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ZF-252(L)/T4000-50 Gas-Insulated Metal-Enclosed Switchgear



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Company Profile

- > Founded in 2004, TGOOD (Stock Code: 300001) was the first company listed on the Growth Enterprise Board of the Shenzhen Stock Exchange in 2009.
- > The mission of TGOOD is to create the world's top brand of prefabricated power equipment.
- > TGOOD's intelligent modular prefabricated substations has occupied a 60% share of power grid and new energy markets.
- > TGOOD has delivered product solutions to 6300+ customers, and provided 11,000+ prefabricated substations.
- > TGOOD's prefabricated and integrated solutions have been implemented in 50+ countries and regions worldwide.

No.1

The world's No.1 brand of prefabricated substation equipment

The largest in the World

One of the largest suppliers of prefabricated substation

The largest in China

TGOOD is the largest R&D and production base for prefabricated substations in China

Only in China

The only manufacturer in China achieving digital, technological, specialized, and large-scale production of prefabricated substations

Champion

MIT manufacturing industry single item champion enterprise

Four Main Manufacture Factories

Cover an area of more than **780,000** square meters



Qingdao West Coast Manufacturing Factory



Qingdao Free Trade Zone (China)



Sichuan Chengdu Manufacturing Factory



Hubei Yichang Manufacturing Factory



Model ZF-252(L)/T4000-50 is gas insulated switchgear, using SF₆ gas as an insulating gas and arc extinguishing medium, is applicable to three-phase 220kV/50Hz AC transmission systems. It is mainly used for the control, protection and measurement of power equipment and transmission lines in substations.



Applicable Standard

- IEC 62271-203: High-Voltage Switchgear and Controlgear - Part 203: AC Gas-Insulated Metal-Enclosed Switchgear for Rated Voltages Above 52 kV
- IEC 62271-1: High-Voltage Switchgear and Controlgear - Part 1: Common Specifications for Alternating Current Switchgear and Controlgear
- GB/T 7674 Gas-Insulated Metal-Enclosed Switchgear for Rated Voltages of 72.5 kV and Above
- GB/T 11022 Common Specifications for High-Voltage Alternating-Current Switchgear and Controlgear Standards

Product Features

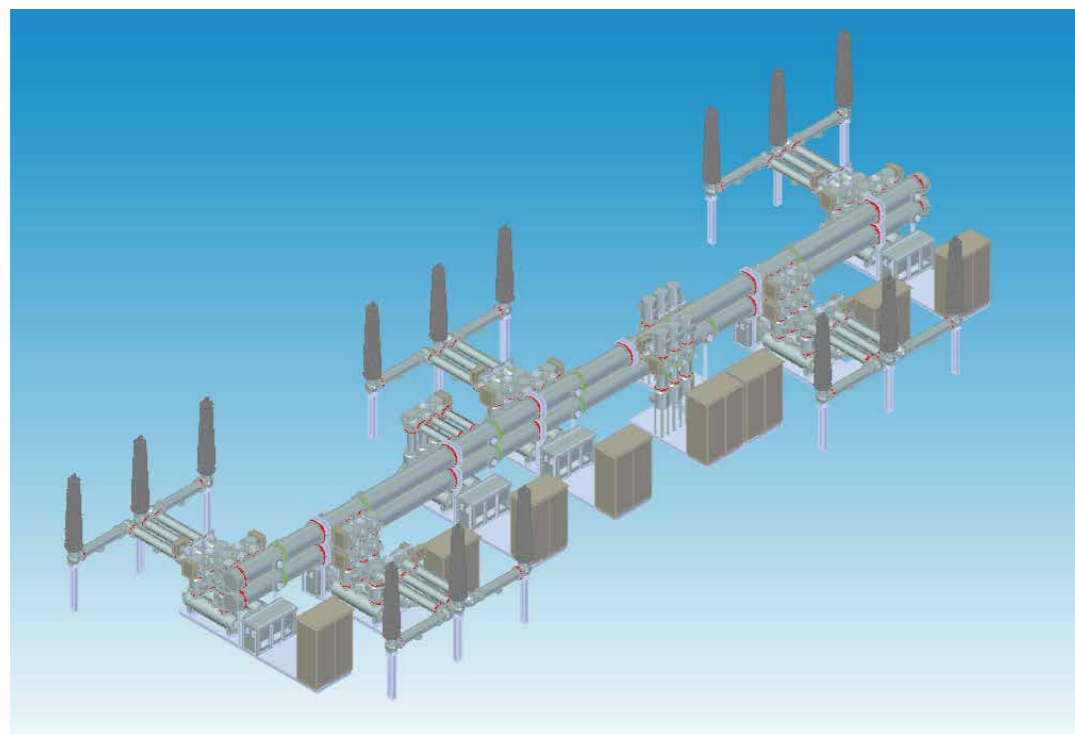
- **Modular and Compact Design**
- **Low Operating Energy**
- **High Mechanical Reliability**
- **Excellent Breaking Performance**
- **Low Maintenance Burden**

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2.1 Product Overview

Model ZF-252(L)/T4000-50, using SF₆ gas as an insulating gas and arc extinguishing medium, is applicable to three-phase 220kV/50Hz AC transmission systems. It consists of circuit breaker, disconnecter, earthing switch, current transformer, voltage transformer, zinc oxide surge arrester, busbar and other standard functional modules.

