9	Outlook diagram (for reference only)		

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2.4. System cabinet of battery container

The system cabinet is one of the main equipment of the battery container. Its functions include battery stack management and BUS functions, container auxiliary power distribution functions, environmental management functions, emergency stop, and communication functions.

1) Battery stack management & BUS

The bus bar switch and BAMS (Battery Stack Management System) are installed in the system cabinet. The output of each battery cluster is connected to the incoming side of the bus bar switch, and the outlet of the bus bar switch is connected to the PCS (bidirectional converter) to realize the bus bar and control functions of the battery stack.

At the same time, BAMS detects the voltage, current, insulation and other information of the DC main circuit, receives BCMS (Battery Cluster Management Unit) information downward, and receives EMS or monitoring background commands upward. Combined with its own protection logic, it can manage and protect the battery stack.

2) Container power distribution

The system cabinet meets all power distribution functions in the battery box, including:

The electricity meter collects the self-consumption of the container, and the incoming line is designed with a surge protector;

Try to balance the three-phase load in the box, each branch has a complete protection function, and complete the AC power supply of industrial air conditioning, lighting, fire protection, emergency lights, and sockets inside and outside the container.

Equipped with 24V and 48V DC power supply to realize the power supply of fans and BMS in the battery system; the important load is equipped with a backup power supply, which can achieve uninterrupted power supply for ≥30 minutes after the mains failure.

3) Environmental management function

The system cabinet is designed with an environmental management unit, which can collect information such as the temperature and humidity status in the box, the switching status of each component, the operating status of the air conditioner, the water ban, the fire protection status, the status of the surge protector, and the status of the mains failure; and upload various information. To the monitoring background, and as a logical reference for the BMS.

4) Emergency stop function

Emergency stop buttons are installed inside and outside the container. Pressing the emergency button can realize the shutdown of the whole container, realize the opening of the DC circuit, and the opening of the auxiliary power supply incoming switch; and upload the emergency stop status to the BMS and monitoring background.

When a container fire occurs, the fire protection system sends out a fire alarm signal to realize the opening of the DC circuit and the opening of the auxiliary power supply incoming switch; and upload the emergency stop status to the BAMS and monitoring background.

The container supports remote hard-wired emergency shutdown, which can operate the energy storage system in the monitoring room for emergency shutdown, realize the opening of the DC circuit, and the opening of the auxiliary power supply incoming switch; and upload the emergency stop status to the BMS and monitoring background.

When BAMS is in emergency stop state, it can realize DC circuit opening and auxiliary power supply incoming line switch opening; and upload the emergency stop state to PCS and monitoring background.

5) Communication

Internal and external switches are installed in the system cabinet to realize internal battery cluster communication and communicate with the upper layer through external switches.

2.5. Grounding System

In the design of energy storage container, the grounding involved mainly includes protective grounding and functional part grounding. The container provides external grounding points for protective grounding and functional grounding respectively.

The functional grounding is mainly the protective grounding of the cabinet shell and the lightning protection grounding. The protective grounding is mainly the safety grounding of the cabinet. It is the metal part of the system (cabinet chassis , console chassis, etc.) conductive connections to protect equipment and personal safety. The reason is that the power supply of the system is a high voltage (380, 220 or 110V), and the maximum DC voltage of the battery bus is near 1500V. Usually, the chassis is not with charge. When a fault occurs (such as a host power failure or other faults) cause the live wire of the power supply is short-circuited with conductive metal parts such as the casing, these metal parts or casings form electrical live parts. If there is no well grounding, there will be a high potential difference between the live parts and the ground. If someone accidentally touch these live parts , they will form a pathway through the human body and cause danger. Therefore, a good connection must be made between the metal casing and the ground, so that the casing and the ground are equipotential. Lightning protection grounding is a part of lightning protection measures, and its function is to introduce the surge through the lightning protection device into the ground. The lightning protection of electrical equipment is mainly to use one end of the lightning arrester to connect with the protected equipment, and the other end to connect to the ground device. When a direct lightning strike occurs, the lightning protection device will lead the generated surge to itself, and the surge current will pass through it. The down line and grounding device enter the earth, thereby avoiding damage to electrical equipment or endangering personal safety.

Functional grounding is mainly the grounding of control devices, terminals, measuring equipment, and shielded cables in the container. It can improve the anti-interference ability of the

secondary equipment of the energy storage system, reduce the probability of abnormal conditions, and ensure the safety and reliability of the secondary circuit in the energy storage system.

