power your future

ZPUE®
Koronea group

Transformer Stations and Renewable Energy Equipment – **RES**

Let's protect our environment

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Renewable Energy Equipment – RES

- **SPS** - Intelligent transformer stations with energy storage adapted to cooperate with RES
- Energy storage systems
- Container transformer stations
- LV and MV switchgears
- Pole transformer stations

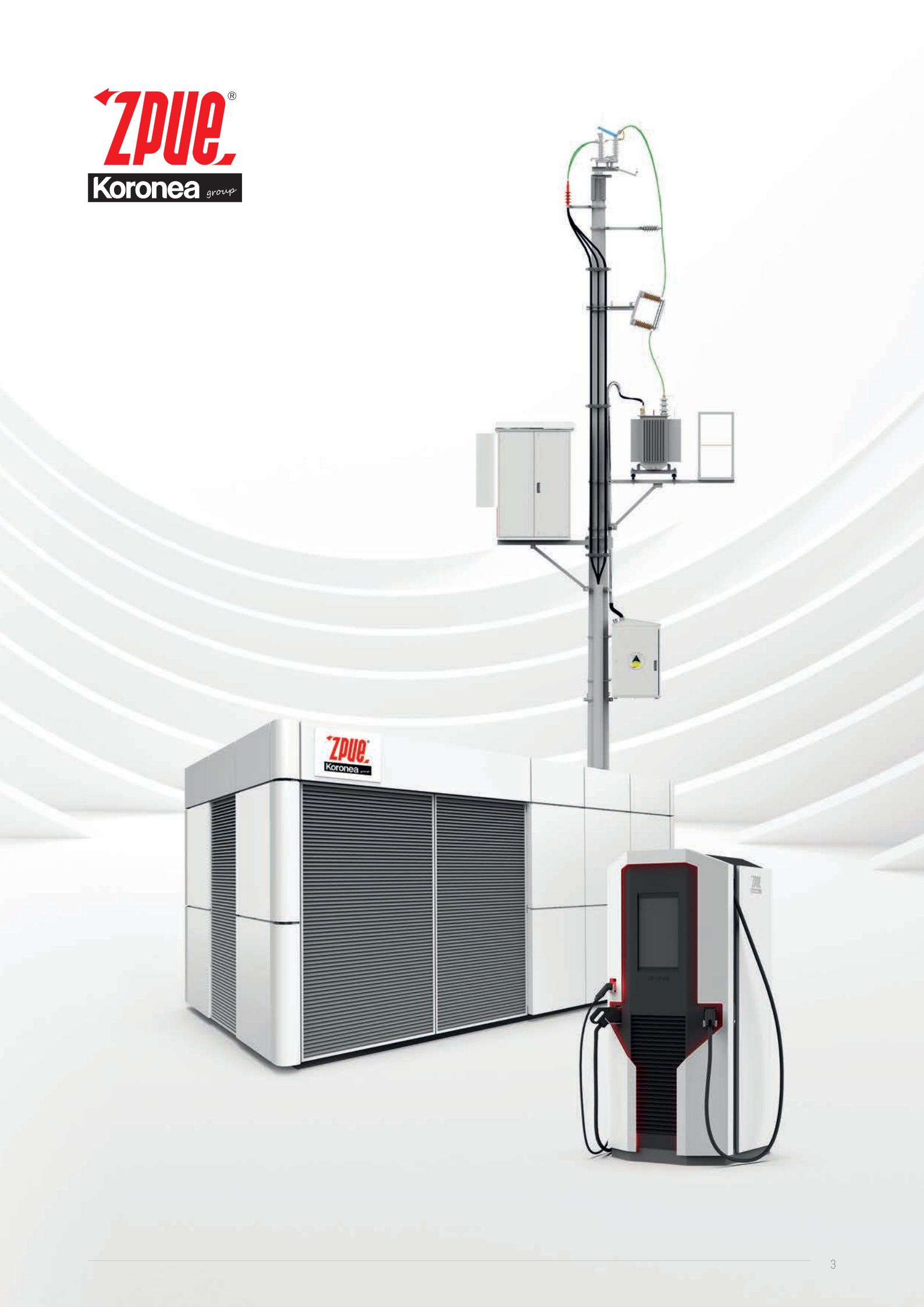
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Table of contents

1 Introduction

Operating in the power industry for over thirty-five years, we see how the approach to environmental issues in our yard is changing, not only in terms of legal solutions, but also impressive innovations that change our reality. World power industry is one of the branches of the global economy that are doing their homework with responsibility for the environment and climate most urgently.

Even 30 years ago in our country the use of renewable energy sources, such as wind or sun, seemed to be absolute science fiction. Most electricity used to be generated at conventional power plants using fossil fuels. The alternative to this solution were renewable energy sources (RES). Their resources are replenished through natural processes, which makes them essentially inexhaustible. In Polish conditions, renewable energy includes the energy produced directly from solar radiation (converted into electricity or heat), wind, geothermal resources, water resources, solid biomass, biogas and liquid biofuels.

72 stations with a capacity of 1 MW equipped with MV and LV switchgears produced by ZPUE S.A.

ZPUE S.A. is a company aware of the changes taking place in the world. Our products have repeatedly set new standards for the sector. It is no different in the era of „ECO-revolution". Our engineers and designers working on new solutions take into account not only the applicable standards, but are looking for new opportunities for environmental protection, themselves. And all this for a healthy future for future generations. It depends on us what world they will find. Instead of the carbon footprint, let's leave a green path of concern for the health and comfort of our children.

ZPUE is a company with many years of experience in the energy distribution industry for the energy and renewable energy industries.

Thanks to our tremendous intellectual and manufacturing potential, we have been actively involved in the construction of RES plants for many years, making electrical equipment integrated with the systems of the DSOs (electricity distribution system operators). We combine complex, technically advanced designs with high quality, short lead times and economical solutions.

The most advanced projects are not a challenge for us. We are present in every energy sector, from generation and distribution to industry and energy storage. We support our clients at every stage of the project, from conception to assembly and commissioning.

In the catalog we have collected examples of the possibilities of using our devices to cooperate with Renewable Energy Sources.

2.0

MEW / SPS - intelligent transformer station with energy storage adapted to cooperate with renewable energy sources.

Energy storage is a necessary condition to stabilize the system and improve energy safety. It is particularly important in the case of less stable renewable sources. Various energy storage technologies have been developed for many years, but currently technologies based on mainly lithium electrochemical cells are being developed the cheapest and most dynamically. The main purpose of energy storage is to balance the network in a 24-hour cycle, alleviate the load on the power grid in the peaks and accumulate energy when it is over-produced. This is particularly important for non-controllable renewable sources. Large-scale storage maintains a surplus when wind and solar production exceeds demand and then releases it to the grid when renewable energy resources are insufficient to meet consumption.

More and more renewable sources are connected to the network. This makes it necessary to maintain a balance between production and consumption. The lack of this balance leads to destabilization of the system and thus to loss of energy security. It may even threaten economic development, because for companies investing in Poland, reliability of energy supply is very important.

Connecting new renewable energy installations in some sections of the MV network is no longer as obvious as it might seem. Technical limitations of the MV infrastructure are slowly beginning to bother investors. This infrastructure in some nodes of the network becomes insufficient to be able to connect further RES, while those that are already operating are not fully used in favorable weather conditions. To fully exploit the potential of installed sources and enable connections to new ones, without the need for long and costly reconstruction of the MV network, it is necessary to use energy storage, which main purpose will be to properly balance the network in the daily cycle and reduce the transfer of produced energy to the network during peak production.

A typical example of a station integrated with energy storage is the MEW / SPS station.

The MEW energy storage system is a collection of equipment used for the controlled import and export of electricity to and from the power system on the LV and MV sides. The primary components of the energy storage system include the battery energy storage unit, a bi-directional AC/DC converter, an SPS Control system, LV and MV switchgear and an HVAC system.

SPS is an intelligent transformer station with an energy storage. A solution that integrates the functions of a remotely managed, distribution transformer station operating in a Smart Grid system with a two-way inverter (energy charging / supplying) cooperating with the energy storage system. The system is supplemented with the possibility of supplying energy storage or consumers directly from renewable energy sources, e.g. photovoltaic or wind farms.

Individual components can create independent installations or work together as one advanced system that effectively improves the reliability of power supply for facilities, optimizing the demand for electricity and related financial outlays.

Basic advantages:

- stabilization of power network parameters and improvement of power supply reliability;
- smoothing the diurnal load curve;
- reactive power compensation;
- elimination of load unevenness, voltage and frequency drops;
- increasing the security of supplying public utilities, hospitals and the continuity of technological processes in industrial plants;
- energy storage system based on lithium-ion technology that guarantees a lifetime of up to 5000 full cycles, which translates into a service life of up to 20 years.

The need to invest in energy storage is confirmed by the fact that Distribution System Operators have identified the necessity of using and investigating the advantages of energy storage depending on the demand at various points of the power system. The development of the power industry and the related sector of Renewable Energy Sources will certainly contribute to further growth of energy storage due to the need to increase the security of energy supply and the stability of the power system.

Experts agree that it is impossible to talk about the development of renewable energy and the new generation of energy without appropriate energy storage technologies. Energy can be stored using several technologies, but electrochemical cell technology, especially lithium-ion, is the most developmental direction of storage in recent years.

Western energy companies as well as other companies from the sector are building large-scale energy storage facilities. The largest such facilities in the world already exceed the capacities of 250 MW and 1000 MWh. Such large units have a tremendous impact on the stability of the power grid, and – over 20 years' time – they will be able to generate savings equivalent to more than PLN 300 million.

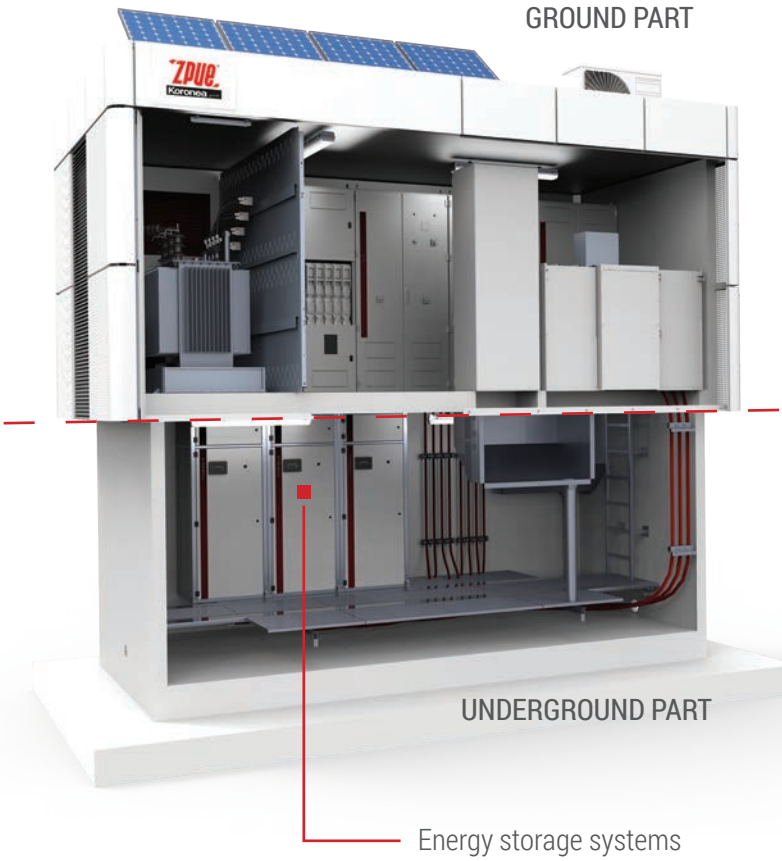
Advantages of underground energy storage:

- Smaller footprint, which is important in highly urbanised areas, where vacant space is scarce and every square metre is expensive.

- Smaller costs connected with the maintenance of a suitable ambient temperature for the batteries. Underground batteries have much better operating conditions in terms of temperature. This significantly reduces the cost of maintaining the temperature in all weather conditions and in every season.

- Improved fire safety Underground batteries are safer due to the lower risk of fire because the earth and the reinforced concrete walls of the container form an excellent fire barrier.

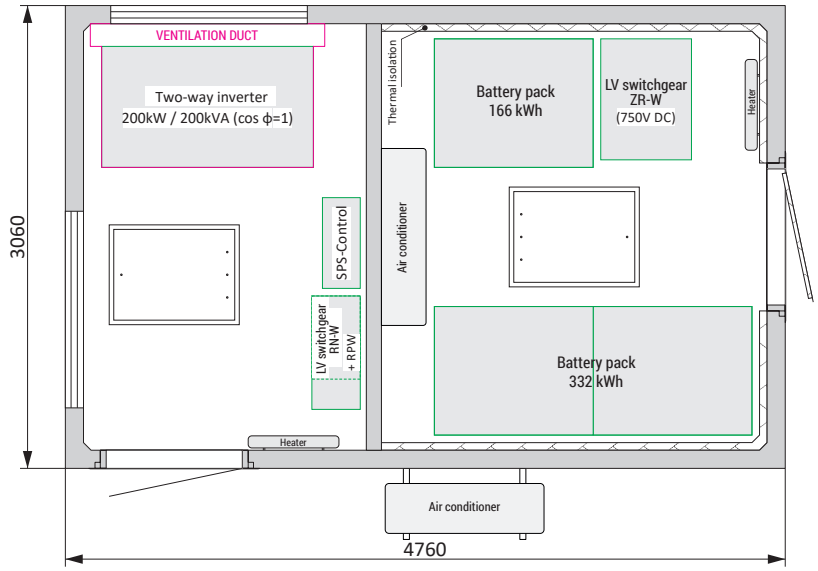
- Excellent resistance to mechanical impacts. Equipment installed in reinforced concrete containers underground is much better protected against mechanical impacts. Substations installed near roads and circulation routes require better protection for sensitive equipment – this can be achieved by constructing the substation with an underground part, forming a "bunker" for the installation of the batteries.



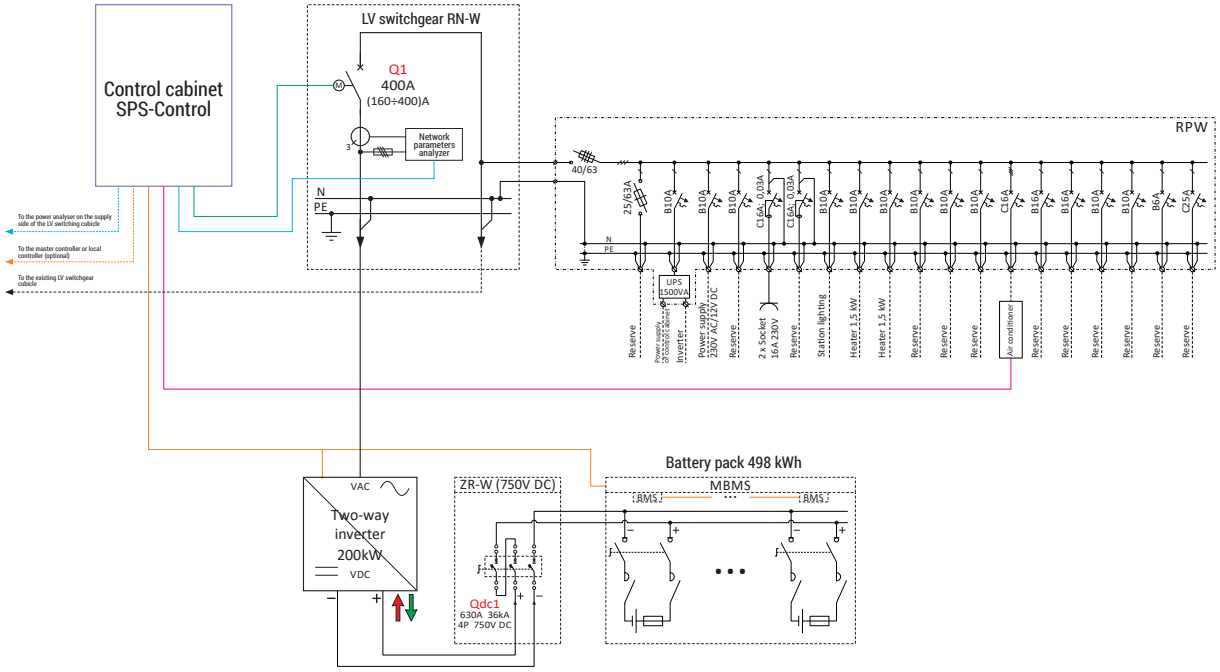
The catalogue shows examples of substations with energy storage that have been implemented for RES plants. It is possible to produce many other solutions customised to the individual needs of the customer.

MEW-b (200 kW / 498 kWh) - energy storage system with a capacity of 498 kWh and power output of 200 kW

TOP VIEW / ARRANGEMENT OF THE ACCESSORIES



ELECTRICAL DIAGRAM

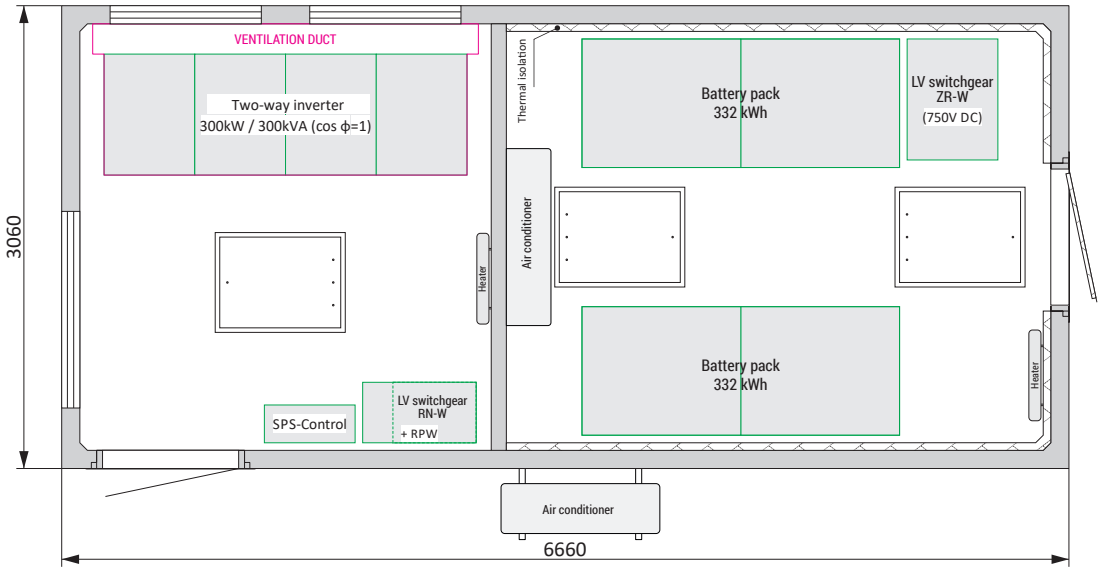


Maximum power of the energy storage	200 kW
Maximum energy storage capacity	498 kWh
Rated voltage / LV Rated current (AC)	0,4 kV / 400 A
External dimensions (length / width / height from the ground)	4760mm / 3060mm / 3230mm

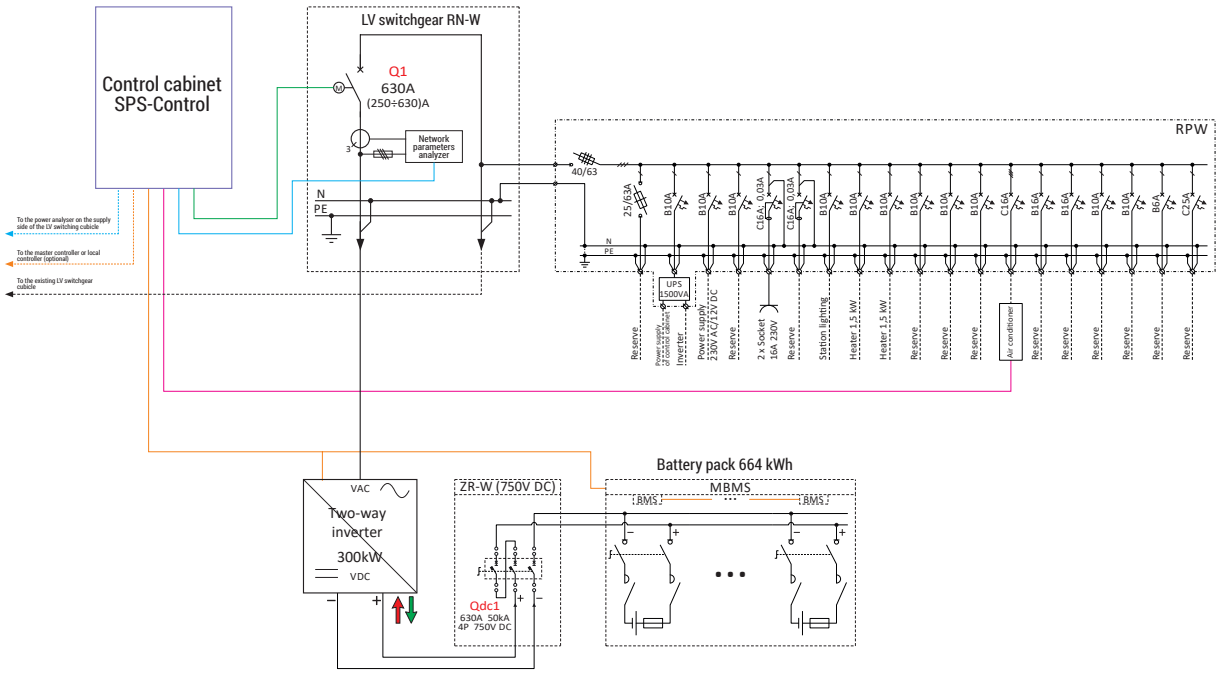
→ **NOTE!** The catalogue shows the sample configuration of the station.

MEW-b (300 kW / 664 kWh) - energy storage system with a capacity of 664 kWh and power output of 300 kW

TOP VIEW / ARRANGEMENT OF THE ACCESSORIES



ELECTRICAL DIAGRAM



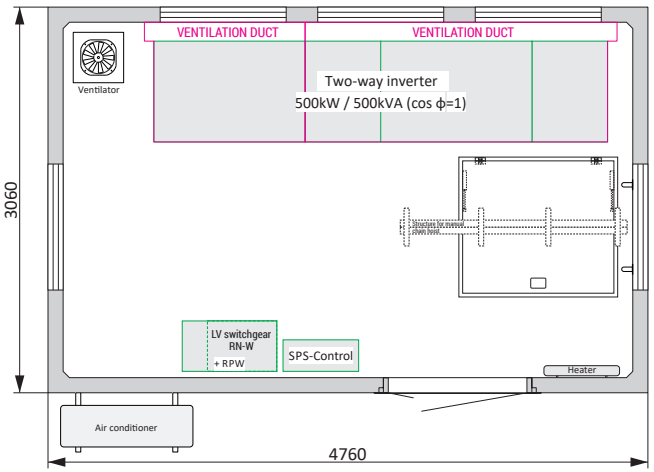
Maximum power of the energy storage	300 kW
Maximum energy storage capacity	664 kWh
Rated voltage / LV Rated current (AC)	0,4 kV / 630 A
External dimensions (length / width / height from the ground)	6660mm / 3060mm / 3230mm

→ **NOTE!** The catalogue shows the sample configuration of the station.

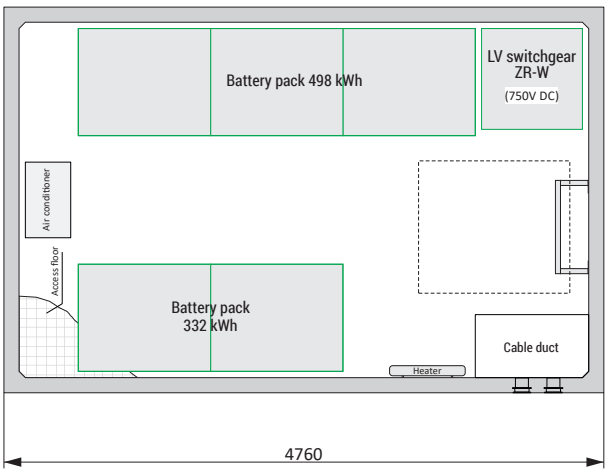
MEW-b (500 kW / 830 kWh) - energy storage system with a capacity of 830 kWh and power output of 500 kW

TOP VIEW / ARRANGEMENT OF THE ACCESSORIES

GROUND PART



UNDERGROUND PART



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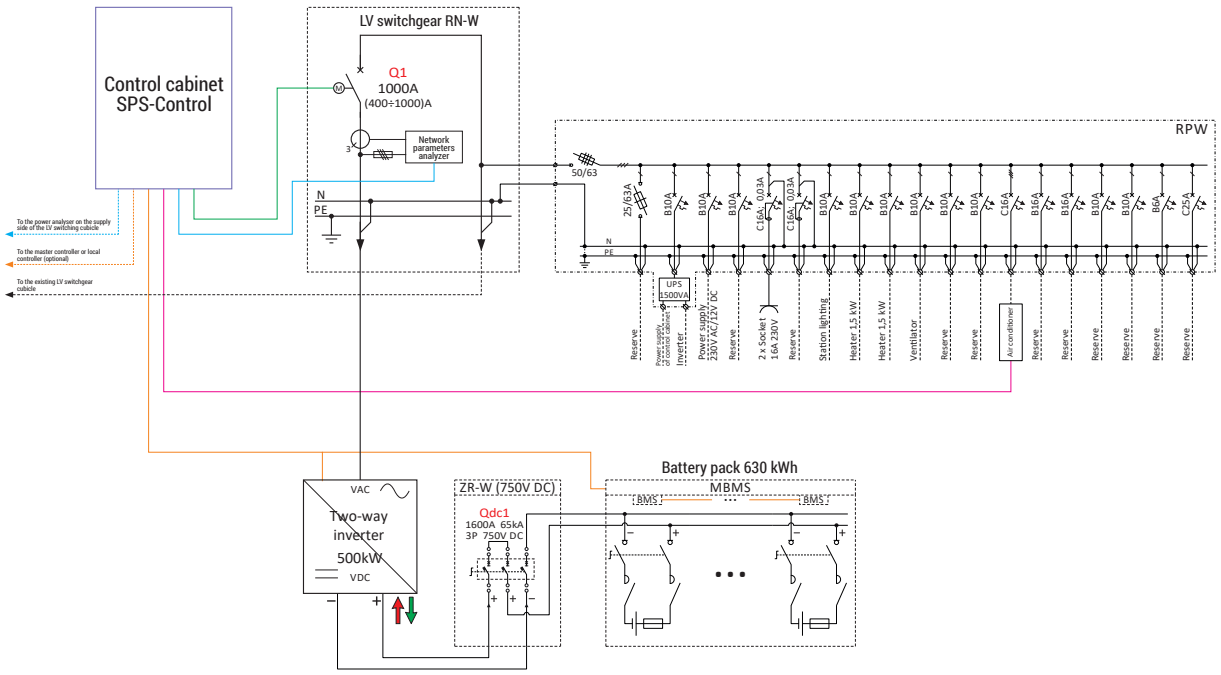
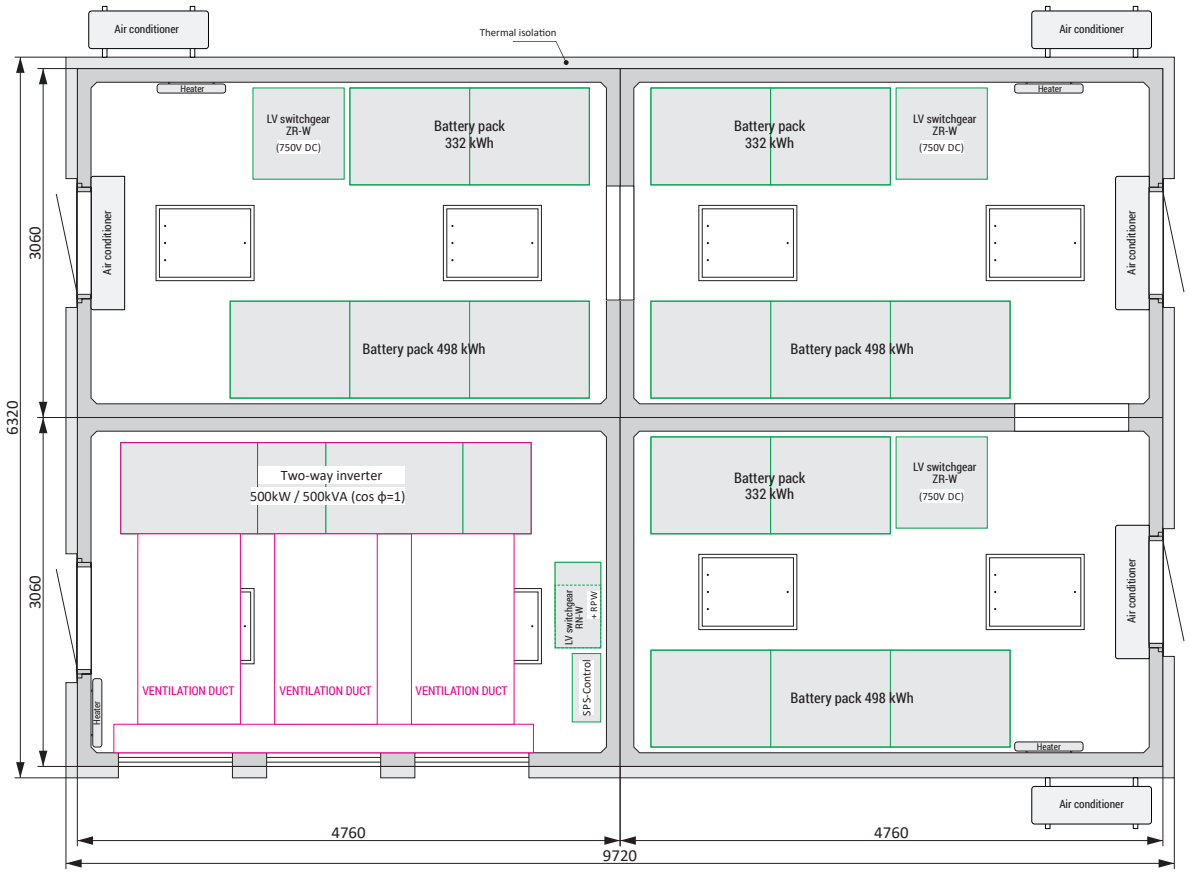


Maximum power of the energy storage	500 kW
Maximum energy storage capacity	830 kWh
Rated voltage / LV Rated current (AC)	0,4 kV / 1000 A
External dimensions (length / width / height from the ground)	4760mm / 3060mm / 3230mm

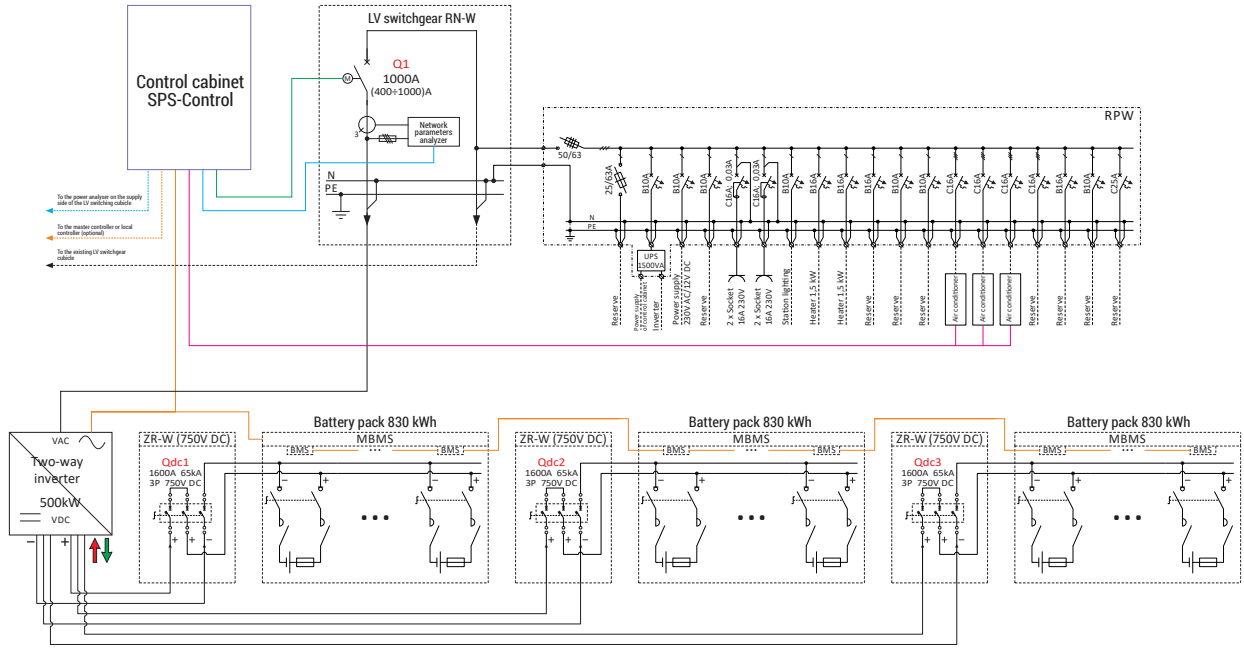
→ **NOTE!** The catalogue shows the sample configuration of the station.

MEW-b (0,5 MW / 2,49 MWh) - energy storage system with a capacity of 2490 kWh and power output of 500 kW

TOP VIEW / ARRANGEMENT OF THE ACCESSORIES



ELECTRICAL DIAGRAM

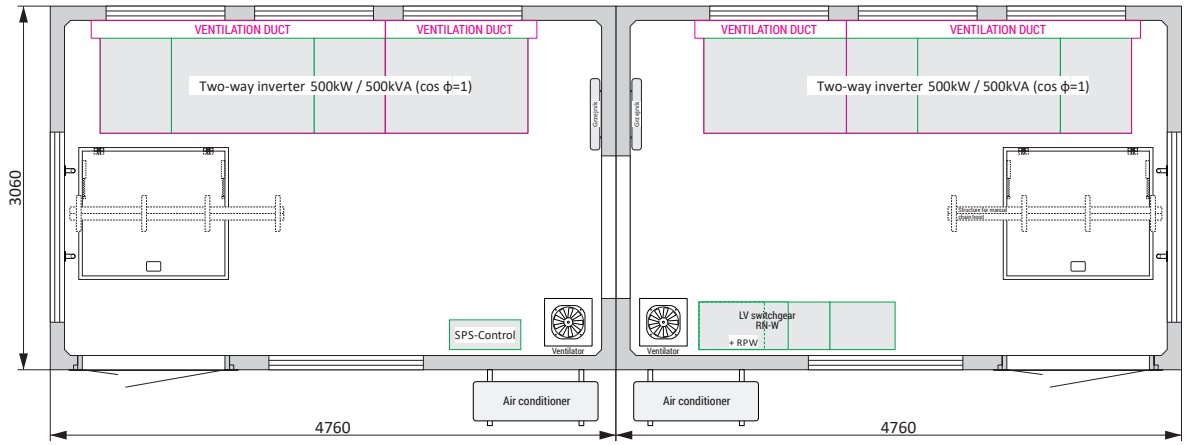


Maximum power of the energy storage	500 kW
Maximum energy storage capacity	2490 kWh
Rated voltage / LV Rated current (AC)	0,4 kV / 1000 A
External dimensions (length / width / height from the ground)	9720mm / 6320mm / 3260mm

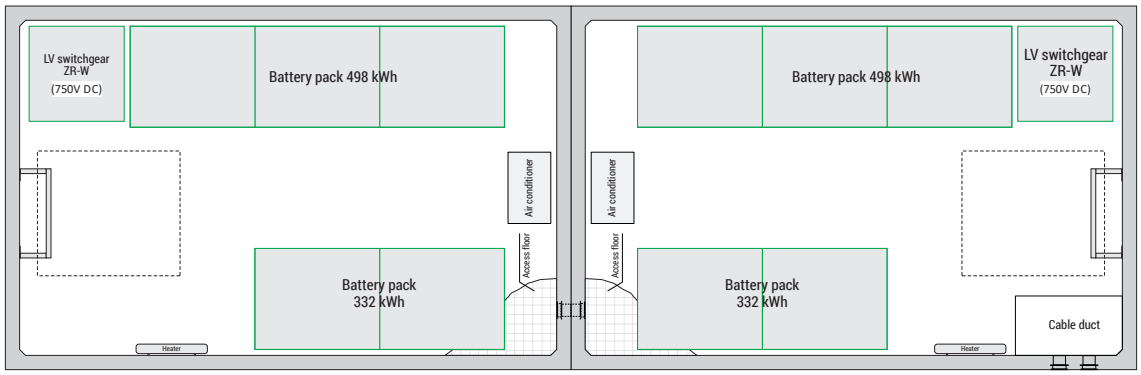
→ **NOTE!** The catalogue shows the sample configuration of the station.

