



# TGP145

Gas insulated switchgear up to 145kV 3150A 40kA

Catalogue

2016

**TGOOD**

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TGP145

### Product description

The TGP145 is a compact metal encapsulated switchgear consisting of high-voltage components such as circuit-breakers and disconnectors.

The TGP145 is used, where space is limited, such as extensions, on roofs and offshore platforms, in city buildings, industrial plants and hydro power plants.

TGP145 GIS comply to the international standard IEC 62271-203; all elements mounted inside the GIS conform to international standards as certified by KEMA.

### Condition and technical data

#### Environment condition

Items	Data
Assembly location	indoor or outdoor
Ambient temperature	-30°C ~ +40°C
Altitude	1000m (no limit for special order)
Air humidity	daily average ≥ 95%; monthly average ≥ 95% (25°C)
Wind speed	≥35m/s (wind pressure ≤700Pa)
Illumination intensity	≤0.1W/cm <sup>2</sup> (wind speed 0.5m/s)
Earthquake intensity	horizontal acceleration ≤0.4g, vertical acceleration ≤0.2g
Icing thickness	≤10mm
Creepage distance	25mm/kV (pollution level III) 31mm/kV (pollution level IV)

TGP145 is used in an area without inflammable & explosive materials, corrosive chemicals and violent vibration.

#### Technical data

Items	Unit	Data
Rated voltage	kV	145
Rated frequency	Hz	50/60
Rated current	A	2000,2500,3150
Rated short-time withstand current / time	kA/s	40/3
Rated peak withstand current	kA	104
Insulation level	Rated short-time power frequency withstand current (1 minute)	kV 275 (to earth, between phases) 315 (between contacts)
	Withstand voltage with zero-gauge pressure (5 minutes)	kV 109
	Rated lightning impulse withstand voltage (peak value)	kV 650 (to earth, between phases) 750 (between contacts)
Rated SF <sub>6</sub> gas pressure / min. functional pressure (20°C)	MPa	VT / LA gas chamber 0.5/0.45
Water content in SF <sub>6</sub>	μL/L	CB chamber ≤150 (during handover)
		Other gas chambers ≤250 (during handover)
Partial discharge	pC	≤5
Annual leakage ratio of SF <sub>6</sub>	%/ year	≤0.3
Level of radio interference	μV	≤500
Bay width	mm	800



Urban substation

## Characteristics of TGP145

- It is a new designed compact GIS with 3-phase in a standard tank, the minimum bay width is 0.8m, the footprint of standard bay is 2.90m<sup>2</sup>.
- The circuit breaker of TGP145 adopts self-arc-extinguishing technology. It brings excellent performance such as breaking capacity, short arc time and long electrical life. Total breaking time is within 3 wave cycles. TGP145 can realize 22 times full capacity breaking.
- The circuit breaker is equipped with CT spring type operation mechanism, which features a simple and compact structure, with high reliability and less maintenance. The mechanical endurance reaches 10,000 times.
- The modular design facilitates the layout as well as future expansion and reconstruction. According to customer requirements, the configuration mode includes sectionalized single-bus, Bus-tie or double-bus.
- The 3-phase in standard tank structure could remarkably reduce the eddy loss, which also boasts an elegant and aesthetic appearance.
- The TGP145 enclosure is made of aluminum alloy, the light product weight results in low requirement upon foundation load. Corrosion-resistance performance is high and the eddy loss is low thanks to the enclosure.
- Wireless interference level is lower than 500μV which is suitable for construction and assembly in urban areas, including being very close to residential areas.
- The TGP145 demonstrates good environmental compatibility, which is suitable for areas with harsh environmental conditions (areas with serious pollution, excess water mist and hail, etc.), high altitude areas or earthquake prone locations, as well as urban areas with limited land resources, or a hydropower station in mountainous area with difficult earthworks.
- Besides the outgoing cable sleeve and some connection bus, at most 3 bays of TGP145 can be delivered together, which shortens the site assembly period and reduces site construction & assembly workload especially on civil works significantly.
- TGP145 can be assembled indoors and outdoors, allowing greater compatibility.



Outdoor application



Indoor application

## Quality assurance

### Certified quality: ISO 9001

#### A major asset

TGOOD integrates a functional organization whose main role is to check quality and monitor compliance with standards. This procedure is:

- uniform throughout all departments
- recognized by many customers and approved organizations. But above all, it is its strict application that has allowed us to obtain the recognition of an independent organization:

The International Accreditation Forum (IAF). The quality system for the design and manufacture of THP is certified to be in conformity with the requirements of ISO 9001: 2015 quality assurance standard.

#### Strict and systematic checks

During manufacture, each THP functional unit is subject to systematic routine testing with the aim of checking the quality and conformity of the following features:

- measuring of opening and closing speeds
- dielectric test
- testing of safety systems and interlocks
- testing of low voltage components
- conformity with drawings and diagrams.

The results obtained are recorded and approved by the quality control department on each device's test certificate. This therefore guarantees product traceability. Control of vacuum interrupters Each vacuum interrupter, sealed and airtight, is checked for the quality of the vacuum obtained. This pressure measurement is based on the proven "magnetron discharge" method. Using this sophisticated procedure, measurement is very precise and does not require access to the inside of the bulb, thus not affecting the airtight seal.

## Protected environment

As part of the group's environmental policy, TGOOD provides you to recover high voltage switchgear and thus eliminate any discharge to atmosphere. In order to help you protect the environment and to relieve you of any concerns in terms of stock or dismantling, TGOOD service offers to take back your equipment at the end of its life. THP has been designed with environmental protection in mind:

- all materials used, for instance insulators and conductors, are identified, and easily separable and recyclable.
- SF<sub>6</sub> usage is reduced in THP, and SF<sub>6</sub> can be recovered at the end of the equipment's life and reused after treatment.
- production sites are certified to ISO 14001.

## Occupational Health and Safety

Occupational Health and Safety (OH&S) bears highest importance at TGOOD. TGOOD demonstrates its commitment towards control of the risks and improvement in performance of OH&S by complying to OHSAS 18001:2007 certified by China National Accreditation Service (CNAS). TGOOD management believes in process approach and its policy is based on PDCA methodology that focuses on elimination or minimizing risks to personnel and other interested parties who could be exposed to OH&S hazards associated with its activities. Strong mechanisms are in place to assure that TGOOD performance on OH&S not only meets, but will continue to meet, its legal and policy requirements.





