CHINA-PAKISTAN
ECONOMIC CORRIDOR

阀水冷系统事件解析

2021/4/19

Contents

MAIN PUMP POWER FREQUENCY/FREQUENCY CONVERSION START, STOP LOGIC, SWITCHING LOGIC

(MUHAMMAD WAHAJ HUSSAIN)

1) MAIN CIRCULATION PUMP:

There are two pumps in the valve cooling system, each acting as the standby for the other, the one of them works in the running state while the other in the standby state. There are two independent working circuits for each pump and the correct operation of any circuit would ensure the normal operation of the pump, if in case there is same flow in the circuitry of working pump it would automatically switch to standby pump.

2) NORMAL SWITCHING OF PUMPS:

There might be some conditions in which the current pump operates with the power frequency, the standby pump is triggered through the soft start to power frequency and the working of current pump is stopped, the conditions are specified below.

1. If any pump has been continuously running for 168 hours at the power frequency without faults, the automatic switch logic of main circulation pump will be started according to which the other pumps put into the operation through the soft start, then will switch to power frequency and the previous pump will stop.
2. The local water cooling operation panel can make the realization of logical switching of two main circulation pumps.

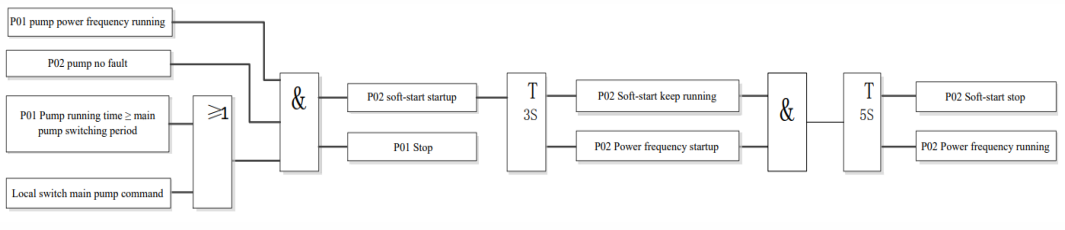


Fig 1: P01 pump switches to P02 pump (normal switching logic)

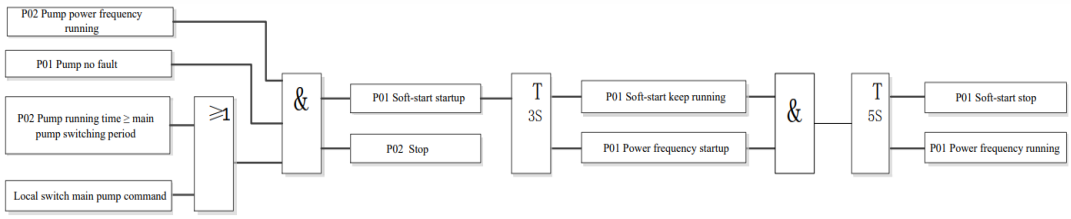


Fig 2: P02 pump switches to P01 pump (normal switching logic)

3) FAULT SWITCHING OF PUMP:

Apart from the normal switching of one pump to another there may arise some unusual condition in which the system switches to the standby pump to trigger the switching from soft start to power frequency running.

1. Main pump overheat alarm: The PT100 thermistor has been installed in the circulation pump for the real time temperature detection, when the measured temperature value exceeds 95C, the switching will take place to the standby pump and an alarm via the control system will be prompted with the indication of “Main circulation pump overheating state”.
2. Main circulation pump fault alarm: In order to protect the power frequency circuit, the circuit breaker is installed, in result of the operation of the circuit breaker, there will be an alarm from the control system with an indication “main circulation pump power frequency fault”.
3. Station 400V power supply fault: Each of the two pump is connected to separate supply bus, that is P01 main circulation pump is connected to Section 1 bus, PO2 circulation pump is connected to Section II bus, if in case the power of the supply bus to the relevant pump is disturbed then there will be an alarm such as “API

cabinet AC power fault" and there will be a switching from main pump to the standby pump after 500ms.

The main circulation pump safety switch is opened and will not be involved in the main pump switching. The main circulation pump power circuit is equipped with local maintenance safety switch, when switch is disconnected, the control system will alarm with the corresponding signal indicating "the main circulation pump safety switch is opened". The disconnection of safety switch in the main circulation pump involved in the current operation will switch the main pump to the standby pump for operation due to low system pressure.

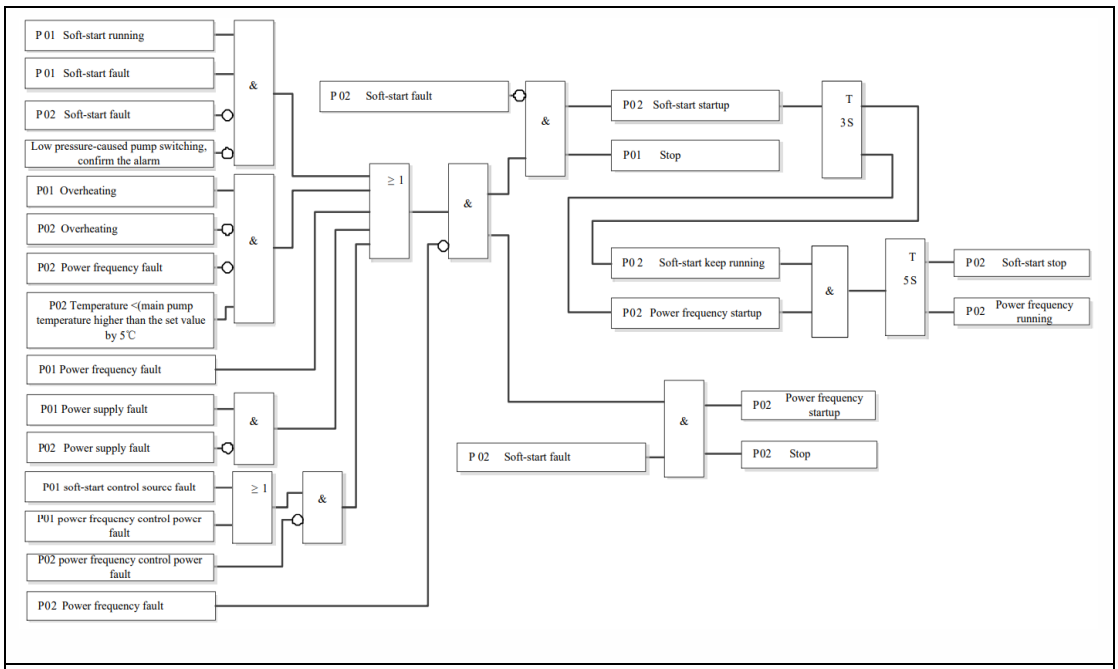


Fig 3: P01 pump switches to P02 pump (fault switching logic)

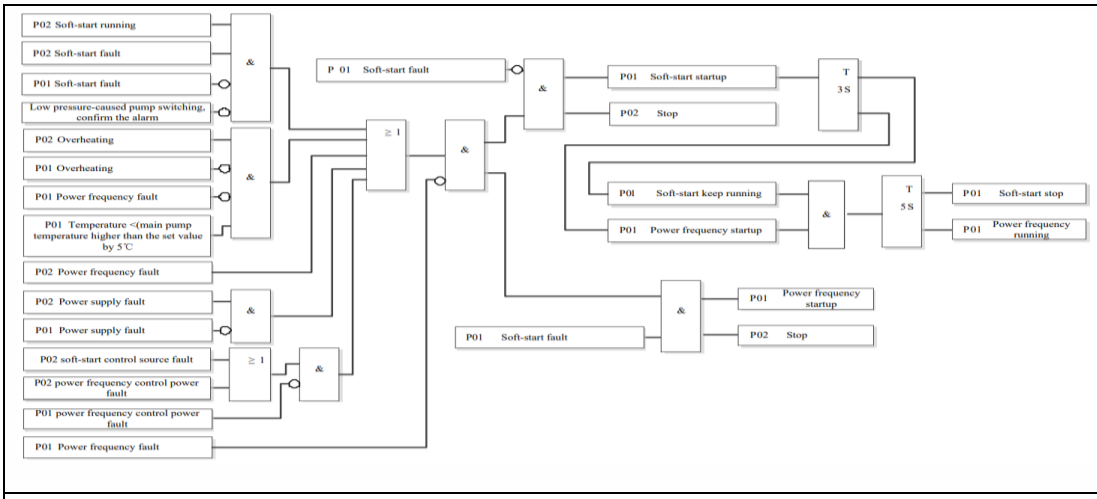


Fig 4: P02 pump switches to P01 pump (fault switching logic)

4) PUMP SWITCHING IN CASE OF LOW PRESSURE:

There are two pressure transmitters that are installed in the main circulation pump along with the three upstream pressure transmitters, if in case the measured value of the main pump downstream pressure transmitter and that of any upstream pressure transmitter is lower than the setting value of protection, then after delay of 3 seconds, the standby pump will be switched on the direct power frequency and there will be an alarm with an indication “Switching the main pump due to low pressure of valve cooling system”. In this case the pump with the low pressure alarm will not be further involved in the switching.

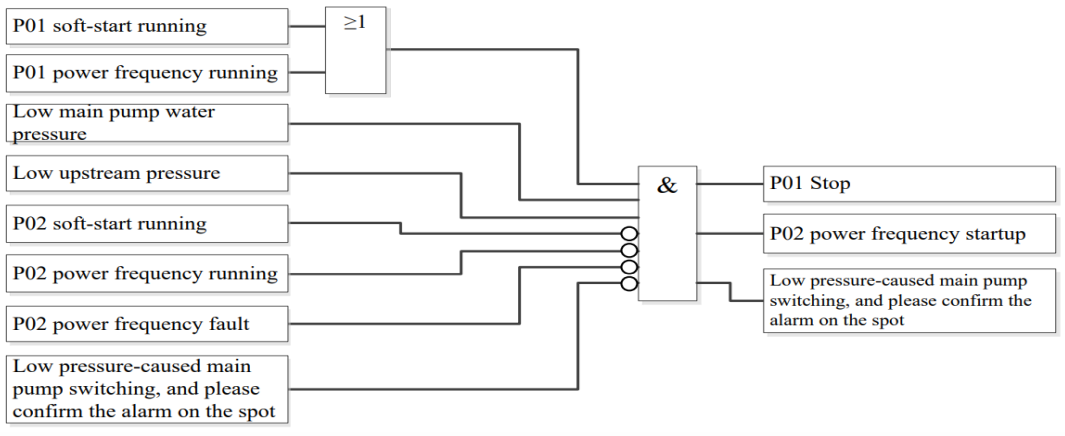


Fig 5: P01 pump switches to P02 pump (low pressure switching logic)

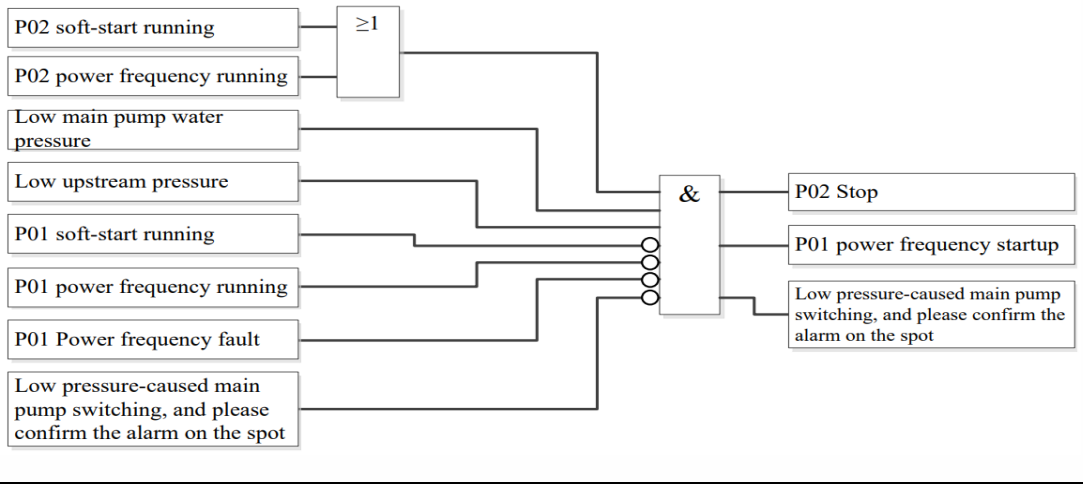


Fig 6: P01 pump switches to P02 pump (low pressure switching logic)

5) BACK SWITCHING DUE TO SWITCHING FAULT:

In the case of normal switching of main pump to the standby pump, there might arise an unusual and unwanted situation and in this particular case the control system detects the relevant alarm and the back switching is done back again to the main pump, the back switching conditions consist of

a) Currently running main pump overheating alarm.
b) The main circulation pump fault alarm.
c) Power station 400V power fault.
d) The main pump low outlet water pressure low upstream alarm.

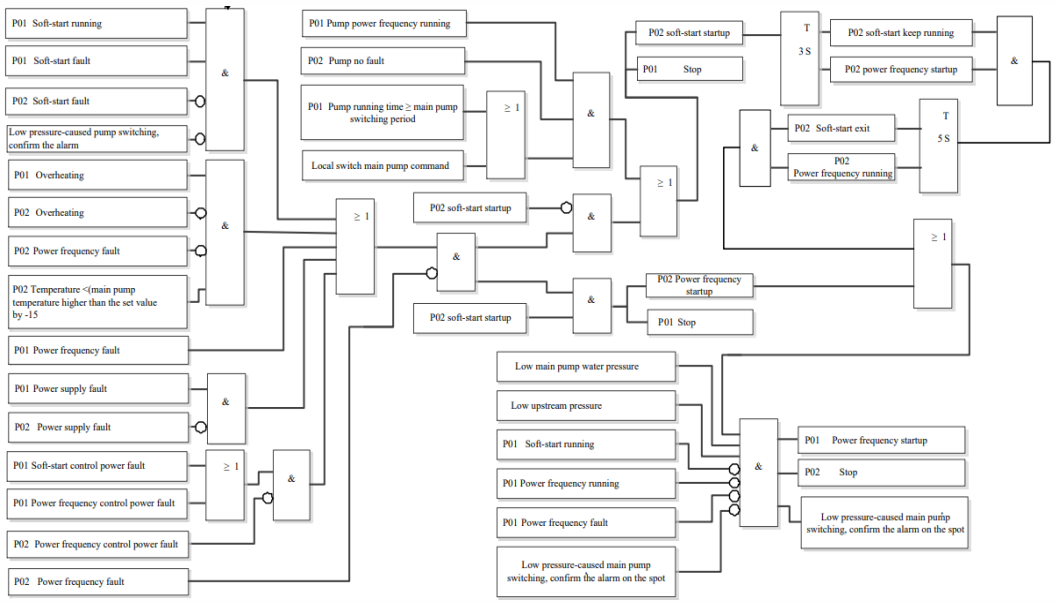


Fig 7: P01 pump switches to P02 pump (back switching logic)

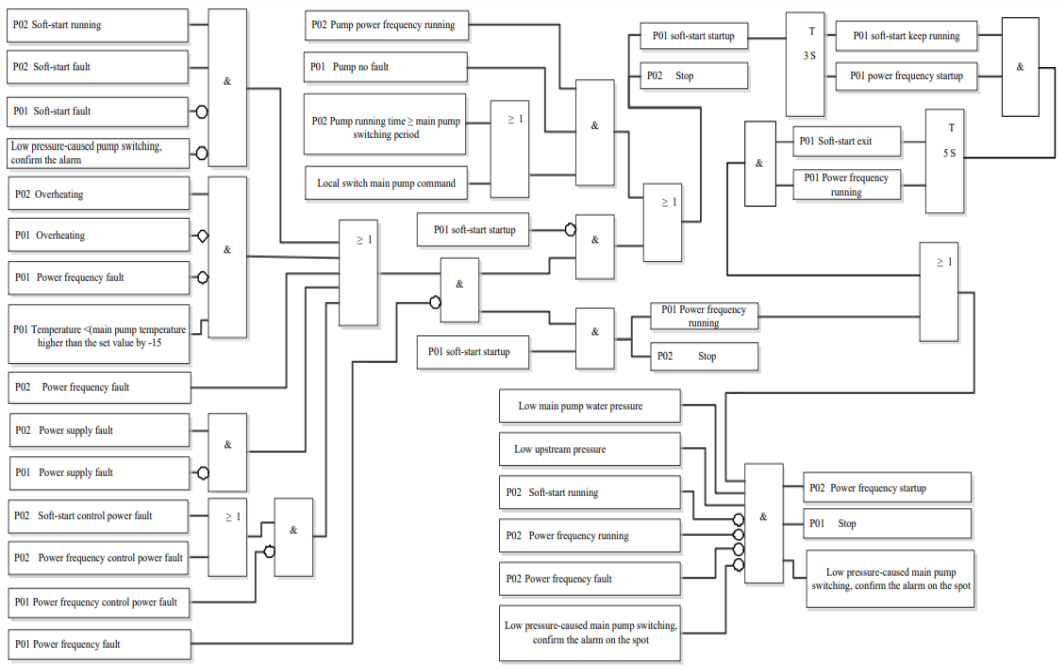


Fig 8: P01 pump switches to P02 pump (back switching logic)

H01 ELECTRIC HEATER FAILURE

(ADIL MUNEER ABBASI)

1) EVENT OVERVIEW

When the outdoor environment temperature is extremely low in winter and the converter valve is operating at low load, the electric heater will start to avoid cooling water. The inlet valve temperature is too low.

When the cooling water inlet valve temperature is ≤14℃, the electric heaters H01 will start; when the cooling water inlet valve temperature is ≥16℃, electric heating H01 stop.

Electric heaters: a total of four, H01, H02, H03, H04.

When the QFH01 circuit breaker is opened, report "H01 electric heater fault".

2) ALARM PRINCIPLE ANALYSIS

2.1) H01 ELECTRIC HEATER CONTROL PRINCIPLE

The working principle of the H01 electric heater. Under normal operation, the H01 power switch QFH01 is closed. The CPU judges through logic. When the electric heater operating conditions are met, the switch output module outputs a high level, and the KAH01A relay is energized. The normally open auxiliary contact is closed, as shown in Figure 1, and the KMH01 contactor in the control circuit as shown in Figure 2 is excited, the contact is closed, and the electrical circuit of the H01 electric heater is turned on to start heating. When the electric heater stop condition is met, the KMH01 contactor loses power, the contact is disconnected, and the H01 electric heater electric circuit is disconnected to stop heating. The electric heater can be controlled by connecting the normally open contacts of KMH01

in series.

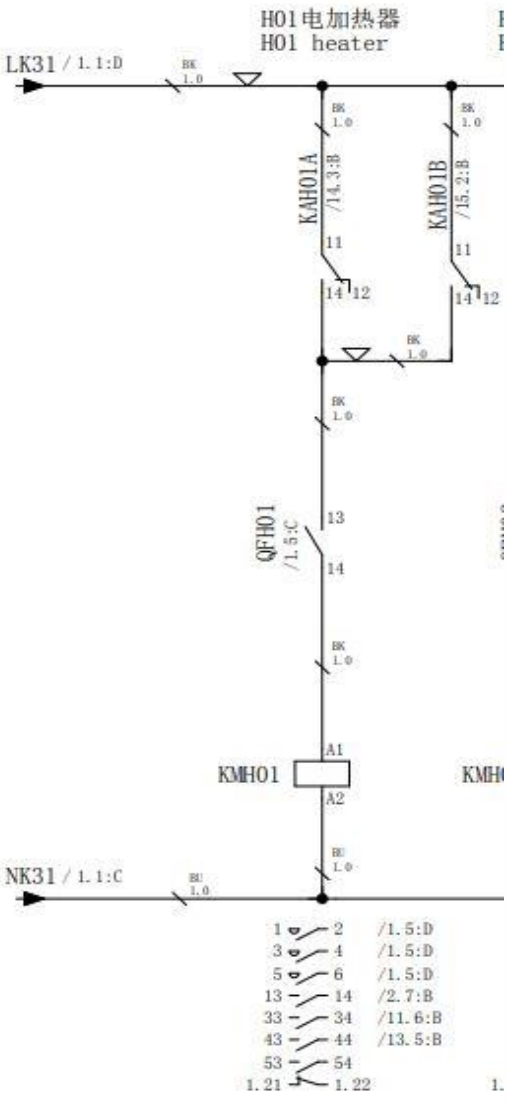


Fig 1: H01 control circuit diagram

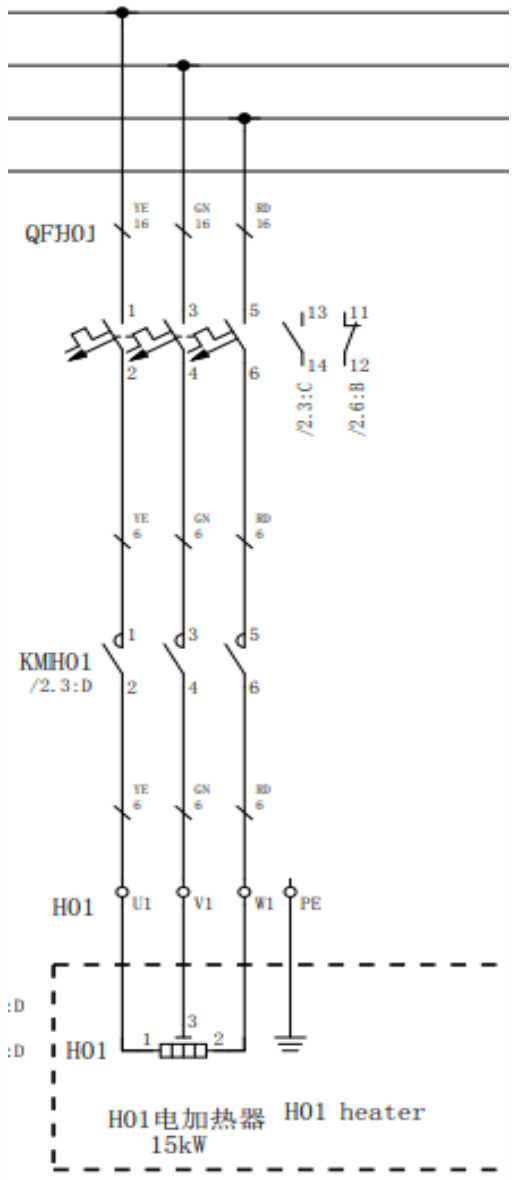


Fig 2: H01 power circuit diagram

The PLC monitors the operating status of each device through the auxiliary contacts of the relay. When the H01 electric heater is running, the contact "33 34" of the KMH01 relay is used to light up the H01 heater operation indicator on the AP4 panel cabinet, and the normally open contacts "13 14" and "43 44" of the KMH01 relay are closed as PLCA. The H01 heater operation input of the system and PLCB system is used to upload the H01 heater operation status event.

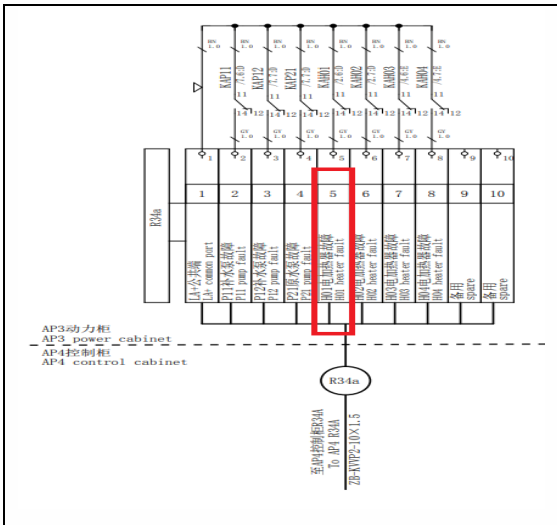


Fig 3: Ap3 Power Cabinet to Ap4 Control Cabinet

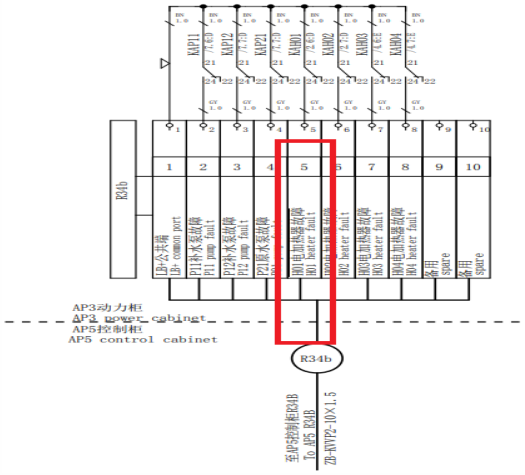


Fig 4: Ap3 Power Cabinet to Ap5 Control Cabinet

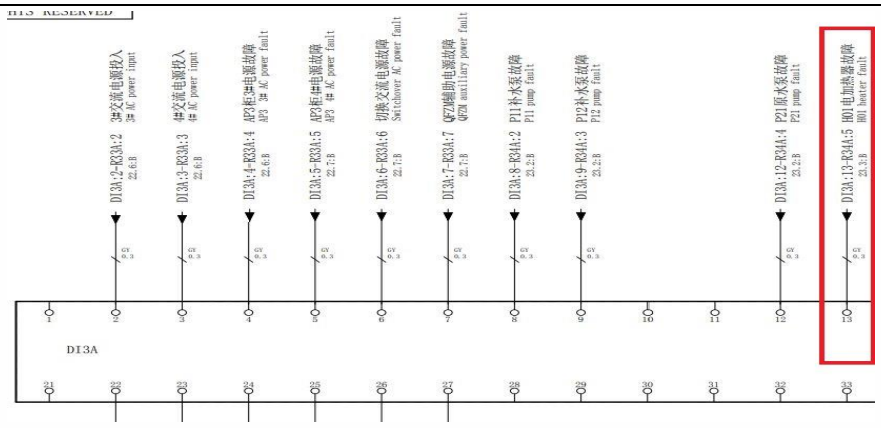


Fig 5: R34A to DI3A

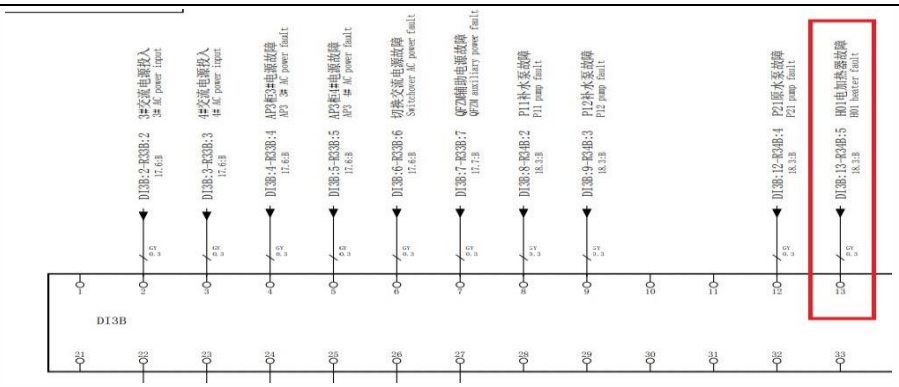


Fig 6: R34B to DI3B

2.2) FAILURE PRINCIPLE OF H01 ELECTRIC HEATER

During normal operation, the circuit breaker QFH01 of the H01 heater is closed, its auxiliary contact "11 12" is open, and the K44 relay is de-energized. When the QFH01 circuit breaker is open, the auxiliary contact "11 12" Closed, the K44 relay is energized, as shown in Figure 5, the "11 14" normally open contact of the K44 relay is closed, the switch input signal, the control system sends out the H01 heater failure signal.

3) INSPECTION AND TREATMENT

3.1 Check whether the H01 heater power switch QFH01 in the AP4 cabinet is tripped, as shown in Figure 7. If it trips, try and close it once, and notify the maintenance staff if it fails.

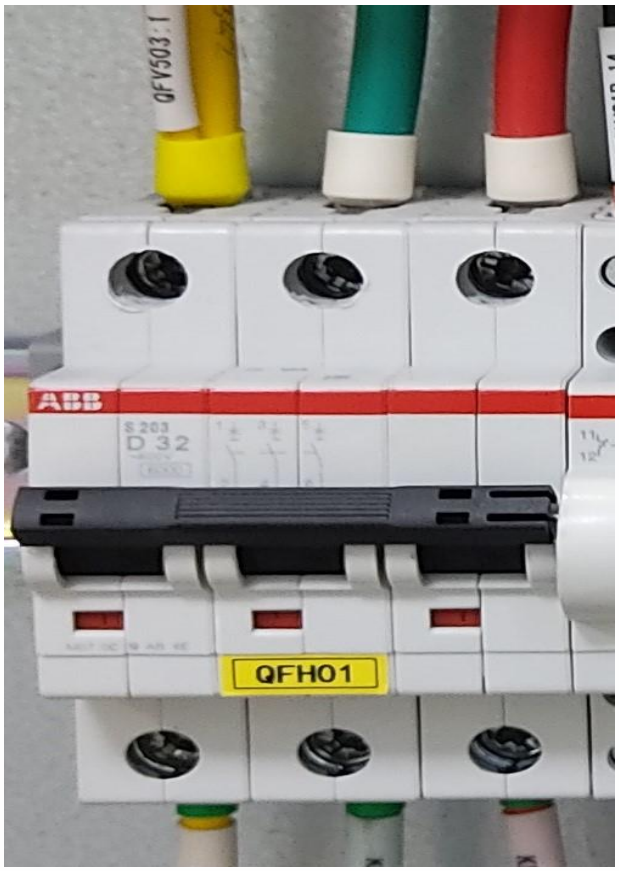


Fig 7: H01 heater power switch QFH01 in AP4 cabinet

3.2 If the H01 heater power switch QFh1 in the AP4 cabinet is in the closed position, check that the K44 relay "H01 heater operation indicator light" is on and the relay is excited, and check whether the auxiliary contact of the QFh1 switch is intact.

3.3 If the K44 relay is not energized, check whether the relay is faulty and make its internal contacts sticky and closed.

3.4 If no fault is found in the above inspections, check the H01 heater fault input circuit and other related circuit wiring conditions, whether there is a short circuit, etc.; and notify the maintenance personnel to check and deal with it.

P01 MAIN CIRCULATION PUMP QFK01A CIRCUIT BREAKER IS NOT CLOSED

(MIR ARSLAN ALI)

1) EVENT OVERVIEW:

The P01 main circulation pump power circuit is equipped with a soft starter loop control circuit breaker QFK01A, when the control circuit breaker trips, the control system will alarm with the corresponding signal indicating "QFK01A circuit breaker is open".