MEW-b (1 MW / 1,66 MWh) - energy storage system with a capacity of 1660 kWh and an installed capacity of 1000 kW

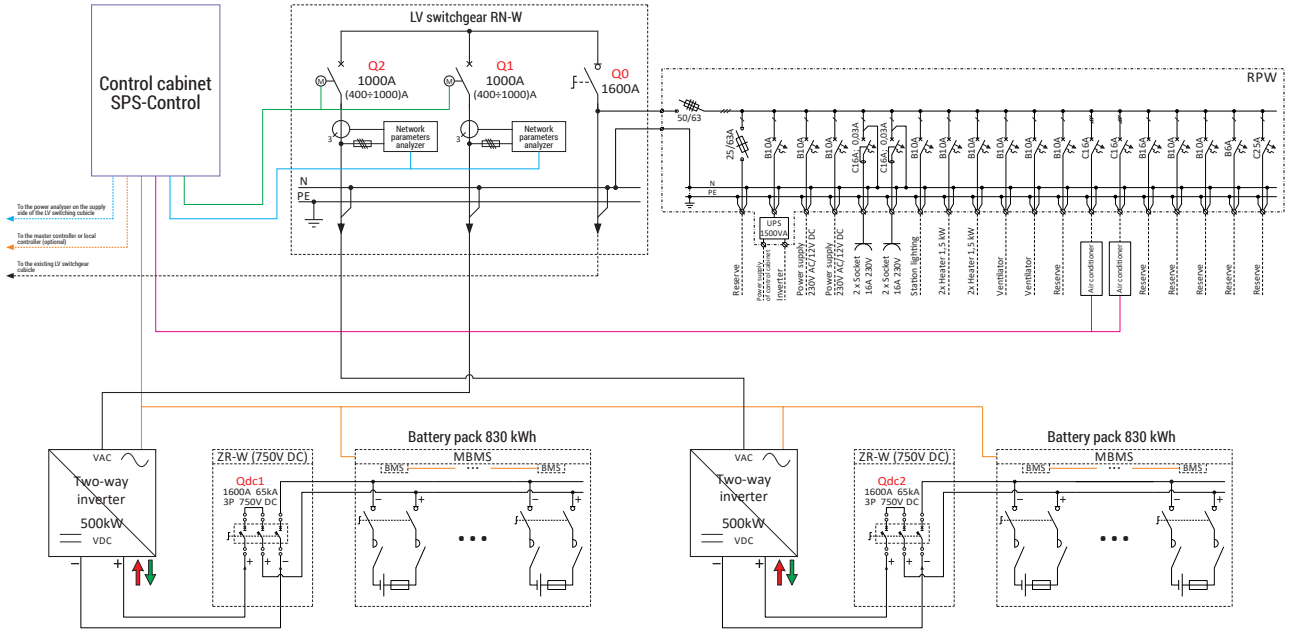
TOP VIEW / ARRANGEMENT OF THE ACCESSORIES - GROUND PART



TOP VIEW / ARRANGEMENT OF THE ACCESSORIES - UNDERGROUND PART



ELECTRICAL DIAGRAM

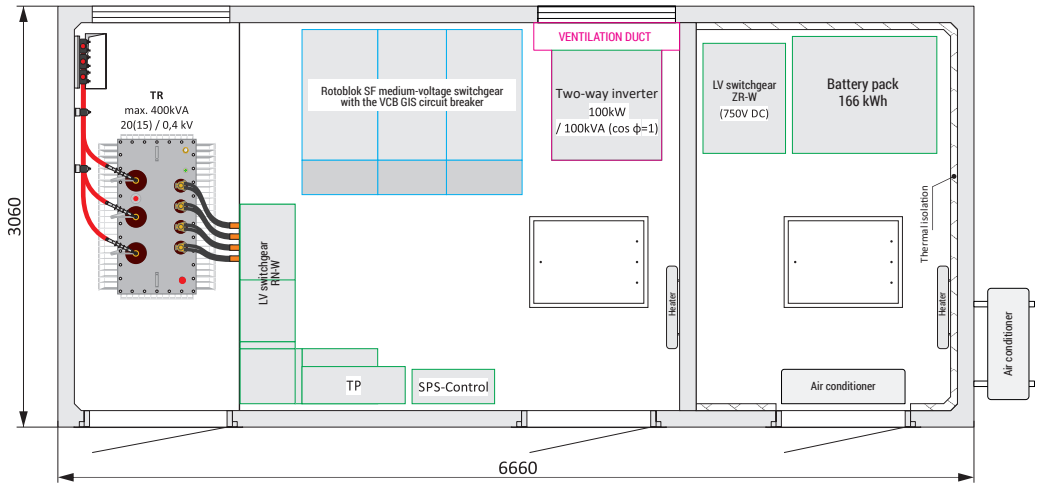


Maximum power of the energy storage	1000 kW
Maximum energy storage capacity	1660 kWh
Rated voltage / LV Rated current (AC)	0,4 kV / 1600 A
External dimensions (length / width / height from the ground)	9520mm / 3060mm / 3230mm

→ **NOTE!** The catalogue shows the sample configuration of the station.

MEW-b 20/400-3 (100 kW / 166 kWh) - substation with energy storage with a capacity of 166 kWh and power output of 100 kW

TOP VIEW / ARRANGEMENT OF THE ACCESSORIES



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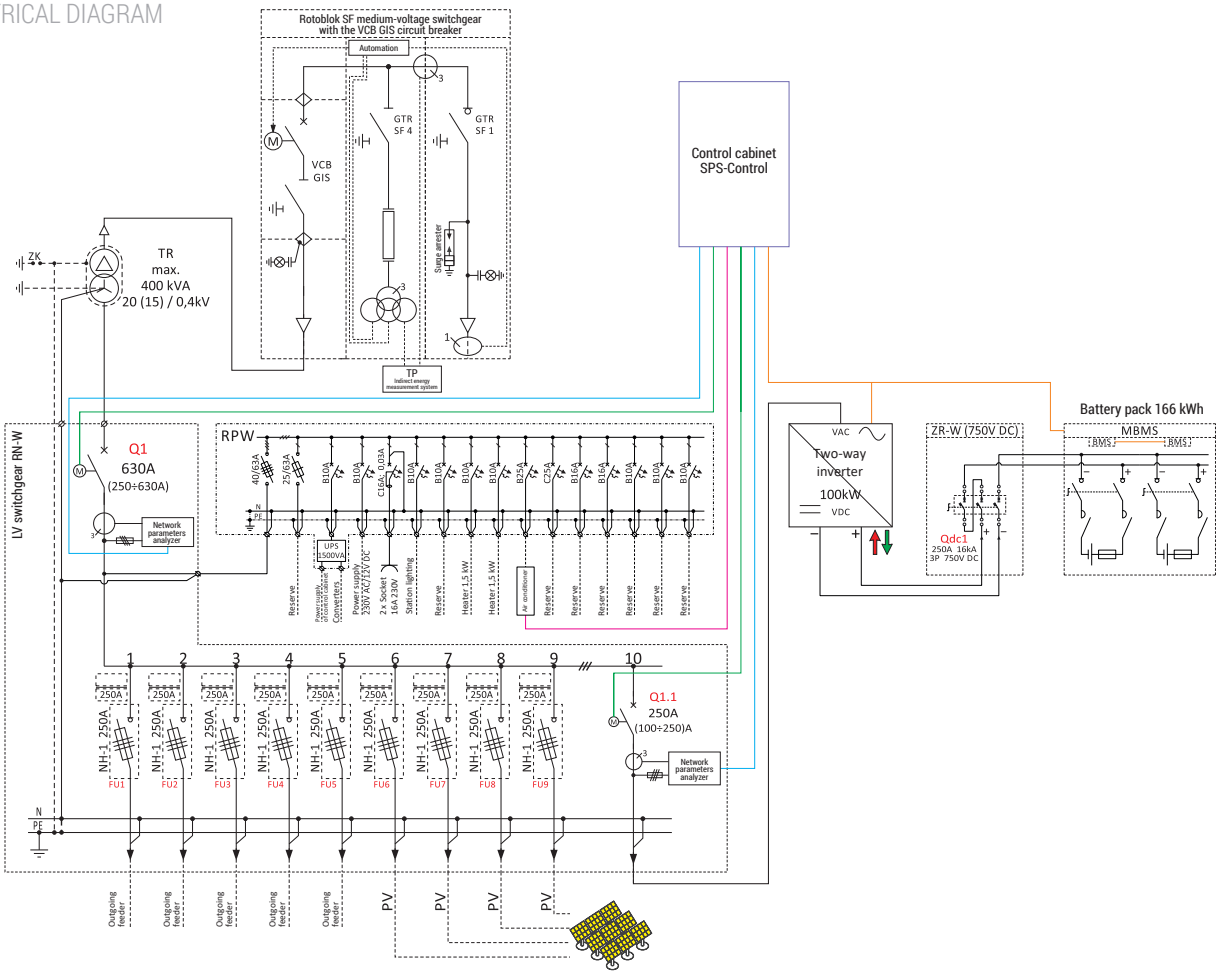
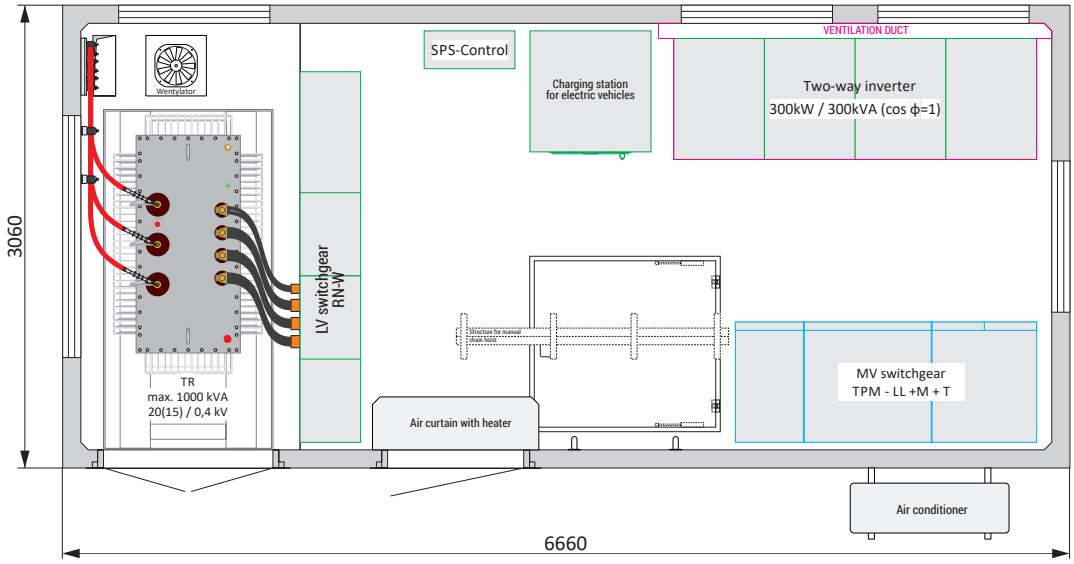


Maximum rated power of transformer	400 kVA	
Maximum power of the energy storage	100 kW	
Installed capacity of energy storage	166 kWh	
	MV	LV (AC)
Rated voltage	20(15) kV	0,4 kV
Rated current	630 A	630 A
External dimensions (length / width / height from the ground)	6660mm / 3060mm / 3230mm	

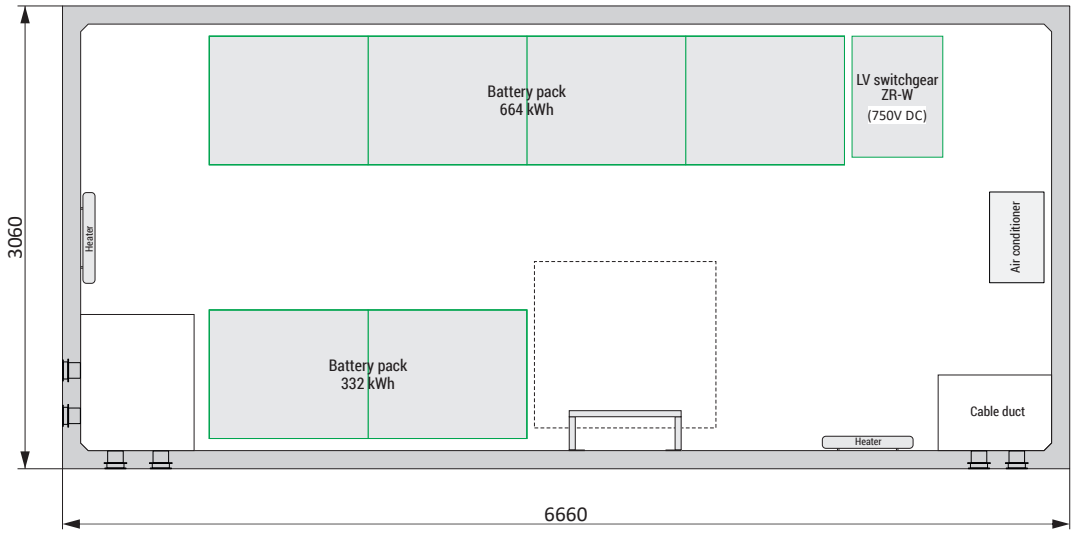
→ **NOTE!** The catalogue shows the sample configuration of the station.

MEW-b 20/1000-4 (300 kW / 996 kWh) - substation with energy storage with a capacity of 996 kWh and power output of 300 kW and a DC charging station

TOP VIEW / ARRANGEMENT OF THE ACCESSORIES - UNDERGROUND PART



TOP VIEW / ARRANGEMENT OF THE ACCESSORIES - UNDERGROUND PART



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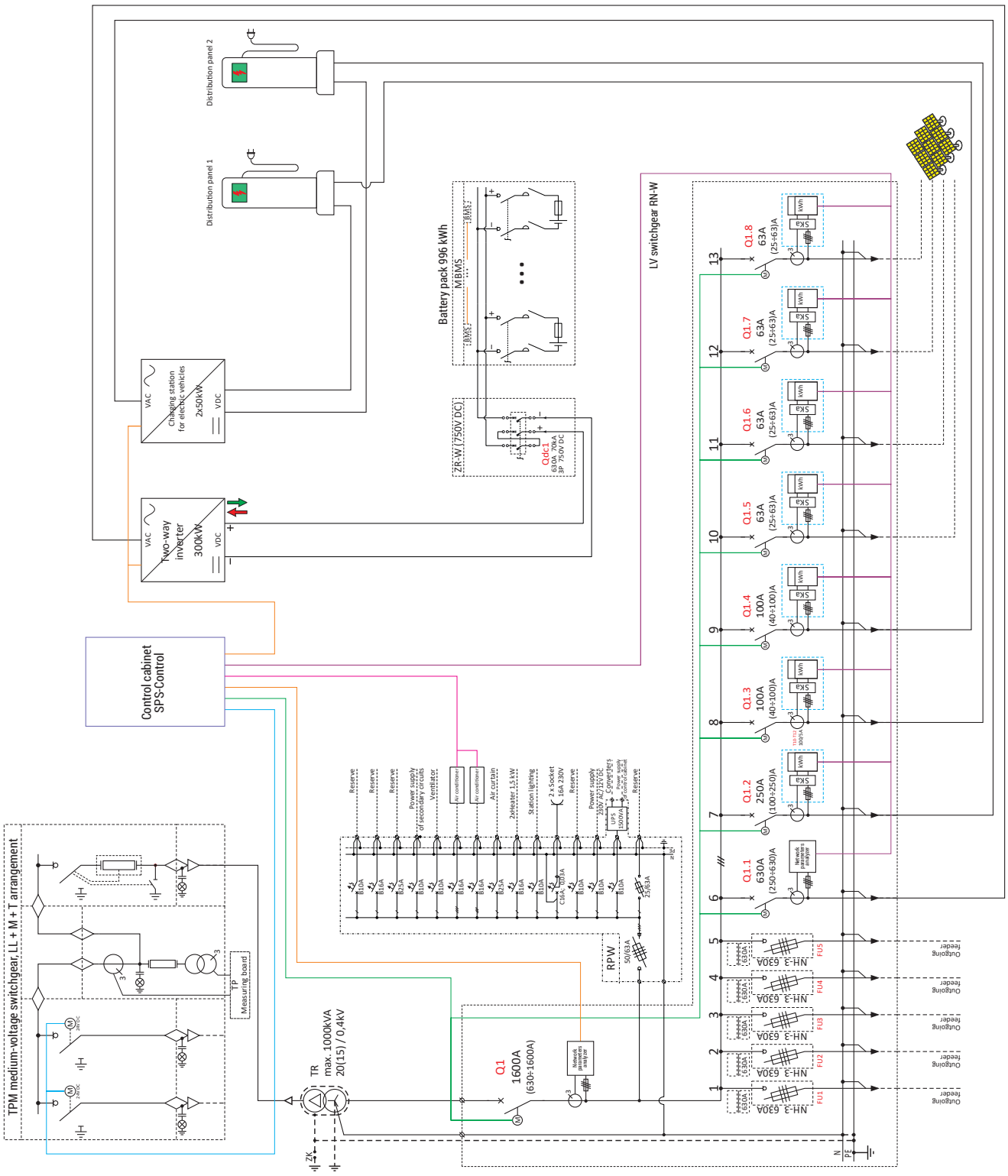
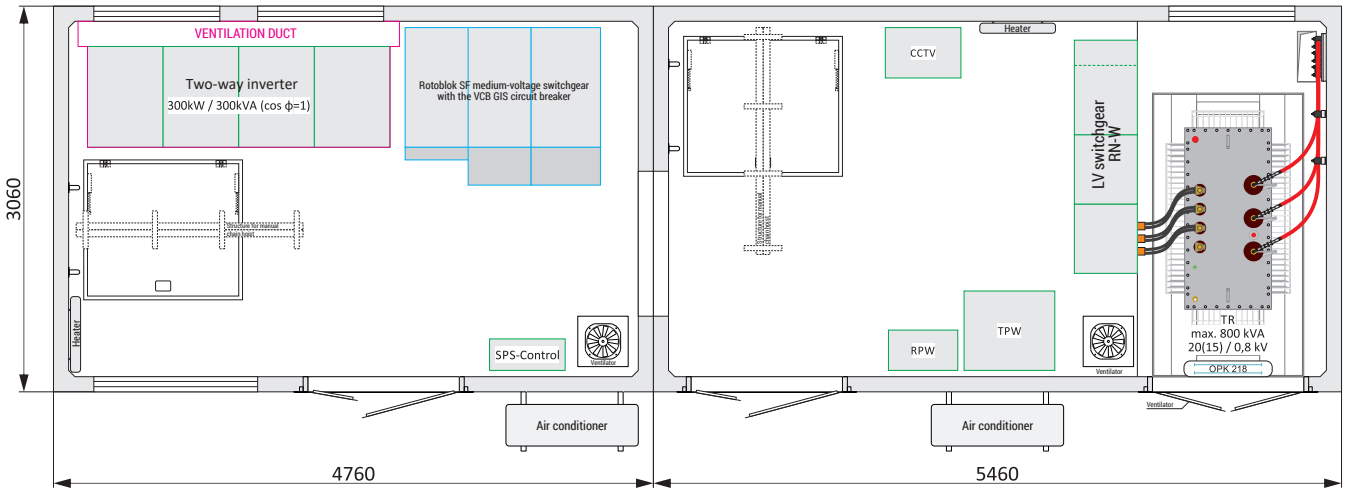


Maximum rated power of transformer	1000 kVA	
Maximum power of the energy storage	300 kW	
Installed capacity of energy storage	996 kWh	
Capacity of a DC charging station for electric vehicles	2x50 kW	
	MV	LV (AC)
Rated voltage	20(15) kV	0,4 kV
Rated current	630 A	630 A
External dimensions (length / width / height from the ground)	6660mm / 3060mm / 3230mm	

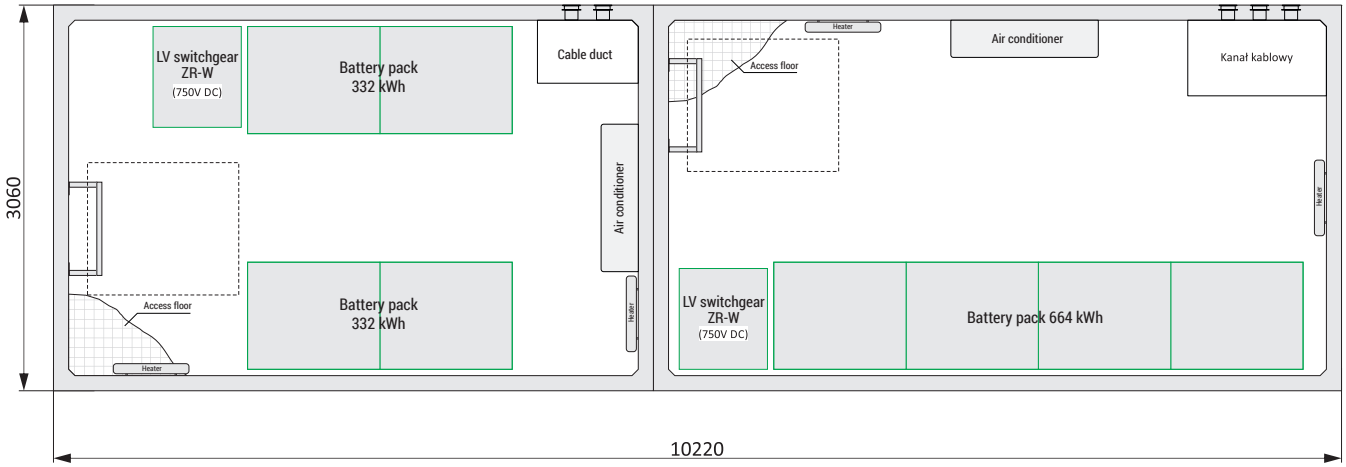
→ **NOTE!** Sample station configurations are presented in the catalog.

MEW-b 20/800-3 (0,3 MW / 1,33 MWh) - substation with energy storage with a capacity of 1,33 MWh and power output of 0,3 MW

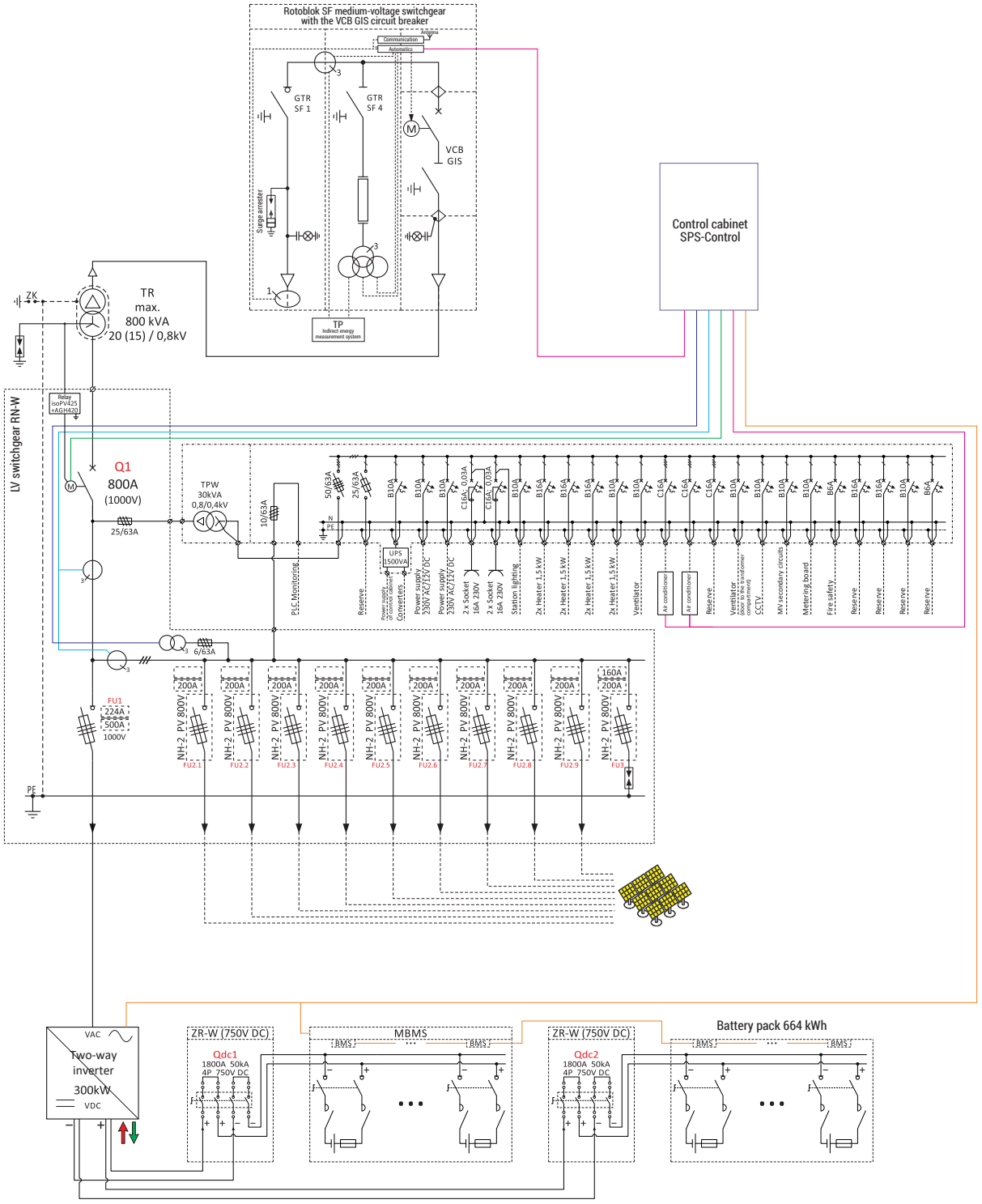
TOP VIEW / ARRANGEMENT OF THE ACCESSORIES - GROUND PART



TOP VIEW / ARRANGEMENT OF THE ACCESSORIES - GROUND PART



ELECTRICAL DIAGRAM

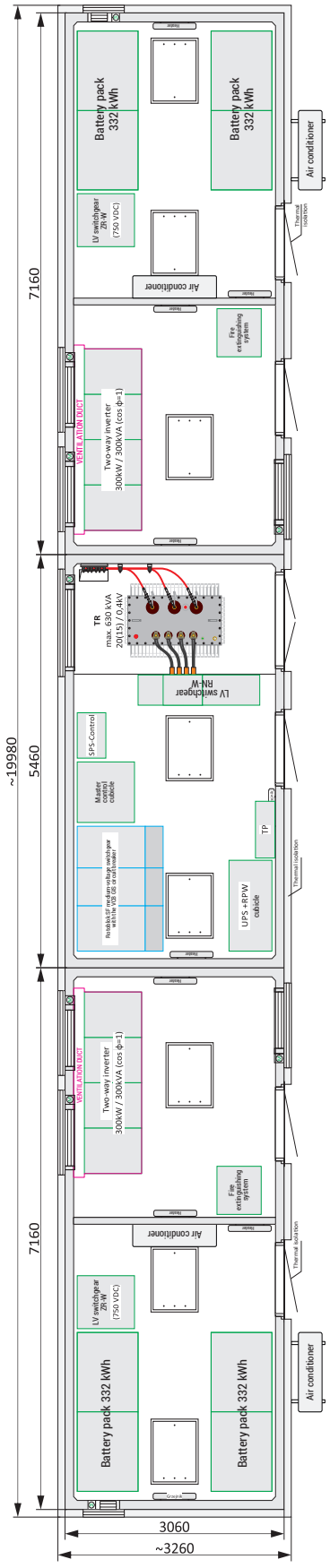


Maximum rated power of transformer	800 kVA	
Maximum power of the energy storage	300 kW	
Installed capacity of energy storage	1328 kWh	
	MV	LV (AC)
Rated voltage	20(15) kV	0,8 kV
Rated current	630 A	800 A
External dimensions (length / width / height from the ground)	10220mm / 3060mm / 3230mm	

→ **NOTE!** Sample station configurations are presented in the catalog.

MEW-b 20/600-3 (0,6 MW / 1,33 MWh) - substation with energy storage with a capacity of 1,33 MWh and power output of 0,6 MW

TOP VIEW / ARRANGEMENT OF THE ACCESSORIES



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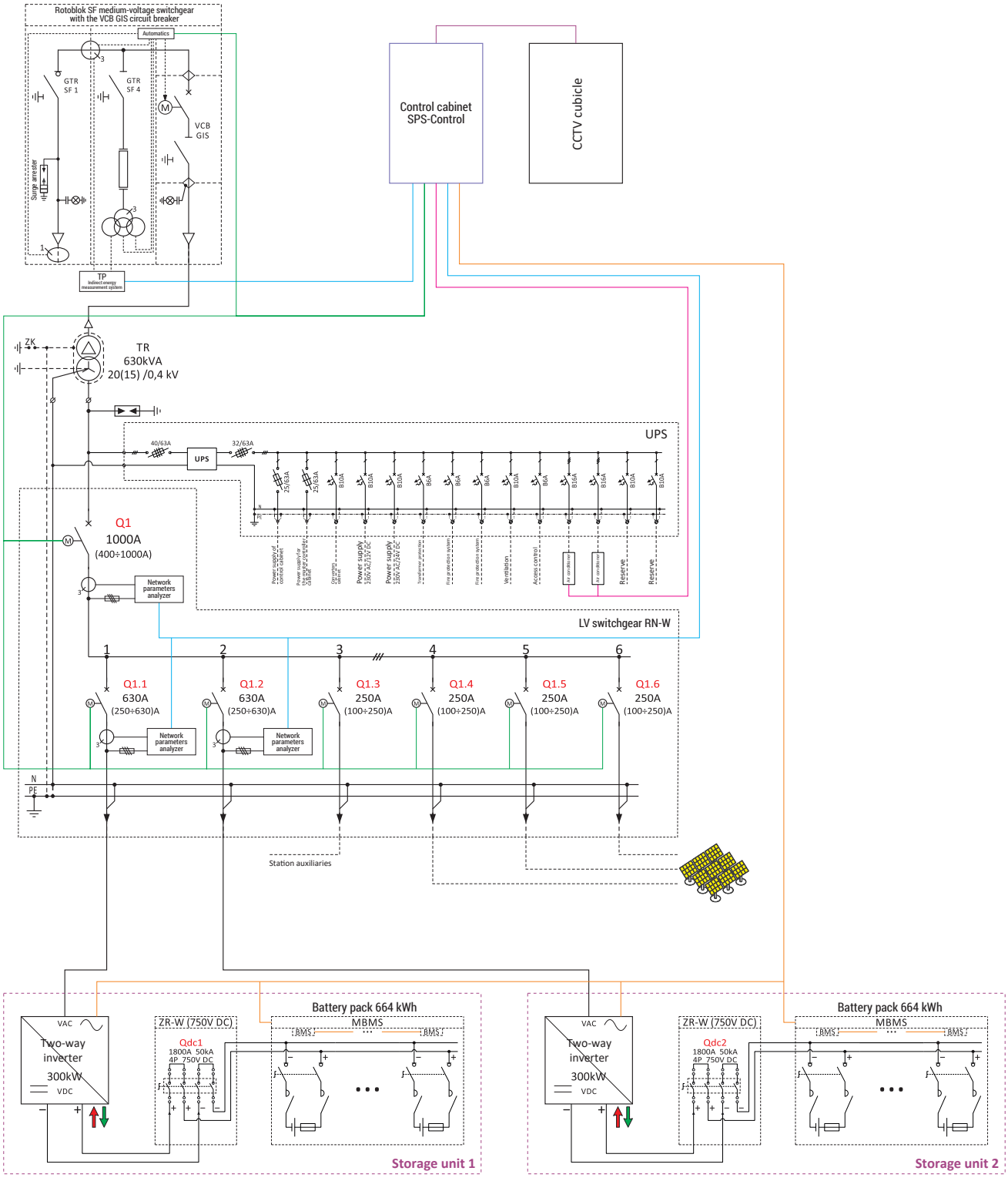
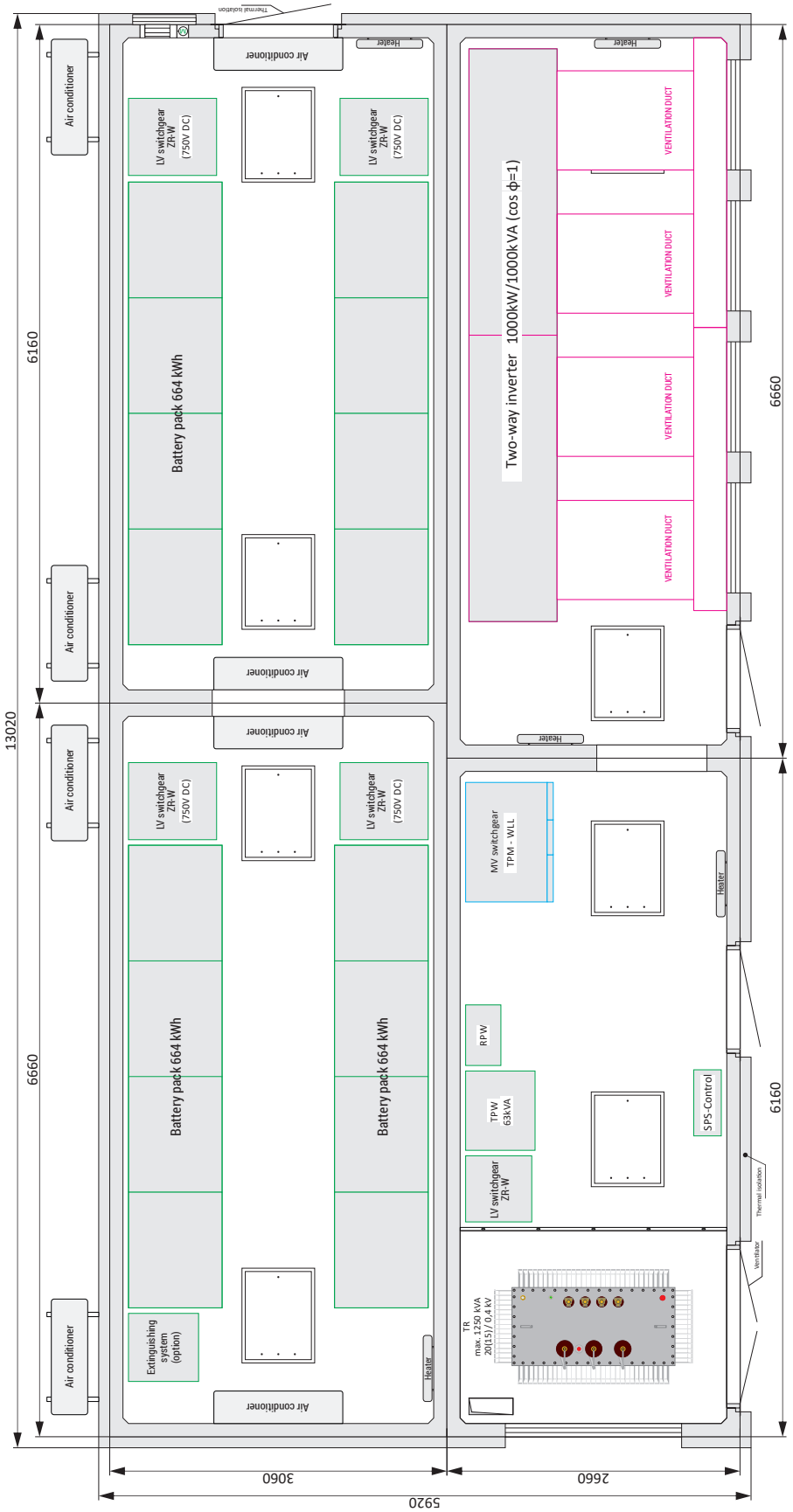


Maximum rated power of transformer	630 kVA	
Maximum power of the energy storage	600 kW	
Installed capacity of energy storage	1328 kWh	
	MV	LV (AC)
Rated voltage	20(15) kV	0,4 kV
Rated current	630 A	1000 A
External dimensions (length / width / height from the ground)	19980mm / 3260mm / 3230mm	

→ **NOTE!** Sample station configurations are presented in the catalog.

