HD5

Water-cooling Container &Dry-cooling Tower Product Manual

Version: V1

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BITMAIN TECHNOLOGIES INC.

www.bitmain.com

Declaration

The Product Installation and Operation Manual (hereinafter collectively referred to as the Product Manual) is intended only to provide guidance and information to assist you in the proper use of the 'ANTSPACE HD5' Water-Cooling Container System (hereinafter referred to as the Product), and it is your responsibility to read all of the information delivered, especially the precautions mentioned in the Product Manual, before installing and using the Product for the first time. Before installing and using the product for the first time, you are obliged to read carefully all the information supplied, especially the precautions mentioned in the product manual, which will help you to use the product in a better and safer way.

Before using this product, please check whether the product parts are complete, if there is any missing, please contact BITMAIN in time and do a detailed inspection of the product before use before installation and use.

BITMAIN will not be liable for any loss of life or property of you or any third party caused by the following circumstances, and any damage caused to the product will not be covered by the warranty. If the user requests maintenance service, BITMAIN can provide paid maintenance service after the judgement of BITMAIN service organization.

1. Request for repair service when the whole machine or parts of this product have exceeded the free warranty period or damage caused by abnormal use or abnormal natural environment;
2. Installing, using or storing the product incorrectly or not in accordance with the instructions and requirements of the product manual;
3. Operating the product under conditions of use beyond those specified in the product manual;
4. Exceeding the scope of installation and use as specified in international standards or in the laws, regulations, or industrial rules of the place of use;

5. Repairing or altering the product by technicians other than those authorised by BITMAIN;
6. The use of software other than that supplied with the product, or the use of software other than the software supplied with the product or specialised software on the product;
7. Other scenarios for which no liability is required within the laws of the country (territory) of operation.

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Product specifications are not intended to indicate that BITMAIN makes any promises or warranties, express or implied, with respect to its products and services, including, but not limited to, warranties of fitness, safety, and suitability for a particular purpose with respect to the use of the products recommended in the product specifications.

The photographs, graphs, charts and illustrations provided in the product manuals are for explanatory and illustrative purposes only and may differ from the actual products. The actual specifications and configuration of the products may be changed from time to time as required, and therefore differ from the contents of the product manuals, so please refer to the actual products purchased.

Due to the continuous iteration of products and the application of new designs, materials and technologies, BITMAIN will improve or modify the software and hardware described in the product specifications and the contents of the product specifications at any time without prior notice based on factors including, but not limited to, product characteristics, product performance, and the environment in which they are used. If you find any inconsistency between the actual condition of the product and the product specification in the process of using the product, or if you want to get the latest information or have any questions and ideas, please feel free to call us or visit the service website for enquiry.

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Revised record

Version number	Change Items	Content before change	Revised content	Date of change	Change agent
V1.0.2	First edition	/	/	2025.1.23	

1 About This Manual

This manual describes the working principle, troubleshooting and maintenance of the ANTSPACE HD5 water cooling system.

1.1 Scope of Application

This manual applies to the following models: ANTSPACE HD5.

The following is a brief description of the installation and operation of the product, using the dry cooling tower version as an example, unless otherwise specified.

1.2 Readership

This manual is intended for professional technicians who are required to install, operate and maintain the product. Professional technicians need to meet the following requirements:

Should have certain electronic, electrical wiring and mechanical expertise, familiar with electrical and mechanical schematic diagrams.

Should be familiar with the water-cooling system and related products composition and working principle.

Should have received professional training related to the installation and commissioning of electrical products.

Should have the ability to respond in an emergency to hazards or emergencies that arise during installation or commissioning.

Should be familiar with the relevant standards and codes of the country where the project is located.

1.3 Use of Instructions

Please read the instructions carefully before using the product.

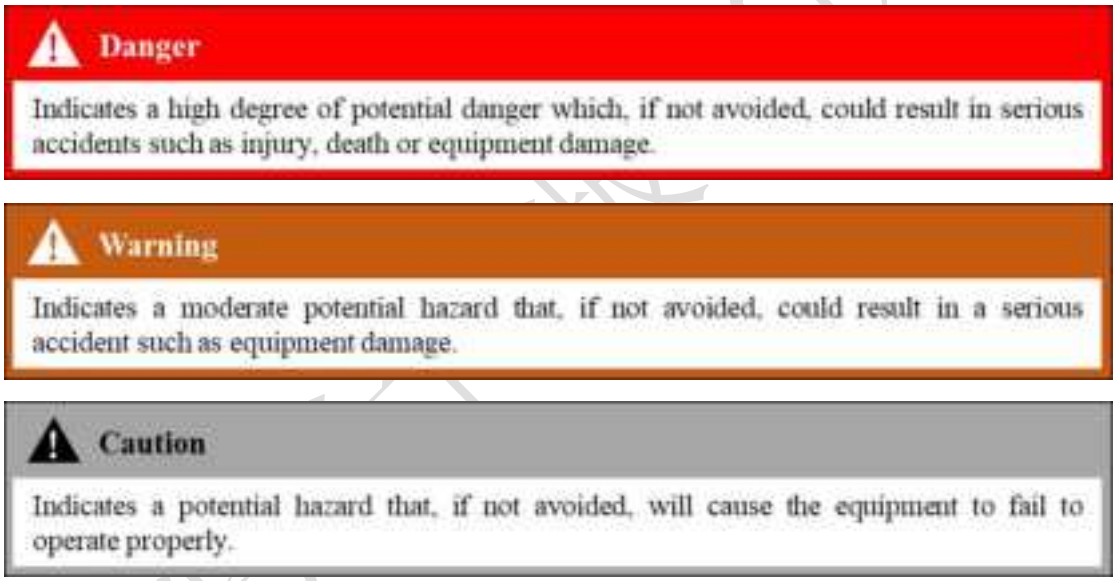
The contents of the manual will be constantly updated and amended, but there is

inevitably a slight discrepancy or error with the actual product. Users should be based on the actual product purchased, and can be downloaded through the 'www.bitmain.com' or sales channels to obtain the latest version of the manual information.

1.4 Use of Symbols

In order to ensure the safety of the user's person and property when using the product, as well as the efficient and optimal use of the product, the following symbols are used to highlight the information provided in the instruction manual.

The following is a list of symbols that may be used in this manual, so please read them carefully for better use of this manual.



2 Safety Instructions

2.1 General Safety Precautions

DISCLAIMER: The equipment company is not responsible in the event of any of the following.

1) It is not operated in the conditions of use described in this manual.
2) The installation and operating environment exceeds that specified in the relevant international standards.
3) Failure to follow the operating instructions and safety warnings in the product and documentation.
4) Damage to the equipment caused by abnormal natural conditions.

2.2 All Safety Precautions

For personal and equipment safety, follow all safety precautions indicated on the equipment and in the manuals when installing, operating and maintaining the equipment.

The "CAUTION", "WARNING" and "DANGER" items in the manual do not represent all the safety items to be observed, but only supplement all safety precautions.

1) Local regulations and norms

Comply with local regulations and codes when operating equipment. The safety precautions in the manual are intended only as a supplement to local safety codes.

2) Basic Installation Requirements

Personnel responsible for installing and maintaining equipment must be strictly trained in all safety precautions and correct operating methods before installing, operating and maintaining equipment.

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

Replacement and modification of equipment or components (including software), must be done by personnel certified or authorized by the equipment manufacturer.

Operators should report malfunctions or errors that could lead to safety problems to the person in charge in a timely manner.

3) Grounding requirements

The following requirements are for equipment requiring grounding only:

When installing equipment, it must be grounded first; when removing equipment, remove the grounding conductor last.

Tampering with the grounding conductor is prohibited.

It is prohibited to operate equipment without a grounding conductor installed.

Equipment shall be permanently connected to a protective earth.

4) Physical security

Personnel other than the operator should not approach the equipment.

Before operating the equipment, wear insulated shoes, insulated gloves, pay attention to eye protection, and remove easily conductive objects such as jewelry and watches to avoid electric shock or burns.

The handles of the tools used need to be insulated.

5) Equipment Safety

Keep the key or special tool on the cabinet door securely during installation, operation and maintenance.

Before operation, securely fasten the unit to the floor or other solid object, such as a wall or mounting bracket.

Do not block the air vents while the system is in operation.

When installing the panel, if the screws need to be tightened, you must use a tool to do so.

Remove empty packing material from around the unit when installation is complete.

2.3 Electrical Safety

1) High voltage

Danger

High-voltage power supplies provide electricity for the operation of equipment. Direct contact or indirect contact with high-voltage power supplies through wet objects (or conductors) is fatal.
Unregulated and incorrect high-voltage operation can cause accidents such as fire or electric shock. Signal wires should be tied separately from strong current or high-voltage wires.

2) High leakage current

Danger

1. All parts of the equipment and the main grounding wire must be grounded before connecting to the power supply, otherwise personal and equipment safety will be jeopardized.
2. If there is a "large leakage current" sign affixed near the power supply terminals of the equipment, before connecting the AC input power supply, the protective earth terminal of the equipment case must be grounded to prevent the leakage current of the equipment from generating electric shocks to the human body.
3. Exposed cables in the equipment should be immediately wrapped with insulating tape and properly placed.

3) Power line

Danger

Installation and removal of power cords with electricity is prohibited. The moment a power cord core touches a conductor, it can arc or spark, which can cause a fire or eye injury.

Before installing or removing the power cord, the power switch must be turned off.

Before connecting the power cord, you must make sure that the power cord label is correctly marked before connecting it.

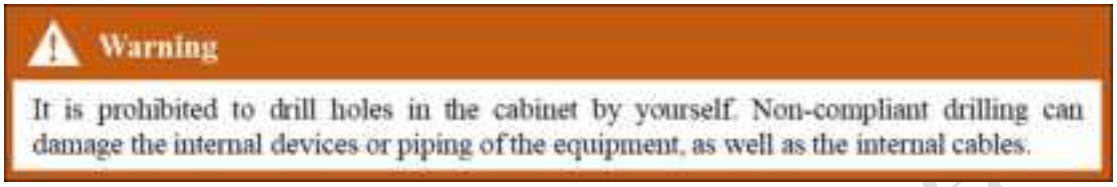
If the power cord is damaged, it must be replaced by the manufacturer, its business agent or a similarly qualified person to avoid risk.

The equipment shall be provided with a means of disconnection from the mains supply, with contact intervals at all levels, capable of disconnecting under Class III overvoltage conditions, and which shall be incorporated into the fixed wiring in

accordance with the wiring principles.

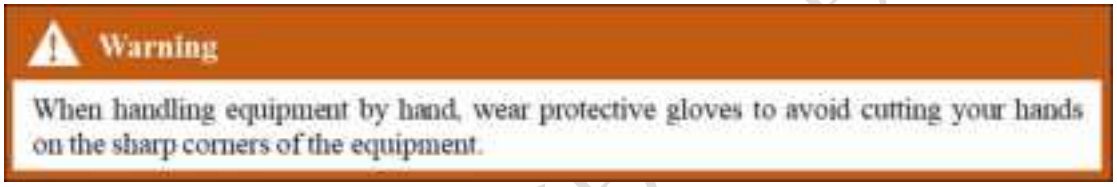
2.4 Safety of Machinery

1) Drilling



2) Sharp object

The fins of the dry cooling tower heat exchanger are exceptionally sharp and protective gloves should be worn when working close to the fins.



3) Fans

When replacing parts, take care to place parts, screws, tools, and other objects so that they do not fall into the running fan and damage the fan or equipment.

When replacing equipment around the fan, do not put your fingers or veneer into the running fan until the fan is powered off and stops rotating to avoid injury to your hands or damage to the equipment.

4) High-speed operation

Attention to high-speed components: fans, pumps.

5) Lifting 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 Operational Safety

1) High temperature and pressure

Improper operation may result in excessive system pressure, which may cause the cooling medium to spray out.

Pay attention to high-pressure parts: exhaust valve, drain valve, plastic hose.

2.6 Others

1) Taping signal wires

Caution

Taping signal wires should be tied separately from strong current or high voltage wires.

2) Cable laying

When the temperature is too low, violent shocks and vibrations may cause brittle cracking of the cable's plastic sheath. To ensure construction safety, the following requirements should be followed:

All cables should be laid and installed above an ambient temperature of 0˚C.

If cables are stored at ambient temperatures below 0˚C, the cables must be moved to room temperature for storage for more than 24 hours prior to laying and deployment operations.

When handling cables, especially in low-temperature environment, the cable

should be gently held and put down, and it is prohibited to push the cable down directly from the car and other irregular operations.

3) Storage

Equipment must not be stored in areas near heat sources or in direct sunlight.

Do not allow any source of ignition or hot objects to come close to the equipment, especially equipment loaded with high-pressure nitrogen and equipment charged with refrigerant, in order to prevent an explosion under high pressure or personal injury due to refrigerant leakage.

4) Recycling

The symbol below indicates that this product cannot be separated from other shell wastes in the EU. In order to prevent potentially hazardous substances from causing uncontrollable waste disposal hazards to the environment and human health, please separate and recycle your waste to promote the sustainable re-use of material resources.

Figure 2.1 Symbol

3 System Composition and Working Principle

3.1 Overview of the System

The water-cooling container system is designed to continuously provide the internal high-calculation power server cooling unit with coolant that meets the pressure, temperature and flow rate requirements to ensure a good working environment for the load.

The water-cooling container system is in the form of forced air cooling (dry cooling tower), and the internal cooling medium can be selected from antifreeze, deionized water or pure water according to the local ambient temperature.

3.2 System Components

Table 3.1 Main components of water-cooling container systems

Subcomponents	Component functions	Main parts and components
Pump Stations	Delivering and monitoring the coolant status to maintain the stable operation of the system.	Centrifugal pumps, expansion tanks, sensors, valves, exhaust valves, filters, pipelines and other related accessories.
Control cabinets	Control the operation of each component of the pumping station, read the value display of each sensor and upload it.	Air switch, intermediate relay, PLC, switching power supply, touch screen and other related accessories.
Network & Distribution Systems	Networking and power distribution for high-calculation servers.	Switches, air plugs, cables, switches and other related accessories.
Distributor components	Distribution and delivery of flow rate.	Distributors, elbows, hoses, chucks, valves and other related accessories.
Accessories that come with the box	Water-cooling container system components and spare parts required for use.	Screws, micro switches, aviation plugs, clamps, rubber hoses and other related accessories.

Dry Cooling Towers	Transfer of heat from the load to the atmosphere.	Stainless steel heat exchanger components, valves, pressure gauges and other related accessories.

3.3 Principle of Operation

HD5 container is divided into two sets of liquid-cooling cooling systems A and B, in which the two sets of cooling systems can be switched on individually or together without interfering with each other, and the two sets of liquid-cooling cooling systems share a main control cabinet. When turning on A/B liquid cooling thermal system, the dry cooling tower A/B side cooling fan starts at the same time, after which the A/B side miner can start.

The pump station provides the coolant with temperature, pressure, flow rate and medium meeting the requirements to the distributor assembly, and the distributor transports the coolant to the water-cooling plate after two-stage distribution, and the water-cooling plate takes away the heat inside the equipment; the warmed-up coolant enters into the dry-cooling tower and carries out forced heat exchange with the outside air, and the cooling-down coolant is once again transported to the water-cooling plate through the pump station and the distributor assembly in such a cycle so as to take away the heat inside the heat load and ensure that the heat load can be cooling in the dry-cooling tower at the same time, which is a good solution to the problem. The coolant after warming goes into the dry cooling tower to exchange heat with the outside air, and the coolant after cooling is delivered to the water-cooling plate again through the pump station and the distributor assembly.

Dry cooling tower working principle: through the power fan forced air convection to achieve the heat exchange of air and internal circulation medium, and then achieve the overall heat dissipation.

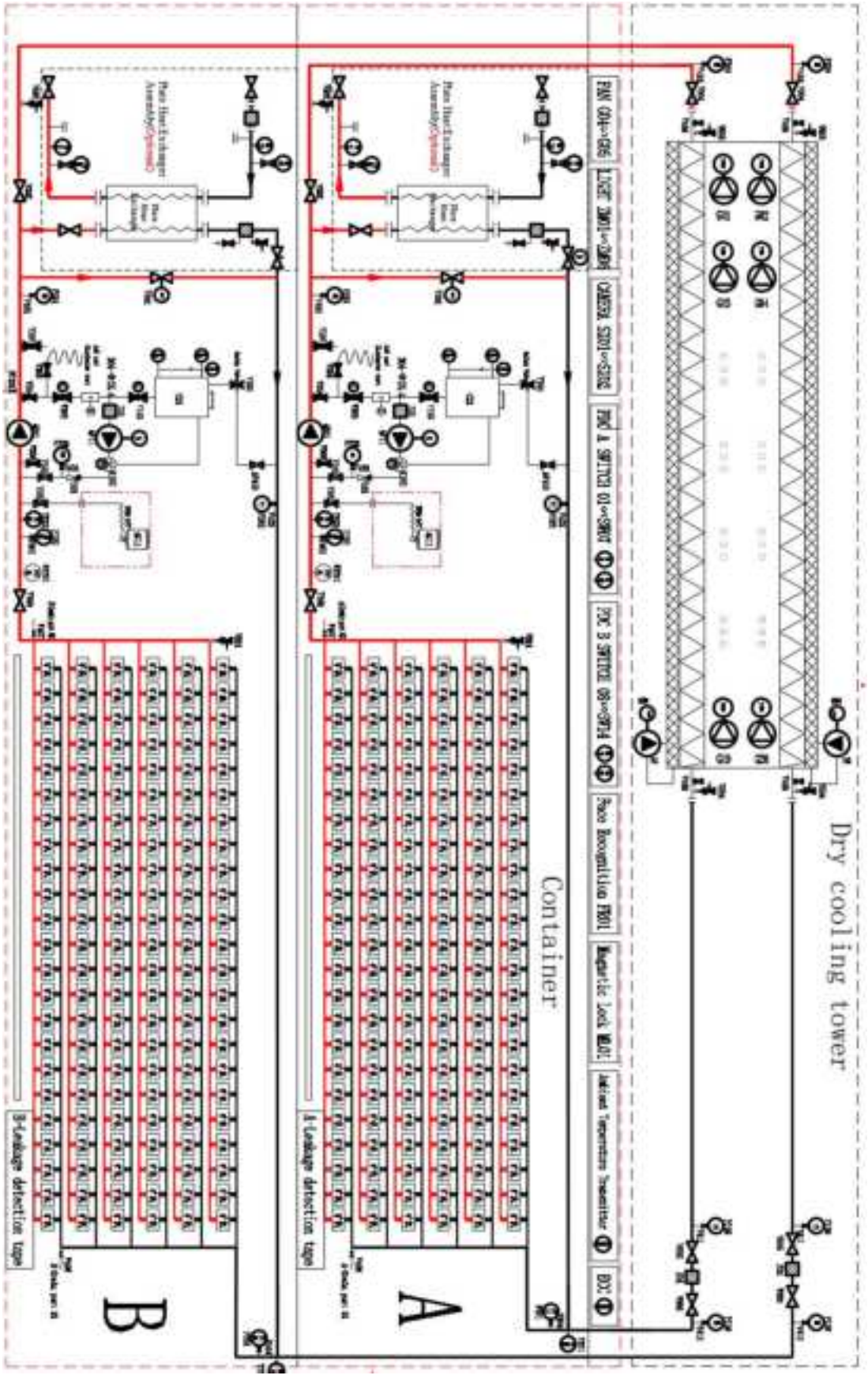


Figure 3.1 Schematic diagram of water-cooling container system

4 System Performance Indicators

Container liquid-cooling system performance indicators mainly include environmental indicators and liquid-cooling system performance indicators, environmental indicators stipulate the use of liquid-cooling system ambient temperature, humidity and altitude requirements. The performance indexes define the size, weight, noise, thermal performance and electrical performance of the liquid cooling system.

