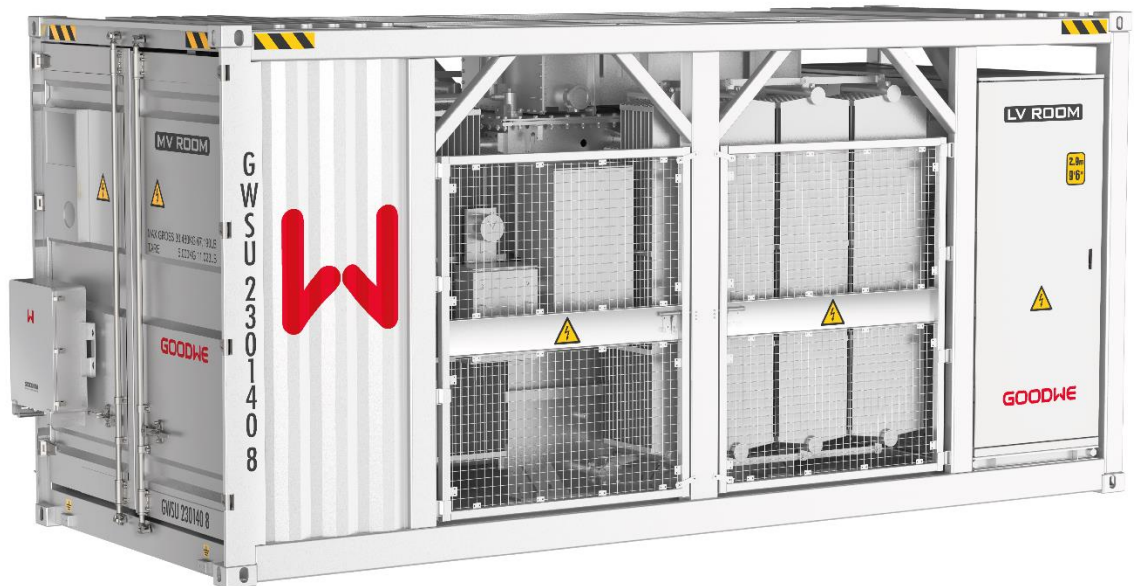


GOODWE

GW9100K-MVS Smart Transformer Station

User Manual



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1. About This Document

1.1. Intended Audience

This manual is intended for maintenance personnel. It's applicable to personnel who transport, install and operate this product. They should at least meet the following requirements:

- Have certain expertise in electronics, electrical wiring and machinery, be familiar with electrical and mechanical schematics diagrams.
- Be familiar with the composition and working principle of PV power generation system.
- Be familiar with the composition and working principle of MVS and it's front and rear level equipment.
- Have received professional training related to the installation and commissioning of electrical equipment.
- Have the emergency response capability to the danger or emergency in the process of installation or commissioning.
- Be familiar with the relevant standards and specifications of the country/region where the project is located, and must obtain the operation certificate of the relevant standards and specifications of the country/region where the project is located.
- Be familiar with what is described in this manual.



1.2. Manual Description

Please read this manual carefully before transporting and installing this product. You can start operation only after you understand the contents of the manual. Please keep this manual and other document of parts of the product together to ensure that relevant personnel can access them at any time.

The symbols that may be found in this manual are defined as follows:

⚠ DANGER
Indicates a high-level hazard that, if not avoided, will result in death or serious injury.
⚠ WARNING
Indicates a medium-level hazard that, if not avoided, could result in death or serious injury.
⚠ CAUTION
Indicates a low-level hazard that, if not avoided, could result in minor or moderate injury.
NOTICE
Indicates a potential hazard that, if not avoided, could result in equipment malfunction or property damage.

Please always pay attention to the danger warning signs on the housing of the MVS, including:

Label	Explanation
	This label indicates that there is a high voltage inside and touching it may cause an electric shock.
	This label indicates that this is the protecting earthing (PE) terminal, which needs to be firmly grounded to ensure operator safety.

1.3. Safety Precautions

The safety instructions in this manual must be strictly followed at all times. In order to avoid possible casualties and property losses during installation or operation, and to extend the service life of the MVS, please be sure to read all safety instructions.

1.3.1. General Safety Rules

DANGER

There is a danger of electric shock if you touch the power grid or the contacts, terminals, etc. inside the equipment that connected to the grid!

- Do not touch terminals or conductors connected to the power grid circuit.
- Pay attention to all instructions or safety instructions regarding connection to the power grid.
- Lethally high voltage exists inside the product.
- Heed and follow warning signs on the product.
- Observe the safety precautions listed in this manual and other documentation related to this equipment.
- Damaged equipment or system failure can cause electric shock or fire!
- Preliminary visual inspection of equipment for damage or other hazards before operation.
- Check whether other external equipment or circuit connections are safe.
- Be sure the equipment is in a safe state before operation.

WARNING

- The installation and operation of the MVS must comply with the relevant standards and regulations of the country where the project is located.
- Make sure that the installation environment (such as voltage, temperature, humidity, altitude, pollution level, water proof and dust proof level) is within the allowable range.
- Before operation, the locking device on the pressure relief valve must be removed.
- Mechanical installation, electrical connection, commissioning, maintenance and troubleshooting must be performed by professional technicians in accordance with local regulations. Before operation, the operator should read this manual in full and understand the safety precaution related to the operation.

NOTICE

- Place eye-catching warning signs at the front and rear of the MVS and at the switch to avoid accidents caused by wrong closing.
- Set up warning signs or safety tapes near the field operation area.
- The warning signs on the MVS and the electrical equipment inside contain important information for safe operation of the MVS and the internal equipment. It is strictly forbidden to tear or damage them manually.
- Ensure that the warning signs on the body are always clear and readable.
- If the warning signs on the body are damaged or blurred, they must be replaced immediately.

1.3.2. Electrical Safety** DANGER**

- Before electrical connections, make sure that the MVS and its internal electrical equipment are in good condition. All electrical connections must comply with local country/ regional electrical standards.
- When a grounding fault occurs in a PV system, fatal high voltage may exist on the originally uncharged parts which is very dangerous if touched accidentally! Before operation, please ensure that there is no grounding fault in the system. At the same time, relevant protective measures should also be taken.
- Only when it is ensured through a display or other way that the MVS, especially the housing of the MVS, is completely neutral, all operations can be performed on it.
- Ensure that the escape route is unobstructed during the entire operation.
- Ensure that the power-off equipment will not be accidentally re-powered. After the MVS is completely out of operation, be sure to wait at least 10 minutes before operating the MVS to ensure the complete neutrality of the MVS.
- Use a multimeter and electrical testing equipment to ensure that the complete neutrality inside the equipment.
- Necessary grounding and short-circuit connections can be done only after confirming the neutrality.
- Use insulating cloth to insulate and cover the operating parts near potentially live parts.
- There are high voltages in the equipment inside the MVS, accidental touch may cause a fatal electric shock hazard, so during live measurement, you should take precautions (such as wearing insulating gloves, etc.) and there must be accompanying personnel to ensure personal safety.

⚠ WARNING

- When conducting electrical connections, trial runs, and other operations on MVS, it is necessary to use relevant electrical measurement equipment to ensure that all electrical parameters meet the requirements.
- The measuring range and usable conditions of the tool must meet the requirements of the site.
- Ensure that the connection and use of the measuring tool are correct and standard to avoid dangers such as arcing.

⚠ CAUTION

- Touching or improperly handling printed circuit boards or other electrostatically sensitive components can damage the device. Please discharge static electricity before operation.
- Avoid unnecessary contact with circuit boards.
- Comply with electrostatic protection regulations, such as wearing an anti-static wrist strap, etc.

NOTICE

During daily operation, it is necessary to ensure that the doors of the MVS and the internal equipment are closed and locked, and the keys have been pulled out and handed over to a dedicated person for safekeeping in order to avoid unauthorized people entering or exposure to rain, animals, etc. of the internal equipment. At the same time, the MVS and internal equipment should be regularly inspected and maintained to ensure long-term reliable operation.

1.3.3. Mechanical Safety

Please repair the paint scratches of the equipment in time. It is strictly forbidden to expose the scratched parts to the air for a long time which is easy to cause rusting.

If you want to perform arc welding, cutting and other operations on the equipment, or install other equipment on the top of the equipment, please contact GoodWe first.

Prohibit the use of tools with scars, expiration dates, and inspection failures, and ensure that the tools are not overloaded.

For high-altitude operations, please refer to and comply with the relevant high-altitude operation safety codes.

For the use of ladders, please refer to and comply with the local relevant ladder use safety codes.

When it comes to hoisting, please refer to and comply with local safety regulations.

It is strictly prohibited to drill holes on the equipment. Drilling holes can damage the leakproofness, electromagnetic shielding performance, internal

components and cables of the equipment, and the generated metal chips entering the equipment can cause circuit board short circuits. For handling heavy objects, please comply with relevant safety regulations and work safely after training.

1.3.4. Environment Requirement

- Site selection should comply with local laws, regulations, and relevant standards.
- Do not expose the equipment to flammable or explosive gas or smoke. Do not perform any operation on the equipment in such environments. Do not store any flammable or explosive materials in the equipment area. Do not place the equipment near heat sources or fire sources.
- Ensure that the equipment is stored in a clean, dry, and well-ventilated area with proper temperature and humidity and is protected from dust and condensation.
- It is strictly prohibited to install and operate the equipment in an environment that exceeds the scope of technical specifications or is harmful to the container. Otherwise, the performance and safety of the equipment will be affected.
- Do not install, use, or operate outdoor equipment and cables in harsh weather conditions.
- Ensure that the ground in the installation environment is solid, free from spongy or soft soil, and not prone to subsidence. The site must not be located in a low-lying land prone to water accumulation, and the horizontal level of the site must be above the highest water level of that area in history. Do not install the equipment in a position that may be submerged in water.
- If the equipment is installed in a place with abundant vegetation, in addition to routine weeding, harden the ground underneath the equipment using cement or gravel
- Before installation, operation, and maintenance of the equipment, clean up any water, ice, snow, or other foreign objects on the top of the equipment to prevent foreign objects from falling into the equipment.
- When installing the equipment, ensure that the installation surface is solid enough to bear the weight of the equipment. After installing the equipment, remove the packing materials such as cartons, foam, plastics, and cable ties from the equipment area.

1.3.5. Transportation Requirement

- Choose appropriate means of transportation based on the dimensions and weight of the equipment. The equipment should be placed horizontally during transportation to prevent being deformed or scratched by collision.
- Stacking layer should not exceed the allowable maximum layers, the equipment should be placed neatly, and the tilt angle should not exceed 15° during transportation.

- For road transport, a road survey must be conducted in advance to identify obstacles on the route to ensure that vehicles can pass through the route; for water transport, it is necessary to ensure that the route meet the full load navigation of the ships.

1.3.6. Storage Requirement

- The equipment is placed horizontally during storage and the container doors are closed tightly. Store the equipment in a clean and dry place, and prevent the erosion of dust and water vapor.
- The temperature and humidity of the storage environment are proper (-35°C ~70°C, and 5%~95%RH). Otherwise, the equipment may be damaged.
- For extended periods of storage, place silica gel moisture absorbent packs in the MVS based on the site environment, and check and replace the silica gel moisture absorbent packs on a regular basis. After extended periods of storage, test the equipment in accordance with local laws and regulations and applicable standards before use.

2. Product Introduction

NOTICE

The figures displayed in this manual are for reference only, please refer to the actual product for details.

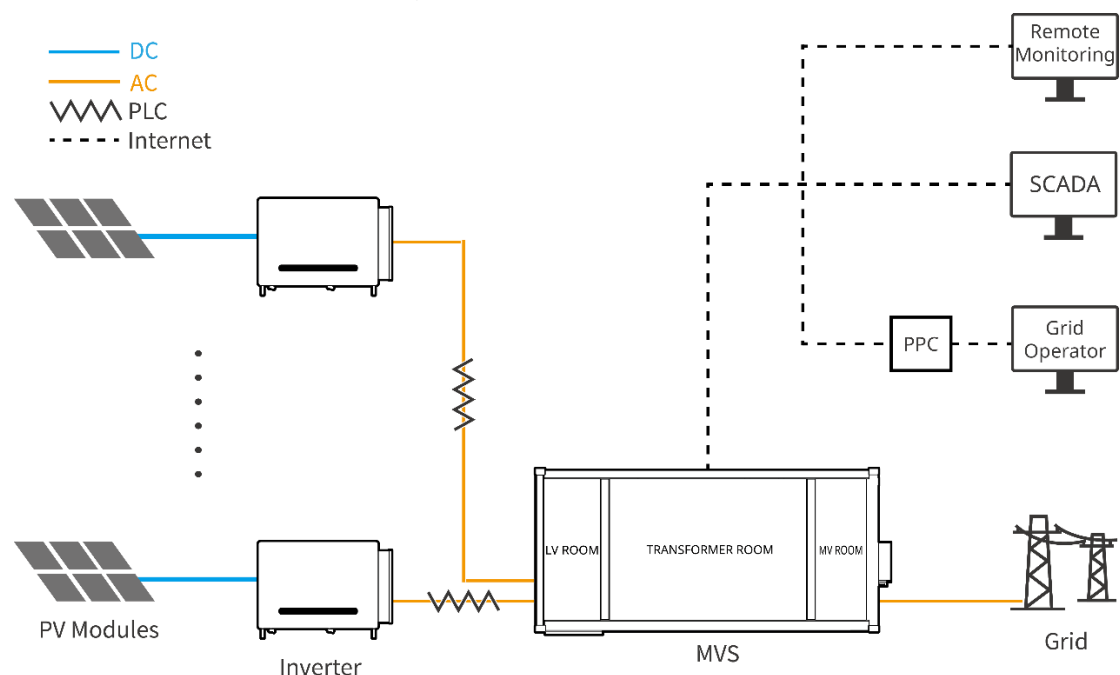
2.1. Product Overview

2.1.1. Function

A Medium Voltage Substation (MVS) converts low-voltage (LV) AC power generated by solar inverters into medium-voltage (MV) AC power and feeds it into a power grid.

It is a steel-structure container that includes devices include the LV cabinet, MVS transformer, ring main unit, measuring and controlling device, and auxiliary transformer to provide a highly integrated power transformation and distribution solution for utility-scale PV plants in MV grid-connection scenarios. Each MVS is connected upstream to the equipment on the substation side through a ring main unit, and downstream to the equipment on the inverter side through a LV cabinet.

The typical application diagram is as follows:



2.1.2. Appearance

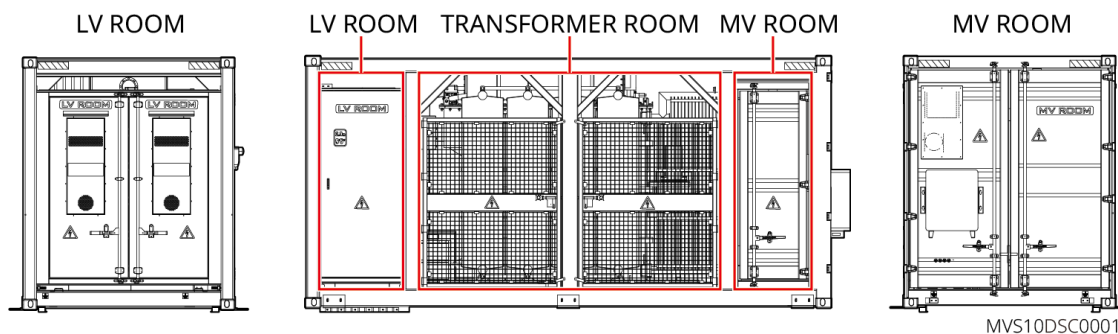


Figure 2-2 Appearance

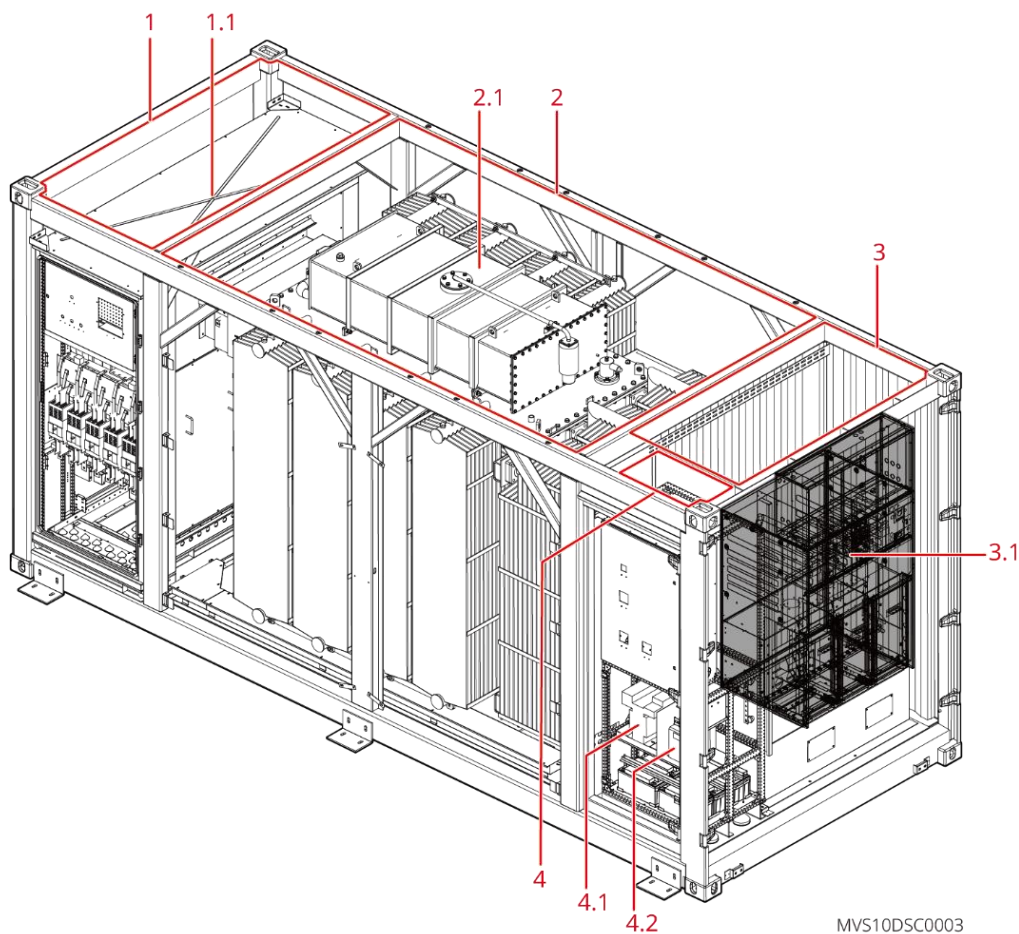


Figure 2-3 Component

- | | |
|---------------------------|---------------------------|
| 1 LV(Low voltage) room | 1.1 LV Cabinet |
| 2 Transformer room | 2.1 Transformer |
| 3 MV(Medium voltage) room | 3.1 Ring main unit (RMU) |
| 4 Power distribution room | 4.1 Auxiliary transformer |
| | 4.2 UPS |

2.1.3. Dimensions

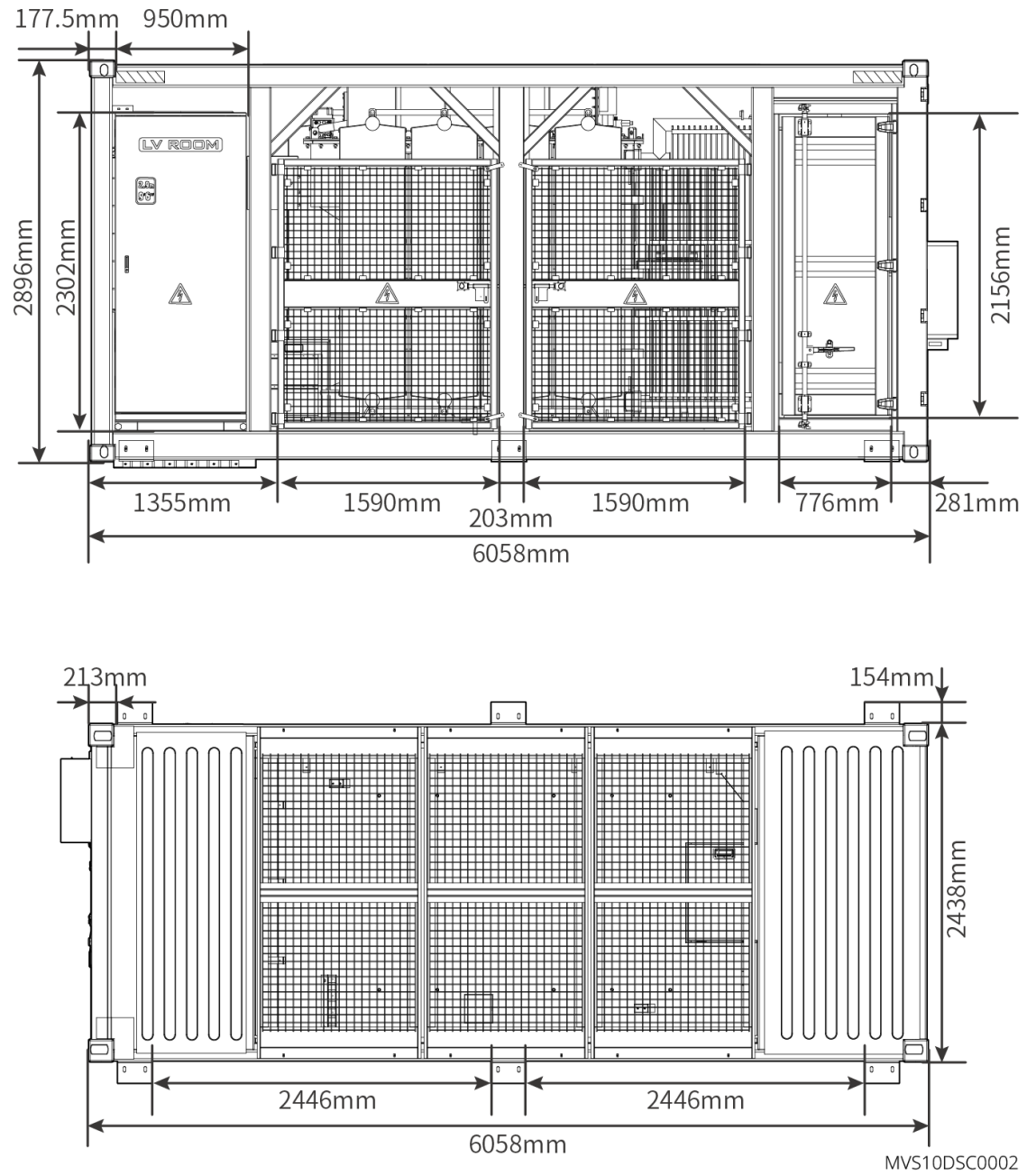





Figure 2-4 Container dimensions

2.1.4. Nameplate

GOODWE		Smart Transformer Station	
Model :GW9100K-MVS			
Rated Input Voltage	AC 800V	Frequency	50Hz
Rated Input Current	2*3302.5A	Standard	IEC62271-202
Rated Power	9152kVA	Dimensions (W*H*D)	6058*2896*2438mm
Rated Output Voltage	AC 33kV	IP Rating	IP 54
Rated Output Current	160.1A	Weight	24700kg
Serial Number	****	Manufacture Date	****
GoodWe Technologies Co., Ltd.		Made In China	

Figure 2-5 Nameplate

Label	Label Name	Explanation
	Electric shock warning	The equipment operates at high voltage. Only qualified and trained electrical technicians are allowed to install and operate the equipment.
	Grounding	Indicates the position for connecting the protecting earthing (PE) cable.
	Height label	The equipment is high. You may need tools such as an insulation stool or a step ladder to facilitate operation.

