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ZPUE®
Koronea group

Container transformer substations

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TABLE OF CONTENTS

Container transformer substations

1 / Container transformer substations in concrete enclosures

INTRODUCTION

ZPUE S.A has been manufacturing container substations for over 30 years. Our experience combined with highly specialised engineering knowledge has enabled us to create a wide range of solutions for the commercial power sector, industry, renewable energy sources and for specialist uses – dedicated for railway transport. Manufacturing over 3000 substations annually ensures that ZPUE S.A. is the market leader on the Polish market. Over the years, the company became a trusted and important partner supplying both European and global markets.

MRw-b substations in concrete enclosures with internal service corridor are prefabricated containers composed of three monolithic reinforced concrete elements, constructed with C30/37 class concrete – foundations, main structure and roof. In standard version, substation design enables the placement of hermetically sealed transformers with a power up to 1000 kVA. Our offer also includes solutions which enable installation of higher power units, even up to 4 MVA in various versions (specialised, resin and oil transformers with conservator tank).

Such solutions, due to their specific features, have to be consulted with the substation manufacturer. The transformer is installed through the transformer chamber doors or from the top, after removing the roof, and is operated after opening the doors to the transformer chamber.

Depending on the intended use, switchgears of our own manufacture are installed in the substations:

- MV – primary distribution of power: RELF, RELF 2S, RXD,
- MV – secondary distribution of power: Rotoblok, Rotoblok SF, Rotoblok VCB, TPM,
- LV – RN-W, Instal-Blok, ZR-W, Sivacon.

Others on arrangement with the manufacturer.

The aforementioned switchgears are independently installed elements of substation equipment, and they are operated, depending on the version of the substation, either from an internal corridor or from the outside, after opening the doors of a given compartment. Connections between the MV switchgear and the transformer and between the transformer and the LV switchgear are made with cables, and as option in special versions with busbar bridges or bus ducts.

TECHNICAL PARAMETERS

Electrical parameters	MV	LV
Rated voltage	up to 36 kV	up to 1 kV
Rated current	up to 4000 A	up to 6300 A
Rated short-time withstand current	up to 40 kA (3s)	up to 105 kA (1s)
Rated peak withstand current	up to 100 kA	up to 231 kA
Rated frequency	50/60 Hz	
Maximum transformer power	up to 4000 kVA	
Ingress protection rating	IP 23D or IP 43	
Enclosure mechanical impact resistance	IK10 (20J)	

Substations were tested for compliance with the standards in force in accredited European laboratories.

Compliance with standards

• **PN-EN 62271-202 -** High-voltage switchgear and controlgear. High-voltage/low-voltage prefabricated substation; + related standards

Fuse links and rated current transformers (40÷4000 kVA) selection table

Transformer power [kVA]	Transformer rated voltage										
	6 kV	10 kV	15 kV	20 kV	30 kV	6 kV	10 kV	15 kV	20 kV	30 kV	0,4 kV
	Fuse link rated current [A]					Transformer rated current [A]					
40	-	6,3	6,3	6,3	-	-	2,3	1,5	1,15	-	57,7
63	16	10	10	6,3	6,3	-	3,6	2,4	1,8	-	90,9
100	25	16	16	10	6,3	9,6	5,8	3,8	2,9	1,9	144,3
160	40	25	20	16	10	15,4	9,2	6,2	4,6	3,1	230,9
250	63	40	25	20	16	24,1	14,4	9,6	7,2	4,8	360,8
400	80	63	40	31,5	25	38,5	23,1	15,4	11,5	7,7	577,4
630	125*	80	63	50	40	60,6	36,4	24,2	18,2	12,1	909,3
800	125*	100	63	50	40	77	46,2	30,8	23,1	15,4	1155
1000	-	125*	80	63	40	96,2	57,7	38,5	28,9	19,2	1443
1250	-	-	100	80	50	120,3	72,2	48,1	36,1	24,1	1804
1600	-	-	125*	100	63	154	92,4	61,6	46,2	30,8	2309
2000	-	-	-	125*	-	192,5	115,5	77	57,7	38,5	2887
2500	-	-	-	-	-	240,6	144,3	96,2	72,2	48,1	3608
3150	-	-	-	-	-	303,1	181,9	121,2	90,9	60,6	4547
4000	-	-	-	-	-	384,9	230,9	154	115,5	77	5774

* - apply to Rotoblok SF i TPM type MV switchgears

NOTE!

1) Typical fuse links according to the standard IEC 282-1, DIN 43625 with thermal protector should be used.
2) In the calculation of rated current 20% overloading were not included.

TRANSFORMER SUBSTATION VERSIONS

The catalogue only presents example solutions for container substations.
Our many years of experience and a team of experienced engineers enable us to prepare a solution designed in accordance with individual needs of even the most demanding customers. This can be demonstrated by deliveries for the leading power distribution companies all over Europe, Asia and Africa, as well as to individual customers which represent most branches of industry. Our substations work with most of renewable energy sources, and are able to provide energy storage, improving power grid efficiency.

MAIN STRUCTURE

Design

The intended use of the main structure is the installation of MV and LV switchgears, remote control devices, signalling, measurement systems, transformers, power generators and other devices in accordance with the design.

Substation enclosures with internal service corridor are manufactured as complete, self-supporting reinforced concrete structures, forming a monolithic cast of side walls with a floor slab. The main structure of the substation with external servicing is constructed as a combination of side walls with a foundation basin.

Reinforcement of the main structure (side walls and floor) is constructed as a connected whole — a cage which guarantees equipotential bonding and shields from electromagnetic radiation generated by the devices installed inside. The reinforcement mesh is bonded with substation foundation and roof.

Enclosures are made of at least C30/37 concrete, which ensures high safety of operation and of members of the public, moreover guaranteeing many years of safe operation without the need to perform maintenance work. A hatch into the foundations, which also form a cable chamber, can be found in the floor of the corridor of the substation with an internal service corridor.

Wall finish

The internal wall surface is covered with white plaster or paint for decorative purposes. External walls in standard design are covered with decorative plaster. The colour sets and references to the RAL colour palette are presented below.

It is possible to construct the substation in accordance with individual architectural requirements, taking into account all available methods and materials for the finishing of concrete surfaces. Types of plaster (e.g. silicone, mosaic, colours or materials such as clinker, brick effect etc.) not included in this list are available on arrangement with the manufacturer. It should be however kept in mind that this will result in a longer order delivery time and an individual technical and price offer.

Primary plaster colours	Colour similar to
TEXAS TX2	RAL 1015
ATLANTIC AT2	RAL 7047
White	RAL 9010

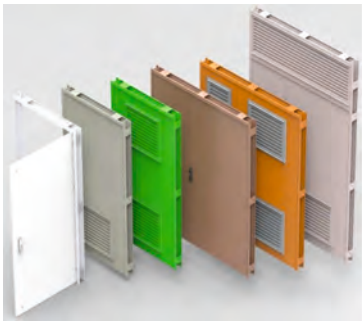
Primary plaster colours	Colour similar to
BALI BL2	RAL 6019
ETNA ET2	RAL 7044
FLORIDA FL2	RAL 1015
MADEIRA MD1	RAL 1015
POLAR PL1	RAL 7047
SAVANNE SV4	RAL 1001

NOTE!

The colours shown in the table may differ from reality.
When selecting colours always compare with the original colour chart.

SUBSTATION JOINERY

All metal elements installed on the outside of the substation are made from powder painted aluminium, with RAL palette colours. The list below contains the basic colour scheme for doors and ventilation louvres. Other materials and colour schemes are available on arrangement with the manufacturer. It should be however kept in mind that this will result in a longer order delivery time and an individual technical and price offer.



RAL 3003	RAL 7032	RAL 8004
RAL 8017	RAL 6001	RAL 8007
RAL 5010	RAL 7024	RAL 9010

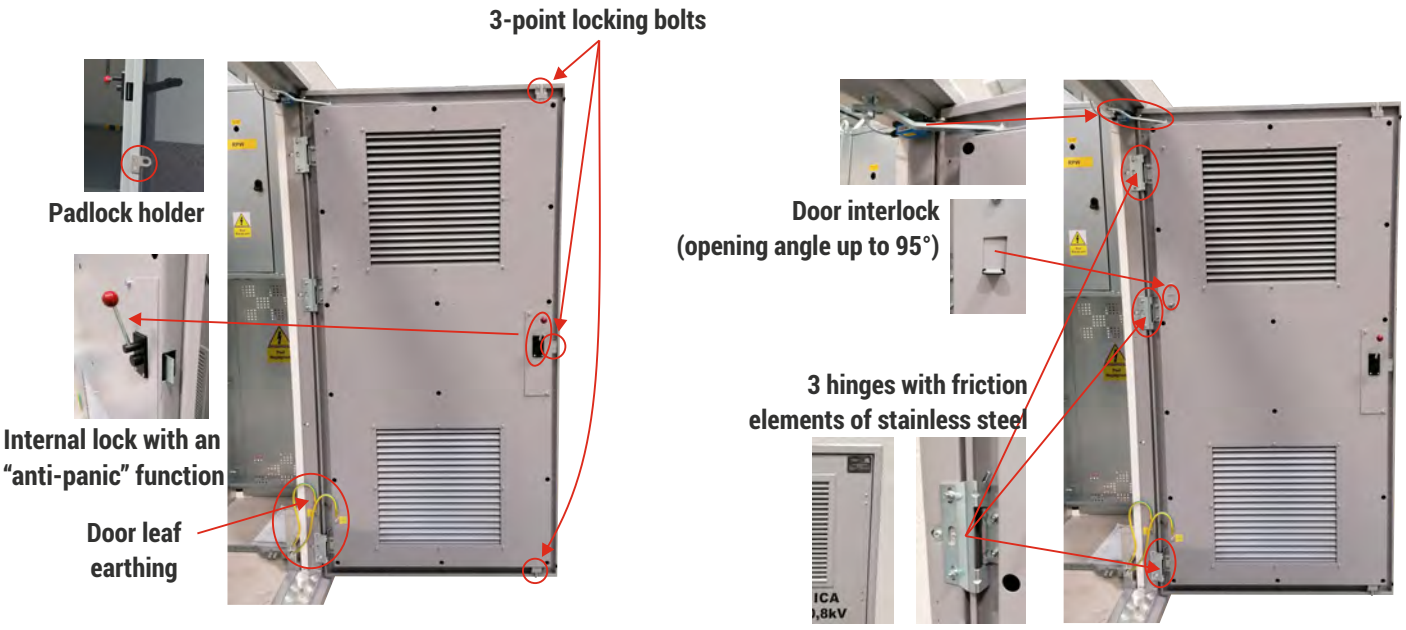
NOTE!

The colours shown in the table may differ from reality.
When selecting colours always compare with the original colour chart.

Doors

Depending on intended use, the substation doors are single leaf (e.g. switchgear operation corridor) or double leaf (e.g. transformer chamber), and their size is adapted to the dimensions of the installed devices. They may be constructed either as solid doors or with ventilation louvres, and the double-shell construction prevents the condensation of water inside the substation. The basic protection rating is IP 23D or IP43 (on arrangement with the manufacturer it is possible to construct doors in another version).

All doors open outwards (opening angle up to 95° – other angles on request), have a mechanism for locking in an open position and covered internal hinges with friction elements made of stainless steel. The doors have three-point locking bolts, locked with a lock adapted to the installation of cylinders with integrated protection against weather conditions. Additionally the doors can be independently equipped with a padlock attachment. For the substation with an internal service corridor, the door lock enables opening the doors from inside regardless of the position of the external handle, which prevents the locking of an employee inside the substation.



Ventilation louvres

The ventilation louvres (supply and exhaust) installed in transformer substations ensure a correct temperature is maintained inside transformer chambers and ensure ventilation of rooms where power engineering devices are installed.

Due to the ingenious, patented labyrinth design with high capacity, gravity ventilation is possible even for transformers with powers up to 1250 kVA while keeping the louvre dimensions to a minimum. This solution minimizes the operational costs of transformer substations due to elimination of the need to use intake or exhaust fans (the costs of electricity, servicing and spare parts, among others).

However, individual requirements concerning transformer substation ventilation should be taken into account, e.g. in case of installation of transformers or devices which generate significant amounts of heat, gravity ventilation must be supplemented with intake and exhaust fans. Their efficiency and location is selected by experienced engineers supported by IT tools.

In standard version ventilation louvres provide an IP 23D or IP 43 protection rating. Louvres with an IP 43 protection rating have internal protection against the ingress of insects.

In locations exposed to significant dust levels (e.g. industrial plants) it is possible to use ventilation louvres with filter cartridges. In this case it should be remembered, however, that an installation equipped with filter cartridges has to be fan-assisted in order to ensure appropriate exchange of air and requires regular cleaning or replacement of filter cartridges.

Cross-section of the IP 23D ventilation louvre

Forced ventilation, system with filters

IP 43 ventilation louvre

LOCATION OF THE STATION FOR FIRE PROTECTION

The location of the station should be implemented in accordance with the ordinance of the minister of infrastructure of April 12, 2002 on the technical conditions to be met by buildings and their location (Journal of Laws of June 15, 2002, No. 75, item 690, as amended) or local regulations.

Individual cases of station location should be considered individually and consulted with ZPUE S.A. or with authorized services (fire safety opinion issued by a fire protection expert).

Fire protection

In order to ensure the highest possible level of fire safety and to limit the possibility of a fire or its possible effects in transformer stations, passive protection measures are used, such as: fire separation walls and ceilings, cut-off dampers or fire doors.

The basic means of fire protection of most transformer stations manufactured by ZPUE is the special structure of external walls or partition walls and ceilings, ensuring the separation class at the REI 120 level, where the individual values mean respectively: R - fire resistance (structure strength), E - fire integrity (flame penetration or gases through the surface), I - fire insulation (surface heating), 120 - time expressed in minutes for the criteria listed. The quality of the walls has been confirmed by the Fire Testing Department of the Institute of Building Technology and by independent fire protection experts.

In order to ensure the appropriate class of fire separation of walls with ventilation louvers and ceilings with exhaust fans installed, they use cut-off dampers with protection levels, e.g. EI 60 or EIS 120. During a fire, they ensure fire resistance and prevent the spread of fire, smoke and fire gases both to the rest of the building not affected by the fire, as well as outside the station.

