HK3

Water Cooling Container & Plate Heat Exchanger (PHE) Product Manual

Version: V6

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BITMAIN TECHNOLOGIES INC.
www.bitmain.com

Declaration

The purpose of the Product Use and Maintenance Manual (hereinafter referred to as the product manual) is only to provide guidance information to help you correctly use the ANTSPACE HK3 liquid cooling container system (hereinafter referred to as this product). Before installing and using this product for the first time, you are obligated to carefully read all the materials delivered, especially the precautions mentioned in the product manual, which will help you better and safely use this product. Please keep the product manual properly for future reference.

Before using this product, please check if the product components are complete. If there are any missing parts, please contact BITMAIN in a timely manner and carefully inspect the product before installation and use.

When the following situations cause property damage to you or third-party personnel, BITMAIN will not be responsible, and the product damage caused is not covered by the warranty. If the user requests repair services, after being determined by the BITMAIN service organization, paid repair services can be provided.

a. The entire equipment and components of this product have exceeded the free warranty period, or have been damaged due to abnormal use or natural environment.

b. Incorrect or failure to install, use, and store this product according to the instructions and requirements of the product manual.

c. Operate this product under operating environmental conditions that exceed the requirements specified in the product manual.

d. Exceeding the installation and use scope specified in international standards or local laws, regulations, and industry regulations.

e. Repairs or changes to this product by non BITMAIN authorized technical personnel;

f. Use the software provided with the product outside of this product, or use other software other than non random software or specialized software on this product.

g. Other scenarios that do not require liability within the legal scope of the country (region) where the operation is carried out.

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The photos, graphics, charts, and illustrations provided in the product manual are for explanatory and explanatory purposes only, and may differ from the actual product. The actual specifications and configurations of the product may change from time to time as needed, so they may differ from the content of the product manual. Please refer to the actual product purchased.

Due to the continuous iteration of products and the application of new designs, materials, and technologies, BITMAIN will make improvements or modifications to the software and hardware described in the product manual and the content of the product manual at any time based on factors including but not limited to product characteristics, product performance, and usage environment, without prior notice. If you find any inconsistencies between the actual situation of this product and the product manual during use, or if you want the latest information or have any questions or ideas, please feel free to call us or log in to the service website for inquiries.

Change History

Version	Change items	Before changing	After changing	Change time	Change by
V1.0.9	Initial version	/	/	2023.7.4	
V2.0.5	Split manual versions by cooling method	/	/	2024.5.28	

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Contents

1 About This Document

This manual mainly introduces the working principle, fault handling, and maintenance methods of the ANTSPACE HK3 liquid cooling system.

1.1 Application Scope

This manual is applicable to the ANTSPACE HK3 model.

1.2 Intended Audience

This manual is applicable to professional technical personnel who need to install, operate, and maintain the product. Professional technical personnel must meet the following requirements:

a. Possess certain professional knowledge in electronics, electrical wiring, and machinery, and be familiar with electrical and mechanical schematic diagrams.

b. Familiar with the composition and working principles of liquid cooling systems and related products.

c. It should have received professional training related to the installation and trial operation of electrical products.

d. It should have the ability to respond urgently to hazards or unexpected situations that occur during installation or trial operation.

e. Familiar with the relevant standards and specifications of the country/region where the project is located.

1.3 Use of Manual

Please read the manual carefully before using the product.

The content of the manual will continue to be updated and corrected, but it is inevitable that there may be slight discrepancies or errors with the actual product. Users should refer to the actual product they purchased and can download or obtain the latest version of the manual materials through www.bitmain.com or sales channels.

1.4 Symbol Conventions

In order to ensure the personal and property safety of users when using the product, and to use the product more efficiently and optimally, the manual provides relevant information and highlights it with the following symbols.

The following are the symbols that may be used in this manual. Please read carefully to better use this manual.

Danger

Indicates a high potential danger that, if not avoided, could result in serious accidents such as personal injury, equipment damage, etc.

Warning

Indicates a moderate potential hazard, which, if not avoided, could result in serious accidents such as equipment damage.

Caution

Indicates a potential danger that, if not avoided, may result in the equipment not functioning properly.

2 Safety Description

2.1 General Safety Instructions

DISCLAIMER: The equipment company is not responsible for any of the following situations.

a. Operation beyond the conditions specified in this document.

b. Usage under installation and operating environments which are not specified in related international specifications.

c. Failure to follow the operation instructions and safety precautions on the product and in the document.

d. Damage caused by abnormal natural environments.

2.2 All Safety Instructions

To ensure safety of humans and the equipment, pay attention to the safety symbols on the equipment and all the safety instructions in this document.

The "CAUTION", "WARNING" and "DANGER" marks in this document do not represent all the safety instructions. They are only supplements to the safety instructions.

1) Local Safety Regulations

When operating the equipment, you must follow the local laws and regulations. The safety instructions in this document are only supplements to the local laws and regulations.

2) Personal Requirements

Only trained and qualified personnel are allowed to install, operate, and maintain BITMAIN equipment, and they must understand basic safety precautions to avoid hazards.

Only trained and qualified personnel are allowed to install, operate, and maintain BITMAIN equipment.

Only personnel certified or authorized by equipment provider are allowed to replace or change the equipment or components (including software).

Any fault or error that might cause safety problems must be reported immediately to a supervisor.

3) Grounding Requirements

Equipment to be grounded must meet the following requirements:

a. When installing the device, always make the ground connection first and disconnect it at the end.

b. Do not damage the ground conductor.

c. Do not operate the equipment in the absence of a properly installed ground conductor.

d. Ensure that the equipment is connected permanently to the protective ground.

4) Personal Safety

Keep irrelevant people away from the equipment. Only operators are allowed to access the equipment.

Before operating a device, wear insulated shoes and insulated gloves, and pay attention to eye protection. Remove conductive objects such as jewelry and watches to avoid electric shocks or burns.

Ensure that tool handles are insulated.

5) Equipment Safety

Put away the keys to the device when installation, operation and maintenance.

Before operations, ensure that the equipment is firmly secured to the floor or other solid objects, such as a wall or an installation rack.

Do not block the ventilation while the device is operating.

Tighten the screws by using a tool after initial installation and subsequent access to the panel.

After the installation, remove packing materials from the equipment area.

2.3 Electrical Safety

1) High Voltage

Danger

The high-voltage power supply provides power for the operation of the equipment. Direct contact or indirect contact with the high-voltage power supply through wet objects (or conductors) is fatal. Irregular and incorrect high-voltage operation may cause accidents such as fire or electric shock. Signal wires should be tied separately from high-current wires or high-voltage wires.

2) High Electrical Leakage

Danger

1. Before turning on the power, all components of the equipment and the general grounding wire must be grounded, otherwise personal and equipment safety will be endangered.
2. If a "large leakage current" sign is pasted near the power terminal of the equipment, the protective grounding terminal of the equipment chassis must be grounded before connecting to the AC input power supply to prevent the equipment's leakage current from causing electric shock to the human body.
3. Exposed cables in the equipment should be insulated immediately.

3) Power Cable

Danger

It is prohibited to install or remove the power cord while the power is on. The moment the power cord core comes into contact with a conductor, arcs or sparks will occur.

Before installing or removing a power cable, turn off the power switch.

Before connecting a power cable, check that the label on the power cable is correct.

If the power cable is damaged, it must be replaced by the manufacturer, its service agent or similarly qualified persons in order to avoid a hazard.

The appliance should fit with means for disconnection from the supply mains having a contact separation in all poles that provide full disconnection under overvoltage category III conditions, and these means must be incorporated in the fixed wiring in accordance with the wiring rules.

2.4 Mechanical Safety

1) Drilling Holes

Warning

It is prohibited to drill holes in the cabinet by yourself. Drilling holes that do not meet the requirements will damage the internal components or pipelines of the equipment and damage the internal cables.

2) Sharp Objects

The fins of the heat exchanger of dry tower are extremely sharp. Please wear protective gloves when operating close to the fins.

Warning

When carrying the equipment by hand, you should wear protective gloves to prevent your hands from being cut by the sharp corners of the equipment.

3) Fan

When replacing a component, place the component, screws, and tools in a safe place. Otherwise, if any of them fall into the operating fans, the fans may be damaged.

When replacing a component near fans, do not insert your fingers or boards into the operating fans until the fans are switched off and stops running.

4) Moving Heavy Objects

Warning

1. Please wear protective gloves when carrying heavy objects to avoid scratching your hands.
2. When carrying heavy objects, be prepared to bear the weight to avoid being crushed or sprained by heavy objects.
3. When pulling the equipment out of the cabinet, be careful because the equipment installed on the cabinet may be unstable or heavy to avoid being crushed or hit.
4. It is prohibited for one person to carry heavy equipment alone. When transporting the device, do not tilt the device more than 15° (relative to vertical).
5. When moving or lifting the equipment, please protect the equipment to avoid scratches or bumps.
6. When transporting, it is strictly prohibited to use the components as a supporting point to prevent damage to the components.

2.5 Operation Safety

1) High Temperature and Pressure

Misoperations may cause over high pressure, which may result in eruption of coolant.

Pay attention to high-pressure parts: exhaust valves and drain valves.

2) High Speed Running

Pay attention to high-speed running part: fan.

2.6 Others

1) Binding Signal Cables

Caution

Bundling signal wires should be bundled separately from high-current wires or high-voltage wires.

2) Laying Out Power Cables

When the temperature is very low, violent strike or vibration may damage the power cable sheathing. To ensure safety, comply with the following requirements:

Power cables can be laid or installed only when the temperature is higher than 0˚C.

Before laying out power cables which have been stored in a temperature lower than 0˚C, move the power cables to an environment of the ambient temperature and store them at the ambient temperature for at least 24 hours.

Handle power cables with caution, especially at a low temperature. Do not drop the power cables directly from the vehicle.

3) Storage

Do not store devices near a heat source or under direct sunshine.

Keep devices away from fire or high-temperature objects, especially devices injected with pressurized nitrogen or refrigerant; otherwise, explosion or refrigerant leakage may occur, causing personal injury.

4) Recovery and Disposal

The sign indicates that the product cannot be disposed of with other wastes that have a shell in European Union (EU) areas. To prevent possible harm to the environment or human health from uncontrolled waste disposal, recycle it responsibly to promote the sustainable reuse of material resources.

Figure 2.1 Recycle marking.

3 System Composition and Working Principle

3.1 System Overview

The liquid cooling container system aims to continuously provide cooling liquid that meets the pressure, temperature, and flow requirements for the heat dissipation unit of the internal high computing power server, ensuring a good working environment for the load.

There are three types of heat dissipation options for liquid cooling container systems: evaporative cooling (dry wet combined dry tower), water-water heat exchange (plate exchange component), and forced air cooling (dry tower). The internal cooling medium can be selected according to the local environmental temperature, such as suitable antifreeze, deionized water, or pure water.

3.2 System Composition

Table 3.1 Main components of liquid cooling container system.

Sub system	Function	Main components
Pump station	Transport and monitor the cooling liquid status to maintain stable system operation.	Centrifugal pumps, expansion tanks, sensors, valves, exhaust valves, filters, pipelines, and other related accessories.
Control cabinet	Control the operation of various components in the pump station, read the numerical display of each sensor, and upload it.	Circuit breakers, intermediate relay, PLC, switch power supply, touch screen, and other related accessories.
Network and distribution system	Distribute network and power for high computing power servers.	Circuit breakers, aviation plugs, cables, switches, and other related accessories.
Manifold system	Flow distribution and transportation.	Manifold, elbows, hoses, chucks, valves, and other related accessories.
Accessories	Supporting components and spare accessories required for the use of liquid cooling container system.	Screws, miniature circuit breakers, aviation plugs, clamps, rubber hoses and other related accessories.
Dry wet tower (optional)	Transfer heat from the load to the atmosphere.	Spray pumps, coolers, air inlet grilles, fans, and other related accessories.
Dry tower (optional)	Transfer heat from the load to the atmosphere.	Stainless steel heat exchanger components, valves, pressure gauges, and other related accessories.
Plate heat exchanger component (optional)	Transfer heat from the load to the cold side water.	Plate heat exchangers, sensors, valves, and other related accessories.

3.3 System Operation Principles

1) Pump Station

The pump station provides two cooling liquids that meet the requirements for temperature, pressure, flow rate, and medium to the liquid distributor components. After two stages of liquid

separation, the water separator delivers the cooling liquid to the water-cooled plate, which takes away the heat inside the equipment.

The heated cooling liquid enters the dry tower for forced heat exchange with the external air, or enters a plate heat exchanger for heat exchange with the external cold source. The cooled cooling liquid is then transported to the water-cooled plate again through the pump station and water separator components for circulation, thereby taking away the heat inside the heating load and ensuring that the heating load operates in a good environment.

2) Dry Wet Tower

The dry wet tower for both dry and wet use should be used for both dry and wet working conditions. The working principle of wet working conditions is to use water and air as cooling media, and use the evaporation of some cooling water to carry away the heat released by the cooling liquid during the flow process inside the coil. Internally equipped with: spray device, serpentine condensing coil, (filler heat exchange layer) dehydrator, bottom with a water collection tank, external spray pump, and top with an axial flow fan. During operation, cooling water is pumped from the spray pump to the upper part of the condensing disc and the liquid condensed by the cooling water outside the tube flows out from the lower part of the condensing disc. After absorbing the heat of the coolant, a portion of the water evaporates into water vapor, which is sucked away by an axial flow fan and discharged into the atmosphere. The non evaporative cooling water drips into the lower collection tank for circulation by the spray pump. The axial flow fan draws air from the top, strengthening air flow, causing the water collection tank to bear negative pressure, reducing the evaporation temperature of water, accelerating water film evaporation, and strengthening the heat release of the condensing coil. The function of a dehydrator is to block non evaporative water droplets in the air and allow them to flow back to the collection tank, in order to reduce the consumption of cooling water. In addition, a floating ball valve is also installed in the water collection tank. When the water continuously evaporates and consumes, the floating ball valve automatically opens to provide supplementary spray water. The working principle of dry working condition is to forcibly exchange heat between the cooling liquid with high temperature from the water-cooled plate and low-temperature air, and the cooling liquid with reduced water temperature enters the system again through the pump unit for heat dissipation.

3) Dry Tower

Similar to the dry wet tower, the dry tower uses a power fan to force air convection to achieve heat exchange between the air and the internal circulating medium, thereby achieving overall heat dissipation.

4) Plate Heat Exchanger

During the operation of a plate heat exchanger, a thin rectangular fluid channel is formed between each heat exchange plate. The cold and hot heat exchange media enter these narrow and tortuous flow channels through the holes at the four corners of the plate. The ripples on the plate enhance the stiffness of the plate and also enhance the turbulence of the fluid. Two types of media form a parallel flow or a reverse flow between the plates, and heat exchange is carried out through the intermediate layer plates to achieve the purpose of use.

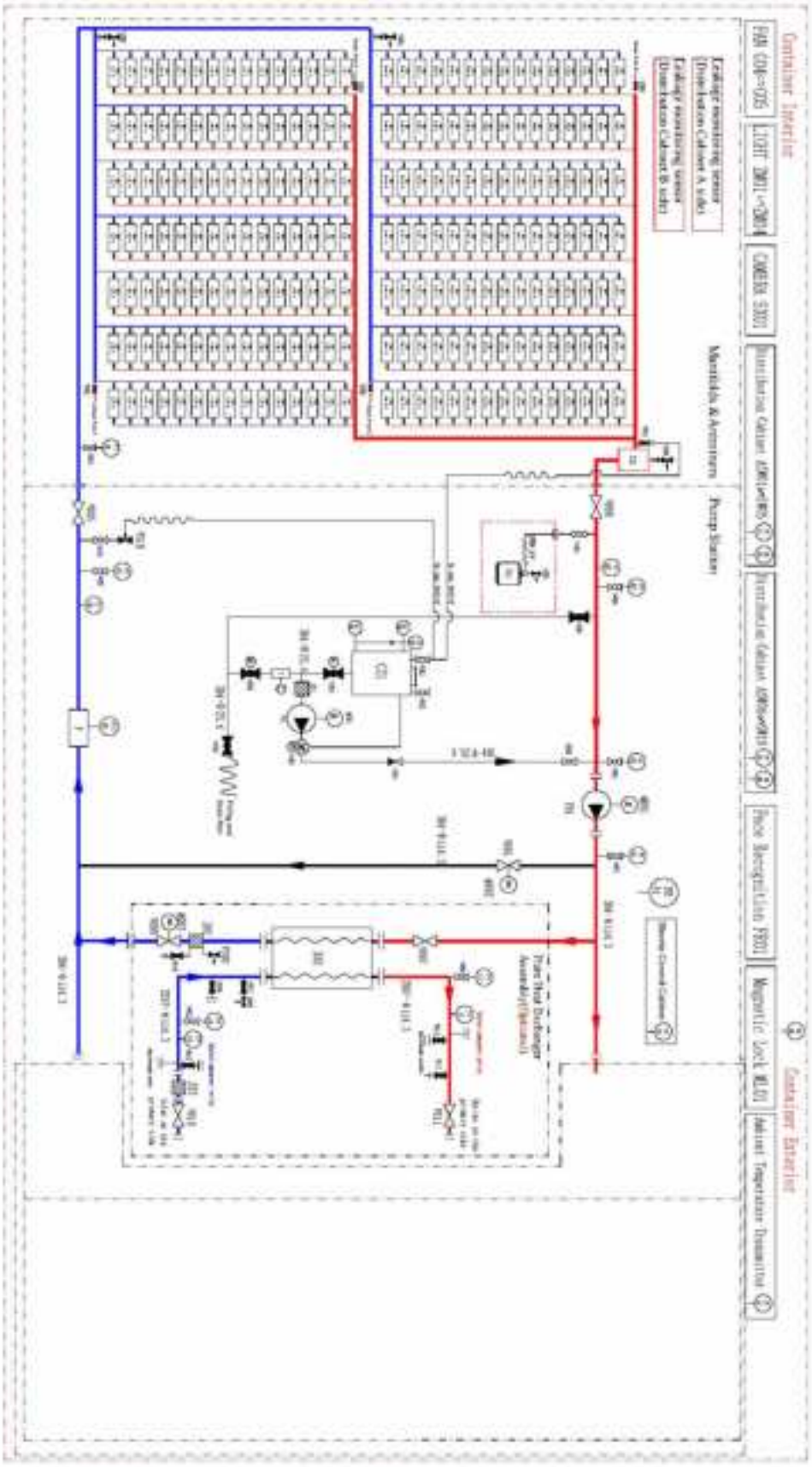

Figure 3.1 Plate heat exchanger schematic diagram of liquid cooling container system.

4 Performance Index Requirements

Table 4.1 Liquid cooling container system performance index requirements

SN	Items	Performance index	Remarks
Environment			
1	Working temperature	-35～40˚C	Outdoor
	Working temperature	5～40˚C	Indoor (controllable temperature range by adjusting the fan)
2	Working humidity	10～90%	
3	Storage temperature	-35～70˚C	
4	Storage humidity	5～95%	
5	Altitude	≤ 2000 m	
Container technology			
1	External dimensions (L× W× H) (mm)	6058× 2438× 2896	
2	High computing power server capacity	210 S19 Hyd. series high computing servers	
3	Box certification	China Classification Society Certification	
4	Safety certification	NFPA 79:2021 UL 508A:2018 R8.21 CSA C22.2 No. 14-18 ANSI/ISO 12100: 2012	
5	Operating power (kW)	1047～1050	Excluding dry wet tower power consumption
6	Input voltage and power	400 V± 5%,60 Hz/50 Hz	
7	Transport weight (T)	8	Excluding high computing power servers and cooling liquid
8	Operating weight (T)	12	Including high computing power servers and cooling liquid
9	Main switch capacity of distribution cabinet (A)	1200	The liquid cooling container system includes two distribution cabinets, each with a 1200 A main switch
10	Rated current (A)	≤ 986	Rated current of each distribution cabinet inside the container
11	Standard power (kW)	1047	Excluding dry tower power consumption
12	Maximum power (kW)	1050	Excluding dry tower power consumption
13	Single unit rated current (A)	≤ 10	The liquid cooling container system includes two distribution cabinets, each with a 1200 A main switch
14	Provided interface (dry tower)	DN125 (nominal size 139.7-ISO 2852)	
15	Provided interface (heating & plate exchanger interface)	DN100 (GB/T 9119-2010 PN16 DN100)	
16	Flow rate (m^3/h)	≥ 85	

SN	Items	Performance index	Remarks
Plate Heat Exchanger (PHE)			
1	Type	Plate Heat Exchanger	
2	External dimensions (L× W× H) (mm)	775× 480× 1069	
3	Heat dissipation capacity (kW)	1200	
4	Operating water temperature@30˚C Cold side inlet water temperature	35˚C ± 1˚C	
5	Cold side water temperature (˚C)	0~30	
6	Cold side flow rate (m^3/h)	33~110	
	Hot side flow rate (m^3/h)	100	
7	Operating power (kW)	20~32	
8	Transport weight (kg)	379	
9	Operating weight (kg)	461	
10	Connection Interface	DN100(GB/T 9122-2010 PN16 DN100)	
11	Material	TI	

5 System Structural Views

5.1 External View of Liquid Cooling Container System

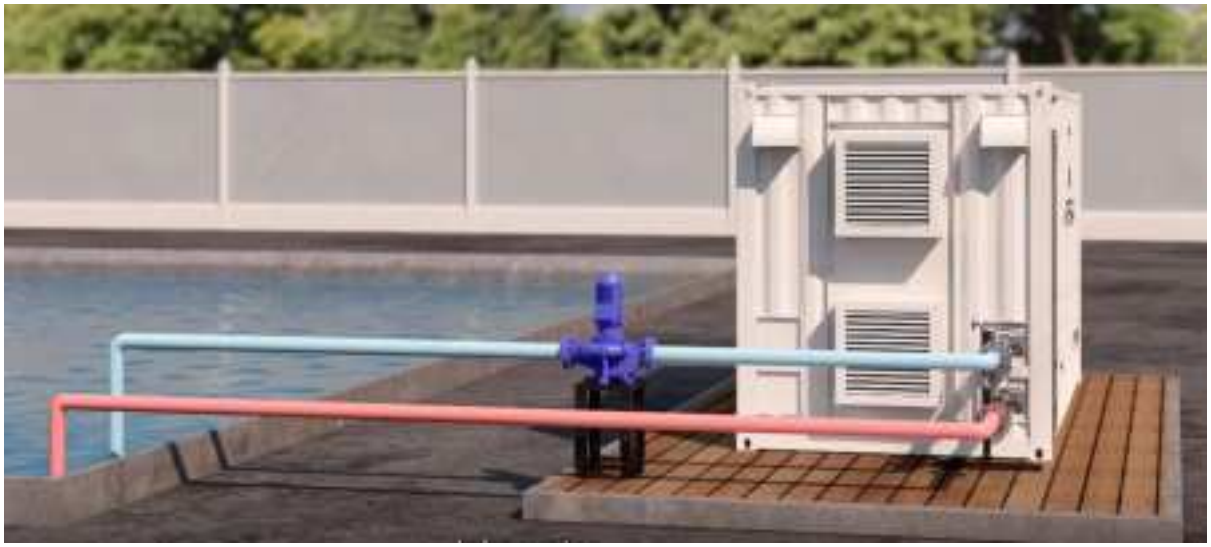

Figure 5.1 External view of liquid cooling container system.

