THP/TCB

Up to 145kV Hybrid Gas Insulated Switchgear

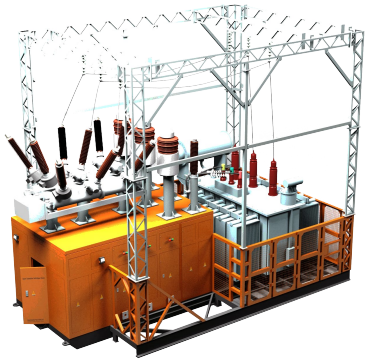
Catalogue

2020

TGOOD

tgood.com

Application



Product description

THP is hybrid gas insulated switchgear: Hybrid means integration of advantages of AIS and GIS – usage of mature reliable components of GIS and AIS busbar module.

THP parameters as below:
- Rated voltage: 40.5kV, 72.5kV, 145kV
- Rated current: 2000A~3150A
- Rated short circuit current: 31.5kA~40kA
- Rated short circuit withstand current (peak): up to 104kA
- Space occupied: average 2.9m²

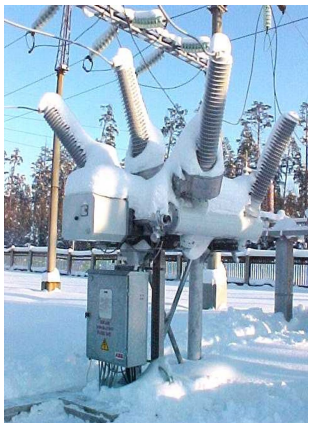
Application

It has been widely used in many industries:
- Power and renewables
- Railway
- Coal
- Metallurgy
- Petrochemical

THP provides reliable and compact solution for outdoor substations. Its factory-prefabrication and modularization the demand for applications where:
- Substation construction or redevelopment has limited land for the substation
- Lead time for equipment and/or site works is minimal

THP's design and performance is proven by its installation across a wide range of applications and industries worldwide.

Benefits



Operational efficiency and reliability

- Reduced substation footprint, capital investment can be reduced significantly
- Reduced civil work saves construction time and cost.
- Pre-assembly and commissioning performed in factory significantly reduces time on site, improves quality, and decreases WHS risks associated with site work.
- Improved reliability through reduced components and critical operating mechanisms insulated from the environment.
- Reduced weight and size resulting in improved transport logistics and cost reduction.
- Significantly lower maintenance than AIS equivalent systems.
- The GIS concept adopted for THP make it suitable to run in the harshest environments with reliability.
- Intelligent solution for THP increase the operation efficiency in terms of monitoring, analysis and control

TGOOD THP is the ideal solution to High Voltage Substations applications that don't have the land available required for traditional Air Insulated Substations, but still want an Outdoor Substation without the costs associated with fully Gas Insulated Substations.

Components

Similar to GIS, hybrid GIS THP integrates versatile modules:

- Circuit breaker
- 3-position disconnector/earthing switch
- Current transformer (CT)
- Voltage transformer (VT)
- Local control cubicle

The busbar is not included because busbar is not assembled in SF_6 gas chamber, so the structure is clear, simple and compact, which shall ensure convenient assembly, repair, maintenance and reliable operation.

1. Bushing
2. 3-position disconnector/earthing switch
3. Circuit breaker
4. Current transformer (CT)
5. Operation mechanism
6. Local control cubicle
7. 3-position-switch viewing window

Components

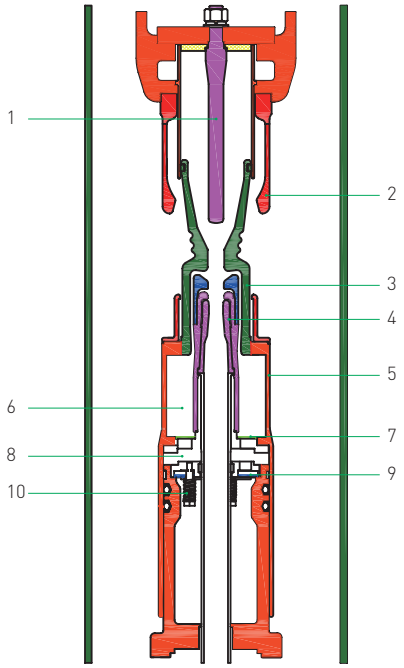
Circuit breaker

The core component of THP is circuit breaker, which is composed of:

- Automatic arc-extinguishing chamber
- Spring mechanism.

During large current switching, the arc energy heats and inflates the thermal expansion chamber, the one-way valve is closed. At current zero-crossing, the high pressure gas in the thermal expansion chamber blows at the fracture to extinguish the arc. During the opening process, the gas in supporting compression chamber is compressed; the pressure-relief valve will be opened when a threshold value is reached, to avoid over-large reaction force of compression on the mechanism, in this way the operation power can be reduced remarkably.

During small current switching, pressure generated from thermal expansion chamber is low, which is lower than pressure in the supporting compression chamber; at this point the one-way valve is opened, the compressed gas blows at the fracture.



1. Fixed arc contact
2. Main contact
3. Nozzle
4. Moving arc contact
5. Cylinder
6. Thermal expansion chamber
7. One-way valve
8. Compression chamber
9. Pressure relief valve
10. Pressure relief spring

Structure of arc-extinguishing chamber

Characteristics:

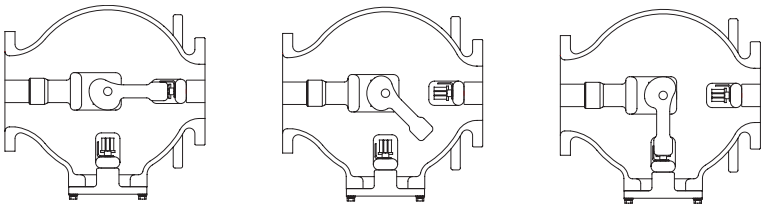
- Automatic arc-extinguishing chamber reduce the operation power
- Mature CT-30 operation mechanism
- Long mechanical lifespan with reliability

Components

3-Position switch

The functions of disconnector and earthing switch are integrated into a 3-position switching device, which share a rotary moving contact. The overall structure is simplified and the dimension is reduced. The 3-position structure shall avoid mis-operation between normal disconnector and earthing switch in terms of mechanical structure, so that the electrical interlock is simplified. The CJ-23 3-position disconnector mechanism enhances reliable switching.

Characteristics:
- 3-position structure reduces electrical interlocks and enhances reliability
- The contact of 3-position switch increases the current flux
- Its operation mechanism with clutch can realize manual operation, 10NO 10NC auxiliary contacts are provided
- 2 peepholes facilitate visual inspection of contact position



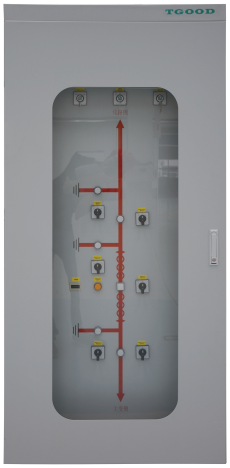
Closed position *Disconnection position* *Earthing position*

Bushing

The silicon rubber composite insulation bushing is made from epoxy resin impregnated fiberglass tube with silicone rubber shed.

Traditional porcelain bushing can be provided for special circumstances.

Characteristics:
- Excellent safety performance (fracture / explosion resistance)
- Light weight
- Outstanding pollution / rain resistant performance (water repellent);
- Dust storm resistant;
- Maintenance-free



Local control panel

Current transformer

Bushing type ring core CT is used for the THP. The external assembly of current transformer shall facilitate maintenance and replacement as well as production. Each CT can be equipped with multiple winding if necessary.

Local control cubicle (LCC)

LCC adopts double layer enclosure, with better heat insulation / waterproofing performance, shall ensure reliable operation of electronic elements inside.

Characteristics:
- Stainless steel enclosure ensuring long-term reliable outdoor application
- Position indication of all units
- Electrical interlocking
- Signals to central control room and protective equipment
- Sensors equipped for temperature / humidity and heating device
- IP4XDW

Compactness and flexibility

This kind of design for THP brings advantages of compactness, flexibility, and reliability, furthermore, a built-in intelligent solution also can be provided on customer request.

Compactness

Similar to compact structure of GIS, the circuit breaker, disconnector and VT are integrated into a fully-enclosed system of THP which is filled with SF_6.

- Land saving, one-time investment can be reduced
- Civil work can be reduced
- Weight and size can be reduced; compartment delivered as a whole
- Short power-off time during substation reconstruction

Double busbar arrangement

Single busbar arrangement

Flexibility

The different modules of THP can be combined to different solution which meet diversified demands. The main advantage includes:

- Indoor or outdoor application
- Short delivery time
- Double busbar and single busbar arrangement

Roof installation

Indoor installation

Reliability

THP decreases some risks which exist on AIS:
- Low reliability of disconnector and Circuit Breaker during outdoor operation
- Porcelain bottle damage
- Operation failure
- Overheat of conduction main circuit
- Corrosion

The reliability of THP is enhanced thanks to reduced quantity of components and pre-assembly & factory commissioning:
- Component quantity reduced

Due to optimized design, the quantity of insulation bushing and support bar is reduced by 30% ~ 50% for THP; the flashover (to earth) frequency of insulation support bar caused by pollution is reduced, the operation reliability is enhanced as a result.
- Pre-assembly & factory commissioning

In contrast with AIS, the characteristic of THP is that the assembly and commissioning of the equipment can be performed in workshop, so that the quality of equipment can be enhanced.
According to statistics[1], 70% defects of the newly-built substation within 2 years are resulted from quality problems of assembly and commissioning, which are eliminated in workshop for THP. One THP means a complete protection compartment. All internal components are assembled in workshops with cleanness level of 100,000 ppm.

Voltage withstand routine test

Circuit resistance measurement

(1) Resource from SGCC information

Intelligent solutions

Intelligent substation

THP can provide on-line monitoring, data analysis and automatic diagnosis through sensor and intelligent terminal technologies.

Characteristics:

- Electronic transformer: which features small size, light weight, high precision, large bandwidth, large measurement scope, good linearity, mature technologies and simple structure
- Optical fiber communication: it replaces complicated control cables to simplify the secondary wiring and reduce cost
- Intelligent terminal: It converts the opening and closing commands from protection, measurement and control device
- Digital monitoring: on-line monitoring and management system discover defects of equipment in time and reduce unexpected issues

Electronic transformer

It isintegral to the functioning of a smart substation, which takes digital measurements of primary circuit in substation. The electronic transformer can be divided into active and passive type according to the criteria that whether power supply is needed at high voltage side.

- The active electronic transformer shall measure the primary large current through Rogowski coil or LPCT coil, and measure primary high voltage through capacitive voltage divider or reactive voltage divider.
- Passive electronic transformer shall measure current through Faraday magneto-optic effect and Sagnac effect, and measure the voltage through Pockel electro-optic effect.

