

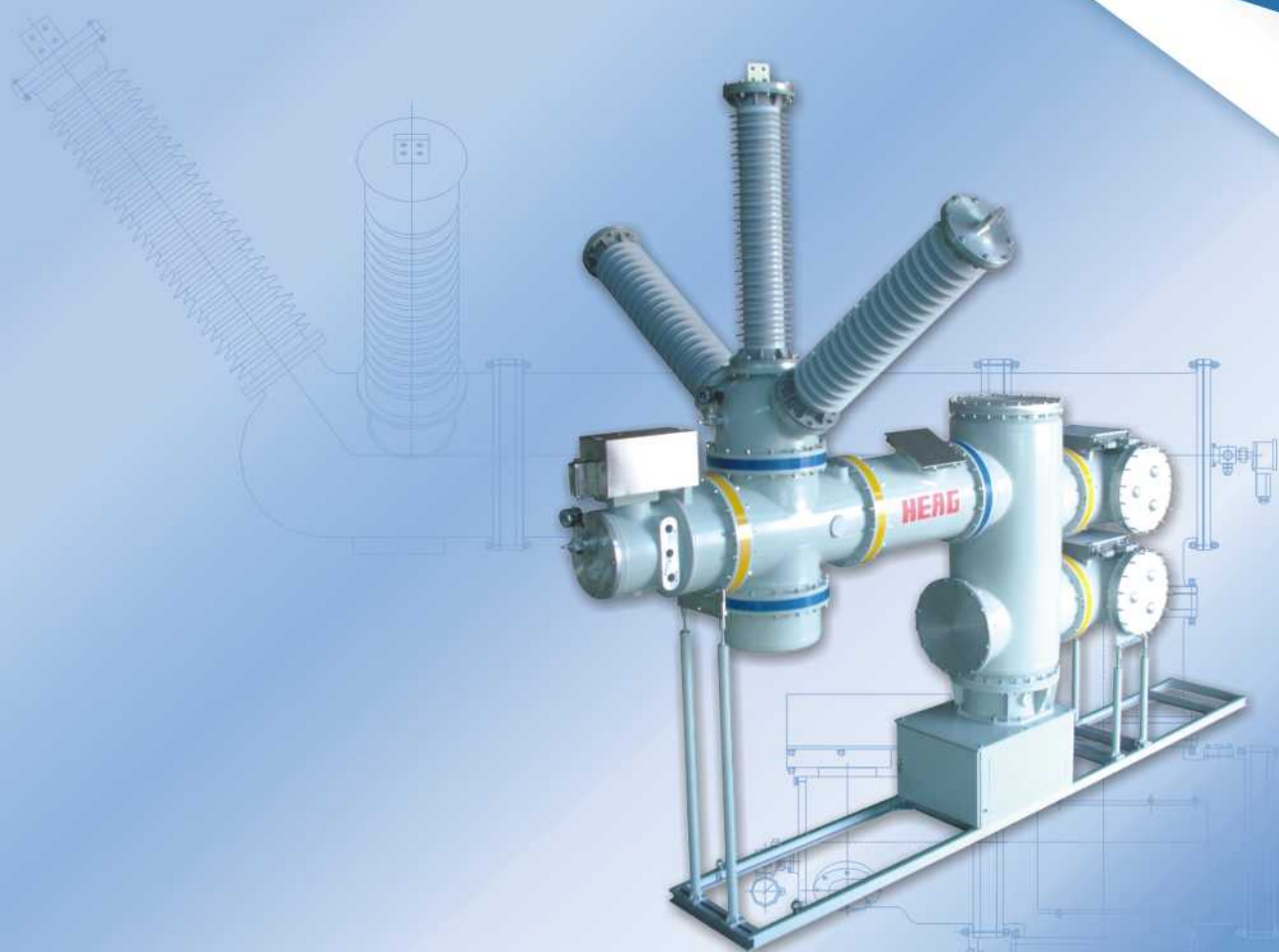
TECHNICAL DATA

# VZF1-126 Model Gas-insulated Metal-enclosed Switchgear

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HUAYI ELECTRIC

## GENERAL

VZF1-126 model Gas-insulated Metal-enclosed Switchgear (hereinafter referred to as GIS) is a mini nonsegregated phase GIS jointly developed by HEAG and VEI-Longyuan Research Institute(VLI for short) after they jointly introduced the technology of V. I. Lenin All-Russian Electro technical Institute(VEI for short), which is an improved new high-tech product on the basic of digestion and absorption of Russian GIS/GCB advanced technology. This product not only is in accordance with high reliability of Russian high-tech products, but also can satisfy domestic miniaturization requirement.

The product mainly accords with the standards of IEC 62271-1-2007, idt GB/T11022 <High-voltage switchgear and controlgear - Part 1: Common specifications>, IEC 62271-203-2003 <High-voltage switchgear and controlgear - Part 203: Gas-insulated metal-enclosed switchgear for rated voltages above 52 kV >. It has outstanding advantages as following:

◆ Technology cooperation of China and Russia

This product is supported by basic theory, product design capability and operating experience of VEI, its technology and technics is mature.

◆ Modular design, high reliability

GIS is a combination of standardized function modules such as circuit breakers, busbar/disconnector/earth switch, outgoing disconnector/fast EIS, current transformer, potential transformer, aerial/cable outgoing, etc. is of nonsegregated phase structure and a function combination. Compared to the traditional GIS, the quantity of components and gas sealing face greatly decrease; three-position disconnector/earth switch ensure the reliable inter-locking between disconnector and earth switch, so as to greatly improve the operating reliability.

◆ Small volume, light weight

This product is one of domestic GIS with smallest bay unit, the width of standard bay is only 0.8m. Both enclosure and conductors are made of Al alloy, light weight and corrosion protection, and the weight of standard bay is less than 3 tons.

◆ Strong breaking ability

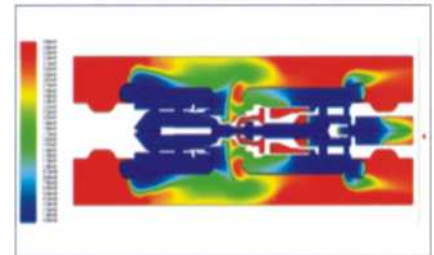
The circuit breaker adopts third generation of advanced arc extinguishing principle “auto puffer + small gas pressure” , and applies the advanced fluid analysis software to analyse the gas flow field in the breaking process to get the best gas flow structure, so that, it has high short-circuit breaking and making capacity, the charging current of switching circuit does not have reignition and restrike events and the full capacity electrical durability can be over 20 times; The disconnector can satisfy the requirements of switching busbar transfer current and charging current ; The earth switch can satisfy the requirements of making short-circuit current and switching induction current.