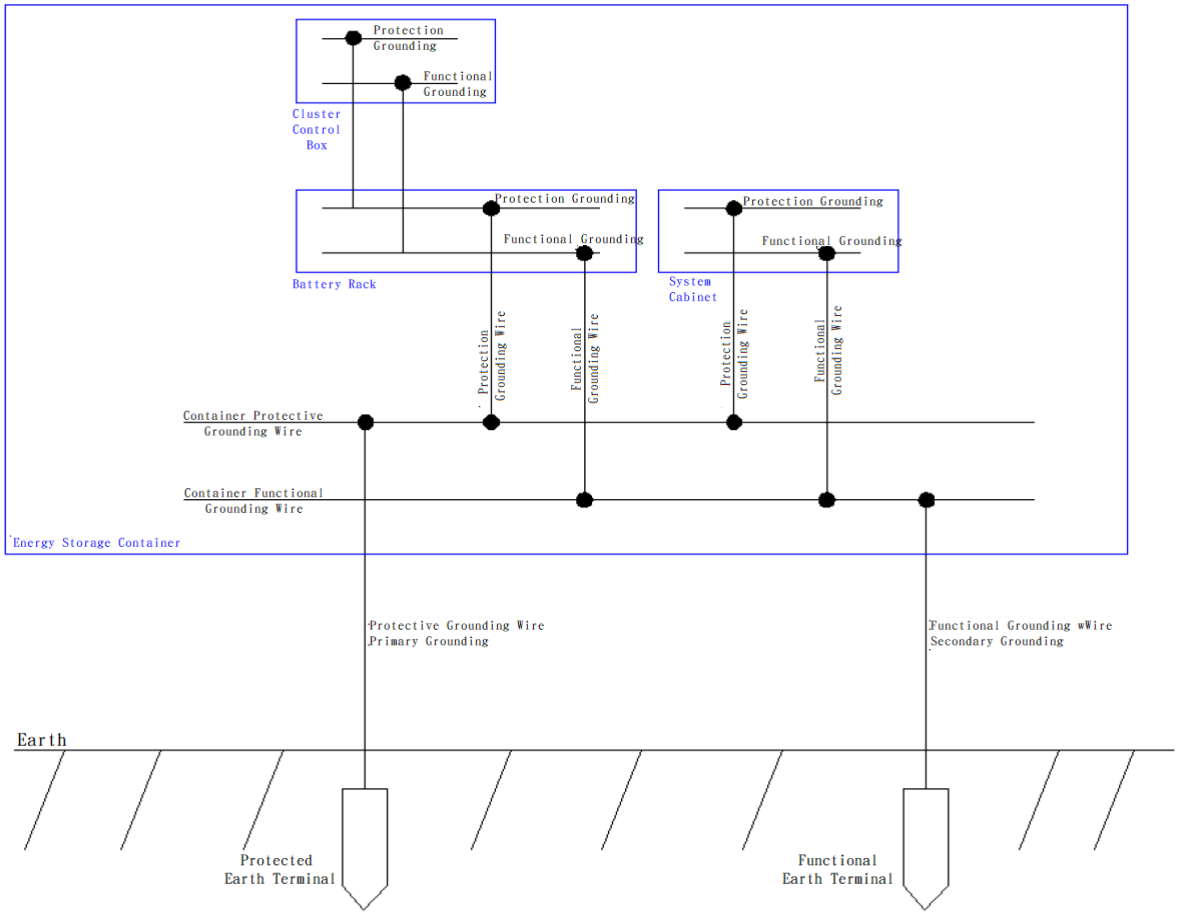

Figure 2-2 Grounding Diagram

2.6. Fire System

According to GB50116-2013 《Code for Design of Automatic Fire Alarm System》 and GB50370-2005 《Code for Design of Gas Fire Extinguishing System》, a high-sensitivity fire alarm system is set up in the system protection area, equipped with temperature and smoke detectors. After the danger, the fire alarm is issued through the alarm bell and the sound and light alarm, the fire information is uploaded to the firefighting host, and the heptafluoropropane cabinet fire extinguishing system is activated at the same time to extinguish the fire. The system has the functions of automatic fire detection, automatic alarm, automatic start of fire extinguishing and automatic upload of fire status. At the same time, it has the function of self-inspection, regular automatic inspection, fault monitoring and fault alarm to ensure the fire safety of the energy storage power station.

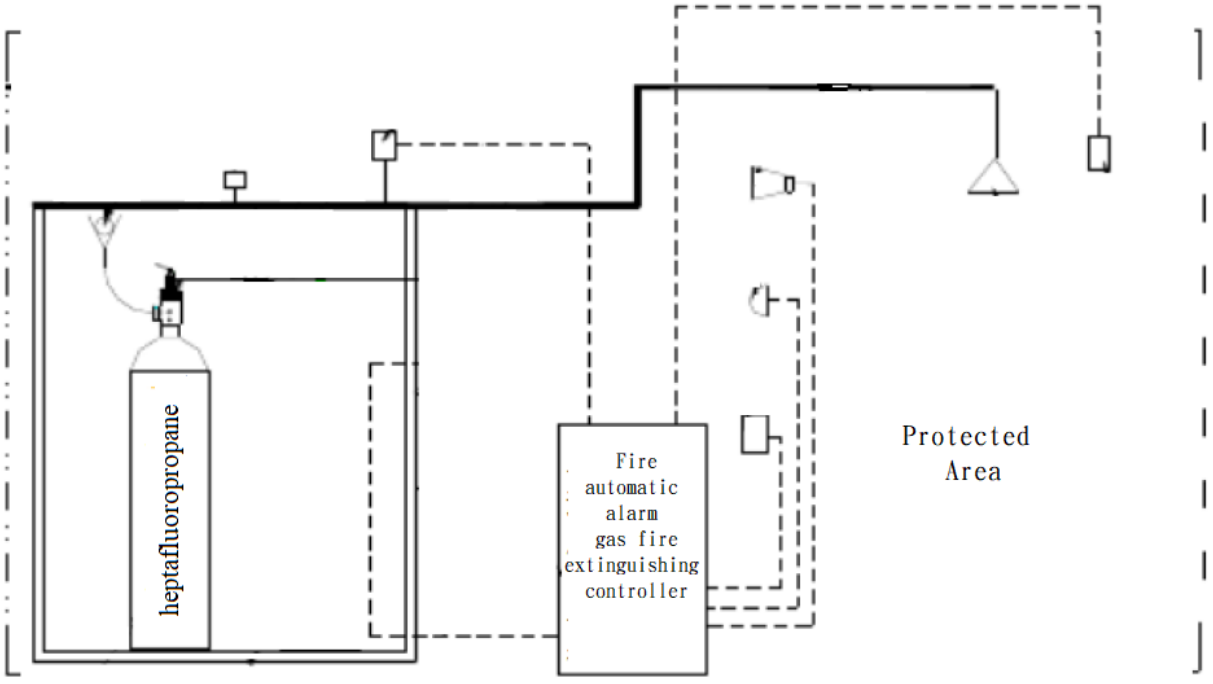

Figure 2-3 Schematic diagram of heptafluoropropane gas fire extinguishing in energy storage tank

The equipment protection area adopts the total submerged fire extinguishing method, and adopts the cabinet type heptafluoropropane fire extinguishing device to automatically extinguish the fire. The system has three starting modes: automatic, manual and mechanical emergency.

1) Automatic start: When the fire extinguishing controller is set to the automatic state, if there is smoke in the protection zone or the temperature rises abnormally, the smoke (or temperature) detector in the protection zone will act and send a fire alarm signal to the fire extinguishing controller (When the temperature of the temperature detector reaches 54℃ or the temperature rises by 3℃ within 1 minute, the alarm will be activated), the fire extinguishing controller will enter a single fire alarm state, and at the same time drive the fire alarm bell to send out a single

fire alarm signal. control signal. With the spread of the fire in the protection area, the temperature continues to rise or smoke is generated, the temperature (or smoke) detector of the other circuit is activated, and another fire alarm signal is sent to the fire extinguishing controller, and the fire extinguishing controller immediately confirms that a fire has occurred and Send out composite fire alarm signals and linkage signals (close air supply and exhaust devices, fire dampers, fire shutters, etc.). After a set (30s) time delay, the fire-extinguishing controller outputs a signal to start the fire-extinguishing system, and the fire-extinguishing agent is released to the protection zone through the delivery pipeline for fire-extinguishing. After receiving the feedback signal from the pressure annunciator, the fire extinguishing controller will light up the deflation indicator outside the protection zone door to prevent people from entering by mistake.

2) Manual start: When there are people working in the protection area, the manual/automatic switch on the host outside the protection area can be used to switch the system from the automatic state to the manual state. When a fire occurs in the protection area, the alarm controller will only send out Alarm signal, no action signal is output. When the fire alarm is confirmed by the on-duty personnel, the fire extinguishing device can be started immediately and the heptafluoropropane fire extinguishing agent can be sprayed by pressing the controller panel or breaking the emergency start button outside the door of the protection zone.

