



# Trailer substation

Catalogue

**TGOOD**

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# CONTENTS

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<b>Presentation .....</b>	<b>2</b>
TGOOD introduction.....	2
Quality assurance - Environment .....	4
Trailer substation introduction .....	5
Application and reference .....	6
 <b>HV/MV trailer substation .....</b>	 <b>7</b>
Design and structure.....	7
Main components .....	10
Auxiliary system.....	12
 <b>Configuration.....</b>	 <b>13</b>
252kV/17.5kV trailer substation .....	13
40.5kV/12kV trailer substation .....	15
12kV/0.4kV trailer substation .....	17
 <b>Transportation.....</b>	 <b>18</b>
Lifting and fixing .....	18

TGOOD is the global leader in prefabricated electric power distribution solutions. It is the company that first comes to mind when cost-effective electric power solutions are required fast. TGOOD, as a passionate team of professionals, delights its customers with solutions that exceed expectations.

TGOOD listens to customers, and responds to their specific needs by providing innovative power solutions globally with exceptionally short lead times, high degree of flexibility, and great value for money.

TGOOD specialises in providing vertically integrated substations solutions from power products through to and including modular buildings and structural fabrication. TGOOD stands alone on the global stage with such vertical integration and manufactures medium and high voltage power products up to 252kV. TGOOD's products can meet the requirements of various industries and have successfully executed installations in utility, transportation, mining, oil & gas, renewable energy and building sectors.

Since 2004, more than 100,000 TGOOD prefabricated substations installed worldwide!

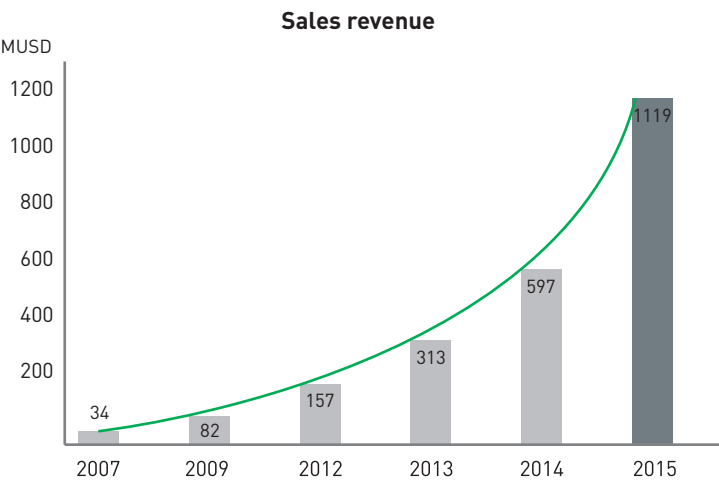
### Successful history of innovative solutions

- 2004 First railway remote substation
- 2004 First 35 kV compact prefabricated substation
- 2006 First offshore platform substation
- 2007 First intelligent railway remote substation
- 2007 First skid substation
- 2008 First 110 kV urban substation
- 2009 First coal dual power supply substation
- 2010 First trailer substation
- 2012 First 145 kV modular substation
- 2013 First PV integrated substation
- 2014 First E-vehicle group charging substation
- 2015 First 40.5kV and 12kV PV pad-mounted substation
- 2016 First 3x3 sectioned 110kV modular substation
- 2017 252kV modular substation

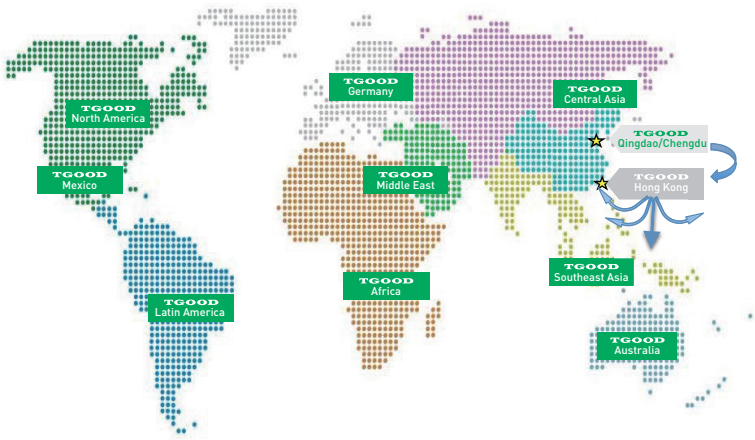


The increasing sales performance of TGOOD illustrates the excellent quality of its prefabricated substations.