◆ High insulation level

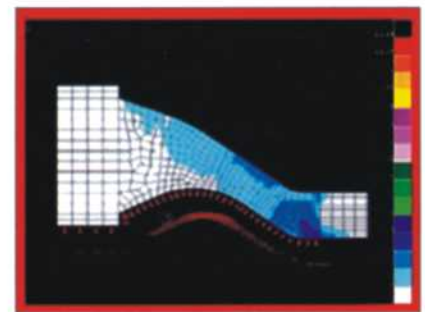
The insulation structure design is reasonable, all the insulation parts are strictly inspected, and the general withstand voltage level meets or exceeds the relative national standard or IEC standard, as a result, its insulation level is stable and reliable .

◆ Long life

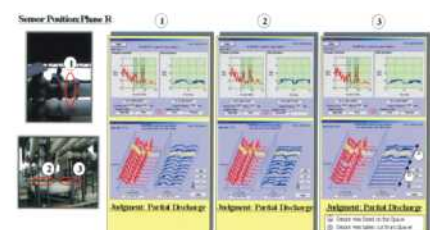
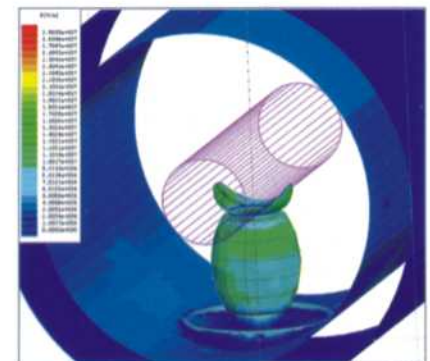
The circuit breaker is combined with spring operating mechanism, its operating feature is stable and the mechanical life is over 10000 times; The combined disconnector and earth switch is combined with a high-performance three-position mechanism, its mechanical life is over 10000 times.



Gas flow analysis



Electric field analysis





◆ Good to environment

The insulation structure is optimal design after E.M. field analysis, air consumption is little; The rotating seal adopts the special structure, which is without leakage and the sealing performance will be up to 20 years; The static seal adopts single-channel double-sealing technology to ensure the annually leakage rate is far less than 0.5%.

◆ Short site installation period, low maintenance

The product is pre-assembled at the factory, then is completely delivered to the user site after test, so the amount of site installation work is little and the site installation time is greatly saved, also for this reason, it fully ensures the quality of each function unit, the product can be immediately delivered into operation after site installation & commissioning. This GIS is a real maintenance-free or low maintenance product, the overhaul period is up to 20 years, and the cost performance is extremely high.

## NORMAL SERVICE CONDITIONS

Installation site	Indoor	Outdoor
Environmental temperature (°C)	-25~+40	-30~+40
Altitude above sea level (m)	1000 (2000*, 3000*)	
Relative humidity (°C)	Daily average ≤95%	condensation and rainwater
Pollution class	III grade, IV grade	
Max. wind speed (m/s)	/	34
Earthquake intensity (g)	Level acceleration ≤0.4, vertical acceleration ≤0.2	
Sunshine strength (w/m <sup>2</sup> )	/	≤1000
Ice covering thickness (mm)	/	≤20

Remarks: For \* Special service conditions, please consult with the manufacturer.

## MAIN TECHNICAL PARAMETERS

### 3.1 Main technical parameters of GIS

table 1

Rated voltage	126kV	
Rated frequency	50 or 60Hz	
Rated current	630, 1250, 1600, 2000, 2500, 3150A	
Main busbar	630, 1250, 1600, 2000, 2500, 3150A	
Rated short-time withstand current	40kA	
Rated short-circuit continuous time	main circuit: 4s; control circuit 2s.	
Rated peak withstand current	100kA	
Rated insulation level	Rated short-time P.F. withstand voltage	To ground, interphase: 230/265kV; between gaps: 230+73*kV
	Rated lightning impulse withstand voltage	To ground: 550/650kV; between gaps: 230+103*kV
SF6 gas pressure (20°C gauge pressure) Ratings/Alarm value/Locking value	Circuit breaker bay: 0.6/0.55/0.5MPa other bays: 0.5/0.45MPa	
5 min P.F. withstand voltage at SF6 zero gauge pressure	To ground, between gaps, interphase: 95kV	
Annual gas leakage rate of SF6 gas	≤0.5%	
Rated voltage of control circuit and auxiliary circuit	DC 220V, AC 220V	

Remarks: \* —Polarity reversal applied voltage.

### 3.2 Tank type SF6 circuit breaker

SF6 circuit breaker is of nonsegregated phase structure, three phases commonly use an operating mechanism and is mechanical interlocking. Main technical parameters refer to the following table.

Rated short-time withstand current/continuous time	40kA/4s	
Rated peak withstand current	100kA	
Rated short-circuit breaking current	40kA	
First pole factor	1.5	
Rated short-circuit making current	100kA	
Rated operating sequence	O-0.3s-CO-180s-CO	
Rated operating time	Opening time: $30 \pm 5$ ms Breaking time: $\leq 60$ ms Closing time: $80 \pm 15$ ms Closing/opening time: $\leq 60$ ms	
Main circuit resistance of each phase	$\leq 80 \mu \Omega$	
Rated control voltage	DC 220V	
Rated control voltage of motor	DC 220V or AC 220V	
Rated voltage of opening/closing coil	DC 220V	
Rated current of opening/closing coil	2A	
Motor for mechanism	Voltage	DC 220V
	Power	720W
Heater	Voltage	AV 220V
	Power	200W
Opening/closing time without overhaul	$\geq 10000$ times	

### 3.3 Three-position combined disconnecter and earth switch

Combined disconnecter and earth switch is of nonsegregated phase structure and three-position type, three phases commonly use an operating mechanism. Main technical parameters refer to the following table.

