HYGN01-20260127

www.qdtgood.com


OINGDAO TGOOD ELECTRIC CO.,LTD.

**TGOOD ELECTRIC(300001.SZ)**

Address: No.336 Songling Road,Laoshan District,Qingdao,China

E-mail: info@qdtgood.com

Tel:+86 532 8908 8929

Fax:+86 532 8908 3066



# 33kV Step-up Compact Substation

TGOOD GLOBAL
-ENERGY.FAST!-

www.qdtgood.com


# 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

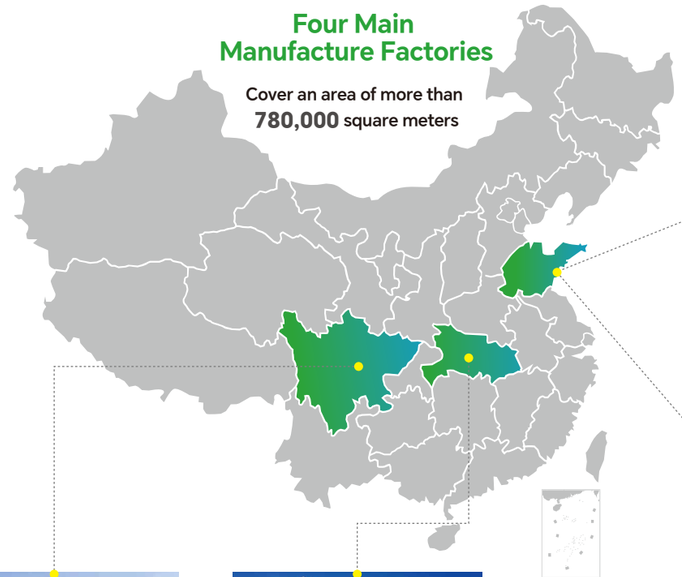
## The largest in China
TGOOD is the largest R&D and production base for prefabricated substations in China

## 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

# Product Overview


This step-up compact substation converts the low-voltage AC power generated by photovoltaic inverters into medium-voltage AC power and then feeds it to the power grid. Integrating a ring main unit, a transformer, a low-voltage switchgear, and an auxiliary power supply into a standard 20-foot container, the step-up prefabricated substation provides a highly integrated power transformation and distribution solution for ground-based photovoltaic power plants.

## Applicable Standard

- IEC 62271-202:2022, High-voltage switchgear and controlgear—Part 202: High-voltage/low-voltage prefabricated substation
- IEC 62271-200:2021, High-voltage switchgear and controlgear-Part 200: AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV
- IEC 61439-1:2021， Low-voltage switchgear and controlgear assemblies - Part 1: General rules
- GB/T 17467-2020 High-Voltage/Low-Voltage Prefabricated Substation

## Product Features

- **Intelligence:**
  The operation status of ring main units, transformers, and low-voltage switchgear is under real-time monitoring.
- **Prefabrication:**
  The internal equipment has been prefabricated, assembled, and debugged, and a 20-foot container structure is adopted to facilitate transportation and installation.
- **Reliability:**
  The structural design is robust and reliable, with the degree of protection up to IP54 for both MV switchgear and LV switchgear rooms.



# Table of Contents

## 2.1 Product Overview

### Features

The step-up compact substation converts the 0.4-0.8kV low-voltage AC power generated by photovoltaic inverters into the 12kV (or above) medium-voltage AC power and then feeds it to the power grid. Integrating a ring main unit, a transformer, a low-voltage switchgear, and an auxiliary power supply into a standard 20-foot container, the step-up prefabricated substation provides a highly integrated power transformation and distribution solution for ground-based photovoltaic power plants.

- **Rated voltage: 12-40.5kV / 0.4-0.8kV**
- **Transformer capacity: 3000kVA-9000kVA**

### Typical Applications

The 12-40.5kV step-up compact substation is mainly used in photovoltaic power generation scenarios.

### Technology

- With a grid-like layout and through modular prefabrication, the step-up compact substation adopts a highly integrated design, a compact structure, and a small footprint.
- The transformer features short-circuit resistance, high overload capacity, high seismic performance, and high mechanical strength to ensure reliable operation.
- The sealed enclosure design, combined with an efficient anti-corrosion system, ensures durable and stable operation in harsh environments.
- The real-time monitoring over the operating status and parameters of the medium-voltage ring main unit, the transformer, and the low-voltage switchgear, supports the remote control of frame circuit breakers and allows the remote query of the information of the step-up substation.
- The prefabricated E-house adopts standard container modules, supports multi-layer stacking for transportation, simplifies on-site lifting and construction, thus achieving fast and flexible deployment, shortening project cycles and saving overall costs.

### Safety

#### Personal Safety

- A robust earthing system ensures reliable earthing and realizes safe contact with equipment enclosures.
- The medium-voltage ring main unit is equipped with a dedicated arcing pressure relief channel for timely pressure relief, to ensure the safety of operators.
- The low-voltage switchgear is equipped with safety baffles to physically isolate live parts such as copper busbars and provide safety protection.
- The medium-voltage ring main unit adopts a dual interlocking design, to prevent mis-operation risks from the physical and electrical levels and protect the safety of the operators.
- An intelligent environment monitoring and control system can adjust parameters such as temperature and humidity in real time, to maintain a stable environment for equipment operation.