The main busbar, the disconnecter and the earthing switch form a three-phase-in-one-enclosure structure, while the other functional modules are arranged in a three-phase-in-different-enclosure structure. This model is mainly used for the control, protection and measurement of power equipment and transmission lines in substations.



2.2 Applicable Standard

- > **IEC 62271-203:** High-Voltage Switchgear and Controlgear – Part 203: AC Gas-Insulated Metal-Enclosed Switchgear for Rated Voltages Above 52 kV
- > **IEC 62271-1:** High-Voltage Switchgear and Controlgear – Part 1: Common Specifications for Alternating Current Switchgear and Controlgear
- > **IEC 62271-100:** High-Voltage Switchgear and Controlgear – Part 100: Alternating-Current Circuit-Breakers
- > **IEC 62271-102:** High-Voltage Switchgear and Controlgear – Part 102: Alternating-Current Disconnectors and Earthing Switches
- > **GB/T 7674** Gas-Insulated Metal-Enclosed Switchgear for Rated Voltages of 72.5 kV and Above
- > **GB/T 11022** Common Specifications for High-Voltage Alternating-Current Switchgear and Controlgear Standards
- > **GB/T 1984** High-Voltage Alternating-Current Circuit-Breakers
- > **GB/T 1985** High-Voltage Alternating-Current Disconnectors and Earthing Switches
- > **DL/T 617** Specification for Gas-Insulated Metal-Enclosed Switchgear
- > **DL/T 593** Common Specifications for High-Voltage Alternating-Current Switchgear and Controlgear Standards
- > **DL/T 402** High-Voltage Alternating-Current Circuit-Breakers
- > **DL/T 486** High-Voltage Alternating-Current Disconnectors and Earthing Switches

2.3 Product Features

Low Operating Energy

- The “thermal-expansion” self-suppression interruption principle adopted fully utilizes the arc energy during the opening operation to achieve optimal arc extinguishing performance, and minimizes the energy required for operation
- Breaking the traditional single-acting operation mode, a double-acting contact system is adopted to achieve the reverse movement of the arc contact during closing and opening operations, which improves the speed at instant of contacts separating and significantly reduces the operating energy

Low Maintenance Burden

- The double-acting self-suppression arc-extinguishing technology greatly reduces the operating energy of circuit breakers, and realizes that one single pole or all three poles are commonly operated by a full-spring operating mechanism
- The full-spring operating mechanism features no risk of oil and gas leakage, low maintenance burden, high cost-effectiveness and long service life

High Mechanical Reliability

- The full-spring operating mechanism for circuit breakers adopts helical compression spring to reduce the dynamic operation impact. After the closing operation, excess energy is absorbed and stored by the opening spring to ensure the lowest “reactive power” loss of the mechanism. Low operating energy brings high reliability, and extends the mechanical endurance of circuit breakers to 10,000 operating cycles, meeting the highest level – Class M2, as stipulated by IEC62271-100, GB1984 and DL408
- The mechanical endurance for other switching devices such as disconnectors, earthing switches and fast earthing switches reaches 10,000 operating cycles – Class M2

Excellent Breaking Performance

- The circuit breaker goes through 20 consecutive electrical endurance tests at a rated short-circuit current of 50kA, without requiring any maintenance
- Disconnector busbar switching current reaches 1600A/300V

Modular and Intensive Design

- Horizontal circuit breaker and three-position switch (TPS) feature compact structure design, and the compartment unit can be transported as a whole
- TPS disconnector and earthing switch can be combined with the earthing switch and fast earthing switch according to the line layout requirements
- TPS disconnector and earthing switch and the main busbar both adopt a three-phase-in-one-enclosure structure, which reduces the sealing surface
- The flange joint surfaces all use a double-seal-ring structure and reduce the probability of gas leakage