TGOOD provide a service near you throughout the lifetime of your installation.

### Specifying

We help you to define your solutions: selection guide, technical assistance, expert advice...

### Implementing

We oversee the completion and commissioning of your installation: design, cost optimization, guaranteed performances and dependability, commissioning tests, etc.

### Operating

We help run your daily operations in real time: maintenance contract, technical assistance, supply of replacement parts, corrective and preventive maintenance, operation and maintenance training, etc.

### Modernizing

We can keep your installation up to date with all the latest upgrades: installation audit, switchgear diagnosis, adaptation and modification, end of life recycling, etc.

### Dismantling

We dismantle your complete switchgear at the end of its service life: disassembly, material data sheets, environmentally-compatible recycling.

### Examples of services provided

- Warranty extension

A warranty extension is proposed if your installation is checked by ourselves before being commissioned.

- Circuit-breaker-disconnector diagnosis

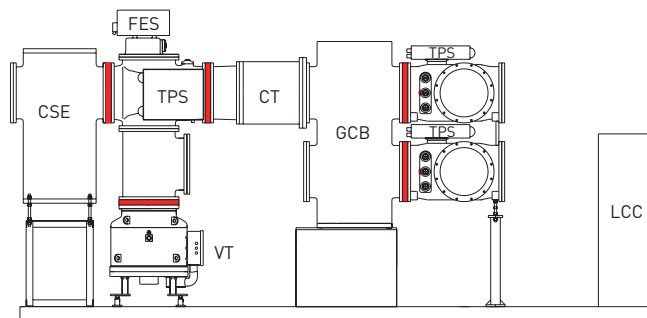
Throughout the life of the equipment, it is possible to carry out routine measurement of its characteristics in order to optimize maintenance. This service may be part of a global installation maintenance contract.

- End-of-life recycling

TGOOD Services allow you to recycle your high voltage switchgear.

The TGP145 is a 145kV gas-insulated metal-enclosed switchgear. This is assembled from modules including:

- Circuit breakers (GCB)
- 3-position switches (TPS)
- Fast earthing switches (FES)
- Current transformers (CT)
- Voltage transformer (VT)
- Lightning arrester (LA)
- Cable terminals(CSE)
- Busbar
- Enclosure
- Local control cubicle(LCC)



*GCB with spring mechanism*

### Circuit breaker(GCB)

The GCB is a standard tank style device in which the three phases of the GCB share one spring-driven mechanism to achieve mechanical linkage.

The circuit breaker adopts the self-arc-extinguishing technology. When the short-circuit current is broken the arc burns between the moving arc contact and fixed arc contact, which produces massive energy to heat the  $\text{SF}_6$  gas in the expansion room. This allows the gas pressure in the expansion chamber to increase, causing a pressure difference in and out the expansion room. When the moving contact reaches a certain position during the process of opening, the nozzle will be drawn out from the fixed contact and blow the burning arc to be quenched.

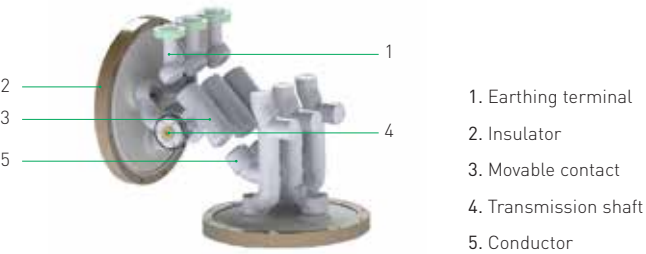
### Spring mechanism

The GCB incorporates a spring mechanism which is equipped with a mechanical anti-bound device with an electrical anti-bound also available.



3-position switch

The compact 3-position switch of the TGP145 enables conduction, isolation, and grounding. The three-phase linkage driven by an actuator has an opening and closing bus switching current capability.



3-position switch module



This well designed 3-position switch boasts a compact structure and reliable performance. As one of the standard modules, it can realize connection with the VT, incoming/outgoing module, earthing switch, busbar, lightning arrester, etc. This 3-position switch on the busbar side could also be used directly as the busbar (replacing the busbar).

A motor operating mechanism is incorporated, including 2 driving motors. The positive and negative rotation of the motor force the spindle to turn, which will make the driving nut in linear movement. The driving nut forces the output shaft to turn through the pin shaft. Through changeover by a toothed wheel and belt, the reciprocating movements of moving contact among connecting, disconnecting and earthing can be achieved.



*FES mechanism*

### Fast earthing switch (FES) and earthing switch (ES)

The ES of the TGP145 can also be mounted separately besides the one in the 3-position switch. It can be divided into the working ES that provides protection during maintenance and the FES (also known as the fault switching earthing switch) that is able to switch short circuit current and inductive current. The working ES is equipped with a motor mechanism, while the FES is equipped with a motor-spring operating mechanism.

The ES can be separated from the earthing enclosure; an electrical connection with the main circuit through the moving contact is available after disassembling the earthing busbar from the earthing enclosure for measuring the circuit resistance and mechanical performance test, which could facilitate the test work.

Interlocks among FES and the related 3-position switch and circuit breaker are available to prevent fault operation.

### Operating mechanism

The working ES is equipped with a motor mechanism that is the same or similar to that of the 3-position switch, while the FES is matched with a motor-spring mechanism (CTJ). The CTJ motor-spring mechanism is comprised of parts like the motor, driving mechanism, charging spring, buffer and jiggle switch, etc. The motor drives the worm wheel, which forces the spring bent arm to compress the charging spring to its dead point at which point the spring cannot be compressed any further. At this position the charging spring releases its stored energy automatically; then the high speed rotation of the spring bent arm and output bent arm drive the ES to complete the opening / closing action with high speed through the connecting rod.

The opening / closing operation of the mechanism is achieved by the positive and negative rotation of the control motor.

Local opening / closing is possible by hand through the operating handle that is available for the CTJ mechanism.

## Current transformer(CT)

The CT is an element used to achieve current measurement and over-current protection in the TGP145. The TGP145 is matched with LR (D) Ring-core type CTs. There is a screen between the conducting rod and the secondary coil.

The outgoing line of the secondary coil is induced to the external through the terminal board sealed with an epoxy cast.

The secondary coil of the CT cannot be opened during operation, as it will result in an abnormally high voltage surge and may destroy the insulation performance of the secondary coil, outgoing terminal, relay or gauges.