Electronic CT

Electronic VT

Hybrid GIS THP

Items			Unit	Parameter		
Rated voltage			kV	40.5	72.5	145
Rated current			A	2000	2500	2500
Rated frequency			Hz	50, 60	50,60	50, 60
Rated power frequency withstand voltage (1 min)		between phases, between phase and earth	kV	95	140	275
		fracture	kV	118	160	315
Rated lightning impulse withstand voltage (peak)		between phases, between phase and earth	kV	185	325	650
		fracture	kV	215	375	750
Rated short time withstand current			kA	31.5	40	40
Rated peak withstand current			kA	80	104	104
Rated short-circuit duration			s	3	3	3
Resistance of main circuit			μΩ	≤140	≤140	≤140
SF_6 gas pressure (gauge pressure, 20°C)		Rated pressure	MPa	0.50	o.62	0.65
		Alarming pressure	MPa	0.45	0.60	0.62
		Locking pressure	MPa	0.40	0.60	0.60
Water content of SF_6 gas (value at 20°Cduring acceptance inspection)			ppm(v/v)	≤150	≤150	≤150
Annual leakage ratio of SF_6 gas			%/year	≤0.1	≤0.1	≤0.1
Level of partial discharge		1 compartment	pC	≤5	≤5	≤5
		single insulating part	pC	≤3	≤3	≤3
Noise level			dB(A)	≤80	≤110	≤110
Bushing	Material		Porcelain or composite material			
	Creepage distance		mm	1013/1256	1813/2248	3625/4495
	Static load on terminal	Horizontal longitudinal	N	750	750	1250
		Horizontal transverse	N	500	750	750
		Vertical	N	750	1000	1000
Ambient temperature	Lowest[1]		°C	-35	-25	-25
	Highest		°C	40	40	40
Altitude[2]			m	≤2000	≤2000	≤2000

(1) Ambient temperature: -45°C~+55°C is optional;
(2) Higher altitude can be reached on request.

TCB Circuit breaker

Items		Unit	Parameter		
Rated voltage		kV	40.5	72.5	145
Rated current		A	3150	3150	3150
First-pole-to-clear factor			1.5	1.5	1.5
Rated short-circuit breaking current		kA	31.5	40	40
Rated short-circuit making current (peak)		kA	80	104	104
Capacitive current swithing	Line-charging	A	50	50	50
	Cable-charging	A	160	160	160
Rated operating sequence			0 – 0.3s – CO – 180s – CO		
Accumulative breaking times under rated short circuit breaking current		times	20	20	20
Mechanical lifecycle		times	10,000	10,000	10,000
Opening time (under rated operating voltage)		ms	50±10	30±5	30±5
Closing time (under rated operating voltage)		ms	70±10	80±10	80±10
Inter-phase unsynchronized opening time		ms	≤3	≤3	≤3
Inter-phase unsynchronized closing time		ms	≤5	≤5	≤5

Mechanism of disconnector / earthing switch

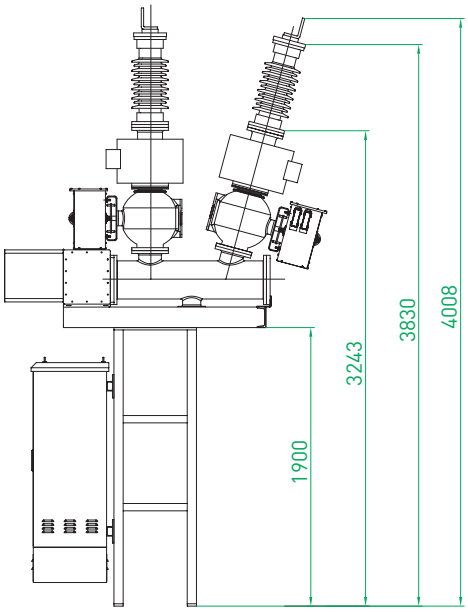
Items		Unit	Parameter
Mechanical lifecycle		times	2000 / 2000
Opening time		s	3~4
Closing time		s	3~4
Operating mechanism	Rated voltage	V	AC/DC 220
	Rated output power	W	360
	Output torque	N•m	120

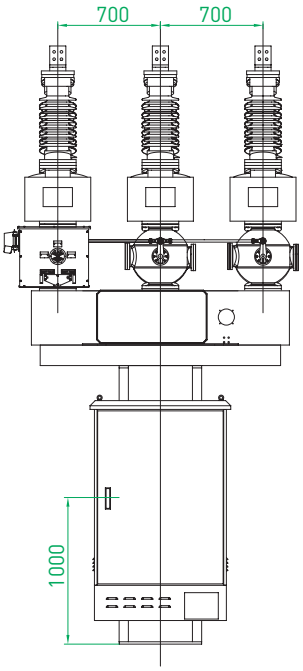
Current transformer

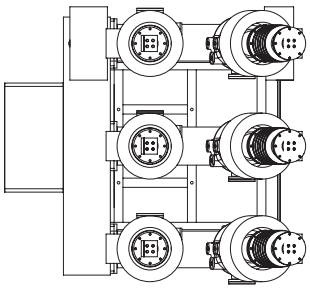
Items		Unit	Parameter	Remark
Normal transformer	Current at primary side	A	150/200/300/400/600/800/1000/1200/1600 /2000/3000	Detailed CT parameters shall be determined through negotiation between buyer and seller.
	Current at secondary side		5/1	
	Capacity	VA	15/20/30/40	
	Accuracy class		Measurement: 0.2s/0.2/0.5; Protection: 5P/10P	
Electronic transformer	Current at primary side	A	150/200/300/400/600/800/1000/1200/1600 /2000/3150	
	Rated secondary output		01CFH (protection), 2D41H(measurement)	
	Accuracy class		5TPE (protection), 0.2s (measurement)	

Dimension and installation

Out size dimensions

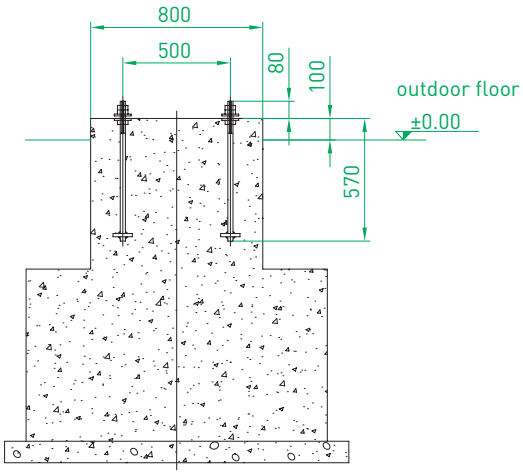


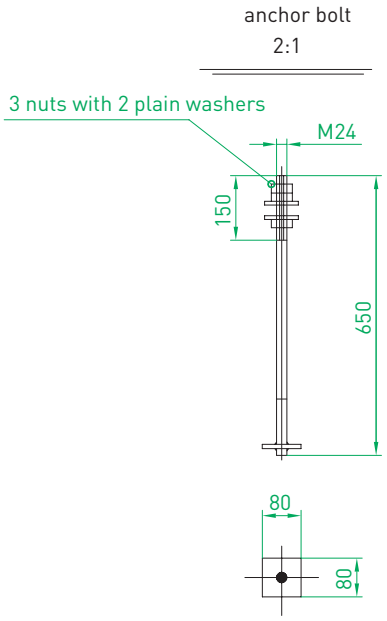


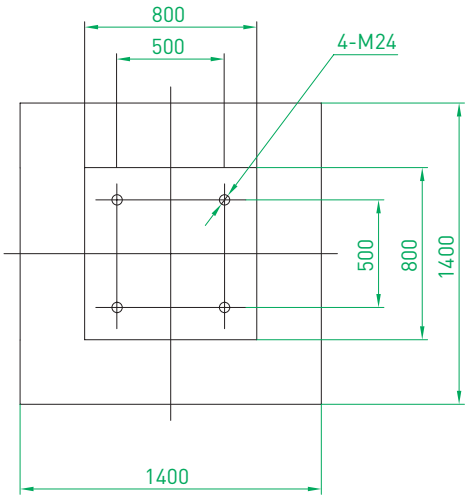


Dimension and installation

Foundation drawing







Note:

1. The anchor bolts shall be made of Q235-A steel. Chamfer the ends of thread area (2 x 45°); surface roughness of thread area is Ra6.3, the value for the rest area is Ra25. The fillet weld height of bottom square board > 8mm; all parts shall be treated with thermal galvanization, the zinc-layer thickness shall be greater than 85μm. The dimension requirements are for product after galvanization.
2. The length of the exposed part of the embedded M24 anchor bolt shall be 80mm; dimension tolerance of anchor bolt is +1mm.
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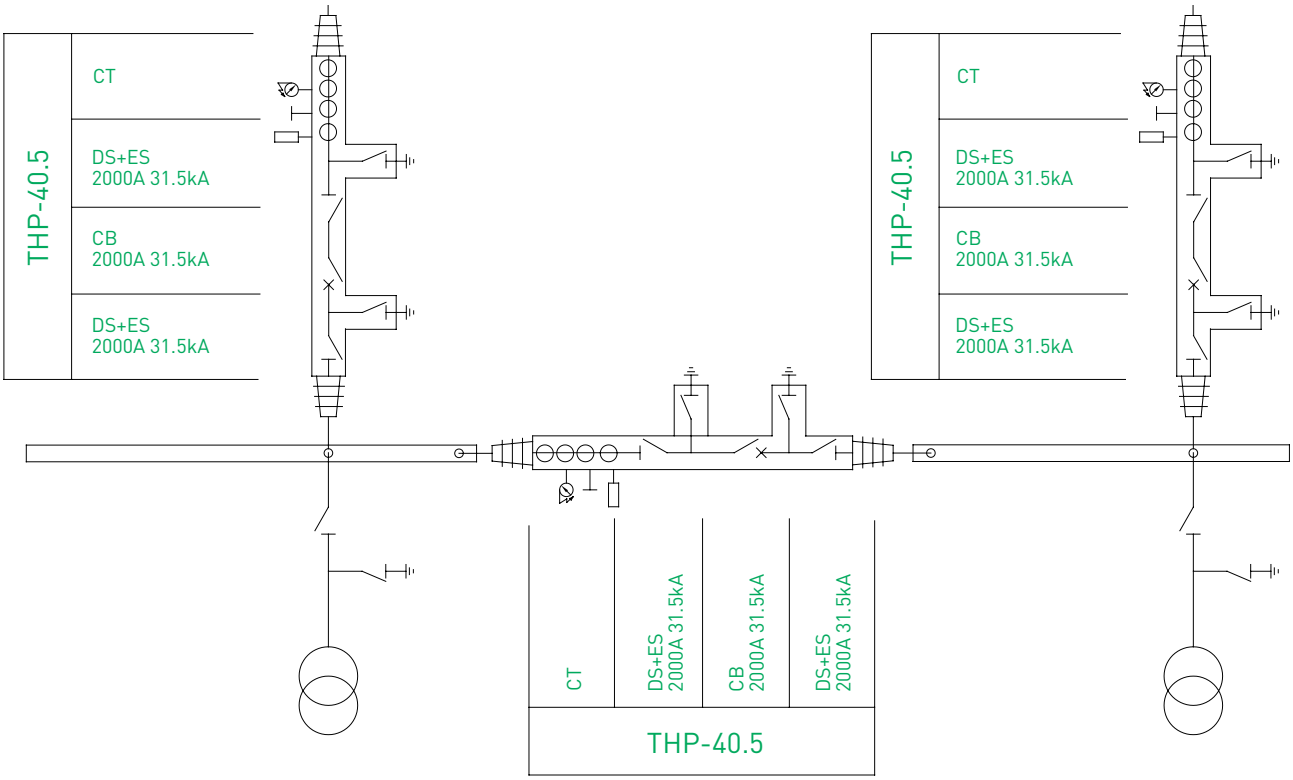
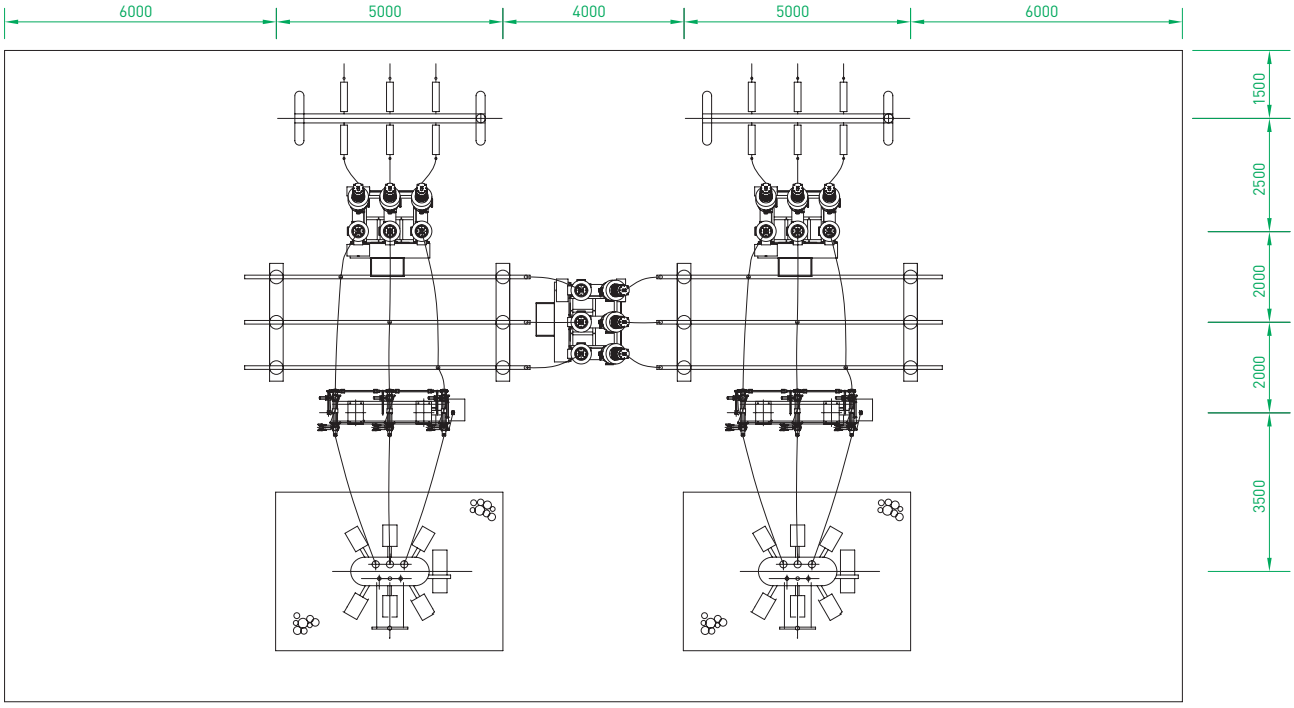
Inner-bridge configuration