Rated switching busbar transfer current	1600A
Rated busbar charging current	0.1A
Circuit resistance	$\leq 30 \mu \Omega$
Rated opening time	$\leq 2$ s
Rated closing time	$\leq 2$ s
Rated control voltage	Three-position motor operating mechanism: DC 220V
Rated power of motor	Three-position motor operating mechanism: 360W
Opening/closing time without overhaul	$\geq 10000$ times

### 3.4 Fast earth switch

Fast earth switch is separately in a bay and is operated by a motor spring operating mechanism.

Rated short-circuit making current /time	100kA/ 5 times
Rated switching electromagnetic induction current/voltage	100A/6kV
Rated switching static induction current/voltage	5A/6kV

Rated opening time	≤0.1s
Rated closing time	≤0.1s
Rated control voltage	DC 220V
Rated power of motor	CT model spring operating mechanism: 360W

### 3.5 Current transformer

Current transformer is of nonsegregated phase type and combined with circuit breaker in a same bay, is ring iron core type structure. Its main technical parameters refer to the following table. The user can select the corresponding specification according to the requirements.

Rated voltage	126kV
Rated primary current	300, 500, (600), 750, (800), 1000, 1250, 1500, 2000, 2500, 3150A
Rated secondary current	5A or 1A
Rated output capacity and accuracy class	see table 1

table 1

Current ratio	Rated output capacity VA	Measurement accuracy	Protection accuracy
300/5	20	0.2/0.5	5P20
500/5	30	0.2/0.5	5P20
750/5	30	0.2s/0.2/0.5	5P20
1000/5	30, 40	0.2s/0.2/0.5	5P20
1250/5	40, 50	0.2s/0.2/0.5	5P20
1500/5	40, 50	0.2s/0.2/0.5	5P20
2000/5	50	0.2s/0.2/0.5	5P20

### 3.6 Potential transformer

SF<sub>6</sub> gas-insulated electromagnetic PT or capacitive PT is optional, which will be of nonsegregated phase structure. Main technical parameters refers to the following table.

Rated primary voltage	110/√3kV
Rated secondary voltage	110/√3kV
Rated voltage of residual winding	100V
Rated output capacity and accuracy class	Secondary measurement winding: 0.2/75VA Secondary protection winding: 3P/120VA Residual winding: 3P/300VA

### 3.7 Lightning arrester

GIS can be combined with SF<sub>6</sub> gas-insulated tank type lightning arrester, which will be of nonsegregated phase structure. Main technical parameters refers to the following table.

Electric corona level	interference level not more than 500 μV under 1.1 time of rated voltage
Creepage distance of porcelain bushing	25mm/kV \31mm/kV*
Static pull force of terminal	Level force: longitudinal 1250N, transverse 750N; Vertical force: 1000N

Remarks: Please consult with the manufacturer if special requirements.



## STRUCTURE FEATURES AND WORK PRINCIPLE

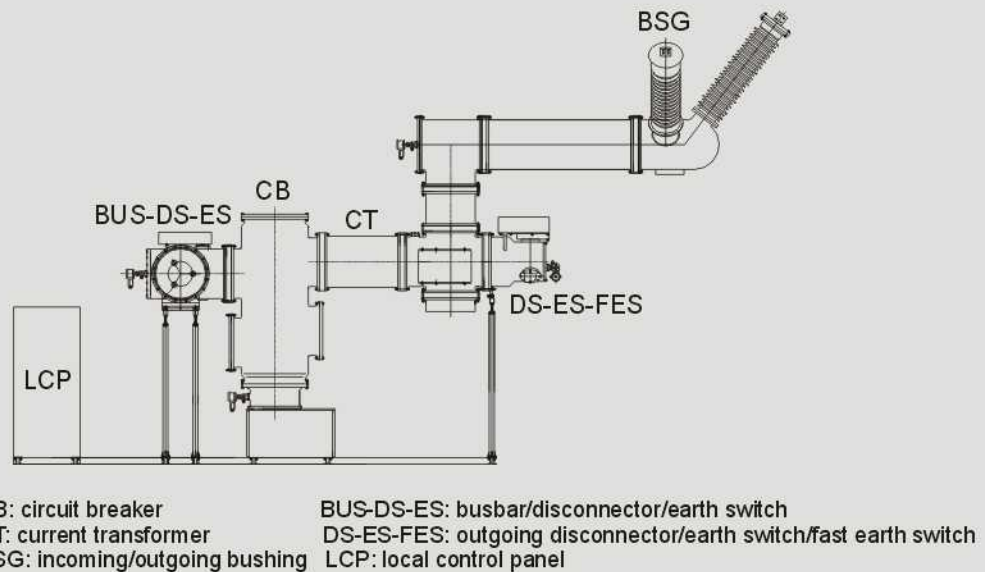


Fig. 1 Typical Bay Layout Diagram

GIS commonly is a combination of standardized function modules such as circuit breakers, busbar/disconnector/earth switch, outgoing disconnector/fast EIS, current transformer, potential transformer, aerial/cable outgoing, etc. and the bays commonly includes incoming bay, outgoing bay, measurement & protection bay and so on. It can adopt different connection diagrams such as single busbar, single busbar section, double busbar and bridge type connection.

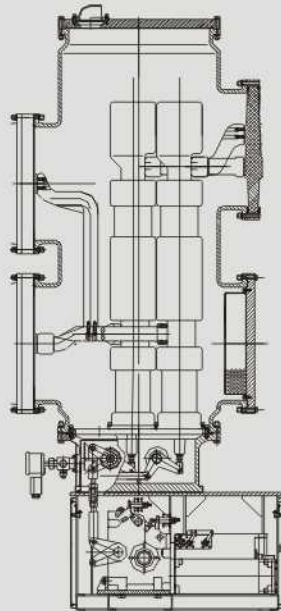


Fig.2 Structure Diagram of Circuit Breaker

### 4.1 Circuit breaker

The circuit breaker is of nonsegregated phase structure, three phases are controlled by one operating mechanism, and is mechanical interlocking.

The stationary and moving contacts of circuit breaker are fixed on the lower flange by the supporting conductor and the

support insulator, the movable end is connected with the crutch arm box through the insulation pull rod. The interrupter is of self extinguishing structure, arc extinguishing is mainly by self arc blowout and supplemented by compress gas blowout.

While opening, the insulation pull rod will drive the movable parts such as the moving contact, the nozzle and the cylinder to move to the opening position under the pulling of the operating mechanism. During movement process, the stationary main contact firstly separates from the moving main contact and creates electric arc.