Optionally, in the walls of the station where the door is located, and it is necessary to ensure the appropriate fire resistance class by the enclosure, doors are installed that ensure the fire separation class EI 60 or EI 120. When selecting the class of closures or fire barriers, the total area of the enclosure on the wall should be taken into account. or the ceiling of the station.

a cut-off damper, installed in the station walls in front of the ventilation shutters (e.g. mcr WIP / S)

cut-off damper, installed in the station's ceiling, under the exhaust fan (e.g. mcr FID S / S c / P)

Exemplary producer: https://www.mercor.com.pl/pl/produkty/wentylacja-pożarowa/klapy-przeciwpożarowe/

INTERNAL SYSTEMS

Earthing system

In order to ensure a high level of safety of the operating personnel and members of the public, all substations are equipped with a complete, internal earthing system. The system is constructed in accordance with the legal regulations in force, and also based on technical standards of power distribution companies and individual guidelines of the customers.

The main earthing busbar may be constructed from zinc-coated steel, copper or copper-coated flat bars. All conducting elements of substation equipment (switchgear enclosures, doors, ventilation louvres, support structures etc.) are permanently connected to the main earthing busbar. The type and manner of connection is selected individually, in accordance with the intended use.

The concrete enclosure itself provides additional, natural insulation. It guarantees safety even when internal connections to the external earthing systems are damaged.



Auxiliary power system

The auxiliary power system is a standard equipment of transformer substations. It consists of an auxiliary switchgear with protection of electrical circuits, lighting system, and a set of sockets and switches necessary for its correct operation.

The location of lighting fixtures, adapted to the installation of energy-saving light sources, is designed in order to ensure an appropriate minimum lighting level required for the operation of technical devices, in accordance with standards and regulations on operational safety. Optionally the substation may be equipped with an individual or central emergency lighting system connected to substation automation.

Depending on the customer's requirements and on the type of devices installed in the substation, as well as local conditions, substations may be equipped with a heating, ventilation or air conditioning system. Control is fully automatic, and temperature or humidity sensors are placed in such a manner as to ensure optimum operating conditions.



FOUNDATIONS

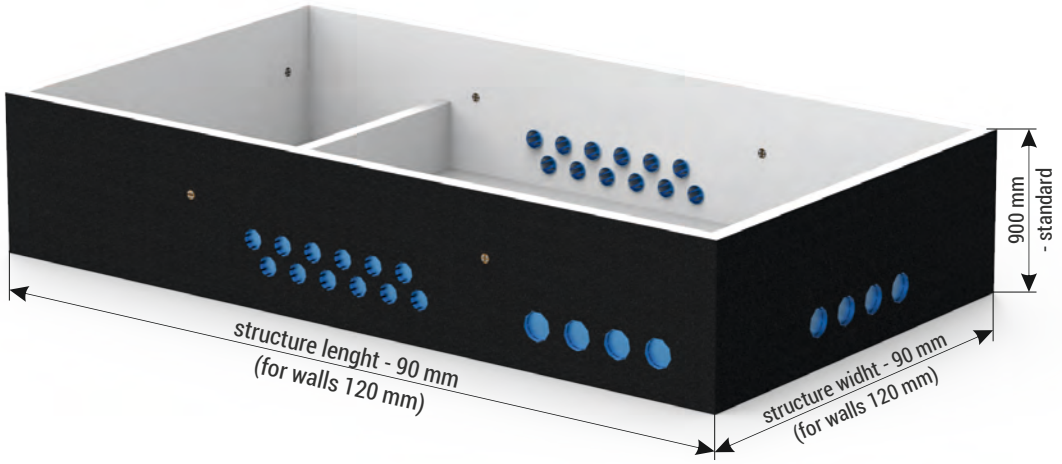
Design

Foundation of a substation with an internal service corridor, similarly to the main structure, is constructed as complete, self-supporting reinforced concrete structure (monolithic cast of side walls with a floor slab) using at least C30/37 class concrete. The foundations of transformer substations with external servicing and MV cable connection boxes in concrete enclosures have a similar design. Foundations have separate compartments, one containing an oil sump, which can contain at least 100% or more of the volume of oil from the transformer installed in the substation.

Due to the special formulation, the foundation is waterproof and oilproof, which effectively prevents water infiltration and leaking of oil outside the transformer substation in case of a transformer failure. Additionally, it is also protected with a waterproofing sealing on the outside, to secure it against the destructive impact of groundwater.

In addition to the oil sump, the foundations of transformer substations and cable connection boxes also have a cable compartment with integrated MV and LV cable entries (constructed at the foundation prefabrication stage) in an amount enabling the connection of all incoming and outgoing cables over a full range of conductor cross-sections from 25 to 300 mm^2. Cable entries are adapted to the installation of sealing inserts. Their number and type should be established at the ordering stage.

The foundation also has cable entries for the feeding and sealing of cables or hoops of the internal earthing system.



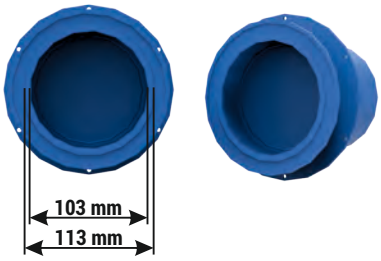
Foundations with external servicing Mzb1 type

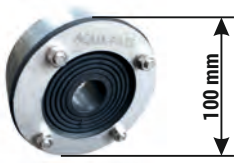
Foundations of MRw-b substations (examples)

MV AND LV CABLE ENTRIES AND SEALS

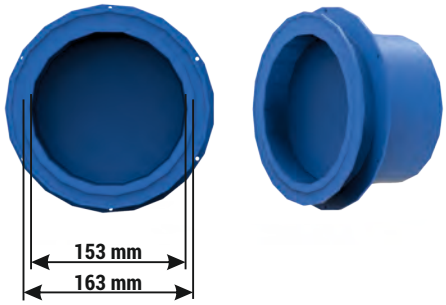
- **A system of APP type closed membrane cable entries and APW type sealing inserts in the “mechanical compression” technology.**

Closed cable entries		Sealing inserts		Closing inserts
APP-100		**APW1-100/30/U**		**APWZ-100**
diameter to the membrane	113 mm	range of diameters	1 x 24 - 63 mm	
diameter behind the membrane	103 mm	cable cross-sections	1 x 50 - 240 mm^2	





Closed cable entries		Sealing inserts		Closing inserts
APP-150		**APW3-150/30/3xU**		**APWZ-150**
diameter to the membrane	163 mm	range of diameters	3 x 30 - 41 mm	
diameter behind the membrane	153 mm	cable cross-sections	3 x 70 - 300 mm^2	



View of installed cable entries

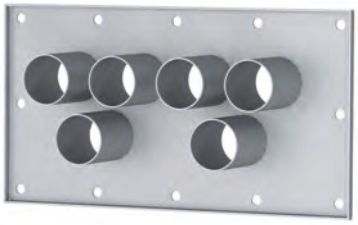
NOTE!

On arrangement with the manufacturer it is possible to use different systems of cable entries and seals.

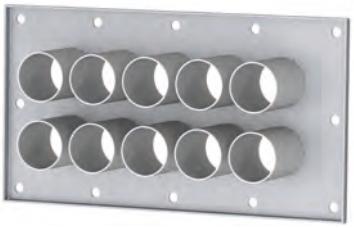
MV AND LV CABLE ENTRIES AND SEALS

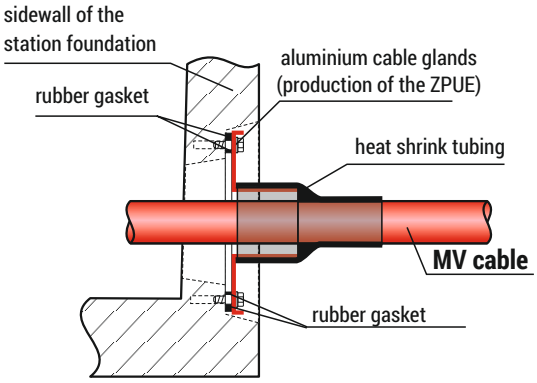
Plate type cable entries

MV entry
6 openings Ø66 pipes

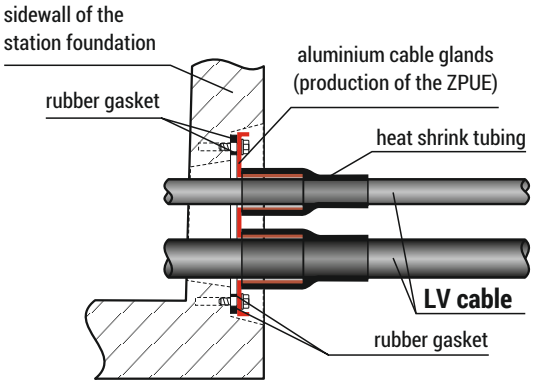


LV entry
10 openings Ø66 pipes





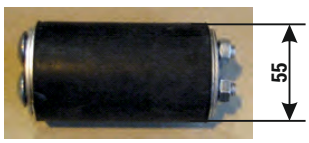
MV cables mounting method



LV cables mounting method

SEALING OF THE EARTHING SYSTEM

Sealing of hoops (flat bar)



Sealing and clamp of hoop earthing (M12 bolt)

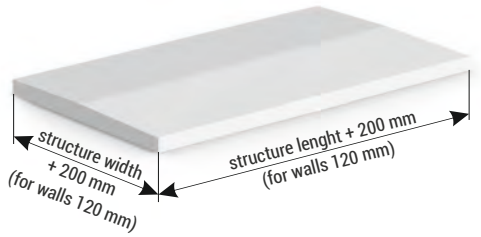
NOTE!

On arrangement with the manufacturer it is possible to use different systems of cable entries and seals.

ROOFS

Concrete roof – basic equipment

In standard versions, transformer substations are equipped with concrete roofs, which protect the devices installed inside against external elements. They are constructed similarly to the enclosures, with C30/37 reinforced concrete. They are prepared for connecting to the reinforcement of the main structure, crating a uniform cage providing shielding against electromagnetic radiation which may be generated by devices installed within the substation. The external part of the roof is protected with coats of paint resistant to weather conditions and UV radiation.



- Slope of approx. ~ 2-3°,
- Height above the substation structure level - 130 mm,
- Resistance to mechanical loads - 2500 N/m^2.

Colour		
RAL 9010	RAL 5010	RAL 8004
RAL 7032	RAL 6001	RAL 8007
RAL 3003	RAL 7024	RAL 8017

Metal roofs (architectural covers) – optional equipment – examples

Metal roofs are used mainly in locations where a reference to existing buildings has to be made for architectural purposes. The roof frame is constructed of structural steel protected against corrosion.

There are many versions of coverings available, e.g. sheet metal roofing tiles, ceramic roofing tiles or asphalt shingle. Due to a wide range of manufactured transformer substation enclosures, both the height (above the level of main structure), and the slope of the roof will depend on the substation dimensions, which should be taken into account when preparing construction designs. Metal roofs may be placed as architectural covers over a concrete roof, in which case their height is specified combined with the concrete roof, or as an independent, self-supporting structure.

Low roofs

Hip (cottage) roofs

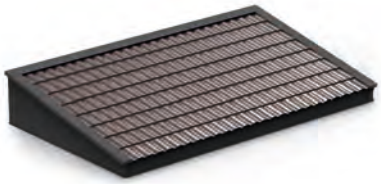
Slope: 20–25°, height: 700–800 mm

Gable roofs

Slope: 20-25°, height: 700-800 mm

Shed roofs

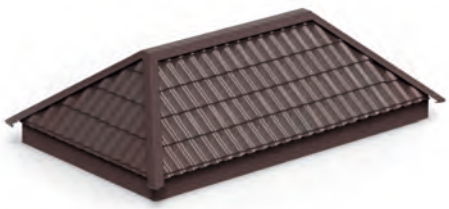
Slope: 5-12°, height: 400-800 mm



High roofs, custom designs

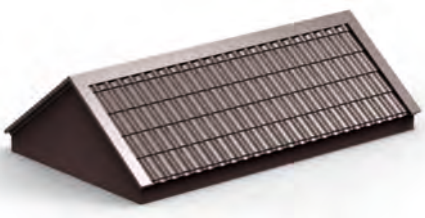
Hip (cottage) roofs

Slope: 30-40°, height: ~ 1200 mm



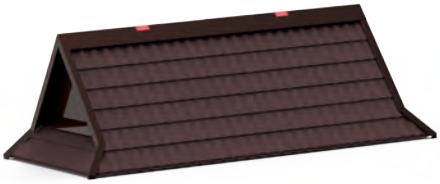
Gable roofs

Slope: 30-40°, height: ~ 1200 mm



Zakopane style roofs

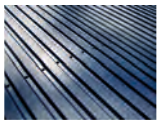
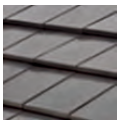
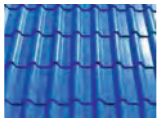
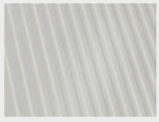
Slope: 45-50°, height: 1850 - 2500 mm



NOTE!

On arrangement with the manufacturer it is possible to construct a roof according to an individual design.

Types of roof coverings – examples

Roofing sheet or troughed sheet	Colour	Ceramic tile	Asphalt shingle	Colour
	BTX 2710 (red)			Red
	BTX 6701 (dark bronze) RAL 8017 (dark bronze)			Bronze
	BTX 7700 (graphite / black) BTX 2610 (graphite / gray)			Graphite
	BTX 4702 (dark green)			Graphite
	RAL 5010 (blue)			Black
	RAL 9010 (white)			Melange

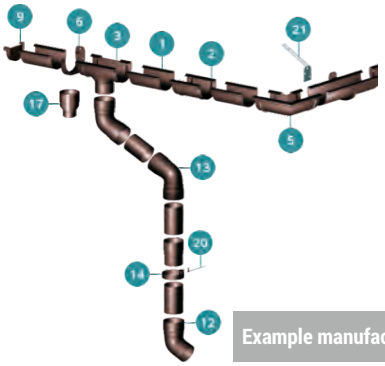
Finishing / structure: BTX – coarse matt RAL – gloss

NOTE!

The catalogue contains examples of roof coverings, both materials and colours.
Presented colours may differ from reality. When selecting colours always compare with the original colour chart.
On arrangement with the manufacturer it is possible to optionally construct a roof covering according to an individual design.

Roof gutters – optional equipment – examples

Both concrete and metal roofs may be optionally equipped with gutter systems for collection of rainwater. They may be constructed of both PVC and steel. They are designed individually for a given roof section. Initial assembly is performed in a factory, and final assembly at the intended location of the substation, in order to avoid damage in transport.