Table 4.1 Water-cooling container system performance indicators

Serial number	Name	Norm	Note
Environmental indicators			
1	Working Temperature	-35～40˚C	outdoor
	Working Temperature	5～40˚C	Indoor (temperature range controlled by adjusting fan/enclosure assembly)
2	Operating humidity	10～90%	
3	Storage Temperature	-35～70˚C	
4	Storage humidity	5～95%	
5	Altitude	≤2000m	
Container technical indicators			
1	Overall dimensions（L×W×H）（mm）	12196×2438×2896	Tolerances in accordance with Classification Society requirements
2	High-calculation server capacity	Up to 308 S21 Hyd. series and S19 Hyd. series high-computing-power servers	

Serial number	Name	Norm	Note
3	Box Certification	China Classification Society Certification	
4	Safety certification	North America，CE	
5	Operating power (kW)	≤100	Unload
6	Input voltage and frequency	AC400V±5%,60Hz/50Hz	
7	Transport weight (T)	11	High-computing-power servers and coolant not included
8	Operating weight (T)	17.2	With high-computing power servers and coolant
9	Main switching capacity of distribution cabinet (A)	1200×4	Water-cooling container system includes two switchboards, each with two 1200A main switches.
10	Rated current (A)	≤800	Rated current of each external power supply in the container
11	Standard power (kW)	1512	Server power 5.4kW/desk
12	Maximum power (kW)	1665	Server power 5.4kW/desk
13	Rated current of single position (A)	≤10	The water-cooling container system contains two distribution cabinets, each with one 1200A main switch.
14	External interface	DN100 national standard flange PN16	Corresponds to 140 miners on one side
15	Rated flow rate (m^3/h)	67.2	Corresponds to 154 Main pump frequency: around 41Hz

Serial number	Name	Norm	Note
		73.9	Corresponds to 140 Main pump frequency: around 45Hz
Dry cooling tower technical indicators			
1	typology	dry-cooling tower	
2	Overall dimensions（L×W×H）（mm）	12196×2438×2896	Tolerances in accordance with Classification Society requirements
3	Heat dissipation capacity（kW）	1500	750*2
4	water discharge temperature@30˚C cyclic temperature	35˚C±1˚C	
5	Case Certification	China Classification Society	
7	Operating power（kW）	≤80	
8	Shipping weight（T）	12	
9	Operating weight（T）	15	
10	External interfaces (containers)	DN100 national standard flange(PN16)	With connecting line
11	noises @25˚C,15 metres	≤75dBA	

5 System Architecture View

5.1 External View of Water-Cooling Container System

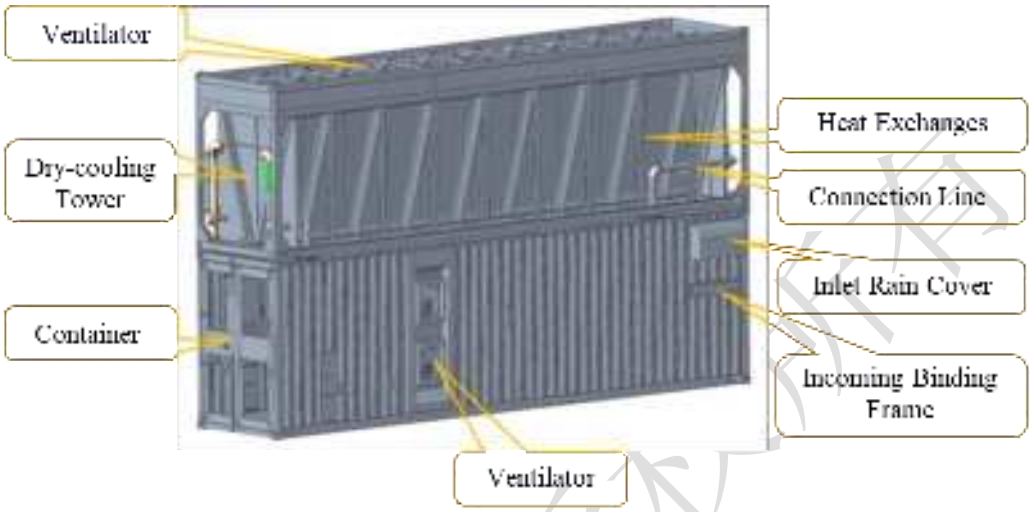


Figure 5.1 External view of water-cooling container

5.2 Interior View of Water-Cooling Container System

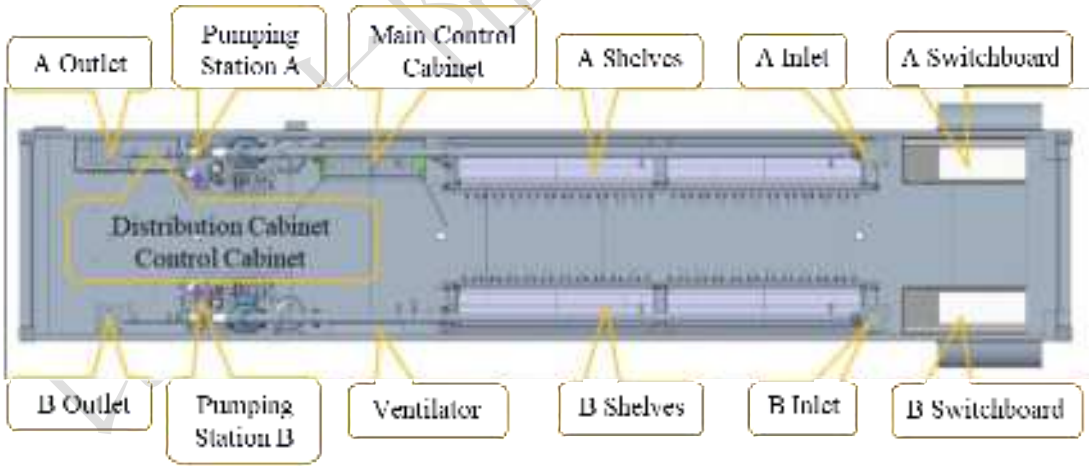


Figure 5.2 Container interior view

Figure 5.3 Internal view of manifold assembly

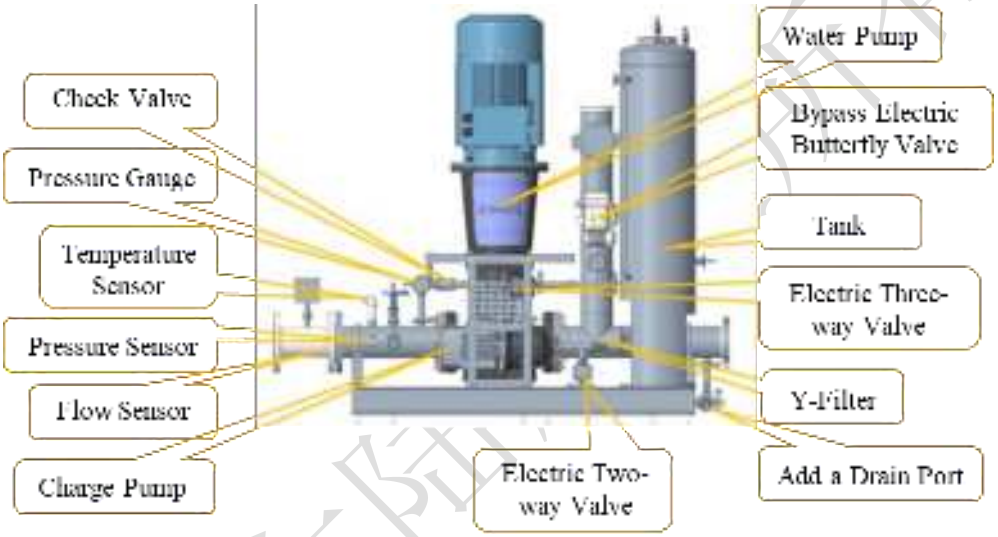


Figure 5.4 Pump Station View

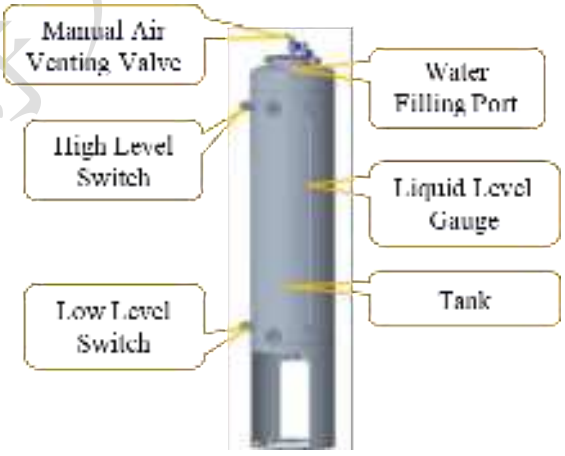


Figure 5.5 Liquid storage tank

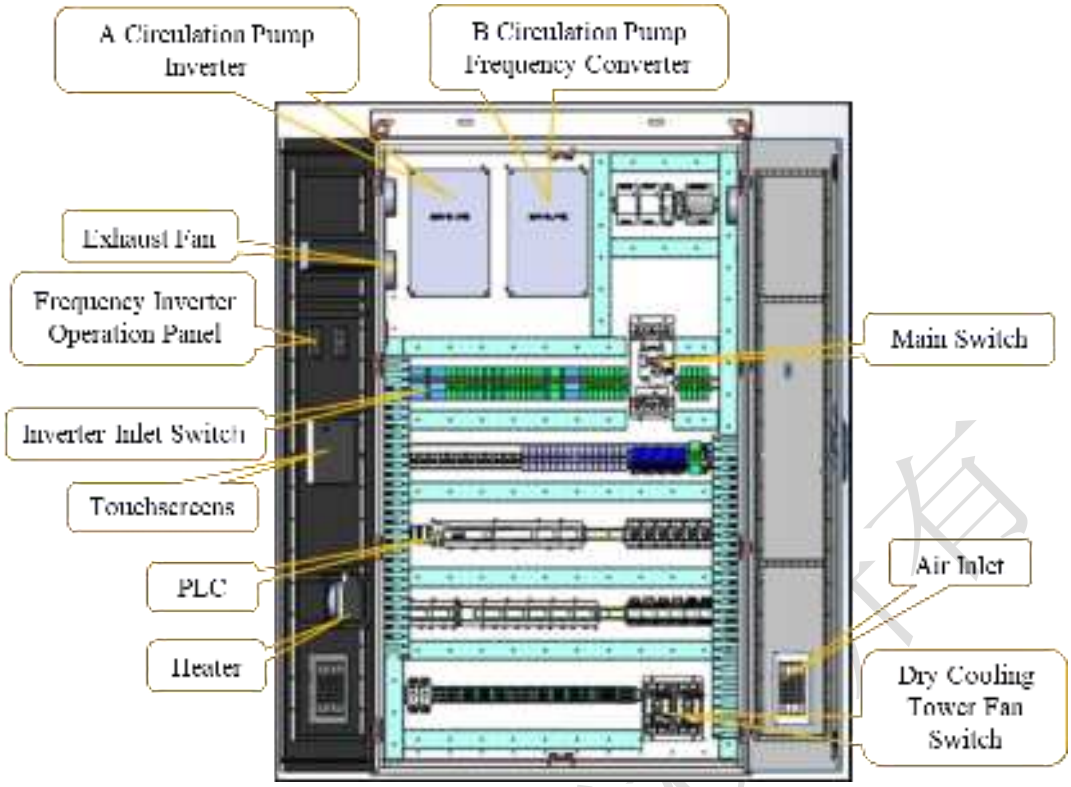


Figure 5.6 Internal view of the main control cabinet

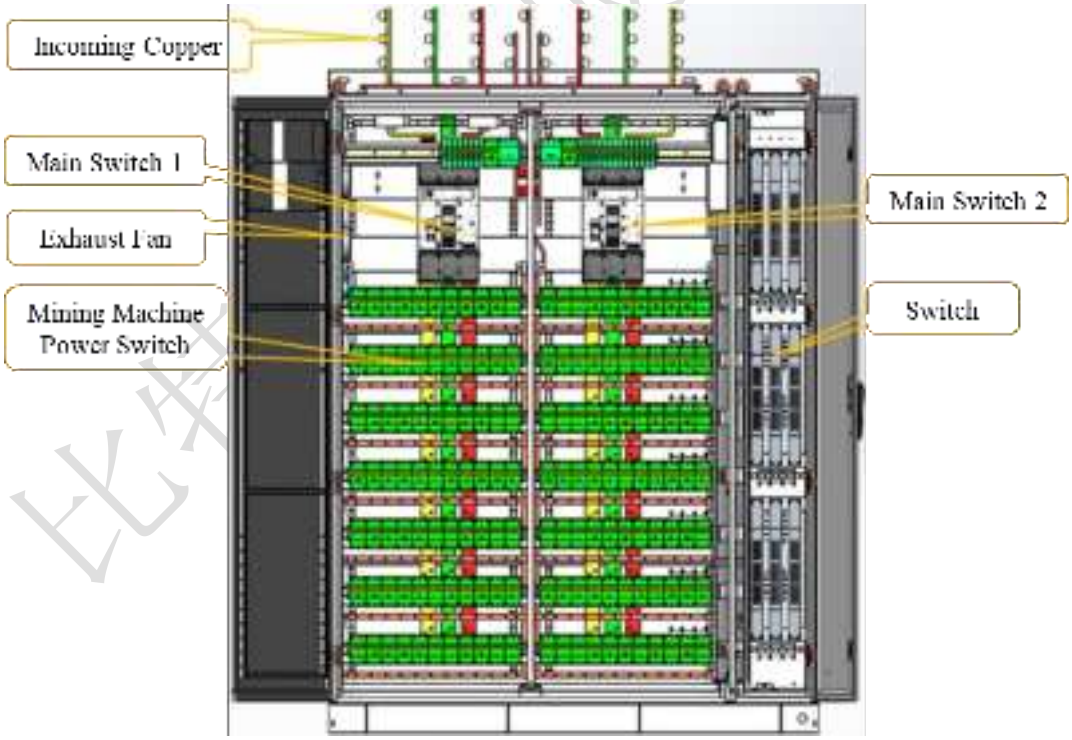


Figure 5.7 Internal view of distribution cabinet B

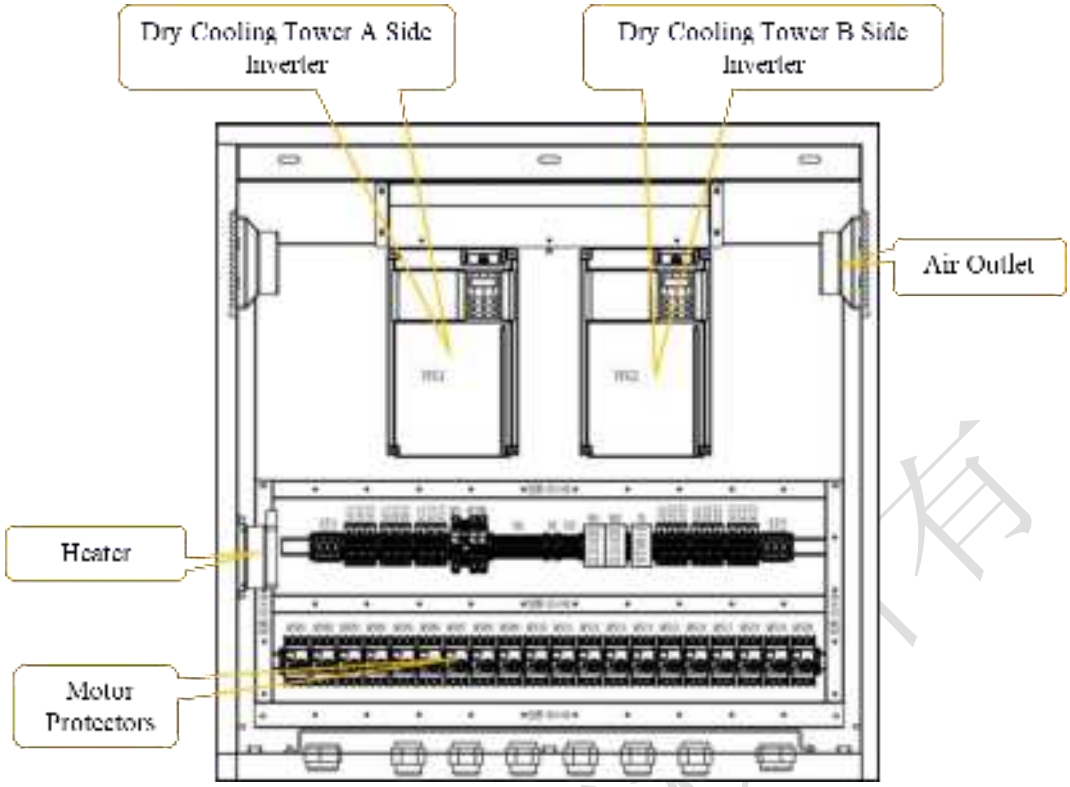


Figure 5.8 Internal view of dry cooling tower control cabinet

6 System Product Installation

6.1 Levelling of Containers before Installation

Place the level on the ground, before using the level needs to be accurate levelling work, so that the level bubble can be in the middle position. The leveller adjusts a reference line, uses a ruler to measure the height of the reference line from the top of the cement foundation, uses a steel plate or other materials to adjust the height to the same size, after the adjustment, the foundation has been adjusted to the level, and the containers can be lifted on the foundation for subsequent installation. The total weight of the system after stacking is more than 32 tonnes, the foundation should be able to support the weight of the system and have a safety margin.

6.2 Installation of Dry-Cooling Towers

Remove the outer packaging sealing plate of the dry cooling tower, the panel of the dry cooling tower is divided into the top sealing plate and the side sealing plate, there is no assembly relationship between the top sealing plate and the side sealing plate, so you can either dismantle the top sealing plate or dismantle the side sealing plate first, and the process of dismantling the side sealing plate is as shown in Figure 6.1.

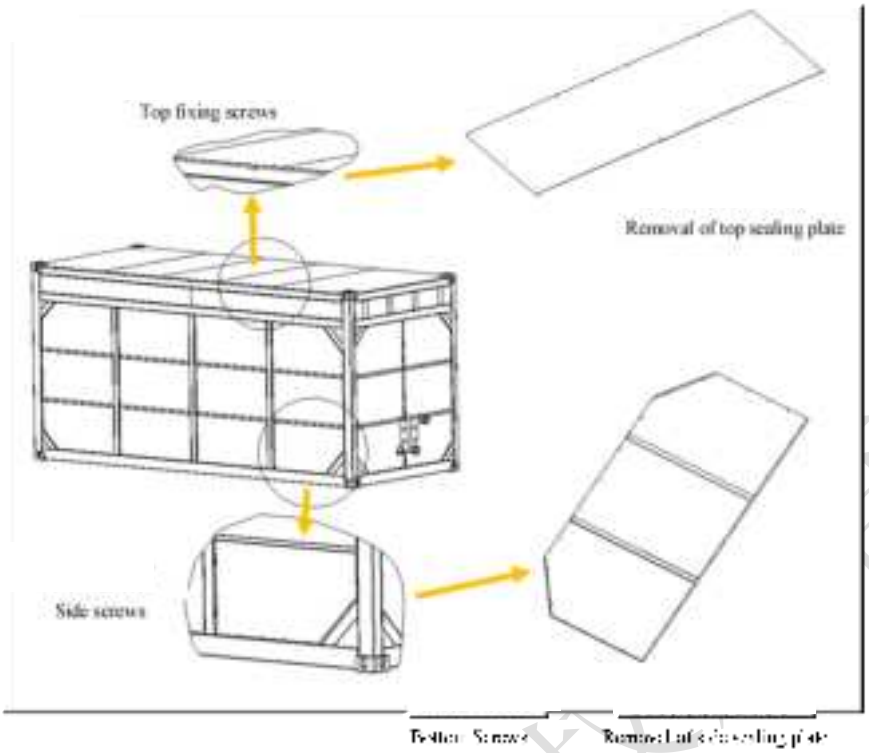


Figure 6.1 Schematic diagram of top and side closure plate removal

The side and top closure panels are each separate and independent, with no removal sequence required.

In addition to the external sealing plate, the pipeline inlet and outlet pipeline sealing plate at the bottom of the dry cooling tower needs to be removed in advance, and the position of removing the sealing plate is as shown in the Figure.

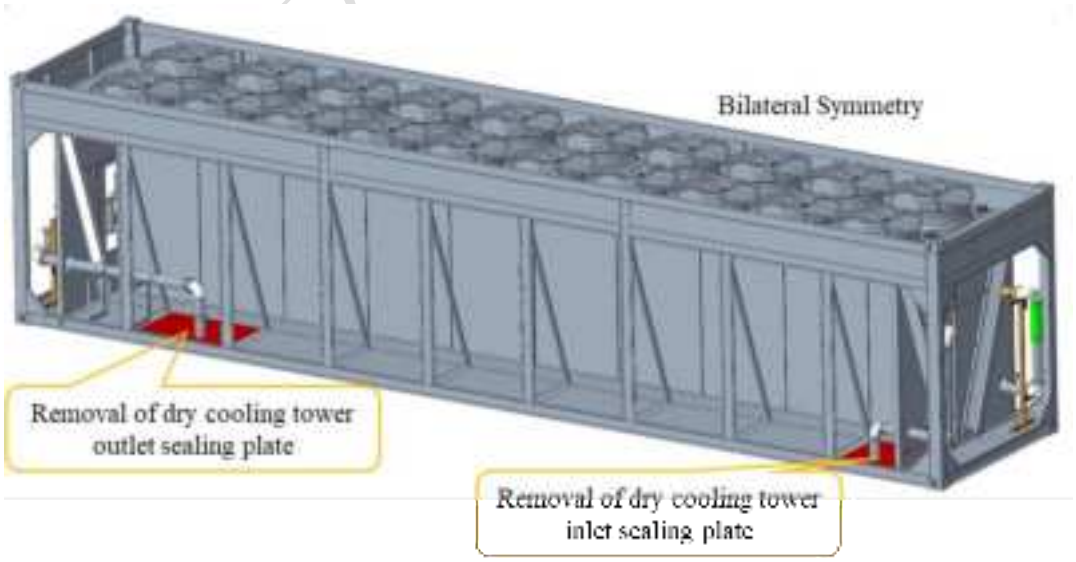


Figure 6.2 Schematic diagram of bottom inlet and outlet piping seal plate removal

Caution

Please keep the sealing plate after removing it for subsequent transportation.

