Compact Gas Insulated Switchgear (GIS) up to 145kV

126kV,145kV Compact Gas Insulated Switchgear (GIS)

1. Standard: IEC 62271-203

2. Typical Feature

2.1 Great Breaking Character of Circuit Breaker

The circuit breaker adopt the self-extinguishing principle, it can achieve three-pole linking operation by only adopting a spring mechanism with small operating power.

2.2 Compact Design

- Adopt the advanced three-position switch, less parts, simple structure, small space and high reliability.
- Adopt the advanced PLC intelligent control system, reduce the secondary elements, shrink the volume of cabinet greatly.
- The width of the bay is only 0.8m, compact design compared with traditional width of 1.5m.

2.3 High Reliability of Mechanism

The circuit breaker adopts a spring mechanism with small operate power, and the three-position switch adopts electric operating mechanism from Japan.

2.4 Convenient Transportation and Installation

It can be transported as bigger unit and it is easy to install.

2.5 High Reliability and Maintenance

No maintenance under normal condition.

3. Technical Parameter

3.1 126kV Compact Gas Insulated Switchgear (GIS)

3.1.1 Ambient Environment Condition

Description		Indoor	Outdoor
Temperature (℃)		−15～+40	−40～+40
Sunshine w/m^2 (fine in midday)		–	1000
Wind velocity (m/s)		–	≤34
Relative humidity (daily average value)		≤95%	
Relative humidity (monthly average value)		≤90%	
Reek pressure kPa (daily average value)		≤2.2	
Reek pressure kPa (monthly average value)		≤1.8	
Altitude(m)		≤1000 (customized above 1000m)	
Earthquake condition	Common region	Horizontal acceleration 0.15g, vertical acceleration 0.075g	
	Strong shock region	Horizontal acceleration 0.30g, vertical acceleration 0.15g	
Outside insulation pollution level		Ⅲ degree，Ⅳ degree	
Bushing thickness of ice (mm)		10, 20	

3.1.2 GIS Technical Parameters

Description			Unit	Parameter
Rated voltage			kV	126
Rated current/main bus rated current			A	2500/3150
Rated frequence			Hz	50
Rated short-time withstand current			kA/s	40/3
Rated peak withstand current(peak)			kA	100
Rated insulation level	Rated power frequency withstand voltage for 1min	To earth/between poles	kV	230
		Open contacts	kV	230+73
	Rated lightening impulse withstand voltage(peak)	To earth/poles to earth	kV	550
		Open contacts	kV	550+103
SF_6 zero gauge pressure rated power frequency withstand voltage for 1min		To earth	kV	$126/\sqrt{3}\times1.3$
		Between poles	kV	$126/\sqrt{3}\times1.3$
Radio influence level(at 1.1 times rated pole voltage)			μV	≤500
Partial discharge(full bay)			pC	<5
Rated SF_6 pressure (20℃)	Breaker	Rated voltage	MPa	0.60
		Alarm pressure	MPa	0.55
		Blocking pressure	MPa	0.50
	Other gas room	Rated voltage	MPa	0.50
		Alarm pressure	MPa	0.40
SF_6 annual leakage rate			%	≤0.5
Short circuit current of fault making earthing switch (peak)			Ka	100(5 times)
Main bus change-over current of three-position switch				30V/1600A/100 times
Rated breaking short circuit current of circuit breaker			Ka	40
Electric life of circuit breaker			Times	20
Mechanical life of circuit breaker, three-position switch and fault making earthing switch			Times	10000

3.2 145kV Compact Gas Insulated Switchgear (GIS)

3.2.1 Ambient Environment Condition

Description	Indoor	Outdoor
Temperature (℃)	-40～+40	
Sunshine w/m² (fine in midday)	–	1000
Wind velocity (m/s)	–	≤34
Relative humidity (daily average value)	≤95%	
Relative humidity (monthly average value)	≤90%	
Reek pressure kPa (daily average value)	≤2.2	
Reek pressure kPa (monthly average value)	≤1.8	
Altitude(m)	≤1000 (customized above 1000m)	
Earthquake condition	Horizontal acceleration 0.30g, vertical acceleration 0.15g	
Outside insulation pollution level	Ⅲ degree，Ⅳ degree	
Bushing thickness of ice (mm)	10, 20	