Increasing business



Global customer service





## Quality assurance certified quality: ISO 9001 standard

### A major asset

TGOOD is a highly functional organization with the primary role of checking quality and monitoring compliance with standards. This policy is:

- Uniform throughout all departments
- Recognised and appreciated by our many customers and approved organizations

But above all, it is our strict adherence to the quality policy that has allowed us to obtain the recognition of an independent organization, the International Accreditation Forum (IAF). Our quality system, for the design and manufacture of TGOOD's skid substations, is certified to conform with the requirements of ISO 9001:2015's quality assurance standards.

### Strict and systematic checks

During manufacture each skid substation's functional unit is subjected 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, guaranteeing product traceability.



### Environment protection

As part of the group's environmental policy, TGOOD offers a service to recover and dispose of end-of-life high voltage switchgears, thereby helping to eliminate any risk of SF<sub>6</sub> gas discharge into the atmosphere. To help you protect the environment and to relieve you of any concerns in terms of stock or dismantling, TGOOD offers to take back your equipment at the end of its life. The skid substation 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 the trailer substation, can be recovered at the end of the equipment's life and reused after treatment.
- Production sites are certified to ISO 14001 standards.

### Occupational health and safety

Occupational Health and Safety (OH&S) standards are of the highest importance at TGOOD. TGOOD demonstrates its commitment towards the control of risks and the improvement in performance of OH&S by complying to OHSAS 18001:2007,22 standards certified by the China National Accreditation Service (CNAS). TGOOD management believes in a process approach. Its policy is based on the plan-do-check-act (PDCA) methodology that focuses on eliminating or minimizing risks to personnel and other involved parties who are or could be exposed to OH&S hazards. Strong control mechanisms are in place to assure that TGOOD's OH&S performance not only meets, but will continue to meet, its legal and policy requirements.



## Challenges in substation load transfer

- **Insufficient construction area** - difficult to obtain sufficient space for facilities, storage and operation.
- **Potential safety risks** - temporary loads on site are served by old equipment which increases safety risks.
- **Unacceptable long power-off time** - complicated reconstruction methods increase power-off time.
- **Difficult load transfer** - the substation's existing old lines cannot take the load during reconstruction.
- **Long construction duration** - time needed for reconstruction is determined by the time need for constructing the main building and assembly of equipment.

## TGOOD solution

Thanks to TGOOD's rich R&D experience and its core technology used in its trailer substations they can be used in widely different industry segments, especially for emergency substation repair.

The trailer mounted substation is designed to meet the needs of temporary power supply on construction sites, substation maintenance and emergency power supply. It is composed of:

- HV/LV distribution equipment with anti-vibration technology
- A mobile trailer
- A transformer

According to the voltage level, it can be divided into 252kV and 40.5kV types, the main features include:

- **Speed** - fast movement, fast response, rapid deployment and fast energization
- **Easy construction** - the primary and secondary systems of the substation are integrated, the trailer substation is manufactured, assembled and commissioned in the factory, on site construction is easy (no room, no walls, no cable trench, no complicated foundation)
- **Compact** - highly integrated design, compact structure, able to meet ergonomic requirements
- **Optimized design** - vibration reduction measures are taken into account for primary and secondary systems
- **Advanced technology** - heat insulation, temperature and humidity control technology are applied to secure the stability of the operational environment inside the enclosure
- **Anti-corrosion** - the best-in-class anti-corrosion technology is used to prevent the trailer substation from rusting for 30 years. This enables the trailer substation to be used in areas of high UV, high salt spray and other harsh environments

### Mobile

- Reinforced movable structure
- Compact structure easy to move

### Reliable

- Core components of high reliability products
- Switchgear structure optimized design

### Integrated

- Integrated primary and secondary systems
- Optimized performance



## Applicable condition:

- Pollution level: II
- Environment temperature:
  - Maximum day temperature: 40°C (higher temperature optional)
  - Minimum day temperature: -40°C (lower temperature optional)
  - Maximum day temperature difference: 30°C
- Humidity (%)
  - Daily average relative humidity ( $\leq$ ): 95
  - Monthly average relative humidity ( $\leq$ ): 90
- Altitude ( $\leq$ m): 95
- Solar radiation intensity ( $W/cm^2$ ): 0.1
- Maximum ice thickness (mm): 10
- Maximum wind speed lasting 10 minutes and 10m above ground (m/s): 35
- Earthquake resistance ability
  - The ground level acceleration: 0.5g (horizontal and vertical)
  - Three sine resonance cycle safety coefficient ( $\geq$ ): 1.67
  - Application area: outdoors

## References



### 110kV/12kV trailer substation

- Location: Columbia
- Incoming/outgoing line: cables mounted laterally
- 25MVA transformer
- 12kV incoming line oneway, outgoing line six ways



