BITMAIN

ANTSPACE

ANTSPACE HK3

V2/V3/V5

Liquid Cooling System

Operation and Maintenance Manual

Catalogue

1. Summary of the ANTSPACE HK3

ANTSPACE liquid cooling system aims to continuously provide coolant that meets the requirements of pressure, temperature and flow rate for the internal heat dissipation unit of mining machine, and ensure a good working environment for load. There are two heat dissipation forms for the ANTSPACE liquid cooling system: evaporative cooling (cooling tower) or water-water heat exchange (plate heat exchanger). The internal cooling medium can choose the legitimate brand antifreeze or purified water according to the local ambient temperature.

2. Composition and Working Principles of the ANTSPACE HK3

2.1 Composition of the system

Table 2-1 Major components of ANTSPACE liquid cooling system

Components	Functions of components	Main parts
Pump station	To transport and monitor the status of coolant to maintain stable operation of the system	Centrifugal pump, expansion vessel, sensor, valve, exhaust valve, filter, pipeline and other related accessories
Cooling tower	To transfer heat from the load to the atmosphere	Spray pump, cooler, air inlet grill, fan and other related accessories
Electric cabinet	To control the operation of each component of the pump station, read and upload the numerical display of each sensor	Air switch, intermediate relay, programmable logic controller (PLC), switch power supply, touch screen and other related accessories
Network system and PDC	Distribution of network and power for mining machine	Circuit breaker, aviation connector, cable, switch and other related accessories
Water separator assembly	Distribution and delivery of flow	Water distributor, elbow, hose, chuck, valve and other related accessories
Fitting	Supporting parts and accessories for container water cooling system	Screw, miniature circuit breaker, aviation plug, clamp, rubber hose and other related accessories

2.2 Working principles

The pump station provides two ways of coolant with temperature, pressure, flow rate and medium to meet the requirements to the water distributor assembly, the water distributor conveys the coolant to the water cooling plate after two stages of liquid distribution, and the water cooling plate takes away the heat inside the equipment; the coolant after heating enters the cooling tower and the outside air for forced heat exchange, or enters the plate heat exchanger and the outside cold source for cold exchange, and the coolant after cooling is again conveyed to the water cooling plate through the pump station and the water distributor assembly. The coolant after cooling enters the cooling tower and the outside air for forced heat exchange or enters the plate heat exchanger and the outside cold source for heat exchange.

The working principle of Dry-Wet Combined Type Air Cooling Tower is divided into dry working condition and wet working condition.

Its working principle under wet condition is as follows: The cooling tower takes water and air as the cooling medium, and USES partial evaporation of cooling water to take away the heat generated by cooling fluid flowing in the coil. Inside are: spray device, snake type condensing coil, (packing heat exchange layer) water remover, bottom set water tray. The outside of the box is equipped with a circulating pump and an axial fan on the side of the condensing coil.

During operation, the cooling water is sent from the pump to the upper part of the condenser coil and the liquid condensed by the cooling water outside the tube flows from the lower part of the condenser coil

And out the other. After absorbing the heat from the refrigerant, some of the water is evaporated into water vapor, which is sucked up by the axial fan and discharged into the atmosphere. The cooling water that has not evaporated falls on the lower collector plate, which is used for recycling by the water pump. The axial circulating fan is drawn by the top to strengthen the air flow, the negative pressure in the water tank, to reduce the evaporation temperature of water, to promote the evaporation of water film, and to strengthen the heat release of the condensing coil. The role of the water eliminator is to block unevaporated water droplets in the air and make

It leaves the water tray to reduce the consumption of cooling water. In addition, the float ball valve is also set in the water pan. When the water is continuously evaporated, the float ball valve will open automatically, providing supplementary cooling water.

The working principle under dry working condition is to force the higher temperature coolant from the water cooling plate to exchange heat with the low-temperature air, and the coolant after reducing the water temperature enters the system again through the pump set for heat dissipation.

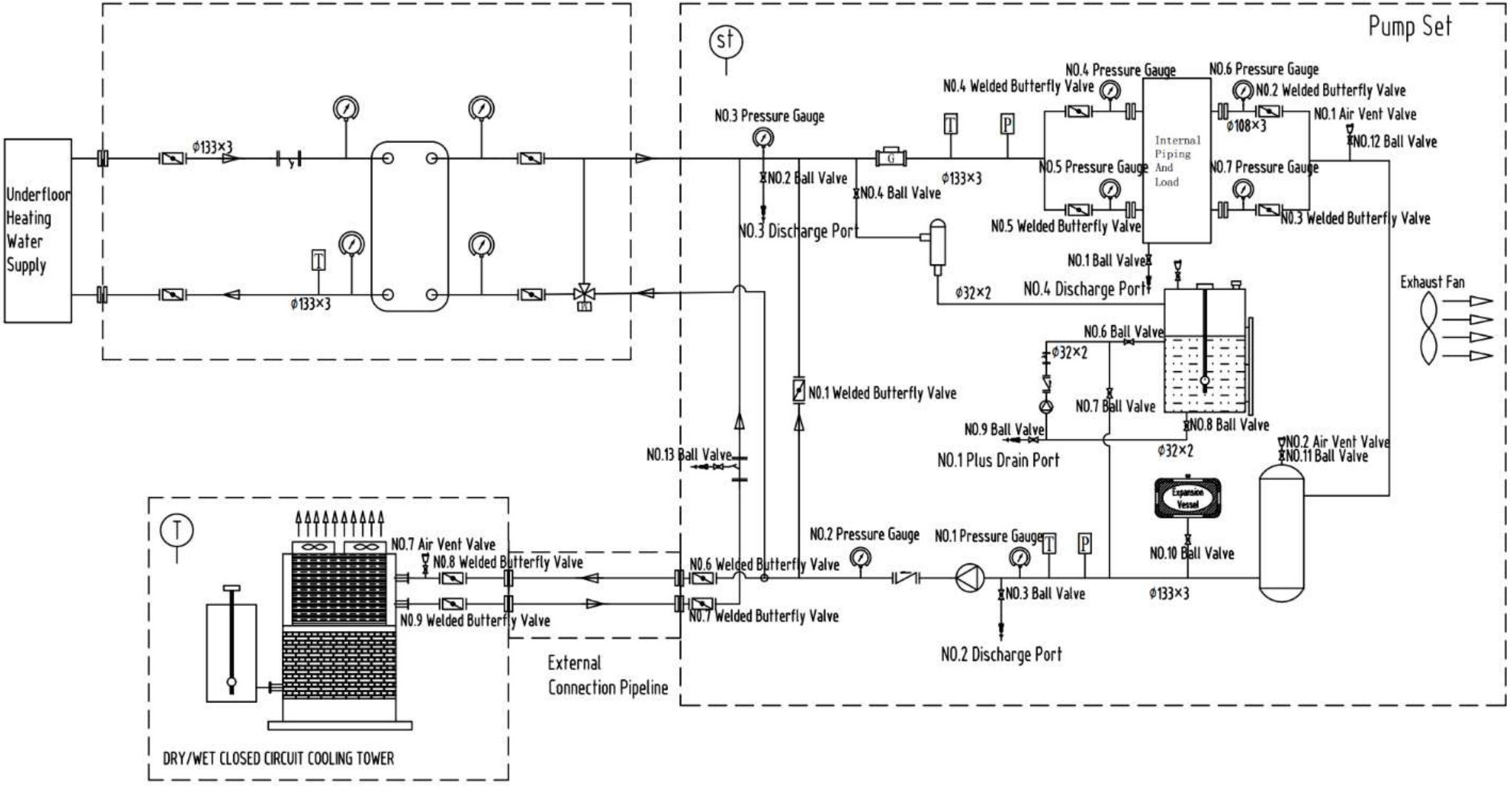

Figure 2-1 Schematic diagram of ANTSPACE liquid cooling system

Summary of functions of valves in schematic diagram				
No.	**Name**	**Function**	**State**	**Remark**
1.	1#ball valve	Drain of Liquid separator	Closed	
2.	2#ball valve	Drain of Main pipeline	Closed	
3.	3#ball valve	Drain of Main pipeline	Closed	
4.	4#ball valve	The safety valve can be closed for maintenance in case of safety valve failure	Open Closed(Pressurization)	
5.	5#ball valve	The valve at the front end of the make-up filter shall be closed during filter maintenance	Open	
6.	6#ball valve	The liquid can be added to the tank after opening this valve after opening this valve	Closed	
7.	7#ball valve	The liquid can be added to the system after opening this valve	Open	
8.	8#ball valve	The tank is connected with the system and can automatically replenish or discharge liquid after opening this valve	Open	
9.	9#ball valve	After opening this valve, the external liquid can be replenished to the inside of the system / tank during liquid filling; When discharging liquid, the liquid inside the tank can also be discharged	Closed	
10.	10#ball valve	The expansion vessel can be serviced by closing the valve	Open Closed(Pressurization)	
11.	11#ball valve	The exhaust valve on the top of degassing tank can be serviced by closing the valve	Open	
12.	12#ball valve	The exhaust valve can be serviced by closing the valve	Open	
13.	13#ball valve	The Y-filter can be serviced by closing the valve	Closed	
14.	1# butterfly valve	When the ambient temperature is low, open this valve to reduce heat exchange	Closed	
15.	2# butterfly valve	The valve of the water separator on the left side of the return liquid shall cooperate with 4# butterfly valve to isolate the water separator assembly on the left side	Open	
16.	3# butterfly valve	The valve of the water separator on the right side of the return liquid shall cooperate with 5# butterfly valve to isolate the water separator assembly on the left side	Open	
17.	4# butterfly valve	The valve of the water separator on the left side of the liquid supply is matched with 2# welded butterfly valve to isolate the water separator assembly on the left side	Open	
18.	5# butterfly valve	The valve of the water separator on the right side of the liquid supply is matched with 3# welded butterfly valve to isolate the water separator assembly on the left side	Open	
19.	6# butterfly valve	Due to this liquid supply valve, the ANTSPACE cooling system is independent, and closing the valve can facilitate the movement of the system. In addition, when cooperating with 8# welded butterfly valve to maintain the filter, the system does not need to discharge a large amount of liquid	Open	
20.	7# butterfly valve	Due to this return valve, the ANTSPACE cooling system is independent. Closing the valve can facilitate the movement of the system	Open	
21.	8# butterfly valve	Due to this liquid supply valve, the cooling tower is independent, and closing the valve can facilitate the movement of the system. In addition, when cooperating with 8# welded butterfly valve to maintain the filter, the system does not need to discharge a large amount of liquid	Open	
22.	9# butterfly valve	Due to this return valve, the cooling tower is independent. Closing the valve can facilitate the movement of the system	Open	
23.	1# Pressure gauge	The water pump suction pressure gauge can judge whether the water pump suction pressure (≥ 0.1MPa) is normal, and check whether the water pump suction pressure sensor is normal	/	
24.	2# Pressure gauge	The outlet pressure gauge of the water pump, together with 1# pressure gauge, can analyze whether the operating condition of the water pump is consistent with the design condition (the difference is the pump head at this time)	/	

25.	3# Pressure gauge	The pressure gauge of main liquid supply pipeline shall cooperate with 2# pressure gauge to analyze whether the outlet pressure of water pump is normal and whether there is fault in the system	/	
26.	4# Pressure gauge	The pressure gauge of the left branch pipe for liquid supply, together with 6# pressure gauge, can analyze whether the flow resistance of the left water separator assembly is normal	/	
27.	5# Pressure gauge	The pressure gauge of the right branch pipe for liquid supply, together with 7# pressure gauge, can analyze whether the flow resistance of the right water separator assembly is normal	/	
28.	6# Pressure gauge	The pressure gauge of the left branch pipe for liquid supply, together with 4# pressure gauge, can analyze whether the flow resistance of the left water separator assembly is normal	/	
29.	7# Pressure gauge	The pressure gauge of the right branch pipe for liquid supply, together with 5# pressure gauge, can analyze whether the flow resistance of the right water separator assembly is normal	/	

3. Main technical specification of the ANTSPACE HK3

Table 3-1 System performance indicators

No.	Description	Indicators	Remarks
Environmental indicators			
1.	Working temperature	-35～40℃	Outdoor
	Working temperature	5～40℃	Indoor（The temperature range can be controlled by adjusting the fan）
2.	Working humidity	10～90%	
3.	Storage temperature	-35～70℃	
4.	Storage humidity	5～95%	
5.	Height above sea level	≤2000m	
Container Specifications			
1.	Dimensions (L*W*H) (mm)	6058×2438×2896	
2.	AntMiner capacity	210 units -S19 Hydro Series	
3.	Container Certification	CCS	
4.	Safety Certification	NFPA 79:2021（V2 version） UL 508A:2018 R8.21（V2 version） CSA C22.2 No. 14-18（V2 version） ANSI/ISO 12100:2012（V2 version） 2014/35/EU（V5 version） 2006/42/EC（V5 version）	
5.	Operating Power (kW)	1047～1050	Excluding cooling tower power consumption
6.	Input voltage and frequency	415V±5%/60Hz（V2 version） 400V±5%/60Hz（V3/V5 version）	
7.	Transport Weight(t)	8	Excluding miner and coolant
8.	Operating Weight(t)	12	Including miner and coolant

9.	PDU main switch capacity (A)	1200A（V2 version） 1250A（V3/V5 version）	The container contains two power distribution cabinets, each with a 1200A (UL)/1250A(CE)main switch.
10.	Rated Current (A)	952	The rated current of each distribution cabinet in the container is 952 A.
11.	Rated Power (kW)	1047	Excluding cooling tower power consumption
12.	Max Power (kW)	1050	Excluding cooling tower power consumption
13.	Rated Current per PDU (A)	10	The container contains two power distribution cabinets, each with a 1200A (UL)/1250A(CE)main switch.
14.	Connection Interface （Cooling Tower）	DN125（GB/T 9119-2010 PN16 DN125）	
15.	Connection Interface (Heat Exchange Interface)	DN100（GB/T 9119-2010 PN16 DN100）	
16.	Flow Rate (m^3/h)	＞85	
Cooling Tower Specifications			
1.	Type	Dry-Wet Combined Type Air Cooling Tower	
2.	Dimensions (L*W*H) (mm)	6058×2438×2896	Excluding cage ladder
3.	Heat Dissipation Capacity (kW)	1000	
4.	Outlet Temperature	35℃±1℃	@ 28℃ Wet Bulb Temperature
5.	Container Certification	CCS	
6.	Safety Certification	NFPA 79:2021（V2 version） UL 508A:2018 R8.21（V2 version） CSA C22.2 No. 14-18（V2 version） ANSI/ISO 12100:2012（V2 version） 2014/35/EU（V5 version） 2006/42/EC（V5 version）	
7.	Operating Power (kW)	14~28	
8.	Transport Weight(t)	7t	
9.	Operating Weight(t)	12t	
10.	Connection Interface (Container)	DN125（GB/T 9119-2010 PN16 DN125）	
11.	Water Resupply Hose Interface	DN40（Internal thread）	
12.	Drain Hose Interface	DN65（Internal thread）	
13.	Noise Level @25℃, 16m	70dBA	
14.	Water Consumption	1～1.5m^3/h	