MEW-b 20/1250-3 (1 MW / 2,66 MWh) - energy storage system with a capacity of 2,66 MWh and power output of 1 MW

TOP VIEW / ARRANGEMENT OF THE ACCESSORIES



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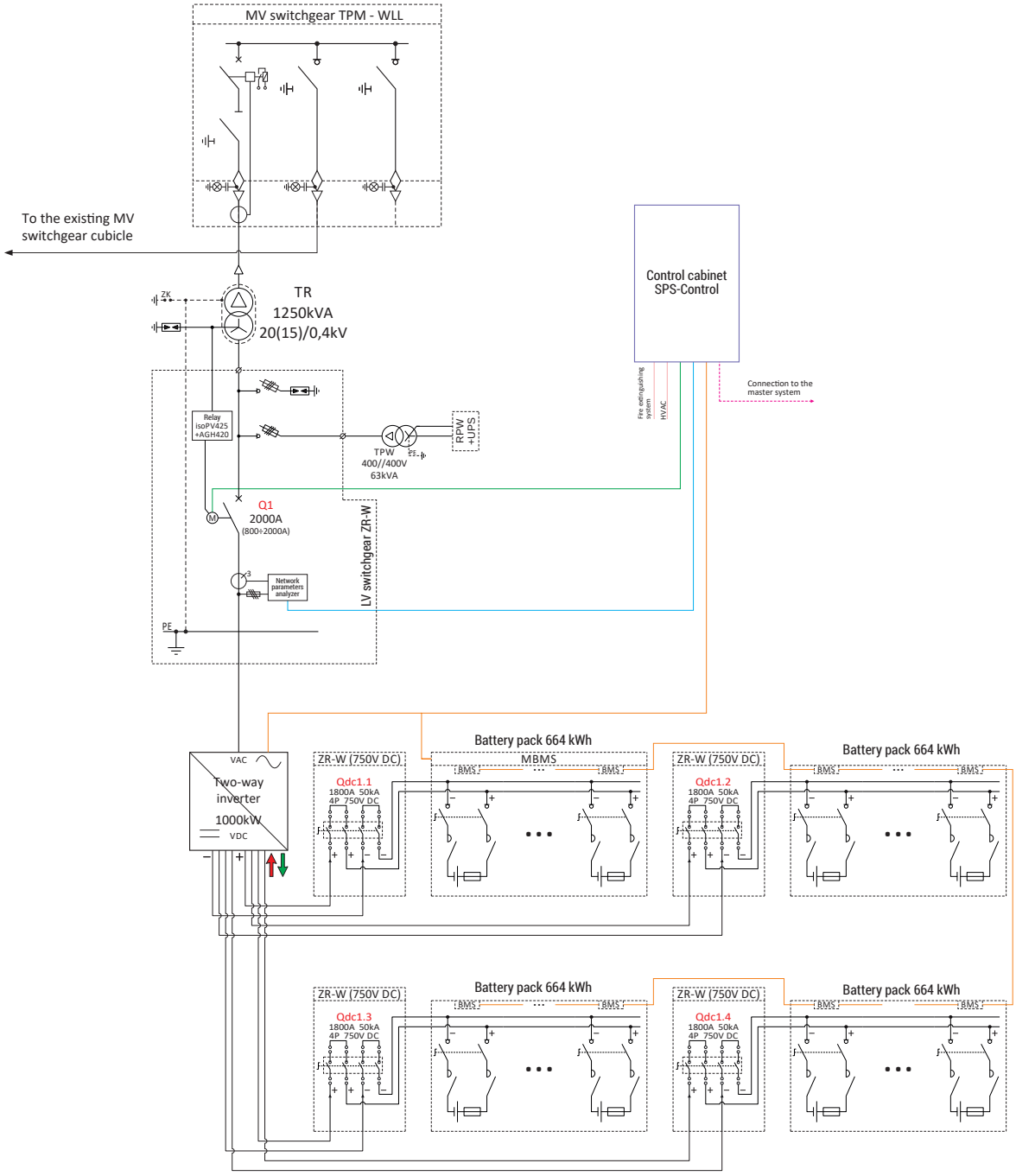
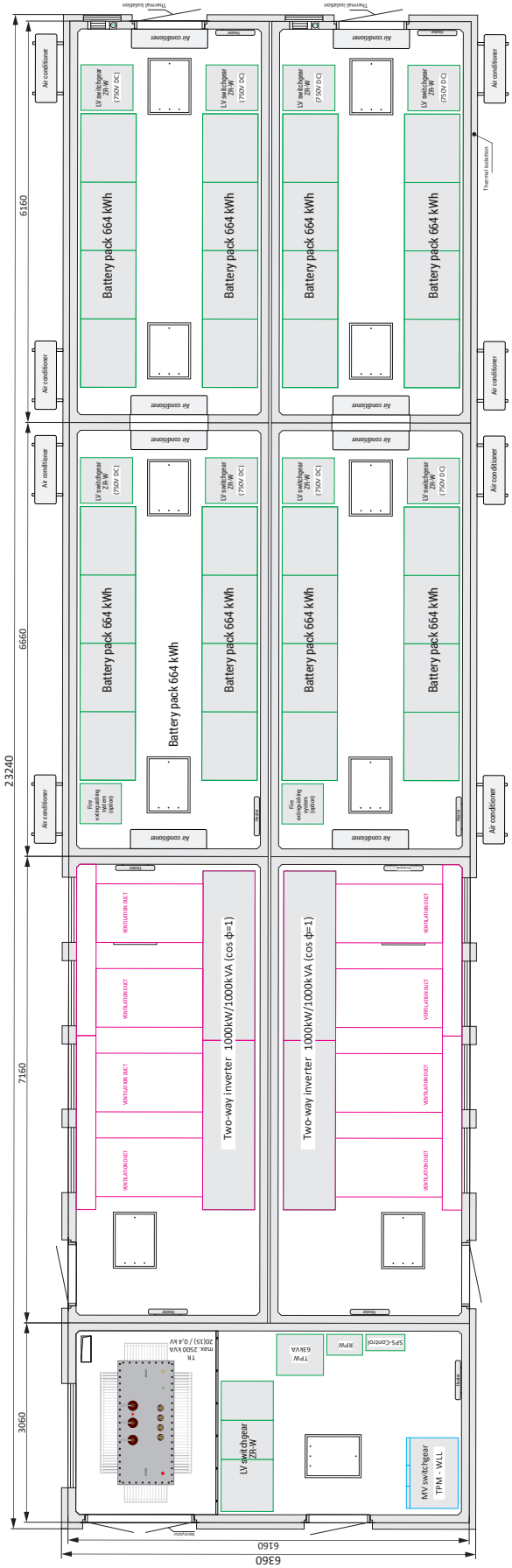


Maximum rated power of transformer	1250 kVA	
Maximum power of the energy storage	1000 kW	
Installed capacity of energy storage	2656 kWh	
	MV	LV (AC)
Rated voltage	20(15) kV	0,4 kV
Rated current	630 A	2000 A
External dimensions (length / width / height from the ground)	13020mm / 5920mm / 3260mm	

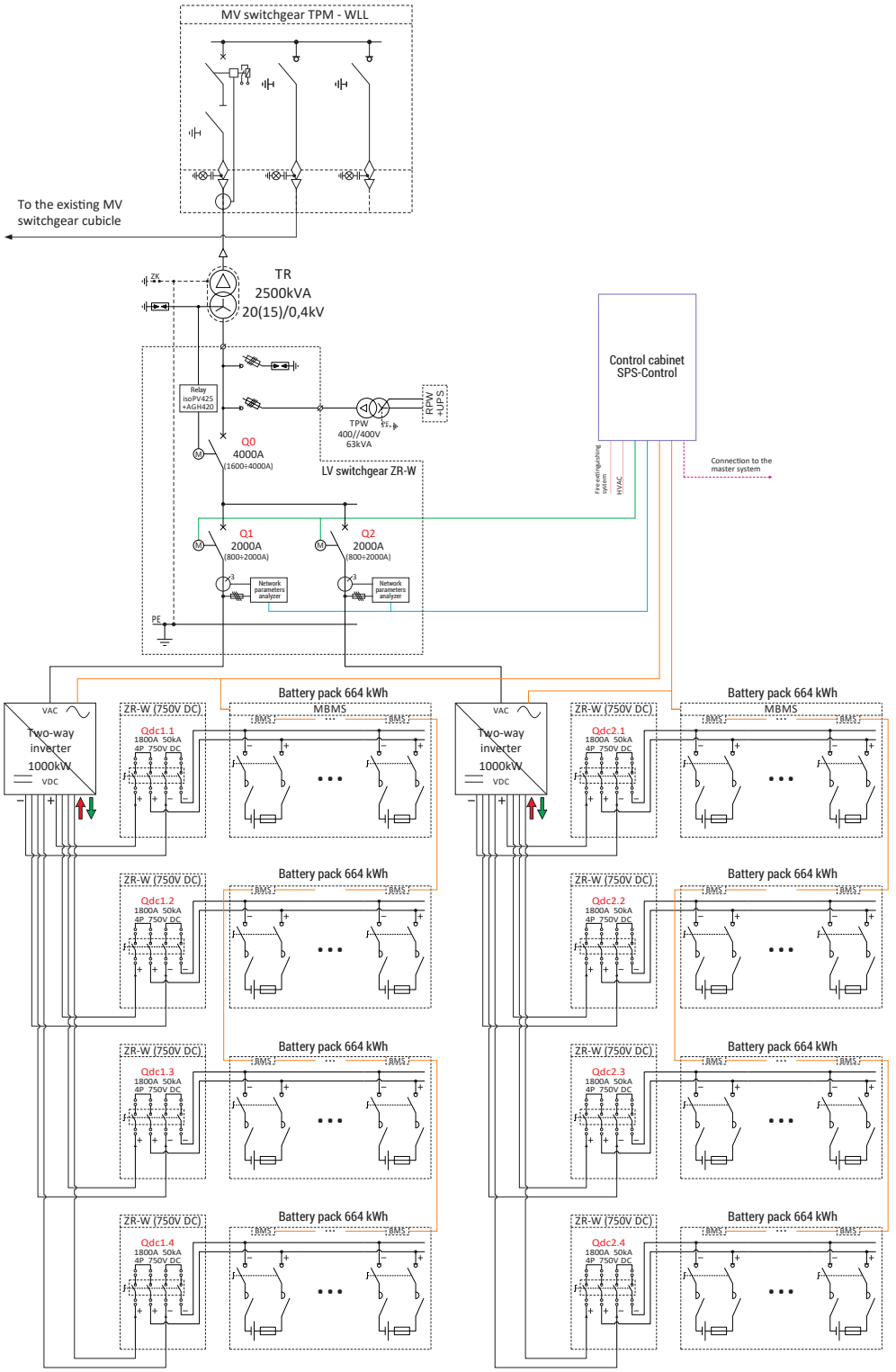
→ **NOTE!** Sample station configurations are presented in the catalog.

MEW-b 20/2500-3 (2 MW / 5,31 MWh) - energy storage system with a capacity of 5,31 MWh and power output of 2 MW

TOP VIEW / ARRANGEMENT OF THE ACCESSORIES



ELECTRICAL DIAGRAM



Maximum rated power of transformer	2500 kVA	
Maximum power of the energy storage	2000 kW	
Installed capacity of energy storage	5312 kWh	
	MV	LV (AC)
Rated voltage	20(15) kV	0,4 kV
Rated current	630 A	4000 A
External dimensions (length / width / height from the ground)	23240mm / 6360mm / 3260mm	

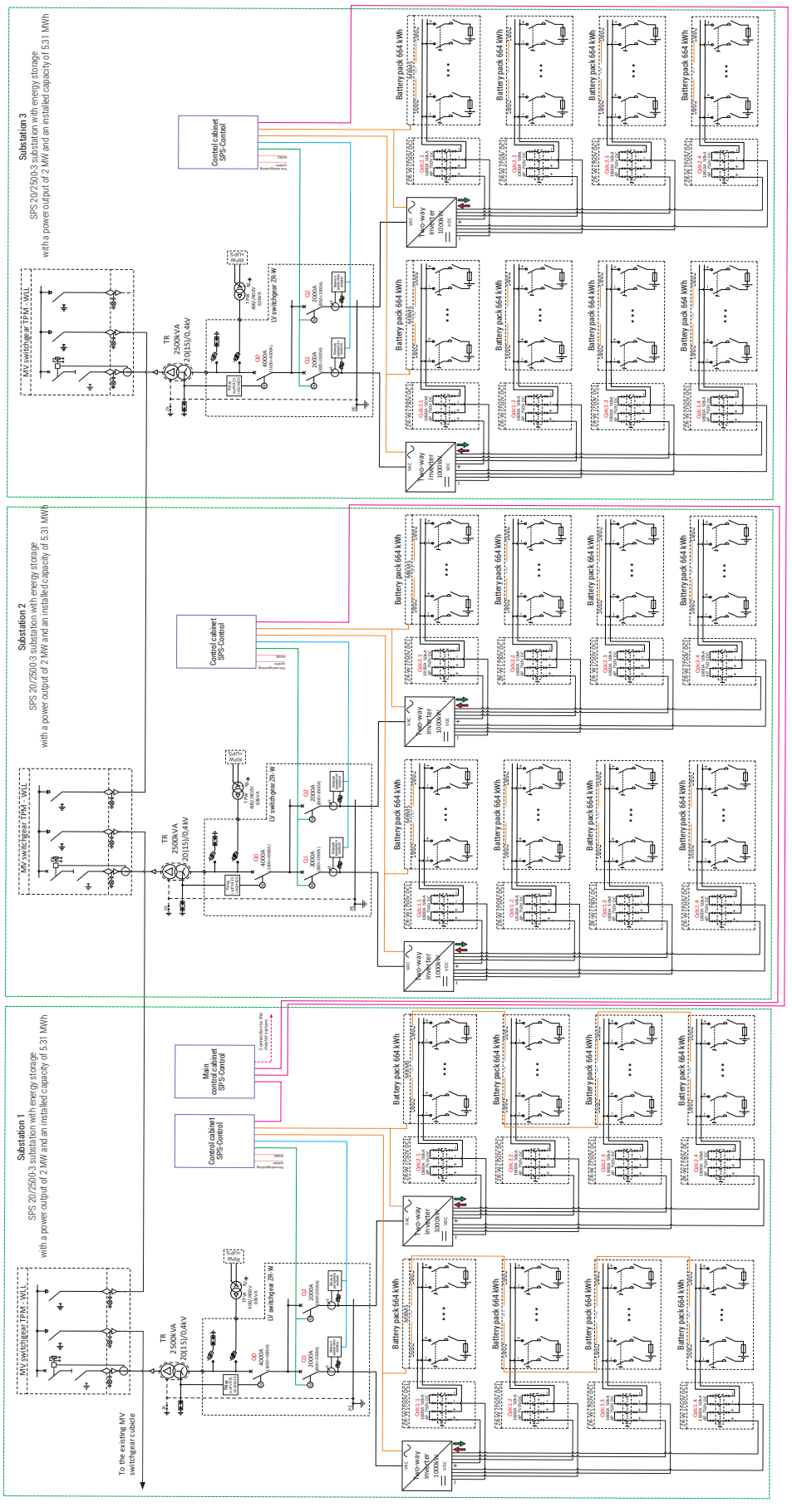
→ **NOTE!** Sample station configurations are presented in the catalog.

3x MEW-b 20/2500-3 (2 MW / 5,31 MWh) - energy storage system with a capacity of 15,93 MWh and power output of 6 MW

Maximum rated power of transformer		3x 2500 kVA
Maximum power of the energy storage		6 MW
Installed capacity of energy storage		15,93 MWh
	MV	LV (AC)
Rated voltage	20(15) kV	0,4 kV
Rated current	630 A	4000 A
External dimensions (length / width / height from the ground)	3x (23240mm / 6360mm / 3260mm)	

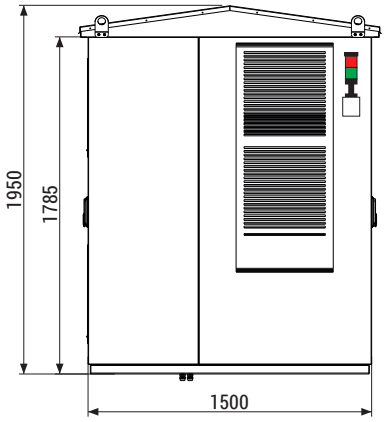
→ NOTE! The catalogue shows a sample configuration of a substation with energy storage with a maximum power output of 6 MW and an installed capacity of 15.93 MWh. The substation consists of three SPS 20/2500-3 substations integrated on the MV side.

ELECTRICAL DIAGRAM

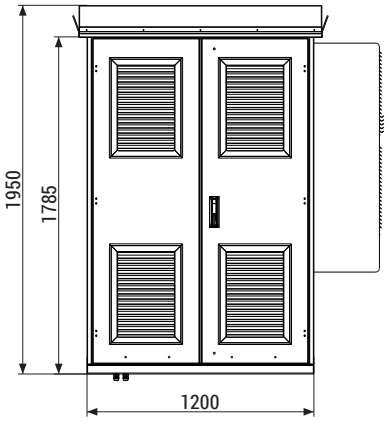


MEW-s - pole-mounted energy storage

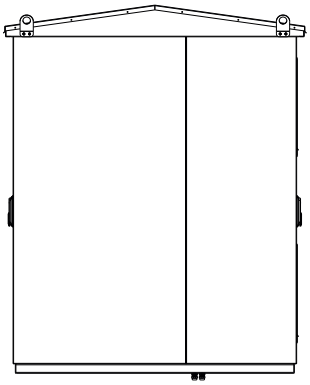
Front panel



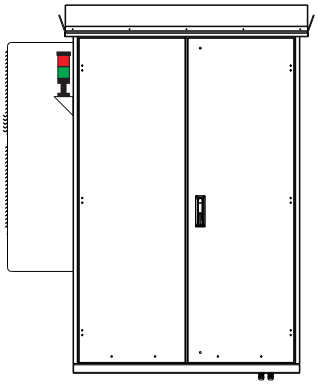
Side panel – left



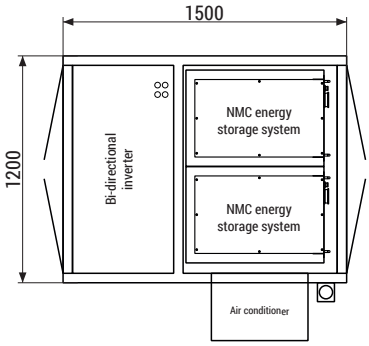
Rear panel



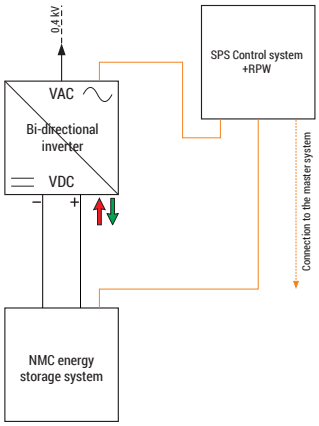
Side panel – right



Top view



Electrical diagram



	MEW-s (50 kW / 52,5 kWh)	MEW-s (50 kW / 105 kWh)	MEW-s (100 kW / 105 kWh)
Maximum power of the energy storage	50 kW	50 kW	100 kW
Installed capacity of energy storage	52,5 kWh	105 kWh	105 kWh
Rated voltage	0,4 kV	0,4 kV	0,4 kV
Rated current	78 A	78 A	156 A
External dimensions (length / width / height)	1500mm / 1200mm / 1950mm		

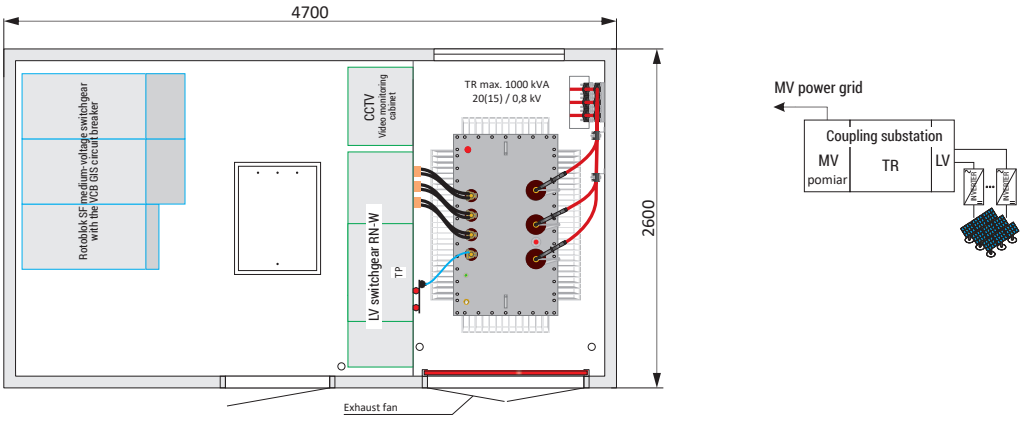
3.1

Container transformer stations with a capacity of up to 1MWp, with a billing metering system, connected to MV grids

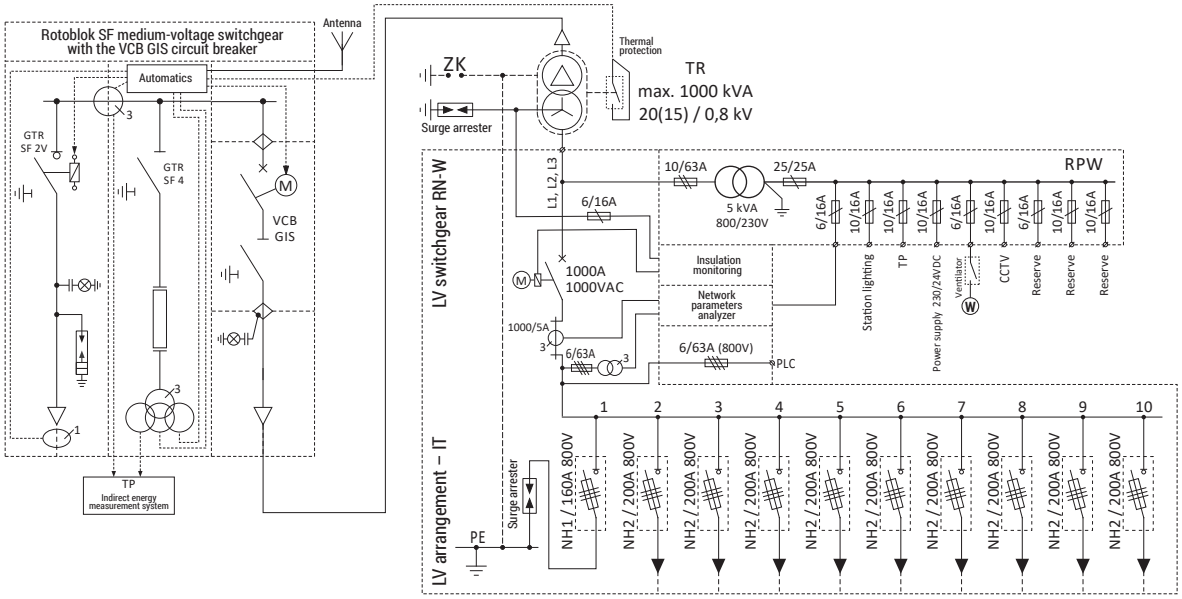
The most characteristic feature of this solution is the configuration of the MV switchgear cubicle with the billing meter and a full range of automation and protection systems required for safe integration with the power grid. The capacity of such substations may be even higher, but – due to the existing auction system for plants up to 1 MW – the substations are designed and manufactured in this configuration.

MRw-b 20/1000-3 - Substations with an internal access corridor. Inverter voltage on the AC side - 800 V, LV arrangement – IT

TOP VIEW / ARRANGEMENT OF THE ACCESSORIES



ELECTRICAL DIAGRAM



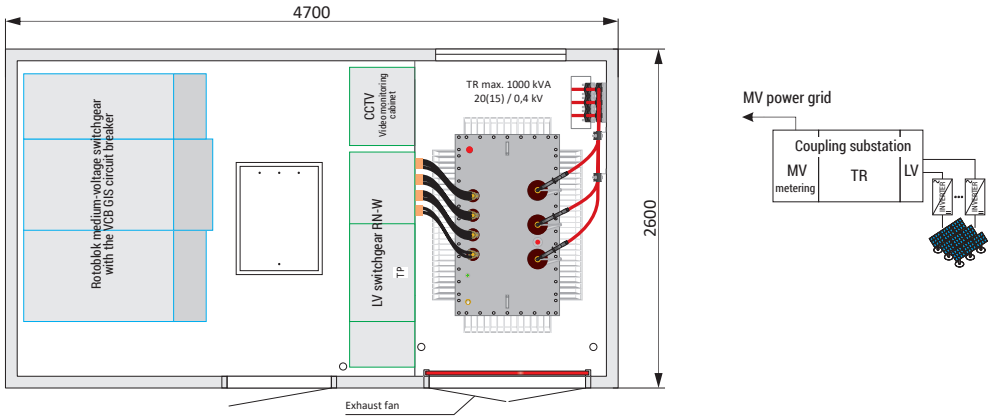
Maximum rated power of transformer	1000 kVA	
	MV	LV
Rated voltage	20 kV	0,8 kV
Rated voltage of the LV own needs switchgear		0,23 kV
Rated current	630 A	1000 A

→ **NOTE!** Sample station configurations are presented in the catalog.

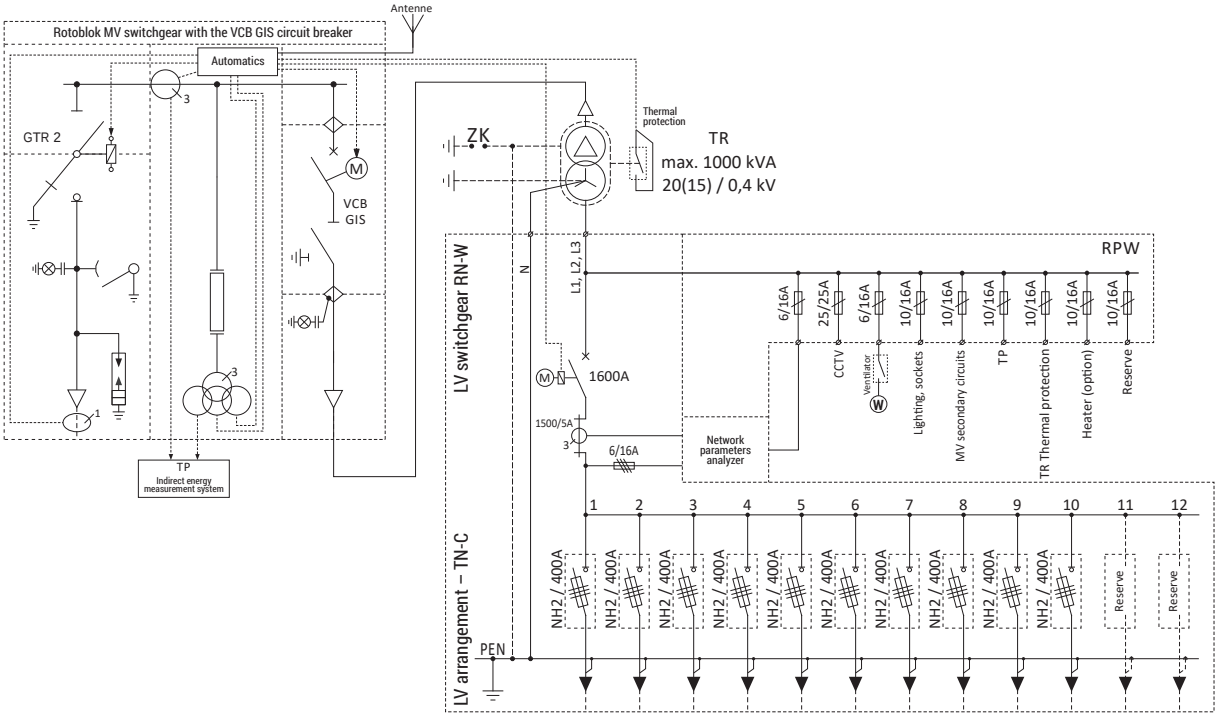
The LV switchgear cubicle may be prepared in a version suitable for integration in the IT and TN-C arrangement.

MRw-b 20/1000-3 – Substations with an internal access corridor. Inverter voltage on the AC side - 400 V, LV arrangement – TN-C

TOP VIEW / ARRANGEMENT OF THE ACCESSORIES



ELECTRICAL DIAGRAM



Maximum rated power of transformer	1000 kVA	
	MV	LV
Rated voltage	up to 20 kV	0,4 kV
Rated current	630 A	1600 A

→ **NOTE!** Sample station configurations are presented in the catalog.

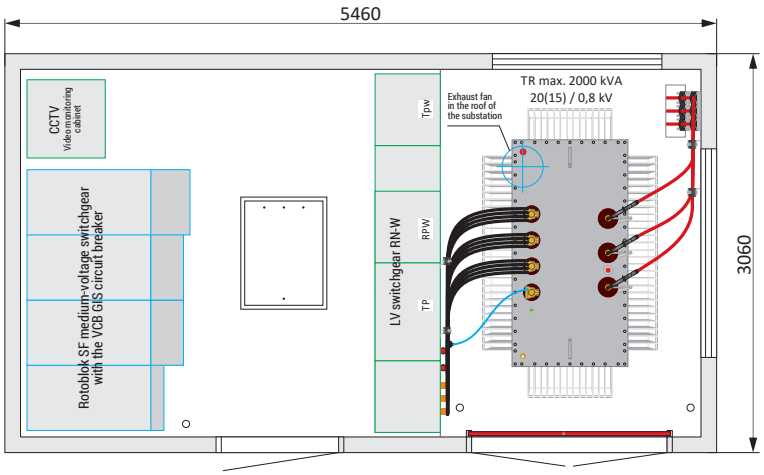
The LV switchgear cubicle may be prepared in a version suitable for integration in the TN-C and IT arrangement.

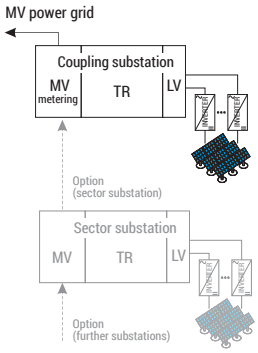
Container transformer stations with a capacity of over 1 MWp, with a billing metering system, connected to MV grids

In terms of the connection to the MV grid and electricity billing, this solution is similar to systems in the range of up to 1 MWp. The primary difference is its capacity (usually not exceeding 20 MWp) and its configuration, which includes a coupling substation with a metering system and/or one or several sector substations without metering systems. The capacity of the individual substations does not exceed 7 MW.

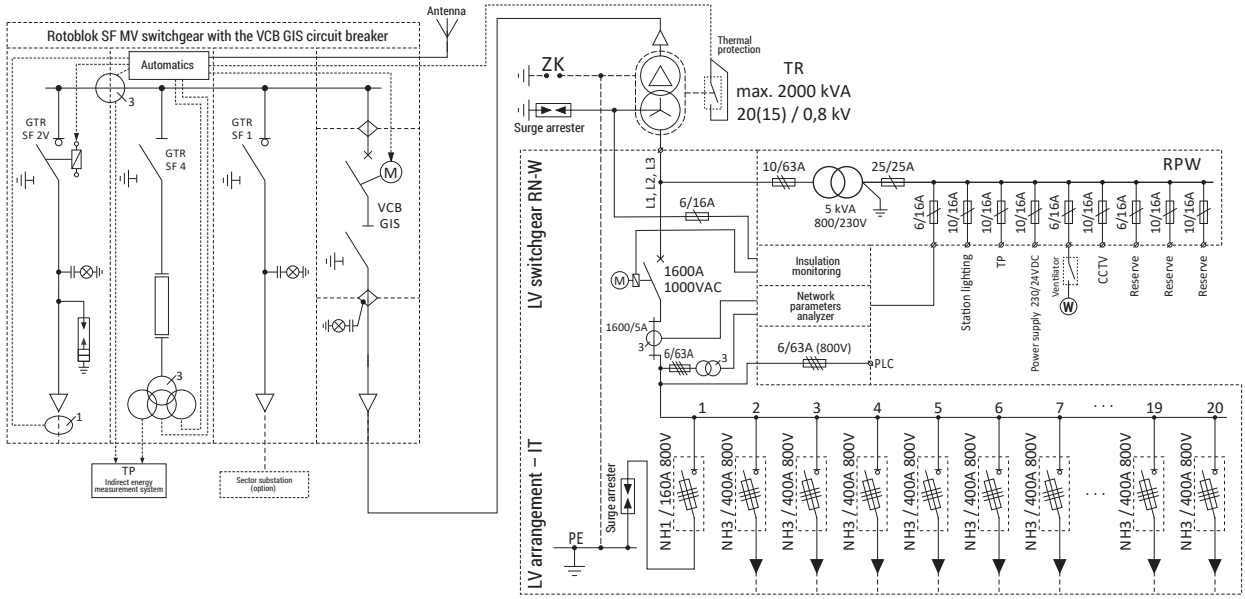
MRw-b 20/2000-4 – Substations with an internal access corridor. Inverter voltage on the AC side - 800 V, LV arrangement – IT

TOP VIEW / ARRANGEMENT OF THE ACCESSORIES





ELECTRICAL DIAGRAM



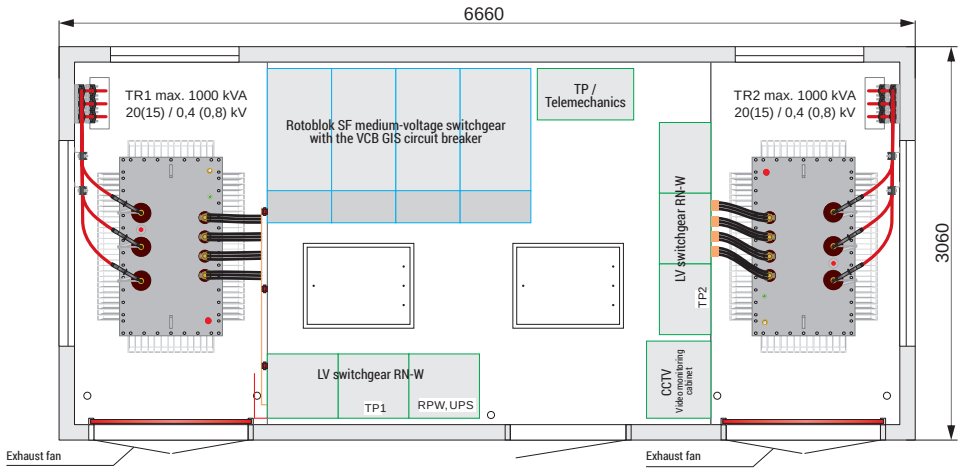
Maximum rated power of transformer	2000 kVA	
	MV	LV
Rated voltage	20 kV	0,8 kV
Rated voltage of the LV own needs switchgear		0,23 kV
Rated current	630 A	1600 A

→ **NOTE!** Sample station configurations are presented in the catalog.

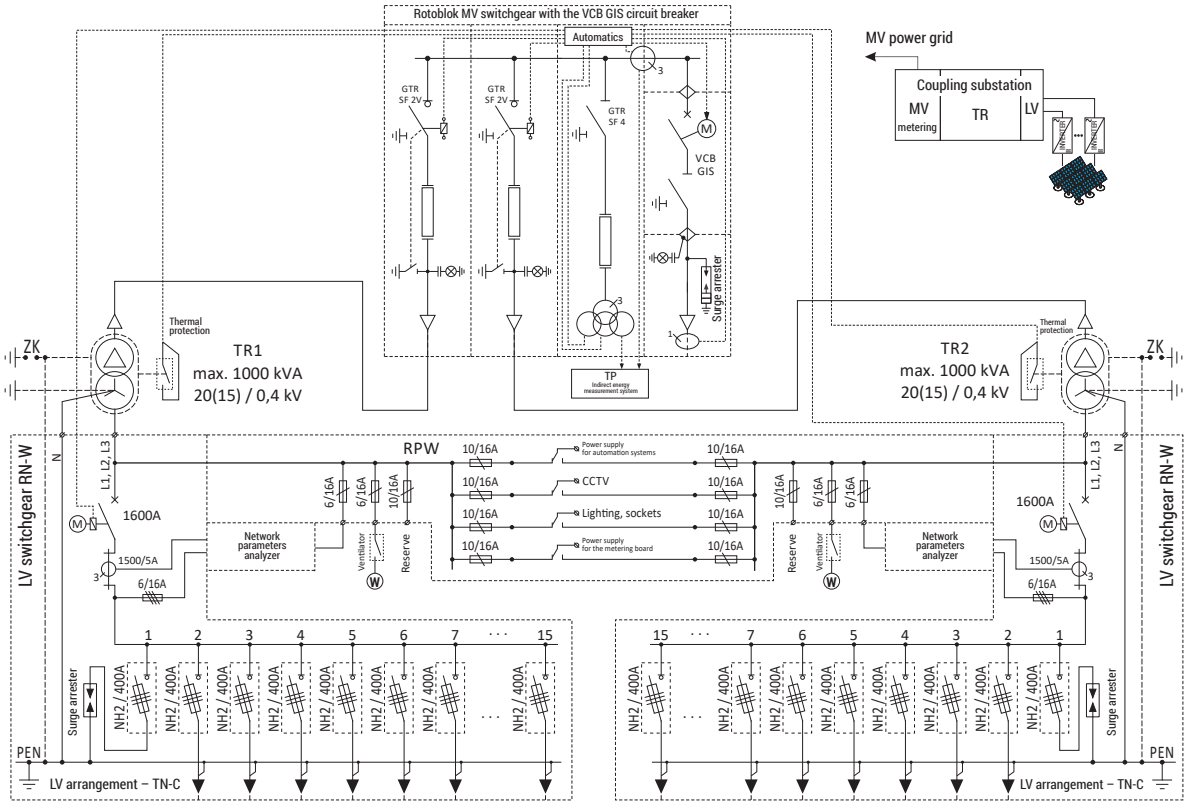
The LV switchgear cubicle may be prepared in a version suitable for integration in the IT and TN-C arrangement.