2.2. Components Introduction

2.2.1. LV Room

The low-voltage room mainly includes secondary equipment. The main components are as follows:

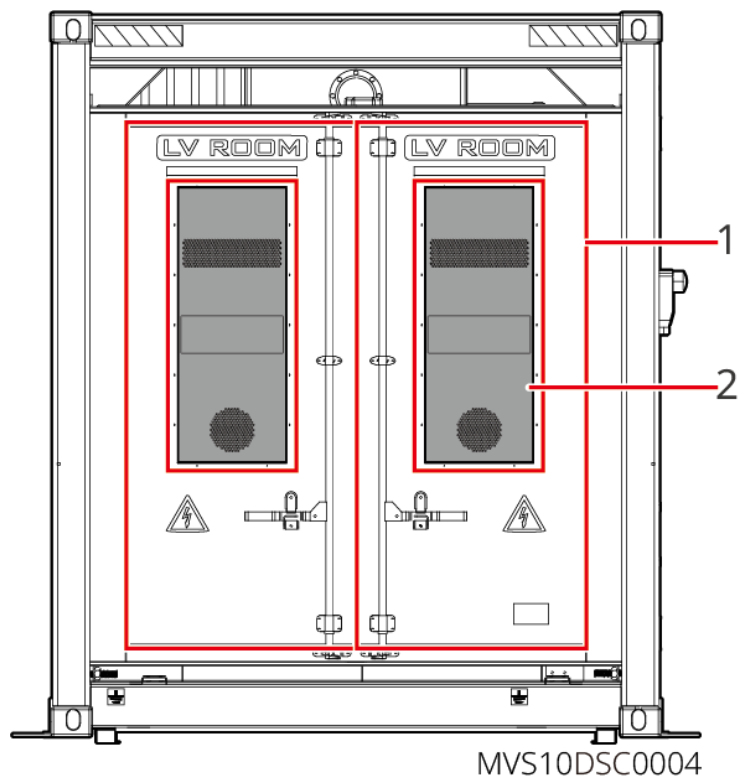


Figure 2-6 LV Room Structure

1. LV Cabinet

2. Heat exchangers

LV Cabinet Interior:

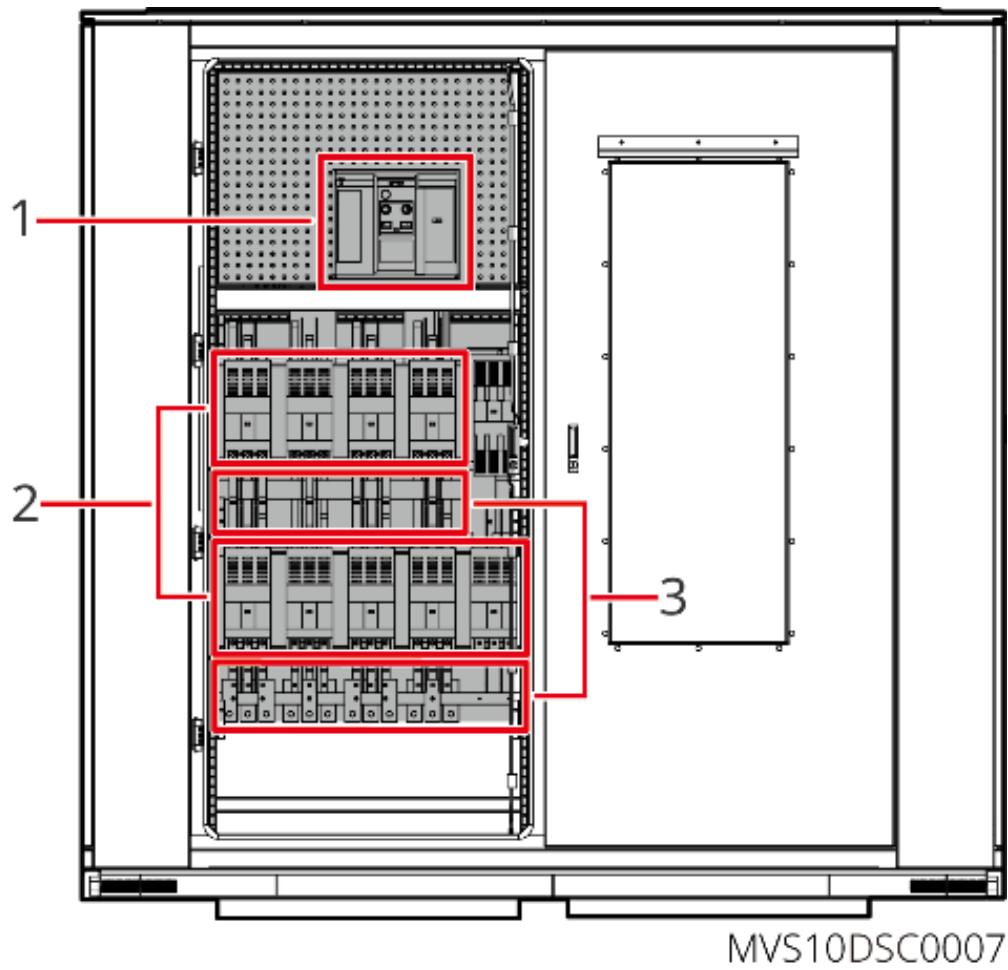


Figure 2-7 LV Room Structure

- 1. Air circuit breaker
- 2. Molded case circuit breaker
- 3. Wiring area

2.2.2. Transformer Room

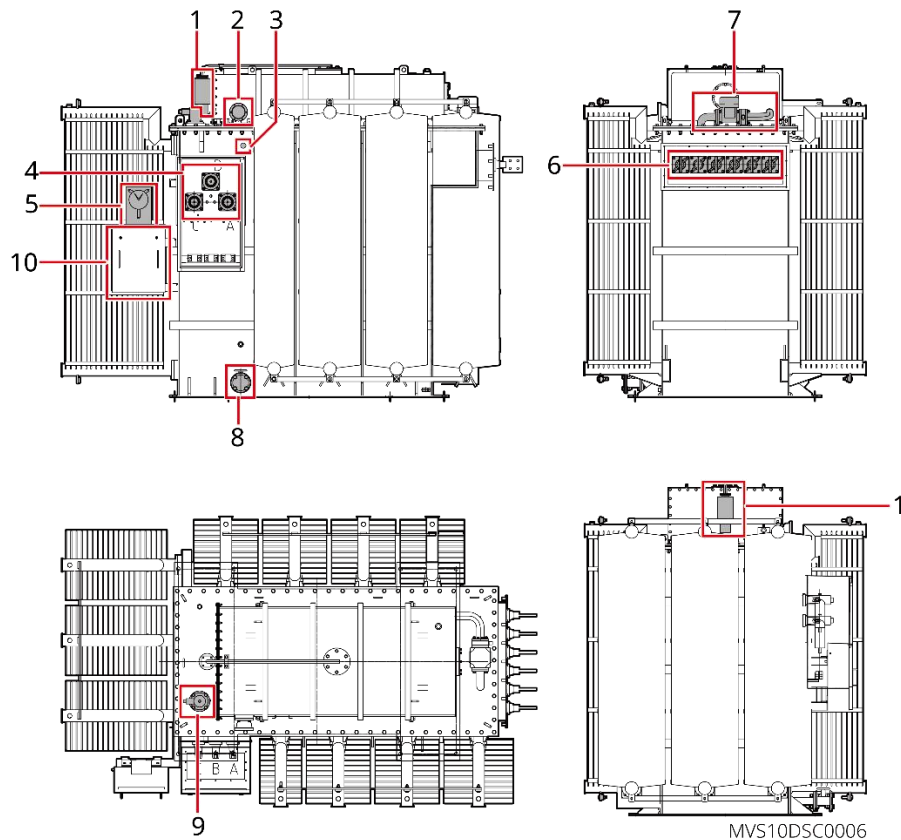
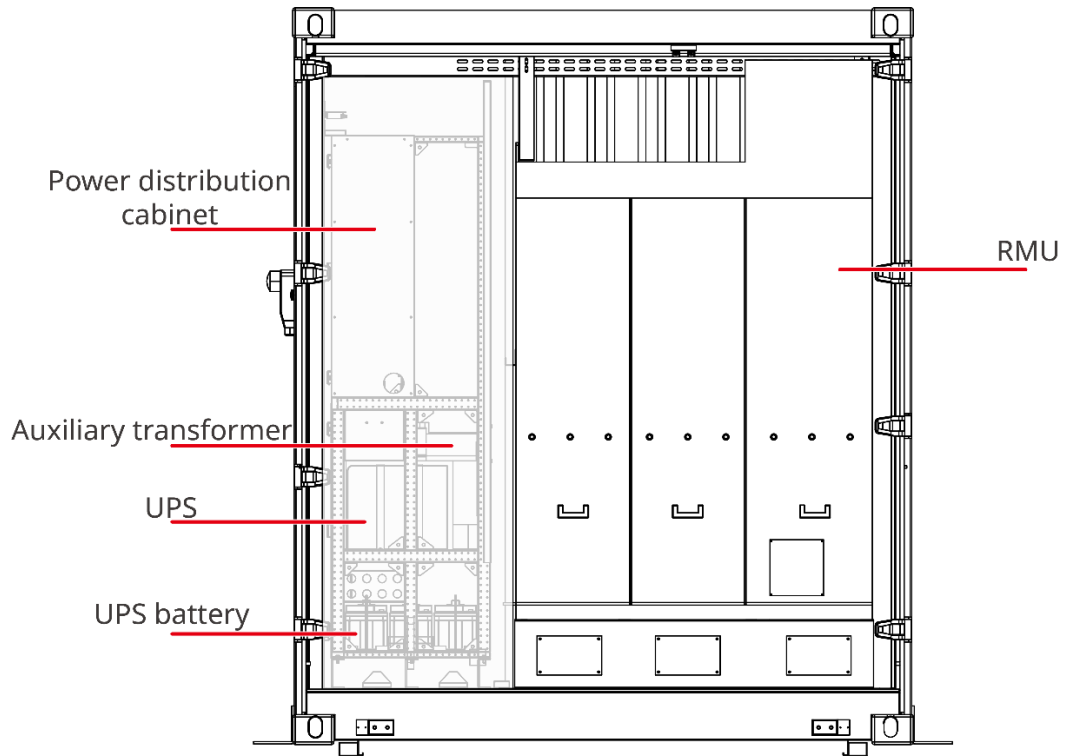


Figure 2-8 Structural layout of transformer room

- | | | |
|---------------------------------------|-------------------------|--------------------------|
| 1 Moisture absorber | 2 Oil level gauge | 3 Off-load tap changer |
| 4 Medium voltage bushing | 5 Oil temperature gauge | 6 Low voltage bushing |
| 7 Gas relay | 8 Oil drain valve | 9 Pressure release valve |
| 10 secondary control transmit cabinet | | |

When a fault occurs inside the transformer, a significant amount of gas will be produced, causing the sharp pressure increase inside the transformer. When the gas content is low, the transformer alarms. When the gas content reaches the activation pressure, the oil will be discharged, rapidly reducing the internal pressure of the transformer to the normal level. At the same time, a trip signal is sent out to trip the circuit breaker of the ring main unit.

2.2.3. MV Room



MVS10DSC0009

Figure 2-9 MV Room Layout

2.2.3.1. DAQO 24, 40.5kV Ring Main Unit

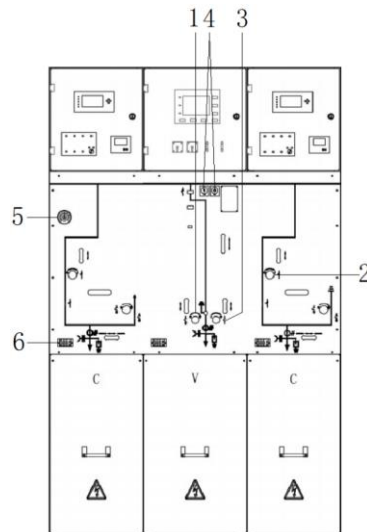


Figure 2-10 Ring main unit DQS-40.5 CVC appearance

- | | | |
|---------------------------------------|---------------------------------|----------------------------------|
| 1 Earthing switch
operating hole | 2 Load switch
operating hole | 3 Three position
disconnecter |
| 4 Circuit breaker
operation button | 5 densimeter | 6 Live display |

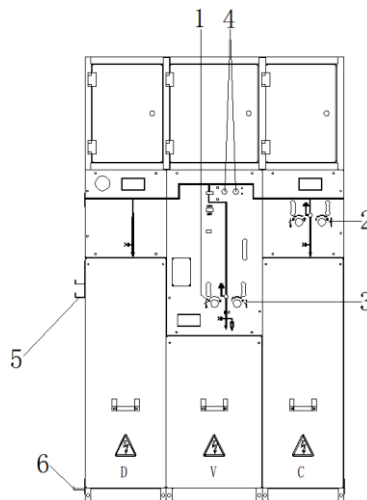


Figure 2-11 Ring main unit DQS-24 DVC appearance

- | | | |
|---------------------------------------|---------------------------------|----------------------------------|
| 1 Earthing switch
operating hole | 2 Load switch
operating hole | 3 Three position
disconnecter |
| 4 Circuit breaker
operation button | 5 Operation handle | 6 Earth bar |

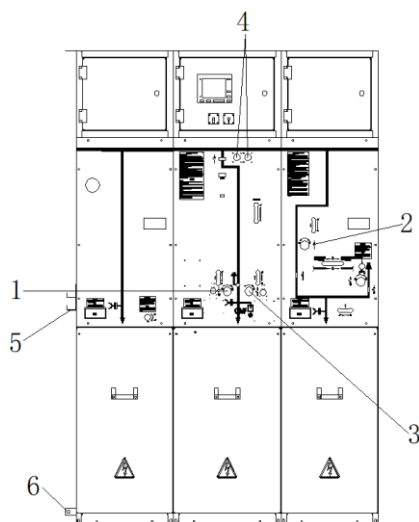


Figure 2-12 Ring main unit DQS-40.5 DVC appearance

- | | | |
|---------------------------------------|---------------------------------|----------------------------------|
| 1 Earthing switch
operating hole | 2 Load switch
operating hole | 3 Three position
disconnector |
| 4 Circuit breaker
operation button | 5 Operation handle | 6 Earth bar |

2.2.3.2. ABB 24, 40.5kV Ring Main Unit

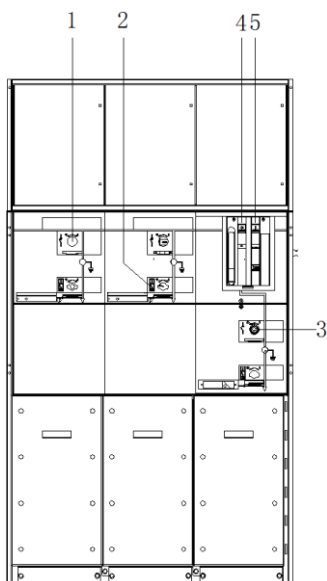


Figure 2-13 Ring main unit SAFE 12/24 CCV appearance

- | | | |
|----------------------|---------------------|----------------------------------|
| 1 Load break switch | 2 Earthing switch | 3 Three position
disconnector |
| 4 Push buttons close | 5 Push buttons open | |

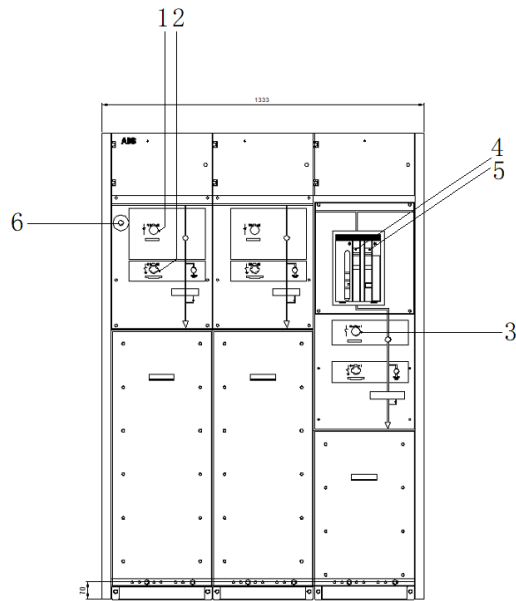


Figure 2-14 Ring main unit SAFE 40.5 CCV appearance

- | | | |
|----------------------|---------------------|-------------------------------|
| 1 Load break switch | 2 Earthing switch | 3 Three position disconnector |
| 4 Push buttons close | 5 Push buttons open | 6 densimeter |

2.2.3.4. Siemens 24, 36kV Ring main unit

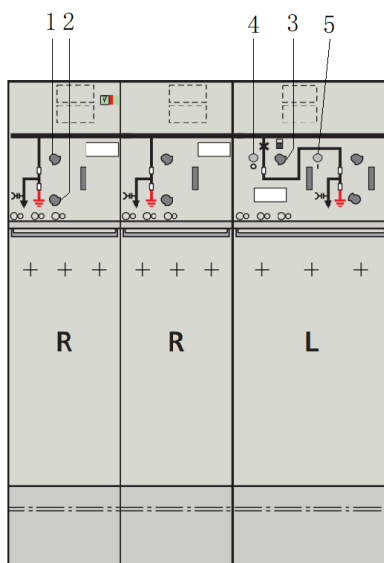


Figure 2-15 Ring main unit 24kV RRL appearance

- 1 Load break switch 2 Earthing switch 3 Three position disconnect
 4 Push buttons close 5 Push buttons open

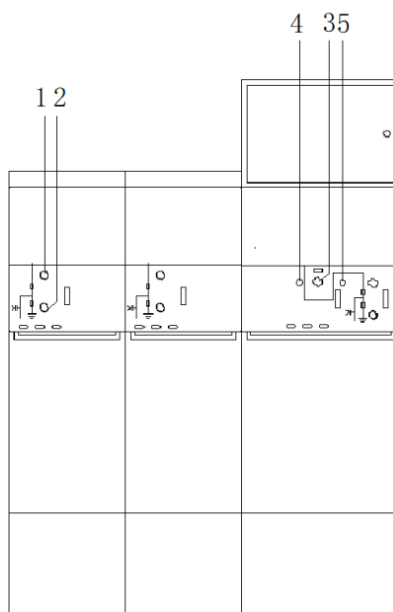
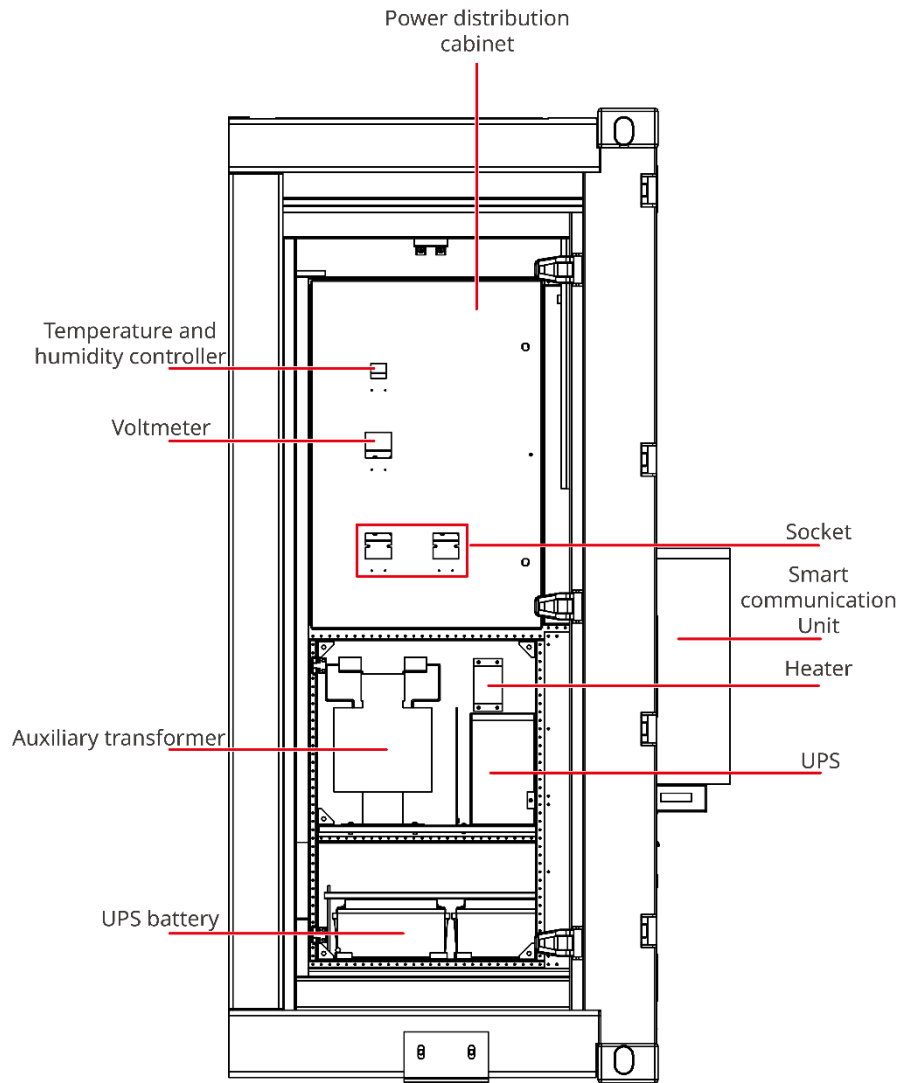


Figure 2-16 Ring main unit 36kV RRL appearance

- 1 Load break switch 2 Earthing switch 3 Three position disconnect
 4 Push buttons close 5 Push buttons open

Index: See the RMU user manual for details.