As breaking heavy short-circuit current, arc energy between arc contacts is strong due to heavy current, hot airflow of arc zone will flow into the heat-up volume, where heat exchange is done and generates low-temperature and high-pressure gas, then the one-way valve will close because the pressure in the heat-up volume is higher than that in the compression volume. When the nozzle is open, the low pressure gas in the heat-up volume will blow to the gap to extinguish arc when current exceeds zero.

During opening operation, the gas pressure in the compression volume will be compressed little by little, however, the spring release valve of the compression volume will open when the gas pressure reaches a certain value, and pressing gas and releasing gas will be done at same time to maintain a fairly constant gas pressure and eliminate more counterforce of pressure gas, so as to greatly decrease the operating power of the operating mechanism.

As breaking low current (usually lower than few thousands of ampere), it generates low gas pressure in the heat-up volume due to low current. Here, the higher pressure in the compression volume will flow into the heat-up volume through the one-way valve and create blowing pressure. When the nozzle is open, it will blow to the gap to extinguish arc when current exceeds zero.

During the closing operation, the insulation pull rod will drive the movable parts such as the moving contact, the nozzle and the cylinder to move to the opening position under the pulling of the operating mechanism, meanwhile, SF<sub>6</sub> gas quickly enters into the cylinder, the moving contact connects with the stationary contact, so that closing operation is completed.

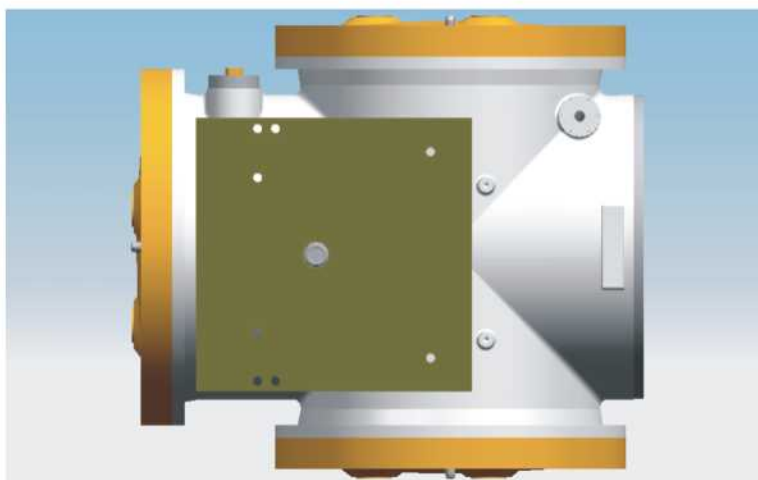


Fig.3 Structure Diagram of Busbar with Combined Disconnecter and Earth Switch

#### 4.2 Busbar with combined disconnecter/earth switch

Disconnecter is of nonsegregated phase structure in “—” shape layout; the enclosure is made of aluminum alloy, three phases are controlled by one operating mechanism, and mechanical interlocking is realized through the transmission rod. There is an observation window on the enclosure to observe the actual status of gap of combined disconnecter and earth switch.

Meanwhile, this module is a part of main busbar in the complete GIS.

For the structure, please refer to Fig. 3.

#### 4.3 Outgoing disconnecter/earth switch/fast earth switch

The earth switches are divided into working earth switch and fast earth switch, hereinto, the former is used for safety protection during overhaul which is realized by the earthing function of three-position earth switch, the latter combined with the electrical spring operating mechanism has the ability of short-circuit making/breaking induction current.

The fast earth switch is fixed above three-position combined disconnector and earth switch, the structure refers to the diagram below. There are electrical interlockings between fast earth switch and disconnector and circuit breaker to prevent mal-operation.

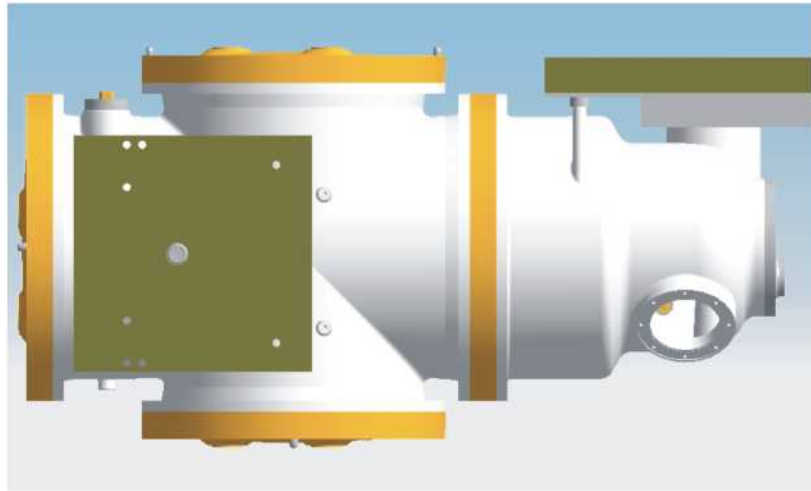


Fig. 4 Structure Diagram of Outgoing Disconnector/Earth Switch/Fast Earth Switch

#### 4.4 Current transformer

CTs are the measurement & protection components in GIS, primary conductors constitute CT's primary winding, and the iron core with secondary winding is designed according to accuracy class, capacity and the other requirements. Secondary connection tap is drawn outside the enclosure through the sealing terminal plate of CT body. The structure refers to Fig.5.

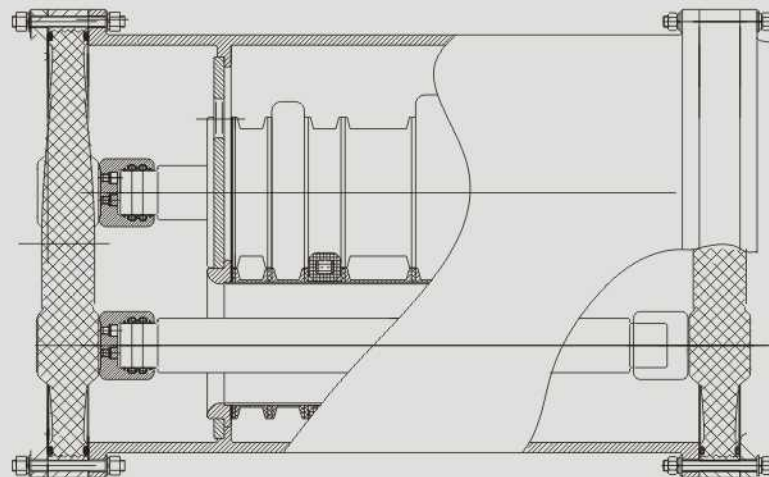


Fig. 5 Structure Diagram of Current Transformer

#### 4.5 Incoming/outgoing bushings

The conversion from GIS to air-insulated equipments or aerial lines is realized through the gasfilled bushings. The structure refers to Fig. 6.