4. Structural view of ANTSPACE HK3

4.1 External view of ANTSPACE Liquid Cooling System

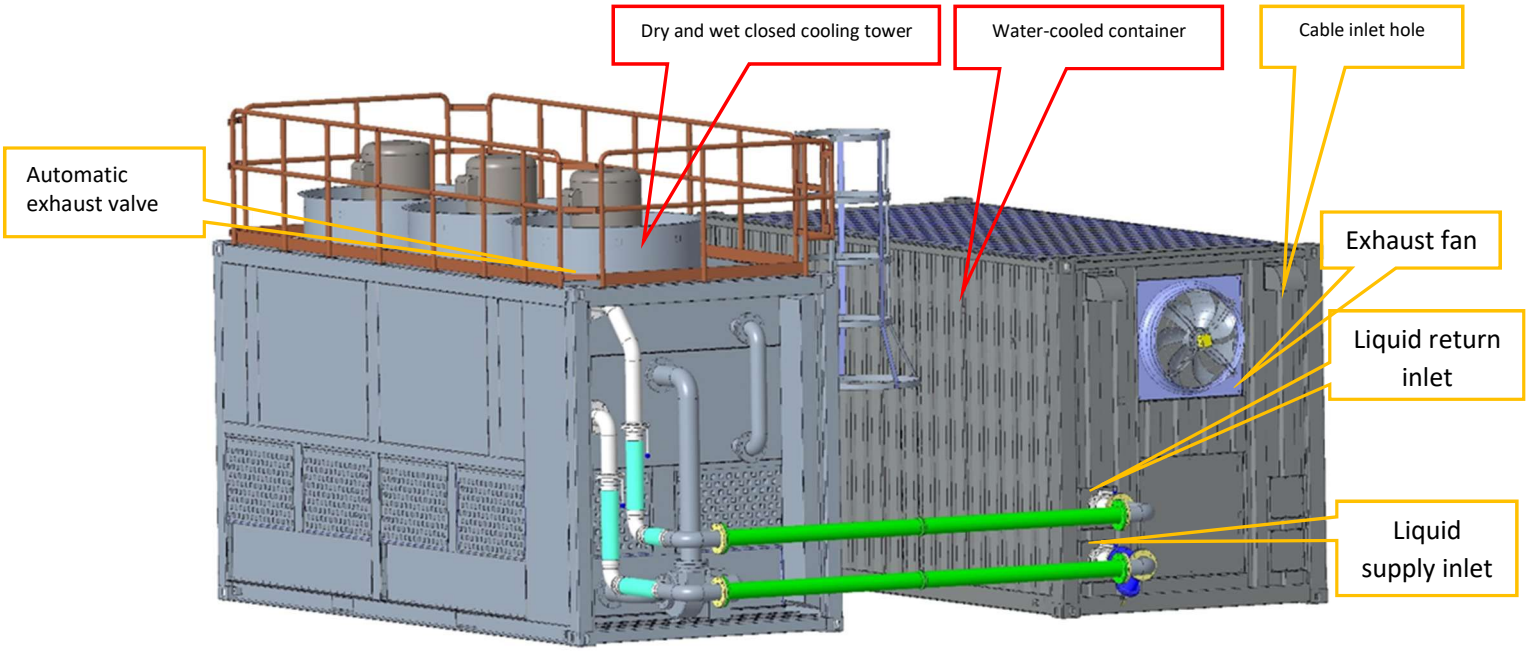

Figure 4-1-1 External view 01 of ANTSPACE liquid cooling system

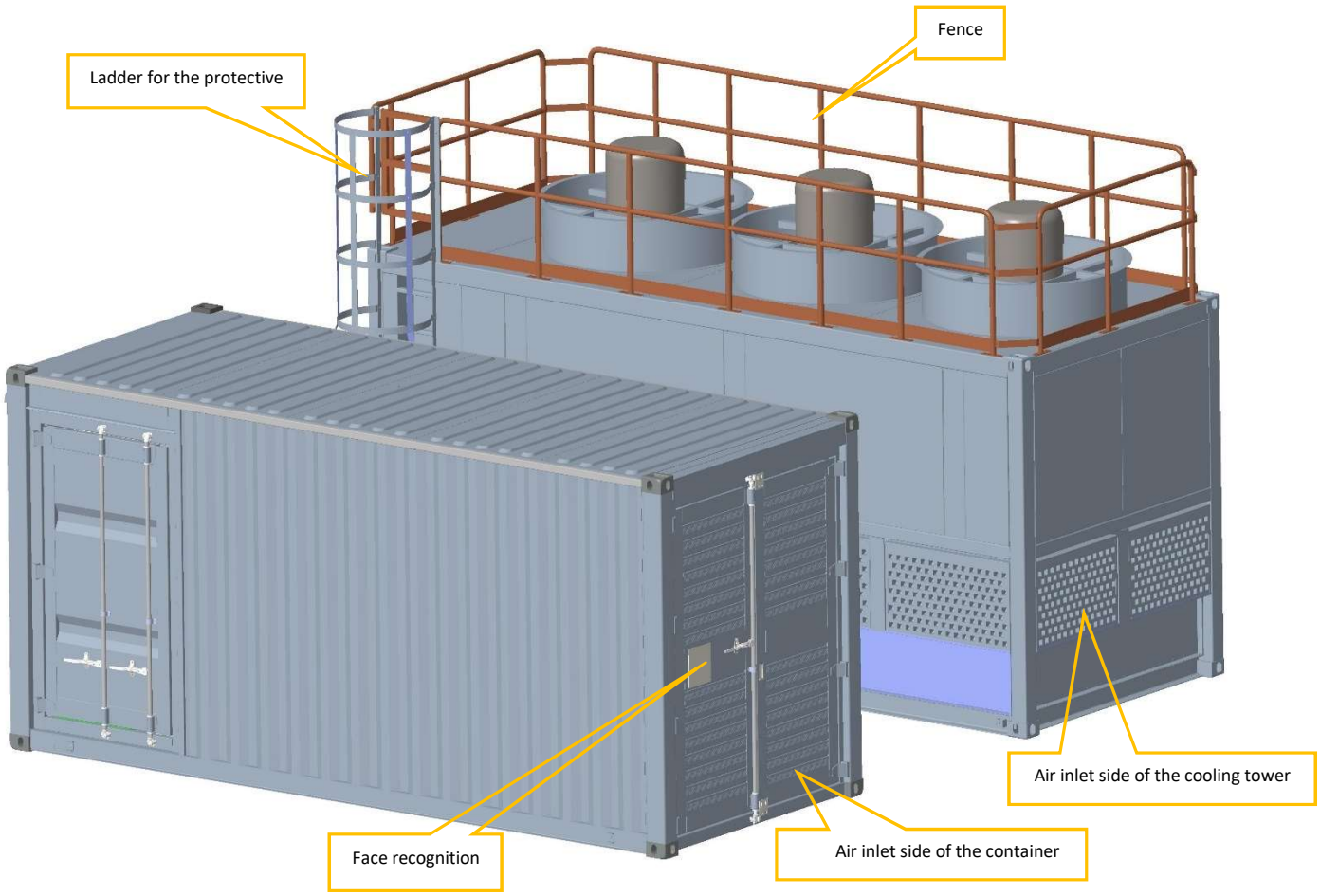

Figure 4-1-2 External view 02 of ANTSPACE liquid cooling system

4.2 Internal view of ANTSPACE Liquid Cooling System

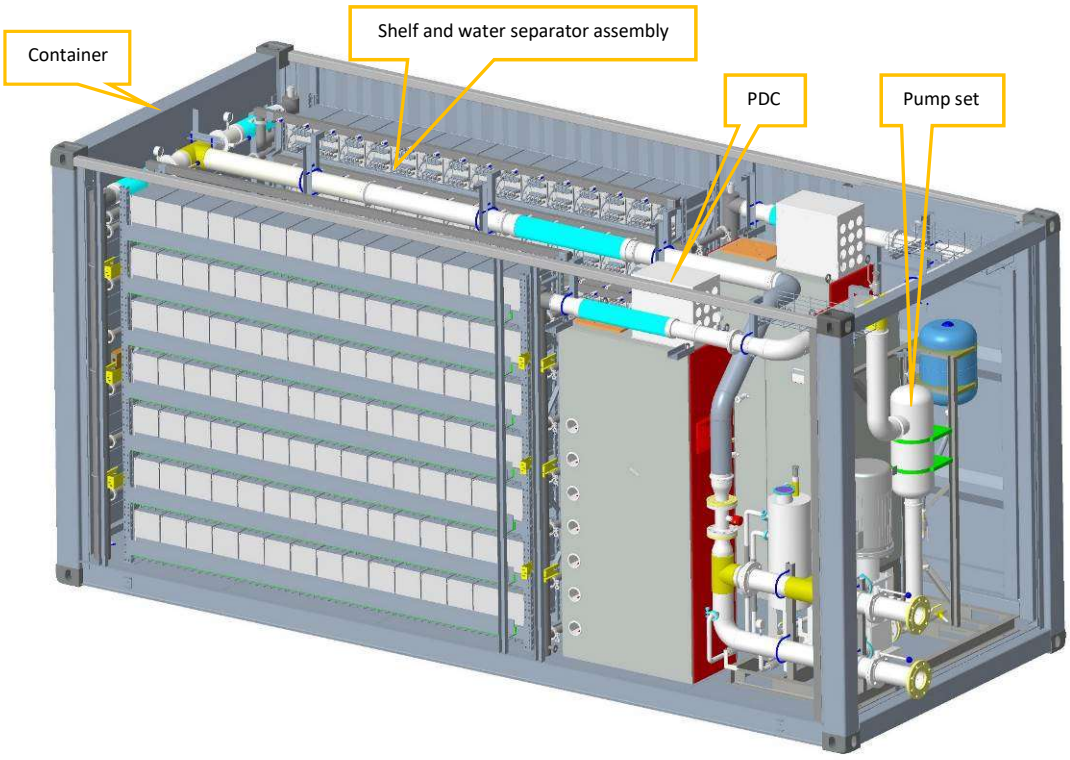

Figure 4-2-1 Internal view 01 of the container

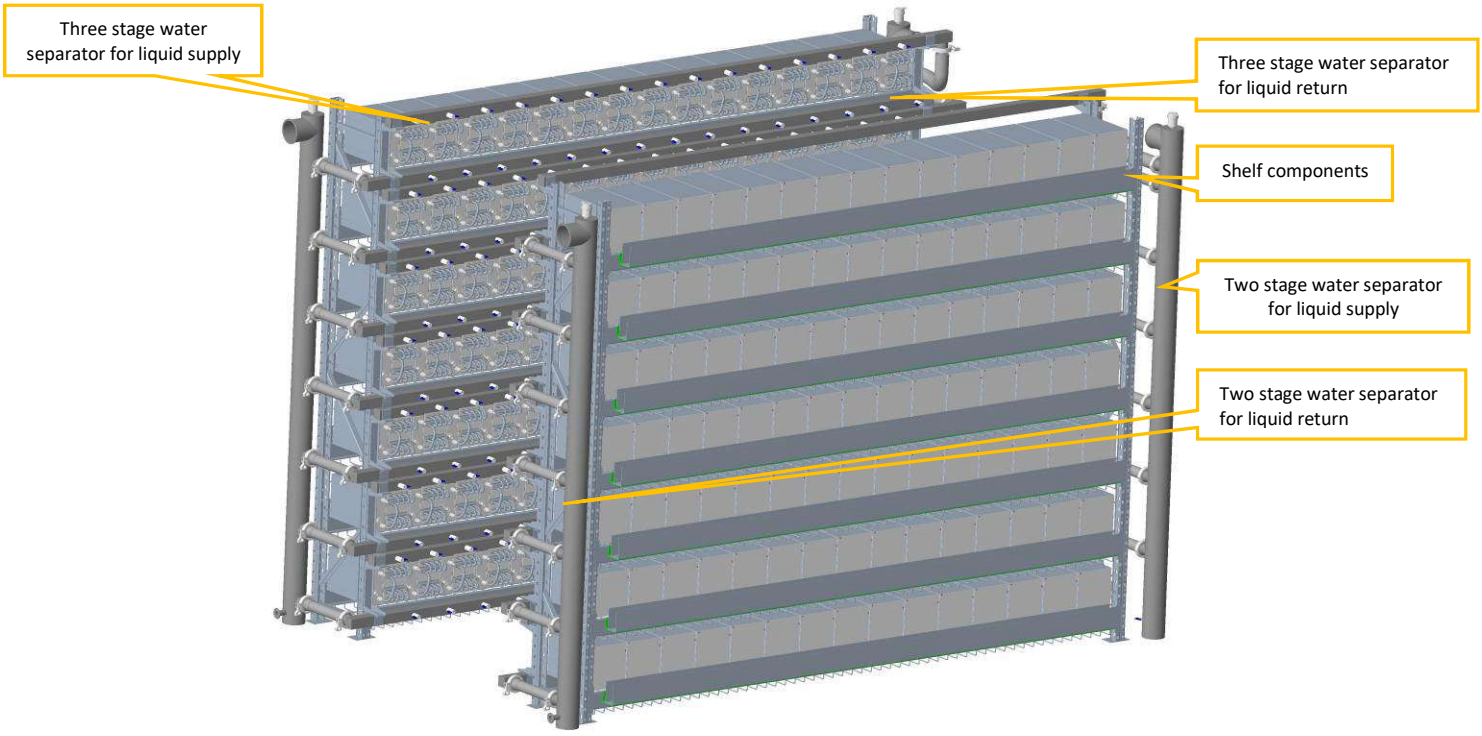

Figure 4-2-2 Internal view 01 of the water separator assembly

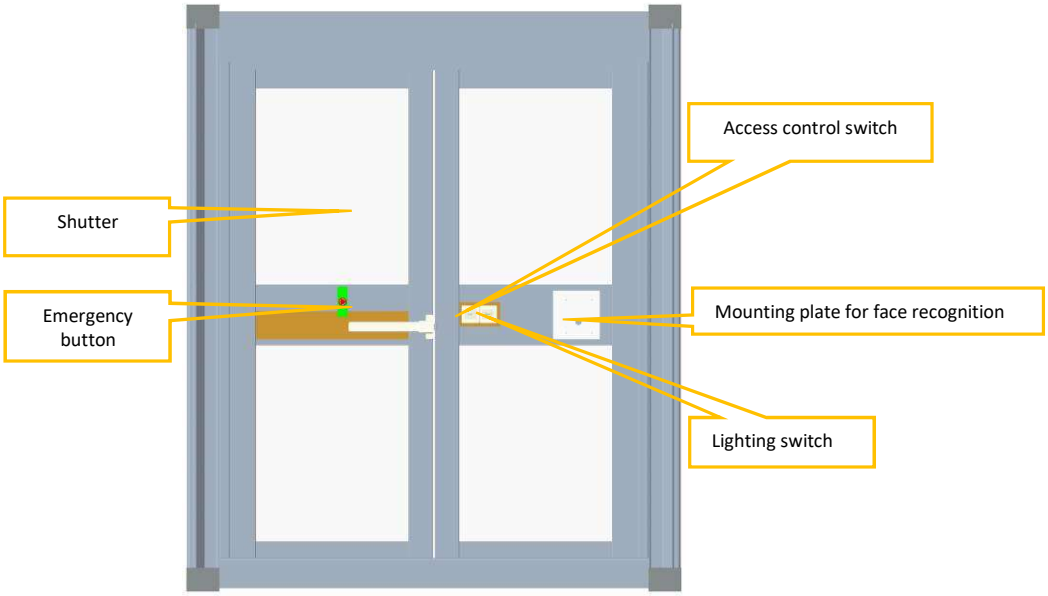

Figure 4-2-3 Internal view 01 of the front door of the container

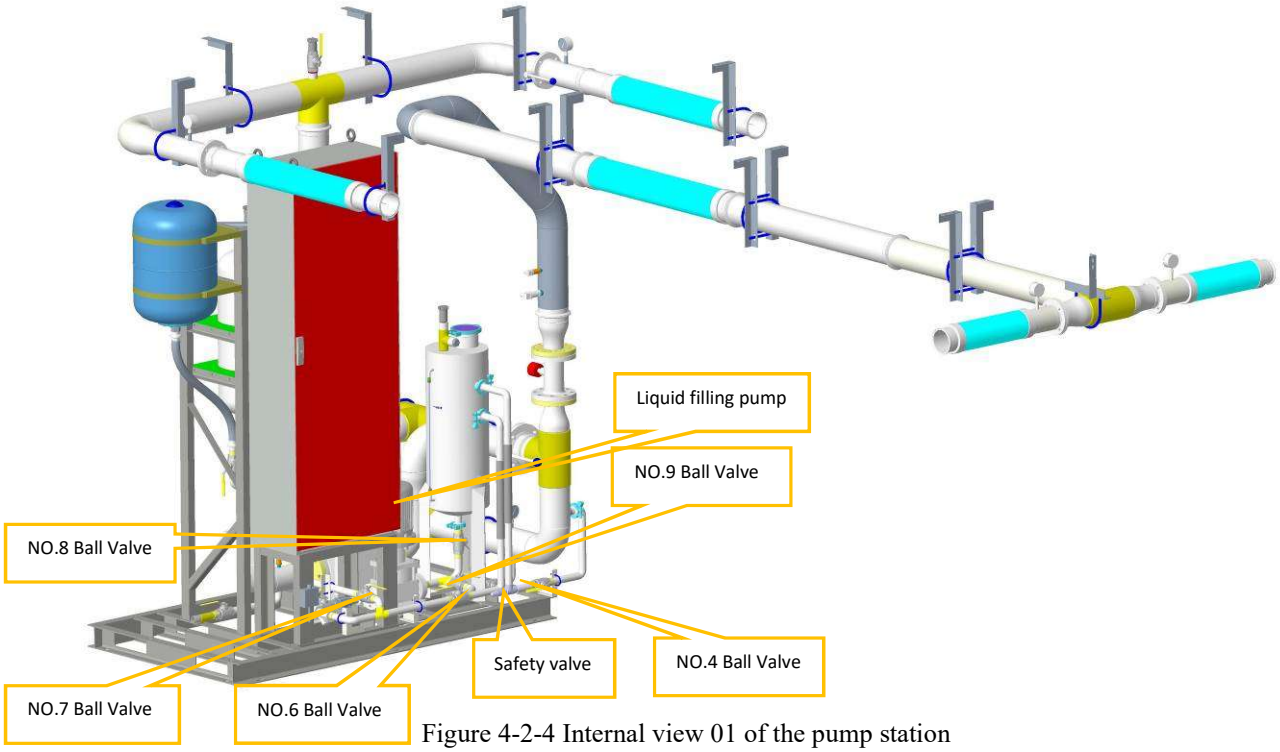

Figure 4-2-4 Internal view 01 of the pump station

The status and functions of common valves are summarized as follows:

4#ball valve(open)：The safety valve can be closed for maintenance in case of safety valve failure，It is normally open except that it is closed during pressurization.

6#ball valve(closed): The liquid can be added to the tank after opening this valve after opening this valve.

7#ball valve(open): The liquid can be added to the system after opening this valve.

8#ball valve(open): The tank is connected with the system and can automatically replenish or discharge liquid after opening this valve.

9#ball valve(closed): After opening this valve, the external liquid can be replenished to the inside of the system / tank during liquid filling; When discharging liquid, the liquid inside the tank can also be discharged.