- Location: Deyang, Sichuan province
- Incoming/outgoing line: cables mounted laterally
- 20MVA transformer
- 12kV incoming line oneway, outgoing line six ways



- Location: Xi'an
- Incoming/outgoing line: cables mounted laterally
- 31.5 MVA transformer
- 12kV incoming line oneway, outgoing line eight ways

### 40.5kV/12kV trailer substation

- Location: Qingdao, Shandong province
- Incoming/outgoing line: cables mounted laterally
- 20MVA transformer
- 12kV incoming line oneway, outgoing line eight ways



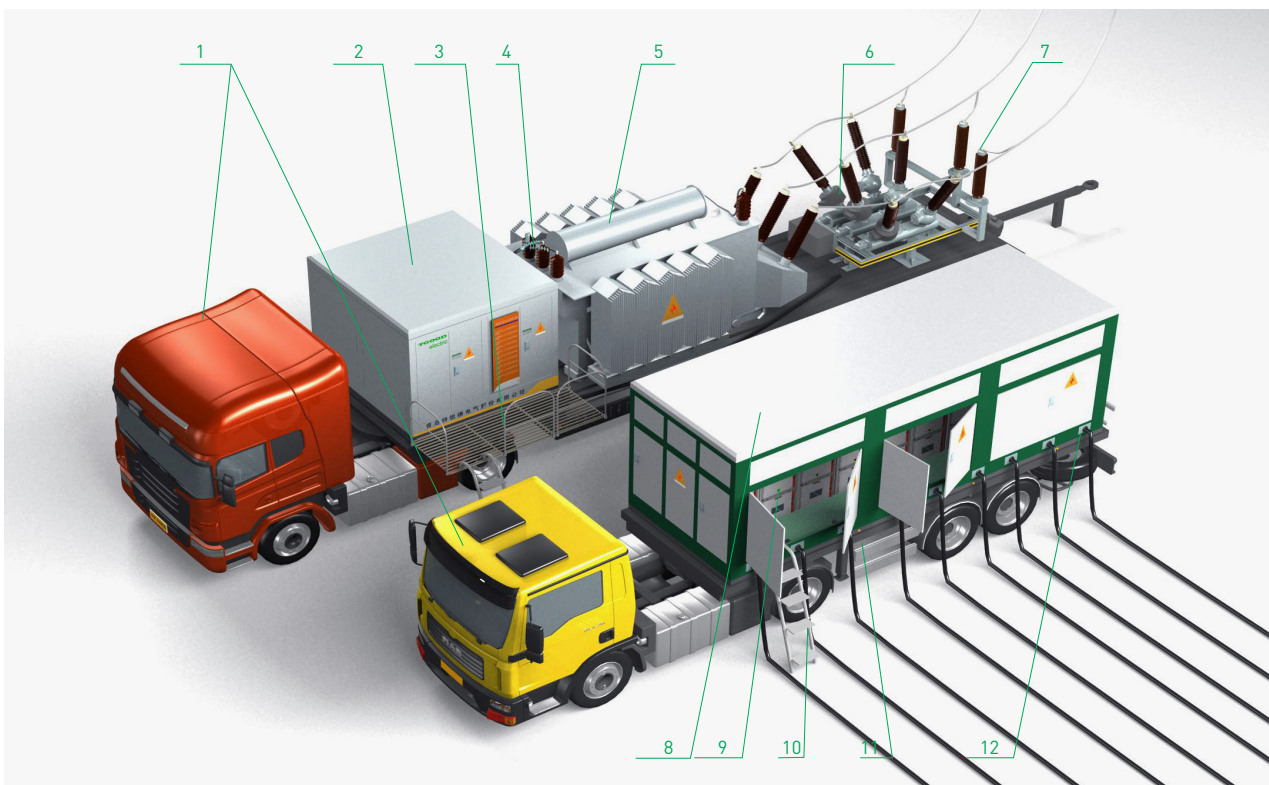
### 12kV/0.4kV trailer substation

- Location: Tianjin
- Incoming/outgoing line: cables mounted laterally
- 630kVA transformer
- 12kV incoming line one way; 0.4kV outgoing line ten ways



The 252kV trailer substation is made up of two trailers, the first trailer carries a 252kV hybrid gas insulated switchgear (HGIS) module, transformer module and 17.5kV distribution module. The second trailer carries a 17.5kV prefabricated switching substation. The first trailer, including the HGIS can be split into two independent trailers.