Electrical diagram

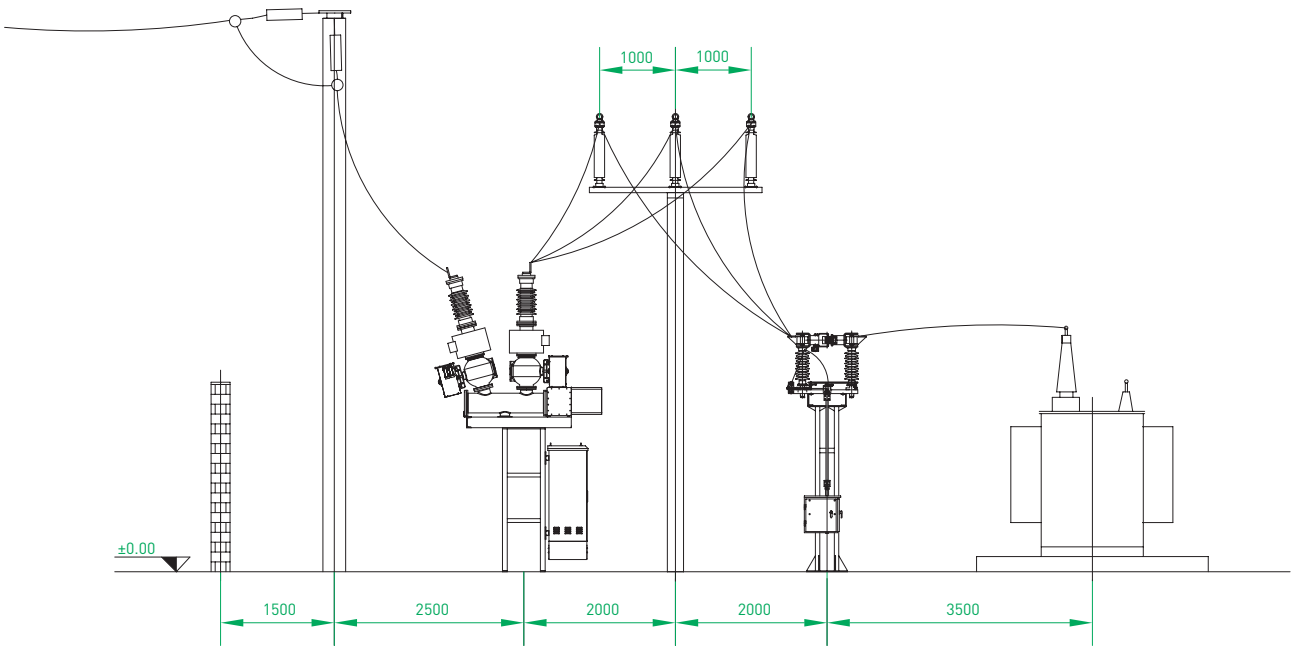


Inner-bridge configuration

Layout

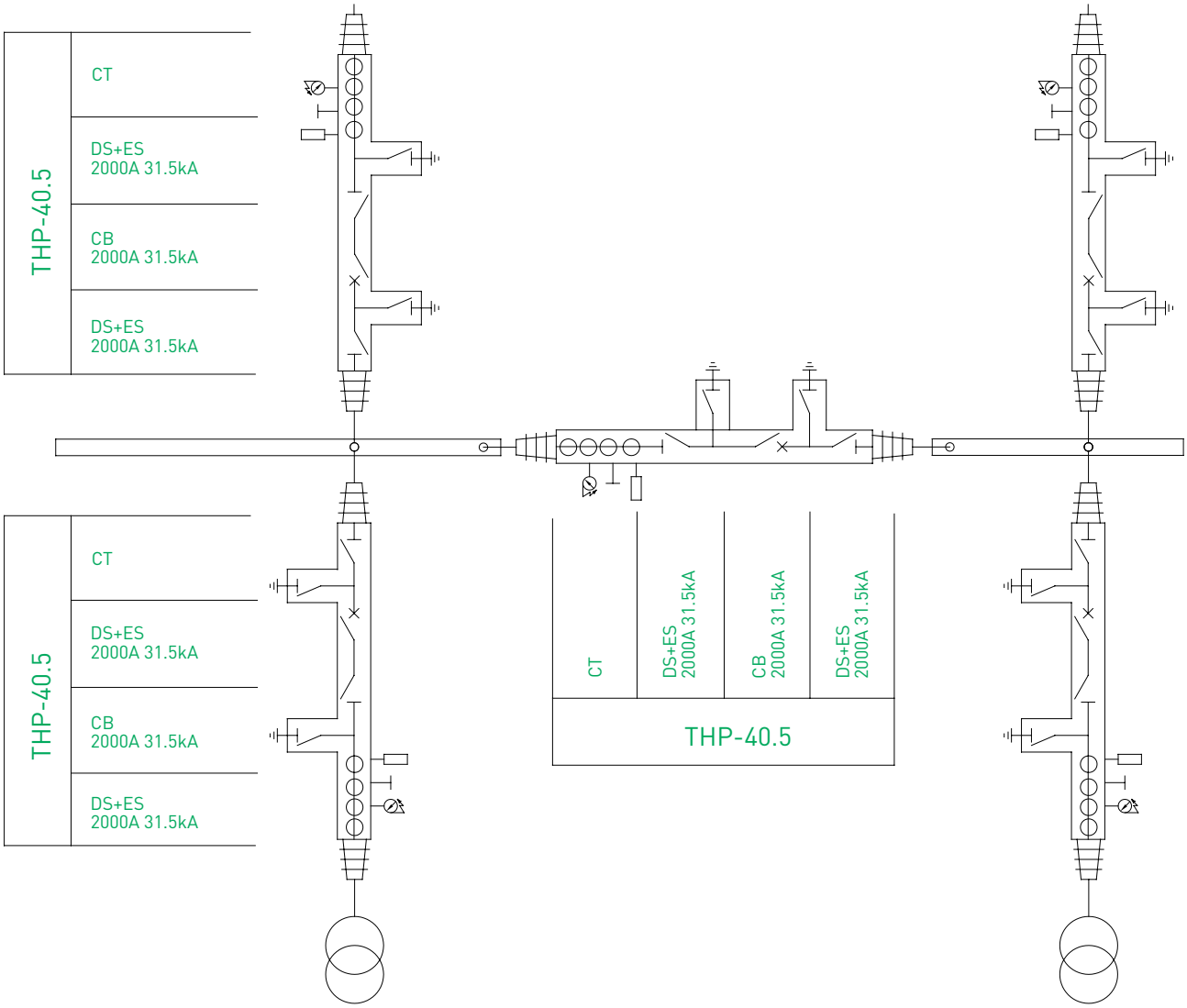


Section drawing



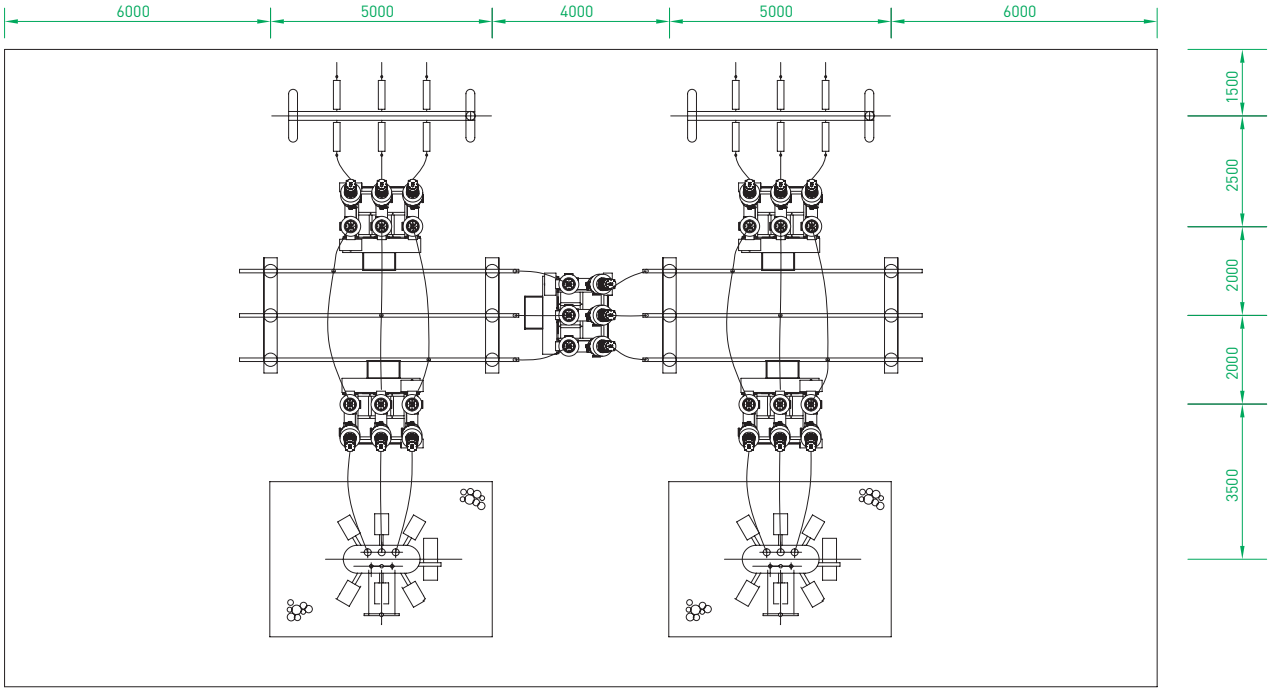
H type configuration

Electrical diagram



H type configuration

Layout



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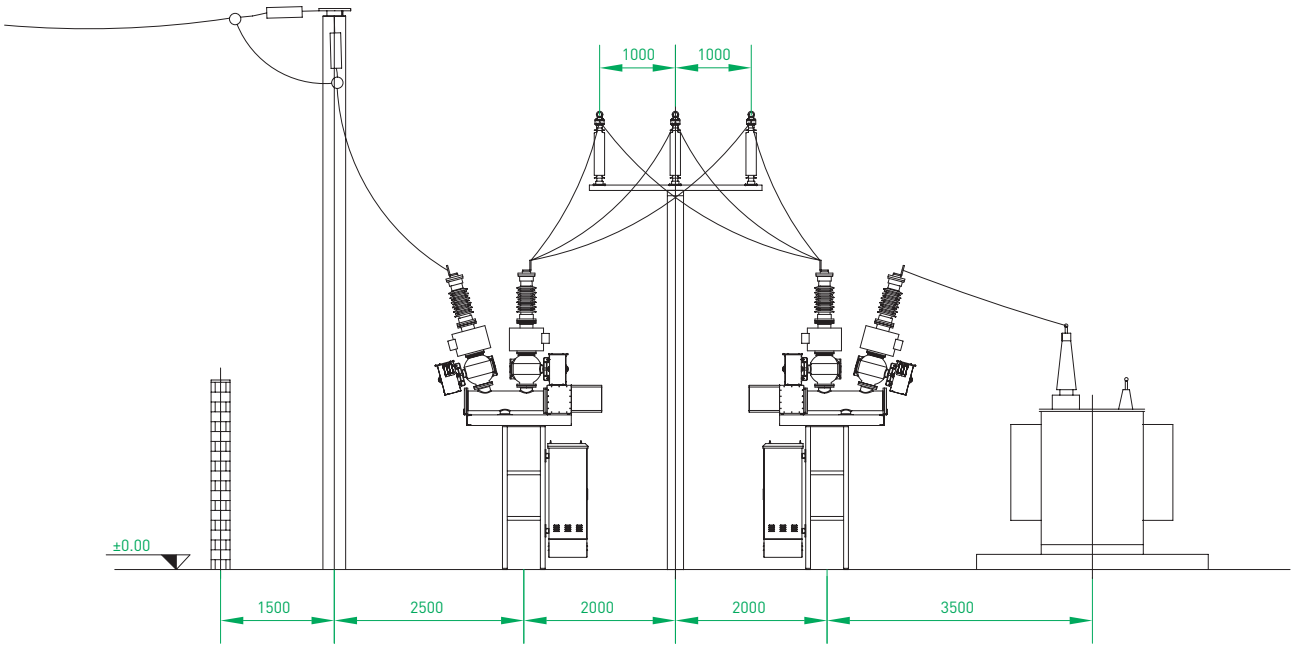
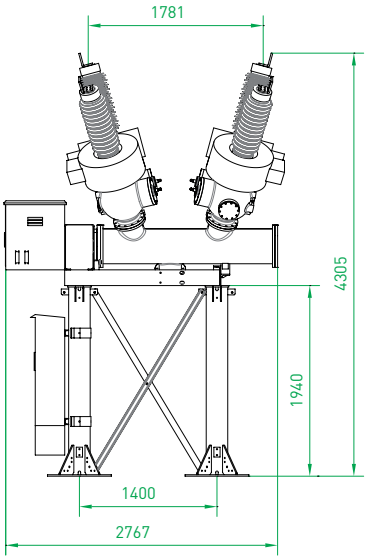
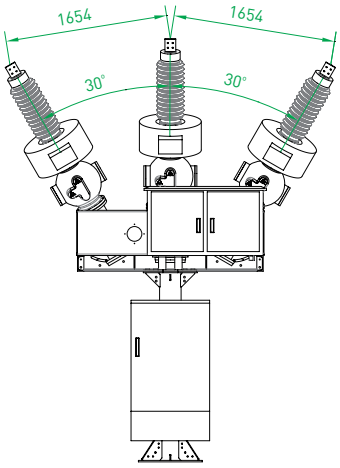
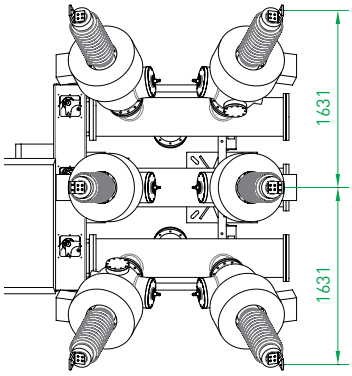


Dimension and installation

Out size with single busbar

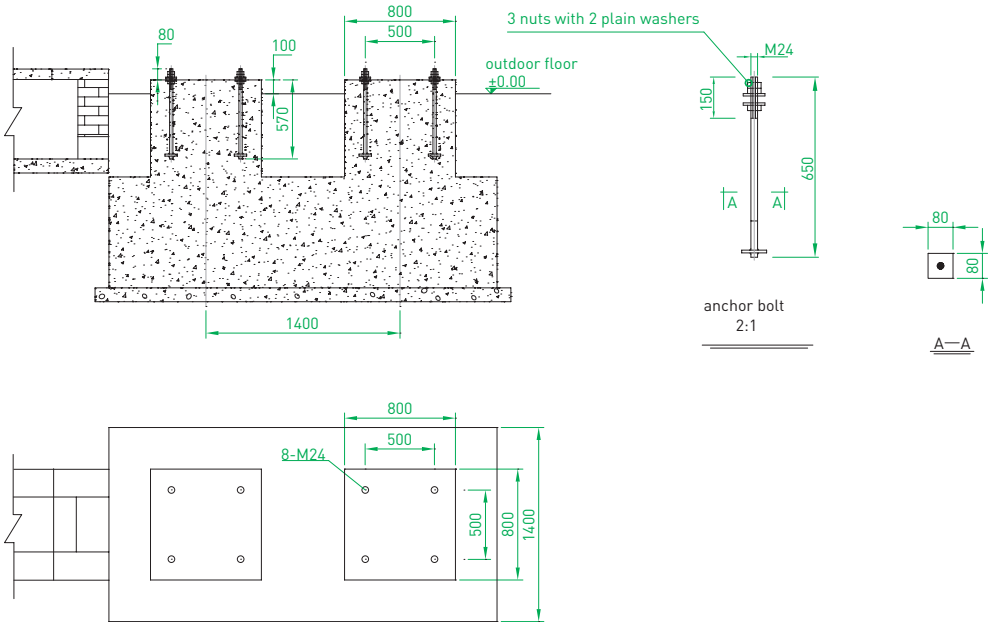