MRw-b 20/2x1000-4 – Substations with an internal access corridor. Inverter voltage on the AC side - 400 V, LV arrangement – TN-C

TOP VIEW / ARRANGEMENT OF THE ACCESSORIES



ELECTRICAL DIAGRAM

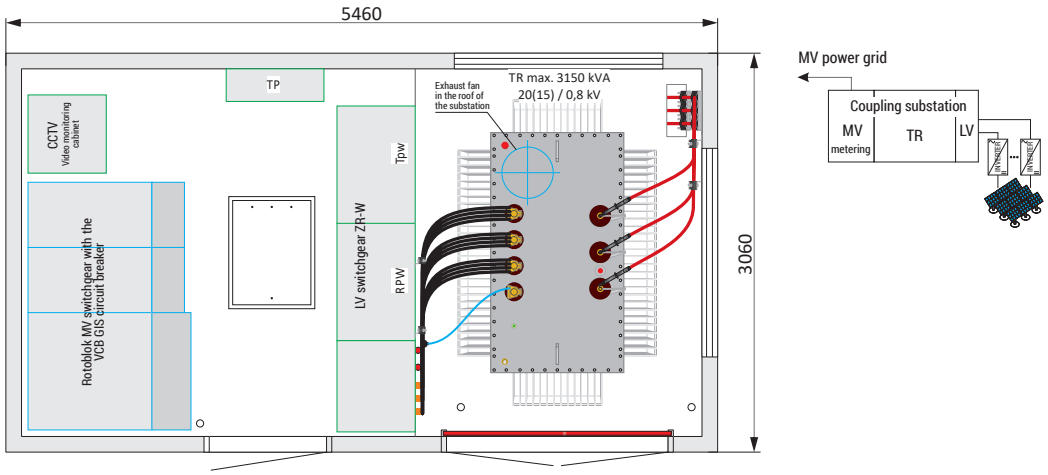


Maximum rated power of transformer	2 x 1000 kVA		
	MV	LV	
Rated voltage	20 kV	0,4 kV	0,8 kV
Rated voltage of the LV own needs switchgear			0,23 kV
Rated current	630 A	1600 A	1000 A

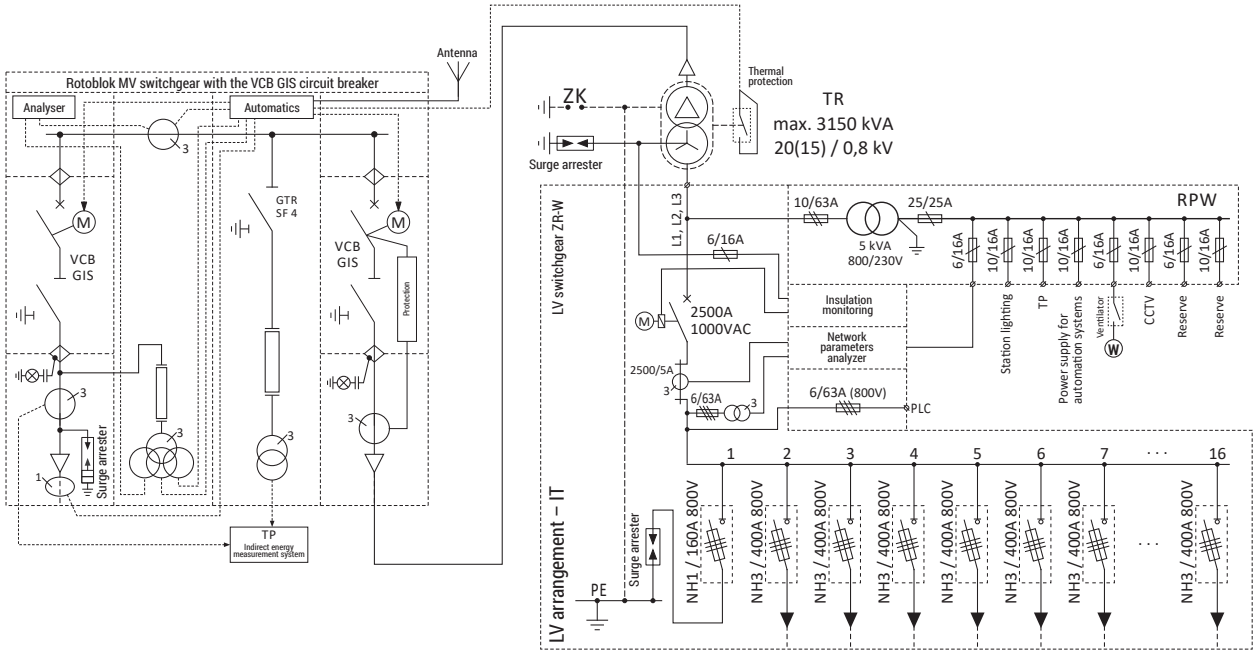
→ **NOTE!** Sample station configurations are presented in the catalog.

MRw-b 20/3150-3 – Substations with an internal access corridor. Inverter voltage on the AC side - 800 V, LV arrangement – IT

TOP VIEW / ARRANGEMENT OF THE ACCESSORIES



ELECTRICAL DIAGRAM



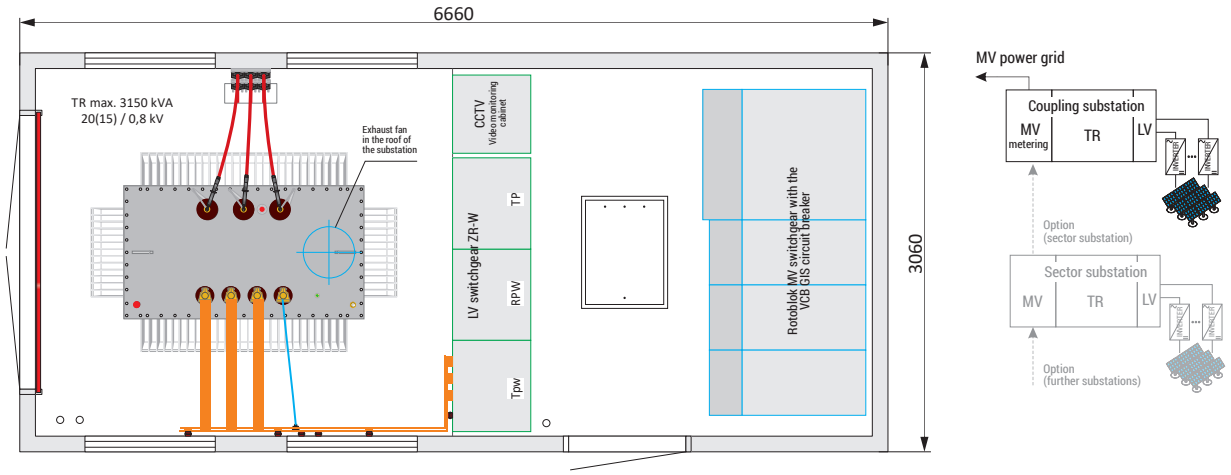
Maximum rated power of transformer	3150 kVA	
	MV	LV
Rated voltage	20 kV	0,8 kV
Rated voltage of the LV own needs switchgear		0,23 kV
Rated current	630 A	2500 A

→ **NOTE!** Sample station configurations are presented in the catalog.

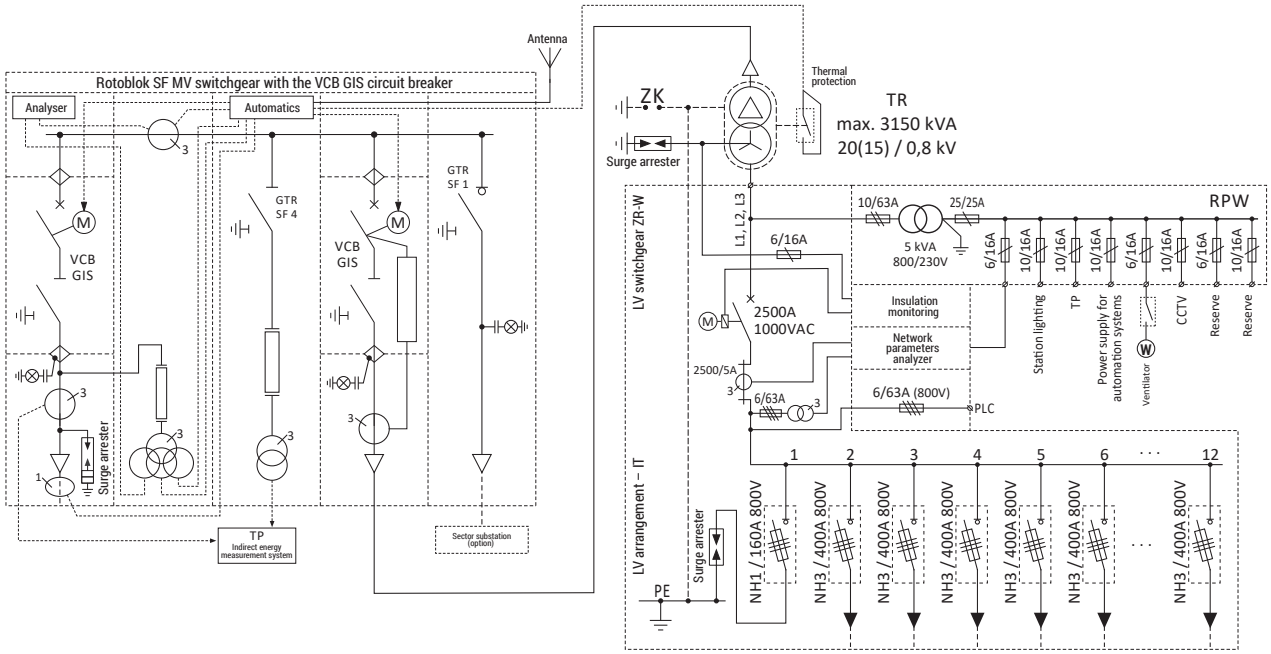
The LV switchgear cubicle may be prepared in a version suitable for integration in the IT and TN-C arrangement.

MRw-b 20/3150-4 – Substations with an internal access corridor. Inverter voltage on the AC side - 800 V, LV arrangement – IT

TOP VIEW / ARRANGEMENT OF THE ACCESSORIES



ELECTRICAL DIAGRAM



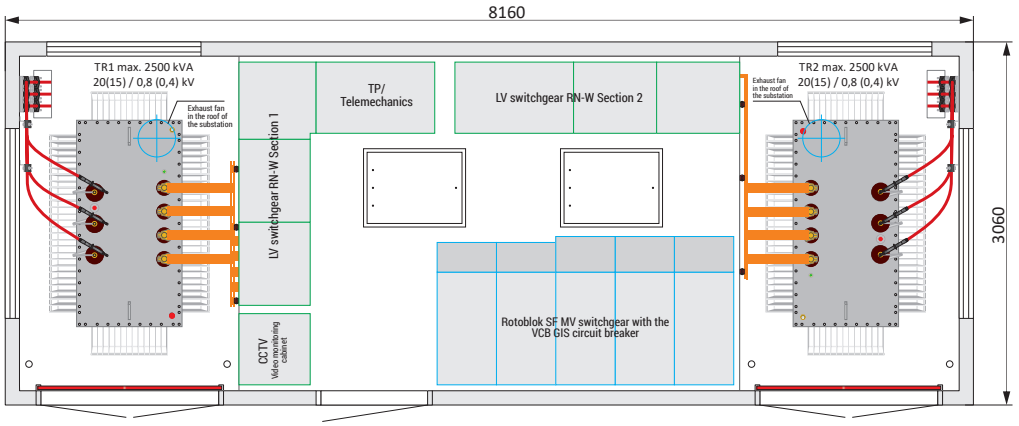
Maximum rated power of transformer	3150 kVA	
	MV	LV
Rated voltage	20 kV	0,8 kV
Rated voltage of the LV own needs switchgear		0,23 kV
Rated current	630 A	2500 A

→ **NOTE!** Sample station configurations are presented in the catalog.

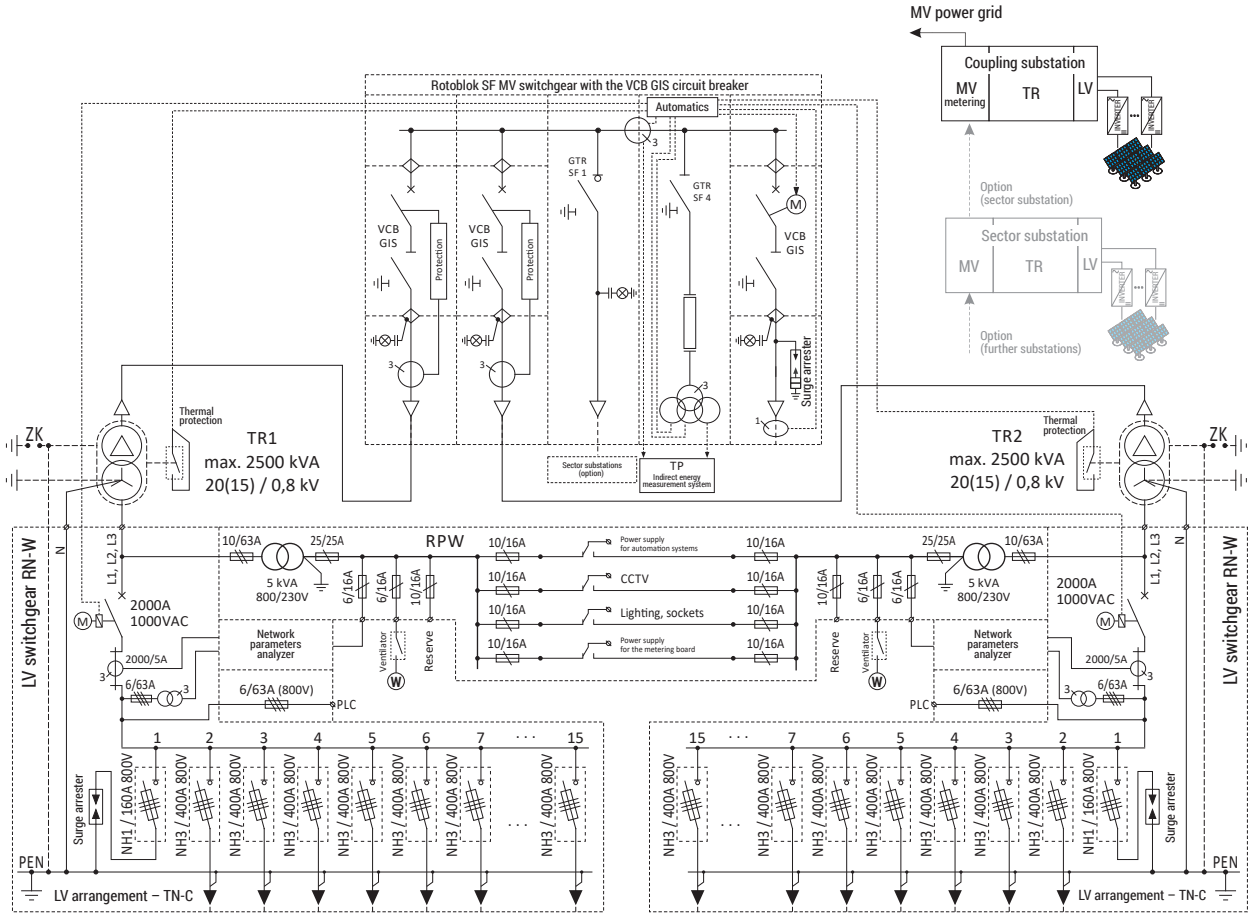
The LV switchgear cubicle may be prepared in a version suitable for integration in the IT and TN-C arrangement.

MRw-b 20/2x2500-5 – Substations with an internal access corridor. Inverter voltage on the AC side - 800 V, LV arrangement – TN-C

TOP VIEW / ARRANGEMENT OF THE ACCESSORIES



ELECTRICAL DIAGRAM

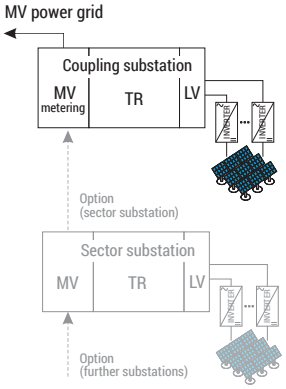


Maximum rated power of transformer	2 x 2500 kVA	
	MV	LV
Rated voltage	20 kV	0,8 kV
Rated voltage of the LV own needs switchgear		0,23 kV
Rated current	630 A	2000 A

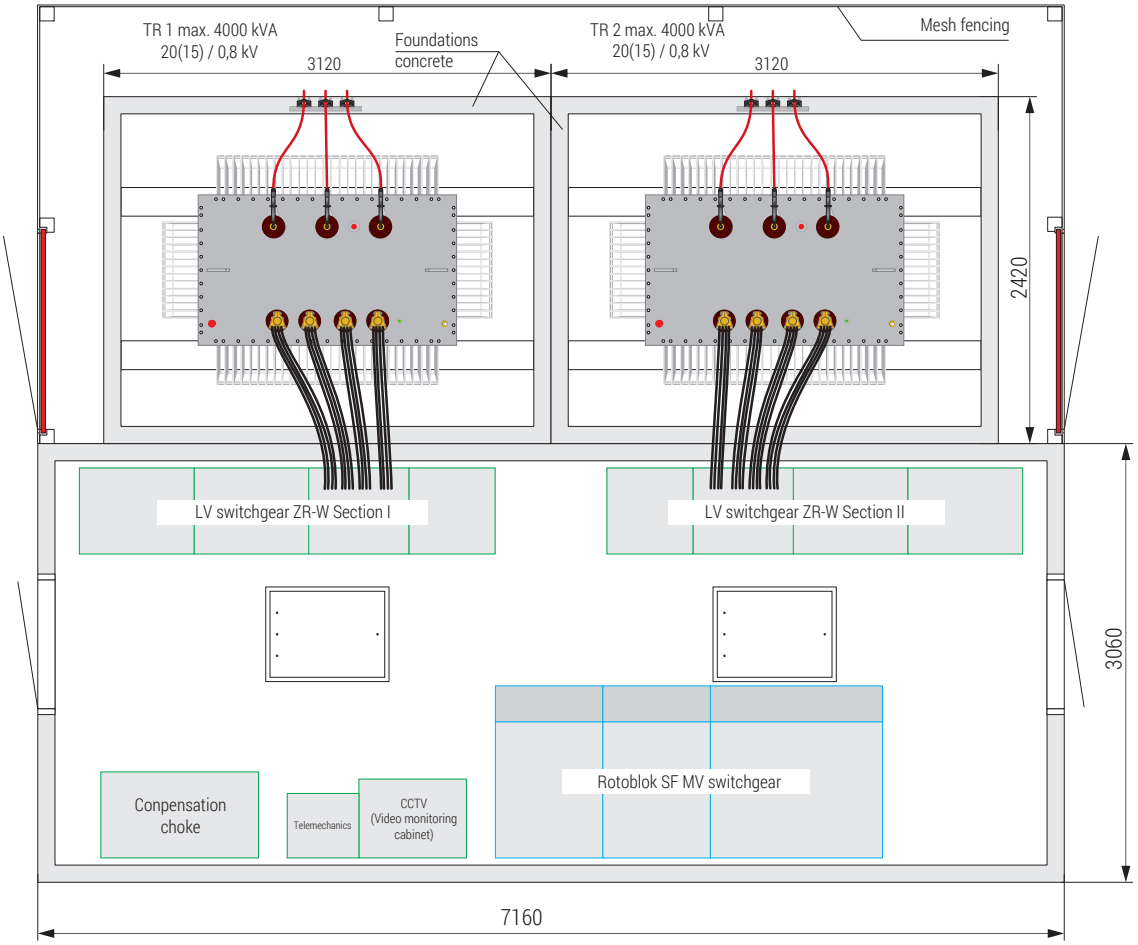
→ **NOTE!** Sample station configurations are presented in the catalog.

The LV switchgear cubicle may be prepared in a version suitable for integration in the TN-C and IT arrangement.

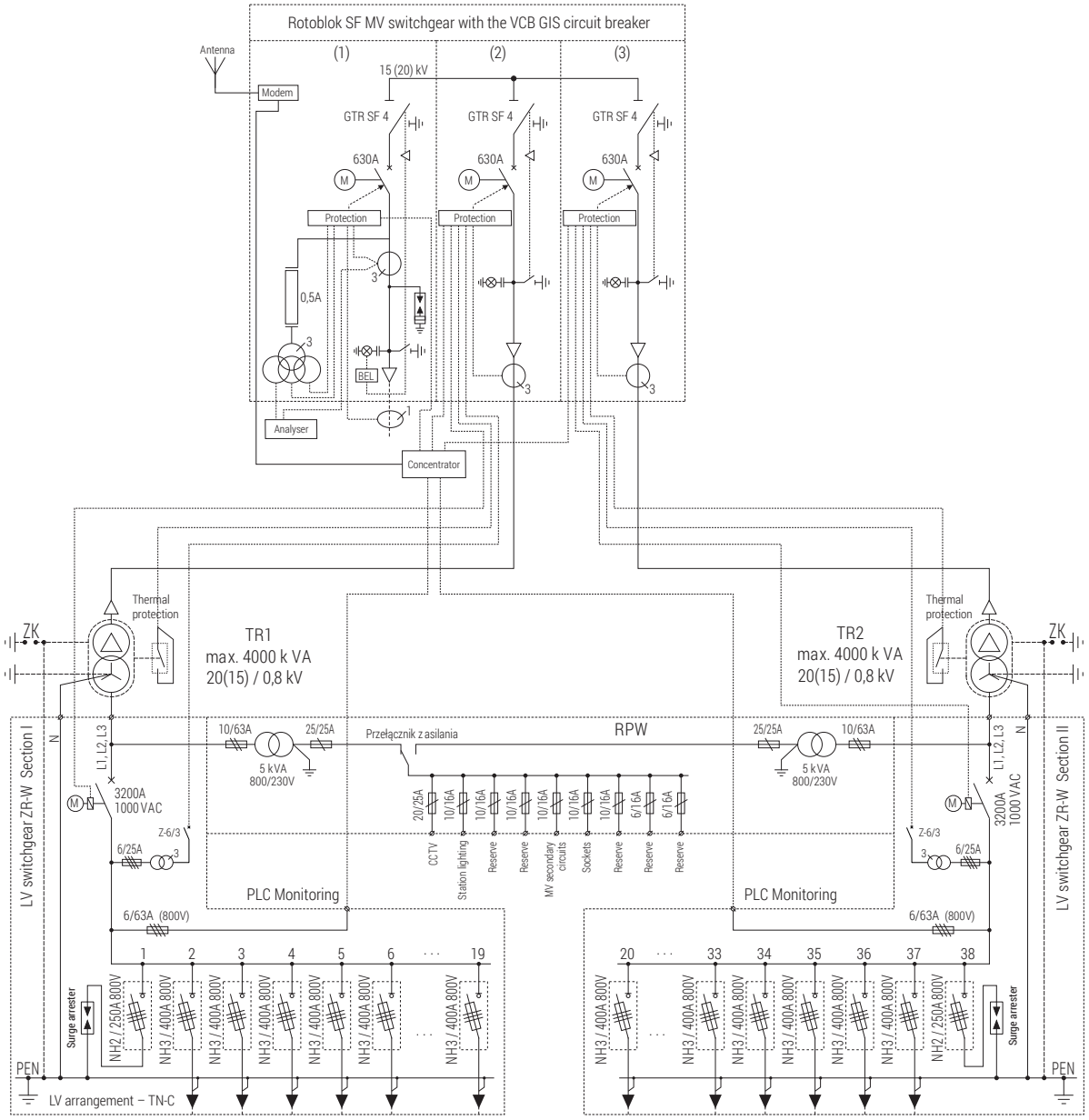
MRw-b 20/2x4000-3 – Substations with an internal access corridor. Inverter voltage on the AC side-800 V, LV arrangement – TN-C



TOP VIEW / ARRANGEMENT OF THE ACCESSORIES



ELECTRICAL DIAGRAM

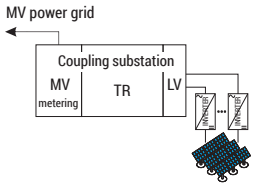


Maximum rated power of transformer	2 x 4000 kVA	
	MV	LV
Rated voltage	20 kV	0,8 kV
Rated voltage of the LV own needs switchgear		0,23 kV
Rated current	630 A	3200 A

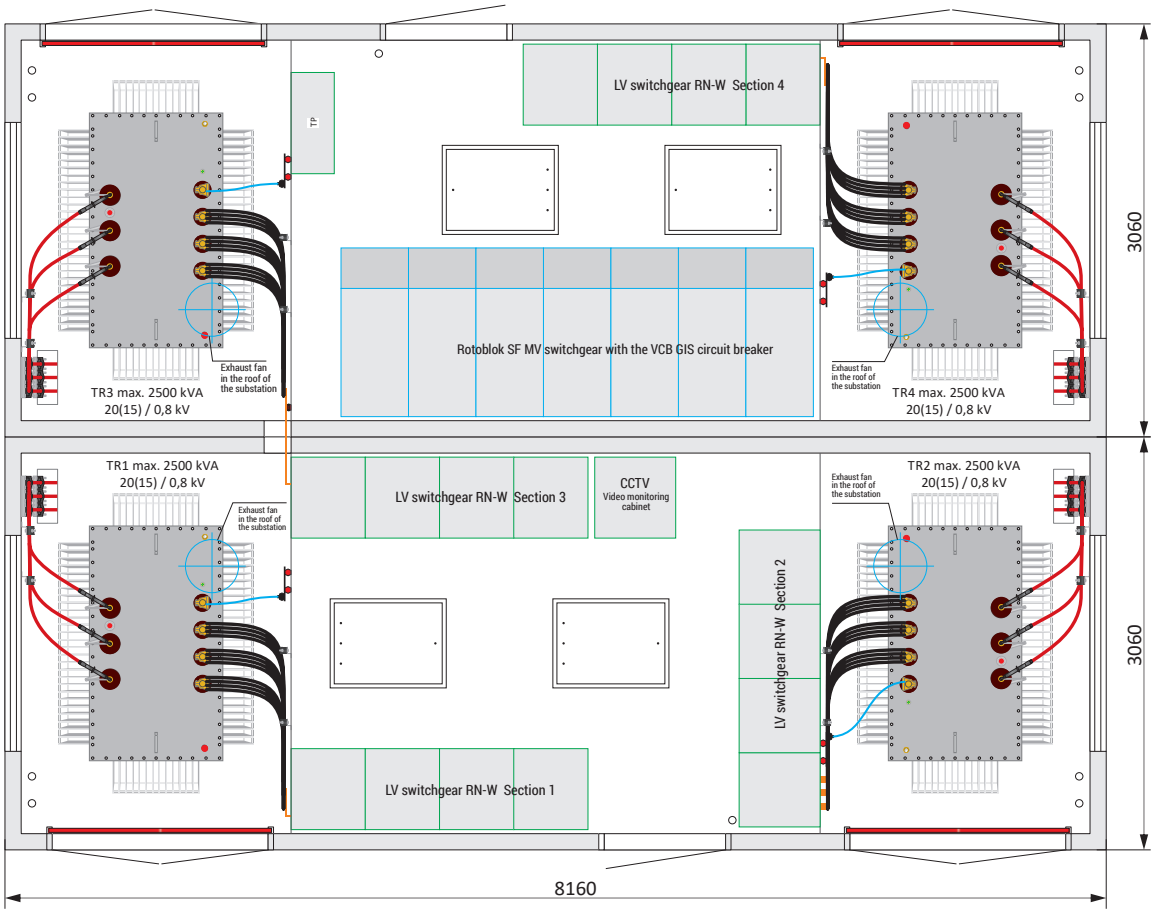
→ **NOTE!** Sample station configurations are presented in the catalog.

The LV switchgear cubicle may be prepared in a version suitable for integration in the TN-C and IT arrangement.

MRw-bS 20/4x2500-6 – Substations with an internal access corridor. Inverter voltage on the AC side - 800 V, LV arrangement – IT



TOP VIEW / ARRANGEMENT OF THE ACCESSORIES



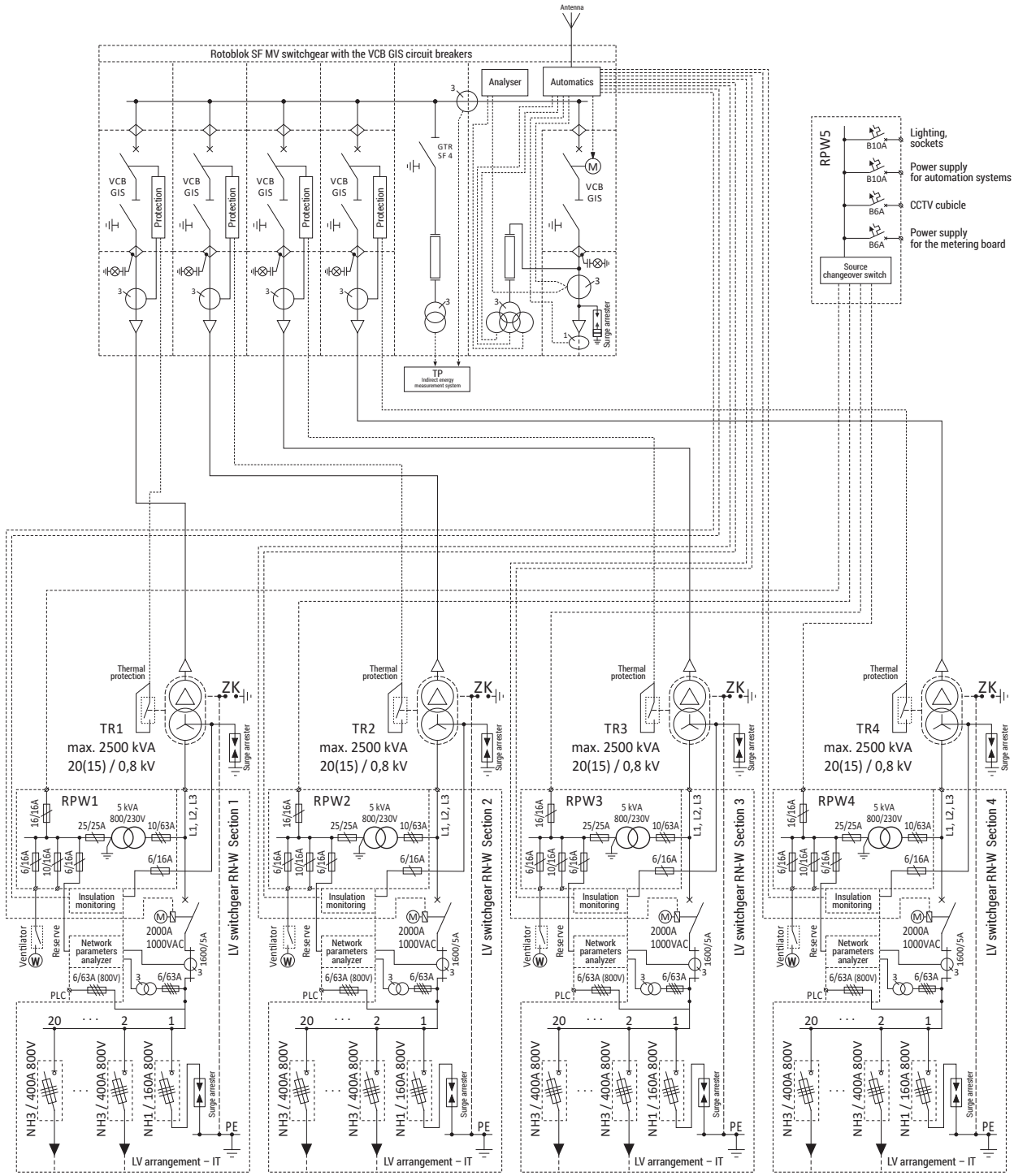
Maximum rated power of transformer	4 x 2500 kVA		
	MV	LV	
Rated voltage	20 kV	0,4 kV	0,8 kV
Rated voltage of the LV own needs switchgear			0,23 kV
Rated current	630 A	4000 A	2000 A

→ **NOTE!** Sample station configurations are presented in the catalog.

The LV switchgear cubicle may be prepared in a version suitable for integration in the IT and TN-C arrangement.

MRw-bS 20/4x2500-6 – Substations with an internal access corridor.
Inverter voltage on the AC side - 800 V, LV arrangement – IT

ELECTRICAL DIAGRAM



Maximum rated power of transformer	4 x 2500 kVA		
	MV	LV	
Rated voltage	20 kV	0,4 kV	0,8 kV
Rated voltage of the LV own needs switchgear			0,23 kV
Rated current	630 A	4000 A	2000 A

→ **NOTE!** Sample station configurations are presented in the catalog.

The LV switchgear cubicle may be prepared in a version suitable for integration in the IT and TN-C arrangement.

Container (sector) transformer stations with a capacity of over 1 MWp connected to the MV grid via coupling substations or to the HV grid via collector substations

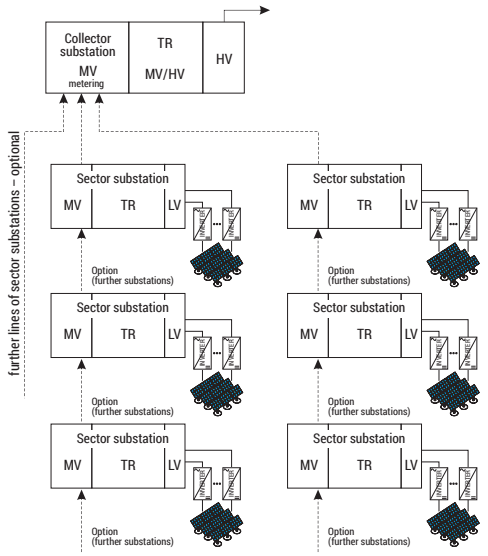
Large-scale solar farms whose capacity can reach tens (e.g., 40–50 MW) or even hundredths of MW require extensive power infrastructure due to the large area they occupy, which depends on the capacity and topography at the places of their installation. This translates into dozens of kilometres of cables and conductors and electrical infrastructure used to receive the electricity generated by the solar cells. At such large solar farms, the electrical infrastructure is slightly different from what can be found at farms with a capacity of 1 MW. Large farms are divided into sectors, where the minimum capacity of the panels in the sector is no smaller than 0.8 MWp. Depending on the scale of the project and type of inverters, the capacities of the sectors, i.e., of the individual substations, usually range from 0.8 MW to 4 MW, but there are also substations with individual capacities of 6–7 MW.

Although the LV switchgear cubicles of such substations are not substantially different from solutions with capacities up to 1 MW, there is a noticeable difference as regards MV switchgear. This is mainly due to the absence of billing metering systems and the use of automation and protection systems that are designed primarily to protect the MV/LV transformer installed at the substation. Such substations are incorporated into a common, internal MV main line, from which the generated energy is transferred to the power grid. This is done via coupling substations with billing meters for the entire farm and the automation and protection systems that ensure stable parameters of the electricity transferred to the power grid. Due to the installed capacities of the solar farms and the transmission capacities of the power grids, it is necessary to construct a distribution substation in addition to the infrastructure described above for large capacities (e.g., over 20 MW). In general, with such systems, it would be more accurate to refer to this type of substation as a collector substation. At collector substations, voltage is increased to, for instance, 110 kV (high voltage) or higher, so that the electricity generated by the photovoltaic systems can be transferred across significant distances via the transmission grids of PSE.

Depending on the design, most of the substations shown in this catalogue will find application in large-scale solar farms. The differences will be noticeable primarily with respect to the configuration of MV switchgear.