Colour	
RAL 8019	RAL 7016
RAL 9010	RAL 6009
RAL 9017	RAL 8004

Example manufacturer: https://gamrat.pl/en/oferta/gutter-systems/

SUBSTATION NAMING SYSTEM

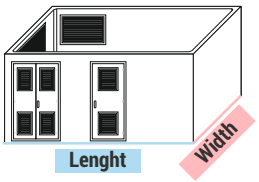
MRw-b (5,4 × 3) 20 / 630 – 4 „a”

Enclosure / substation type:
MRw-b - concrete, single level
with an internal service corridor
... pp - compartmentalized with fire walls
...(pp)**S** - with multiple structures
...(pp)S**P** - with multiple floors
Mzb1 / Mzb2 / Minibox
- concrete with external servicing
Mzb1 - access to the MV switchgear
from the front
Mzb2 / Minibox - access to the MV
switchgear on the side wall
WST - advertising pole
PST-b - underground
ZK-SN - MV connection box in a concrete enclosure
MRw - metal enclosure
(-m — mobile, -P — “pontoon”, -k — modular)

Lenght

Width

Dimensions of the main structure of the substation [m.],
Optional descripction



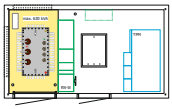
Operational voltage of the MV switchgear

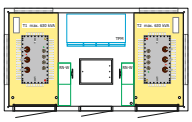
Type, number and maximum power [kVA] of transformer / reactor / generator unit

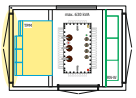
Product range of substation / number of installed MV switchgear bays

Location of the transformer chamber / MV switchgear or substation version:

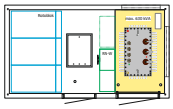
„a” - left side;

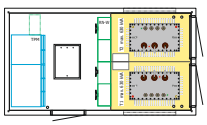


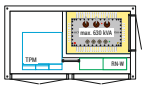




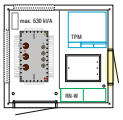
„b” - right side;



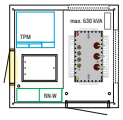




„c” - service corridor right side;

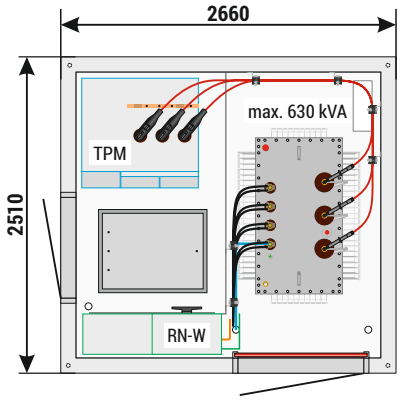


„d” - service corridor left side;

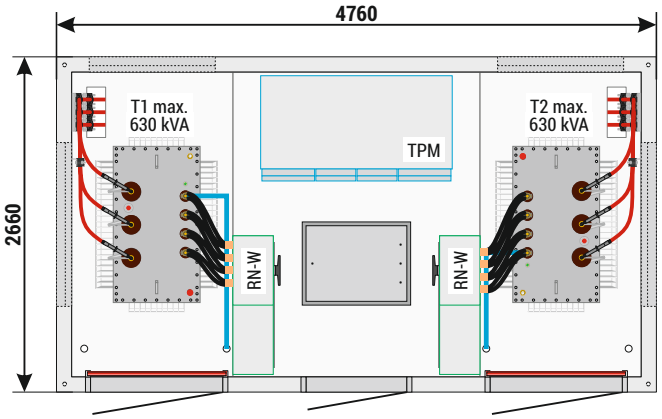


Substation naming system - examples

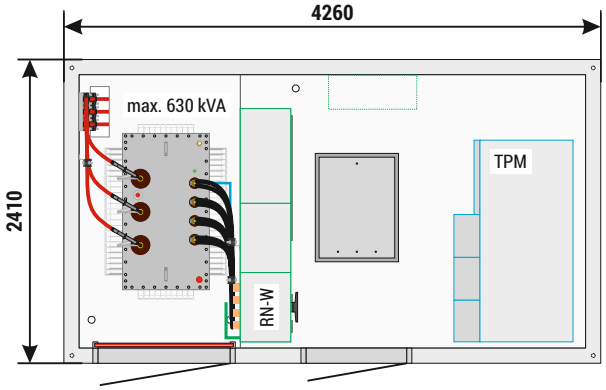
MRw-b1(pp) 20/630-4"d"



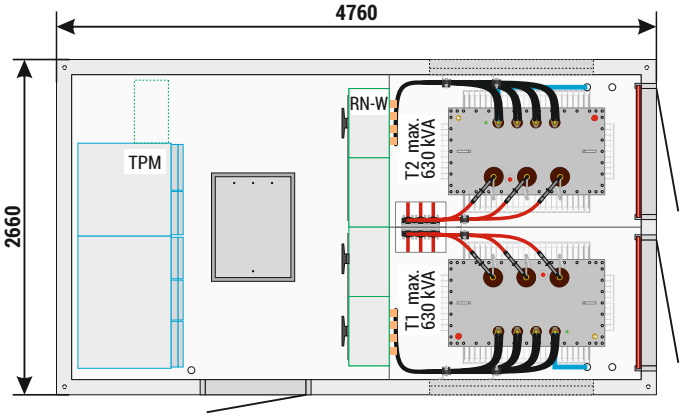
MRw-b(pp) 20/2x630-4"a"



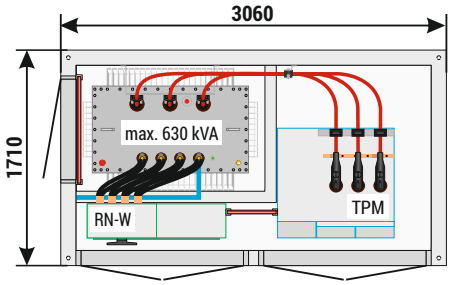
MRw-bpp 20/630-3"a"



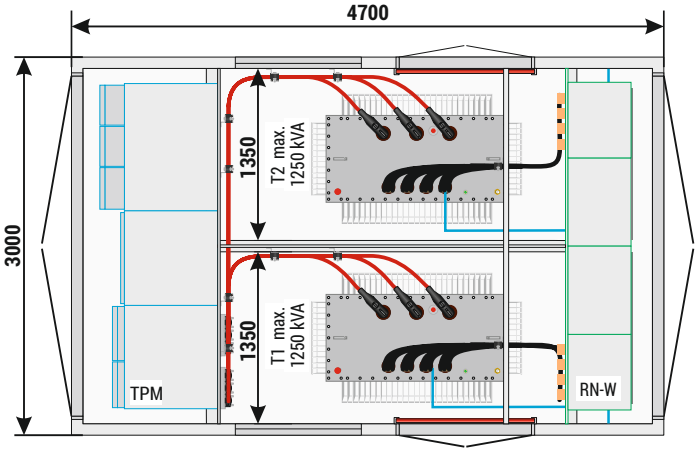
MRw-b(pp) 20/2x630-5"b"



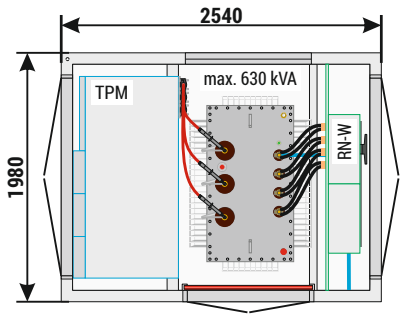
Mzb1 20/630-4"a"



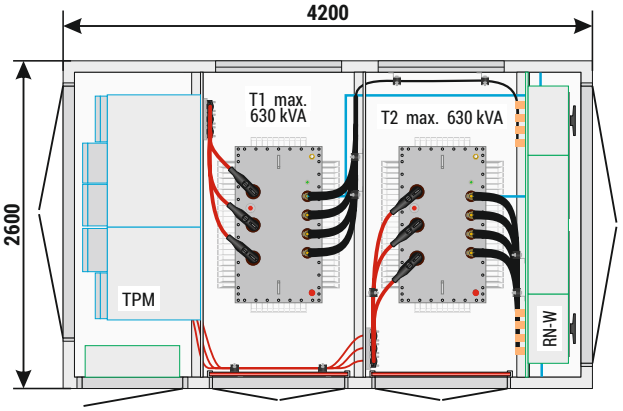
Mzb2 (4,7x3) 20/2x1250-6



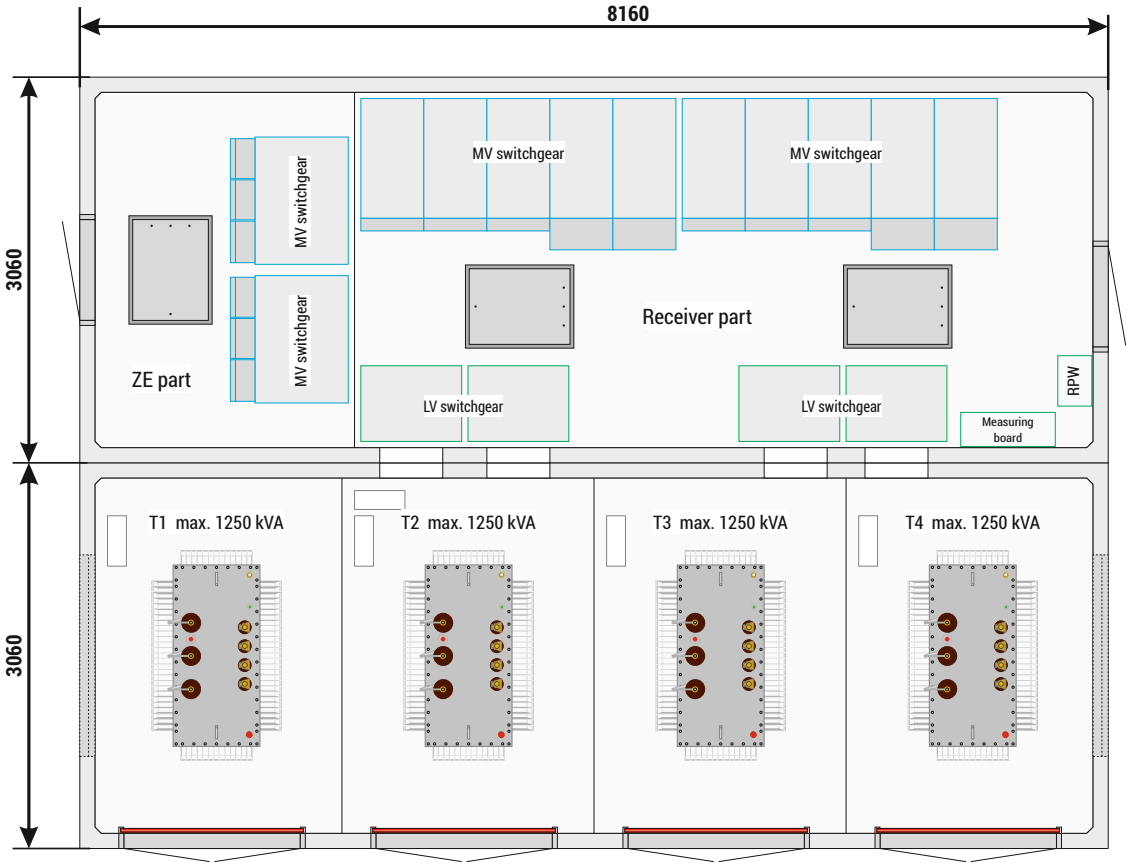
Mzb2 (2,54x1,98) 20/630-4



Mzb2 (4,2x2,6) 20/2x630-5



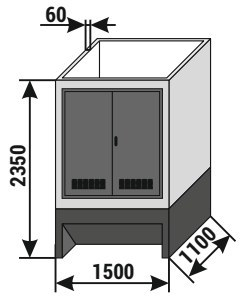
MRw-bS 20/4x1250-18

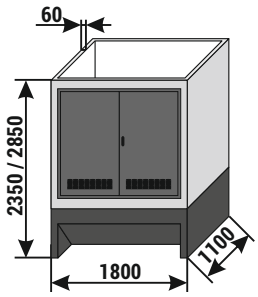


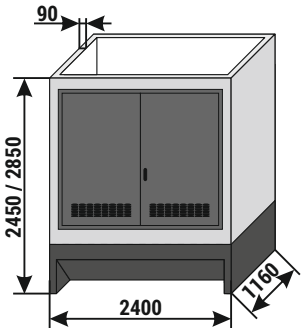
LIST OF MANUFACTURED ENCLOSURES

Dedicated concrete enclosures for MV connection boxes with external enclosure, ZK-SN type

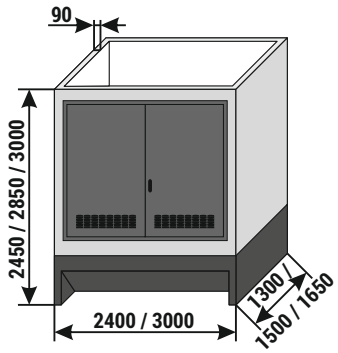
ZK-SN (1,5x1,1) „3"	ZK-SN (1,8x1,1) „4"	ZK-SN (2,4x1,16) „5"

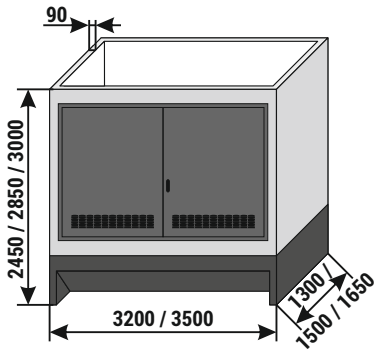






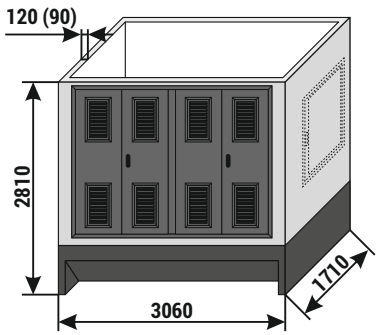
ZK-SN (2,4x1,3) ⋮ ZK-SN (3,0x1,65)	ZK-SN (3,2x1,3) ⋮ ZK-SN (3,5x1,65)

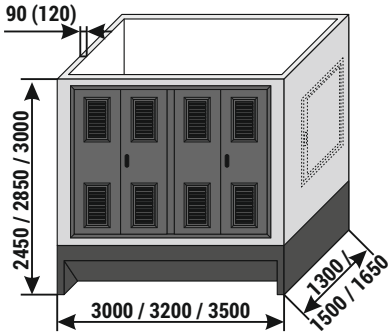


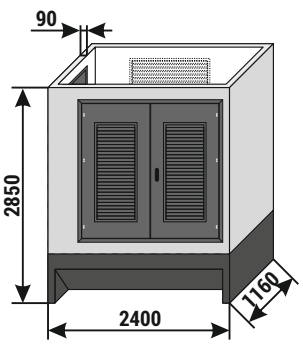


Dedicated concrete enclosures for transformer substations with external servicing, Mzb1 type

Mzb1 (3,06 x 1,71)	Mzb1 (3,0 x 1,3) ⋮ Mzb1 (3,56x1,71)	Mzb1 (2,4x1,16)







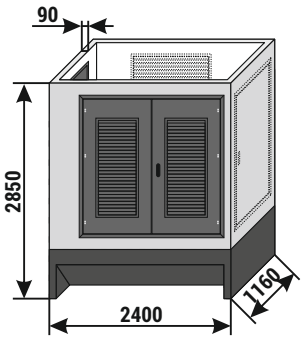
NOTE!