5.2 Internal View of Liquid Cooling Container System

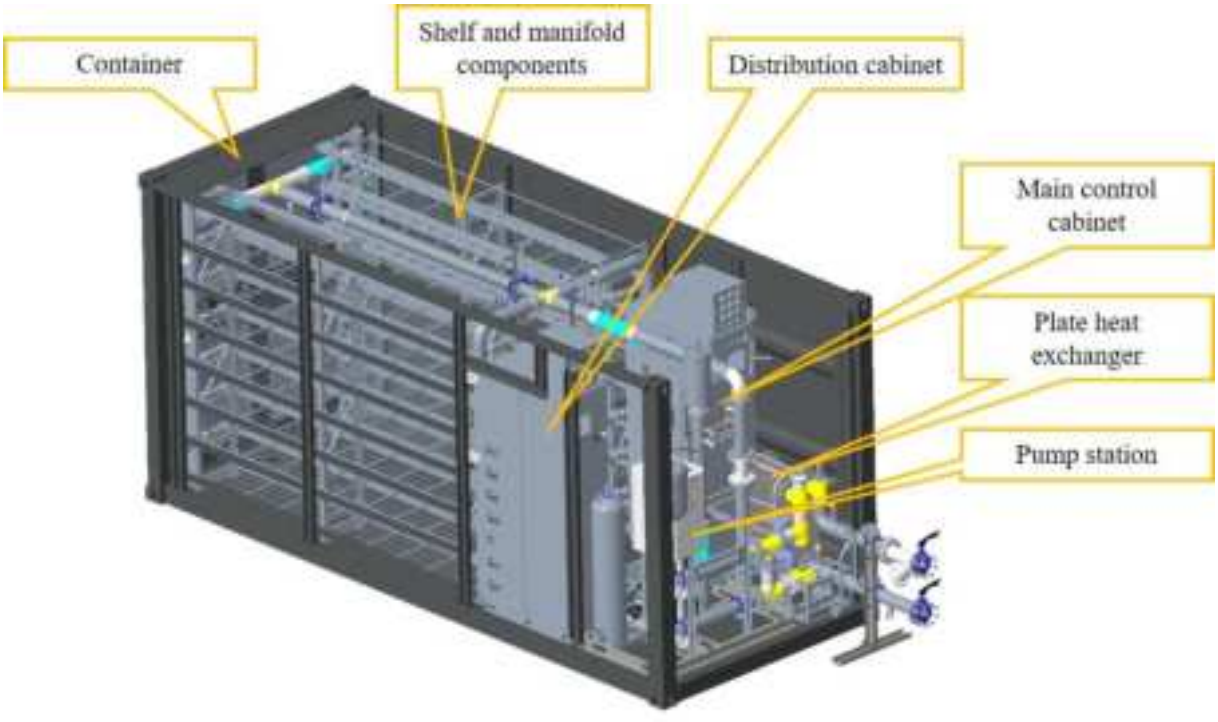

Figure 5.2 Internal view of container.

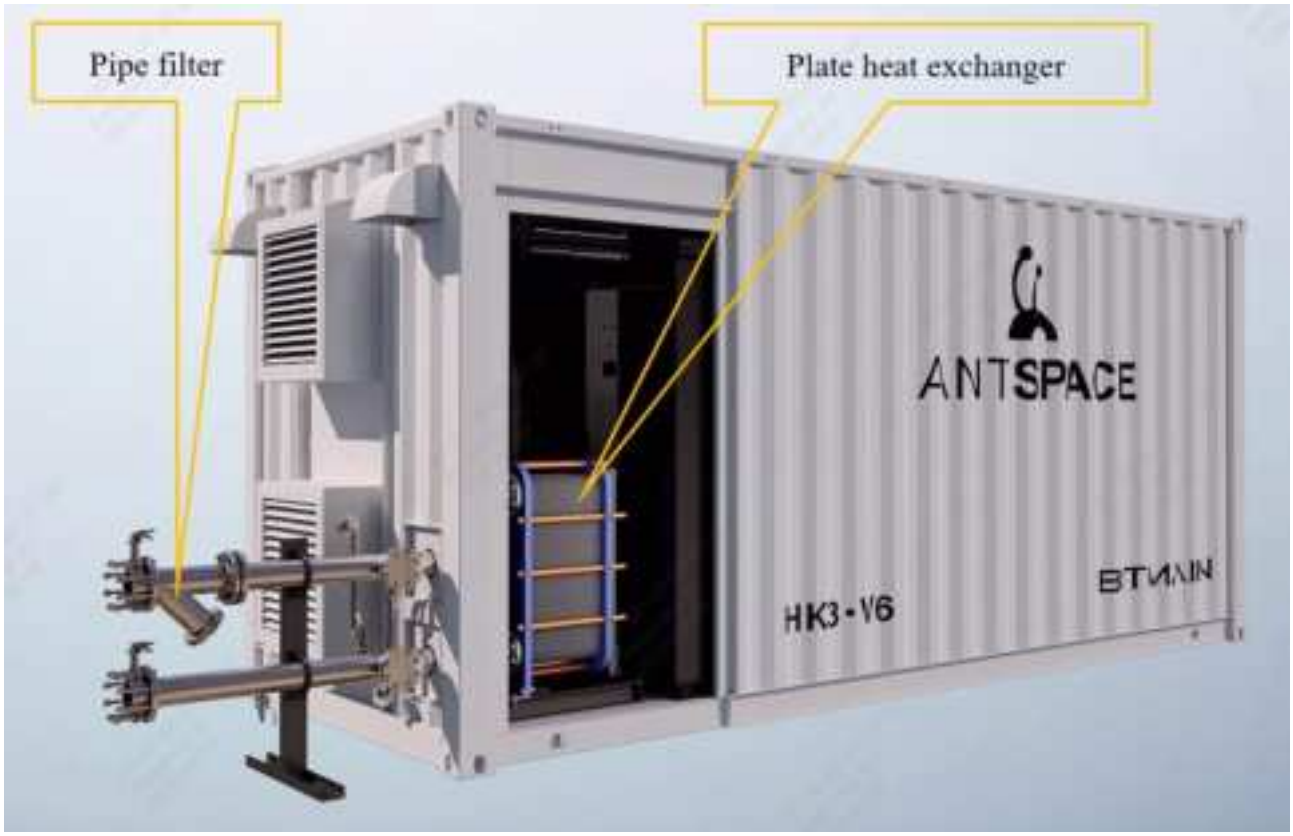

Figure 5.3 Exterior view of container.

Figure 5.4 Internal view of manifold components.

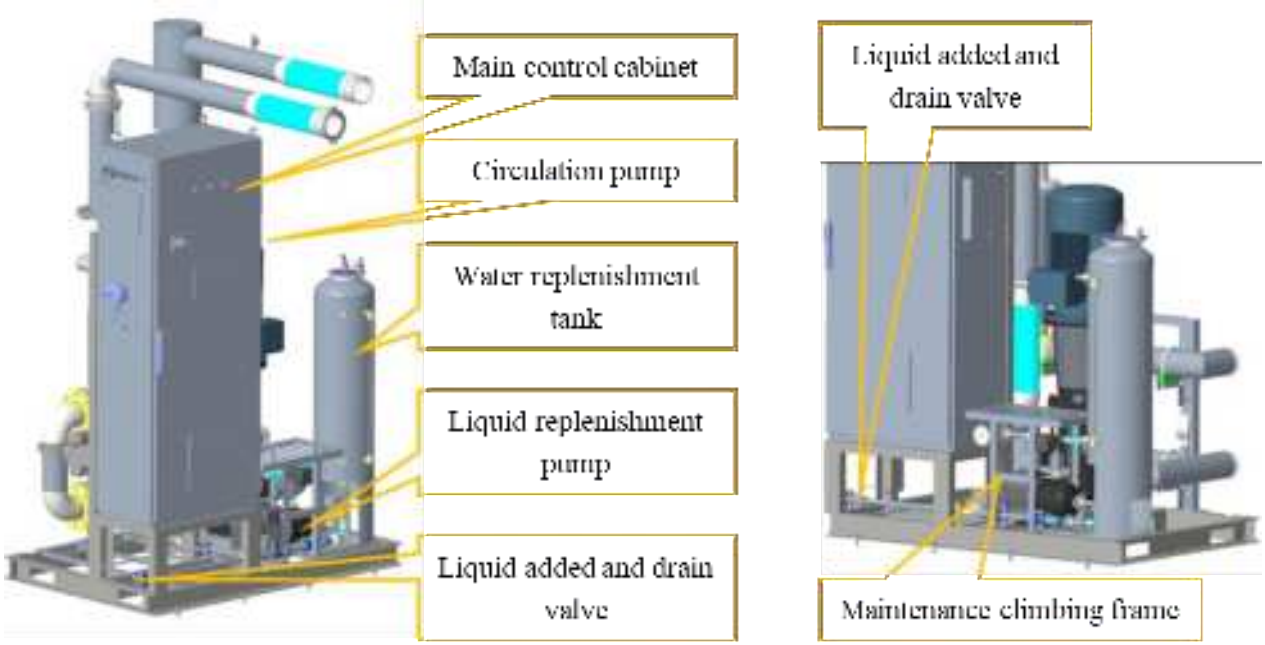

Figure 5.5 Internal view of pump station.

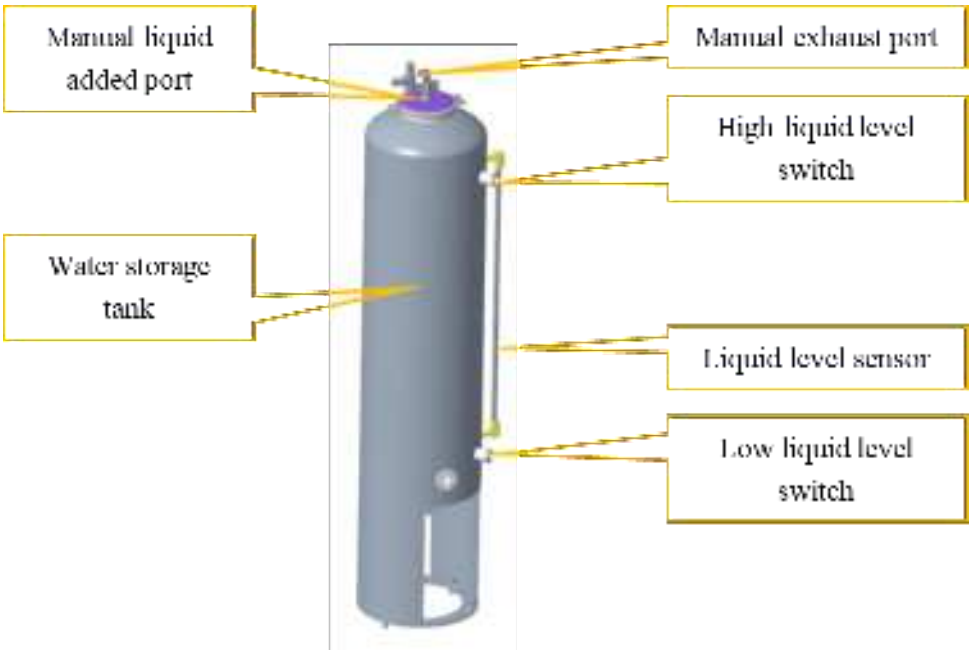

Figure 5.6 Water storage tank.

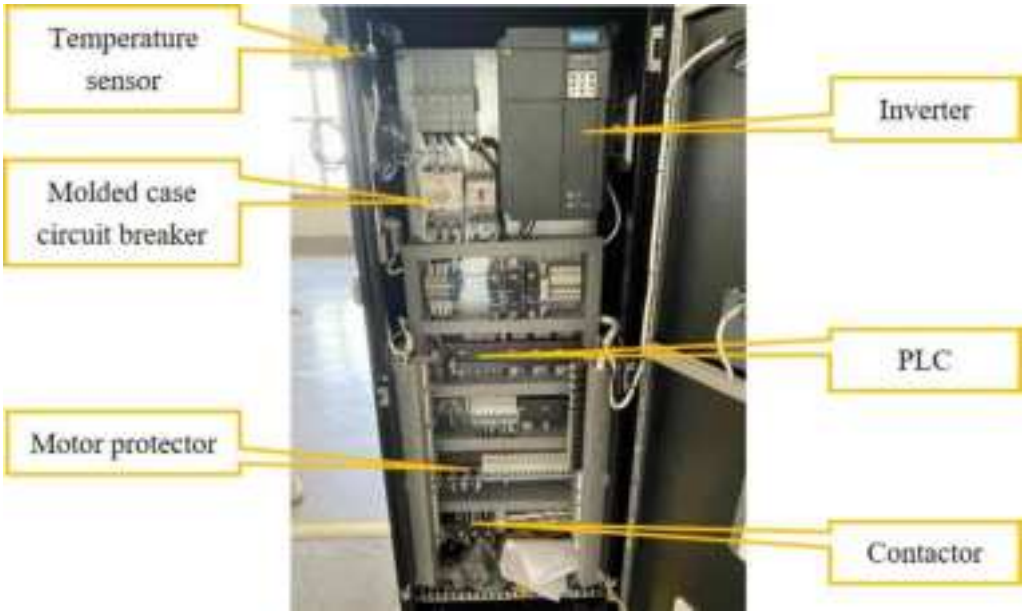

Figure 5.7 Internal view of main control cabinet.

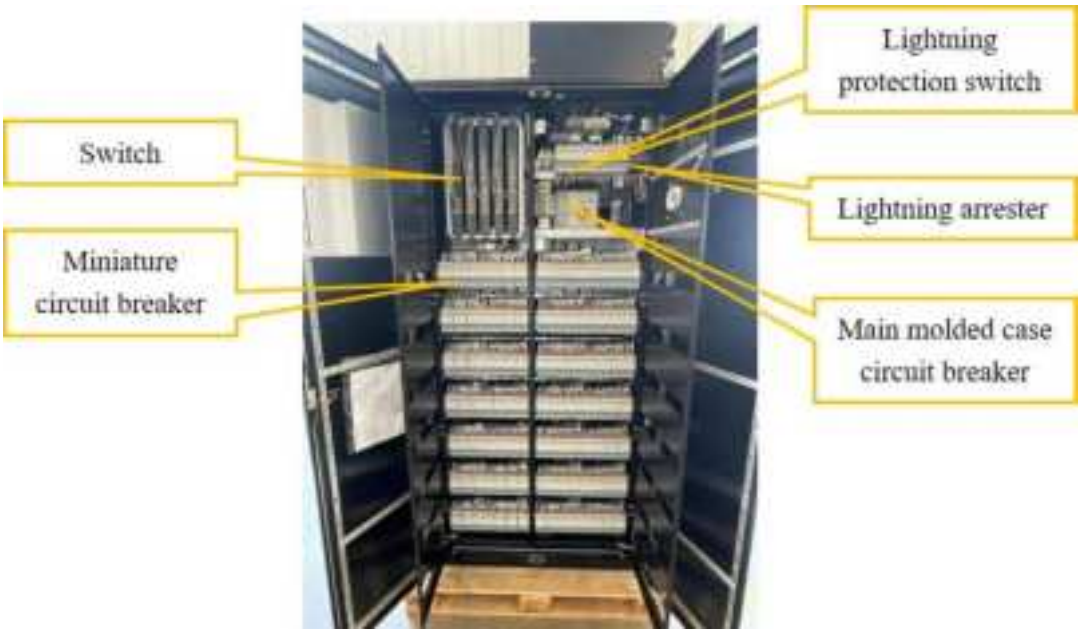

Figure 5.8 Internal view of distribution cabinet.

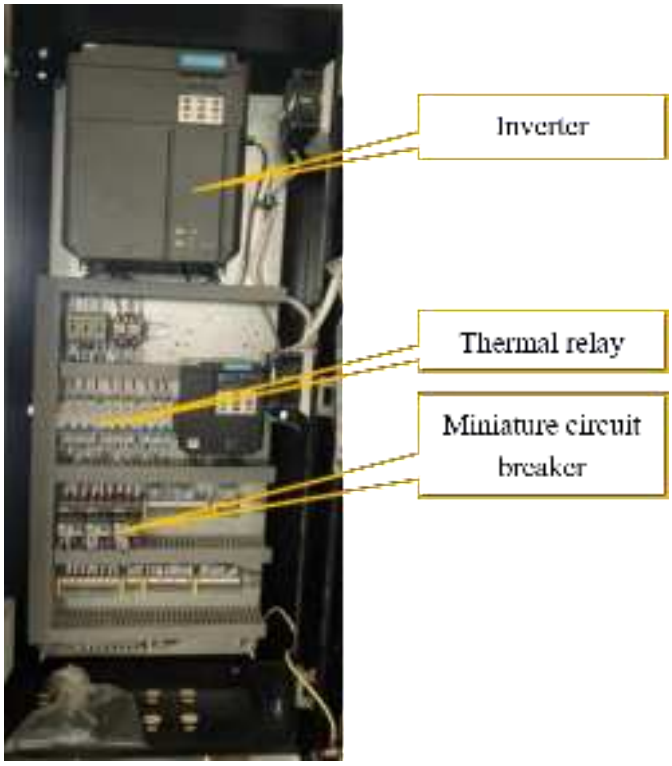

Figure 5.9 Internal view of dry tower control cabinet.

6 Installation of Liquid Cooling Container System

6.1 Container Leveling Before Installation

The ANTSPACE HK3 containerised water cooling system consists mainly of a container (with plate change inside) and associated pipework and other accessories.

6.2 Plate Heat Exchanger (PHE) Installation

1) Primary Side Piping Container Internal Piping Installation

Connect and fix the primary side pipes 01 and 02 to the plate heat exchanger as shown in Figure 6.1.