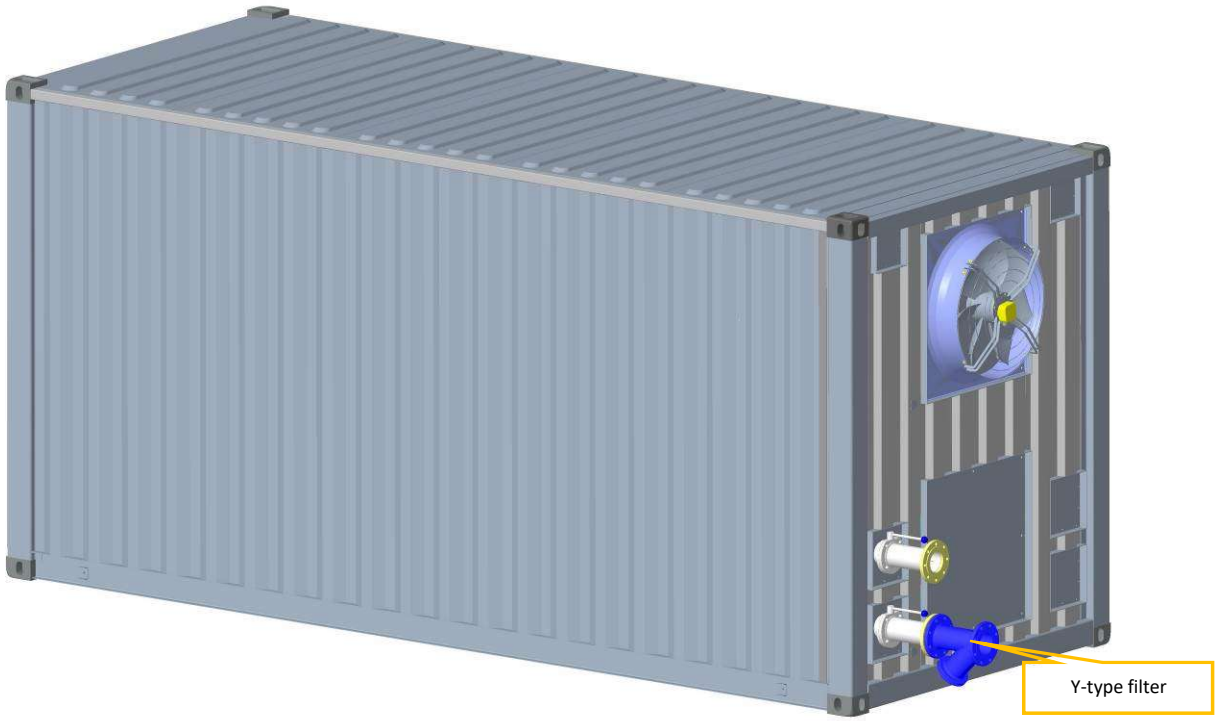

Figure 4-2-5 Internal view 02 of the pump station

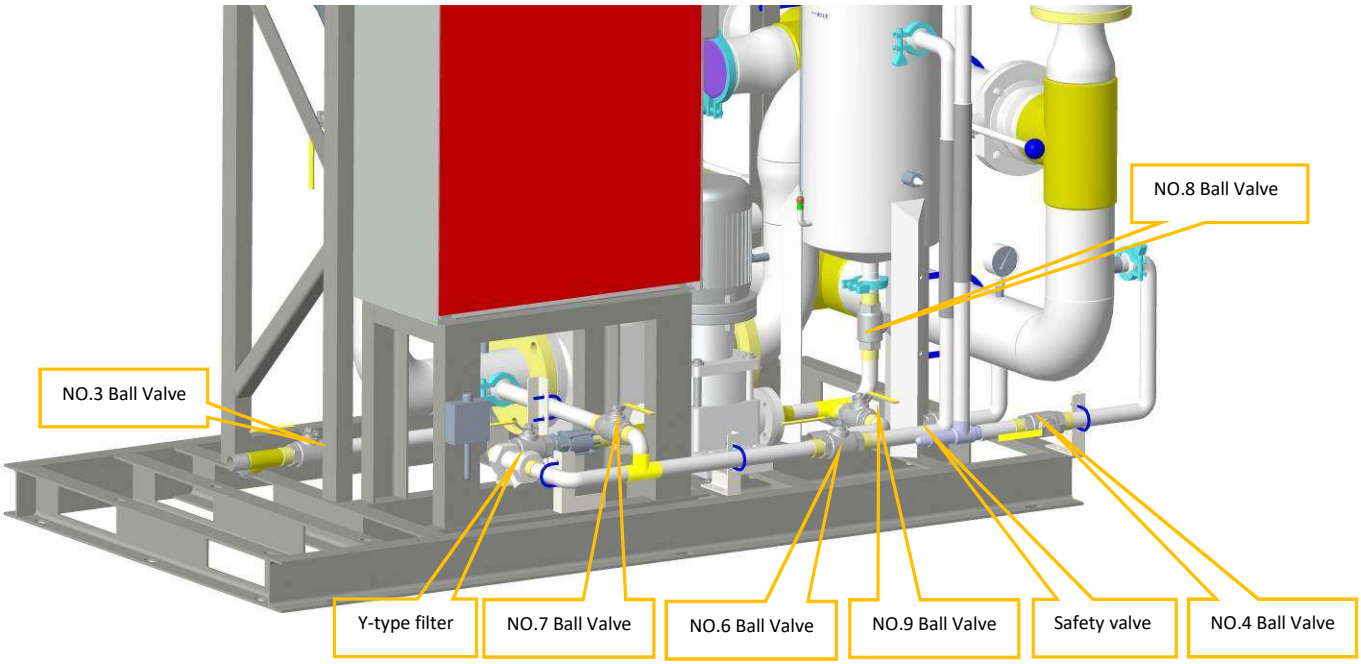

Figure 4-2-6 Internal view 03 of the pump station

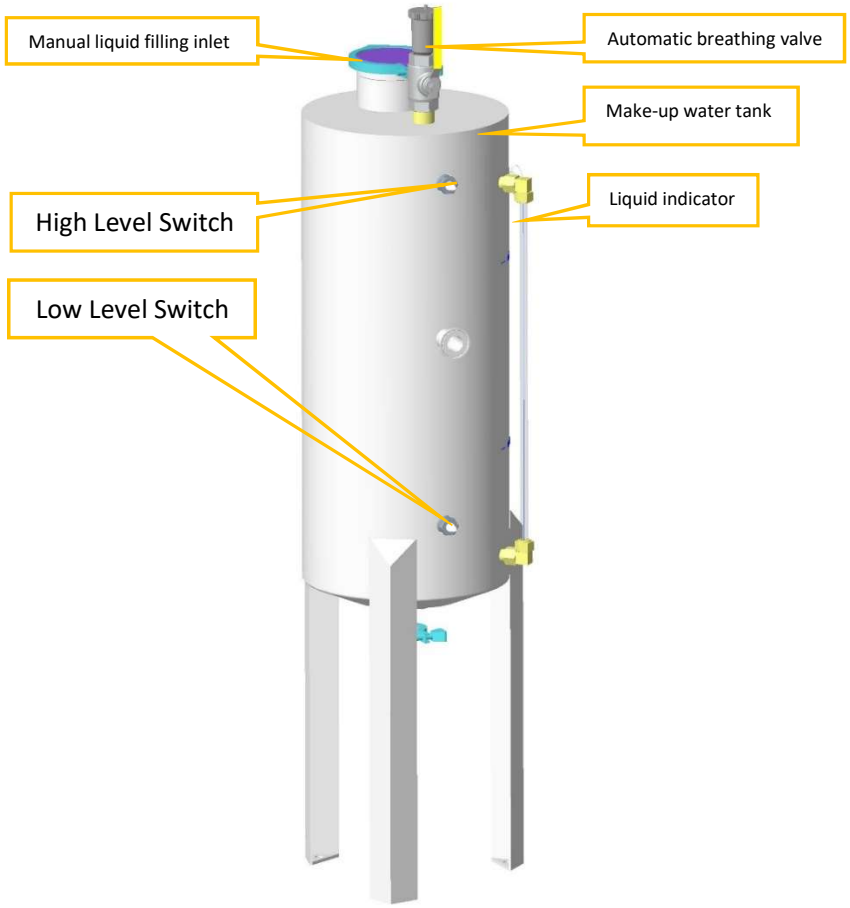

Figure 4-2-7 Internal view 04 of the pump station

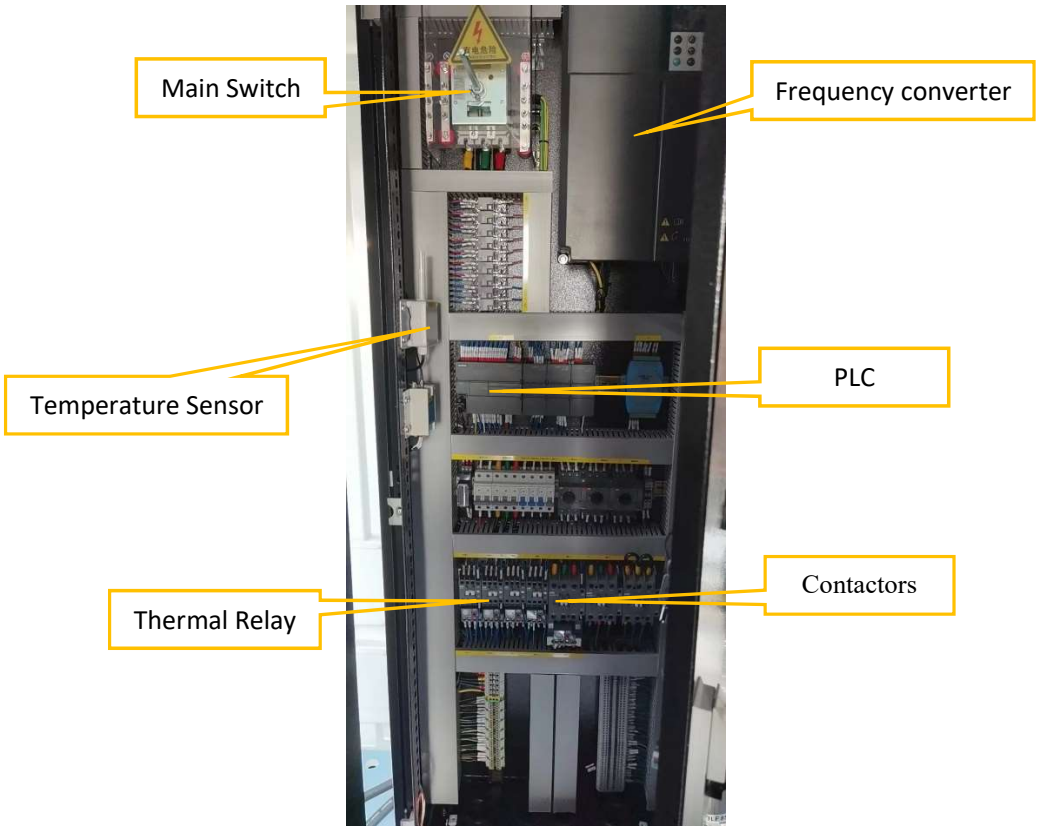

Figure 4-2-8 Internal view 01 of ECC

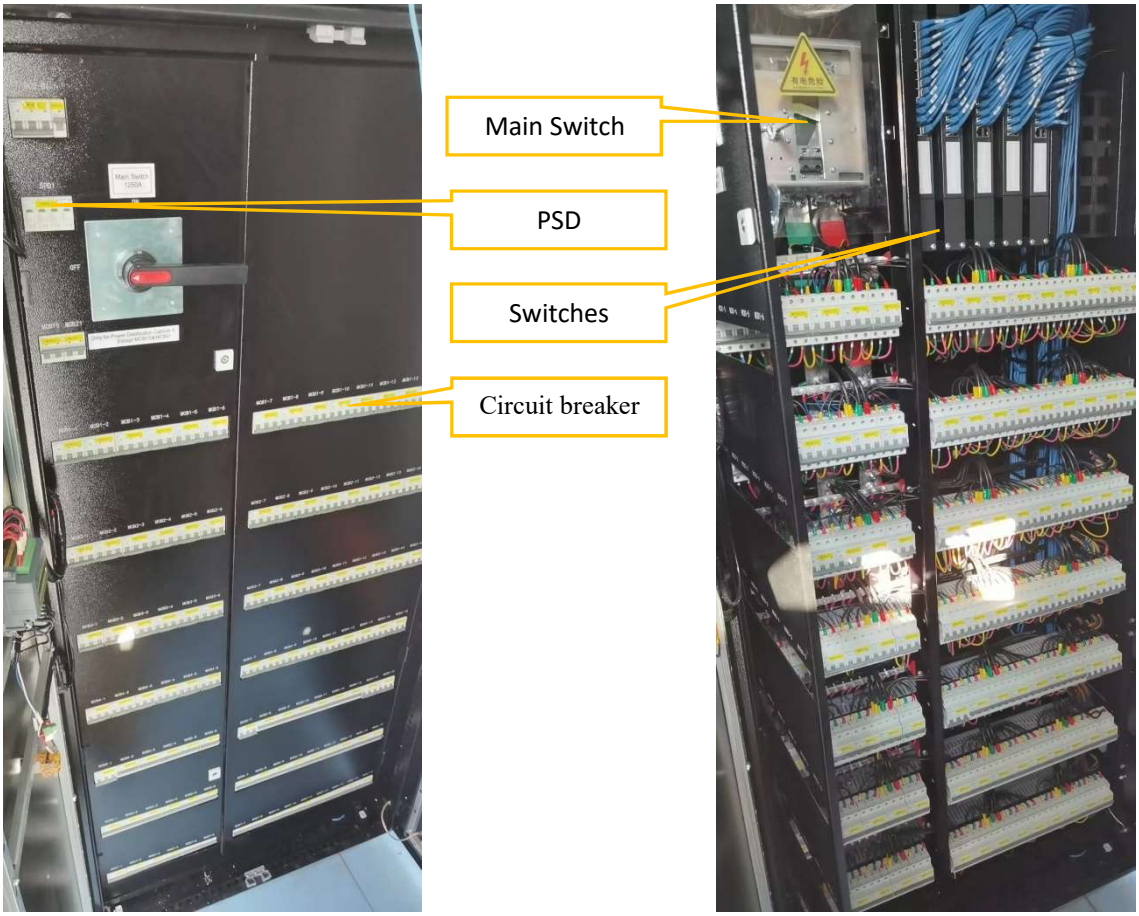

Figure 4-2-9 Internal view 01 of PDC

5. Use and Operation of ANTSPACE HK3

5.1 Safety regulations

5.1.1 A symbolic distinction indicating the degree of danger

"⚡" is the logo for electrical charge. It is forbidden to open the cover plate with the logo.

5.1.2 Precautions for operation

1） Filtered coolant should be used as the cooling medium, and there should be no floating objects, or particles in the liquid supply circulation system.

Note: the cooling medium should use the coolants produced by manufacturers. It is not allowed to make them with different substances by yourself. Otherwise, we will not be responsible for any problems. It is recommended to choose organic coolants. Inorganic coolants contain phosphorus, silicon, boron, molybdenum, nitrate, etc., which will generate precipitate over a long time. The recommended manufacturers for coolants: Great Wall brand, Shell brand, etc.

2） When the ambient temperature is below 0 ℃, the water in the sump and spray pipeline must be completely discharged to prevent icing damage to the equipment.

3） The equipment should not be wired without permission, and it is forbidden to be used in parallel with other equipment.

4） If the equipment has abnormal conditions (such as burning smells, etc.), it should be shut down, disconnected from the power supply, and checked.

5） There is an emergency stop on the entry door and on the door of electric cabinet A and B, when an emergency occurs, press the emergency stop, then the power circuit breaker will be disconnected immediately.After the emergency is reset, turn the main circuit breaker to the OFF position before power on the switch again；

Figure 5-1-1 Emergency stop button

6） The Circuit breaker MCB-A1 only can de-energize PDC A.

7） The Circuit breaker MCB-A2 only can de-energize PDC B.

Figure5-1-2 MCB-A2

8） The Circuit breaker MCB17 only can de-energize control cabinet ;

9） In order to prevent hazards, when a single computing unit is repaired, disconnect with the corresponding power supply of

the computing unit in PDC, disconnect with the corresponding network cable, water supply of the computing unit, and finally disconnect with the power supply of the computing unit.

To power off the entire container, perform the following steps:

a） First, 210 computing units are disconnected.

Figure 5-1-3 Schematic diagram of the air switch of a PDC

b） After 10 seconds, disconnect the main power supply of the control device.

Figure 5-1-4 Schematic diagram inside the ECC

c） Disconnect the main switch of the two PDC.

Note: The lighting circuit of the container is led from the main PDC. Bring a portable lighting lamp with you if you want to perform the above operation.

Figure 5-1-5 Schematic diagram of the main air switch of PDC

d） Disconnect the main switch at the transformer end if necessary. Be reminded that the sequence for switch off should be strictly conducted in accordance with the above requirements.

10） Do not open the protective cover on the fan.

11） Do not operate the device with wet hands; otherwise, electric shock may occur. It is forbidden to put sundries inside the unit to ensure that the fire passageway is always unblocked.

Note: If the equipment does not work over a long time, disconnect the main power supply.

5.2 Pressure test of the system

Preparation for the pressure test:

1） Get hoses and air pumps ready; (Recommended brand: Outstanding, model 2200w-40L; Selection basis: The internal volume of the system is about 1.5m^3/h, and the corresponding exhaust volume air pump is selected according to the time requirements; the maximum output air pressure is more than 8bar, and 10bar is the best)

2） Connect the external pipeline according to the ANTSPACE field installation manual.

3） Check if the automatic exhaust valves or the ball valves on the internal and external pipes of the container are closed. Screw the top nut of the automatic exhaust valve to open/close the automatic exhaust valve. (See Figures 6-2-1 through 6-2-4).

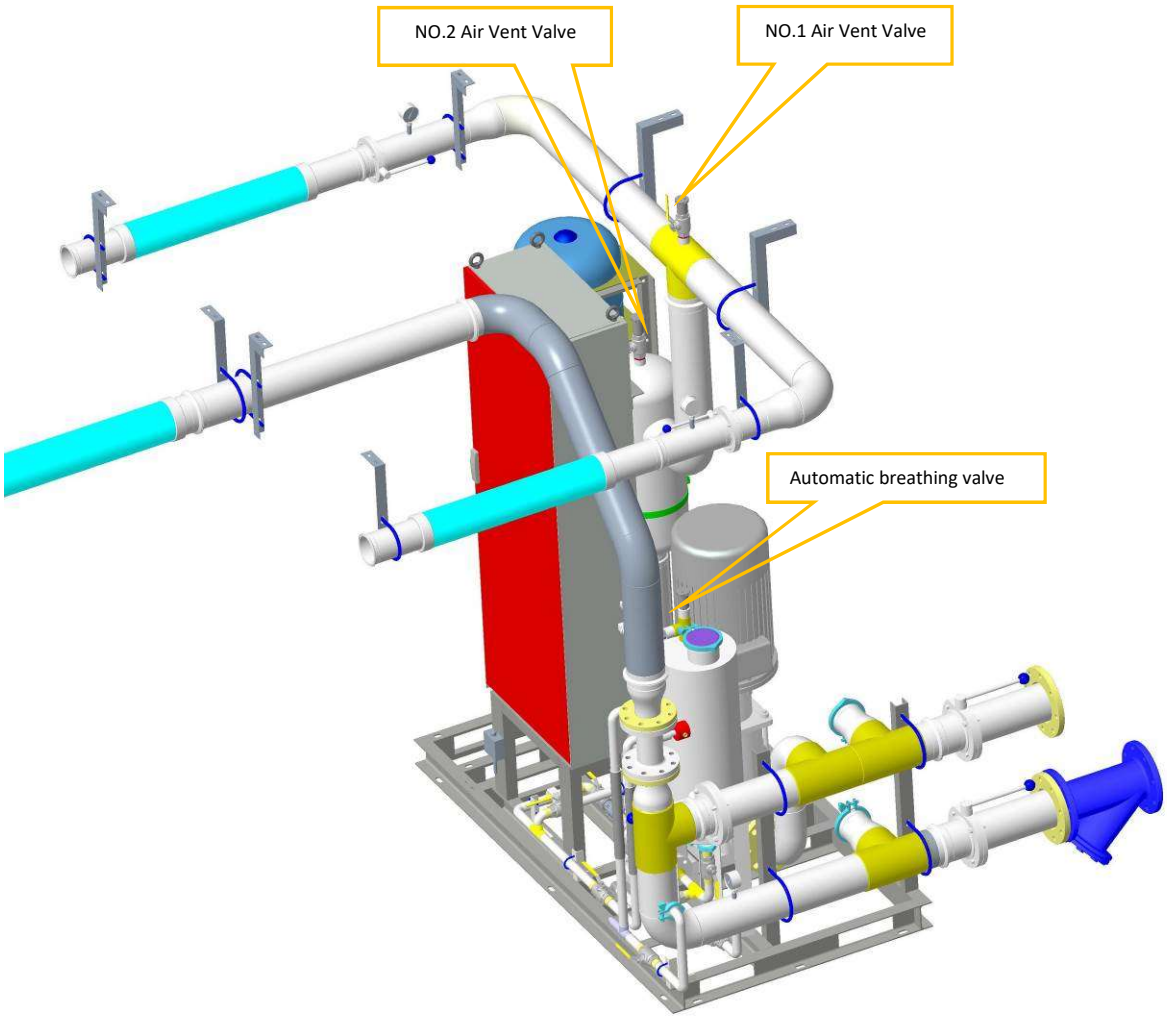

Figure 5-2-1 Pump station - automatic exhaust valve

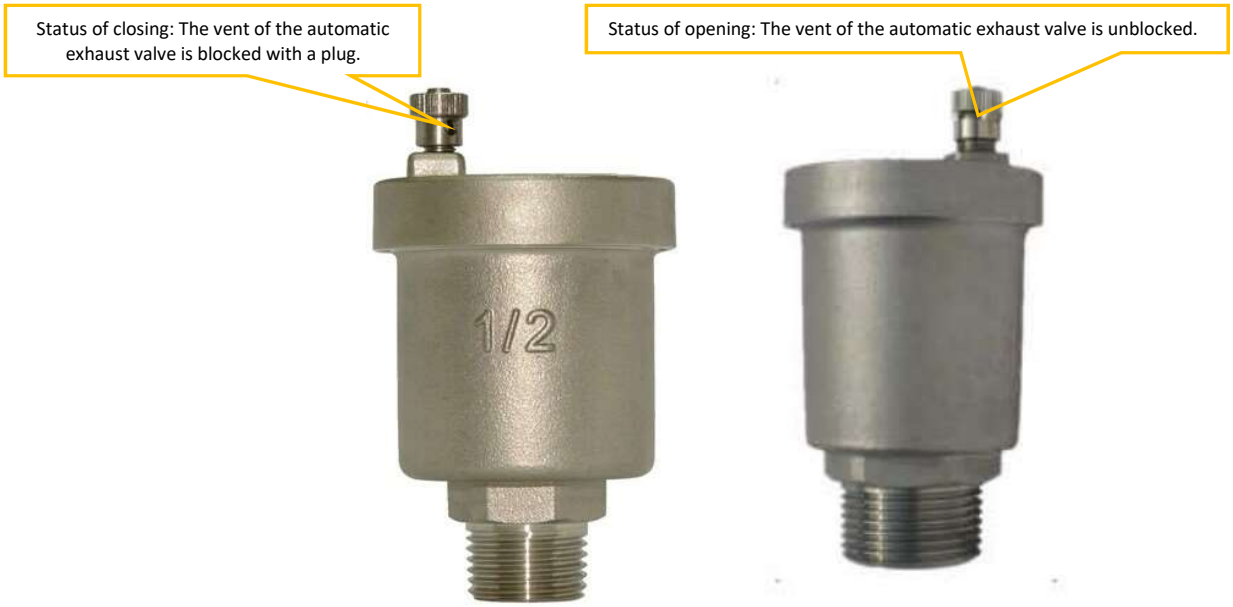

Figure 5-2-2 Schematic diagram of opening and closing of automatic exhaust valve

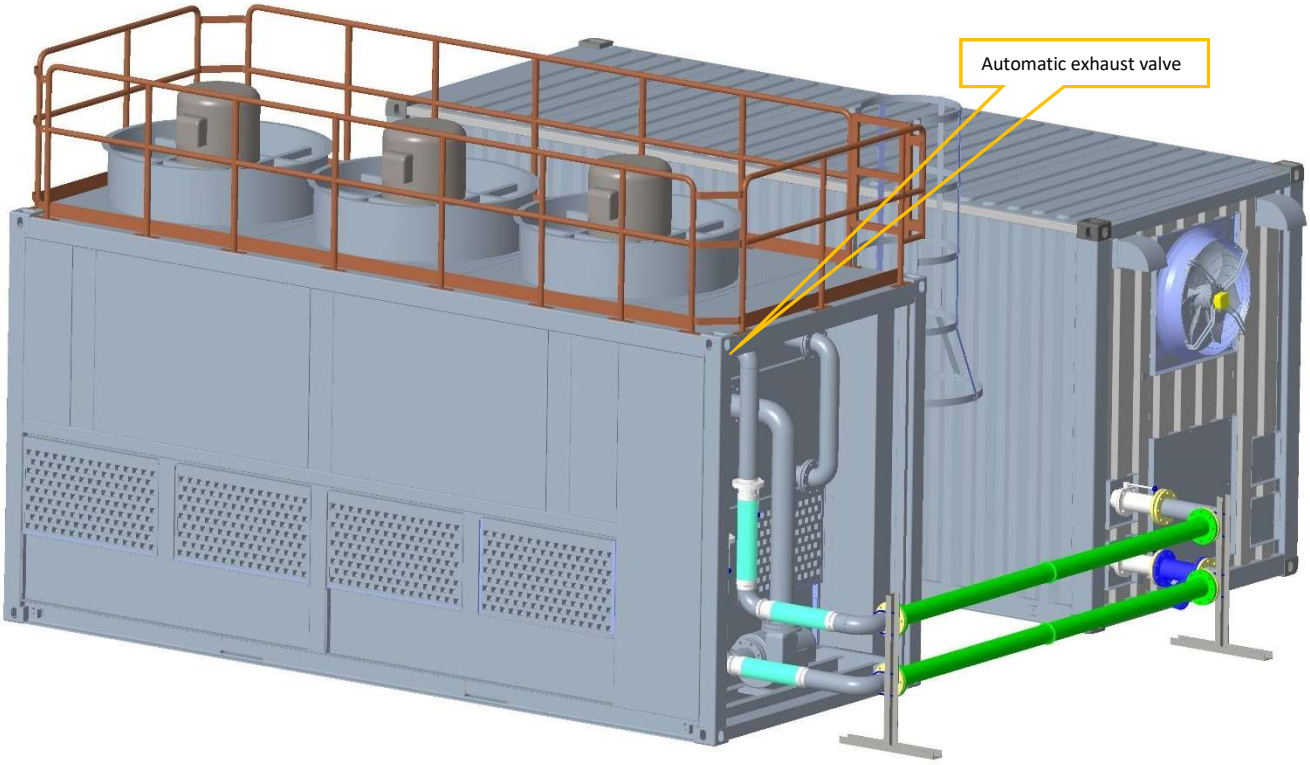

Figure 5-2-3 External connecting pipelines - automatic exhaust valve

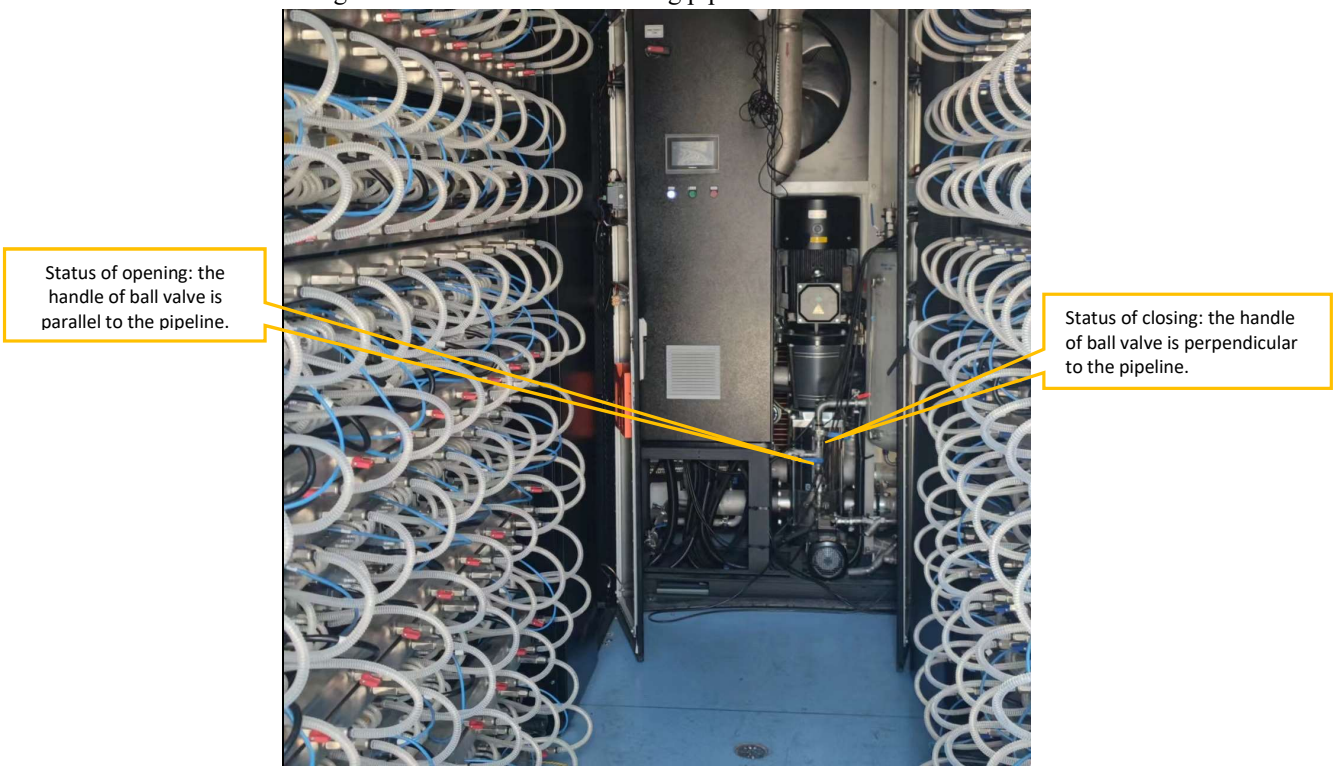

Figure 5-2-5 Schematic diagram of opening and closing of ball valve

Procedures for the pressure test:

1） Check again whether the exhaust valve and the ball valve are closed;

2） Close the NO.7 Ball Valve;

3） Refer to 5-2-6 for example, using a bellows to connect the manifold inlet and outlet and open all mini ball valves on the water distributor;

4） Connect the air pipe to any fast plug-in interface, and close the corresponding ball valve.