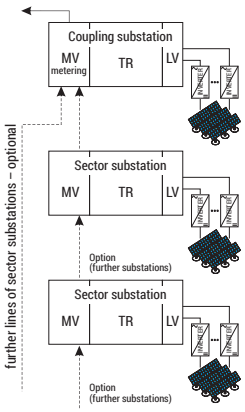
TOPOGRAPHY OF A PV SYSTEM CONNECTED TO AN HV GRID VIA A COLLECTOR SUBSTATION

HV POWER GRID



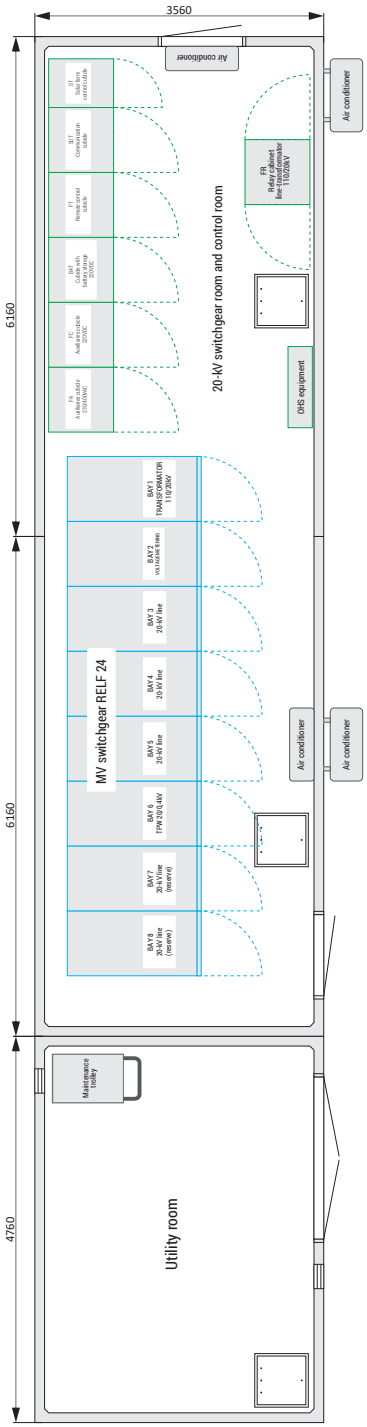
TOPOGRAPHY OF A PV SYSTEM CONNECTED TO AN MV GRID VIA COUPLING SUBSTATIONS

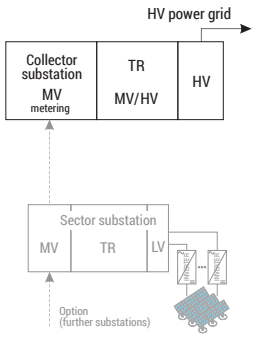
MV POWER GRID



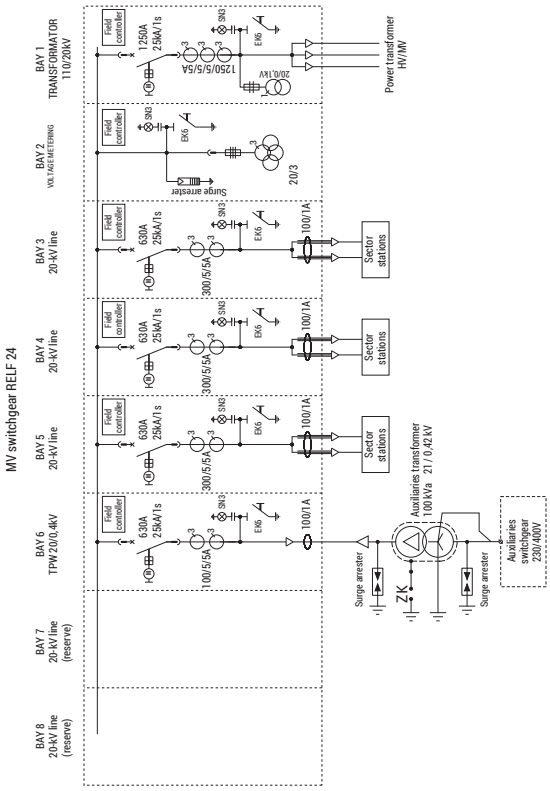
MRw-bS 20-8 – Collector substation

TOP VIEW / ARRANGEMENT OF THE ACCESSORIES





ELECTRICAL DIAGRAM



→ **NOTE!** Sample station configurations are presented in the catalog.

RELF 24 - MV switchgear cubicle dedicated to collector substations

RELF 24 are metal-clad, four-compartment, draw-out air-insulated (AIS) MV switchgear cubicles with a single busbar system.

The switchgear cubicle is designed for operation in distribution transformer stations at industrial sites that generate, distribute or consume electricity. It meets the requirements of (IEC) PN-EN 62271-200, (IEC) PN-EN 62271-1 and GOST standards and has the IP4X protection rating. The device should be operated in normal conditions as described in (IEC) PN-EN 62271-1 standard.

The cubicle is of frameless design made from riveted galvanised steel sheets. It is provided in the form of a multi-compartment cubicle whose walls and partitions form a self-supporting structure.

The following compartments can be identified in a single switchgear cubicle: connections, busbars, apparatus with a withdrawable module and an auxiliary circuitry compartment.

Switchgear cubicle features and advantages:

- air-insulated,
- switches may be equipped with motor operating mechanisms – fully automated switchgear,
- LSC2B service continuity class (three compartments of the primary circuit),
- availability of current and voltage sensors – a solution friendly to the environment,
- internal arcing class IAC AFLR,
- interlocks and protection against incorrect switching operations,
- available in the freestanding or wall-mounted version,
- optional thermal video measurements of cable connections or a temperature monitoring system,
- expandability,
- bay replacement without having to slide apart adjacent bays,
- easy operation.

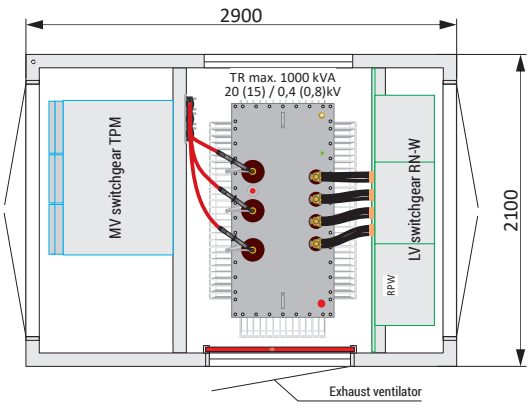
The switchgear cubicle ensures a high level of safety thanks to the following:

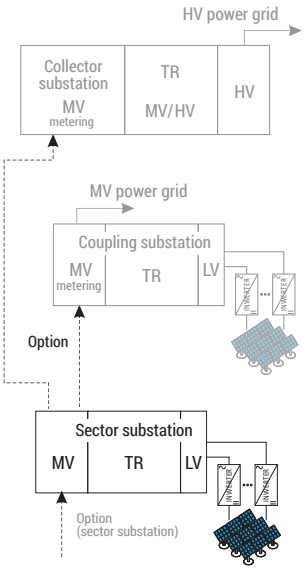
- internal arc resistance of the switchgear enclosure,
- mechanical interlocks preventing incorrect switching operations and door opening,
- racking in/out of the withdrawable module when the door is closed,
- using compartments with PM-class partitions,
- visual inspection of switching operations through inspection windows,
- application of explosion relief panels whose primary function is to evacuate excessive pressure built up inside the compartment as a result of internal arcing,
- availability of explosion relief panels to evacuate the hot gases formed by internal arcing inside the enclosure outside the premises where the switchgear cubicle is installed,
- voltage indication in individual bays.

Rated voltage	24 kV
Rated continuous current of main busbars and feeder bay	630-2500 A
Rated power frequency withstand voltage (50 Hz)	50 kV
Rated lightning impulse withstand voltage	125 kV
Rated frequency	50 kV
Rated short-time withstand current	up to 31,5 kA/3s
Rated peak withstand current	up to 80 kA
Internal arc resistance	up to 31,5 kA/1s
Protection rating	up to IP4X
Cubicle height	2250 mm
Cubicle width	800/1000 mm
Cubicle depth	1600/1688/1725 mm

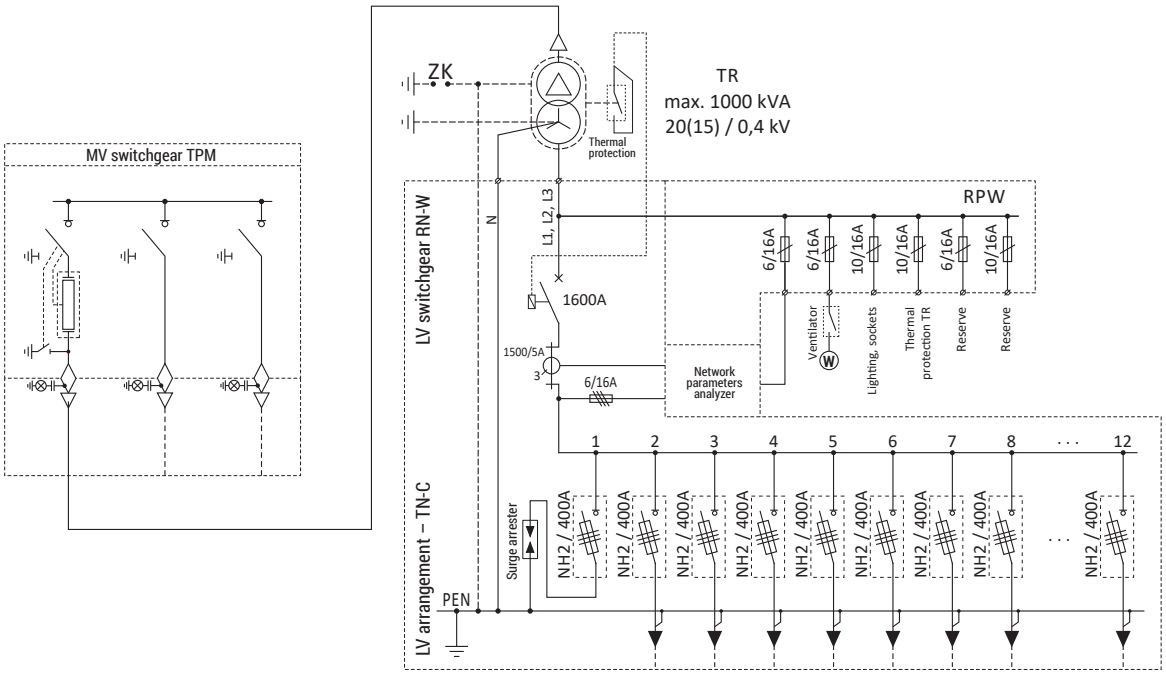
Mzb2 20/1000-3 – Sector substation with external access.
Inverter voltage on the AC side - 400 V, LV arrangement – TN-C

TOP VIEW / ARRANGEMENT OF THE ACCESSORIES





ELECTRICAL DIAGRAM



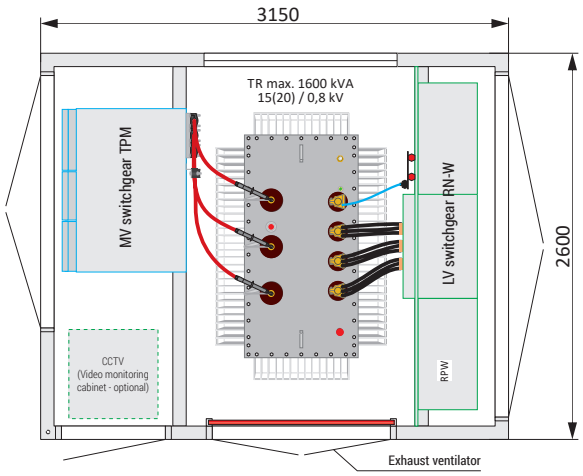
Maximum rated power of transformer	1000 kVA		
	MV	LV	
Rated voltage	20 kV	0,4 kV	0,8 kV
Rated voltage of the LV own needs switchgear			0,23 kV
Rated current	630 A	1600 A	1000 A

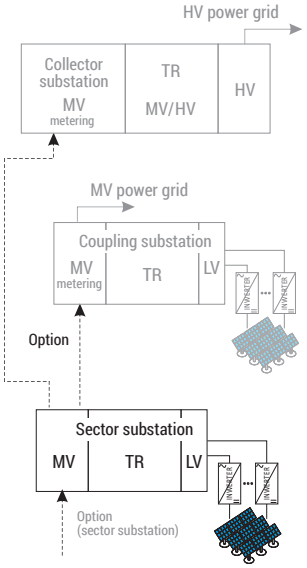
→ **NOTE!** Sample station configurations are presented in the catalog.

The LV switchgear cubicle may be prepared in a version suitable for integration in the TN-C and IT arrangement.

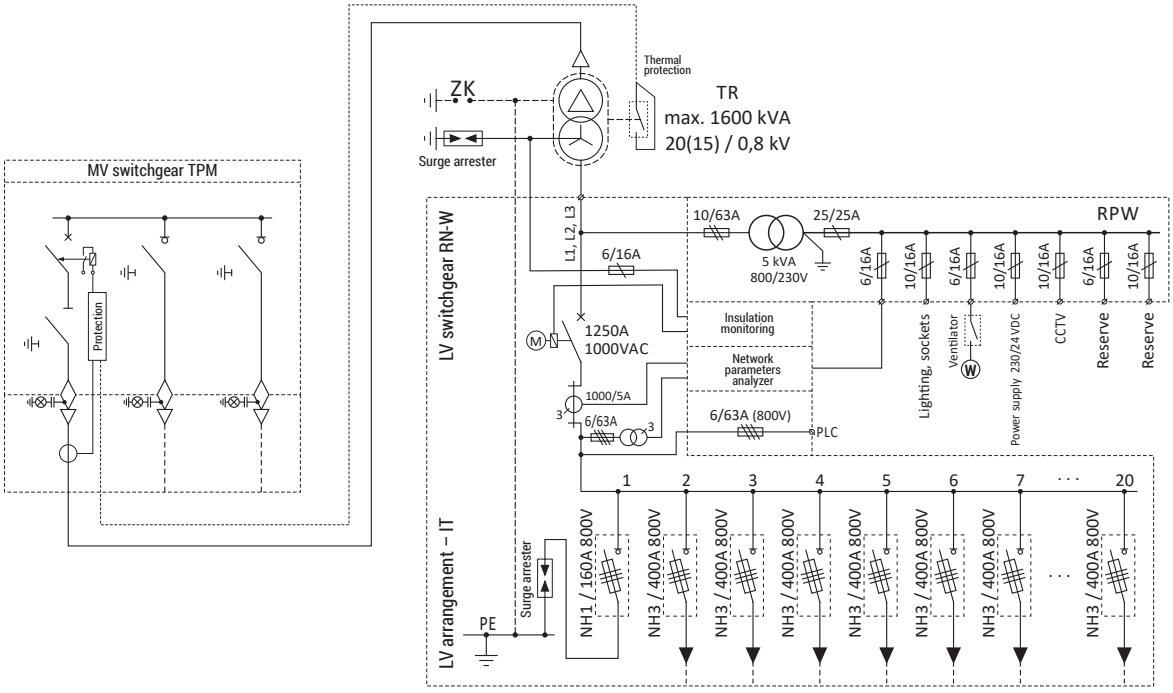
Mzb2 20/1600-3 – Sector substation with external access. Inverter voltage on the AC side - 800 V, LV arrangement – IT

TOP VIEW / ARRANGEMENT OF THE ACCESSORIES





ELECTRICAL DIAGRAM



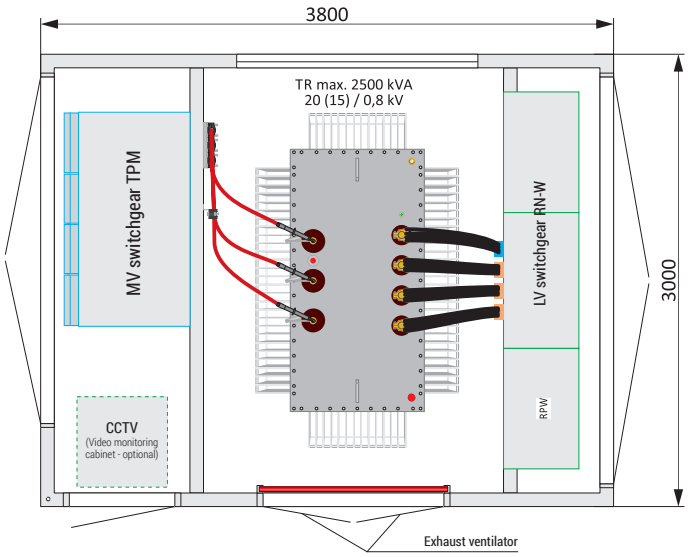
Maximum rated power of transformer	1600 kVA		
	MV	LV	
Rated voltage	20 kV	0,4 kV	0,8 kV
Rated voltage of the LV own needs switchgear			0,23 kV
Rated current	630 A	2500 A	1250 A

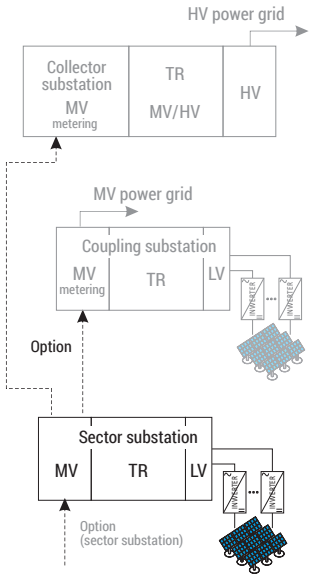
→ **NOTE!** Sample station configurations are presented in the catalog.

The LV switchgear cubicle may be prepared in a version suitable for integration in the IT and TN-C arrangement.

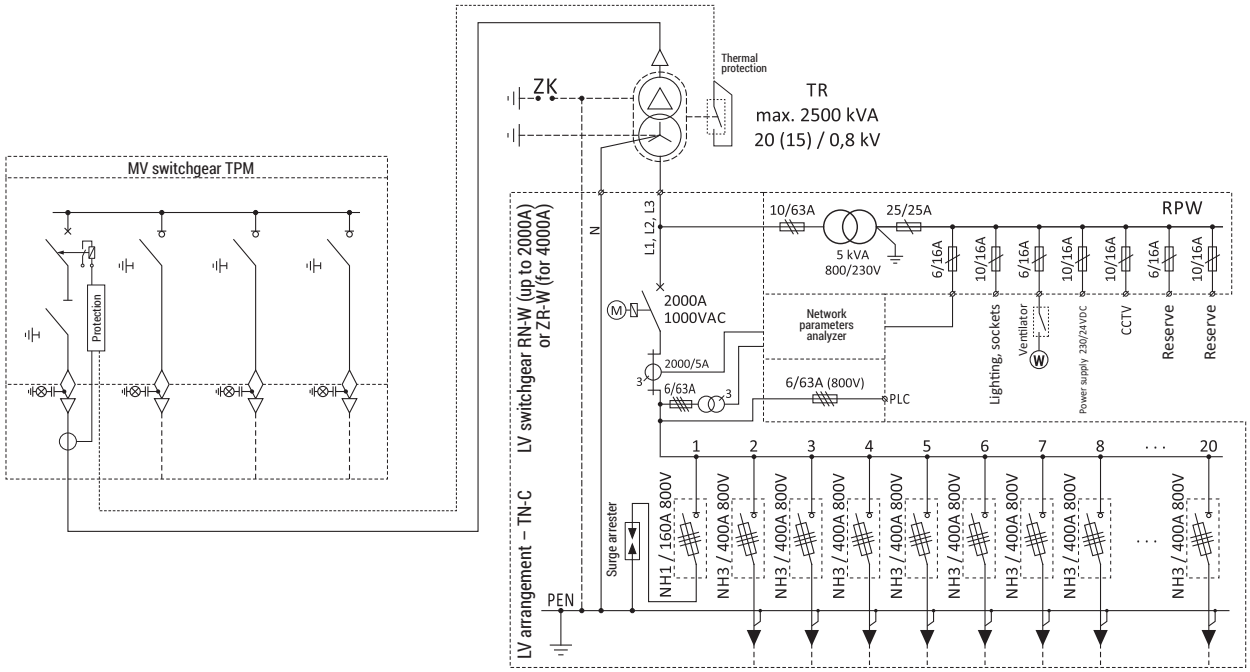
Mzb2 20/2500-4 – Sector substation with external access.
Inverter voltage on the AC side - 800 V, LV arrangement – TN-C

TOP VIEW / ARRANGEMENT OF THE ACCESSORIES





ELECTRICAL DIAGRAM



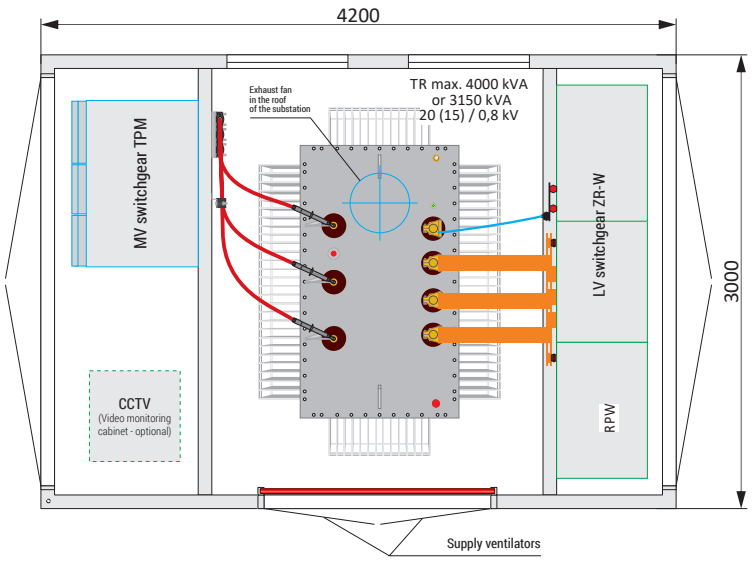
Maximum rated power of transformer	2500 kVA		
	MV	LV	
Rated voltage	20 kV	0,4 kV	0,8 kV
Rated voltage of the LV own needs switchgear			0,23 kV
Rated current	630 A	4000 A	2000 A

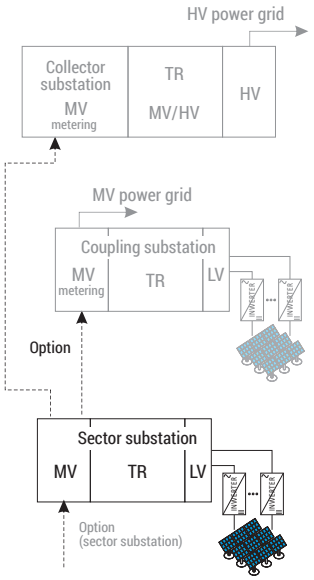
→ **NOTE!** Sample station configurations are presented in the catalog.

The LV switchgear cubicle may be prepared in a version suitable for integration in the TN-C and IT arrangement.

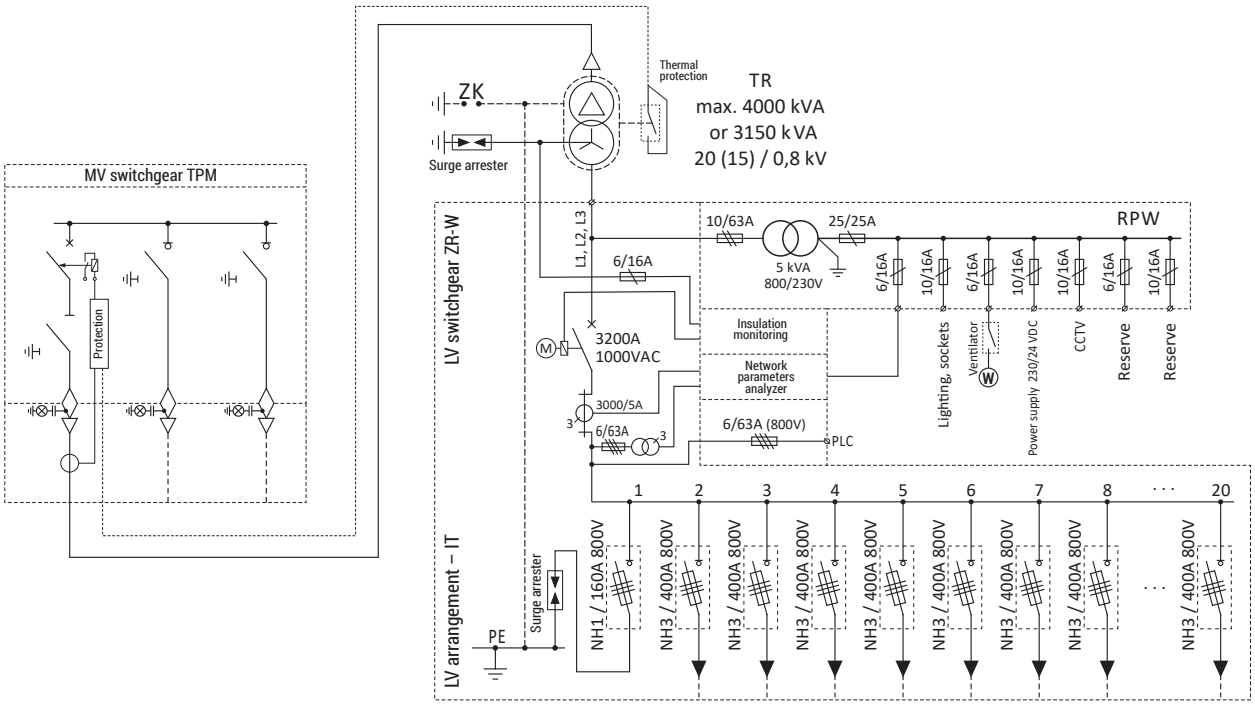
Mzb2 20/4000 (or 3150)-3 – Sector substation with external access. Inverter voltage on the AC side - 800 V, LV arrangement – IT

TOP VIEW / ARRANGEMENT OF THE ACCESSORIES





ELECTRICAL DIAGRAM



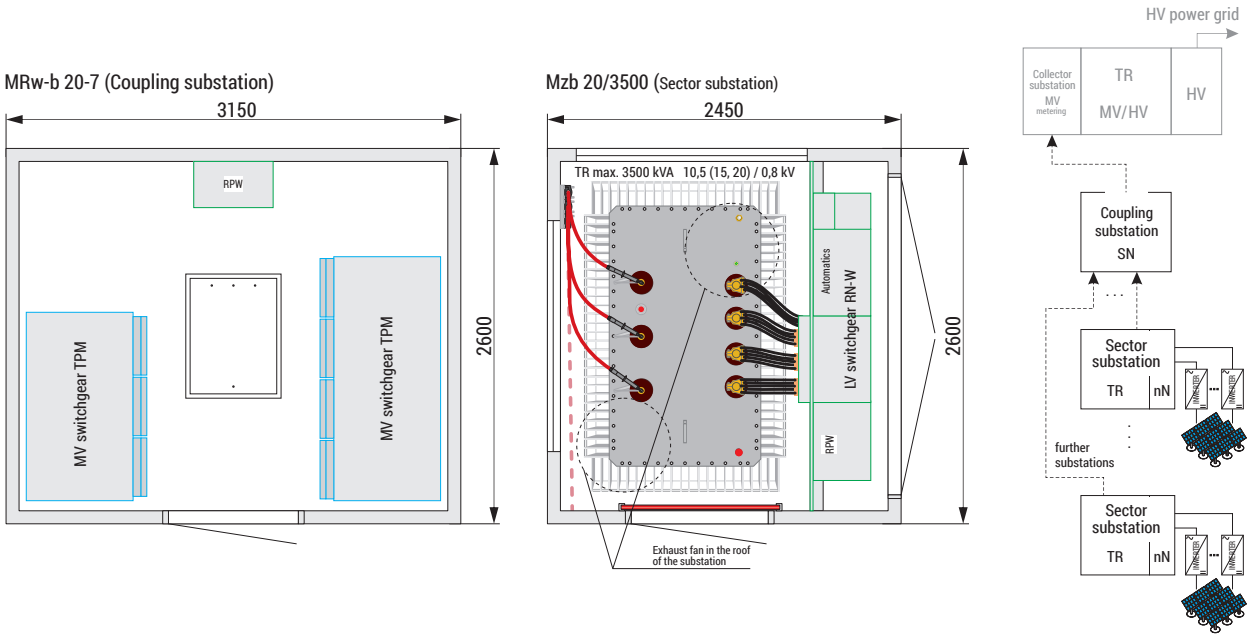
Maximum rated power of transformer	4000 kVA	
	MV	LV
Rated voltage		0,8 kV
Rated voltage of the LV own needs switchgear		0,23 kV
Rated current	630 A	3200 A

→ **NOTE!** Sample station configurations are presented in the catalog.

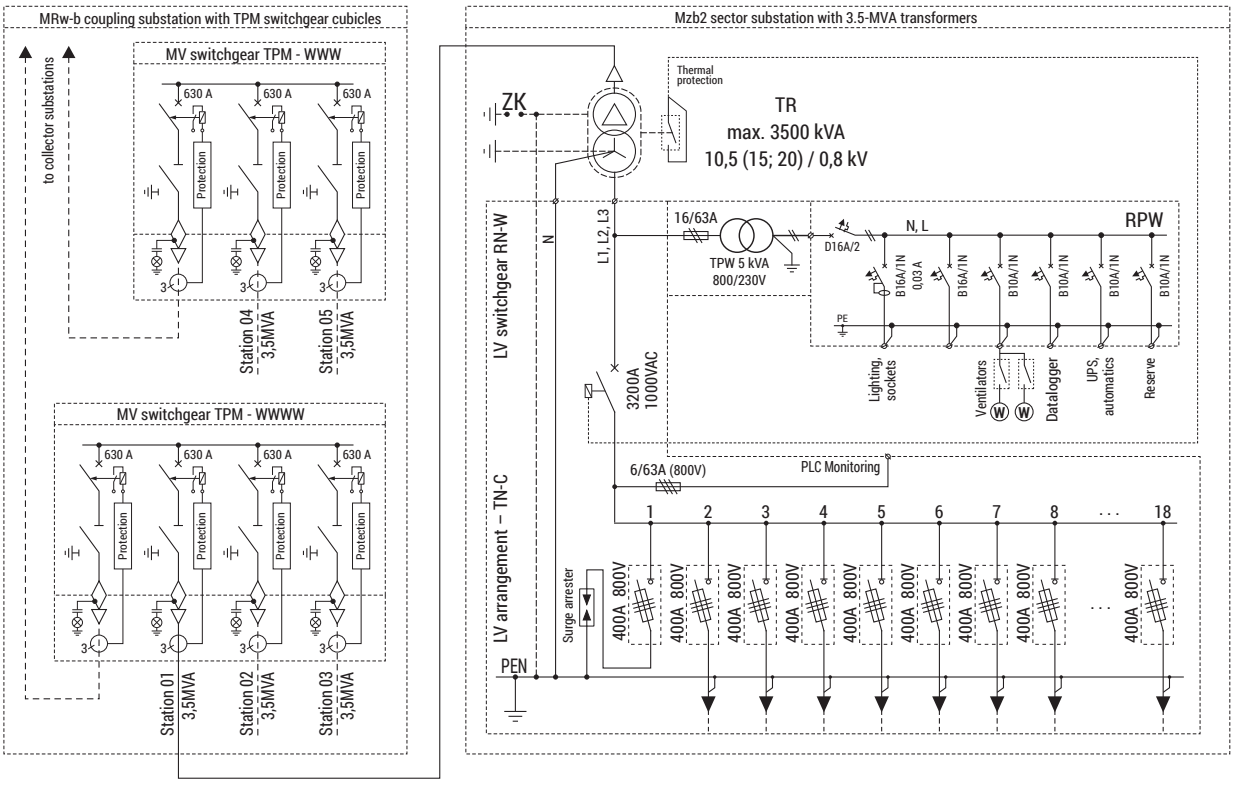
The LV switchgear cubicle may be prepared in a version suitable for integration in the IT and TN-C arrangement.

Mzb2 20/3500 - Sector substation; MRw-b 20-7 – Coupling substation.
Inverter voltage on the AC side - 800 V, LV arrangement – TN-C, MV – up to 20 kV

TOP VIEW / ARRANGEMENT OF THE ACCESSORIES



ELECTRICAL DIAGRAM



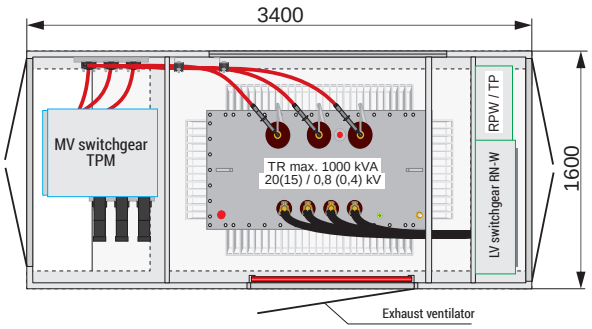
Maximum rated power of transformer	3500 kVA	
	MV	LV
Rated voltage	10,5 (15, 20) kV	0,8 kV
Rated voltage of the LV own needs switchgear		0,23 kV
Rated current	630 A	3200 A

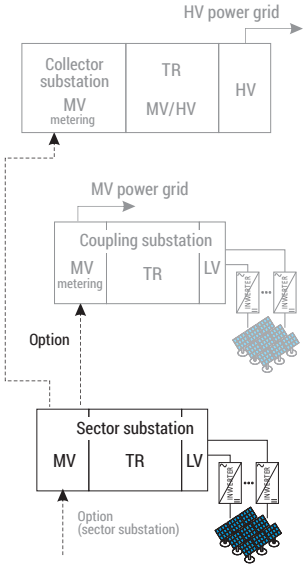
→ **NOTE!** Sample station configurations are presented in the catalog.

The LV switchgear cubicle may be prepared in a version suitable for integration in the TN-C and IT arrangement.

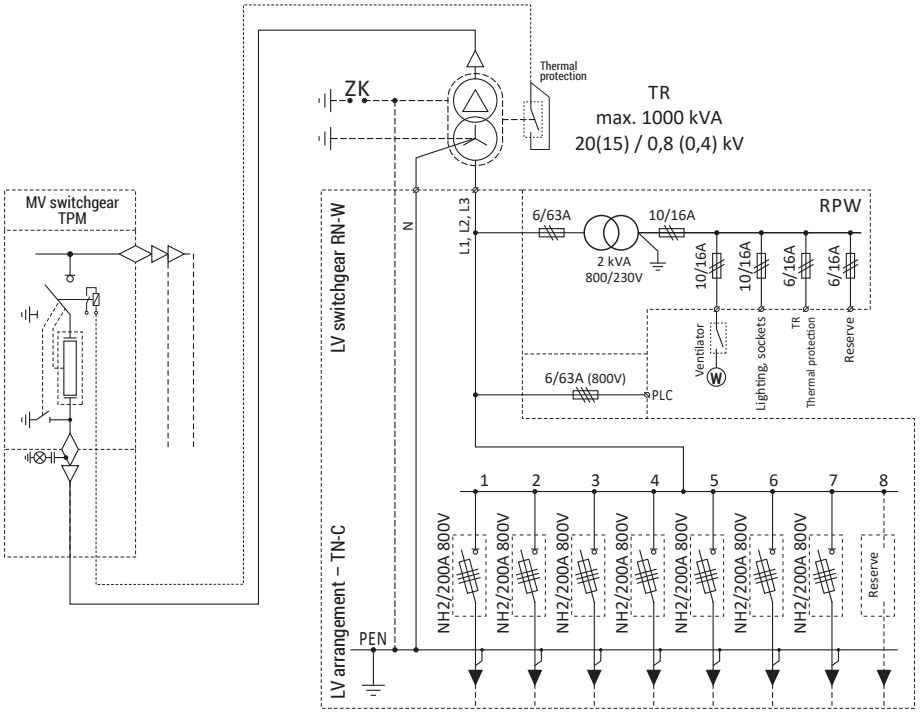
MRw 20/1000-1 – Metal-clad sector substation with external access. Inverter voltage on the AC side - 800 V, LV arrangement – TN-C

TOP VIEW / ARRANGEMENT OF THE ACCESSORIES





ELECTRICAL DIAGRAM



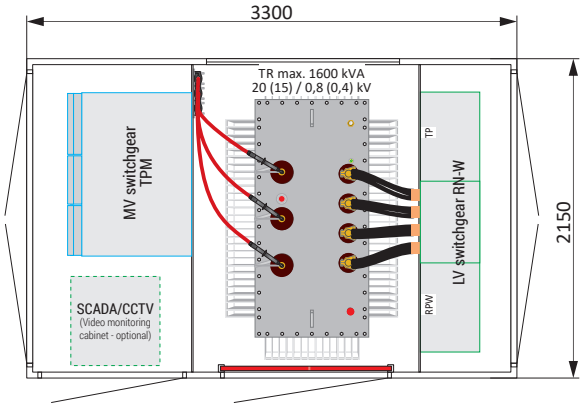
Maximum rated power of transformer	1000 kVA		
	MV	LV	
Rated voltage	20 kV	0,4 kV	0,8 kV
Rated voltage of the LV own needs switchgear			0,23 kV
Rated current	630 A	1600 A	1000 A

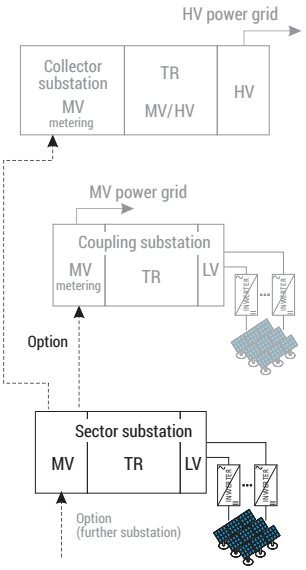
→ **NOTE!** Sample station configurations are presented in the catalog.

The LV switchgear cubicle may be prepared in a version suitable for integration in the IT and TN-C arrangement.