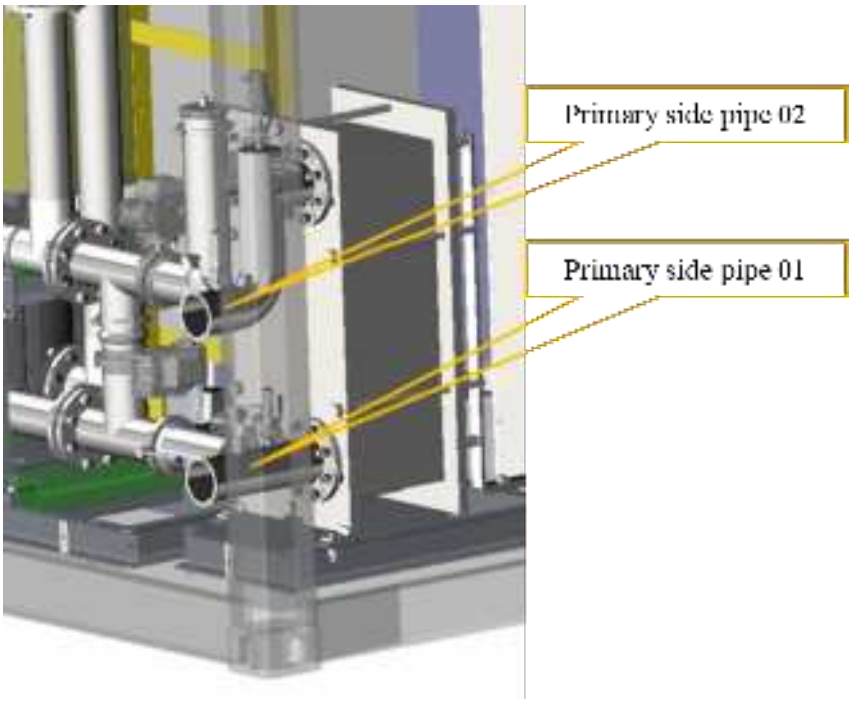

Figure 6.1 Primary side piping installation.

2) Outer Pipe and Bracket Installation:

As shown in Figure 6.2, installing the outer pipe bracket ZJ01, outer pipe G01, outer pipe G02, and butterfly valve V010 and butterfly valve V011 in sequence.

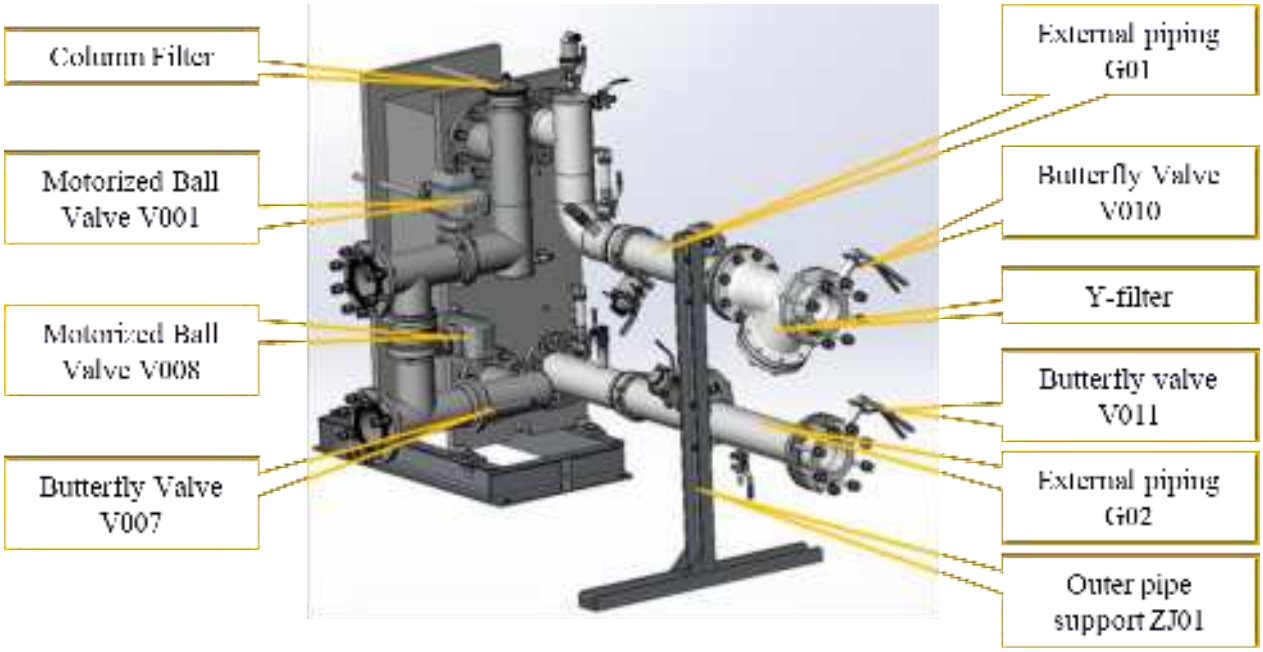

Figure 6.2 Outer pipe and bracket installation.

6.3 Installing Exhaust Fans for Container

After determining the relative position of the container and the dry tower, take out the container exhaust fan assembly (exhaust fans G04 & G05, louvers, and insect proof nets are integrated, as shown in Figure 6.3 (a) from the container accessories wooden box, unpack it and perform installation:

a. Installed at the rear door of the container, as shown in Figure 6.3 (b).

b. Remove the protective sealing plate on the rear door.

c. Secure the fan assembly as a whole to the rear door using bolts (M10 outer hexagonal bolts).

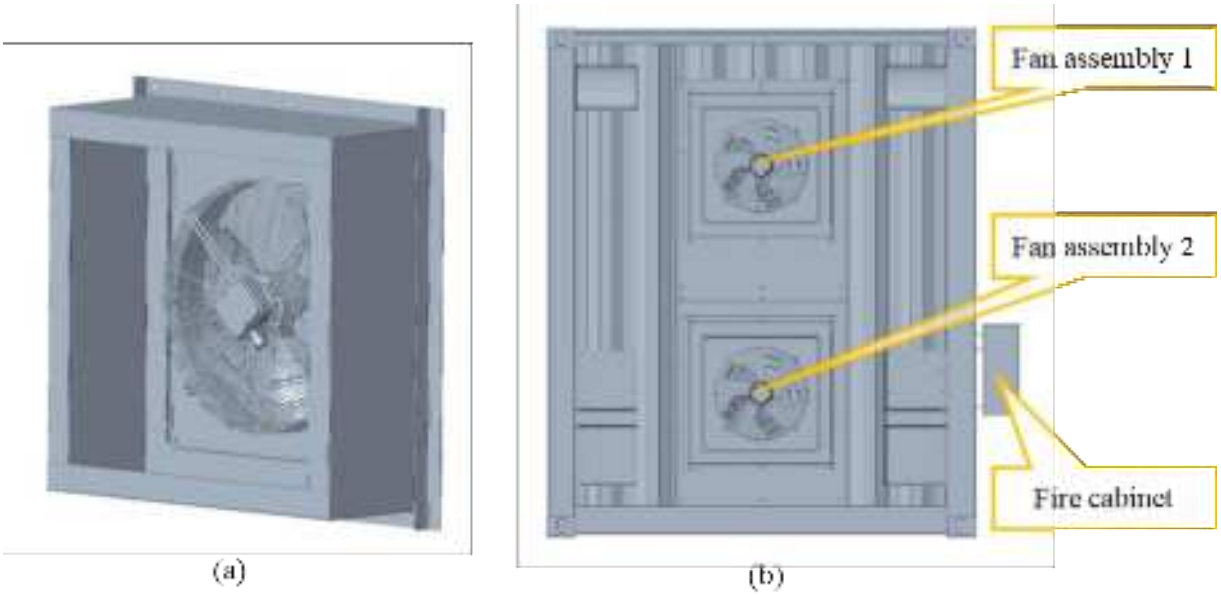

Figure 6.3 (a) Diagram of fan assembly (b) Installation diagram of container fans.

6.4 Power Distribution

1) Power Distribution Steps

Refer to the container use manual for power cable wiring.

a. Connect the cable from the upper two holes on the side of the container exhaust fan. Specific location is shown in Figure 6.4 (Note: Use the rain cover in the accessory for protection). The cable is connected from the top wiring box of the two power distribution cabinets, extends to the corresponding copper block, and is fixed with screws.

b. There are grounding studs on both sides of the container. Ensure that the shell of the container is reliably grounded. At least two diagonal corners of the container should be reliably grounded. Specific location is shown in Figure 6.4.

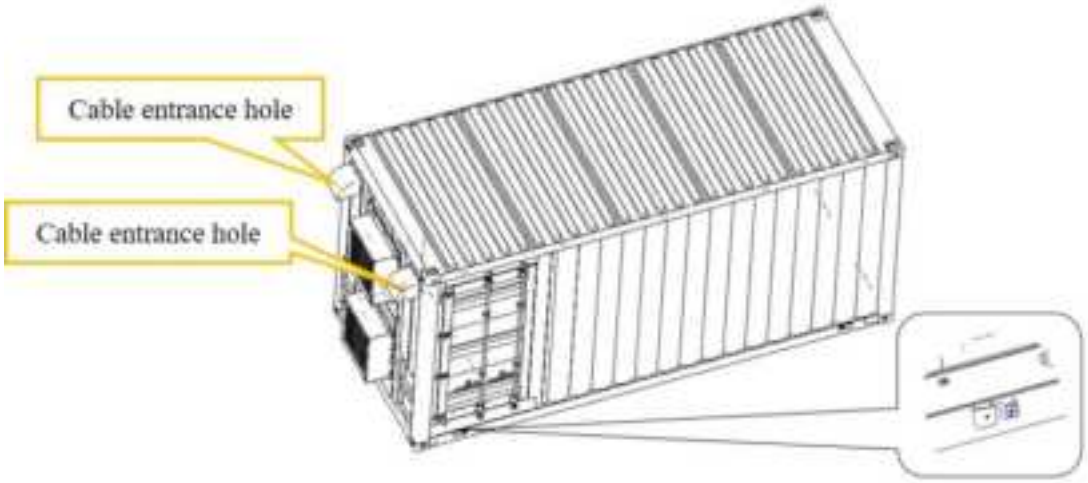

Figure 6.4 Cable entrance holes (under the rain cover).

The phase sequence of the equipment is determined when leaving the factory. When the equipment is transported to the site, it only needs to be adapted to the phase sequence of the on-site substation. The operation is as follows:

a. Connect the three-phase electricity of the substation to the power distribution cabinet, power on the electric control box, and check whether the power monitor is faulty.

b. If there is a fault, adjust the phase sequence of the accessed electric control box.

c. If there is no fault, the equipment can run normally.

2) Connect the Main Power Cable

L1, L2, L3, N, PE rows are connected to the corresponding terminals. Pay attention to calibrate the torque. For the selection of wiring model, please refer to the maximum running current of the unit.

The PDC end of the container adopts OT terminal. Select appropriate terminal at the on-site substation end according to the actual conditions. Schematic diagram of copper-row wiring in the wiring box on the top of the PDC is shown as below:

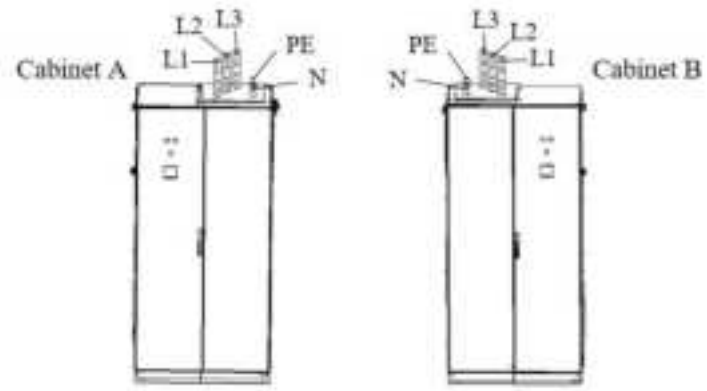

Figure 6.5 Wring diagram for wiring box.

Caution

Before connecting cables, wiring personnel must take appropriate anti-static measures. The schematic diagram of the indoor unit control interface is for reference only. The installation is subject to the special wiring diagram affixed to the unit.

3) Plate Heat Exchanger (PHE) Wiring Instructions

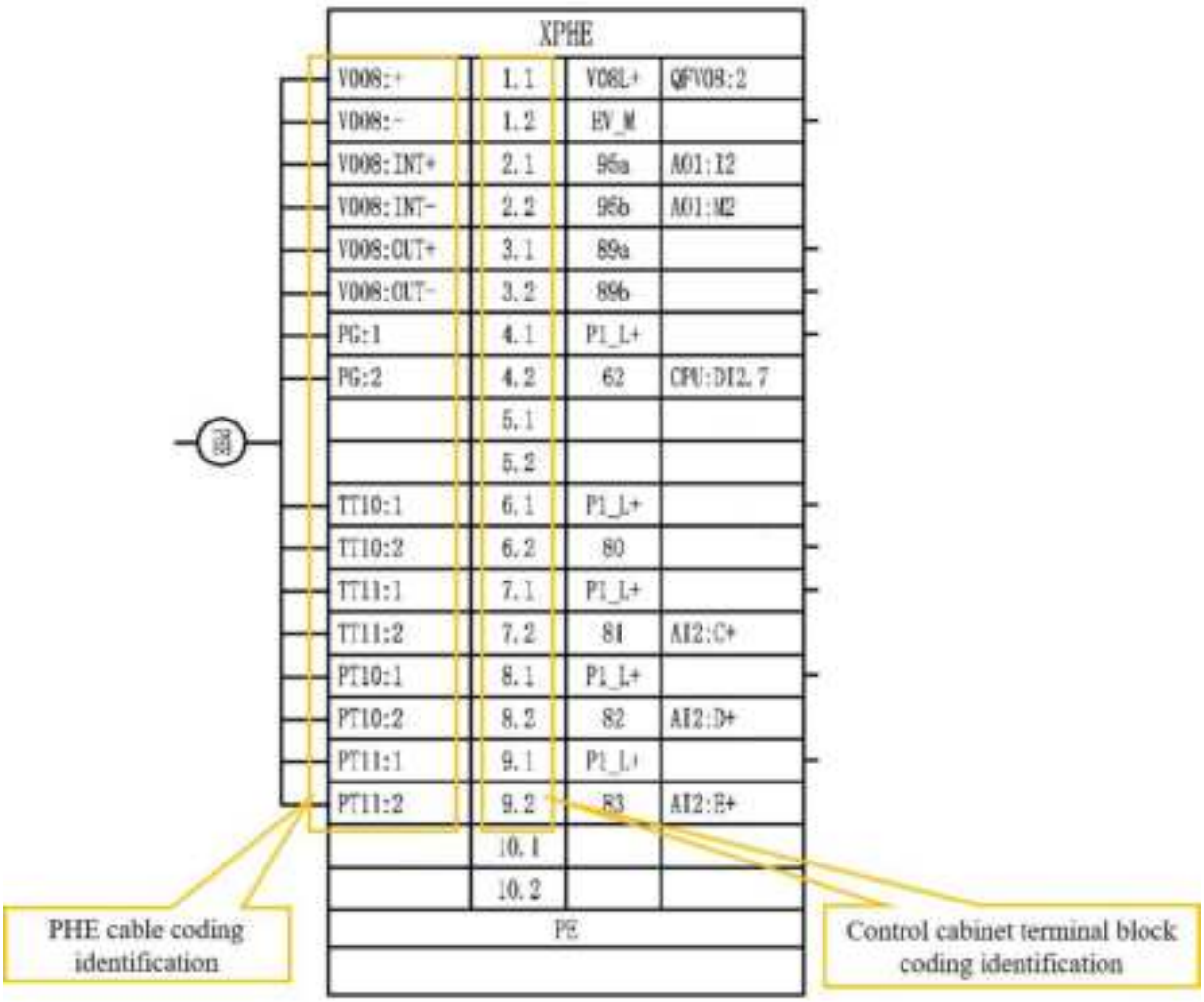

Figure 6.6 Corresponding relationship between cables and terminal blocks.

The wiring of the PHE component is relatively simple, and the corresponding relationship with the wiring of the container control cabinet is as shown in the figure above. Arrange the cables in a neat and tidy manner and tie them well.

Caution

Before powering on for the first time, check whether each current-carrying screw is loose. If it is loose, please tighten it according to the specified torque.

7 Use and Operation

7.1 Safety Rules

1) Hazard Level

Danger

Inside the device is a live label, and it is prohibited to open protective panels with live labels. Even in case of power outage, non professionals are prohibited from opening the cover plate.

2) Precautions for Use

Filtered coolant should be used as the cooling medium, and there should be no floating or particulate matter in the supply circulation system.

Warning

The cooling medium should be produced by a reputable manufacturer and should not be mixed by oneself. Otherwise, we will not be responsible for any problems that may arise. It is recommended to use organic cooling liquid (inorganic cooling liquid contain P, Si, B, Mo, nitrate, etc., which can generate sediment over time). Recommended manufacturers of cooling liquid include Great Wall, Shell, etc. The coolant model is selected based on the minimum temperature of the project location.

Warning

It is prohibited to add tap water or exceed the specified coolant in the system. The system operation should have regular monitoring of the coolant. Once the coolant properties change, a new coolant must be replaced.

When the ambient temperature is below 0˚C, the water in the collection tank and spray pipeline must be completely drained to prevent freezing and damage to the equipment.

Equipment should avoid wiring midway and is strictly prohibited from being used in parallel with other equipment.

If there are any abnormalities in the equipment (such as stink, etc.), it should be shut down, disconnected from the power supply, and inspected.

There are emergency stops on the entrance doors and container doors of distribution cabinets A and B. When an emergency occurs, pressing the emergency stop will immediately disconnect the power circuit breaker. After an emergency reset, first turn the main circuit breaker to the OFF position and then power on again.

Switch MCB-A1 can only cut off power to distribution cabinet A.

Switch MCB-A2 can only cut off power to distribution cabinet B.

Warning

All emergency stop buttons used in this system are rotary release type. After the emergency stop button is pressed and confirmed and confirming that the system is functioning properly, it is necessary to rotate the emergency stop button counterclockwise to release it. Then, the main switch of the distribution cabinet and the main control cabinet can be closed. Before closing the switch, it needs to be turned to the OFF position and then re-closed.

Danger

The silk screen on the inner door of the power distribution cabinet indicates which switches are still live after the main switch is powered off. Please read carefully before operation. Avoid causing electric shock accidents.

Figure 7.1 (a) Emergency stop knobs on the front door (b) Location of MCB-A1/A2.

The circuit breaker QFWCU can only power off the main control cabinet.

To prevent danger, when repairing a single high computing power server, the power switch corresponding to the serial number of the high computing power server in the distribution cabinet must be disconnected, and then the power interface, network cable interface, and water supply interface of the corresponding high computing power server must be unplugged. Finally, the power source of the high computing power server must be unplugged to repair the high computing power server. If it is necessary to power off the entire container equipment, the steps are as follows:

a. Firstly, disconnect the micro circuit breakers of 210 high computing power servers.

b. After an interval of 10 seconds, disconnect the main power supply of the main control cabinet.

c. Then disconnect the main switches of the two distribution cabinets.

d. If necessary, also disconnect the main switch at the transformer end. Remember to strictly follow the above requirements for the closing sequence of switches.

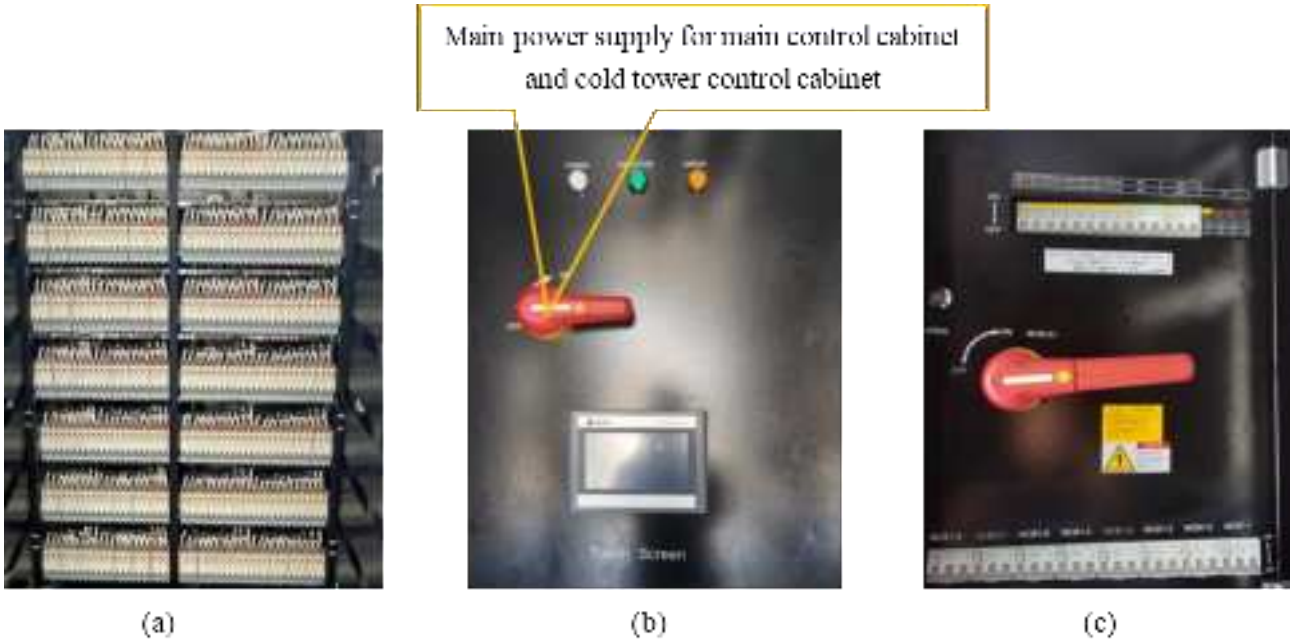

Figure 7.2 (a) Distribution cabinet power switches of high computing power servers (b) Internal of the main control cabinet (c) The main switch of the distribution cabinet.