- Modular structure design, the two trucks for the 252kV and 17.5kV parts can be operated separately. All equipment is highly integrated and installed on the flatbed chassis, which can be pulled.
- The hybrid gas insulated switchgear THP has a high safety margin, is reliable and maintenance free.
- Special anti-vibration designed oil-immersed transformer can be safely transported and utilizes anti-vibration technology.
- The hydraulic gooseneck combined with the flat-bed trailer is flexible and convenient for transportation.
- The 17.5kV high-voltage unit is an integrated welded structure, which is stable and capable of being transported thanks to its high mechanical strength. The 17.5kV part uses imported circuit breakers and a fixed anti-vibration structure.
- Equipped with a maintenance work platform that enables easy operation of the facilities. There are many options for the connection of incoming and outgoing lines.



- |                          |                            |
|--------------------------|----------------------------|
| 1. Trailer               | 7. Surge arrestor          |
| 2. Incoming/outgoing bay | 8. 12kV switching station  |
| 3. Maintenance platform  | 9. TXGN-12                 |
| 4. Cable connection      | 10. Ladder                 |
| 5. Transformer           | 11. Maintenance passageway |
| 6. HGIS                  | 12. Cable clamp device     |

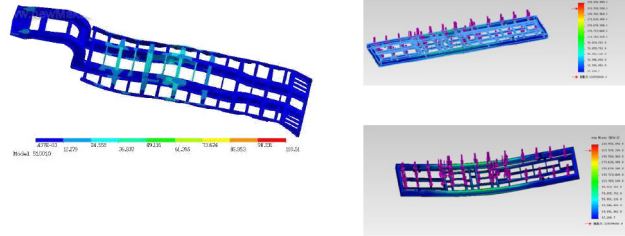


### 252kV trailer substation design

Due to its large size, the trailer substation, especially the 252kV type, has higher than normal technical and operating requirements. TGOOD develops the world's leading level of HV/MV trailer substation thanks to their advanced prefabricated substation R&D, production and manufacturing technology.

#### Designed to be strong and capable of withstanding damage when being transported

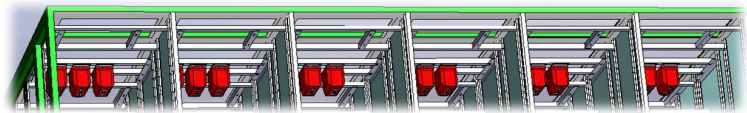
- The structure of the substation is reinforced by its welded frame.
- Analysis of the mechanical strength was carried out to find weaknesses in the design of the substation.
- All compartments are welded in one piece. Each switch unit uses welding panels specially designed by TGOOD. Thanks to these specially designed panels the substation is more compact and stronger, allowing safe transportation by truck.



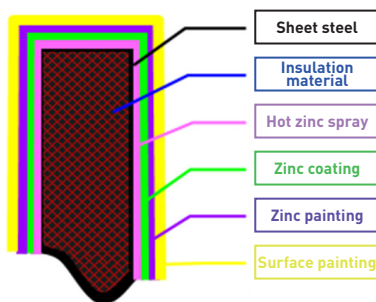
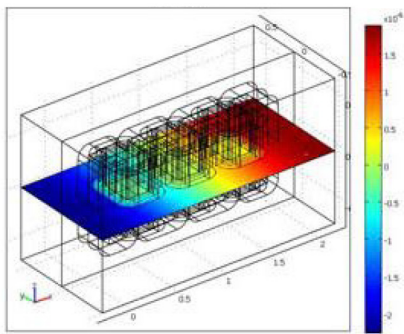
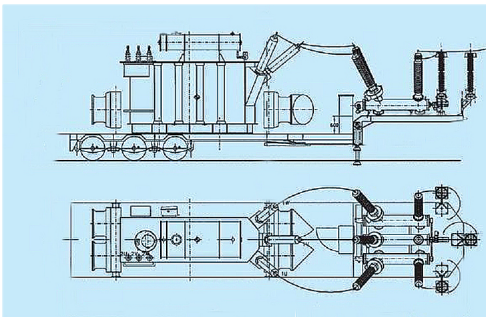
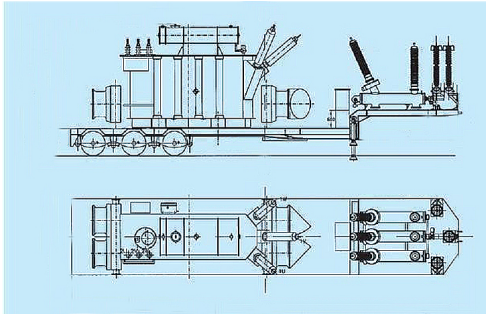
Strength analysis to substructure

#### Designed with anti-vibration technology to eliminate the risk of damage during transportation.

- Support points have been added to the main busbar to make it more robust. During transportation vibration damage to the bushing and primary components is prevented.
- To test the design of the reinforced frame, structural stress analysis, mechanical strength finite element analysis and verification are performed.
- An industrial rubber vibration isolation cushion and vibration isolation device ensure the connection strength of the switchgear and can protect against low frequency vibration.
- When assembling, the entire core is compressed with uniform pressure to prevent the transformer core from loosening.
- The number of transformer substructure and structure restraint points have been increased.
- A dynamic isolation system is provided to increase the strength of the fastener, so that the transformer can be fixed on the vehicle platform safely.