2.4 Application Scenarios



Renewable Energy



Transport



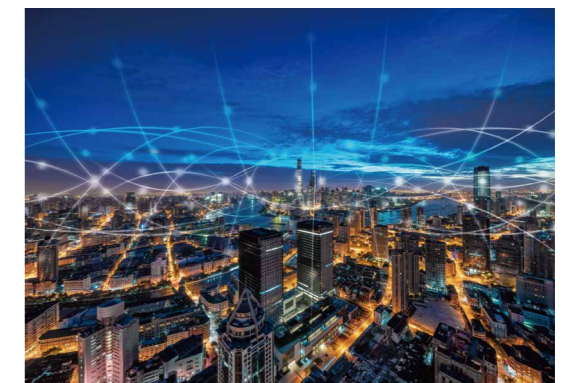
Petrochemical Engineering



State Grid



Railway and Metro



Urban Power Distribution

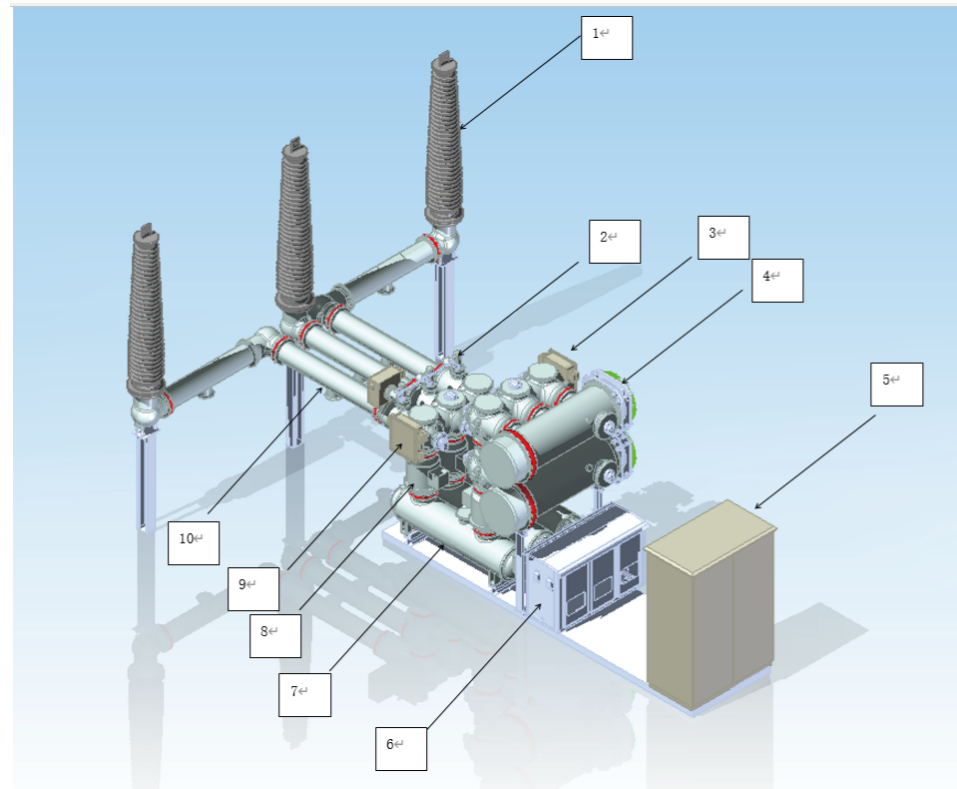
3.1 Operating Environment

- > **Installation location:**
Indoor or outdoor
- > **Ambient temperature:**
-25 °C to 40 °C (up to -45°C to 55°C to meet special requirements)
- > **Altitude:**
≤1000m (special orders are not limited)
- > **Air humidity:**
Daily average ≥ 95%, monthly average ≥ 90% (at 25 °C)
- > **Wind speed:**
≥35m/s (wind pressure not more than 700 Pa)
- > **Seismic fortification intensity = 9 degrees:**
horizontal acceleration ≤ 0.5g, and vertical acceleration ≤ 0.25g
- > **Ice thickness:**
≤10mm
- > **Pollution class:**
Class e
- > **Under 1.1 times the highest voltage:**
no visible corona at night on sunny days
- > **Wind speed:**
not exceeding 34m/s (equivalent to 700 Pa on the cylindrical surface)

3.2 Technical Data

Name		Unit	Data
Rated voltage		kV	252
Rated frequency		Hz	50
Rated current		A	4000
Rated short-circuit breaking current		kA	50
Rated short-time withstand current		kA	50
Rated duration of short-circuit		s	3
Rated peak withstand current		kA	125
Rated 1 min power frequency withstand voltage	Phase-to-earth / phase-to-phase	kV	460
	Through disconnections	kV	460+145
Rated lightning impulse withstand voltage	Phase-to-earth / phase to-phase	kV	1050
	Through disconnections	kV	1050+206
Rated lightning impulse withstand voltage	Whole unit / one compartment	pC	≤3
	Single insulator	pC	≤2
Radio interference level		μV	<500
SF ₆ rated pressure (20°C) gauge pressure		MPa	0.58
SF ₆ annual leakage rate			≤0.05%
SF ₆ moisture content in circuit breaker, busbar-side disconnector in double busbar compartment, and gas compartment of fast earthing switch		μL/L	≤150
SF ₆ moisture content in other gas compartments		μL/L	≤250
Degree of protection	Indoor		IP5X
	Outdoor		IP55W
Noise level		dB	≤90
Static tensile force of incomer and feeder bushing terminal	Horizontal longitudinal	N	2000
	Horizontal transverse		1500
	Vertical force		1500