Dimension and installation

Foundation with single busbar



Note:

1. The anchor bolts shall be made of Q235-A steel. Chamfer the ends of thread area (2 x 45°); surface roughness of thread area is Ra6.3, the value for the rest area is Ra25. The fillet weld height of bottom square board > 8mm; all parts shall be treated with thermal galvanization, the zinc-layer thickness shall be greater than 85μm. The dimension requirements are for product after galvanization.
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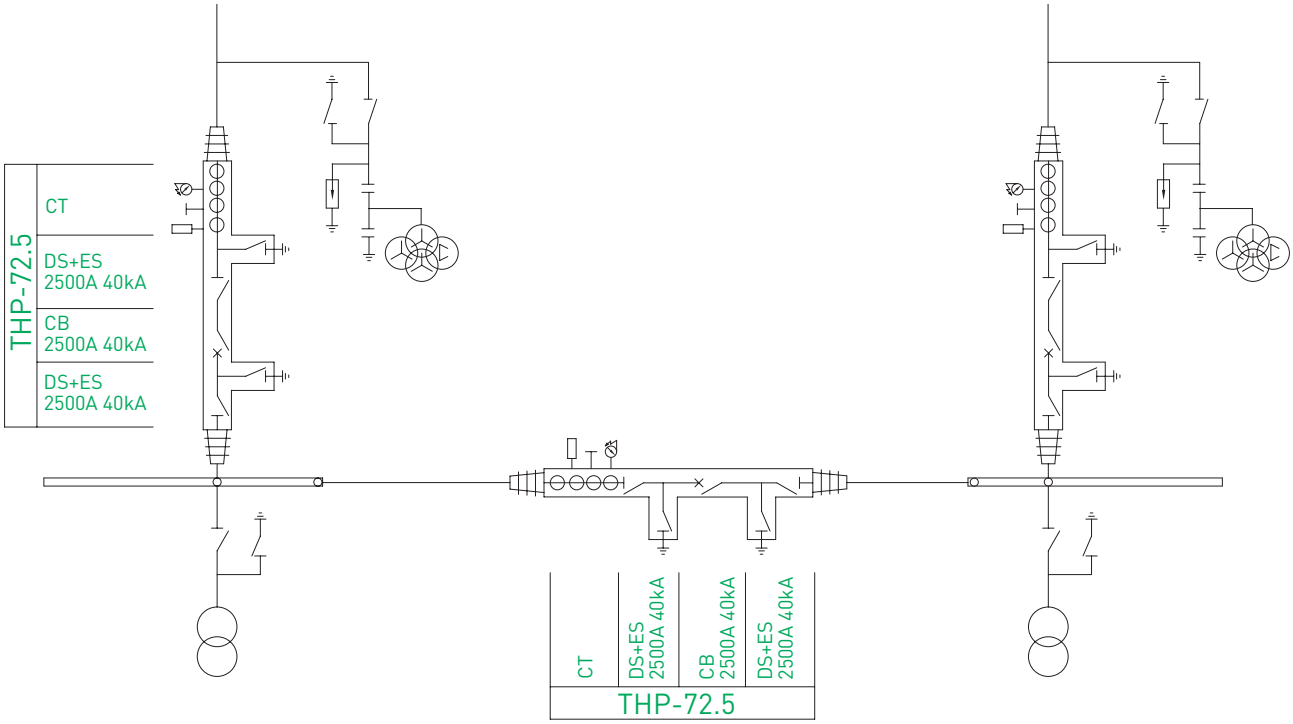
Configuration
Inner-bridge configuration