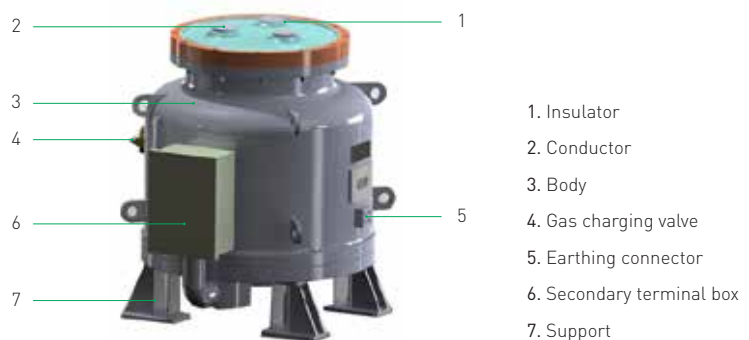


CT module

## Voltage transformer(VT)

The VT is an element to achieve voltage measurement and abnormal voltage protection in the TGP145. The TGP145 includes an electromagnetic 3-phase  $SF_6$  VT. The secondary winding and primary winding is twisted on the coaxial tube, while the terminal of the secondary winding and the terminal marked "N" of the primary winding is led to external by the epoxy cast terminal board. The terminals with "A", "B" and "C" of the primary winding are connected to the HV electrode.

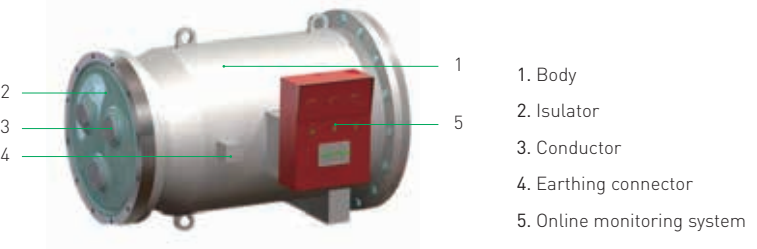
Short circuit of the secondary side is forbidden when VT is in operation, otherwise the large current on the secondary side will damage the VT.



VT module

Lightning arrester

The lightning arrester used in the TGP145 uses 3-phase SF<sub>6</sub> insulation and is in a tank style, with a gapless metallic oxide structure. The protection performance is good, with low residual voltage.



Lightning arrester module

Busbar

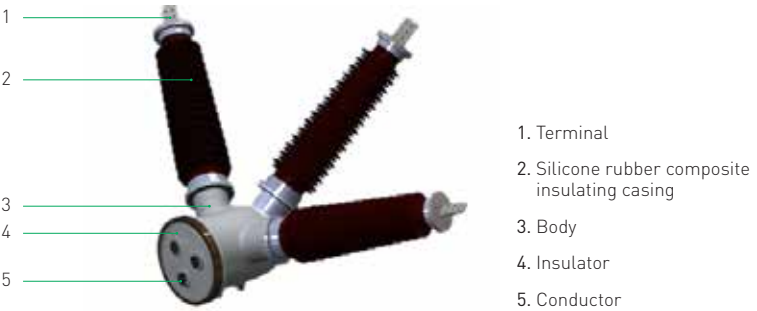
The TGP145 main busbar is a 3-phase enclosure-sharing structure (the 3-position switch shares part of the busbar). The 3 phase conductors are in a delta layout inside the enclosure, which are fixed to the enclosure using insulators.



Busbar module

Bushing

The porcelain bushing of the TGP145 filled with SF<sub>6</sub> gas or silicon rubber porcelain is used to connect the GIS with overhead lines. The external insulating creepage distance is 25mm/kV (class III pollution) or 31mm/kV (class IV pollution).



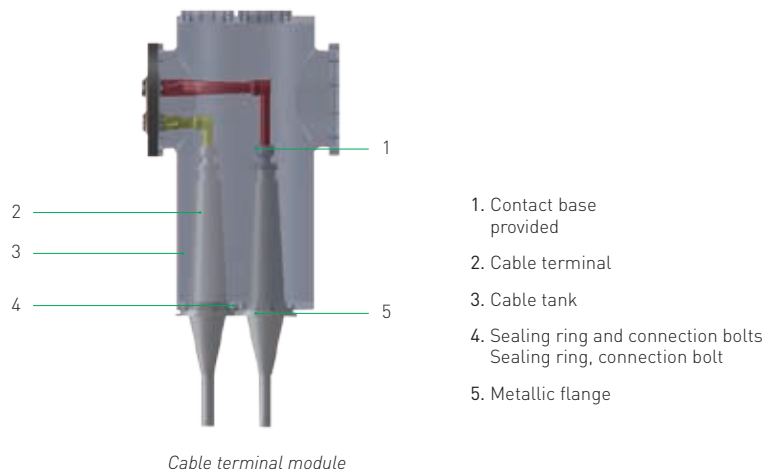
Bushing module



TGP145 with overhead line

### Cable terminal

The Cable terminal of the TGP145 is used between the GIS and outgoing cable part. According to IEC 60859, the cable and terminal supplier is responsible for the installation of the cable and the terminal. The GIS supplier is responsible for the joining of the cable terminal and GIS, including sealing and connecting of the conductive loop.



*Local control cubicle*

### Enclosure

The TGP145 enclosure is mainly used for sealing and supporting the primary main conducting circuit. The enclosure is made from welded aluminum alloy or cast aluminum alloy, which is light, corrosion resistant, does not suffer from eddy current loss and small increases in the temperature.

### Local control cubicle

The secondary control, measurement and monitoring devices are designed into the local control panel which serves not only as a relay hub for various components inside and outside of the TGP145 bay, but also as a central hub for site control, monitoring and remote measurement and, control and communication.

The local control panel has functions such as local control, signal transmission, protection and relay, as well as monitoring of the gas compartments of the GIS.

According to the different control modes of the secondary part, the TGP145 can be classified into an intelligent GIS with digital control and a standard GIS with normal control and monitoring technologies.



*Density controller*



*Red and green*

### Summary of modules

The 3 phases of the TGP145 share one standard enclosure, while the other components are separated into different compartments. The main conducting circuit is supported in the middle part of the enclosure by a solid insulating assembly, and spring contacts are adopted as a transitional connection. It can be connected with the overhead line through gas-filling tubes, connected with the power cable through the cable terminal or connected with the transformer directly through oil bushing.