One piece welded compartments



### Protection for wiring, primary and secondary components

- The primary components make use of an anti-loosening system with high strength fasteners.
- The added suspension system and shock absorber pads enhance the secondary components shock resistance.
- All secondary wiring lines are laid through the purpose built wiring channel to prevent them falling out due to vibration.
- Electrical parts can be connected quickly using the military connectors on the disconnect/earthing switch operating mechanism.

### The bushings' construction and design

To tackle the issue of limited lateral space, the substation has been designed and constructed to allow the unfolding of the side bushings without using a crane. In addition, the insulation distance between the bushings and other electrical equipment has been increased so that the substation can be used in extreme weather conditions.

### Designed to reduce the risk of transformer partial discharge

During transportation, vibration can cause damage to the components, such as the transformer iron core and other supporting components. This damage can cause partial discharge, insulation issues or even serious accidents.

Specialized analysis has been conducted on the transformer core and related components to ensure that the core and coil strength possess adequate anti-vibration qualities. To protect against movement of the transformer body inside the cabinet, the strength of the insulation layer between the bottom of the transformer body and the oil tank has been increased.

High quality, low consumption, cold rolled silicon steel sheets are used to improve the performance of the iron core. During assembly the entire core is compressed with uniform pressure to prevent the transformer core from loosening.

### Anti-corrosion process

The enclosure and frame use a welded 4mm cold rolled steel plate construction with improved strength and tightness. The cabinet uses a double-layer structure to create a constant internal environment. An advanced anticorrosive process is used inside and outside the enclosure. "Zinc plus" protection and thermal sprayed zinc ensure that the enclosure is rust free for 30 years. The trailer substation is well suited for use in dusty, contaminative and harsh environments.

### Interlocking

- To prevent on-load closing, the disconnect cannot be opened or closed when the circuit breaker is closed.
- To prevent any incorrect opening or closing of the circuit breaker, it cannot be operated when the disconnect is closed.
- To prevent live earthing, the earthing switch cannot be operated when the circuit breaker or disconnect is closed.
- To prevent energizing when the earthing is connected, the circuit breaker or disconnect cannot be operated when the earthing is connected.
- To prevent unsafe access to a live bay, the lower door of the switchgear can only be opened when the earthing switch is closed.



### Hybrid gas insulated switchgear

#### Product specification

Item	Unit	Specification		
Rated voltage	kV	40.5	145	252
Rated current	A	2000	2500	3150
Rated frequency	Hz	50/60	50/60	50/60
Power frequency withstand voltage	kA(1min)	95/118	275/315	460
Lightning impulse withstand voltage	kV Peak	185/215	650/750	1050
Rated short-time withstand current	kA(3s)	31.5	40	63
Rated peak withstand current	kA	80/82	100/104	170
SF <sub>6</sub> pressure at 20°C	MPa	0.50/0.40	0.60/0.50	0.62/0.55
Moisture content of SF <sub>6</sub> gas at 20°C	ppm(v/v)	≤150	≤150	≤150
SF <sub>6</sub> leakage	%/year	≤0.1	≤0.1	≤0.3
Rated operating sequence		0-0.3s-co-180s-co		
Lifetime Ratings-Number of Operations				
Breaker (mechanical endurance)	Time	>10,000		
Breaker (electrical endurance)	Time	>20		
Three position switch	Time	>3,000		
Fast earthing switch	Time	>5,000		



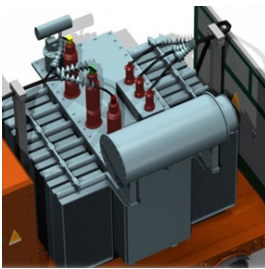
### MV switchgear

Item	Unit	Value	
Structure type		Metal-enclosed	
Rated voltage	kV	17.5	40.5
Rated frequency	Hz	50/60	50/60
Rated current	A	2500	2500
Temperature rise test		1.0 Ir	1.0 Ir
Rated power frequency withstand voltage (1 min)	kV	42	118
Rated lightning impulse withstand peak voltage (1.2/50μs)	kV	95	215
Rated short-circuit breaking current	kA	31.5	31.5
Rated short-circuit making current	kA	80/82	80
Rated short-time withstand current and time of duration	kA/s	31.5/3	31.5/3
Rated peak withstand current	kA	80/82	80
Short-time power frequency withstand voltage of subsidiary and control loop	kV	2	2
Power supply	Control circuit	V	DC220
	Auxiliary circuit	V	AC 380/ AC 220
Life time	year	≥30	
Protection level	Enclosure	IP3X	
	Between compartments	IP2X	