#### Operation Safety

- The product adopts a grid-like layout to physically separate the medium-voltage compartment, the low-voltage compartment, and the transformer compartment from each other.
- Other protection, monitoring, and control systems are equipped to support the stable operation of the equipment.
- Mechanical interlocking devices are installed to effectively prevent the risk of misoperation by operators.

#### Maintenance and Service

- During storage, the product is recommended to be kept in a dry environment with high terrain and smooth drainage, far away from the areas of stagnant water, strong magnetism, and high electricity, to prevent damage to equipment components.
- The real-time support is provided for the daily operations of the equipment, covering maintenance contracts, technical consultation, spare parts supply, corrective and preventive maintenance, operation and maintenance training, and other services.

#### Reliability

- The product that passes both the type test and the factory test has stable and reliable performance.
- The standardized CNC production (as the core), coupled with strict process requirements throughout the entire process, ensures the stable and reliable performance of the product.

#### Quality and Environment

- Quality and environmental management system meet the requirements of ISO 9001 and ISO 18001.

#### Service Life

- The expected service life is at least 20 years under normal operating conditions.

# 2 Introduction

## 2.2 Application Scenarios

Renewable Energy

Transport

Petrochemical Engineering

State Grid

Rail Transport

Urban Power Distribution

# 3 Technical Data

## 3.1 Electrical Data - Step-up Compact Substation

| Type | 3000kVA | 6000kVA | 9000kVA |
|---|---|---|---|
| **Transformer** | | | |
| Transformer Type | Oil-Immersed Transformer | | |
| Rated Power | 3000kVA@40℃ Note 1 | 6000kVA@40℃ Note 1 | 9000kVA@40℃ Note 1 |
| Maximum Power | 3400kVA@30℃ | 6800kVA@30℃ | 10000kVA@30℃ |
| Connection Group Number | Dy11 | Dy11y11 | Dy11y11 |
| Low/Medium Voltage | 0.4-0.8kV/12-40.5kV | 0.4-0.8kV/0.4-0.8kV/12-40.5kV Note 2 | |
| Maximum Input Current at Rated Voltage | 2500A*1 | 2500A*2 | 4000A*2 |
| Frequency | 50Hz/60Hz | | |
| Tap at High Voltage Side | 0，±2×2.5% | | |
| Efficiency | ≥99% | | |
| Cooling Method | Oil-immersed Natural Cooling (Oil Natural Circulation, Air Natural Cooling) | Oil-immersed Natural Cooling (Oil Natural Circulation, Air Natural Cooling) | Oil-immersed Natural Cooling (Oil Natural Circulation, Air Natural Cooling) |
| Impedance | 6.5%(±10%) | 6.5%(±10%) | 9.5%(±10%) |
| Insulating Oil Type | Mineral Oil (PCB Free) | | |
| Winding Material | Aluminum/Aluminum | | |
| Installation Category | A | | |
| **Medium-Voltage Switchgear** | | | |
| Insulation Type | $SF_6$ | | |
| Rated Voltage | 12-40.5kV Note 2 | | |
| Rated Current | 630A | | |
| Internal Arcing Classification | IAC AFLR 25kA/1s | | |
| Number of Feeder | 2-3 Circuits | | |
| Medium Voltage Surge Arrester for VCB | Optional Note 3 | | |
| **Low-Voltage Switchgear** | | | |
| Specification of Frame Circuit Breakers | 2900A/800V/3P, 1 set | 2900A/800V/3P, 2 sets | 4000A/800V/3P, 2 sets |
| Specification of Molded Case Circuit Breaker | 320A/800V/3P, 1*11 sets | 320A/800V/3P, 2*11 sets | 320A/800V/3P, 2*15 sets |

# 3 Technical Data

## 3.1 Electrical Data - Step-up Compact Substation

| Type | 3000kVA | 6000kVA | 9000kVA |
|---|---|---|---|
| **Protective Device** | | | |
| Protection for AC Incoming Line | Circuit breaker | | |
| Protection for Transformer Body | Oil Temperature, Oil Level and Pressure Relief Valve | | |
| Relay Protection | 50/51,50N/51N | | |
| Over-voltage Protection at Low Voltage Side | AC Class II (Optional: AC Class I + II) | | |
| Corrosion Resistance Level | C5 - Intermediate | | |
| **General Technical Parameters** | | | |
| Dimensions (Length × Width × Height) | 6058mm×2896mm×2438mm | | |
| Approximate Total Weight | ≤17T | ≤22T | ≤28T |
| Operating Temperature Range | -25 ℃ to 60 ℃ Note 4 | | |
| Auxiliary Power Supply Capacity | 5kVA/400V (Up to 40kVA) | | |
| 2kVA UPS (Uninterruptible Power Supply) | Optional Note 3 | | |
| Degrees of Protection Provided by Enclosure | IP54 | | |
| Allowable Relative Humidity (no condensation) | 0 ~ 95% | | |
| Operating Altitude | ≤1000 Note 5 m (Standard)/>1000 m (Optional) | | |
| Communication Interface | RS485, Ethernet, Fiber Optic | | |
| Applicable Standards | IEC 60076, IEC 62271-200, IEC 62271-202, IEC 61439-1, EN 50588-1 | | |