#### 4.6 Local control panel

Local control panel (hereinafter referred to as LCP) is a centralized control panel for controlling and monitoring GIS at site. It commonly has the functions of local control, protection, signal transmission, relay and monitor for SF6 gas system.

Main functions as following:

- A. Centralized operation and selectable operation for circuit breaker, disconnector and earth switch;
- B. Monitor the Closing/Opening status of circuit breaker, disconnector, earth switch;



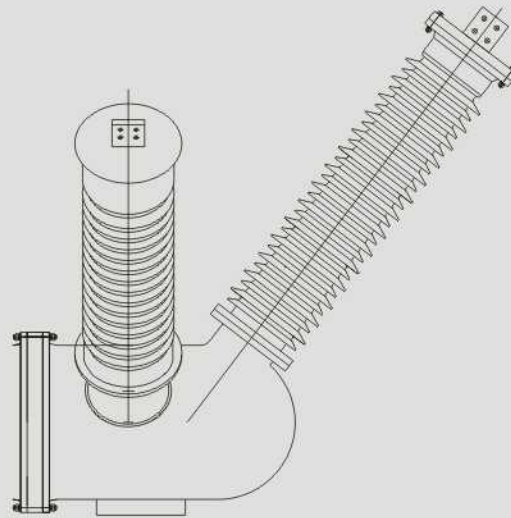


Fig. 5 Structure Diagram of Incoming/Outgoing Bushing

- C. Indication of gas pressure and density, control, alarm signal transmission;
- D. Realize electrical interlocking between the components in local bay and other bays;
- E. Display primary connection mode and its real time operation status;
- F. Used as a relay terminal box between the components of each GIS bay and between GIS and main control room for receiving and sending out the signals.

## ORDERING INSTRUCTIONS

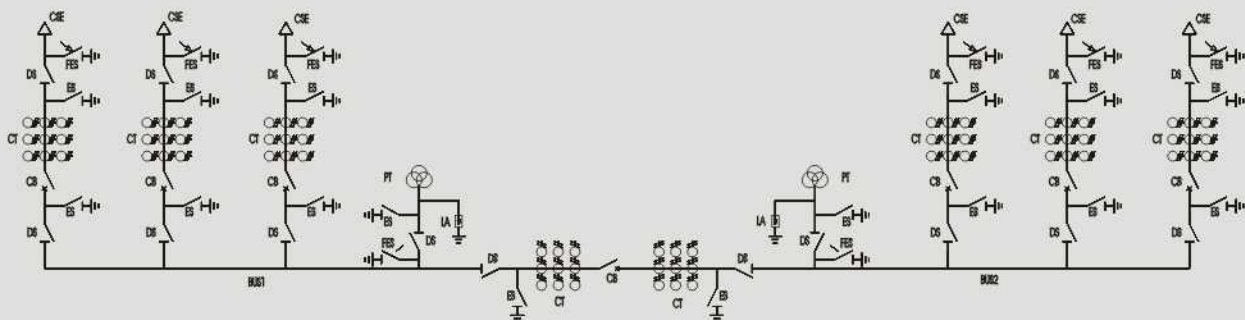
- 5.1 Both Buyer and Seller shall confirm the technical parameters and technical solution before signing the contract;
- 5.2 Buyer shall provide the basic diagrams and secondary control principle diagram for the user's confirmation within one month after signing the contract.
- 5.3 The supply scope and quantity of spare parts and auxiliary equipments shall be clearly stated in the contract.
- 5.4 Technical training and installation service required by the user shall be clearly stated in the contract.
- 5.5 The general tools and materials that shall be used during installation and overhaul shall be prepared by the user.

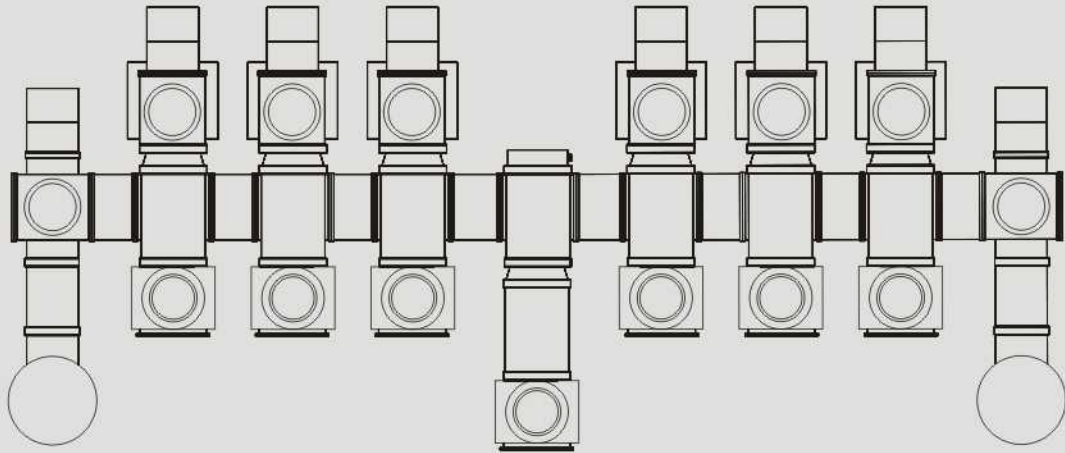
## VERSION EXAMPLES

All the components of GIS is independent and they can be combined in different layout mode according to building block principle to satisfy the different requirements of the user.