### Vacuum circuit breaker up to 40.5kV

- Spring mechanism
- 30 years maintenance free
- Rated voltage: up to 40.5kV
- Rated current: 2500A/31.5kA
- Opening time (ms):  $\leq 43$
- Closing time (ms):  $\leq 70$
- Operating sequence: 0-0.3s-CO-180s-CO
- One minute power frequency withstand voltage: up to 118kV
- Lightning impulse withstand voltage: up to 215kV
- Mechanical endurance: 10,000 times



### HV/MV transformer

- Service voltage up to 252kV
- Low consumption, low noise, low partial discharge, small temperature rise
- The compact design reduces overall dimensions
- Anti vibration design prevents damage to transformer
- Inlet and outlet bushings are fully enclosed
- Reinforced transformer core
- Equipped with an acceleration sensor to monitor the movement of transformer during transportation
- Oil chromatography online monitoring system



### Protection system

- 32-bit floating-point DSP (120M) and 16-bit high-precision AD sampling with powerful operation and logic function
- Hierarchical distributed structure and multi-CPU parallel processing mode improves reliability
- Modular design with strong scalability
- Sealed and enhanced cabinet with anti-vibration design suitable for harsh environment application
- Monitoring and control functions.
- Providing CAN BUS, RS-485 and optic fiber ethernet interface



### Combined hydraulic trailer

- Axles/suspension: 4/8
- Tire type: 215/15R17.5
- Load per axis: 30,000kg
- Maximum speed: semi-trailer is 50 km/h, whole trailer is 20 km/h
- Load capacity:
  - No more than 30,000 kg at every axle at 6 km/h
  - No more than 25,000 kg at every axle at 20 km/h
  - No more than 16,800 kg at every axle at 50 km/h
- Gradeability:
  - Longitudinal slope: 6 %
  - Cross slope: 7°
- Platform height: 1,050<sup>+250</sup>/<sub>-300</sub> mm
- Power unit:
  - Engine: diesel
  - Power / rotate speed: 13.2 kW /1500r/min, 20 kW/2000r/min
  - Oil pump: plunger pump

### Lighting system

If there is a power failure, lights in the corridor can be used for emergency lighting. Lights on the operation panel can be used for maintenance. The lighting outside can be used as a station searchlight.

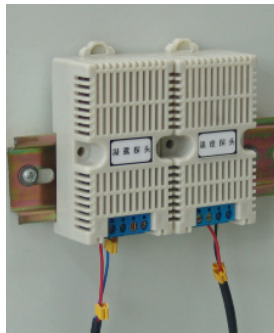
### Smoke detection system

The pre-installed smoke alarm can automatically notify the central control room of any smoke or fire detected.



### Temperature and humidity control system

To keep the temperature and humidity constant in the cabinet and to ensure more reliable operation of the components, the cabinet is equipped with a condensation and temperature probe. During winter when the temperature decreases, the thermal management system can ensure a constant temperature inside the substation. During summer the ventilation system can be used for ventilation and cooling.



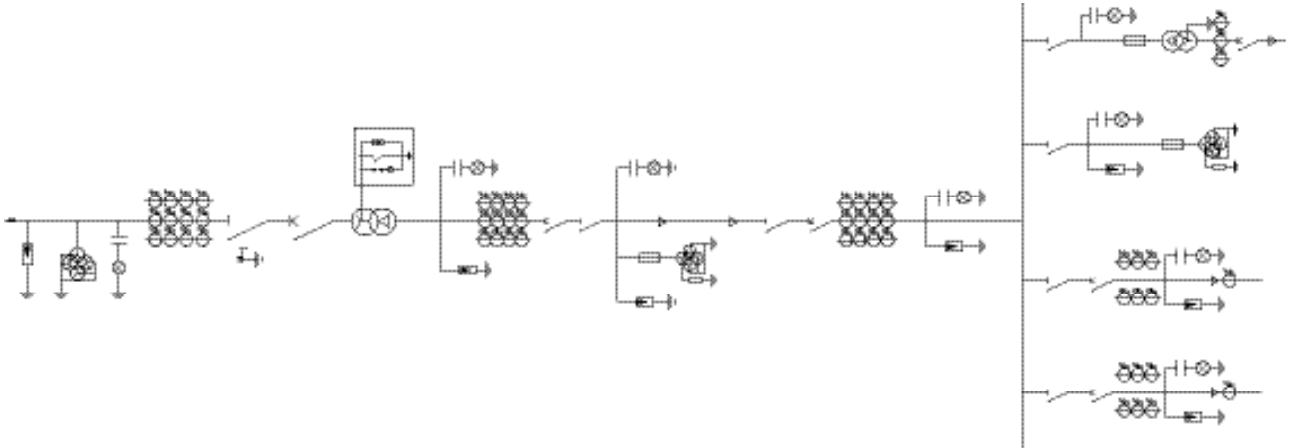
### Quick connection system

The quick connection clamp designed by TGOOD ensures the operator can connect cables easily.