2) ALARM PRINCIPLE ANALYSIS:

2.1) THE WORKING PRINCIPLE OF THE MAIN CIRCULATING PUMP CONTROL CIRCUIT BREAKER:

Under normal circumstances, the circuit breaker (**QFK01A)** is closed and the control power required for the soft starter control circuit is provided and the soft starter works normally to start the main circulation pump at constant voltage as shown in the figure 1 and 2. If due to any fault the MCB gets tripped the power to the control circuit will be disrupted and an event “P01 main circulation pump QFK01A circuit breaker is not closed” will appear giving warning to the operator that the soft starter control circuit has no power. Thus, the constant voltage startup of the pump is not possible which needs immediate checkup and fixture to avoid its impact on the station electricity consumption and limiting high startup current of the pump.

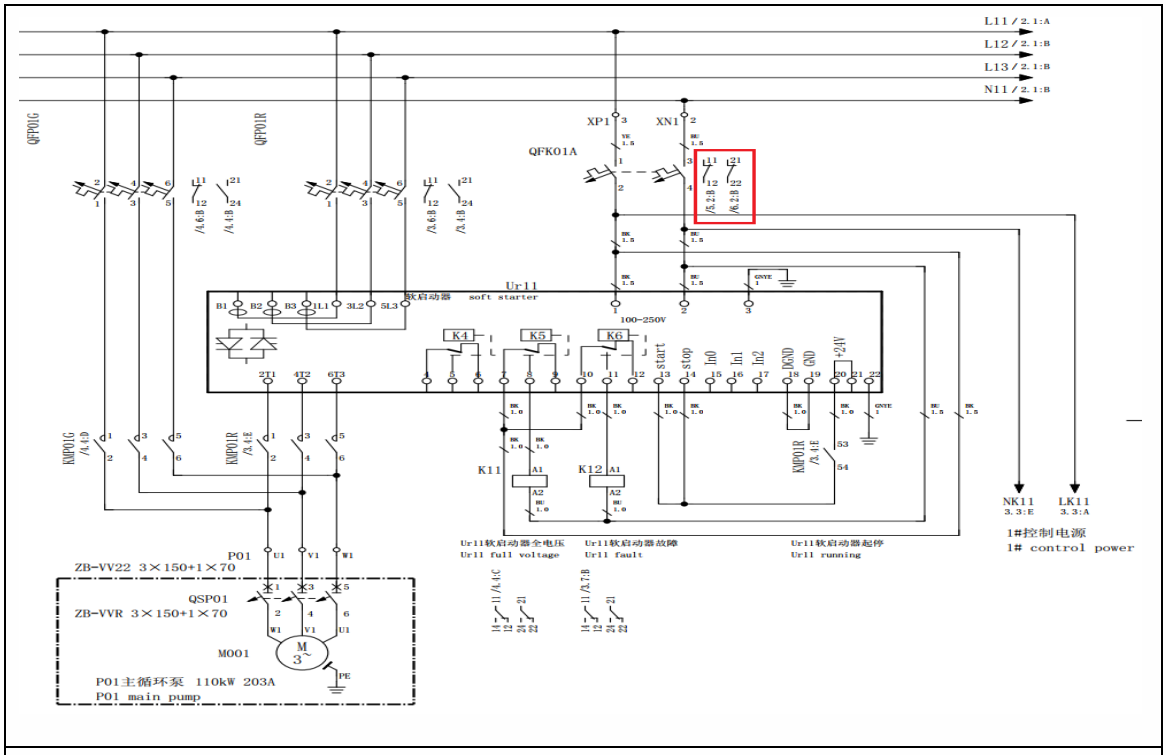


Fig 1: QFK 01A Circuit Breaker and its auxiliary contacts

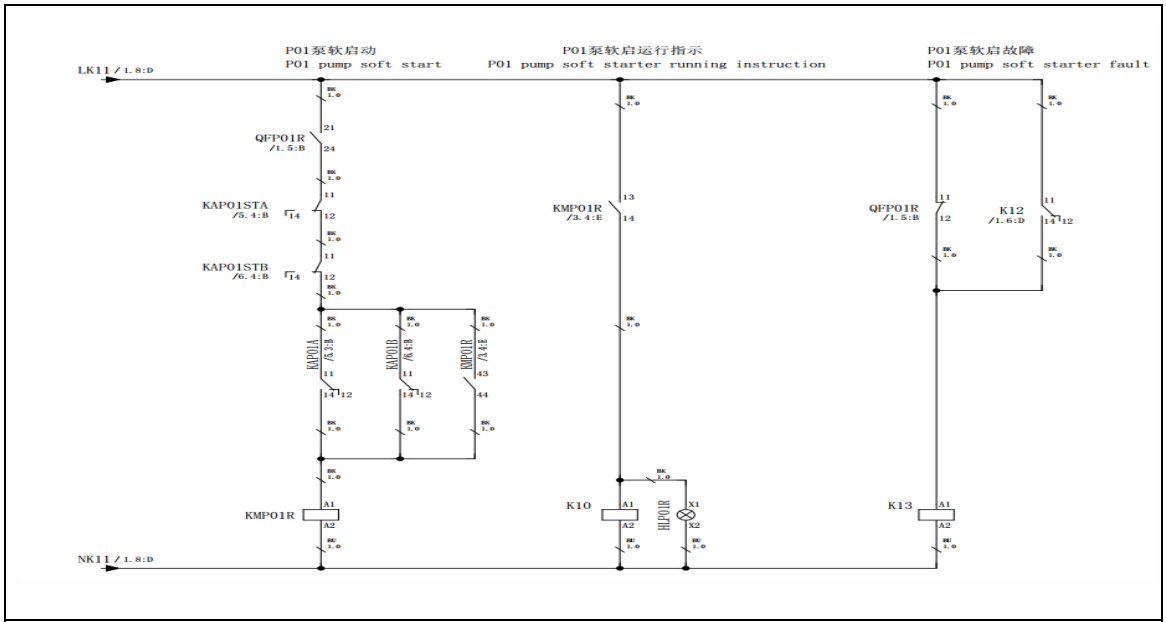


Fig 2: Control Circuit of the soft starter

2.2) FAULT ANALYSIS OF THE CIRCUIT BREAKER:

During normal running conditions, QFK01A circuit breaker is closed and the auxiliary contacts of (11, 12) and (21, 22) which are in normally closed position remain open thus no signal is generated. If due to any fault or excess current flowing from the circuit breaker (**QFK01A)** trips the circuit breaker then it's auxiliary contacts (11, 12) and (21, 22) change their position from open to close and the corresponding event "QF01A circuit breaker open" is generated, as shown in figure 3 and 4. Finally the generated event signals are sent to the valve cooling control system A and B, as shown in Figure 5 and 6.

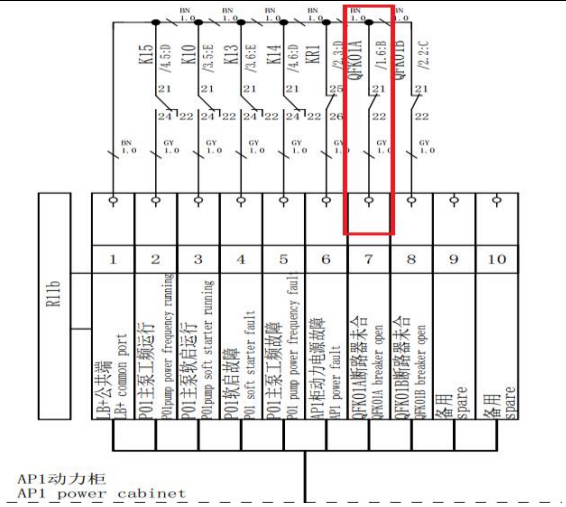


Fig 3: Signal connection point R11a in AP1

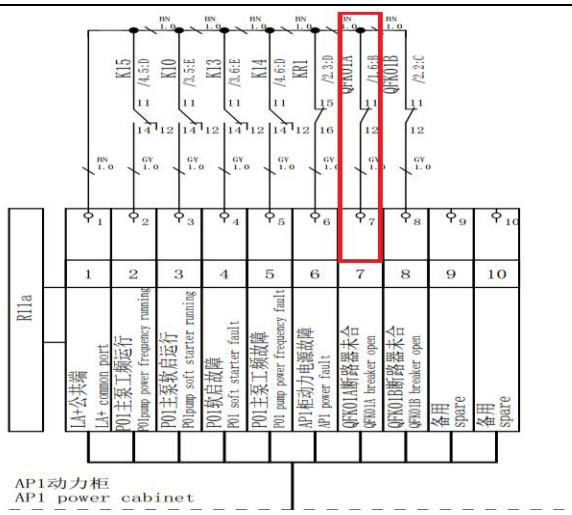


Fig 4: Signal connection point R11b in AP1

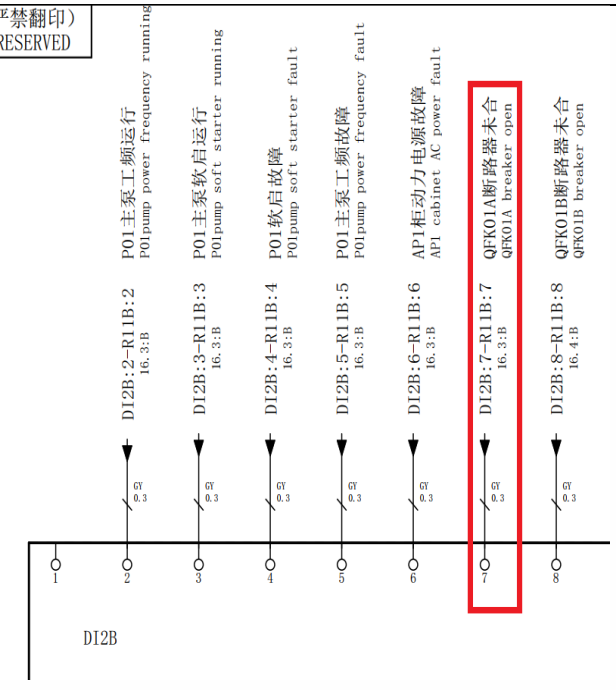


Fig 5: Signal to valve cooling control system A

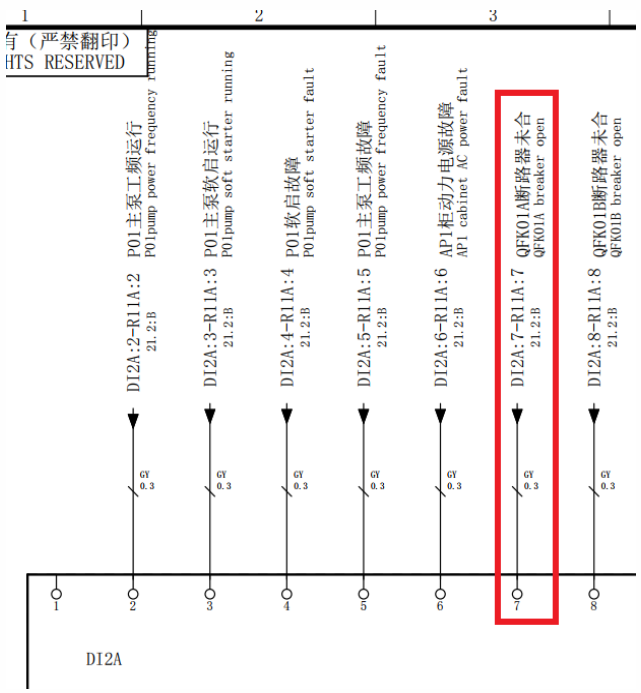


Fig 6: Signal to valve cooling control system B

3) INSPECTION AND FAULT ERADICATION PLAN:

When the circuit breaker trips, you should bring multi meter and other equipment to the site to check the operating status of the equipment.

- Open the AP1 cabinet, smell the cabinet for any peculiar smell, check the QFK01A circuit breaker.

Fig 7 : QFK01 Main Circulation pump soft starter loop control power circuit breaker

- If the 400V switch is accompanied by a trip or load switching signal, the status of the 400V switch should also be checked.
- Check whether the main pump power circuit cable is short-circuited or damaged. Notify maintenance personnel to check and deal with it.

AP10 POWER CABINET:

(MUHAMMAD AHMED)

AP10 power cabinet has two AC power inputs from site namely 101/L and 102/L and it powers P33 Spray pump and P36 Spray pump.

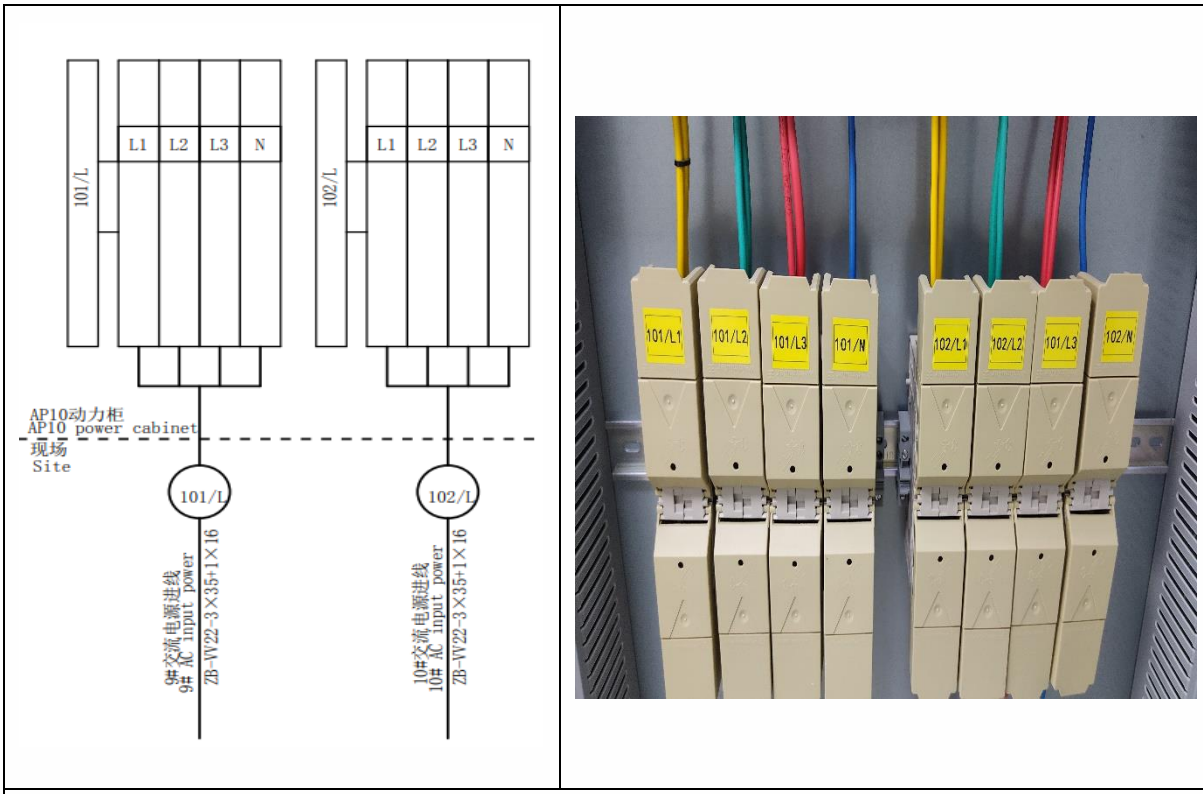


Fig 1: AC Power Input for AP10 cabinet

QFK101 is control power circuit breaker of:

1. AC power input 101/L of AP10 cabinet.
2. QFC101 Breaker Open Circuit

3. P33 Spray Pump Control
4. P33 Spray pump fault control

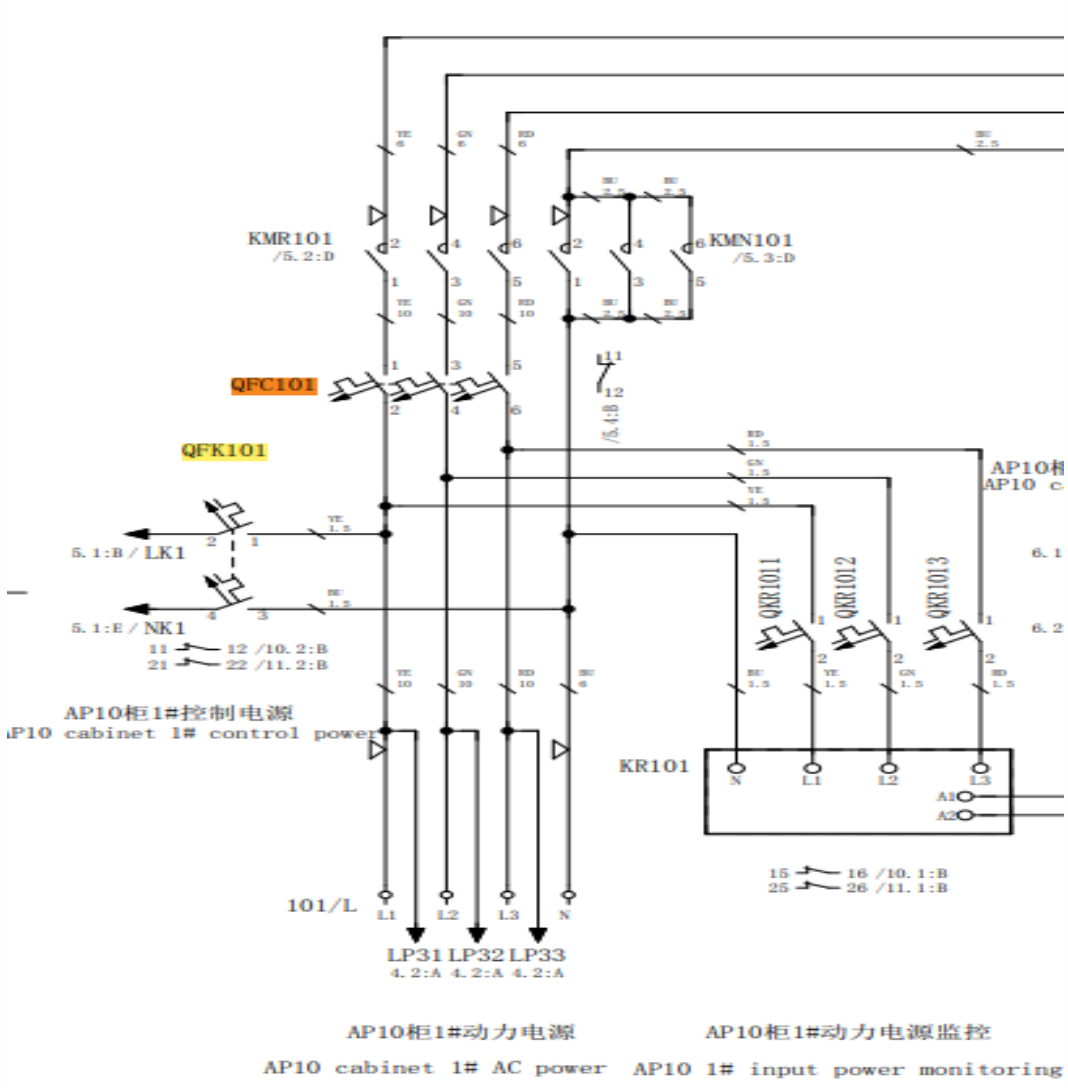


Fig 2: QFK101 drawing

From the above figure we can see if the QFK101 Control power Circuit breaker is not closed, then the QFC101 AC Power circuit breaker is also not closed. Also the Contactors KMR101 and KMN101 are open leaving the bus without power from 101/L.

From the terminals LK1 and NK1 is the logic circuit connected to the breaker QFK101.

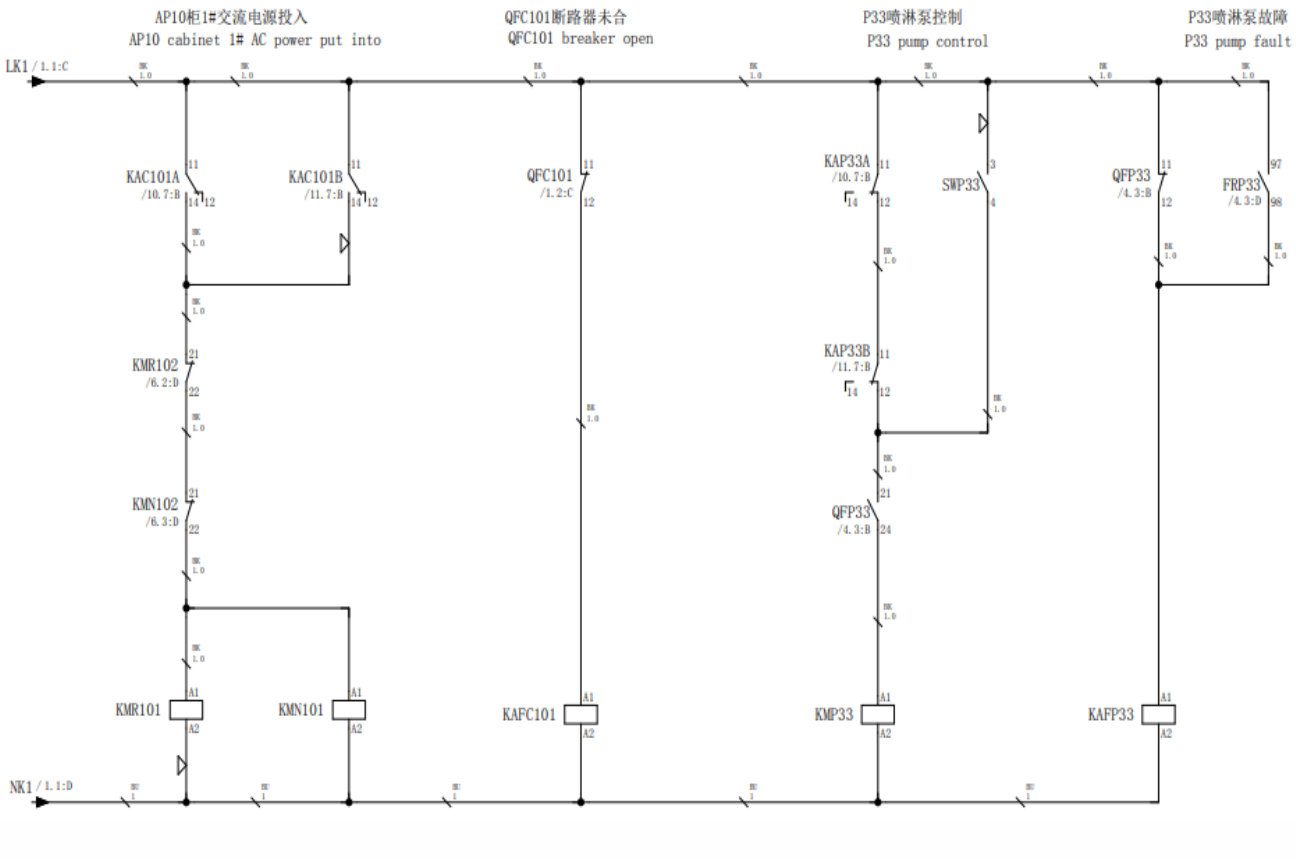


Fig 3: Logic Circuit connected to QFK101

So if QFK101 is not closed, the auxiliary contacts 11-12 of QFC101 Breaker open circuit are Normally closed, keeping the beaker QFC101 open and not powering AP10 cabinet from 1# AC Power (101/L).

Also the QFP 33 Circuit breaker of P33 Spray Pump is open when QFK101 is not closed, hence P33 pump not powered.

And at the end there will be **P33 Pump fault signal**, as you can see from the figure that the QFP33 auxiliary contacts 11-12 for the pump fault are normally closed when QFK101 is not closed.

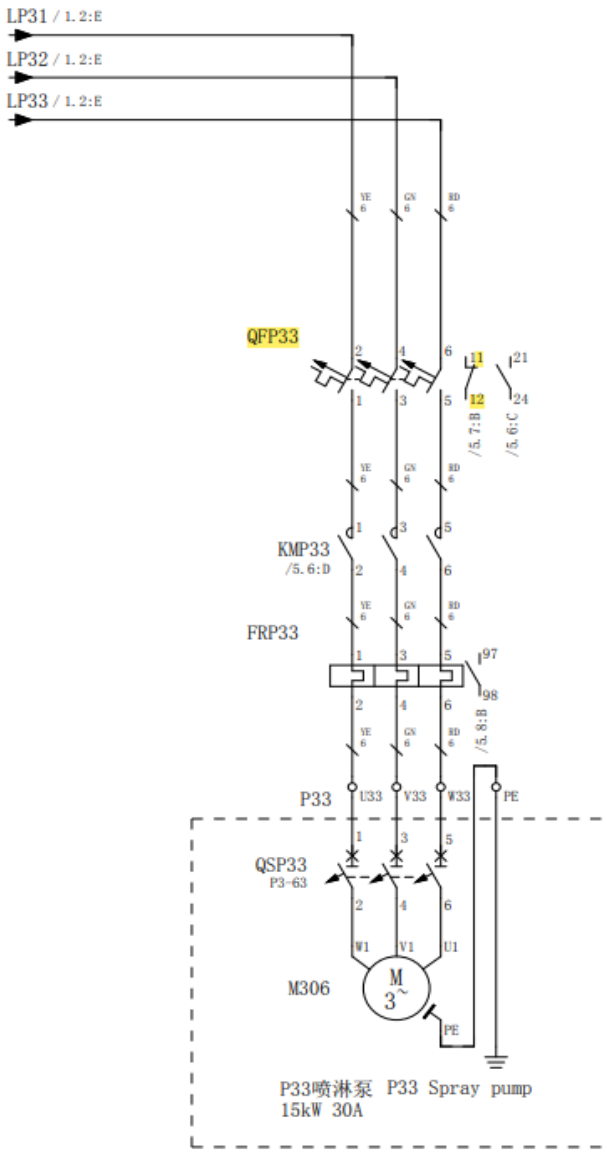


Fig 4: P33 Spray pump circuit breaker QFP33

From the figure above, we can see that when the QFP33 auxiliary contacts 11-12 are closed the circuit breaker remains open and hence P33 Pump Fault will appear.

COOLING TOWER FAN CONTROL LOGIC OF EXTERNAL COOLING SYSTEM:

(SHAFEO FAZAL JUNEJO)

1) EVENT OVERVIEW:

The closed cooling tower is used as the outdoor heat exchange equipment of the converter valve cooling system to transfer the heat loss of the converter valve to the spray water and the atmosphere (Through the cooling fans).

6 External cooling fans are present and the Control protection Cooling tower comprises a total of 6 fans, which includes G01, G02, G03, G04, G05 and G06 fans, there are two group of fans; G01, G03 and G05 work simultaneously while G02, G04 and G06 work simultaneously. The entire working of the fans depends on the cooling water inlet valve value that is sensed by TT01, TT02 and TT03 which are cooling water upstream temperature transmitters.

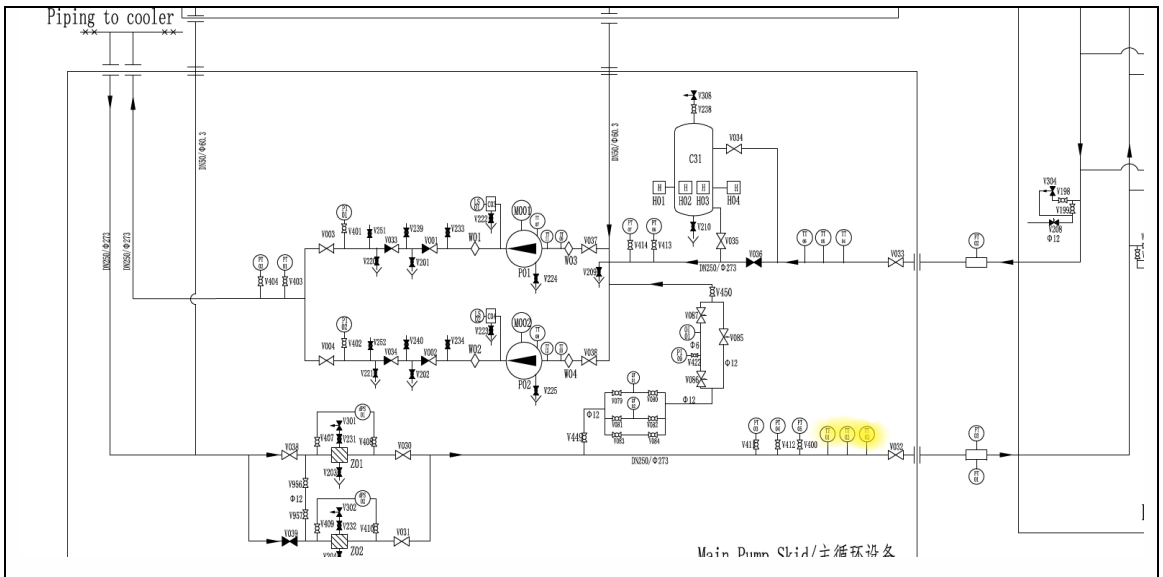


Fig 1: TT01, TT02 and TT03 are highlighted on the diagram

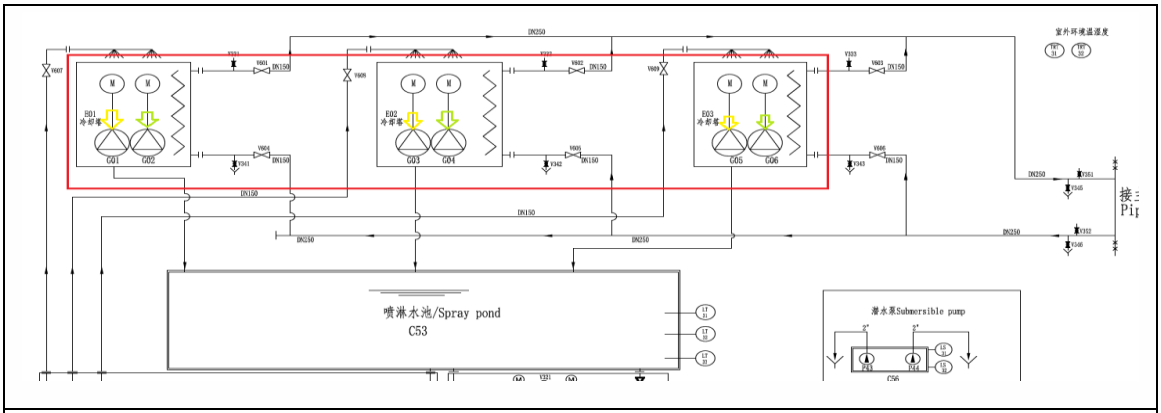


Fig 2: Showing the fan groups; One group is indicated by yellow arrows while the other is indicated by green arrows

2) FANS CONTROL LOGIC:

The heat exchange equipment control system is responsible for the automatic start-stop control and temperature adjustment logic of the fan, and performs PID on the speed of the cooling fan adjust and is responsible for fan speed control (frequency converter adjustment) and protection.