- **Note 1:** For more detailed information on the AC power supply, please refer to the capacity reduction curve.
- **Note 2:** The optional rated output voltage is 12-40.5kV and provided according to contract requirements.
- **Note 3:** Optional functions not included in the standard version of the product will be provided at additional charges, and more options are available upon request.
- **Note 4:** When the ambient temperature is higher than 25 ℃, customers need to install an extended roof/ventilation cover for the substation on site.
- **Note 5:** When the actual operating location of the product is at an altitude of more than 1000m above sea level, it needs to be clearly stated in the contract.



## 3.2 Electrical Data - 40.5kV Ring Main Unit

**Medium-Voltage Switchgear**

| Name | | Unit | TGS-40.5 |
|---|---|---|---|
| Rated voltage | | kV | 40.5 |
| Rated frequency | | Hz | 50/60 |
| Rated short-time power frequency withstand voltage | | kV | 95 |
| Rated lightning impulse withstand voltage | | kV | 185 |
| Rated busbar current | | A | 630 |
| Rated short-circuit breaking current | | kA | 25 |
| Rated Short-Time Withstand Current/Duration | Load-breaker | kA/s | 25/3 |
| | Circuit breaker | kA/s | 25/3 |
| Degree of Protection for the Gas-Insulated Compartment | | IP | 67 |
| Degree of Protection for the Switchgear Enclosure | | IP | 4X |
| Dimensions (Excluding Top Accessories) (Width × Depth × Height) | | mm | 450/500×980/1000×1900 |
| Weight of Functional Units | | kg | 650 ~ 700 |
| Expansion Method | | / | Side |
| Internal Arcing Classification | | kA/s | Classification C: AFLR 25/1<br>Classification V: AFLR 25/1 |

## 3.3 Electrical Data - Transformer

### Step-up Transformer

| Name | | Unit | 9000/33, three-winding, oil-immersed |
|---|---|---|---|
| Rated Capacity | | kVA | 9000 |
| Connection Group Number | | / | Dy11y11 |
| Cooling Method | | / | Oil-immersed Natural Cooling (Oil Natural Circulation, Air Natural Cooling) |
| Rated Voltage | High Voltage Side | kV | 33 |
| | Low Voltage Side | kV | 0.8 |
| | Frequency Deviation | / | ±10% |
| Rated Current | High Voltage Side | A | 154 |
| | Low Voltage Side 1 | A | 3248 |
| | Low Voltage Side 2 | A | 3248 |
| Number of Phases | | / | 3 |
| Rated Frequency | | Hz | 50/60 |
| Allowable Frequency Deviation | | % | ±5 |
| Winding Conductor Material | High Voltage Side | / | Aluminum |
| | Low Voltage Side | / | Aluminum |
| Tap Changer | Low Voltage Side | / | No Excitation Regulation (Blackout Regulation) |
| | Tap Range at High Voltage Side | / | ±2×2.5% |
| Insulation Class | High Voltage Side | kV | Lightning Impulse Withstand Voltage 170 kV / Power Frequency Withstand Voltage 70 kV |
| | Low Voltage Side | kV | Power Frequency Withstand Voltage 5 kV |

## 3.4 Electrical Data - Low Voltage Switchgear

### Low-Voltage Switchgear

| Name | Unit | TLS |
|---|---|---|
| Applicable Standard | / | IEC 61439 |
| Rated voltage | V | AC 400 ~ 800 |
| Insulation voltage | V | AC 1000 |
| Degrees of Protection Provided by Enclosure | IP | IP65 |
| Rated short-time withstand current | kA/s | 50kA/1s |
| Surge Withstand Voltage | kV | Incoming Unit: 12kV; Feeder Unit: 8kV |
| Low-voltage universal circuit breaker | / | Fixed type; manually/electrically operated; rated voltage = AC800V, rated insulation voltage Ui = 1250V, surge withstand voltage Uimp = 12kV, rated operating voltage Ue = 800V, rated current In = 4000A, rated short-circuit breaking capacity Icu = 75kA (at AC800V), and rated short-time withstand current Icw = 75kA/1s. The above parameters can be customized as needed. |
| Molded case circuit breaker | / | Fixed type; manually operated; rated voltage = AC800V, rated insulation voltage Ui = 1000V, surge withstand voltage Uimp = 8kV, rated operating voltage Ue = 800V, rated current In = 320A, and rated short-circuit breaking capacity Icu = 50kA; thermal magnetic trip (TMD); the above parameters can be customized as needed. |
| Molded case circuit breaker | / | Fixed type; manually operated; rated voltage = AC800V, rated insulation voltage Ui = 1000V, surge withstand voltage Uimp = 8kV, rated operating voltage Ue = 800V, rated current In = 250A, and rated short-circuit breaking capacity Icu = 50kA; thermal magnetic trip (TMD); the above parameters can be customized as needed. |
| Incoming AC Cable Terminal | / | Screw connection for copper or aluminum cables, with a maximum cross-section of 300 $mm^2$ |
| Cable Incoming Method | / | Based on the specific design |
| Surge Protection Device | / | Maximum continuous operating voltage Uc=1500V |
| Power Measurement Instruments | / | Used to measure current, voltage, active and reactive power, etc. |
| Air conditioner | Set | 2 |
| Overall dimensions | mm | W2240 × D1040 × H2400 |