2.2.4. Power distribution room



MVS10DSC0010

Figure 2-17 Power distribution cabinet front view layout Figure

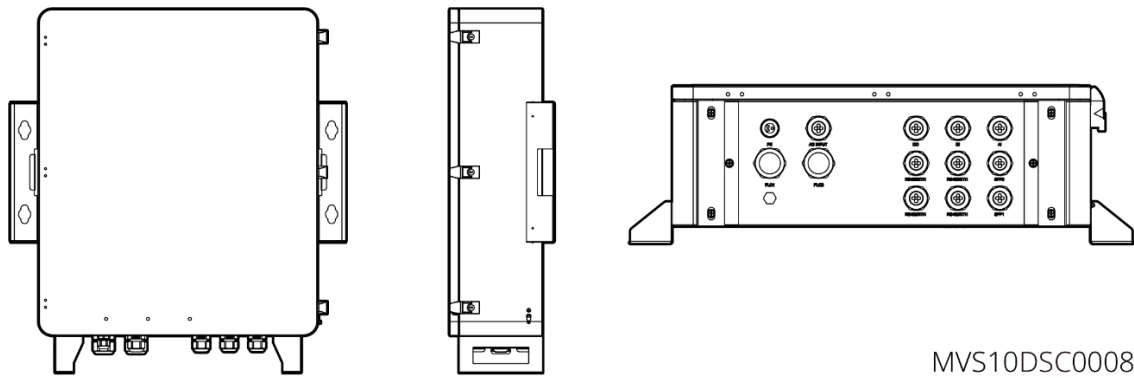


Figure 2-18 Smart Communication Unit appearance

Index: See the Smart Communication Unit (SCU3000A) user manual for details.



Figure 2-19 QR code for SCU3000A User Manual

3. Installation

Please check the Installation Manual and strictly follow the steps in the manual for installation.

4. Hot and Cold Commissioning

4.1. Introduction

4.1.1. Introduction to main equipment for cold commissioning

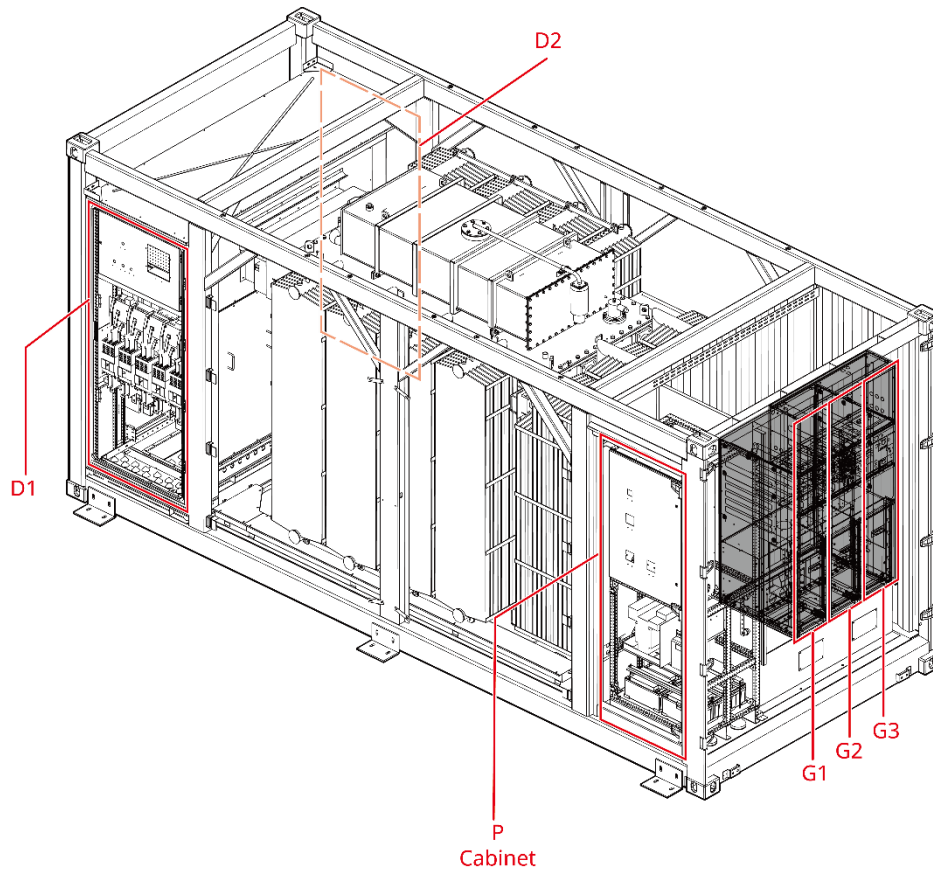


Figure 4-1 Cabinets

Name	Type	Location	Function
G1	Switchgear	Inside the MV Room	Incoming cable cabinet
G2	Switchgear	Inside the MV Room	Vacuum circuit breaker cabinet
G3	Switchgear	Inside the MV Room	Outlet cable cabinet
D1	Switchgear	LV Room	Connecting to inverters
D2	Switchgear	LV Room	Connecting to inverters
P cabinet	Power distribution cabinet	Near the ring main unit	Power distribution device installation

Refer to the project electrical label on the device for the specific functions.

4.1.2. MVS Interlocking and Key Diagram

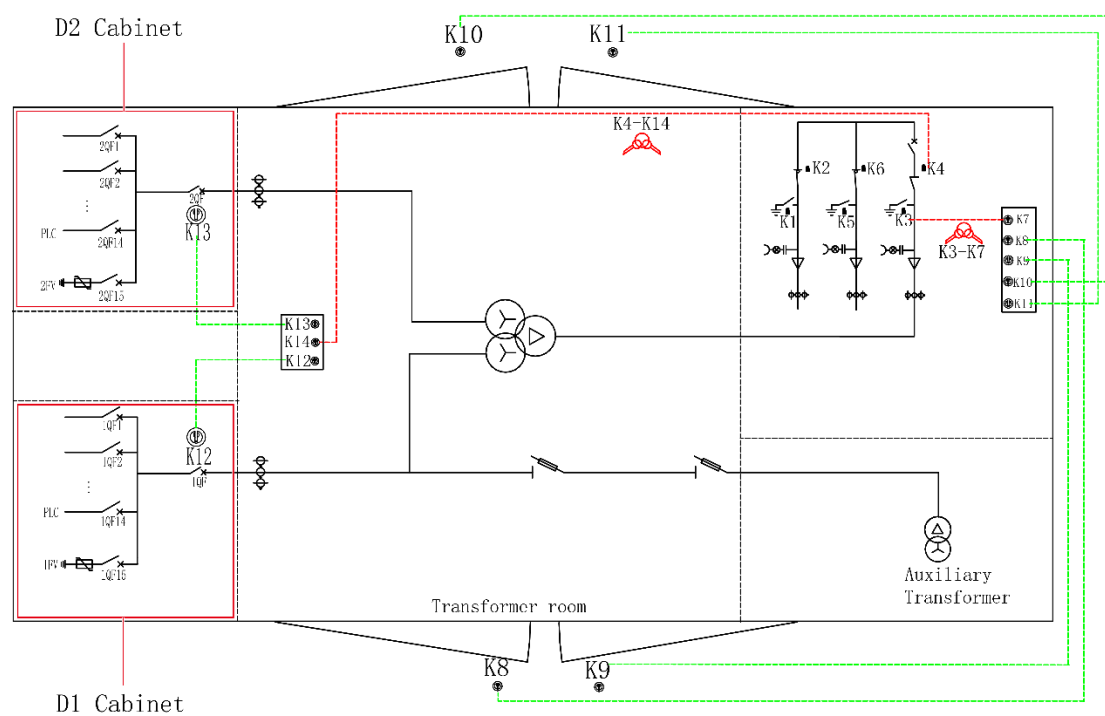
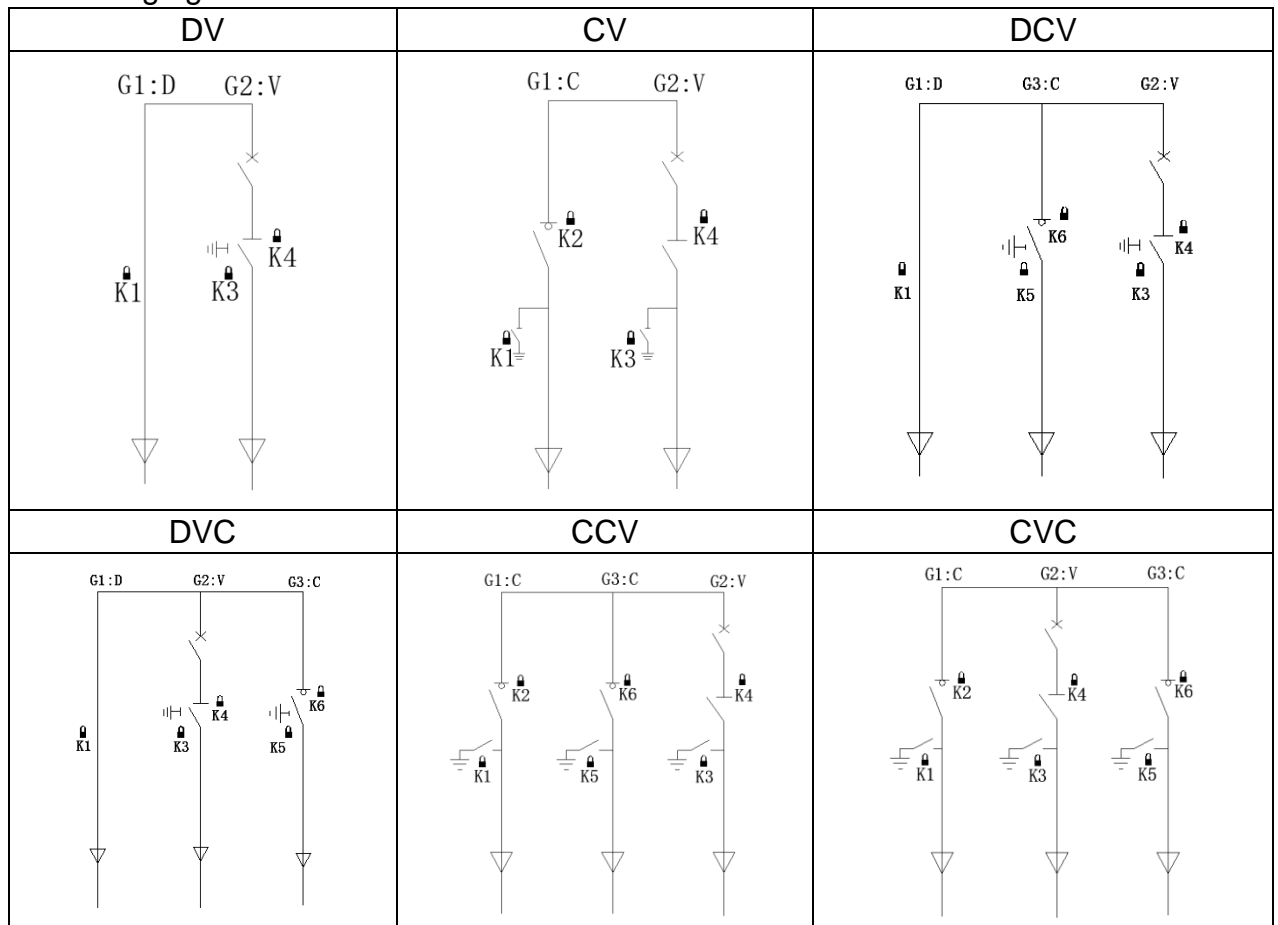


Figure 4-2 Interlocking Diagram

The key locations of different types of RMU (ring main unit) are shown in the following figure:



4.1.3. Interlocking Type between MVSS

NOTICE

- The G1 cabinet of each MVS points to the grid side. The G1 and G3 cabinets is not allowed to be swapped, otherwise it will cause interlocking disorder between MVSS.
- Each MVS and each switch will has a unique number. The number of the corresponding MVS and the specific switch number will be marked on the key plate.

4.1.3.1. Normal Interlocking

(1) The introduction to the normal key interlocking device of G1 cabinet with load switches in CCV/CVC type cabinet is as follows:

The purpose of normal interlocking is to prevent the downstream earthing switch from closing misoperation. As shown in figure, one of the interlocking devices is installed near the operating shaft of the earthing switch in the upstream G3, and the other interlocking device is installed near the operating shaft of the earthing switch in the downstream G1.

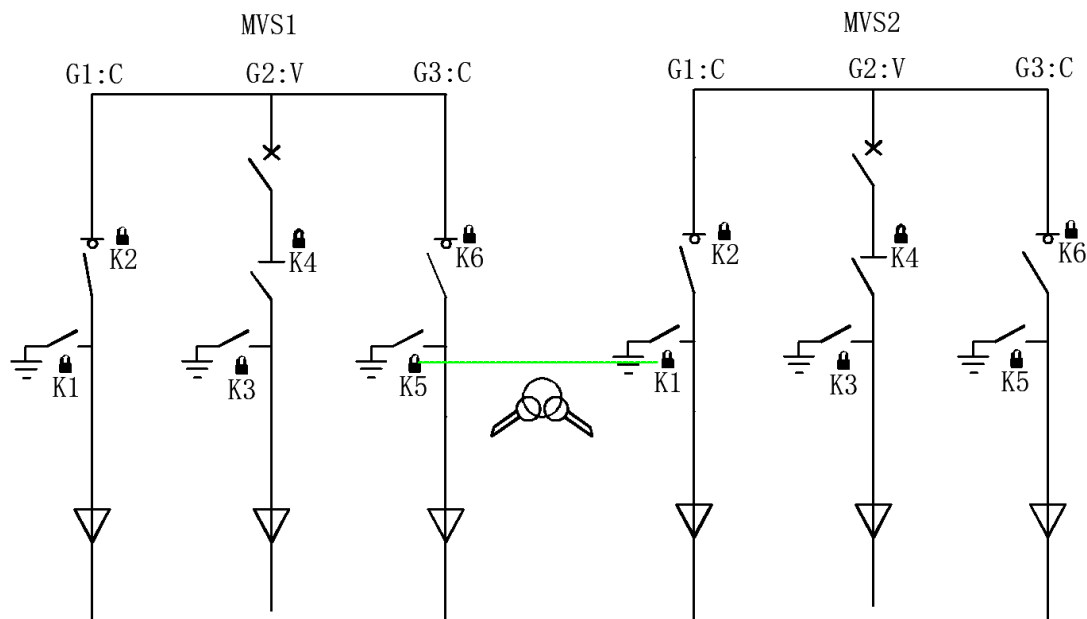


Figure 4-3 The normal interlocking of G1 cabinet with load switch

If the earthing switch in upstream G3 is in the open position, the key cannot be pulled out from the key interlocking device. The G1 earthing switch on the downstream side can be closed only when the earthing switch on the upstream G3 cabinet is closed.

Procedure

Step 1: Place the load switch which is in the upstream G3 in an open position.

Step 2: Place the earthing switch in an closed position.

Step 3: After step 1 and 2, then the key interlocking device can be operated.

Step 4: Take out the key and insert it into the key interlocking device on the earthing switch of downstream G1. After unlocking the earthing switch, the downstream earthing switch can be closed.

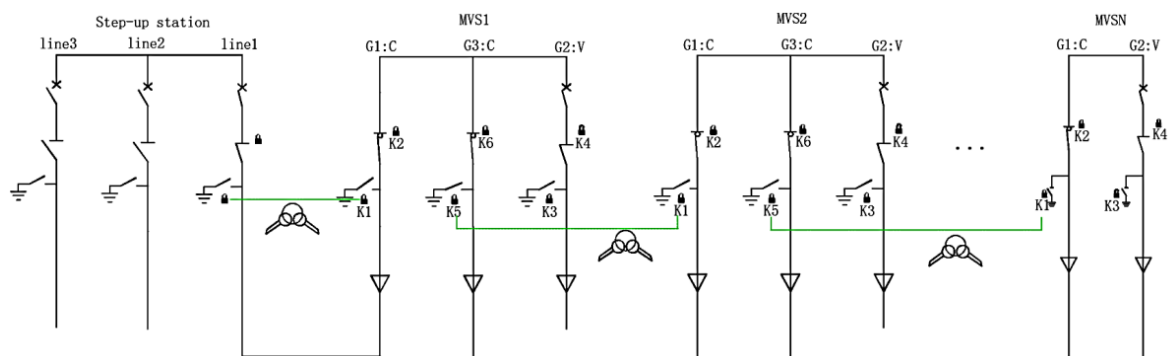


Figure 4-4 CCV type ring main unit normal interlocking

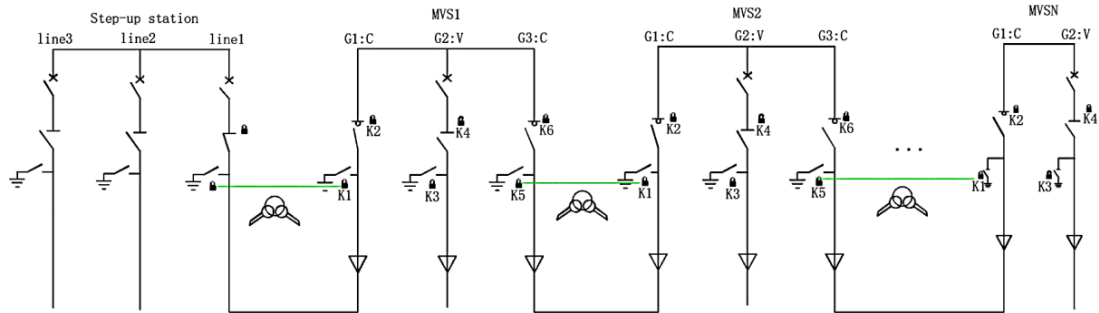


Figure 4-5 CVC type ring main unit normal interlocking

(2) The introduction to the normal key interlocking device for G1 cabinet without load switch in DCV/DVC type cabinet is as follows:

As shown in Figure, one of the interlocking devices is installed near the operating shaft of the earthing switch in the upstream G3, and the other key is on the cable room door in the downstream G1.