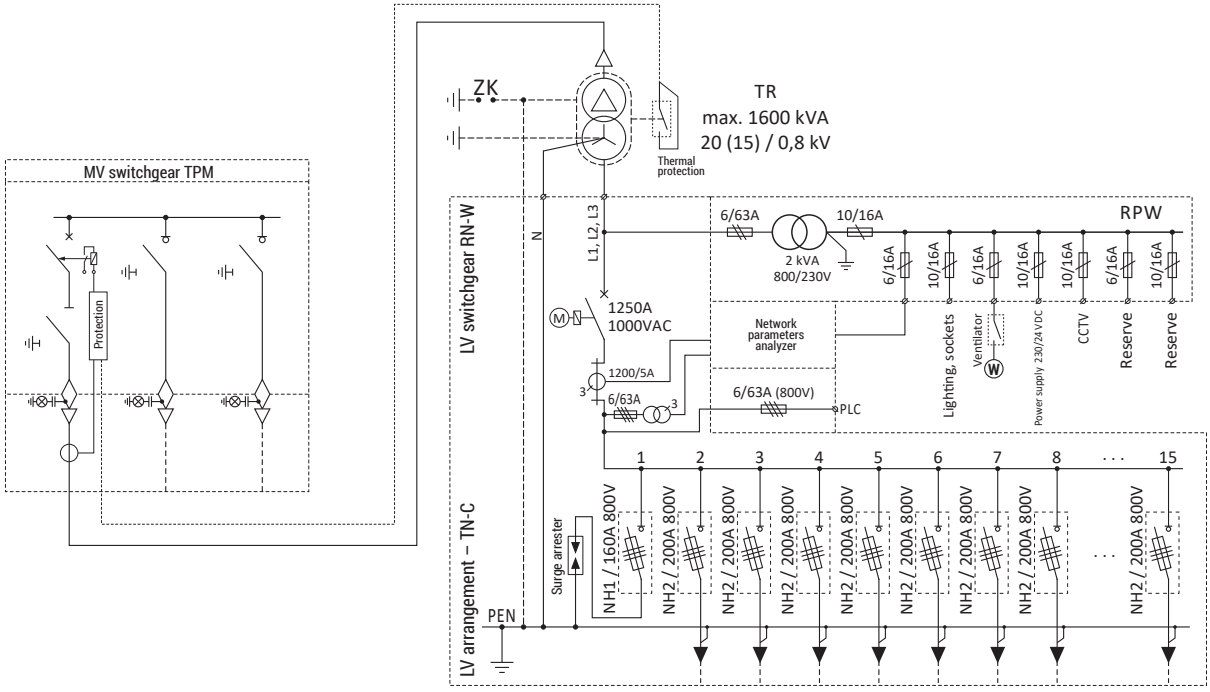
MRw 20/1600-3 – Metal-clad sector substation with external access. Inverter voltage on the AC side - 800 V, LV arrangement – TN-C

TOP VIEW / ARRANGEMENT OF THE ACCESSORIES





ELECTRICAL DIAGRAM



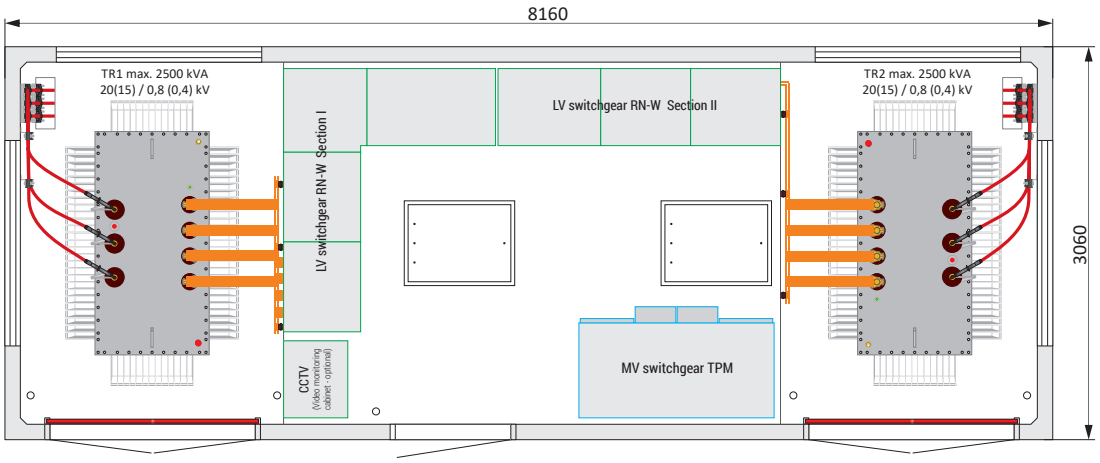
Maximum rated power of transformer	1600 kVA		
	MV	LV	
Rated voltage	up to 30 kV	0,4 kV	0,8 kV
Rated voltage of the LV own needs switchgear			0,23 kV
Rated current	630 A	2500 A	1250 A

NOTE! Sample station configurations are presented in the catalog.

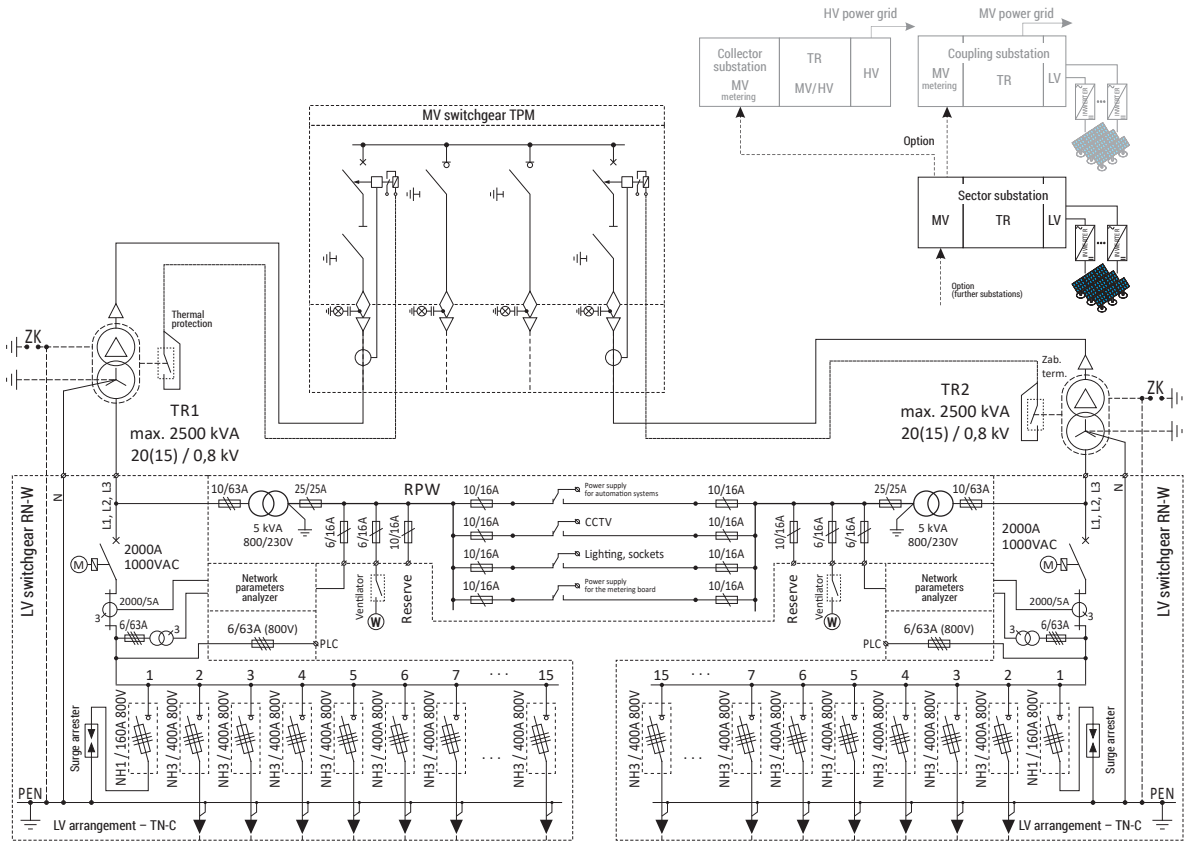
The LV switchgear cubicle may be prepared in a version suitable for integration in the TN-C and IT arrangement.

MRw-b 20/2x2500-4 – Sector substations with an internal access corridor. Inverter voltage on the AC side - 800 V, LV arrangement – TN-C

TOP VIEW / ARRANGEMENT OF THE ACCESSORIES



ELECTRICAL DIAGRAM



Maximum rated power of transformer	2 x 2500 kVA	
	MV	LV
Rated voltage	20 kV	0,8 kV
Rated voltage of the LV own needs switchgear		0,23 kV
Rated current	630 A	2000 A

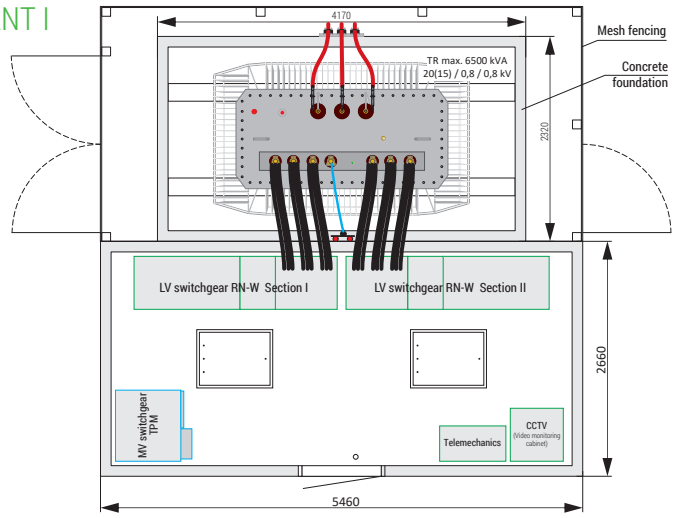
→ **NOTE!** Sample station configurations are presented in the catalog.

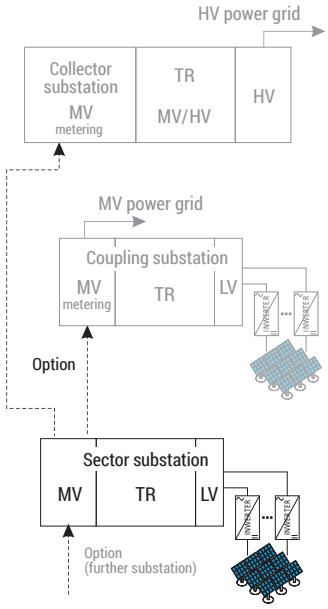
The LV switchgear cubicle may be prepared in a version suitable for integration in the TN-C and IT arrangement.

MRw-b 20/6500-2 – Sector substations with an internal access corridor. Inverter voltage on the AC side - 800 V, LV arrangement – IT

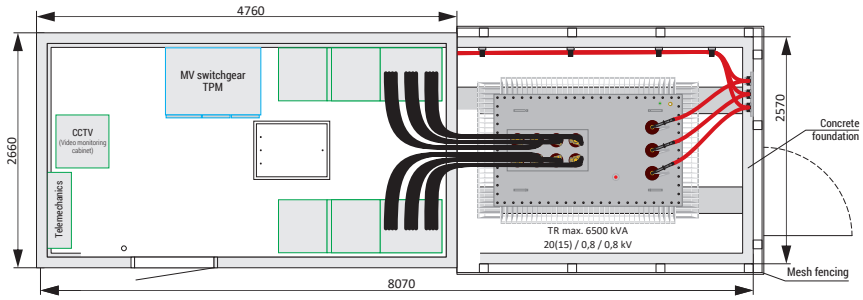
TOP VIEW / ARRANGEMENT OF THE ACCESSORIES

VARIANT I

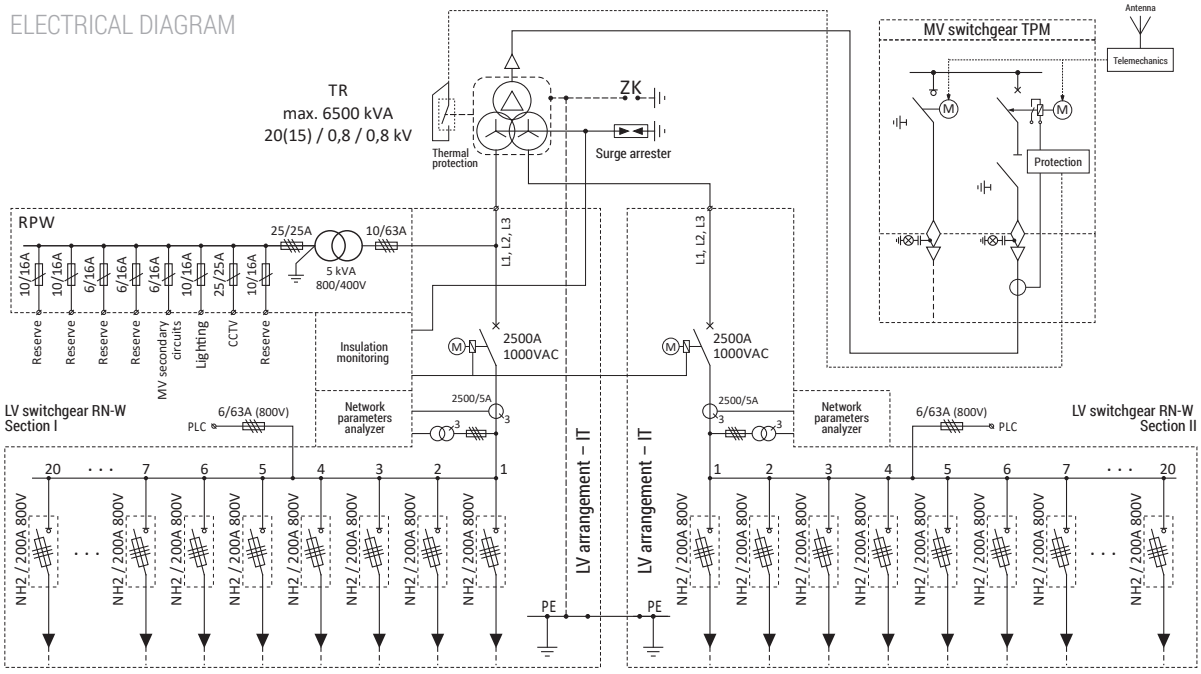




VARIANT II



ELECTRICAL DIAGRAM



Maximum rated power of transformer	6500 kVA	
	MV	LV
Rated voltage	up to 20 kV	0,8 kV
Rated voltage of the LV own needs switchgear		0,4 kV
Rated current	630 A	2x2500 A

→ **NOTE!** Sample station configurations are presented in the catalog.

The LV switchgear cubicle may be prepared in a version suitable for integration in the IT and TN-C arrangement.

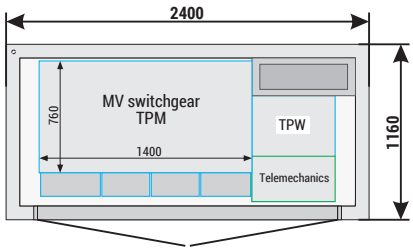
Selected equipment and photovoltaic infrastructure solutions

ZK-SN – Medium voltage cable box

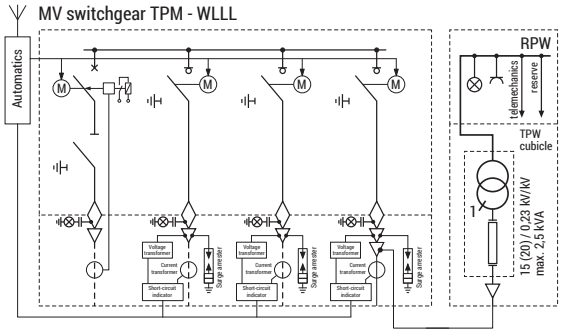
The following are examples of cable connection solutions cooperating with individually metered stations dedicated to photovoltaic farms. Thanks to this solution, it is possible to create large-scale photovoltaic systems consisting of installations with individual power, e.g. ~ 1MW. This configuration not only affects the technical aspects (it enables connecting many PV installations to the power system in places where there are no other technical possibilities - one free bay in the switching station), but also economical, minimizing the need for additional cable routes, as well as the reconstruction of the switching station itself. It is possible to make many other solutions for individual customer needs, including solutions for MV cable connectors with indirect energy measurement.

ZK-SN (2,4x1,16) / 4-tpw

TOP VIEW / ARRANGEMENT OF THE ACCESSORIES

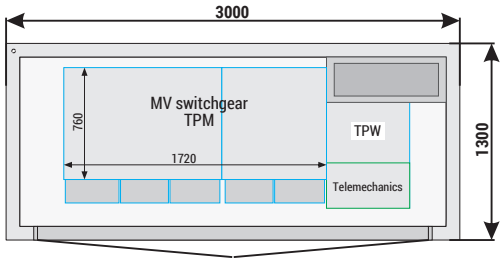


ELECTRICAL DIAGRAM

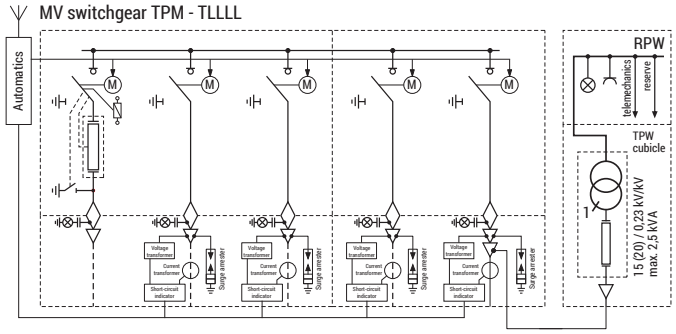


ZK-SN (3x1,3) / 5-tpw

TOP VIEW / ARRANGEMENT OF THE ACCESSORIES

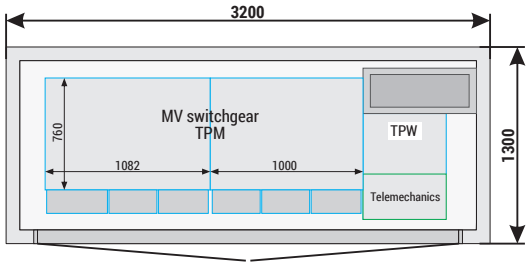


ELECTRICAL DIAGRAM

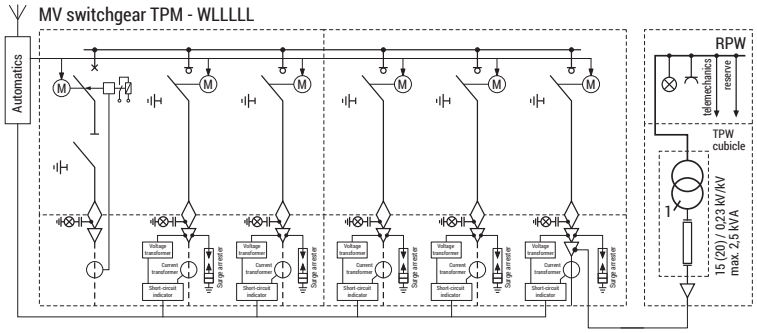


ZK-SN (3,2x1,3) / 6-tpw

TOP VIEW / ARRANGEMENT OF THE ACCESSORIES



ELECTRICAL DIAGRAM



	MV	LV
Rated voltage	20 kV	-
Rated voltage of the LV own needs switchgear	-	0,23 kV
Rated current	630 A	-

→ **NOTE!** Sample station configurations are presented in the catalog.

LV and MV switchgears as the main equipment of stations dedicated to renewable energy sources

Depending on the variant and intended use of the substation, the equipment of the MV part is based on proven solutions of Rotoblok SF or TPM switchgear cubicles. Thanks to the use of enclosed switchgear (sealed stainless steel tanks), the cubicles can function correctly even in places with high dust concentration (the substations intended for PV systems are often located between fields). During the selection of MV switchgear, it is also necessary to consider the radically different daily operating cycle of the substation in PV systems in comparison with substations operating in electricity distribution systems.

One of the more important parameters is the correct selection of the mechanical and electrical endurance class of the switches used for the connection with the grid. Over the course of a single day, the farm can be switched on and off repeatedly. That is why we recommend using M2/E2 circuit breakers and M2/E3 disconnectors, respectively. For instance, if we assume just

3 switching cycles per day (and sometimes, there can be as many as 5–10), this adds up to over a 1000 switching operations per year. If you select "cheap" circuit breakers with fairly low endurance, e.g., 2000 cycles, you have to expect rapid wear and expensive replacement before the lapse of, for instance, 2 years from the commissioning of the system.

Of particular importance is the LV side of the substations dedicated to photovoltaic systems. LV switchgear can work with voltage up to 800 VAC, both in the TN arrangement (earthed system) and IT arrangement (insulated system). Switchgear cubicles in the IT arrangement provide tangible benefits to the investors in the form of savings on the connections between the inverters located in the field and the LV switchgear cubicle located at the substation (3 cables instead of 4). Thanks to the increase of the operating voltage to 800 V, in turn, it is possible to reduce the cross-section of the cables, due to lower operating currents. This directly reduces energy losses in the system, enabling integration with string inverters with capacities as high as 250 kW, reducing the number of the incoming circuits of the LV switchgear cubicle itself.

When LV switchgear cubicles are used in the IT arrangement, however, it is necessary to remember that in order for the switchgear to operate correctly, providing full protection and safety, there is a need to use equipment that continuously monitors the condition of cable insulation – such equipment is used, for instance, in the mining industry. Another aspect that is just as important as the selection of automation and protection systems is the selection of the devices for the LV switchgear cubicle rated to 800 VAC. In such a situation, it is necessary to use switchgear with a rated voltage of 1000 V AC or more, suitable for the particular arrangement of the system. The substation has to be provided with an auxiliaries system with a transformer that reduces the voltage from 800 V to 400 or 230 V to supply the control systems, lighting, ventilation or CCTV panel, among others.

At many of our substations, the inverters communicate with the master system using the Power Line Communication technology. This is a new technology that can be used to communicate with the inverters directly through the current lines connecting the inverters to the LV switchgear at the substation. This improves the transparency of the system, eliminating the need to install additional wired or wireless communication infrastructure. It also minimises the risk of faults and enables independence from the external providers of telecommunications services within the particular system.

Specific information about the LV and MV switchgear manufactured by ZPUE can be found in our product catalogue.

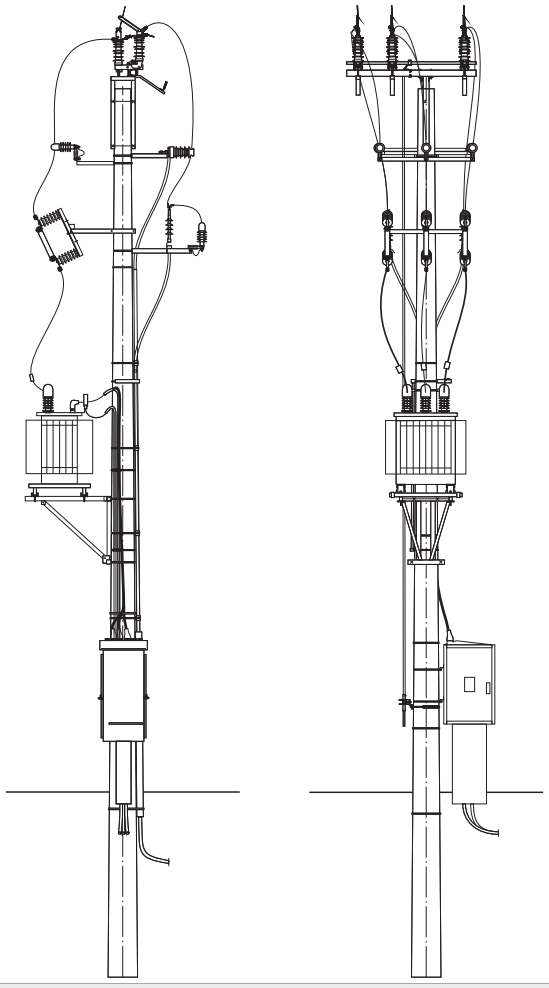
Pole transformer stations and **overhead disconnection points** dedicated to photovoltaic farms

Pole transformer stations are designed to work with small photovoltaic farms, which power does not exceed 630 kWp They are ideal for cooperation with overhead and cable distribution lines with a voltage of 15; 20 or 30 kV, which are most often found in areas designated for this type of investment. These solutions are characterized by low financial outlays, which significantly shortens the investment amortization period. Due to their specificity, they occupy a small area and their installation is quick and does not require the use of heavy construction equipment.

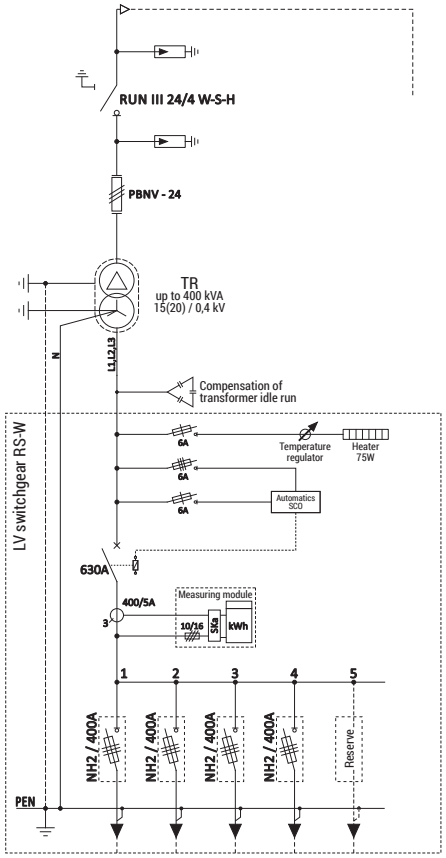
The catalog presents only selected examples of pole stations for RES needs. Thanks to our own production of precast concrete poles and supporting structures, it is possible to make many other solutions for the individual needs of the customer.

STNKo-20/400 with a **RUN III 24/4 W-S-H** disconnector– Pole-mounted substation dedicated to solar farms with capacities up to 0,4 MWp

VIEWS / ARRANGEMENT OF THE ACCESSORIES



ELECTRICAL DIAGRAM

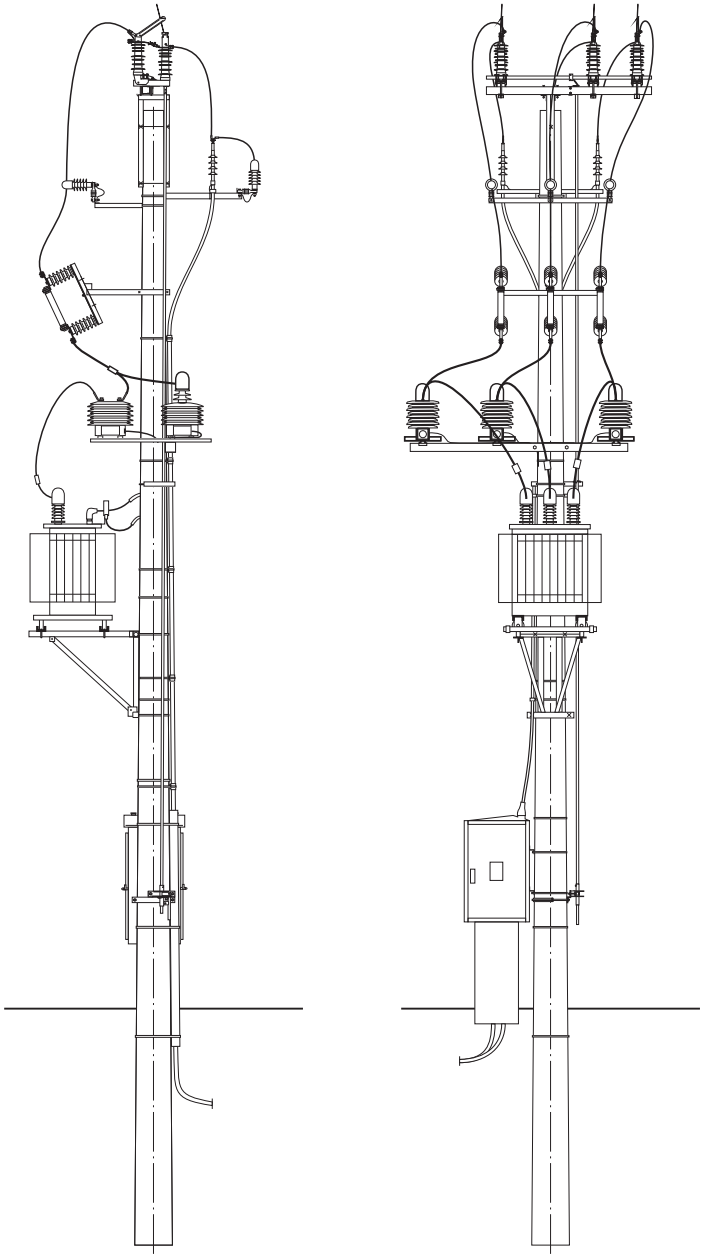


Maximum rated power of transformer	400 kVA	
Maximum power of PV installation connected to one pole station	400 kWp	
	MV	LV
Rated voltage	15/20 kV	0,4 kV
Rated current	400 A	630 A

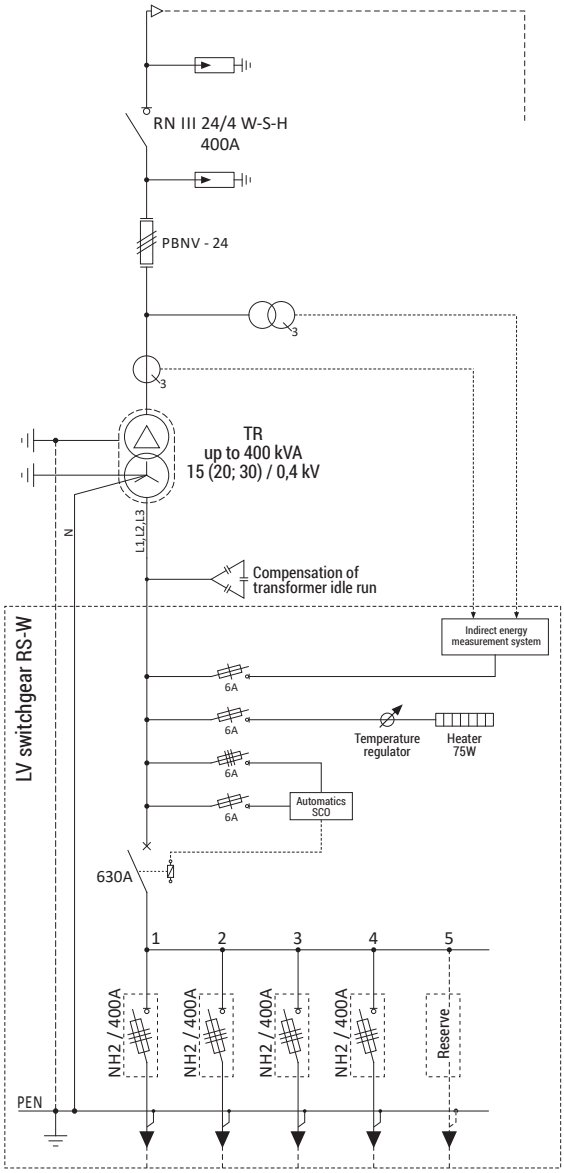
→ **NOTE!** Sample pole station configurations are presented in the catalog dedicated to RES.

STNKo-20/400/PP3 with a **RN III 24/4 W-S-H** disconnector – Pole-mounted substation dedicated to solar farms with capacities up to 0,4 MWp

VIEWS / ARRANGEMENT OF THE ACCESSORIES



ELECTRICAL DIAGRAM

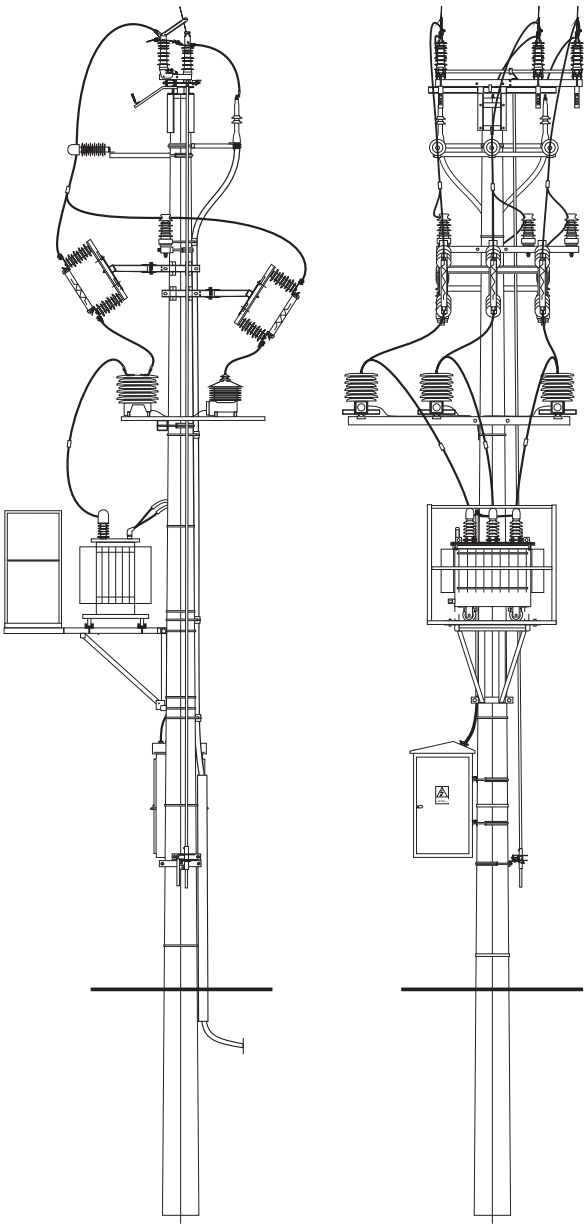


Maximum rated power of transformer	400 kVA	
Maximum power of PV installation connected to one pole station	400 kWp	
	MV	LV
Rated voltage	15/20/30 kV	0,4 kV
Rated current	400 A	630 A

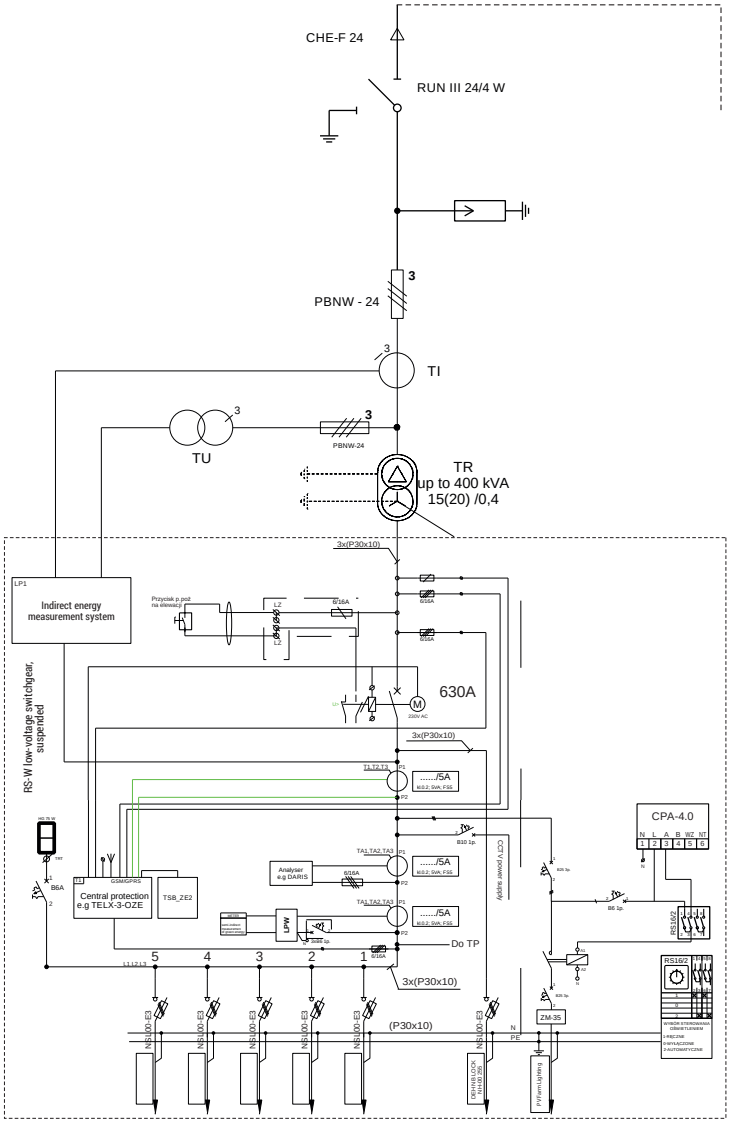
→ **NOTE!** Sample pole station configurations are presented in the catalog dedicated to RES.