1. The control system automatically adjusts the fan speed according to the deviation between the cooling water inlet valve temperature and the set target temperature.
2. The frequency conversion speed control of the fan: the fan speed is controlled by the target temperature setting value and the current cooling water inlet valve temperature The target temperature can be set in the man-machine interface of the heat exchange equipment control system, and the controller is based on the current cooling water inlet valve temperature and target after the temperature deviation changes, after PID calculation, it outputs an analog signal to the inverter, and the inverter will respond to the increase/decrease to increase/decrease frequency, control the fan speed to change the heat dissipation of the system, and make the temperature of the cooling water inlet valve to gradually approach the target temperature. The temperature is finally stabilized near the target temperature to achieve the purpose of accurately controlling the temperature of the cooling water inlet valve.
3. Automatic start and stop control of the fan: the start of the fan is controlled by

setting the target temperature. When the temperature of the cooling water inlet valve is higher than at the target temperature, all fans are started, and the speed is determined by PID calculation. When the cooling water upstream temperature exceeds the protection value, the fans start. Adjustment is done by PID according to the change of cooling water upstream temperature, if the cooling water upstream temperature falls below the fan start value diminished 4℃ and the fan frequency is 20Hz, then after delay for 5 minute, the fan will stop. At Matiari converter station there are a set of fixed values at which the group of fans will start and stop working, if the fan group G01, G02 and G03 start first, they will start at a temperature of 33℃ and if the upstream cooling water temperature falls to a value of 29℃ then they will stop working while the other fan group (that is G02, G04 and G06) will start at a value of 36℃ and stop when temperature of the upstream cooling water falls to 32℃, in both conditions the fan groups will stop while running at 20Hz after reaching the lower temperature for a time period of 5 minutes.

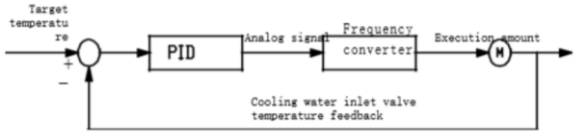


Fig 3: Control Logic of cooling fans showing the feedback path of the cooling water inlet valve temperature to PID controller

P02 MAIN CIRCULATION PUMP LEAKAGE-PLEASE CHECK

(SHARIQ ZAHID)

1) INTRODUCTION

A water leakage detection feature is built into the main circulation pump. The main pump's leakage water is collected by the water leakage monitoring unit. The float-type liquid level switch will work and send a signal to the water cooling control system when the water accumulated in the water leakage detection device exceeds the limit. It then sends out the **P02 main circulation pump leakage-please check signal** to the OWS.

2) ALARM SIGNAL

When the level of water in the water accumulator on site rises, the buoy will rise to make the normally open contact of the leak detection switch LS02 (11 AND 14) closed to realize the signal. The two points of LS02 switch is connected to the X43 Terminal Block (terminal 7 and 8) of AP4 control cabinet.

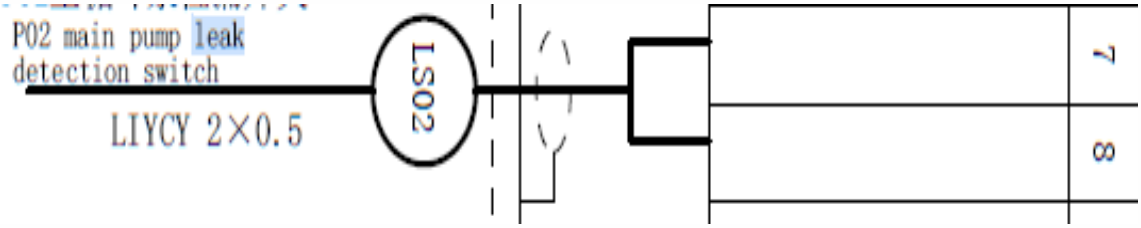


Fig 1: Main pump P02 switch LS02 connected to the 7 and 8 terminal of X43

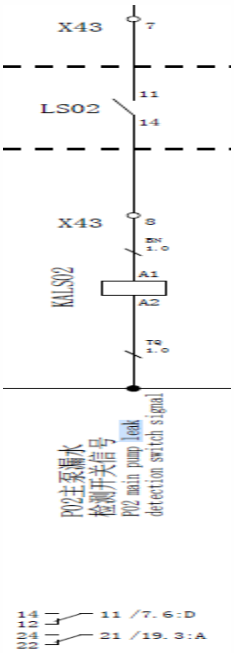


Fig 2: Main pump relay KALS02 sends signal when switch is closed

After the LS02 gets close the relay KALS02 gets excited and closes its terminal 11-14 and 21-24 to send the signal to AP4 and AP5 control cabinet respectively. The terminal 11-14

closes and sends the signal to DI1A terminal block of the AP4 control cabinet. The terminal 21-24 closes to send the signal to X1A terminal block of the AP4 control cabinet and X1A then sends the signal to X1B terminal block of the AP5 control cabinet. From X1B the signal is send to DI1B of the AP5 control cabinet. From DI1A and DI1B, the signal is sent to CPUA and CPUB respectively through bus.

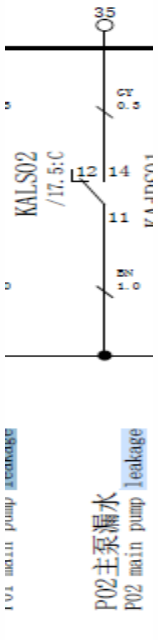


Fig 3: Contacts 11-14 closes to send signal to DI1A of AP4 control cabinet

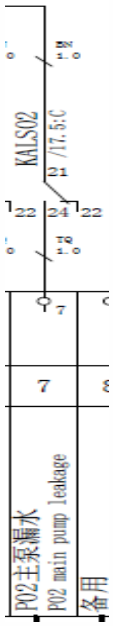


Fig 4: Contacts 21-24 closes to send signal to X1A of AP4 control cabinet

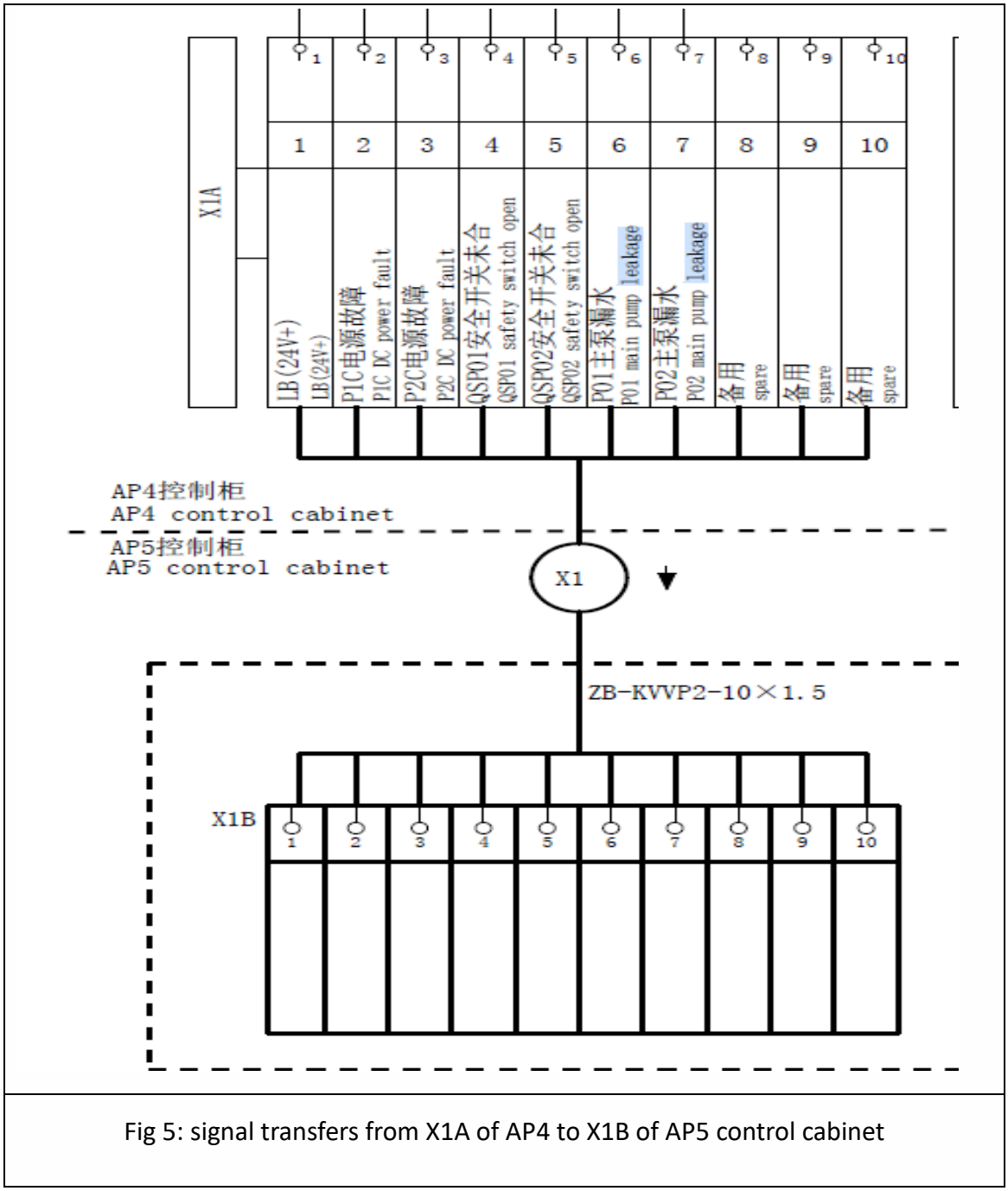


Fig 5: signal transfers from X1A of AP4 to X1B of AP5 control cabinet

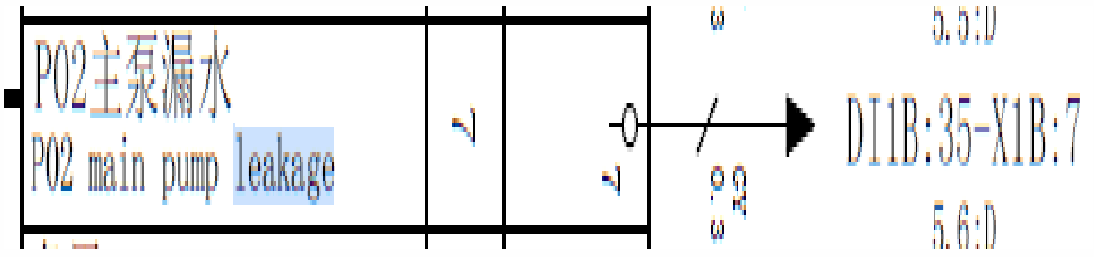


Fig 6: Signal transfers from X1B block to DI1B of AP5 control cabinet

3) INSPECTION AND MAINTENANCE

● First, check the operation of the main circulating pump on site. If the main circulating pump is indeed leaking and the detection switch is closed, immediately switch the standby pump manually, find the leakage point of the main circulating pump, and notify for maintenance Personnel to perform maintenance.

● If there is no trace of leakage in the main pump, check whether the LS02 leak detection switch is incorrectly closed;

● If the leak detection switch is not closed, check whether the terminals 5 and 6 of the X43 terminal block are loose and short-circuited; check KALS02 relay 11-14 contacts or 21-24 contacts are closed.

● Check DI1A and DI1B whether the wiring is loose or close. And notify the maintenance personnel to check and deal with it.

P01 MAIN CIRCULATING PUMP MOTOR TEMPERATURE IS HIGH

(ALI UMAIR)

1) EVENT OVERVIEW:

The main circulation circuit of cooling system at Matiari Converter Station has 2 pumps i.e. one main and one standby. When any of the two pumps is operated for a long period of time, it risks being overheated so there are multiple temperature transmitter mounted on main pump which continuously monitor the health of various parts of main pump including the motor.

Pump motor temperature is high event is generated and the event is displayed on OWS if the winding temperature of the related motor crosses 95℃. When this condition occurs, the system switches over to the standby pump and at the same, the system status reports “P01 main circulating pump motor temperature is high.” If circulating pump motor temperature is high, it is advised to switch to standby pump to avoid any unwanted situation.

2) ALARM PRINCIPLE ANALYSIS:

The P01 main circulating pump motor winding temperature is monitored by TT07 sensor. 24V DC power supply is used to power up TT07. The input supply to the sensor is kept redundant for the purpose reliability. The figure below shows the sensor powered by DC supply.

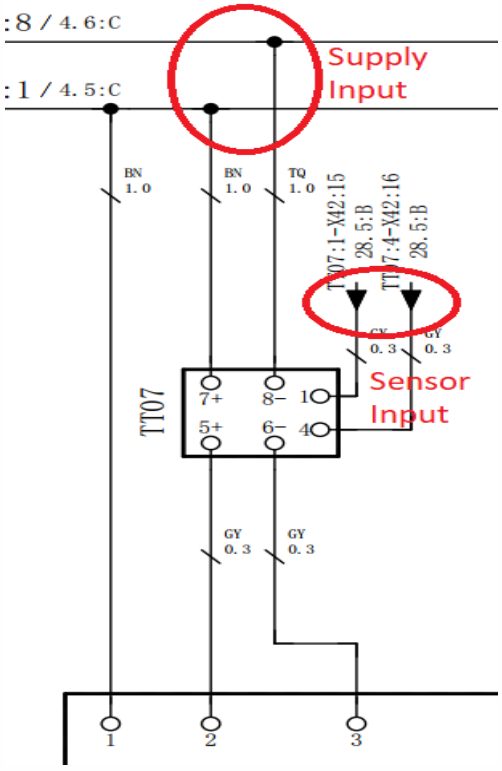


Fig 1: DC Power supplied to TT07.

TT07 is tasked to continuously monitor the motor winding temperature of P01 pump. The set value for alarm is 95°C and if at any time, this value is sensed at the input of sensor, TT07 waits for 3 seconds because the temperature could be just a transient but if the temperature does not fall below the set value within the mentioned time, TT07 will send a signal to PLC through Analog Input module (AI2C).

The PLC receives the signal and processes the temperature transmitter signal and judges whether the winding temperature is within the normal range according to the set temperature value. Since the temperature exceeds the high value of 95 degrees Celsius, the standby main circulating pump P02 will be started immediately to enter the working state and cut off P01 main circulating pump power supply, and

at the same time "P01 main circulating pump motor temperature is high" is sent to OWS.

The figures below show the sensor signal and supply signal sent by TT07.

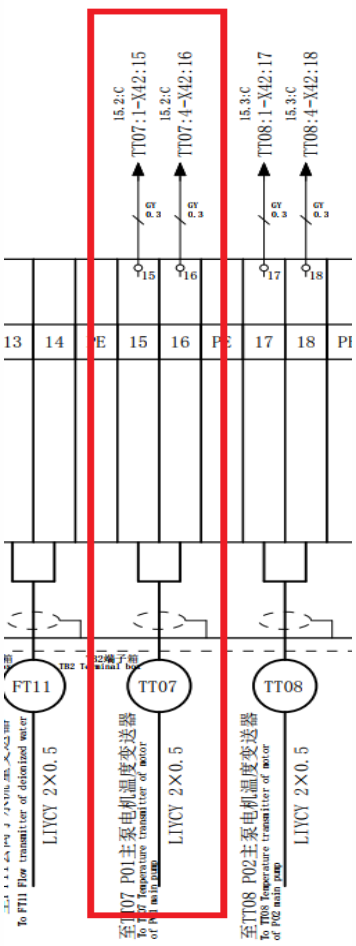


Fig 2 : Sensor signal.

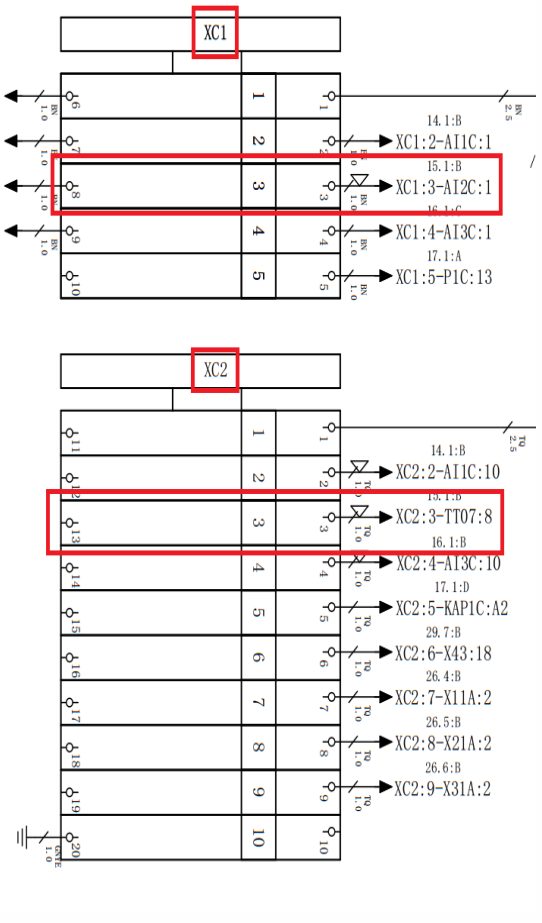


Fig 3: Supply signal.

3) INSPECTION AND TREATMENT:

- Check the operation of the main circulating pumps of P01 and P02 on site. In case this event is generated, P01 should stop running on site and the cooling system should switchover to P02 for its normal operation.
- Check that the water-cooling parameters of pole 1 are within the normal range, and carry an infrared thermometer to perform infrared temperature measurement on the P01 main circulation pump that is out of service, record the data, and notify the maintenance team for emergency treatment.
- Check the control circuit in AP4 cabinet and calibration of the sensor as well.
- Check whether the TT07 sensor is faulty or not and notify maintenance personnel if there is some problem with the sensor.

P01 MAIN PUMP MOTOR END BEARING TEMPERATURE IS HIGH

(ABDUL WAHAB)

1) INTRODUCTION

The temperature indicator play an important role to prevent the failure in operation and malfunctioning of the motor and also extend the life of motor by protecting it from over heating.

There are multiple temperature transmitter mounted on main pump which monitor the health of various parts of main pump.

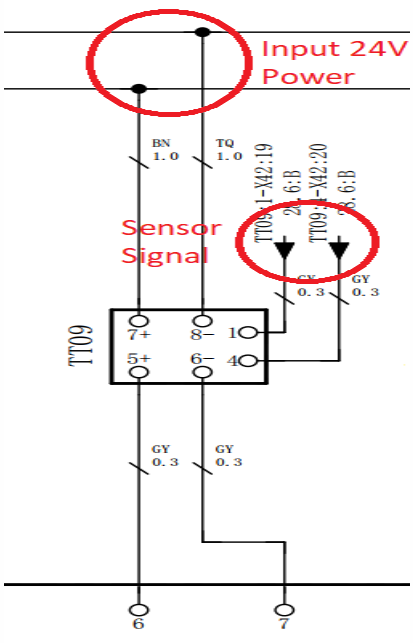


Fig 1 : Main circuit

2) EVENT SUMMARY

In case of the motor bearing temperature exceed from 80°C, the TT09 generate an alarm of “P01 main pump motor end bearing temperature is high” and send it to OWS and there will be switching of pump from P01 to P02 and vice verse.

3) ALARM PRINCIPLE ANALYSIS

When motor bearing temperature of main pump P01 get increase and cross the maximum limit (i.e. 80°C) the TT09 send an alarm to PLC through analogue input modular (AI2C) and system quickly shift to main pump P02.

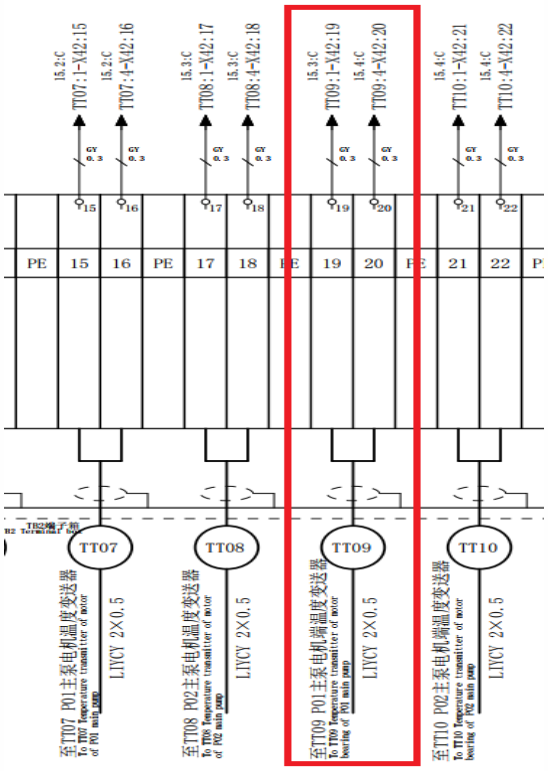


Fig 2 : Sensor signal

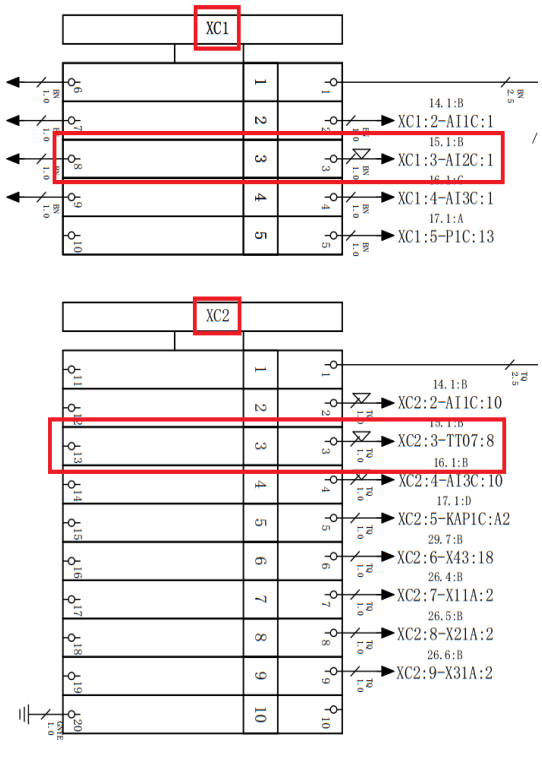


Fig 3 :Supply signal

CHECK AND DEAL WITH

- First check the TT09 temperature transmitter indicator status of the P01 main pump in the AP4 screen cabinet
- Check the 15 channels in AI2C module in AP4 cabinet
- Check the TT09 calibration.
- Check the control circuitry
- Check whether the TT09 sensor is faulty, and notify the maintenance personnel to deal with it.

Fig 4 : Physical picture of TT11

EVENT: P01 MAIN PUMP PUMP END BEARING TEMPERATURE IS HIGH:

(HASEEB KHALIL)

1) INTRODUCTION

Internal valve cooling system have two main circulation pumps (P01 & P02), at a time one pump is used and other pump is used as standby or backup. If the running pump fails or cannot provide rated pressure or flow, immediately switch to the standby pump. The main pump normal continuous operation for a period (168 hours) will automatically switch after. The system flow and pressure remain stable during switching. The basic principle of temperature sensor/indicator is to detect overheating to prevent the failure in operation and malfunctioning of the pumps. There are multiple temperature sensor/transmitter is mounted on main pump to monitor the over temperature and health of various components/parts of pump.

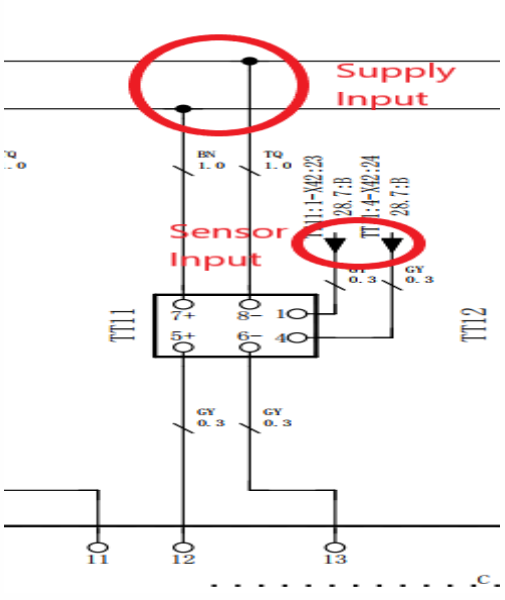


Fig 1: Main circuit

2) EVENT OVERVIEW

TT11 temperature transmitter is mounted on main circulating pump and when pump end bearing temperature exceed from 80°C, the TT11 generate an alarm signal of "P01 main pump end bearing temperature is high" and send this event to OWS, where a warning events is received.

3) ALARM PRINCIPLE ANALYSIS

When the temperature of main pump bearing end get increased and exceed the set value or cross the maximum limits which (i.e. 80°C) ,the TT11 send an alarm to PLC through Analogue input modular (AI2C) and system quickly shift to main pump P02 and there is a delay of 3 seconds.

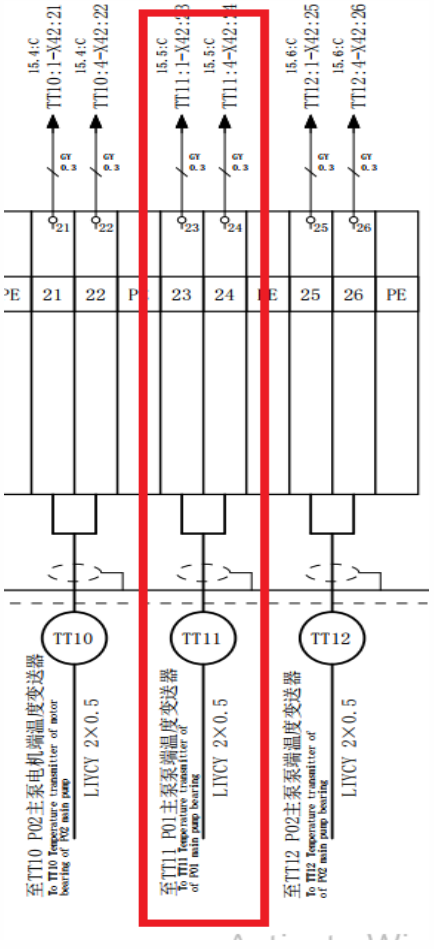


Fig 2: Sensor signal

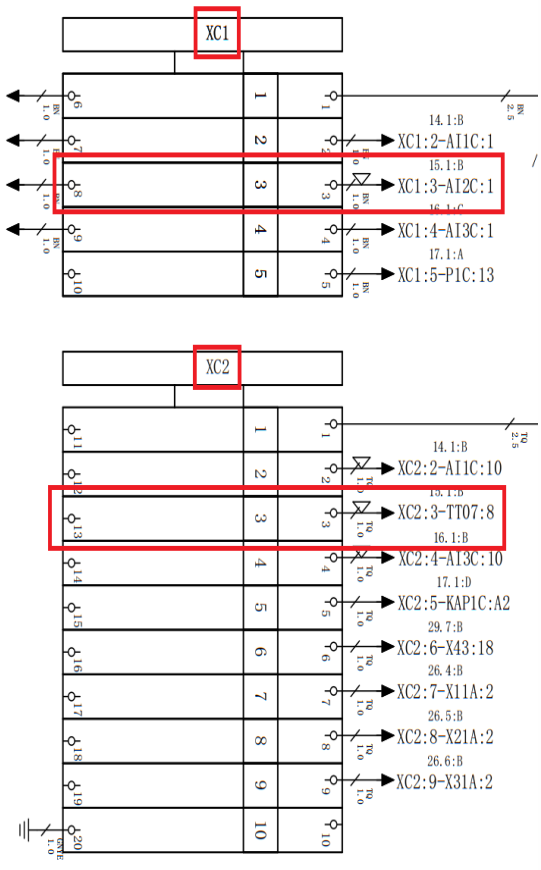


Fig 3: Supply signal

4) INSPECTION AND TREATMENT

- In the AP4 screen cabinet, first all we check the TT11 temperature transmitter sensor/indicator status of the P01 main pump and check the relevant channel in AI2C module in AP4 cabinet.
- Now check the control circuitry and then check the calibration of TT11.
- Verify and check whether the TT11 sensor is faulty, and if there is any fault then notify the maintenance personnel to deal with it.
- Carry an infrared thermometer to perform infrared temperature measurement on the P01 main circulation pump, record the data, and notify the maintenance crew for emergency treatment.

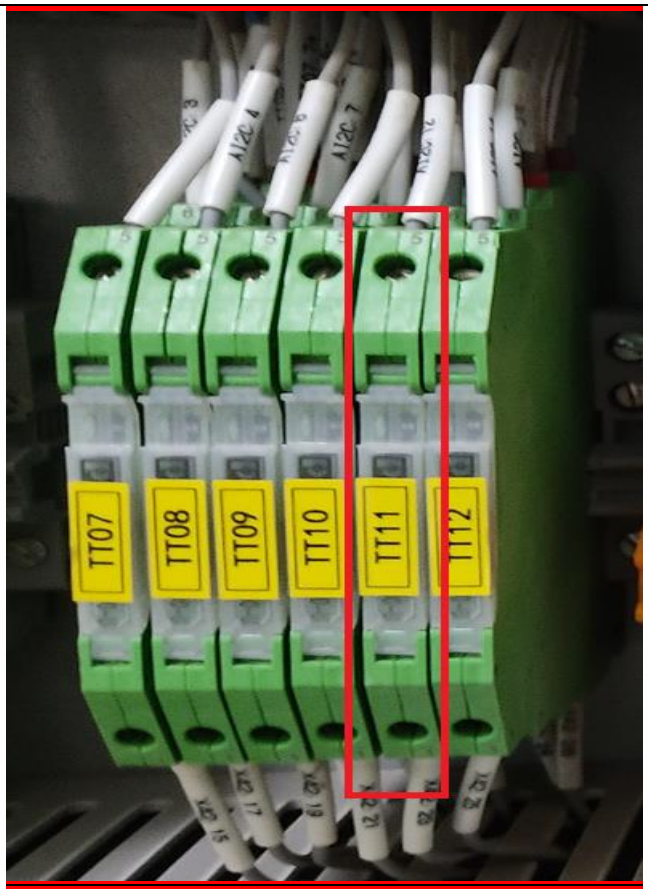


Fig 4 : Physical picture of TT11

AP3 CABINET 1# AC POWER FAILURE

(RANA MUHAMMAD AHMED BILAL)

1) OVERVIEW

AP3 cabinet overlook two power supply sources namely 3#AC Power 380V 50Hz and 4#AC Power 380V 50Hz which are 1# AC power supply and 2# AC power supply of the AP3 cabinet, respectively. 1# AC power supply is supplying power to Heater H01 & H02 respectively as well as to Air filling solenoid valve V503 without any redundant source availability. Similarly, 2# AC power supply is supplying power to Heater H03 & H04 respectively as well as to Air filling solenoid valve V504 independently.

However, P21 raw water pump, P11 make-up pump, P12 make-up pump and 3# control power are provided with redundant power source.

2) MONITORING OF INCOMING POWER SUPPLY

KR31 & KR32 are input power monitoring devices for power supply AP3 3# & AP3 4# respectively. When an abnormal behavior is detected such as voltage less than or higher than threshold voltage, it will send a signal to isolate power supply or switch to the redundant power supply. When the power supply is lost or breaker failure is detected, the same procedure is followed, and interlock relay will be operated.