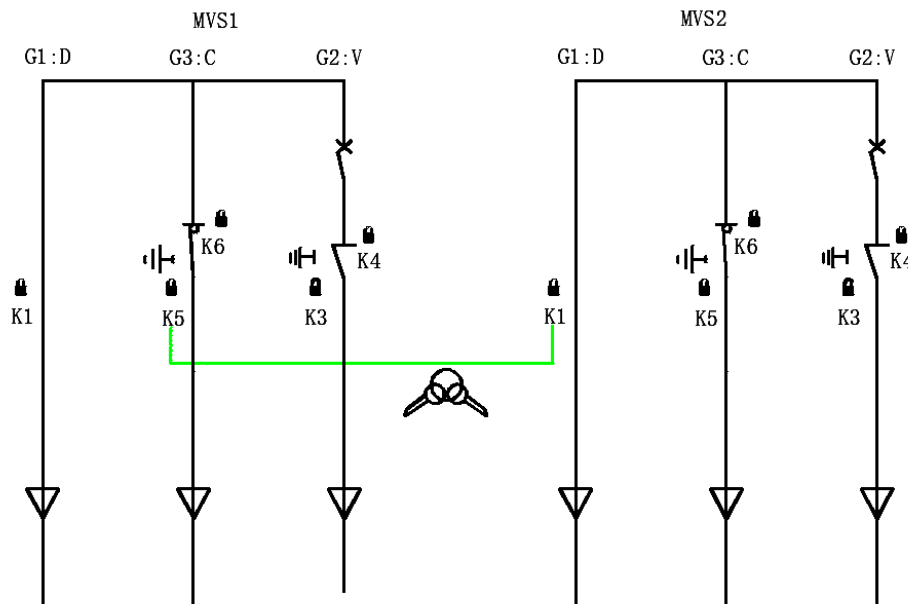


Figure 4-6 The normal interlocking of the G1 cabinet without load switch

If the earthing switch in upstream G3 is on an open position, the key cannot be pulled out from the key interlock. The downstream G1 cable room door can be opened only when the earthing switch on the upstream G3 cabinet is closed.

First, the load switch in the upstream G3 must be placed in an open position and the earthing switch must be placed in the open position. Only then can the key interlocking device be operated, that is locking the upstream earthing switch in the closed position. Then you can take out the key and insert it into the cable room of downstream G1. After unlocking, the cable room can be opened.

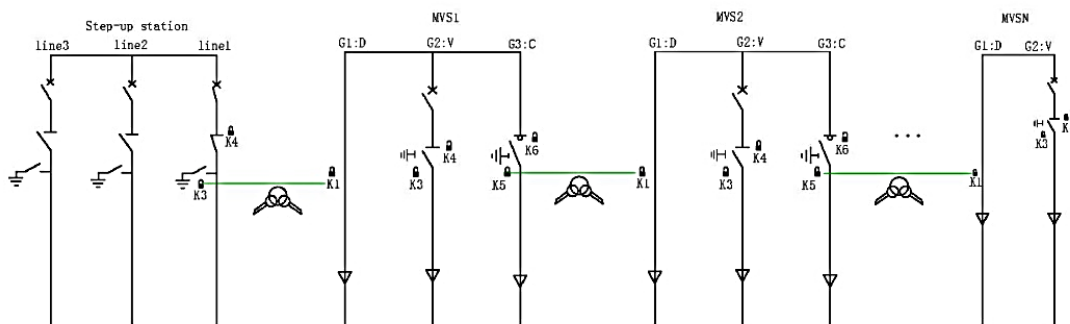


Figure 4-7 The normal interlocking of the DVC ring main unit

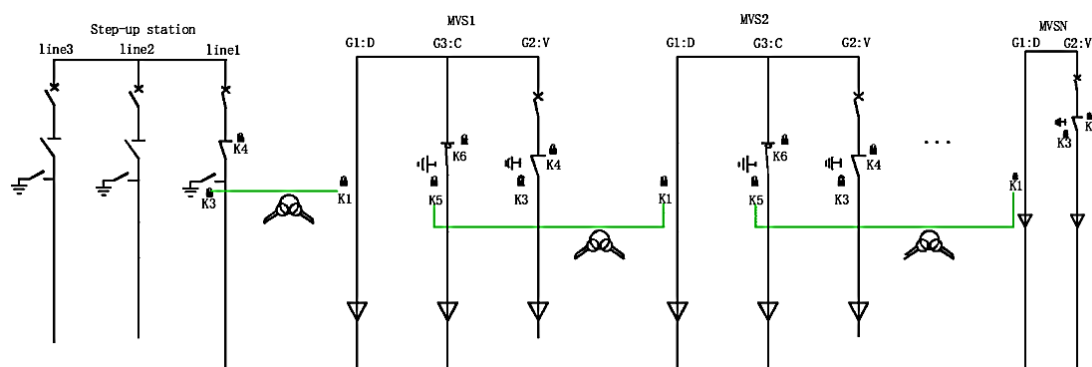


Figure 4-8 The normal interlocking of the DCV ring main unit

4.1.3.2. (Optional requirement: G1 cabinet with load switch) A3

Interlocking

The purpose of the A3 key interlocking device is described in the following example:

As shown in the figure, one of the interlocking devices is installed near the operating shaft of the load switch in the upstream G3, and the other interlocking device is installed near the operating shaft of the earthing switch in the downstream G1.

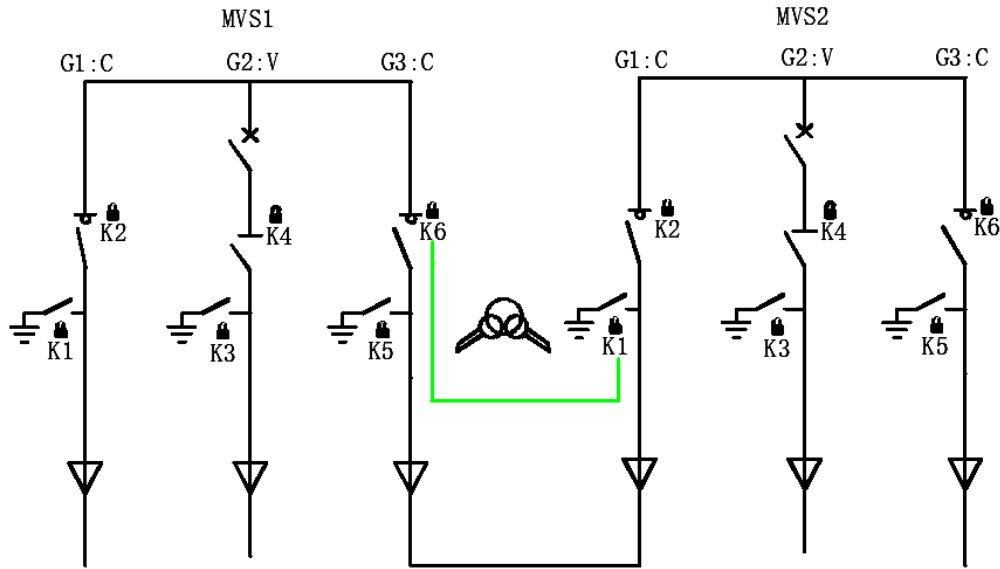


Figure 4-9 A3 Interlocking

If the load switch in upstream G3 is in a closed position, the key cannot be pulled out from the key interlock. The downstream G1 earthing switch can be closed only when the load switch on the upstream G3 cabinet is open. First, the load switch must be placed in an open position. Only then can the key interlocking device be operated and can the key be turned, that is locking the load switch in the open position. Then after you take out the key and insert it into the interlocking device of the earthing switch of downstream G1, the earthing switch can be opened.

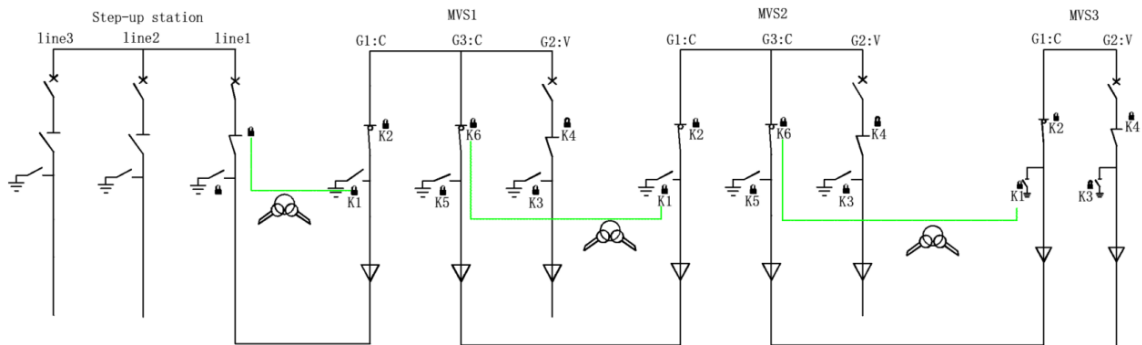


Figure 4-10 The A3 interlocking of the CCV ring main unit

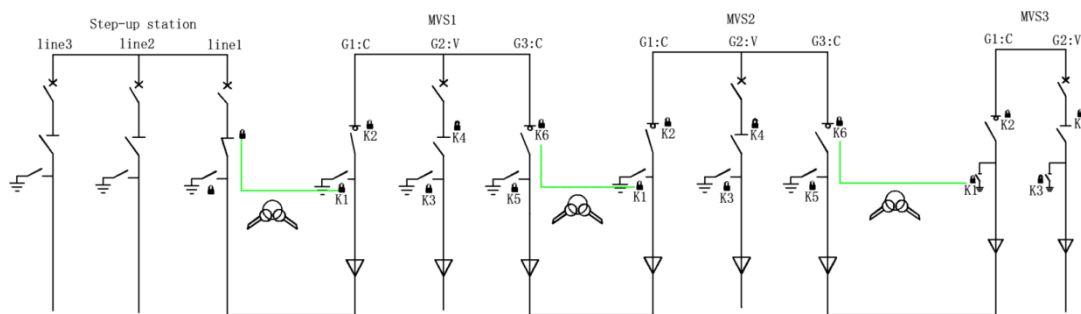


Figure 4-11 The A3 interlocking of the CVC ring main unit

4.1.3.3. (Optional requirements: G1 cabinet with load switch) P1

Interlocking

The purpose of the P1 key interlocking device is described in the following example:

The purpose of P1 interlocking is to ensure absolutely safe operation of the upstream G3 and downstream G1 by avoiding the closing of the upstream or downstream earthing switch since there is power supply both upstream and downstream to.

As shown in the figure, one of the interlocking devices is installed near the operating shaft of the earthing switch in the upstream G3, and the other interlocking device is located near the load switch; the same interlocking device is installed near the operating shaft of the earthing switch in the downstream G1, and another interlocking device is located near the load switch.

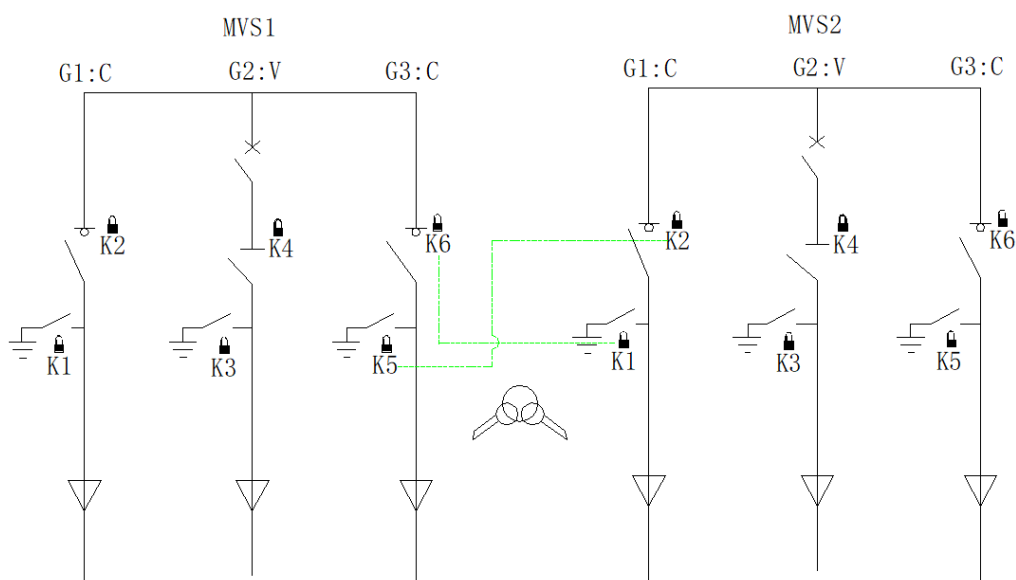


Figure 4-12 P1 Interlocking

If the load switch in the upstream G3 is in a closed position, the key cannot be pulled out or rotated in the key interlock device. The downstream earthing switch can be closed only when the load switch in the upstream G3 is opened. If the load switch in the downstream G1 is in a closed position, the key cannot be pulled out or turned in the key interlock device. The upstream earthing switch can be closed only when the downstream G1 load switch is opened.

From upstream to downstream, the load switch must first be opened in the upstream G3, and then the key interlocking device can be operated to lock the load switch in the open position. Then you can pull out the key and insert it into the key interlocking device on the earthing switch of downstream G1, and the earthing switch can be closed.

From downstream to upstream, the load switch must first be placed in an open position in downstream G1 before the key interlocking device can be operated and interlocking the load switch in the open position. Then you can pull out the key and insert it into the key interlocking device on the upstream G3 earthing switch to unlock it, and then close the earthing switch.

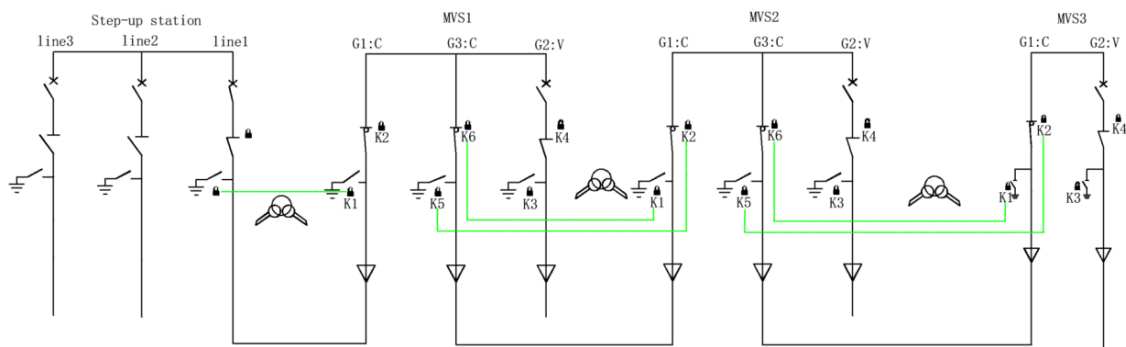


Figure 4-13 The P1 interlocking of the CCV ring main unit

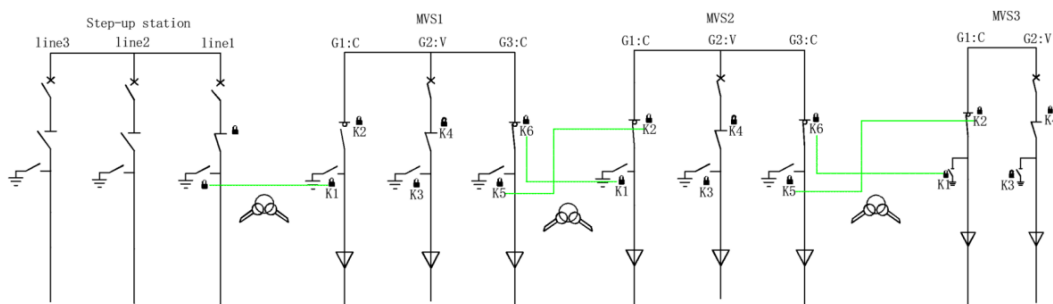


Figure 4-14 The P1 interlocking of the CVC ring main unit

4.2. Cold Commissioning

The specific steps for cold commissioning after the completion of installation are as following:

- 1) Overall inspection;
- 2) Insulation test;
- 3) Testing of components inside the MVS;
- 4) Hot commissioning preparation status setting.

4.2.1. Overall Inspection before Cold Commissioning

4.2.1.1. Overall Appearance Inspection of Container

Steps	Operation	Yes/No	Note
1	The appearance of the container should be intact and free of rust or paint damage. If there are abnormalities, rust removal and touch-up work will be required. Please refer to the "Troubleshooting Manual" for details.		
2	The labels and nameplates of the equipment must not be damaged or lost, and the writing should be clear and legible. If not, the label and nameplate should be replaced.		

4.2.1.2. Check the Interlocking function

Introduction to the Key Status inside the MVS					
Interlocking device	Key name	Switch status	Key status	Yes/No	Note
G1: Earthing switch	K1	Opened	can be pulled out after unlocked		N.A.
		Closed	can not be pulled out		N.A.
G1: Load switch	K2	Opened	can be pulled out after unlocked		N.A.
		Closed	can not be pulled out		N.A.
G2: Earthing switch	K3	Opened	can not be pulled out		
		Closed	can be pulled out after unlocked		
G2: Three position disconnecter	K4	Opened	can not be pulled out		
		Closed	can be pulled out after unlocked		
G3: Earthing switch (normal interlocking)	K5	Opened	can not be pulled out		
		Closed	can be pulled out after unlocked		
G3: Earthing switch (A3,P1 interlocking)	K5	Opened	can be pulled out after unlocked		
		Closed	can not be pulled out		
G3: Load switch	K6	Opened	can be pulled out after unlocked		
		Closed	can not be pulled out		
MV key container	K7	K8,K9,K10,K11 inserted	can be pulled out after unlocked		

		K8,K9,K10,K11 not inserted	can not be pulled out		
Transformer door K8	K8	Door closed	can be pulled out after unlocked		
		Door opened	can not be pulled out		
Transformer door K9	K9	Door closed	can be pulled out after unlocked		
		Door opened	can not be pulled out		
Transformer door K10	K10	Door closed	can be pulled out after unlocked		
		Door opened	can not be pulled out		
Transformer door K11	K11	Door closed	can be pulled out after unlocked		
		Door opened	can not be pulled out		
Air circuit breaker 1QF in D1	K12	Closed	can not be pulled out		
		Opened	can be pulled out after unlocked		
Air circuit breaker 2QF in D2	K13	Closed	can not be pulled out		
		Opened	can be pulled out after unlocked		
MV key container master control	K14	K12,K13 inserted	can be pulled out after unlocked		
		K12,K13 not inserted	can not be pulled out		

Steps	Interlocking between 1QF & 2QF and G2 three position disconnecter	Yes/No	Note
1	There is a key chain K14&K4 between the G2 three position disconnecter key K4 and the LV key container key K14.		
2	When the MVS leaving the factory, K4 (key chain) is inserted next to the G2 three position disconnecter. At this time, K12 and K13 cannot be pulled out.		
3	After you close the G2 three position disconnecter, K4 can be pulled out. (When the G2 three position disconnecter is opened, K4 cannot be pulled out).		
4	After you insert K14 into the LV key container, K12 and K13 be pulled out. After you insert it into the key holes of 1QF and 2QF, K14 cannot be pulled out.		
5	Insert K12 and K13 into the air circuit breaker and turn off the air circuit breaker. K12 and K13 cannot be pulled out.		
6	Open the operating air circuit breaker, pull out K12 and K13, insert them back into the LV key container, pull out K14 and insert K4 of the key chain back into G2.		

Steps	Interlocking between transformer door and G2 earthing switch	Yes/No	Note
1	After manufacture, there are keys K8, K9, K10, K11 for the four doors of the transformer in the MV key container. There is a key chain K3&K7 for the key K7 of the MV room key container and the G2 earthing switch key K3.		
2	When the G2 earthing switch is opened, K3 cannot be pulled out.		
3	After manufacture, G2 earthing switch is closed, pull out K3 and insert K7 into the MV key container to unlock K8, K9, K10, K11.		
4	Pull out the key from the key container, unlock the transformer door, and confirm that the key cannot be removed after opening the transformer door.		
5	At this time, the MV key container K7 cannot be pulled out.		
6	Close the transformer room door and pull out the key, insert it back into the MV key container.		

Steps	Normal interlocking between the MVS 1 and MVS 2 (CCV/CVC/RRL)	Yes/No	Note
1	MVS 1 is the upstream, and MVS 2 is the downstream.		
2	Open the G3 load switch of MVS1, close the G3 earthing switch of MVS 1, and take out the key K5 of the earthing switch of MVS 1.		
3	Open the G1 load switch of MVS 2, close the G1 earthing switch of MVS 2, and take out the key K1 of the earthing switch of MVS 2		
4	String K5 of MVS 1 and K1 of MVS 2 in key chains K5&K1.		
5	Insert the key chain to G3 of MVS 1.		

Steps	Normal interlocking between the MVS 1 and MVS 2 (DCV/DVC/RRL)	Yes/No	Note
1	MVS 1 is the upstream, and MVS 2 is the downstream.		
2	Open the G3 load switch of MVS 1, close the G3 earthing switch of MVS 1, and take out the key K5 of the earthing switch of MVS 1.		
3	Take out the incoming cabinet door key K1 of MVS 2.		
4	String K5 of MVS 1 and K1 of MVS 2 to the key chains K5&K1.		
5	Insert the key chain into G3 of MVS 1.		

Note:

1. To remove keys K8 to K11, key K7 must be inserted into the key container and in locked status. Keys K8, K9, K10, and K11 must be unlocked in sequence from top to bottom to successfully remove them.
2. To lock keys K11, K10, K9, and K8 for K7 key removal, strictly rotate the K8~11 keys clockwise in the sequence of K11, K10, K9, and K8 from bottom to top to the locked position. At this point, these keys cannot be removed.