Danger

Wear protective gear during the removal of the dry cooling tower sealing plate to avoid being scratched by the sealing plate.

6.3 Lifting of Dry-Cooling Towers

The dry cooling tower is fixed in accordance with the operating procedure as follows:

a) Determine the removal of engineered pipe assemblies installed inside the dry-cooling tower to prevent dislodgement during lifting.

b) Pass the sling through each of the four corner pieces above the unit, the positions of which are shown in Figure 6.3.

c) Lift the unit horizontally by means of a lifting bar and crane and place it on a concrete floor, leaving enough space for the container to be installed.

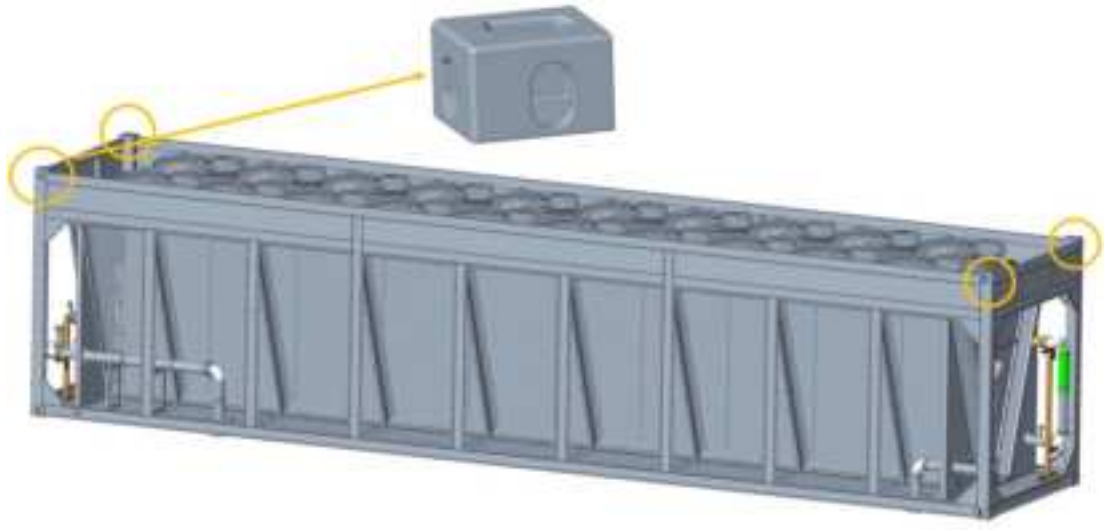


Figure 6.3 Lifting Schematic

Danger

Professional operation is required when lifting the unit.
The hooks must be hung at the four corners of the container during the main lifting, and are strictly prohibited to be hung at other positions of the unit.
When lifting, be careful not to stuff the sling into the corner pieces, otherwise it is easy to wear the sling.

6.4 Container and Dry-Cooling Tower Installation

Place the container on the ground, which requires a certain degree of strength (able to withstand a weight of 32 tonnes, ground level ± 1°); place the twist locks correctly on the four corner pieces of the top of the container. After that, the dry cooling tower is lifted on the top of the container (the lifting direction refers to the position of the inlet and outlet of the dry cooling tower and the inlet and outlet of the container, which need to be corresponding to the top and bottom), and the four corners of the bottom of the dry cooling tower are completely overlapped with the twist locks, and then the twist locks are locked.

When lifting the dry cooling tower, it is required that the top of the dry cooling tower should not be covered, and the top of the container should not have debris. Connect the container with the cable of the dry cooling tower after the lifting is completed. As shown in Figure 6.4 below.

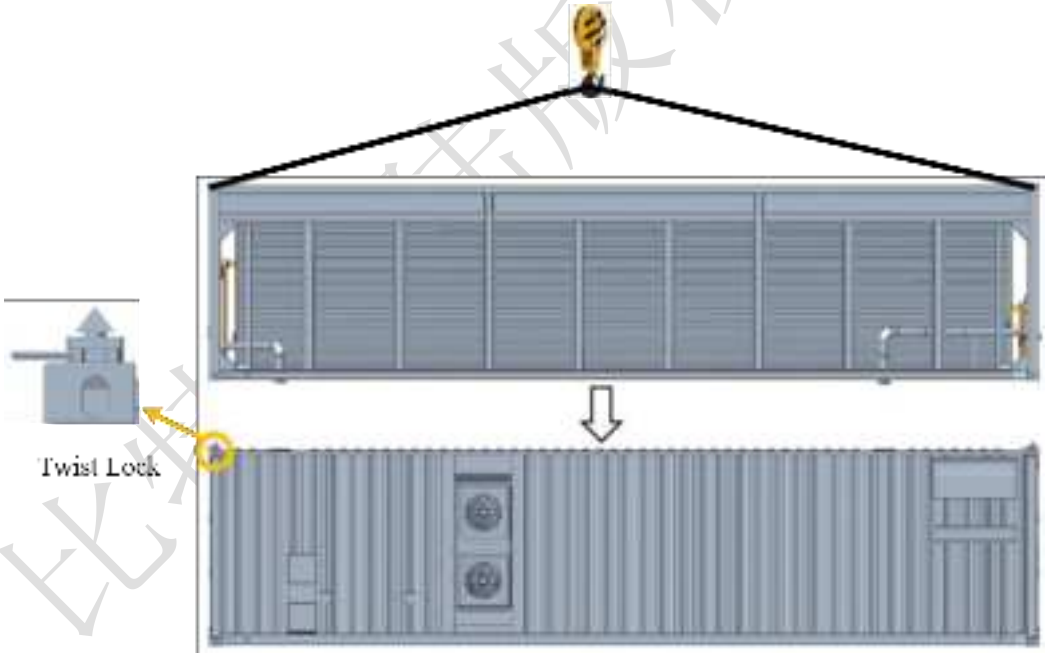


Figure 6.4 Container and dry cooling tower installation

6.5 Layout and Installation of Intermediate Connection Pipework

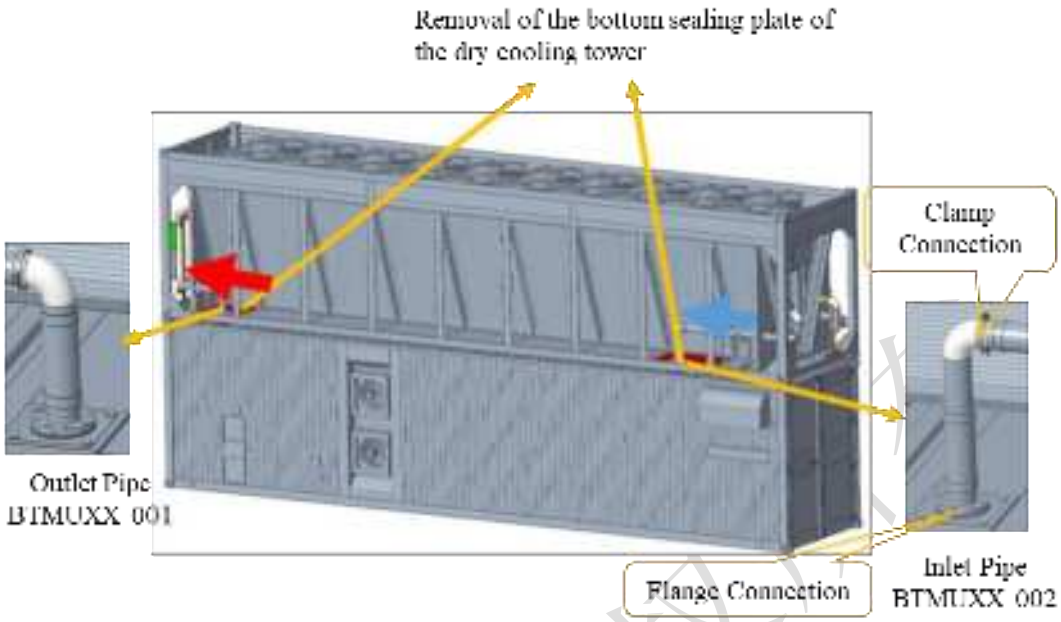


Figure 6.5 Schematic diagram of pipework assembly

To connect a dry cooling tower, proceed as follows：

a) Connect the pipes and components on both sides of the dry-cooling tower according to the piping assembly schematic.

b) Connection pipe type DN100, steel pipe code rear end with nuts, spring washers, fixed with flat washers. The bolt specification is M16×75, and the tightening torque is 45 N·m.

c) Pipe bolts need to be lubricated before tightening, recommended brands (Mobilift SHC220 for water pumps).

Warning

The flange is fixed with bolts made of 304, lubricant needs to be added during the fixing process to avoid the threads from biting.

6.6 Distribution Work

Danger

Power distribution is a hazardous operation, the operator must be a professional and qualified person, in accordance with local regulations, and carry out standard operation according to professional procedures, and prohibit unrelated persons from operating.

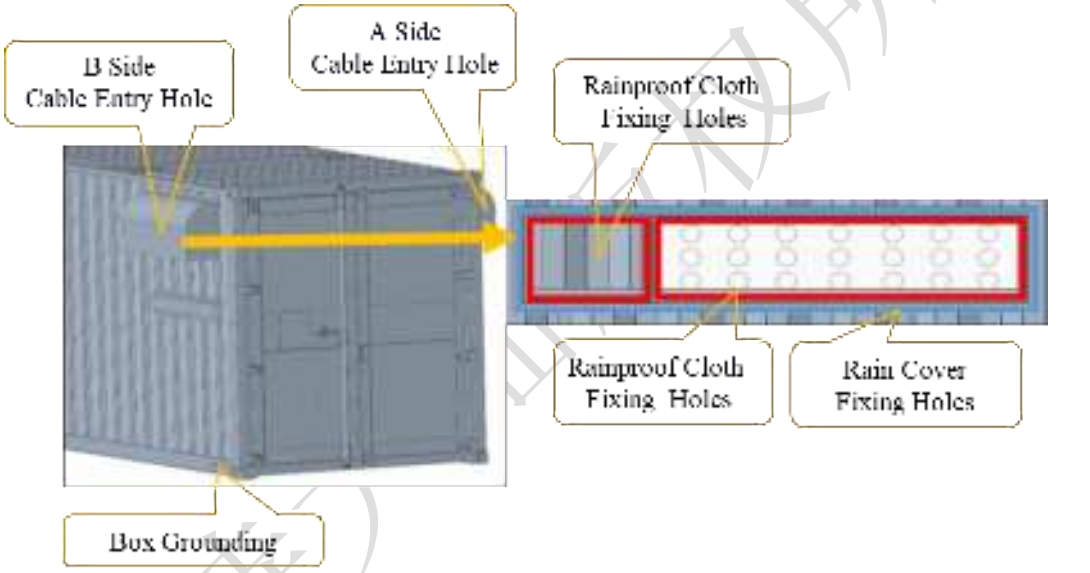
Table 6.1 Specification Parameters of Power Cord

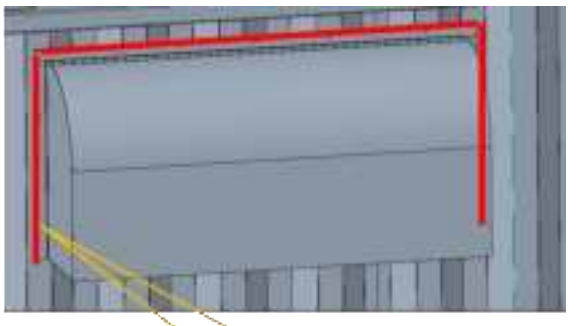
Switch box	Phase sequence	Cable material	Cable cross section	Number of cables
A,B	L1	Copper wire	400kcMil（185mm²）	8（Two single-phase, two incoming wires to each of the AB cabinets）
A,B	L2			8（Two single-phase, two incoming wires to each of the AB cabinets）
A,B	L3			8（Two single-phase, two incoming wires to each of the AB cabinets）
A,B	N	Copper wire	400kcMil（185mm²）	4（Two single-phase, two incoming wires to each of the AB cabinets）
A,B	PE			4（One single-phase, two incoming wires to each of the AB cabinets）

Switch Box	Phase Sequence	Cable Material	Cable cross section	Number of cables
A,B	L1	Aluminum wire	600kcMil 300mm²	8（Two single-phase, two incoming wires to each of the AB cabinets）
A,B	L2			8（Two single-phase, two incoming wires to each of the AB cabinets）
A,B	L3			8（Two single-phase, two incoming wires to each of the AB cabinets）
A,B	N	Aluminum wire	600kcMil 300mm²	4（Two single-phase, two incoming wires to each of the AB cabinets）
A,B	PE			4（One single-phase, two incoming wires to each of the AB cabinets）

a) Cable line respectively from the container on both sides of the feeder aperture access, access before the need to install a good rain cover, rain cloth, etc., in order to further prevent rainwater from the connection into the container after the rain cover, in the rain cover at the seams into the line sealing treatment, after the installation of a good rain cover. Specific location see Figure 6.6, where the cable from the top of the two distribution cabinets junction box access, has been extended to the corresponding copper rows, with screws installed and fixed!

b) Container on both sides of the grounding studs, the need for reliable grounding of the container shell, the container should be at least diagonal two or more reliable grounding, the specific location of the Figure 6.7.





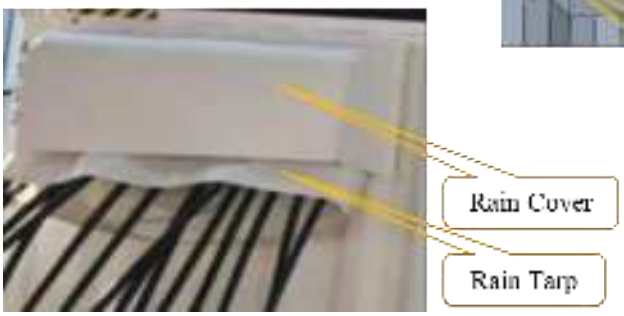


Figure 6.6 Cable Entry Hole Level Rain Sheet Installation Location

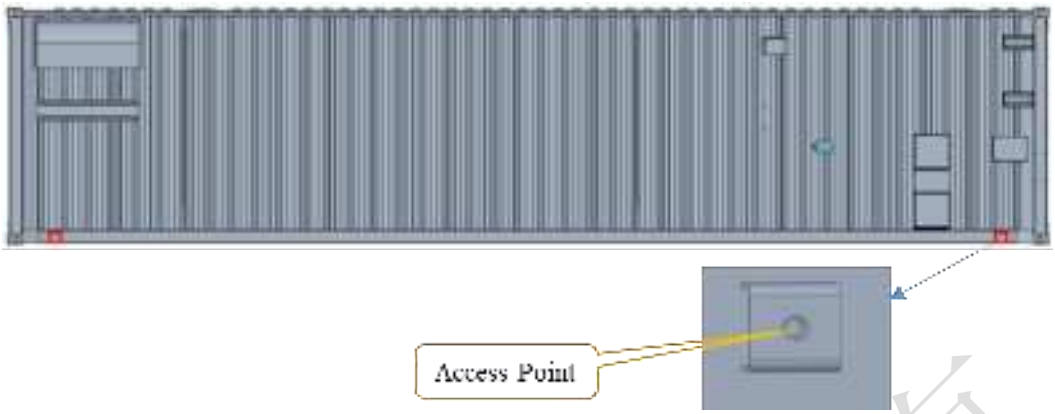


Figure 6.7 Schematic diagram of container grounding location

The phase sequence of the equipment is determined at the factory, and when the equipment arrives at the site, it only needs to be adapted to the phase sequence of the substation at the site.

Danger

Before power on the need for withstand voltage value, insulation resistance and grounding resistance value test, meet the requirements before power on, the reference values are as follows.
Withstand voltage: use voltage tester to test the leakage current between each phase line and between phase and ground at the power input of the equipment, test voltage AC1500V, test time 30s, leakage current ≤ 10mA.
Insulation resistance: use a shaking table to test the insulation resistance between phase lines and between phase and ground at the power input of the equipment, with a test voltage of DC500V and an insulation resistance of ≥10MΩ.
Grounding resistance: use the grounding resistance tester to test the equipment grounding and equipment outside the grounding stud resistance.

The operation is as follows:

a) Connecting three-phase power from the substation to the distribution cabinet.
b) Power up the electrical control box and observe whether there is any power monitor failure.
c) If there is a fault, after power failure, please adjust the phase sequence of the power supply which is connected to the distribution cabinet on the A side near the direction of the main control cabinet.

Danger

Before adjusting the phase sequence, the equipment must be disconnected and the voltage level ≤ 36V must be measured with a multimeter to ensure safety before entering the line to adjust the phase sequence.

d) If there is no fault, it can be operated normally. Connect the main power cable: L1, L2, L3, N, PE rows are connected to the corresponding end, pay attention to the calibration torque (copper row fixing bolts are M16, recommended torque is 120 N·m).Please refer to the maximum running current value of the whole machine for the selection of wiring type, OT terminal is used at the end of the container distribution cabinet, and the appropriate terminal is selected at the end of the on-site substation according to the actual situation, and the wiring diagram of the copper row in the terminal box at the top of the distribution cabinet.

Figure 6.8 Junction box wiring diagram

Danger

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

After the external feed cable is connected, the cable needs to be fixed, fixed in the form shown in Figure 6.9 below, the outside of the container is left with fixed holes, (such as the site has other ways to fix the cable, can also be used to ensure that the cable outside the support and other fixing measures), the external cable is fixed, check the internal copper wiring again to see if there is a deformation of the cable pulling and tugging, fixing bolts loose and so on. If there is any abnormality, deal with

it in time.

Figure 6.9 Schematic diagram of external cable fixing bracket for container

Danger

External cables must be securely fastened to prevent the power supply cables from swaying due to external factors, which can lead to various serious consequences.

1) Dry Cooling Tower Wiring Instructions:

The dry cooling tower distribution cabinet is located inside the container, which needs to connect 20 dry cooling tower fans, 2 water curtain pumps and the dry cooling tower distribution cabinet, all connections are made with electrical connectors, the user only needs to follow the plug cable labelling and the corresponding socket cable labelling to plug and connect firmly. The internal layout of the electrical control box of the dry cooling tower is shown in Figure 5.8 above.

Dry cooling tower AB side schematic diagram as shown in Figure 6.10, dry cooling tower AB side and container AB side of the same direction, the container side of the main control cabinet for the A side, the container side of the exhaust fan for the B side.

The dry cooling tower and the AB side of the container are schematically shown as follows:

Figure 6.10 Schematic diagram of the dry cooling tower with the AB side of the container. (split by the red center line)

The dry-cooling tower can be routed as follows, with the cables routed up the side of the container on side A (with an entry hole in the side of the container) to the dry-cooling tower, as shown in Figure 6.11 below.

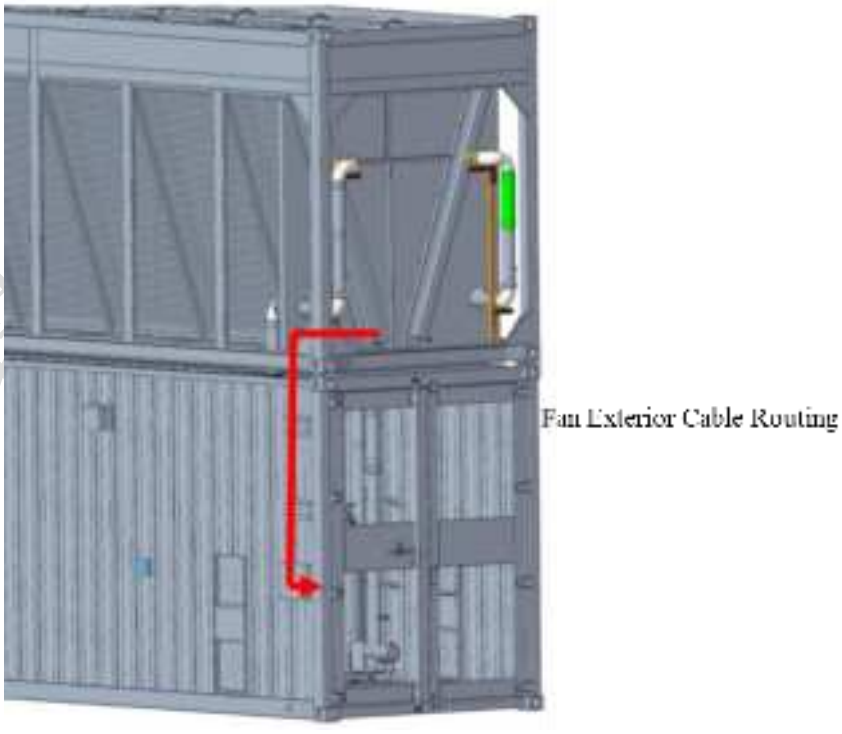


Figure 6.11 Schematic diagram of cable layout along project pipework (cabling paths in red)

Cables need to be protected by metal bellows, follow the pipeline below for routing, routing needs to be close to the pipeline, not hanging or touching the ground.