# 3 Technical Data

## 3.5 Electrical Data - Auxiliary Power Supply System

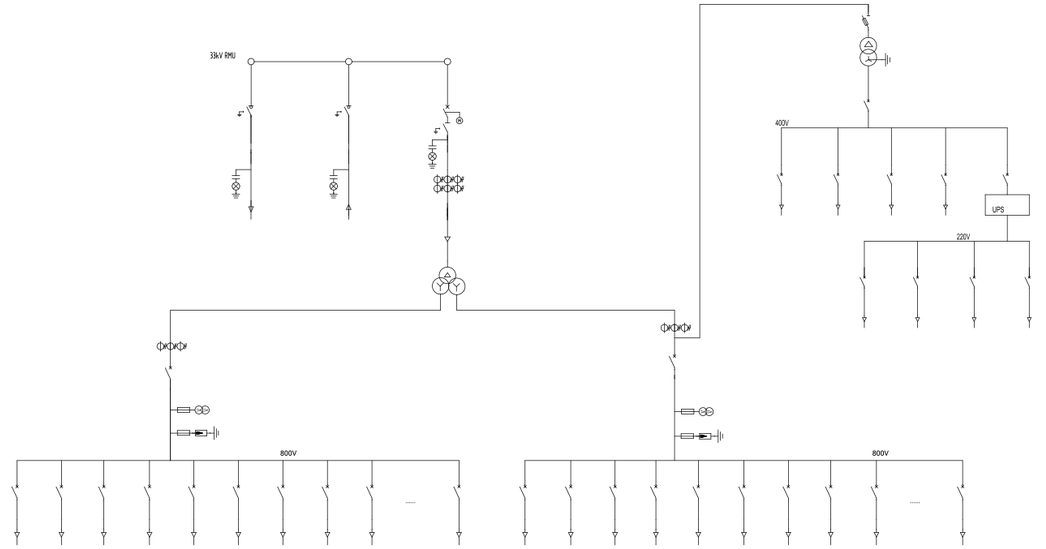
The auxiliary power system consists of an auxiliary transformer, an auxiliary power distribution box, and an uninterruptible power supply (UPS).

| Auxiliary Transformer | | |
|---|---|---|
| **Name** | **Unit** | **Parameter value** |
| Transformer capacity | kVA | 15 (5-15 (available), or >15 (customized) |
| Rated voltage | V | AC 400 ~ 800 |
| Connection group number | / | Dyn11 |
| Dimension of Protective Enclosure of Transformer | mm | W400 × D400 × H500 |
| Installation Location | / | Floor-mounted in the medium voltage room |
| **Auxiliary Transformer** | | |
| Miniature Circuit Breaker for Incoming Line | Set | 1,63/C32A, 3-pole, OF |
| Miniature Circuit Breaker for Feeder | Set | 5,63/C16/10/6A, 2-pole, 400V |
| Miniature Circuit Breaker for Feeder | Set | 4,63/C32/6A, 2-pole, 220V |
| Dimension | mm | W600 × D180 × H800 |
| **Uninterruptible Power Supply** | | |
| UPS Main Unit | Set | 1×2kVA/2 Hours (or customized as needed) |
| UPS Main Unit | Pieces | 6×12V/7Ah (or customized as needed) |