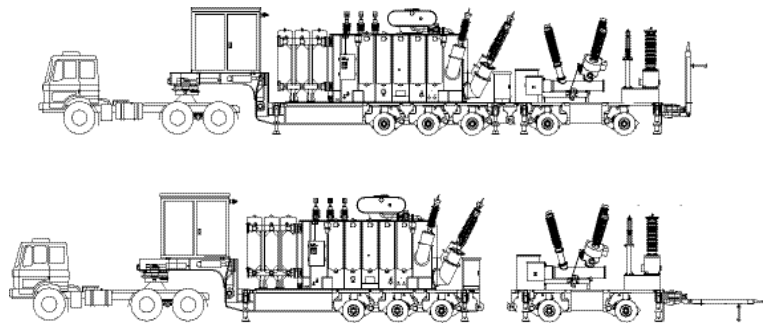


## 252kV/17.5kV trailer substation

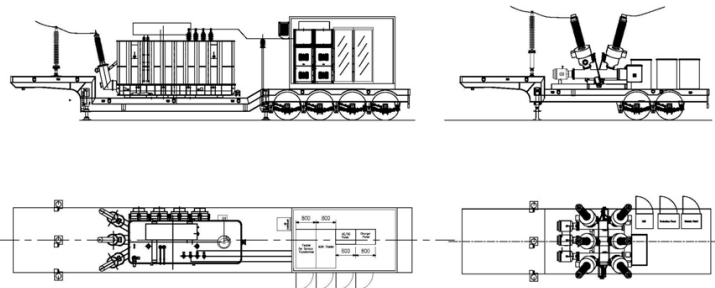


Single line drawing of 252kV/17.5kV trailer substation

## Transformer trailer



Solution 1: transformer trailer (with the VT mounted separately)

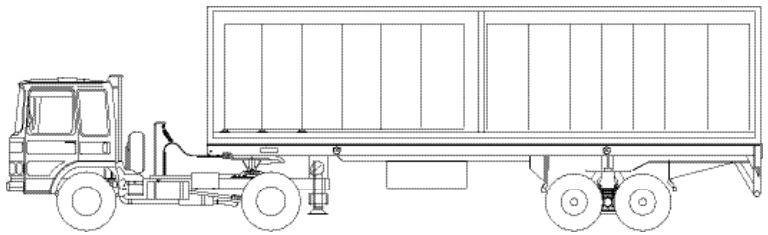


Solution 2: transformer trailer (with VT mounted on HGIS)



Photo of transformer trailer

### 17.5kV power distribution trailer

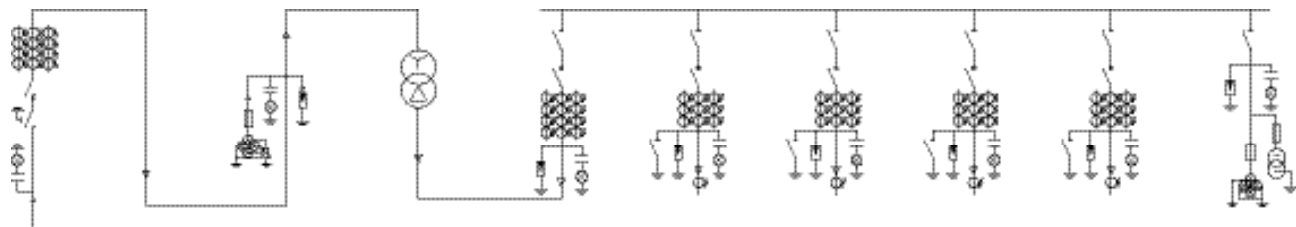


Overview of 17.5kV distribution trailer

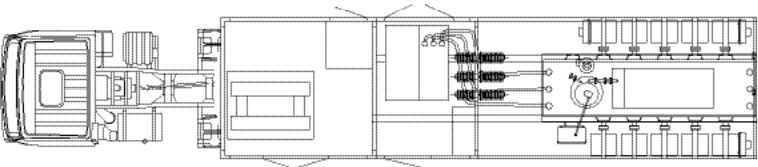
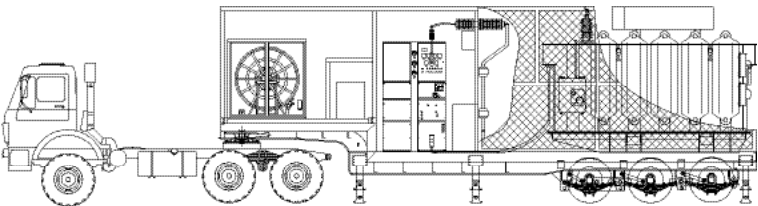