The gas system of the TGP145 can be divided into several gas chambers. Normally the CB shares a gas chamber with the CT; while the main busbar, VT and lightning arrester are mounted in separate chambers respectively, and the other components are enclosed in their related chambers according to the engineering requirements. Each gas chamber is equipped with a density controller for gas pressure monitoring. The gas-tight bushing or gas-permeable bushing can be distinguished by the red and green ring belt around the tube.

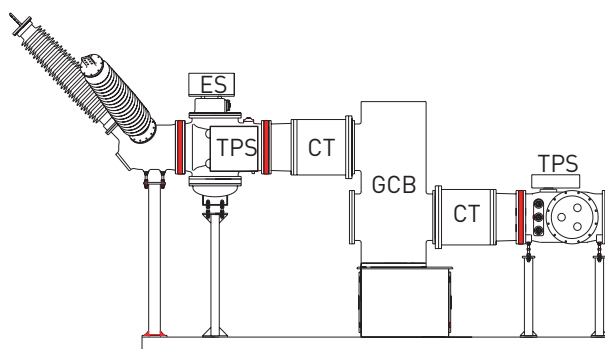
Generally, each configuration of the TGP145 is designed with a local control cubicle (LCC). The control and state signals of various components, density monitoring and measuring signals of various gas compartments and the secondary outgoing lines of the CT and VT all lead to the local control cubicle which in turn is connected to the main control room.

The modules of the TGP145 are integrated together into a sealed and grounded metal enclosure which depending on requirements can be set into various configurations to create bays that are then connected together via the busbar. The TGP145 uses SF<sub>6</sub> gas at pressure as the insulation medium resulting in an outstanding environmental performance.

It is comprised of various partitions called bays that serve different functions, it includes:

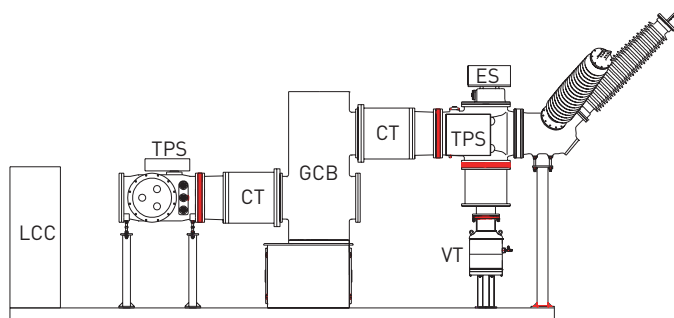
- Incomer (feeder) bay
- Single-bus main transformer bay
- Single-bus line bay
- Busbar coupler bay
- Measurement and protection bay