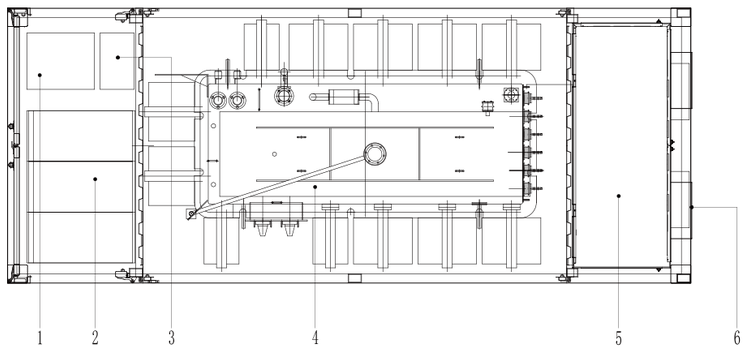


# 4 Design and Structure

## 4.1 Typical Primary Scheme of Renewable Energy Step-Up Kiosk



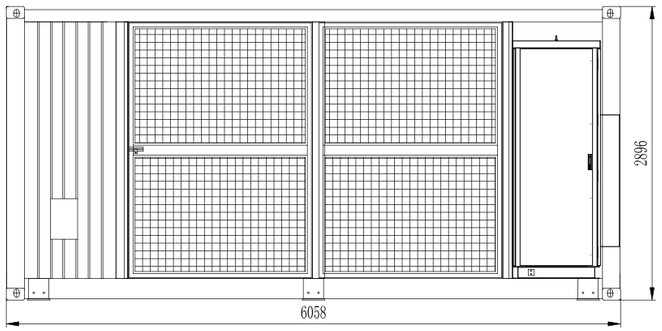

## 4.2 Typical Arrangement Scheme

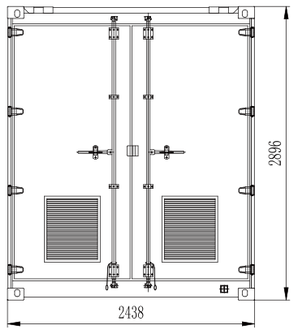



1. Auxiliary Transformer
2. Medium Voltage Switchgear (Ring Main Unit)
3. UPS Cabinet and Communication Box
4. Transformer
5. Low Voltage Switchgear
6. Air conditioner

## 4.3 Appearance of Renewable energy Step-Up Kiosk

## 4.4 External Dimensions




The 33kV step-up compact substation adopts a 20-foot standard container structure, which contains an MV compartment, a transformer compartment and an LV compartment (which are independently separated). The transformer compartment is located inside the kiosk in the middle of the substation, with an overall grid-like layout. Featuring factory prefabrication, high integration, compact structure, and small footprint, the substation is available with the degree of protections up to IP56 for different operating environments.

## 4.5 Appearance Diagram and Technical Characteristics of the 40.5kV TGS Ring Main Unit

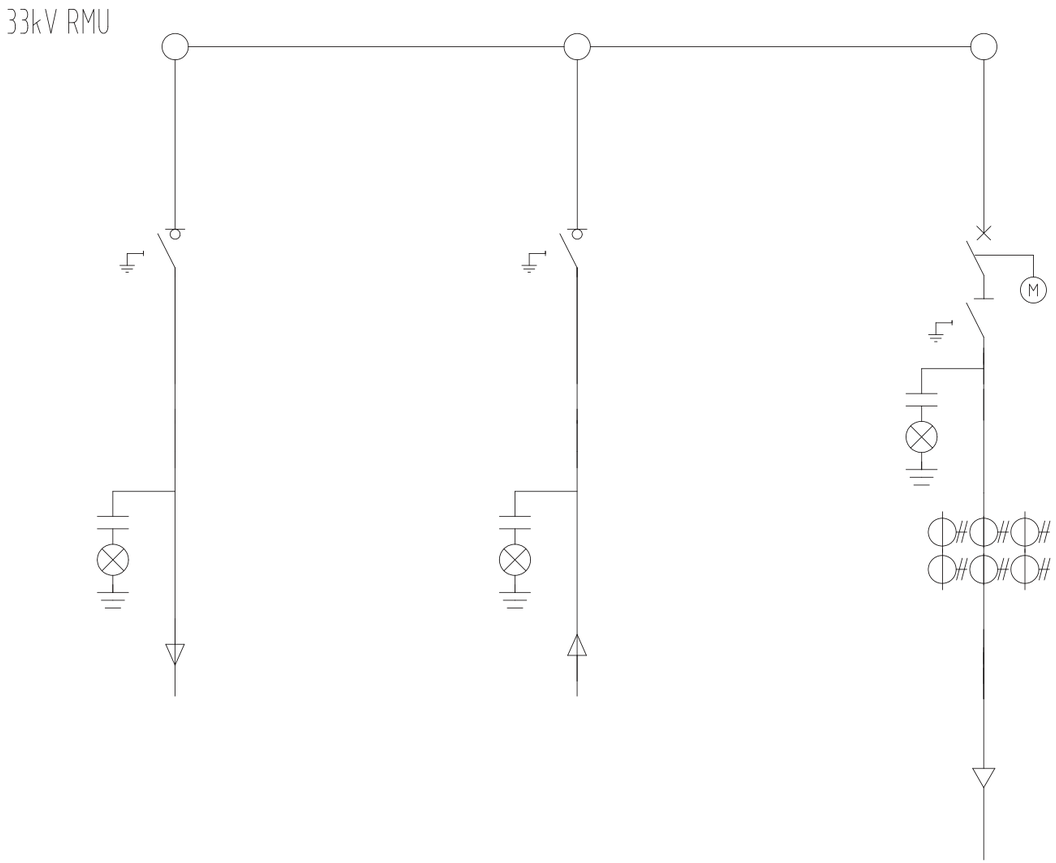

- The MV switchgear room can be equipped with a 40.5kV TGS ring main unit. Each ring main unit consists of a circuit breaker cabinet (V Cabinet) and two load switch cabinets (C Cabinet).