4.1 Product Structures and Components

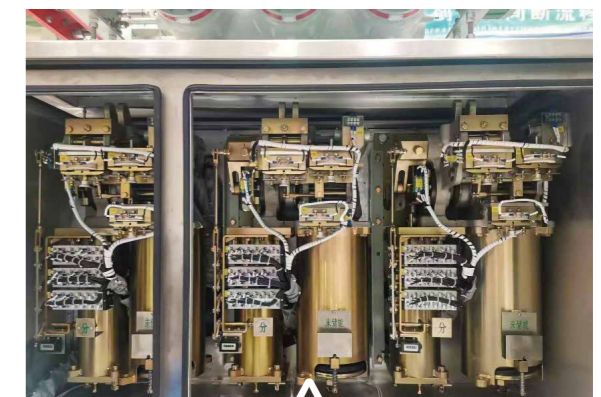
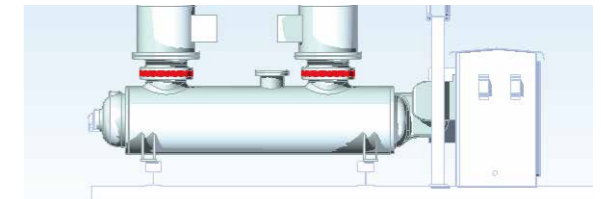


1. Incomer and feeder bushing module
2. Fast earthing module
3. Busbar TPS module
4. Common-enclosure busbar module
5. Secondary control cabinet module
6. Circuit breaker operating mechanism module
7. Circuit breaker module
8. Current transformer module
9. Disconnecter module
10. Separate-enclosure busbar module

4.2 Main Functional Modules

Circuit Breaker Module

- The arc extinguishing mode of the circuit breaker adopts the internationally leading “double-acting contact structure + thermal expansion + blow assistance” arc extinguishing design, which has excellent breaking performance, high stability and reliability
- The circuit breaker is designed according to E1-M2-C2 standards, with a mechanical endurance of up to 10,000 operations, and goes through 20 consecutive electrical endurance tests at a rated short-circuit current of 50kA, a line charging current switching test of 150A C2; and a cable charging current switching test of 250A C2
- The circuit breaker module adopts a separate-enclosure vertical structure, with an aluminum enclosure to reduce the weight of the circuit breaker. The three-pole independent operation, electrical interlock operation scheme, or three-pole mechanical interlock operation can be flexibly selected by the user
- The closing and opening time is <math><60\text{ms}</math>, which improves system stability during the breaking process
- The full-spring operating mechanism is compact, oil-free and gas-free
- Various observation windows are set for easy inspection, making it convenient to check the status of various mechanisms
- All bearings used in the spring mechanism adopt high reliable material
- The mechanism is installed compactly with the main body, with the closing spring and opening spring positioned for easy observation and maintenance



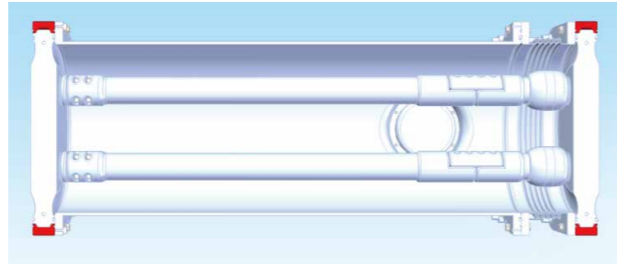
Spring Operating Mechanism



4.2 Main Functional Modules

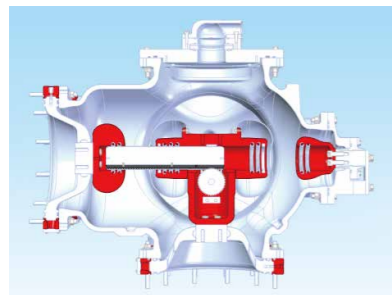
Three-Phase Common-Enclosure Enclosed Main Busbar

- SF₆ gas-insulated busbars are used to connect various GIS modules and compartments. The busbar can continuously carry the rated current, rated peak withstand current, and thermal stability current, and can realize 1.1×4000A through current
- The busbar consists of an enclosure, a branch conductor fixed on basin-type insulators, and three-phase conductive rods
- Metal bellow are installed at suitable positions for busbar connections, to eliminate thermal expansion and contraction deformation and assembly errors

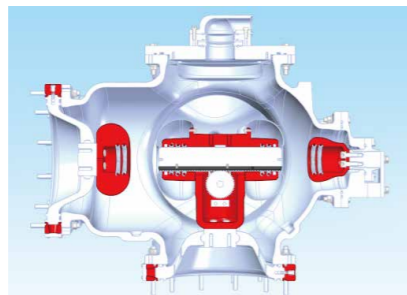


TPS Disconnecter and Earthing Switch

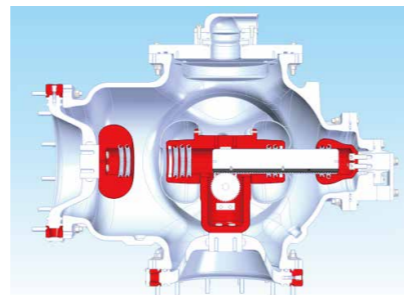
- Particle traps are installed to avoid the risk of internal discharges
- The full three-phase-in-one enclosure design is adopted
- TPS design, combination earthing switch, and natural mechanical interlock effectively to prevent mis-operation
- Direct coupling transmission, along with a non-exposed four-bar mechanism, improves transmission efficiency and enhances weather resistance
- Mechanical endurance is up to 10,000 operating cycles