Access to the dry cooling tower cable from the dry cooling tower electrical control cabinet to the dry cooling tower, divided into 4 strands of 20 bundles of wires connected to 20 dry cooling tower fan, fan wiring diagram 6.12 as follows, please check carefully, do not connect the wrong. Recommended torque for tightening process is 2.2N • m.

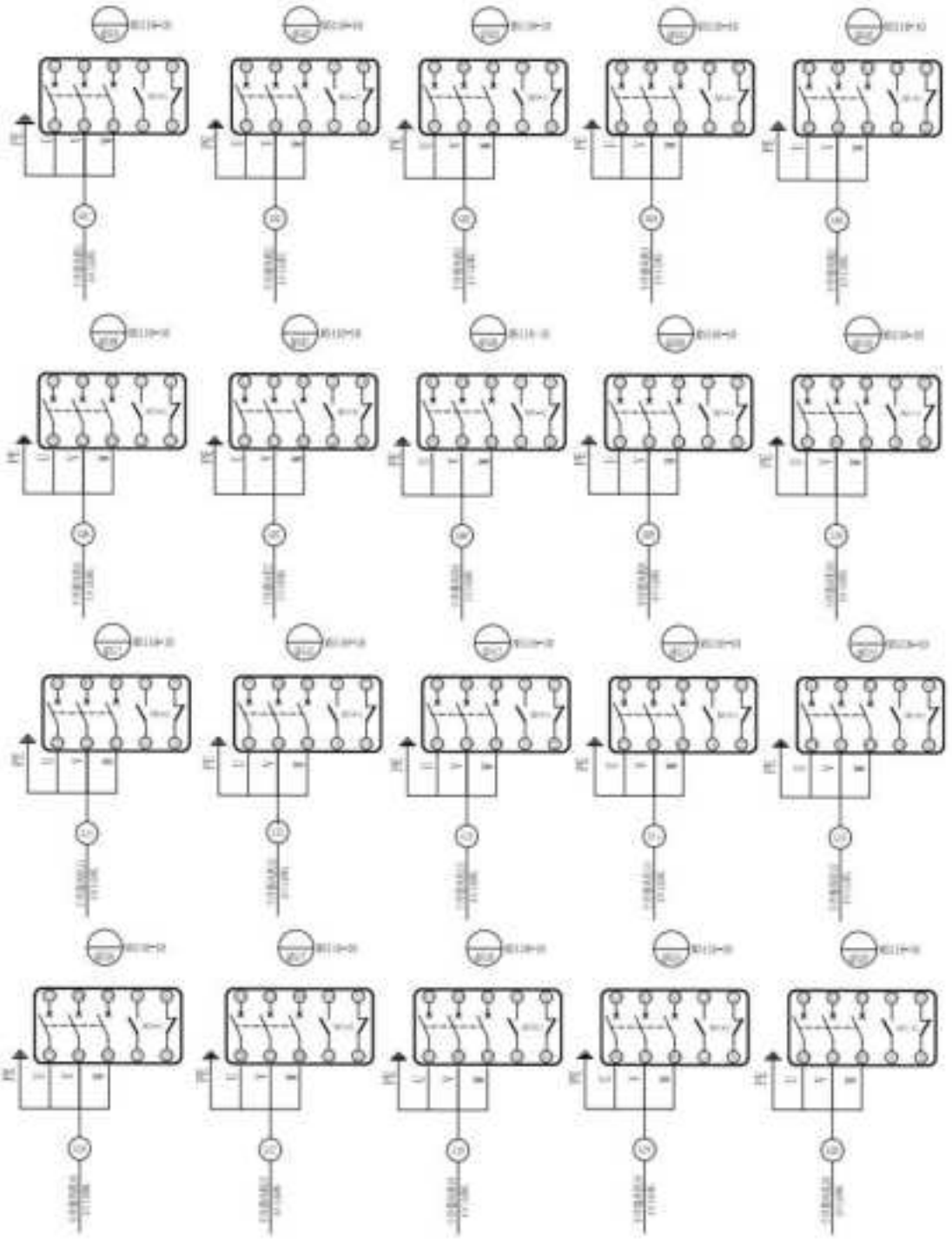


Figure 6.12 Fan Wiring Diagram

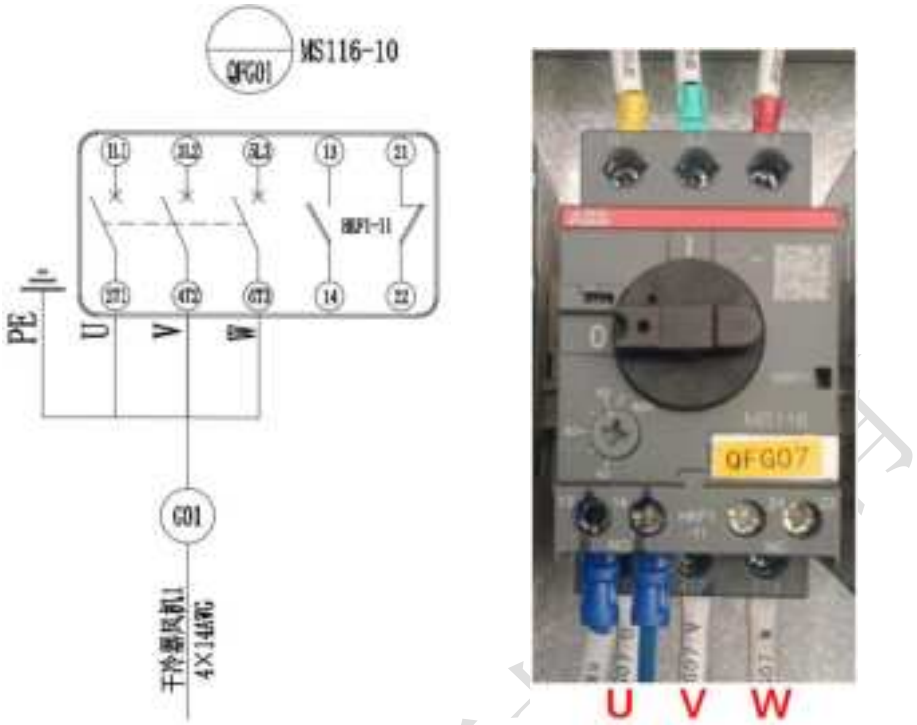


Figure 6.13 Schematic diagram of wiring for a single fan

Warning

Please carefully check if the fan wiring is correct. Do not connect it incorrectly. The recommended torque for tightening is 2.2N·m.

Caution

Check whether the current-carrying screws are loose before the first power-up, if so, please tighten them according to the specified torque.

7 System Use and Operation

7.1 Security Rules

1) Symbolic differentiation of the degree of risk

Danger

Inside the equipment, ⚠ is labeled as electrically charged, and it is prohibited to open the shield with the electrically charged label. Even in the event of a power failure, it is prohibited for non-professionals to open the cover.

2) Precautions for use

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

Warning

Cooling medium should be used regular manufacturers of coolant, do not allow their own blending, or produce problems will not be responsible; recommended the use of organic coolant: (no type of coolant containing P, Si, B, Mo, nitrate, etc., long time will generate deposits); coolant recommended manufacturers: the Great Wall, Shell and so on. The coolant model refers to the lowest temperature of the project site selection.

Warning

It is forbidden to add tap water or coolant that exceeds the above regulations to the system. System operation should have regular monitoring of the coolant, once the coolant properties have changed, the coolant must be replaced with new coolant.

BITMAIN Coolant URL:
https://shop.bitmain.com/product/detail?pid=00020240910144834316bANb9NFf067A

b) When the ambient temperature is below 0˚C, the water in the catch basin and the sprinkler line must be discharged to prevent freezing and damage to the equipment.

c) The equipment should avoid wiring in the middle of the road, and it is strictly prohibited to use it in parallel with other equipment.

d) The equipment should be shut down, disconnected from the power supply and inspected if there are any abnormalities (e.g. burnt odor, etc.).

e) There are emergency stops on the A and B entrance doors of the switchboard

and the container door, when an emergency occurs, press the emergency stop, then the power switch will be disconnected immediately; after the emergency reset, firstly, turn the main switch to OFF position, and then re-start the electricity.

f) Switch MCB-A1 can only de-energies the A1 side of switchboard A, switch MCB-A2 can only de-energies the A2 side of switchboard A.

g) Switch MCB-B1 can only de-energies the B1 side of switchboard B. Switch MCB-B2 can only de-energies the B2 side of switchboard B.

h) Switch QFWCU can only de-energies the main control cabinet.

Warning

All the emergency stop buttons used in this system are rotary release type emergency stop buttons. After the emergency stop button is tapped and the system is confirmed to be OK, the emergency stop button needs to be released by rotating it clockwise, and then the main switch in the distribution cabinet and the main control cabinet switch can be closed. The switch needs to be triggered to OFF position before closing the gate. Then re-close the gate.

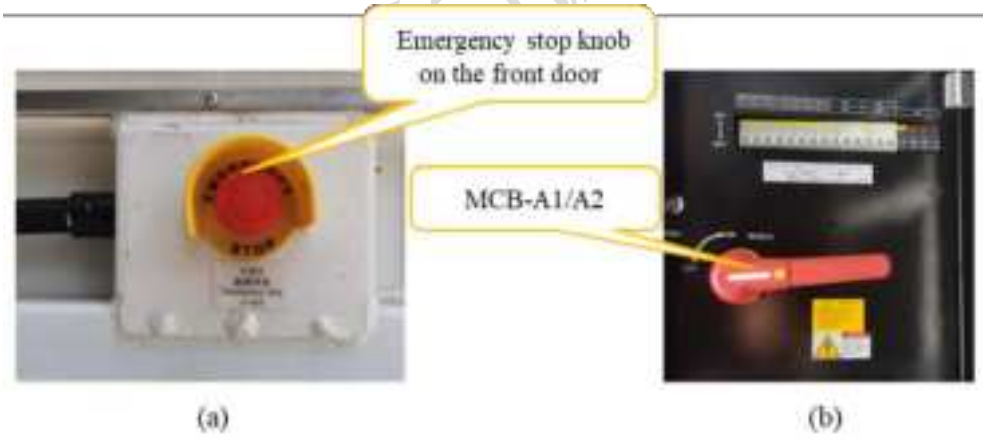


Figure 7.1 (a) Container Front Door Emergency Stop Knob Position (b) Schematic diagram of MCB-A1/A2 position

Danger

There are instructions printed on the inner door of the distribution cabinet to explain which switches are still charged after the main switch is disconnected, so please read them carefully before operation to avoid electric shock accidents.

To prevent danger, when a single high-calculation server is serviced, the power switch corresponding to the serial number of the high-calculation server in the power

distribution cabinet must be disconnected, and then the power, network, and water connections of the corresponding high-calculation server must be unplugged. If it is necessary to power down the entire container equipment, the steps are as follows:

a) Firstly, disconnect all high-computing-power servers on the AB side.
b) After an interval of 10s, disconnect the main power supply of the main control cabinet.
c) Disconnect the four main switches of the switchboard AB.
d) If there is a prolonged power failure, also disconnect the main switch at the transformer end. Remember that the sequence of switching off is strictly in accordance with the above requirements.

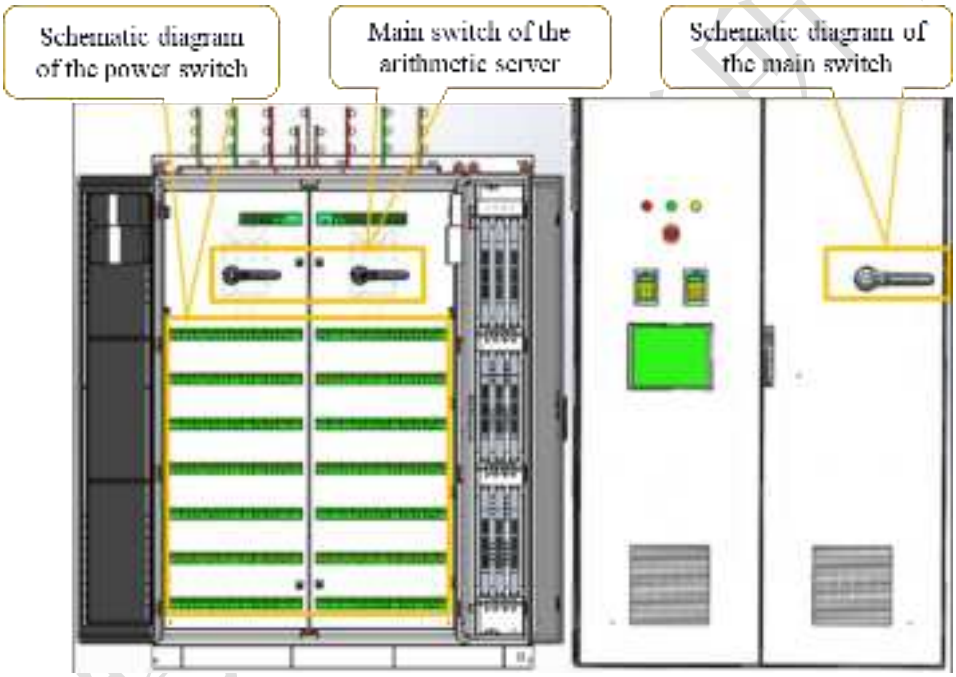


Figure 7.2 (a) Schematic diagram of the power switch and main switch of the Arithmetic server in the distribution cabinet (b) Schematic diagram of the main switch in the main control cabinet

Caution

As the container lighting circuits are led from the main control cabinet, carry a portable lighting kit if you want to carry out the above operations.

Warning

1. If the equipment does not work for a long time, please disconnect the main power supply.
2. It is strictly prohibited to open the protective cover on the fan.
3. It is strictly prohibited to touch the fan blades directly with your hands to try whether the fan rotates or not, or to rotate the fan blades with your hands.
4. It is forbidden to operate the equipment with wet hands, otherwise it is easy to cause electric shock accidents, and it is forbidden to put sundries inside

7.2 Systematic Suppression

Equipment, piping site installation is completed, the first 7bar air pressure test, at least 12h; then 7bar water pressure test, at least 90min pressure, check the piping and interfaces whether there is leakage, such as no leakage and the pressure shows a decrease of 5% or less means that the site installation inspection is qualified. Pressure process is as follows:

1) Preparation for pressurization
   a) Prepare the hose and air pump (recommended brand: OUTSTANDING Otus, model 2200W-40L; selection basis: the internal volume of the system is about 1.5m3, according to the time requirements to choose the corresponding exhaust volume air pump; the highest output air pressure requirements of more than 8bar, 10bar is the best).
   b) Connect the external pipework as described in the previous section.
   c) Check whether the plugs on the automatic air venting valves on the pipelines connecting the internal pipelines of the container to the external pipelines are all closed (the automatic air venting valves include two on the manifold and two above the outlet of the water pump. Four automatic exhaust valves for dry cooling tower and four manual exhaust valves) (the automatic exhaust valves can be opened/closed by screwing the nut on the top of the automatic exhaust valves).
   d) Check that the safety valve ball valves and expansion tank ball valves are closed, and check that all the liquid-adding and discharging valves are closed (including the liquid-adding and discharging port valves corresponding to the two water distributors, the liquid-adding and discharging port valves corresponding to the two pumping stations, and the four discharge valves of

the dry-cooling tower).

Figure 7.3 Automatic air venting valve

Figure 7.4 Schematic diagram of valve opening and closing

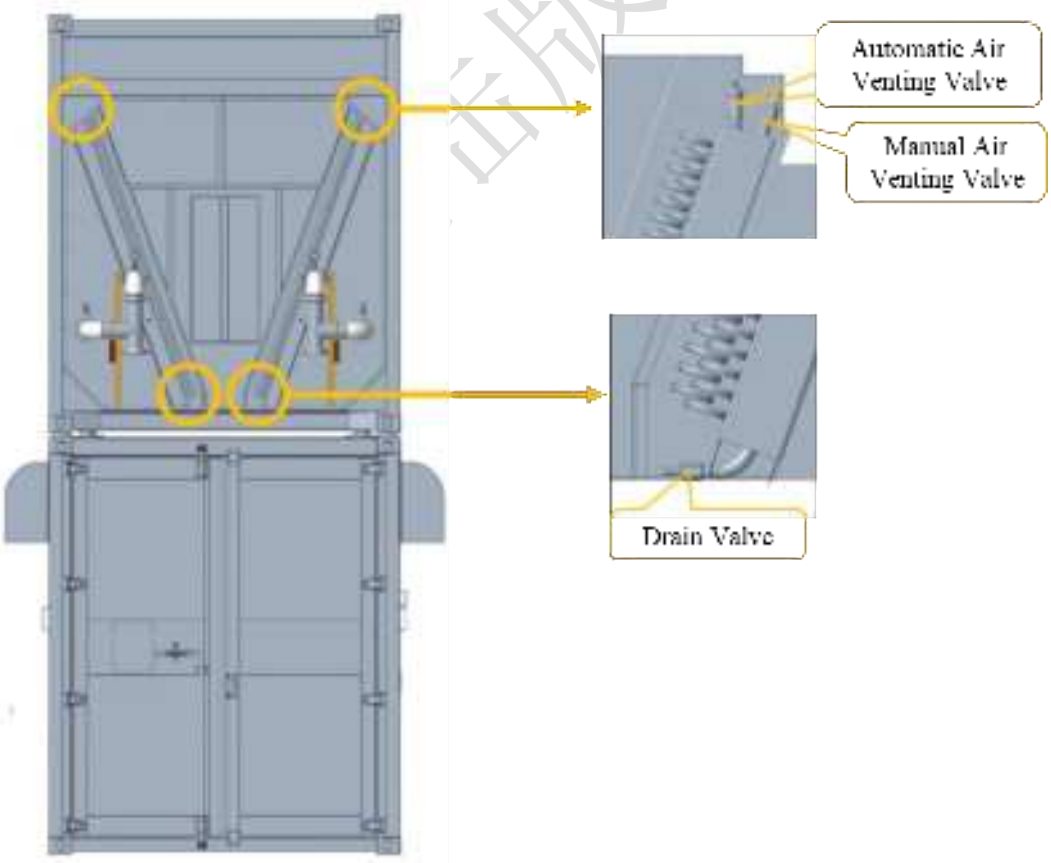


Figure 7.5 Location of dry cooling tower exhaust and drain valves

Danger

The manual exhaust valve is located at the upper end of the dry cooling tower, at a position of 5 meters or more. When it is necessary to operate this valve, it is an ascent operation and requires ascent qualifications, climbing ladders and protective devices that comply with local codes of practice for ascent operations.

2) Pressing Procedure

a) Re-check that the exhaust valve plug and ball valve are closed.

b) Close the ball valve for liquid filling and draining, the valve at the front of the expansion tank, and the valve at the front of the safety valve.

c) Open all mini ball valves on the distributor.

d) Connect an air hose to any quick-connect port and close the corresponding ball valve on this line.

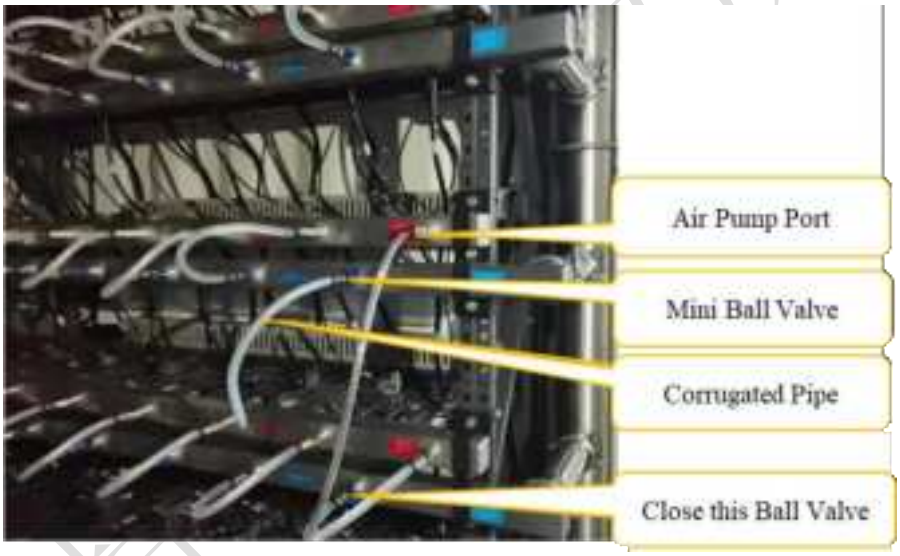


Figure 7.6 System Piping Connection Ball Valve

e) Use an air compressor to pressurize to 7 bar, stabilize for more than 12h and check for leaks.