3) Mechanical emergency start: When a fire occurs in the protection area, the fire extinguishing system cannot be started due to the failure of the control system. At this time, the fire alarm should be confirmed by the on-duty personnel, the linkage equipment should be closed, and the corresponding protection area in the bottle storage room should be pulled out to start the bottle group. Press the manual button firmly to open the valve of the starting bottle group. After the starting gas is released, open the corresponding selection valve and container bottle group, and release the heptafluoropropane fire extinguisher to extinguish the fire.

2.7. BMS

The main components of the energy storage battery management system are: battery stack management system (BAMS), battery cluster management system (BCMS), environmental monitoring management unit (EMMU), battery management unit (BMU) and human-machine interface (HMI).

The battery stack management system (BAMS) mainly obtains the voltage, current, temperature and other information of the battery stack, battery cluster, and battery module for processing, and calculates the battery stack SOC, SOH, chargeable and discharge capacity, system operation alarm and protection status, etc. According to the obtained data and calculation results, the corresponding scheduling strategy, temperature control strategy, balancing plan, etc. are executed, and various important operations, alarms and protection log files are recorded, and all operating information of the battery stack during system operation is recorded in real time. Upload data to cloud platform, ESS management platform, etc.

The battery cluster management system (BCMS) mainly obtains the voltage, current, temperature and other information of the battery cluster and the battery module of the cluster for processing, calculates the battery cluster SOC, SOH, chargeable and discharge capacity, cluster

operation alarm and protection status, etc. Send the acquired data and calculation result data to BAMS, record various important operations, alarms and protection log files, record all operating information of the battery cluster during system operation in real time, and execute the scheduling and control instructions issued by BAMS at the same time.

The Environmental Monitoring Management Unit (EMMU) mainly collects the operating status of the environment, power, security, fire protection and other equipment, obtains the temperature and humidity data in the box, calculates the heat distribution data in the box, and controls fans, air conditioners, etc. Adjust the temperature in the box, record important logs, events, temperature and other data during the operation of the system, and upload the data to BAMS, ESS, cloud platform, etc.

The battery management unit (BMU) mainly collects battery cell voltage, temperature, balance voltage, balance current, total battery string voltage, pressure data, fan speed, etc., calculates battery characteristic information, alarm and protection status, etc., and records battery module operation. For important logs, events and other data in the process, implement the temperature control strategy and balancing strategy issued by BCMS, and report battery-related data to BCMS at the same time.

Human-machine interface (HMI) is the medium of interaction between the system and the user. The user can intuitively view data information such as battery stacks, battery clusters, and battery packs through the HMI, and can control the system (such as threshold settings, circuit breakers, etc.). status settings, etc.).

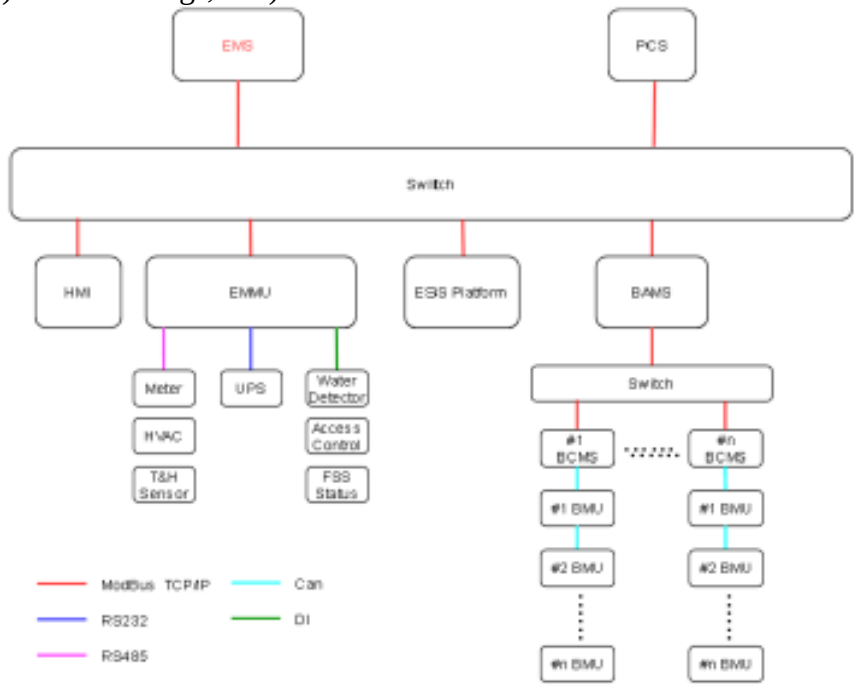

Figure 2-4 Communication topology

3. PCS Boost Cabin

The PCS booster cabinet includes a 2750kW energy storage bidirectional converter and a 2750kVA American type transformer, which are integrated into one unit, which is convenient for transportation, installation and maintenance. Figure 3-1 shows the layout of the PCS booster cabinet.

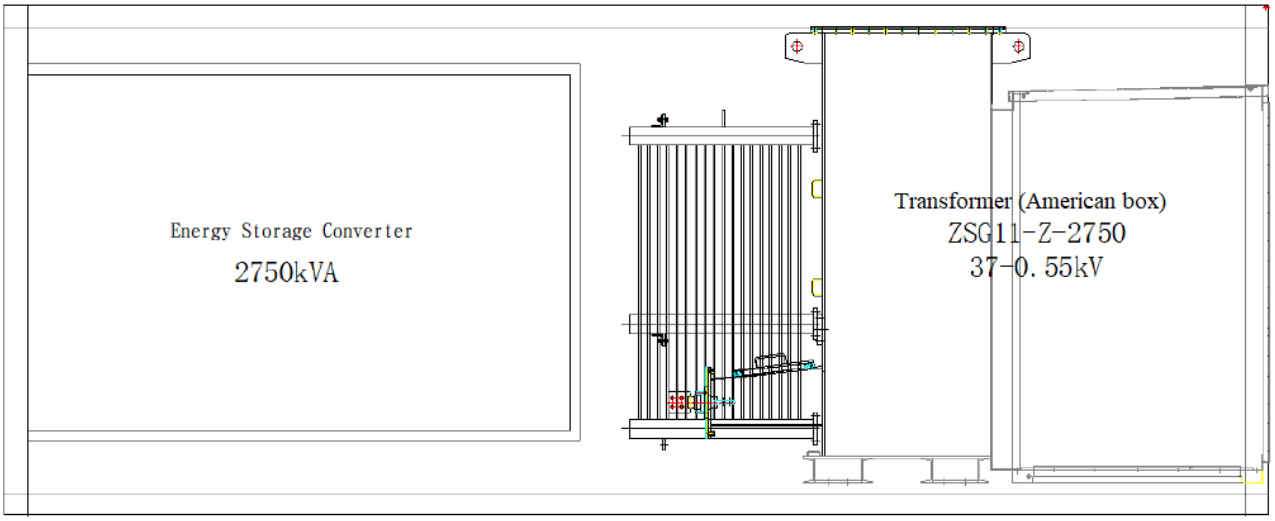

Figure 3-1 PCS booster cabinet layout

Table 3-1 Configuration list of key equipment in PCS booster cabin

Specification	Parameter	Q'ty	Remark
Energy Storage Converter	HD-2750	1 Unit	2750kW
Transformer	ZSG11-Z-2750 37/0.55kV	1 Unit	Different Voltage level could be selected by grid connection point