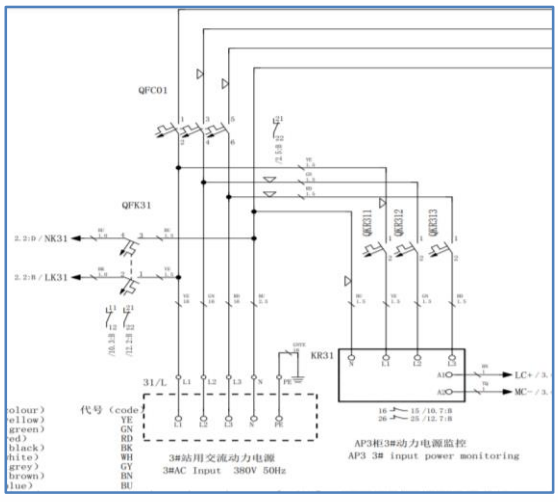


Fig 1: Control Signal of PLC A

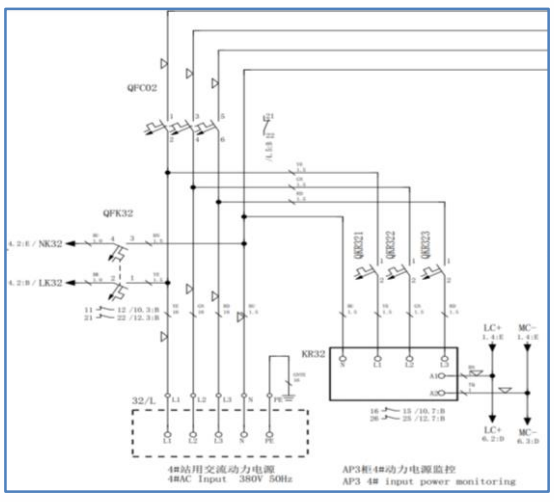


Fig 2: Control Signal of PLC B

Control signal for AC power failure will be send to PLC A & PLC B simultaneously. Any abnormal activity is monitored by both PLCs to make system more reliable.

AC Power Failure signal for AC Power 3# & AC Power4# is send to PLC A through Terminal section R33A. Terminal 4# is used for AC Power3# and Terminal 5# is used for AC Power4#. Fault at PLC A will be detected when contact # “15” & “16” will be normally open whenever an abnormal activity will be happened at AC Power input.

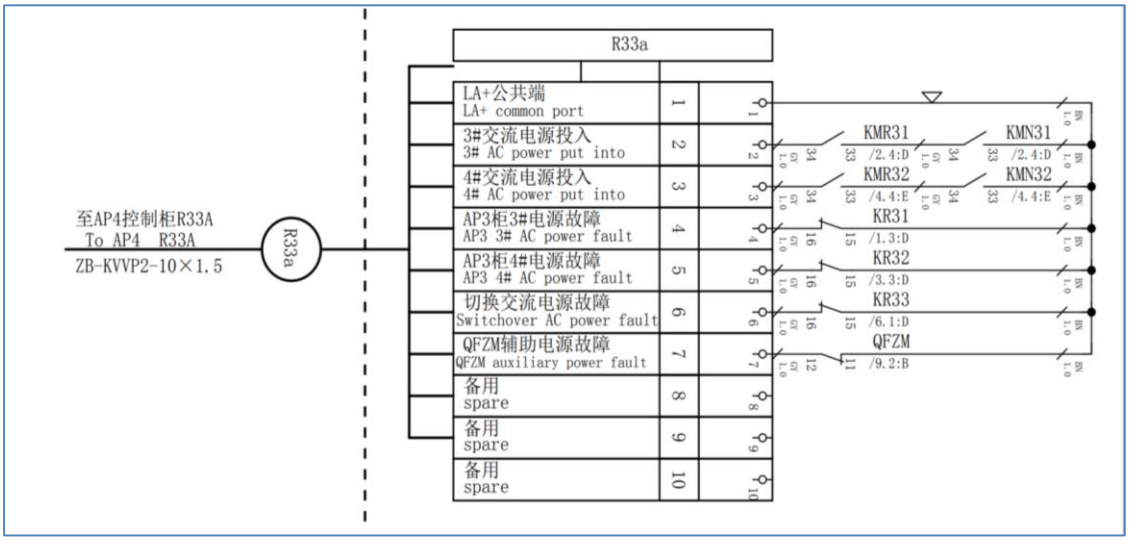


Fig 4: Signal Flow

AC Power Failure signal for AC Power 3# & AC Power4# is send to PLC B through Terminal section R33B. Terminal 4# is used for AC Power3# and Terminal 5# is used for AC Power4#. Fault at PLC B will be detected when contact # “25” & “26” will be normally open whenever an abnormal activity will be happened at AC Power input.

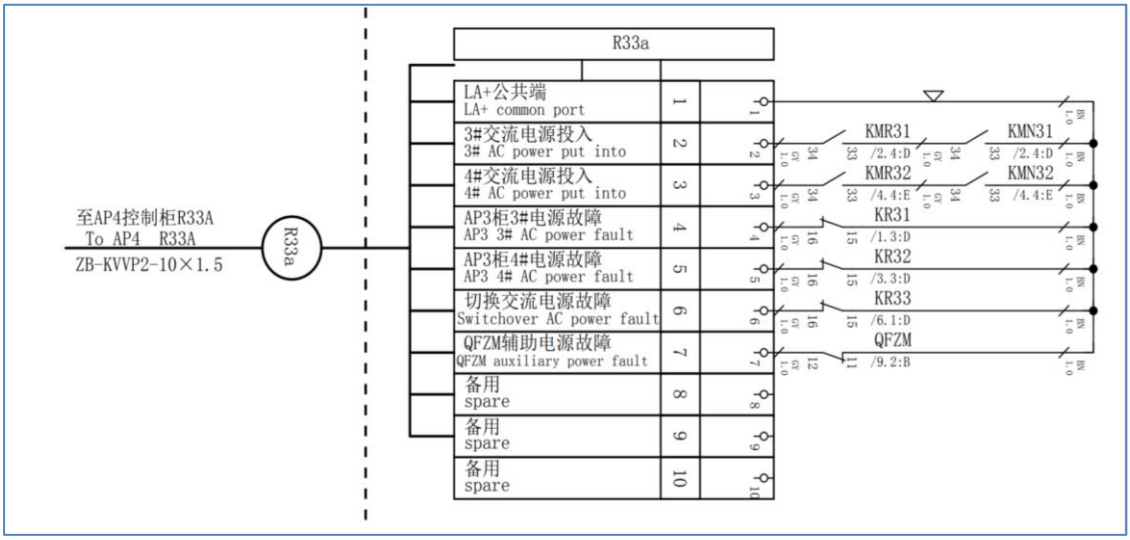


Fig 5: Signal Flow

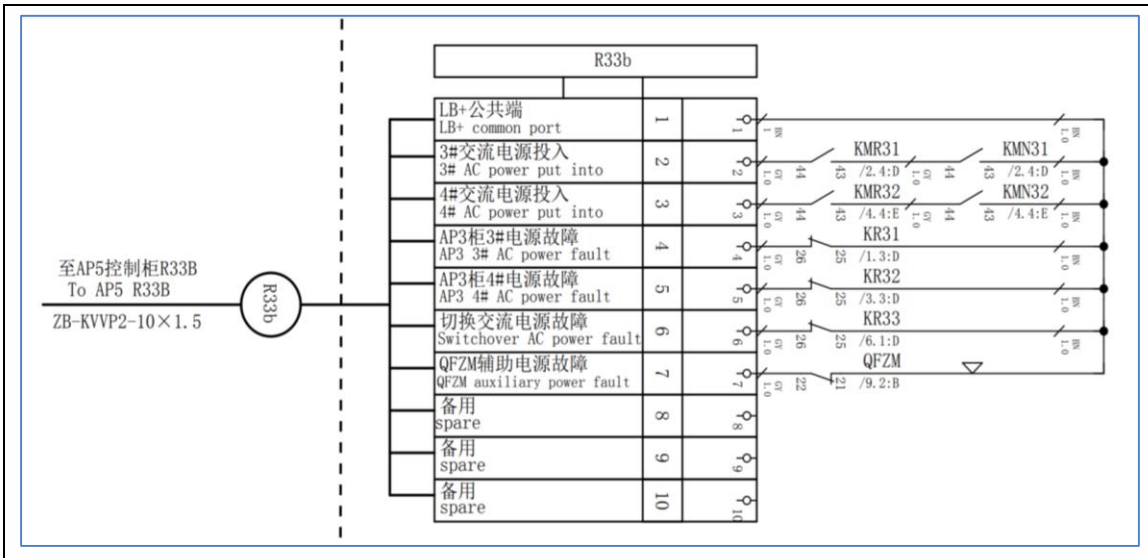


Fig 6: Signal Flow

- Inspection and Troubleshoot

- To check the background events, confirm that both CPU indicate alarm at the same time, accompanied by the standby power input signal.
- Check the lighting of the input monitoring relay at the AP3 cabinet.

- After the successful switching of the power, check if there is no alarm regarding the motor device and electric valves.
- If possible, check the reason of the power failure and contact the maintenance department.

AC POWER FAILURE OF AP3 CABINET SWITCHING

(MUHAMMAD TALHA)

1) EVENT OVERVIEW:

Two incoming power supply in AP3 cabinet through the Circuit breaker QFC31 and QFC32 is selected by the Magnetic contractor KMR31/KMR32/KMN31/KMN32 which are energized with PLC output through the relay KAC01A/KAC02A. Internal valve cooling control system monitors the power circuit through the voltage monitoring relay, the function of this relay is to monitors each of the phases to detect when the voltage in any one phase falls by a predetermined amount below the average of all three phases. Similarly, if complete loss of a phase is detected, or the relay MCBs are opened (i.e. QKR331, QKR332, and QKR333) the relay will report “Valve internal cooling AP3 switchover AC power fault” to the PLC Input module in AP3 and AP4.

Fig 1: Main Breaker QFC31 and QFC32

Fig 2: Magnetic contractors

Fig 3: Relays connect to DO of PLC

Fig 4: Monitoring relay

The basic flow of signal in this event is shown below figure

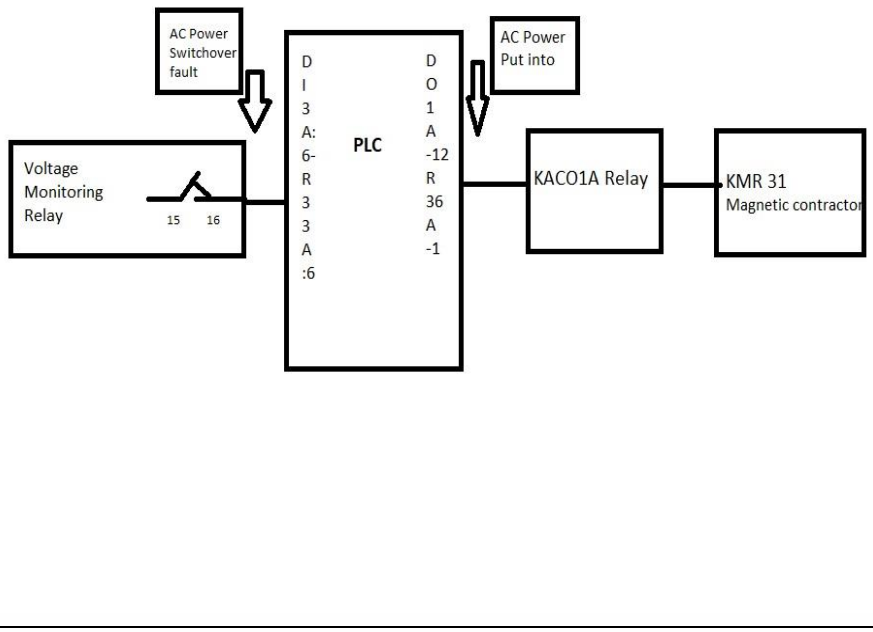


Fig 5: Signal flow

2) ALARM PRINCIPLE ANALYSIS:

KM33 is voltage monitoring relay which monitor the line voltages of L31 L32 L33 and N31 when the voltage level is greater or less then the set value it send a signal to Digital input modular (DI3A) to PLC through interface module IM1A to Porifbus A1 and IM1B to Profibus B1. For example if one phase of L31 is lost, the Normally contacts of KR33 (15,16 or 25,26) are become opened the valve internal cooling system reports "Switchover AC power fault", the signal is send to the Digital input module of PLC, PLC verify the signal and make decision to actuates the Magnetic contractor KMR31/KMR32/KMN31/KMN32 through relay KAC01A/KAC02A when this relay activated and the valve internal cooling system reports "AC Power Put Into".

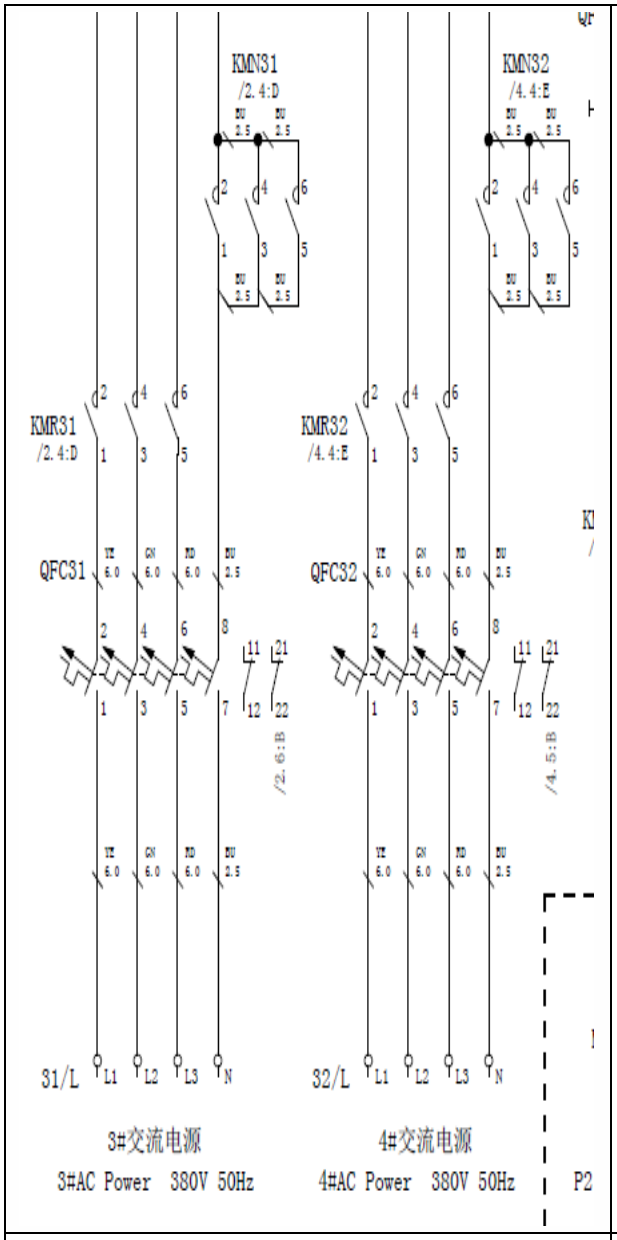


Fig 6: Incoming AC supply and contractors

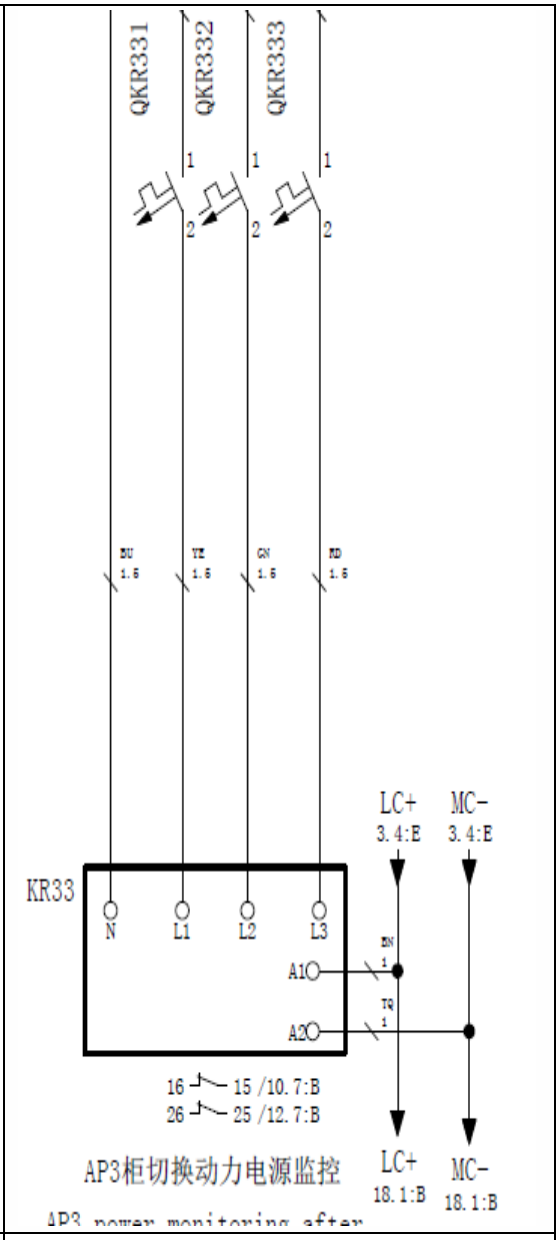


Fig 7: Voltage Monitoring relay and its Breakers

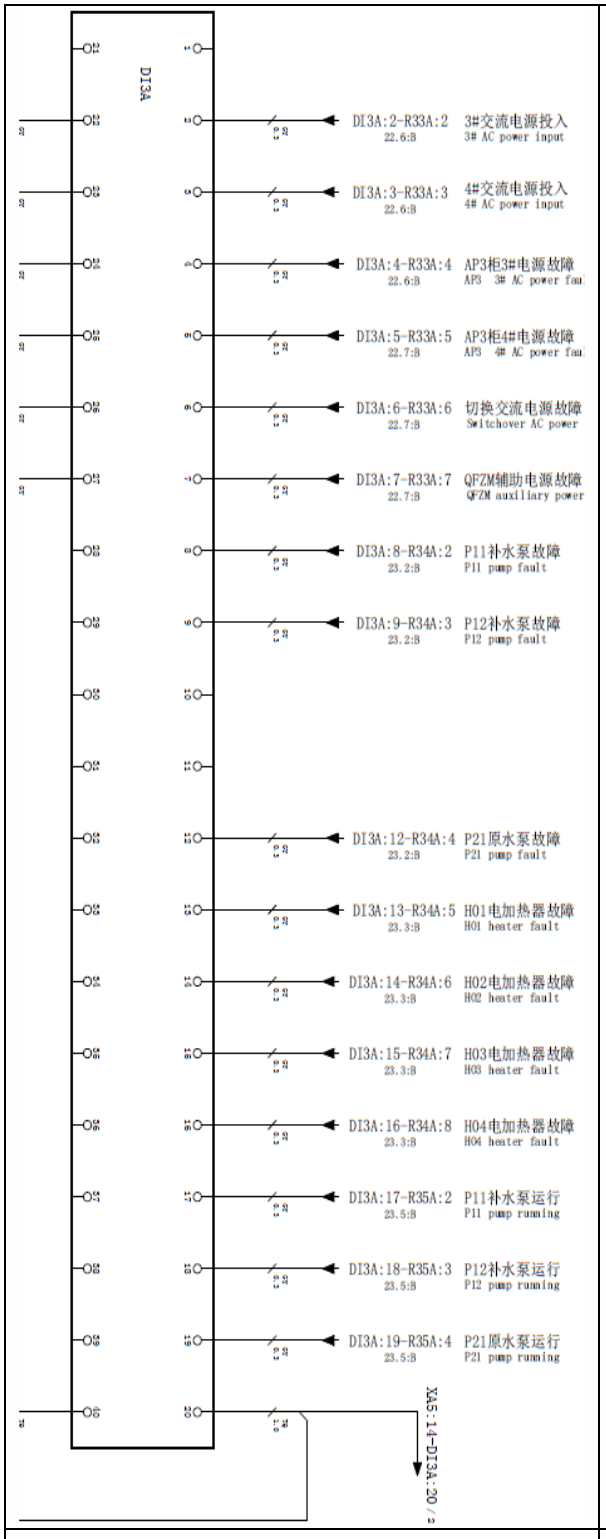


Fig 8: DI3A

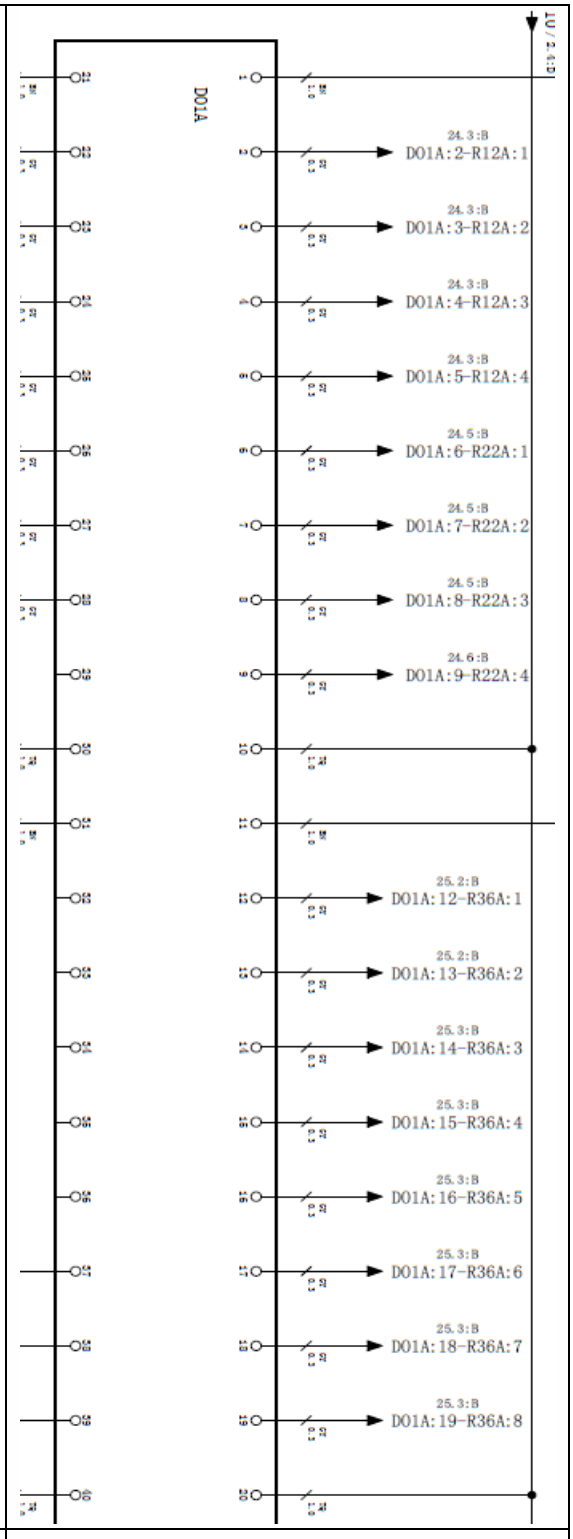


Fig 9: D01A

3) INSPECTION AND TREATMENT.

3.1) INFRARED TEMPERATURE MEASUREMENT:
After the fault occurs, immediately perform infrared temperature measurement of other components in the screen cabinet, and no abnormality is found. The other power monitoring relays are all around 30°C.

3.2) VISUAL INSPECTION:

Check the appearance of the fault relay, the wiring is correct and there is no looseness. Check that the MCB of the DC signal circuit is normal and there is no disconnection. It can be preliminarily judged that the damage of the relay is not caused by the damage of the signal power
If you check that the QKR331 or QKR332 switch is tripped, you can try to close it once, and then it will not overlap after it is tripped again. Contact the maintenance personnel for inspection and handling.
Check the KAC01A and KAC01B relay excitation, and check the contacts of the actuator KMR31 KMR32 KMN31 and KMN32.

3.3) CHECK WHETHER THE KM33 MONITORING RELAY IS FAULTY, AND NOTIFY THE MAINTENANCE PERSONNEL TO DEAL WITH IT.

I. SETTING CHECK

The setting of the two faulty relays was checked on site, and the result of the check was normal.

Relay model: CM-MPS, the fixed value is set as follows:

<U:180V,>U:264V, unbalance threshold: 10%, time adjustment 2s, time delay: ON

II. REPLACE THE RELAY

When replacing, pay attention to prevent short circuit of signal circuit and prevent wrong wiring.

III. CHECK THE REPLACED RELAY

The inspection found that the pressure-sensitive components inside the relay are burnt, indicating that there is an instantaneous overvoltage phenomenon。

QFC31 AC POWER CIRCUIT BREAKER IS NOT CLOSED

(SAMI UL HAQUE)

1) INTRODUCTION

QFC31 is basically a MCB which powers the raw water pump (P21), make up pumps (P11 & P12) and also the solenoid valve (V511 & V512). The QFC32 serve as a backup to supply the power in case of failure of QFC31 or the incoming power.

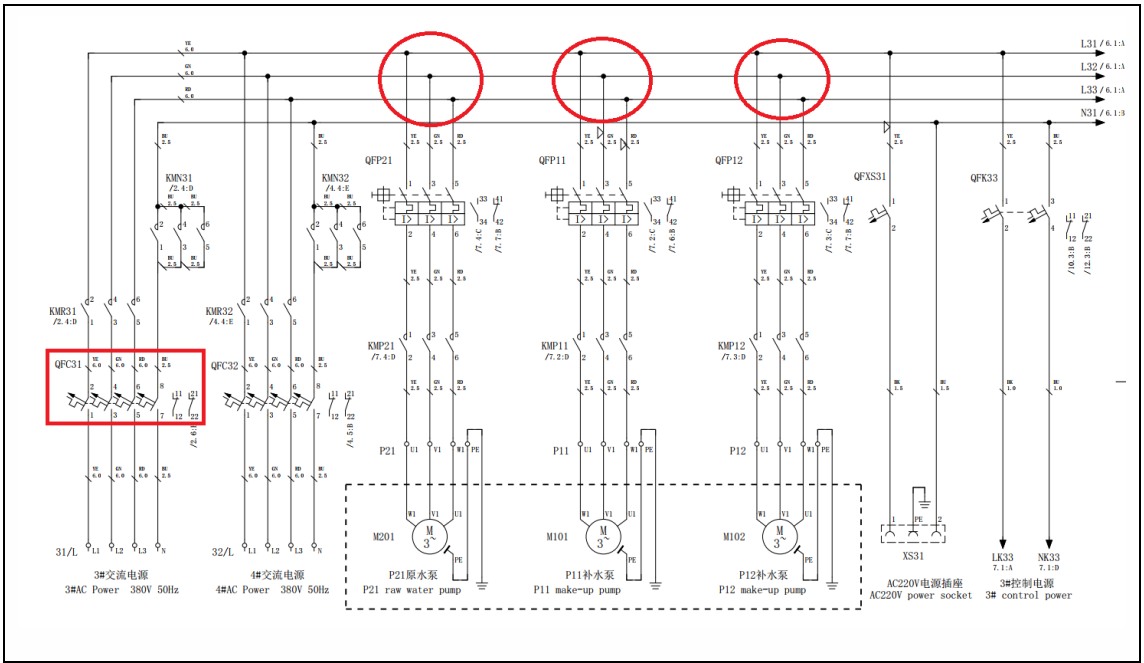


Fig 1 : AC power circuit

2) EVENT SUMMARY

QFC31 control logic has normally close auxiliary contact which initiate an alarm “AC power circuit breaker is not close” when the relay (KAQFC31) get energies.

3) ALARM PRINCIPLE ANALYSIS

When QFC31 get open the auxiliary contact 21/22 and 11/12 of the breaker get closed and the relay (KAQFC31) contacts get energize which initially is NO (normally open) and send the signal through R31a to AP4 panel digital input modular (D12A) which is connect to the profi bus through interface module IM1A and IM2A.

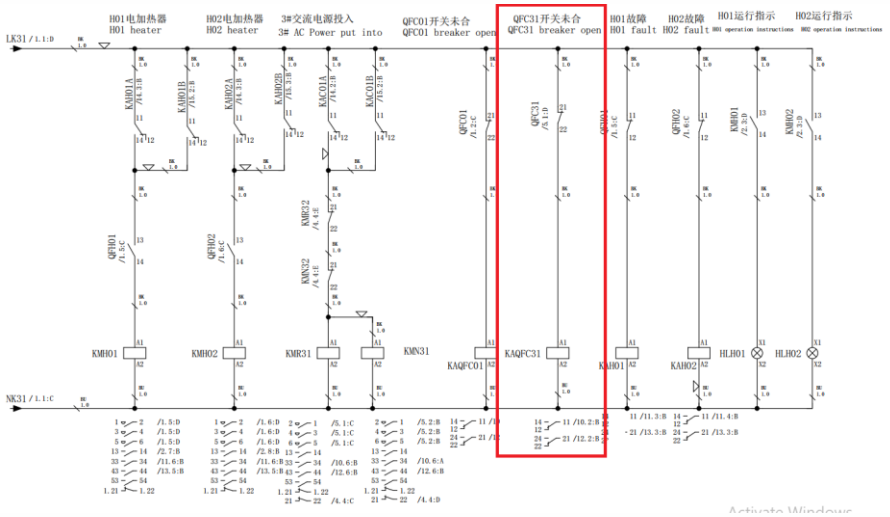


Fig 2: Control logic circuit

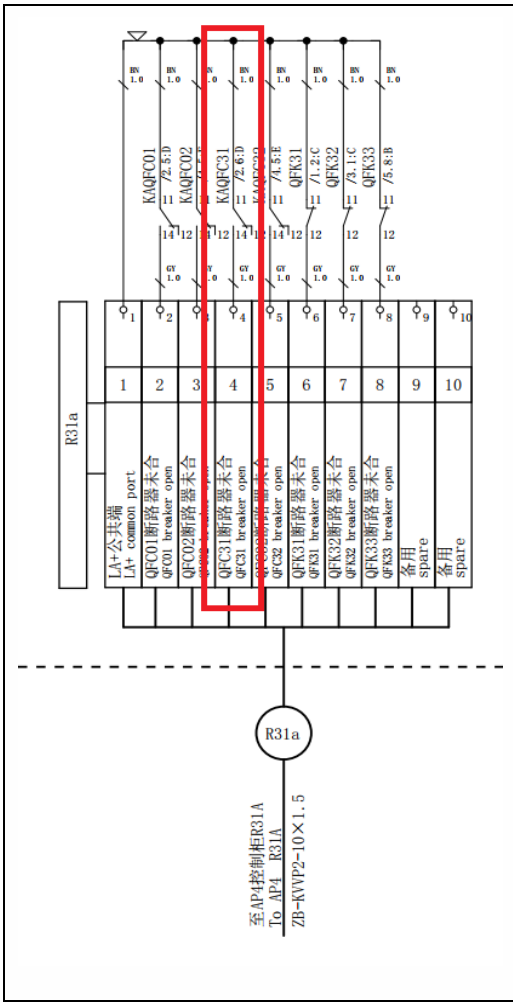


Fig 3: Relay logic

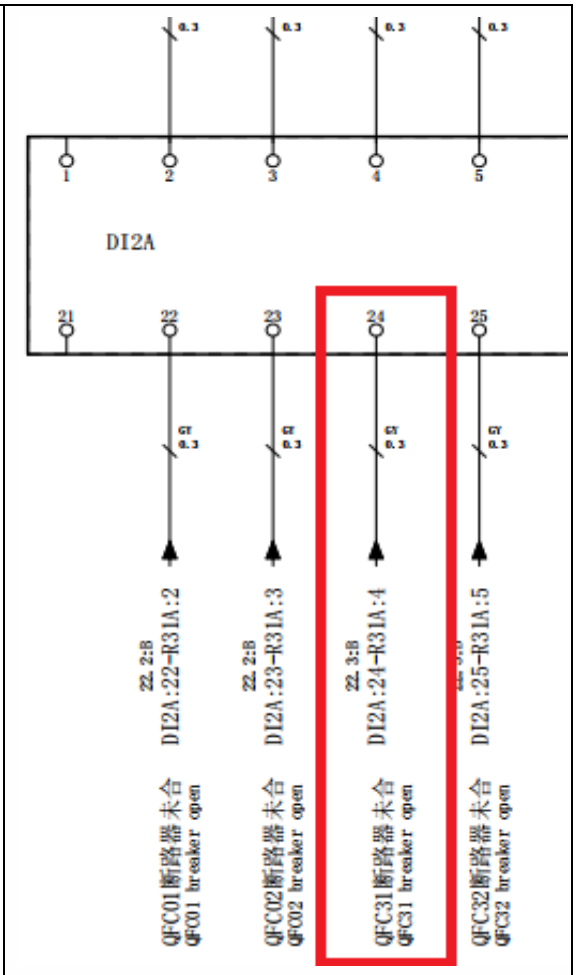


Fig 4: Digital input modular connect with interface

4) CHECK AND DEAL WITH

When the Circuit breaker get open the following condition may check.