3.2.2 GIS Technical Parameters

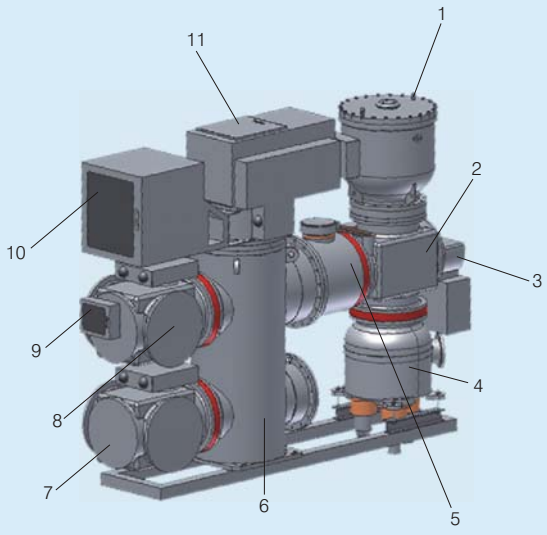
Description			Unit	Parameter
Rated voltage			kV	145
Rated current			A	2500，3150
Rated frequence			Hz	50
Rated short-time withstand current			kA/s	40
Rated peak withstand current(peak)			kA	100
Rated short circuit duration			S	4
Rated insulation level	Rated power frequency withstand voltage for 1min	To earth/between poles	kV	275
		Open contacts	kV	275+84
	Rated lightening impulse withstand voltage (peak)	To earth/poles to earth	kV	650
		Open contacts	kV	650+119
SF_6 zero gauge pressure rated power frequency withstand voltage for 5mins		To earth	kV	$145/\sqrt{3}\times1.3$
		Between poles	kV	$145/\sqrt{3}\times1.3$
Radio influence level(at 1.1 times rated pole voltage)			μV	≤500
Partial discharge(full bay)			pC	<5
Rated SF_6 pressure (20℃)	Circuit breaker	Rated voltage	MPa	0.60
		Alarm pressure	MPa	0.55
		Blocking pressure	MPa	0.50
	Other gas room	Rated voltage	MPa	0.50
		Alarm pressure	MPa	0.45
Moisture content of SF_6 gas in gas rooms	Circuit breaker gas room	Acceptance value	PPm(V/V)	150
		Operating value	PPm(V/V)	300
	Other gas rooms	Acceptance value	PPm(V/V)	250
		Operating value	PPm(V/V)	500
SF_6 annual leakage rate			%	≤0.5
Protection degree of auxiliary circuit and moving part			–	IP4X/IP5X（Indoor）
				IP4XW/IP5XW（Outdoor）

4. Structure

4.1 General Structure

See 126kV,145kV Compact GIS general structure in the following diagram:

Fig.1 3D Structure diagram of 126kV,145kV Compact GIS

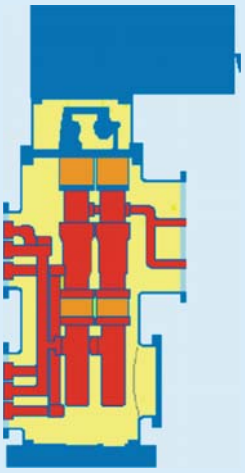


1. Voltage transformer
2. Outgoing and incoming three-position switch
3. Fault-making earthing switch
4. Cable terminal
5. Current transformer
6. Circuit breaker
7. Busbar three-position switch 1
8. Busbar three-position switch 2
9. Touch-screen
10. Intelligent control cubicle
11. Spring operating mechanism

4.2 Circuit Breaker Module

The circuit breaker is of three-pole common box typed structure and consists of two components: Interrupter unit and operating mechanism.