### Single-bus main transformer bay



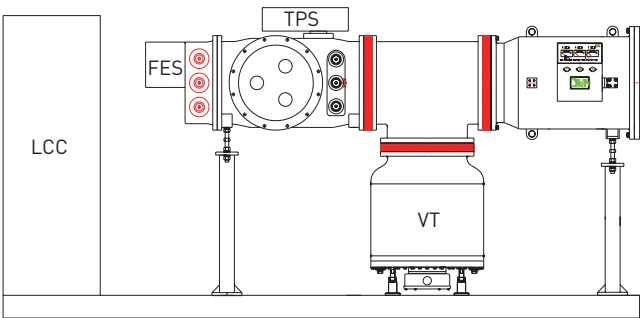
*Single-bus main transformer bay*

### Single-bus line bay



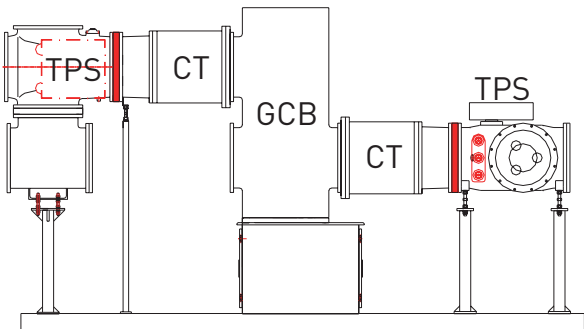
*Single-bus line bay*

Measurement & Protection bay



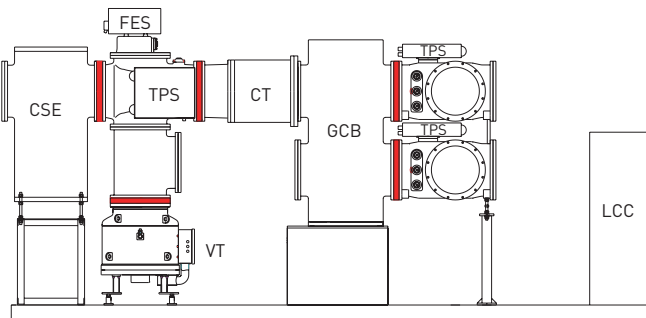
Measurement & Protection bay

Coupler bay



Busbar coupler bay

Double-bus bay



Double-bus bay

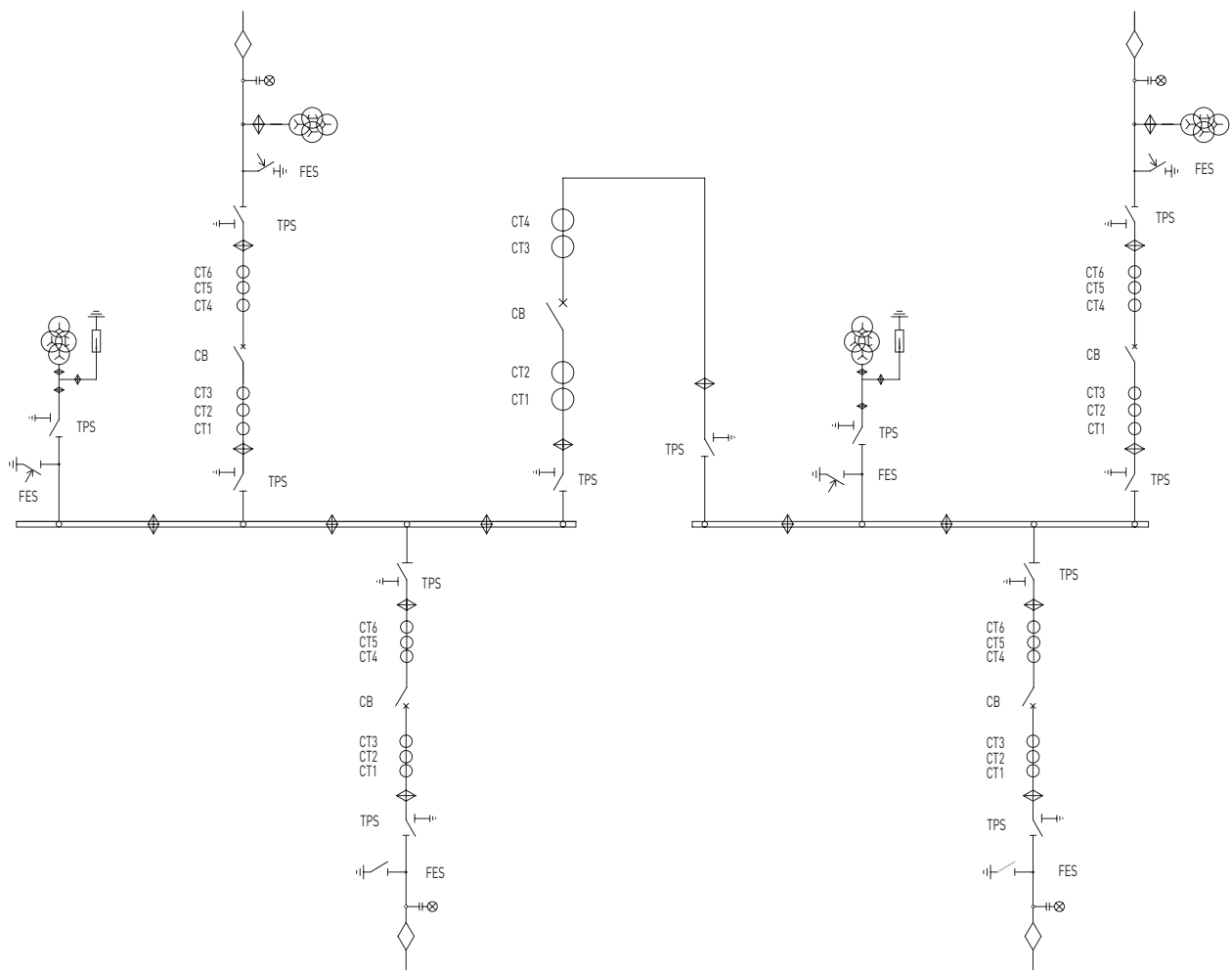


Multiple styles of connections can be provided according to the different requirements of each customer, such as:

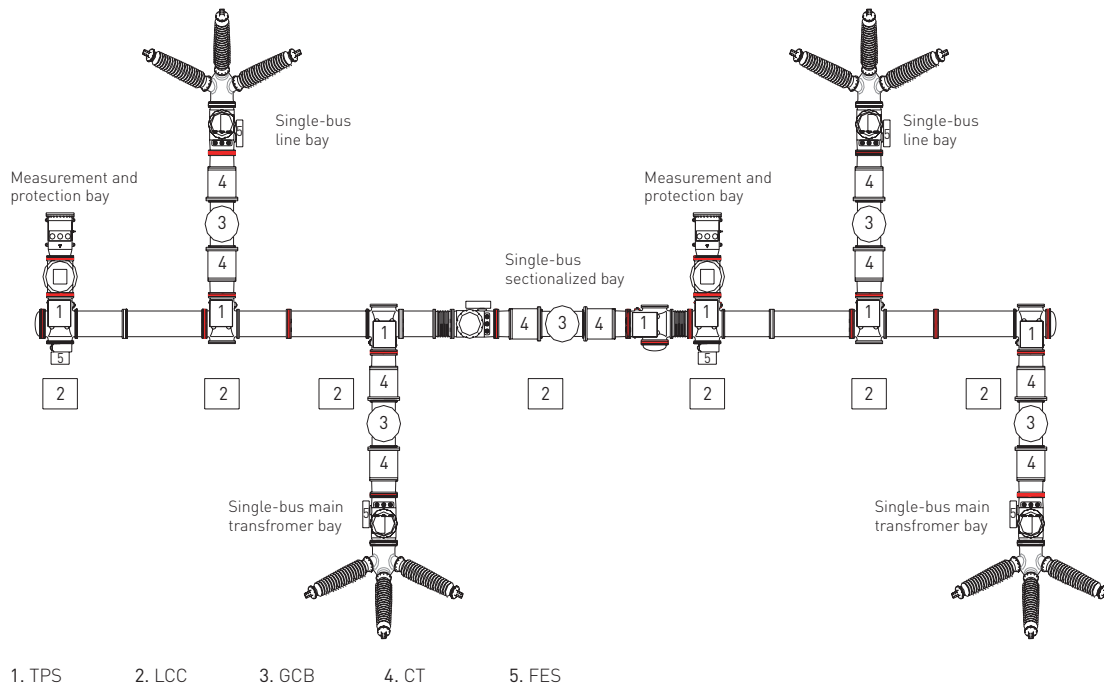
- sectionalized single-bus configuration,
- double-bus configuration
- bus-tie configuration.

## Single busbar configuration

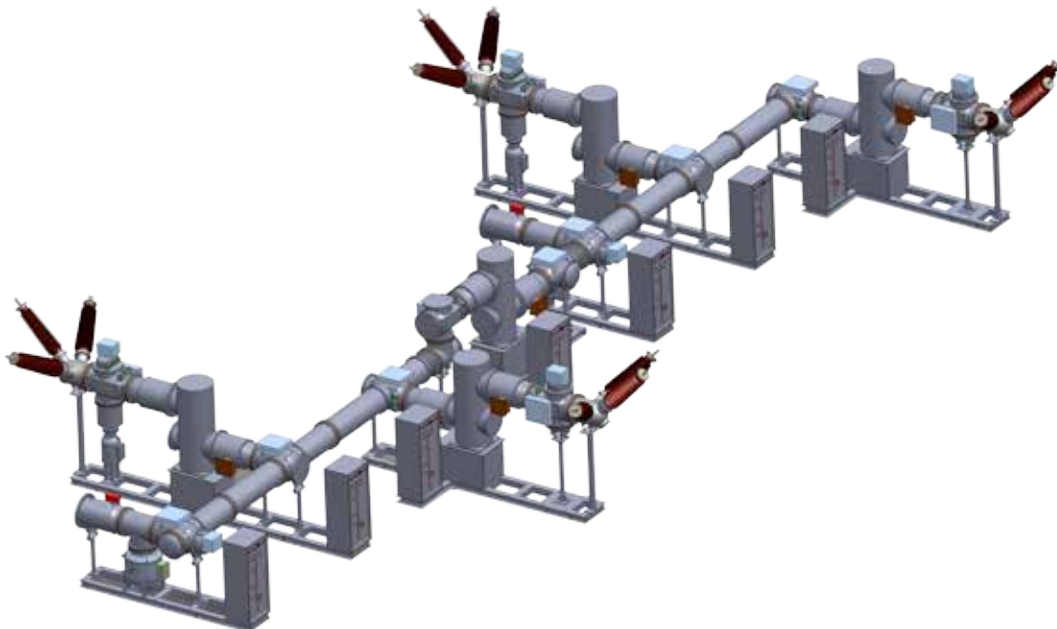
Smaller substations or single-feed stations are frequently designed with single busbar arrangement. The layout of a substation with single busbar arrangement is similar to that of one with a double busbar. Either the lower or upper busbar is not applicable. A single busbar arrangement can later be upgraded to a double busbar arrangement, when appropriate connection flanges are added to the circuit breakers on the initial version.