- AC Input power failure
- Control logic circuitry failure
- Auxiliary contact of the breaker

When the alarm is reported on the OWS,

- Go to the site to check the status of make up pumps and raw water pump.
- In case of failure of QFC31 the operating status of the water cooling system should be closely monitored and always pay attention whether the other circuit breaker get trip

or not.

Fig 5: Physical picture of QFC31

QFK31 CONTROL POWER CIRCUIT BREAKER IS NOT CLOSED.

(MUHAMMAD OWAIS SIDDIQUI)

1) EVENT OVERVIEW

QFK31 circuit breaker has two normally closed alarm auxiliary contacts. When the circuit breaker is open and the auxiliary contact is closed, the background will report “QFK31 Circuit breaker is not closed”.

2) ALARM PRINCIPLE ANALYSIS

The control circuit of auxiliary equipment such as heater are powered by two connections (NK31 and LK31) through circuit breaker QFK31, as shown in Figure 1.

In the normal state, the circuit breaker is closed. When disconnected at the same time, the two line contactors of the heater will not be able to be closed, the heater will not be able to operate, and at the same time a signal " QFK31 control power circuit breaker is not closed " is reported in the background.

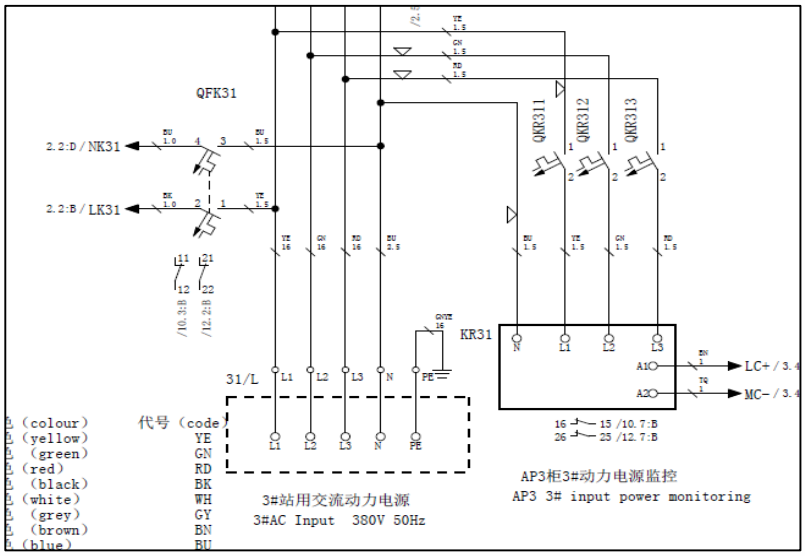


Fig 1: AP3 Cabinet schematic diagram showing connection of QFK31 breaker

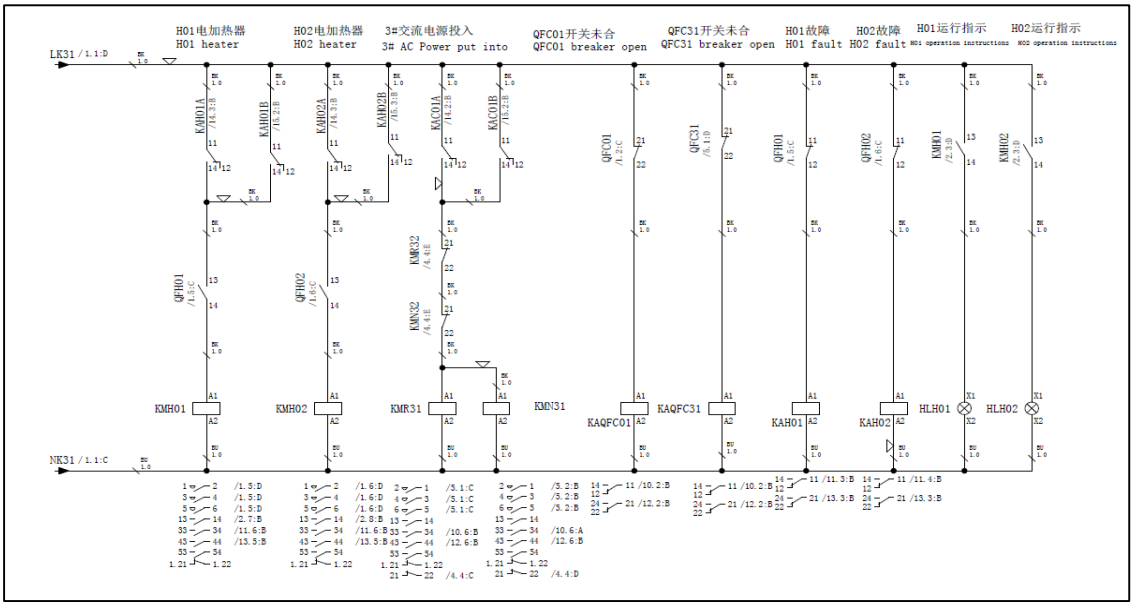


Fig 2: Control circuit of auxiliaries in AP3 Cabinet

2.2) QFK31 IS NOT CLOSED ALARM ANALYSIS:

In normal conditions the QFK31 breaker is closed and its contacts “11” “12” and “21” “22” are open. When the QFK31 switch is opened its contacts “11”, “12” and “21”, “22” are closed which generate a signal to AP4 and AP5 control cabinets as shown in figure.

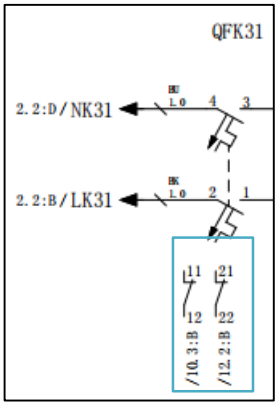


Fig 3: Contacts 11 12 and 21 22

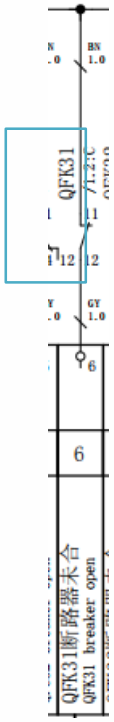


Fig 4: To PLCA

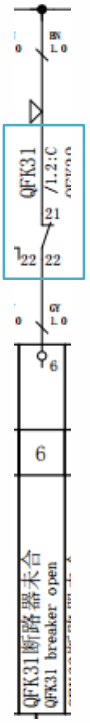


Fig 5: To PLCA

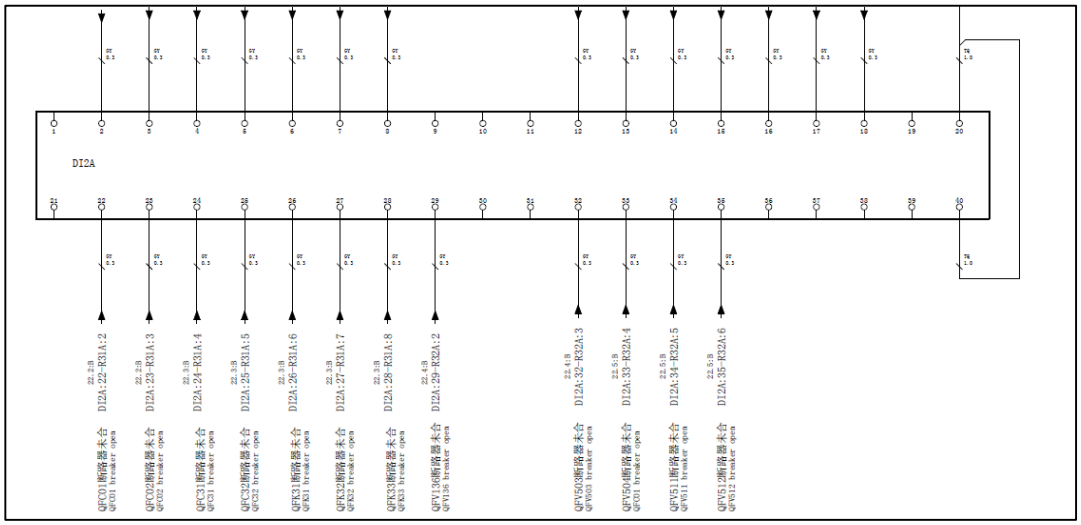


Fig 6: Connections of DI2A in AP4 Cabinet

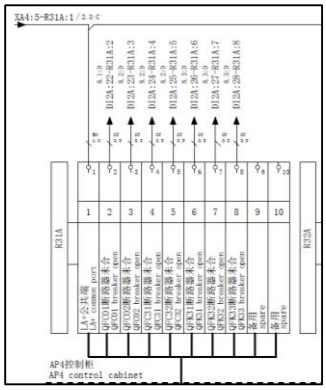


Fig 7: Connection of QFK31 breaker with AP4 Cabinet

The contacts 11-12 are connected to pin 26 of DI2A which goes to Interface module, where it is connected to Profibus A, as shown in diagram. The status signal of Profibus A pass to CPU A.

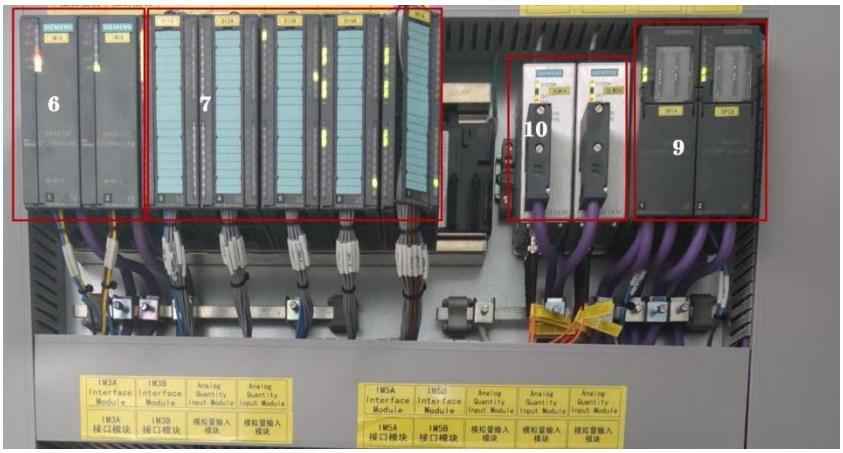


Fig 8: Connections of DI2A with Interface Module

The connections of 21-22 contact are same as the signal pass through the Profibus B to CPU B.

3) INSPECTION AND TREATMENT:

3.1 First check the QFK31 switch status in the A3 cabinet.

Figure 9: QFK31 Power Circuit Breaker

3.2 Check the auxiliary contacts “11” “12” and “21” “22” of the switch.

3.3 If the QFK31 switch is open then check if there any short circuit or any other reason of the tripping.

P11 MAKEUP PUMP FAILURE

(HAFIZ HAMZA SALEEM)

1) EVENT OVERVIEW:

When the QFP11 switch is tripped, the valve internal cooling control system determines that the P11 makeup pump is malfunctioning. The valve internal cooling control system reports“P11 make-up pump fault”.

2) ALARM PRINCIPLE ANALYSIS

P11 MAKEUP PUMP CONTROL PRINCIPLE: In the normal conditions the makeup pump breaker QFP11 contacts ”33” and “34” are closed and “41” and “42” are open. In order to start the makeup pump KAP11A or KAP11B relay receive the starting command as shown in figure , the KAP11A and KAP11B relay gets excited and its “11” and “12” contacts are closed. After which KMP11 contactor gets excited and its “1” ”2” ,”3” “4” and “5” ”6” contacts are closed and the P11 makeup pump is started as shown in figure

2.2) FAILURE PRINCIPLE OF P11 MAKEUP PUMP:

During the normal condition QFP11 breaker is in closed condition and contacts “41” “42” are open. When a fault occurs in makeup pump, the QFP11 breaker is open its contacts “41” ”42” are closed and KAP12 relay is excited and its contact “11” “14” are closed and signal is sent to PLCA and “21” “24” are closed and signal is sent to PLCB

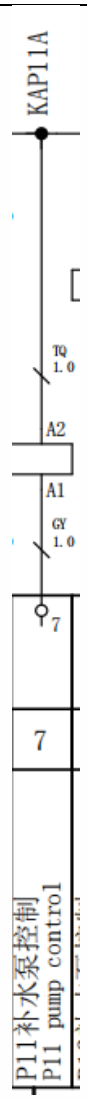
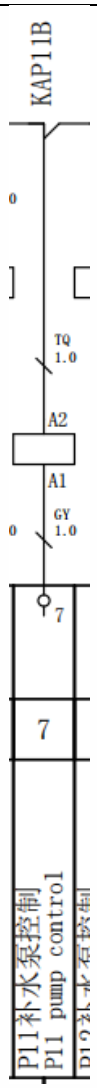
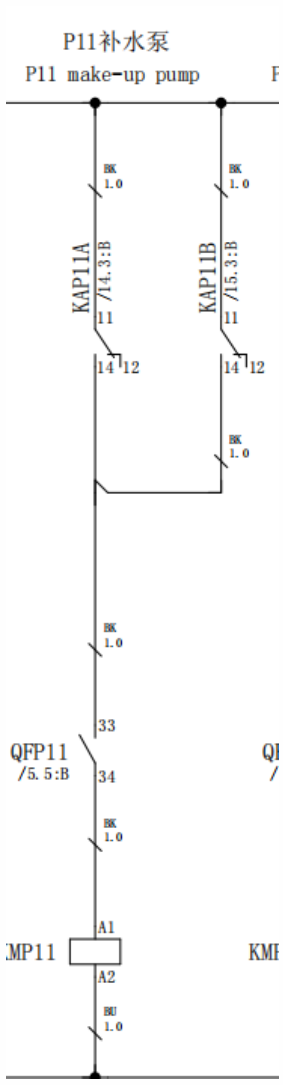
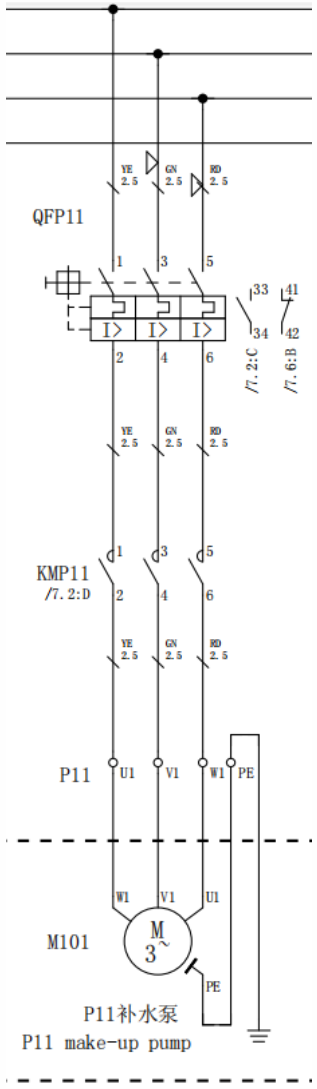
			

Fig 1: From PLCA	Fig 2: From PLCB	Fig 3 : 11 12 contacts are closed	Fig 4: P11 starts running

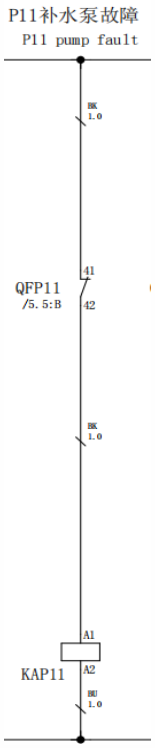


Fig 5: Fault signal generated

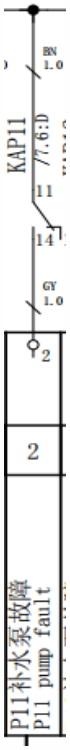


Fig 6: PLCA

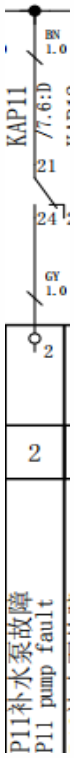


Fig 7:PLC B

3) INSPECTION AND TREATMENT.

3.1 First check the QFP11 status of the P11 makeup pump power switch in the AP3 cabinet

Fig 8: QFP11

3.2 Check the 15 channels in DI3A module in AP4 cabinet and 15 channels of DI3B module in AP5 cabinet are turned on.

3.3 If you check that the QFP11 switch is tripped, you can try to close it once, and then it will not overlap after it is tripped again. Contact the maintenance personnel for inspection and handling

3.4 If QFP11 switch does not trip, check the KAP11 relay excitation, and check the status of the auxiliary contact "41 42" of the QFP11 switch

Fig 9: KAP11 relay

3.5 If check the QFP11 auxiliary contact is normal, check whether the KAP11 relay is faulty, and notify the maintenance personnel to deal with it.

P12 MAKE UP PUMP FAILURE

(MUSTAFA BHATTI)

1) EVENT OVERVIEW:

The valve internal cooling control system determines whether the P12 makeup pump is malfunctioning. When the QFP12 switch is tripped, the valve internal cooling control system reports failure of the P12 make-up pump.

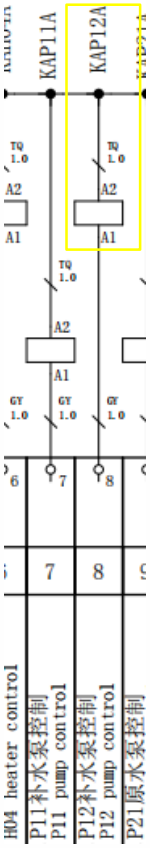
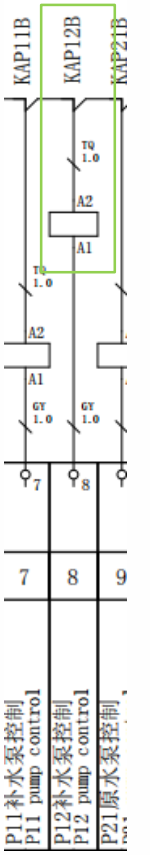
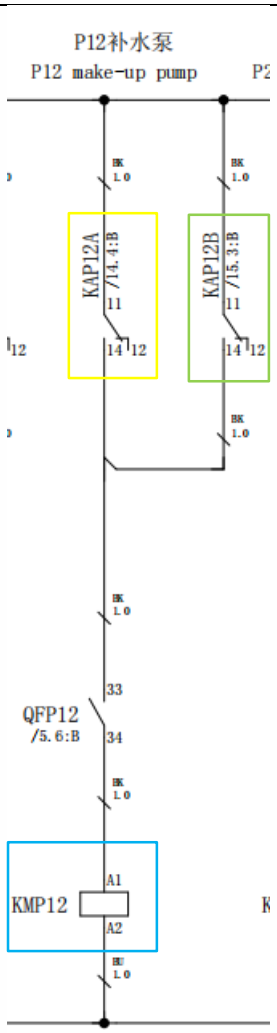
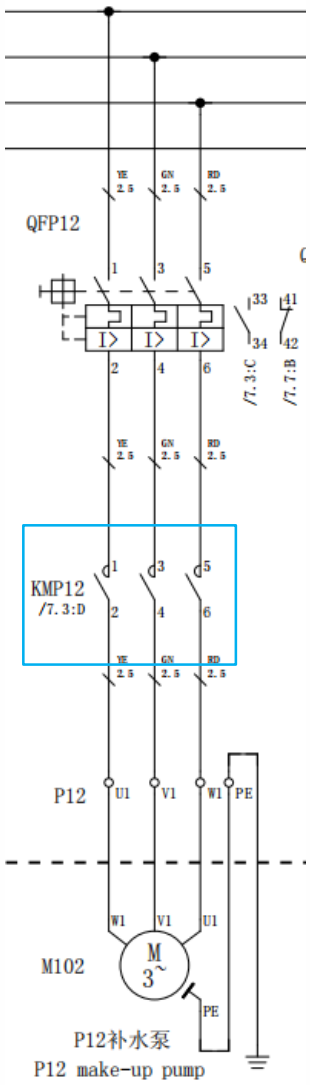
2) ALARM PRINCIPLES ANALYSIS:

2.1) P12 MAKEUP PUMP CONTROL PRINCIPLE:

In the normal conditions the makeup pump breaker QFP12 contacts ”33” and “34” are closed and “41” and “42” are open. When KAP12A or KAP12B relay receive the starting command as shown in figure , the KAP12A and KAP12B relay gets excited and its “11” and “12” contacts are closed. After which KMP12 contactor gets excited and its “1” ”2” ,”3” “4” and “5” ”6” contacts are closed and the P12 makeup pump is started as shown in figure

2.2) FAILURE PRINCIPLE OF P11 MAKEUP PUMP:

During the normal condition QFP12 breaker is in closed condition and contacts “41” “42” are open. When a fault occurs in makeup pump, the QFP12 breaker is open its contacts “41” ”42” are closed and KAP12 relay is excited and its contact “11” “14” and “21” “24” are closed. The fault signal is sent to PLCA and PLCB as “P12 makeup pump fault”

 From PLC A	 From PLC B		
Fig 1: KAP12A gets excited	Fig 2: KAP12B gets excited	Fig 3: KMP12 GETS EXCITED	Fig 4: KMP12 contactor CLOSES

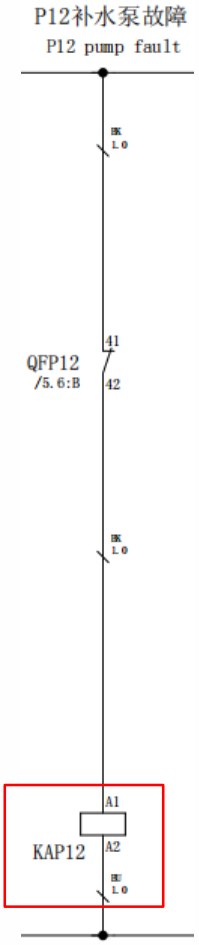


Fig 4: KAP12 gets excited

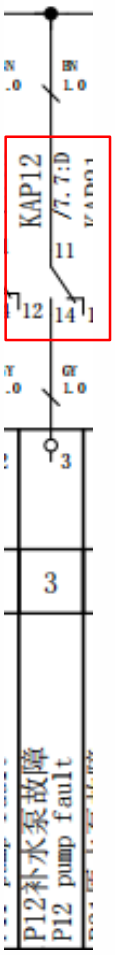


Fig 5: To AP4 PLCA

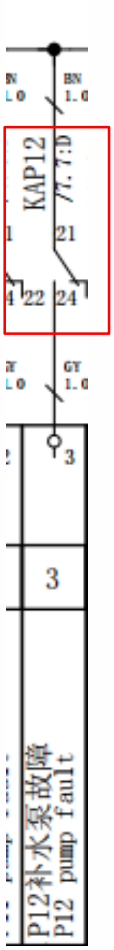


Fig 6: To AP5 PLCB

3) INSPECTION AND TREATMENT.

3.1 First check the QFP12 status of the P12 makeup pump power switch in the AP3 cabinet.

Fig 7: QFP12 switch

3.2 Check the 15 channels in DI3A module in AP4 cabinet and 15 channels of DI3B module in AP5 cabinet are turned on.

3.3 If you check that the QFP12 switch is tripped, you can try to close it once, and then it will not overlap after it is tripped again. Contact the maintenance personnel for inspection and handling

3.4 If QFP12 switch does not trip, check the KAP12 relay excitation, and check the status of the auxiliary contact "41 42" of the QFP12 switch

Fig 8: KAP12 relay

3.5 If check the QFP12 auxiliary contact is normal, check whether the KAP12 relay is faulty, and notify the maintenance personnel to deal with it.

P21 RAW WATER PUMP FAILURE

(BILAL AHMED)

1) EVENT OVERVIEW:

When the QFP21 switch is tripped, The valve internal cooling control system determines that the P21 makeup pump is malfunctioning.

The valve internal cooling control system reports “P21 make-up pump fault”.

2) ALARM PRINCIPAL ANALYSIS

2.1) P11 MAKEUP PUMP CONTROL PRINCIPLE:

In the normal conditions the makeup pump breaker QFP21 contacts ”33” and “34” are closed and “41” and “42” are open.

In order to start the makeup pump KAP21A or KAP21B relay receive the starting command as shown in figure, the KAP21A and KAP21B relay gets excited and its “11” and “12” contacts are closed. After which KMP21 contactor gets excited and its “1” ”2”,”3” “4” and “5” ”6” contacts are closed and the P21 makeup pump is started as shown in figure

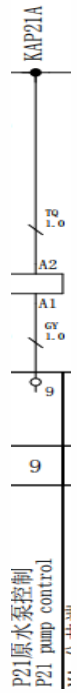
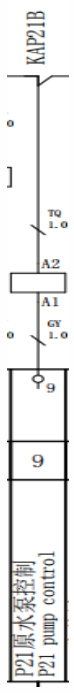
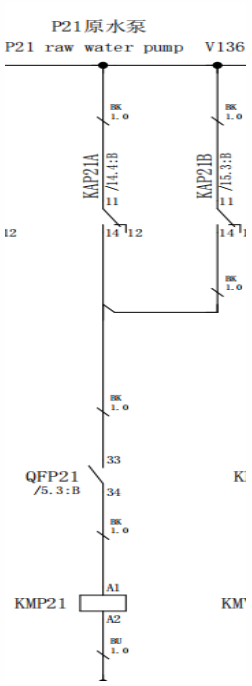
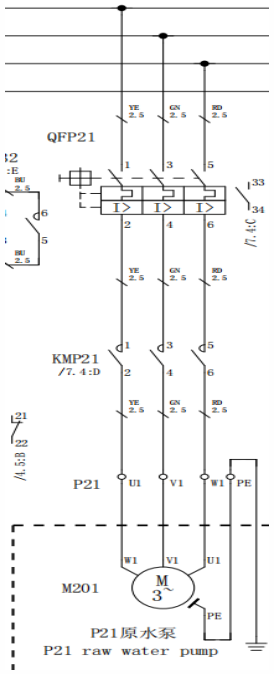
			

Fig 1:From PLCA	Fig 2: From PLCB	Fig 3: 11 12 contacts are closed	Fig 4: P21 starts running

2.2) FAILURE PRINCIPLE OF P11 MAKEUP PUMP:

During the normal condition QFP21 breaker is in closed condition and contacts “41” “42” are open. When a fault occurs in makeup pump, the QFP21 breaker is open its contacts “41” ”42” are closed and KAP21 relay is excited and its contact “11” “14” are closed and signal is sent to PLCA and “21” “24” are closed and signal is sent to PLCB.

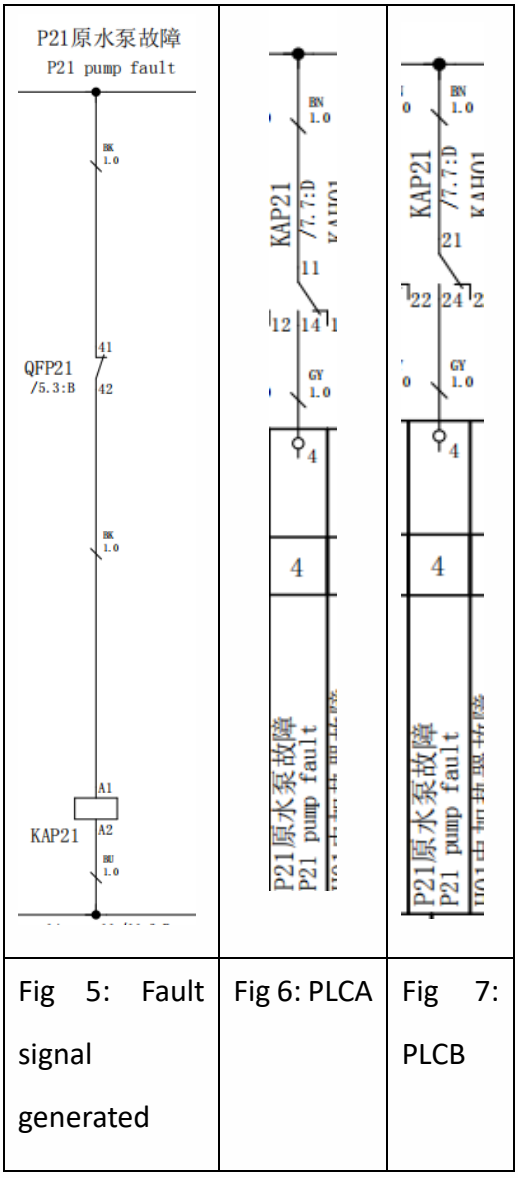


Fig 5: Fault signal generated	Fig 6: PLCA	Fig 7: PLCB

3) INSPECTION AND TREATMENT.