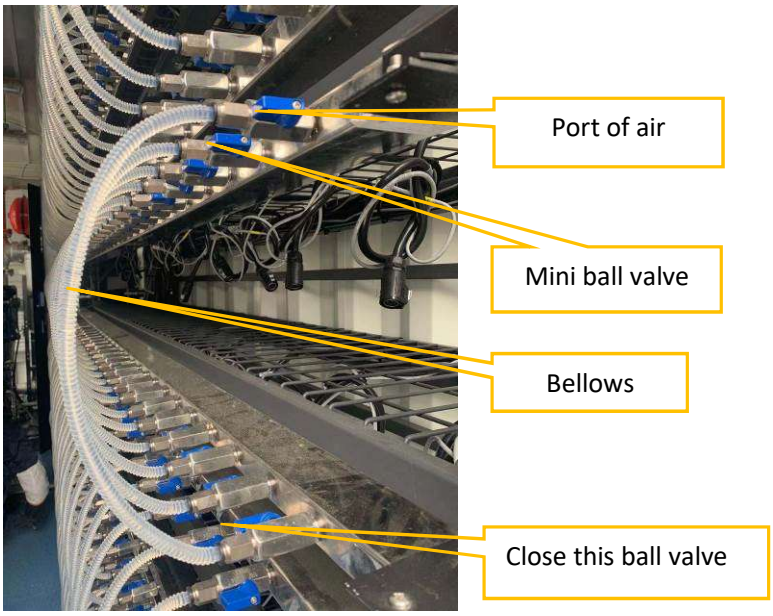

Figure 5-2-5 System - ball valve for connecting pipelines

5） Use an air compressor to press to 7 bar, keep the pressure for more than 30 minutes, and check for leakage;

6） Key sites for inspection are as follows:

a） Connection between the fast connection-peg and the mini ball valve;

b） Joint between the quick plug ball valve and the bellows;

c） Connection between the mini ball valve and the water separator;

d） Connection between the fast-plug connector and the computing equipment;

e） Flange/chuck/thread/welded joints.

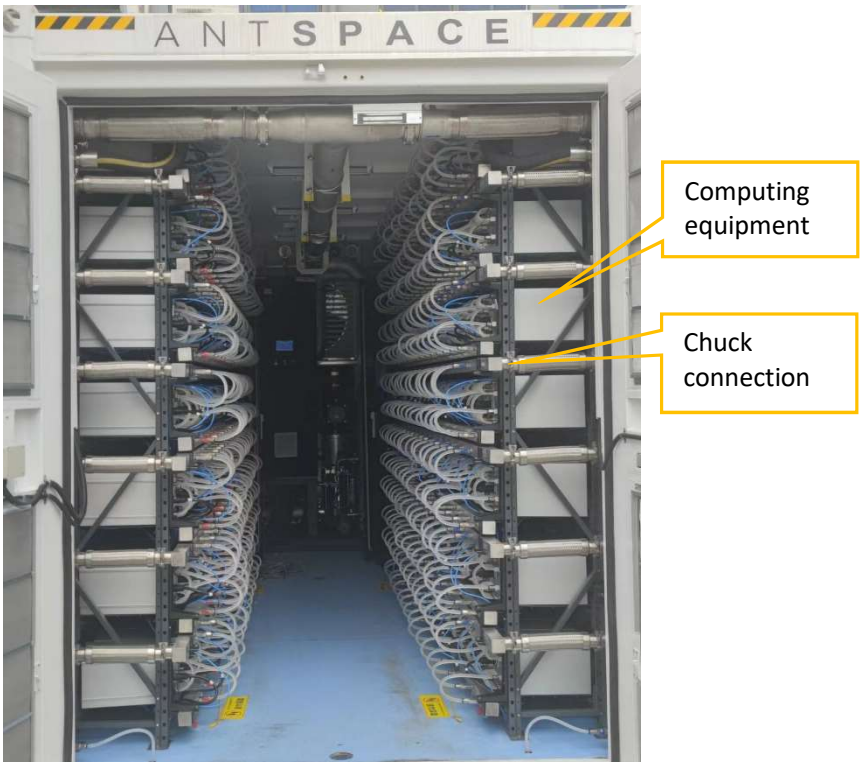

Figure 5-2-6 System - chuck connection

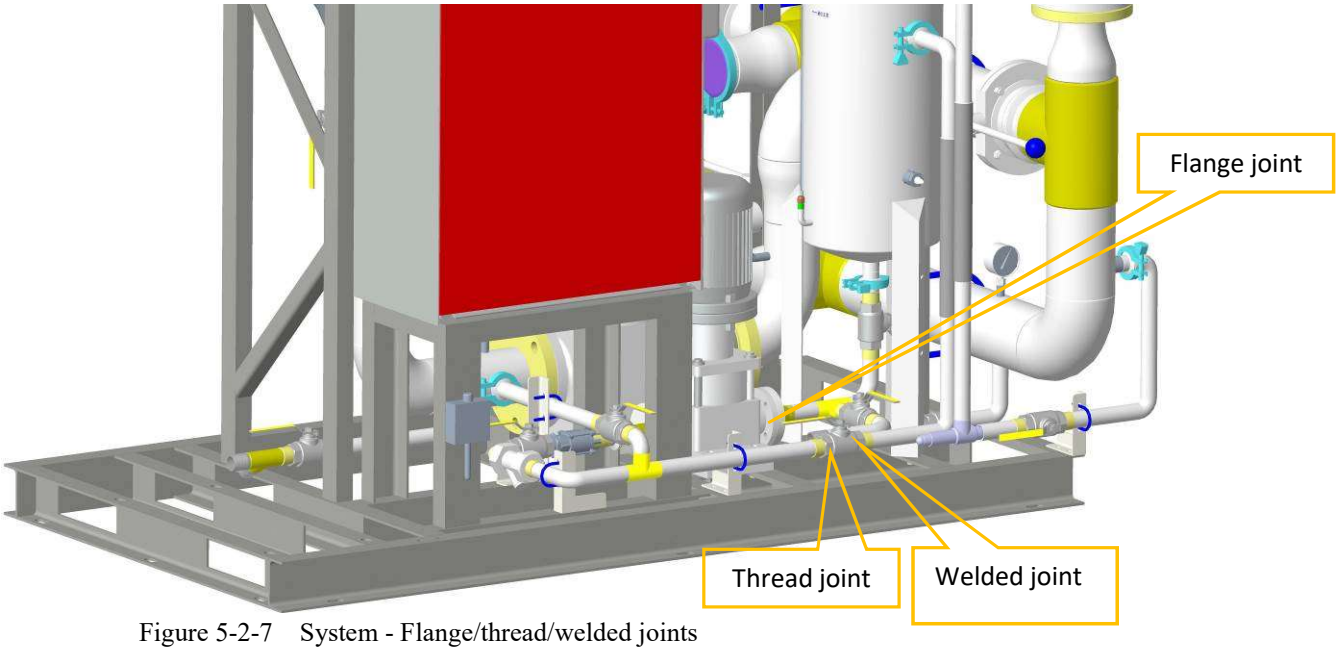

Figure 5-2-7 System - Flange/thread/welded joints

7） The check methods are as follows:

a） Seeing, hearing and touching are applicable to leakage inspection.

b） Choose one of soap, washing powder and detergent, add water to one of them to make soapy liquid and apply it to the suspected leakage points, especially at the connections. The part with bubbles is the leak point.

8） Repressurization：

After the high-calculus server is online, it needs to be checked again for gas-liquid mixture, pressure 7 bar, stable for more than 2h, and check whether there are leakage points in the above

5.3 The system filled with coolant

System rehydration consists of four steps:

1） Preparation: prepare materials and tools and open all exhaust valves of the system;

2） System fluid replenishment: use self-priming pump and fluid replenishment pump to replenish the system;

3） Replenishment of water tank: replenish the water tank with the cooperation of self-priming pump and replenishment pump;

4） Regular replenishment: self priming pump and replenishment pump can be used together, or the manual replenishment port on the top of the water tank can be used to replenish the water tank;

Step 1: preparation

1） Get the coolant ready.

2） Connect the external pipeline according to the ANTSPACE field installation manual;

3） Check if the automatic exhaust valves or the ball valves on the internal and external pipes of the container are opened. (See Figures 5-3-1 through5-3-3);

4） Open the top exhaust valve of the water tank and install the chuck, ensuring that the tank is connected to atmospheric pressure. (See Figure 5-3-2).

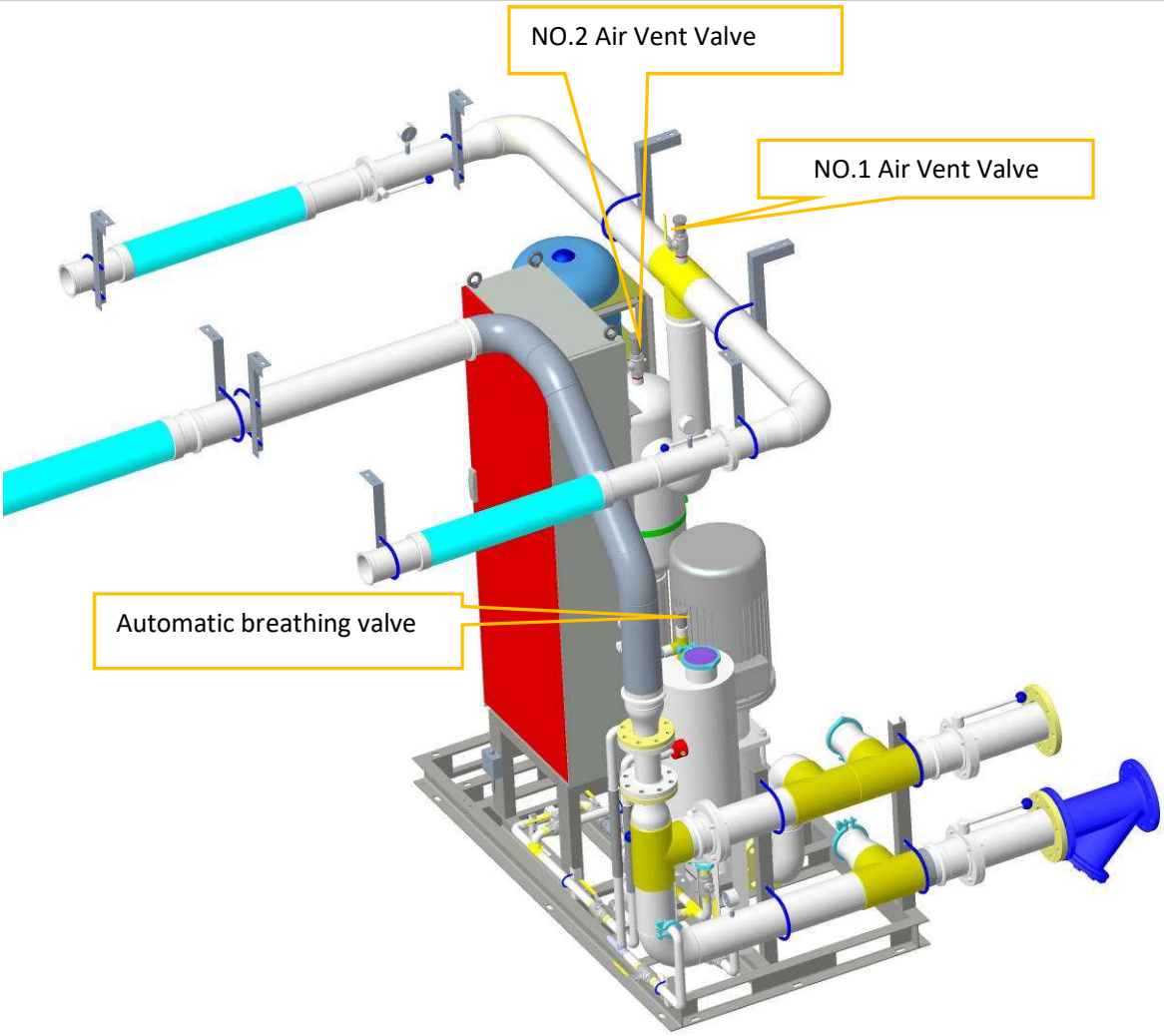

Figure 5-3-1 Internal container - automatic exhaust valve

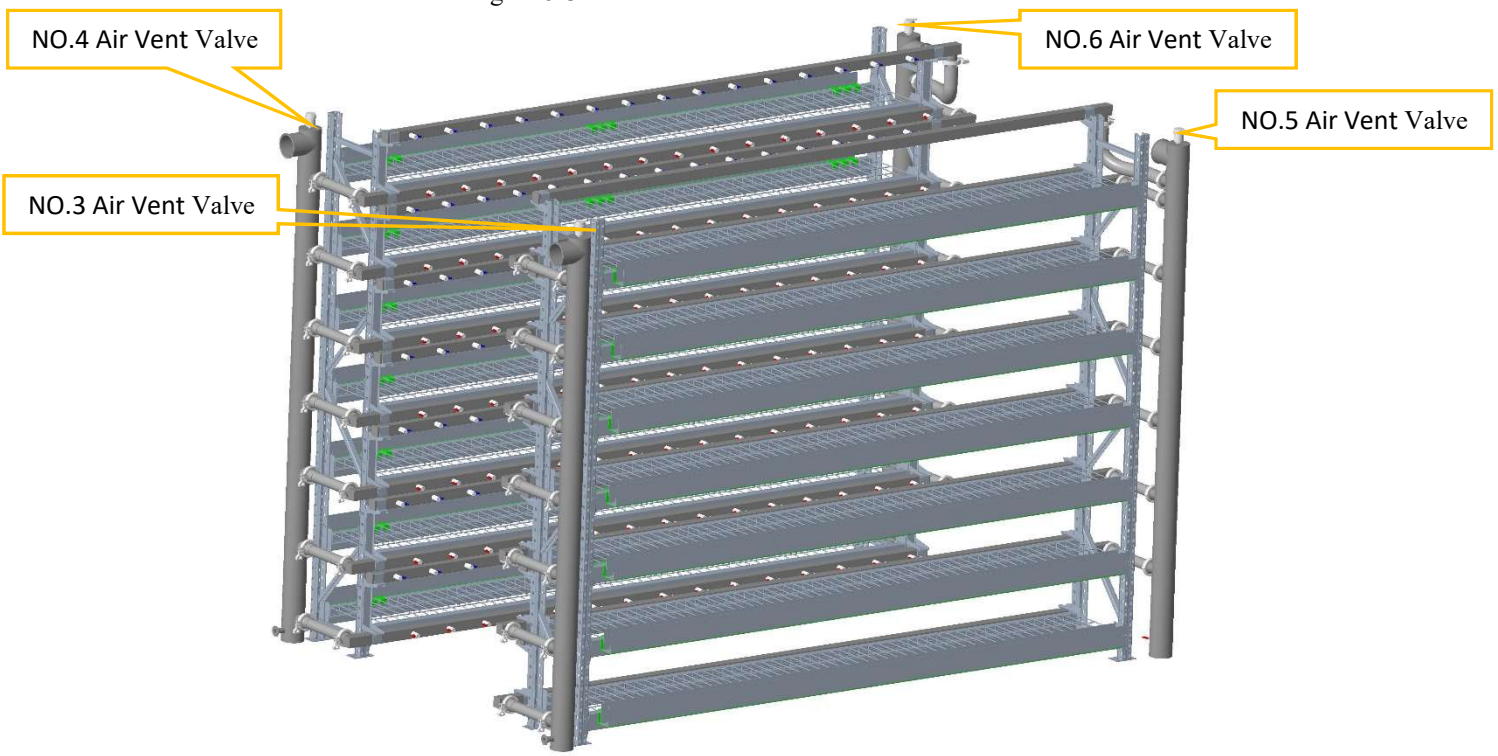

Figure 5-3-2 Manifold-Air Vent Valve

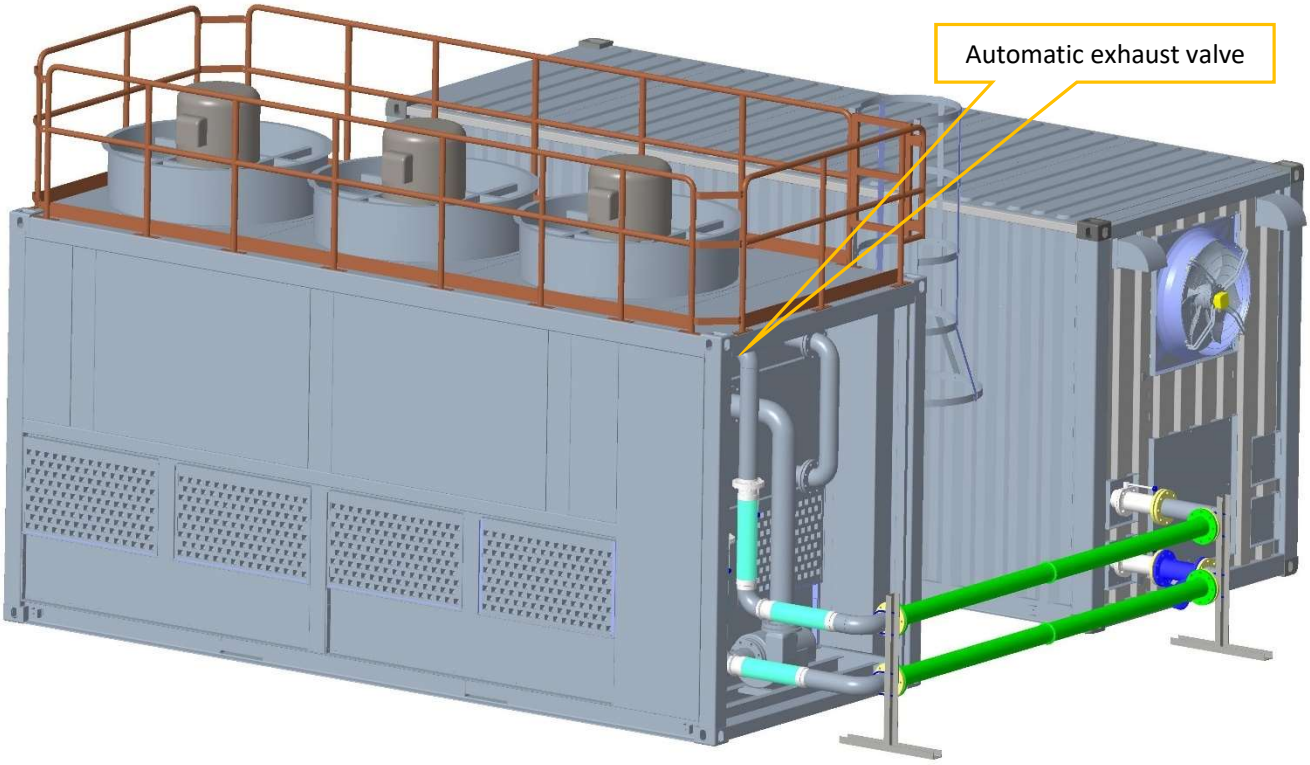

Figure 5-3-3 External connecting pipelines - automatic exhaust valve

Step 2-3：Procedures for the coolant charge:

1） A self-priming pump must be installed outside the container，The self-priming pump needs to inject liquid into the pump head for the first time. Find the port for coolant charge outside the container (at the side door of the container), plug in the hose, and clean it. External coolant is added into the suction port of the self-priming pump. (see Figure 5-3-4)

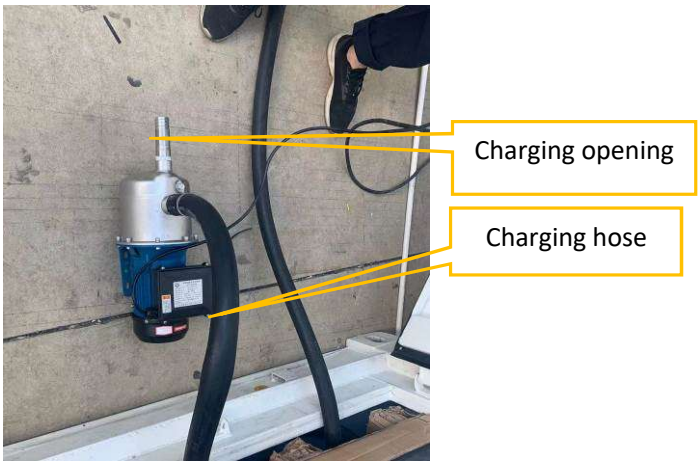

Figure 5-3-4 Pump station - charging hose

Note: the recommended brands and parameters of self-priming pumps are as follows:

(i) Nanfang pump 25qy-2, rated flow 2m3 / h, rated lift 40m, motor power 1.1kw, electric system 380V / 50Hz;

(ii) Lingxiao pump bjz150, rated flow 3m3 / h, rated lift 30m, Output Power 1KW, electric system 380V / 50Hz;

(iii) Nanfang pump 32zw (f) 5-20, rated flow 5M3 / h, rated head 20m, motor power 1.5kw, electric system 380V / 50Hz;