3) Focused inspections：

a) Inspection parts: connection between snap-in fitting and mini-ball valve, connection between snap-in ball valve and bellows, connection between mini-ball valve and manifold, connection between snap-in and arithmetic server, each flange/chuck/thread/welded connection.

b) Inspection methods: eye, ear, hand with the leakage detection; any soap, washing powder, detergent one of the three, add water to make a soap solution,

coated in the suspected leakage points, especially at the interface, there are bubbles bulging parts is the leakage points.

4) Repression again

After the high-calculation power server is online, it is necessary to carry out the gas-liquid mixing inspection again, with a pressure of 7 bar and a stability of more than 2h, to check whether there are any leakage points in the above areas.

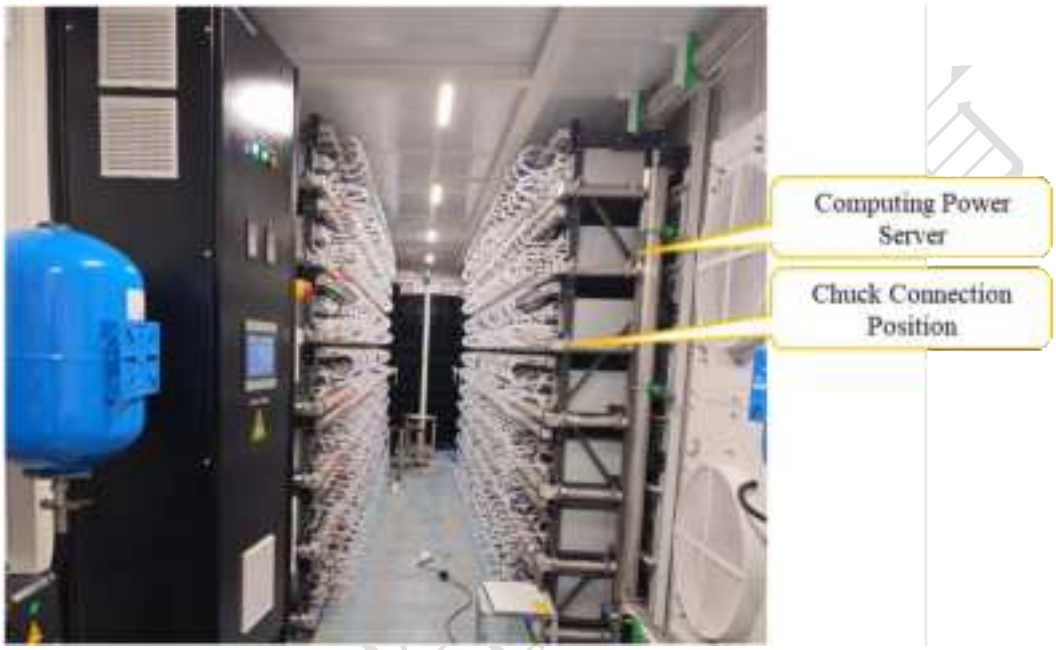


Figure 7.7 System chuck connections (schematic)

7.3 Systemic Rehydration

During the installation of the external pipework, it is necessary to check that the filters in the external pipework are in good condition.

Figure 7.8 Filter inspection

For the selection of circulating medium in the dry cooling tower and container, it is recommended to select appropriate antifreeze or pure water according to the local

climate condition. Firstly, use the liquid filling pump to add liquid to the system, when the return pressure reaches the required value, you can stop adding liquid to the system; switch the pipeline switch, open the liquid filling pump to fill the liquid in the tank, when the liquid level in the tank reaches the required height, switch the pipeline switch, the system can be put into automatic operation. Specific liquid filling process is as follows:

Systemic rehydration consists of four steps:

Preparation: Prepare materials and tools, open all the exhaust valves of the system (open the manual exhaust valve of the system and the manual exhaust valve on the dry-cooling tower for the first time of adding liquid);

System replenishment: use the replenishment pump P11/P21 to replenish the system;

Water tank replenishment: use the replenishment pump P11/P21 to replenish the water tank;

Regular replenishment: you can use the replenishment pump P11/P21 with can also use the top of the tank manual replenishment port to the water tank for replenishing liquid.

1) Preparations
   a) Prepare the coolant.
   b) Connect the external pipework in accordance with section 6.5.
   c) Check that the plugs on the automatic air venting valves in the internal pipework of the container and the external connection pipework are all open.
   d) Open the filling hand valve and close the draining hand valve.
   e) Open the exhaust ball valve at the top of the tank to ensure that the tank is connected to atmospheric pressure.
   f) Opening of the manual venting valve above the dry-cooling tower (to speed up the first refueling).
2) System/tank replenishment
   a) Replenishment of the system and tanks AC21/BC21 with replenishment pumps P11/P21.
   b) find an external water source (need to have a certain pressure), connect the hose and the container plus the discharge port, the first time to add liquid need to be connected to the internal pipeline is full of liquid (after the flow of water),

(the pump or the pipe air, may not be able to pump the water); to find the container outside of the liquid port insert the hose (the container side door), at this time, the external water tank is connected to the pump to add liquid.

c) Open the charge pump exhaust valve (hexagonal spanner), switch to manual mode on the touch screen, open the solenoid valve V202, and after water is discharged, close the manual exhaust valve of the charge pump, as shown in Figure 7.9.

Figure 7.9 Recharge Pump Drain and Bleed Valve

d) Close the solenoid valve V202, switch to manual mode on the touch screen, open the replenishment system ‘manual replenishment’ mode ‘external → system’, i.e., replenish the system, open the ‘external → C21’, that is, external to the water tank C21 replenishment, refer to Figure 7.11.

e) When adding liquid to the system, pay attention to the exhaust valve of the dry cooling tower and the manual exhaust valve of the system to see if there is water flow, when there is water flow, it means that the system has been filled up to close the manual exhaust valve of the dry cooling tower, open the automatic exhaust valve and close the manual exhaust valve of the system.

f) Static pressure of 0.7 bar (refer to Figure 7.12, touch screen reading) or more can be turned on the circulation pump for 10s (replenishment pump does not need to be stopped), after which the circulation pump is stopped.

g) Continue to add fluid and repeat this twice to ensure that 1.1 to 1.3 tones of coolant is added (single-sided system)；

h) When the static pressure reaches 1.0-1.5 bar, stop adding liquid (just observe the reading of the main interface pressure sensor, see Figure 7.12 below).

i) Then turn on the circulation pump again to circulate the medium in the system, ensuring that all automatic air vents are open.

j) Due to the initial addition of liquid, there is gas in the system, the pump cycle

process gas discharge will lead to a drop in pressure in the system, at this time, open the refill function, the tank to the system refill to ensure that the return pressure of liquid between 1.0-1.5bar.

k) After the above operations are completed, the system back pressure (pressure gauge/return pressure sensor PT02) will be stabilized at 1-1.5 bar for normal operation, and you can turn on the automatic mode and open the arithmetic server for operation.

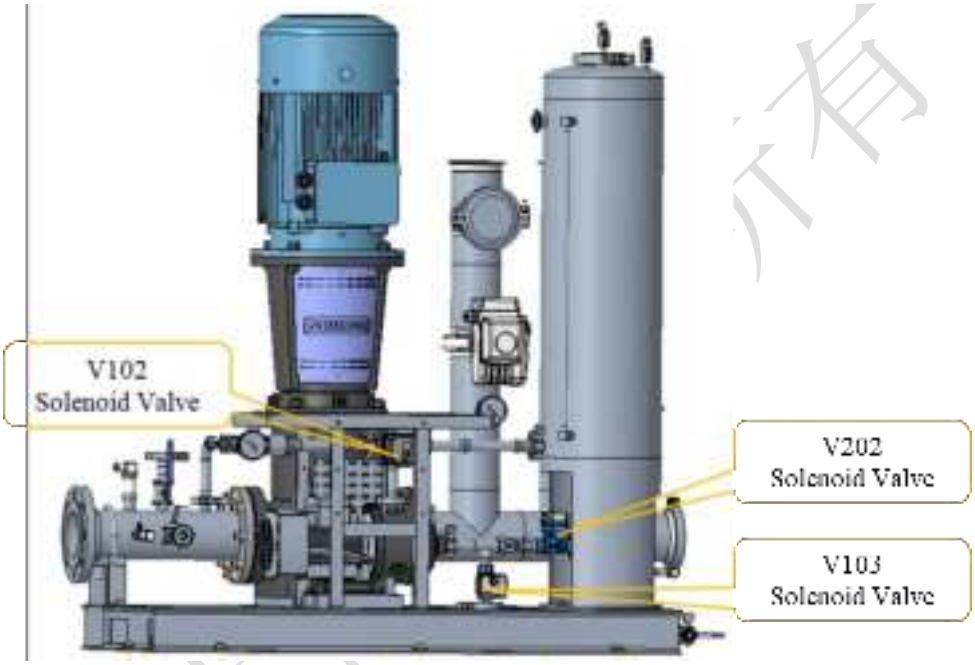


Figure 7.10 Distribution of solenoid valves in the rehydration system

Figure 7.11 Replenishment system interface

Figure 7.12 System operation screen

3) Water tanks are regularly refilled

When it is necessary to replenish liquid to water tank C21:

Method 1: Same as the initial replenishment, connect the replenishment pump to the external water source (the external water source has a certain pressure to fill the connecting line), turn on the replenishment mode, and replenish the liquid externally to the water tank;

Method 2: You can open the exhaust valve mounting chuck at the top of the tank (refer to Figure 7.10), and manually refill the tank from the manual refill port.

7.4 Electrical Wiring

Equipment electrical system requirements for the TN-S three-phase five-wire system, as the equipment is two internal distribution cabinets, each distribution cabinet has two input power, in order to ensure that the equipment can operate safely and stably, the site should be prepared in advance four three-phase five-wire cable, cable parameters refer to the table 6.1 show.

Danger

The electrical connection must be operated by qualified personnel, and the operation procedure must comply with the requirements of the local electrical code and safety regulations of the project in addition to the requirements of this manual.
It is strictly prohibited for unqualified personnel to make electrical connections to the equipment.
The specification and number of input cables of the equipment must comply with the local electrical regulations, if necessary, please consult a qualified electrical engineer.
L1.L2.L3 input copper rows on the top of A/B cabinet are reserved for 3 M16 bolts, and the center hole of cable fixing terminal is specified to have a head of 17mm diameter. 2 M12 bolts are reserved for N copper rows, and M12 bolts are reserved for PE copper rows.

Caution

M16 bolt fixing torque 100N.m, M12 bolt fixing torque 80N.m，or refer to the electrical standard of the project site to ensure reliable electrical connection.

Stripping and crimping diagrams are shown below:

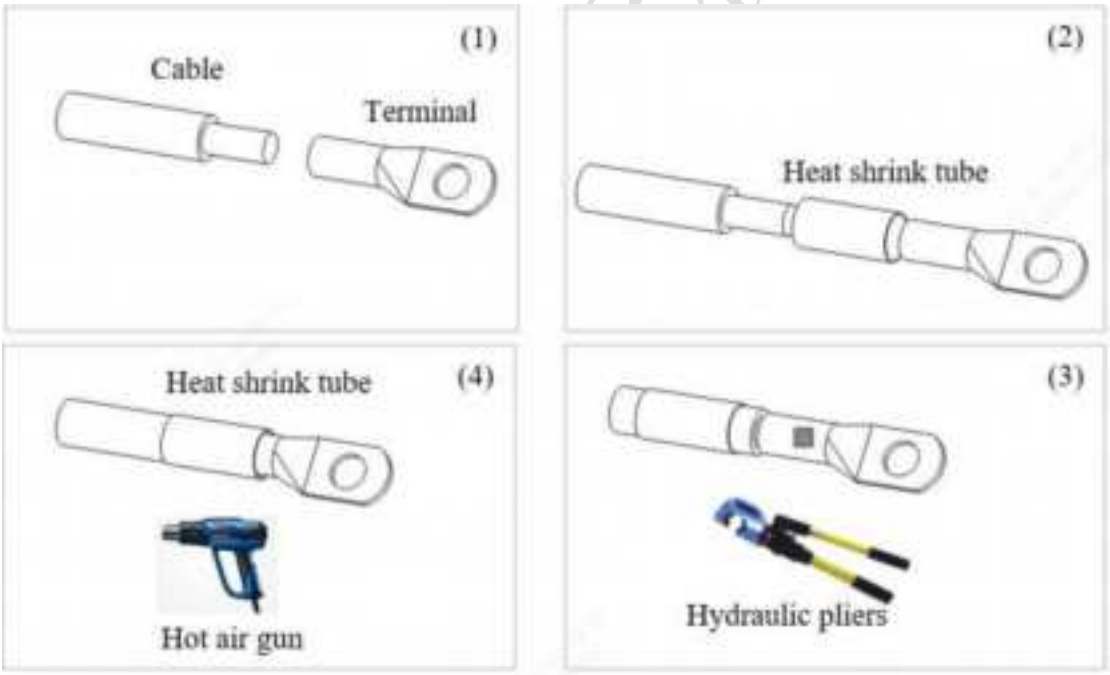


Figure 7.13 Stripping and Crimping Diagrams

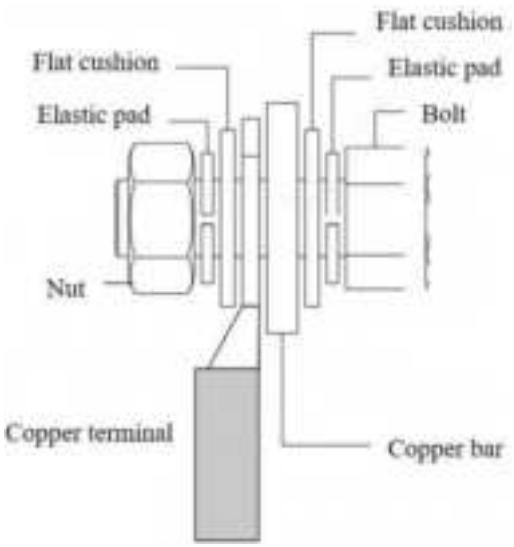


Figure 7.14 Selected Copper Connection

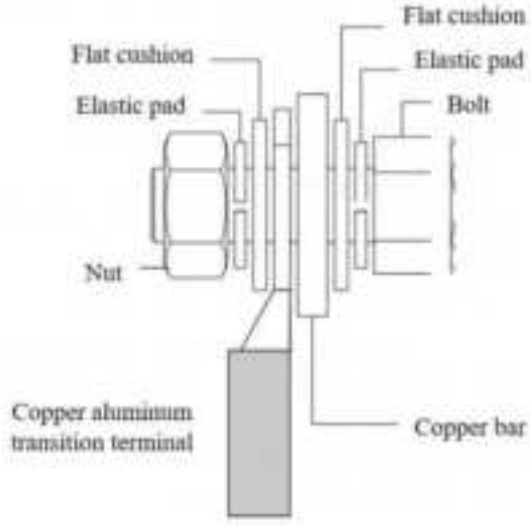


Figure 7.15 Selection of aluminum wire connection

After torque fixing the bolt, mark the nut head with a marker pen for subsequent inspection.

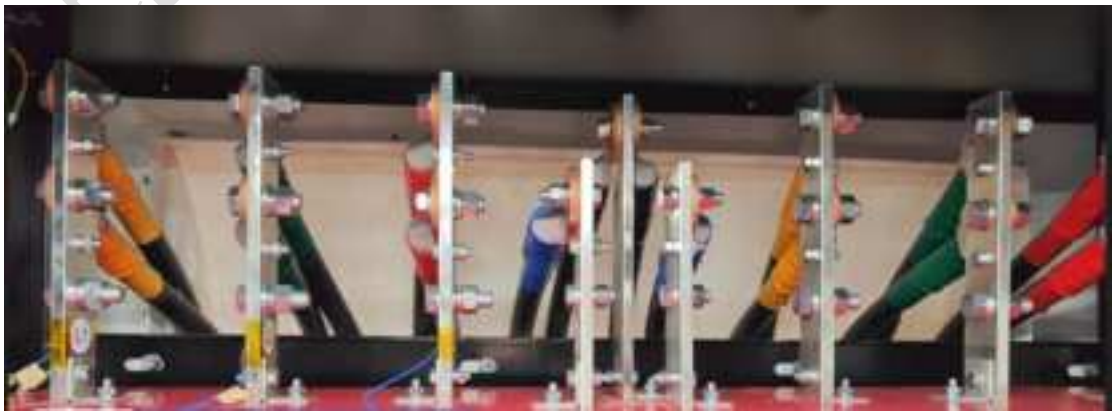


Figure 7.16 Cable connection schematic (two cables in parallel)

Danger

After the completion of the copper busbar main cable wiring, it is necessary to clean and inspect the wiring position. There are no related bolts, cables, terminal heads, wiring tools, or other unrelated components in the junction box, which may cause power line short circuits and pose a danger.

After the completion of the copper busbar main cable wiring, it is necessary to clean and inspect the wiring position. There are no related bolts, cables, terminal heads, wiring tools, or other unrelated components in the junction box, which may cause power line short circuits and pose a danger.

The cable wires are accessed from the upper two openings on one side of the container exhaust fan, see Figure 7.16 for exact locations (note: rainproof cloth and rain cover in the accessories are required for protection).The cable is connected from the top junction box of the two distribution cabinets, and extends to the corresponding copper row, and is installed and fixed with screws (which have been installed in the openings of the copper row).The location of the cable entry holes is shown in Figure 6.6.

There are grounding studs on both sides of the container, and the switchgear cabinet must also be reliably grounded. Therefore, it has been chosen to reliably ground both the shell of the container and the shell of the distribution cabinet. The phase sequence of the equipment has already been determined at the factory, and when the equipment arrives at the site, it only needs to be adapted to the phase sequence of the on-site substation.

Operation is as follows: L1, L2, L3, N, PE three-phase five-wire access to the substation distribution cabinet, test the withstand voltage and insulation impedance, the main switch of the main control cabinet, observe the LCD screen whether there is a power failure alarm; if there is a power failure alarm, please adjust the access to the main control cabinet L1, L2, L3 three-phase phase sequence; such as the LCD screen no failure alarm, then normal operation!