For substations in version with optional 120 mm wall thickness, the specified dimensions should be increased by 60 mm (30 mm per wall), e.g. for dimensions of 3200 mm x 1500 mm, it will be respectively 3260 mm x 1560 mm.

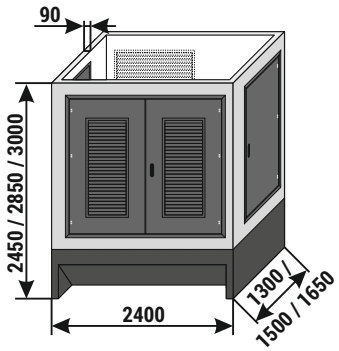
LIST OF MANUFACTURED ENCLOSURES

Dedicated concrete enclosures for transformer substations with external servicing, Mzb2 type

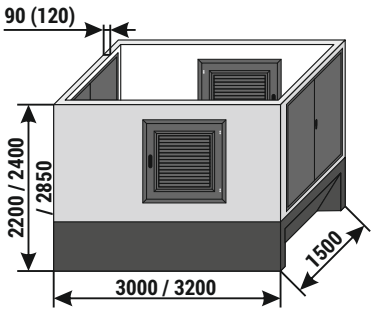
Mzb2 (2,4x1,16)



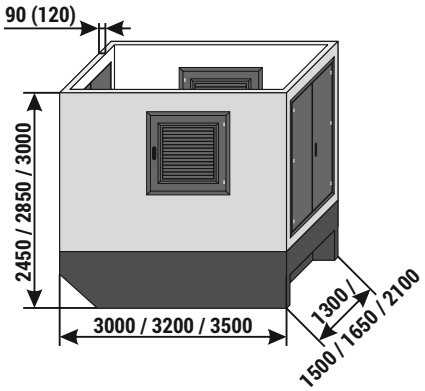
Mzb2 (2,4x1,3)
:
Mzb2 (2,4x1,65)



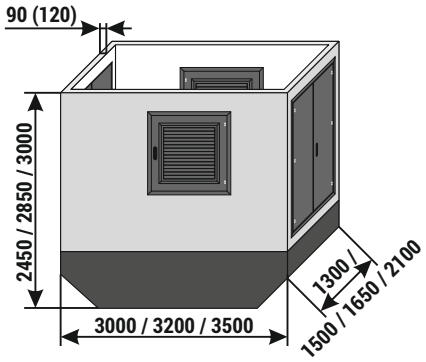
Mzb2 (3,0 lub 3,2x1,5)



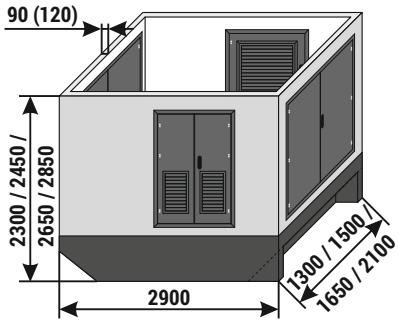
Mzb2 (3,0x1,3) „one slant"
:
Mzb2 (3,56x2,16) „one slant"



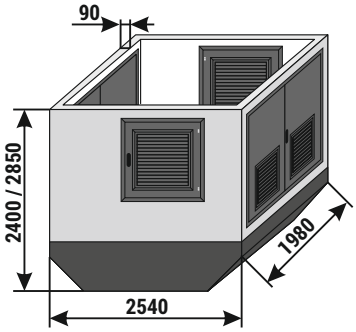
Mzb2 (3,0x1,3) „two slants"
:
Mzb2 (3,56x2,16) „two slants"



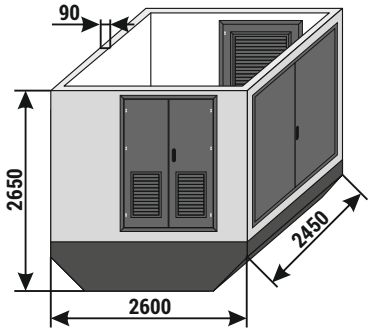
Mzb2 (2,9x1,3)
:
Mzb2 (2,96x2,16)



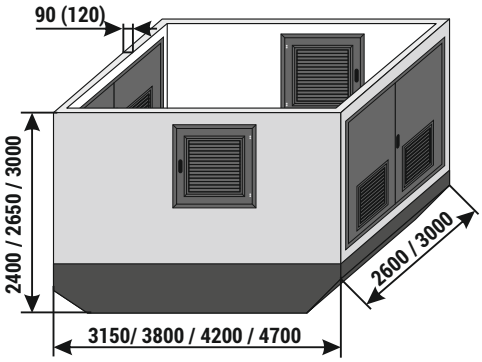
Mzb2 (2,54x1,98) (Minibox)



Mzb2"b" (2,6x2,45



Mzb2 (3,15x2,6)
:
Mzb2 (4,76-3,06)



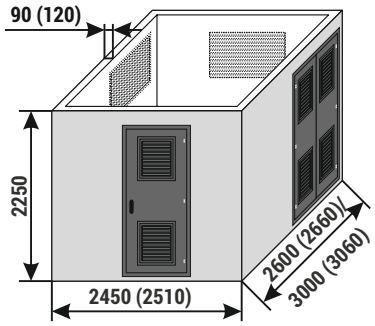
NOTE!

The views present standard heights of enclosures. It is possible to construct the main structure of the substation up to a height of 3500 mm, however such solutions should be consulted every time with the manufacturer.

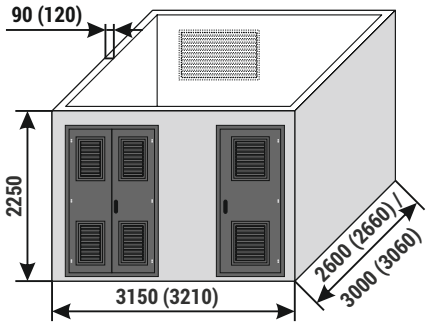
LIST OF MANUFACTURED ENCLOSURES

Dedicated concrete enclosures for transformer substations with an internal service corridor, MRw-b type

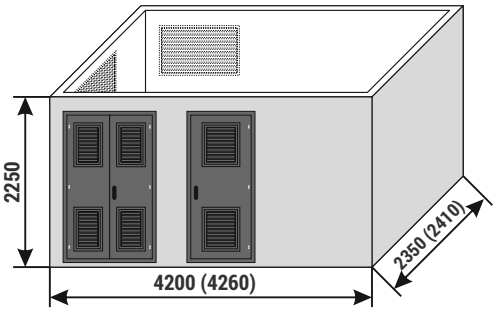
MRw-b1(pp) (2,45x2,6 ··· 2,51x3,06)



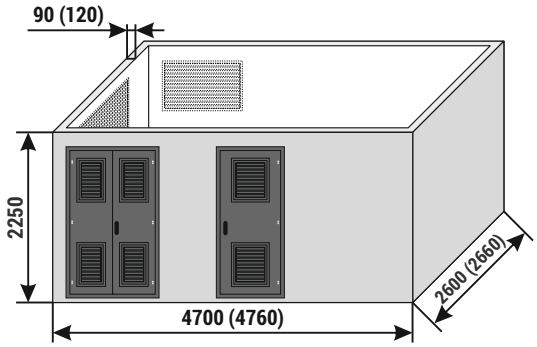
MRw-b2(pp) (3,15x2,6 ··· 3,21x3,06)



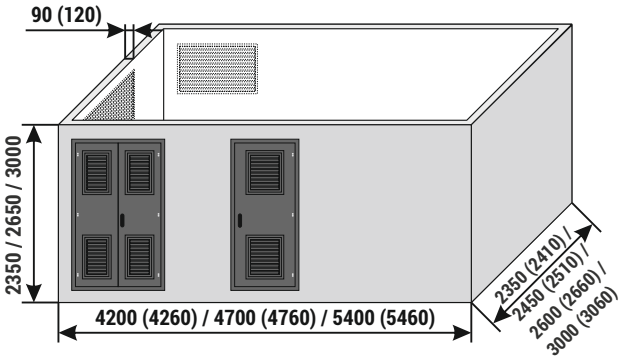
MRw-b(pp) 20/630-3 (4,2x2,35 ··· 4,26x2,41)



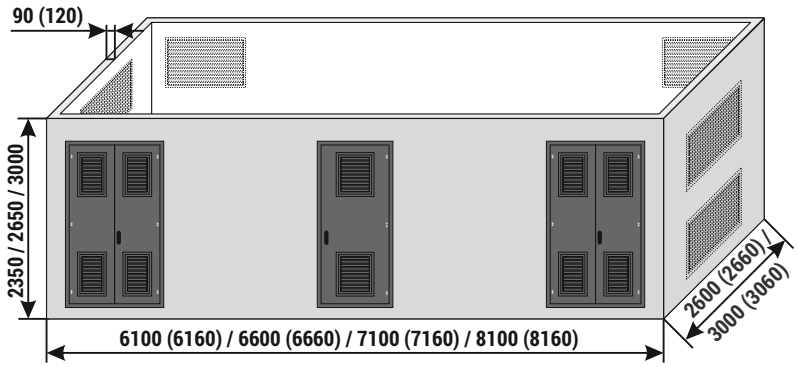
MRw-b(pp) 20/630-4 (4,7x2,6 ··· 4,76x2,66)



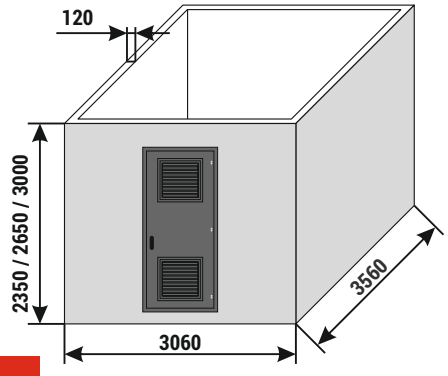
MRw-b(pp) (4,2x2,35 • • • 5,46x3,06)



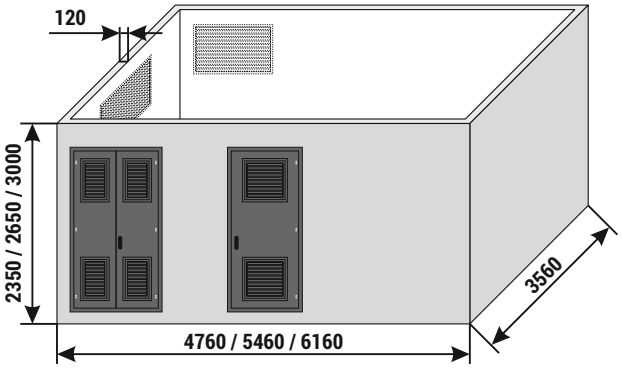
MRw-b(pp) (6,1x2,6 • • • 8,16x3,06)



MRw-b(pp) (3,06x3,56)



MRw-b(pp) (4,76 • • • 6,16x3,56)



NOTE!

The views present standard heights of enclosures. It is possible to construct the main structure of the substation up to a height of 3500 mm, however such solutions should be consulted every time with the manufacturer.

MRw-b TYPE SUBSTATION PLACEMENT

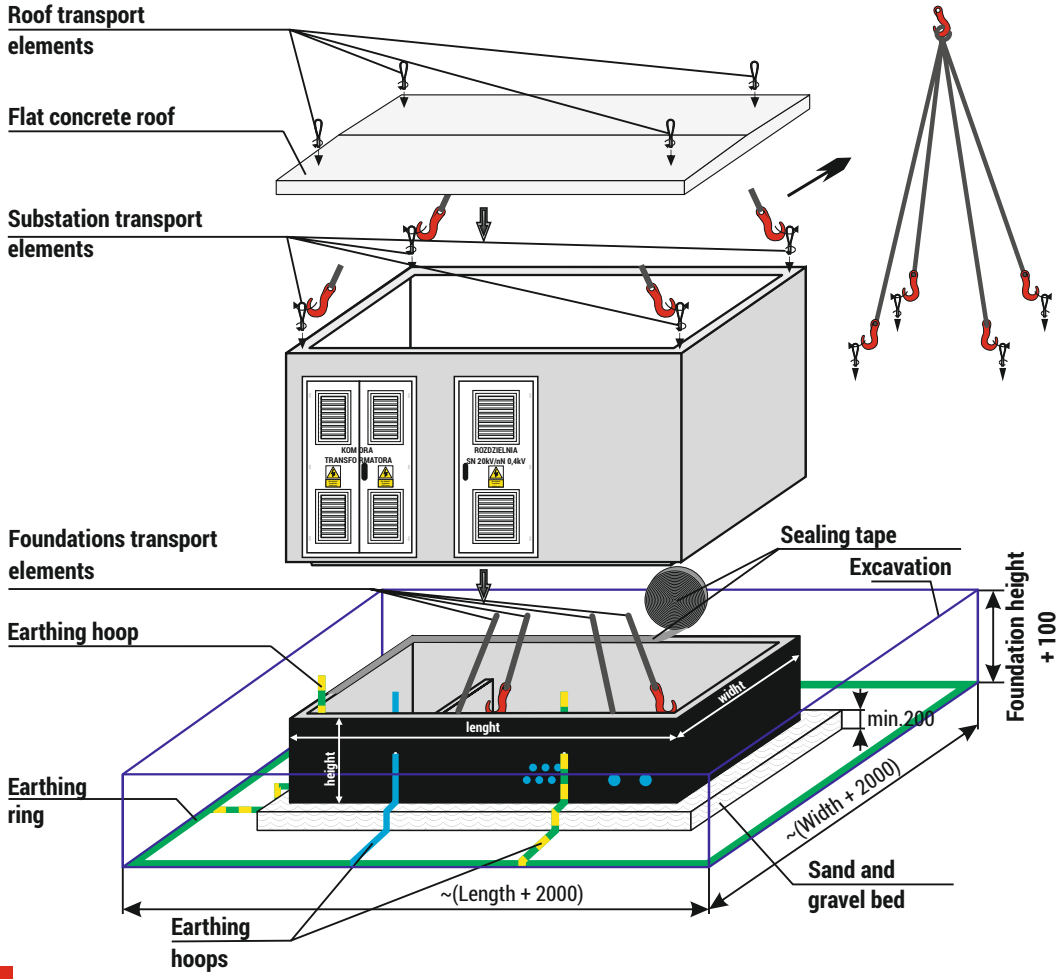
All works related to substation placement should be performed in accordance with a technical design drawn up on the basis of current standards and industry regulations and local guidelines, taking into account geotechnical conditions. The guidelines specified below should be treated as examples, which should be verified every time using data at the given substation location. The first stage of substation placement is excavation of a trench. External earthing of the substation in the form of an earthing ring (or other, in accordance with local earthing requirements) should be placed in the prepared trench.