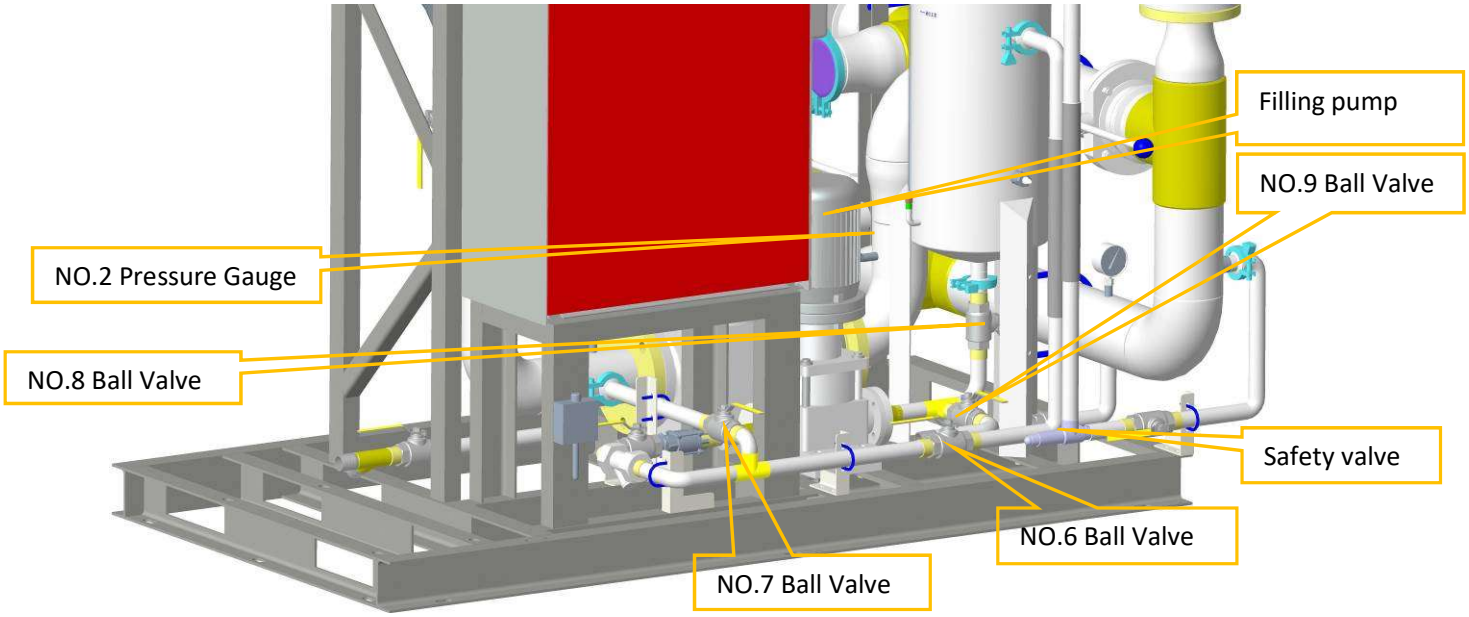

Figure 5-3-5 Pump station - charging valve

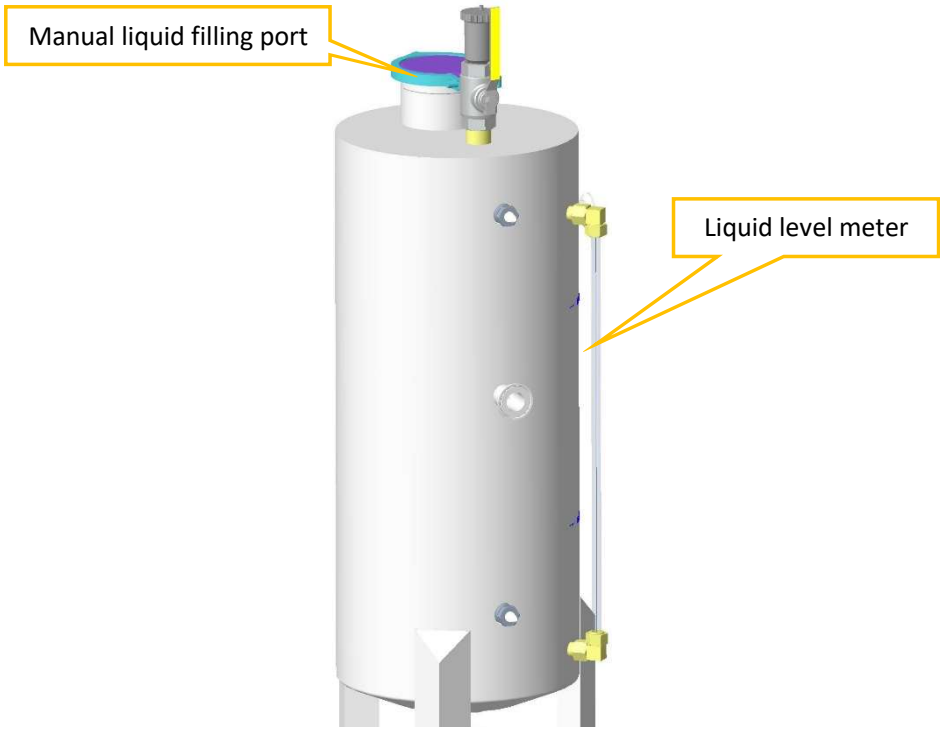

Figure 5-3-6 Pump station - liquid level meter

2） Close NO.8 Ball Valve and NO.6 Ball Valve as shown in Figure 5-3-5, open NO.7 Ball Valve, click on the filling pump on the touch screen interface, and turn it on. The refilling pump can be used for refilling both the system and the water tank. If the valve handle is parallel to the pipeline, the valve is in the open state; if the valve handle is perpendicular to the pipeline, the valve is in the closed state.

3） When the system is filled with liquid, if the static pressure reaches more than 0.7 bar (Refer to figure 5-3-7 for touch screen readings), the circulating pump can operate for 10 seconds, and then it should be stopped.

4） Continue to add liquid. Repeat twice to ensure that 1.3 to 1.5 tonnes of coolant is added.

5） When the static pressure reaches 1.0 bars, stop adding coolant(Just observe the reading of the pressure sensor on the main interface, as shown in figure 5-3-7 below).

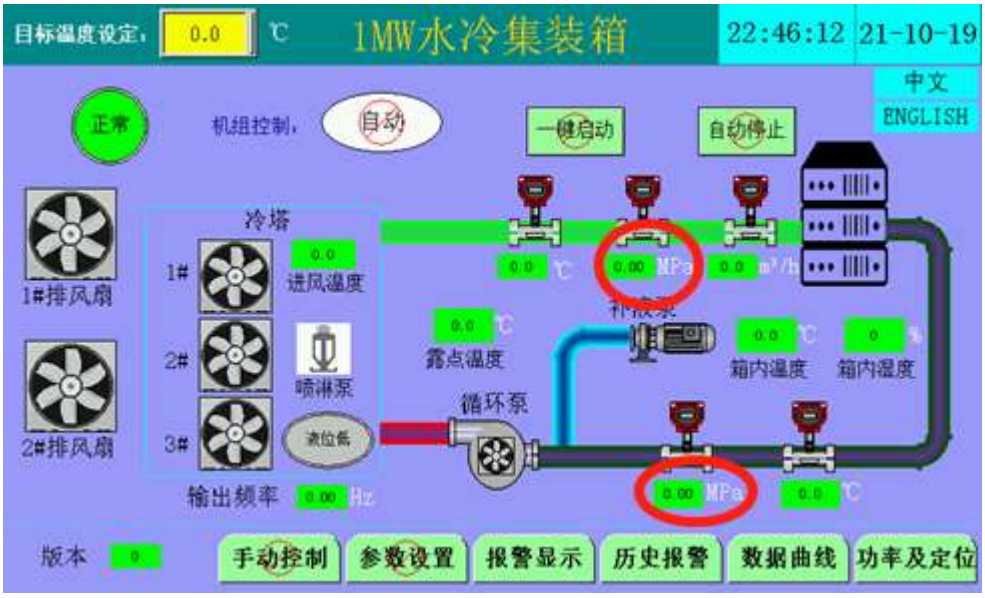

Figure 5-3-7 pressure sensor reading on main interface

6） Then open the circulation pump again, circulate the medium in the system, ensure that the exhaust valves are all opened.

7） Then open NO.6 Ball Valve, close NO.7 Ball Valve, click on the refilling pump on the touch screen interface, and turn it on. Fill the water tank with coolant, and stop refilling coolant when the level gauge in the water tank reaches more than 2/3 (see Figure 5-3-6 for the location of the level gauge).

8） Close NO.9 Ball Valve and NO.6 Ball Valve outside the container, and open NO.8 Ball Valve and NO.7 Ball Valve.

9） After the above operation is completed, the system back pressure (1# pressure gauge/return pressure sensor) will be stabilized at 1-1.5 bar for normal operation.

Step 4：Regular replenishment of water tank

When the water tank needs to add a small amount of coolant, you can open the top exhaust valve of the water tank to install the chuck (see 5-3-6), and manually add coolant to the water tank from the manual feeding port.

Note: If the valve handle is parallel to the valve, the valve is in the open state; if the valve handle is perpendicular to the valve, the valve is in the closed state.

5.4 Electrical wiring

There are two 500 kW PDC inside the equipment. In order to ensure the safe and stable operation of the equipment, two three-phase five-wire cables carrying 500 kW should be prepared on site in advance (no specification is specified). The two cables are respectively connected via the upper two holes on one side of the exhaust fan of the container, see Figure 5-4-1.（Note: the rainproof cloth and rainproof cover in the accessories shall be used for protection）Three-phase cables are connected to the top of two PDC. The zero line enters to the top of PDC, extends to the zero line row where it is installed and fixed with screws.

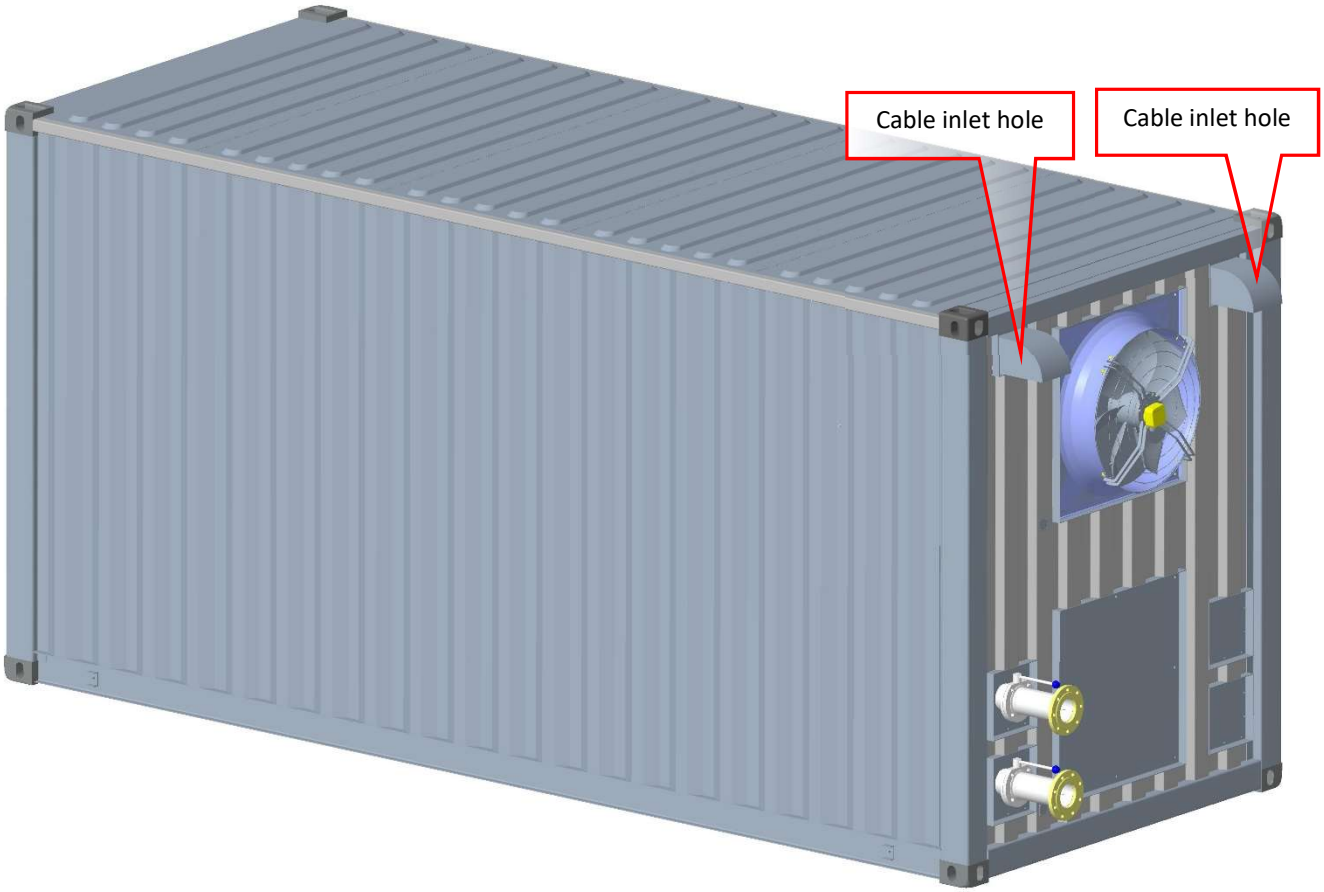

Figure 5-4-1 Cable inlet hole

Both sides of the container have grounding studs, and PDC must also be grounded securely. Therefore, ensure that both the container shell and PDC shell are grounded securely.

When leaving the factory, the phase sequence of the equipment has been determined. After the equipment arrives at the site, it only needs adapt to the phase sequence of the on-site substation. The operation is as follows: connect the three-phase power of the substation to the distribution cabinet, power on the electric control cabinet, and observe whether there is power failure; In case of power failure, please adjust the phase sequence connected to the electric cabinet; If there is no fault, it can operate normally.

The cooling tower is separated from the container, and above the cooling tower are three cooling fans and a spray pump, as well as a liquid level sensor. After the cold tower is fully secured on top of the container, connect cables to four motors and one sensor. After the cold tower is fully secured on top of the container, connect cables to four motors and one sensor as shown in Figure 5-4-2.Five wires have been reserved. The sequence of the three cooling fans is not specified, but their wiring sequence is U, V and W (from left to right), the location of cooling fan as shown in Figure 5-4-3. Among them, cable trough is reserved at the top and side of the cooling tower, and the cables need to be arranged along the trough . The wiring sequence of the spray pump is also U, V and W (from left to right). The position for the liquid level sensor has been reserved. Find the npt1

/ 2 nut and gasket from the cooling tower spare parts box, remove the cooling tower air inlet grid, install the liquid level sensor from inside to outside, and install the liquid level sensor as shown in figure 5-4-4 below.

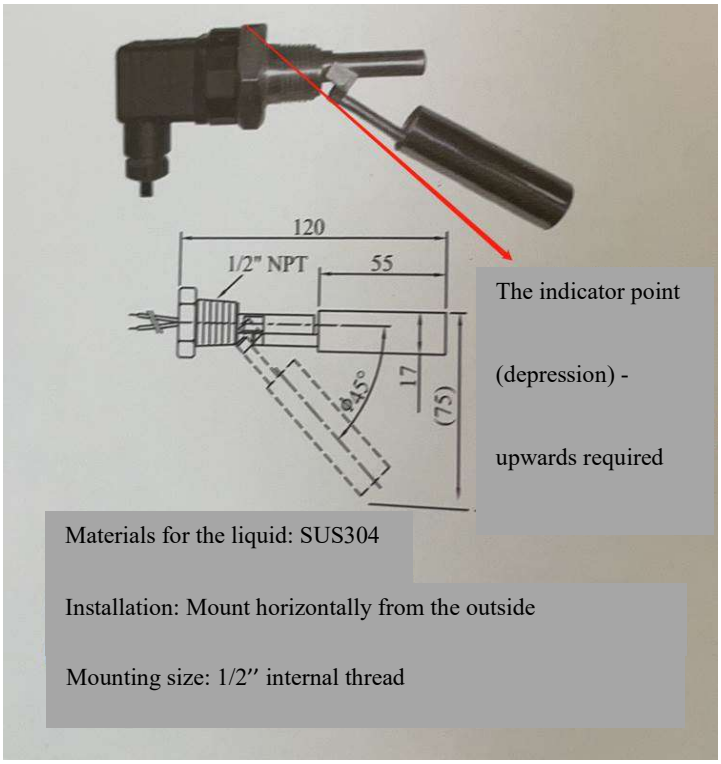

Figure5-4-2 Liquid level sensor

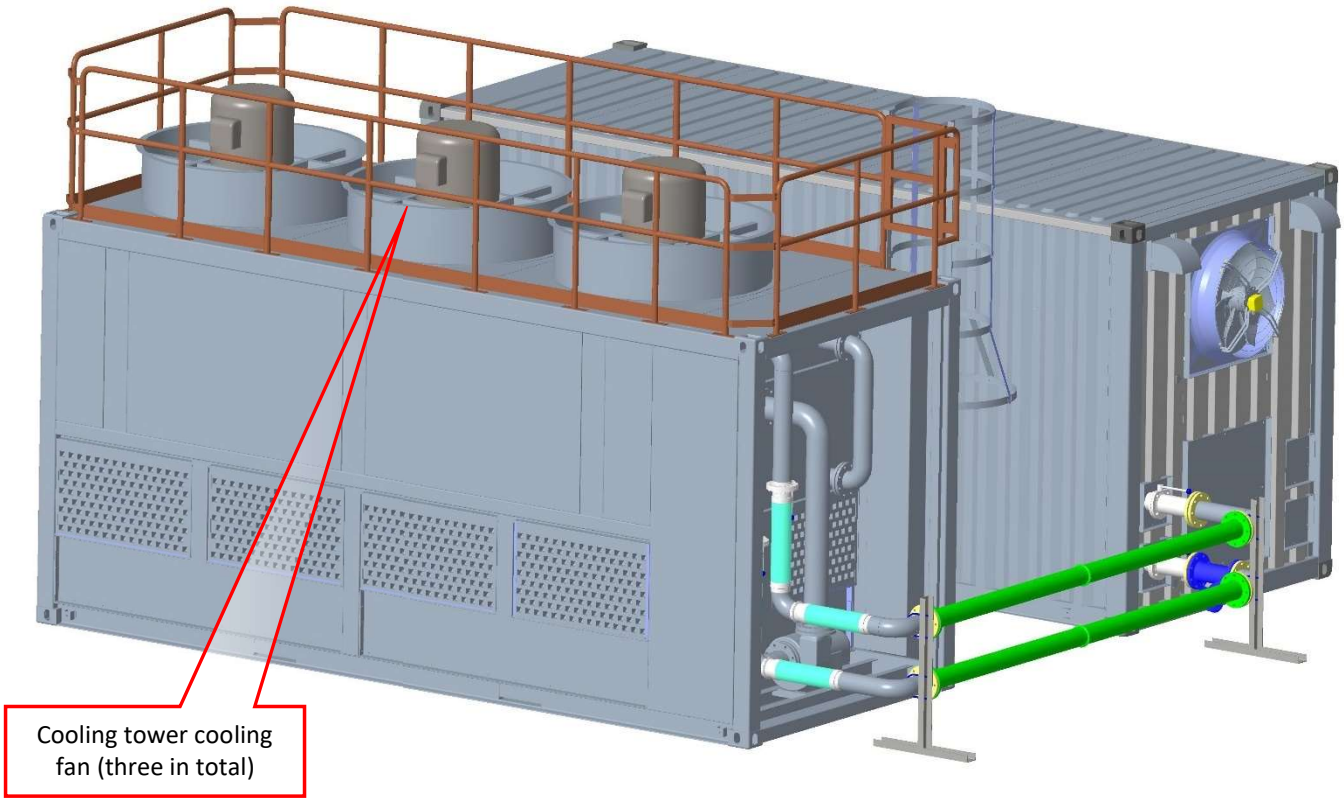

Figure 5-4-3 Location of cooling tower cooling fan

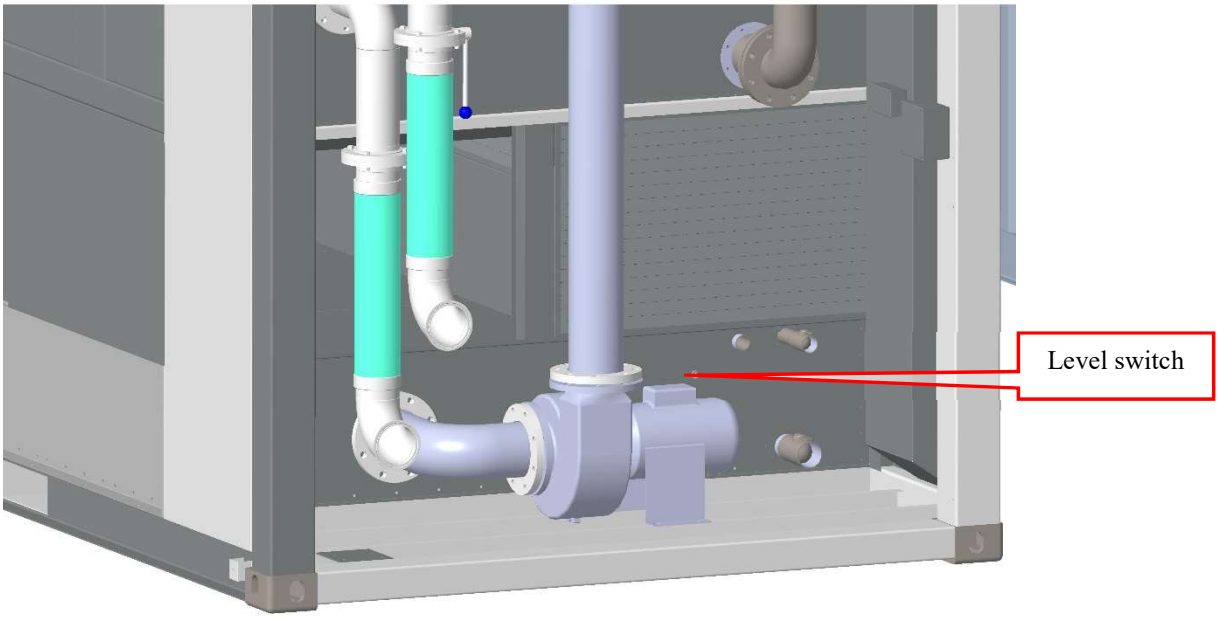

Figure 5-4-4 Installation diagram of liquid level sensor

5.5 System power on and power off process

The switches in the electric cabinet are shown in the figure below:

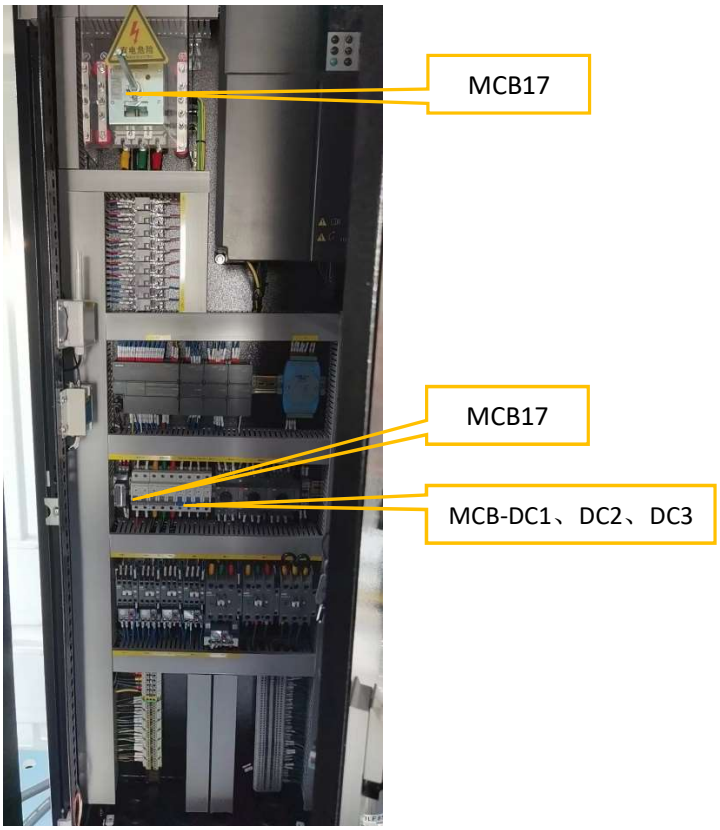

Figure 5-5-1 ECC

5.5.1 Function description of circuit breaker in the system

Table 6-5-1 Function description of circuit breaker in electric cabinet

Switching components (No.)	function
MCB17	Main switch of system control power supply and pump station power supply.
MCB18	The system controls the switch of power supply. After the switch is powered on, the system has AC220V power supply.
MCB-DC1	Switch of DC24V power supply in the system. After the switch is powered on, the sensor in the system can read the signal and upload it to PLC; The touch screen is also powered on, which can control the system from the touch screen end.
MCB-DC2	Switch of DC12 power supply in the system. After the switch is powered on, the face recognition and door magnet in the system are powered on; You can open the door by scanning the face.
MCB-DC3	Switch of DC5V power supply in the system. When the switch is powered on, the camera and main control module in the system are powered on.
MSS6	The circuit breaker is a short-circuit protection switch at the front end of the frequency converter, mainly to prevent the frequency converter from overload.
MCB-31	The circuit breaker is a switch in the electric control cabinet that is responsible for disconnecting the excitation coil of mcb17. When the single circuit breaker is closed and the emergency stop button on the container door is pressed, mcb17 is disconnected and the electric control box is powered off.

Table 6-5-2 Function description of circuit breaker in distribution cabinet A

Switching components (No.)	function
MCB-A1	Main switch of distribution cabinet A
MCB-B1	Pre protection switch of surge protector
MCB-15	Supply power to the switch in distribution cabinet A
MCB-21	Supply power to the electric energy meter in distribution cabinet A
MCB1-1~MCB7-15	Power the computing unit on one side of the container.
MCB-30	The circuit breaker is the excitation coil switch in distribution cabinet A, which is responsible for disconnecting MCB-A1. When the single circuit breaker is closed and the emergency stop button on door of distribution cabinet A or container door is pressed, MCB-A1 is disconnected and distribution cabinet A is powered off.

Table 6-5-3 Function description of circuit breaker in distribution cabinet B

Switching components (No.)	function
MCB-A2	Main switch of distribution cabinet B
MCB-B2	Pre protection switch of surge protector
MCB-16	Supply power to the switch in distribution cabinet B
MCB-22	Supply power to the electric energy meter in distribution cabinet B
MCB8-1~MCB14-15	Power the computing unit on one side of the container.
MCB-32	The circuit breaker is the excitation coil switch in distribution cabinet B, which is responsible for disconnecting MCB-A2. When the single circuit breaker is closed and the emergency stop button on door of distribution cabinet B or container door is pressed, MCB-A2 is disconnected and distribution cabinet B is powered off.

5.5.2 Precautions for the first power on of the system

After the wiring of the whole system is completed, the unit can be powered on for commissioning.

However, before power on, it is also necessary to use a multimeter to measure whether there is a short circuit between phases, between phases and zero, between phases and ground and between zero and ground of the two power supplies. If not, it means

that it can be powered on normally. If there is a short circuit in any of the above items, the fault shall be found out first and then powered on.

After the front-end of the system is powered on (the system itself is not powered on), it is also necessary to measure the voltage of the front-end to see whether it meets the power requirements of the equipment.

The power requirements of the equipment are: AC415V± 5%, 60Hz（UL）/ AC400V± 5%, 50Hz（CE）.

5.5.3 System power on sequence

1: First, power on the electric cabinet:

When the electric control cabinet door is opened, first open MCB17, then MCB 18 and MSS6, and then open the circuit breaker at the front end of the frequency converter. MCB -DC1, MCB -DC2 and MCB -DC3 are 24V, 12V and 5V DC switches. After power is applied, ensure that the three switches are on. At this time, the screen on the cabinet door and the PLC begin to work.

When the electric control cabinet door is closed and the system needs to be powered on, first open the protection switches in the cabinet MCB18, MSS6, MCB-DC1, MCB-DC2, MCB-DC3 and the front end of the frequency converter, then close the cabinet door and open MCB17 through the cabinet door operating handle. At this time, the device is powered on.

Trained electricians can operate the system through the touch screen, set parameters, modify threshold, change operation mode (automatic / manual), start and stop a motor separately or operate automatically. At this time, the liquid cooling system can be operated first to control the liquid supply temperature within the required temperature range, and then the conditions for starting the calculation unit can be met.

2: After the electric cabinet is powered on, the conditions for starting the computing unit can be met only when the liquid supply temperature is maintained near the target temperature according to the operation process of the control system. At this time, the circuit breakers in distribution cabinets A and B can be opened to power on the computing unit. The power on sequence of distribution cabinet is as follows:

First open MCB-A1 and A2, then MCB-15, 16, 21, 22, B1 and B2, and then start rows of computing units in order as required. Since there are 210 computing units in total, there are 14 rows in total. When starting a computing unit, start the next row at an interval of 20s after starting a row (15 computing units), and so on.

5.5.4 System power-off sequence

When the system needs to be powered off for some reason, first disconnect the power supply of the computing unit according to the requirements, in order to ensure that the water temperature of the computing unit is consistent before and after power failure, which is equivalent to protecting the power module of the computing unit.

When the computing unit is powered off, manually stop the liquid cooling system through the touch screen. At this time, the water temperature will rise slightly, but it has no impact on the system. Finally, disconnect the main power supply of the electric control box and distribution cabinet to make the whole system completely powered off.

The above practice is the behavior of safe power failure. However, in case of serious fault in the system, you can directly press the emergency stop button on the inner door of the container to make the main circuit breaker of the distribution cabinet and the main circuit breaker of the electric control box trip instantly, so as to make the system in a complete power-off state, which is convenient for professionals to carry out maintenance work.

5.5.5 Division of personnel responsibilities

Responsibilities of general operation and maintenance personnel:

General power on and power off (disconnect or combine circuit breakers), system startup and shutdown (touch screen key operation), network cable detection and exchange.

Professional electrician responsibilities:

General power on and power off work (disconnecting or combining circuit breakers), system startup and shutdown (touch screen key operation), network cable detection and exchange. When the equipment has short circuit, phase loss, reverse phase, no indication of sensor, no response of corresponding equipment after circuit breaker closing and abnormal

5.6 Screen display

5.6.1 Main screen display

After the screen is powered on, the screen displays as follows:

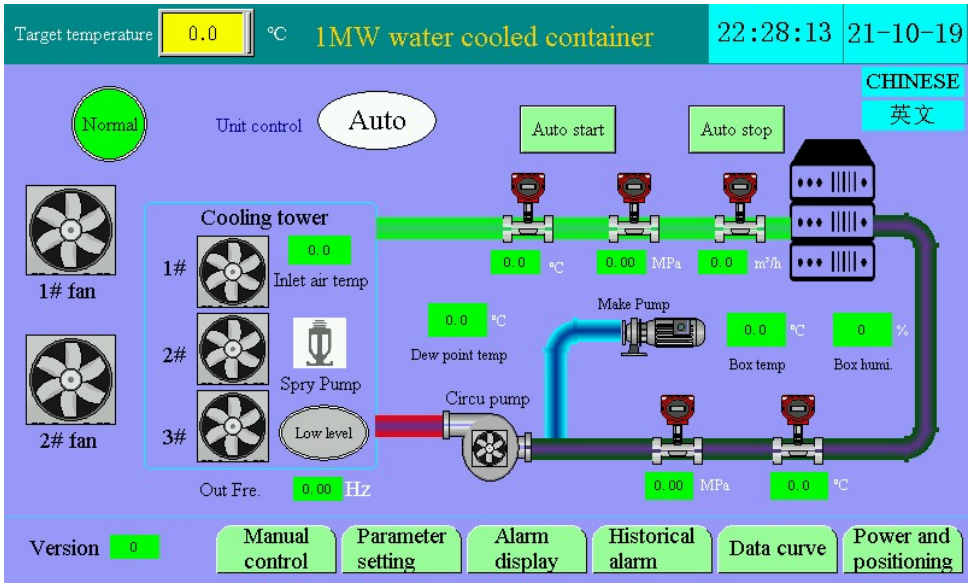

Figure 5-6-1 Main screen display

The main screen displays the unit control mode "automatic / manual", target temperature (settable), total fault display and analog quantity display. The system can set the operation control mode of the unit through the main screen. Manual control is used for commissioning and automatic control is used for system operation.

When the system needs to run automatically, it is necessary to ensure that the pressure in the system is higher than 0.05Mpa, and then all parameter settings in the parameter setting screen have been set. Then click "one key start" in the

main screen, and the motors in the system will be executed according to the automatic control logic sequence. When it needs to be closed, please click "automatic stop" in the main screen.

5.6.2 Manual control screen

When the unit needs to add liquid for commissioning, the unit control mode needs to be adjusted to the "manual" position, and then enter the "manual control" screen, as shown in the following figure:

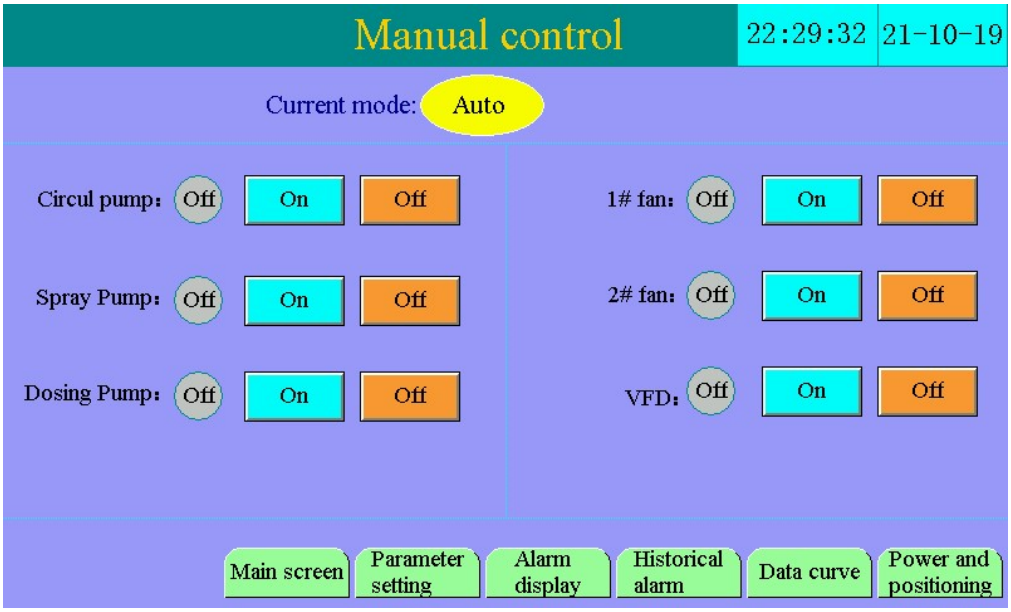

Figure 5-6-2 Manual control screen

At this time, the motor and frequency converter to be operated can be inched. Generally, when the system is filled with liquid, it is necessary to manually start the make-up pump and circulating pump. However, before starting, it is necessary to ensure that the running direction of the motor is correct.

Therefore, after power on, turn on the 1# exhaust fan and observe its running direction. When the wind blows out of the container, it indicates a positive rotation. Before the equipment leaves the factory, all motors have been debugged and rotate forward. Therefore, you only need to observe the running state of one motor. When the motor reverses, it is necessary to phase adjust the three-phase power input to MCB17, that is, change the phase sequence of two cables.

5.6.3 Parameter setting screen

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

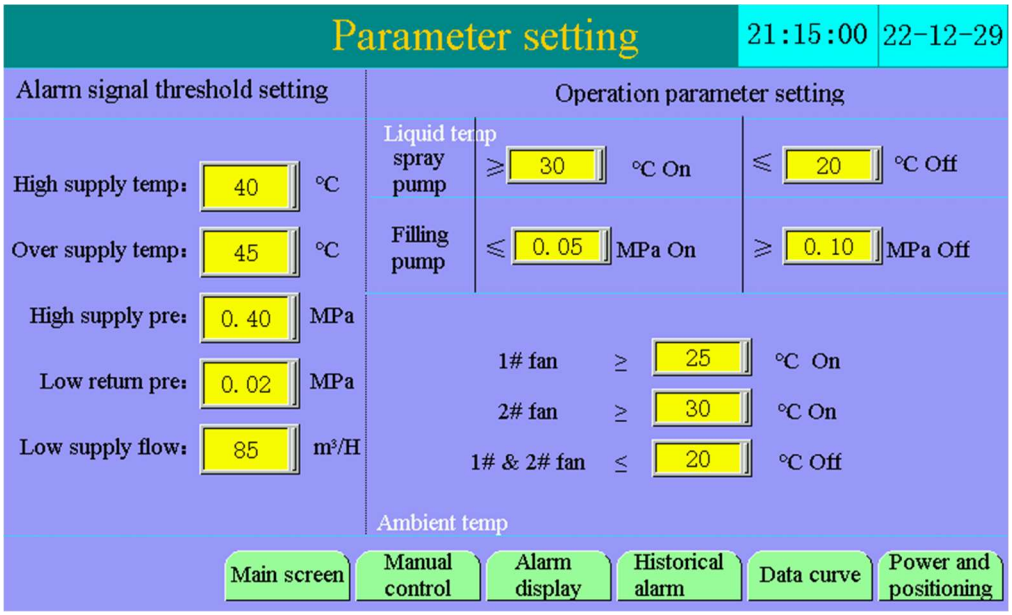

Figure 5-6-3 Parameter setting screen

Real parameter setting value, please follow this setting.

5.6.4 Alarm display screen

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

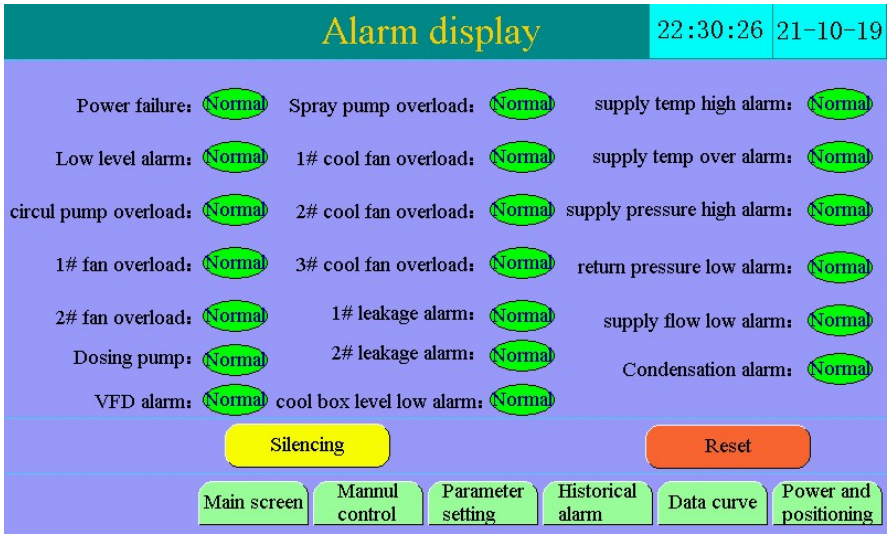

Figure 5-6-4 Alarm display screen

After a fault occurs, the alarm sound will sound. You can click "Silence" to first analyze the cause of the fault, then troubleshoot the fault, and finally click "reset" on the screen.

5.6.5 Historical alarm screen

The alarm information in the system will be saved in this screen with time record, which is convenient for the user to find the time of failure.

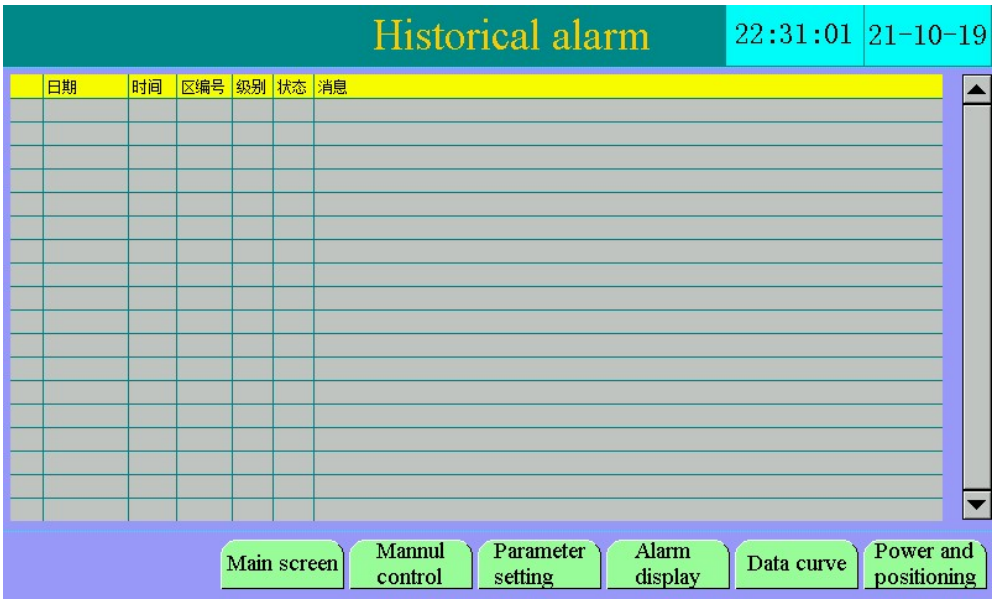

Figure 5-6-5 Historical alarm screen

5.6.6 Data curve screen

The information of liquid supply temperature, liquid return temperature, liquid supply pressure, liquid return pressure and liquid supply flow can be displayed in this screen. Each analog quantity corresponds to a different color.