Danger

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

7.5 System Power-Up and Power-Down Process

The switches in the main control cabinet are shown below:

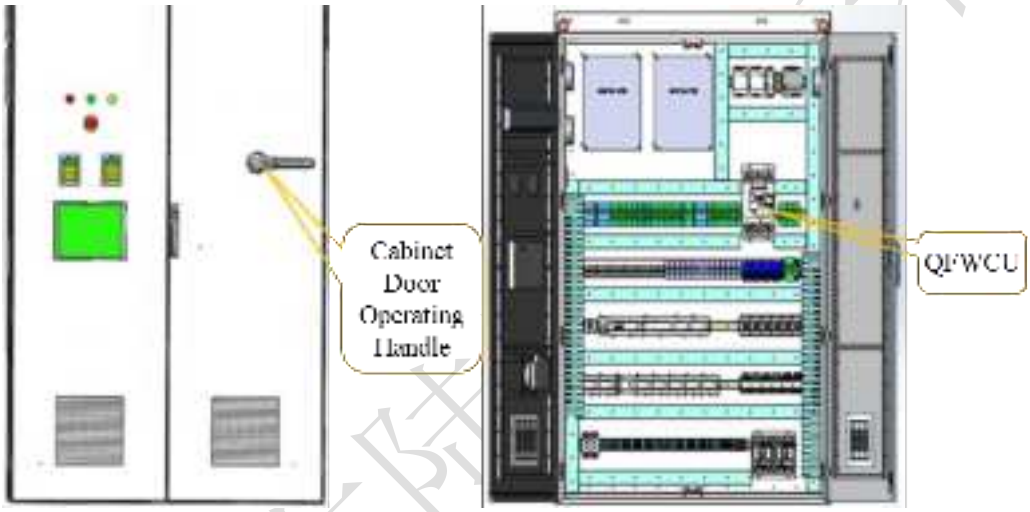


Figure 7.19 Internal and external view of the main switch in the main control cabinet

1) Functional description of switches in the system

Table 7.1 Description of switching functions in the main control cabinet of the water-cooling container system

Serial number	Name	Starting point	Orientations	Finishing line
1	QFWCU	power supply XT1, L1, L2, L3	→	QFWCU
2	QFKR1	XD11, L1	→	Power Monitor L1
3	QFKR2	XD12, L12	→	Power Monitor L2
4	QFKR3	XD13, L13	→	Power Monitor L3
5	QFHL1	power supply L1	→	Power indicator (white)
6	QFHL2	power supply L3		

Serial number	Name	Starting point	Orientations	Finishing line
7	QFHL3 QFHL4	power supply L11	→	Error indicator (yellow) Closing indicator (green)
8		power supply L13	→	
9	QFD1	L11, N	→	Backup power
10	QFaSW	L11, N	→	Switchboard A switchboard power supply
11	QFbSW	L11, N	→	Switchboard B switchboard power supply
12	QFVF01	L11, L12, L13	→	Main pump frequency converter VF01:R, S, T
13	QFVF02	L11, L12, L13	→	Main pump frequency converter VF02:R, S, T
14	QFMB	L11, L12, L13,N	→	Air-conditioning componentsL1, L2, L3,N
15	QFGL01	L11, L12, L13,N	→	A-side dry cooling tower inverter power supply
16	QFGL02	L11, L12, L13,N	→	B-side dry cooling tower inverter power supply
17	QFV08	EV_L+	→	V008 Power+
18	QFP1	L11	→	PLC switching power supply P1 pin L
19	QFPZ1	PLC power supply P1 Pin V+	→	P1_L+
20	QFP2	XD13, L13	→	Container Lighting P2 Pin L
21	QFPZ2	P2 SDR-480-24	→	Container Lighting Power Switch

Serial number	Name	Starting point	Orientations	Finishing line
22	QFJRQ	Pin V+	→	Main control cabinet heater switch
23	QFRDC	L13,N	→	AB distribution cabinet, dry cooling tower electric cabinet fan
24	QFMF	P2 SDR-480-24	→	Main control cabinet internal cooling fan
25	QFP3	Pin V+	→	SDR-75-12V P3 Pin L
26	QFPZ3	P2 SDR-480-24	→	Spare
27	QFP4	L11	→	MDR-75-12 P4 Pin L
28	QFPZ4	MDR-75-12 P4	→	Face Recognition Systems
29	QFP5	Pin V+	→	MDR-20-5 P5 Pin L
30	QFPZ5	L12	→	Black Box, Camera Power Supply
31	QFRST	MDR-20-5 P4	→	Power Distribution Cabinet
32	QFV1A	Pin V+	→	Separate excitation disconnectors
33	QFV1B	EV_L+	→	A-side system valve power supply

Table 7.2 Functional description of switches in switchgear cabinet A for water-cooling container systems

Serial number	Name	Starting point	Orientations	Endpoint
1	MCB-A1	1L1, 1L2, 1L3	→	Master busbarL4, L5, L6
2	MCB-A2	2L1, 2L2, 2L3	→	Master busbarL7, L8, L9
3	MCB24-1	1L1	→	Power indicator HL1
4	MCB24-2	1L3	→	
5	MCB24-3	2L1	→	Power indicator HL3
6	MCB24-4	2L3	→	
7	MCB25-1	L4	→	Closing indicator HL2

Serial number	Name	Starting point	Orientations	Endpoint
8	MCB25-2	L6	→	
9	MCB25-3	L7	→	Closing indicator HL4
10	MCB25-4	L9	→	
11	MCB-B1	1L1,1 L2, 1L3	→	SPD1
12	MCB-B2	2L1,2 L2, 2L3	→	SPD2
13	MCB21-1	1L1	→	PMM1 V1
14	MCB21-2	1L2	→	PMM1 V2
15	MCB21-3	1L3	→	PMM1 V3
16	MCB21-4	2L1	→	PMM2 V1
17	MCB21-5	2L2	→	PMM2 V2
18	MCB21-6	2L3	→	PMM2 V3
19	MCB26	XRDC 1		Cooling fan 24V+ in cabinet A
20	MCB15-1, 2, 3, 4, 5,6,7,8			Switchboard switch on A side
21	MCB1-1, 7-22			A-side high-computing power server switch

Table 7.3 Functional description of switches in switchgear cabinet B for water-cooling container systems

Serial number	Name	Starting point	Orientations	Endpoint
1	MCB-A3	1L1, 1L2, 1L3	→	Main female rows L4, L5, L6
2	MCB-A4	2L1, 2L2, 2L3	→	Main female L7, L8, L9
3	MCB27-1	1L1	→	Power indicator HL1
4	MCB27-2	1L3	→	
5	MCB27-3	2L1	→	Power indicator HL3
6	MCB27-4	2L3	→	
7	MCB28-1	L4	→	Closing indicator HL2
8	MCB28-2	L6	→	
9	MCB28-3	L7	→	Closing indicator HL4

Serial number	Name	Starting point	Orientations	Endpoint
10	MCB28-4	L9	→	
11	MCB-B3	1L1,1 L2, 1L3	→	SPD3
12	MCB-B4	2L1,2 L2, 2L3	→	SPD4
13	MCB22-1	1L1	→	PMM3 V1
14	MCB22-2	1L2	→	PMM3 V2
15	MCB22-3	1L3	→	PMM3 V3
16	MCB22-4	2L1	→	PMM4 V1
17	MCB22-5	2L2	→	PMM4 V2
18	MCB22-6	2L3	→	PMM4 V3
19	MCB29	XRDC 1		Cooling fan 24V+ in B cabinet
20	MCB16-1, 2, 3, 4, 5,6,7,8			Switchboard switch on B side
21	MCB8-1, 14-22			B-side high-computing power server switch

2) Precautions for the first power-up of the system

After the wiring of the whole system is completed, use an insulation shaking table multimeter to test the phase-to-phase and ground-to-ground insulation without problems before the equipment can be energised for commissioning. If any of the above short-circuit conditions exist, the fault should be checked before powering up the system. After the front-end of the system is powered up (the system itself has not been powered up, the main switch of the distribution cabinet, the main control cabinet switch is not closed), it is also necessary to measure the voltage of the front-end to see if it meets the power requirements of the equipment.

The device's power requirements are: 400V ± 5%, AC 50/60Hz.

Danger

Before connecting the entire system to the output circuit of the front-end transformer (substation), a multimeter is required to measure whether there is a short circuit between the phase lines and between the input A/B distribution cabinets, between the phase lines and the neutral line, between the phase lines and the ground line, and directly between the neutral line and the ground line. If the resistance value is not ", the short circuit must be checked before powering on, otherwise there is a risk of short circuit explosion and electric shock in the system.

Danger

Before power on the need for withstand voltage value, insulation resistance and grounding resistance value test, meet the requirements before power on, the reference values are as follows.
Withstand voltage: use voltage tester to test the leakage current between each phase line and between phase and ground at the power input of the equipment, test voltage AC1500V, test time 30s, leakage current ≤ 10mA.
Insulation resistance: use a shaking table to test the insulation resistance between phase lines and between phase and ground at the power input of the equipment, with a test voltage of DC500V and an insulation resistance of ≥10MΩ.
Grounding resistance: use the grounding resistance tester to test the equipment grounding and equipment outside the grounding stud resistance, test results ≤ 0.1Ω.

3) System power-up sequence

Once the front end of the system is powered up and the voltage meets the requirements of the device, the system can be powered up at this point.

a) Firstly power up the main control cabinet

When the main control cabinet door is opened, the QFWCU is turned on first, and then all switches in the main control cabinet are turned on. The switches are defined in Table 7.1.When power is applied, the screen on the cabinet door and the PLC begin to operate.

When the main control cabinet door is closed and the system needs to be energized, all micro-switches and the two molded case switches QFGL01 and QFGL02 inside the cabinet are switched on, then the door is closed and the QFWCU is switched on via the door operating handle. At this point, the unit is energized.

A trained electrician can operate the system via the touch screen to set parameters, modify thresholds, change the mode of operation (auto/manual), start and stop a motor individually or run it automatically. At this point, the water-cooling system can be run to keep the fluid supply temperature within the required

temperature range before the conditions for switching on the high-calculation server are met.

b) Power-up of switchboard

After the main control cabinet is powered up, the conditions for powering up the high-calculation server are met when the fluid supply temperature is maintained near the target temperature in accordance with the control system operating procedures. At this time, you can open the switches in the distribution cabinets A and B to start powering up the high-calculation server.

Turn on MCB-A1, A2, A3 and A4 first, then turn on the other micro break switches, and then start the rows of high-calculation servers in an orderly manner as required. As there are 308 high-calculation servers in total, there are 14 rows. When starting the high-calculation servers, you should start one row and then start the next row after an interval of 20S, and so on. It is important to avoid starting a large number of servers in a short period of time.

Caution

Refer to Table 7.1 for device and switch bit number correspondence.

4) System power-down sequence

When the system is to be disconnected for some reason, the power supply of the high-calculation server is first disconnected according to the requirements, in order to ensure that the water temperature is the same before and after the disconnection of the high-calculation server, which is equivalent to the protection of the high-calculation server's power supply module. When the high-calculation server power failure, a delay of 20 seconds, and then artificially through the touch screen to make the water-cooling system to stop working, at this time the water temperature may rise a little bit, but the system has no effect. Finally, disconnect the main power supply of the main control cabinet and power distribution cabinet, so that the whole system is in a complete power failure.

The above practice is the behavior of safe power failure. However, when there is a serious fault in the system, you can directly press the emergency stop button on the door of the container, so that the main switch of the distribution cabinet is tripped instantly, and the main switch of the main control cabinet is tripped after a delay of 5S,

so that the system is in a state of complete power failure, which is convenient for the professionals to carry out overhaul work.

Danger

In case of emergency, please press the emergency stop button on the front of the distribution cabinet, the emergency stop button on the top of each distribution cabinet controls the power supply of this distribution cabinet, when pressed, this distribution cabinet will be powered off, but the switchboard, the lightning protector, the meter display will not be powered off, the operation of opening the door panel must be a professional person.

Caution

Pressing the emergency stop, before re-energizing after troubleshooting, it is necessary to release the emergency stop switch by rotating it clockwise, the main switch of the distribution cabinet, and the main control cabinet switch will be moved to the OFF position first before reclosing the gate.

5) Personnel interfaces

General Operations and Maintenance Staff Duties: General power-up , and power down work (disconnecting or merging switches), system power-up and shutdown (touch screen button operation), network cable testing and swapping.

Duties of professional electricians: general power up and down work (disconnecting or combining switches), system start-up and shutdown (touch-screen key operation), network cable detection and replacement, when the equipment has a short-circuit, phase loss, phase reversal, no display of sensors, no response from the corresponding equipment after the switch is closed, and the motor does not work properly, it is necessary to rely on the operation of the professional electricians.

7.6 Touch Screen Operation Instructions

Danger

Note: It is strictly prohibited to plug and unplug the communication cable between the touch screen and PLC with electricity, otherwise it will cause damage to the touch screen or PLC communication serial port!

Caution

The touch panel operation password is "1000".

1) Initial screen

After powering up the system, the initial screen display is shown in Figure 7.18.

Figure 7.18 Initial power-up screen

After confirming that the USB stick has been inserted, enter the main interface.

Figure 7.19 Control Main Screen

The screen displays the unit control modes "Auto/Manual", "Local/Remote", target temperature, total fault display and analogue display. The system allows you to set the unit's operating control mode from the main screen.。

The screen is divided into A-side system monitoring area, B-side system monitoring area and public area.

2) Main screen

In dry cooling tower mode, manual control is used for commissioning and

automatic control is used for system operation.

Click "Auto A/Auto B" button, the A/B system enters the manual control screen.

Click "Manual Control" button to enter manual control screen.

Click the "Parameter Setting" button to enter the parameter setting screen.

Click "Instrument Setting" button to enter the instrument setting screen.

Click "Alarm Display" button to enter the fault alarm screen.

Click "History Alarm" button to enter the history alarm screen.

Click "Data Record" button to enter the data information screen.

Click the "Power and Positioning" button to enter the power and positioning information screen.

Remote control mode can only be effective when the unit is in automatic mode and has a lower priority than local control.

3) Manual control screen

When the equipment needs to add liquid debugging, you need to adjust the equipment control mode to the "manual" position, and then enter the "manual control" screen, the manual control interface is divided into the A-side system, the B-side system and the public area as follows:

Figure 7.20 Manual Control Screen

At this point, the motor and inverter to be operated can be started on demand. Generally, when the system needs to add liquid, it is necessary to manually start and correspond to the motorized valves, replenishment pumps and circulation pumps. However, before starting, it is necessary to ensure that the motor is running in the

correct direction.

Therefore, after powering up the system, switch on the G03 and G04 exhaust fans and observe their direction of operation. When the wind is pumped out of the container, it indicates positive rotation. Before the equipment leaves the factory, all motors have been commissioned and are running positively. Therefore, it is only necessary to observe the running status of one motor. When the motor reverses, it is necessary to phase adjust the three-phase power input of the QFWCU, i.e., change the phase sequence of the two cables.

4) Parameter setting screen

The parameters have been set in the system and the interface is divided into A-side, B-side and common areas.The screens are as follows (will be shown in the real screen):

Figure 7.21 Parameter setting screen

After the unit is switched on, the above parameter values have been set to the initial default values. The first time the unit is switched on, it is necessary to check whether the parameter settings are reasonable or not, and if there is any inappropriateness, it can be reset. Through the parameter setting interface, you can manually set the automatic liquid replenishment parameter, V001 electric butterfly valve opening degree, container fan operation parameter and dry cooling tower fan operation parameter. In addition, through the keys in the manual replenishment box in the parameter setting interface, manual replenishment can be carried out for different working conditions of the system.

5) Table Setting Screen

Figure 7.22 Schematic diagram of the meter setup interface

The instrument setting interface is also divided into A-side and B-side areas, as well as the public area. Alarm thresholds for supply and return liquid temperature, supply and return liquid pressure, flow rate, temperature in the main control cabinet, temperature in the distribution cabinet and differential pressure on the cold side can be set through the instrument setup interface, and the parameters will revert to the factory settings the first time the system is switched on. If modification is required, please ask the operation and maintenance personnel to judge the possible problems before modification, and confirm that the parameters can be modified to a certain extent without affecting the operation of the system. This interface contains clock setting, system time can be calibrated here.

6) Alarm display screen

Once the system is running, if there is a fault in the system, it will be displayed in 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 analyses the cause of the fault, then troubleshoot the fault, and finally click "Reset" on the manual control screen.

Figure 7.23 Alarm Display Screen

7) Alarm history screen

Alarm information in the system will be saved in this screen through the time record, which is convenient for users to find the time of failure.

Figure 7.24 Historical Alarms Page (Example)

8) Data curve screen

This interface has three sub-interfaces, which can display information such as supply and return liquid temperature curve, supply and return liquid pressure curve, and supply and return liquid flow curve respectively. Each parameter corresponds to a different color.

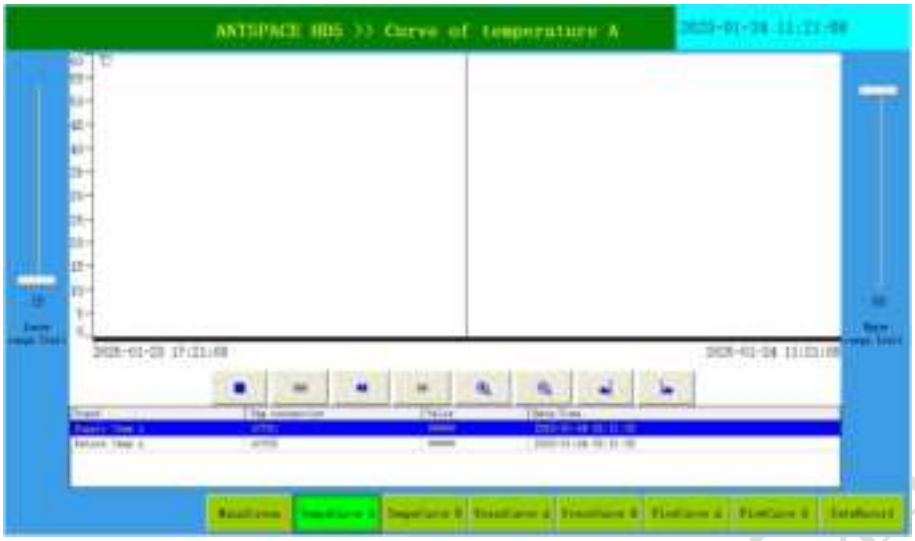


Figure 7.25 Temperature profile

Figure 7.26 Pressure curve

Figure 7.27 Flow curve

9) Power and Positioning Screen

The screen displays the ambient temperature in the three cabinets, power quality information for the two distribution cabinets with a total of four power sources in use, and latitude and longitude information for the equipment. Among them, the power information and latitude and longitude information is used for debugging and display, and the reading format is floating point type.

Figure 7.28 Power and Positioning

10) Automatic control mode

When the A or B side of the system needs to run automatically, you must ensure that the pressure (PT01/PT02) in the system is higher than 0.05MPa, and then set all the parameters in the parameter setting screen. Then click "One Key Start" in the main screen, the motors in the system will be executed according to the automatic control logic sequence. To shut down, click "One Key Stop" in the main screen.

The specific steps for switching from manual mode to automatic mode are as follows (using System B as an example):

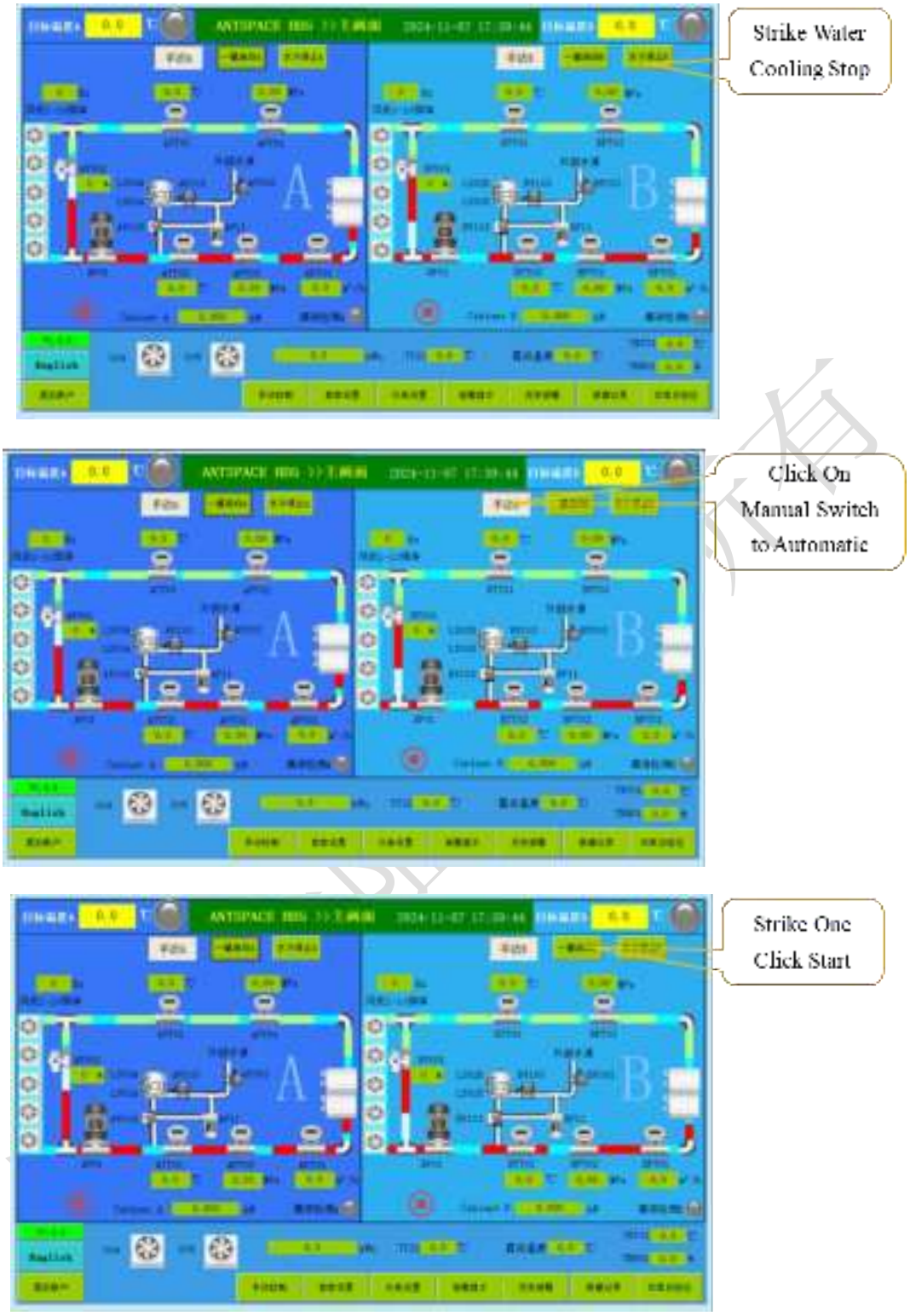


Figure 7.29 Manual Mode to Automatic Mode Operation Procedure

7.7 Summary of On-Site Installation

1) Summary of on-site installation

When the equipment arrives at the site, it is necessary to install the equipment in

accordance with Table 7.4. After the installation is completed, you can change the control mode to "automatic", click "one key start", and the system will run automatically.。

Table 7.4 Summary of Field Installation Steps

Serial number	Step content	Note
1	Container and dry-cooling tower on-site location positioning, lifting and installation	Remove the container fan baffle, the baffle around the dry cooling tower and the fan baffle. Position the container and lift it into place. Using the pipework connection as a reference, lift the dry cooling tower to the top of the container and lock it with a twist lock.
2	Container and dry cooling tower intermediate connection piping installation	The pipeline is installed correctly, sealed well and without leakage.
3	Container and dry cooling tower power distribution work	Reasonable alignment, standardized wiring, torque calibration, power-on test.
4	Container pressurization operation	No leakage after 7bar/12h gas test and 7bar/30min gas-liquid test.
5	Container liquid filling operation	Preparation - system refill - tank refill - regular refill

2) On-site installation inspection

After the installation of the unit is completed, the following items need to be verified and fully qualified before powering up and switching on the unit.