Under the foundation a sand and gravel bed with a final thickness (after compaction) of at least 20 cm should be constructed. The thickness of the sand and gravel bed should be adapted to the local water and soil conditions and the local freezing zone. The surface of the sand and gravel bed should be level in the substation placement plane, and the quality of bed preparation in the excavation confirmed in the acceptance report. The foundation basin of the substation should be placed in the prepared location. Place a single layer of sealing tape on the upper part of the foundation basin. When placing the sealing tape, make sure that it does not overlap and does not stretch. This could cause damage or deformation.

Place the main structure of the substation over the foundation prepared in this manner, and then place the roof over it. The next stage is covering the foundation, performed by stages, with 20 cm layers of compacted filtering soil. Special care should be taken when covering the excavation at the site of contact with foundation wall, not to break the applied water insulation of vertical surfaces. Pay special care in the location where cables enter the cable entries, since mechanical compaction may cause damage to entries or cables.

It is important that the walls of the foundation basin protrude by no less than 10 cm above the final ground level. Placement in complex and complicated water and soil conditions, in mining areas and post-mining areas is recommended after a separate, individual design is prepared by a certified design body, with required geological and engineering documentation, under supervision performed by duly authorised personnel.

EXAMPLE PLACEMENT OF A SUBSTATION WITH AN INTERNAL SERVICE CORRIDOR



NOTE!

The placement diagram above, due to the method of raising the main structure, is dedicated to substations with dimensions not exceeding: length: 5460; width: 3060; height: 2350.

TRANSPORT

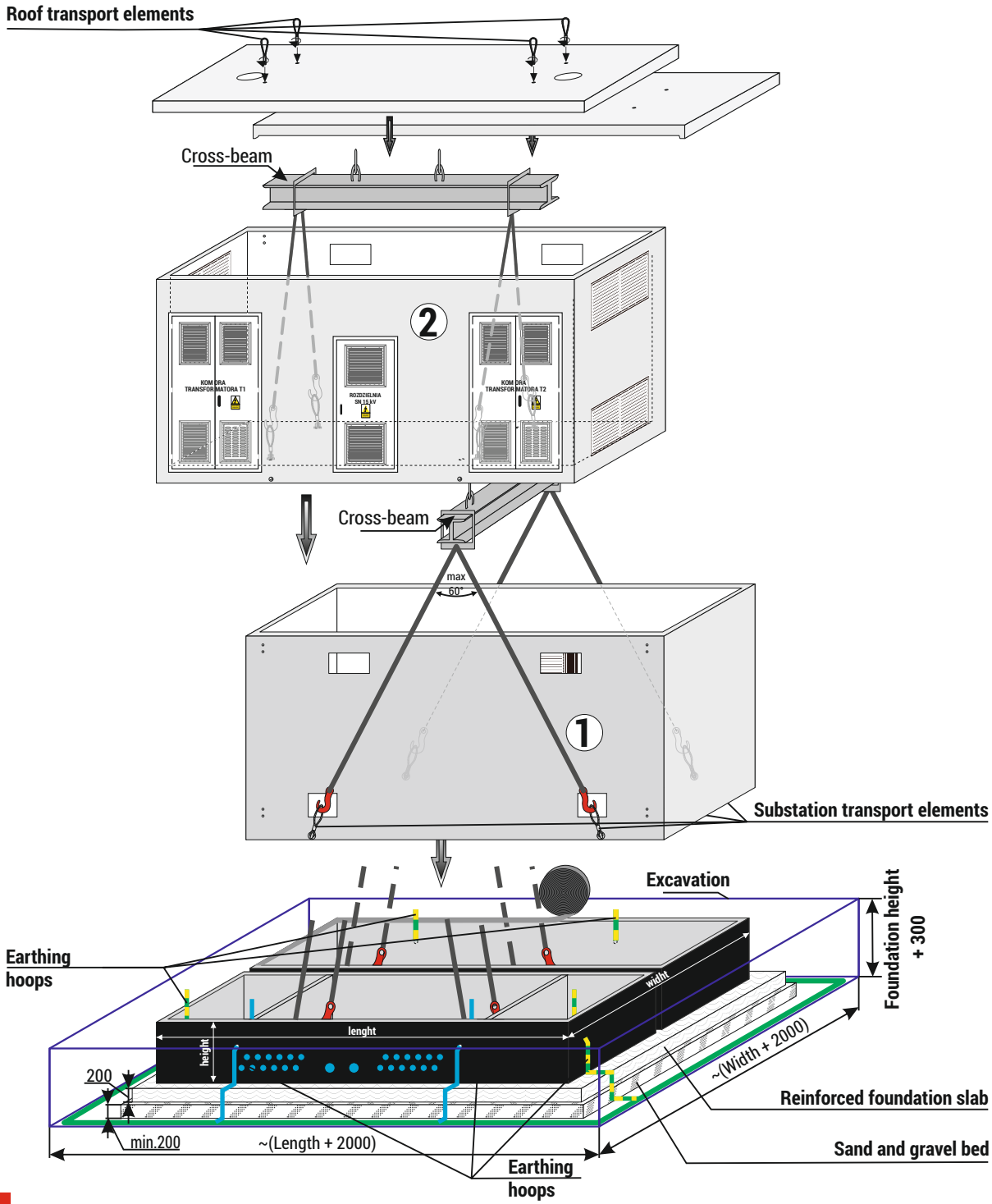
ZPUE S.A. has its own fleet, as one of few companies manufacturing prefabricated container substations. Provision of transport services is intended to lower the costs of transporting ZPUE S.A. equipment and to improve the quality of customer service. We offer a transport set with a gross vehicle weight rating of 70 tonnes, which can carry even up to 50 tonnes of cargo. Our road tractors are the latest generation models which meet Euro 6 exhaust emissions (standard for allowed exhaust emissions for new vehicles sold in the European Union).

EXAMPLE OF TRANSFORMER SUBSTATION TRANSPORT

MRw-bS TYPE SUBSTATION PLACEMENT

The placement of an MRw-bS type substation is performed in the same manner as for an MRw-b type substation, with the difference that after the sand and gravel bed is made, a reinforced concrete stabilisation slab is poured, which prevents slab faulting and non-uniform settling of individual substations. Recommended minimum thickness of reinforced concrete slab 20 cm, C16/20 class concrete, minimum reinforcement with meshes at the top and bottom using ribbed bars Ø10/Ø12 mm top/bottom, spaced no more than 25 cm apart, made of AIIIN steel (e.g. RB 500W, 20G2VY-b – weldable steel), top and bottom reinforcement shifted in relation to each other by half of mesh size.

The actual and target thickness of the stabilising slab and the used reinforcement should be verified with structural calculations, taking into account load-bearing capacity at the placement site, taking into account the weight of the complete substation with equipment.



NOTE!

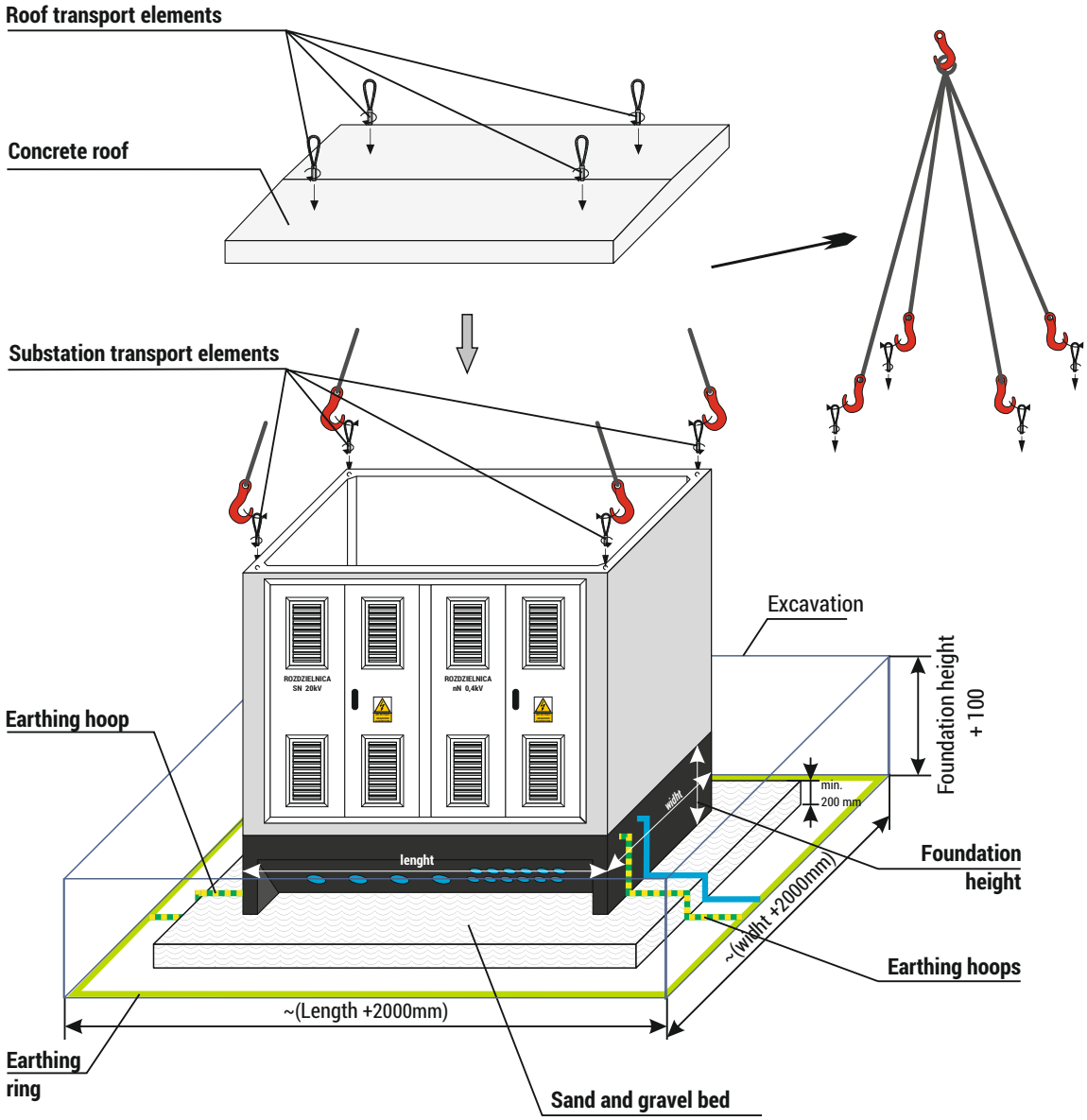
Placement of a substation with dimensions exceeding: length: 5460; width: 3060; height: 2350 should be performed in the same manner as on the figure above (elements used to raise the substation should be screwed into threaded sleeves prepared in the lower part of side walls or in the floor, depending on the construction version).

PLACEMENT OF A SUBSTATION WITH EXTERNAL SERVICING, Mzb TYPE

A substation placement site for an Mzb type substation with external servicing should be prepared in the same manner as for an MRw-b type substation.

The difference will stem only from the substation's design. In case of MRw-b type substations, the foundation and the main structure form two independent elements, whereas in case of an Mzb type substation with external servicing these elements form a single unit (foundation is combined with the main structure), which should be placed in the prepared excavation. Then a transformer is inserted from above (before the roof is attached), and in the last stage the roof is placed on the substation's main structure.