Disconnecter CLOSE
+ Earthing Switch OPEN



Disconnecter OPEN
+ Earthing Switch OPEN

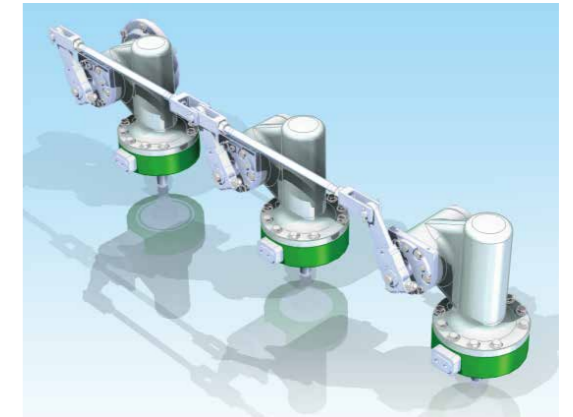


Disconnecter OPEN
+ Earthing Switch CLOSE

4.2 Main Functional Modules

Fast Earthing Switch

- The fault-closing earthing switch has a compact structure and occupies a small space. The contact fingers have a double self-acting structure and are capable of closing short-circuit currents. It is equipped with an electric spring operating mechanism
- Good short-circuit current making capability supports 2 times at 50kA
- The mechanical endurance of the fast earthing switch is: 10,000 operating cycles



Current Transformer

- Three-phase-in-different enclosure structure
- The coil adopts waterproof polyester film for interlayer insulation. The outer winding is cast with epoxy resin
- The secondary winding is impregnated with polyurethane, ensuring high electrical and mechanical strength and good heat resistance
- Vacuum packaging for transportation



4.2 Main Functional Modules

Voltage Transformer

- The insulation of the winding layer uses a polyester film that offers high insulation strength and good waterproofing properties
- The partial discharge test is conducted at 80% of power-frequency withstand voltage, with partial discharge less than 5 pC
- The transformer can be installed horizontally or vertically
- The base is equipped with a metal explosion-proof plate to improve the safety of the product



Surge Arrester

- As protection components of GIS, single-phase tank-type surge arresters are used to limit overvoltage in the power system, achieve overvoltage protection, and protect electrical equipment insulation from damage
- Each surge arrester is equipped with an online monitoring device to monitor discharge counts and leakage current
- SF₆ gas is used for insulation in combination with standardized interfaces, to facilitate installation and docking on site



4.2 Main Functional Modules

Terminal Connection Module

- SF₆ high-voltage bushings are adopted
- SF₆ high-voltage bushings are connected to the overhead line, with SF₆ gas as the main insulating medium inside the bushings. The bushing can be made of porcelain or composite materials, meeting different user requirements



Adoption of Cable Termination

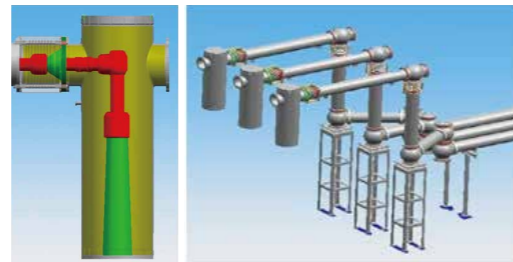
High-voltage cables are connected through cable terminations which are provided by cable manufacturers, with both parties executing the works in accordance with standards such as GB/T 22381 and IEC/TS 62271-209.



4.2 Main Functional Modules

Adoption of Oil-gas Bushings

The design and manufacturing of the GIS and transformer connection are shared according to IEC 61639 or GB/T 22382; oil-gas bushings are configured with independent gas compartments; and a non-metallic ring-basin structure is used to connect the GIS branch busbar to the transformer.



Secondary Control System

- A double-layer local control cabinet is used to offer better thermal insulation and waterproof functions, with a protection degree of IP54 or above, ensuring the reliable operation of internal electronic components
- A key-type local/remote and interlock/unlock transfer switch is equipped to realize safe local operation
- Mimic diagram adopting a screen printing process offer long service life and an attractive appearance.
- Internal components under international famous brands are adopted to ensure reliable quality
- All auxiliary circuits and voltage transformer circuits are equipped with MCB or other protection device
- Control cabinets with different functions, including conventional control cabinets and integrated intelligent cabinets, can be provided based on customer requirements



4.2 Main Functional Modules

Intelligent Module

In accordance with IEC 61850 and the guidelines for intelligent substations, the physical structure of GIS equipment and intelligent components are matched, mechanical and electrical performance are compatible, and communication protocols are standardized. An integrated and systematic approach is used to integrate GIS state online monitoring (partial discharge, SF₆ gas status), switch controllers, and other intelligent components, enabling the online monitoring, comprehensive analysis, and intelligent control of the state of GIS.