Electrical diagram



Configuration

H type configuration

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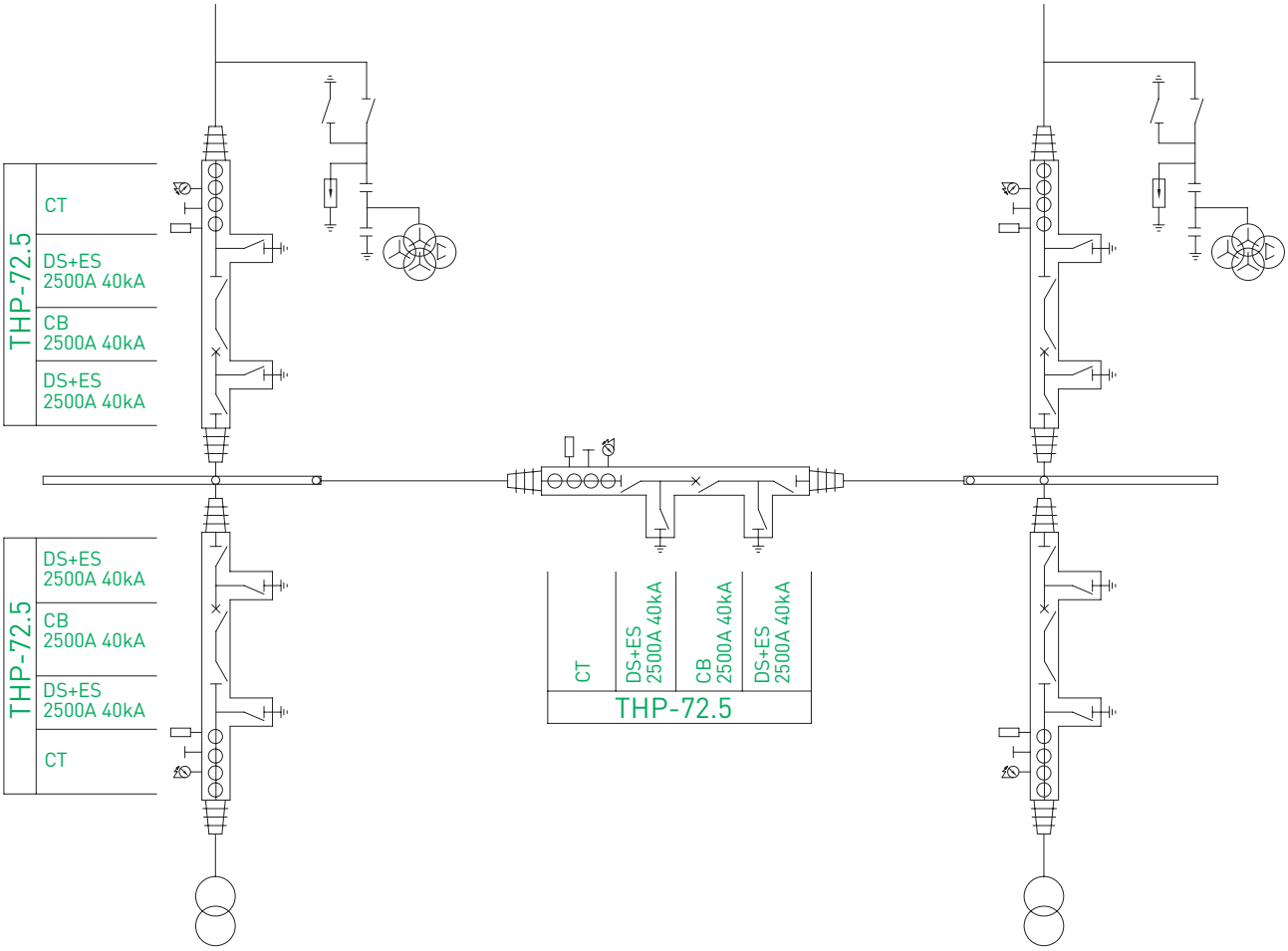
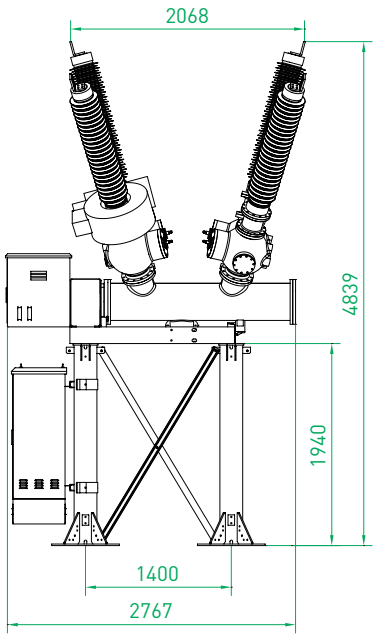
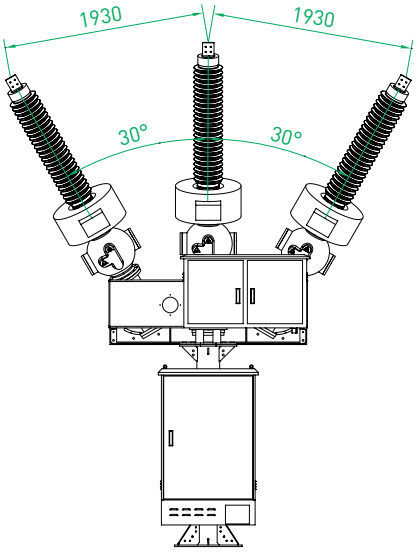
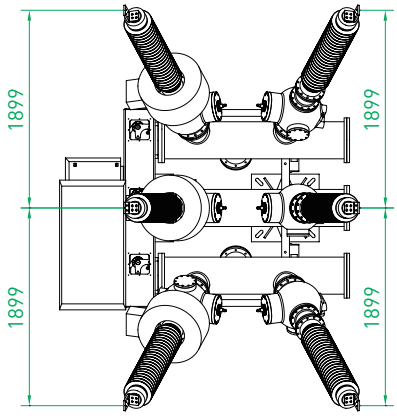


Dimension and installation

Out size with single busbar

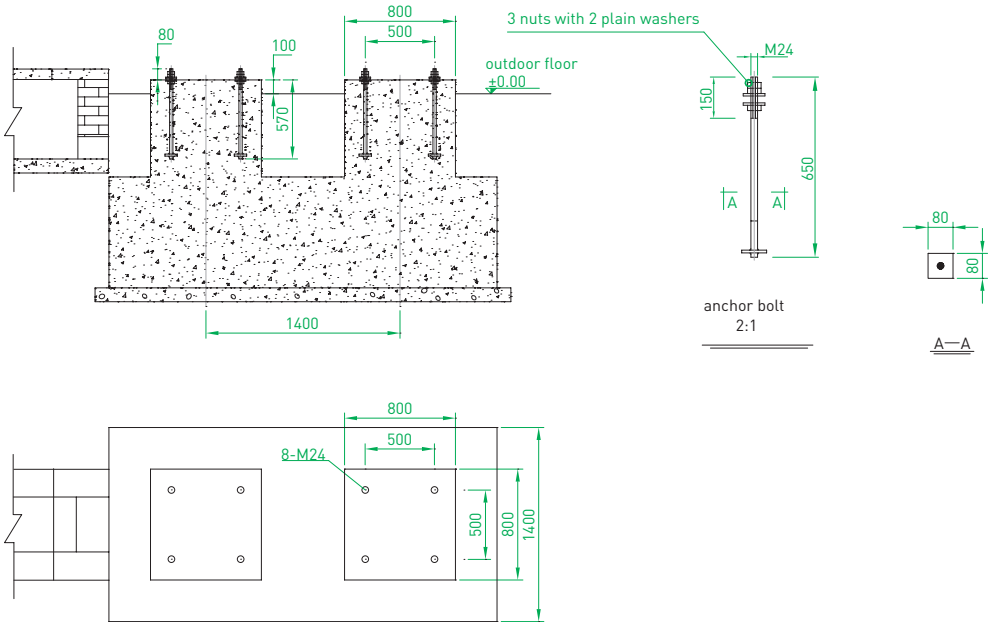






Dimension and installation

Foundation with single busbar



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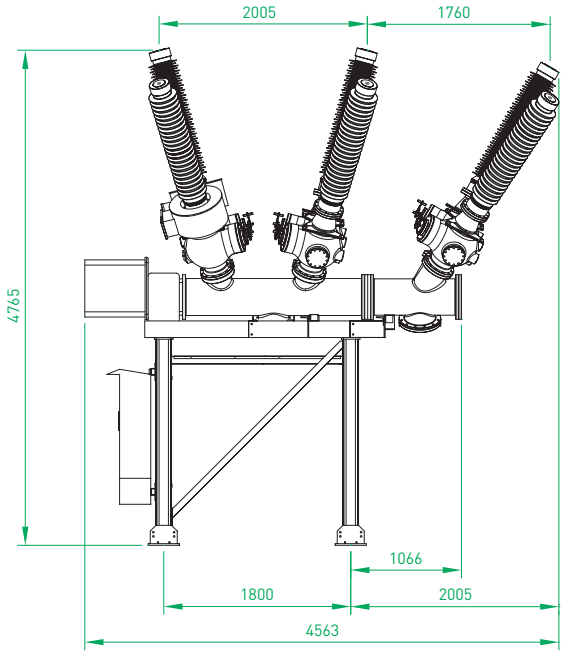
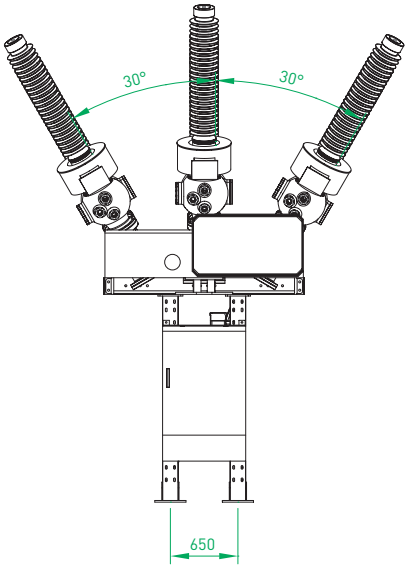
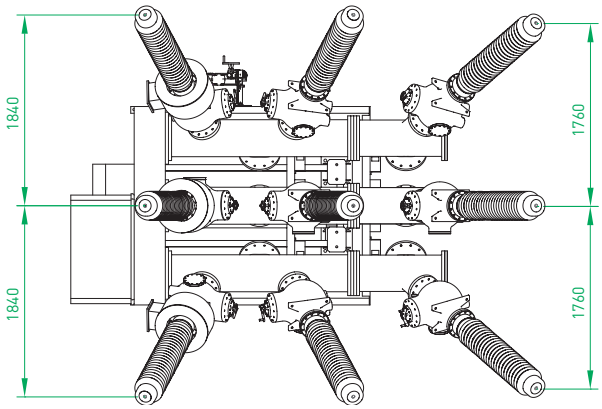
Dimension and installation