EXAMPLE PLACEMENT OF A SUBSTATION WITH EXTERNAL SERVICING



Container transformer substations

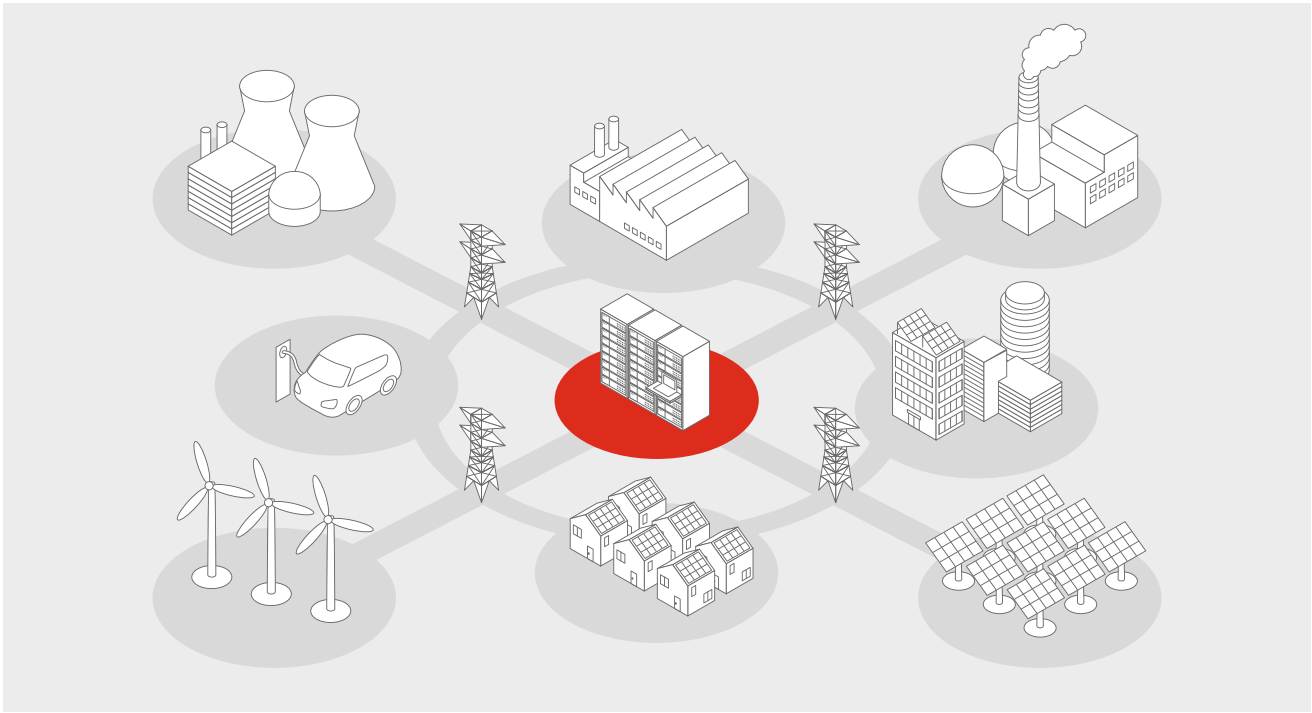
1.1 / SMART GRID smart energy management system

INTRODUCTION

To meet the increasing needs of customers, ZPUE S.A. has introduced devices based on state-of-the-art technologies, which cooperate with energy network management systems into it offer. In order to make the cooperation of many systems possible, the idea of a smart energy management system (called the "Smart Grid") has emerged.

It consists of devices and technologies which enable the management of transmission and distribution networks. Emphasis was put on process automation in order to dynamically manage transmission and distribution networks with switching, metering and control points and nodes located within a distributed electricity infrastructure.

The aim is to create one logically connected system, improving technical and economic efficiency of electricity production. Automation of distribution networks requires the installation of smart devices equipped with telemetry and protection automation. It provides a wide range of functions, including: telemetry, overcurrent and ground fault protection, short-circuit detection, analysis of energy quality, and fuse links monitoring.



Communication with control centres within Smart Grid networks

TECHNICAL SOLUTIONS BY ZPUE S.A. FOR A SMART GRID SYSTEM

An example of the devices manufactured by ZPUE S.A. designed for power distribution networks in the Smart Grid system are urban, compact container transformer substations equipped with state-of-the-art technologically advanced MV and LV switchgears, with remote monitoring and controlling options.

The basic equipment of the aforementioned substations are modern MV switchgears from a wide range of solutions of our own manufacture, with an installed system of motor-driven switches, which enable both local and remote control of "open" and "close" functions of individual switches. An auxiliary contacts system installed in all critical points of the switchgear informs us of the operation state (state of switch disconnectors, circuit breakers, earthing switches, closed covers, SF_6 gas).

This system, along with individual controllers installed in each function bay of the switchgear is a part of a smart interlock, which prevents performing incorrect switching operations and certainly increases the switchgear's operational safety.

Another very important component of the substation is the LV switchgear, equipped on its outgoing feeders with fuse disconnectors with device state and fuse links monitoring modules.

In the switchgear, on each incoming and outgoing feeder metering systems can be installed, making it possible to control and balance the energy consumption of individual customers and to transmit data to the dispatch system.

Another example of Smart Grid dedicated devices include MV connection boxes in ZK-SN type concrete enclosure, which enable the branching of cable lines from cable routes, connecting them to the subscriber stations and switching in distribution networks. The basic equipment of the aforementioned connection boxes include TPM type MV switchgears with equipment similar to one used in transformer substations, which provides remote monitoring and control. An innovative system of auxiliary power supply should be mentioned, based on a transformer supplied directly from the MV switchgear's primary busbars, which works with the power supply and a battery bank. This solution guarantees autonomy of the whole system, which is perfect for inaccessible areas where connection boxes are installed, especially during winter.

Container transformer substations

1.2 / Container transformer substations in concrete enclosures with an internal service corridor

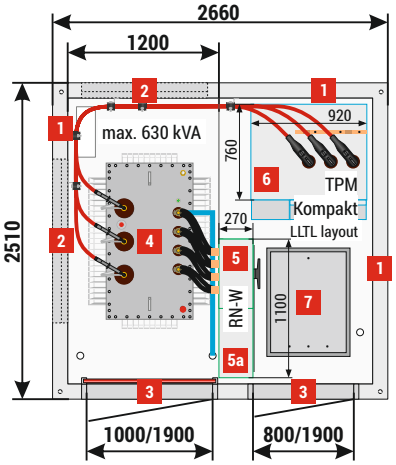
MRw-b1(pp) TYPE SUBSTATION 20/630

External/internal height of the main structure of the substation:	
Standard	2250 mm / 2150 mm
Optional	2650 mm / 2450 mm or 3000 mm / 2800 mm

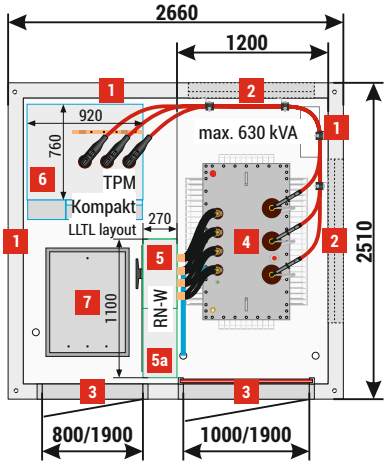
1	Walls, 120 mm thick - **standard**, 90 mm thick - **optional**
	Walls without holes - REI 120 fire integrity class
2	Ventilation louvres IP 23D - **standard**, IP 43 - **optional**
	In ventilation louvres mounted in walls with fire integrity class, fire dampers are installed (e.g. EI 60 or EIS 120) - **optional**
3	Doors: solid or with ventilation louvres, IP 23D - **standard**, IP 43 - **optional**
	Doors with fire resistance e.g EI 60 or EI 120 - **optional**
4	Transformer
5	LV switchgear
5a	AMI cabinet / telemetry / auxiliary
6	MV switchgear
7	Cable duct hatch door

Placement of equipment

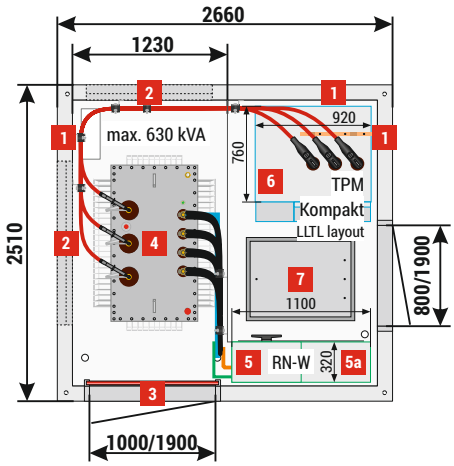
MRw-b1(pp) 20/630-4"a"



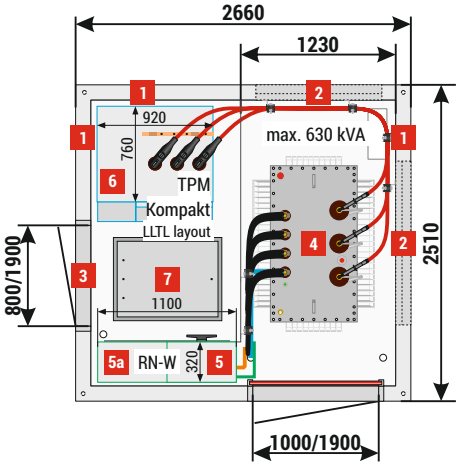
MRw-b1(pp) 20/630-4"b"



MRw-b1(pp) 20/630-4"c"



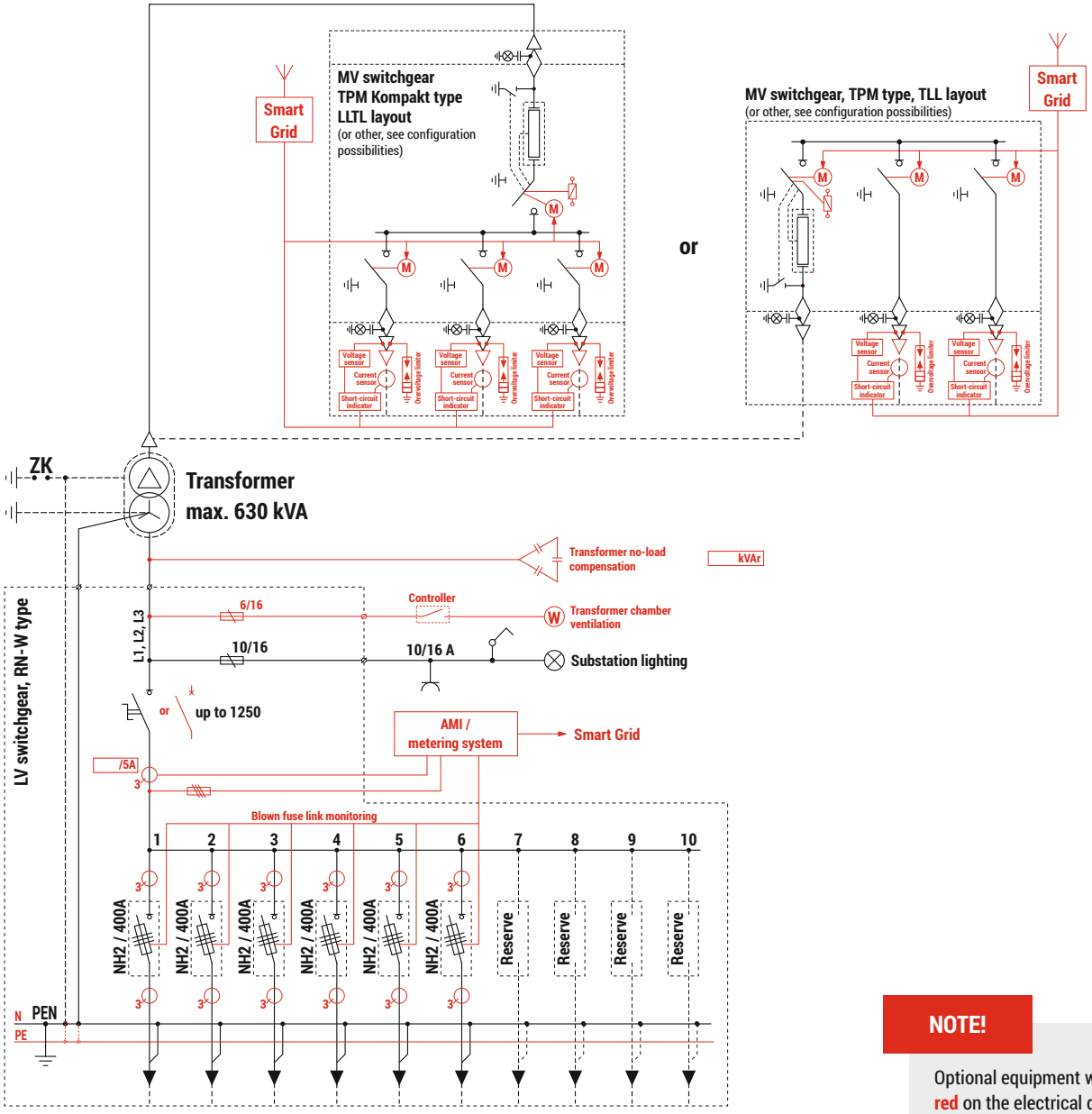
MRw-b1(pp) 20/630-4"d"



NOTE!

The catalogue presents example substation configurations.

Electrical diagram



NOTE!

Optional equipment was **marked with red** on the electrical diagram.

Technical parameters / configuration possibilities		
Transformer (4) Maximum power / dimension	630 kVA / 980* x 2000 x 1850 [mm]	
Internal arc resistance classification	IAC-AB-16 kA-1s	
Enclosure class	up to 10 (depending on substation configuration)	
Electrical parameters of switchgears	**MV**	**LV**
Rated voltage	up to 25 kV	up to 0,69 kV
Rated current	up to 630 A	up to 1250 A
Rated short-time withstand current	up to 20 kA (1s)	up to 25 kA (1s)
Rated peak withstand current	up to 50 kA	up to 52,5 kA
Switchgear**	**Type**	**Maximum number of bays**
LV (5)	RN-W	10
MV (6)	TPM Kompakt / TPM	4 (LLTL) / 2 (TL or WL) or 3 (TLL or WLL only in „c", „d" layouts)

Mass / Area	
Foundation	4 000 kg
Main structure	10 000 kg
Concrete roof	2 400 kg
Metal roof	300-550 kg
Usable area	5,49 m^2

* Maximum width of the transformer installed through the substation doors. Wider transformers may be installed from the top.

** Detailed selection of switchgears and their equipment is listed in chapters dedicated to individual devices in the catalogue.

Example layouts of switchgears and corresponding substation configurations are specified in parentheses, if any.