Table 3-2 Technical Parameters of PCS Booster cabin

Specification	Parameter	Remark
Rated power (MW)	2.75	
Rated AC Voltage (kV)	35	By grid connection point
Rated DC Voltage (V)	800~1500	
Transformer	ZSG11-Z-2750	
PCS Model	HD-2750	
Communication	Ethernet, CAN 2.0, RS485	
Protection class	IP54	
Altitude	≤5000m (greater than 2000m derating)	
Operating Temperature	－30℃～+60℃	
Allowable Humidity	0~100%，Non-condensing	

Noise	<65dB	
Weight (T)	15	
Dimension (mm)	L*W*H：6058*2438*2896	

3.1. Transformer (American type)

The PCS booster cabin adopts American box transformer by default (dry transformer is optional), and the transformer parameters are shown in Table 3-3.

Table 3-3 Transformer Technical Parameters

Specification	Parameter	Remark
Model	ZSG11-Z-2750	
Capacity	2750kVA	
HV side rated voltage	37kV	Optional
LV side rated voltage	0.55kV	
Rated Frequency	50Hz	
Resistance voltage	6.5%	
Voltage adjustment range	37±2x2.5%	Optional
Connection	Dy11	
Cooling Method	ONAN	
Insulation Class	A	
Noise level	<65 dB	
Material	All copper	

3.1.1 Transformer protection accessories and signals

1) The transformer is equipped with a pointer oil temperature gauge, which is used to monitor the oil temperature of the top layer of the transformer. The oil surface temperature can be observed on the spot, and at least two sets of dry node signals are provided, one of which is used for over-temperature 90℃ alarm. One set is used for tripping over temperature 100℃;

2) One PT100 is buried in the transformer oil surface;

3) The transformer is equipped with an oil level indicating device to monitor the oil level status of the transformer, and is equipped with at least one set of low oil level protection dry points;

4) The transformer is equipped with a pressure gauge and a pressure relief valve to monitor the sealing condition of the oil tank and maintain the normal pressure of the oil tank, and is equipped with at least one set of pressure protection dry nodes;

5) High-voltage protection fuses are equipped with fuse blown state signal dry nodes;

3.1.2 Incoming and outgoing wiring

1) High voltage incoming wiring:

The high voltage outlet of the box transformer uses copper terminals to meet the connection function of 3 groups of independent power cables.

2) Low voltage outlet:

The low-voltage side of the box transformer uses the low-voltage bushing copper discharge line, and the bushing copper discharge current meets the long-term operation requirements of the current under the maximum operating condition of the transformer.

3.2. PCS

The bidirectional converter is a power electronic interface device that connects the power grid and the energy storage battery pack. It can realize the AC-DC bidirectional conversion function of voltage and current through control. It is composed of main power part, signal detection part, control part, driving part, monitoring display part and auxiliary power supply.

The DC power generated by the energy storage battery is converted into a high-frequency three-phase chopper voltage by the three-phase bridge converter of the energy storage bidirectional converter, and filtered into a sine wave through a filter, and then merged into the power grid to generate electricity. The main circuit is shown in Figure 3-2, and the technical parameter table is shown in Table 3-4.

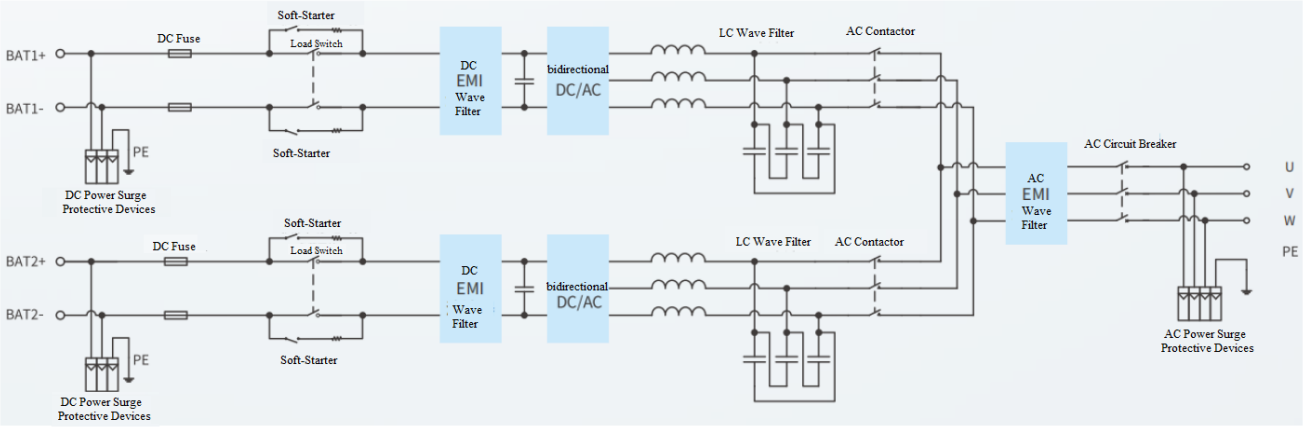

Figure 3-2 PCS primary topology

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Table 3-4 PCS technical parameter table

Specification	Parameter	Remark
Model	HD-2750	
AC Side		
AC connection configuration (Isolation Mode)	Three-phase three-wire (without isolation transmitter)	
Rated Power	2750kW	
Max. Capacity	3025 kVA	
Rated Grid Voltage	550V,3W+PE	
Voltage Operating Range	467.5V~605V(settable)	
Max. AC current	3176A	
Rated Grid Frequency	50Hz/60Hz	
THDi	<1.5% (Rated Power)	
Power Factor	0.99 (leading) to 0.99 (lagging)	
DC Side		
DC Voltage Range	800~1500 V	
Max. Operating Current	3858A	
Number of battery packs that can be connected	1/2	
System		
Max. Conversion Efficiency	99.0%	
Dimension (W*H*D)	2650 *2250 *1800(mm)	
Weight	2700kg	
Max. Allowed Altitude	5000 meter	>2000m ,de-rating operation
Protection class	IP65	
Operating temperature	－30℃～+60℃	
Cooling Method	Temperature controlled forced air cooling	
Allowable Relative Humidity	0～95%, Non-condensing	
Communication	Ethernet, RS485, CAN2.0	

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4. Energy Management System (EMS)

4.1. General Description

The equipment configuration and functional requirements of the EMS energy management system are designed according to the number of people on duty in the energy storage power station, and the interface and function configuration to realize the unattended operation of the energy storage power station are reserved. Information exchange shall follow the DL/T 634 (IEC 60870-5) series of standards or the DL/T 860 (IEC 61850) series of standards.