4.2.1.3. The Inspection of LV Cabinet

Step	Project	Status Confirmed	Yes/No	Note
1	LV cabinet	The equipment is in good condition, with no rust or paint peeling. (If any paint peeled, repaint it).		
		Labels on the device are clearly visible. Damaged labels must be replaced prompt.		
		There is no damage to the appearance of micro-breakers, fuses, switching power supplies and other devices.		
		The wiring is neat, the connections are tight, and the wire markings are clear.		
		All MCCBs perform 5 closing and 5 opening operation cycle.		
2	Measuring and controlling device	The appearance is not damaged and the labels on the buttons are clearly visible.		
		The terminals on the back of the measuring and controlling device are firmly connected, without damage, and the line markings are clear.		
3	Temperature and humidity controller	The appearance is not damaged, and the labels on the buttons are clearly visible.		
4	Inspection of the heat exchanger	The appearance of the heat exchanger is intact, without any damage, and is well fixed. The wires are well secured and the labels are clearly visible.		
		Take out the heat exchanger rain shield and screws, and install the rain shield to the heat exchanger.		
5	Foreign object inspection	There is no foreign object in the low-voltage room. If there is any foreign object, please clean it.		

4.2.1.4. The Inspection of the Transformer

Step	Project	Status Confirmed	Yes/No	Note
1	Appearance inspection	There are no cracks, scratches or dents on the appearance of the transformer.		
		The connection cover between the transformer and the LV room is free of damage, rust, or paint peeling, and is well sealed.		
		The external cables of the transformer room are neat and free of damage and burrs.		
2	Oil leakage inspection	There is no oil leakage in the transformer.		
3	Inspection of the oil temperature gauge	The indicator is not damaged and the cover is firmly installed.		
		The oil temperature displayed by the white pointer of the transformer oil temperature gauge is close to the nearby ambient temperature.		
4	Inspection of the oil level gauge	There is no damage to the appearance of the oil level gauge, and the cover is firmly installed.		
		The indication of the transformer oil level gauge is consistent with the oil temperature-oil level curve.		
5	Inspection of the moisture absorber	If the hygroscopic silica gel is dry, the color should be blue.		
		If the color of more than half of the silica gel changed, the moisture absorber should be replaced.		
6	Inspection of the off-load tap changer	The appearance of the off-load tap changer is intact and without damage.		
		The off-load tap changer should be set according to user requirements. If there are no special requirements, it should be set to the rated level (level 3).		
7	Inspection of the transformer secondary wire transfer container	There is no damage, dents or peeling paint on the appearance of the container, and no fallen hole plugs.		
		The wiring inside the container is tight and not damaged, and the wire markings are clear.		
8	Inspection of the oil drain hole	The transformer oil drain hole is not blocked.		

9	The pressure relief valve	There is no appearance damage. Remove the pressure relief valve cover and check that it has not popped up.		
10	Gas relay inspection	There is no appearance damage or no gas inside the gas relay. If there is a small amount of gas, the air can be exhausted through the exhaust plug. The butterfly valve is open.		
11	Foreign object inspection	There is no foreign object in the transformer room. If so, it needs to be cleaned.		

4.2.1.5. The Inspection of the Ring Main Unit

Step	Project	Status Confirmed	Yes/No	Note
1	Appearance inspection	No cracks, dents or scratches on the exterior.		
		The appearance of all components on the panel is intact, with no missing buttons, knobs, etc. The cable room door is closed.		
2	SF6 densimeter	The SF6 densimeter pointer is in the green area and is a certain distance from the yellow or red area.		
3	Vacuum circuit breaker inspection	Operate the charge lever of the vacuum circuit breaker to set the circuit breaker in the energy storage state. Open and close the circuit breaker 5 times.		
4	Inspection of the relay protection device room	The appearance of each component is normal, the wiring is tight, and the writing on the wiring label is clear.		
5	G2 cable room inspection	The appearance of the arrester is normal and there is no damage. It is securely installed.		
		Check for foreign objects. If there is, it needs to be cleared.		
		After checking, close the cable room door.		

4.2.1.6. The Inspection of the Power Distribution Room

Step	Project	Status Confirmed	Yes/No	Note
1	Overall inspection	All components in the power distribution room are intact, buttons and keys are clearly written, and there are no loose installations.		
		All wiring is tight and undamaged.		
		No foreign objects. If there is, it needs to be cleared.		
2	Inspection of the internal of the distribution container in the distribution room	All components should be in good condition.		
		The secondary wiring is tight, undamaged, and the wiring labels are clear.		
		No foreign objects. If there is, it needs to be cleared.		

4.2.2. Insulation Test

NOTICE

- Before installing and sealing the outgoing cable, insulation test should be conducted on the LV side. If the cable wiring is completed, all MCCBs connected to the inverters need to be turned off.
- Insulation testing is mainly for the LV side.
- The LV side insulation test requires opening the PLC switch inside SCU3000A.
- Before the test, the fuse should be disconnected, and after the test, the fuse should be closed.
- The operation method for conducting this insulation test on CVC/CCV/DVC/DCV ring main unit cabinets is consistent.
- This manual takes CCV type ring main unit as an example, and other types please refer to this test method.

The testing schematic is shown below:

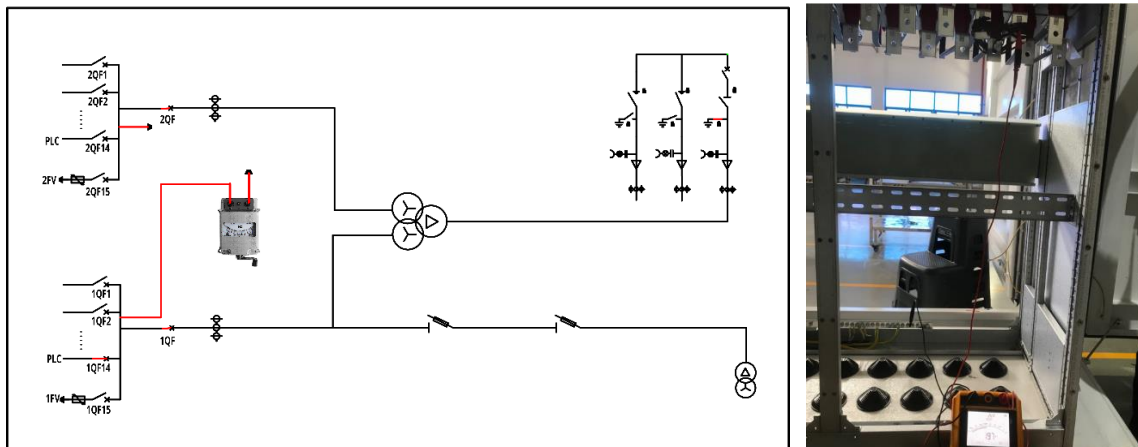


Figure 4-15 Test diagram of low-voltage cabinet D1

Steps	Insulation test for LV cabinet D1	Yes/No	Note
1	Adjust the switch according to the test diagram of LV cabinet D1.		
2	Open the load switch of G1 and G3 cabinets, close the earthing switch, open the circuit breaker of G2 cabinet, open the three position disconnector and close the earthing switch.		
3	Use temporary cables to ground the three-phase of D2.		
4	Short circuit the three-phase busbar of D1 (as shown in the above figure), connect the positive pole of the insulation tester to one of the phases, and ground the negative pole.		
5	Test voltage is 1000V, test duration is 1 minute, record the resistance value at 10 seconds (should be greater than 10M Ω)		
6	Record the resistance value at 30s (should be greater than 10M Ω)		
7	Record the resistance value at 60 seconds, then stop the test and turn off the tester (it should be greater than 10M Ω)		
8	Use a grounding cable to discharge the test circuit and remove all test cable.		

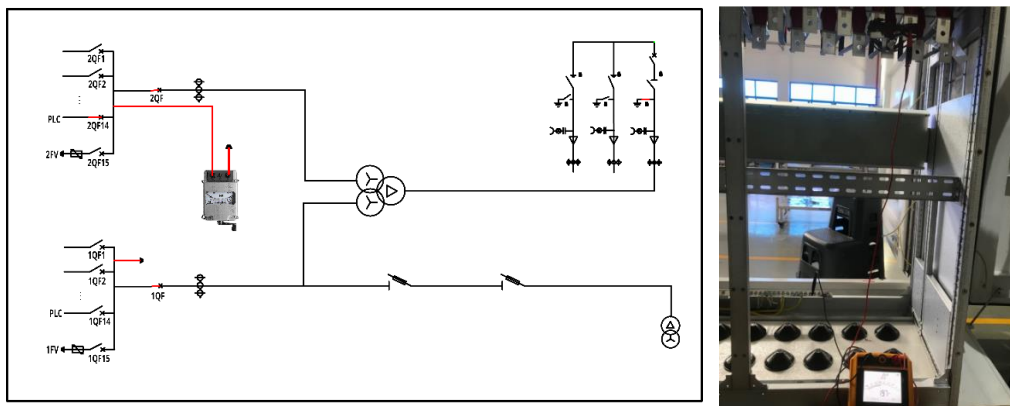


Figure 4-16 Test diagram of low-voltage cabinet D2

Steps	Insulation test for LV cabinet D2	Yes/No	Note
1	Adjust the switch according to the test diagram of LV cabinet D2.		
2	Open the load switch of G1 and G3 cabinets, close the earthing switch, open the circuit breaker of G2 cabinet, open the three position disconnector and close the earthing switch.		
3	Use temporary cables to ground the three-phase of D1.		
4	Short circuit the three-phase busbar of D2 (as shown in the above figure), connect the positive pole of the insulation tester to one of the phases, and ground the negative pole.		
5	Test voltage is 1000V, test duration is 1 minute, record the resistance value at 10 seconds (should be greater than 10M Ω)		
6	Record the resistance value at 30s (should be greater than 10M Ω)		
7	Record the resistance value at 60 seconds, then stop the test and turn off the tester (it should be greater than 10M Ω)		
8	Use a grounding cable to discharge the test circuit and remove all test cable.		

4.2.3. Device testing inside the MVS

The test of the components inside the MVS needs to be powered by an external power supply. There are two types of external power supply:

- Three-phase generator (three-phase four-wire) with an output voltage of 380V.
- A single-phase generator with an output voltage of 220V (the single-phase generator charges the UPS, and the UPS supplies power to the components. The battery power may not be able to support the entire commissioning).

Illustration:

- Prioritizing 380V generators as all loads can be tested using 380V generators. If 220V is used, the following equipment cannot be tested: heat exchanger, air conditioners, and temperature and humidity controllers.
- The test procedures vary for different power supplies.
- Make sure all switches are open before testing.
- The switch is based on the primary and secondary electrical figures of the actual project.

4.2.3.1. AC 380V Generator Power Supply

Step	Operation	Yes/No	Note
1	Connect the generator power cable (three-phase four wire) to the MVS		
2	Close the relevant MCB of the UPS		
3	Close the relevant MCB of ACB controller 1		
4	Close the relevant MCB of ACB controller 2		
5	Closed RMU related MCB		
6	Closed MVS measurement and control MCB		
7	Closed the meter MCB		
8	Closed lighting MCB		
9	Close the MCB of SCU3000A		
10	Closed heat exchanger MCB		
11	Closed temperature and humidity controller MCB		
12	Closed air conditioning MCB		
13	Close the MCB of P1 socket		
14	Close the MCB of P2 socket		

15	Power on the SCU3000A and connect it to the computer, establishing communication between the inverter and the MVS. Open the website to display the commissioning interface and check that all signals are normal; If it is abnormal, please record the phenomenon and contact relevant personnel. Please note that the door of the distribution room should be open now, so a "door open" warning should appear. Operate the travel switch of the distribution room door and check if the interface alarm disappears.		
16	Remote control operation G2 vacuum circuit breaker to open and close 5 times each.		
17	Remote control operation 1QF (ACB-1) opening and closing 5 times each.		
18	Remote control operation 2QF (ACB-2) opening and closing 5 times each.		
19	Disconnect all MCBs of the devices in sequence, turn off UPS, disconnect all test cables, and remove all external power sources.		
20	Test completed		

4.2.3.2. AC 220V Generator Power Supply (UPS)

NOTICE

- The specific steps for commissioning the smart communication unit refer to its user manual.
- The specific steps for commissioning the inverter refer to the inverter user manual.

Test conditions: There is a single-phase generator on site as the external power supply.

Step	Operation	Yes/No	Note
1	Connect the generator to the MVS		
2	Close the relevant MCB of the UPS		
3	Close the relevant MCB of ACB controller 1		
4	Close the relevant MCB of ACB controller 2		
5	Closed RMU related MCB		
6	Closed MVS measurement and control MCB		
7	Closed the meter MCB		
8	Closed lighting MCB		
9	Close the MCB of SCU3000A		

10	<p>Power on the SCU3000A and connect it to the computer. Open the website to display the commissioning interface and check that all signals are normal; If it is abnormal, please record the phenomenon and contact relevant personnel.</p> <p>Please note that the door of the distribution room should be open, so a "door open" warning should appear. Operate the travel switch of the distribution room door and check if the interface alarm disappears.</p>		
11	Remote control operation G2 breaker to open and close 5 times each		
12	Remote control operation 1QF opening and closing 5 times each		
13	Remote control operation 2QF (ACB-2) opening and closing 5 times each		
14	Disconnect all MCBs of the devices in sequence, turn off UPS, disconnect all test cables, and remove all external power sources.		
15	Test completed		

4.2.4. Hot Commission Readiness Setting

NOTICE

It is recommended that cold and hot commission should be performed within a one month interval, and follow the steps below for the commissioning; Otherwise, all MCCBs, MCBs, FUSES in the LV cabinet and P room will be disconnected.

Step	Operation	Yes/No	Note	Step
1	LV cabinet	Disconnect all MCCBs and ACBs		
		Switch the ACB "Remote/Local" switch to "Local"		
		Close FUSE and open all MCBs		
2	Internal operation of P room distribution container	Close all FUSE		
		Open all other MCBs		
4	RMU	Close the G1 incoming cabinet door		
		Close the G1 earthing switch (if G1: C)		
		Disconnect the G2 vacuum circuit breaker		
		Disconnect the G2 three position disconnecter		
		Close the G2 earthing switch		
		Close G3 earthing switch (If RMU: CV/DV, without G3)		
5	RMU Remote/Local switch	Disconnect G3 load switch (If RMU: CV/DV, without G3)		
		Switch "Remote/Local" switch to "Local"		

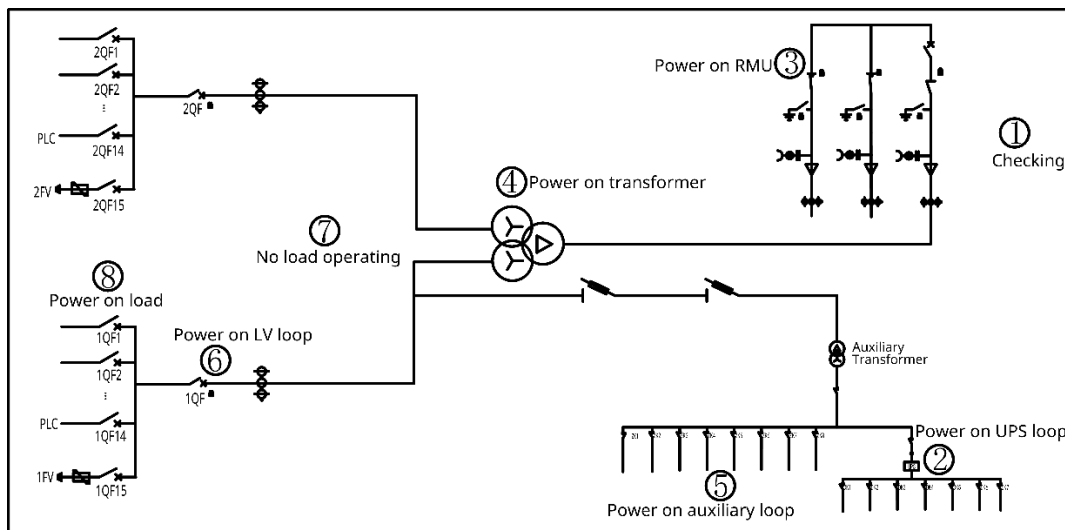
4.3. Hot Commissioning

NOTICE

- Special protective equipment must be used during the operation, such as wearing protective clothing, insulated boots, wearing face protection helmets, insulated gloves, etc.
- It is necessary to set up the parameters correctly by professional personnel for the first running of the equipment. Incorrect settings may cause the non-compliance of the grid connection requirements of the country/region, affecting the normal operation of the device.
- The operation inside the MVS must be carried out by professional operation and maintenance personnel. Non-professional operation and maintenance personnel are prohibited from operating to avoid personal injury caused by improper operation.
- Before powering on, please ensure that the MVS is securely installed, all internal components have been installed, and all inspections before powering on have been completed.
- If any abnormalities is found during the operation, please stop any operation immediately and continue the operation only after the abnormalities are resolved.
- Before powering on, insulation pads should be laid under the feet of the work area.
- The document takes the connection of three MVSs as an example to introduce the power-on operation.

4.3.1. Pre-hot Commissioning Inspection Program

The steps for hot commissioning are as shown in the Figure table.

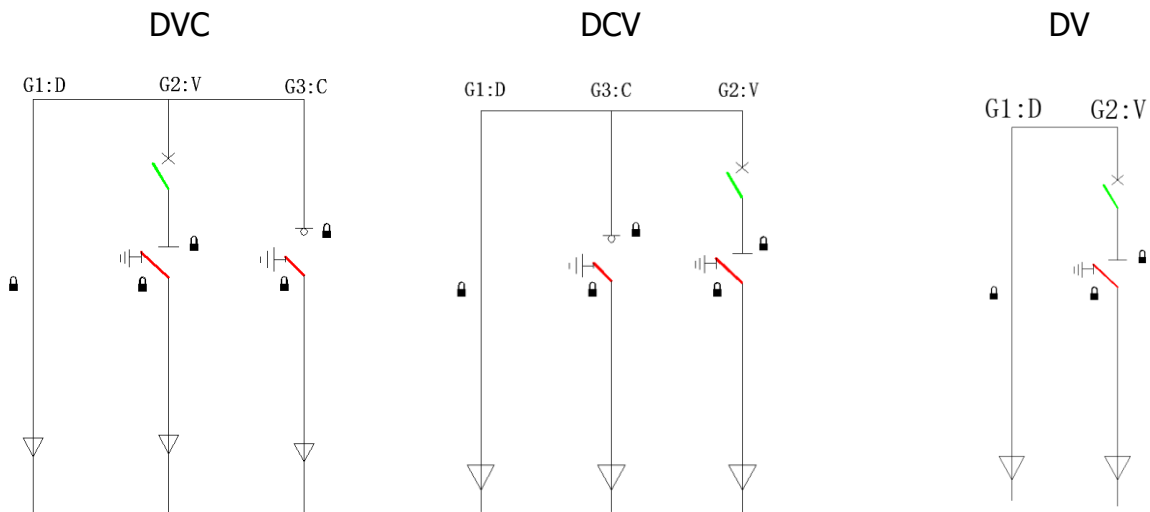


Steps	Item	Yes/No	Note
1	4.3.1 Pre-hot commissioning inspection-check the ring main unit, transformer, and boosting station		
2	4.3.2 UPS circuit power-on—power on the protection equipment of the MVS		
3	4.3.3 RMU power-on—Ring main unit		
4	4.3.4 Transformer power-on—Impulse once		
5	4.3.5 Auxiliary circuit power-on—Power on the internal equipment of the MVS		
6	4.3.6 LV circuit power-on—Power on the air circuit breaker.		
7	4.3.7 No-load operation—24 hours.		
8	4.3.8 Operation with load—the inverter connected to the MVS.		

4.3.1.1. Inspection of the Ring Main Unit (DVC/DCV/DV)

Steps	Operation	Yes/No	Note
Transformer	Check that both transformer doors are closed and the door keys are placed in the key container in the MV room.		
MVS 3 (DV)	Check that the G2 earthing switch is closed, the three position disconnector is open, and the vacuum circuit breaker is open. The live display is off.		
MVS 2	Check that the G3 earthing switch is closed and the load switch is open.		
	Check that the G2 earthing switch is closed, the three position disconnector is open, and the vacuum circuit breaker is open. The live display is off.		
MVS 1	Check that the G3 earthing switch is closed and the load switch is open.		
	Check that the G2 earthing switch is closed, the three position disconnector is open, and the vacuum circuit breaker is open. The live display is off.		
Step-up substation	Check that the earthing switch is closed, the three position disconnector is open, and the vacuum circuit breaker is open.		