3.1 First check the QFP21 status of the P21 makeup pump power switch in the AP3 cabinet.

Fig 8 : QFP21 switch

3.2 Check the 15 channels in DI3A module in AP4 cabinet and 15 channels of DI3B module in AP5 cabinet are turned on.

3.3 If you check that the QFP21 switch is tripped, you can try to close it once, and then it will not overlap after it is tripped again. Contact the maintenance personnel for inspection and handling

3.4 If QFP21 switch does not trip, check the KAP21 relay excitation, and check the status of the auxiliary contact "41 42" of the QFP21 switch

Fig 9 : KAP21 relay

3.5 If check the QFP21 auxiliary contact is normal, check whether the KAP21 relay is faulty, and notify the maintenance personnel to deal with it.

V136 WATER REPLENISHMENT ELECTRIC VALVE FAILURE

(FAZUL MUHAMMAD)

1) EVENT OVERVIEW

Electric valve needs to be opened When the limit is opened, the limit cannot be opened when it needs to be closed, and the limit cannot be closed when the needs to be closed.

In automatic water mode: the valve cooling system can automatically water according to the liquid level of the expansion tank during manual or automatic operation of the valve cooling system. When the liquid level of the expansion tank is lower than the set value, the water replenishment pump starts to automatically replenish water, and the electric valve for replenishing water is automatically opened until the open limit; when the liquid level of the expansion tank reaches the stop pump liquid level, the water replenishing pump is stopped, and the electric valve for water replenishment is automatically closed at the same time, Until the limit is closed.

In manual water replenishment mode: the electric water replenishment valve can be manually started to the open limit through the button on the OP panel; the electric water replenishment valve can be manually stopped to the off limit through the button on the OP panel.

2) ALARM PRINCIPAL ANALYSIS

When the Valve internal cooling control system sends the V136 electric ball valve opening command and still does not receive the V136 electric ball valve open limit signal, it reports " V136 water replenishment electric valve failure ", and the closing process principle is the same.

2.1) THE NORMAL WORKING PRINCIPLE OF THE VALVE V136

The open circuit of the electric ball valve V136 is connected by the auxiliary contact of the KMV136K relay. The closed circuit is connected by the auxiliary contact of the KMV136G relay. Its control loop redundancy design can issue commands through the CPU on the AP4 cabinet and AP5 cabinet respectively. Take the AP4 cabinet as an example below. When the CPU issues a command to open the V136 ball valve, through digital output module a high level to turn on the KAV136K relay circuit At this time, the normally open contacts 11 and 14 of the KAV136K are closed. The circuit of KMV136K is turned on, and the normally open contacts "1 2", "3 4" and "5 6" of KMV136K are closed, so that the open circuit of the electric ball valve V136 is turned on).

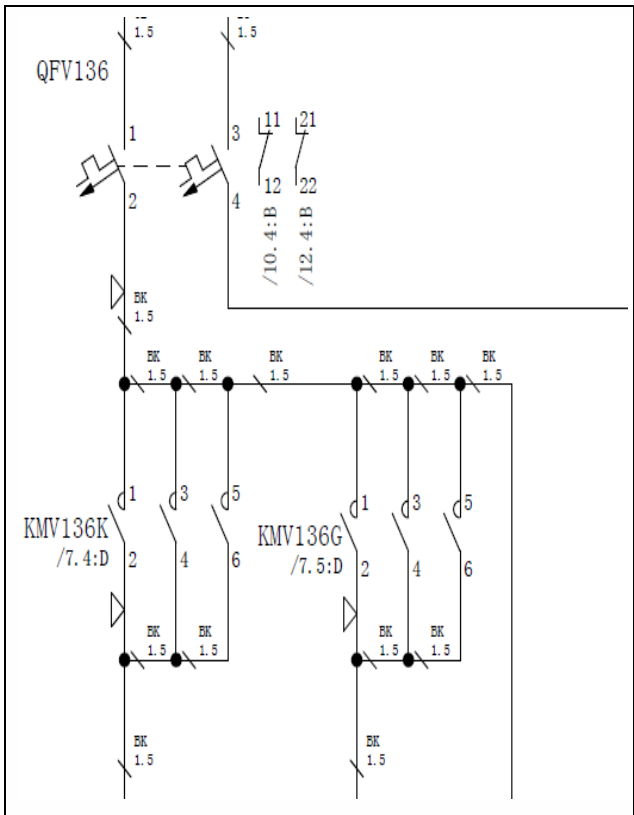


Fig 1: V136 control circuit diagram

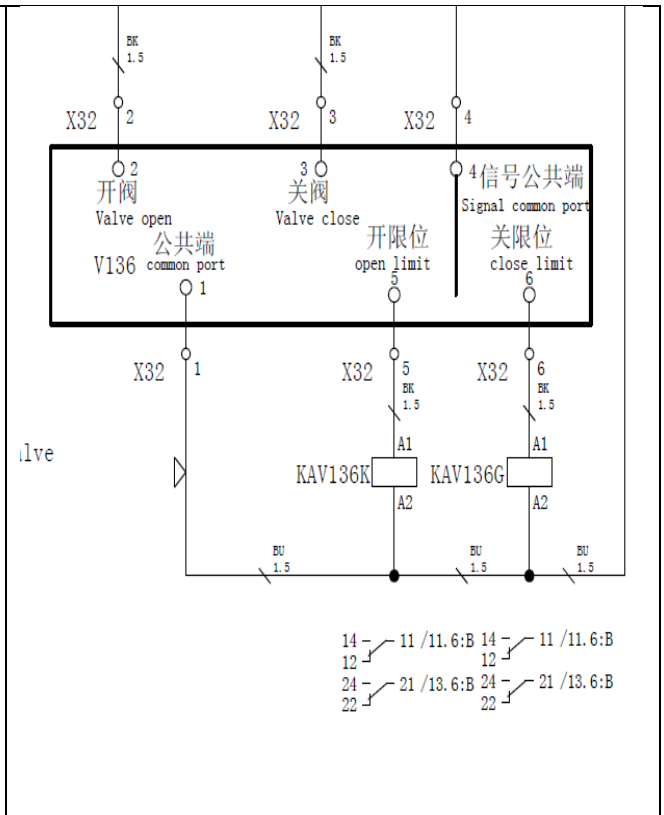


Fig 2: Limit Switch coil

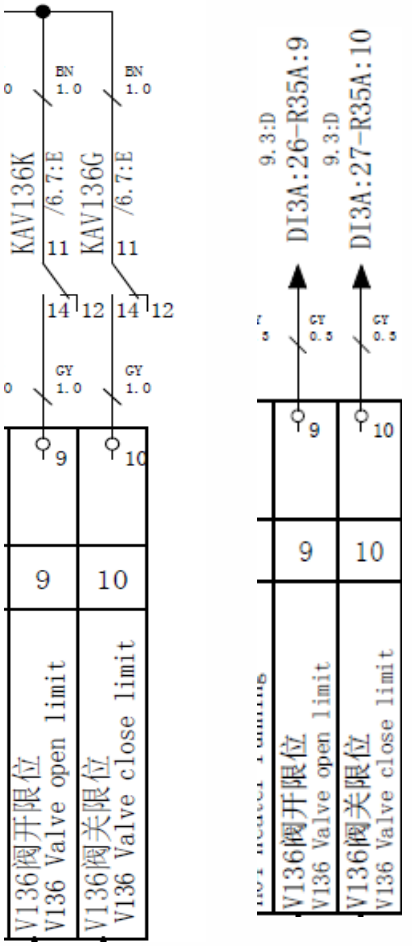


Fig 3: Terminal of AP3 and AP4

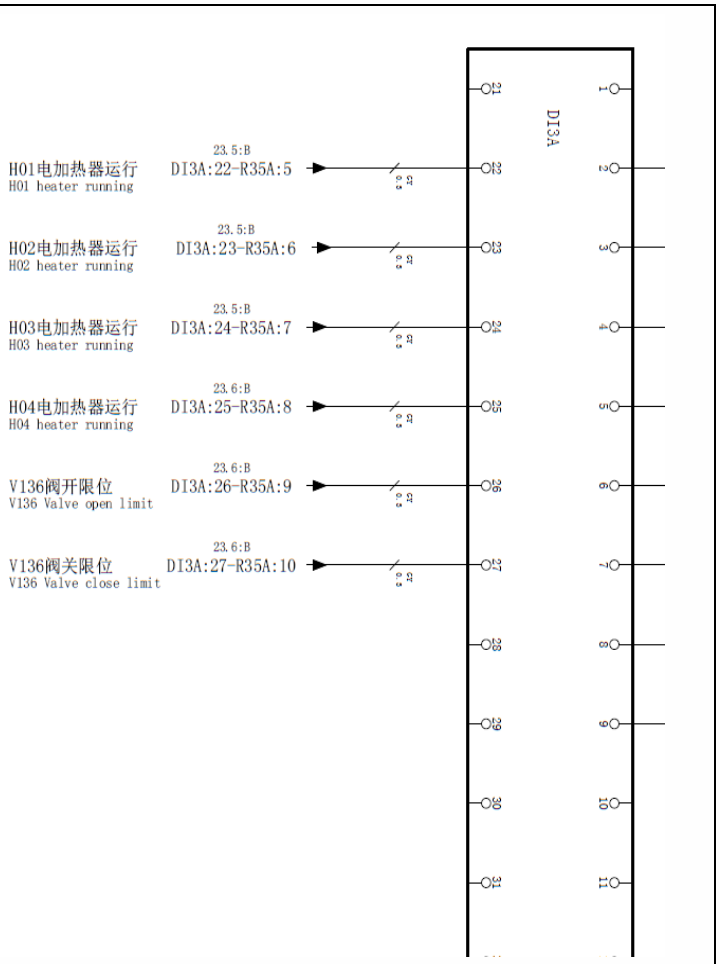


Fig 4: DI3A circuit configuration

2.2) CONCEPTUAL OVERVIEW

Below diagram shows a conceptual overview of the event analysis

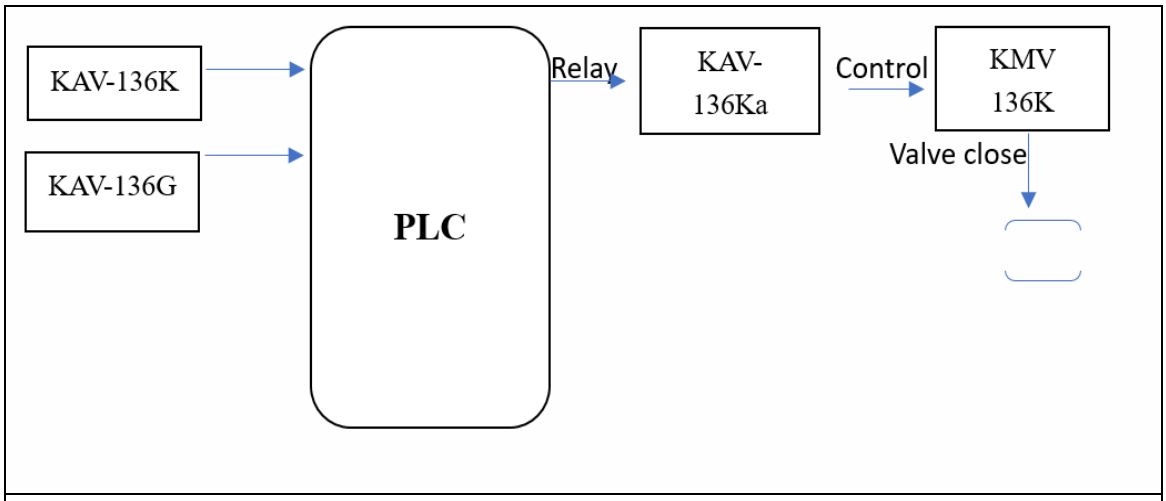


Fig 5: Conceptual Overview

2.2) CHECK AND DEAL WITH ELECTRIC VALVE V136 FAILURE

Electric valve V136 opens automatically, and its field normally open contact is closed. The two pairs of normally open contacts (KAV136K) 11, 14 (connected to the PLCA system of the AP4 cabinet) and 21, 24 (connected to the PLCB system of the AP5 cabinet) of are closed, and the alarm loop shown in Figure 6 is connected, and the digital input module.

The CPU judges that the V136 electric ball valve is open limit. When the valve internal cooling control system sends out the V136 electric ball valve opening command and does not receive the V136 electric ball valve open limit signal, it will report " **V136 water replenishment electric valve failure** ".

3) INSPECTION AND TREATMENT

3.1 Check mechanical position indication

Fig 6: Physical picture of V136 electric valve

Under normal circumstances, V136 is located at “0” near SHOT or “0” at OPEN If the pointer is between these two scales, it is judged as an open limit fault or a closed limit fault.

3.2 If the mechanical position of the V136 valve is not in place during the opening process, open the black plastic cover in the figure below and use the "electric ball valve Insert the "handle" mechanical handle into the hole clockwise to manually close the V136 valve.

Fig 7: V136 electric valve physical image

3.3 If the mechanical position is in place, check whether the excitation light of the KAV136K and KAV136G relay is on.

3.4 If the V136 valve does not move at all, check that the power switch QFV136 in the AP3 screen cabinet is in the closed position. If it is off, try and close it once. If it fails, notify the maintenance personnel to deal with it.

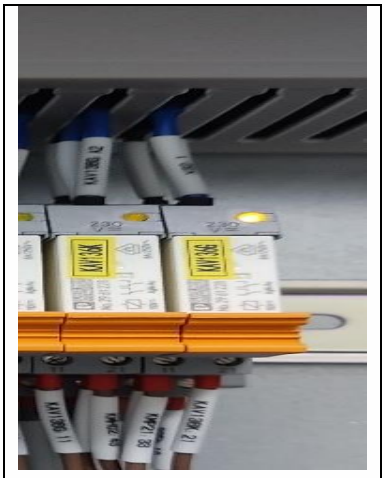


Fig 8: KAV136 relay physical image

Fig 9: QFV136 switch physical figure

3.5 If the power switch QFV136 in the AP3 panel is closed, check the wiring of other control circuits. And notify the maintenance personnel to deal with it.

V503 AIR SUPPLEMENT SOLENOID VALVE FAILURE

(WASIQ AHMED)

1) EVENT OVERVIEW:

For Pole 1 Valve internal cooling there are two solenoid valves i.e., V503 & V504. One is main and the other is standby but it is not fixed that which one is main and which one is standby. If one does not operate so the other will operate but an alarm of valve failure is sent to the system. V503 and V504 solenoid valve are installed across nitrogen (N_2) cylinders connected to the expansion tank in valve cooling system.

When the pressure of the expansion tank is lower than 2.8 bar, and if this time V503 is acting as main valve so the CPU will send a pulse to turn on the V503 valve. And after 25 minutes, if the set pressure (3.0 bar) of the expansion tank does not reach, the CPU will report **"V503 Solenoid Valve Failure"** alarm and automatically transfer to V504 (standby valve) to operate for air supplement.

1.1) WORKING PRINCIPLE:

i. When the pressure of expansion tank is less than 2.8 bar, and system A is active at the moment so the CPU senses the pressure and send the pulses to AP5 control cabinet so the relay in the AP4 cabinet gets energized and the contacts **11 and 14** of the KAV503A in the AP4 power cabinet are closed. Hence V503 valve is opened and can be used for expansion tank.

ii. When the pressure of the expansion tank reaches 3.0 bar, so the pressure transmitter sends its signal to CPU and CPU will stop the pulses and the contacts 11 and 14 in AP4 cabinet gets deenergized and valve V503 will be shut off.

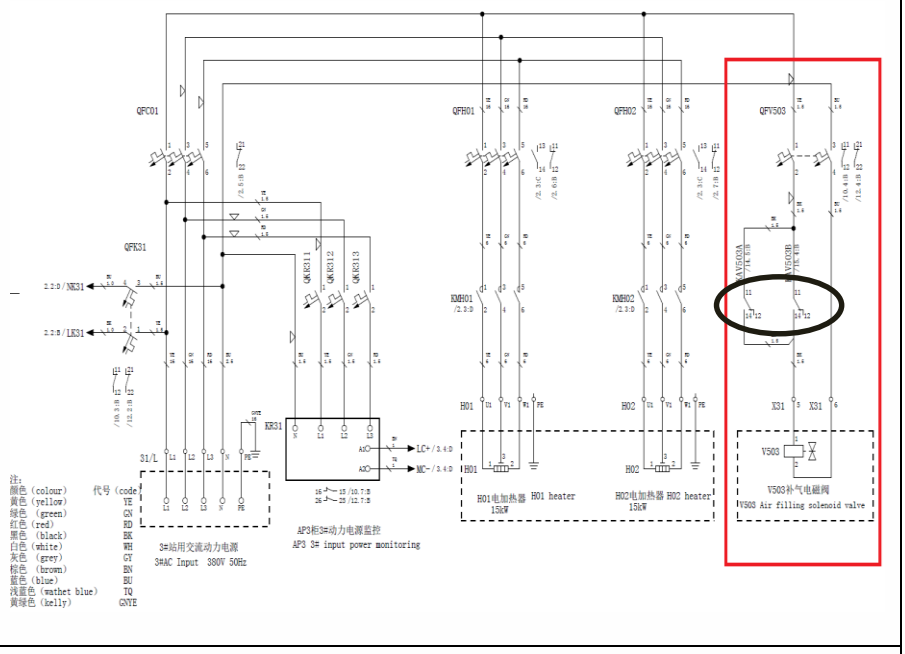


Fig 1: Identification of connections

2) ANALYSIS OF ALARM:

1. If the relays KAV503A and KAV503B of V503 solenoid valve are burnt out so the contacts of relays can't get closed, hence this will result the V503 solenoid valve failure.

2. When the power supply QFV503 in the AP4 power cabinet is disconnected, the V503 solenoid valve has no power supply, which will cause the V503 to fail to supply air and cause a malfunction.

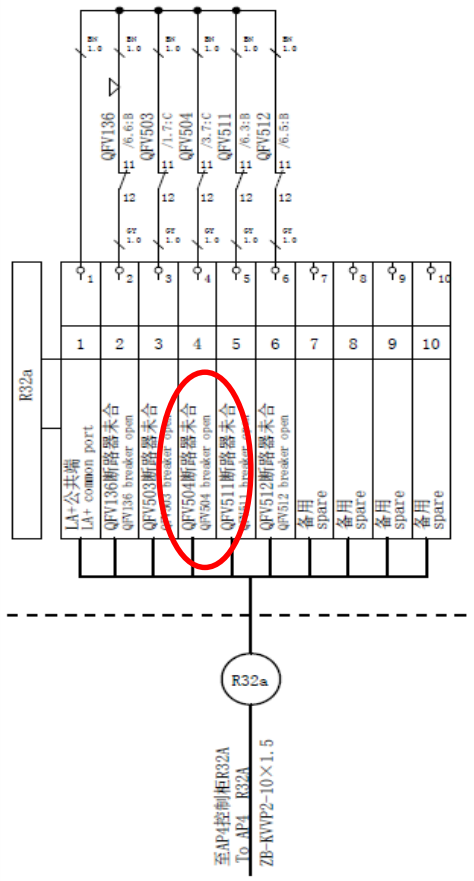


Fig 2: Signal flow

3. Another reason can be the burning of solenoid coil of valve itself due to overheating or overcurrent passed through it. This will also result in the valve failure.

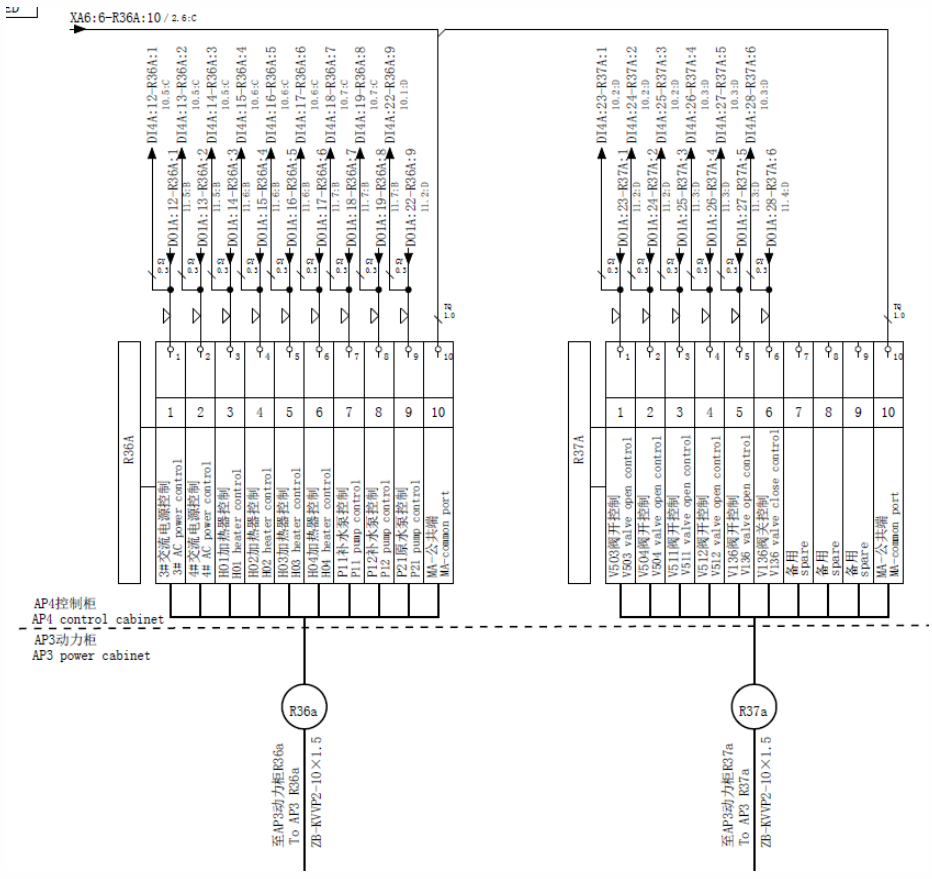


Fig 3: Signal flow

3) INSPECTION AND TREATMENT:

- When a V503 solenoid valve failure is reported, the camera should be brought to the valve internal cooling control room for inspection immediately.
- First, check the pressure value of expansion tank. If it is lower than 3 bar and V504 is in normal position, then we will check the operation status of V503 solenoid valve that either it is in open or in close position.

Fig 4: V503 in reality

- Check the respective relays in the AP4 cabinet. When the relay is closed, the yellow light should be on.
- Check the QFV503 Circuit breaker position. If it is close then try to close it once.

V511 EXHAUST SOLENOID VALVE FAILURE

(MUHAMMAD SIRAJ)

1) EVENT OVERVIEW

The expansion tank is part of the nitrogen regulating system, which consists of the expansion tank, the nitrogen cylinder and the rehydration system. When the internal cold water due to temperature increases the expansion tank level rise, the pressure in the tank increases through the exhaust solenoid valve V511 exhaust, in order to maintain the pressure of the internal cold-water line constant and the cooling medium is full. The normal pressure range of the expansion tank is between 2.8 and 3.0 bar, according to the fixed value, the solenoid valve opening pressure is 3.4 bar, the closing pressure is 3.2 bar, when the pressure of the expansion tank exceeds 3.4 bar after the opening solenoid valve V511 command pressure has not yet dropped to the normal range, the background report "extreme 1 valve cold expansion tank exhaust solenoid valve V511 fault".

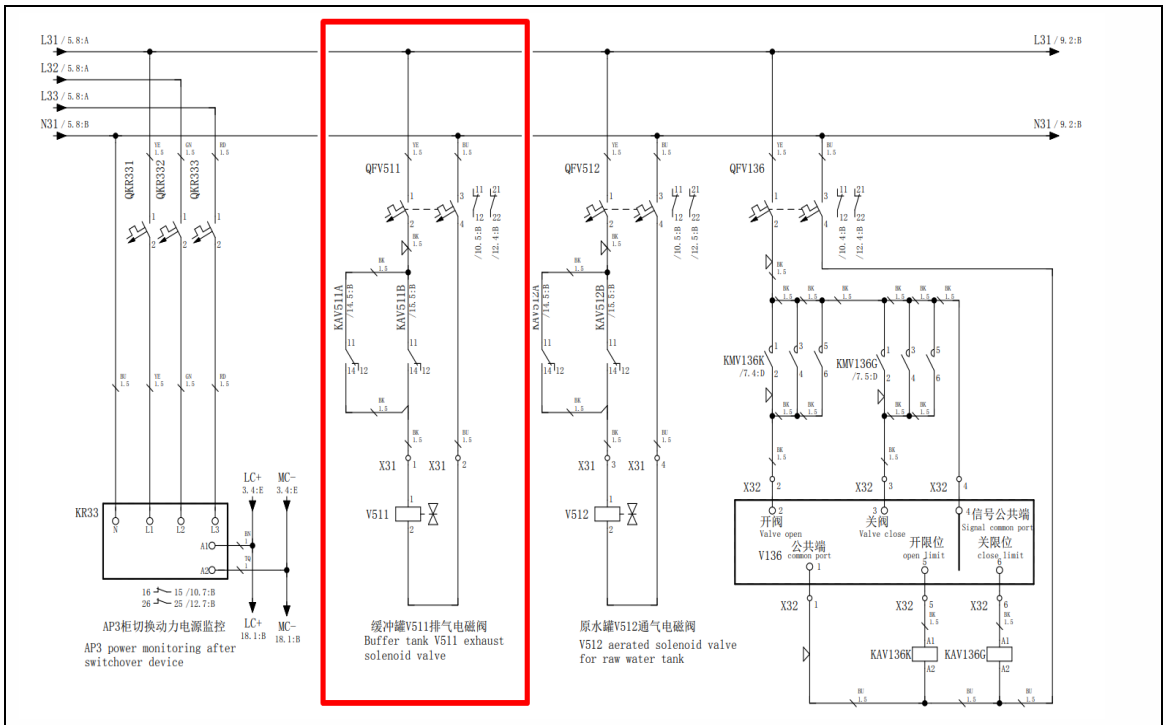


Fig 1: Main circuit

2) ALARM PRINCIPAL ANALYSIS

2.1) SOLENOID VALVE V511 EXHAUST PRINCIPLE:

Take the A system as an example, when the CPU detects that the pressure of the expansion tank is greater than set value, the CPU pulses to the AP4 control cabinet IM1A makes the relay KAV511A of the relay AP3 cabinet live, the 11th and 14th contacts in the AP3 power cabinet are closed, the rehydration circuit is switched on, the V511 solenoid valve is exhausted, and when the exhaust to the expansion tank pressure is 3.2bar, the solenoid valve closes and stops.

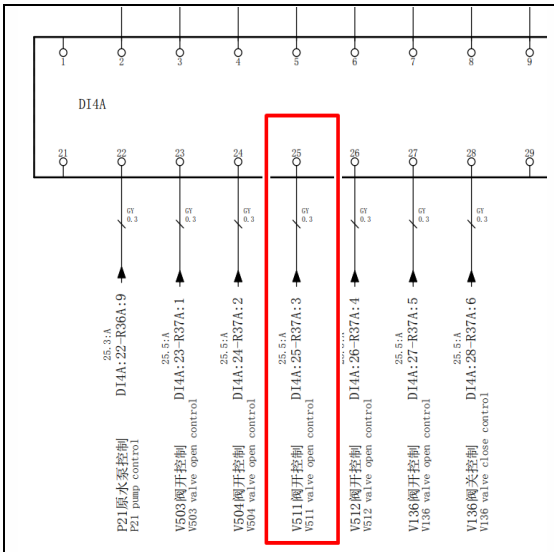


Fig 2: Digital input

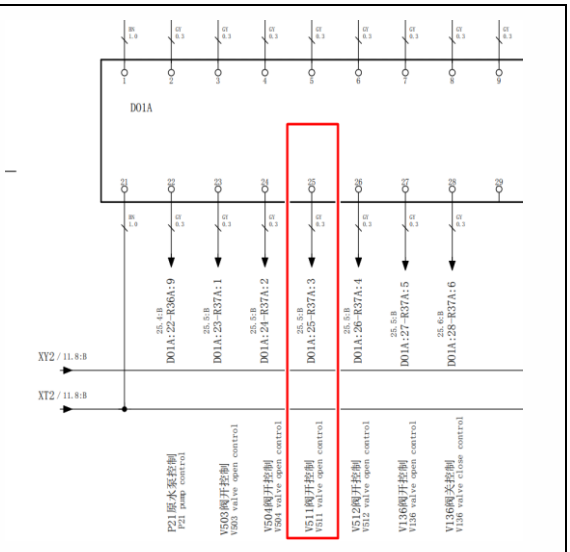


Fig 3: Digital output

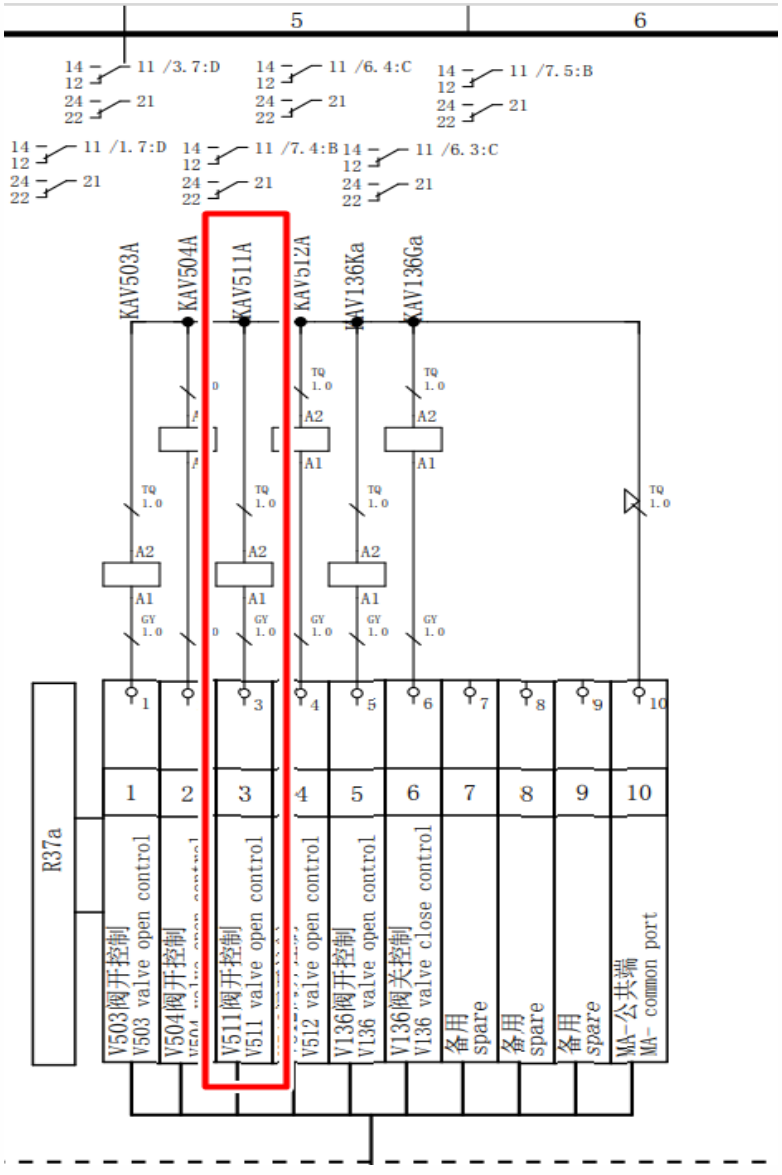
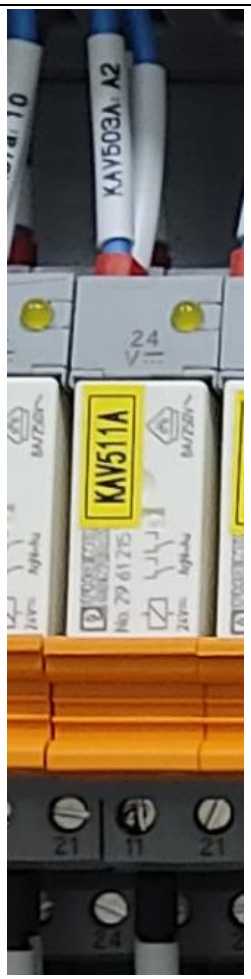


Fig 4: Relay contact

3) INSPECTION AND HANDLING

Check whether the open QFV511 of V511 in the AP3 power cabinet is still in place, if not in position, the QFV511 should be tested in the Water-cooling room AP3 control cabinet, if the combination is not successfully notified maintenance class treatment.