Embedded Sensors and Electronic Transformers



Electronic current transformer



Electronic voltage transformer



SF₆ gas online monitoring sensor



UHF-local sensor



Surge arrester online monitoring sensor

Intelligent Control Elements



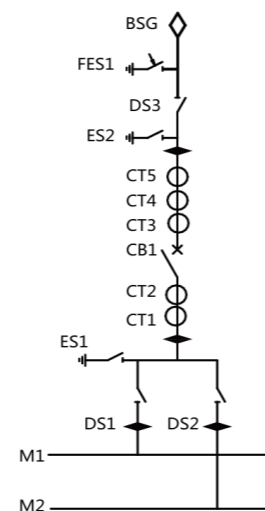
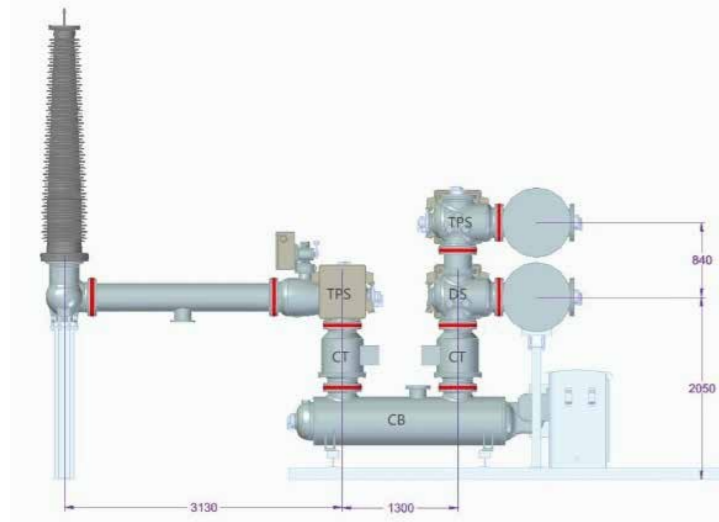
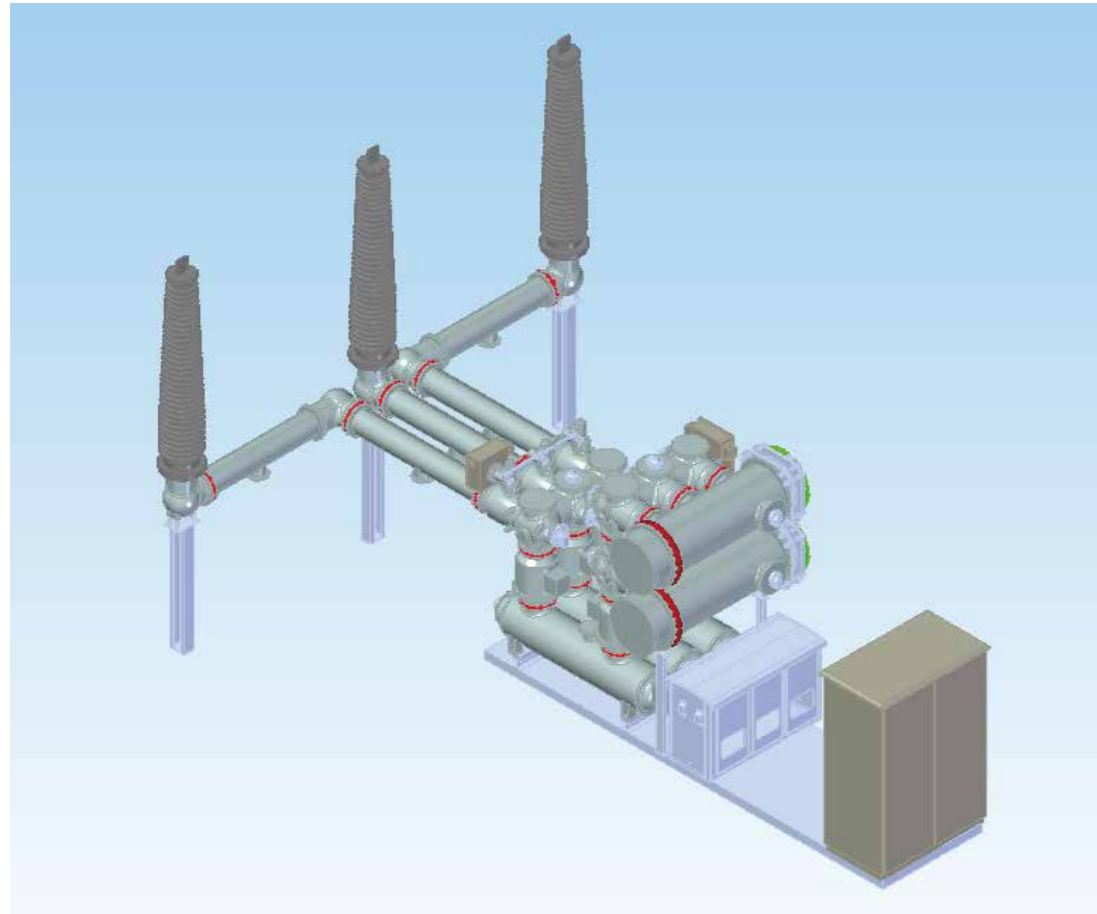
Merging unit