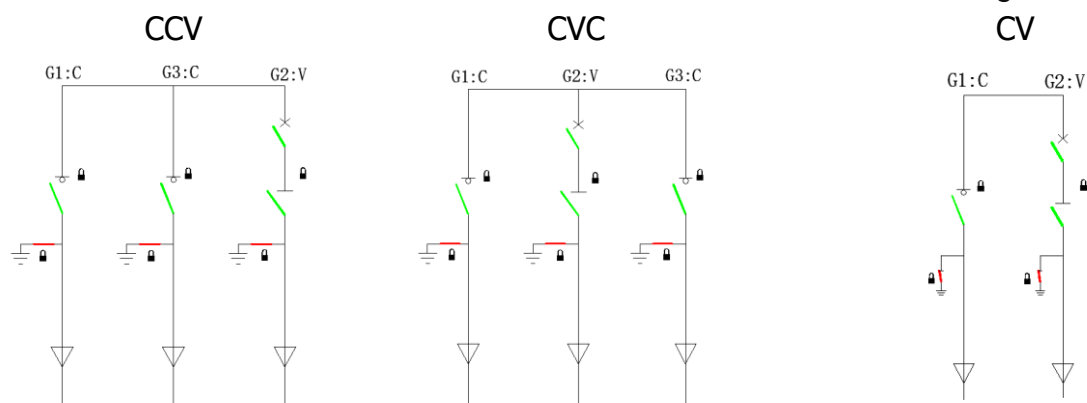
Check that the switch status of the RMU matches the status in the figure below:



4.3.1.2. Inspection of the Ring Main Unit (CCV/CVC/CV)

Steps	Operation	Yes/No	Note
Transformer	Check that both transformer doors are closed and the door keys are placed in the key container of the MV room.		
MVS 3 (CV)	Check that the G2 earthing switch is closed, the three position disconnecter is open, and the vacuum circuit breaker is open. The live display is off.		
	Check that the G1 load switch is open and the earthing switch is closed.		
MVS 2	Check that the G3 earthing switch is closed and the load switch is open.		
	Check that the G2 earthing switch is closed, the three position disconnecter is open, and the vacuum circuit breaker is open. The live display is off.		
	Check that the G1 load switch is open and the earthing switch is closed.		
MVS 1	Check that the G3 earthing switch is closed and the load switch is open.		
	Check that the G2 earthing switch is closed, the three position disconnecter is open, and the vacuum circuit breaker is open. The live display is off.		
	Check that the G1 load switch is open and the earthing switch is closed.		
Step-up substation	Check that the earthing switch is closed, the three position disconnecter is open, and the vacuum circuit breaker is open.		

Check that the switch status of the RMU matches the status in the figure below:



4.3.2. UPS Circuit Power-On

Turn on the UPS, close all switches downstream of the UPS, and ensure that the following devices are operating normally.

Steps	Operation	Phenomenon	Yes/No	Note
1	Close the relevant MCB of ACB controller 1	The device display shows values		
2	Close the relevant MCB of ACB controller 2	The device display shows values		
3	Closed RMU related MCB	Relay protection enabled		
4	Closed MVS measurement and control MCB	Device turned on		
5	Closed meter MCB	Device turned on		
6	Closed lighting MCB	The light is always on		
7	Close the MCB of SCU3000A	nothing		

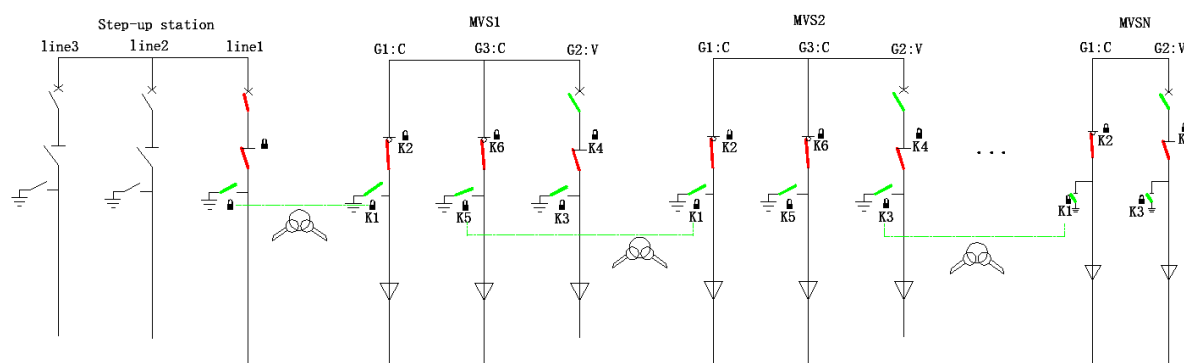
4.3.3. RMU Power-On

4.3.3.1. Power On the Ring Main Unit (CCV/CVC/CV)

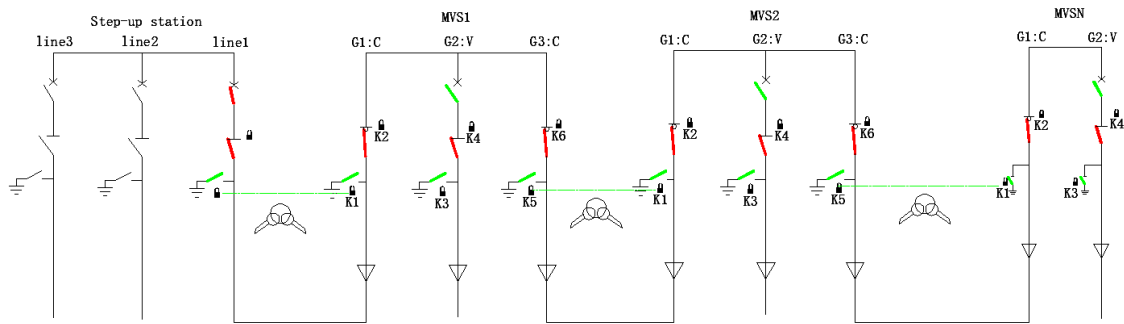
Steps	Operation	Yes/No	Note
MVS 3(CV)	For G2, close the three position disconnector after inserting the key and unlocking it.		
	For G1, open the earthing switch after inserting the key and unlocking it, and close the load switch.		
MVS 2	For G3, open the earthing switch after inserting the key and unlocking it, and close the load switch.		
	For G2, open the earthing switch after inserting the key and unlocking it, and close the three position disconnector.		
	For G1, open the earthing switch after inserting the key and unlocking it, and close the load switch.		
MVS 1	For G3, open the earthing switch after inserting the key and unlocking it, and close the load switch.		
	For G2, open the earthing switch after inserting the key and unlocking it, and close the three position disconnector.		
	For G1, open the earthing switch after inserting the key and unlocking it, and close the load switch.		
Step-up substation	Open the earthing switch after inserting the key and unlocking it, and close the three position disconnector.		
	Close the breaker		

Check that the switch status of RMU matches the status shown in figure below:

CCV+CV



CVC+CV



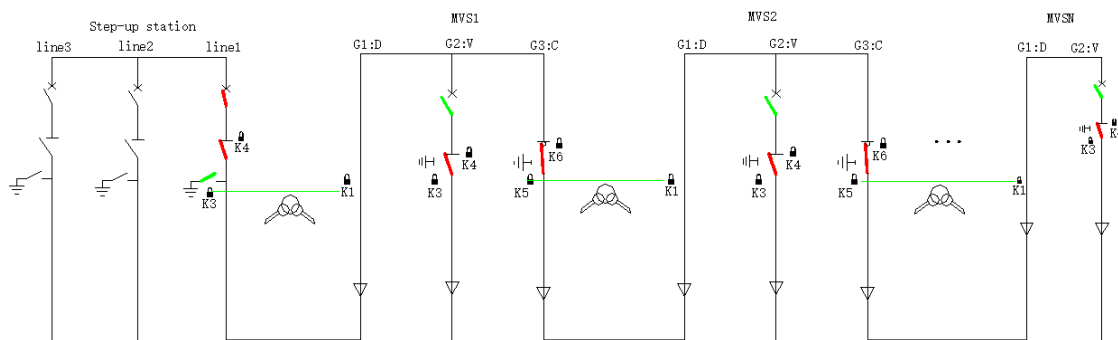
4.3.3.2. Power On the Ring Main Unit (DVC/DCV/DV)

For G2, close the three position disconnector after inserting the key and unlocking it.

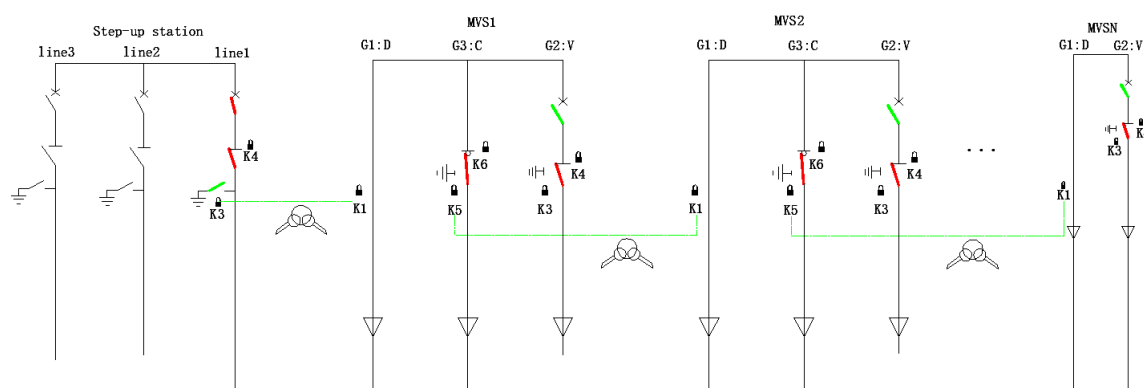
Steps	Operation	Yes/No	Note
MVS 3(DV)	For G2, close the three position disconnector after inserting the key and unlocking it.		
MVS 2	For G3, open the earthing switch after inserting the key and unlocking it, and close the load switch.		
	For G2, open the earthing switch after inserting the key and unlocking it, and close the three position disconnector.		
MVS 1	For G3, open the earthing switch after inserting the key and unlocking it, and close the load switch.		
	For G2, open the earthing switch after inserting the key and unlocking it, and close the three position disconnector.		
Step-up substation	Open the earthing switch after inserting the key and unlocking it, and close the three position disconnector.		
	Close the breaker		

The status of RMU after power on is shown as below:

DVC+DV



DCV+DV



After the RMU is powered on, check the following items:

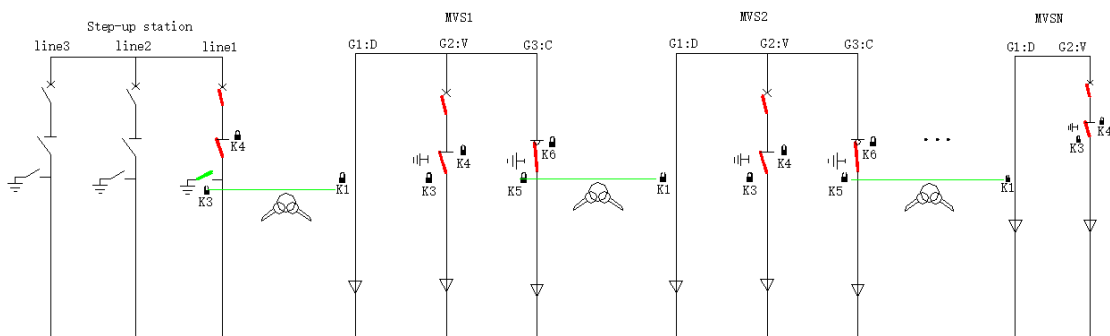
Steps	Operation	Yes/No	Note
MVS 1	The display of G1 cabinet flash.		
	The display of G2 cabinet is powered off.		
	The display of G3 cabinet flash.		
MVS 2	The display of G1 cabinet flash.		
	The display of G2 cabinet is powered off.		
	The display of G3 cabinet flash		
MVS 3 (CV or DV)	The display of G1 cabinet flash.		
	The display of G2 cabinet is powered off.		

4.3.4. Power On the Transformer

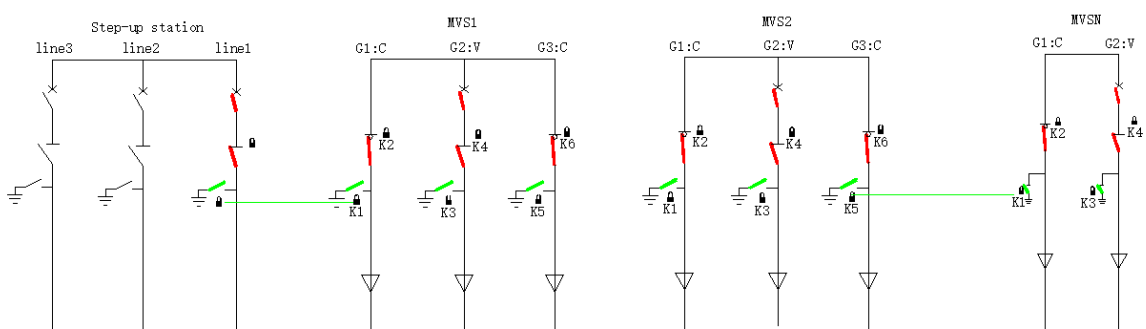
Steps	Operation	Yes/No	Note
MVS 1	Store energy to the vacuum circuit breaker in G2 manually or electrically.		
	Close the vacuum circuit breaker in G2		
	Check if RMU is running		
	Check if the transformer is running		
MVS 2	Store energy to the vacuum circuit breaker in G2 manually or electrically.		
	Close the vacuum circuit breaker in G2		
	Check if RMU is running		
	Check if the transformer is running		
MVS 3	Store energy to the vacuum circuit breaker in G2 manually or electrically.		
	Close the vacuum circuit breaker in G2		
	Check if RMU is running		
	Check if the transformer is running		

The status of transformer after power on is shown as below:

DVC+DV



CVC+CV



4.3.5. Power on the Auxiliary Circuit

Close all micro breaker in the P cabinet to ensure that the following equipment is operating properly.

Steps	Operation	Yes/No	Note
1	Heat exchanger		
2	Temperature and humidity controller		
3	Air-conditioning		
4	P1 socket		
5	P2 socket		

4.3.6. Power on the LV Circuit

Steps	Operation	Yes/No	Note
ACB unlocking	Take out the low-voltage room key chains K4&K14 from the G2 cabinet of the RMU after closing the three position disconnecter of the ring main unit, place the key K14 in the low-voltage room key container, and turn the key to unlock it.		
	Take out the 1QF key K12 from the LV room key container, insert the key into the 1QF (ACB-1) hole, and rotate to unlock it.		
	Take out the key K13 of 2QF from the key container in the LV room, insert the key into the hole of 2QF (ACB-2), and rotate it to unlock.		
LV cabinet	Set "Remote/Local" of ACB to "Local".		
	Press the "ON" button and the circuit breaker closed.		
	Set "Remote/Local" of ACB to "Remote".		

4.3.7. Running without Load

Steps	Operation	Yes/No	Note
1	When the above steps are completed, close all doors		
2	Keep the MVS running without load for 24 hours (recommended 24 hours, the specific time is subject to the project)		
3	After no-load running without abnormality or failure, open the container door and proceed to the next step.		

4.3.8. Running with Load

Steps	Operation	Yes/No	Note
Power on the inverter	Close all MCCBs in the low voltage cabinet.		
	Start the inverter to output current without alarm.		
Check the operating status of the MVS	Check the current value and ACB current value of the multi-function meter of the LV cabinet.		
	Check the current value displayed in the "Relay Protection" of the ring main unit.		
	Check the current, voltage, active power and reactive power of the measuring and controlling device.		
	Check if there is an alert.		

5. Routine maintenance

The components inside the MVS may age and wear out due to the influence of ambient temperature, humidity, dust, vibration, etc., leading to potential failures. Therefore, it is necessary to perform daily and regular maintenance to ensure normal operation and to extend service life. All measures and methods that help keep the MVS in good working condition belong to the scope of maintenance.

5.1. Precautions

DANGER

- Please wear insulating gloves and use insulating tools to avoid electric shock or short circuit failure.
- Do not use a wet rag to clean exposed copper bars or other potentially conductive parts.

WARNING

- There is fatal high voltage in the equipment which may cause fatal electric shock if touched accidentally. After the equipment has been shutdown, please wait at least 10 minutes before opening doors. Before maintaining, make sure that the equipment is completely neutral.
- Only qualified and authorized personnel can perform maintenance and other operations on the MVS.
- When maintaining work, do not leave screws, washers and other metal parts in the MVS, otherwise the equipment may be damaged.
- The entry of sand and moisture may damage the electrical equipment in the MVS or affect the performance of the equipment.
- Do not open the cabinet doors in the MVS during sandstorm season or when the relative humidity is greater than 95%.
- Maintenance work only be done when there is no wind and sand and the weather is clear and dry.
- If only turn off switches of the AC side, LV side and high-voltage side, terminals inside the MVS are still live! To avoid the risk of electric shock, before maintenance, inspection and other operations, please:
 - 1) turn off all internal switches.
 - 2) turn off all the switches of the front and rear level equipment of the MVS.
 - 3) if there are live objects nearby, please use insulating boards or tapes to shield or wrap them.
- Use a grounding cable to connect the circuit to be inspected and the main grounding circuit before performing operation and maintenance.

NOTICE

- Please maintain the equipment only when you are familiar with the contents of this manual and have appropriate tools and testing devices.
- During the maintenance process, please try to prevent irrelevant personnel from entering, and temporary warning signs or fences must be erected for isolation.
- If the equipment fails, please contact your dealer.
- The equipment can only be powered on again after the fault has been resolved, otherwise the fault may expand and damage the equipment.
- After the maintenance is completed, remove the ground cable between the maintained circuit and the main ground circuit.

5.2. Power off and Shut down for Maintenance**5.2.1. Transformer**

This section takes the ring main unit DVC as an example (the model of the ring main unit does not affect the power-off steps of the transformer) to introduce the power-off steps for transformer maintenance. The switch status before maintenance:

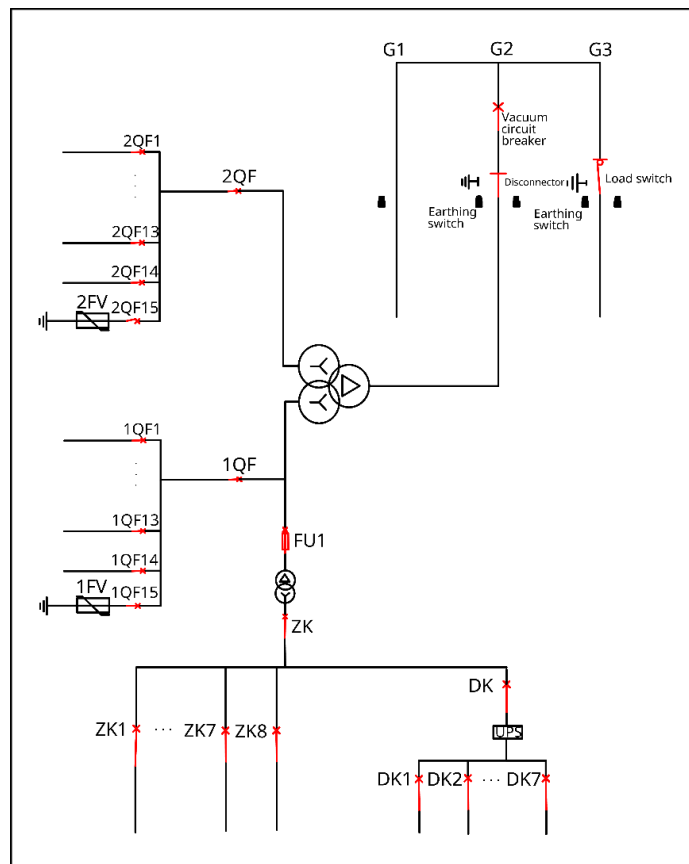


Figure 5-1 The switch status before maintenance

Steps	Operation	Yes/No	Note
1	Remote control opening LV cabinet 1QF air circuit breaker		
2	Remote control opening LV cabinet 2QF air circuit breaker		
3	Remote control opening ring main unit G2 cabinet vacuum circuit breaker.		
4	Manually open the three position disconnector of the ring main unit G2 on site and confirm that the live display is off.		
5	Manually close the grounding knife of the G2 cabinet, padlock the grounding knife operating hole, and install a prohibited operation sign.		
6	Manually open all incoming MCCBs and use grounding cable to discharge the low-voltage cabinet busbars.		

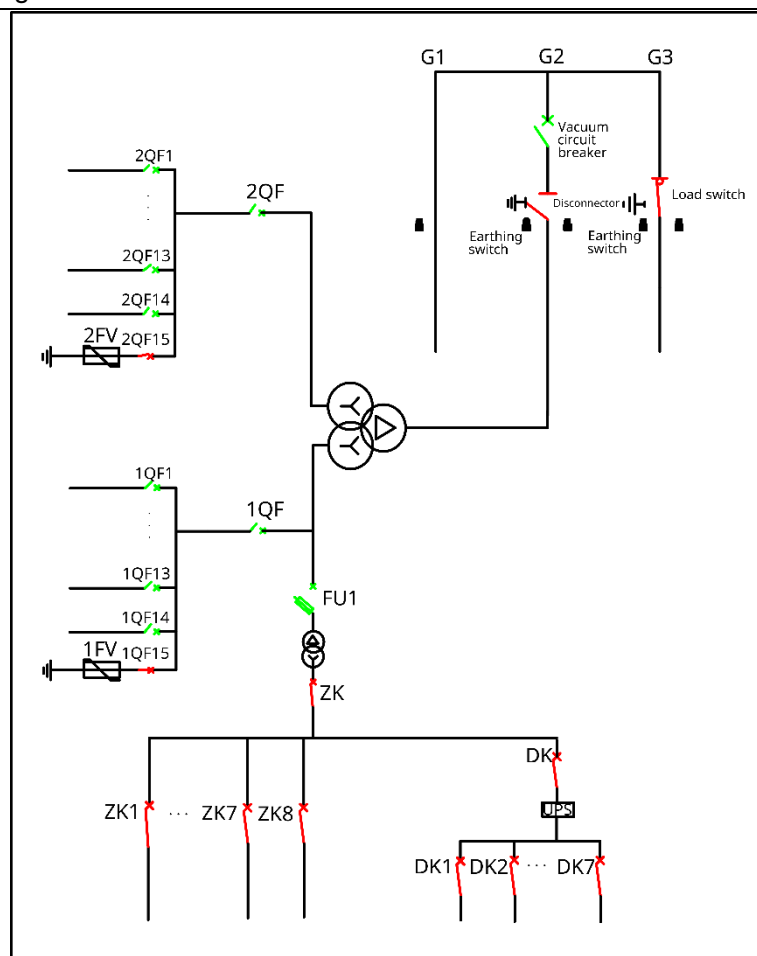


Figure 5-2 The switch status after maintenance

5.2.2. Ring Main Unit

This section takes the second MVS (MVS 2) as an example to introduce the power off and maintenance procedures of the ring main unit. The operation steps of DCV and CVC are the same.