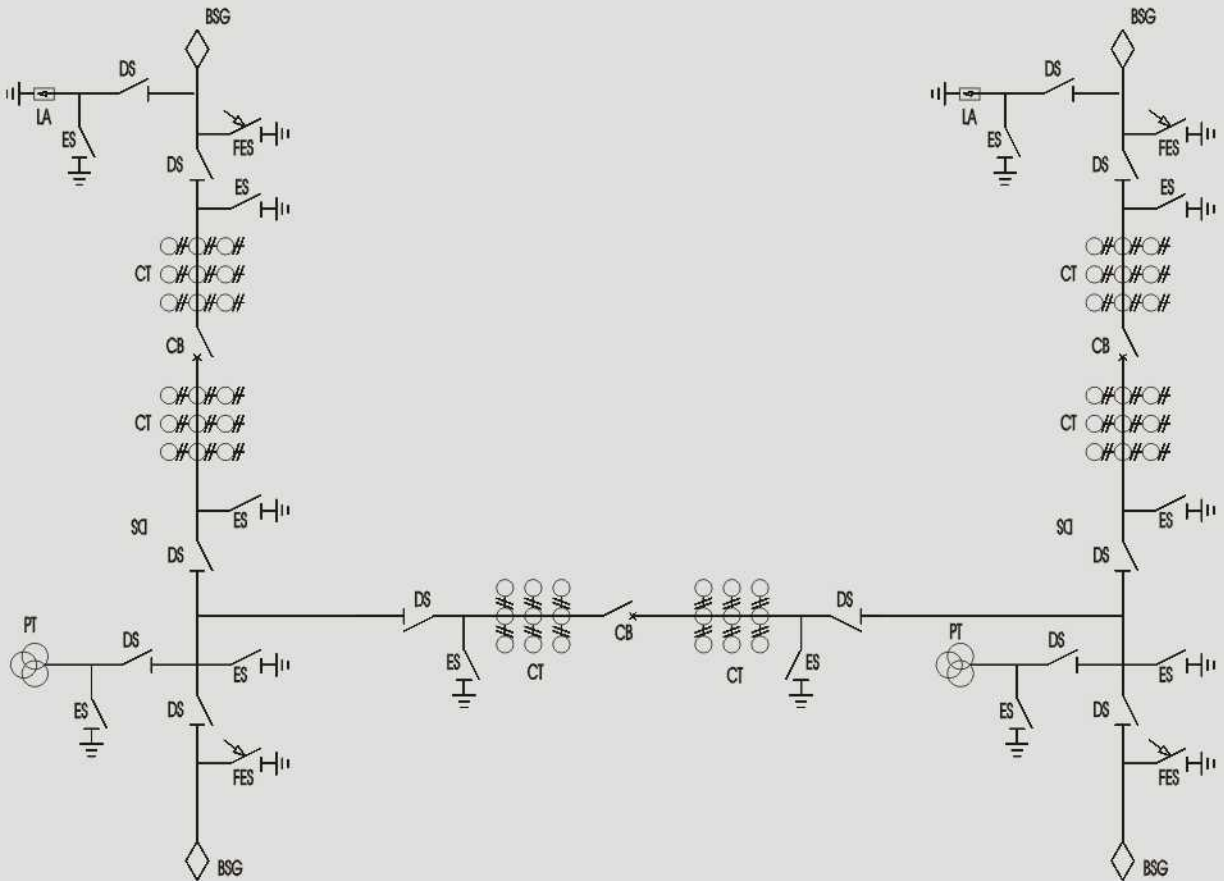
### 6.1 General layout example

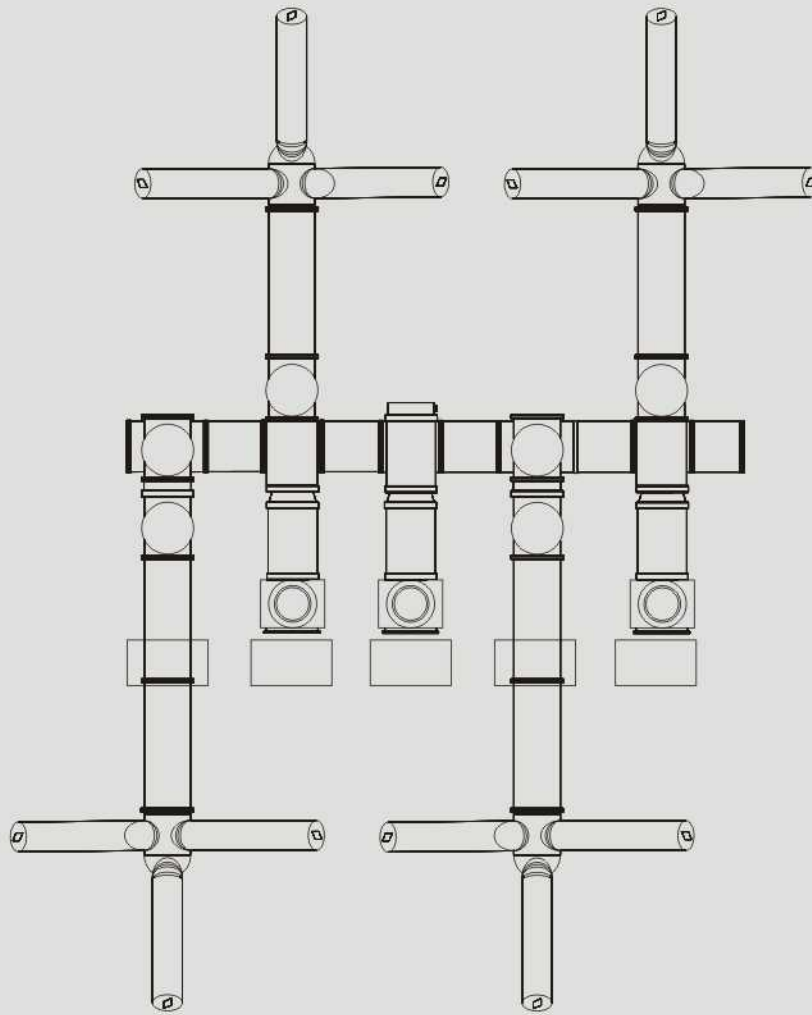
#### 1-1 Single line diagram of single busbar section