Intelligent components

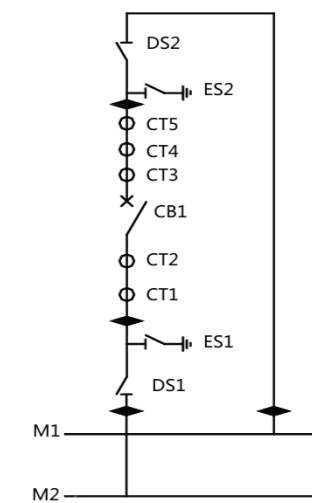
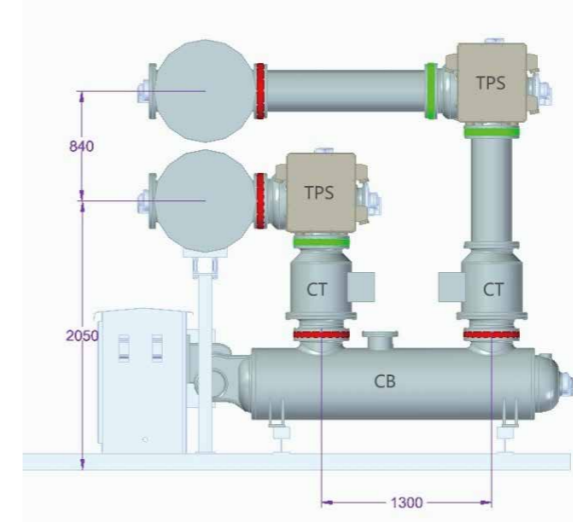
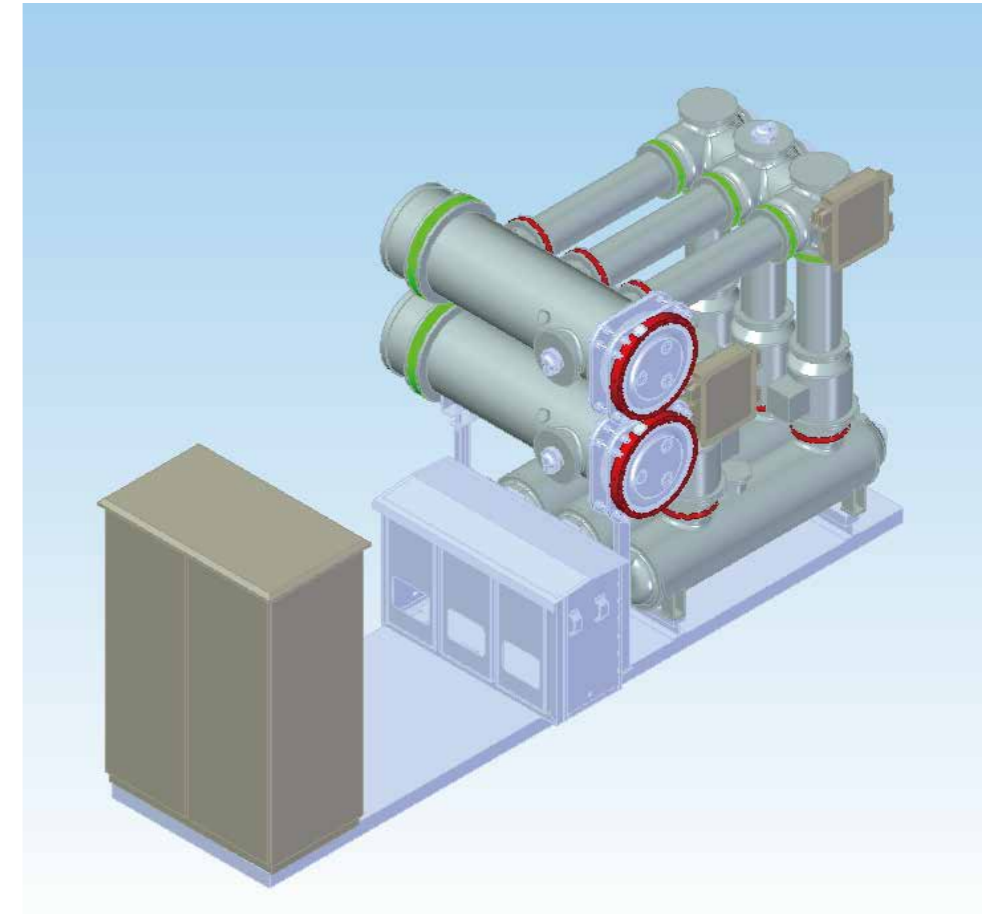
5 Typical Bay and Arrangement