	
Fig 5: Breaker	Fig 6: Relay

INTERNAL VALVE COOLING RAW WATER TANK VENTILATION SOLENOID VALVE V512 FAILURE

(AHMED ABDULLAH)

1) EVENT OVERVIEW

Raw water tank is used to store deionized water and use this water to maintain flow of main cooling cycle. This tank is sealed to maintain the stability of the supplementary water quality. The raw water tank is equipped with a magnetic flap level gauge. When the liquid level of the raw water tank is lower than the set value, the operator is prompted to start the raw water pump to replenish water and keep the replenishing water in the raw water tank full. The raw water tank is equipped with an automatic solenoid valve(V512), which is usually closed, and automatically opens when raw water pump is started to maintain water supply and the purity of the raw water.

	
Fig 1: Raw water tank(c21)	Fig 2: Raw water pump (p21)

2) ALARM PRINCIPLE ANALYSIS

2.1) PRINCIPLE OF SOLENOID VALVE V512 VENTILATION

Raw water tank does not operate automatically it can be operated manually using HMI, When the raw water tank falls to a low level, the system will issue alarm. It is recommended that operator regularly check the drop in the level of raw water tank to prevent system from having insufficient water storage when it necessary to maintain water supply.

When the operator manually switches on the pump(P21), It energizes relay coil KAV512 this makes the ventilation solenoid valve (V512) to open.

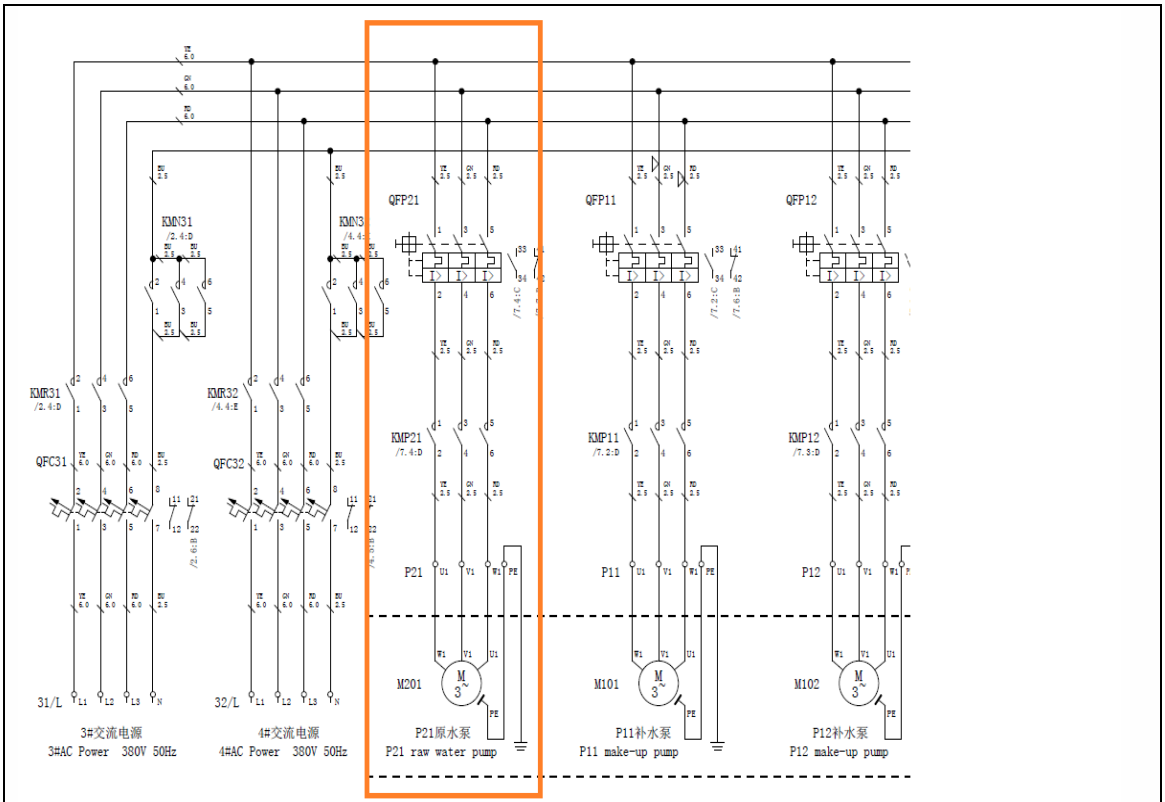


Fig 3: P21 raw water pump circuit (When this pump is turned on V512 valve is automatically turned on)

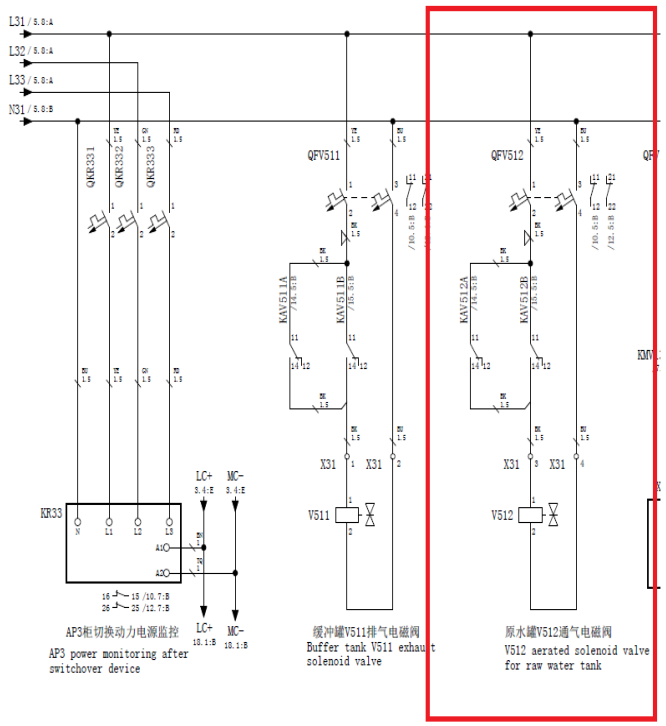


Fig 4: V512 solenoid Valve Connection diagram

Fig 5: V512 Solenoid Valve

3) ALARM INSPECTION AND TREATMENT

3.1) ALARM SCENARIO:

If PLC issued a signal to raw water tank solenoid valve V512 to turn on or off and V512 does not respond to the instruction to carry out the relevant action.

3.2) ALARM INSPECTION

If the alarm automatically disappears quickly than it could be because of the V512 power supply jump or could be because of V512 on/off relay damage. Check the Valve cooling cabinet and notify the maintenance team if relay is damaged.

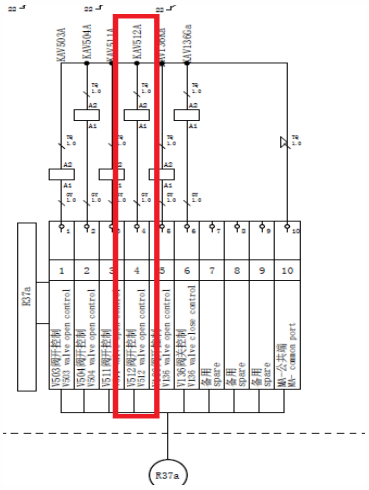


Fig 6: KAV512 relay coil circuit (system A)

Fig 7: KAV512 Relay (system A)

If the alarm does not disappear than you should check whether the V512 circuit breaker QFV512 in the AP3 power cabinet is still closed. If it is not in the closed position, you should go to the AP4 control cabinet in the water-cooling room to test the QFV512. If the closing is unsuccessful, notify the maintenance team to deal with it.

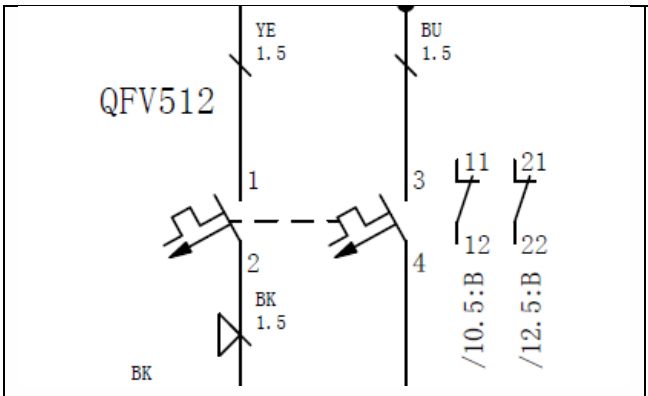


Fig 8: Circuit Breaker of V512

INTERNAL COOLING P1A DC CONTROL POWER SUPPLY FAILURE

(M. MUZAMMIL AHMED)

1) EVENT OVERVIEW:

Internal cooling of valve cooling system has two AC/DC Switching power supply namely P1A and P2A and Quint diode V1A as shown in figure 1.1.

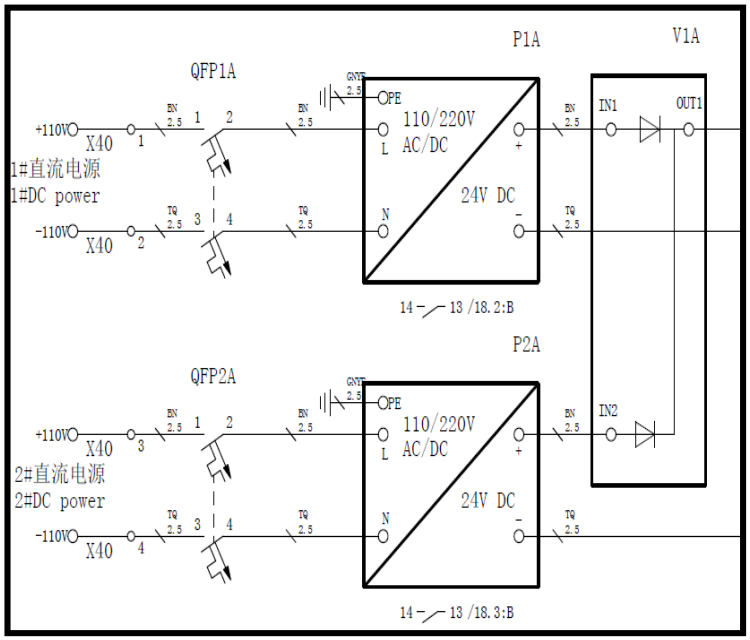


Fig 1: AC/DC switching power supply, Quint diode.

Failure of anyone power supply generates "DC Power Failure" signal to PLC. It also occurs when the incoming power supply circuit breaker trips event (QFP1A), then the

corresponding alarm contact will report the "DC power failure" signal through the background.

2) ALARM PRINCIPLE ANALYSIS

The two incoming DC Power supplies comes from the DC distribution panel A and DC distribution panel B of Pole 1 DC 220V room.

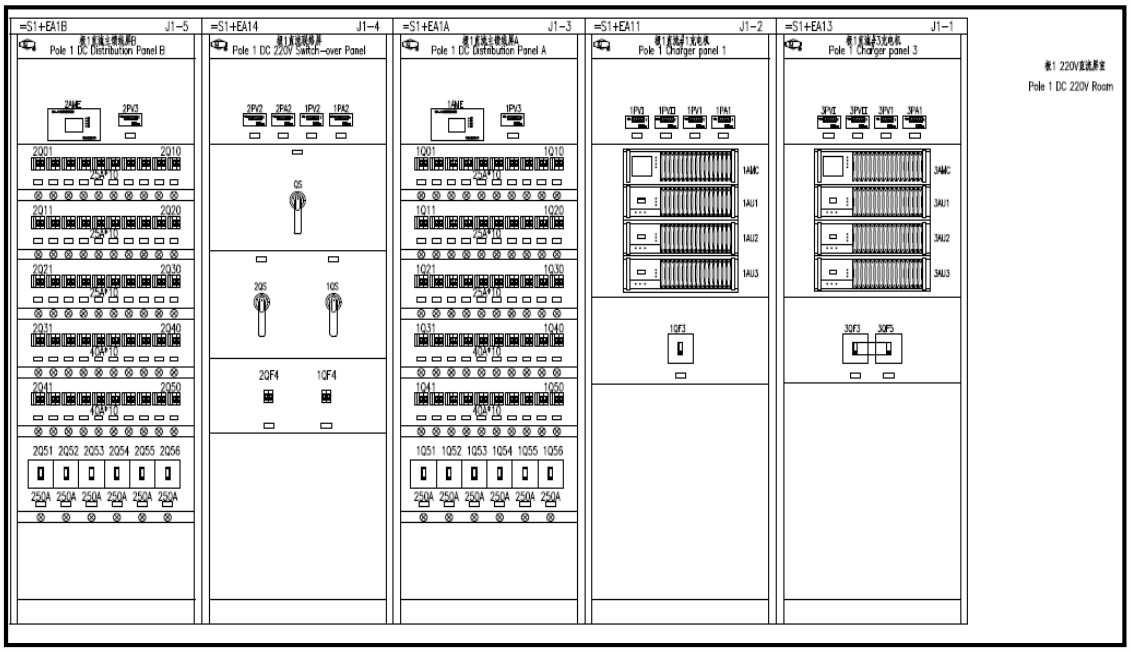


Fig 2: DC distribution panels in pole 1 DC 220V room.

From Magnetic contactors (KM1-, KM1+) of DC distribution panel A and (KM2-, KM2+) of DC distribution panel B, it comes to Pole 1 Valve cooling Control and Protection room.

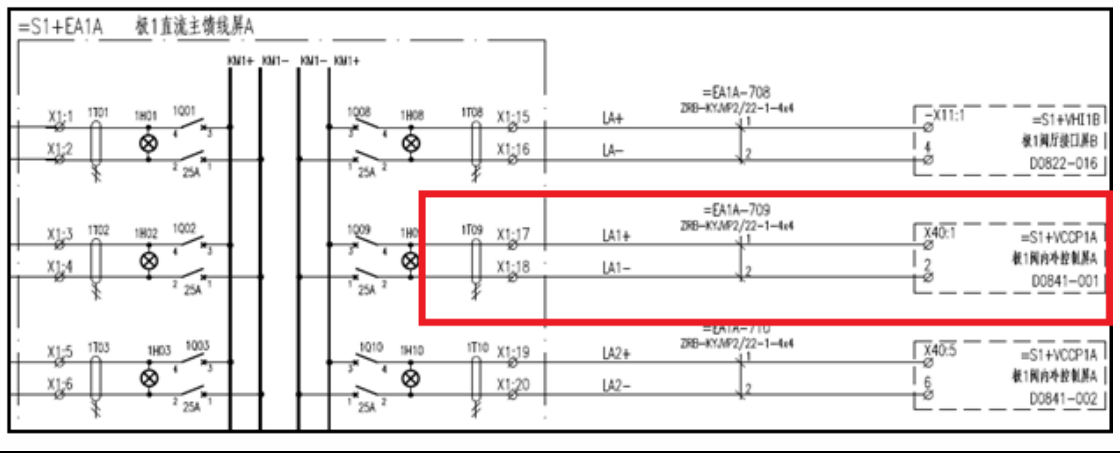


Fig 3: From distribution panel A to valve cooling

From Magnetic contactors (KM1-, KM1+) of DC distribution panel A and (KM2-, KM2+) of DC distribution panel B, it comes to Pole 1 Valve cooling Control and Protection room.

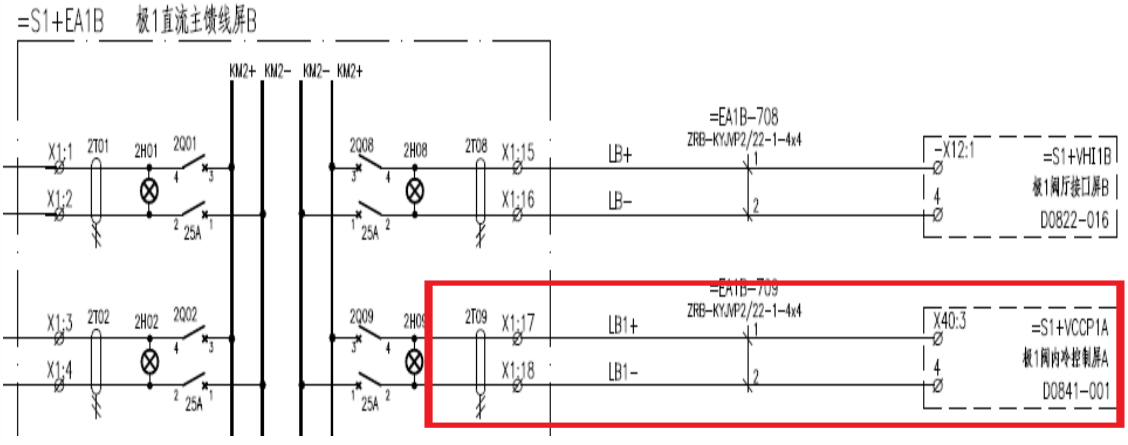


Fig 4: From distribution panel B to valve cooling

2.1) CONTROL POWER SUPPLY

Redundant configuration (internal cooling):
A control cabinet: four-channel DC, 4×DC110V; 1# and 2# DC panel room provide.
B control cabinet: two DC channels, 2×DC110V; 1# and 2# DC panel room provide.

The valve cooling control and protection system adopts DC110V to DC24V switching power supply, 1#, 2#, 5#, 6# DC power supply is connected to the internal cooling A control system,

and the 3#, 4# DC power supply is connected to the internal cooling B control system.

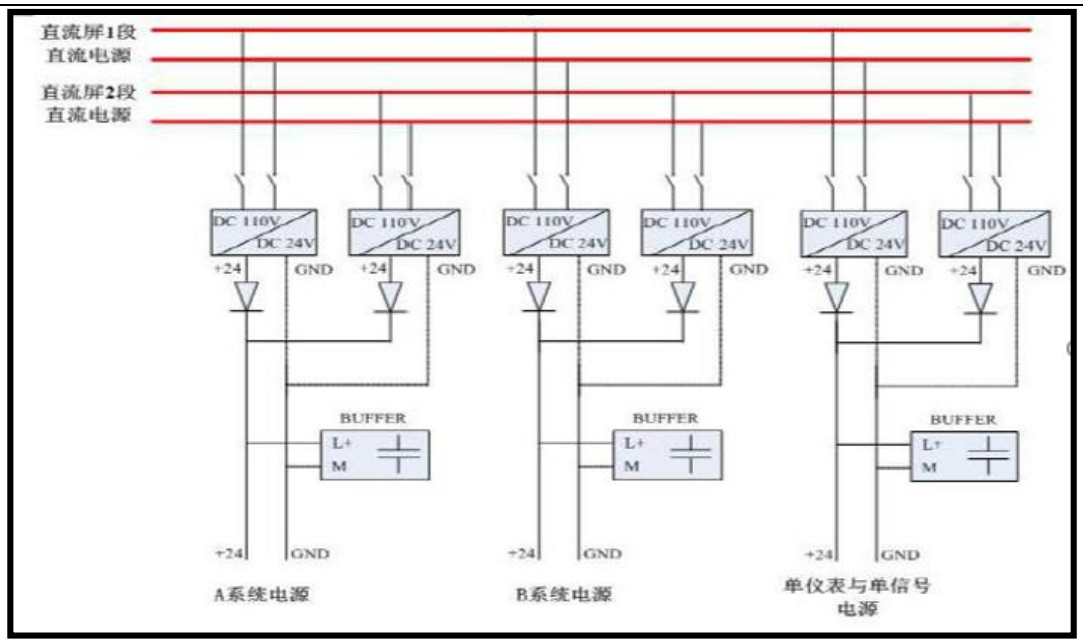


Fig 5: Inside valve cooling controlling system

The two DC110V DC incoming lines in the AP4 cabinet are respectively transformed into DC24V through a transformer, and then the Quint diode is used to jointly supply power to the load in the panel cabinet, so that if one power supply fails, it automatically switches to another power supply by closing QFP2A to provide power and report "DC Power failure" signal to PLC.

The two transformers transform into DC24V, and then provide power for the common load of the internal cooling system through the coupling module. When a DC110V power circuit breaker (QFP1A) trips, then the corresponding alarm contacts of P1A (13 &14) is closed which excites the KAP1A relay.

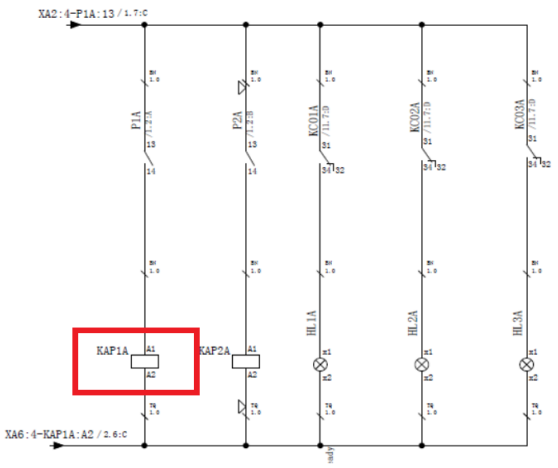


Fig 6: KAP1A relay

Fig 7: QFP1A breaker

The relay sends alarm signal to Digital Input board (DI1A).

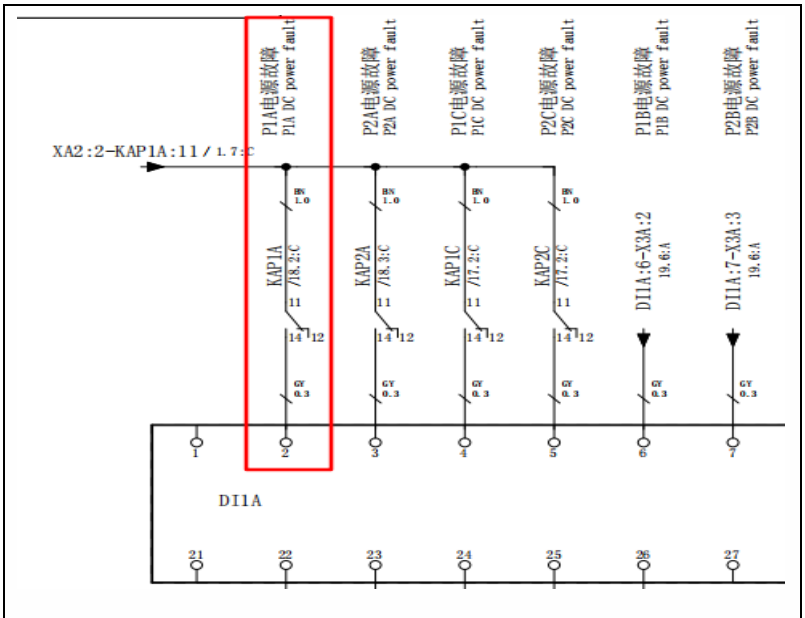


Fig 8: Relay sending DC power failure signal to DI1A

DI1A then transmit signal to Interface module (IM1A), which finally report DC power failure signal to PLC1 using Profibus (A1).

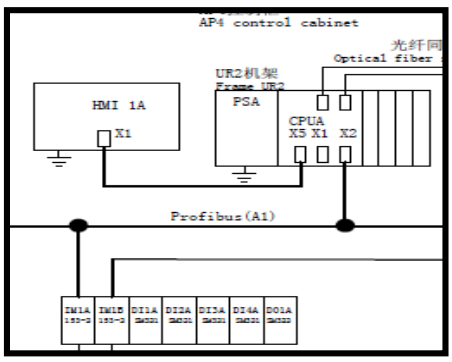


Fig 9: Signal route to PLC1

The power failure signal also reported to AP5 cabinet PLC2 when the contacts 21 and 24 closed.

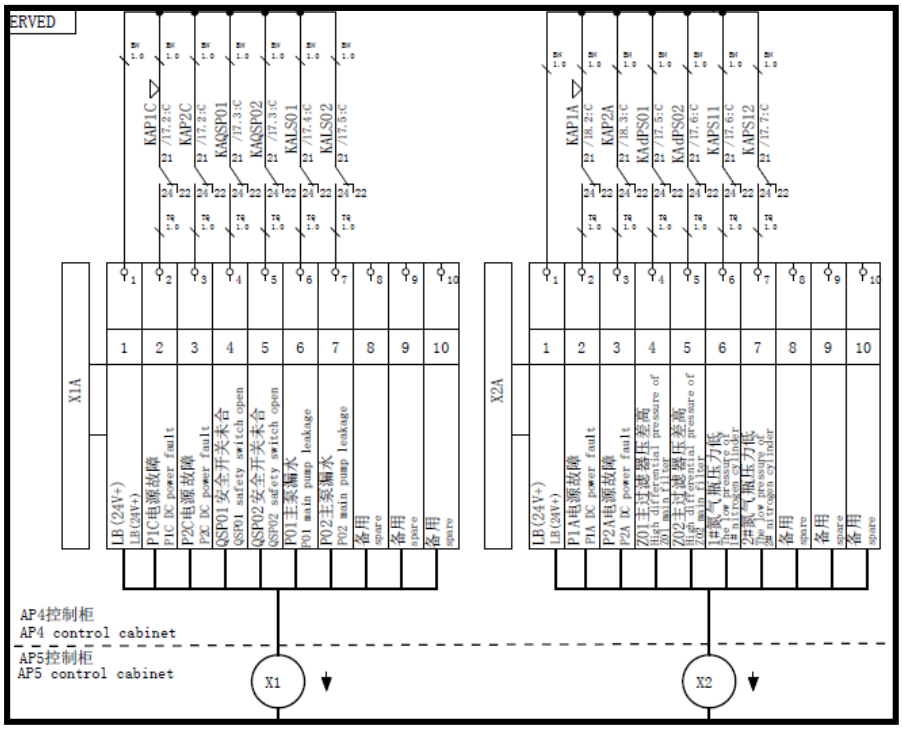


Fig 10: Power failure signal from AP4 cabinet to AP5 cabinet PLC 2

3) CHECK AND DEAL WITH:

When the PLC reports AP5 control cabinet 1# DC power failure.

3.1 first check the background water cooling interface parameters show normal, there is no load loss phenomenon; check the 110V operation status, whether there are other equipment power loss and switching Signal.

3.2 Check whether the DC power supply circuit internal cooling panel has tripped, whether the PLC operation is normal, and whether the board work indicator light is normal.

3.3 If there are no other abnormal conditions on site (peculiar smell, obviously loose wiring, etc.), you can try to close the breaker. If it is on again, Contact the maintenance personnel to check and deal with it.

INTERNAL COOLING P1C DC CONTROL POWER SUPPLY FAILURE

(KARAN KUMAR)

1) EVENT OVERVIEW:

Internal cooling of valve cooling system has two AC/DC Switching power supply namely P1C and P2C as shown in figure 1.1

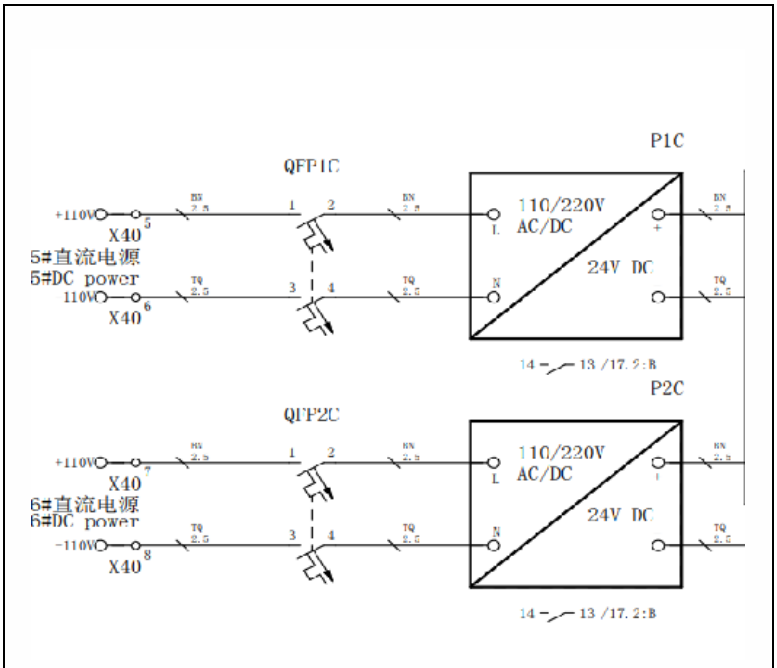


Fig 1: AC/DC Switching Power supply

Failure of anyone power supply generates "DC Power Failure" signal to PLC.

It also occurs when the incoming power supply circuit breaker trips event (QFP1C), then the corresponding alarm contact will report the "DC power failure" signal through the background.

2) ALARM PRINCIPLE ANALYSIS

The two incoming DC Power supplies comes from the DC distribution panel A and DC distribution panel B of Pole 1 DC 220V room.