Out size with double busbar

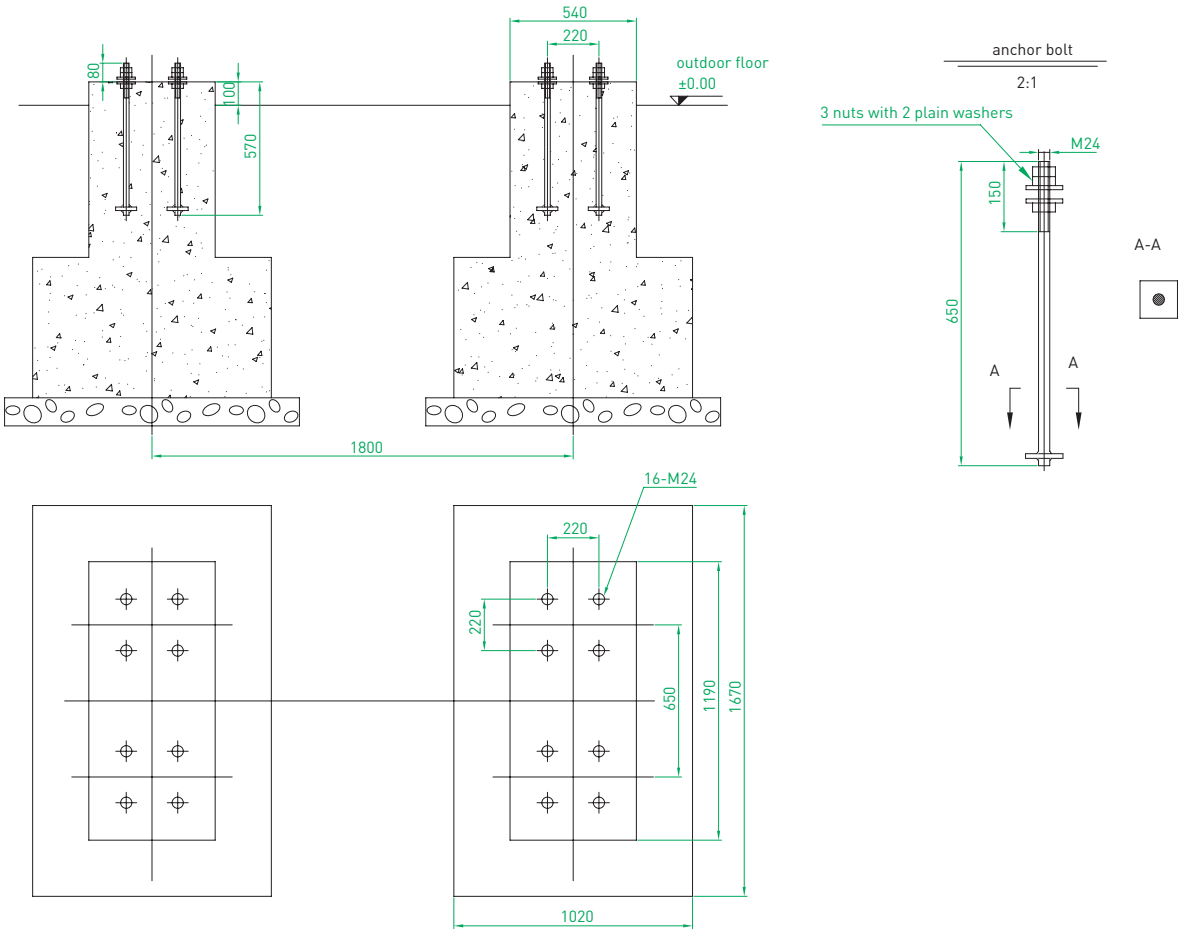






Dimension and installation

Foundation with double busbar

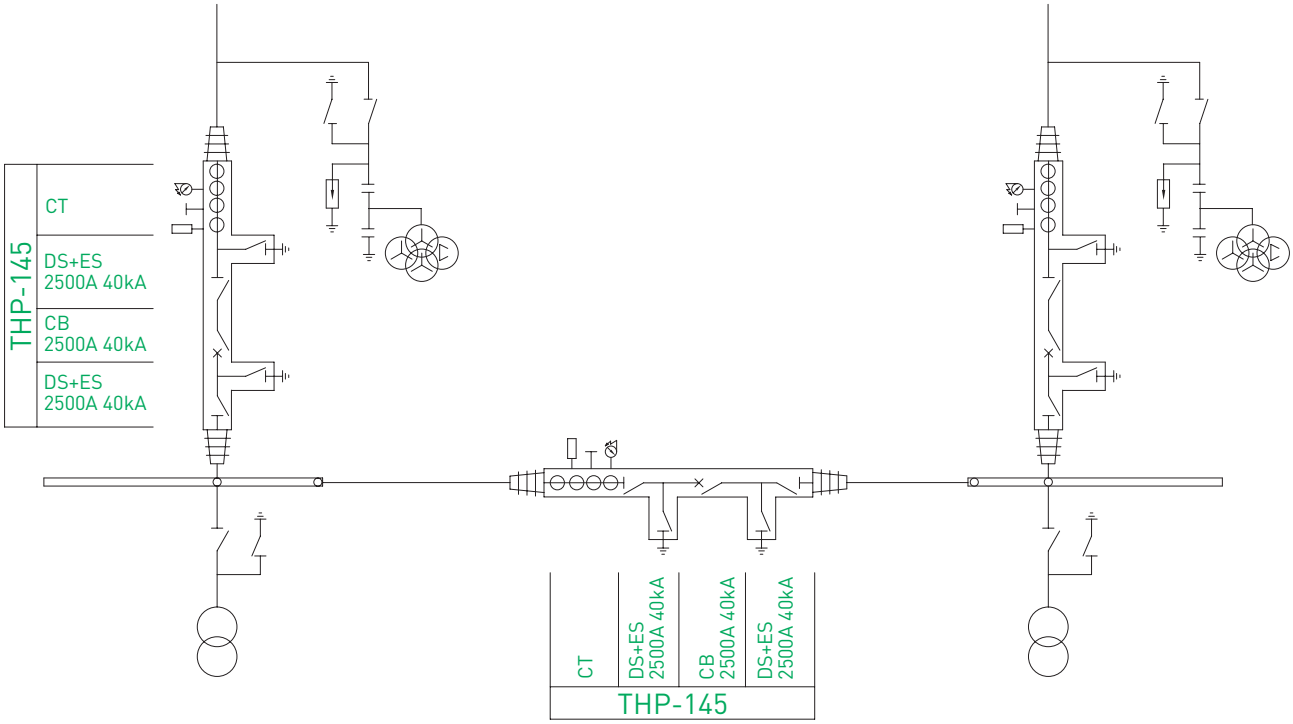


Note:

1. The anchor bolts shall be made of Q235-A steel. Chamfer the ends of thread area (2 x 45°); surface roughness of thread area is Ra6.3, the value for the rest area is Ra25. The fillet weld height of bottom square board > 8mm; all parts shall be treated with thermal galvanization, the zinc-layer thickness shall be greater than 85μm. The dimension requirements are for product after galvanization.
2. The length of the exposed part of the embedded M24 anchor bolt shall be 80mm; dimension tolerance of anchor bolt is +1mm.
3. Dimension template can be used during the assembly of M24 anchor bolt to ensure the dimension tolerance.
4. The foundation drawing is only for reference. The construction drawing must be designed according to local geological conditions.

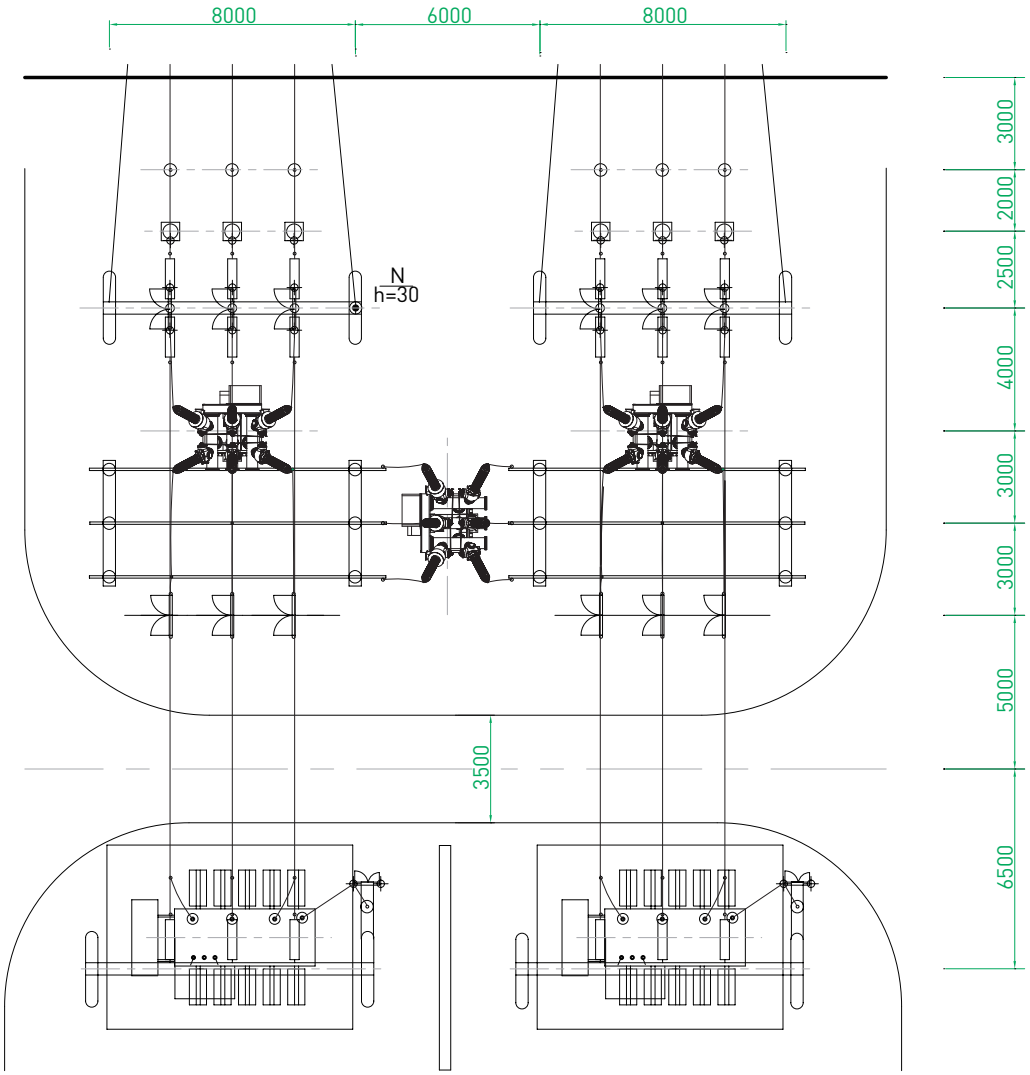
Configuration
Inner-bridge configuration