The switch status before maintenance:

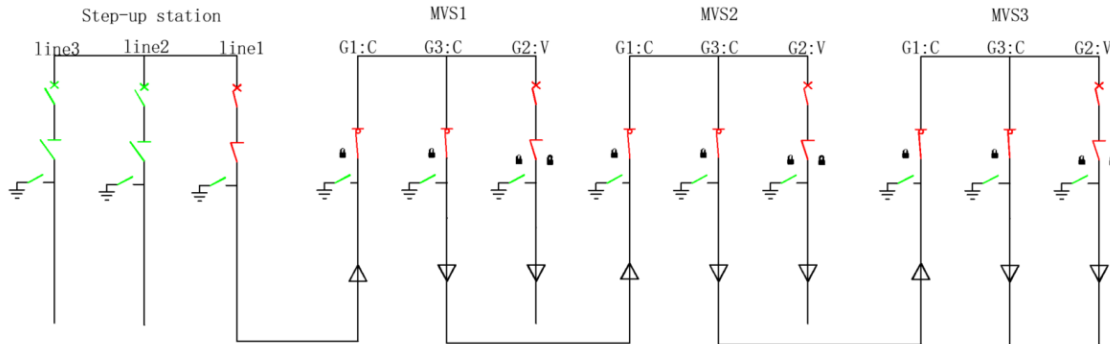


Figure 5-3 The switch status before maintenance:

Steps	Operation	Yes/No	Note
1	Remote control the opening of this level LV cabinet 1QF air circuit breaker.		
2	Remote control the opening of this level LV cabinet 2QF air circuit breaker.		
3	G2 cabinet of this level: opening vacuum circuit breaker, opening three position disconnector, closing earthing switch.		
4	Remote control the opening of the next level LV cabinet 1QF air circuit breaker.		
5	Remote control the opening of the next level LV cabinet 22QF air circuit breaker.		
6	All G2 cabinet of the next level: opening vacuum circuit breaker, opening three position disconnector, closing earthing switch, and confirm that the live display is off.		
7	The upper lever G3 cabinet: open the load switch, observe that the live display of G3 cabinet is off, and close the earthing switch. Install prohibited operation signs.		
8	The main circuit of the ring main unit 2 of the MVS has been powered off and safety measures have been taken, and maintenance can be carried out.		

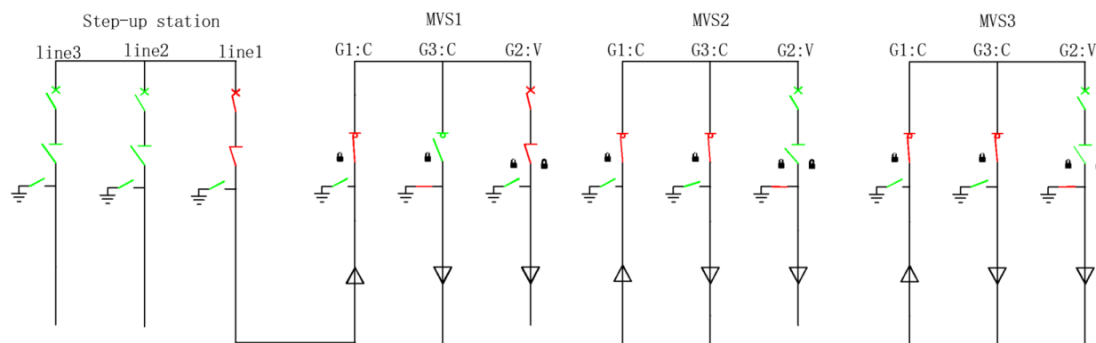


Figure 5-4 the switch status after maintenance

5.2.3. Cables between Ring Main Units

This section takes the second MVS (MVS 2) as an example, and take the MVS 1 and MVS 2 as an example to introduce the power off and maintenance procedures between MVSs.

5.2.3.1. Ring main unit G1 is cabinet C

The switch status before maintenance:

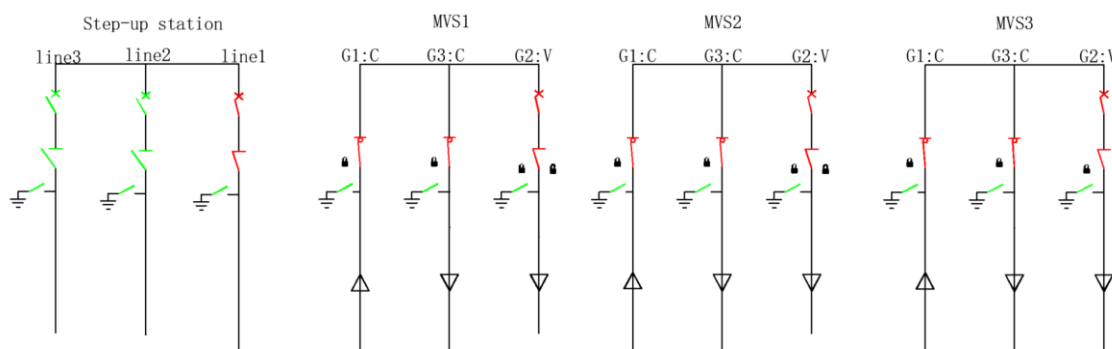


Figure 5-5 the switch status before maintenance

Steps	Operation	Yes/No	Note
1	Remote control the opening of this level LV cabinet 1QF air circuit breaker.		
2	Remote control the opening of this level LV cabinet 2QF air circuit breaker.		
3	G2 cabinet of this level: opening vacuum circuit breaker, opening three position disconnector, closing earthing switch.		
4	Remote control the opening of the next level LV cabinet 1QF air circuit breaker.		
5	Remote control the opening of the next level LV cabinet 2QF air circuit breaker.		
6	All the G2 cabinet of the next level: opening vacuum circuit breaker, opening three position disconnector, closing earthing switch.		

7	The upper lever G3 cabinet: open the load switch, observe that the live display of G3 cabinet is not flashing, and close the earthing switch. Install prohibited operation signs.		
8	This lever G1 cabinet: open the load switch, observe that the live display of G1 cabinet is not flashing, and close the earthing switch. Install prohibited operation signs.		
9	Both ends of the cable between the MVS 1 and the MVS 2 have been grounded and safety measures have been taken, and the cable room doors at both ends of the cable have been unlocked and can be inspected.		

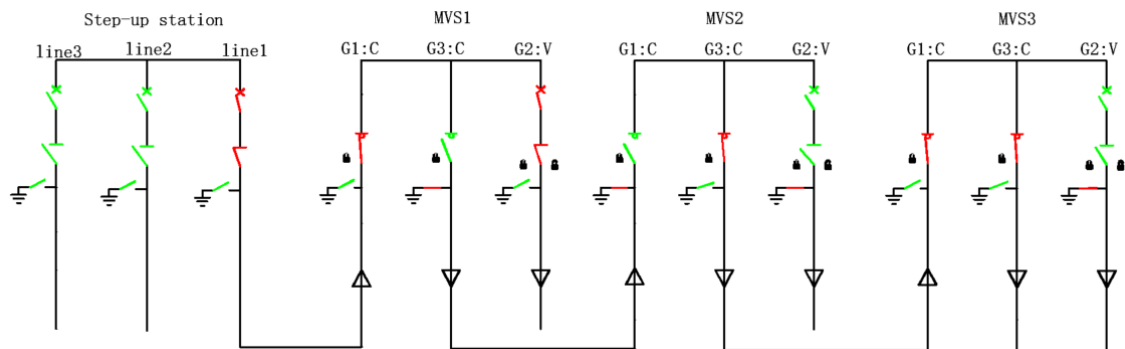


Figure 5-6 The switch status after maintenance

5.2.3.2. Ring main unit G1 is Cabinet D

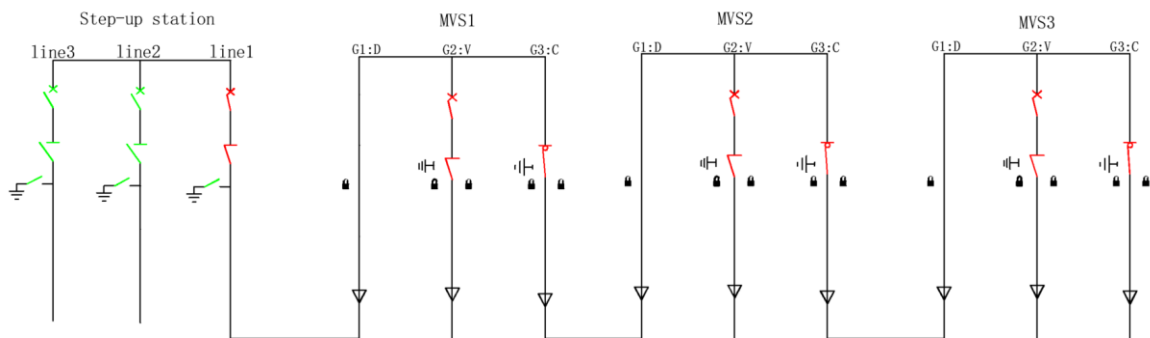


Figure 5-7 The switch status before maintenance

Steps	Operation	Yes/No	Note
1	Remote control the opening of this level LV cabinet 1QF air circuit breaker.		
2	Remote control the opening of this level LV cabinet 2QF air circuit breaker.		
3	G2 cabinet of this level: opening vacuum circuit breaker, opening three position disconnector, closing earthing switch.		
4	Remote control the opening of all the next level LV cabinet 1QF air circuit breaker.		
5	Remote control the opening of all the next level LV cabinet 2QF air circuit breaker.		
6	All the G2 cabinet of the next level: opening vacuum circuit breaker, opening three position disconnector, closing earthing switch.		
7	The upper lever G3 cabinet: open the load switch, observe that the live display of G3 cabinet is not flashing, and close the earthing switch. Install prohibited operation signs.		
8	Both ends of the cable between the MVS 1 and the MVS 2 have been grounded and safety measures have been taken, and the cable room doors at both ends of the cable have been unlocked and can be inspected.		

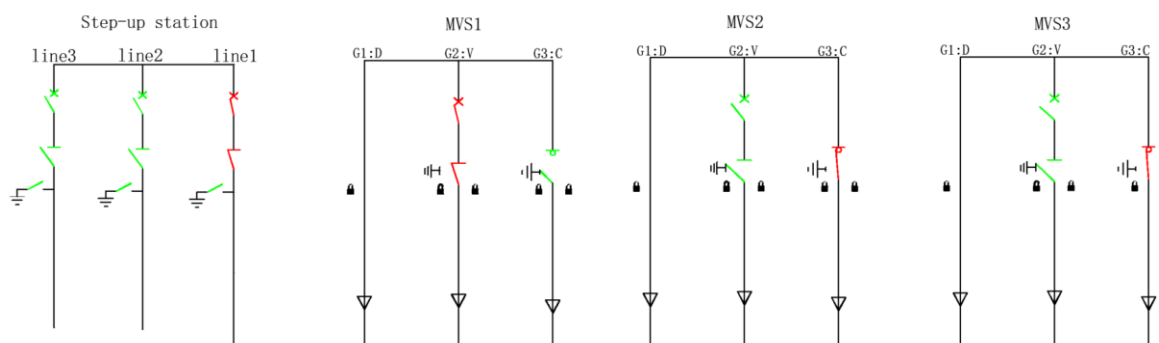


Figure 5-8 the switch status after maintenance

5.3. Routine maintenance

Routine inspection and maintenance must comply with the relevant regulations of the power company. Inspection, maintenance and repairs can only be performed by trained personnel who are familiar with the equipment. Personnel must be certified and comply with safety regulations issued by the power company.

Inspection item	Inspection method	Period
System Status and Cleaning	Check whether the MVS and internal equipment are damaged or deformed.	Once a month
	Check whether there is abnormal noise during the operation of the internal equipment.	
	Check whether the temperature inside the MVS is too high.	
	Check that warning signs, labels, etc. are clearly visible and not defaced. Replace them if necessary.	
	Check whether the humidity is too high and dust too series, and clean the equipment if necessary.	
	Check whether there is oxidation or corrosion inside the MVS. If present, arrange a rust removal.	
Fan / heat exchanger / air condition	Clean or replace the dust filter.	Once every half a year after the first commissioning, and once every half a year, once a year thereafter
	Check the operating status of the fan/heat exchanger.	
	Check whether the fan / heat exchanger makes abnormal sound during operation	
Cable connection	Check whether the power cable is loose. If it is loose, tighten it according to the torque specified in the manual.	Once every half a year after the first commissioning and once every two years thereafter
	Check whether the power cables and control cables are damaged, especially whether the layer in contact with the metal surface has any signs of cuts.	
	Check whether the insulating wrapping tape of the power cable terminal is peeled off	
MV ring main unit	Check the SF6 barometer to see if the pointer is within the green range. If the pointer approaches red, please stop the operation and replenish gas to it.	Once a month
	Check the live indicator and check whether the L1 / L2 / L3 indicator is normal. If it is abnormal, please replace the L1/L2/L3 indicator lights when the power is off.	
	Conduct a manual operation test on the operating mechanism to check the flexibility. If it is hard to close or open, please repair in time.	Once a year

Transformer	During operation, check whether the sound of the transformer is normal.	Once a month
	Check the transformer oil level indicator. If the oil level is low, please power off the MVS and fill in oil in time	
	Check whether there is oil leakage around the pressure relief valve. If yes, tighten the valve or replace parts.	
	Check the sheath of LV cabinet and HV cabinet to see if there is oil leakage. If yes, tighten the valve or replace parts.	
	Check whether there is oil leakage at the joint between the transformer heat sink and the oil tank flange. If yes, please tighten the valve or replace parts in time.	
	Check whether the real-time temperature of the oil thermometer is normal. If abnormal, measure the resistance of PT1/PT2 and PT3 with a multimeter. If the result is unqualified, it means that the temperature gauge is faulty and needs to be repaired in time.	
	Clean the surface of the transformer oil tank, oil pillow, chips and other parts, and tighten the bolts such as the foundation, grounding and main circuit.	
LV cabinet	Check whether the lightning arrester indicator is normal (green) or faulty (red).	Once a month
	Check for condensation on interior side panels and top cover	
	Check whether the indication of voltage, current meter and opening and closing indicator light in LV incoming cabinet are normal. If abnormal, it needs to be replaced in time.	
	Conduct closing and opening experiments on the LV cabinet ACB.	Once half a year
Carry out a leakage test on the residual current circuit breaker, and press the test button to make the circuit breaker operate to check whether the circuit breaker is normal.		
Other equipments	Replace damaged lamps promptly.	When necessary
	Replace damaged smoke sensors and fire extinguishers promptly	
	Replace the temperature and humidity controller in time.	

5.4. Common parts replacement

5.4.1. Replacement of Arrester

NOTICE

Do not replace the arrester on rainy days.

Replacement steps (see the arrester user manual for details):

1. The arrester is located in the cable room of the circuit breaker cabinet of the ring main unit. Open the cable room door and you will see it.
2. Loosen the fixing bracket of the arrester to be replaced (M10 external hexagonal bolt)
3. Remove the grounding cable of the arrester to be replaced.
4. Remove the insulation cap and insulation plug of the arrester.
5. Remove the nut (M12 nut) on the conductive rod assembly.
6. Pull out the arrester.
7. Remove the conductive rod assembly and replace it with a new one (10mm wrench).
9. Install a new lightning arrester
10. Fasten the nut of the conductive rod assembly (M12 nut)
11. Install insulation plugs and rubber caps
12. Reinstall the grounding cable.
13. Fasten the fixed bracket of the arrester.

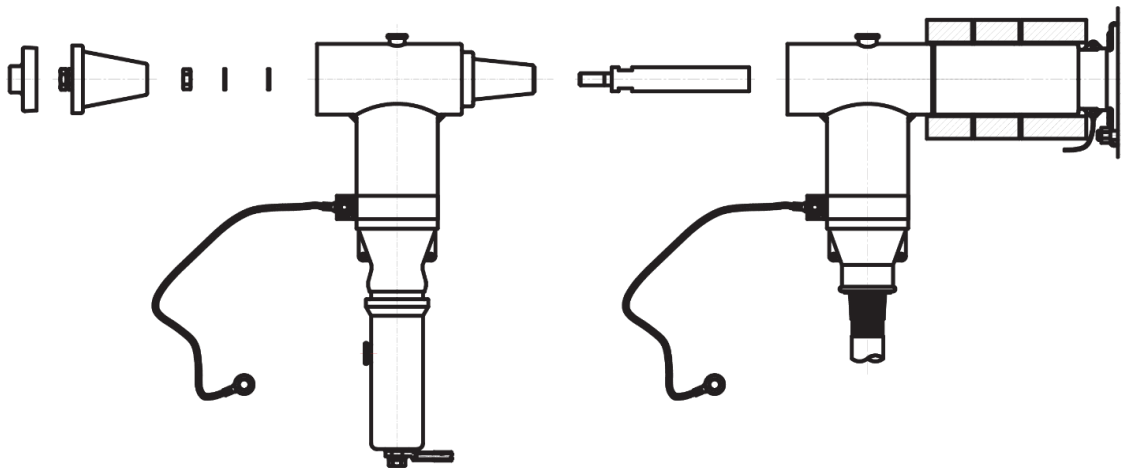


Figure 5-9 Lightning arrester and separable insulating sleeve

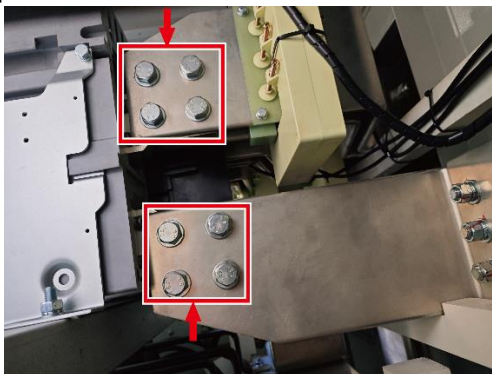
5.4.2. Replacement of Air Circuit Breakers

NOTICE

Make sure the equipment is powered off and the air circuit breaker is in the "OFF" position

Steps:

- 1) Remove the copper bar at the back of the ACB.



- 2) Remove the signal cable and grounding cable of the air circuit breaker and mark them.



- 3) Remove the fixing bolts between the ACB and basement (M10 external hexagonal bolts).



- 4) Replace with a new air circuit breaker and tighten the bottom fixing bolts.
- 5) Reinstall the copper bar, signal cable and grounding cable, and tighten the fixing bolts of the air circuit breaker base.

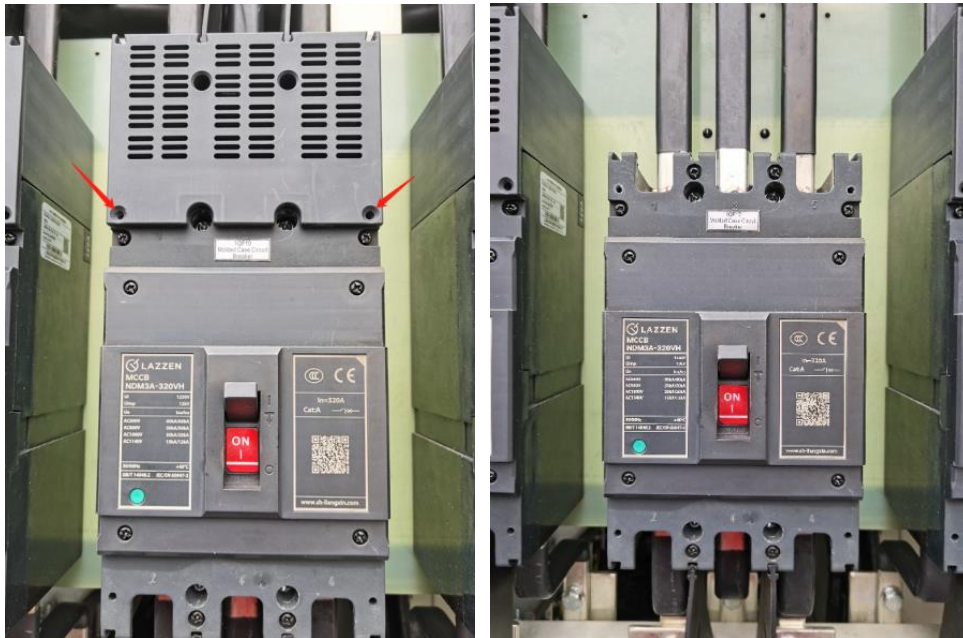
5.4.3. Replacement of Molded Case Circuit Breakers

NOTICE

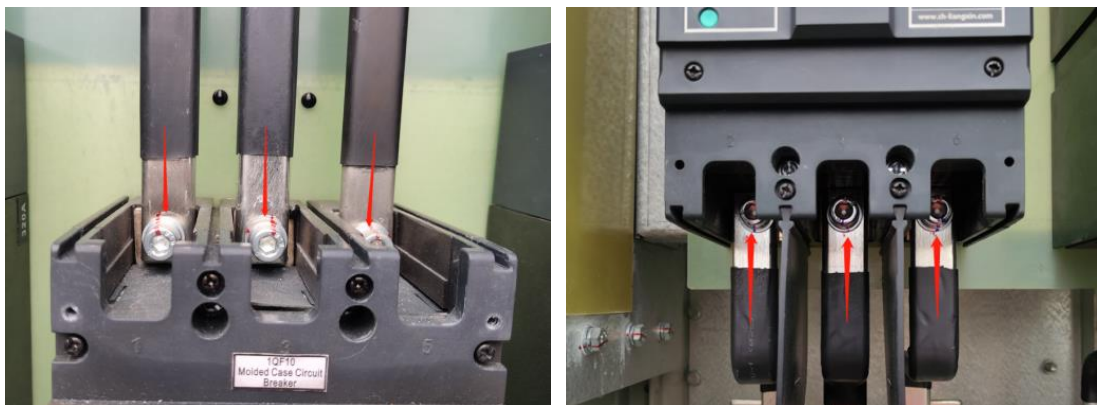
- If need replacement, please contact Goodwe after-sales service or local Goodwe staff according to the spare parts list.
- If the short-circuit fault current \leq ICU (ultimate short-circuit breaking capacity), after one short-circuit fault occurs, the circuit breaker needs to be replaced.
- If the short-circuit fault current \leq ICS (operational short-circuit breaking capacity), the circuit breaker needs to be replaced after three short-circuit faults.
- Make sure the equipment is powered off and the breaker is in the "OFF" position.