Caution

Since the container lighting circuit is led out from the main control cabinet, if you want to perform the above operation, please bring a portable lighting tool.

Warning

If the device is not working for a long time, please disconnect the main power supply.
It is strictly prohibited to open the protective cover on the fan.
It is strictly prohibited to touch the fan blades directly to test whether the fan is rotating, or to rotate the fan blades by hand.
It is prohibited to operate the equipment with wet hands, otherwise it may cause electric shock accidents.
It is prohibited to put debris inside the equipment to ensure that the fire passage is always unobstructed.

7.2 System Pressurization

After the on-site installation of equipment and pipelines is completed, a 7 bar air pressure test should be conducted first, with the pressure maintained for at least 12 hours. Then conduct a 7 bar water pressure test, with the pressure maintained for at least 30 minutes. Check if there is any leakage in each pipeline and interface. If there is no leakage and the pressure reading decreases by less than 5%, it indicates that the on-site installation inspection is qualified. The pressurization process is as follows:

1) Preparation before Pressurization

a. Prepare hoses and air pumps (recommended brand: OUTSTANDING, model 2200W-40L.

Selection basis: the internal volume of the system is about 1.5 m^3, and the air pump with corresponding exhaust volume is selected according to time requirements; the maximum output air pressure is required to be above 8 bar, and 10 bar is optimal).

b. Connect the external pipelines according to the previous chapters.

c. Check if all the plugs on the automatic exhaust valves on the internal and external connection pipelines of the container are closed. Automatic exhaust values include V302 & V303 on the water distributor 7, V301 on the degassing tank, V304 on the expansion tank, manual exhaust valve V701, and dry tower exhaust valve V306. By screwing the top nut of the automatic exhaust valve, the automatic exhaust valve can be opened/closed.

d. Check whether the safety valve ball valve V410 and expansion tank ball valve V105 are closed, and check whether each liquid filling and drain valve is closed. The water distributor has 4 drain valves V205-V208, the pump station has 1 filling/drain valve V104, 1 drain valve V201, and 1 filling valve V209.

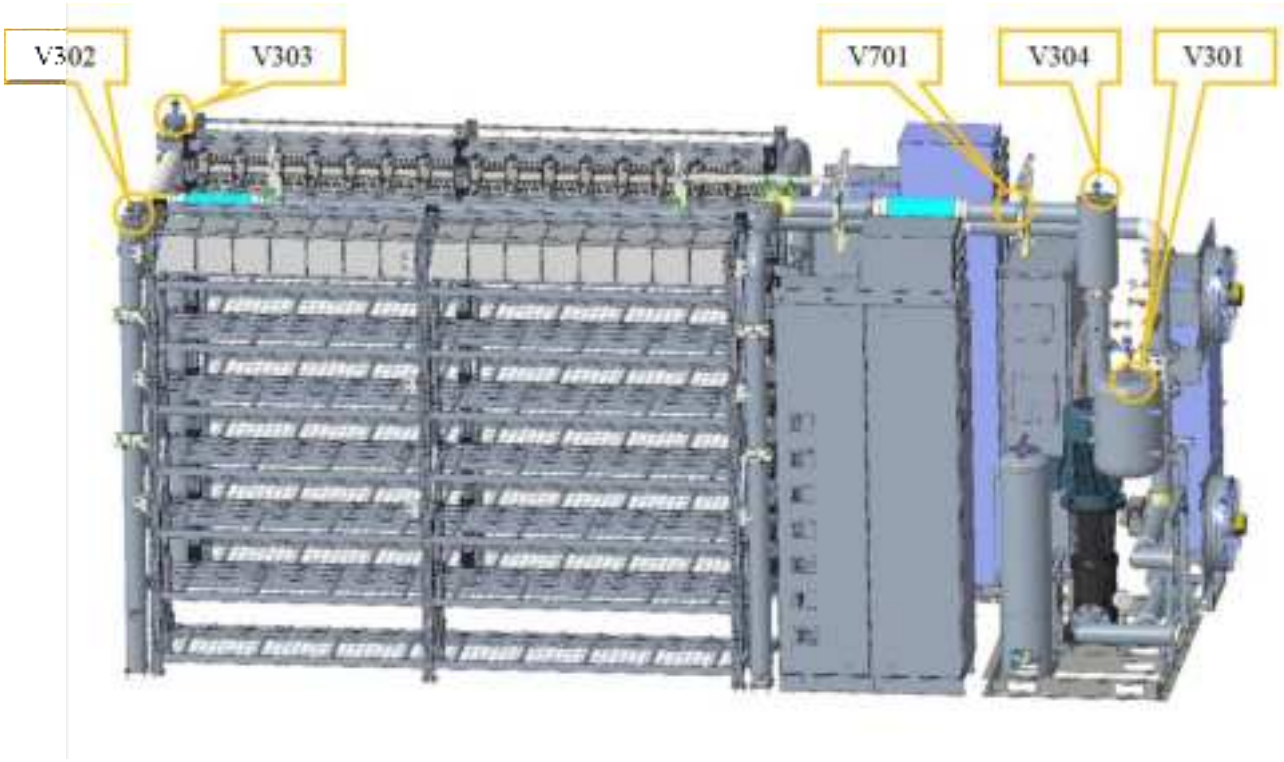

Figure 7.3 Location of the exhaust valve in container system.

Figure 7.4 Water distributor drain port.

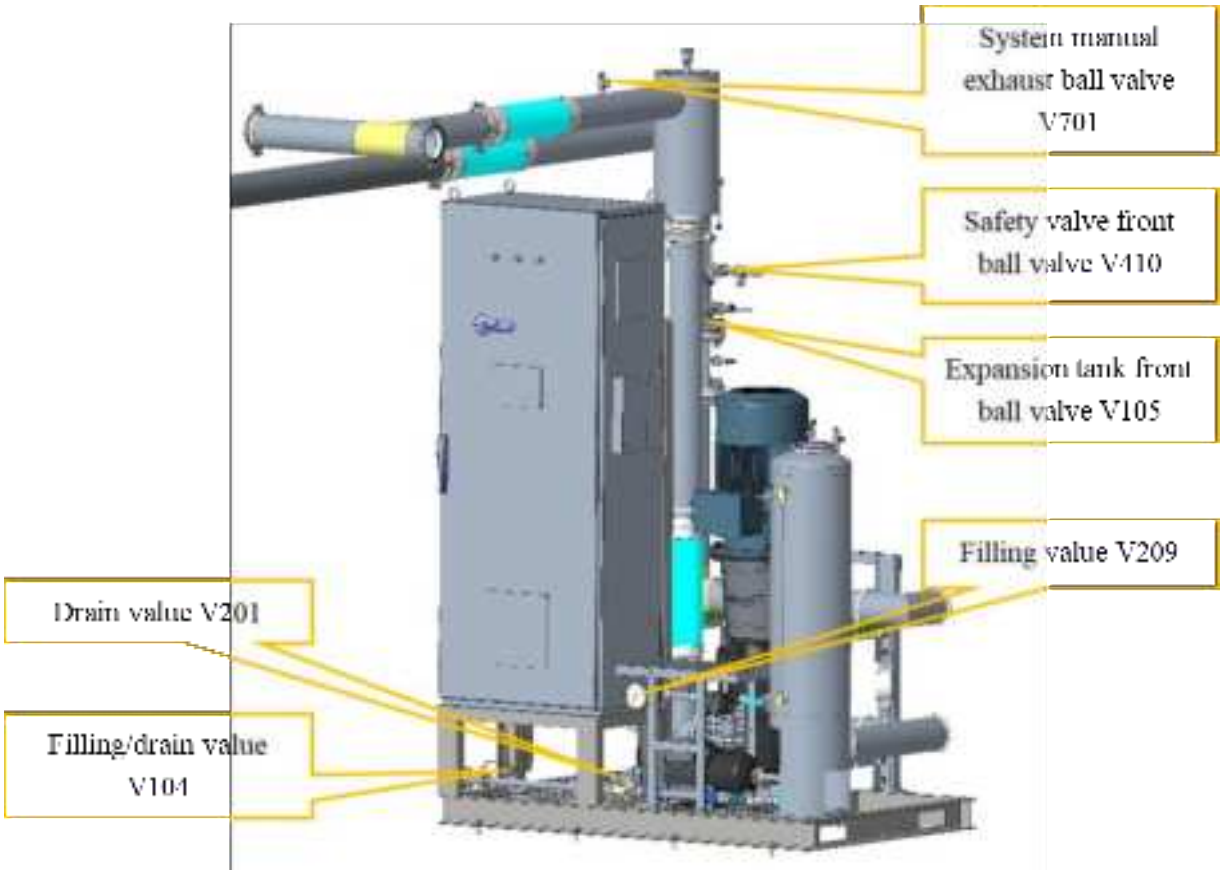

Figure 7.5 Pump station valves.

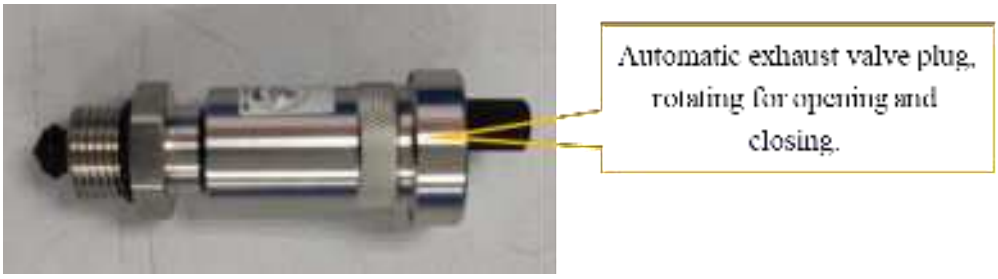

Figure 7.6 Automatic exhaust valve.

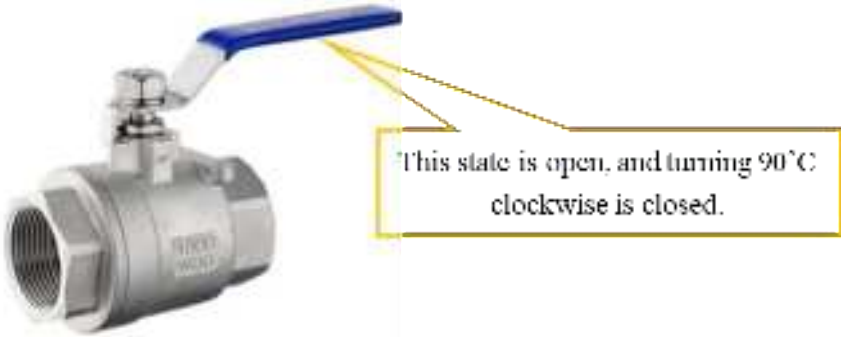

Figure 7.7 Opening and closing of valve.

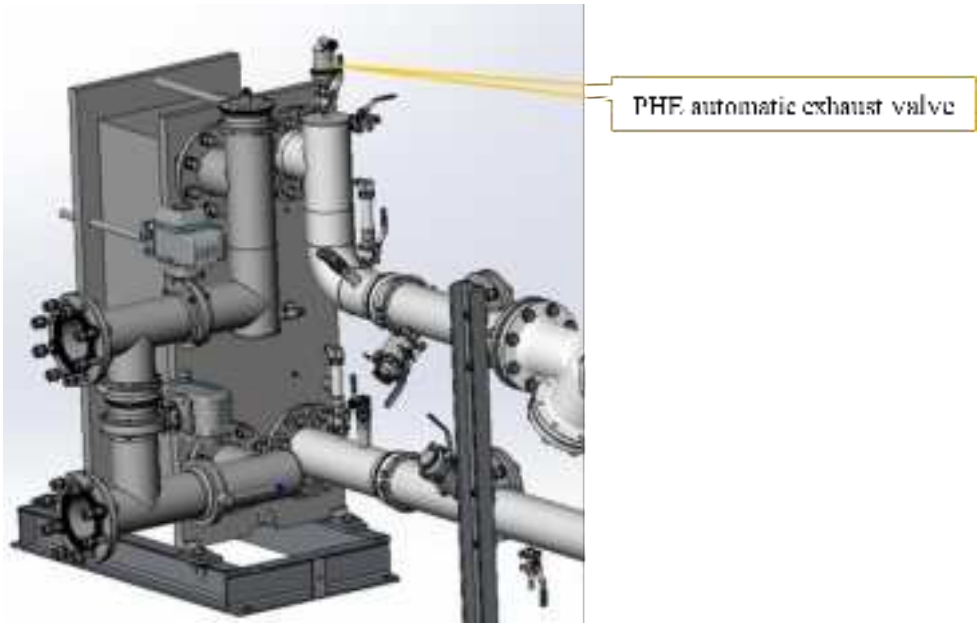

Figure 7.8 PHE exhaust valve position.

2) Pressurization Steps

a. Check again that the exhaust valve plugs and ball valves are closed.

b. Close the filling/drain ball valve V104, the expansion tank front valve V105, and the safety valve front valve V410, as shown in Figure 7.5.

c. Open all mini ball valves on the water distributor.

d. Connect to any quick connection port with the air pipe and close the corresponding ball valve of this circuit.

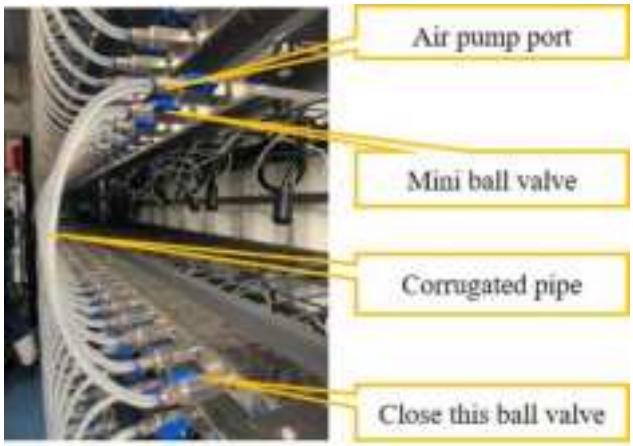

Figure 7.9 System pipeline connection ball valve.

e. Use an air compressor to pressurize to 7 bar and stabilize for more than 12 hours, and check for any leakage points.

f. The key inspection.

Key inspection areas: The connection between the quick connector and the mini ball valve; The connection between the quick connection ball valve and corrugated pipes; The connection between the mini ball valve and the water distributor; The connection between the quick connector and computing power server; Each flange/chuck/threaded/welded connection.

Inspection methods: Choose any soap, washing powder, or detergent, add water to make soap solution, coated in the suspected leakage point, especially the interface, the parts with bubbles bulging is the leakage point.

g. Pressurize again:

After the high computing power server is online, it needs to be gas liquid mixing check again, with a pressure of 7 bar and stabilized for more than 2 h, to check whether there are any leakage points in the above mentioned parts.

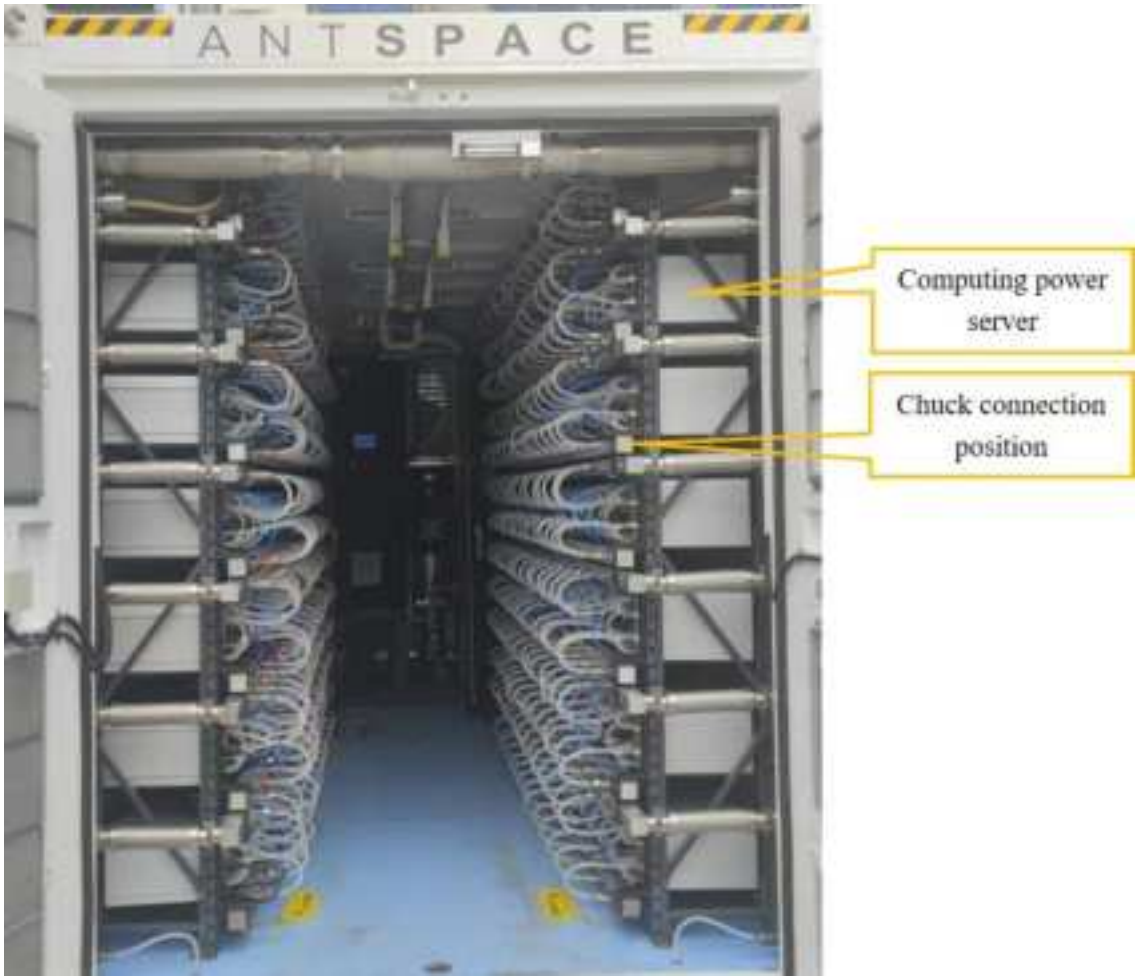

Figure 7.10 System chuck connection.

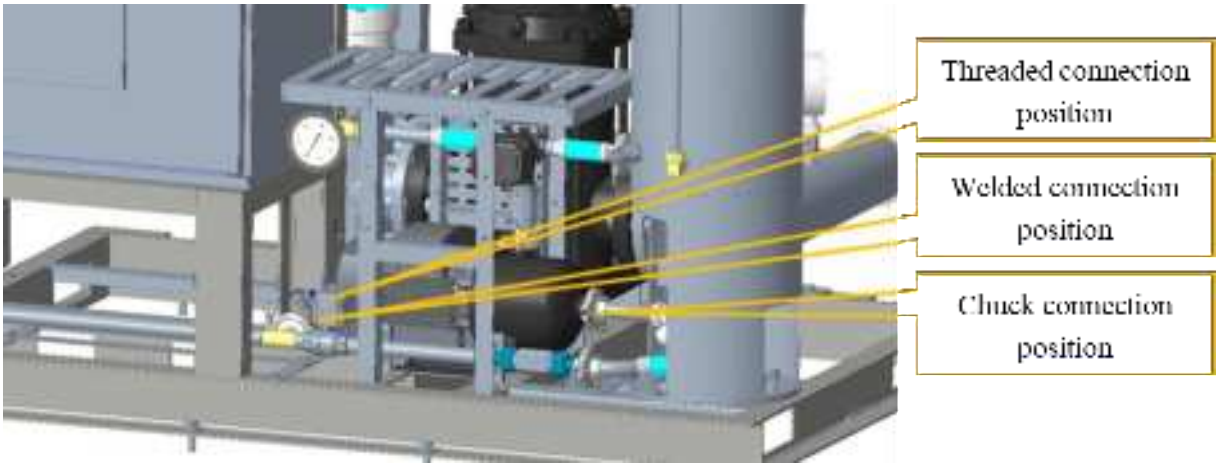

Figure 7.11 System leakage point inspection.

7.3 System Liquid Replenishment

During the installation of the external pipeline, it is necessary to check whether the filter Z01 in the external pipeline 03 is intact.

The spray water inside the dry tower adopts tap water or softened water, and a tap water pipe (DN40) is installed on site. It is recommended to choose appropriate antifreeze or purified water based on local climate conditions as the circulating media in dry tower and container.

Firstly, add liquid to the system with a liquid filling pump. When the return pressure reaches the required value, stop adding liquid to the system. Switch the pipeline switch, and start the liquid filling pump to add liquid to the water tank. When the liquid level in the water tank reaches the required height, switch the pipeline switch, and the system will automatically run.