Single line of Single-bus sectionalized configuration



Top view of Single-bus sectionalized configuration



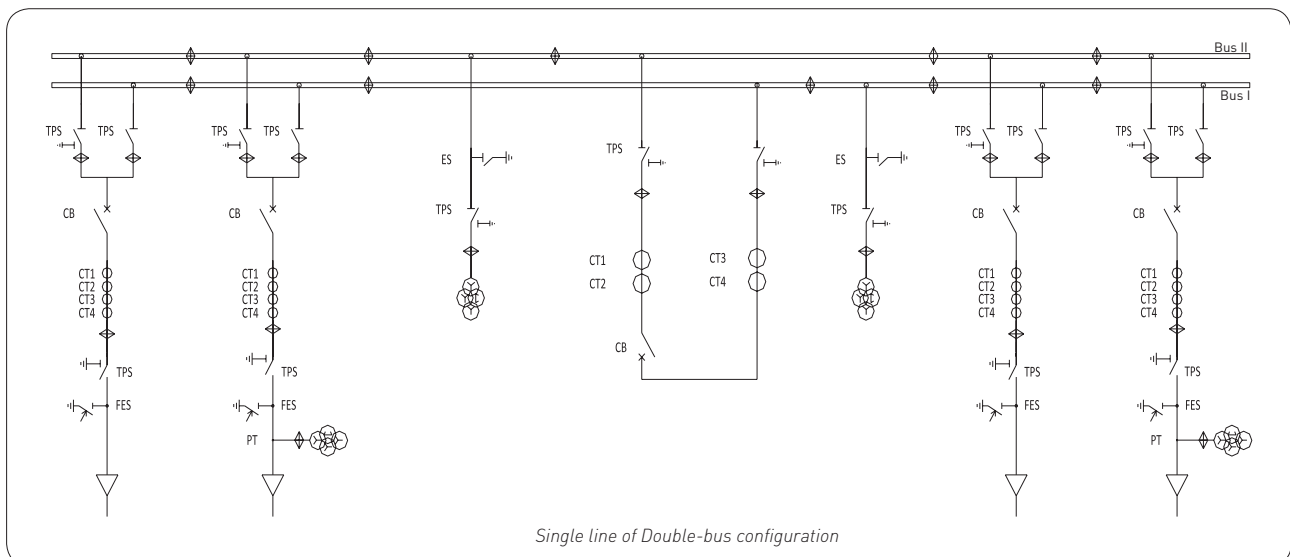
3D view of Single-bus sectionalized configuration

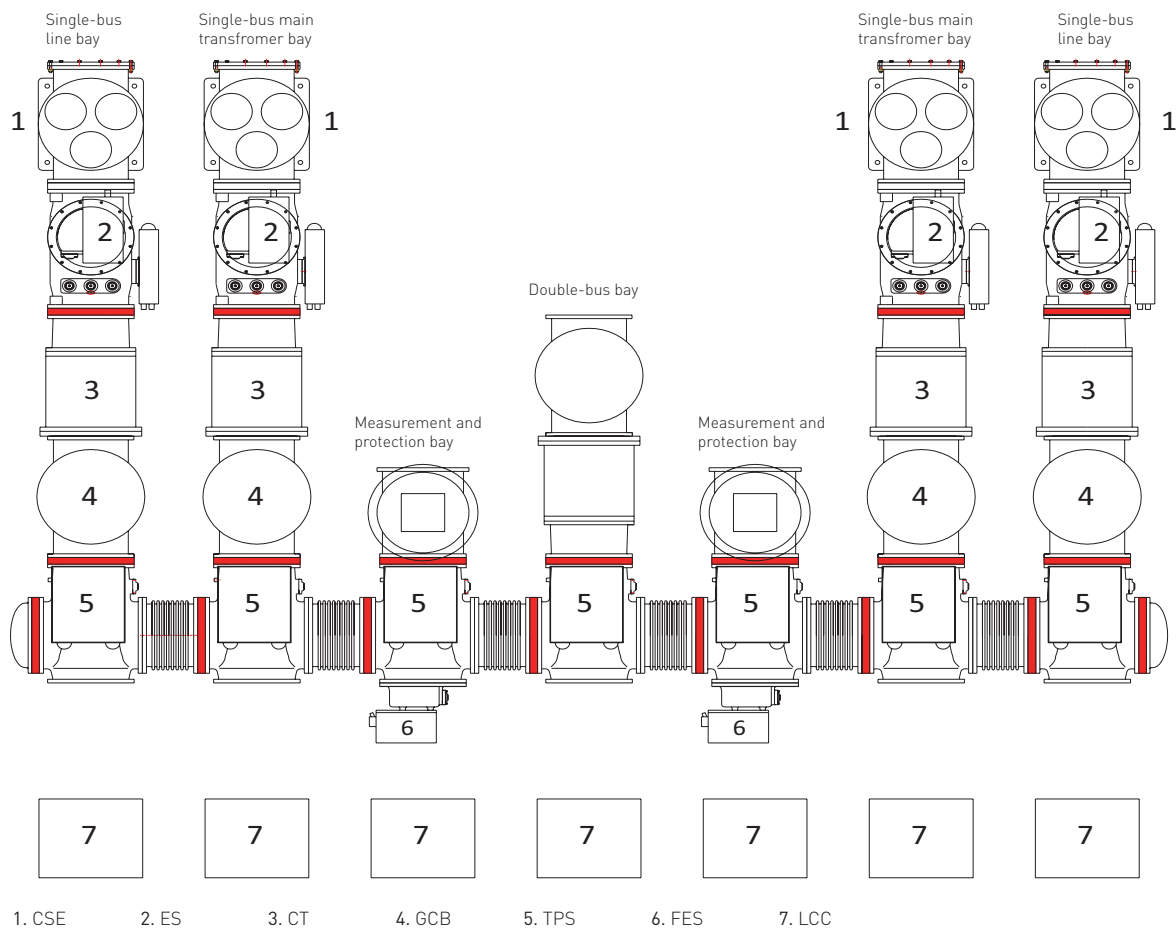
## Double-bus configuration

This configuration is the most common for important substations, power plant feed-ins etc.