  **C Cabinet:** The load switch cabinets, whose main function is to output in the ring network, connect the output of the subarray to the feeding points of the power grid;

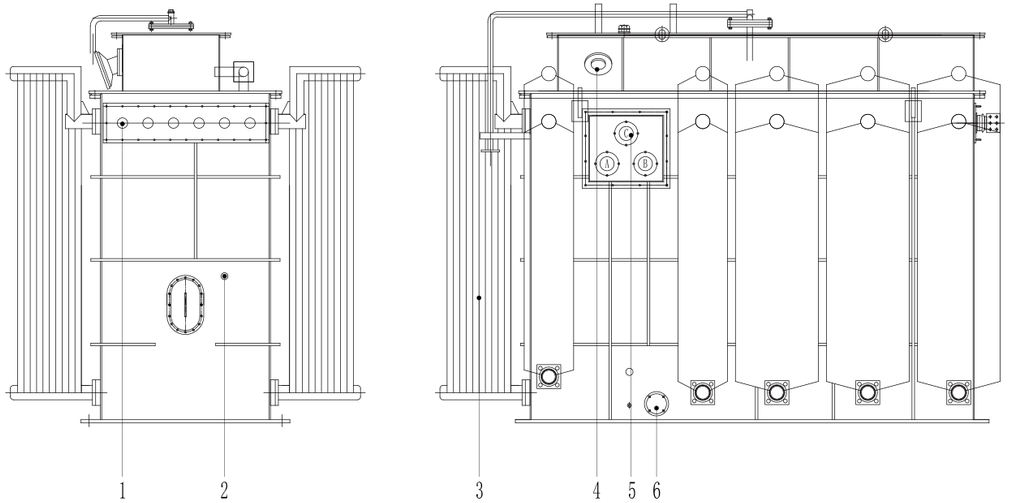
  **V Cabinet:** The circuit breaker cabinet, also known as the transformer protection cabinet, mainly protects the transformer through a relay protection device; when the transformer is overloaded or short-circuited, the V Cabinet can be reliably disconnected; in case of over-temperature, heavy gas, or excessive oil pressure in the transformer, the V Cabinet trips to provide rapid protection to the system.

- 304 stainless steel laser-welded gas-insulated gas compartment with excellent corrosion resistance;
- Independent ventilation channel, significantly improving product heat dissipation capacity;
- Mechanical interlocking for preventing misoperation risks;
- Dedicated arcing pressure relief channel releasing gas pressure downward;
- Verification by strict type test and factory test, and compliance with standardized and rigorous CNC production process;
- Quality and environmental management systems according to ISO 9001 and ISO 18001.

## 4.6 Main Wiring Diagram of the 40.5kV TGS Ring Main Unit




## 4.7 Appearance and Technical Features of Transformer




**1. Low-Voltage Terminal**

**2. Tap Changer**

**3. Heat Sink**

**4. Oil Level Gauge**

**5. Medium-Voltage Terminal**

**6. Oil Drain Valve**

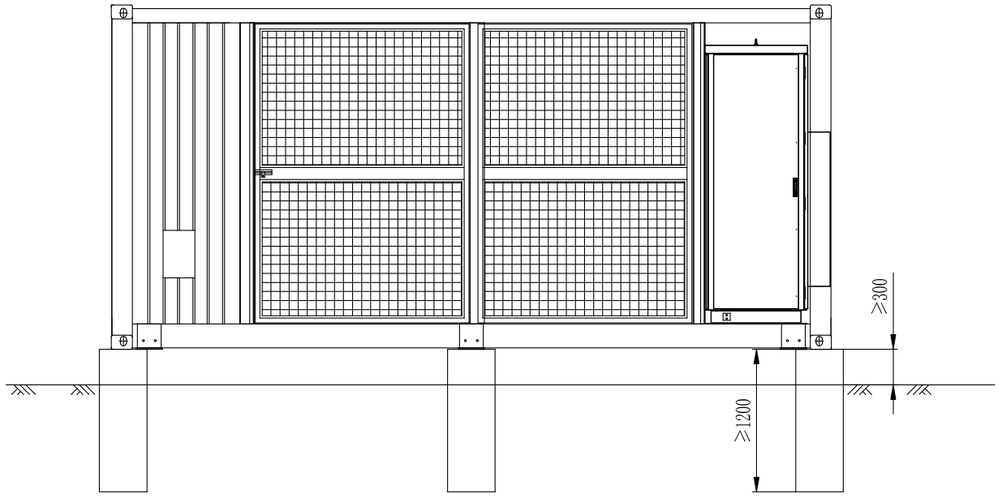
- The top of the transformer compartment adopts a design without a cover;
- The compartment employs an entirely open structure, with safety fences installed on both sides. This meets the requirements of natural ventilation and heat dissipation of the transformer, while balancing isolation safety and heat dissipation efficiency;
- Key accessories, including a pressure relief valve, a tap changer, an/a oil level / pressure / oil temperature indicating device, and oil filling / draining valves, are integrated inside to ensure the safety and reliability of the transformer;
- High overload capacity and reasonable current density, combined with an optimized heat dissipation structure, support long-term stable operation of the equipment;
- The structure with a good mechanical strength and a reliable fastening design can effectively respond to external impacts and improve the safety of equipment operation.