The specific liquid filling procedure is as follows:

a. Preparation: Prepare materials and tools, and open all exhaust valves of the system (open the manual exhaust valve of the system and the manual exhaust valve on the dry tower for the first liquid filling).

b. System liquid replenishment: Replenish the system with liquid filling pump P11.

c. Water tank replenishment: Replenish the water tank with liquid filling pump P11.

d. Regular replenishment of water tank: Replenish the water tank with the liquid filling pump P11 or through the manual filling port on the top of the water tank.

1) Preparation

a. Prepare the coolant.

b. Connect the external pipeline according to the previous chapters.

c. Check if all the plugs on the automatic exhaust valves on the internal and external connecting pipelines of the container are open (see Figure 7.3 and Figure 7.8).

d. Open the filling valve V209 and close the drain valve V201 (see Figure 7.4 and Figure 7.5).

e. Open the exhaust ball valve V702 on the top of the water tank to ensure that the water tank is connected to atmospheric pressure (as shown in Figure 7.12).

f. Open the manual exhaust valve V701 of the system and connect the PU pipe to the quick connector on the water tank (to accelerate the first liquid filling).

g. Switch the exhaust valve of the PHE to the manual exhaust valve (as shown in Figure 7.13).

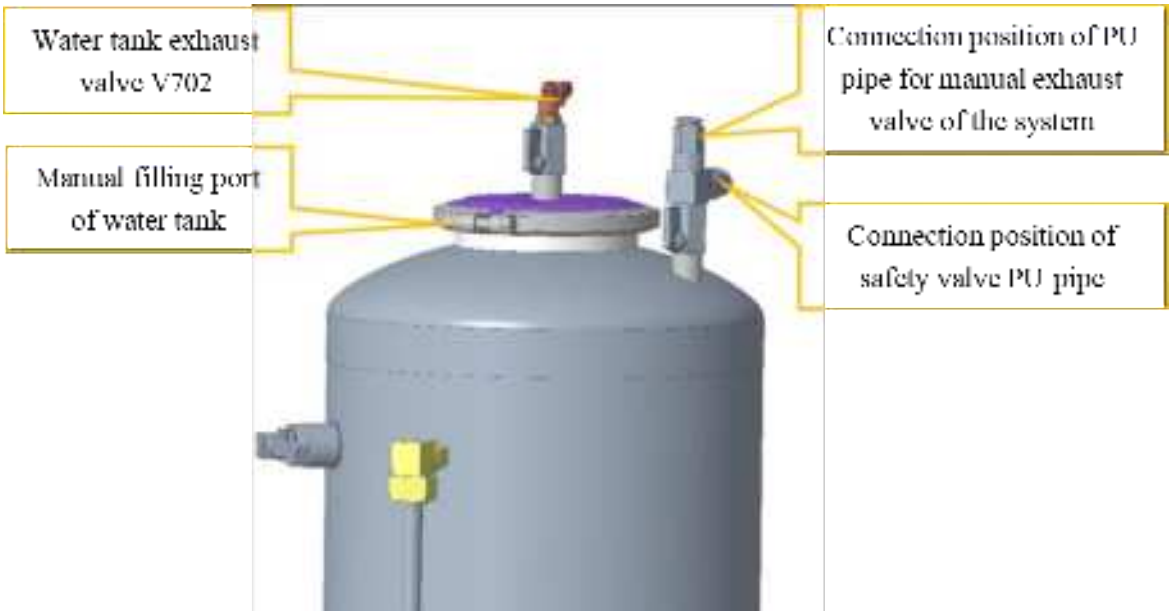

Figure 7.12 Water tank valve.

Figure 7.13 PHE exhaust valve.

2) System and Water Tank Replenishment

a. Replenish the system and water tank C21 with the liquid filling pump P11.

b. Find an external water source (with a certain pressure), and connect the hose to liquid filling/drain port V104 on the container. Fill the connecting pipeline with liquid for the first liquid filling (until water flows out). Find the liquid filling port outside the container and plug in the hose (at the side door of the container). Then, connect the external water tank to the liquid filling pump P11.

c. Open the exhaust valve of the liquid filling pump (Allen wrench), switch to manual mode on the touch screen, and open the solenoid valve V202. After water is discharged, close the manual exhaust valve of the liquid filling pump.

d. Close solenoid valve V202, switch to manual mode on the touch screen, and open the "Manual Liquid Replenishment" mode "External → System" of the liquid filling system,

which means adding liquid to the system. Open "External → C21", which means adding liquid to the water tank C21 externally, as shown in Figure 7.15.

e. When adding liquid to the system, pay attention to whether there is water flowing out of the exhaust valve of the dry tower and the manual exhaust valve of the system. When there is water flowing out, it indicates that the system has been fully filled. Then, close the manual exhaust valve of the dry tower, open the automatic exhaust valve, and close the manual exhaust valve 701 of the system.

f. When the static pressure reaches 0.7 bar (refer to Figure 7.16, touch screen reading) or above, the circulation pump can be started for 10 seconds (without stopping the liquid filling pump), and then the circulation pump can be stopped.

g. Continue to add liquid and repeat for twice to ensure that 1.3-1.5 tons of coolant are added.

h. When the static pressure reaches 1.0-1.5 bar, stop adding liquid (observe the reading of the main interface pressure sensor PT02, as shown in Figure 7.15).

i. Turn on the circulation pump P01 again to circulate the coolant in the system, ensuring that all automatic exhaust valves are in open state.

j. Due to the first liquid filling and the presence of gas in the system, the discharge of gas during the water pump circulation will cause a decrease in pressure in the system. At this time, the liquid filling function is turned on, and the water tank replenishes the system to ensure that the return pressure is between 1.0 and 1.5 bar.

k. After the above operation is completed, the system back pressure (pressure gauge PI03/return pressure sensor PT02) will be stabilized at 1-1.5 bar and for normal operation. Automatic mode can be turned on and the computing power server can be turned on for operation.

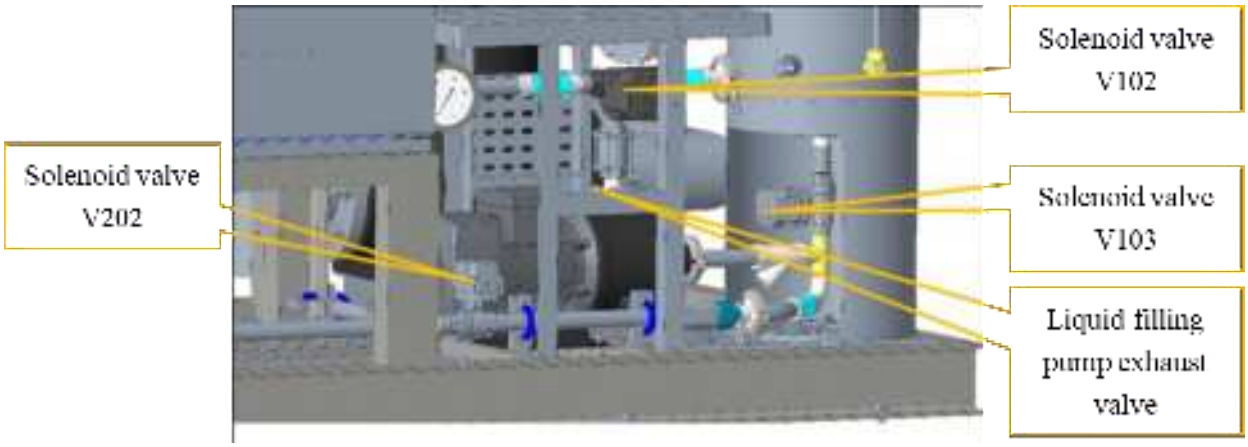

Figure 7.14 Distribution of solenoid valves in the liquid filling system.

Figure 7.15 Liquid filling system interface.

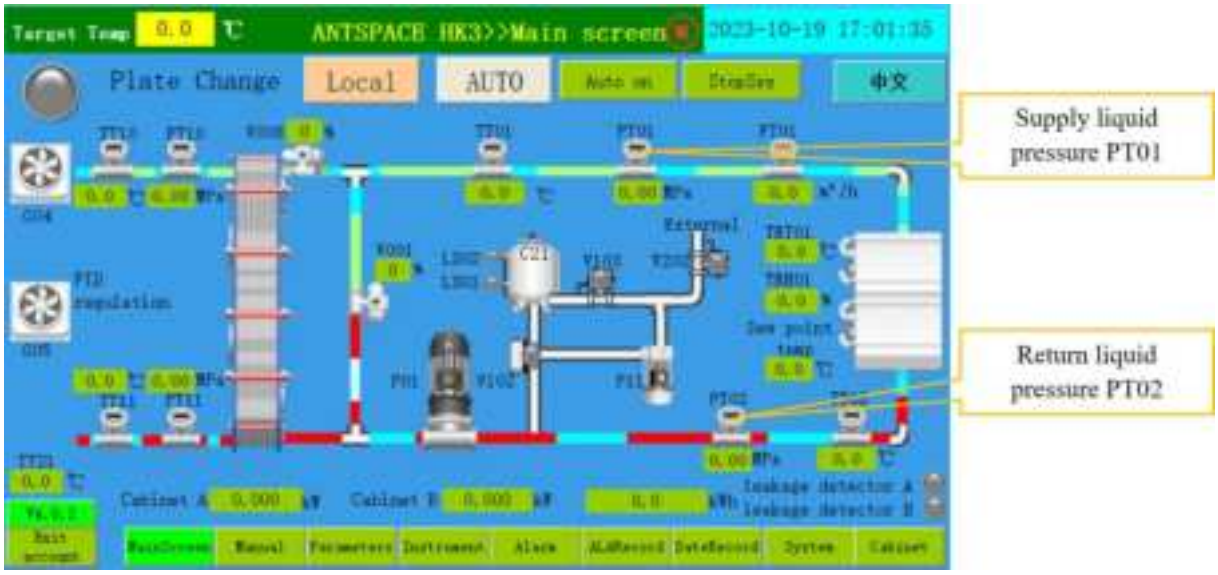

Figure 7.16 System operation interface.

3) Regular Replenishment of Water Tank

When water tank C21 needs to be replenished with a small amount of coolant, the following methods can be referred to:

Method 1: Same as the first liquid filling, connect the liquid filling pump P11 to an external water source (with a certain pressure; fill the connecting pipeline), turn on the liquid replenishment mode, and externally add liquid to the water tank C21.

Method 2: Open the installation chuck of the exhaust valve on the top of the water tank (refer to Figure 7.12), and manually add liquid from the manual filling port to the inside of the water tank.

7.4 Electrical Wiring

The electrical system requirement for the equipment is TN-S three-phase five wire system. Due to the two distribution cabinets (A/B cabinets) inside the equipment, in order to ensure safe and stable operation of the equipment, two 500 kW three-phase five wire cables (with a rated current of 1200 A for the main switch) should be prepared in advance on site.

Danger

Electrical connections must be operated by professionally qualified personnel. In addition to complying with the requirements of this manual, the operation procedures must also comply with the relevant local electrical regulations and safety regulations of the project.
Unqualified personnel are strictly prohibited from making electrical connections to the equipment.
The specifications and quantity of equipment input cables must comply with local electrical regulations. Please consult a qualified electrical engineer when necessary.
Three M16 bolts are reserved for the L1, L2, and L3 input copper bars on the top of the A/B cabinet, and the middle hole of the cable fixing terminal is specified to be 17 mm in diameter. Reserve two M12 bolts for the N copper bar and reserve M12 bolts for the PE copper bar.

Caution

The fixing torque of M16 bolts is 100 N·m, and the fixing torque of M12 bolts is 80 N·m, or refer to the electrical standards of the project. Be sure to ensure reliable electrical connections.

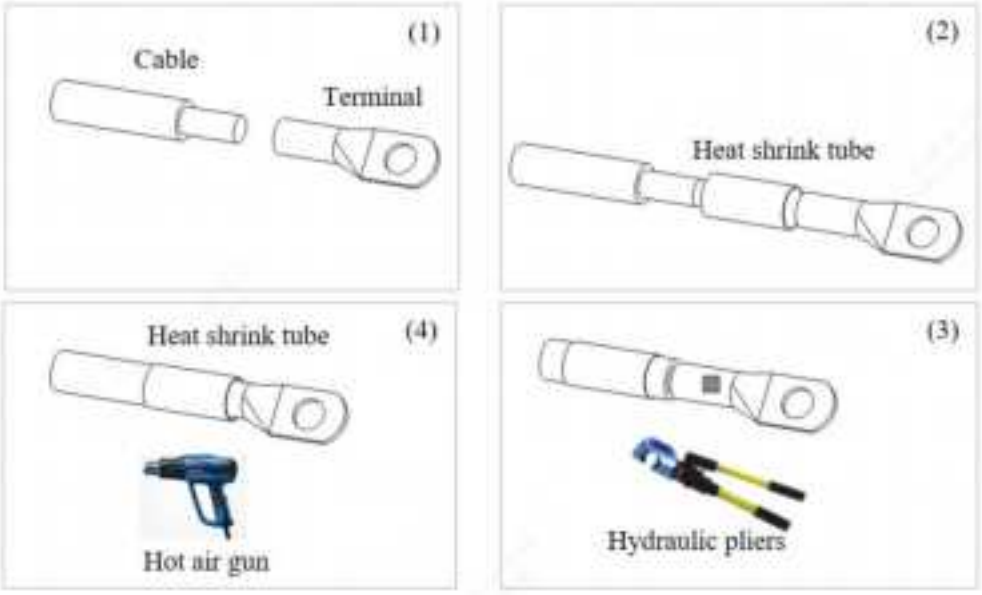

Figure 7.17 Stripping and crimping.

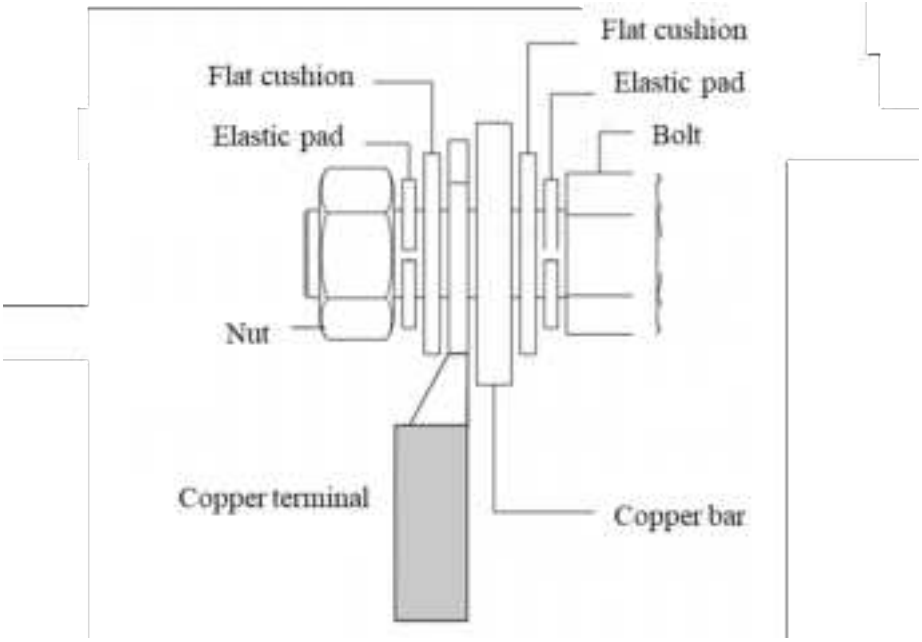

Figure 7.18 Select copper wire.

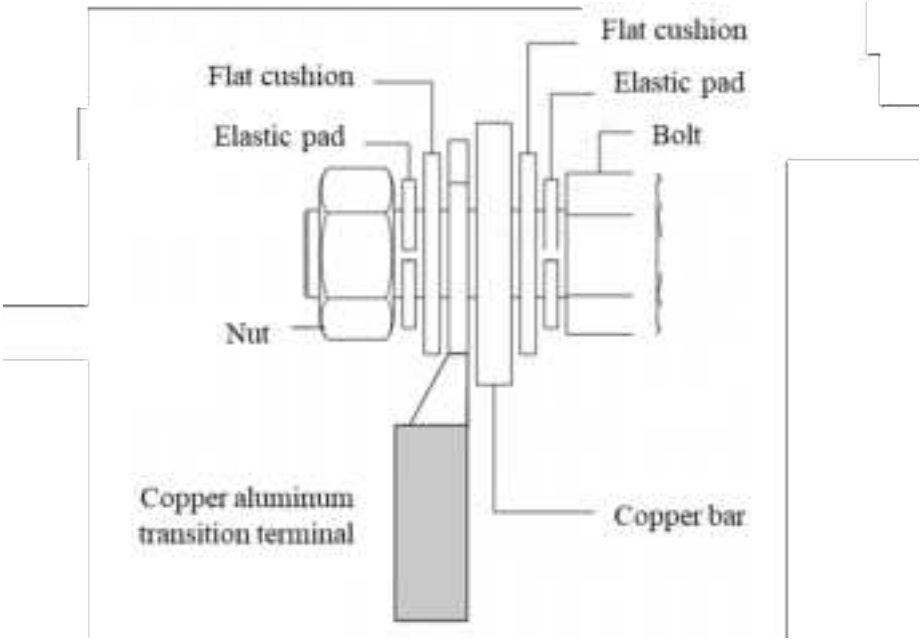

Figure 7.19 Select aluminum wire.

After the wiring is completed and the bolts are fixed according to the torque, use a marking pen to mark the nut head for subsequent inspection.

Figure 7.20 Cable connection diagram.

The cables are connected from the upper two openings on one side of the container exhaust fan, as shown in Figure 7.21 (note: it is necessary to use rainproof cloth and cover in the accessories for protection). The cables are connected from the top junction boxes of the two distribution cabinets and extend all the way to the corresponding copper bars. They are installed and fixed with screws (already installed at the copper bar openings).

Figure 7.21 Cable inlet holes.

There are grounding studs on both sides of the container, and the distribution cabinet should also be reliably grounded. Therefore, it is chosen to reliably ground the shell of the container and the shell of the distribution cabinet. When leaving the factory, the phase sequence of the equipment has been determined. After the equipment arrives at the site, it only needs to adapt to the phase sequence of the on-site substation.

The operation is as follows: connect the L1, L2, L3, N, PE three-phase and five wires of the substation to the distribution cabinet, power on the main switch of the main control cabinet, and observe whether there is a power failure alarm on the LCD screen; If there is a power failure alarm, please adjust the phase sequence of the three phases connected to the main control cabinet L1, L2, L3; If there is no fault alarm on the LCD screen, it can operate normally.

Danger

The three-phase power coming from the transformer must be connected by professionally qualified personnel. When adjusting the phase sequence, the front-end voltage at the input end of the external transformer must be powered off before operation (the white light on the front of the main control cabinet does not light up, and the input line voltage is measured with a multimeter to be 0V). It is prohibited to adjust the phase sequence while the power is on at any time.

7.5 System Power-on and Power-off

The switch in the main control cabinet are shown in the following figure:

Figure 7.22 Internal view of the main switch of the main control cabinet.

1) Functional Description of Circuit Breakers

Table 7.1 Functional description of circuit breakers in the main control cabinet.

SN	Name	Starting point	Direction	End point
1	QFWCU	Power incoming XT1, L1, L2, L3	→	XD11, XD12, XD13, L1, L2, L3
2	QFKR1	XD11, L1	→	Power monitor L1
3	QFKR2	XD12, L2	→	Power monitor L2
4	QFKR3	XD13, L3	→	Power monitor L3
5	QFHL1	XT1, L1	→	Power indicator light (white)
6	QFHL2	XD11, L1	→	Closing indicator light (green)
7	QFD1	L1, N	→	Backup power supply
8	QFaSW	XD11, L1	→	Distribution cabinet switch power supply
9	QFbSW	XD11, L1	→	Distribution cabinet switch power supply
10	QFVF01	XD11, XD12, XD13, L1, L2, L3	→	Main pump frequency converter R, S, T
11	QFCTMF	EV_L1+	→	Power supply 24 V+
12	QFV1	EV_L+	→	KAKV102, KAGV102
13	QFV08	EV_L+	→	V008 power supply+
14	QFP1	XD13, L3	→	PLC power supply P1, pin 2
15	QFPZ1	PLC power supply P1, pin 5	→	P1_L+
16	QFP2	L1.4	→	P2 SDR-480-24 pin L
17	QFPZ2	P2 SDR-480-24 pin V+	→	Container lighting RCT4D
18	QFRDC	P2 SDR-480-24 pin V+	→	Distribution cabinet fan
19	QFMF	P2 SDR-480-24 pin V+	→	Cabinet radiator
20	QFP3	L1.4	→	SDR-75-12V P3 pin L
21	QFPZ3	SDR-75-12V P3 pin V+	→	Face recognition power supply, door magnetic switch power supply
22	QFP4	L1.4	→	MDR-20-5 P4 pin L
23	QFPZ4	MDR-20-5 P4 pin V+	→	Main control module NanoPi-R4S
24	QFRST	EV_L+	→	Main distribution cabinet A shunt release RCT4D

Table 7.2 Function description of circuit breakers in distribution cabinet A.