The EMS energy management system adopts an open hierarchical distribution structure, which consists of a station control layer and an interval layer. The equipment at the station control layer is arranged in the main control station building of the energy storage system, and the equipment at the interval layer is arranged in the corresponding station building. The safety protection of the EMS energy management system meets the requirements of the overall scheme of safety protection for the power secondary system.

4.2. System Configuration

The station control layer equipment mainly includes energy storage EMS coordination controller, engineer workstation, network switch and supporting network equipment.

(1) Energy storage EMS controller, the energy storage EMS controller is mainly used to control multiple PCS, and realize advanced control functions such as fast power tracking response, auxiliary frequency regulation, voltage regulation, etc. Fast power tracking response means that the EMS controller receives external power commands and controls the overall output of the energy storage system to ensure the real-time and accuracy of the overall output power. Auxiliary frequency regulation and voltage regulation is to actively adjust the active and reactive power output by the energy storage system according to the frequency and voltage of the power grid, so as to achieve the purpose of rapid frequency and voltage regulation. The EMS controller can also perform power distribution according to the SOC status of each battery pack, so that the performance status of each battery pack can be balanced. The energy storage EMS controller adopts the group screen (cabinet) method.

(2) Operator-engineer workstation, operator-engineer workstation is the main man-machine interface of the EMS energy management system in the station, used for graphic and report display, event record and alarm status display and query, equipment status and parameter query, operation Guidance, interpretation and issuance of operation control commands, maintenance and management of the entire EMS energy management system, the definition and modification of the database, the definition and modification of system parameters, the production and modification of reports, network maintenance, system diagnosis and other work. The operator can monitor and control the operation of the primary and secondary equipment of the energy storage power station through the operator-engineer workstation. The maintenance of the EMS energy management system is only allowed on the operator-engineer workstation, and protect with reliable login in.