Steps:

- 1) Remove the upper cover of the MCCB.



- 2) Remove the copper bars and cables connected to the upper and lower ends of the molded case circuit breaker.



- 3) Remove the fixing bolts of the molded case circuit breaker and remove the molded case circuit breaker.



- 4) Replace with a new molded case circuit breaker and fix the circuit breaker on the support plate and tighten it.
- 5) Restore the removed copper bars and cables to their original state.
- 6) Install the upper cover of the molded case circuit breaker.

5.4.4. Oil surface temperature gauge replacement

Operational steps:

5.4.4.1 Disassemble the probe of the oil surface temperature gauge

Loosen the transition nut with a wrench, remove the probe, and promptly clean the transformer oil drips on the probe during removal by wiping and cleaning.

5.4.4.2 Remove the oil surface temperature gauge cover

Rotate the oil surface temperature gauge cover counterclockwise slowly, then lift it off.

5.4.4.3 Remove the connection wires of the oil surface temperature gauge

5.4.4.3.1 Lift the cover plate at the bottom of the oil surface temperature gauge, take a photo to record the wiring positions before disconnecting.

5.4.4.3.2 Use a screwdriver to unscrew the corresponding screws, then pull the connection wires out from the bottom outlet of the oil surface temperature gauge, ensuring that the digital display tube does not fall off during the extraction process.

5.4.4.4 Remove the oil surface temperature gauge

Use a screwdriver to remove the screws that secure the oil surface temperature gauge in place.

5.4.4.5 Replace the oil surface temperature gauge and probe

5.4.4.5.1 Take a qualified oil surface temperature gauge along with the

matching screws. Install the fixing screws of oil surface temperature gauge by following these steps (lightly shake to ensure no looseness): Remove the cover of the oil surface temperature gauge. Lift the bottom cover plate. Insert the wires through the bottom opening. Connect the wires according to the recorded wiring configuration. Secure the connections by gently pulling on the wires to ensure they are snug. Close the bottom cover plate. Replace the temperature gauge cover.

Note: Verify if the temperature settings for the over-temperature alarm and over-temperature trip pointer on the temperature gauge panel comply with the requirements on the blueprint.

5.4.4.5.2 Wrap Teflon tape around the threads of the temperature control probe of the temperature gauge. (Note: Wrap the Teflon tape in a clockwise direction to ensure proper tightening.)

5.4.4.5.3 Refilling oil: Inject transformer oil (same as the oil used for the transformer) into the temperature gauge probe seat. It is necessary to control the amount of oil injected. The standard is to fill just above the position where the probe seat meets the container wall weld seam, as indicated by the arrow. (If the deviation near this position is minimal, oil injection may not be necessary.)

5.4.4.5.4 Coil the excess length of the capillary tube into a circle with a diameter not less than $\Phi 150\text{mm}$. Secure the coiled tube to the base of the temperature gauge using cable ties. Note: During installation, special attention should be paid to protecting the capillary tube of the temperature gauge to prevent it from fracturing due to small bending radii.

5.4.4.5.5 Probe Installation: Insert the PT100 temperature probe of the temperature gauge into the oil surface monitoring hole. Ensure that the probe can enter the base without causing oil spillage. First, tighten the transition nut, adjust the orientation of the sensor leads, wrap the fastening nut with thread seal tape, and then tighten it. Note: Under no circumstances should the indicator pointer be turned counterclockwise, as this can damage the temperature gauge.

5.4.5. Replacement of Micro Circuit Breakers

NOTICE

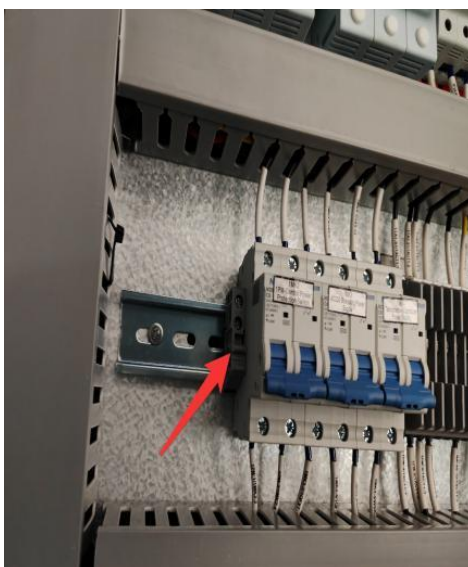
Ensure that the equipment is powered off and place the micro circuit breaker in the "OFF" position

Steps:

- 1) Remove the cables connecting the upper and lower ends of the micro circuit breaker.



- 2) Remove the micro circuit breaker.



- 3) Replace with a new micro circuit breaker and secure it onto the rail.
- 4) Restore the cables connecting the upper and lower ends of the micro circuit breaker to their original state.

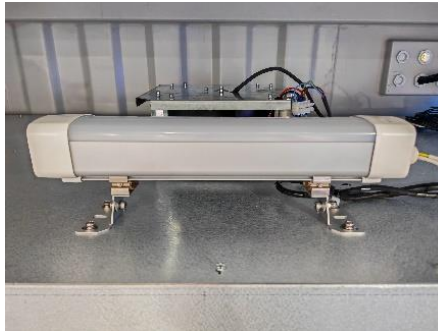
5.4.6. Replacement of lighting lamps

Steps:

1) Remove the cable from the power supply terminal of the lighting lamp and mark it (unscrew the cable terminal cover and press the plastic part as shown in figure with your hand to pull out the cable).



2) Remove the lamp fixing screws (M6 external hexagonal bolts) and remove the lamp.



3) Replace with new lamp and fix it in place.

4) Restore the lamp power supply cable as it is.

5.4.7. Replacement of smoke sensor

Steps:

1) Hold the smoke sensor body and rotate it counterclockwise to separate the card on the sensor from the card fixed on the base as shown in figure. Remove the sensor.



2) Insert the new smoke sensor into the base and rotate it clockwise to the locking position.



5.4.8. Replacement of heater

The heating plate is located under the cable room of the LV cabinet.



Steps:

- 1) Remove the cables on the heating plate and mark them
- 2) Remove the fixing screws of the heating plate (M6 and M4 screws)
- 3) Replace with a new heating plate and secure it
- 4) Restore the heating plate cable to its original status.

5.4.9. Replacement of Measuring and controlling Device

NOTICE

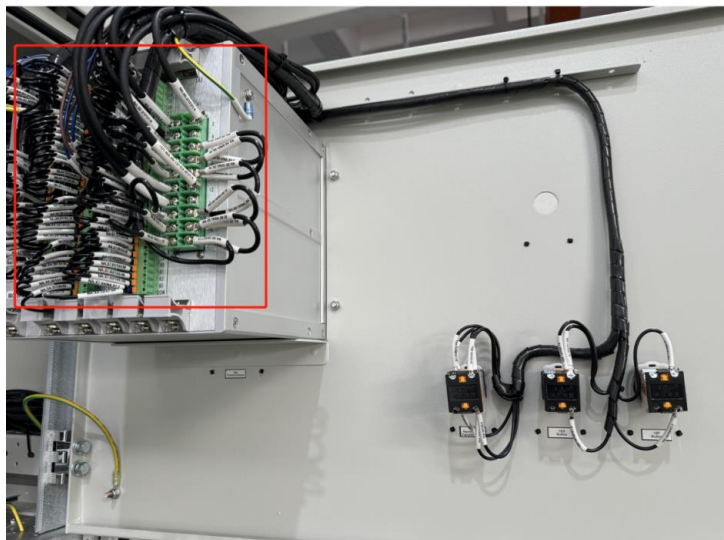
1. Please ensure that the equipment is powered off before replacing the measuring and controlling device.
2. Before replacing the measuring and controlling device, please ensure that the secondary side of the current transformer cannot be open circuited.

Steps:

- 1) The measuring and controlling device is located on the side surface panel of the LV cabinet.



- 2) Open the cabinet where the device is located, remove the cables on the back of the device, and mark the recording location; You can also remove the entire plug-in terminals and install them in the corresponding position of new devices.



- 3) Remove the screws that fix the device, and remove the device (M6 external hexagonal bolts).



- 4) Replace with a device and fix it in its original position.
- 5) Restore the cables on the back of the device to its original status.

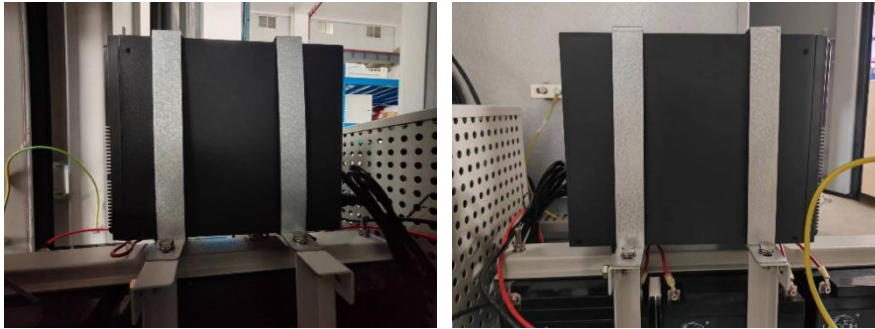
5.4.10. UPS replacement

Steps:

- 1) Remove the cable from the back of the UPS and unplug it.

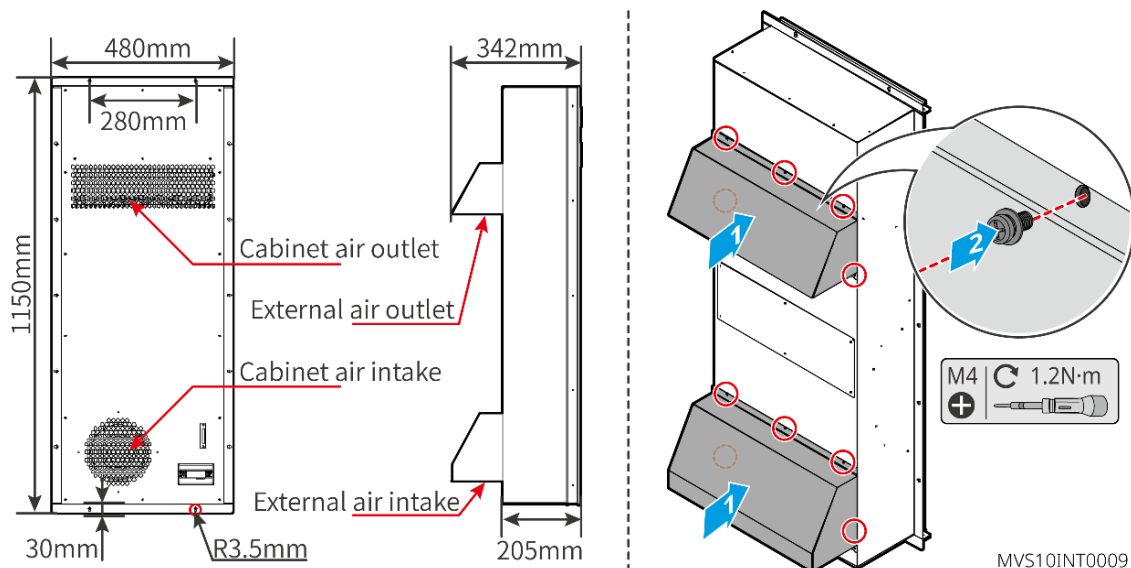


- 2) Remove the UPS fixing bracket and take out the UPS (M8 semi-round head square neck bolt)



- 3) Replace with a new UPS and secure it.
- 4) Restore the cables and plugs on the back of the UPS to the original status.

5.4.11. Replacement of the Heat Exchanger Rain Shield



Step:

- 1) Remove the fixed screws of the heat exchanger rain shield and take off the rain shield (M4 pointed tail self-tapping screws).
- 2) Open the LV room door, remove the cable of the heat exchanger, and mark them properly.
- 3) Remove the fixed screws around the heat exchanger and take off the heat exchanger (M6 external hex bolts).
- 4) Replace with a new heat exchanger and fix it.
- 5) Reinstall the heat exchange upper cable as its original status.
- 6) Reinstall the heat exchange rain shield as its original status.

5.4.12. Replacement of the air conditioner

Steps:

1) Open the door of the power distribution room, remove the cables on the air conditioner, and mark them.



2) Remove a circle of fixing screws around the air conditioner and remove the air conditioner (M5 hexagon socket bolts)



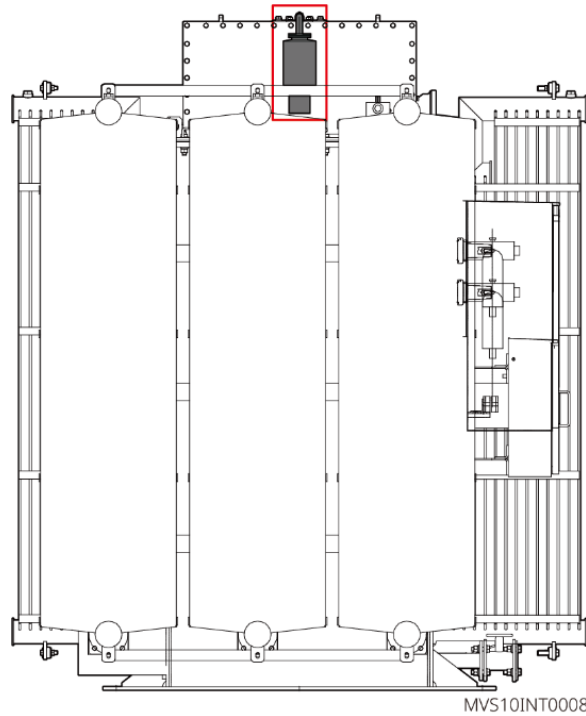
3) Replace with a new air conditioner and fix it.

4) Restore the air conditioning cable to its original status.

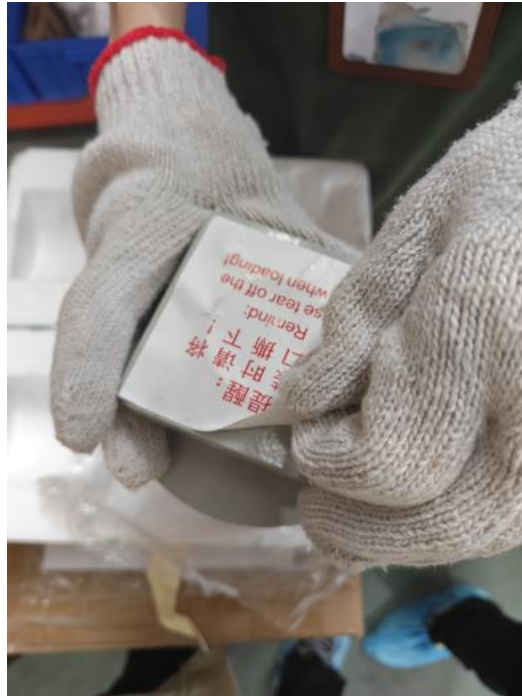
5.4.13. Replacement of the Moisture Absorber

Steps:

- 1) Remove the Moisture Absorber (M12 external hex bolts).



- 2) Tear off the adhesive paper on the breather port.



3) Place a sealing gasket on the breather port.



4) Install the respirator to the breathing tube port, tighten the bolts diagonally, and install the sealing gasket as shown in the following figure.



5) Remove the oil cup and fill the cup with oil level between the two red lines.



6) Install the oil cup.



5.5. Paint repairing

Degree of paint damage	Tools and materials	Steps
Shallow scratches(no exposed steel base material)	Small area paint repairmen: hand spray paint or brush Large area paint repairmen: fine sandpaper, alcohol, cotton cloth, spray gun.	<ol style="list-style-type: none"> 1. Use fine sandpaper to polish the damaged areas and remove stains or rust. 2. Moisten the cotton cloth with alcohol, wipe the polished area or the area to be repaired to remove surface dirt and dust, and then wipe dry with clean cotton cloth. 3. Choose according to the degree of damage, the size of the damaged area of the paint surface, and the existing conditions: Use one of the methods of spray painting, brushing, or spray gun spraying to evenly repair the damaged areas of the coating until no trace of damage to the coating is exposed. 4. The paint film should be as thin and uniform as possible, and the paint film should not be in the shape of droplets, and the surface should be kept smooth; after painting, leave it for about 30 minutes for the paint to solidify.
Stains and rust that cannot be wiped off		
Deep scratches (exposed steel base material)	Small area paint repairmen: hand spray, zinc-rich primer, brush Large area paint repairment: fine sandpaper, alcohol, cotton cloth, spray gun.	<ol style="list-style-type: none"> 1. Same as above step 1 2. Same as above step 2 3. Use paint or a spray gun to touch up the damaged areas with zinc-rich primer. 4. Same as above step 3 5. Same as above step 4

Notes:

- (1) The paint color shall refer to the color number specified in the contract.
- (2) Before paint repairmen, cover other colored parts except damaged paint with tape and white paper to avoid contamination of other parts during the touch-up operation.
- (3) If the base material is exposed in the area to be repaired, you must first apply the epoxy zinc-rich primer until the base material is not exposed after the paint dries, and then apply the topcoat.
- (4) Choose epoxy Zinc-rich primer as the primer, and choose the topcoat according to the color of the surface coating.

6. Technical Parameters

Transformer	GW9100K-MVS
Transformer Type	Oil immersed
Rated Power (kVA)	9152@40°C
Vector Group	Dy11-y11
LV/MV Voltage (kV)	0.8/20~35
Maximum Input Current at Nominal Voltage (A)	2*3302
Frequency (Hz)	50/60
Tapping Range	±2*2.5%
Peak Efficiency Index	≥99%
Cooling Type	ONAN (Oil Natural Air Natural)
Impedance	9.5% (±10%)
Oil Type	Mineral oil (PCB free)
Winding Material	Al/Al
Insulation Class	Class A
MV Switchgear	
Insulation Type	SF6
Rate Voltage (kV)	24~40.5
Rate Current (A)	630
Internal Arcing Fault	IAC AFL 20 kA / 1s
Qty.of Feeder	3 feeders (DCV, Optional: CCV)
Surge Protection	NA
LV Room	
ACB Specification	4000A/800Vac/3P, 2 pcs
MCCB Specification	320A /800Vac/3P, 26 pcs
Protection	
AC Input Protection	Circuit breaker
Transformer Protection	Oil-temperature, oil-level, oil-pressure
LV Overvoltage Protection	AC Type I+II
General Date	
Dimensions (W×H×D mm)	6058*2896*2438
Approximate Weight (t)	<25
Operating Temperature Range (°C)	-25 to 55 (≥40°C derating)
Auxiliary Power Supply	5 kVA/400V (Optional: max. 50kVA)
Ingress Protection Rating	IP54
Relative Humidity	0 - 95 % RH
Max. Operating Altitude (m)	1000 (Optional: 2000)
Anti-corrosion Class	C4H (Optional: C5M)
Noise Emission (dB)	55

Transformer	GW9100K-MVS
Communication	Standard: RS485, Ethernet Optional: Optical Fiber
Compliance	IEC 60076, IEC 62271-200, IEC 62271- 202, IEC 61439-1/2, EN50708-1, CE

7. Appendix

PE	Protecting Earthing
MVS	Medium Voltage Station
O&M	Operations & Maintenance
DC	Direct Current
AC	Alternating Current
MV	Medium Voltage
LV	Low Voltage
RMU	Ring main unit
SPD	Surge Protection Device
UPS	Uninterruptible Power Supply
FU	Fuse
MCCB	Molded Case Circuit Breaker
MCB	Micro Circuit Breaker
ACB	Air Circuit-Breaker
VCB	Vacuum Circuit Breaker
PLC	Power Line Communication
PPE	Personal Protective Equipment



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