SN	Name	Starting point	Direction	End point
1	MCB-A1	L1, L2, L3	→	Main busbar L1, L2, L3
2	MCB24-1	L1	→	Power indicator light HL1 X1
3	MCB24-2	Power indicator light HL1 X2	→	L3
4	MCB25-1	L4	→	Closing indicator light HL2 X1
5	MCB25-2	Closing indicator light HL2 X2	→	L6
6	MCB-B1	L1, L2, L3	→	SPD1

SN	Name	Starting point	Direction	End point
7	MCB21-1	L1	→	1#PMM V1
8	MCB21-2	L2	→	1#PMM V2
9	MCB21-3	L3	→	1#PMM V3
10	MCB26	XRDC		Cooling fan L+ in the cabinet
11	MCB15-1, 2, 3, 4, 5			Switch circuit breaker
12	MCB1-1, 7-15			High computing power server circuit breaker

Table 7.3 Function description of circuit breakers in distribution cabinet B.

SN	Name	Starting point	Direction	End point
1	MCB-A2	L1, L2, L3	→	Main bus bar L1, L2, L3
2	MCB27-1	L1	→	Power indicator light HL3 X1
3	MCB27-2	Power indicator light HL3 X2	→	L3
4	MCB28-1	L4	→	Closing indicator light HL4 X1
5	MCB28-2	Closing indicator light HL4 X2	→	L6
6	MCB-B2	L1, L2, L3	→	SPD2
7	MCB22-1	L1	→	2#PMM V1
8	MCB22-2	L2	→	2#PMM V1
9	MCB22-3	L3	→	2#PMM V1
10	MCB29	XRDC		Cooling fan L+ in the cabinet
11	MCB16-1, 2, 3, 4, 5			Switch circuit breaker
12	MCB8-1, 14-15			High computing power server circuit breaker

2) Precautions for First Power-on of the System

After the entire system wiring is completed, the equipment can be powered on for debugging. However, before powering on, it is necessary to use a multimeter to measure whether there is a short circuit between phase wires, between phases wire and neutral wire, between phase wire and ground wire, and between neutral wire and ground wire of the two power supplies. If not, it means it can be powered on normally. If any of the above short circuits exist, the fault should be identified first and then powered on. After the front-end of the system is powered on (the system itself is not yet powered on, and the main switch of the distribution cabinet and main control cabinet are not closed), it is necessary to measure the voltage of the front-end to see if it meets the power requirements of the equipment.

The power requirement for this device is AC400 V± 5%, 50/60 Hz.

Danger

After the system wiring is completed, a multimeter needs to be used to measure the direct connection between the phase wires between the input A/B power distribution cabinets, between the phase wires and the neutral wire, between the phase wires and the ground wire, and between the neutral wire and the ground wire. Is there a short circuit phenomenon? If there is a display showing that the resistance is 0, the short circuit must be checked before powering on, otherwise the system may be at risk of short circuit failure and electric shock.

3) System Power-on Sequence

After the front-end of the system is powered on and the voltage meets the requirements of the device, the system can be powered on at this time.

a. Firstly, power on the main control cabinet.

When the main control cabinet door is opened, first open QFWCU, and then open all circuit breakers inside the main control cabinet. QFP1 and QFPZ1 are switches for 24 V power supply in PLC, QFP2 and QFPZ2 are switches for system 24 V power supply, QFP3 and QFPZ3 are switches for 12 V power supply, and QFP4 and QFPZ4 are switches for 5 V power supply. After powering on, the screen and PLC on the cabinet door begin to work.

When the main control cabinet door is closed and the system needs to be powered on, first open all miniature circuit breakers and one molded case circuit breaker QFVF02 inside the cabinet, then close the cabinet door and open QFWCU through the cabinet door operating handle. At this point, the equipment has been powered on.

Trained electricians can operate the system through a touch screen, set parameters, modify thresholds, change operating modes (automatic/manual), start and stop a certain motor separately, or operate automatically. At this point, the liquid cooling system can be run first, and the supply temperature can be controlled within the required temperature range before meeting the conditions for starting the high computing power server.

b. Powering up the distribution cabinet

After the main control cabinet is powered on, according to the operation process of the control system, it is only when the liquid supply temperature is maintained near the target temperature that the high computing power server can be turned on. At this point, the circuit breakers in distribution cabinets A and B can be opened to start powering on the high computing power server.

The power on sequence of the distribution cabinet is as follows:

First open MCB-A1 and A2, then other circuit breakers, and then start rows of high computing servers in an orderly manner as required. Due to a total of 210 high computing power servers, there are a total of 14 rows. When starting a high computing power server, the next row should be started at an interval of 20 seconds after starting one row (15 high computing power servers), and so on.

Caution

Please refer to Table 7.1 for the corresponding device and switch position numbers.

4) System Power-off Sequence

When the system needs to power off for some reason, as required, first disconnect the power supply of the high computing power server to ensure that the water temperature before and after the power outage is consistent, which is equivalent to protecting the power module of the high computing power server. After the power outage of the high computing power server, the liquid cooling system is manually stopped through the touch screen. At this time, the water temperature will slightly rise, but it has no impact on the system. Finally, disconnect the main power supply of the main control cabinet and distribution cabinet, leaving the entire system in a completely powered off state.

The above practice is a safe power outage behaviour. However, when a serious fault occurs in the system, the emergency stop button on the inner door of the container can be directly pressed, causing the main circuit breaker of the distribution cabinet and the main circuit breaker of the main control cabinet to trip instantly, leaving the system in a completely powered off state, facilitating professional maintenance work.

Danger

In case of emergency, please press the emergency stop button on the front of the power distribution cabinet. The emergency stop button on each power distribution cabinet controls the power supply of the power distribution cabinet. When pressed, the power distribution cabinet is powered off, but the switch, lightning protector, and electric meter display will not be disconnected, and it is necessary to be a professional person to open the door panel for operation.

Caution

Press the emergency stop, and before re-powering after troubleshooting, you need to rotate the emergency stop switch clockwise to release, the main switch of the distribution cabinet, and the main control cabinet switch first move to the OFF position and then re-close.

5) Personnel Responsibility Division

Responsibilities of general operation and maintenance personnel:

General power on/off work (disconnecting or merging switches), system start up and shutdown (touch screen button operation), network cable detection and replacement.

Professional electrician responsibilities:

General power on and off work (disconnecting or merging circuit breakers), system start up and shutdown (touch screen button operation), network cable detection and replacement. When the equipment experiences short circuits, phase loss, reverse phase, sensor no display, corresponding

equipment no response after circuit breaker closing, and abnormal motor operation, professional electricians are required to operate.

7.6 Touch Screen Operation

Danger

Note: It is strictly prohibited to plug or unplug the communication cable between the touch screen and PLC while the power is on, otherwise the touch screen or PLC communication serial port will be damaged!

Caution

The touch screen operation password is "1000".

1) Mode Switching Interface

After the system is powered on, the screen displays as Figure 7.23.

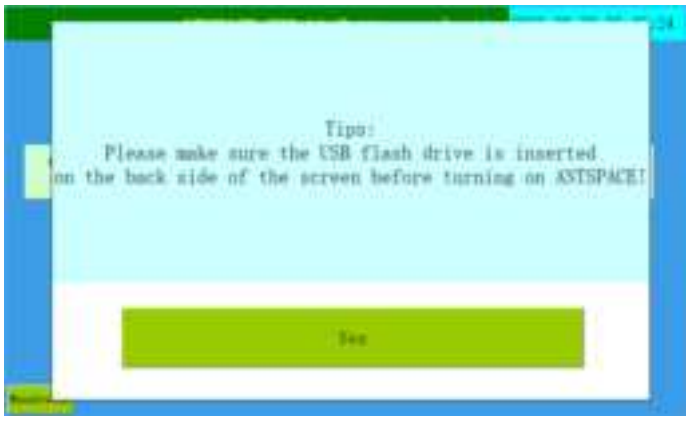

Figure 7.23 Defaults to cooling tower mode.

After confirming that the USB flash drive has been inserted, click the dry tower selection button, such as Figure 7.24.

Figure 7.24 Mode selection interface.

Figure 7.25 Main screen interface of PHE.

The screen display device has control modes of "Auto/Manual", "Local/Remote", target temperature (settable), total fault display, and analogue quantity display. The system can set the operation control mode of the device through the main screen.

When the water cooling system is adapted to board to board components, it is necessary to first switch to board to board mode.

The switching method is to click on the version number at the bottom left of the dry tower mode interface, such as V3.4.11, and the interface will jump to the mode selection interface, as shown Figure 7.24.

2) Main Screen Interface

Figure 7.26 Main screen interface.

When in the PHE mode, manual control is used for debugging and automatic control is used for system operation.

Click the "MC" button to enter the manual control interface.

Click the "PRM-Set" button to enter the parameter setting interface.

Click the "INST-Set s" button to enter the instrument settings interface.

Click the "ADP" button to enter the fault alarm interface.

Click the "HIST-ALR" button to enter the historical alarm interface.

Click the "Data Log" button to enter the data information interface.

Click the "System INFO" button to enter the system information interface.

Click the "CAB-INFO" button to enter the power and positioning information interface.

The remote control mode can only be effective when the unit is in automatic mode, and the priority is lower than local control.

When the system needs to run automatically, it is necessary to ensure that the internal pressure (PT01/PT02) of the system is higher than 0.05 Mpa, and then set all parameters in the parameter setting interface. Then click on "START" on the main screen, and the motors in the system will execute in the order of automatic control logic. When you need to close, click on 'STOP' on the Home interface.

3) Manual Control Interface

When the device needs to be debugged with liquid, it is necessary to adjust the device control mode to the "MC" position, and then enter the "manual control" screen, as shown in the following figure:

Figure 7.27 Manual control interface.

At this point, the motor and frequency converter to be operated can be started by jogging. In general, when the system needs to add liquid, it is necessary to manually start and corresponding electric valves, make-up pumps, and circulation pumps. However, before starting, it is necessary to ensure that the motor runs in the correct direction.

Therefore, after powering on, turn on the 1 # exhaust fan and observe its running direction. When the wind blows out of the container, it indicates positive rotation. Before the equipment leaves the factory, all motors have been debugged and turned forward. Therefore, it is only necessary to observe the operating status of one motor. When the motor reverses, it is necessary to adjust the phase of the three-phase power input of QFWCU, that is, change the phase sequence of the two cables.

4) Parameter Setting Interface

The parameters in the system have been set, and the screen is as follows (which will be displayed in the real screen):

Figure 7.28 Parameter setting interface.

After the unit is turned on, the above parameter values have been set to the initial default values. For the first start up, it is necessary to check whether the parameter setting interface is consistent with Figure 7.28. If there are any differences, they need to be reset according to the figure. The parameter setting interface allows manual settings of automatic liquid replenishment parameters, V001 electric butterfly valve opening, container fan operating parameters. In addition, through the buttons in the manual liquid replenishment box in the parameter setting interface, manual liquid replenishment can be performed for different operating conditions of the system.

5) Instrument Setting Interface

Figure 7.29 Instrument setting interface.

The alarm thresholds for supply and return liquid temperature, supply and return liquid pressure, flow rate, temperature inside the main control cabinet, temperature inside the distribution cabinet, and cold side pressure difference can be set through the instrument setting interface. The values shown in Figure 7.29 are the default initial alarm values. For the first start up, it is necessary to check

whether the parameter setting interface is consistent with Figure 7.29. If there are any differences, they need to be reset according to the figure. If modifications are needed, please ask the operation and maintenance personnel to determine the possible problems before making the modifications, and confirm that they do not affect the system operation before making certain modifications to the parameters.

6) Alarm Display Interface

After the system is running, if there is a fault in the system, it will be displayed on this screen.

When a fault occurs, the yellow alarm lamp lights up. The form of the fault is displayed on the "Alarm Display Screen". At this point, first analyse the cause of the malfunction, then troubleshoot the malfunction, and finally click "Reset" on the manual control screen.

Figure 7.30 Alarm display interface.

After the fault occurs, the yellow alarm light will light up. The fault form will be displayed on the alarm display screen interface. At this point, first analyze the cause of the fault, then troubleshoot it, and finally click on "Reset" in the manual control interface.

7) Historical Alarm Interface

The alarm information in the system will be saved on this screen through time records, making it convenient for users to find the fault time.

Figure 7.31 Historical alarm interface (example, unreal situation).

8) Data Log Interface

This screen can display information such as supply temperature, return temperature, supply pressure, return pressure, and supply flow rate. Each parameter corresponds to a different colour.

Figure 7.32 Temperature curve interface.

Figure 7.33 Pressure curve interface.

Figure 7.34 Flow curve interface.

9) System Information Interface

Figure 7.35 System information interface.

The system information interface can set the system clock.

10) Cabinet Information Interface

The screen can display the ambient temperature in three cabinets, the power quality information used in two distribution cabinets, and the longitude and latitude information of the equipment. Among them, power information and latitude and longitude information are used for debugging and display, and the reading format is floating point.

Figure 7.36 Cabinet information interface.

7.7 Liquid Cooling Container System On-site Installation Summary

1) On-site Installation Summary

After the equipment is transported to the site, it needs to be installed in the order shown in Table 7.4. After installation is completed, the control mode can be changed to automatic. Click One Click Start and the system will automatically run.

Table 7.4 On-site installation summary.

SN	Installation steps	Remarks
1	Location and lifting of containers and dry on site.	Taking the water inlet and outlet of the container as the reference, the dry cooling tower is installed on the left side of the container (the inlet and outlet of the dry cooling tower is on the same side as the inlet and outlet of the container), and the distance between the container and the dry cooling tower is required to be 2 m, and there shall be no blockage on the top of the dry cooling tower. And take the projection line of the bottom frame of the receiver surface of the container as the benchmark, the projection line of the bottom frame of the receiver surface of the dry cooling tower should be kept in the same straight line with it.
2	Installation of container exhaust fans.	
3	Installation of connecting pipeline between container and inlet and outlet water pipe interface.	The pipeline is installed correctly, sealed well, no leakage.
4	Water-cooled container power distribution.	Reasonable alignment, standardized wiring, torque calibration, power-up inspection.
5	Water-cooled container pressurization operation.	After gas detection for 7 bar/12 h, liquid detection for 7 bar/30 min.
6	Liquid filling operation for water-cooled containers.	Preparation-system liquid replenishment-water tank liquid replenishment-regular replenishment of water tank.

2) On-site Installation Inspection

The following items need to be verified after installation. Can only start power on after completely qualified.

Table 7.5 Checklist after installation.

Item	Content	Confirmation
Container	Proper installation, no tilt. Stand on a horizontal hard floor, leave room for maintenance. All the debris inside removed (cable ties, thrums, etc.).	□ Confirmed
Fan	Correct installation according to component functions.	□ Confirmed
Plugging part	Plugging parts and fixings in and outside the container removed. No debris inside.	□ Confirmed
Rain cover	Proper installation above the inlet.	□ Confirmed
Internal pipeline connection	Reliably fix the clamp and pipe of the replenishment port. Fixation of circulating system pipeline. No loosen. The pressure drop of the pipeline meets the requirements.	□ Confirmed
Cable connection	Correct connection of dry tower cables. Connect unit cables to the PDC through inlet under the rain cover.	□ Confirmed
Inlet and outlet pipes	Correct connection of the pipeline between container and dry tower.	□ Confirmed
Electrical inspection	Supply voltage is within the rated voltage range on the nameplate. No damage on the cable. No open circuit, short circuit or wrong connection in system electrical circuit. Ensure correct connection of all cables in the upper and lower electric control boxes. Ensure the external main power circuit breaker is rated correctly according to current value. Fasten all cable and connectors. No loosen with fasten bolts.	□ Confirmed

8 Conventional Faults and Troubleshooting

8.1 Container Faults and Troubleshooting Methods

Table 8.1 List of common faults and troubleshooting methods.

Type	Causes	Solution	Remarks
Power failure	1: Phase failure.	Check for phase loss in the main power supply.	
	2: Overvoltage.	Turn off the upper level circuit breaker QFWCU (in the main control cabinet) to ensure that the main control cabinet is not electrified. Use a flat screwdriver to increase the overvoltage value.	The reason for this situation is that the equipment did not adjust the overvoltage and under voltage values of the power monitor before leaving the factory, or the set values did not match the actual values on site.
	3: Under voltage.	Turn off the upper level circuit breaker QFWCU (in the main control cabinet) to ensure that the main control cabinet is not electrified, and use a flat screwdriver to reduce the under voltage value.	
	4: Phase error.	Adjust the phase sequence of the power lines connecting the distribution cabinet to the main control cabinet.	
Low liquid level alarm	The liquid level in the water tank inside the container is low.	Replenish the water tank inside the container.	
Circulation pump failure	Water pump idling, under pressure (low return pressure), etc. cause circulation pump overflow.	1: Turn off the circuit breaker (QFWCU) in the main control cabinet first. 2: Reset the motor protector (corresponding to FR1) in the main control cabinet (manually press RESET in the motor protector). 3: Check whether the system operating parameters are normal (pressure and flow will report faults first), and troubleshoot problems according to alarm faults. 4: After troubleshooting, reference Figure 7.27，press the right reset button. 5: Start the circulation pump after an interval of 2-3 minutes.	Warning: after the system is powered on, the circulation pump is prohibited from running idle when there is no liquid in the system.
1#/2# exhaust fan failure	The current of the exhaust fan is too high, and there may be strips in the fan blades that hinder the operation of the fan.	1: Turn off the circuit breaker (QFWCU) in the main control cabinet first. 2: If there are debris in the fan blades, first clean them up; If there are no debris and there is no reason for fan failure, the manufacturer needs to be contacted. 3: Reset the motor protector in the main control cabinet (1# exhaust fan corresponds to QFG04; 2# exhaust fan corresponds to QGF05) (manually turn the knob of the motor protector to the vertical position, that is, switch on). 4: After troubleshooting, reference Figure 7.27, press the right reset button. 5: Start the exhaust fan after an interval of 2-3 minutes.	

Type	Causes	Solution	Remarks
Liquid replenishment pump failure	Overload caused by dirty and blocked Y-type filter replacement.	1: Turn off the circuit breaker (QFWCU) in the main control cabinet first. 2: Reset the motor protector (corresponding number QFG11) in the main control cabinet (manually turn the knob of the motor protector to the vertical position, which is the closing). 3: Clean the Y-shaped filter. 4: After troubleshooting, reference Figure 7.27，press the right reset button. 5: After an interval of 2-3 minutes, start the replenishment pump again.	Warning: after the system is powered on, the replenishment pump cannot idle when there is no liquid in the system.
	The position of the suction port of the replenishment pump is too low, resulting in overload.	1: Turn off the circuit breaker (QFWCU) in the main control cabinet first. 2: Reset the motor protector (corresponding number QFG11) in the main control cabinet (manually turn the knob of the motor protector to the vertical position, which is the closing). 3: Lower the external water suction port below the cooling liquid tank.t. 4: After troubleshooting, reference Figure 7.27，press the right reset button. 5: After an interval of 2-3 minutes, start the replenishment pump again.	
Leakage alarm	There is liquid leakage from the inlet and outlet of the high computing power server to the floor, wetting the leakage sensor.	1: Find areas on the floor where there is liquid. 2: Above this area, carefully search for any leakage from the inlet and outlet of the high computing power server. 3: After finding the leaking area, handle it by replacing the quick plug and corrugated pipe, then clean the leaking site and wipe the leaking monitoring tape dry.	
High liquid supply temperature alarm	After the high liquid supply temperature alarm occurred, the operation and maintenance personnel did not handle it in a timely manner, resulting in a continuous increase in the liquid supply temperature.	Before identifying the cause, it is possible to consider shutting down some high computing power servers, reducing the load, and then finding the cause of the high liquid supply temperature alarm. The alarm value for high liquid supply temperature can be set on the screen as needed.	
High liquid supply pressure alarm	1: Filter clogged.	Clean the filter element.	
	2: Liquid supply and return valve malfunction or incomplete opening.	Open the liquid supply and return valves.	
	3: Pressure sensor failure.	Replace the pressure sensor.	
Low return liquid pressure	1: Insufficient cooling liquid in the water tank.	Replenish the water tank with cooling liquid.	