Table 7.5 Installation completion checklist

Inspection items	Inspection content	Confirmation options
Containers	The container is installed in accordance with the installation requirements and is not tilted.	☐confirmed
Dry Cooling	The container is placed on a horizontal hard surface with space for installation and maintenance.	☐confirmed
Plugs	Sundries (e.g. cable ties, wires) inside the container have been removed.	☐confirmed
Rain Shield	The cables of 20 fans of the dry cooling tower are plugged in without any error, and the fans are not.	☐confirmed
Pipe Connections	There is no error in the plugging of water curtain cables.	☐confirmed
Circuit Connection	Container internal and external blocking structural parts, fixed parts have been removed, no sundries inside.	☐confirmed
Inlet and outlet pipes	The rain cover is correctly installed above the inlet, and the rainproof cloth is correctly installed.	☐confirmed
Electrical inspection	The clamps and pipe clamps of the refill port are fixed reliably.	☐confirmed

8 Routine Troubleshooting and Troubleshooting

8.1 Container Troubleshooting

Table 8.1 List of common faults and troubleshooting methods in the equipment section

Type of fault	Analysis of causes	Method settle an issue	Note
Power failure	1： Break phase	1： Check whether there is a lack of phase in the main power supply.	
	2：Over voltage	2: Turn off the air switch QFWCU (in the main control cabinet) of the previous level, ensure that the main control cabinet is not charged, and adjust the over-voltage value with a flat screwdriver (the factory setting value is +10%).	The reason for this situation is that the overvoltage and undervoltage values of the power monitor were not adjusted before the equipment was shipped from the factory, or the set values do not match the actual values in the field.
	3: Undervoltage	3: Switch off the upper air switch QFWCU (in the main control cabinet), make sure that the main control cabinet is not charged, and then use a flat screwdriver to reduce the undervoltage value (factory setting is +10%).	
	4：Wrong phase	4: Adjust the phase sequence of the power distribution cabinet into the main control cabinet power line.	
Low level alarm	Low level of water tanks in containers	Refilling of water tanks in containers	

Type of fault	Analysis of causes	Method settle an issue	Note
Circulation pump fault	Circulation pump overflow due to pump idling, under pressure (low return pressure), etc.	1: Turn off the air switch (QFWCU) in the main control cabinet first; 2: Reset the frequency converter (corresponding to the number VF01) inside the main control cabinet (manually press the RES button of the frequency converter); 3: Check if the system operating parameters are normal (pressure and flow will report faults first), and troubleshoot the problem based on the alarm faults; 4: Turn on the circulating pump again after 2-3min interval.	WARNING: Circulation pumps are prohibited from running at idle when the system is powered up and there is no liquid in the system.
G03/G04 exhaust fan fault	Exhaust fan current is too high, the fan blade may be entrapped with strips, hindering the operation of the fan.	1: Turn off the air switch (QFWCU) in the main control cabinet first; 2: If there is debris in the fan blades, clean out the debris first; if there is no debris and the fan fails for no reason, you need to contact the manufacturer; 3: Then reset the motor protectors (QFG04 for exhaust fan 1 and QGF05 for exhaust fan 2) inside the main control cabinet (manually turn the knob of the motor protector to the vertical position to close); 4. After troubleshooting, Switch on the exhaust fan again after an interval of 2-3min.	
Replenishment pump failure	1: Dirty and clogged refill Y-filter leads to overloading.	1: Turn off the air switch (QFWCU) in the main control cabinet first; 2: Reset the motor protector (corresponding to the number QFG11) inside the main control cabinet (manually turn the knob of the motor protector to the vertical position, which	After the system is powered up, the charge pump cannot idle without liquid in the

Type of fault	Analysis of causes	Method settle an issue	Note
		is the closing); 3: Clean the Y-filter; 4: After troubleshooting, Switch on the refill pump again after an interval of 2-3min.	system.
	2：Refill pump suction port position is too low leading to overloading.	1: Turn off the air switch (QFWCU) in the main control cabinet first; 2: Reset operation of the motor protector (corresponding to No. QFG11) inside the main control cabinet (manually turn the knob of the motor protector to the vertical position, i.e. close the gate); 3: Make the external suction port lower than the coolant drum; 4: After troubleshooting, Turn on the charge pump again after 2-3min interval.	After the system is powered up, the charge pump cannot idle without liquid in the system.
Leakage alarm	Liquid leaking from inlet and outlet ports of high-calculation servers onto the floor, soaking the leakage sensors.	1: Look for areas on the floor where there is liquid; 2: Above that area, look carefully for fluid leaking out of the inlet and outlet ports of the high-calculation server; 3: After finding the liquid leakage site, take the way of changing the quick plug and bellows to deal with it, then clean up the liquid leakage site and dry the liquid leakage monitoring tape.	
Alarm for high temperature of liquid supply	1: Dry cooling tower cooling fan not running.	Check that the dry-cooling tower fan is operating correctly and is turning correctly. Check whether the power supply circuit of the fan is normal.	
	2: Temperature sensor damaged.	Replace the temperature sensor; the high supply temperature alarm value can be set in the screen as required.	

Type of fault	Analysis of causes	Method settle an issue	Note
Alarm for high temperature of liquid supply	After the alarm of high temperature of liquid supply appeared, the operation and maintenance personnel did not deal with it in time, which led to the rising temperature of liquid supply.	Until the cause is identified, consider shutting down some of the high-computing power servers to reduce the load, and then look for the cause of the high fluid supply temperature alarm.	
High supply pressure alarm	1：Filter clogging	The high fluid supply temperature alarm value can be set in the screen as desired.	
	2: supply and return liquid valve failure or not fully open.	Clean the filter cartridge.	
	3：Pressure sensor failure	Open the supply and return valves.	
Low return pressure alarm	1：Lack of liquid in the water tank	Refill the water tank.	
	2：Refill pump failure	Check the cause of the charge pump failure.	
	3：Pressure sensor failure	Replace pressure sensor.	
	4：Leakage	Check system leaks.	
Low flow rate alarm	1：Failure of supply and return valve or not fully open	Open the supply and return valves.	
	2：Filter is dirty and clogged	Clean the filter cartridge.	

Type of fault	Analysis of causes	Method settle an issue	Note
	3: Flow sensor failure	Replace flow sensor.	
	4：Leakage	Check system leaks.	
Condensation alarm	Higher ambient humidity	Once the field O&M sees the alarm message, they only need to increase the fluid supply temperature target by 5˚C to prevent condensation from occurring.	The logic set in the programme is: when the dew point temperature value > supply liquid temperature value -5˚C, then the system prompts a condensation alarm.
Pressure display fluctuates	1: Air in the system	Please ask the on-site operation and maintenance personnel to open the exhaust valve for exhausting.	
	2：Lack of fluid in the system	If the return pressure is lower than the set value, the replenishment pump will automatically replenish the system.	
	3：Damaged sensor	Replace the sensor.	
No pressure display	1：Damaged sensor	Replace the sensor.	
	2: Loose cable	Check the wiring circuit of the pressure sensor and tighten it.	
	3：PLC acquisition channel is damaged	Replace the PLC module corresponding to the sensor.	
Pump running with	1：Air in the pump suction	Use a spanner to open the exhaust port above the suction port of the pump,	

Type of fault	Analysis of causes	Method settle an issue	Note
insufficient flow	port	wait until there is an even flow of liquid, repeat 2-3 times (refer to the use of maintenance instructions for specific operations).	
	2: Filter clogging	Clean the filter cartridge.	
	3：System lack of liquid (low return pressure)	Replenish the system.	
Fan not running	1：Motor burnt out	Replace the fan.	
	2：Loose cable	Check the power supply of the fan with a multimeter and fasten it under power failure.	
	3：Air switch tripped	Close the air switch.	
Noise and rattling	1: Pump cavitation	Check the pressure on the suction side (return pressure or pressure gauge) and replenish the fluid in time.	
	2: Pump shaft connection problems	Check the mechanical connection of the pump shaft.	
	3：Insufficient lubrication of the motor shaft	Add lubricant.	
	4：Safety valve action	Check if there is too much liquid in the tank to relieve the pressure in time, drain the excess liquid from the tank.	
Pump shaft seal		Replace the pump shaft seal.	

8.2 Dry Cooling Tower Routine Fault and Troubleshooting Methods

1) Troubleshooting of dry cooling tower

Product common failure phenomena, analysis and treatment methods, as

shown in Table 8.2.

Table 8.2 Dry cooling tower fault analysis and treatment

Fault phenomenon	Possible causes	Inspection or repair
Fan won't start	1：Motor burnt out	Replacement of fans.
	2：Loose cable	With power on, use a multimeter to check the power supply to the fan and tighten with power off.
	3：Molded case circuit breaker tripped	Close the molded case circuit breaker (QFVF02 for A# dry cooling tower, QFVF03 for B# dry cooling tower).
	4：Inverter failure	1: T Reset the frequency converter inside the control cabinet of the dry cooling tower (A corresponds to VF02, B corresponds to VF03) by manually pressing the frequency converter reset RES button; 2: Check if the system operating parameters are normal, and troubleshoot the problem based on the alarm malfunction; 3: After troubleshooting, Turn on the fan again after an interval of 2-3min in.
	5：Fan overload	1: Turn off the molded case circuit breaker (QFVF02 for A# dry cooling tower and QFVF03 for B# dry cooling tower) in the main control cabinet first; 2: Reset the motor protector inside the control cabinet of the dry cooling tower (manually turn the knob of the motor protector to the vertical position, i.e., close the circuit breaker); 3: After troubleshooting, Switch on the fan again after an interval of 2-3min.
Dry cooling tower disconnected	Loose or damaged disconnected network cable plugs	Check the mesh cable, tighten the mesh port plug or replace the cable.

Fault phenomenon	Possible causes	Inspection or repair
No or poor cooling	Dirty heat exchanger fins	Clean the heat exchanger.
	Insufficient system flow	Clean the filter.

Caution

1. Some circuits of the dry cooling tower system have fatal high voltage, which only allow professional technicians to carry out maintenance operations.
2. When using jumper cables for troubleshooting, always remember to remove the jumper cables when maintenance is complete. Connected jumpers that are left behind may affect control functions and cause equipment damage.

Warning

The unit carries a high voltage. Disconnect the power supply before servicing the inside of the unit. The externally connected power cable may become energized when the unit's air switch is turned off.

2) Winter Frost Maintenance

Dry-cooling towers require special maintenance attention at low winter temperatures.

Some cooling towers are in the low temperature of ambient temperature ≤ 5 ˚C, the circulating system, if not antifreeze, the system is not running for the time being, it is necessary to manually open the drain valve at the bottom of the collector pipe at the end of the dry cooling tower, drain the water in the heat exchanger, to prevent the heat exchanger and pipes from freezing and cracking, and at the same time, it is recommended to drain the water from the pipe, and then rinse it with antifreeze once, to make sure that there is no residual water in the tube, to ensure that there is no icy cracks in the tube. At the same time in the ambient temperature, the system operation cooling fluid must be antifreeze to prevent the cooling fluid from freezing.

Danger

If it is necessary to move the whole unit from a high-temperature area to a low-temperature area, it is necessary to manually open the drain valve at the bottom of the collector pipe at the end of the dry-cooling tower to drain the liquid from the unit, otherwise the heat exchanger and piping will be at risk of freezing and cracking and damage.

3) Dry cooling tower fan replacement

Dry cooling tower fan replacement must be qualified professional and technical personnel to operate, the operation steps are as follows:

a) Switch off the mains power supply.

b) Disassemble the junction box on the top of the fan and remove the fan power input cable.

c) Remove the fastening bolts on the fan mounting plate.

d) Maintenance or replacement of fan and mounting plate assemblies.

e) After maintenance, follow the steps in reverse order to reinstall the fan in place. Mounting torque 13 N·m.

f) Connect the power input line of the original fan to the junction box on the top of the new fan, the tightening torque of the junction box is 2.6N-m, and the locking torque of the wave pipe is 4 N·m.

g) Re-energies and check that the fan is rotating properly.

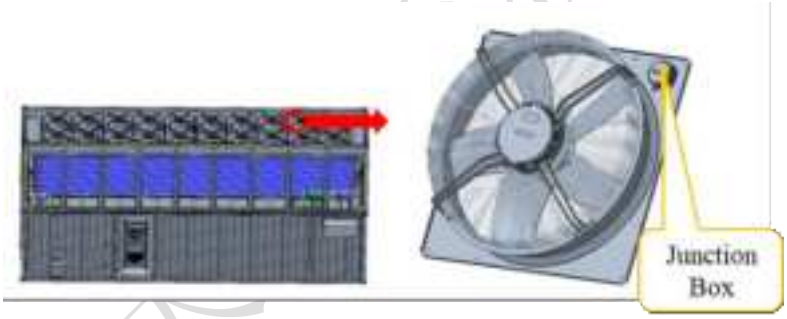


Figure 8.1 Schematic diagram of dry cooling tower fan replacement

Danger

Replacement of wind turbines is an elevated operation that requires elevation qualifications and, when carried out, requires elevation climbing ladders and protective equipment that meets local codes of practice for elevation work.

4) Automatic air vent valve replacement

The procedure for replacing an automatic air change valve is as follows:

a) Close the service ball valve at the front of the automatic air venting valve.

b) Unscrew the automatic air vent with a tool for maintenance or replacement. Make a good thread seal on the exhaust valve link.

c) After maintenance, follow the steps in the opposite direction to reinstall the automatic air venting valve with a torque of 4N·m；

d) restart the equipment, check whether the exhaust valve can be used normally, if there is leakage, need to be reinstalled until there is no leakage.

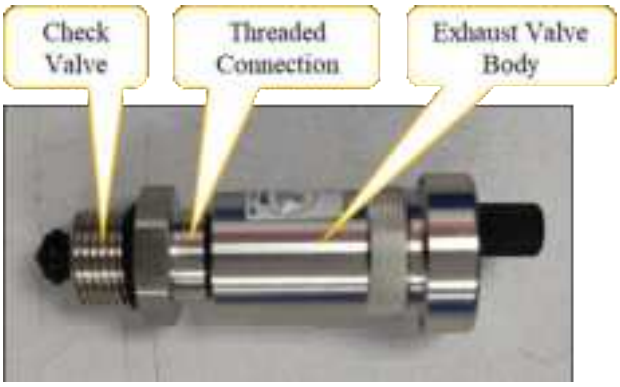


Figure 8.2 Schematic diagram of automatic exhaust valve replacement

9 System Maintenance and Servicing

9.1 General

Preventive maintenance is maintenance carried out at predetermined intervals or in accordance with prescribed guidelines in order to reduce the probability of product failure or prevent functional degradation, mainly including adjustments, periodic inspections and necessary repairs. It enables equipment maintenance and operation personnel to be familiar with product performance, structural principles, use methods and precautions, so that the equipment can perform its proper function.

Improve the maintenance to ensure that the equipment is in good working condition.

9.2 Preventive Maintenance

1) Operator monitoring

The operator monitors the status of the equipment during normal use with the aim of detecting potential faults.

Once the operator finds that the system has a fault alarm, it should be necessary to quickly confirm the fault, check and find out why the fault occurred.

2) Utilization check

Operators perform scheduled periodic inspections during normal use of the equipment to determine if the product is performing the specified function.。

a) Check that the connections of the supply and return lines, power lines, etc. are intact.

   Inspection requirements: no leakage of pipelines and connections, no damage to the cable.

   Inspection method: visual.

b) Check whether the return pressure (back pressure) is low or high, and replenish or drain the liquid in time.

   Inspection requirements: the return pressure value is higher than 0.05MPa or more and the supply pressure is lower than 0.4MPa (observe the main interface

of the touch screen or the pressure gauge), if the return pressure is lower than 0.05MPa, it is necessary to replenish the liquid; if the supply pressure is higher than 0.4MPa, it is necessary to drain the liquid to reduce the risk of system operation.

Inspection method: visual, data comparison.

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

Inspection requirements: Record the supply/return temperature, supply/return pressure, and supply flow rate data, and observe whether the data are stable in long-term operation.

Inspection method: visual, data comparison.

d) Check the system fault alarms such as: temperature, pressure, flow, etc. (the above fault status in the touch screen "fault alarm screen" display), and to do so every half-day record once.

Inspection requirements: check the system alarm points, refer to the instruction manual guidance for troubleshooting.

Inspection method: visual, on-demand.

e) Check the reliability of cable connections in A/B distribution cabinets, main control cabinets and junction boxes of dry-cooling towers after normal operation of containers, which is required for the first time of operation or the first time of operation after relocation, and every six months under normal operation.

Inspection requirements: check whether the cable lap joints are tight, whether there is abnormal temperature rise.

Inspection methods: visual, handheld infrared detector to check the lap joint temperature is abnormal, when the temperature exceeds 70 ˚C or 30 ˚C higher than the ambient temperature, it is necessary to check and re-tighten the connection point.

Danger

When the equipment is found to have an abnormal temperature rise or other abnormal phenomena, it must be shut down for troubleshooting to prevent overheating of components causing equipment burnout or fire accidents, and it is prohibited to turn on the machine before the problem is troubleshooted.

9.3 Periodic Inspection of Containers

1) Filter maintenance

System circulating medium for the coolant, the system is set up to filter the circulation of the filter, when the system runs for a period of time after the need to clean the filter.

Filter cleaning time requirements are as follows:

a) The circulating pipeline filter of the liquid supply system of the pumping unit, located at the liquid outlet of the dry cooling tower, should be cleaned once a month (or as required), and it is recommended to clean the filter once in 72 hours after the first commissioning, so as to prevent the filter from being clogged by the coolant and the impurities in the system.

The steps for filter cleaning and replacement are as follows:

a) Disconnect the main power supply to the equipment；

b) Find the service butterfly valve in the system in Figure 9.1 and close it, open the drain ball valve under the pipeline filter assembly, and drain the pipeline locally.

Caution

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

c) Once the filter is located, open the manual air vent and manual drain valves, remove the clamp connections and take the pipe filter cartridge out of the handle.

d) Remove and clean (or replace) the filter screen inside the filter, refer to Figure 9.2.

e) Fit the cleaned filter and tighten the clamp with a spanner and close the valve.

f) Fill the system recharge tank with coolant when the equipment is re-powered.

Caution

Coolant discharged from the strainer cannot be added directly to the make-up tank.

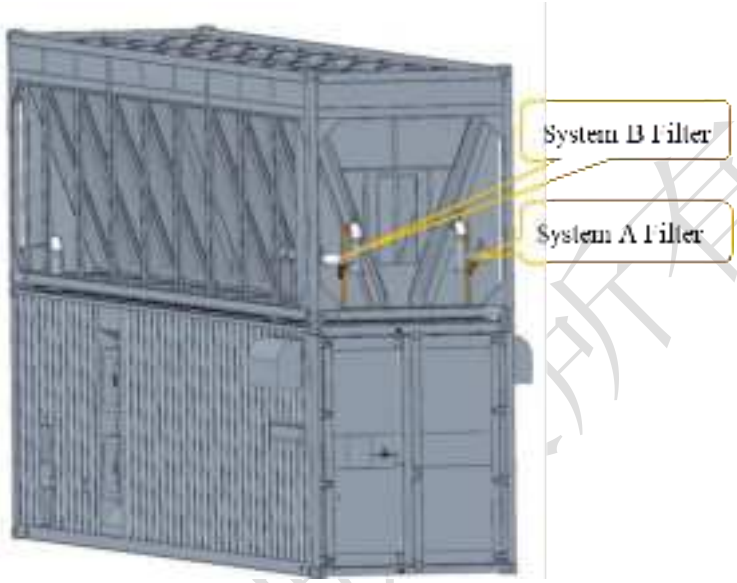


Figure 9.1 Pipeline Access Butterfly Valve and Pipeline Filter Location

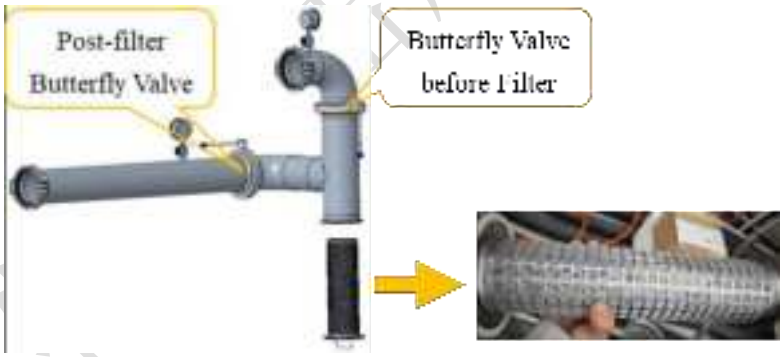


Figure 9.2 Schematic diagram of pipeline filter removal and cleaning

2) Leakage maintenance of pipelines

When the equipment is running for half a year, the pipe network should be inspected for semi-annual leakage prevention fluid, if any leakage or leakage is found, it is necessary to stop the machine immediately for overhauling. Inspection should first stop the user end load device operation, and then stop the equipment operation for repair. At the same time, after the completion of leakage inspection, pay attention to the system to replenish the liquid.