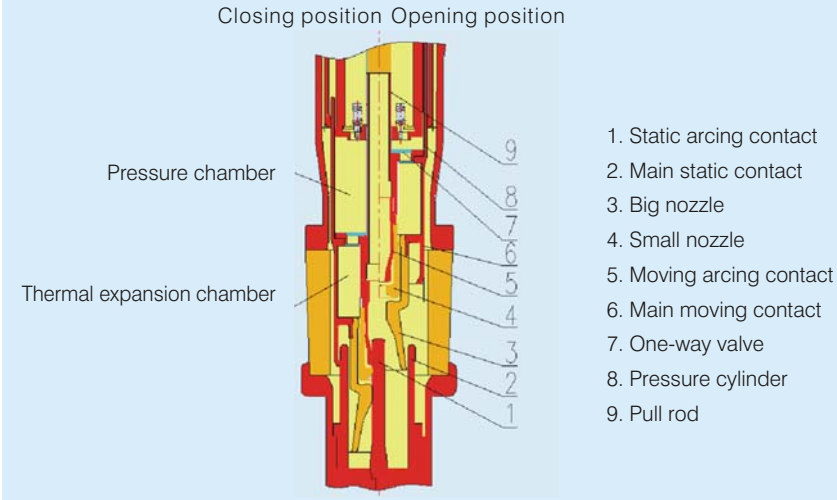
Fig.2 Circuit breaker



4.2.1 Interrupter Unit

The interrupter unit adopts the principle of self thermal expansion and the compression arc-quenching principle.

Fig.3 Principle diagram of interrupter unit



4.2.1.1 Interruption of Short-circuit Current

When the circuit breaker opens, the drag rod (9) moves upward, and drives the pressure cylinder (8), the main moving contact (6), the big nozzle (3), the small nozzle (4) and the moving arcing contact (5) which are connected to it to move upward as well. During the breaking operation, the main moving contact (6) and the main static contact (2) open first and the current commutates on the still closed arcing contacts (1) & (5). The operation progresses on and the arcing contacts are separated and then an arc develops between the arcing contacts (1) & (5). As the breaking current during the operation is very big, the arc energy between the arc contacts is relatively very strong. Then the thermal current in the arc area enters the thermal expansion chamber and begins heat exchange, heats up the SF_6 gas and produces thermal expansion, and low-temperature high-pressure gas is produced in the upper zone and the thermal expansion chamber, which makes the pressure in the thermal expansion chamber bigger than that in the pressure cylinder, and this results in the close of the one-way valve (7). The thermal expansion chamber fully takes advantage of the "blocking effect" of the arc, when it comes to zero-current, the high-pressure gas in the thermal expansion chamber flows into the contact gap and extinguishes the arc.

4.2.1.2 Interruption of Load Current

When breaking small current of several thousand Amps, the arc energy is small and the pressure formed in the thermal expansion chamber is low. Meanwhile the drag rod (9) drives the pressure

cylinder (8), the main moving contact (6), the big nozzle (3), the small nozzle (4) and the moving arcing contact (5) move upward, and leads to a pressure rise in the pressure cylinder. Because the pressure in the pressure cylinder is bigger than that in the thermal expansion chamber, the one-way valve (7) opens and the gas flows out and flows into the contact gap by the compressed SF_6 gas and the arc extinguishes when it comes to zero-current.

4.3 Three-position Switch Module (three-phase common box)

Three-position switch includes bus three-position switch and incoming and outgoing feeder three-position switch, they have the common structural features as follows:

- The disconnector and the earthing switch share a mechanism and a moving contact. Using one electric mechanism can achieve the operation of disconnector close-disconnector open/earthing switch open-earthing switch close, which achieves less parts, small volume, simple structure and high reliability.
- Adopt three-position switch electric mechanism imported from Japan, which can also be manually operated. It is of compact design, small volume and high reliability.