Type	Causes	Solution	Remarks
alarm	2: Replenishment pump failure.	Check the cause of the malfunction of the replenishment pump.	
	3: Pressure sensor failure.	Replace the pressure sensor.	
	4: Leakage.	Check for system leaks.	
Low liquid supply flow alarm	1: Liquid supply and return valve malfunction or incomplete opening.	Open the liquid supply and return valve.	
	2: Dirty and clogged filter.	Clean the filter element.	
	3: Flow sensor failure.	Replace the flow sensor.	
	4: Leakage.	Check for system leaks.	
Condensation alarm	High environmental humidity.	After the on-site operation and maintenance personnel see the alarm message, they only need to increase the target value of the supply liquid temperature by 5˚C to prevent condensation.	The logic set in the program is: when the dew point temperature value is greater than the supply liquid temperature value - 5˚C, the system will prompt a condensation alarm
Pressure display fluctuates	1: There is air in the system.	Please ask on-site operation and maintenance personnel to open the exhaust valve for exhaust.	
	2: System liquid shortage.	If the return pressure is lower than the set value, the replenishment pump will automatically replenish the system.	
	3: Sensor damage.	Replace the sensor.	
No pressure display	1: Sensor damage.	Replace the sensor.	
	2: Loose cables.	Check the wiring circuit of the pressure sensor and tighten it.	
	3: The PLC acquisition channel is damaged.	Replace the module corresponding to the PLC sensor.	
The pump is running, but the flow rate is insufficient	1: There is air at the water pump suction port.	Open the exhaust port above the water pump suction port with a wrench, wait until there is even liquid flowing out, and repeat 2-3 times (refer to the user manual for specific operations).	
	2: Filter clogged.	Clean the filter element.	
	3: Insufficient system coolant (low return pressure).	Replenish the system.	
Fan not running	1: Motor burnt out.	Replace the fan.	
	2: Loose cables.	Under live conditions, use a multimeter to check the power supply of the fan and tighten it when power is cut off.	
	3: Circuit breaker tripped.	Close the circuit breaker.	
Noise and abnormal noise	1: Water pump cavitation.	Check the pressure on the liquid inlet side (return pressure or pressure gauge) and replenish the liquid in a timely manner.	

Type	Causes	Solution	Remarks
	2: Pump shaft connection issue.	Check the mechanical connection of the pump shaft.	
	3: Insufficient lubrication of motor shaft.	Adding lubricating oil.	
	4: Safety valve action.	Check if there is too much liquid in the water tank, unable to release pressure in a timely manner, and discharge excess liquid from the water tank.	
Water pump shaft seal leakage		Replace the water pump shaft seal.	

8.2 Plate Heat Exchanger Routine Failure and Troubleshooting Methods

Product common failure phenomena, analysis and treatment methods, as shown in Table 8.2.

Table 8.2 Analysis and troubleshooting of dry tower faults.

Fault phenomenon	Possible causes	Inspection or repair
Low supply flow alarm	Dirty heat exchanger fins.	Clean the heat exchanger.
	Insufficient system traffic.	Clean the filter.
Over temperature alarm	Dirty heat exchanger fins.	Clean the heat exchanger.
	High temperature of external water source.	Checking external water sources.
	Low flow from external water source.	Checking external water sources.

9 System Maintenance

9.1 Overview

Preventive maintenance refers to the maintenance carried out at predetermined intervals or according to prescribed guidelines to reduce the probability of product failure or prevent functional degradation, mainly including adjustments, regular inspections, and necessary repairs. Familiarize equipment maintenance and operators with the performance, structural principles, usage methods, and precautions of the product, so that the equipment can perform its intended functions.

9.2 Preventive Maintenance

1) Operator Monitoring

Operators monitor the status of equipment during normal use, with the aim of identifying potential faults.

Once the operator discovers a system malfunction alarm, they should quickly conduct fault confirmation and inspection to find the cause of the malfunction.

2) Application Check

During normal use of the equipment, operators conduct regular inspections as planned to determine whether the product performs the specified functions.

a. Check if the connections of the liquid supply and return pipelines, power lines, etc. are correct.

Inspection requirements: No leakage at all pipelines and connections, and no damage to cables.
Inspection method: Visual inspection.

b. Check if the return liquid pressure (back pressure) is low.

Inspection requirements: the return liquid pressure is higher than 0.05 MPa (observe the Home interface of the touch screen or the pressure gauge), and if the pressure is lower than this value, liquid replenishment is required.

Inspection method: Visual inspection and data comparison.

c. Check the liquid supply system and record temperature, pressure, and other data every half a day.

Inspection requirements: Record the supply/return liquid temperature, supply/return liquid pressure, and supply liquid flow data, and observe whether the data tends to stabilize during long-term operation.

Inspection method: Visual inspection and data comparison.

d. Check the fault alarm status of the system, such as temperature, pressure, flow rate, etc. (the

above fault status is displayed in the fault alarm interface on the touch screen), and record it every half a day.

Inspection requirements: Check the system alarm points and follow the instructions for troubleshooting.

Inspection method: Visual inspection and on-demand testing.

9.3 Regular Inspections

1) Maintenance of Filters

The system is divided into internal circulation and external circulation, with the internal circulation medium being coolant and the external circulation medium being tap water. The system has set up a filter to filter the internal and external circulation, and the filter needs to be cleaned after the system has been running for a period of time.

The filter is divided into three parts, and the corresponding cleaning time requirements are as follows:

a. External circulation Y-type filter r, cleaning cycle is once a month.

b. The filter in the internal circulation pipeline of the pump unit liquid supply system has a cleaning cycle of once a month (or as needed).

c. The Y-shaped filter in the internal circulation pipeline of the pump unit replenishment system has a cleaning cycle of once every six months (or as needed).

d. The cleaning method is to wash with clean water and rinse thoroughly before use.

Operation steps：

a. Cut off the main power supply of the equipment.

b. Referring to Figure 9.1, close the maintenance butterfly valves in the system, open the drain ball valve below the pipeline filter component, and drain the local liquid in the pipeline.

⚠ Caution

The discharged coolant needs to be stored in a clean container, and the coolant discharge must comply with local discharge standards. After the butterfly valves at both ends of the filter are closed, about 10 L of coolant will be discharged. A 20 L container is required. The discharged coolant cannot be directly added to the water replenishing tank for reuse without treatment.

c. After finding the position of the filter, open the manual exhaust valve and manual drain valve, remove the clamp connection, and take out the pipeline filter element from the handle.

d. Remove and clean (or replace) the filter screen inside the filter. Reference Figure 9.2.

e. Install the cleaned filter screen, tighten the clamp with a wrench, and close the valve.

f. After the equipment is powered on again, fill the system replenishment tank with coolant.

Caution

The coolant discharged from the filter cannot be directly added to the rehydration water tank.

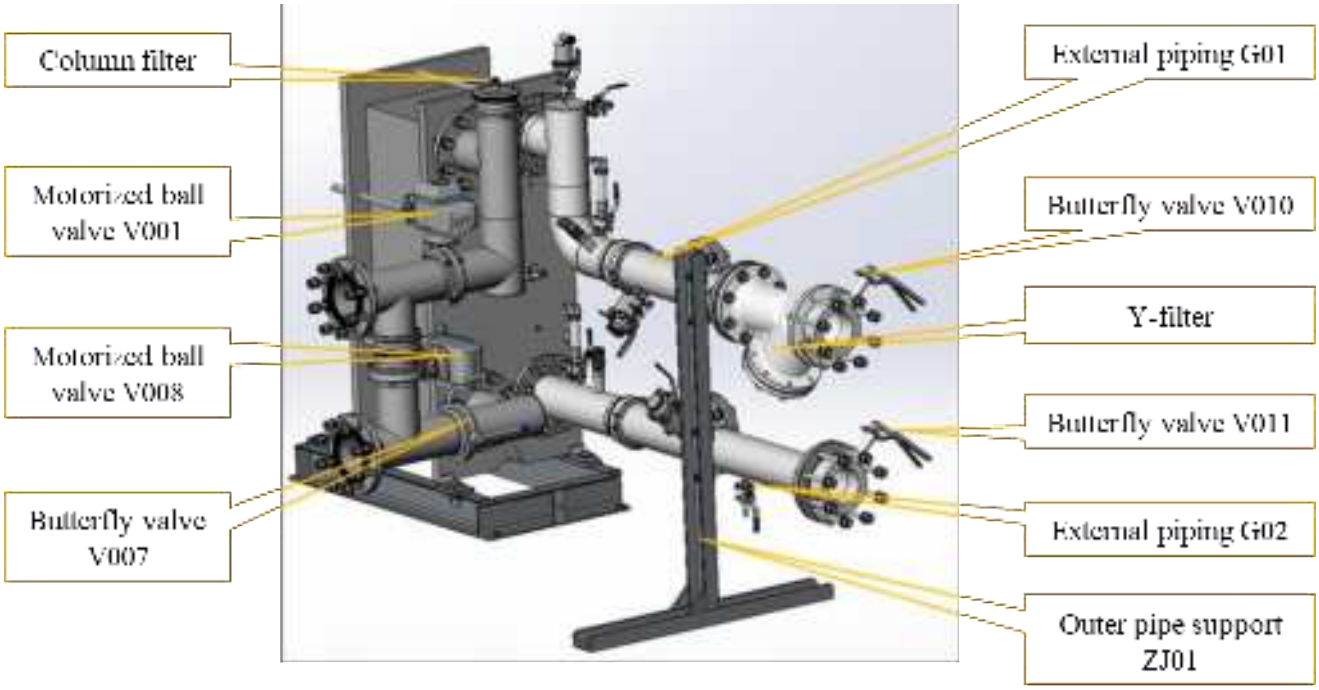

Figure 9.1 Location of butterfly valves and pipeline filters for pipeline maintenance.

Figure 9.2 Remove the pipeline filter.

2) Pipeline Leakage Maintenance

After six months of equipment operation, the pipeline network should be inspected for leakage prevention for six months. If any leakage or leakage is found, it should be immediately shut down for maintenance.

Maintenance should first stop the operation of the load components on the user end, and then stop the operation of the equipment for repair. After completing the leak detection, pay attention to replenishing the system with coolant.

3) Maintenance of Electrical Components

After six months of equipment operation, it is necessary to inspect and maintain the wiring terminals and crimping screws on the electrical components of the main control cabinet inside the water pump cabinet to prevent looseness of the wiring terminals and crimping screws, which may cause poor contact and damage to the components and prevent normal operation of the equipment, thereby affecting the operation of the entire liquid cooling container system.

Caution

Daily operation inspection needs to pay attention to whether there is abnormal noise in system operation, abnormal reading display, and system operation alarm information. If there are any abnormalities, eliminate them promptly.

4) Coolant Drainage

After 1-2 years of operation of the system and water tank, there may be some debris in the system pipeline, and the system coolant should be promptly drained and replaced.

Caution

The system operates with about 1500 L of coolant. Please prepare sufficient storage volume in advance for sewage discharge.

Operation steps：

a. Find the position of the discharge valve (Figure 9.3).

b. Connect the drain hose to the drain ball valve and tighten it with a hose clamp; Guide the hose outside the equipment and open valve V202 (Figure 9.3) to drain the system.

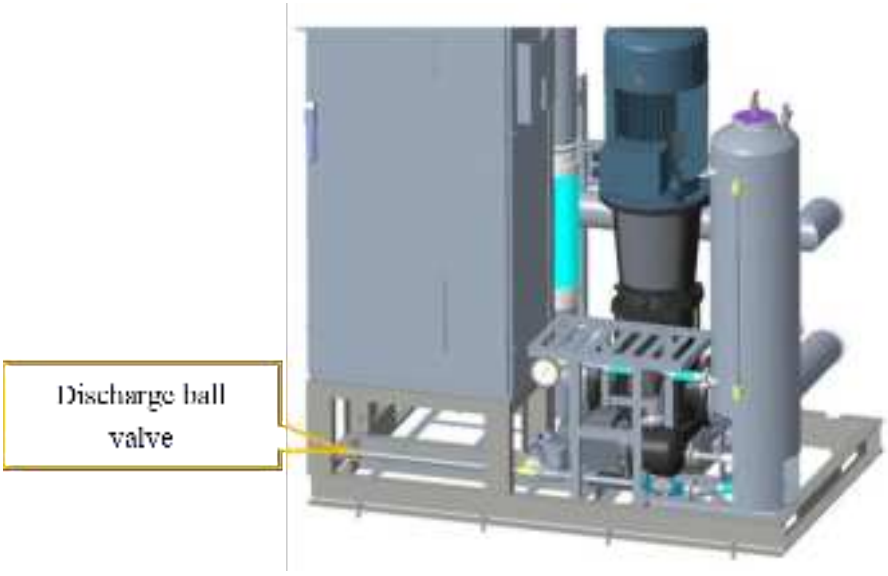

Figure 9.3 Location of discharge ball valve in pump station.

5) Water Tank Level Inspection

The system monitors the liquid levels in two water tanks (inside the container and in the dry tower). When the liquid level in the water tank falls below the required value, the system touch screen will give an alarm indicating that the water tank level is low. At this time, it is necessary to promptly check for faults and replenish the coolant.

Even if there is no alarm for the water tank level, it should be checked regularly on a daily basis:

The liquid level in the water tank inside the container needs to be checked once a week after stable operation. If the water tank does not reach 2/3 of the limit, it needs to be replenished in a timely manner.

The liquid level of the dry tower water tank is required to be checked once a day, and water shutdown is not allowed (unless dry cooling mode is adopted in winter, at which time the internal water of the dry tower needs to be drained).

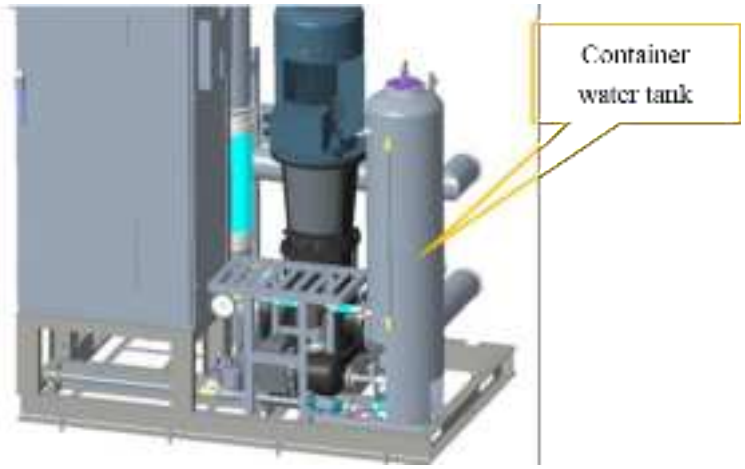

Figure 9.4 Container water tank.

6) Maintenance of Coolant

a. As the core unit of the liquid cooling container system, it is recommended to regularly track and record the coolant, at least once a year (PH value is tested every six months).

b. When purchasing coolant, it is necessary to focus on the relevant parameters in Table 9.1. If the requirements are not met, it is necessary to consider refilling and replacing the coolant as appropriate.

c. Regular testing of coolant focuses on PH value, and it is not recommended to use it when the PH value is below 7 (a PH indicator can be added to the coolant. When the PH is below 6.8, the coolant will change color for easy observation).

d. The coolant needs to be regularly tested, paying attention to freezing point, ethylene glycol ratio, total hardness, etc. In the later stage, attention should be paid to whether the content of elements such as Al, Fe, Cu increases, as an increase indicates that contact corrosion has

already occurred.

e. It is recommended to regularly add corrosion inhibitors according to the supplier's requirements to maintain the coolant.

Danger

The antifreeze must be configured strictly in accordance with the lowest possible temperature in the environment. If the antifreeze is not configured according to the instructions and the ambient temperature is lower than the freezing point of the antifreeze, causing the heat exchanger to freeze and crack, our company will not bear any responsibility!

Table 9.1 Recommended standards for coolant testing.

Items	Reference standards		Remarks
Color	Significant color		Visual inspection
Exterior	No odor, sediment, or suspended solids		Visual inspection
Freezing point	< Local minimum freezing temperature		
Boiling point	108˚C (low temperature type)		
PH value	7-9		
Reserve alkalinity	≥ 4 ml (organic formula) ≥ 9 ml (including inorganic formula)		
Total hardness	< 120 mg/l		
Main element content	B	< 20 mg/kg	
	Si	< 20 mg/kg	
	P	< 20 mg/kg	
	Mo	< 20 mg/kg	
	Ca	< 20 mg/kg	
	Al3+	< 50 mg/L	
	Fe2+	< 50 mg/L	
	Cu2+	< 50 mg/L	

Table 9.2 Glycol refrigerant concentration vs. Freezing and boiling points.

Glycol concentration		Freezing point ˚C
Mass concentration %	Volume concentration %	
0	0	0
5	4.4	-1.4
10	8.9	-3.2
15	13.6	-5.4
20	18.1	-7.8
25	22.9	-10.7
30	27.7	-14.1

35	32.6	-17.9
40	37.5	-22.3
45	42.5	-27.5
50	47.6	-33.8
55	52.7	-41.1
60	57.8	-48.3

Note 1:

Table 9.1 is for the working environment temperature is below 0˚C working conditions need to use the media requirements, if the working environment temperature is higher than 0˚C for a long time, you can use deionized water / pure water as the secondary side of the internal circulation medium, corresponding to the media requirements see Table 9.3.

Note 2:

To ensure long-term reliable operation, when using deionized water/or purified water as the internal circulation medium, it is necessary to replace the internal coolant every 1-2 months.

Table 9.3 Recommended standards for deionized water.

Index	Deionized water	Reference standards	Remarks
PH value	8.5-9.5	Intel 632983	
Sulfide	< 1 ppm	TC9.9/Intel632983	
Sulfate	< 10 ppm	TC9.9/Intel 632983	
Chloride	< 5 ppm	TC9.9/Intel 632983	
Bacterial community	<100 CFU s/ml	TC9.9/Intel 632983	
Total hardness (as CaCO3)	< 20 ppm	TC9.9/Intel 632983	
Conductivity	< 20 us/cm (reference value, not mandatory)	TC9.9	High conductivity is not necessarily unacceptable, such as 1000 us/cm, as corrosion inhibitors and fungicides will both lead to an increase in water conductivity. It is necessary to understand the reasons behind the sharp increase in conductivity trend during circuit operation.
Residues after evaporation	50 ppm	TC9.9/Intel 632983	
Turbidity	< 20 NTU	TC9.9/Intel 632983	
Iron content	0.1 ppm	Industry standards	
Copper content	10 ppm	Industry standards	
Carbon steel corrosion rate	3 mpy (0.075 mm/a)	GB/T 50050-2017	
Corrosion rate of copper or stainless steel	0.2 mpy (0.005 mm/a)	GB/T 50050-2017	

7) Maintenance of Water Pump

In order to maintain the original performance of the rolling bearings of the water pump motor and ensure long-term use in good condition, it is necessary to inspect and maintain the bearings according to the specified time to prevent faults, ensure reliable operation, and improve efficiency and efficiency.

For the three-phase asynchronous motor supporting the water pump of water-cooled container products, the maintenance of the motor bearings can be carried out according to this instruction.

The bearing models of the motor supporting the circulating pump product in the current system are shown in the table below:

Table 9.4 Bearing model.

Model	Bearing	Quantity	Lubrication oil addition cycle		Grease model
			Poles 2P	Poles 4P	
160	DE:7309B NDE:6309ZC3	17	2000 h	5400 h	Polyrex EM

Danger

This system uses a 2P main pump, so the refueling cycle is 2000 h. Bearing grease must be added after about 83 days of continuous operation, or it must be added regularly as needed.

The method for adding lubricating grease to bearings of SHIMGE water pumps can be found in the following video link:

Website: http://100gs.shimge.com/wap/blbxgdjlxbwh_8/2.html；

Attention: If different grades of lubricating grease are mixed, the consistency will change greatly. It is prohibited to mix different grades of lubricating grease. If other brands of grease are to be used, the motor bearings must be removed and the original grease cleaned, otherwise there is a risk of burning the motor bearings.

9.4 Maintenance of Plate Heat Exchanger

In order to keep the plate heat exchanger in good condition, regular maintenance is required. A record needs to be kept of all maintenance performed on the plate heat exchanger.

Plates need to be cleaned regularly. The frequency of cleaning depends on a number of factors such as media type and temperature.

After prolonged use, it may be necessary to reseal the plate heat exchanger by replacing the gasket.

Other maintenance that should be performed on a regular basis is listed below:

a. Keep the upper and lower guide rods clean and lubricated;

b. Keep the fastening bolts cleaned and lubricated.

Before starting, check that all fastening bolts are tensioned and that Dimension A (Dimension A is the distance from Fixing Plate 1 to Pressing Plate 2) is correct. As shown in Figure 9.5.

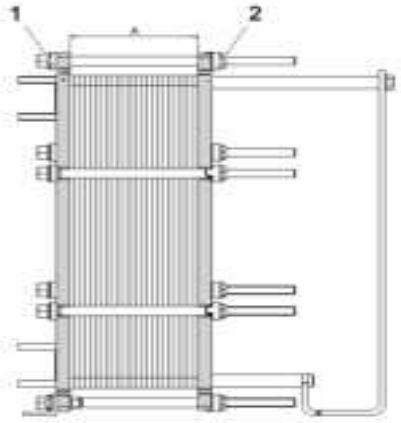

Figure 9.5 Schematic diagram of PHE.

1) Open the Heat Exchanger.

During manual cleaning, the plate heat exchanger needs to be opened to clean the plates.

Caution

Before opening the plate heat exchanger, please check the warranty conditions. If you have any questions, please contact the manufacturer.

Warning

Risk of personal injury.

Plate heat exchangers may be in a high temperature condition and need to be cooled down to 40˚C or less for maintenance.