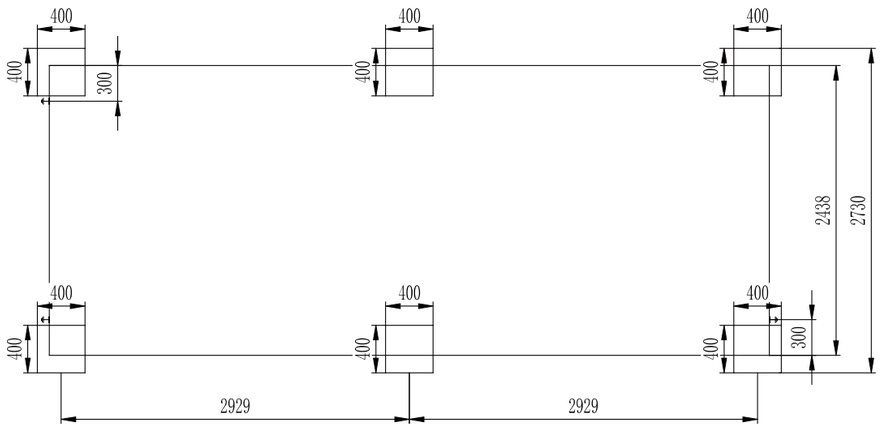
## 4.8 Appearance and Technical Features of Low Voltage Switchgear

- The dedicated structure for outdoor switchgears, with the degree of protection up to IP56, is adaptable to diverse outdoor environmental conditions;
- The low-voltage switchgear room equipped with an air conditioning system can effectively enhance the heat dissipation effect, maintain components at suitable operating temperatures, and ensure stable equipment operation;
- Safety baffles inside the switchgear can physically isolate live parts like copper busbars, provide safety protection and enhance operational safety;
- The switchgear adopts an integrated design to enhance the utilization of space; and the switchgear is connected with the transformer with flexible busbars, which can alleviate the impact of vibrations during transportation and reduce the risk of component damage;
- All copper busbars inside the switchgear are equipped with heat-shrinkable tubing, combined with an insulation support structure design, and meet the mechanical strength and insulation protection requirements.

## 4.9 Suggested Foundation Plan

Steel frame foundations or kiosk foundations
can be chosen according to on-site conditions and requirements