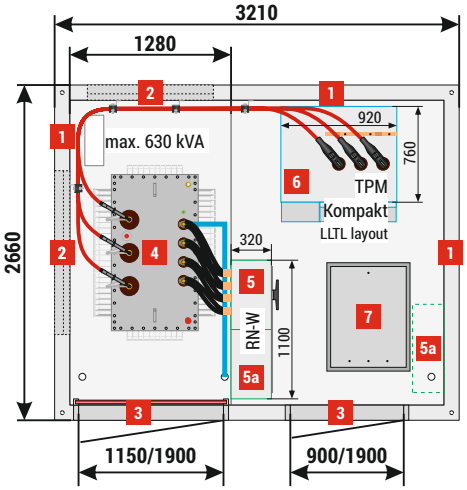
MRw-b2(pp) type substation 20/630

External/internal height of the main structure of the substation:	
Standard	2250 mm / 2150 mm
Optional	2650 mm / 2450 mm or 3000 mm / 2800 mm

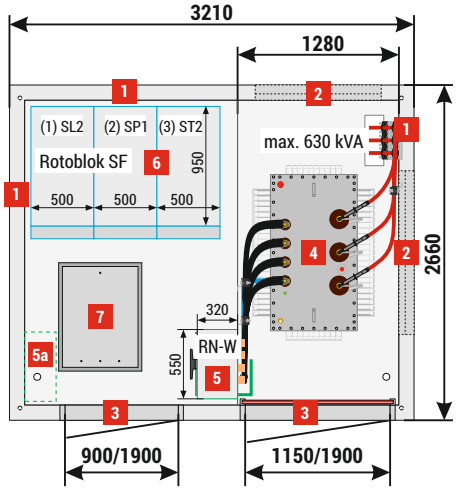
1	Walls, 120 mm thick - **standard**, 90 mm - **optional** Solid walls - REI 120 fire integrity class
2	Ventilation louvres IP 23D - **standard**, IP 43 - **optional** In ventilation louvres mounted in walls with fire integrity class, fire dampers are installed (e.g. EI 60 or EIS 120) - **optional**
3	Doors: solid or with ventilation louvres without fire integrity class, IP 23D - **standard**, IP 43 - **optional** Doors with fire resistance e.g EI 60 or EI 120 - **optional**
4	Transformer
5	LV switchgear
5a	AMI cabinet / telemetry / auxiliary
6	MV switchgear
7	Cable duct hatch door

Placement of equipment

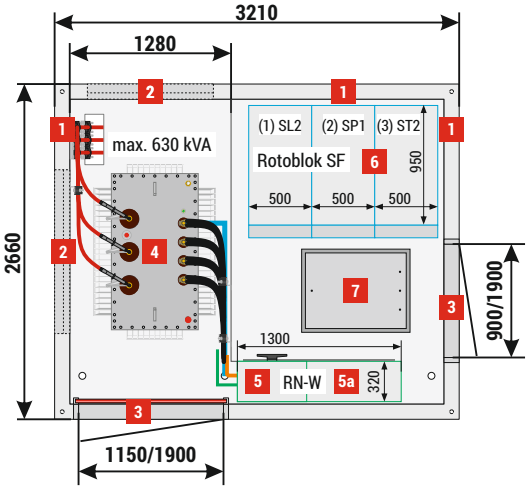
MRw-b2(pp) 20/630-4"a"



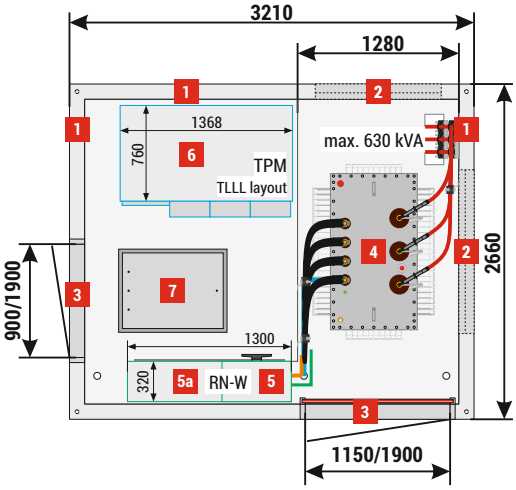
MRw-b2(pp) 20/630-3"b"



MRw-b2(pp) 20/630-3"c"



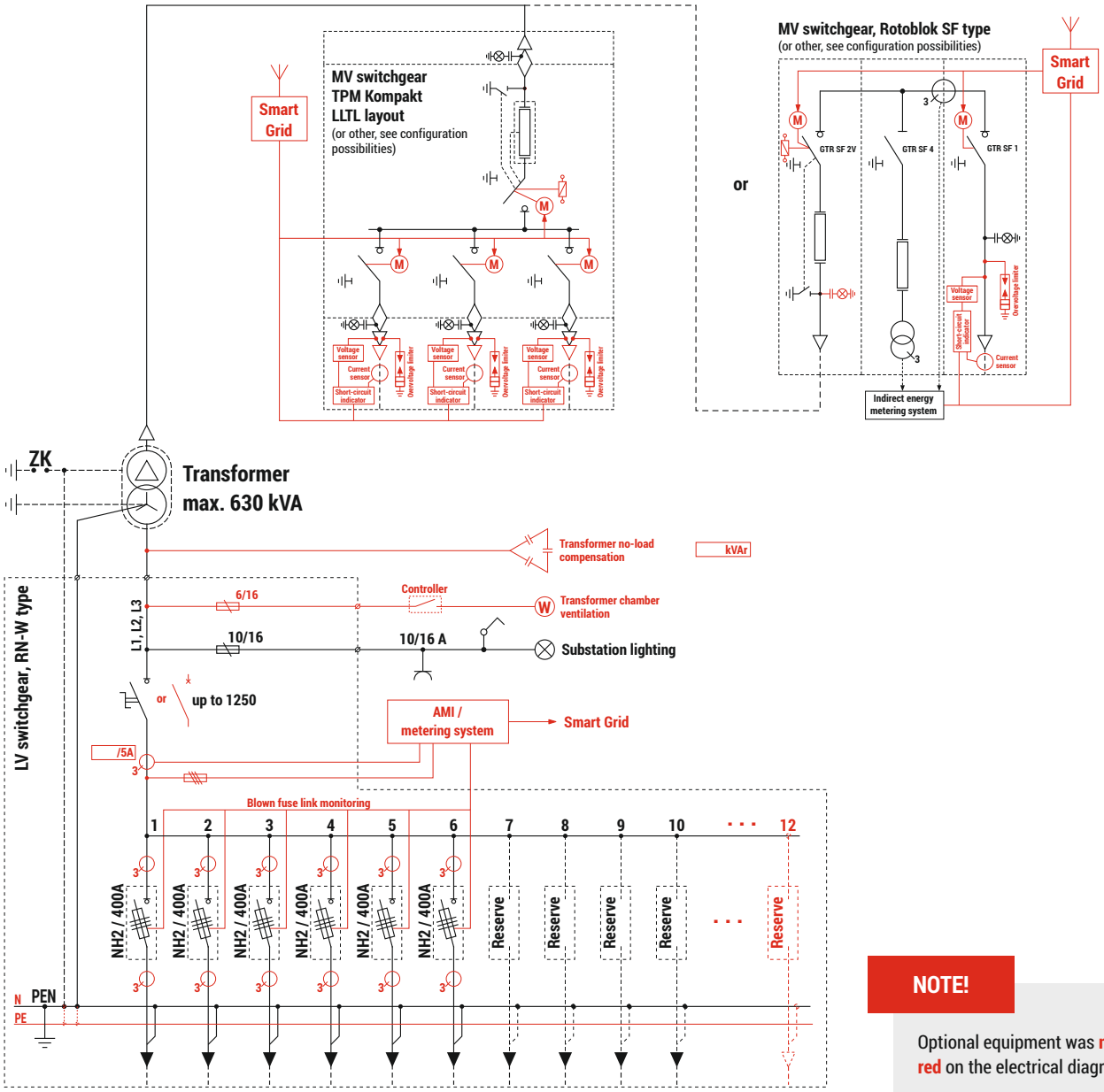
MRw-b2(pp) 20/630-4"d"



NOTE!

The catalogue presents example substation configurations.

Electrical diagram



NOTE!

Optional equipment was **marked with red** on the electrical diagram.

Technical parameters / configuration possibilities		
Transformer (4) Maximum power / dimension	630 kVA / 980* x 2000 x 1850 [mm]	
Internal arc resistance classification	IAC-AB-20 kA-1s	
Enclosure class	up to 10 (depending on substation configuration)	
Electrical parameters of switchgears	**MV**	**LV**
Rated voltage	up to 25 kV	up to 0,69 kV
Rated current	630 A	up to 1250 A
Rated short-time withstand current	up to 20 kA (1s)	up to 25 kA (1s)
Rated peak withstand current	up to 50 kA	up to 52,5 kA
Switchgear**	**Type**	**Maximum number of bays**
LV (5)	RN-W	5 / 10 / 12 (depending on configuration)
MV (6)	TPM / TPM Kompakt	4 (TLLL „c", „d") / 4 (LLTL)
	Rotoblok SF (500)	3 (for „a" or „b" - nN max. 5)

Mass / Area	
Foundation	4 500 kg
Main structure	11 000 kg
Concrete roof	3 200 kg
Metal roof	450-600 kg
Usable area	7,18 m^2

* Maximum width of the transformer installed through the substation doors. Wider transformers may be installed from the top.

** Detailed selection of switchgears and their equipment is listed in chapters dedicated to individual devices in the catalogue.

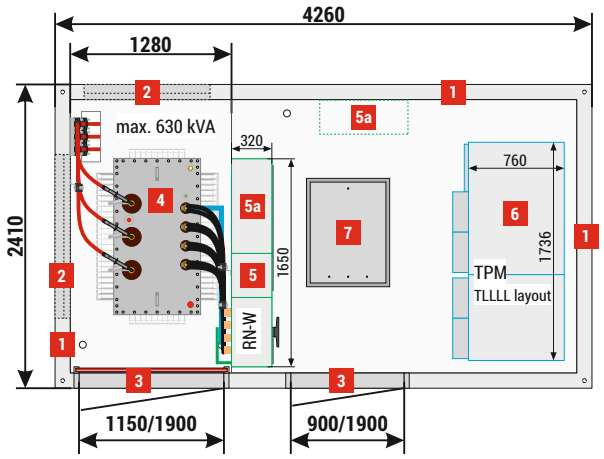
MRw-b(pp) type substation 20/630(1000)-3

External/internal height of the main structure of the substation:	
Standard	2250 mm / 2150 mm
Optional	2650 mm / 2450 mm or 3000 mm / 2800 mm

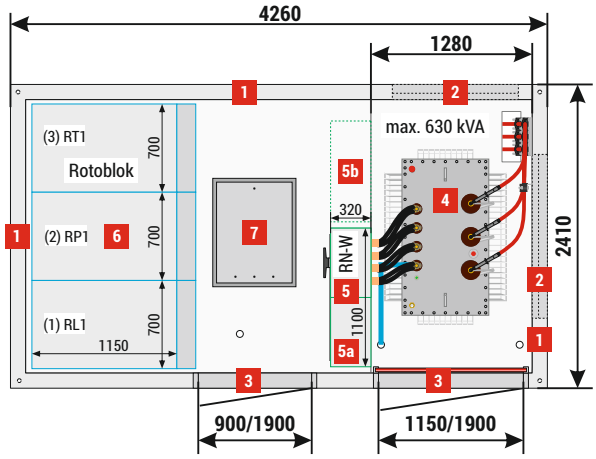
1	Walls, 120 mm thick - **standard**, 90 mm - **optional** Solid walls - REI 120 fire integrity class
2	Ventilation louvres IP 23D - **standard**, IP 43 - **optional** In ventilation louvres mounted in walls with fire integrity class, fire dampers are installed (e.g. EI 60 or EIS 120) - **optional**
3	Doors: solid or with ventilation louvres, without fire integrity class IP 23D - **standard**, IP 43 - **optional** Doors with fire resistance e.g EI 60 or EI 120 - **optional**
4	Transformer
5	LV switchgear
5a	AMI cabinet / telemetry / auxiliary
5b	Capacitor bank
6	MV switchgear
7	Cable duct hatch door

Placement of equipment

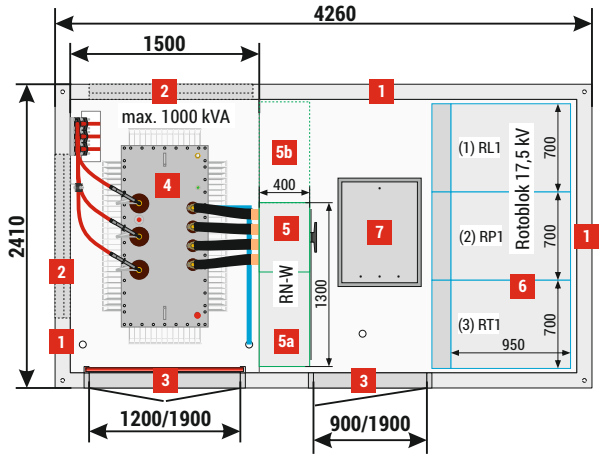
MRw-b(pp) 20/630-3"a"/5



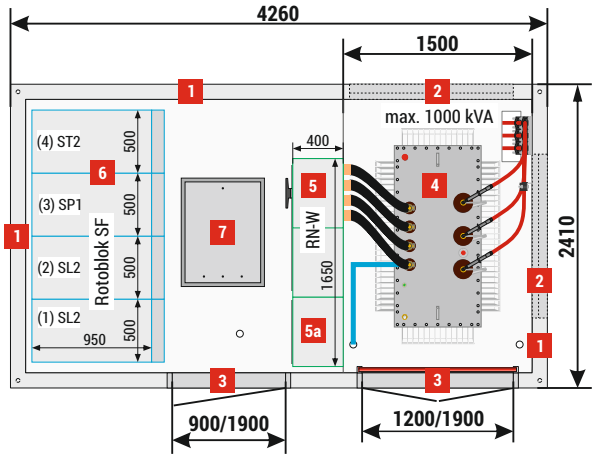
MRw-b(pp) 20/630-3"b"



MRw-b(pp) 20/1000-3"a"