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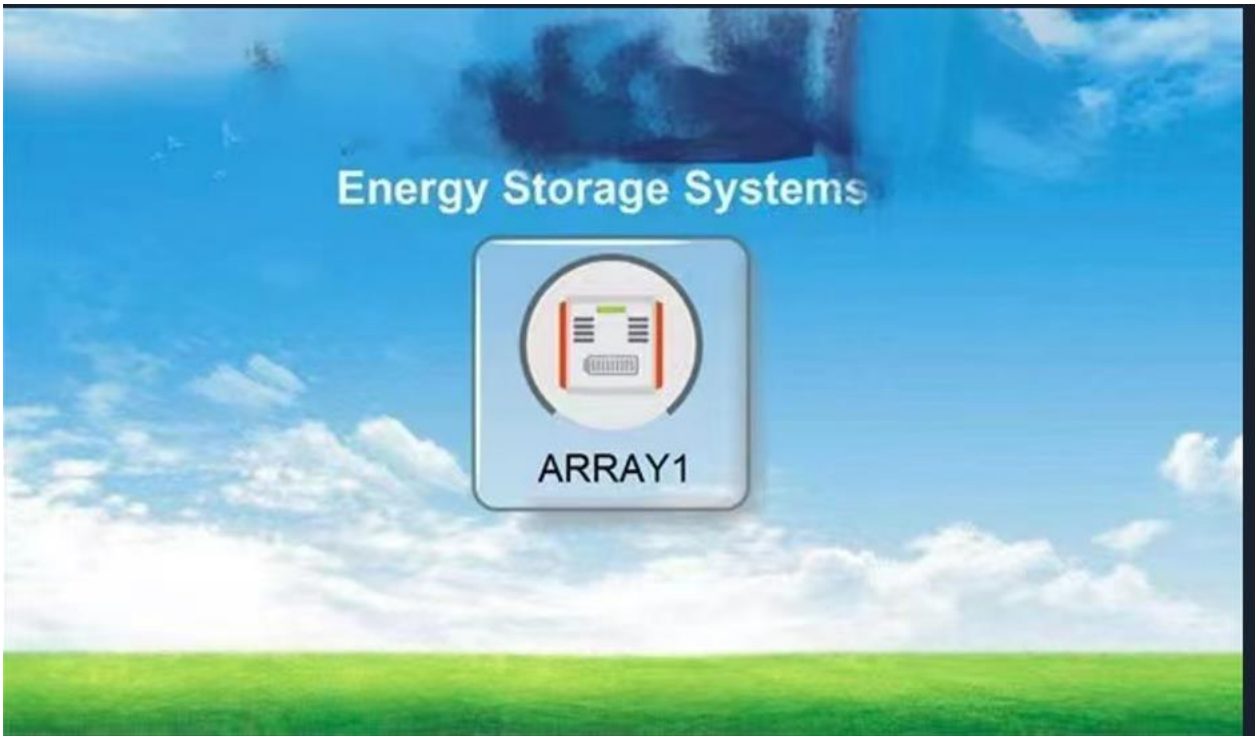
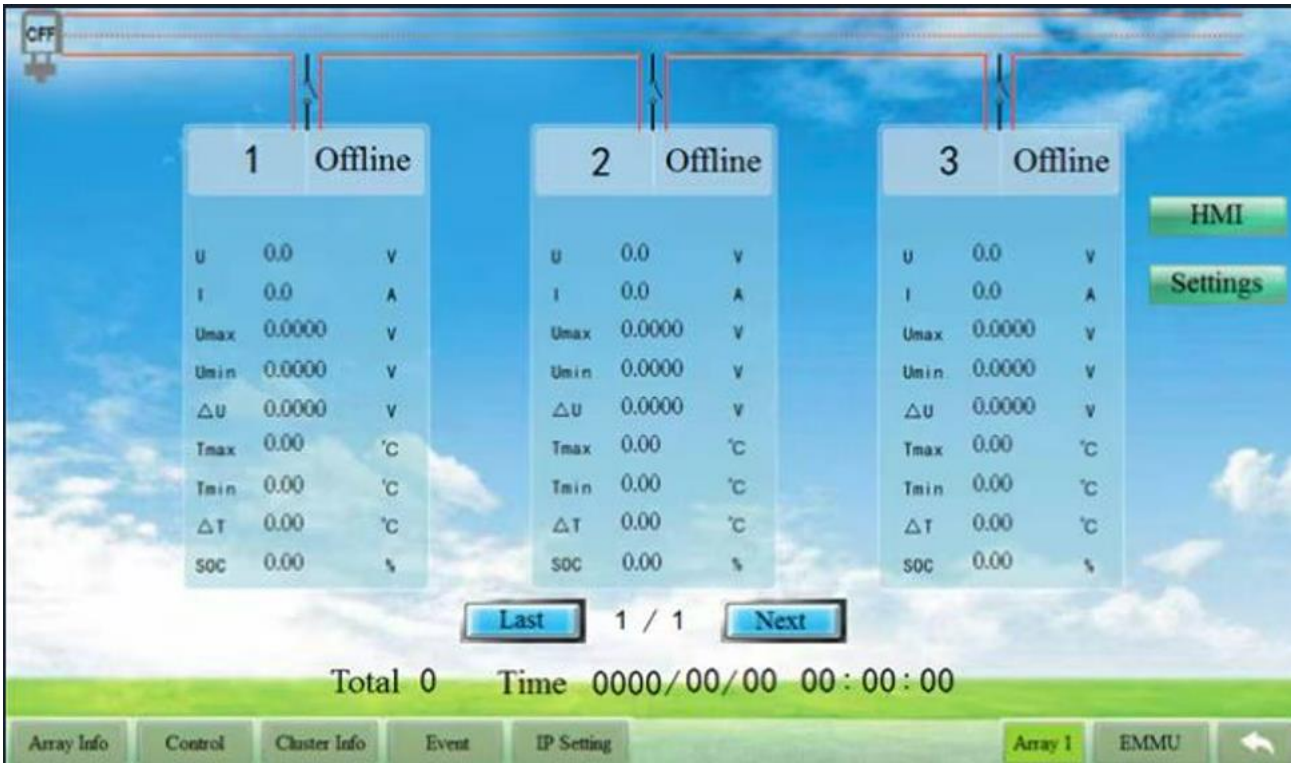
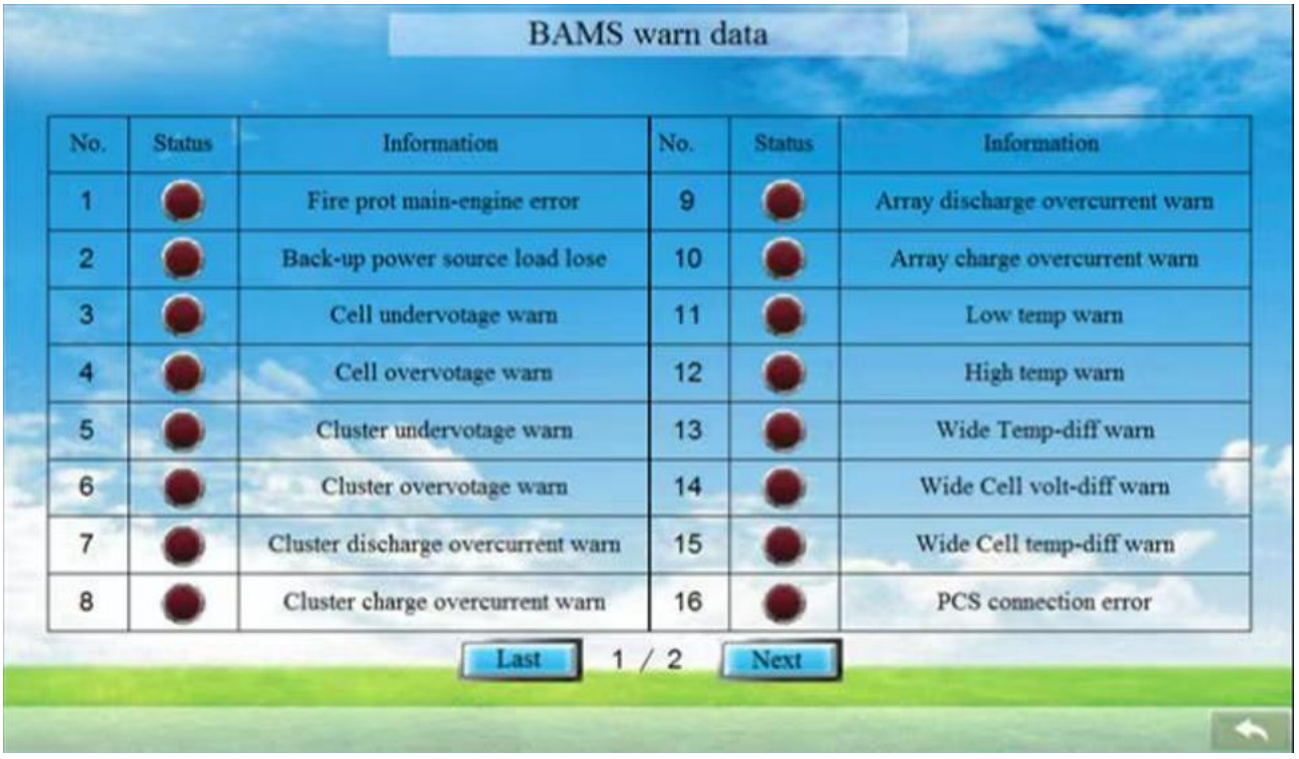
(3) Network switches. The network transmission rate of the network switch is greater than or equal to 100Mbit/s, forming a distributed high-speed industrial-grade dual Ethernet, which should be tested by the state or the power inspection and testing center, and supports AC and DC power supply. The number of electrical ports and optical ports should meet the application requirements of energy storage power stations .

(4) Other network equipment. Including optical/electrical converters, interface equipment (such as optical fiber junction boxes) and network connection lines, cables, optical cables, etc.




OFF
1 Offline
2 Offline
3 Offline
U 0.0 V
I 0.0 A
Umax 0.0000 V
Umin 0.0000 V
ΔU 0.0000 V
Tmax 0.00 'C
Tmin 0.00 'C
ΔT 0.00 'C
SOC 0.00 %
HMI
Settings
Last
1 / 1
Next
Total 0
Time 0000/00/00 00:00:00
Array Info
Control
Cluster Info
Event
IP Setting
Array 1
EMMU


BAMS warn data
No. Status Information No. Status Information
1 Fire prot main-engine error
2 Back-up power source load lose
3 Cell undervotage warn
4 Cell overvotage warn
5 Cluster undervotage warn
6 Cluster overvotage warn
7 Cluster discharge overcurrent warn
8 Cluster charge overcurrent warn
9 Array discharge overcurrent warn
10 Array charge overcurrent warn
11 Low temp warn
12 High temp warn
13 Wide Temp-diff warn
14 Wide Cell volt-diff warn
15 Wide Cell temp-diff warn
16 PCS connection error
Last
1 / 2
Next