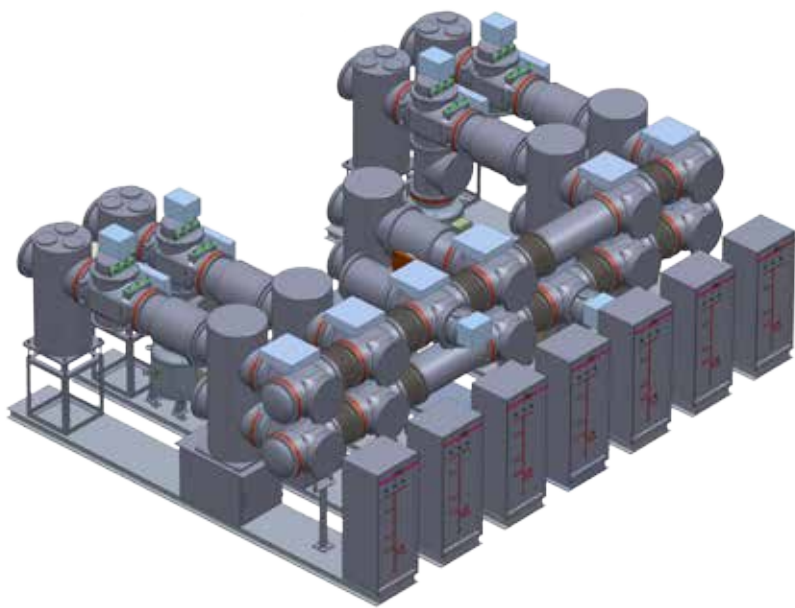
If both busbars are operated with the same priority – as opposed to one main busbar and one reserve – the principle of busbar separation can be applied to reduce the short-circuit current. Both busbars and their feeders are part of separate sub-grids. If required, individual feeders can be allocated to the other sub-grid. This concept relieves the substation equipment as a result of reduced short circuit withstand capability and longer maintenance intervals. In addition, it guarantees greater safety of energy supply.

The different coupling variants show a wide range of applications: Two examples are the simple bus coupling or the combined sectionalizing and bus coupling with six or eight disconnector switches. Double disconnector switches allow even subsequent high voltage tests after station extensions or maintenance during semi-normal operation.