STNKo-20/400 PP3 2xPBNW with the **RUN III 24/4 W-S-H** disconnector and an indirect metering system – Pole-mounted substation with a capacity of up to 0.4 MWp – LV switchgear cubicle with an automatic control system and central protection

VIEWS / ARRANGEMENT OF THE ACCESSORIES



ELECTRICAL DIAGRAM

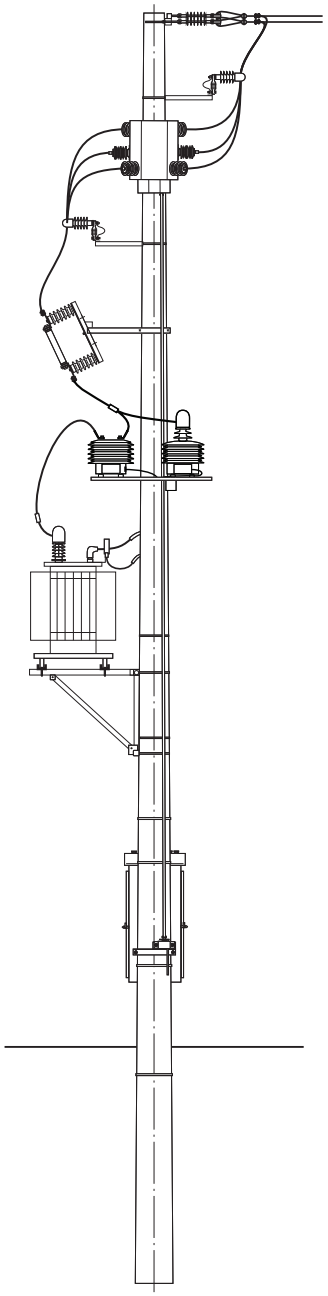


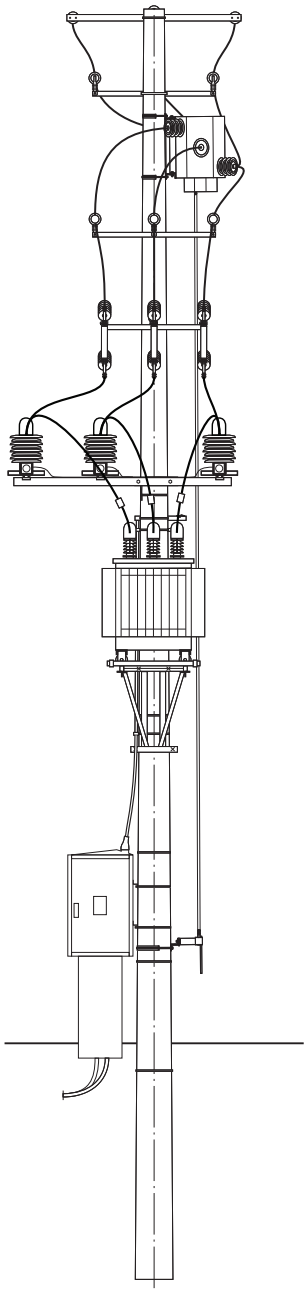
Maximum rated power of transformer	400 kVA	
Maximum power of PV installation (installed in panels on the DC side)	400 kWp	
	MV	LV
Rated voltage	15/20 kV	0,4 kV
Rated current	400 A	400 A

→ **NOTE!** Sample pole station configurations are presented in the catalog dedicated to RES.

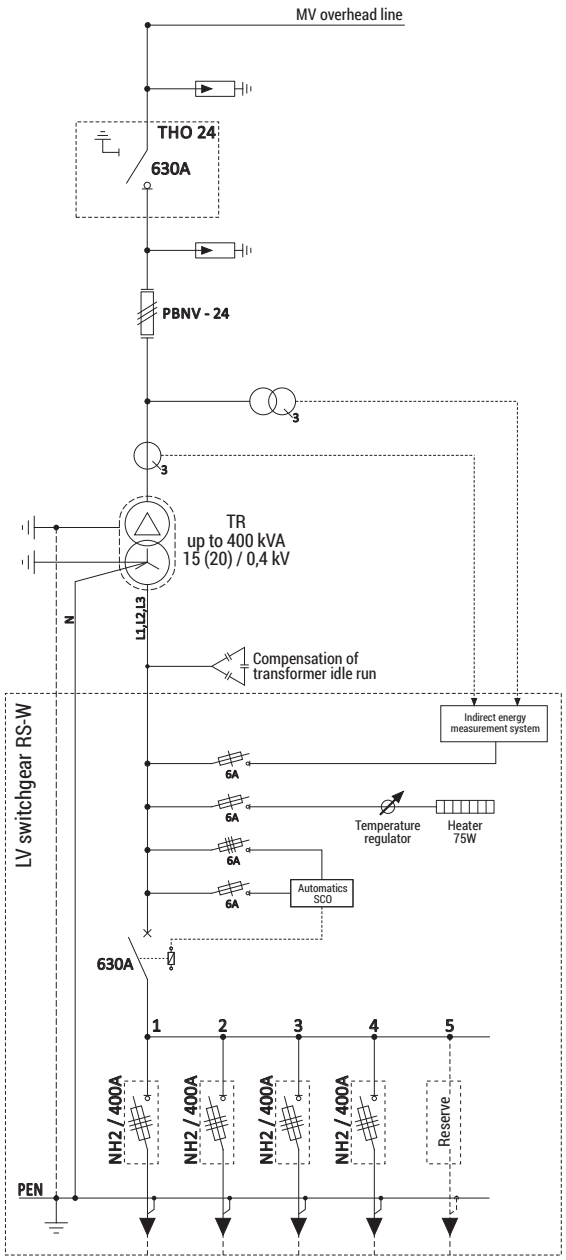
STNr-20/400/PP3 with a THO 24 disconnector and an earthing switch – Pole-mounted substation dedicated to solar farms with capacities up to 0,4 MWp

VIEWS / ARRANGEMENT OF THE ACCESSORIES





ELECTRICAL DIAGRAM

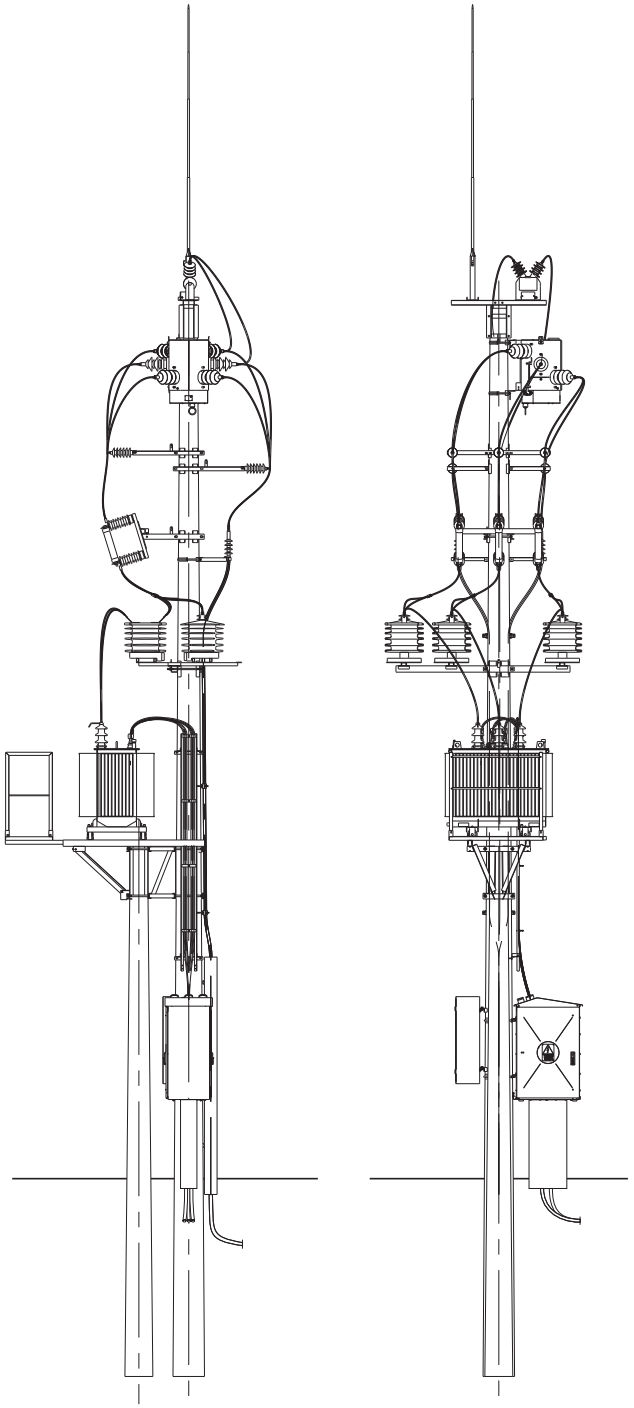


Maximum rated power of transformer	400 kVA	
Maximum power of PV installation connected to one pole station	400 kWp	
	MV	LV
Rated voltage	15/20 kV	0,4 kV
Rated current	630 A	630 A

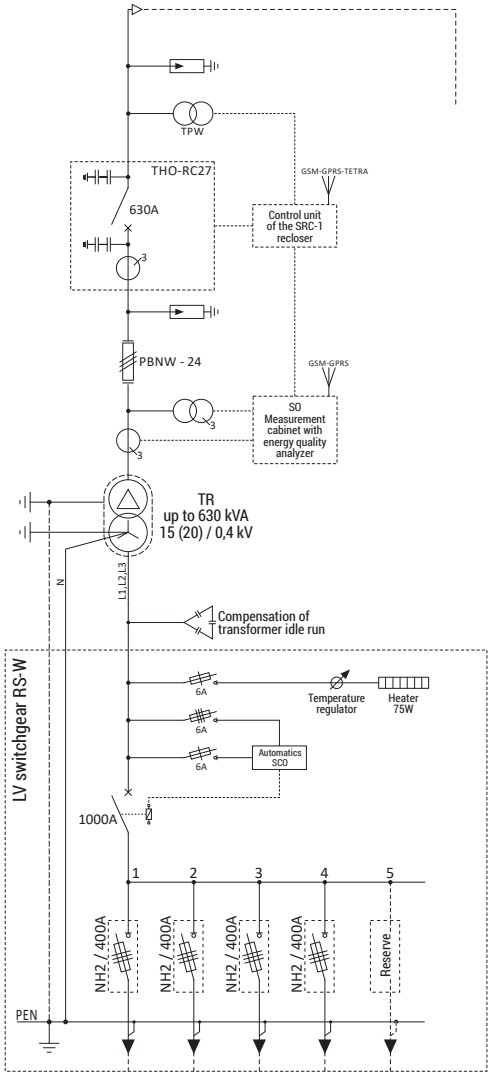
→ **NOTE!** Sample pole station configurations are presented in the catalog dedicated to RES.

STSKpbr-W 20/630/PP3 with a THO-RC27 recloser – Pole-mounted substation dedicated to solar farms with capacities up to 0.63 MWp

VIEWS / ARRANGEMENT OF THE ACCESSORIES



ELECTRICAL DIAGRAM

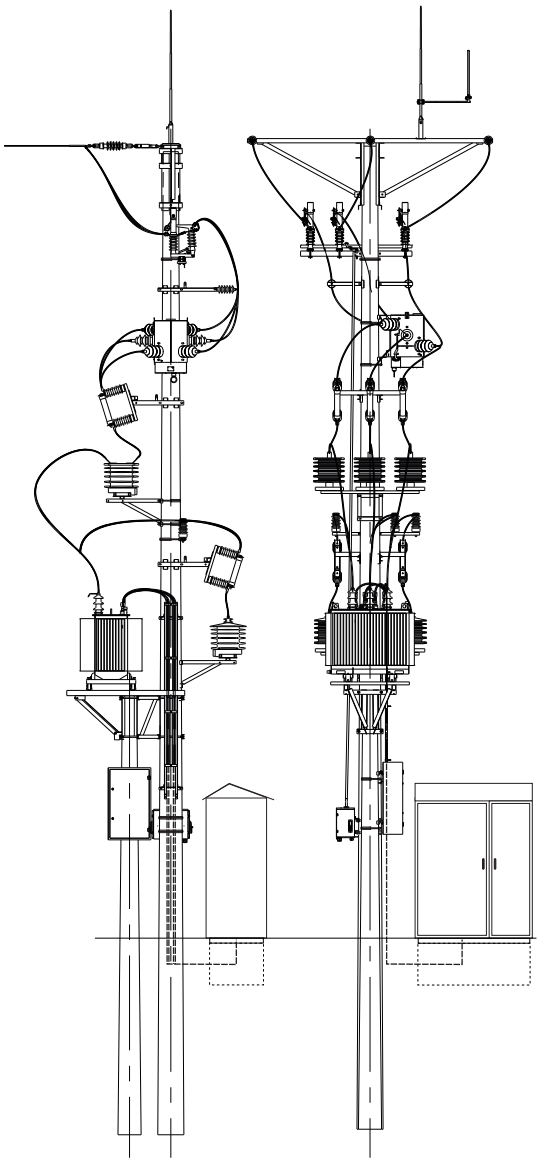


Maximum rated power of transformer	630 kVA	
Maximum power of PV installation connected to one pole station	630 kWp	
	MV	LV
Rated voltage	15/20 kV	0,4 kV
Rated current	630 A	1000 A

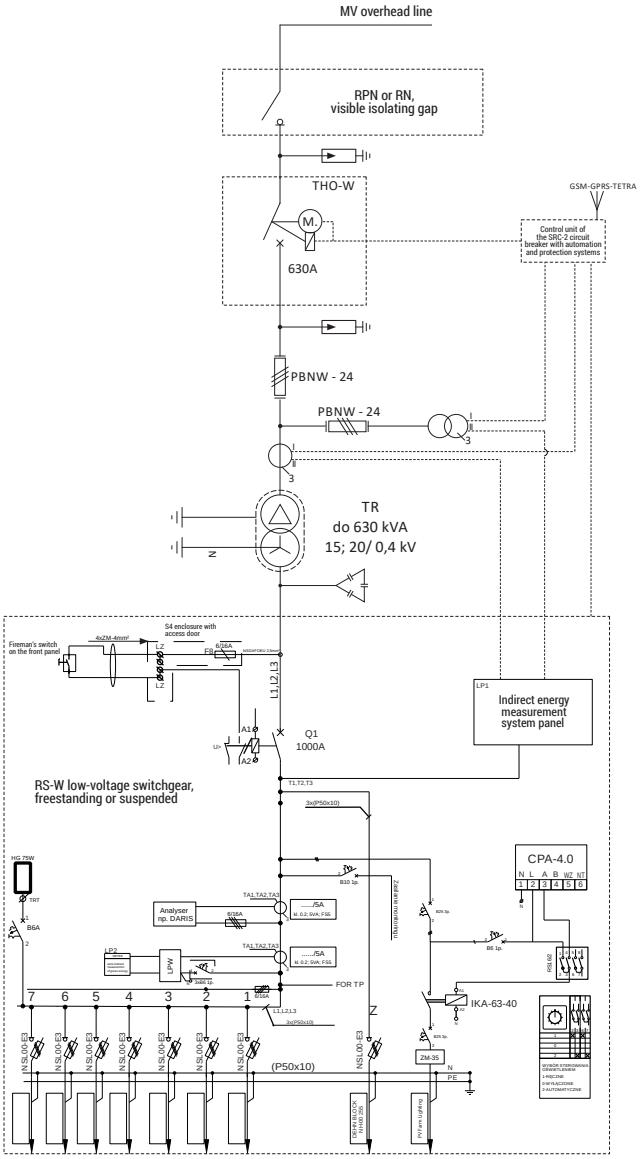
→ **NOTE!** Sample pole station configurations are presented in the catalog dedicated to RES.

STSpbro-W 20/630/PP3 with the THO-W circuit breaker and RPN disconnector – Pole-mounted substation with a capacity of up to 0.63 MWp – Switchgear with a metering system, power analyser and green energy metering

VIEWS / ARRANGEMENT OF THE ACCESSORIES



ELECTRICAL DIAGRAM



Maximum rated power of transformer	up to 630 kVA	
Maximum power of PV installation (installed in panels on the DC side)	630 kWp	
	MV	LV
Rated voltage	15/20 kV	0,4 kV
Rated current	630 A	1000 A

→ **NOTE!** Sample pole station configurations are presented in the catalog dedicated to RES.

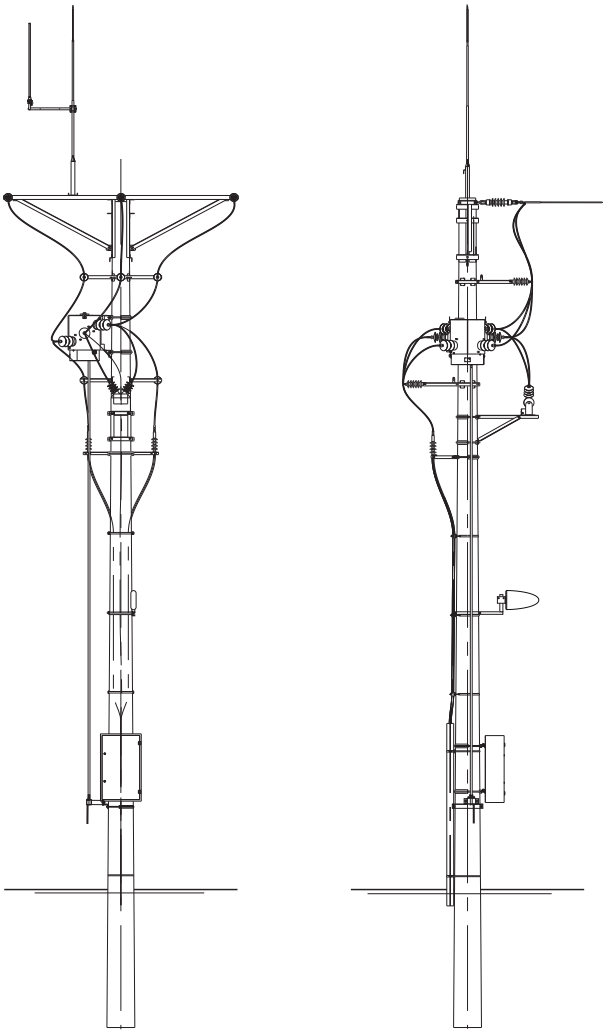
Overhead-cable switch disconnector and recloser

The disconnector and recloser nodes are designed to work with renewable sources that are connected to the MV DSO network. The solution significantly reduces the number and length of interruptions in the supply / sale of energy, as well as fewer customers experiencing power outages caused by disconnecting / connecting the power plant from the DSO network. The applied automation allows for faster and easier management of energy supplied to the network. Power supplied for consumers and producers is restored faster and in a controlled manner, which simultaneously improves the reliability of the energy supplied and the entire network.

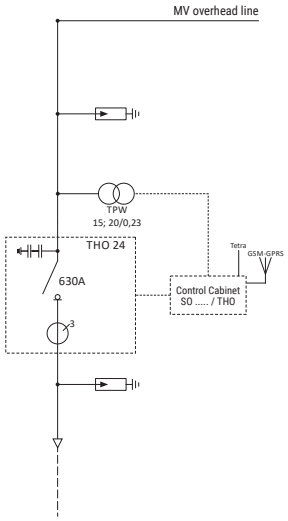
Switches, reclosers and sectionalizers produced by ZPUE S.A. thanks to well-thought-out solutions, they are adapted to work with all available SCADA systems and with the latest applications introduced to the systems as new products, perfectly finding their place in Smart Grid networks.

Pole post **LSN-E-PŁ-K-1g-1rs-THO** with switch disconnector **THO 24**

VIEWS / ARRANGEMENT OF THE ACCESSORIES



ELECTRICAL DIAGRAM

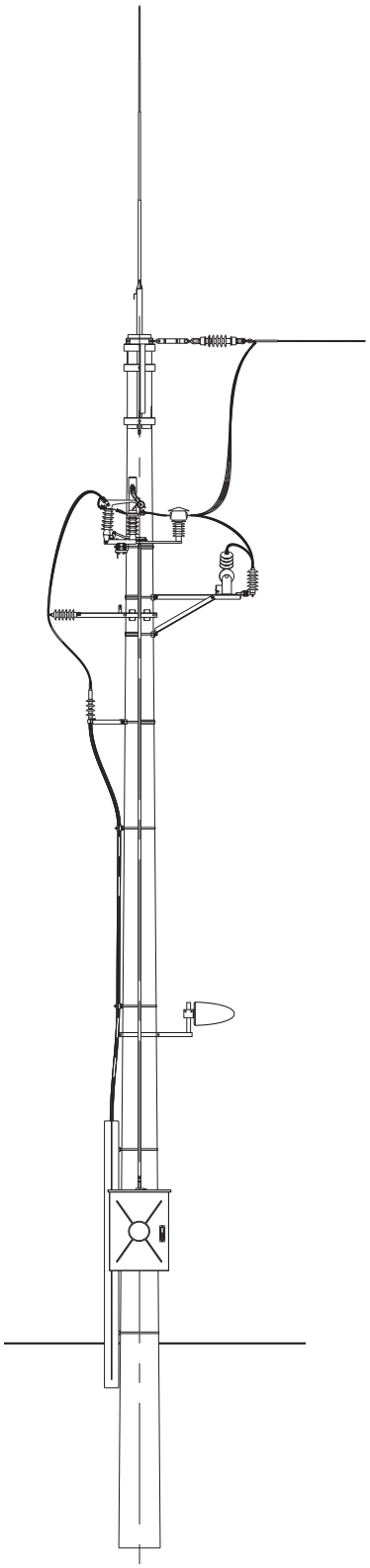


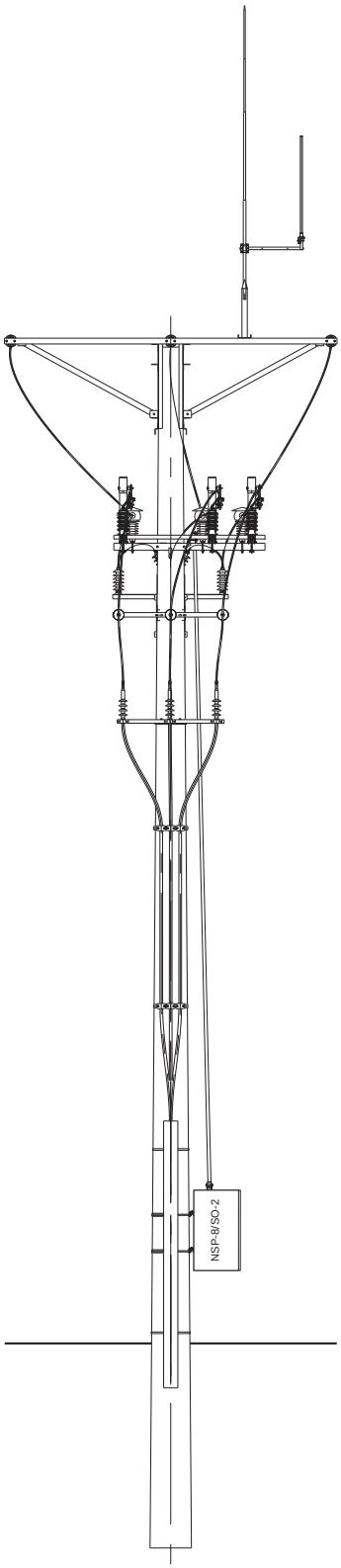
	MV	LV
Rated voltage	15/20 kV	230 VAC
Rated current	630 A	-

→ **NOTE!** The catalogue shows sample configurations of disconnector points dedicated to RES.

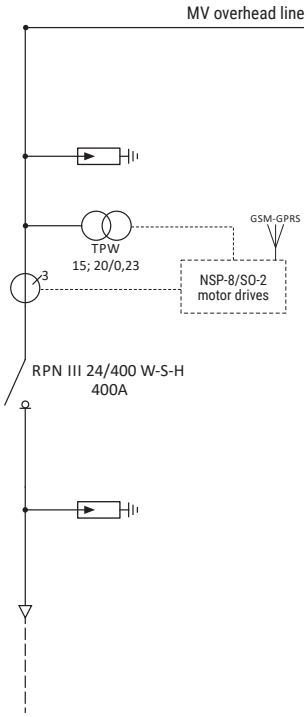
LSN-E-PŁ-K-1g-1rs-RPN with switch disconnector RPN-W 400A and short-circuit indicator

VIEWS / ARRANGEMENT OF THE ACCESSORIES





ELECTRICAL DIAGRAM

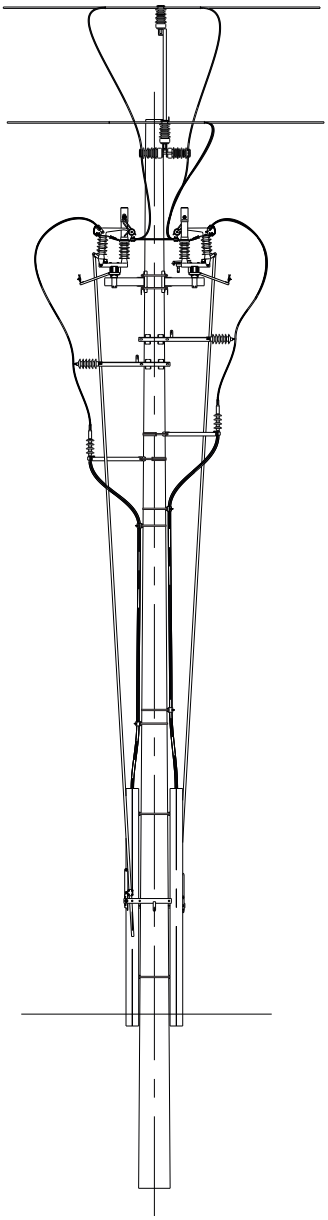


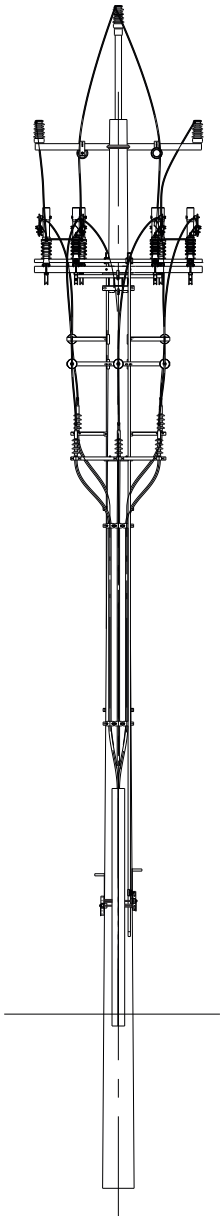
Maximum rated power of transformer	-	
Maximum power of PV installation (installed in panels on the DC side)	-	
	MV	LV
Rated voltage	15/20 kV	230VAC
Rated continuous current and switching current of an MV switch	400 A	-

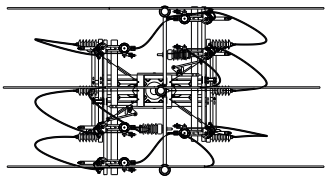
→ **NOTE!** The catalogue shows sample configurations of disconnector points dedicated to RES.

LSN-E-Tr-PS-2g-2r-RPNu with switch disconnector **RPNu 400A** only manual control without automation

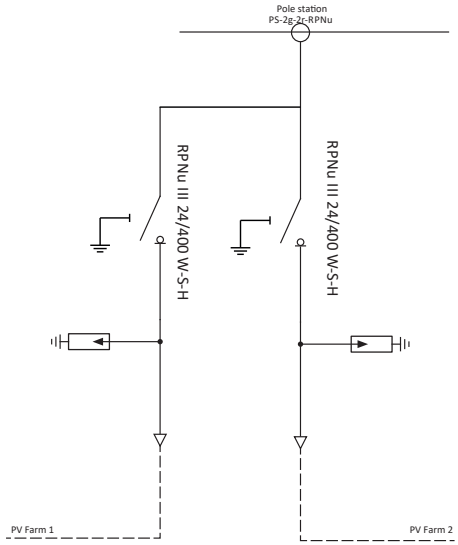
VIEWS / ARRANGEMENT OF THE ACCESSORIES







ELECTRICAL DIAGRAM

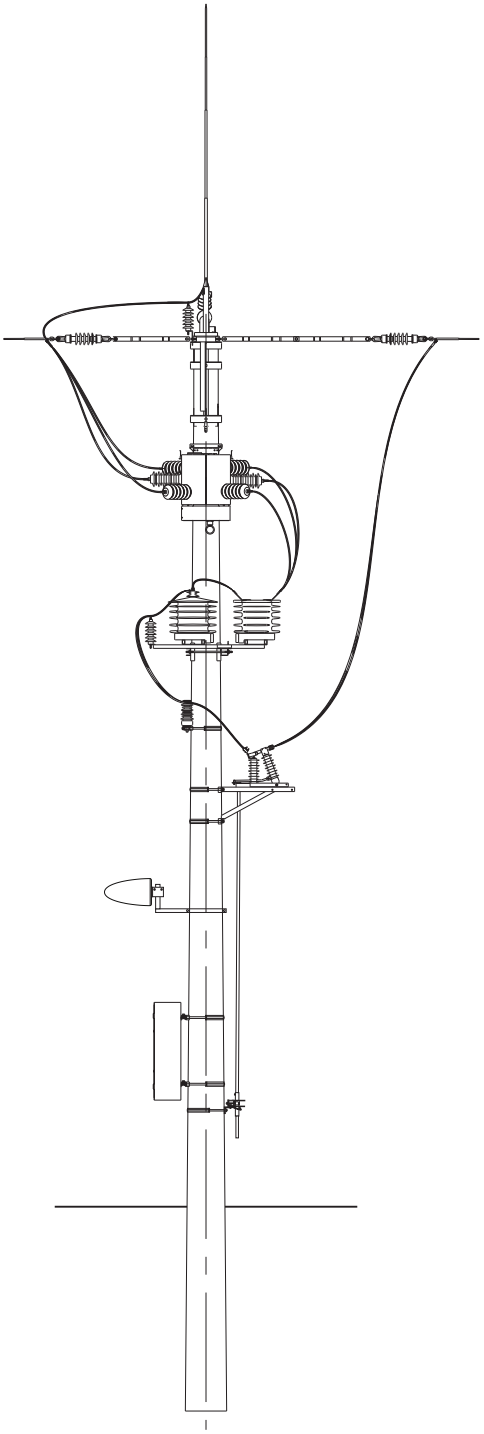


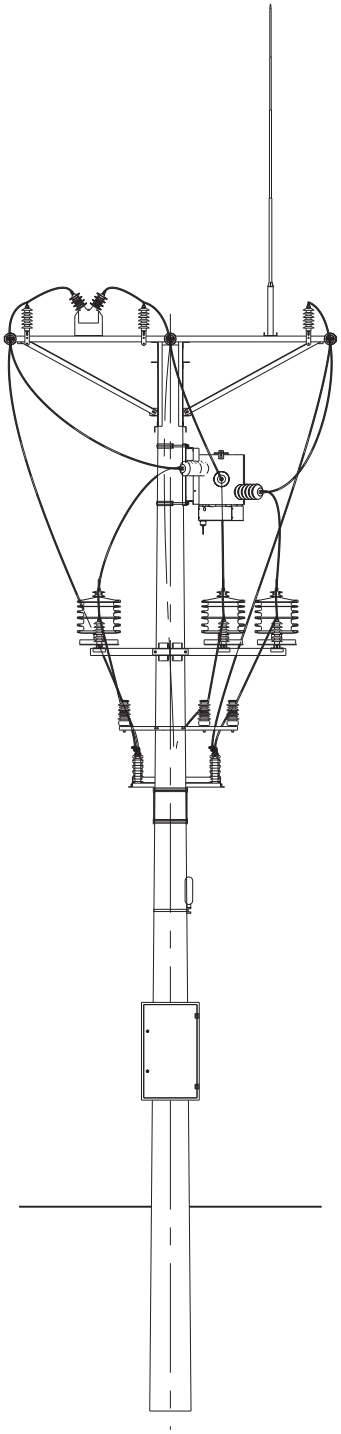
Maximum rated power of transformer	-	
Maximum power of PV installation (installed in panels on the DC side)	-	
	MV	-
Rated voltage	15/20 kV	-
Rated continuous current and switching current of an MV switch	400 A	-

→ **NOTE!** The catalogue shows sample configurations of disconnector points dedicated to RES.

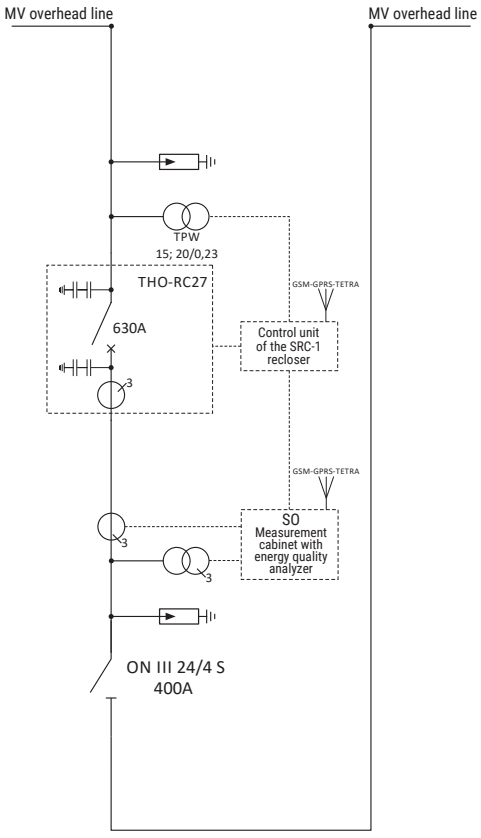
Pole post **LSN-E-PŁ-O-1ws-THO-RC27** – ON with **THO-RC27** recloser and disconnector

VIEWS / ARRANGEMENT OF THE ACCESSORIES





ELECTRICAL DIAGRAM



	MV	LV
Rated voltage	15/20 kV	230 VAC
Rated current	630 A	-

→ **NOTE!** Sample pole station configurations are presented in the catalog dedicated to RES.

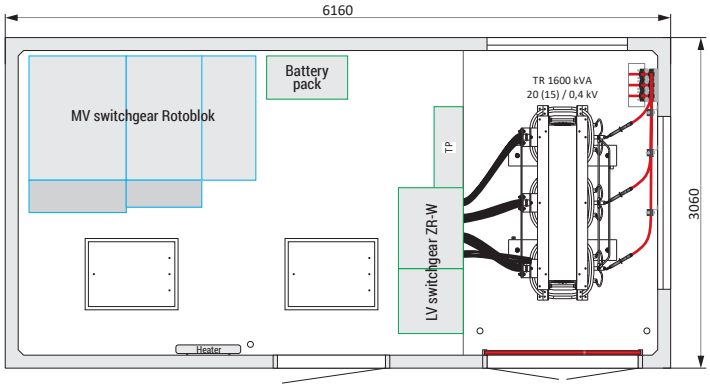
Renewable energy from biofuels - stations for biogas plants

A biogas plant is an installation producing gas from biomass in the methane fermentation process. This biogas has unlimited possibilities of use in the energy sector - both locally for the production of electricity and heat, or in transport. Agricultural biogas can be independently used in industry or energy sector after injecting it into the gas distribution network.

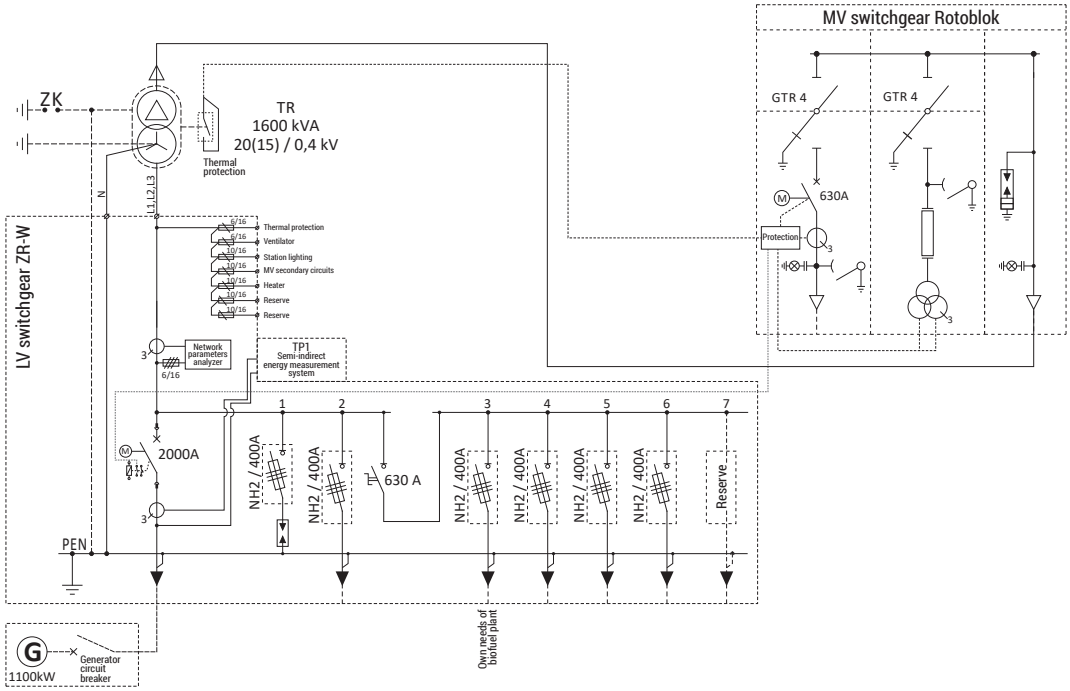
The catalog presents only examples of transformer station solutions for the needs of a biogas plant. It is possible to make many other solutions for individual customer needs.