3) Maintenance of electrical components

After half a year of operation of the equipment, it is necessary to check and maintain the wiring terminals and pressure screws on the electrical components in the main control cabinet inside the pump cabinet, in order to prevent the loosening of the wiring terminals and pressure screws, resulting in poor contact, damage to the components and the equipment can not be operated normally, thus affecting the work of the entire water-cooling container system.

Caution

Daily operation check needs to pay attention to the system operation whether there is abnormal noise, abnormal reading display, system operation alarm message. If there are any abnormalities timely eliminated.

4) System Sewage

After 1-2 years of operation of the system and water tank, there may be some debris in the system piping, the system coolant should be discharged and replaced in a timely manner.

Caution

The system operates with about 2200L of coolant, so please prepare enough storage volume in advance.

The steps for decontamination are as follows:

a) Locate the drain ball valve (see Figure 9.3).

b) Connect the drain hose to the drain ball valve and tighten with the hose clamp.

c) The system can be drained by leading the hose to the outside of the unit and opening the two drain ball valves (Figure 9.3).

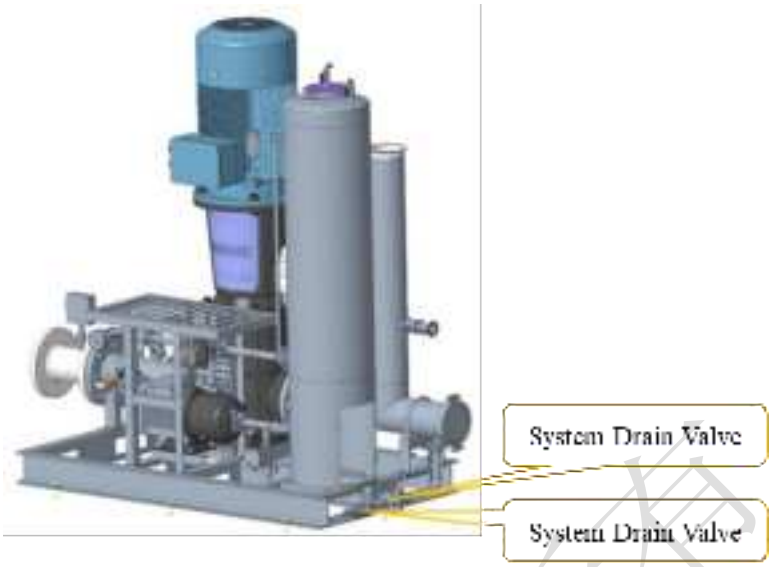


Figure 9.3 Pump Station Drain Ball Valve Location

d) When the dry cooling tower is discharged, a hose can be connected to the discharge port and the discharge ball valve (Figure 9.4) can be opened to discharge the dry cooling tower. There are 4 discharge valves in the dry cooling tower.

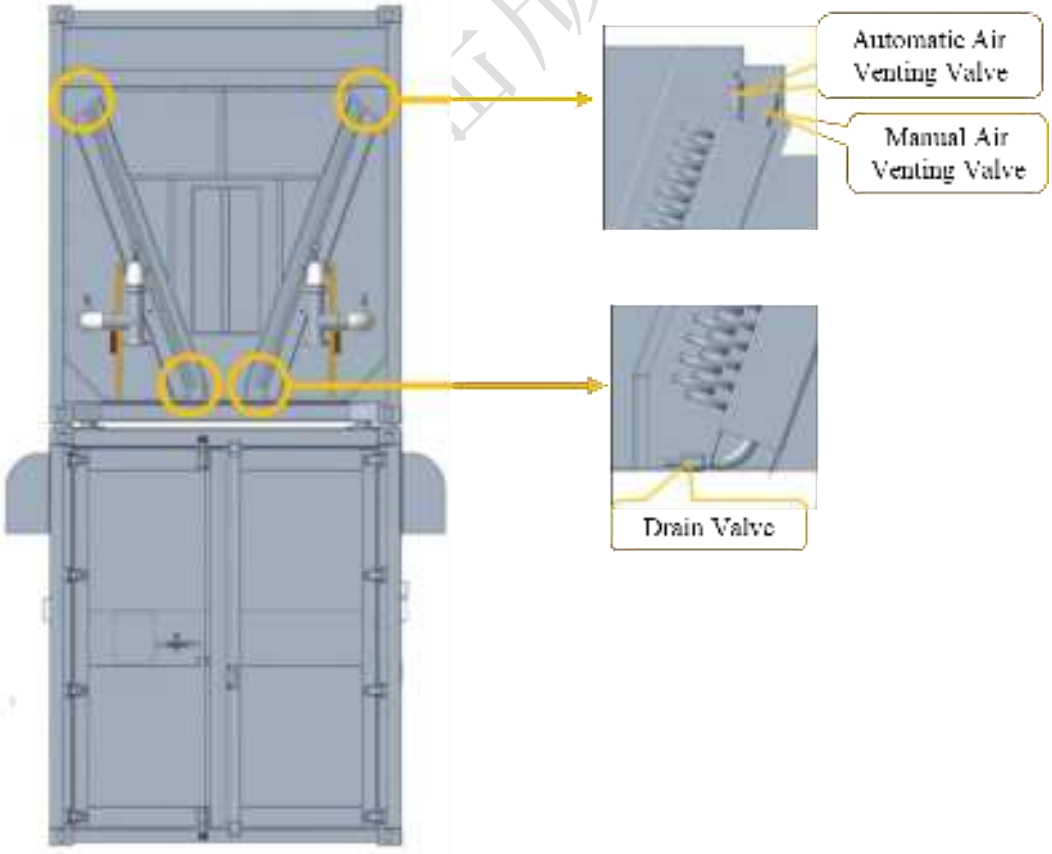


Figure 9.4 Dry cooling tower liquid release ball valve location

5) Tank level check

The system for the two tanks (A system and B system) level are monitored, when the tank level is lower than the required value, the system touch screen will be alarmed to indicate that the tank level is low, at this time you should check for faults in a timely manner and replenish the liquid; but even if the tank level is not alarmed should be checked regularly: the level of water tanks in the container requires stable operation once a week to check the tank is not up to 2/3 of the place, you need to replenish the liquid in time.

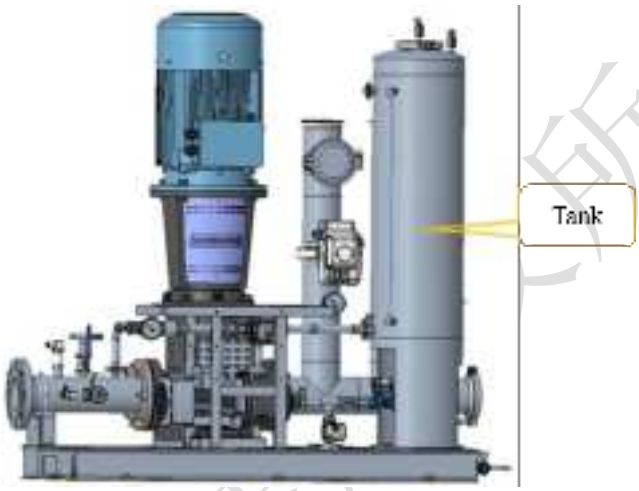


Figure 9.4 Containerized water tanks

6) Coolant Maintenance

a) Coolant, as the core unit in a water-cooling container system, is recommended to be tracked and recorded on a regular basis, at least once a year (PH is tested every six months).

b) Coolant procurement needs to focus on the relevant parameters in Table 9.1, and replenishment and replacement should be considered as appropriate when the requirements are not met.

c) regular testing of the coolant focuses on the PH value, when the PH value is lower than 7 is not recommended (you can add PH indicator in the coolant, when the PH is lower than 6.8, the coolant will change color, easy to observe); test method see the following table.

d) Coolant regular testing followed by attention to the freezing point, glycol ratio, total hardness, etc.; later to pay attention to Al, Fe, Cu and other elements such as whether the content of the rise, the rise means that the contact corrosion has

been produced; test methods are shown in the following table.

e) It is recommended that antifreeze be serviced by adding corrosion inhibitors at regular intervals according to the supplier's requirements.

Danger

Must be strictly in accordance with the lowest possible temperature of the environment to configure antifreeze, if not in accordance with the instructions required to configure antifreeze, the ambient temperature is below the freezing point of antifreeze, resulting in heat exchanger freezing cracks, the company does not assume any responsibility!

Table 9.1 Recommended standards for antifreeze

Sports event	Norm		Recommended testing reference standards
Colour	Remarkable colour		visual assessment
Appearance	No odour, no precipitation, no suspension		visual assessment
Freezing point	<Local minimum freezing temperature		
Boiling Point	108˚C (low temperature type)		
PH Value	7-9		
Reserve Alkalinity	⩾4ml (organic formula) ⩾9ml (with inorganic formulation)		
Total Hardness	<120 mg/l		
Major Element Content	B	<20mg/kg	
	Si	<20mg/kg	
	P	<20mg/kg	
	Mo	<20mg/kg	
	Ca	<20mg/kg	
	Al3+	<50mg/L	
	Fe2+	<50mg/L	
	Cu2+	<50mg/L	

Table 9.2 Glycol Refrigerant Concentration versus Freezing Point

Glycol concentration		Freezing point ˚C
Mass concentration in %	Volume	
0	0.0	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

Table 9.3 Recommended standards for deionized water

Norm	Deionized water	Reference standard	Instructions
PH	8.5-9.5	Intel 632983	
Sulphide	<1ppm	TC9.9/Intel 632983	
Sulphate	<10ppm	TC9.9/Intel 632983	
Chloride	<5ppm	TC9.9/Intel 632983	
Bacterial flora	<100 CFUs/ml	TC9.9/Intel 632983	
Total hardness (as CaCO3)	<20ppm	TC9.9/Intel 632983	
Conductivity	<20us/cm (reference value, not mandatory)	TC9.9	High conductivity is not necessarily unacceptable, e.g. 1000us/cm, as corrosion inhibitors and biocides will both lead to an increase in water conductivity, and the reasons behind the sharp increase in conductivity

Norm	Deionized water	Reference standard	Instructions
			trend during loop operation need to be understood.
Residue after evaporation	50ppm	TC9.9/Intel 632983	
Turbidity	<20 NTU	TC9.9/Intel 632983	
Iron content	0.1ppm	Industry Standards	
Copper content	10 ppb	Industry Standards	
Carbon steel corrosion rate	3mpy（0.075mm/a）	GB/T 50050-2017	
Copper or stainless steel corrosion rate	0.2mpy （0.005mm/a）	GB/T 50050-2017	

Caution

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

Caution

To ensure long term reliable operation, when deionized or purified water is used as the internal circulation medium, it is checked once every 1-2 weeks and the internal coolant needs to be replaced every 1-2 months.

Danger

When using deionized water as the internal circulation medium, please strictly follow the use of greater than 0 ℃ to use the environment, otherwise in the freezing point below, accidental power outages will lead to the system internal pipeline icing, resulting in pipeline blowout. The use of deionized water/pure water must be regularly tested coolant PH value, conductivity and related indicators and parameters and records, when exceeding the requirements of Table 9.3, or abnormal changes, must be replaced in a timely manner with new deionized water/pure water to meet the requirements.

For different concentrations of antifreeze, you can refer to the coolant ratio

method on BITMAIN's official website, which has labeled the basic parameters of the coolant. You can choose according to your own needs by comparing the parameter requirements on the official website.

BITMAIN Coolant URL:

https://shop.bitmain.com/product/detail?pid=00020240910144834316bANb9NFf067A

7) Maintenance of water pumps

Water-cooling container products supporting pump motor bearing maintenance instructions: in order to maintain the original performance of rolling bearings, as far as possible, in good condition for long-term use, must be in accordance with the specified time for the inspection and maintenance of bearings, in order to prevent failures, to ensure that the operation is reliable, improve efficiency and effectiveness. For water-cooling container product pump supporting three-phase asynchronous motor, the maintenance of motor bearings can be in accordance with this instruction for maintenance.

The current system of circulating pump products supporting the motor bearing type is shown in the following table:

Table 9.4 Bearing types

Model number	**Brand name**	**Bear**	**Refueling cycle confirmation**	**Grease type**
			polar logarithm 2P	
CDMF85-2-2 FSLSC	The South	DE:7310	2000h	Mobil SHC220
		NDE:6309		
BL90-2-2U	New Territories	DE:7310	2000h	Mobil SHC220
		NDE:6309		

To the South, the New Territories pumps as an example, specific filling maintenance please contact the manufacturer to confirm before filling.

Figure 9.4 Bearing picture

Danger

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

New Territories water pump bearing lubricating grease filling method refer to the following video link.

Enter the URL: http://100gs.shimge.com/wap/blbxgdjlxbwh_8/2.html

If replacing bearings, please refer to the video link below

Enter the URL: http://100gs.shimge.com/wap/blbxgdjlxbwh_8/216.html

Caution

Mixing different grades of grease will result in a large change in consistency. It is prohibited to mix different grades of grease. If other brands of grease are used, the motor bearings must be removed, and the original grease must be cleaned; or there is a danger of burning the motor bearings.

9.4 Maintenance and Servicing of Dry-Cooling Towers

1) Overview of Routine Maintenance

Routine maintenance is a kind of preventive maintenance, referring to the maintenance personnel in the normal operation of the equipment, periodic inspection and maintenance work, timely detection and elimination of alarms and faults in the equipment hidden danger.

The purpose of routine maintenance is to enable the equipment to operate stably for a long period of time, through routine maintenance.

a) Can timely find the equipment operation in the off fault, avoid further aggravation of the fault, to ensure the stable operation of the equipment.

b) Can detect potential faults in a timely manner, nip faults in the bud and avoid economic downtime losses after a fault occurs.

c) Be able to identify trends in equipment operation and implement targeted optimizations to improve the operational efficiency of the equipment.

The main considerations for routine maintenance are as follows:

a) Before starting the operation, please read the contents of the safety precautions and the product information carefully. Avoid accidents by complying with local

safety regulations and laws. The "CAUTION, WARNING, DANGER" items in each manual do not represent all safety precautions to be observed, but are only supplementary to the safety precautions in each operation. 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 operating the Company's products, the relevant equipment precautions and special safety instructions provided by the equipment company must be strictly adhered to. The safety warnings set out in the manuals represent only that part of the equipment company's knowledge, and the equipment company accepts no liability whatsoever for any breach of the general requirements for safe operation or for any breach of the safety standards for the design, manufacture and use of the equipment.

c) Most maintenance work must be carried out only after the unit has been powered off, and do not switch on the power during maintenance. For certain maintenance tasks that need to be carried out during operation (e.g. measuring current, pressure, temperature, etc.), make sure that the equipment is fully connected before switching on the power supply, and switch off the power supply immediately after the maintenance is completed.

d) Protective measures including but not limited to the wearing of insulated gloves and insulated shoes are required when carrying out electrical maintenance and in accordance with local regulations.

e) Please exercise caution when involving professional maintenance, and consult the Customer Service Centre for details.

Danger

The operation of heights is subject to the requirements of local safety regulations.

2) Dry Cooling Tower Heat Exchanger Fin Maintenance

Table 9.5 Monthly maintenance items for heat exchanger fins

Serial number	Inspection content	Concrete operation	Exception handling

Serial number	Inspection content	Concrete operation	Exception handling
1	Heat exchanger fins are dirty or clogged.	Check fin surface condition. (Recommended monthly inspection)	Dust accumulation is not serious enough to be cleaned with an air gun; more seriously dirty and clogged with a high-pressure water gun sprayed with water to rinse.

Heat exchanger fin cleaning method:

a) Disconnection of the dry cooling tower.

b) Before cleaning the heat exchanger fins, carry out professional cleaning machine debugging, so that the cleaning work is carried out properly.

c) Use professional cleaning machine water gun to adjust to the water column, from the outside of the dry cooling tower on the heat exchanger fins from top to bottom gradually rinsing, until the dry cooling tower surface dust and dirt rinsing until clean.

Figure 9.5 Schematic diagram of cleaning heat exchanger fins

Caution

Finned tubes should be rinsed from the top half to the bottom half as much as possible when cleaning.

Danger

The water used for high-pressure water gun rinsing must be fresh water or fresh water with added professional air conditioner exterior cleaning additives.

3) Dry cooling tower top drain maintenance

Table 9.6 Quarterly Maintenance Items for Top Drainage of Dry Cooling Towers

Serial number	Concrete operation	Exception handling
1	Make sure the top drain hole is not clogged.	Clearing debris, such as leaves, from the top of the dry-cooling tower.

Danger

The operation of heights is subject to local safety regulations.

4) Fan maintenance

Danger

The main power supply must be disconnected before fan maintenance!

Table 9.7 Monthly maintenance items for wind turbines

Serial number	Specific operations	Abnormal handling
1	Make sure there is no foreign matter in the fan	Clean up the foreign matter.
2	Confirm that there is no damage to the blades of the fan	Repair the blades, if it can not be repaired, replace the fan
3	Confirm that the fan running sound is not abnormal, abnormal sound, such as metal friction sound, ear-splitting noise, etc.	Clean up foreign matter and make sure the fan fixing bolts are tightened.
4	Confirm that the fan installation screws are not loose, deformation	Retighten or replace screws
5	Verify that the terminals are not loose	Re-torque

5) Other system maintenance

To ensure proper operation and longevity of the system, it should be inspected at

least once a year.

Caution

It is recommended to increase the frequency of inspection if the product is working in a harsh environment.

10 Safety Instructions

Danger

Containerized liquid cooling systems should be turned off at the main power supply when not in use for an extended period of time. After a prolonged power outage, it should be operated according to the normal power-up process.

10.1 Maintenance

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

10.2 Operation

Fire extinguishers should be provided prior to the start-up of cooling systems in containers.

Caution

Due to transportation and regulatory constraints, the system is shipped without a fire extinguisher. Before the system is operated, please have a fire extinguisher that complies with the local regulations of the project, and the fire extinguisher bracket needs to be secured on-site at the labeled location on the left side of the equipment's entry door.

The equipment must be grounded reliably in more than two locations, and the protective grounding resistance should be verified to ensure continuity, and it should be less than 0.3Ω, otherwise there may be a dangerous situation leading to personal injury or death;

Only after stopping and switching off the power can the equipment be cleaned, otherwise there may be electric shock or injury, do not use water to clean the equipment, otherwise there may be electric shock;

Always check whether the valve (if there is one) is open before switching on the machine;

Safety provisions for the operation of the distribution cabinet and main control cabinet:

In the power distribution cabinet A/B and the main control cabinet before

operation, should ensure that the cabinet door is in a locked state, to prevent personal injury such as electric shock, and to avoid salt spray, moisture, dust in the air or other conductive substances into the interior of the power distribution cabinet and the main control cabinet

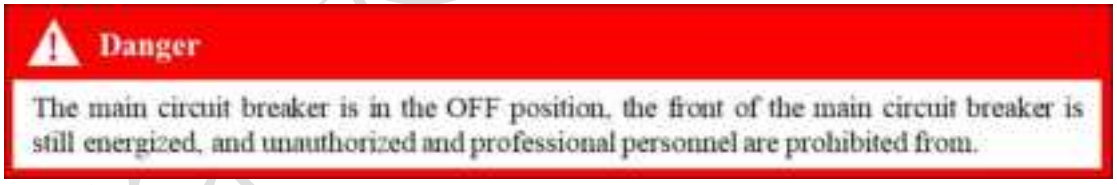
When powering up, it is forbidden to touch the veneer, cables, terminals, modules, sensors and other equipment inside the cabinet to avoid causing safety accidents;

In case of malfunction, odour or abnormal sound, please turn off the five main switches MCB-A1, MCB-A2, MCB-A3, MCB-A4, QFWCU of the three electrical cabinets, or press the emergency stop button on the container door, or it may lead to electric shock or fire accident.

When there is a risk of rapid freezing of the container system under abnormal use conditions, the cooling water in the system must be removed as soon as possible using an air pump, which is referred to in section 7.2) Recommended models.

10.3 Caution.

1) Prohibit non-professionally authorized persons from opening switchboard doors.
2) The switchboard door can only be opened when the main switch is in the OFF position.



Please read this manual carefully before using this equipment, if you have any difficulties or problems, please seek assistance from authorised personnel.