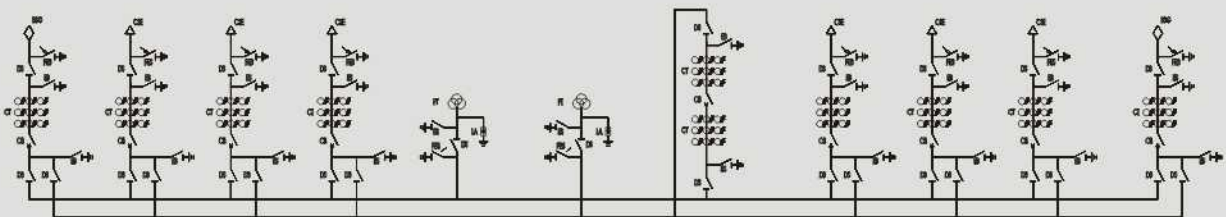


1-2 Single line diagram of inner bridge shape

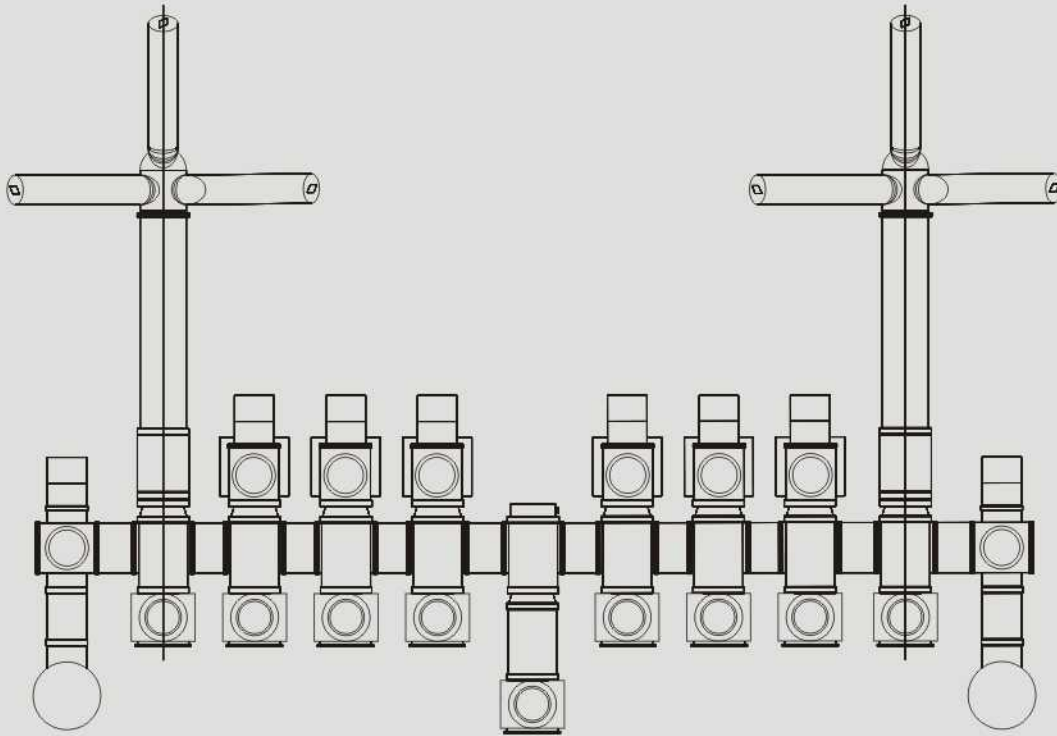




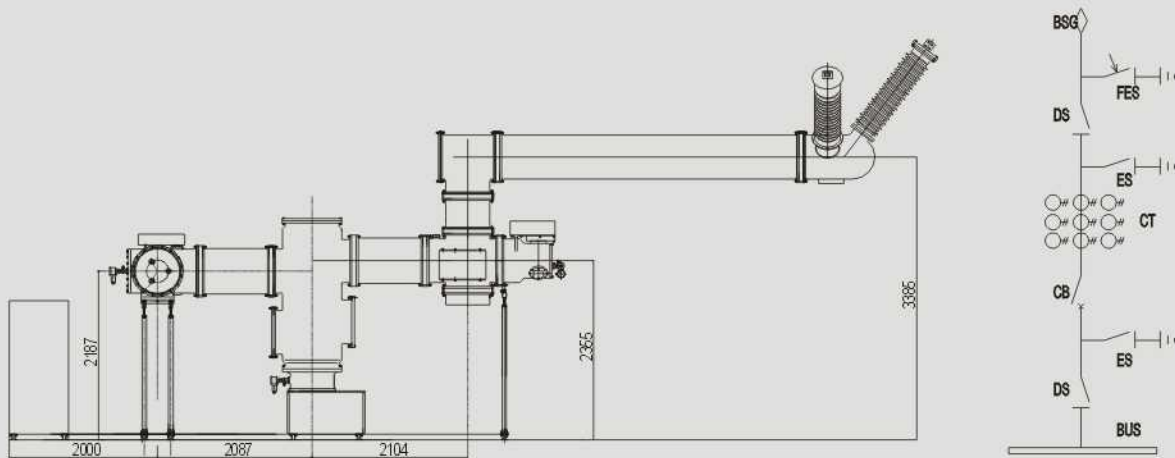
1-3 Single line diagram of double busbar section



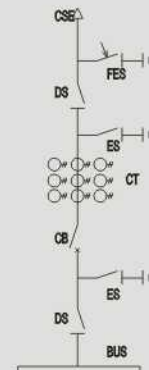
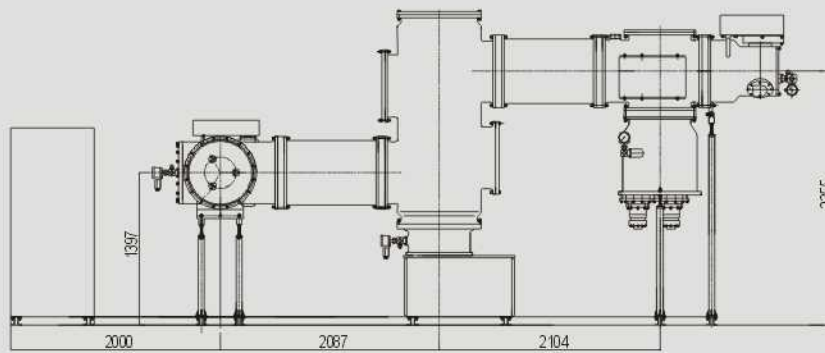