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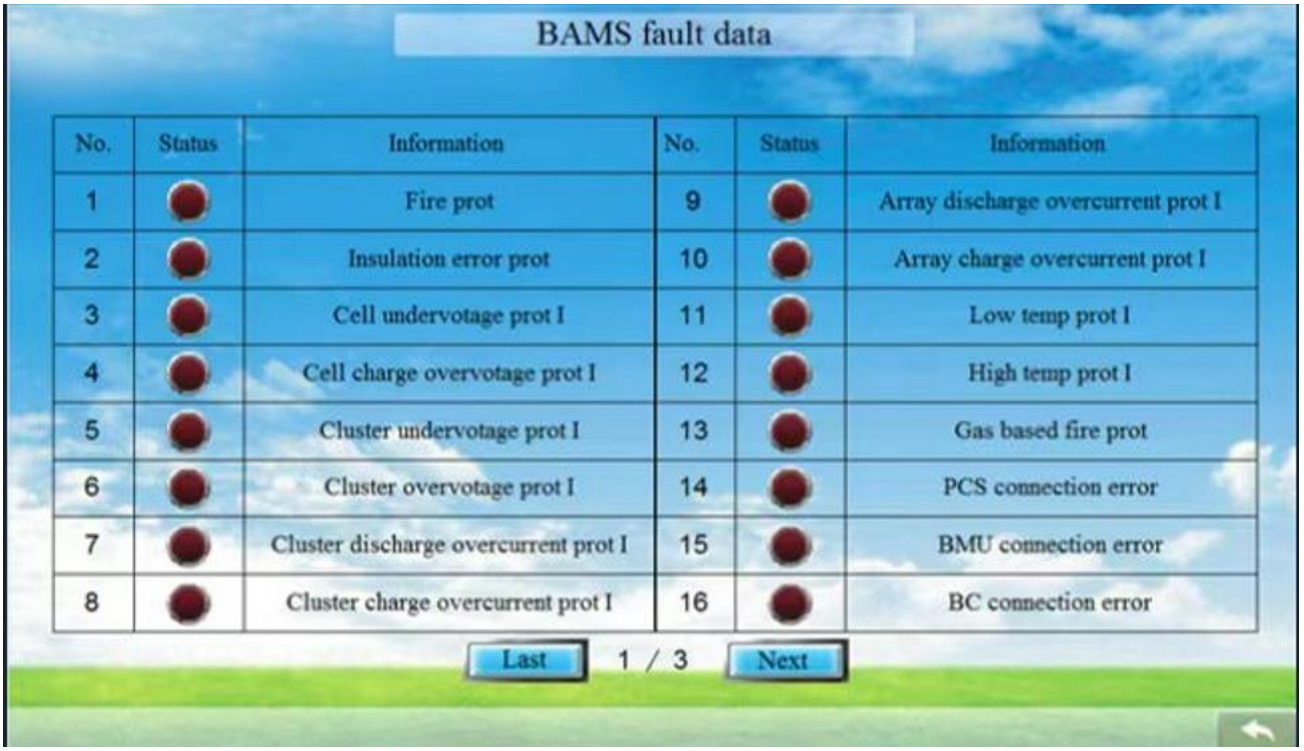