4.3.1 Bus Three-position Switch

- The disconnector closes when the moving contact moves towards left and plugs into the static contact of the disconnector;
  the earthing switch closes when the moving contact moves towards right and plugs into the static contact of the earthing switch.
- The conductor connects the static contact of the disconnector with the middle conductor on the basin- type insulators. It can be used as inside conductor of disconnector/earthing switch as well as used as a main bus, that's also why the GIS has not a separate main bus unit. This greatly Simplifies the structure, saves space and increases product reliability.

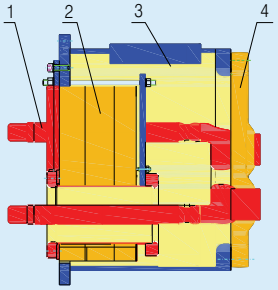
4.3.2 Incoming and Outgoing Feeder Three-position Switch

The position in the figure is the middle position of disconnector open/earthing switch open. The disconnector closes when the moving contact moves towards right and plugs into the static contact of the disconnector; the earthing switch closes when the moving contact moves towards left and plugs into the static contact of the earthing switch. It almost has the same structure with the disconnertor, except it has a fault making earthing switch. The static contact of the fault making earthing switch is connected with the conductor, and the moving contact is connected with the enclosure through the insulator as well as connected with the mechanism through four dog bone drive system. The fault making earthing switch has special electric spring operation mechanism with capability of breaking the short circuit current for more than 5 times.

4.4 Current Transformer(CT) Module

- Adopt toroidal core.
- The secondary winding is epoxide resin casing.
- Three-phase common barrel type.
- Various types of class measurement and protective winding with different class precision, rating and capacity are available on customer requirements.
- Primary winding is the main circuit conductor.
- Outgoing feeder of the secondary winding is led out through the terminal box to the control cubicle (PLC).

Fig.4 Current transformer

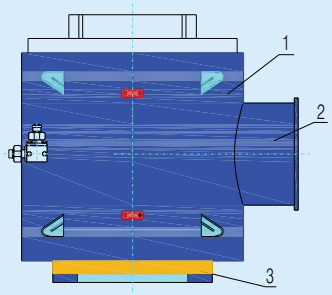


1. Primary winding
2. Secondary winding
3. Terminal box
4. Basin-type insulator

4.5 Voltage Transformer(PT) Module

- Voltage Transformer (also called Potential Transformer) is electromagnetic-type transformer.
- Three-pole common barrel type and single-pole type is available.
- Various types of secondary winding and spare winding available.
- PT can be installed at optional positions in the GIS through basin-type insulator.

Fig.5 Voltage transformer

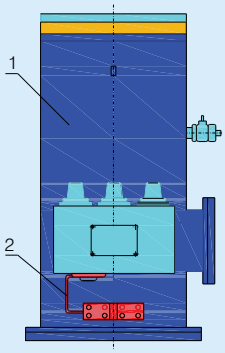


1. Voltage transformer
2. Terminal box
3. Basin-type insulator

4.6 Surge Arrester Module

- Metal Oxide (MO) resistor wafer type valve.
- Three-phase common barrel type.
- As the over-voltage protection device, surge arresters are usually installed on the incoming side of a GIS, and are connected with other modules through basin-type insulators.
- Side-mounted and roof-mounted structures available.

Fig.6 Surge arrester



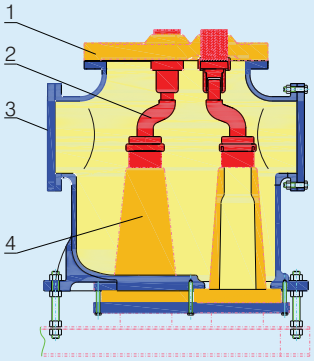
1. Surge arrester
2. Terminal box

4.7 Terminal Module

4.7.1 Cable Sealing End(CSE) Module

- Through cable Sealing End(CSE) box, all kinds of high voltage cables can be connected with GIS.
- Epoxy resin or jack-in type available.
- Primary conductor can be removed to separately do high-voltage test of GIS cable.
- Designed in accordance with IEC62271-305 standard.