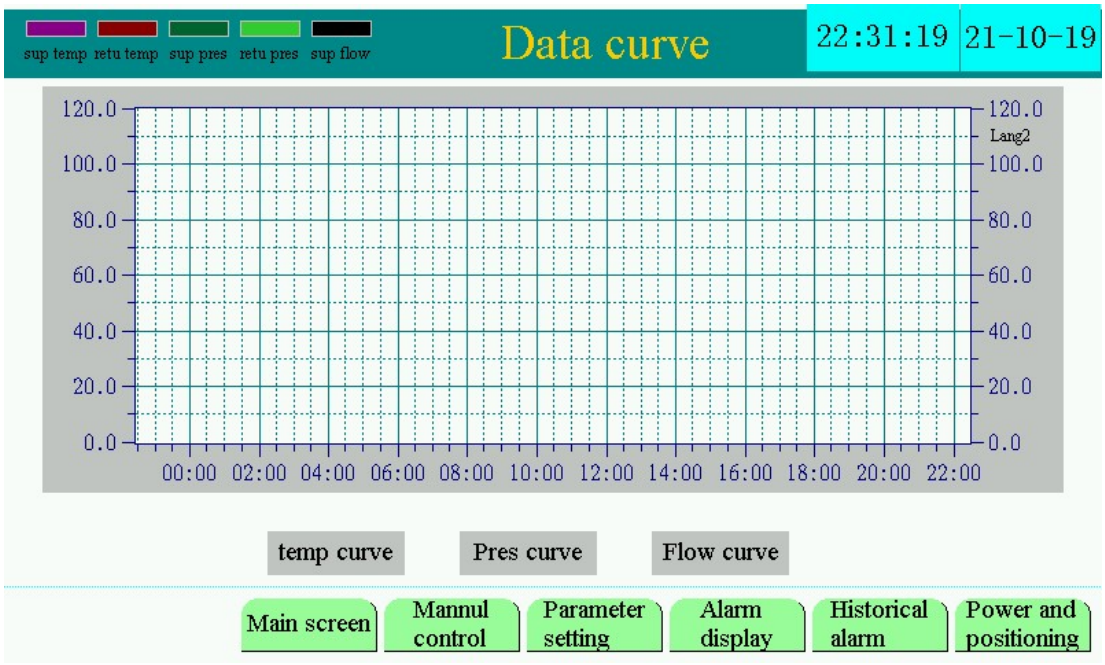

Figure 5-6-6 Data curve screen

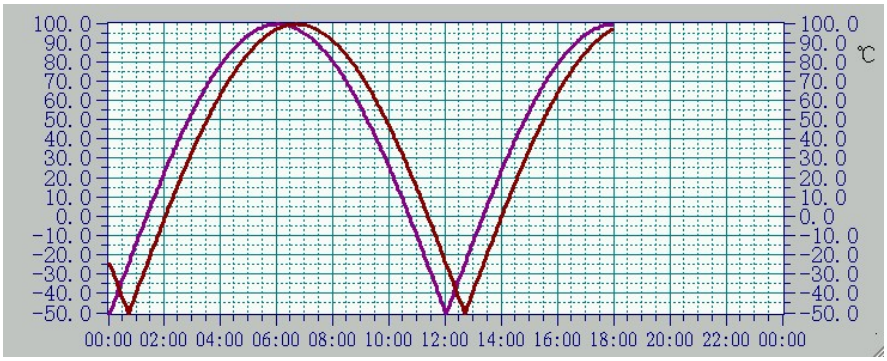

Figure 6-6-7 temperature curve

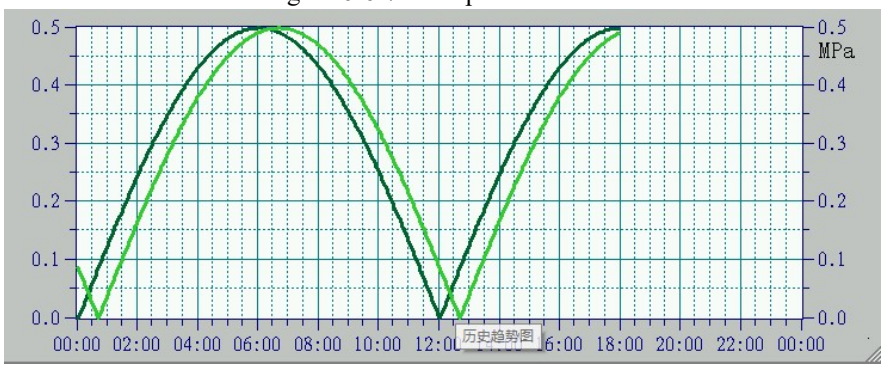

Figure 5-6-8 Pressure curve

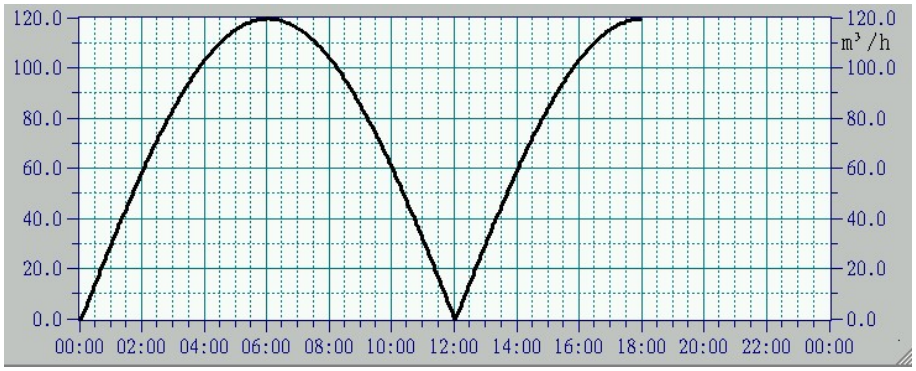

Figure 5-6-9 Flow curve

5.6.7 Power and positioning picture

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

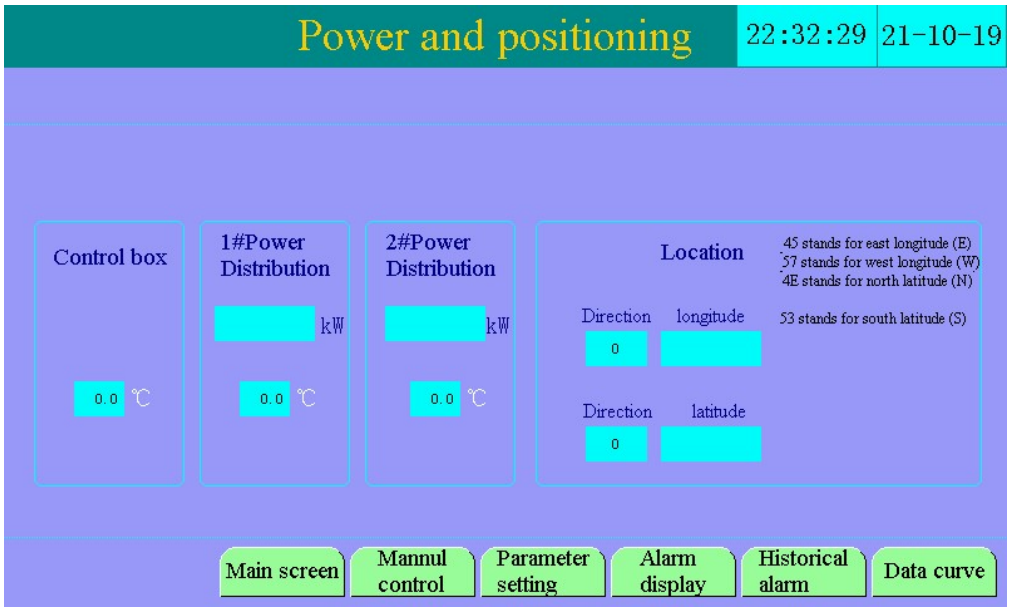

Figure 5-6-10 Power and positioning

6. Common faults and troubleshooting methods of ANTSPACE HK3

Table 6-1 List of common equipment faults and troubleshooting methods

Fault type	Cause Analysis	Solution	Remarks
Electricity failure	1: Phase failure	1: Check whether the main power supply lacks phase	
	2: Overvoltage	2: Turn off the upper-level air switch MCB-C (in the power distribution cabinet) to ensure that the electric control box is not charged, and use a flat-blade screwdriver to increase the overvoltage value	
	3: Undervoltage	3: Turn off the upper air switch MCB-C (in the power distribution cabinet) to ensure that electric control box is not charged, and use a flat-blade screwdriver to adjust the undervoltage value	
	4: Wrong phase	4: Adjust the phase sequence of the power line of power distribution cabinet connected to the electric control box	
Low liquid level alarm	The water tank level in the container is low	Replenish the water tank in the antsapce	
Circulating pump failure	Idling of the pump, underpressure (low return pressure), etc. lead to overcurrent in the circulating pump	1: First turn off the air switch (MCB17) in the electric control box; 2: Reset the thermal relay (corresponding to FR1) in the electric control box (manually press RESET in the thermal relay); 3: Check whether the operating parameters of the system are normal (pressure and flow will report failure first), and troubleshoot the problem according to the alarm failure; 4: After an interval of 2-3 minutes, turn on the circulating pump	
1#/2# Exhaust fan failure	Excessive current of exhaust fan may entrain strips in the fan	1: First turn off the air switch (MCB17) in the electric control box;	

	blades, hindering the operation of fan	2: If there is debris in the fan blade, clean the debris first; if there is no debris, and the fan fails for no reason, operator needs to contact the manufacturer 3: Then reset the thermal relay in the electric control box (1# exhaust fan corresponds to FR21; 2# exhaust fan corresponds to FR22) (manually press RESET in the thermal relay); 4: Turn on the exhaust fan after an interval of 2-3 minutes	
Refill pump failure	1: Dirty blockage of the fluid replacement Y-type filter causes overload	1: First turn off the air switch (MCB17) in the electric control box; 2: Reset the thermal relay (corresponding to FR3) in the electric control box (manually press RESET in the thermal relay); 3: Clean the Y-type filter; 4: After an interval of 2-3 minutes, turn on the rehydration pump	
	2: The position of suction port of the refill pump is too low, resulting in overload	1: First turn off the air switch (MCB17) in the electric control box; 2: Reset the thermal relay (corresponding to FR3) in the electric control box (manually press RESET in the thermal relay); 3: Make external suction port lower than the coolant tank; 4: After an interval of 2-3 minutes, turn on the refill pump	
Spray pump failure	The water tank suction inlet filter is dirty, causing overload	1: First turn off the air switch (MCB17) in the electric control box; 2: Reset the thermal relay (corresponding to FR4) in the electric control box (manually press RESET in the thermal relay); 3: Check if the filter in the cooling tower water tank is dirty and blocked, clean it if dirty; 4: After an interval of 2-3 minutes, turn on the spray pump	After the system is powered on, the spray pump cannot be idling without liquid in the system
1# cooling fan failure 2# cooling fan failure 3# cooling fan failure	Excessive current of the exhaust fan may entrain strips in the fan blades, hindering the operation of the fan	1: First turn off the air switch (MCB17) in the electric control box; 2: If there is debris in the fan blade, clean the debris first; if there is no debris, and the fan fails for no reason, please contact the manufacturer; 3: Then reset the thermal relay in the electric control box (1# fan corresponds to FR51; 2# fan corresponds to FR52; 3# fan corresponds to FR53) (manually press RESET in thermal relay); 4: Turn on the cooling fan after an interval of 2-3 minutes.	
Leakage alarm	Liquid leaked from liquid inlet and outlet of the miner to the floor, soaking the liquid leakage sensor	1: Find the location where there is liquid on the floor; 2: On the top of this part, carefully look for liquid leakage from the liquid inlet and outlet of the miners; 3: After finding the leaking part, replace quick plug and replace the bellows, then clean the leaking site, and wipe the leaking monitoring tape to dry.	
Low cooling tower liquid level alarm	The water level in the cooling tower decreases	Replenish the cooling tower in time and reset the fault	After the cooling tower liquid level low alarm occurs, the system starts timing. After about 50 minutes, the spray pump

			stops spraying. In order to prevent the miner from overheating due to the spray pump stopping spraying, please replenish the cooling tower in time after the alarm.
High liquid supply temperature alarm	1: The cooling fan does not run	Check whether the fan is running normally, check whether the power supply circuit of the fan is normal	
	2: The spray pump does not run	Check whether the spray pump is running normally, and check whether the power supply circuit of spray pump is normal	
	3: The temperature sensor is damaged	Replace the temperature sensor; the high alarm value of liquid supply temperature can be set on the screen as required	
	4: The water level of the cooling tower is abnormal	Check the water level of the cooling tower to ensure normal water replenishment	
High supply liquid temperature alarm	After the high liquid supply temperature alarm occurred, the operation and maintenance personnel did not deal with it in time, causing the liquid supply temperature to continue to rise	Before finding out the cause, consider shutting down some mining machines, reducing the load, and then looking for the cause of high liquid supply temperature alarm; The alarm value for high liquid supply temperature can be set according to the needs on the screen	
High supply pressure alarm	1: The filter is clogged	Cleaning the filter element	
	2: The supply and return valve is faulty or not fully opened	Open the supply and return valve	
	3: Pressure sensor failure	Replace the pressure sensor	
Low return pressure alarm	1: The water tank is short of liquid	Refill the water tank	
	2: Refill pump failure 3: Pressure sensor failure	Check the cause of the failure of refill pump Replace the pressure sensor	
	4: Leakage	Check the system for leaks	
Low supply flow alarm	1: The supply and return valve is faulty or not fully opened	Open the supply and return valve	
	2: The filter is dirty and blocked	Clean filter element	
	3: Flow sensor failure	Replace the flow sensor	
	4: Leakage	Check the system for leaks	
Condensation alarm	Environmental humidity is high	After on-site operation and maintenance checks the alarm information, it is only necessary to increase the target value of liquid supply temperature by 5°C to prevent condensation.	The logic set in the program is as follows: when the dew point temperature value> the supply temperature value -5°C, the system will prompt a condensation alarm.
Pressure fluctuations	1: There is air in the system	Require on-site operation and maintenance personnel to open the exhaust valve to exhaust	
	2: The system is short of fluid	If the return pressure is lower than the set value, the refill pump will automatically refill the system	
	3: The sensor is damaged	Replace the sensor	
No pressure display	1: The sensor is damaged	Replace the sensor	
	2: The cable is loose	Check the wiring circuit of the pressure sensor and tighten it	
	3: The PLC acquisition channel is damaged	Change the acquisition channel or change the PLC	
The pump is running but the	1: There is air at the suction port of pump	Use a wrench to open exhaust port above the suction port of the water pump, wait until there is even liquid flowing out, and repeat 2-3 times	

flow is insufficient		(refer to the maintenance manual for specific operations)	
	2: The filter is clogged	Clean the filter element	
	3: The system is short of liquid (low return pressure)	System rehydration	
Fan does not run	1: Motor burns out	Replace the fan	
	2: The cable is loose	In the case of electrification, use a multimeter to check the power supply of fan, and tighten it in the case of power failure	
	3: Air switch tripped	Close the air switch	
Noise and abnormal sound	1: Water pump cavitation	Detect the pressure on the suction side (return pressure or pressure gauge) and refill in time	
	2: Pump shaft connection problem	Check the mechanical connection of the pump shaft	
	3: Insufficient lubrication of motor shaft	Add lubricating oil	
	4: Safety valve action	Check if there is too much liquid in the water tank to release the pressure in time, and drain the excess liquid in the water tank	
Water pump shaft seal leakage		Replace the water pump shaft seal	

7. Maintenance of ANTSPACE HK3

7.1 Introduction

Preventive maintenance is to reduce the probability of product failure or prevent functional degradation, and is to be done according to the scheduled time interval or in accordance with the specified standards, mainly including adjustment, regular inspection and necessary repair. Through preventive maintenance, equipment maintenance technicians and operators can be familiar with the product performance, structures, principles, methods of use and precautions, so that the equipment can play its due function.

Good maintenance ensures that the equipment is in good working condition.

7.2 Preventive maintenance

7.2.1 Monitored by operators

When using the equipment, operators should monitor its status to discover potential faults.

Once the operator discovers the system has the fault alarm, he should carry on the fault confirmation and inspection quickly, and finds the fault cause.

7.2.2 Inspection during use of the equipment

When using the equipment, the operator shall conduct a qualitative check according to the plan to determine whether the product performs its specified functions.

a) Check whether the liquid supply and return pipelines and power circuits are properly connected.

Inspection requirements: all pipelines and connections shall be free of leakage and cables shall be free of damage;

Inspection method: visual inspection;

b) Check whether the liquid return pressure (back pressure) is low, and timely refill the coolant.

Inspection requirements: the return pressure value is higher than 0.05Mpa (observe the main interface of the touch screen or 1# pressure gauge). If the pressure is lower than this value, it needs to be replenished.

Inspection method: visual inspection and data comparison.

c) Check the liquid supply system and record the temperature and pressure data every half day.

Inspection requirements: record the data of liquid supply / return temperature, liquid supply / return pressure and liquid supply flow, and observe whether the data tends to be stable in long-term operation.

Inspection method: visual inspection and data comparison.

d) Check the fault alarm of the system, such as temperature, pressure, flow, etc. (the above fault state is displayed on the fault alarm screen of the touch screen), and record it every half day.

Inspection requirements: check the system alarm points and conduct troubleshooting according to the instructions;

Inspection method: visual inspection and as required.

7.3 Scheduled maintenance

7.3.1 Maintenance of Y filter

The system is divided into inner circulation and outer circulation. The inner circulation medium is coolant, and the outer circulation medium is tap water. The system has been set filtration of the internal and external circulation. When the system runs for a period of time, the filter needs to be cleaned.

There are three filters, and their corresponding cleaning time requirements are as follows:

1) Spray pump suction filter of cooling tower: the cleaning cycle is once a month.

2) Y-type filter of inner circulation in the liquid supply system of the pump: the cleaning cycle is once every six months(On Demand).

3) Y-type filter of inner circulation in the liquid replenishment system of the pump: the cleaning cycle is once a year.

Cleaning method: wash it with water, rinse it and air dry it before use.

Replacement steps:

a） Cut off the main power supply of the equipment;

b） Locate and close the butterfly repair valve in the system shown in Figure 8-3-2, unscrew the plug on the filter end cover, and partially drain the pipeline;

c） Locate the position of the Y-type filters in Figures 8-3-1 and 8-3-2.

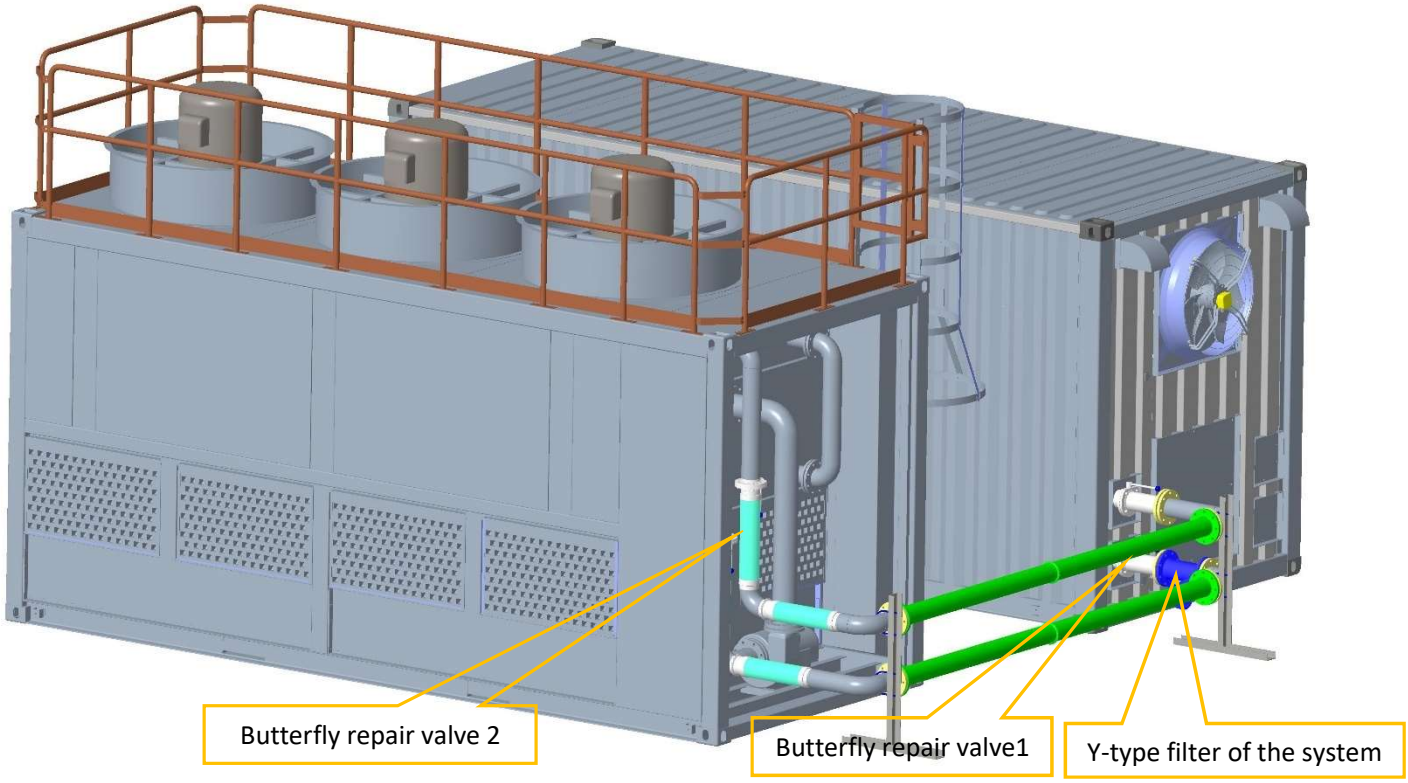

Figure 8-3-1 Positions of the butterfly repair valve and the Y-type filter in the pipelines

d） After finding the filter, unscrew the cap on the filter with an adjustable wrench.