Electrical diagram

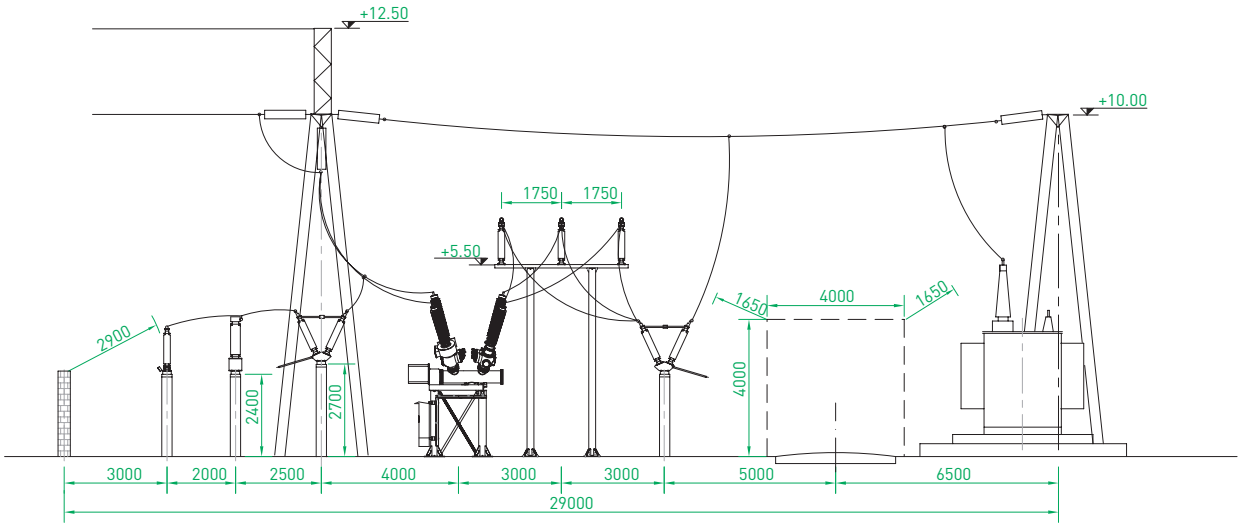


Configuration
Inner-bridge configuration

Layout



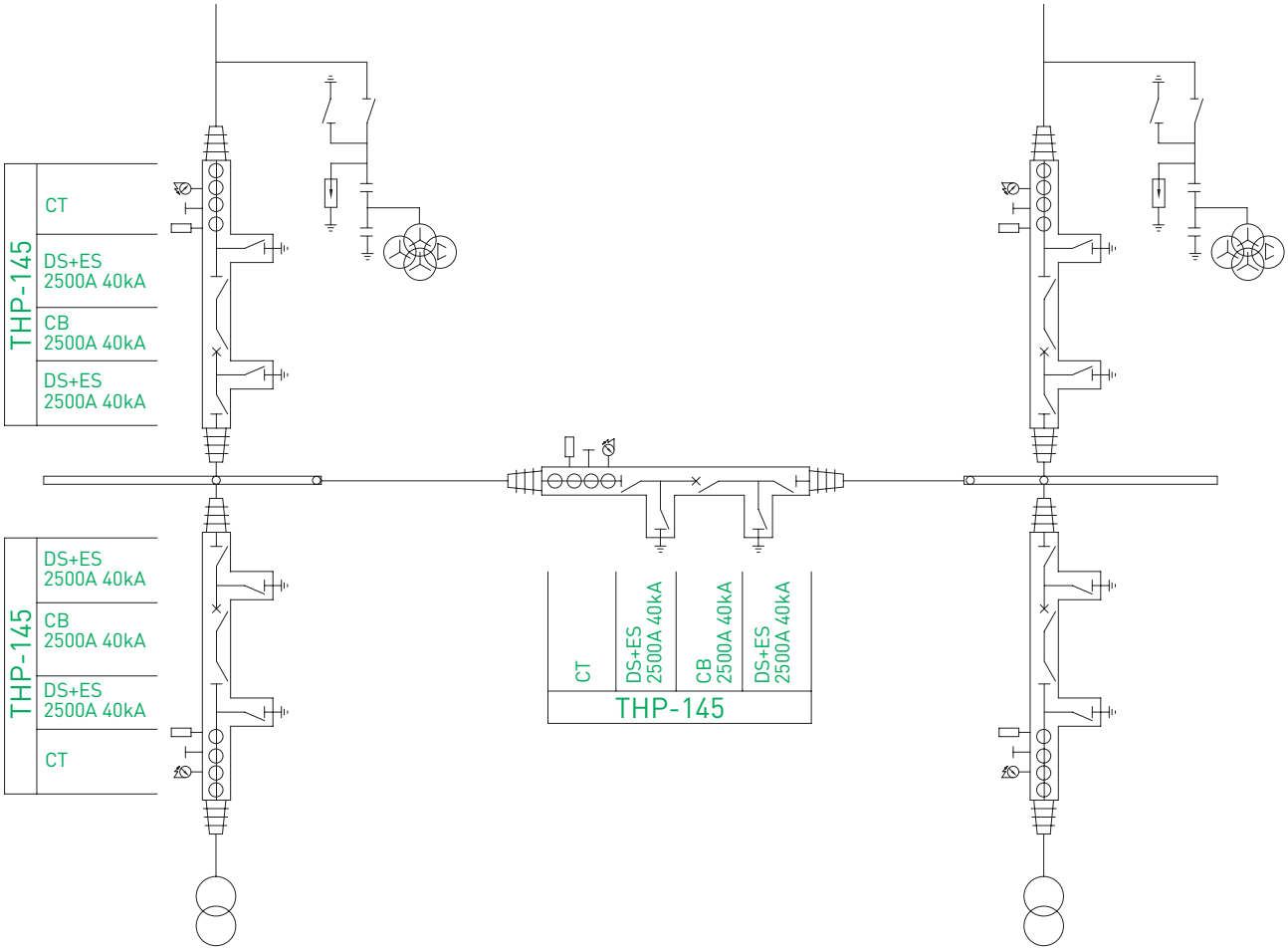
Section drawing



Configuration

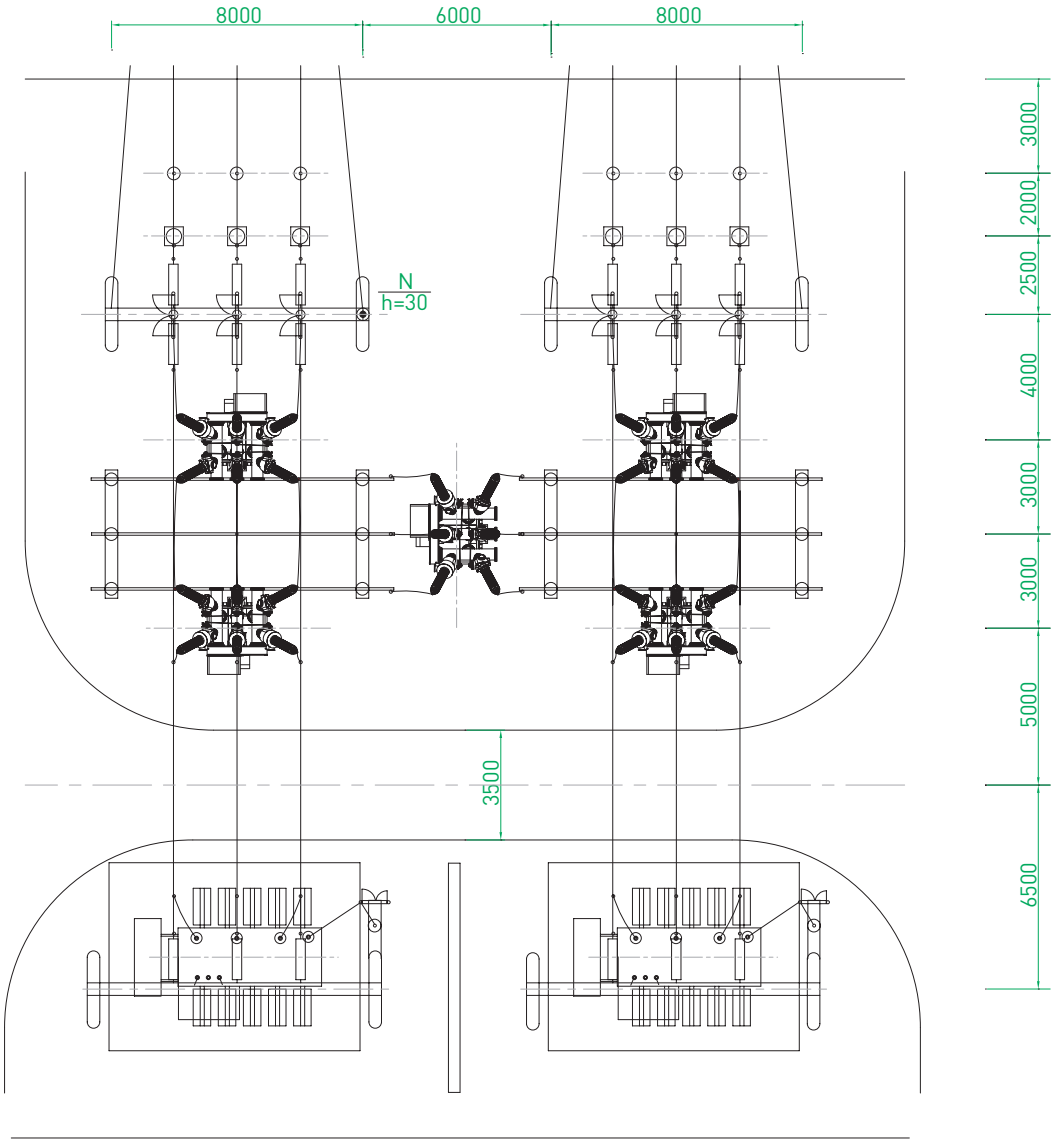
H type configuration

Electrical diagram

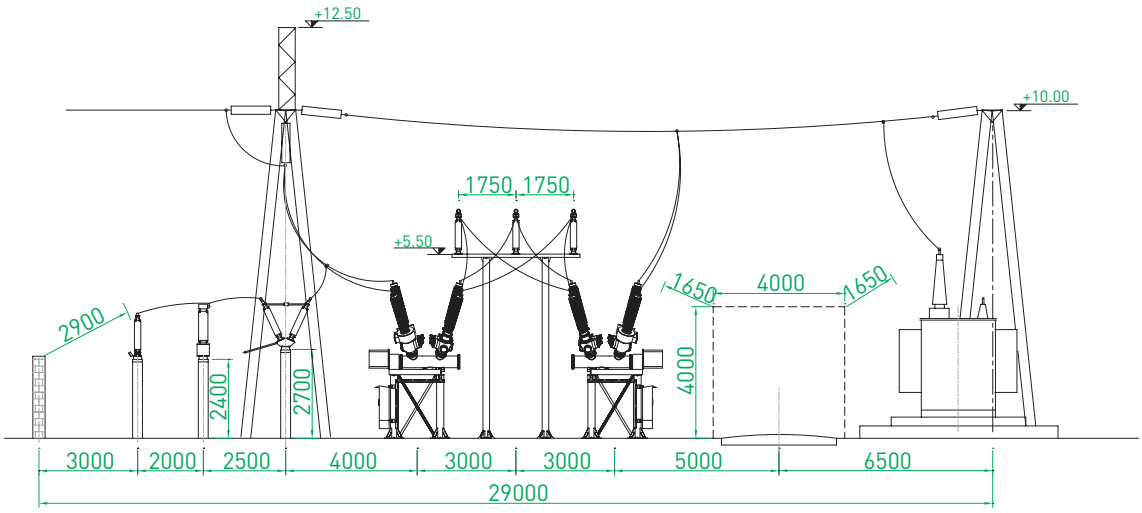


Configuration
H type configuration

Layout