Appropriate protective equipment needs to be used.

Bolt configuration as shown in Figure 9.6.

Plate heat exchanger bolt configurations will vary from model to model. The main forces in the plate set are supported by the fastening bolts (TB). Locking bolts (LB) are also used in order to evenly distribute the force to the fastening and compression plates. Be sure to identify the Tightening Bolt (TB) and Locking Bolt (LB) during the opening and closing steps.

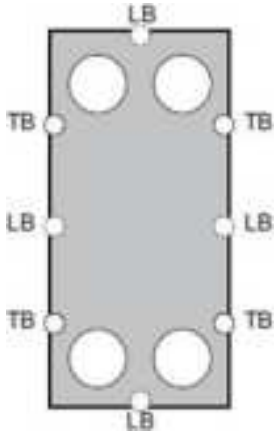

Figure 9.6 Bolt position diagram.

Steps to open:

a. Shut down the plate heat exchanger.

b. Close the valve and isolate the plate heat exchanger from the rest of the system.

Caution

The plate heat exchanger must be pressure-free before disconnection.

c. Plate heat exchanger for purging.

Caution

Open the exhaust valve to avoid vacuum in the plate heat exchanger.

d. Remove guards, if present.

e. Remove the tubing from the hold-down plate to allow the plate to move freely along the carrier bar.

f. Inspect the sliding surface of the carrier bar. Wipe the sliding surface clean and apply grease.

g. Mark by drawing a diagonal line on the outer surface of the plate unit.

h. Check and record dimension A.

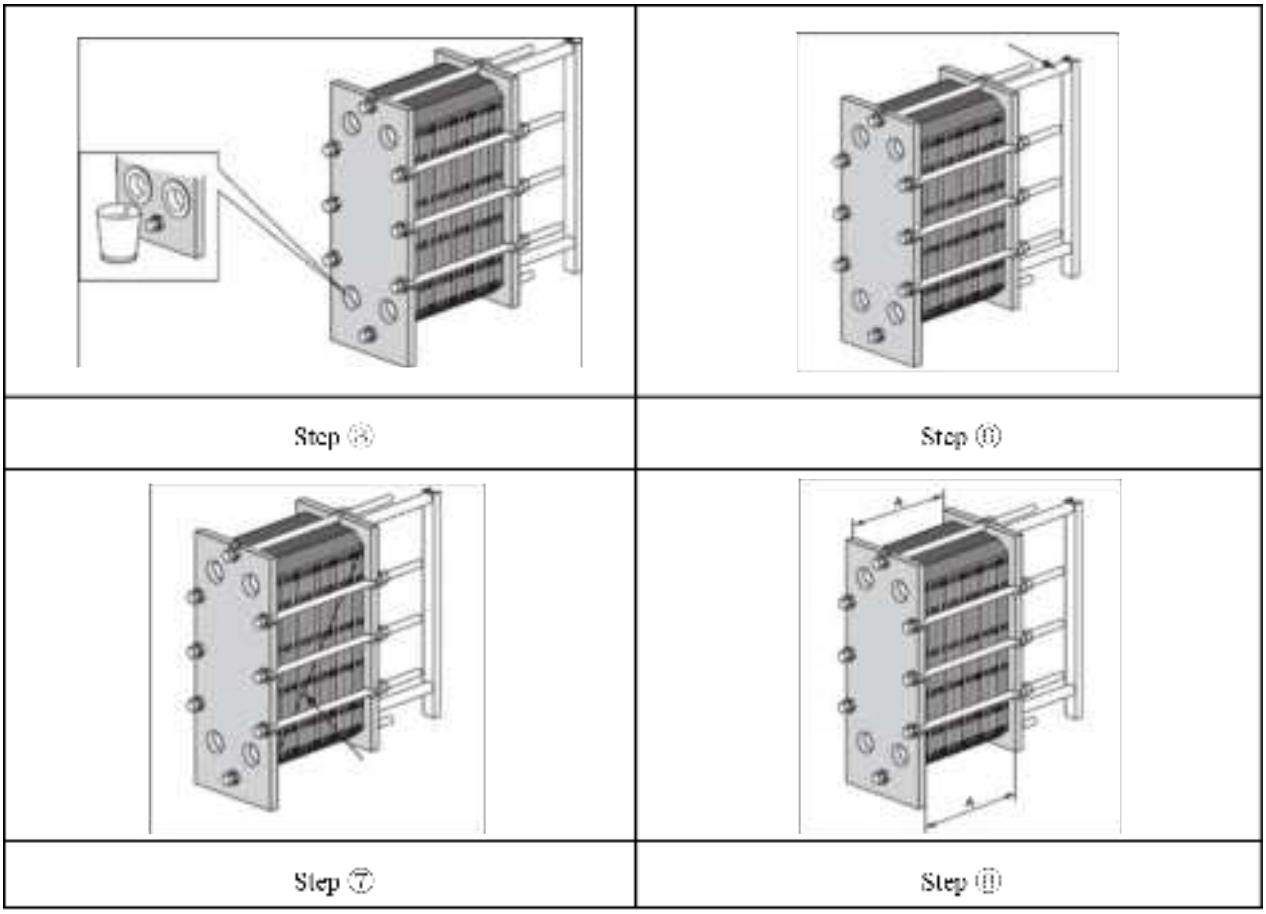

Figure 9.7 Schematic diagram of opening steps of PHE.

i. Loosen and remove the locking bolt.

Caution

Before loosening the fastening bolts, brush the threads of the fastening bolts with a wire brush and lubricate them.

j. Use the fastening bolts to open the plate heat exchanger. Keep the fixing plate and the compression plate parallel during opening. When loosening, the compression plate must be inclined with a horizontal width of less than 10 mm (2 turns per bolt) and a vertical height of less than 25 mm (5 turns per bolt). Loosen the four fastening bolts (1), (2), (3), (4) in diagonal order until the plate set measures 1.05×A. Ensure that the fixing plate and hold-down plate remain parallel when opened. Continue to tighten each bolt alternately until the reaction force of the plate set disappears. Then, remove the bolts.

k. Open the plate set by sliding the hold down plate over the upper guide bar. If the plates are to be numbered, do so before removing the plates. If cleaning is done with water only (i.e. no detergent), it is not necessary to disassemble the plates.

Warning

Risk of personal injury.

Plates and shields have sharp edges. Wear personal protective equipment (PPE) when handling panels and shields.

When opening the M3, T2, and TL3 model sheet sets, be sure to carefully remove the hold down plate. Ensure that the hold-down plate is safely placed from the end of the upper guide bar. A washer (part no. 33500045-45) can be attached to the end of the carrier bar to ensure that the hold-down plate does not slide over the carrier bar. Manual cleaning of opened units.

Warning

Risk of personal injury.

After draining, the sheet set may still contain a small amount of residual liquid. Depending on the type of product and type of installation, special devices (e.g., drain boxes) may be required to avoid personnel injury and equipment damage.

2) Manual Cleaning of Switched-on Devices

Caution

Never use hydrochloric acid on plates.

Water containing more than 330 ppm Cl cannot be used to prepare cleaning solutions. Aluminium upper guide rods and struts must be protected from chemical exposure.

Caution

When cleaning manually, be careful not to damage the sealing gasket.

Warning

Cleaning fluids are corrosive and may cause serious injury to skin and eyes! Use appropriate personal protective equipment when using cleaning fluids.

Sediment that can be removed with water and a brush. It is not necessary to remove the plates from the plate heat exchanger during the cleaning process.

a. Begin cleaning while the heated surface is still wet and the plate is hanging in the frame.

b. Remove sediment with a soft brush and running water.

c. Use a high-pressure hose to spray water to clean.

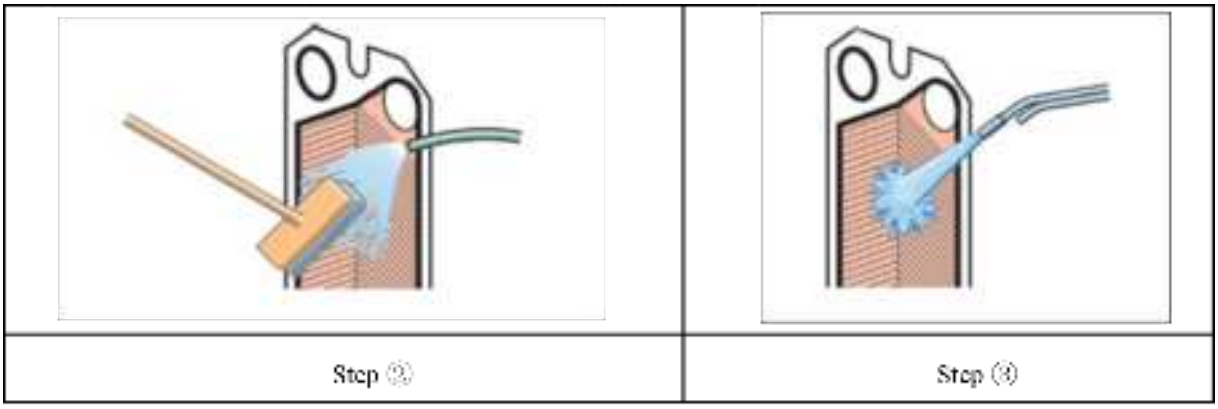

Figure 9.8 Schematic diagram of PHE cleaning (a).

Sediment that cannot be removed with water and brushes. The plates must be removed from the plate heat exchanger for cleaning.

a. Brush with detergent.

b. Wash with water immediately.

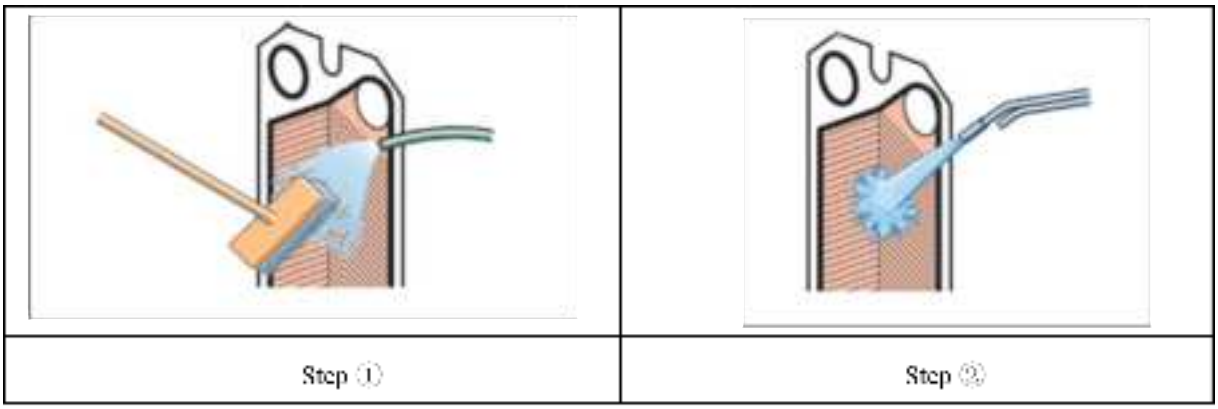

Figure 9.9 Schematic diagram of PHE cleaning (b).

Caution

Prolonged contact with cleaners may damage the sealant.

3) Shut down Plate Heat Exchangers

Follow the instructions below to ensure that the plate heat exchanger shuts down properly.

a. Check that all sealing surfaces are clean.

b. Brush the threads of the bolt clean using a wire brush or Alfa Laval thread cleaner. Lubricate the threads with a thin coat of lubricant, e.g. you can use Gleitmo 800 or similar.

c. Install the gasket onto the plate or check that all gaskets have been properly installed. Check that all gaskets have been placed in their proper locations in the slots.

Caution

If the gasket is installed incorrectly, it will sit above the gasket groove, or outside of the groove.

d. If the plates have been removed, stagger the insertion of the plates and orient the gasket toward the retaining or compression plates as specified in the plate hanging list. Use the marking lines made when opening the plate heat exchanger.

e. If the sheet sets have been marked on the outside, check them according to the procedure in Open - Programs. If the plates are assembled correctly (A/B/A/B etc.), the edges will be "honeycombed" as shown in the figure.

f. Compression plate sheet set. Lay out the four fastening bolts as shown in the illustration. Tighten the four bolts (1), (2), (3), and (4) until the plate sheet set measures 1.10×A. Ensure that the retaining and compression plates remain parallel when closed.

Caution

For TL6: Tighten the four bolts (1), (2), (3), (4) until the plate set measures 1.15×A. When closing, ensure that the fixing plate and the pressure plate remain parallel. The pressure plate remains parallel.

g. Tighten the four bolts (1), (2), (3), and (4) evenly until the A size is reached. If pneumatic tightening equipment is used, see maximum torque in the table below. Check dimension A during tightening.

Table 9.5 Bolt size specifications.

Bolt size	Bolts with washers
	N·m
M10	32
M16	135
M20	265
M24	450
M30	900

If tightening is to be done manually, the tightening torque must be estimated. If dimension A cannot be achieved: Please check the number of plates and size A. Check and make sure all nuts and bearing cartridges are operational. Otherwise, clean and lubricate, or replace parts.

Caution

For TL6: Add the middle bolt and continue tightening with bolts 5 and 6 up to 10 mm. Then, tighten the remaining bolts to the same length. Repeat these steps until dimension A is reached.

h. Install the remaining locking bolts and check dimension A on both ends (top and bottom) as

shown in Figure 9.10.

i. Install guards (if supplied).

j. Connecting Pipes.

k. If the plate heat exchanger does not seal when it reaches dimension A, it can be further tightened to a given dimension A-1.0%.

For TL6: Plate heat exchangers complying with the ASME Pressure Vessel Code should be equipped with top and bottom bolts when ASME-compliant mounting plates are used. Tighten these bolts after completing the above procedure or before reaching dimension A.

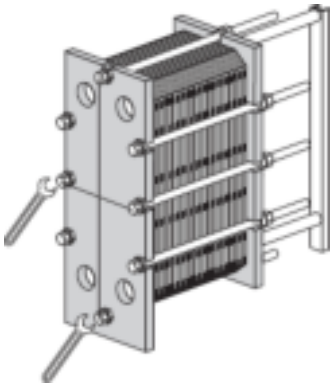

Figure 9.10 Bolt installation diagram.

4) Post-Maintenance Stress Testing

These processes shall be carried out by persons authorized by local laws and regulations and in accordance with applicable standards, failing which they are not permitted to be carried out. If no such person is available in-house, a third party authorized entrepreneur shall apply the appropriate equipment and work in accordance with local laws. Prior to starting production, whenever plates or gaskets are removed, inserted or replaced, it is highly recommended that a hydrostatic leakage test be performed to confirm the internal and external sealing function of the plate heat exchanger. During this test, one media side at a time must be tested while maintaining the other side open to ambient atmospheric pressure. When using a multiple process configuration, all segments of the same side must be tested simultaneously. The recommended test time is 10 minutes for each media side.

Warning

Risk of equipment damage.

The recommended leak test pressure is a pressure that is + 10% above the actual unit operating pressure, but never above the permissible pressure (PS) specified on the nameplate.

Warning

Risk of personal injury.

Testing with gases (compressible media) under pressure can be very dangerous. Local laws and regulations regarding the hazards of testing with compressible media must be observed. Specific hazards include the risk of explosion due to uncontrolled expansion of the medium, and/or the risk of asphyxiation due to lack of oxygen.

Warning

Risk of equipment damage.

Any alterations or modifications to the plate heat exchanger are the responsibility of the end user. For recertification and pressure testing (PT) of plate heat exchangers, local in-service inspection regulations must be followed. Examples of modifications to the heat exchanger include adding more plates to the plate set.

5) Reseal

The following programs relate to face, ring and end gaskets.

Caution

Before removing the old gasket, check how it was installed.

Socket type/Clip Grip as shown in Figure 9.11.

a. Open the plate heat exchanger and remove the plates with new gaskets.

b. Remove the old gasket.

c. Ensure that all sealing surfaces are dry, clean and free of foreign matter such as grease, oil, grease or similar.

d. Before installation, inspect the gasket and remove the rubber residue, as shown below.

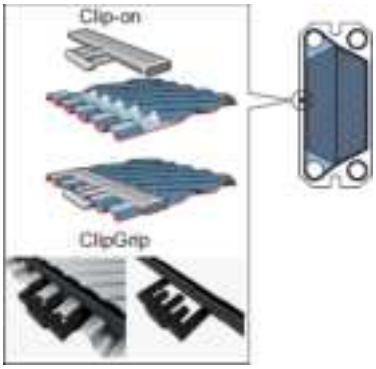

Figure 9.11 Gasket cleaning diagram.

Caution

Especially the end plate gaskets.

e. Install the socket type gasket onto the plate sheet. Pan the gasket insert under the edge of the plate piece.

Caution

Make sure that the pins of both gaskets are correctly positioned.

f. Repeat this procedure for all boards that need to have their liners reset.

6) Adhesive Gasket

Use the glue recommended by Alfa Laval. Separate gluing instructions will be provided with the glue.

Glue other than that recommended may contain chlorides that can damage the board.

Do not use sharp tools when removing the adhesive gasket to avoid damage to the plate.

Regular maintenance considerations are mainly as follows:

a. Before starting the operation, please read the contents of the safety precautions and the product information carefully.

Observe local safety regulations and laws to avoid accidents. The "CAUTION, WARNING, DANGER" items in each manual do not represent all the safety items that should be observed, but only serve as a supplement to the safety precautions in various operations. Therefore, personnel responsible for the installation, maintenance, and other operations of the equipment company's products must have basic knowledge of safe operation, undergo rigorous training, master the correct operating methods, and have the appropriate operating qualifications.

b. When performing various operations on the company's products, the relevant equipment precautions and special safety instructions provided by the equipment company must be strictly observed. The safety warnings listed in the manual represent only the portion of the equipment company's knowledge, and the equipment company assumes no responsibility for any violation of the general safety operation requirements or violation of the safety standards for the design, production and use of the equipment.

c. Most maintenance work must be carried out only after the equipment has been disconnected from the power supply, and do not turn on the power supply during maintenance. For certain maintenance work that needs to be done during operation (such as measuring current, pressure, temperature, etc.), make sure that the equipment is fully connected before turning on the power, and cut off the power immediately after the maintenance is completed.

d. Protective measures, including but not limited to the wearing of insulated gloves and insulated shoes, shall be taken when performing electrical maintenance and shall be in accordance with local codes.

e. Please exercise caution when involving specialized maintenance, and consult the Customer Service Center for details.

9.5 Other System Maintenance

To ensure proper operation and longevity of the system, it should be inspected at least once a year.

Caution

If the working environment of the product is harsh, it is recommended to increase the frequency of inspections.

10 Safety Instructions

Danger

If the container liquid cooling system is not used for a long time, the main power supply should be turned off. After a long power outage, normal power-on procedures should be followed.

10.1 Maintenance

Only qualified and authorized personnel are allowed to carry out maintenance and other operations on the electrical system.

10.2 Operation

a. Before starting the cooling system inside the container, a fire extinguisher should be equipped.

Caution

Due to transportation and regulatory limitations, the system is not equipped with a fire extinguisher during shipment. Before operating the system, please provide a fire extinguisher that complies with local regulations of the project. The fire extinguisher bracket must be fixed on the left side of the equipment entrance label on site.

b. The equipment must have at least two reliable grounding positions, and the protective grounding resistance should be verified to ensure continuity. Its value should be less than 0.3 Ω, otherwise there may be a dangerous situation that may cause personal injury or death.

c. Only clean the equipment after shutting down and turning off the power, otherwise it may cause electric shock or injury. Do not use water to clean the equipment, otherwise it may cause electric shock.

d. Before starting the machine, be sure to check if the valve (if present) is open.

e. Safety clauses for operation of distribution cabinets and main control cabinets:

Before operating the distribution cabinet A/B and main control cabinet, it is necessary to ensure that the cabinet door is locked to prevent personal injury such as electric shock, and to prevent salt mist, moisture, dust or other conductive substances from entering the interior of the distribution cabinet and main control cabinet;

When powering on, it is prohibited to touch the single board, cables, terminals, modules, sensors and other equipment inside the cabinet to avoid safety accidents;

If there is a malfunction, odor, or abnormal sound, please close the main circuit breakers MCB-A1, MCB-A2, and QFWCU of the three cabinets, or press the emergency stop button on the container door and two cabinets, otherwise it may cause electric shock or fire accidents;

When the container system is at risk of rapid freezing under abnormal operating conditions, an air pump must be used to remove the cooling water in the system as soon as possible. For air pumps, refer to the recommended model in Chapter 7.2.1).

10.3 Attention

a. Nonprofessional authorized personnel are prohibited from opening the door of the distribution cabinet

b. Only when the main circuit breaker is in the OFF position can the distribution cabinet door be opened.

c. Before using this equipment, please read this manual carefully. If you have any difficulties or problems, please consult authorized personnel from the factory for assistance.

Danger

The main circuit breaker is in the OFF position, and the front end of the main circuit breaker is live. Unauthorized and professional personnel are prohibited from opening the protective board.