5.1 Typical Bays



Bushing in-coming and feeder bay

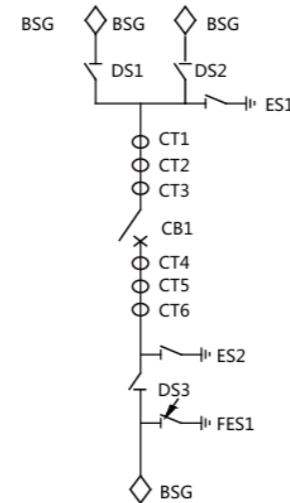
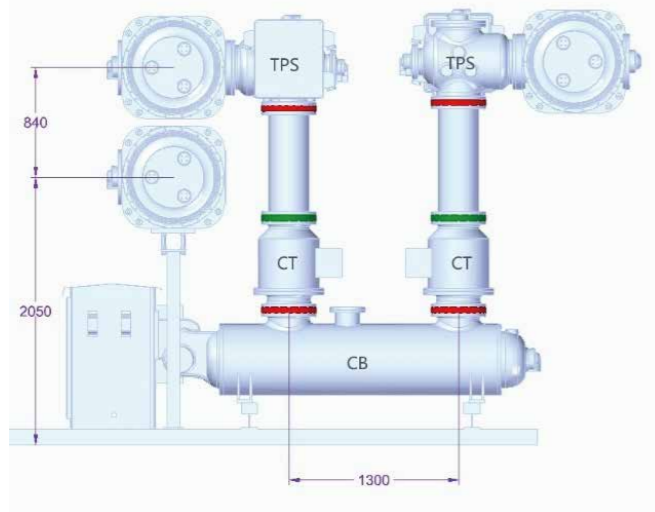
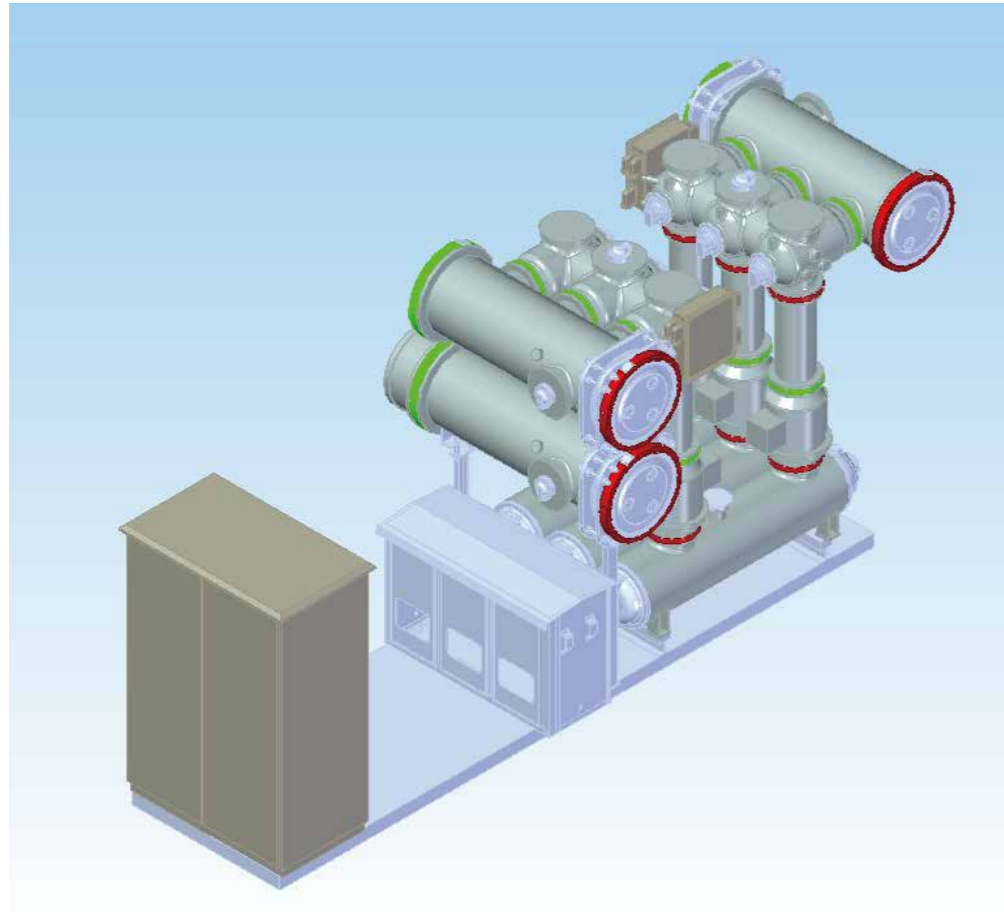
5.1 Typical Bays



Busbar coupler bay

5 Typical Bay and Arrangement

5.1 Typical Bays



Segmental bay

5.2 Arrangement of ZF-252(L)/T4000-50 Gas-Insulated Metal-Enclosed Switchgear