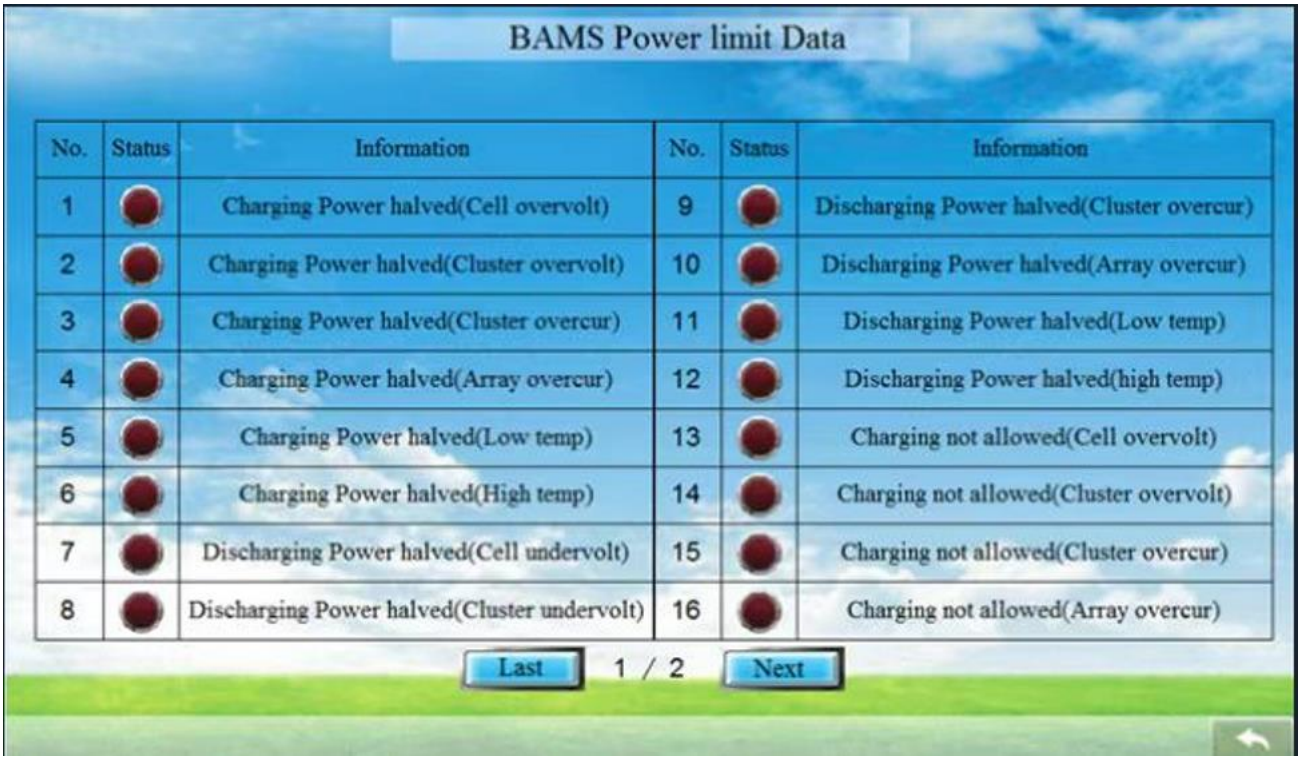

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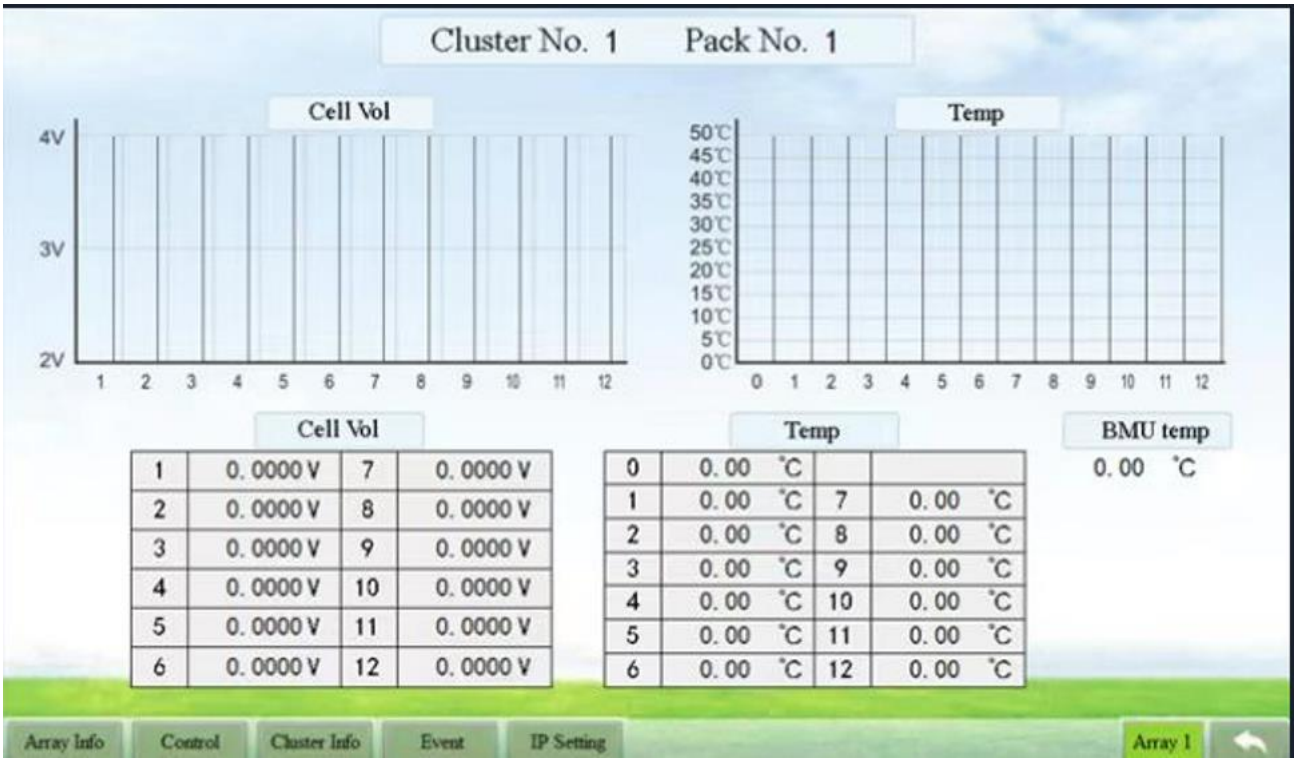
	1	2	3	4	5	6	7	8	9	10	11
Online Status	●	●	●	●	●	●	●	●	●	●	●
Total Volt(V)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Cur(A)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SOC(%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cell Volt(Max V)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
BMU No.	0	0	0	0	0	0	0	0	0	0	0
Cell Volt(Min V)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
BMU No.	0	0	0	0	0	0	0	0	0	0	0
Volt Diff(V)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Cell Temp(Max℃)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BMU No.	0	0	0	0	0	0	0	0	0	0	0
Cell Temp(Min℃)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BMU No.	0	0	0	0	0	0	0	0	0	0	0
Temp Diff(℃)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Array Info | Control | Cluster Info | Event | IP Setting | Array 1

Event

No.	Time	Event	Status
1	0000/ 00/ 00 00:00:00	Reserve	Event end
2	0000/ 00/ 00 00:00:00	Reserve	Event end
3	0000/ 00/ 00 00:00:00	Reserve	Event end
4	0000/ 00/ 00 00:00:00	Reserve	Event end
5	0000/ 00/ 00 00:00:00	Reserve	Event end
6	0000/ 00/ 00 00:00:00	Reserve	Event end
7	0000/ 00/ 00 00:00:00	Reserve	Event end
8	0000/ 00/ 00 00:00:00	Reserve	Event end
9	0000/ 00/ 00 00:00:00	Reserve	Event end
10	0000/ 00/ 00 00:00:00	Reserve	Event end

Array Info | Control | Cluster Info | Event | IP Setting | Array 1



4.3. Network Structure

The network architecture of the EMS energy management system is shown in the following figure:

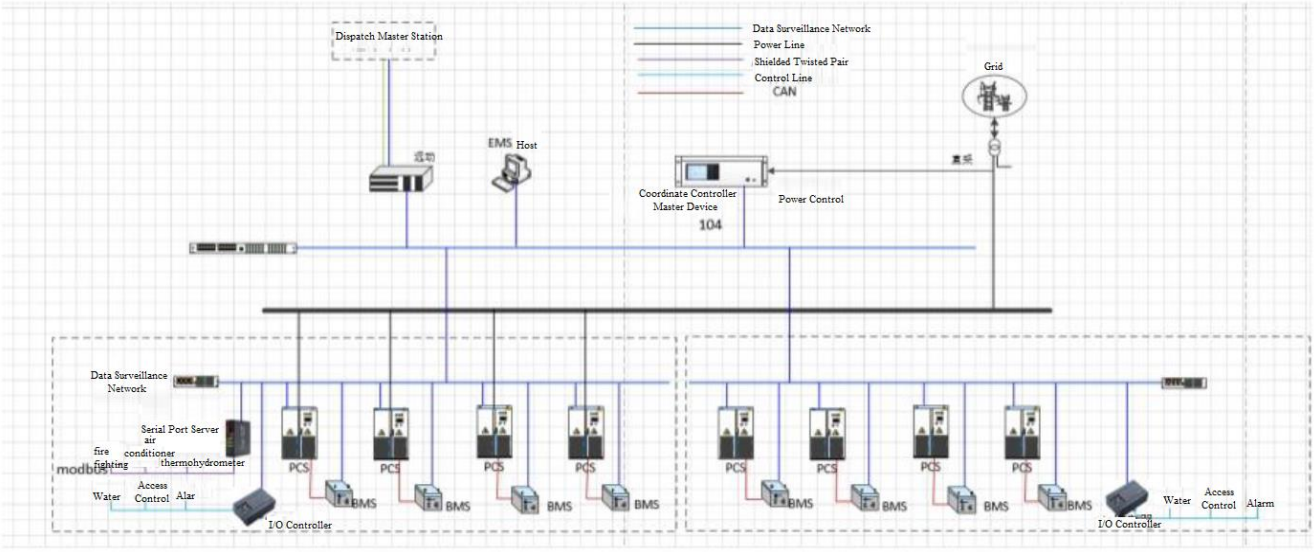


Figure 4-1 EMS energy management system network architecture