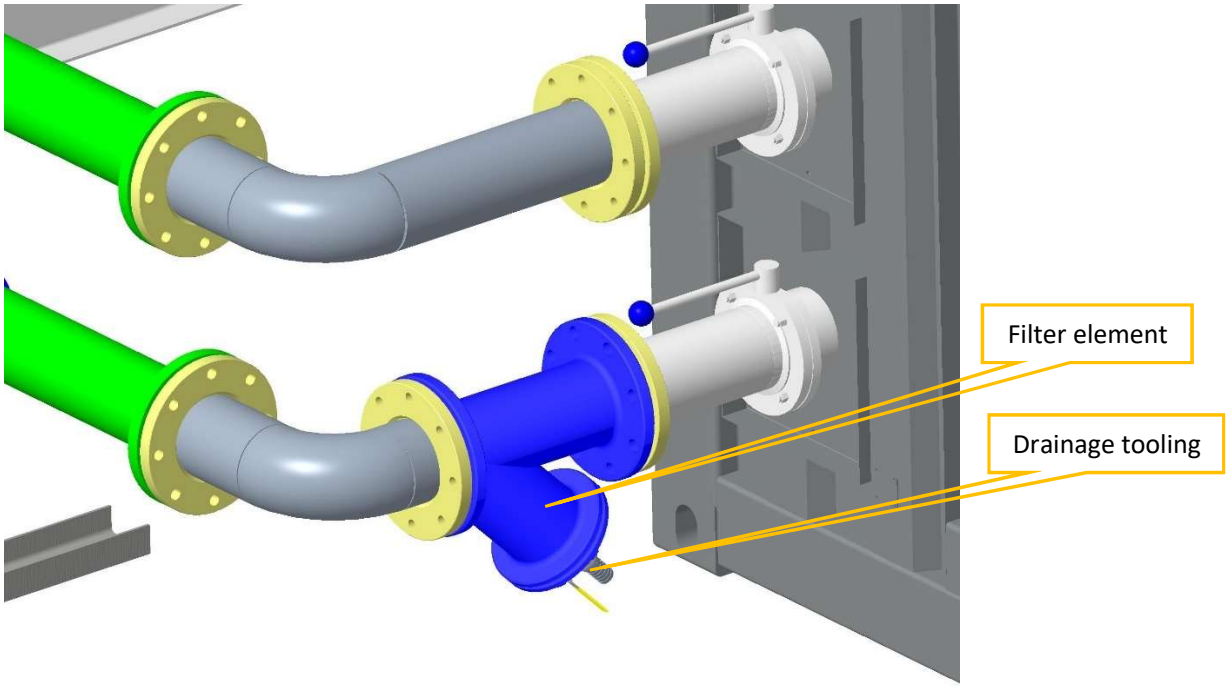

Figure 7-3-2 View of filter

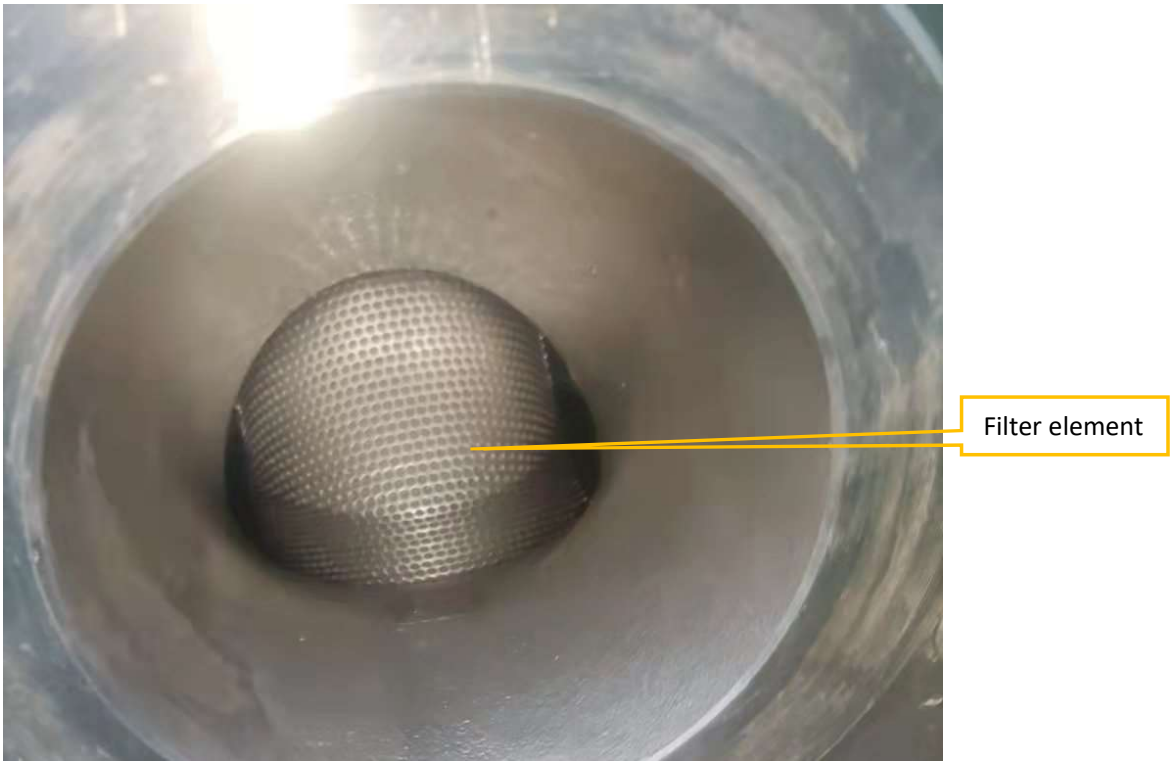

Figure 7-3-3 Schematic diagram of filter cap unscrewed

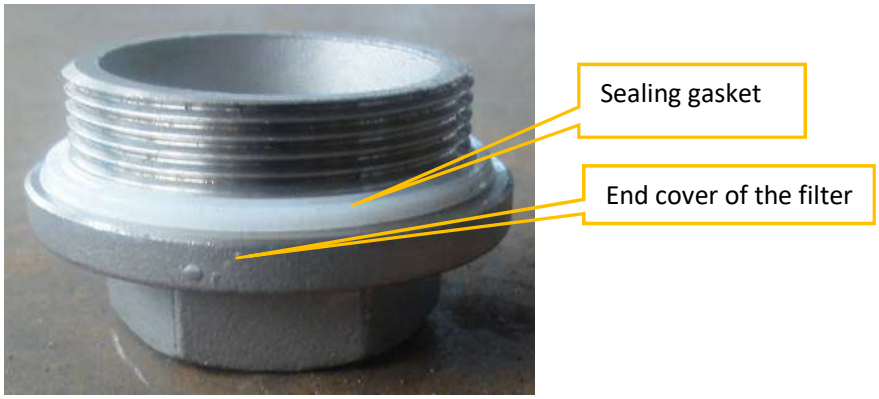

Figure 7-3-4 Schematic diagram of filter cap

e） Remove the filter inside the filter for cleaning (or replacement)

Installation methods:

a） Install the cleaned filter screen and tighten the filter cover with a wrench.

b） Power up the equipment and charge coolant into the system.

Note: the gasket on filter cover should not be damaged.

7.3.2 Pipeline leakage maintenance

When the equipment runs for half a year, the pipe network should be checked for leakage. If leakage is found, the equipment should be stopped immediately for maintenance. During maintenance, the operation of the client load device should be stopped first, and then the unit should be stopped. After the completion of leak detection, the system shall be replenished.

7.3.3 Maintenance of electrical components

After the equipment runs for half a year, it is necessary to check and maintain the wiring terminals and crimping screws on the electrical components of the electric control box inside the water pump cabinet to prevent wiring terminals and crimping screws from loosening, resulting in poor contact and damage of components, and abnormal operation of the unit, thus affecting the work of the whole liquid cooling device.

7.3.4 System sewage discharge

After two years of operation of the system and the water tank, there may be some sundries in the system pipelines, so the sewage in the system should be discharged in a timely fashion.

Sewage discharge steps:

a） Locate the position of NO.1-3 Ball Valve and NO.9 Ball Valve. (See Figure 8-3-5)

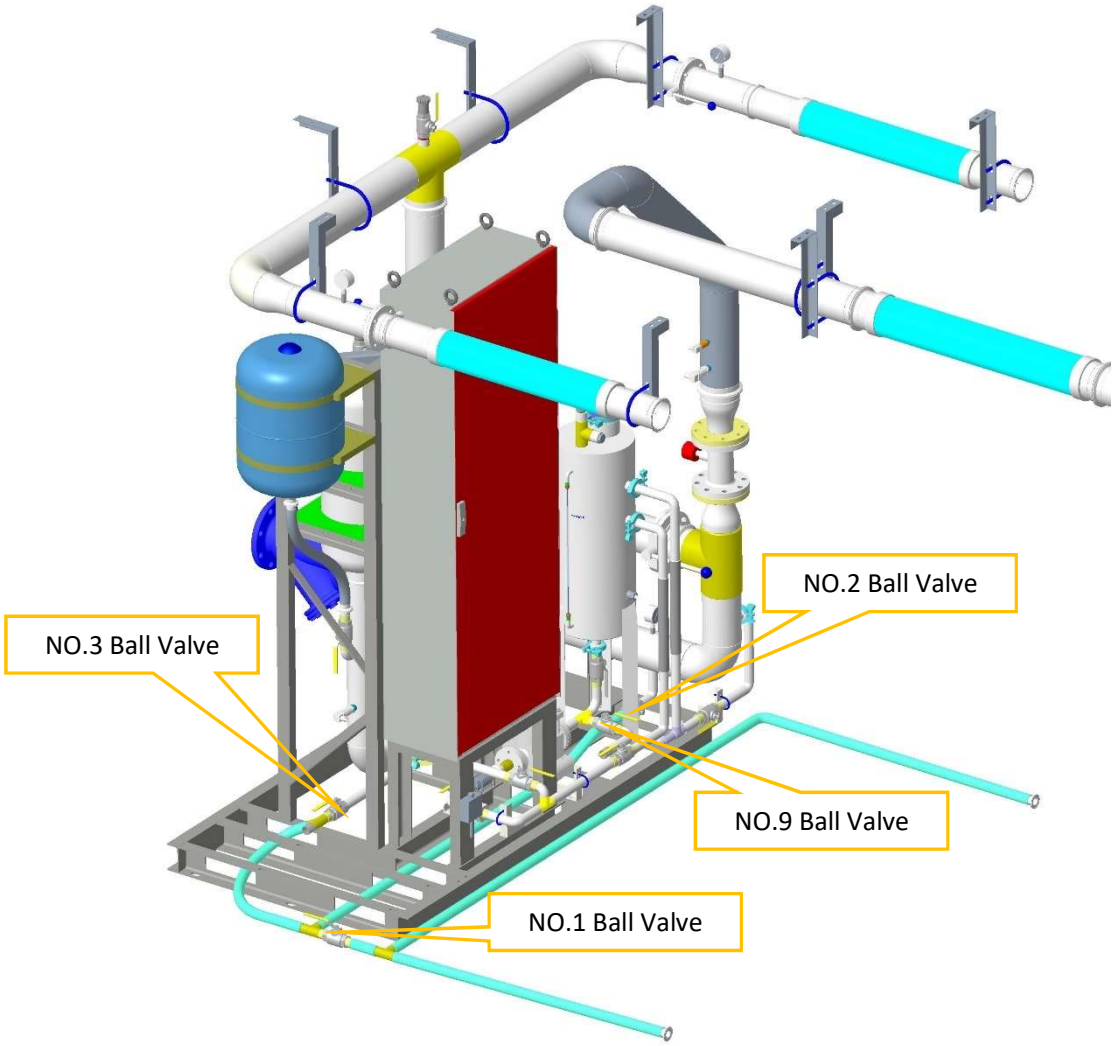

Figure 8-3-5 Filling/discharging valve for the pump station inside the container

b） Connect the drain hose to No. 2 ball valve and No. 3 ball valve, tighten with a hose clamp; Lead the hose out of the unit and open No. 1-3 ball valve and No. 9 ball valve to drain the system.

7.3.5 Checking of the liquid level in the water tank

The system monitors the liquid levels in two water tanks (in the container and in the cooling tower). When the liquid level in the water tank is lower than the required value, a sound and light alarm on the touch screen of the system will go off to indicate the low water level in the water tank. In this case, the fault should be checked and the liquid should be replenished in a timely fashion.

But even if the alarm does not go off for the tank level, the tank level should be checked regularly. The water tank level in the container must be checked once a week after stable operation. If the liquid in the water tank cannot reach 2/3 of the water tank, it is necessary to replenish liquid in a timely fashion. The water tank level of the cooling tower should be checked once a day, and shortage of water is not allowed, unless air cooling mode is adopted in winter, in which case the water inside the cooling tower needs to be emptied.

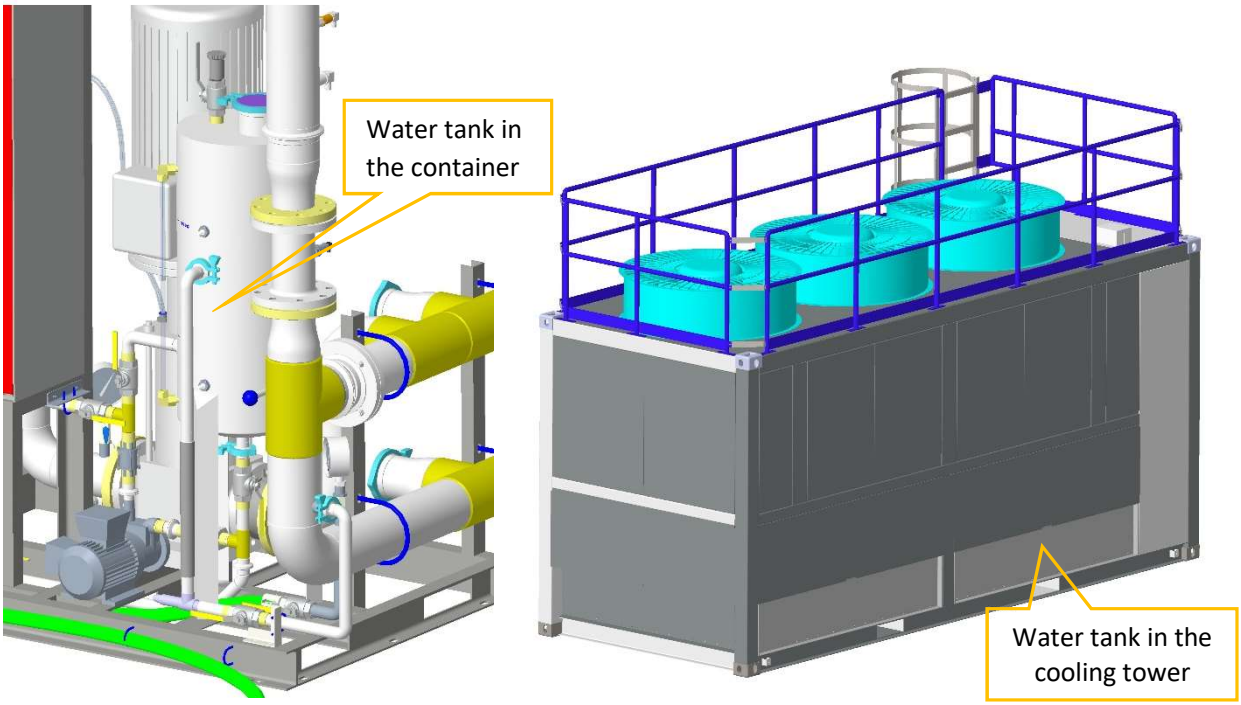

Figure 7-3-6 Water tanks in the container and in the cooling tower

7.3.6 Maintenance of coolant

1） As the core unit of ANTSPACE Liquid Cooling System, it is recommended to track and test the coolant regularly, at least once half year.

2） When purchasing coolant, pay attention to the relevant parameters in Table 8.3.1.

3） The coolant should be tested regularly with a focus on the pH value. It is not recommended to use the coolant when the pH value is lower than 7 (a pH indicator can be added to the coolant. When the pH value is lower than 6.8, the coolant will change color for easy observation). The detection methods are shown in the table below.

4） Freezing point, glycol ratio, total hardness, etc. should be tested. Pay attention to the content of aluminum, ferrum, copper and other elements. If the content of these elements increases, it means that contact corrosion has been produced. The detection methods are shown in the table below.

5） It is recommended to periodically add corrosion inhibitors to the antifreeze solution according to the requirements of the supplier.

Table 8-3-1 Recommended standards for testing coolant

Items	Physical and chemical indicators		Recommended reference standards for testing
Color	Significant color		Visual inspection
Appearance	No peculiar smell, no precipitation, no suspended matter		Visual inspection
Freezing point	-45℃ (low temperature)		
Boiling point	108℃ (low temperature)		
PH value	7-9		
Reserve alkalinity	≥ 4 ml (Organic formula) ≥ 9 ml (Inorganic formula)		
Total hardness	< 120 mg/l		
Content of main elements	B	<20 mg/kg	
	Si	<20 mg/kg	
	P	<20 mg/kg	
	Mo	<20 mg/kg	

	Ca	<20 mg/kg	
	Al^{3+}	<50 mg/L	
	Fe^{2+}	<50 mg/L	
	Cu^{2+}	<50 mg/L	

Note 1: Table 7-3-1 is for the working environment temperature is lower than 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 as the secondary side of the internal circulation medium, the corresponding media requirements are shown in Table 7-3-2.

Note 2: To ensure reliable long-term operation, the internal coolant needs to be replaced every 1 to 2 months when deionised/ or pure water is used as the internal circulation medium.

Table 7-3-2 Recommended standards for deionized water

Items	Deionized water	Reference standard	
PH	8.5-9.5	Intel 632983	
Sulfide	<1 ppm	TC9.9/Intel 632983	
Sulfate	<10 ppm	TC9.9/Intel 632983	
Chloride	<5ppm	TC9.9/Intel 632983	
Bacteria	<100 CFUs/ml	TC9.9/Intel 632983	
Total Hardness (as CaCO3)	<20ppm	TC9.9/Intel 632983	
Conductivity	<20us/cm（reference value）	TC9.9	High conductivity is not necessarily unacceptable, such as 1000US / cm, because corrosion inhibitors and fungicides will increase water conductivity. It is necessary to find out the reason for the sharp increase of conductivity trend during circuit operation.
Residual solids after evaporation	50ppm	TC9.9/Intel 632983	
Turbidity	<20 NTU	TC9.9/Intel 632983	
Iron	0.1ppm	Industry standard	
Copper	10ppb	Industry standard	
Corrosion rate of carbon steel	3mpy（0.075mm/a）	GB/T 50050-2017	
Corrosion rate of copper or stainless steel	0.2mpy（0.005mm/a）	GB/T 50050-2017	

7.3.7 Maintenance of cooling tower

After the cooling tower is put into operation, it is necessary to regularly check the operation, and pay attention to the following points:

1） After the water enters the cooling tower, it must be strictly controlled. The damaged water pipes and nozzles shall be replaced in time to avoid affecting the water distribution effect or damaging the water spraying device. If there are sundries, they shall be removed in time;

2） The suspended solids content of spray water is generally controlled below 20mg / L. when the suspended solids content increases, water quality treatment agent shall be added appropriately for treatment. Scale inhibitor shall be added during long-term operation. See the following figure for water quality requirements (refer to GB / t-18430.1-2007). It is recommended to replace the spray water twice a year:

Table 7-3-3 recommended standards for spray water

Cooling water quality					
Items			Reference value	Inclination	
				Corrosion	Scaling
Benchmark term	PH value(25℃)		6.5～8.0	◯	◯
	Conductivity(25℃)	μS/cm	<800	◯	◯
	Cl^-	mg(Cl^-)/L	<200	◯	
	SO^{2-}	mg(SO^{2-})/L	<200	◯	
	Acid consumption(pH=4.8)	mg($CaCO_2$)/L	<100		◯
	Total hardness	mg($CaCO_3$)/L	<200		◯
Reference term	Fe	mg(Fe)/L	<1.0	◯	
	S^{2-}	mg(S^{2-})/L	none	◯	
	NH^+	mg(NH^+)/L	<1.0	◯	
	S_iO_2	mg(S_iO_2)/L	<50		◯
Note: ◯ Indicate factors related to corrosion or scaling tendency					

3） If any abnormality is found in the fan system, it shall be shut down immediately for inspection and troubleshooting. The blades shall be repaired or replaced according to the actual scouring and wear, so as to ensure that the cooling tower is in good operation condition;

4） If excessive water loss is found during the use of the cooling tower, the manual replenishment device shall be used to replenish water in time. In addition, check whether the water collector is damaged and whether the water collecting tank is leaking;

5） It is required to clean the inside and outside of the tower once a year to prevent the accumulation of dirt from affecting the smooth inflow of water.;

6） After the cooling tower is shut down, the residual water in the sump and pipeline must be vented. If the shutdown time is long, the whole tower shall be inspected to ensure safe and normal operation next time;

7） Fillers, water collectors and other inflammables are strictly prohibited from contacting with open fire during use or maintenance;

8） Under the freezing point temperature in winter, the system will switch to the dry cooling mode. At this time, it is necessary to drain the residual water in the sump and pipeline to prevent equipment damage caused by icing;

9） The filter inside the sump needs to be cleaned once a month to prevent damage to the spray pump caused by dirty blockage;

10）PVC filler shall be flushed regularly and shall not operate when the cooling water temperature is higher than 50 ℃.

8. Safety instructions of ANTSPACE HK3

If ANTSPACE Liquid Cooling System is not used for a long time, the main power supply should be turned off.

—— **This will prevent accidents from happening.**

1） Maintenance:

Only qualified and authorized personnel are allowed to perform maintenance and other operations on electrical system;

2） Operation:

（1）ANTSPACE liquid cooling system in container shall be equipped with fire extinguisher before starting operation;

（2）The equipment must be properly grounded; after electric connection, the protective earthing resistance shall be verified to guarantee continuity, it shall be less than 0.3Ω, otherwise, personal injury or death may occur;

（3）Only after stopping the equipment and turning off the power supply can the equipment be cleaned, otherwise electric shock or injury may occur. Do not clean the unit with water, otherwise electric shock may occur.

（4）Be sure to check whether the valve (if there is a valve) is open before starting the system;

（5）Safety operation of PDC and electric control cabinet:

During the operation of PDC A, B and control cabinet, it shall be ensure that the cabinet door is in a locked state to prevent personal injury such as electric shock, while avoiding salt, moisture, dust or other conductive substances in the air from entering the interior of the cabinet.

If power-on, it is prohibited to contact the cabinet internal single board, cables, terminals, modules, inductors and other devices to prevent safety accidents.

If malfunctions occured, abnormal smell and sound, please power off main circuit breakers MCB-A1, MCB-A2 and MCB17 of three electrical cabinets. Or press the emergency stop button on the door of container, and two electrical cabinets. Otherwise it may lead to electric shock or fire accident.

3） Note:

（1）Non-professional authorized persons are forbidden to open the door of the electrical cabinets.

（2）The electrical cabinets door only can be opened when the main circuit breakers are located on the OFF position.

Please read this instruction carefully before using this equipment. If you have any difficulties or problems, please contact the manufacturer for help.