# 5 Transport and Lifting

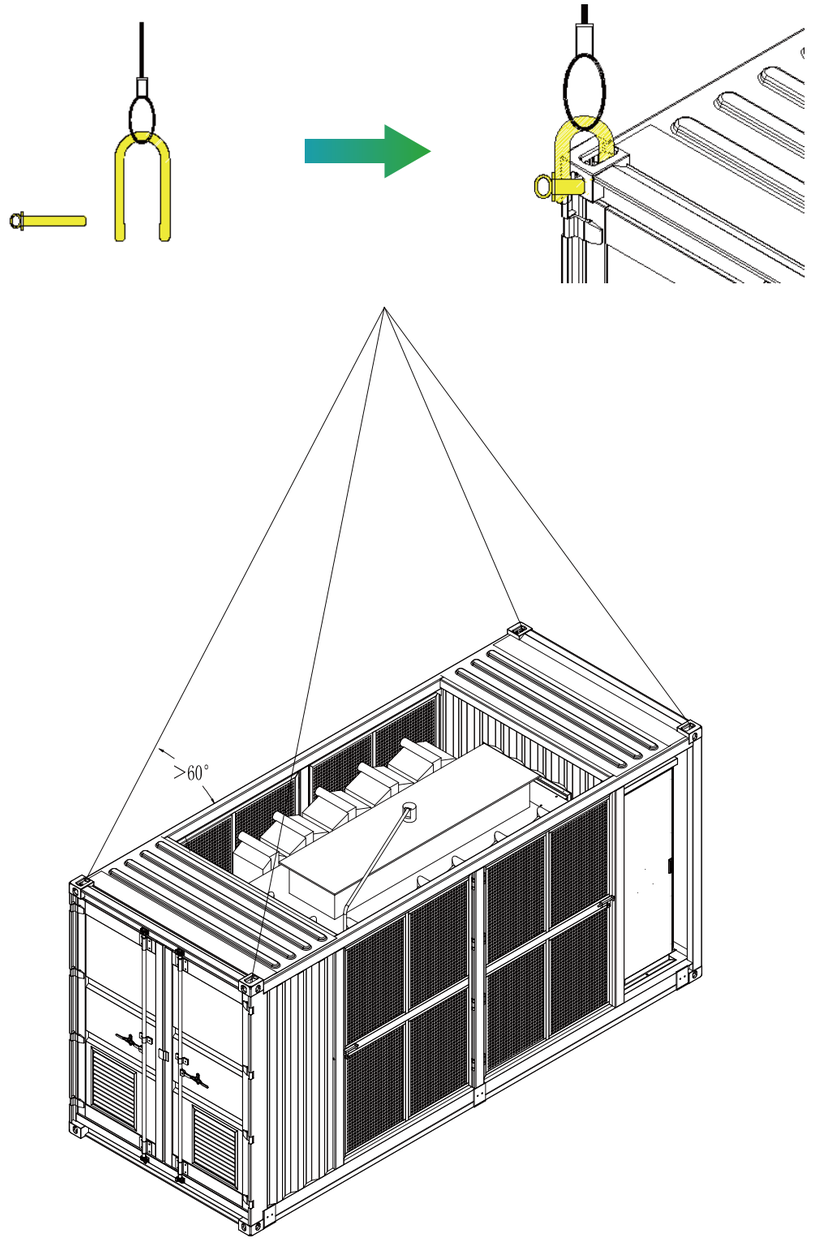
## 5.1 Transport Requirements

- The transportation of this substation must comply with local regulations and standards on the transport and loading/unloading of the container;
- Operators involved in the transportation must hold relevant qualifications and undergo standardized training to possess the ability for safe operation;
- The carrying capacity of the transport vehicle must exceed the total weight of the container, and its vehicle dimension must be greater than the external dimension of the container;
- After the container is lifted onto the transport vehicle, the angle steel must be welded around it for positioning and fixing;
- When the container is fixed with the transport vehicle, it is forbidden to use the binding rope to wrap the container and the transport vehicle for fixing, but the binding rope can be used to fix the holes in the bottom profile of the container and the vehicle body;
- During transportation, it is prohibited to use any binding ropes or steel wire ropes to constrict the container, thus avoiding damage or scratches to the paint layer on the container;
- For ramps, a tractor can be used for assistance as appropriate;
- Smooth start and braking must be maintained throughout the transportation process, avoiding emergency stops or frequent large movements;
- During transportation, large potholes must be avoided, and speed must be controlled when the vehicle passes speed bumps, uneven road surfaces, turns or bends.

## 5.2 Unloading Requirements

- Upon the arrival of the product at the destination, inspections must be conducted to first check for any damages to the product's appearance and verify the completeness of the accessories against the packing list one by one, and the inspection result shall be signed only after confirmation;
- When unloading, the binding ropes connecting the bottom of the container to the transport vehicle must be removed.

## 5.3 Lifting Diagram



## 5.4 Lifting Requirements

- The capacity of the crane for lifting the kiosk must be greater than (with a certain margin) the nominal weight of the kiosk, and selected appropriately according to the lifting position on the site.
- Before lifting, relevant personnel must check and ensure that the corner pieces of the container are free of deformation or cracks; the lifting tools (slings, spreaders, container-specific lifting tools, etc.) must match the sizes of the corner pieces, and that there must be no wear, rust, or fractures posing safety hazards in the lifting tools.
- The connection of lifting tools must be secure and reliable, ensuring even force distribution at all four corners; and in the initial lifting phase, the hook must be raised slowly at a uniform speed after confirming no loosening of the connection;
- During the lifting process, the container must remain level, with an inclination angle not exceeding 3°, to avoid cargo displacement or uneven stress on the container body;
- Throughout the lifting, transportation, and lowering processes, operations must be smooth; rapid ascent, descent or turns are strictly prohibited to prevent collisions or shaking of the container;
- In the lowering process, the container must be aligned with the designated position and lowered slowly to ensure that the container base fits closely on the channel steel of the foundation, with no suspension or tilting;
- After placing the kiosk on the foundation, leveling shims (provided by the manufacturer) should be used to prevent deformation that would make the external doors difficult to open. After the kiosk is positioned, all external doors should be tested for opening and closing to prevent deformation;
- The lifting operation must comply with the safety operation procedures, under the supervision of professional personnel required on site;
- The lifting operation must be carried out when the weather is sunny, and an isolation belt must be set up when the operation is carried out to prevent unauthorized personnel from entering the operation area.

## 5.5 Storage Requirements

- The altitude should generally not exceed 2000m;
- The surrounding air temperature is not higher than +55 ℃ or lower than -25 ℃
- Outdoor wind speed must not exceed 35 m/s;
- Relative humidity: The daily average value must not exceed 80%, and the monthly average value must not exceed 70%;
- The ground slope must not exceed 3°, and the ground must be dry, firm, and with sufficient load-bearing capacity;
- The product must preferably be stored inside the warehouse to prevent condensation or moisture;
- If outdoor storage is required, it is advisable to elevate the substation base to ensure ventilation at the bottom;
- During the storage period, all doors of the product must be kept tightly closed;
- Appropriate protective measures must be taken to prevent dust and moisture from entering the product;
- The accessories of the kiosk must be placed properly, and attention must be paid to fire prevention, rain prevention and moisture prevention;
- During the storage period, the product and the internal equipment must be inspected regularly and relevant records must be kept;