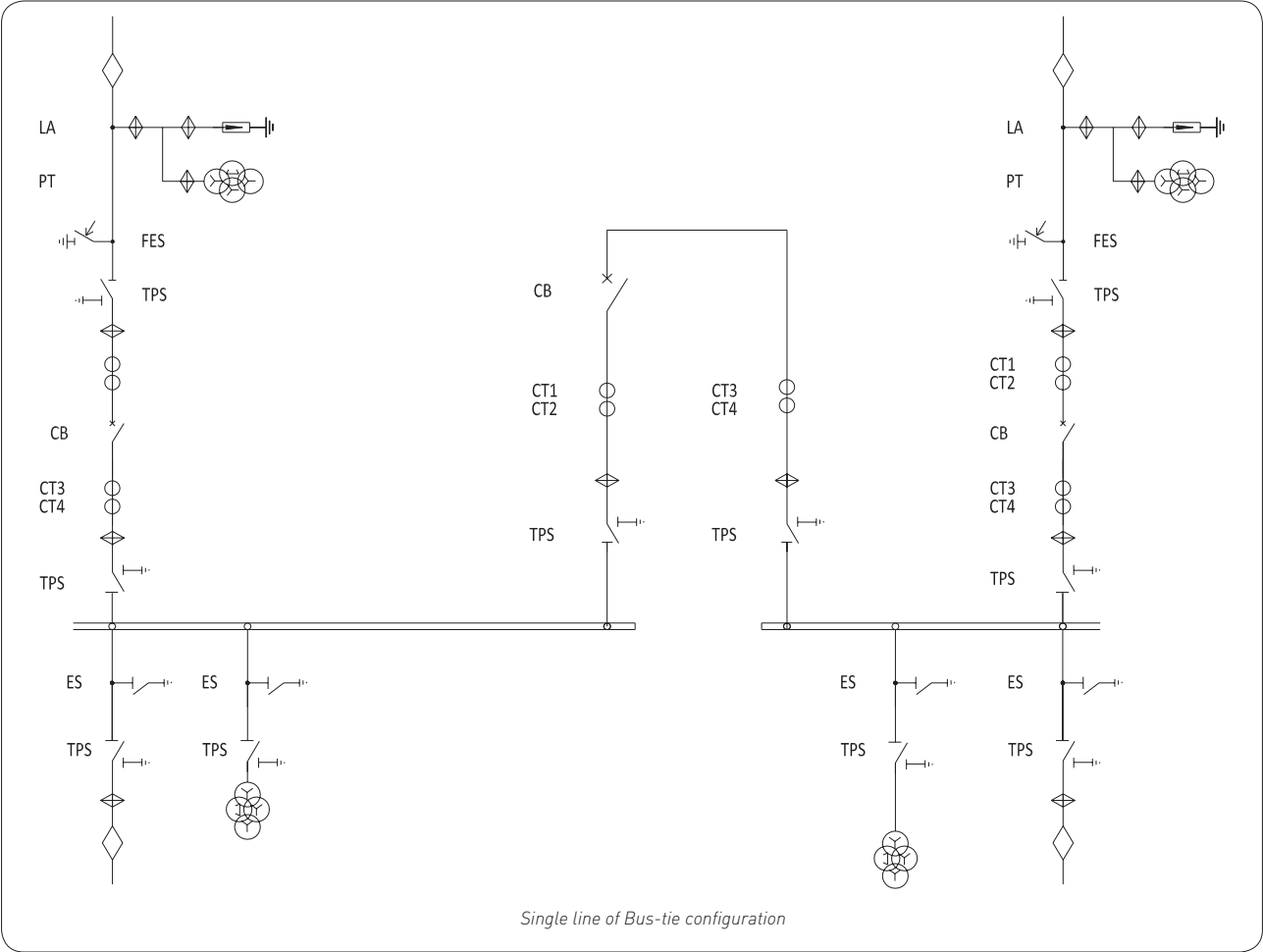


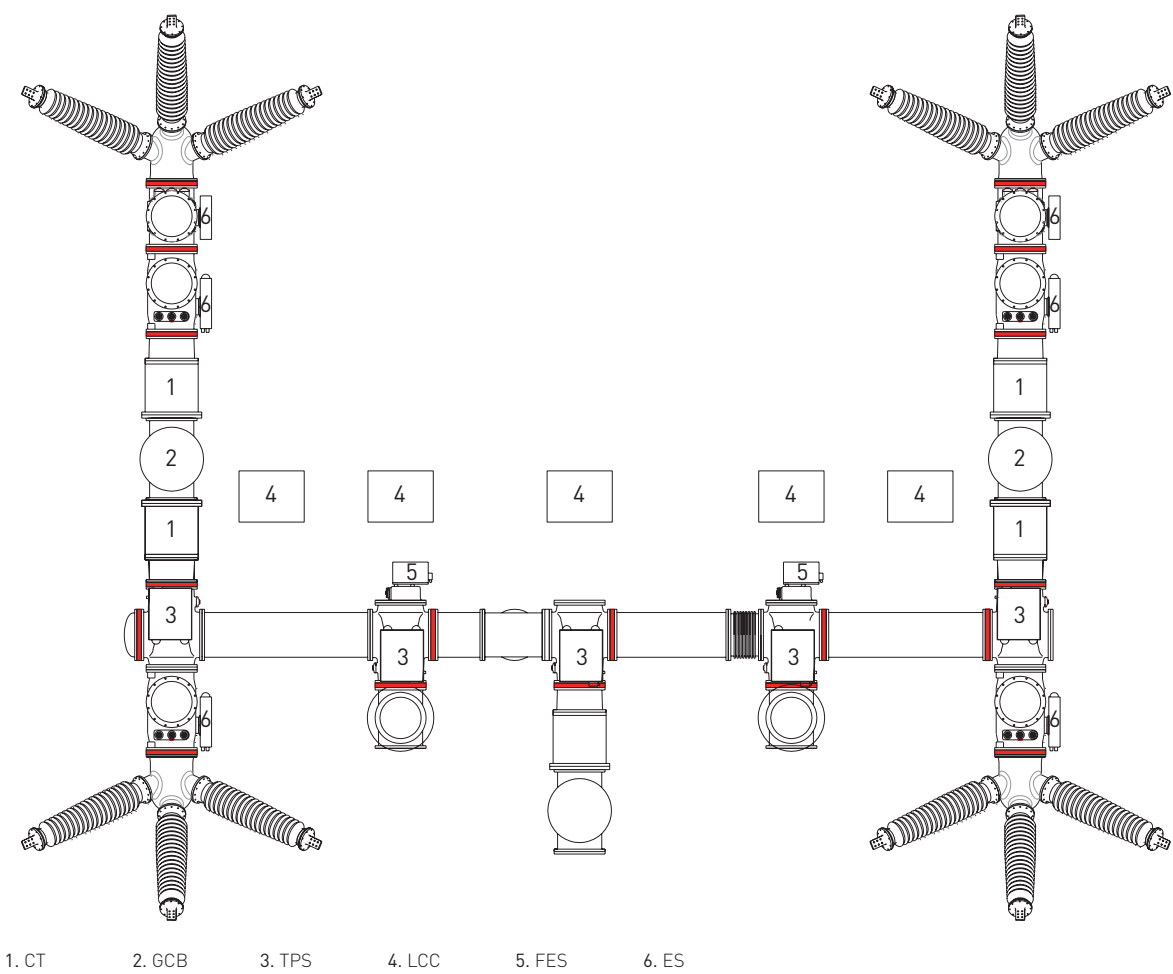
Top view of double-bus configuration



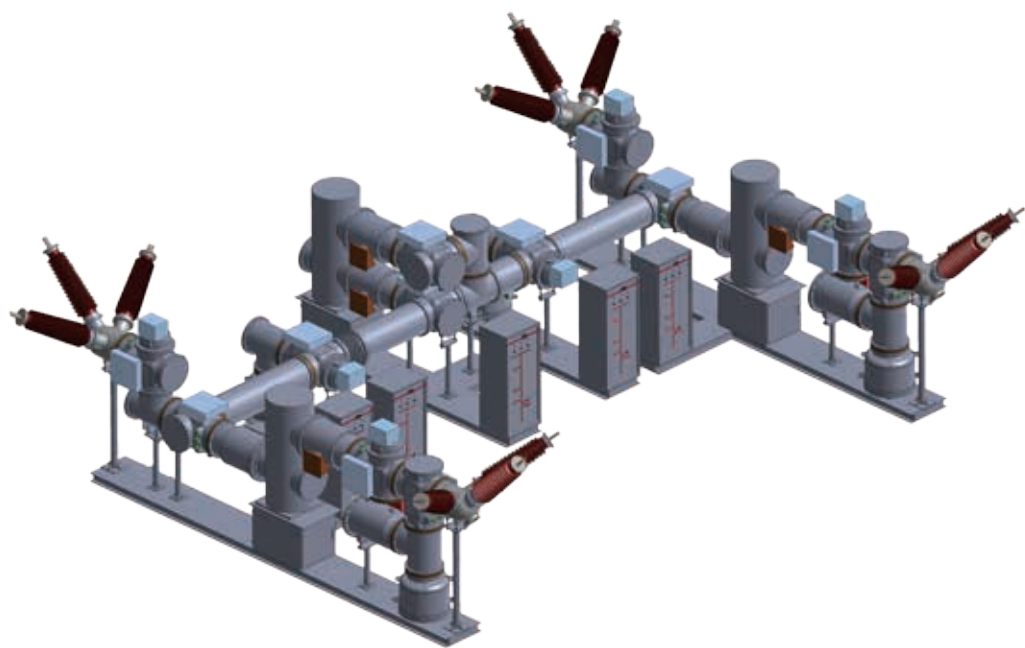
3D model of double-bus configuration

Bus-tie configuration





Top view of Bus-tie configuration



3-D model of Bus-tie configuration

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