Photo of 17.5kV distribution trailer

40.5kV/12kV trailer substation – double trailer solution



Single line drawing of 40.5kV trailer substation



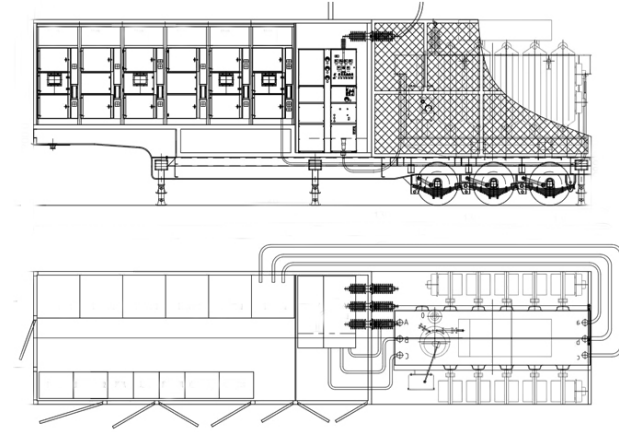
Overview of transformer trailer of 40.5V trailer substation



Photo of transformer trailer of 40.5 kV trailer substation

### 40.5kV/12kV trailer substation – single trailer proposal

Cable connection



### 12kV/0.4kV trailer substation

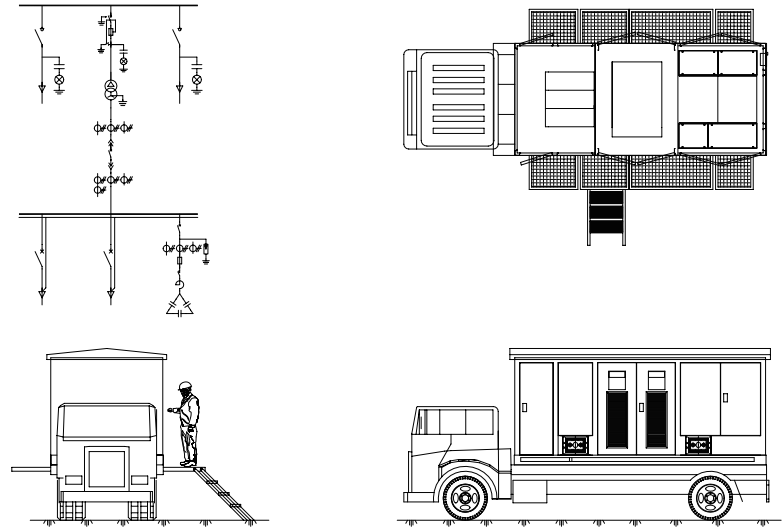
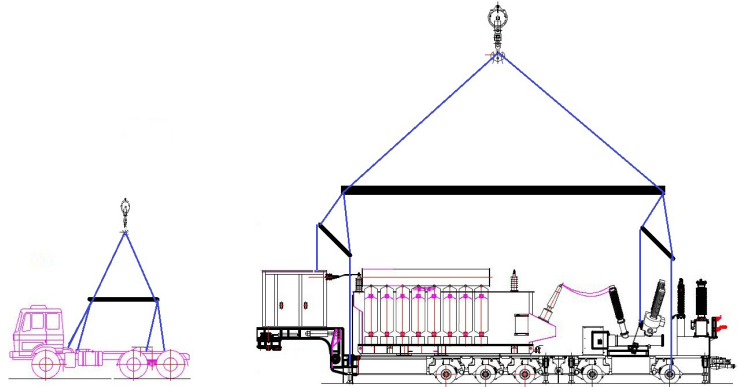


Photo of 12kV/0.4kV Trailer mobile substation



### Lifting:

The chassis structure is designed according to the arrangement of the components and distribution of gravity. The hoisting point locations are positioned according to the substations center of gravity.



### Fixing:

During long distance sea transportation, the trailer substation will be fixed inside the ship with hydraulic legs supporting the whole structure. The picture below is an example of fixing inside a ship.