Fig.7 Cable sealing end

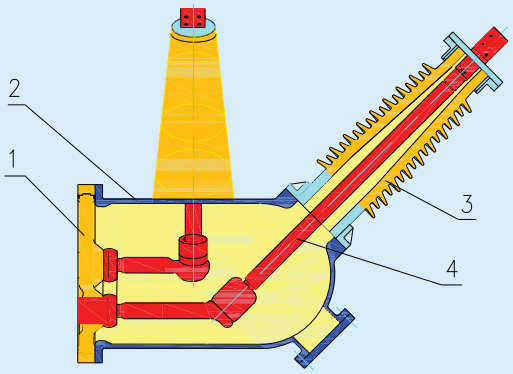


1. Basin-type insulator
2. Conductor
3. Shell
4. Cable Sealing End(CSE)

4.7.2 SF6/Air Bushing Module

- When overhead line is used in GIS as the incoming and outgoing feeder, SF_6/air bushing is adopted.
- The structure of SF_6/air bushing is three-pole spilt phase. The three-phase common barrel type changes to individual pole at the bushing position, then connected to the outside.

Fig.8 SF_6/Air bushing

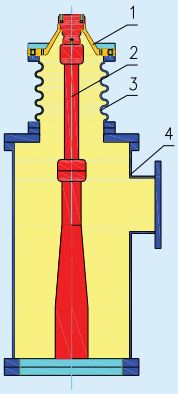


1. Basin-type insulator
2. Shell
3. Porcelain
4. Conductor

4.7.3 SF6/Oil Bushing Module

- The structure of SF_6/oil bushing is three-pole split barrel.
- Transformer is connected with GIS through SF_6/oil bushing.
- Bellows are used to adjust the thermal expansion and contraction and installation errors
- The design and scope of supply of SF_6/oil bushing accord with IEC 62271-306 standard.

Fig.9 SF_6/Oil bushing

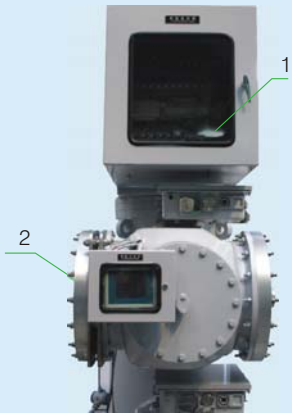


1. Basin-type insulator
2. Conductor
3. Bellows
4. Shell

4.8 Programmable Logic Controller(PLC)

- Liquid crystal monitor with touch screen is used to facilitate the realization of human-computer dialogue and achieve the remote control of CB, DS, ES, FES including conversion, operation, on load displaying status of location and primary line.
- To achieve automatically block among disconnector, circuit breaker and earthing switch as well as relay-based alarm function through software programming.
- Intelligent online monitoring system, through which instant monitoring of SF6 gas pressure value can be achieved.
- Convenient and powerful communication function. PLC communicates with the main control room through data signals communications interface, greatly reduces the cable link with the main control room and makes the whole flow simple and reliable.

Fig.10 Programmable Logic Controller(PLC)



1. Intelligent controller
2. Operating touch screen

4.9 Maximally Adapt to Users' Requirements

- All the components of GIS, such as disconnector, circuit breaker, CT and other connected components are of standard modular structure.
- Each component structure is simplified and pruned to meet clients' requirements of arrangement under different conditions.
- GIS can be designed to be more reliable, more compact, more convenient to install and maintain, easier to achieve the expansion of docking and to maximally meet user's needs.

8. Ordering Information

Users shall give the main technical parameters, the main connection diagram and the relevant plant layout. And we will make the best design with most reasonable arrangement of space and covering least area to meet users' requirements.