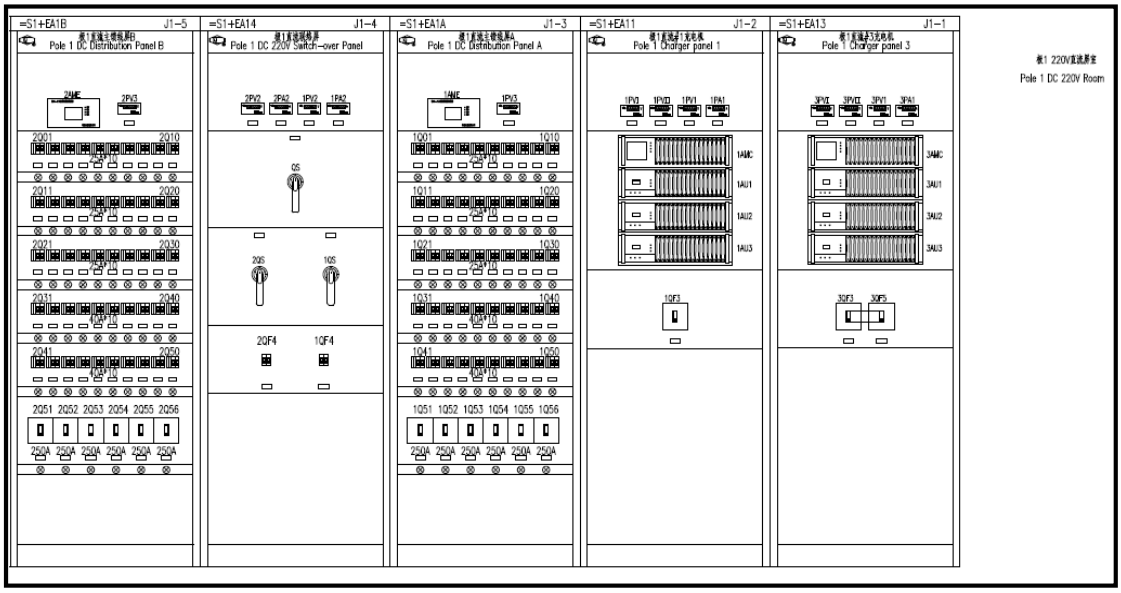


Fig 2: DC distribution panels in pole 1 DC 220V room.

From Magnetic contactors (KM1-, KM1+) of DC distribution panel A and (KM2-, KM2+) of DC distribution panel B, it comes to Pole 1 Valve cooling Control and Protection room.

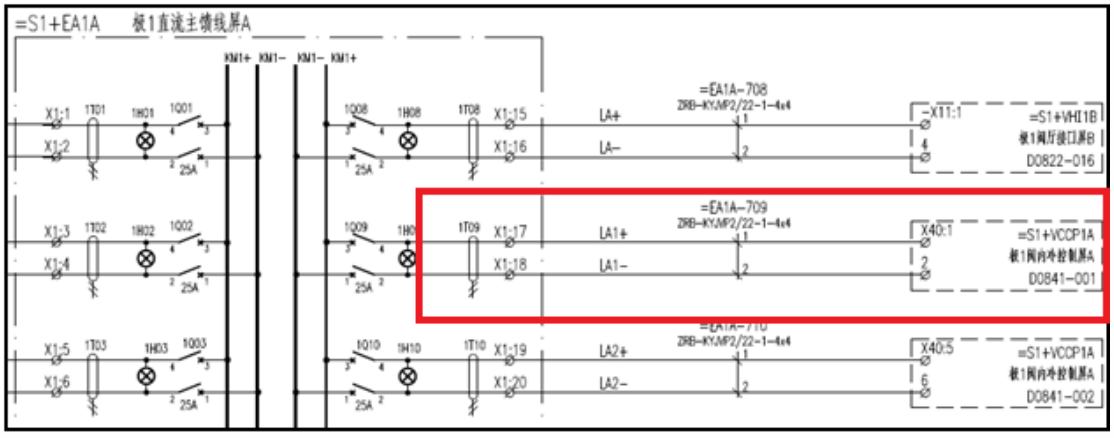


Fig 3 : From distribution panel A to valve cooling

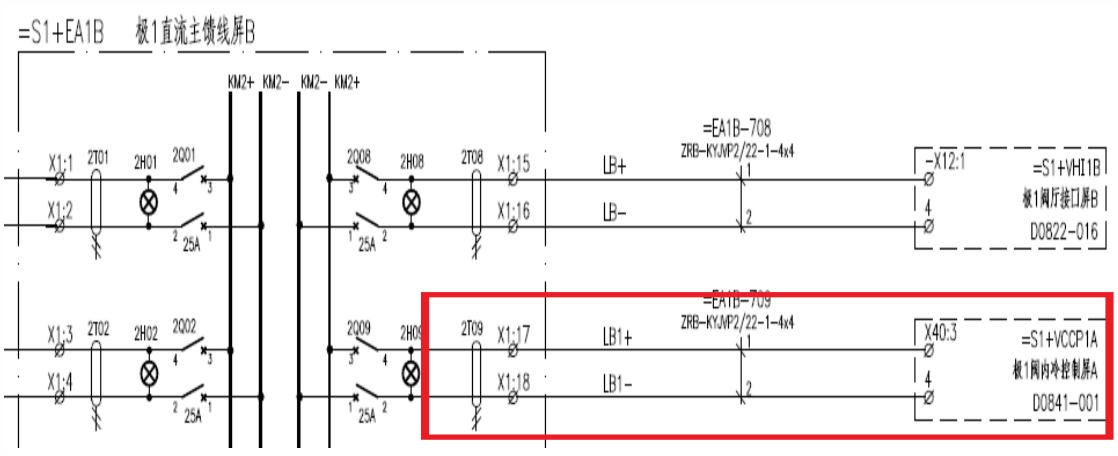


Fig 4: From distribution panel B to valve cooling

2.1) CONTROL POWER SUPPLY

Redundant configuration (internal cooling):
A control cabinet: four-channel DC, 4×DC110V; 1# and 2# DC panel room provide.
B control cabinet: two DC channels, 2×DC110V; 1# and 2# DC panel room provide.

The valve cooling control and protection system adopts DC110V to DC24V switching power supply, 1#, 2#, 5#, 6# DC power supply is connected to the internal cooling A control system, and the 3#, 4# DC power supply is connected to the internal cooling B control system.

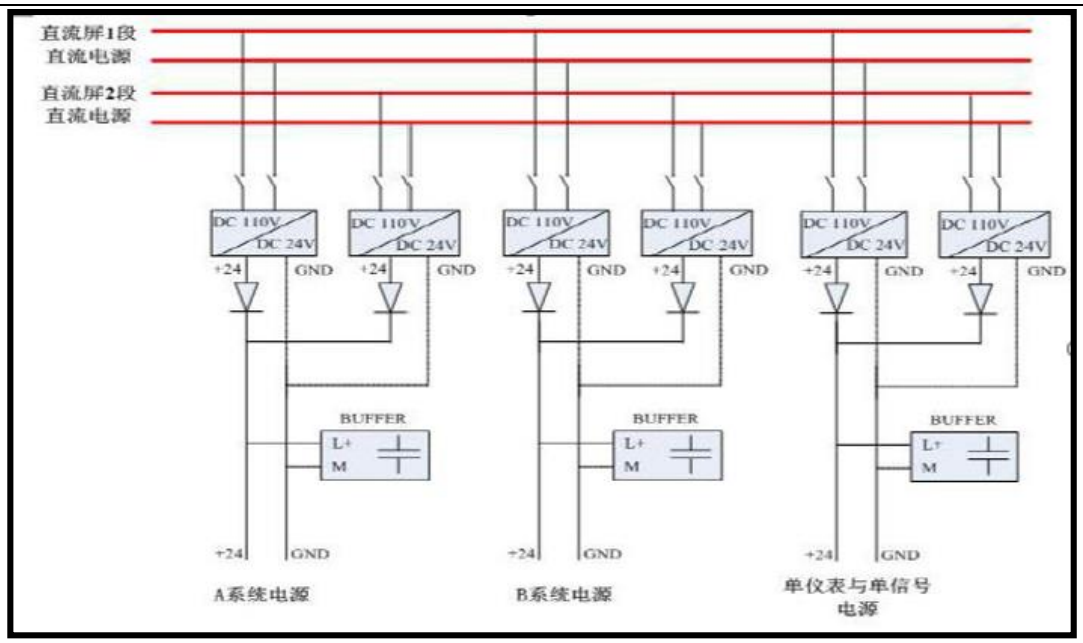


Fig 5: Inside valve cooling controlling system

The two DC110V DC incoming lines in the AP4 cabinet are respectively transformed into DC24V through a transformer, and then the Quint diode is used to jointly supply power to the load in the panel cabinet. The two transformers transform into DC24V, and then provide power for the common load of the internal cooling system through the coupling module.

When a DC110V power circuit breaker (QFP1C) trips, then the corresponding alarm contact of P1C (13 &14) is closed which excites the KAP1C relay.

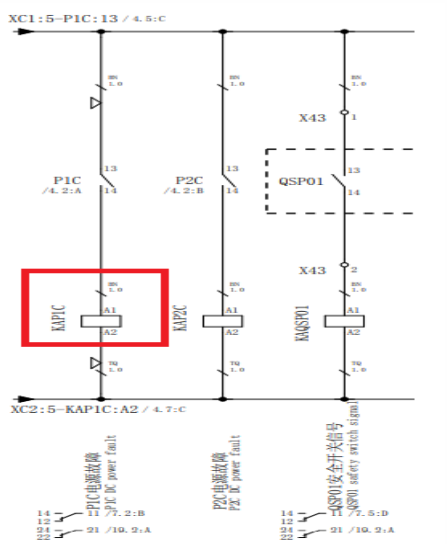


Fig 6: KAP1C relay

Fig 7: QFP1AC breaker

The relay send alarm signal to Digital Input board (DI1A).

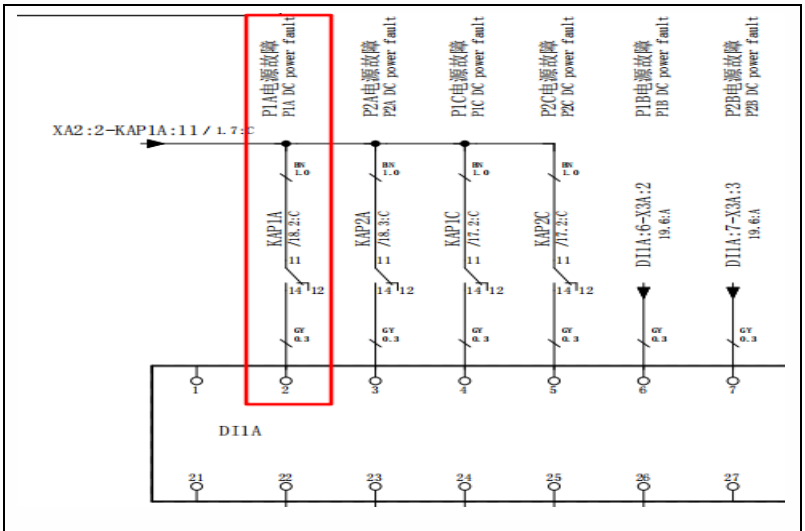


Fig 8 Relay sending DC power failure signal to DI1A

DI1A then transmit signal to Interface module (IM1A), which finally report DC power failure signal to PLC1 using Profibus (A1).

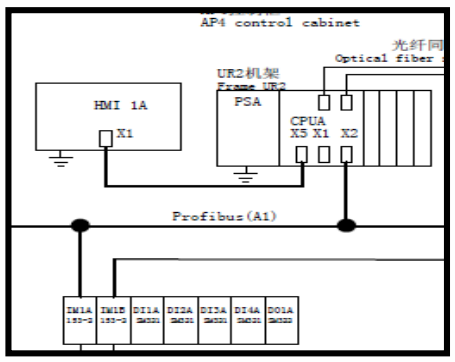


Fig 9: Signal route to PLC1

The power failure signal also reported to AP5 cabinet PLC2 when the contacts 21 and 24 closed.

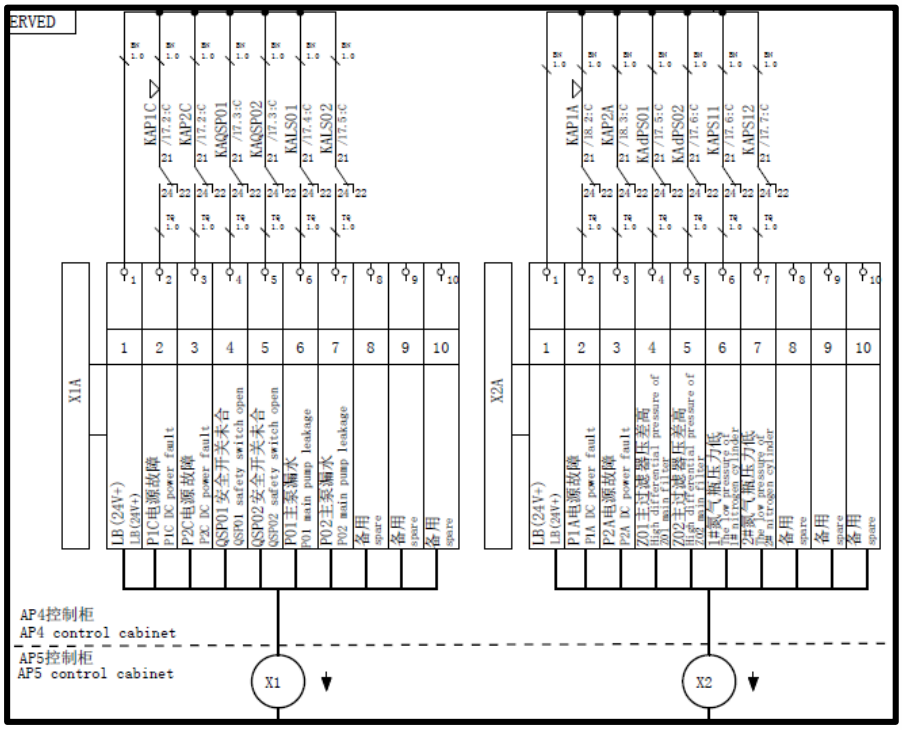


Fig 10: Power failure signal from AP4 cabinet to AP5 cabinet PLC 2

3) CHECK AND DEAL WITH:

The outgoing of both power supplies then enters Quint diode power supply redundancy module. It uses diodes to connect two power supplies to a single load, so that if one power supply fails, it automatically switches to another power supply by closing QFP2Cto provide power and report "DC Power failure" signal to PLC.

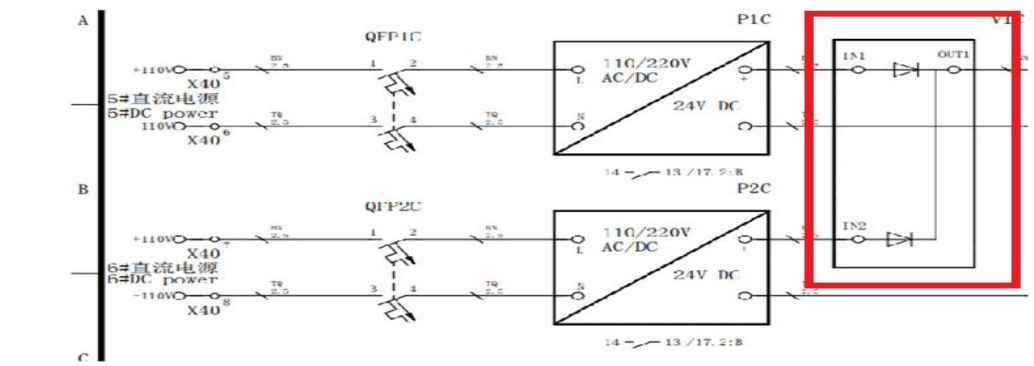


Fig 11: Quint Diode

PLC STATION A FAILURE

(MUHAMMAD AZHAR SALIMEE)

1) EVENT OVERVIEW

For internal valve cooling system, two PLCs (CPU A and CPU B) are installed in AP4 and AP5 control cabinets. One of them is active and other is standby. Both PLCs are synchronizing with each other via optical fiber cable.

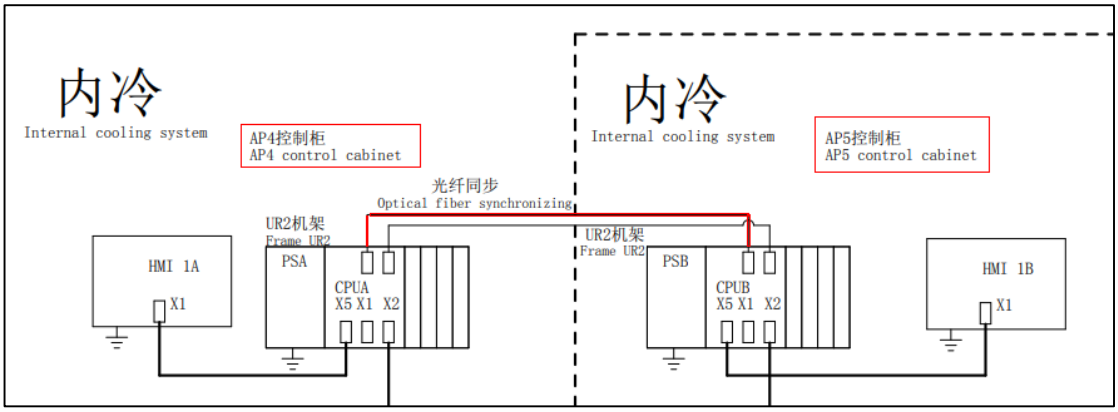


Fig 1: CPU A and CPU B

If PLC Station A is active and failure occurs in it then PLC Station B will become active. The causes of PLC Station A failure may be failure of power supply, failure of Profibus A1, failure of optical modulation signal, or failure in CPU A itself.

2) ALARM PRINCIPLE ANALYSIS

2.1) CPU A Power Supply Failure

CPU A is installed in AP4 control cabinet. The cabinet has redundant power supply P1A and P2A. If fault occurs in only one power supply (I.e. P1A), then other power supply (i.e. P2A) can feed power. So, the PLC A can continue its operation. However, if fault occurs in both power supplies then CPU A cannot perform its processing tasks and event of PLC station A failure occurs. Consequently, standby PLC station B will become active and perform the processing tasks.

Power supply P1A and P2A both have normally open contacts 13-14. If there is a fault in power supplies then these contacts will be closed and will energize KAP1A and KAP2A coils respectively as shown in figure 2-2. Coils KAP1A and KAP2A both have two normally opened contacts 11-14 and 21-24. Contacts 11-14 are connected with digital input module DI1A of PLC A as shown in figure 2-3 and contacts 21-24 are connected to the PLC B as shown in figure 2-4.

If fault occurs on the both power supplies, then there is no power to PLC A to function. Consequently, PLC station A failure occurs.

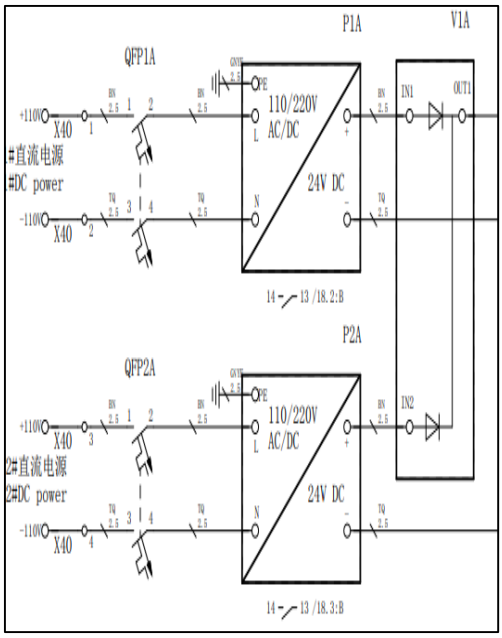


Fig 2: Main power supplies P1A and P2A

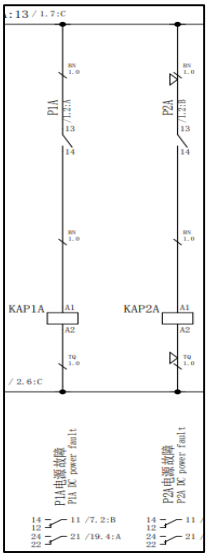


Fig 3: P1A and P2A contacts with KAP1A and KAP2A coils

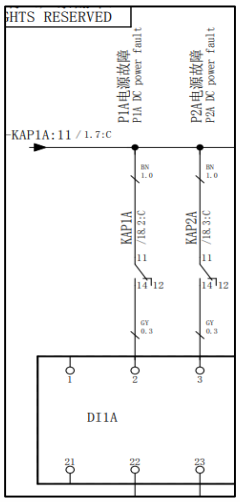


Fig 3: DI1A module of PLC A

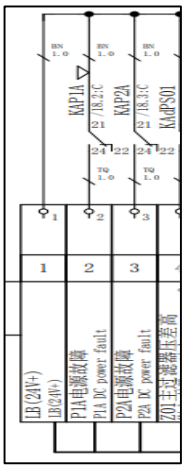


Fig 1: Signal of DC power fault feeds to AP5

Another cause of PLC Station A failure is the fault in the PSA power supply module. This PSA module converts 24V into 5V and then feeds power to PLC. If fault occurs in this module, it will lead to PLC station A failure.

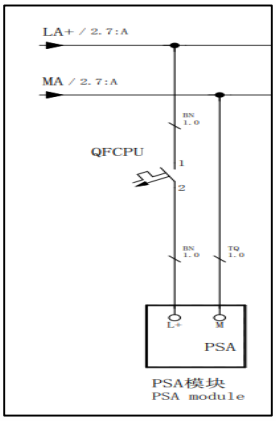


Fig 2: Power supply module PSA for CPU A

2.1A) FAILURE OF PROFIBUS A1

Two field buses are utilized in the valve cooling control and protection system. One is active and other one is redundant. If the fault occurs in the field bus(i.e.Profibus A1) then signals from field instruments via input/output modules will not reach to the CPU A. In such a scenario, PLC station A failure occurs and CPU B becomes active because signals can travel through other field bus (i.e. Profibus B1) to CPU B.

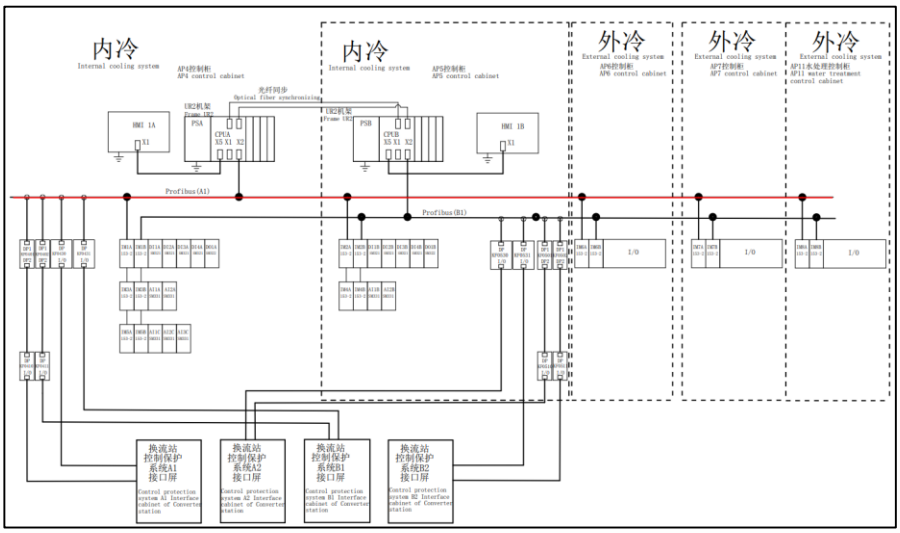


Fig 3: Profibus (A1)

2.1B) FAILURE OF OPTICAL MODULATION SIGNAL

The optical modulation signal upload process is as shown in the figure 2-7. The valve cooling system sends the information to the field bus, and sends it to the pole control A/B system through the PBOLM modulation module connected to the bus, and the pole control performs information processing according to the set logic.

If the fault occurs in both PBOLM modules, then there will be no link of communication between valve cooling system and pole control A/B system. As a result, PLC station A failure occurs.

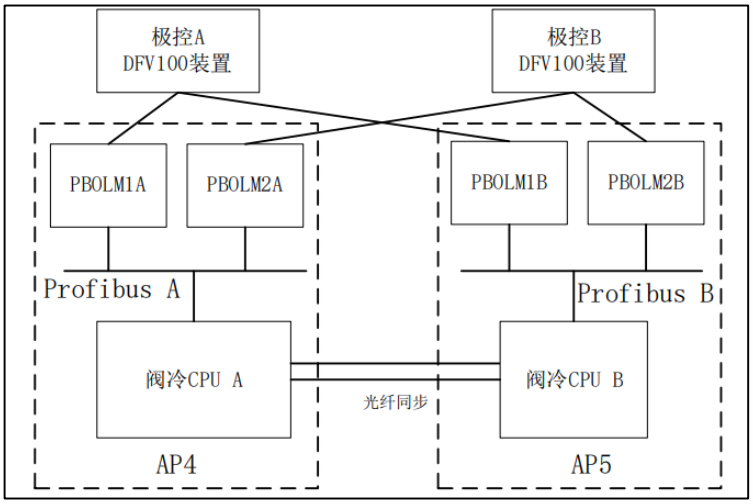


Fig 4: Schematic diagram of optical modulation signal link

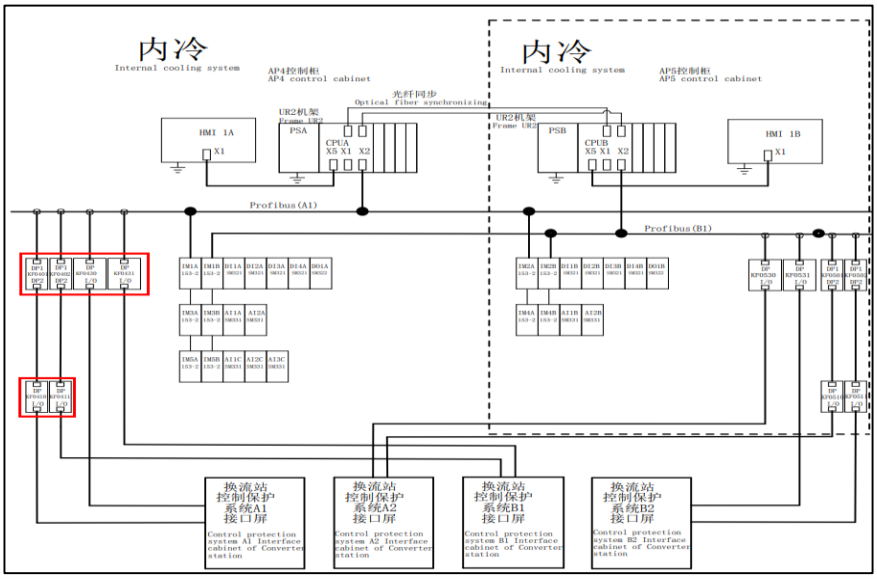


Fig 5: Communication link between PLC A and converter station interface

3) INSPECTION AND TREATMENT

3.1) POWER SUPPLY FAILURE OF PLC A

A. Check the circuit breakers connected to the power supplies, if they are tripped or not.

B. Using multi-meter, check the input voltage to the power supplies if there is voltage or no.

C. Check the line and neutral cable if it is damaged or not.

D. Inspect and troubleshoot the power supply units.

If any thing i.e. cable, CB, or power supplies found faulty, replace it with new one.

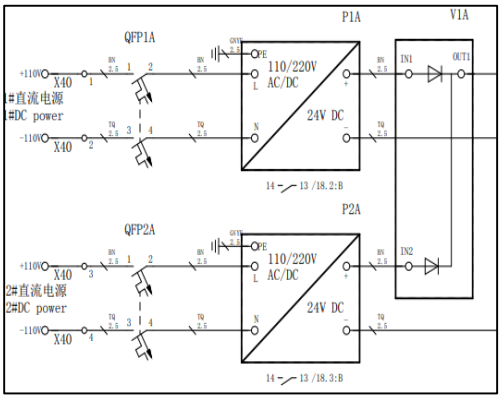


Fig 9: Power supplies with CB

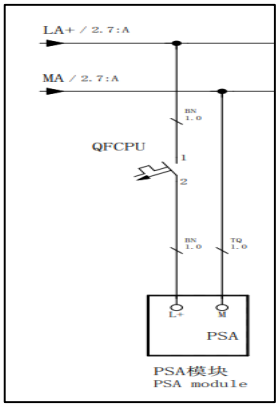


Fig 10: CPU power supply PSA

3.2) PROFIBUS A1 FAILURE

A. Check the profibus cable if it is damaged or okay.

B. Check the connectors of the profibus if these are damaged or loosely connected.

If cable or connector is damaged then replace it with new one.

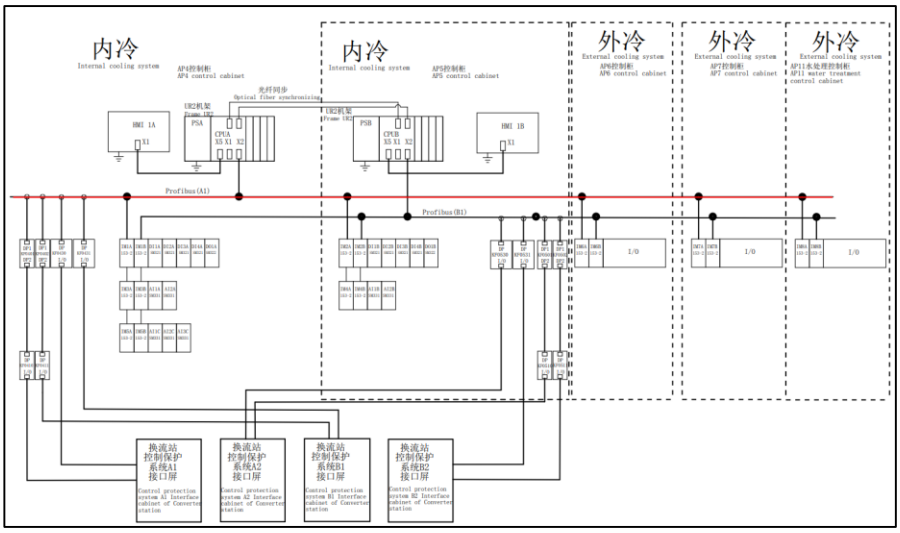


Fig 11: Profibus A1

3.3) OPTICAL MODULATION FAILURE

Check the circuit breaker connected with PBOLM module. Inspect and troubleshoot the PBOLM module. If found faulty replace it with new one.

A. Check the circuit breaker connected to the PBOLM module if it is tripped or not.

B. Check the power cable of the module whether is damaged or not.

C. Inspect and troubleshoot the PBOLM module whether it is damaged or fine.

If any thing i.e. cable, CB, or PBOLM module is found faulty then replace it with new one.

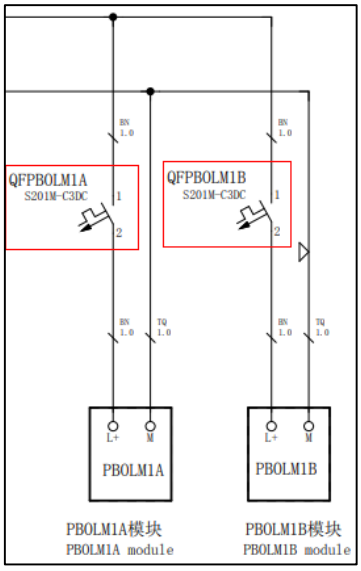


Fig 12: PBOLM module with CB