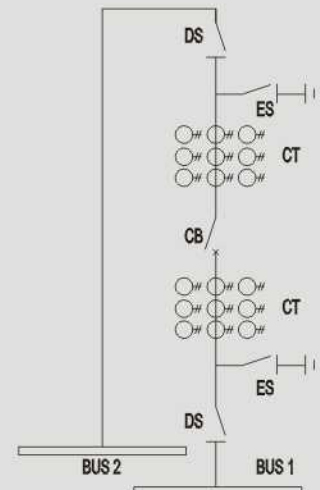
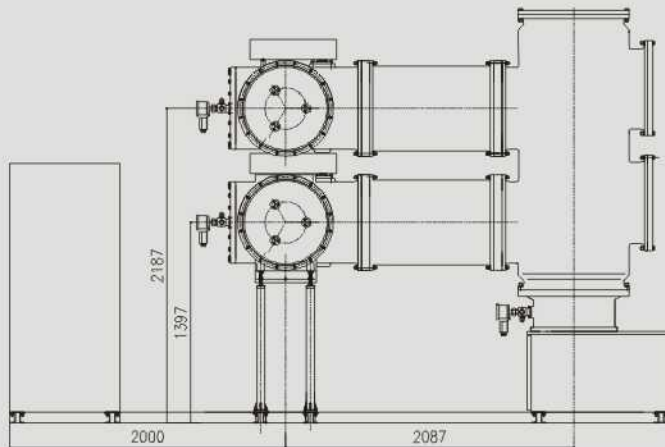
5.2 Typical bay layout example  
 2-1 Single busbar aerial incoming/outgoing bay



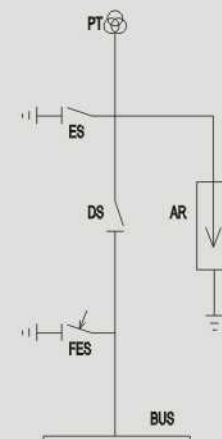
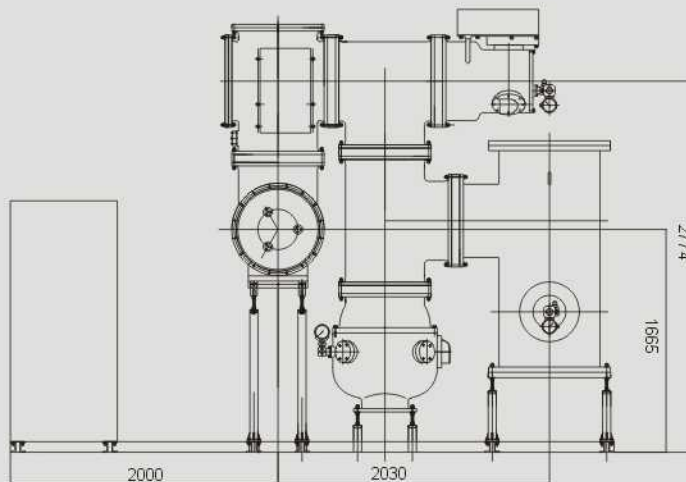
## 2-2 Single busbar cable incoming/outgoing bay



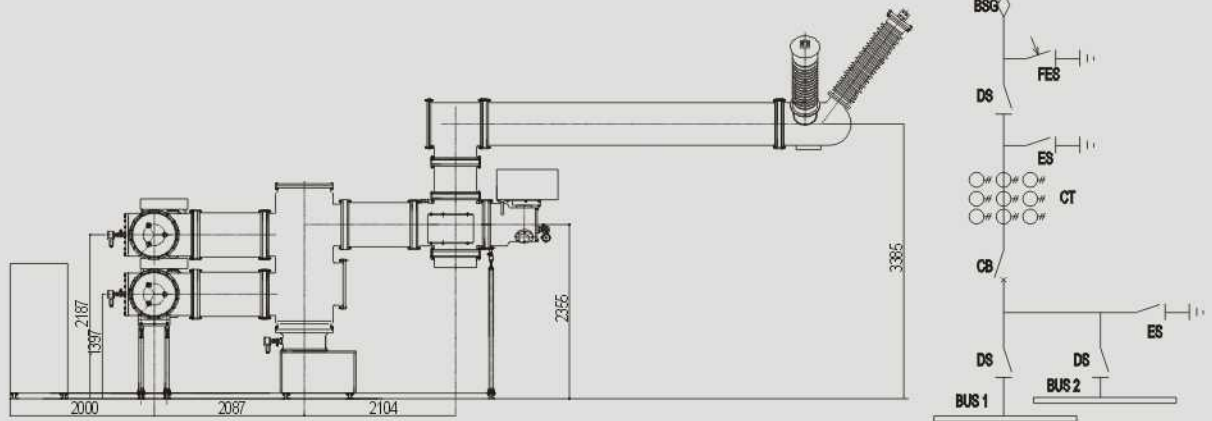
## 2-3 Busbar coupling bay



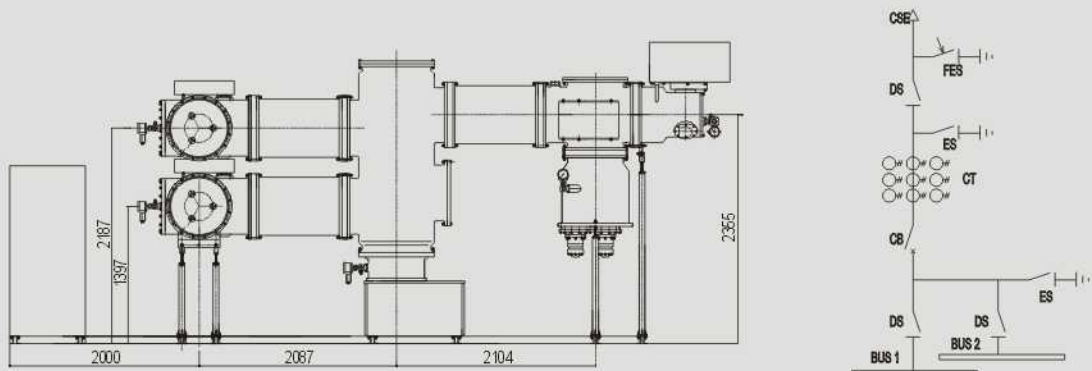
## 2-4 Measurement bay



## 2-5 Double busbar aerial incoming/outgoing bay



## 2-6 Double cable incoming/outgoing bay





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