MRw-b 20/1600-3 (MRw 20/1600-3)

VIEWS / ARRANGEMENT OF THE ACCESSORIES



ELECTRICAL DIAGRAM

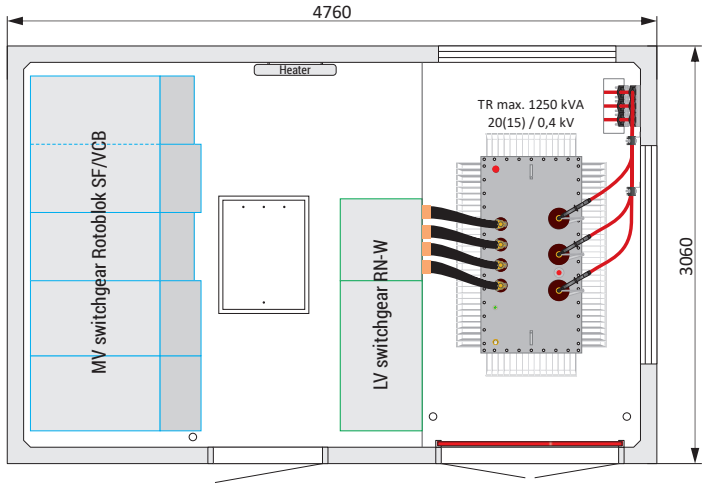


Maximum rated power of transformer	1600 kVA	
	MV	LV
Rated voltage	20 kV	0,4 kV
Rated current	630 A	2500/2000 A

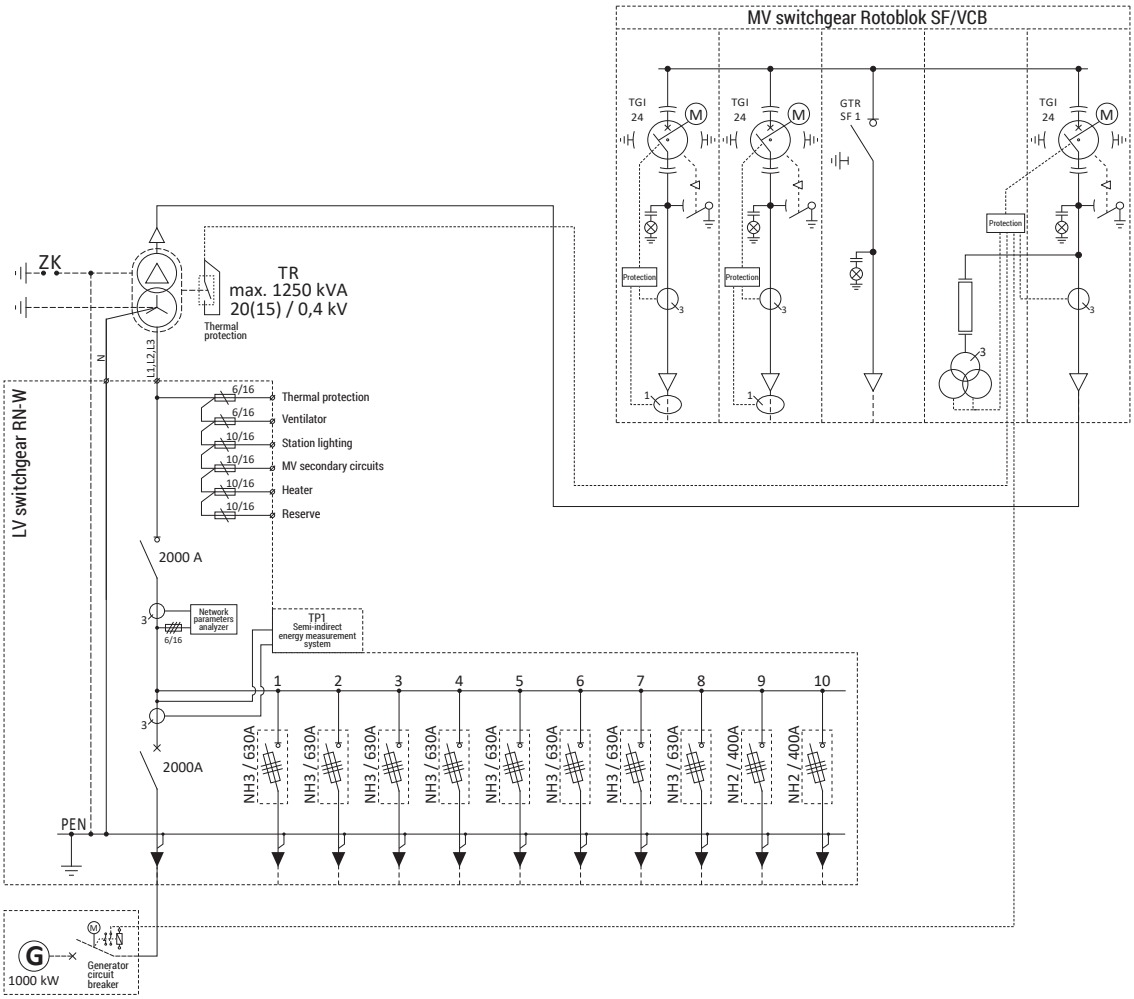
→ **NOTE!** Sample station configurations are presented in the catalog.

MRw-b 20/1250-4 (MRw 20/1250-4)

TOP VIEW / ARRANGEMENT OF THE ACCESSORIES



ELECTRICAL DIAGRAM



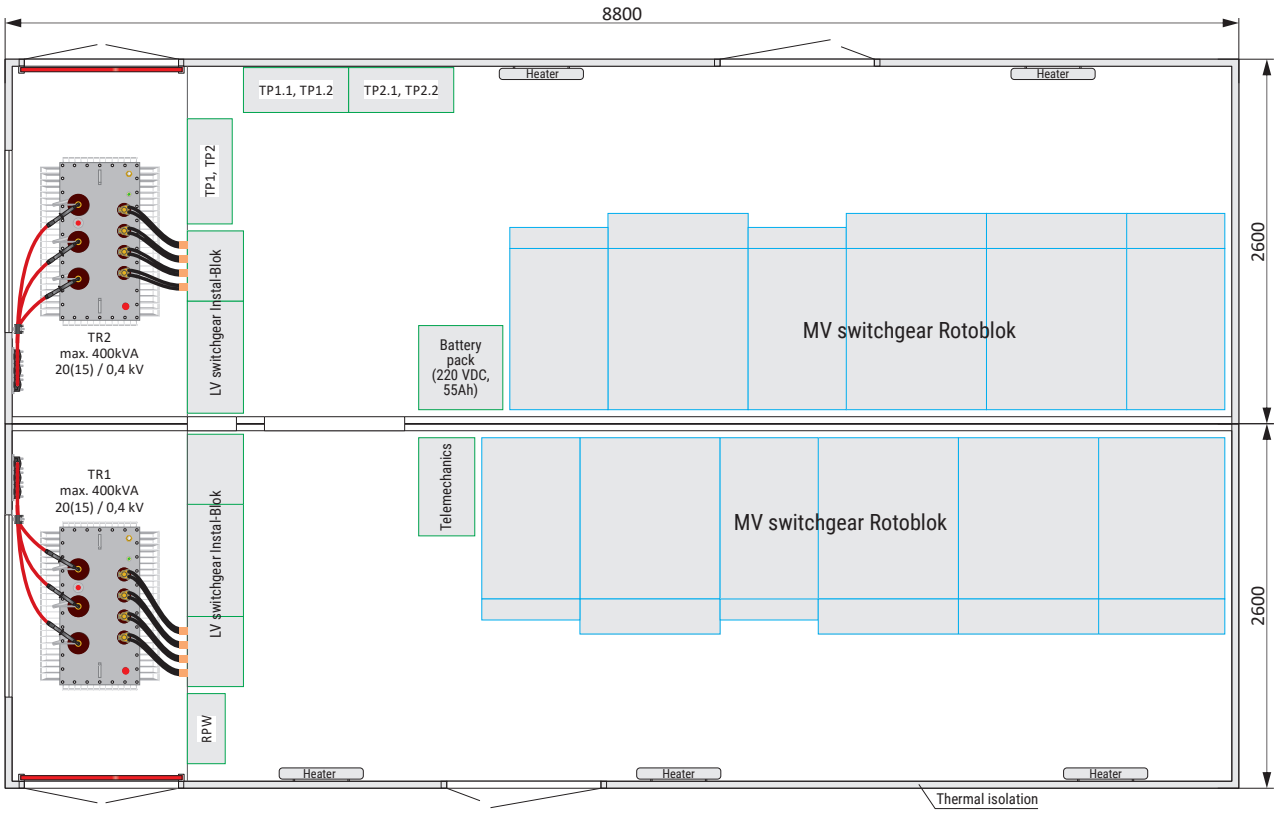
Maximum rated power of transformer	1250 kVA	
	MV	LV
Rated voltage	20 kV	0,4 kV
Rated current	630 A	2000 A

→ **NOTE!** Sample station configurations are presented in the catalog.

MRw 20/2x400-12 + 4x MRw 20/2000

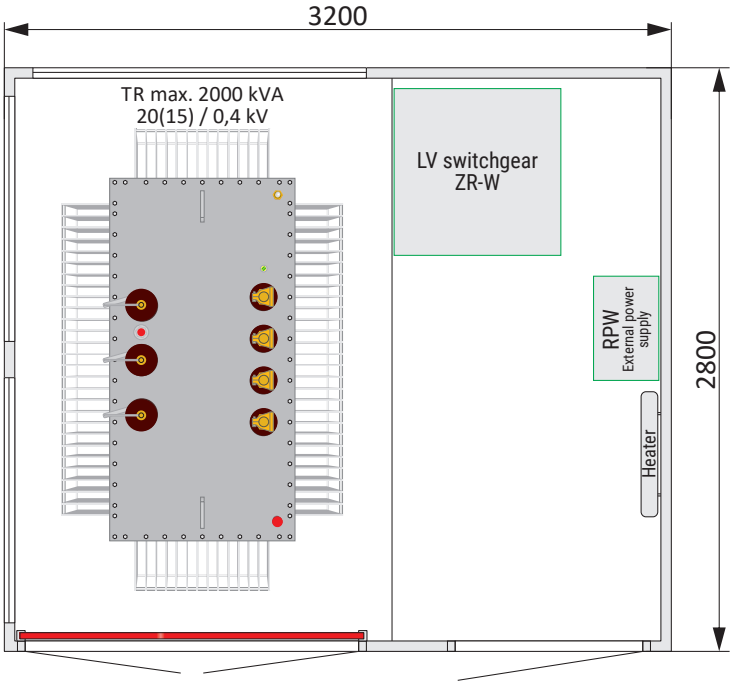
VIEWS / ARRANGEMENT OF THE ACCESSORIES

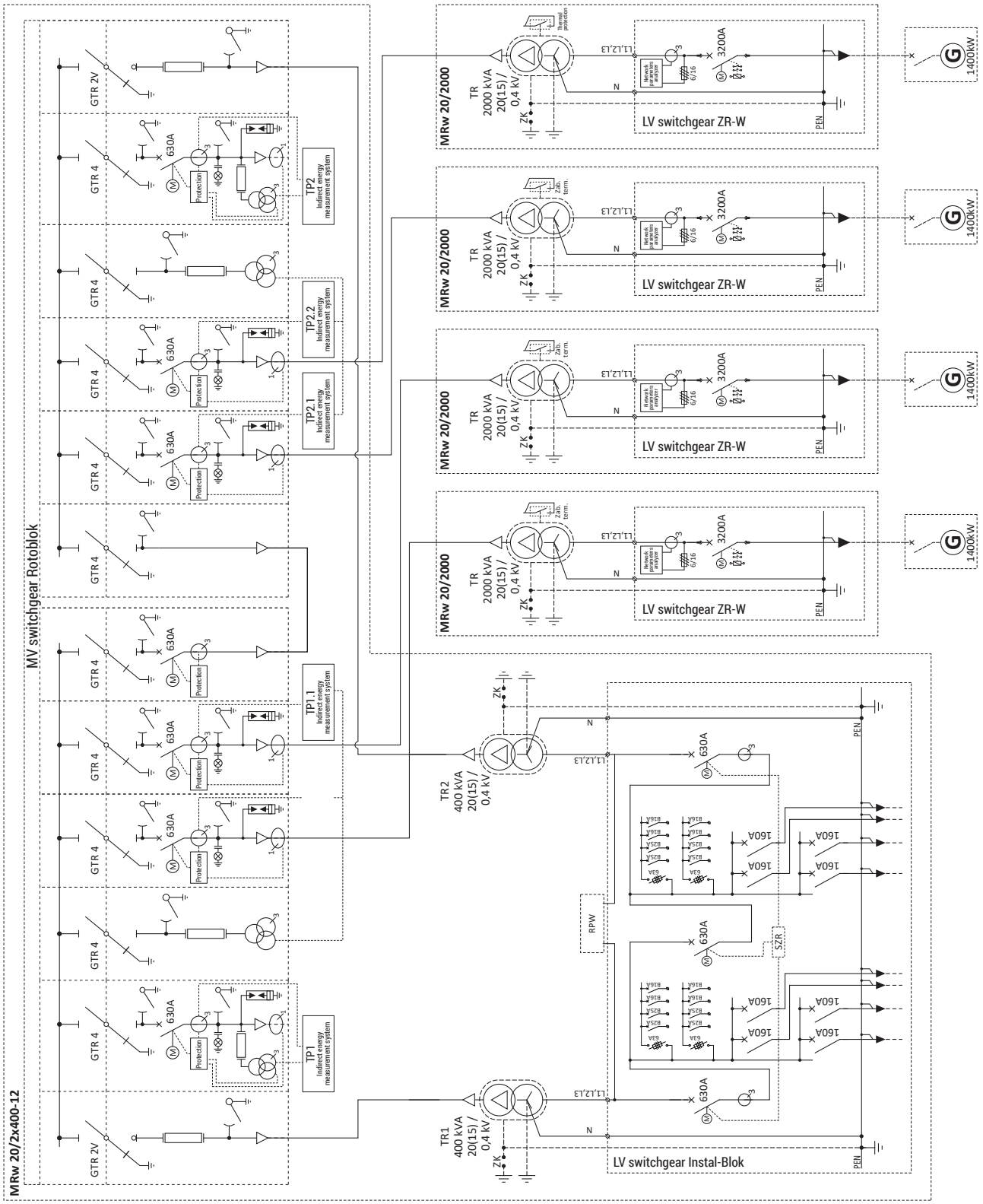
MRw 20/2x400-12 - primary coupling substation



ELECTRICAL DIAGRAM

MRw 20/2000 - substation integrated with a generator (4 pcs.)





Maximum rated power of transformer	4 x 2000 kVA / 2 x 400 kVA	
	MV	LV
Rated voltage	20 kV	0,4 kV
Rated current	630 A	3200 A / 630 A

→ **NOTE!** Sample station configurations are presented in the catalog.

Renewable energy from wind - stations for wind farms

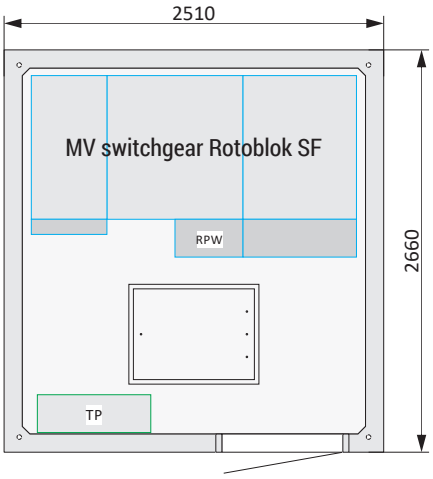
The constantly growing demand for electricity on a global scale, as well as the constantly increasing ecological awareness mean that renewable energy, in particular that obtained from wind power, is one of the fastest growing energy industries in the world in recent years. We, as ZPUE, actively participate in this development, mainly as a supplier of comprehensive solutions for processing, compensation and distribution of energy generated by windmills.

Our offer for wind energy is very wide and covers the entire spectrum of products and services. The company's portfolio includes transformer stations for processing energy generated by turbine generators, reactive power compensation stations, energy storage stations (SPS), distribution transformers, MV and LV switchgears and products necessary to connect wind farms to the MV network.

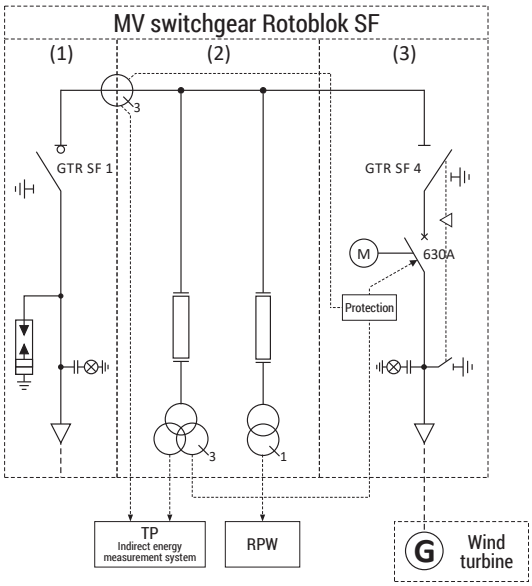
The abovementioned stations may be equipped with protections and automation for telesignaling and telecontrol. Below are examples of stations used for cooperation with wind farms. It is possible to make many other solutions for individual customer needs.

MRw-b 20-3 (MRw 20-3)

VIEWS / ARRANGEMENT OF THE ACCESSORIES



ELECTRICAL DIAGRAM

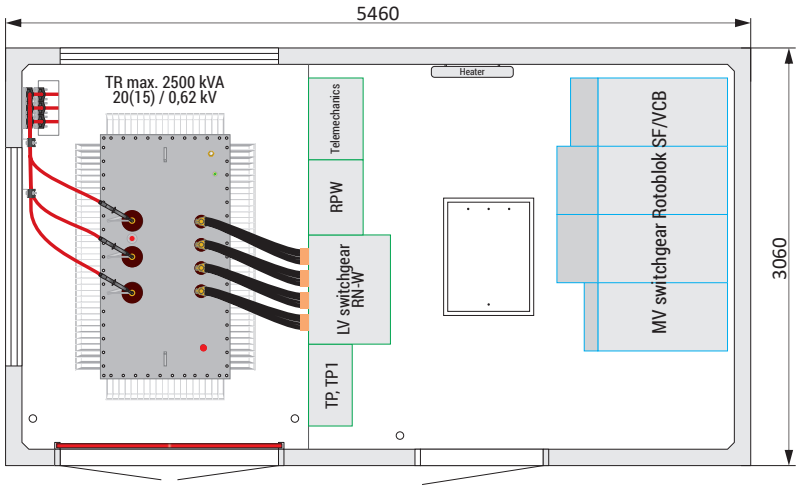


	MV	LV
Rated voltage	20 kV	-
Rated voltage of the LV own needs switchgear	-	0,23 kV
Rated current	630 A	-

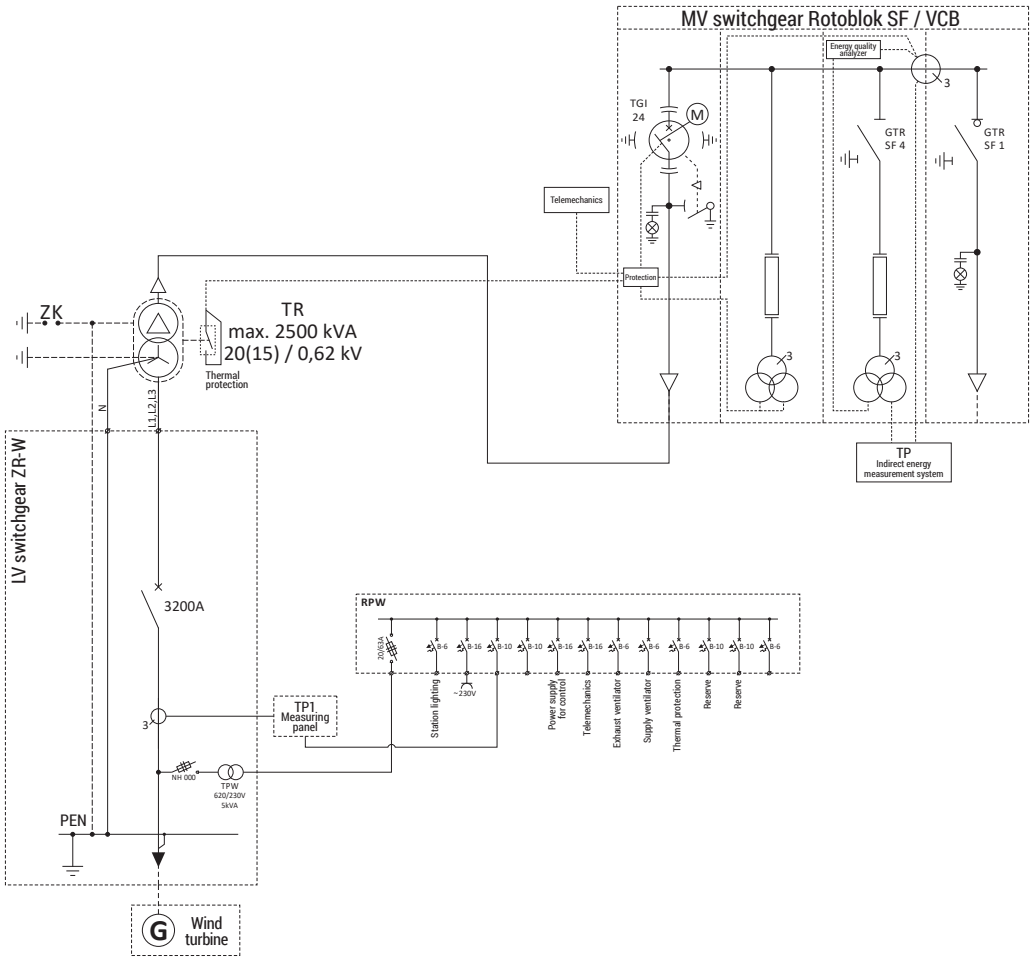
→ **NOTE!** Sample station configurations are presented in the catalog.

MRw-b 20/2500-4 (MRw 20/2500-4)

TOP VIEW / ARRANGEMENT OF THE ACCESSORIES



ELECTRICAL DIAGRAM

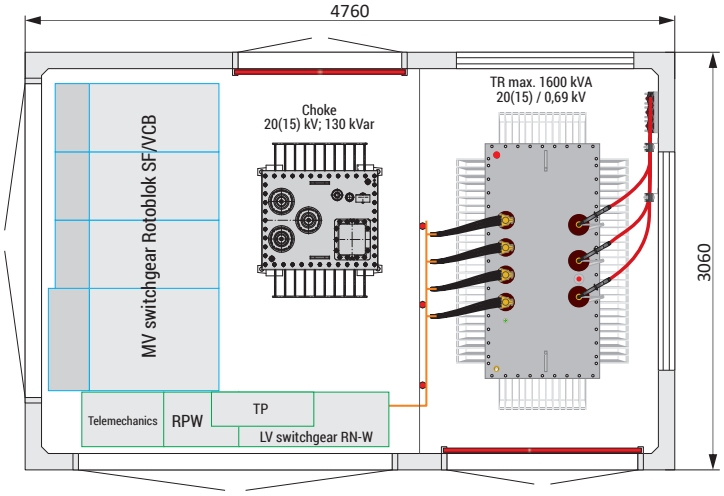


Maximum rated power of transformer	2500 kVA	
	MV	LV
Rated voltage	20 kV	0,62 kV
Rated voltage of the LV own needs switchgear	-	0,23 kV
Rated current	630 A	3200 A

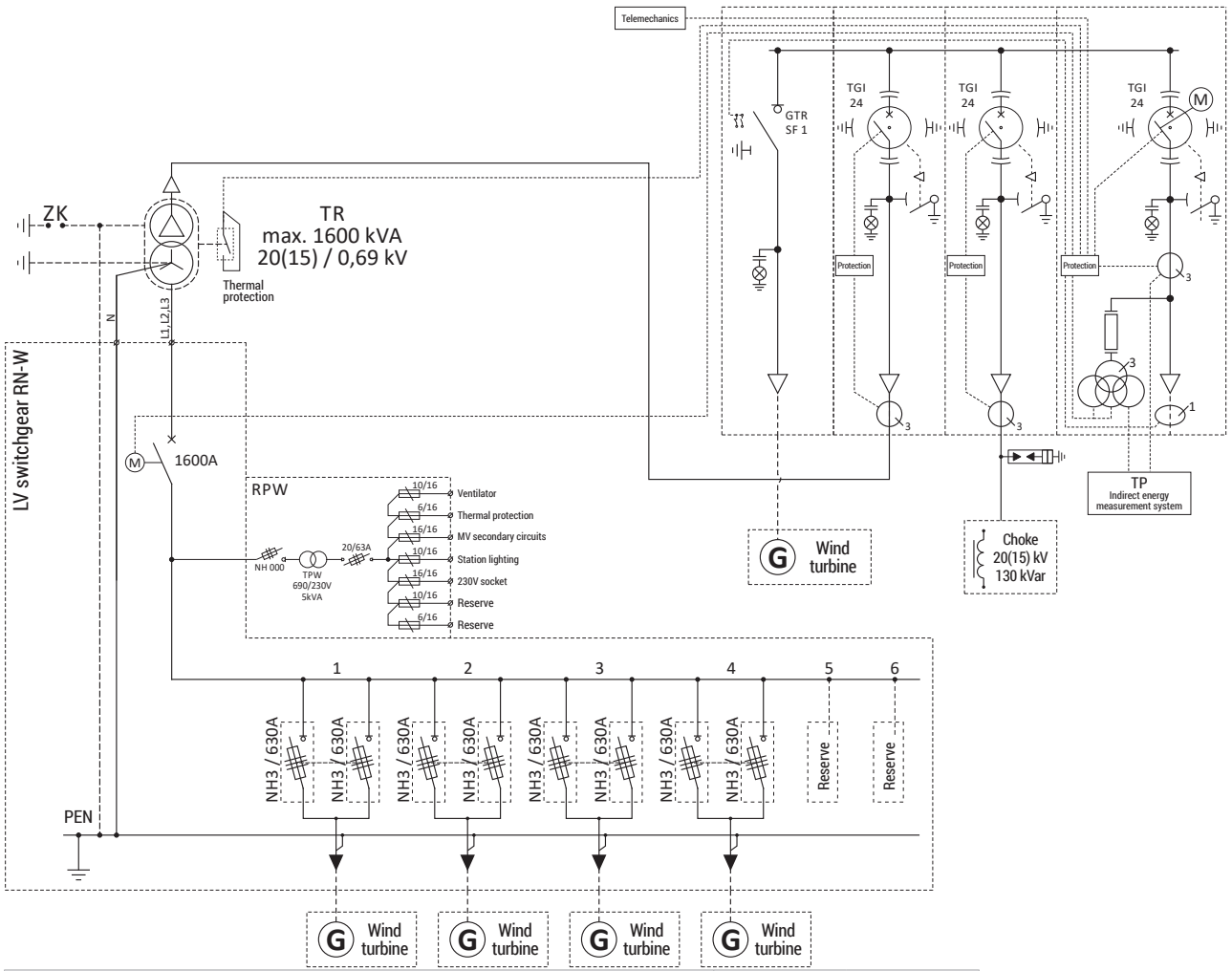
→ **NOTE!** Sample station configurations are presented in the catalog.

MRw-b 20/1600-4 (MRw 20/1600-4)

TOP VIEW / ARRANGEMENT OF THE ACCESSORIES



ELECTRICAL DIAGRAM



Maximum rated power of transformer	1600 kVA	
	MV	LV
Rated voltage	20 kV	0,69 kV
Rated voltage of the LV own needs switchgear	-	0,23 kV
Rated current	630 A	1600 A

→ **NOTE!** Sample station configurations are presented in the catalog.

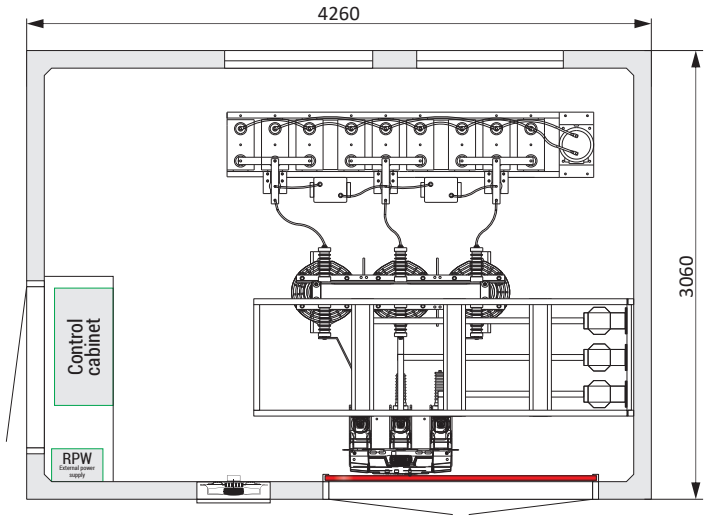
Stations for reactive power compensation in the MV network

During the standstill of the farm and during low generation of active power, reactive power is transmitted to the network. This is due to the generation of capacitive reactive power by extensive MV and HV cable lines. The reactive power transmission causes a deterioration in the quality of power network parameters, causes voltage drops and losses of active power of electrical systems.

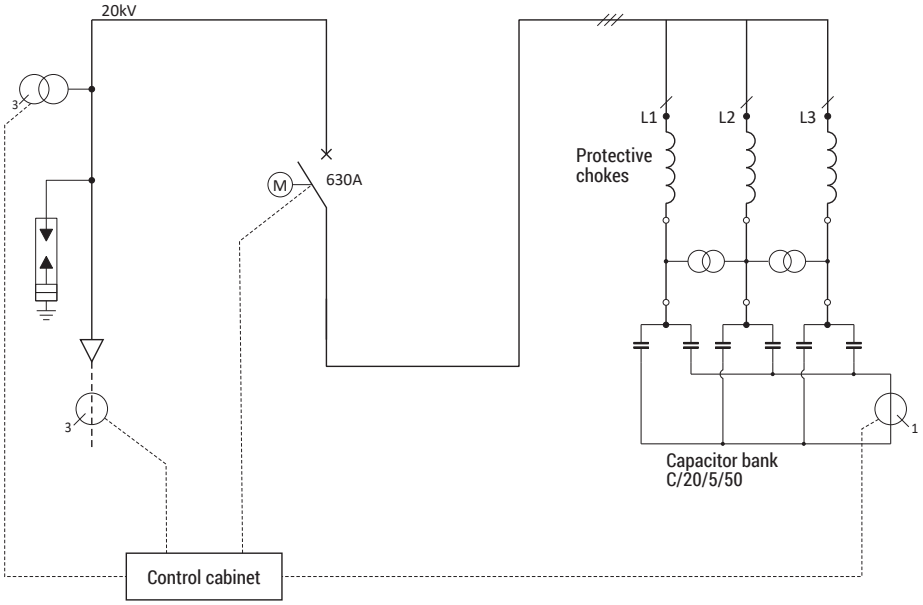
ZPUE S.A. in its offer includes solutions for compensation of inductive and capacitive reactive power. Examples of solutions are presented below. It is possible to make many other solutions for individual customer needs.

Station **MRw-b 20-1** with MV reactive power compensation **(5MVAr)**

VIEWS / ARRANGEMENT OF THE ACCESSORIES



ELECTRICAL DIAGRAM

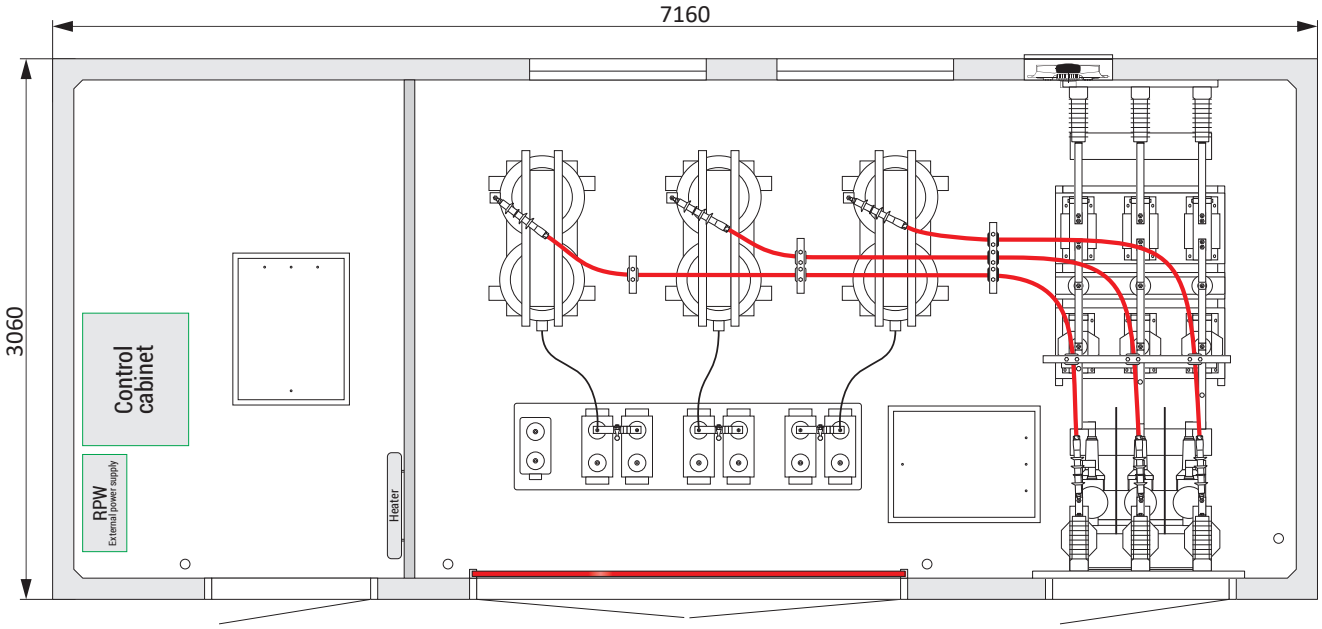


	MV	LV
Rated voltage	20 kV	-
Rated voltage of the LV own needs switchgear	-	0,23 kV
Rated current	630 A	-

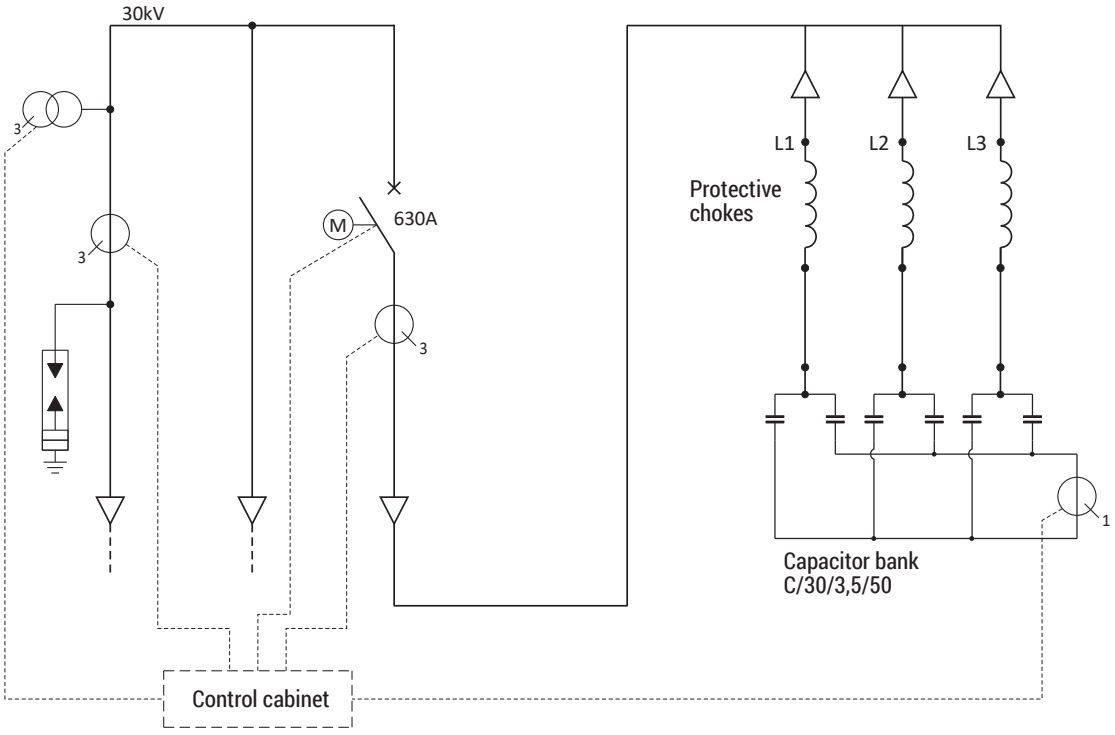
→ **NOTE!** Sample station configurations are presented in the catalog.

MRw-b 30-1 station for MV reactive power compensation (3,5 MVAr)

TOP VIEW / ARRANGEMENT OF THE ACCESSORIES



ELECTRICAL DIAGRAM



	MV	LV
Rated voltage	20 kV	-
Rated voltage of the LV own needs switchgear	-	0,23 kV
Rated current	630 A	-

→ **NOTE!** Sample station configurations are presented in the catalog.

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NOTE: As a result of technological progress manufacturer reserves the right to introduce technical modifications without notification. For updating the offer, we are asking to contact the producer.

The authors ask Honorable Members to submit their comments about errors, inaccuracies or deficiencies noted in this offer to the following e-mail address: katalog@zpue.pl