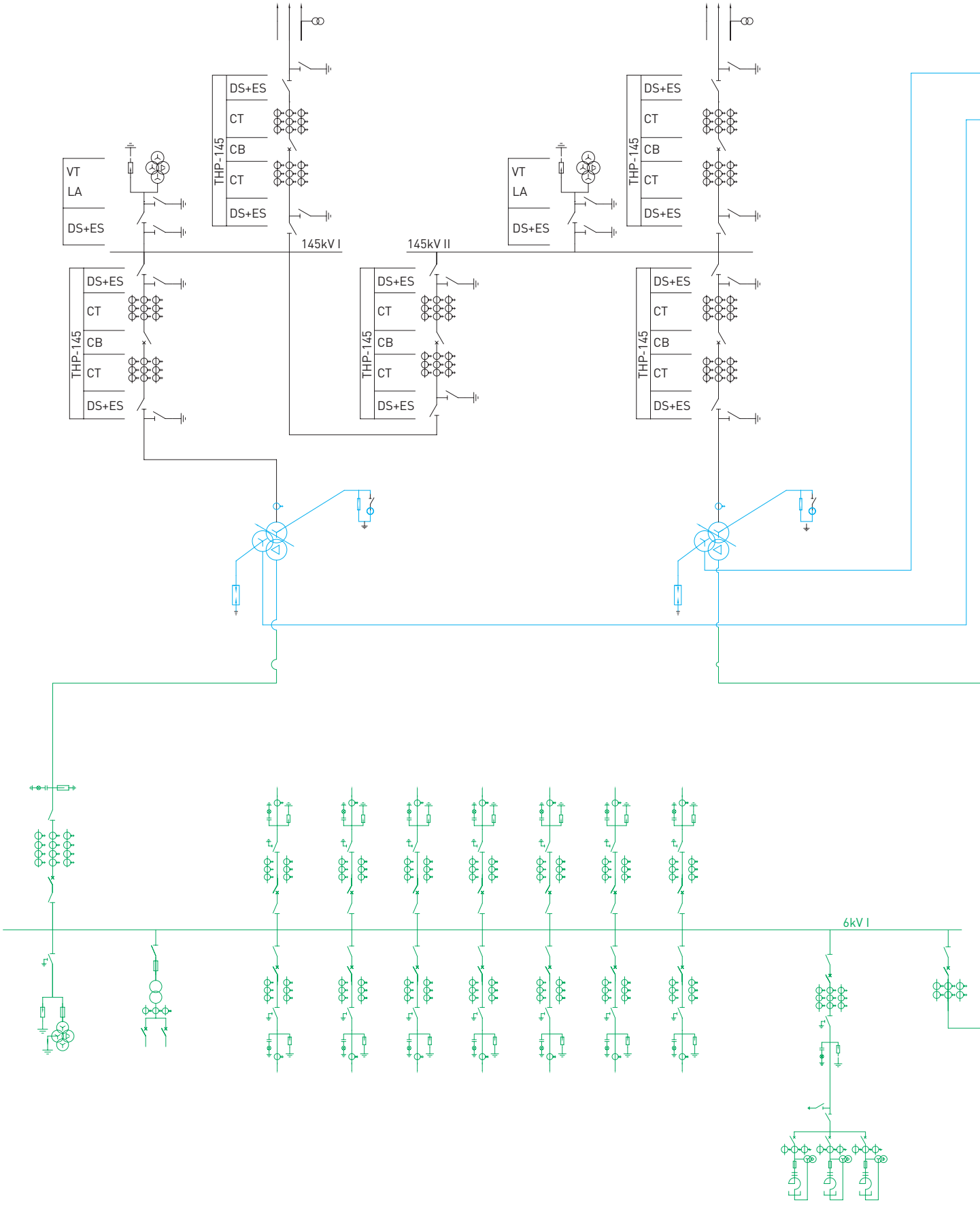
Section drawing

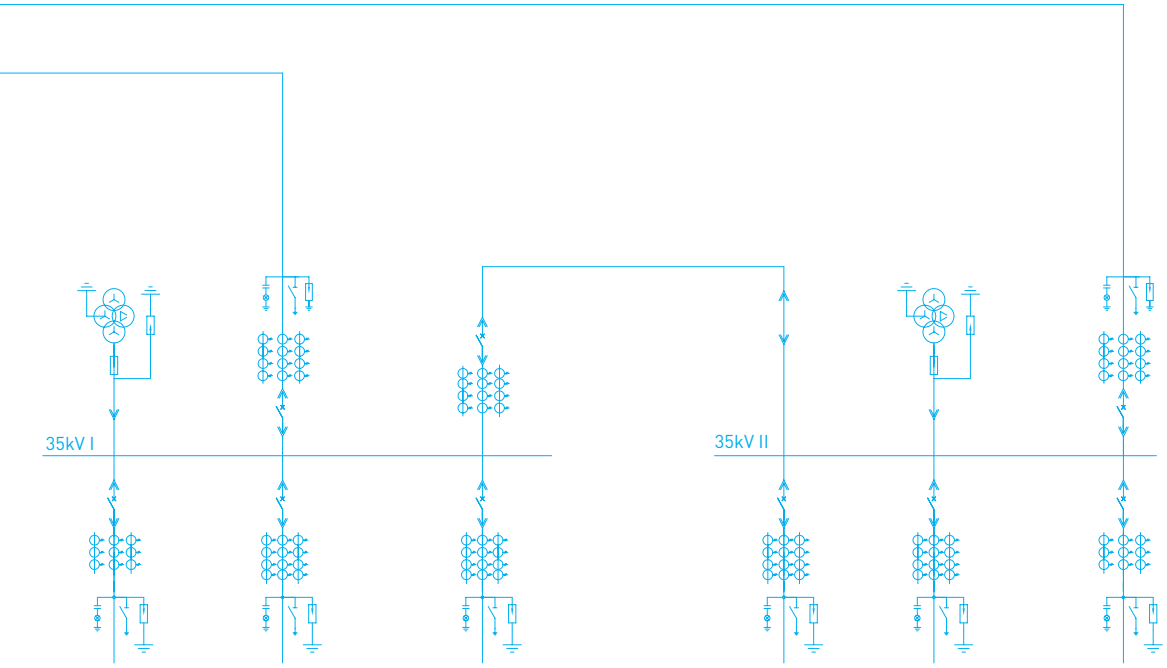


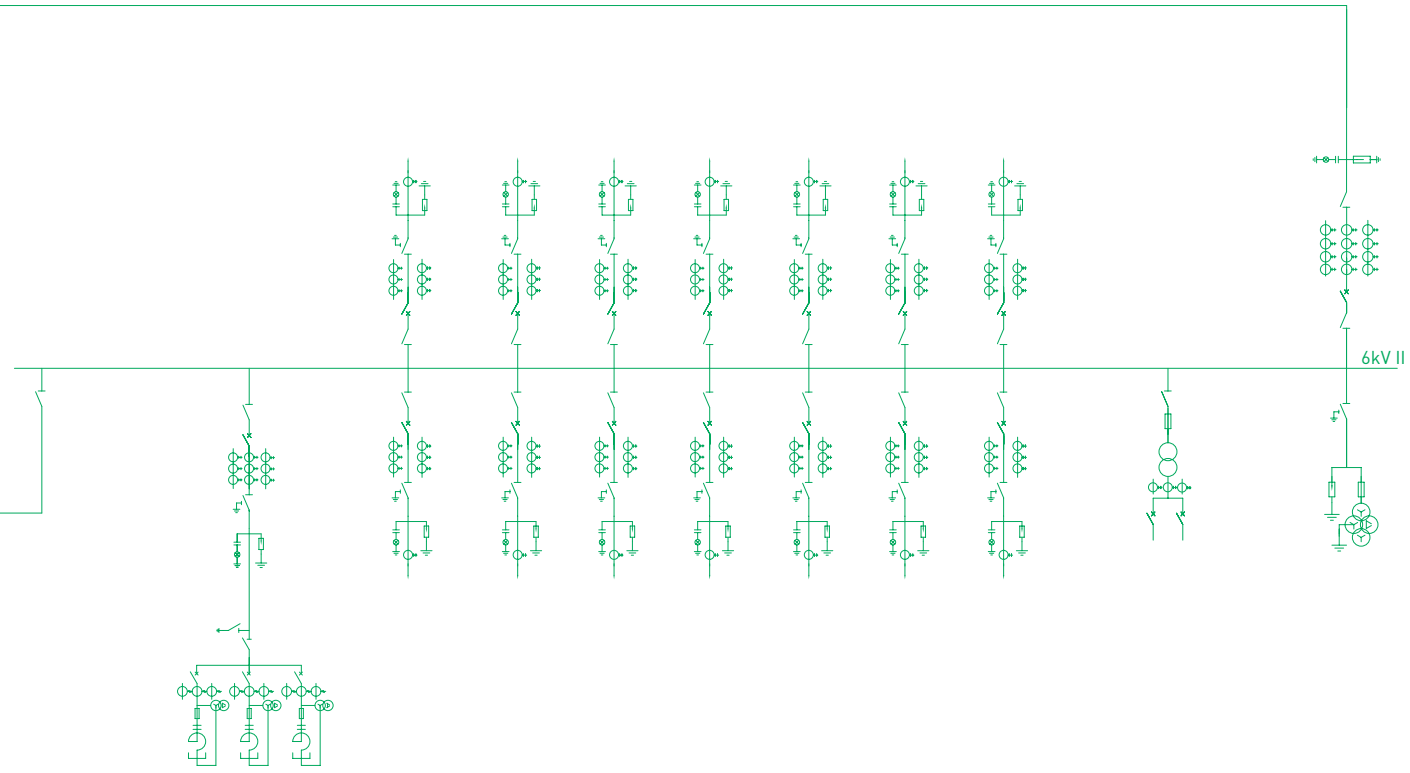
An Example

145kV/40.5kV/6kV power substation

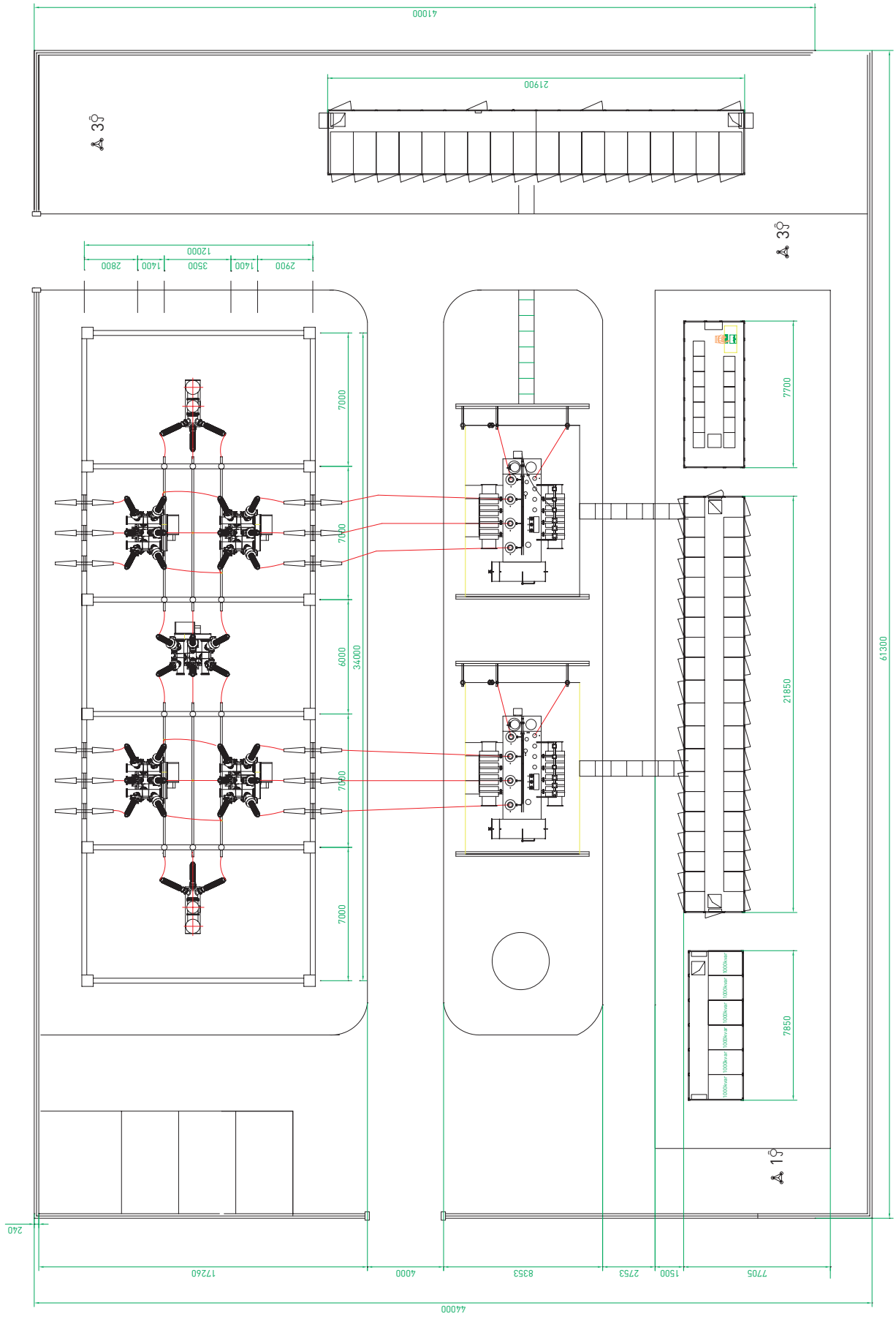
Electrical diagram




35kV I
35kV II


6kV II

145kV/40.5kV/6kV power substation



Electrical diagram

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