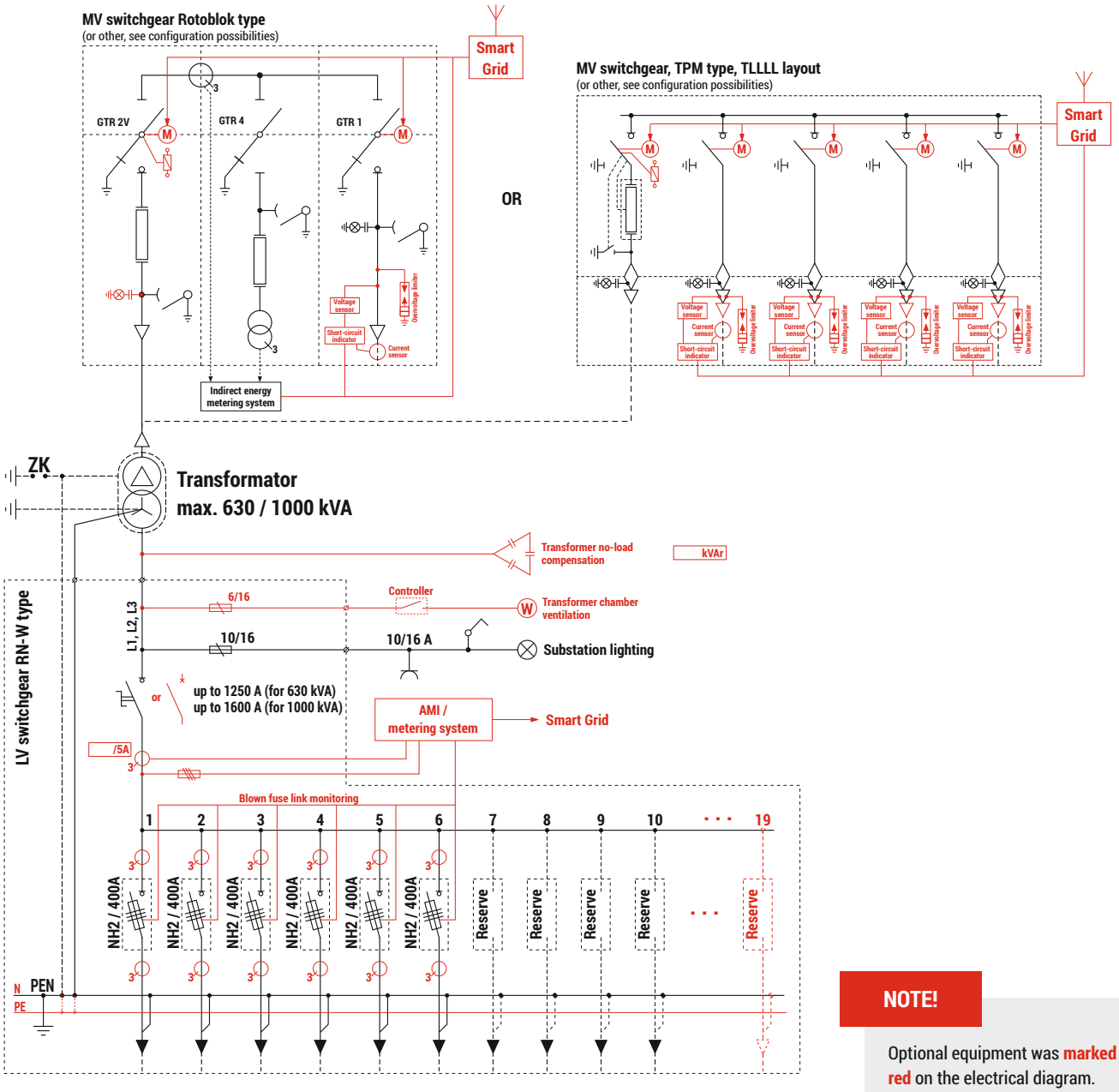
MRw-b(pp) 20/1000-3"b"/4



NOTE!

The catalogue presents example substation configurations.

Electrical diagram



NOTE!

Optional equipment was **marked with red** on the electrical diagram.

Technical parameters / configuration possibilities		
Transformer (4) Maximum power / dimension	630 kVA / 980* x 2000 x 1850 [mm] 1000 kVA / 1150* x 2000 x 1900 [mm]	
Internal arc resistance classification	IAC-AB-20 kA-1s	
Enclosure class	up to 10 (depending on substation configuration)	
Electrical parameters of switchgears	**MV**	**LV**
Rated voltage	up to 25 kV	up to 0,8 kV
Rated current	630 A	up to 1600 A
Rated short-time withstand current	up to 20 kA (1s)	up to 35 kA (1s)
Rated peak withstand current	up to 50 kA	up to 77 kA
Switchgear**	**Type**	**Maximum number of bays**
LV (5)	RN-W	19 (10 - standard)
MV (6)	Rotoblok (700 mm)	3 (630 kVA) / – (1000 kVA)
	Rotoblok 17,5 kV (700 mm)	3
	Rotoblok SF (500 mm)	4
	TPM	5 (e.g. TLLLL or WLLLL)

Mass / Area	
Foundation	5 400 kg
Main structure	13 000 kg
Concrete roof	4 000 kg
Metal roof	450-600 kg
Usable area	8,72 m^2

* Maximum width of the transformer installed through the substation doors. Wider transformers may be installed from the top.

** Detailed selection of switchgears and their equipment is listed in chapters dedicated to individual devices in the catalogue.

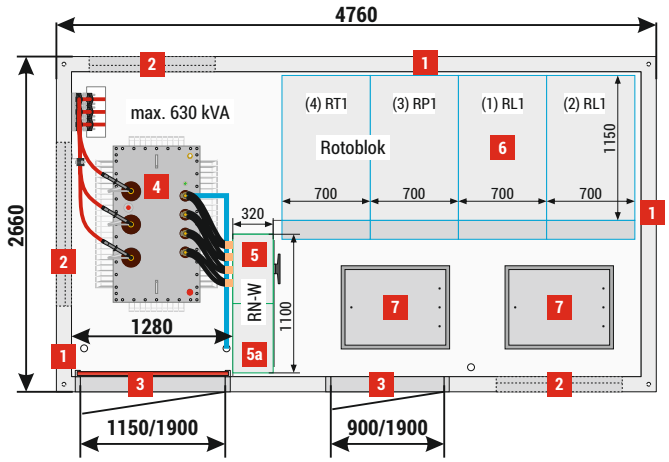
MRw-b(pp) type substation 20/630(1000)-4

External/internal height of the main structure of the substation:	
Standard	2250 mm / 2150 mm
Optional	2650 mm / 2450 mm or 3000 mm / 2800 mm

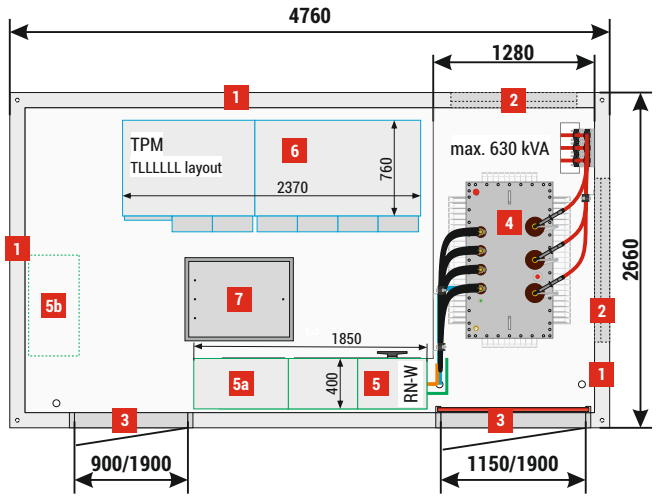
1	Walls, 120 mm thick - **standard**, 90 mm - **optional** Solid walls - REI 120 fire integrity class
2	Ventilation louvres IP 23D - **standard**, IP 43 - **optional** In ventilation louvres mounted in walls with fire integrity class, fire dampers are installed: EI 60 or EIS 120 - **optional**
3	Doors: solid or with ventilation louvres, without fire integrity class IP 23D - **standard**, IP 43 - **optional** Doors with fire resistance e.g EI 60 or EI 120 - **optional**
4	Transformer
5	LV switchgear
5a	AMI cabinet / telemetry / auxiliary
5b	Capacitor bank
6	MV switchgear
7	Cable duct hatch door

Placement of equipment

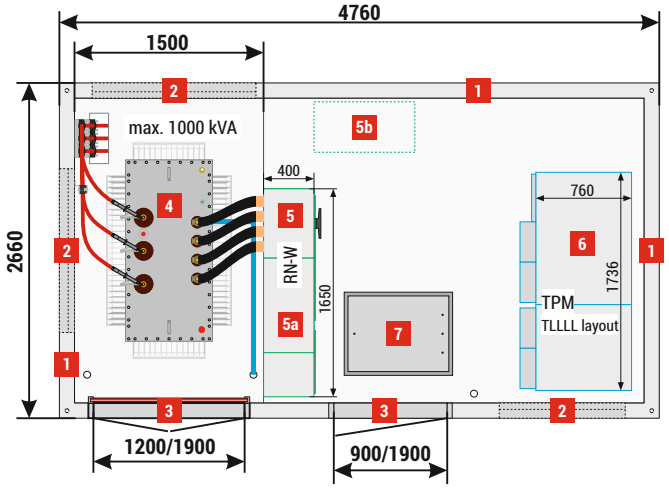
MRw-b(pp) 20/630-4"a"



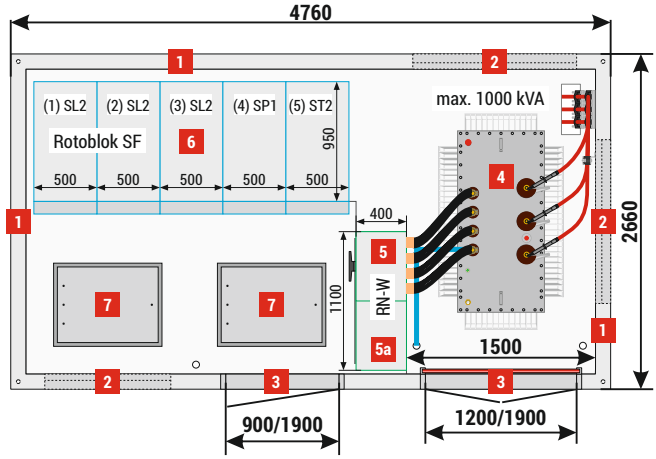
MRw-b(pp) 20/630-4"a"/7



MRw-b(pp) 20/1000-4"a"/5



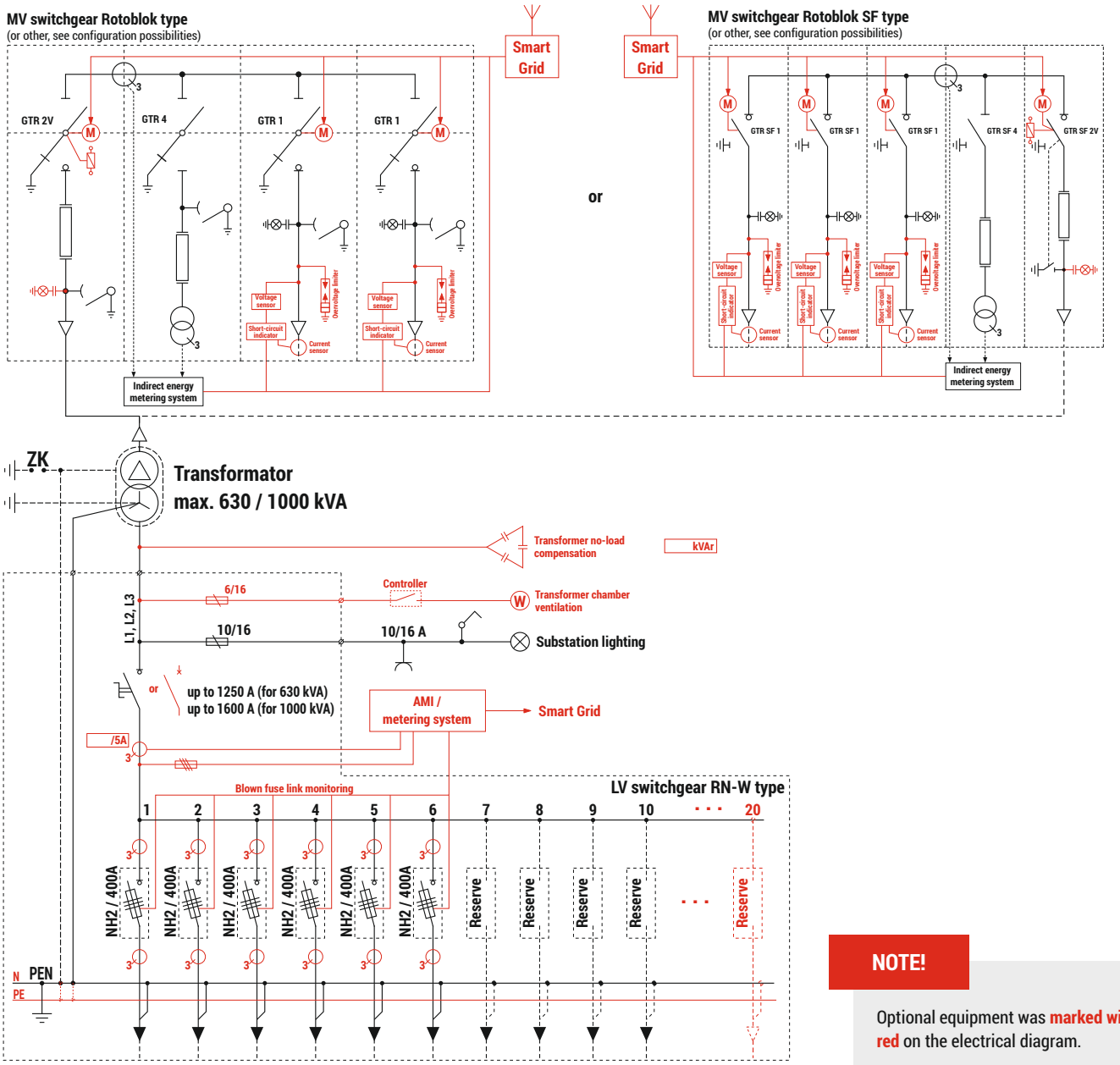
MRw-b(pp) 20/1000-4"b"/5



NOTE!

The catalogue presents example substation configurations.

Electrical diagram



NOTE!

Optional equipment was **marked with red** on the electrical diagram.

Technical parameters / configuration possibilities		
Transformer (4) Maximum power / dimension	630 kVA / 980* x 2000 x 1850 [mm] 1000 kVA / 1150* x 2000 x 1900 [mm]	
Internal arc resistance classification	IAC-AB-20 kA-1s	
Enclosure class	up to 10 (depending on substation configuration)	
Electrical parameters of switchgears	**MV**	**LV**
Rated voltage	up to 25 kV	up to 0,8 kV
Rated current	630 A	up to 1600 A
Rated short-time withstand current	up to 20 kA (1s)	up to 35 kA (1s)
Rated peak withstand current	up to 50 kA	up to 77 kA
Switchgear**	**Type**	**Maximum number of bays**
LV (5)	RN-W	20 (10 - standard)
MV (6)	Rotoblok / Rotoblok 17,5 kV (700 mm)	4 (630 kVA) / 3 (1000 kVA)
	Rotoblok SF (500 mm)	7 (630 kVA) / 6 (1000 kVA)
	TPM	7 (TLL+LLLL)

Mass / Area	
Foundation	6 500 kg
Main structure	14 000 kg
Concrete roof	4 500 kg
Metal roof	600-800 kg
Usable area	10,93 m^2

* Maximum width of the transformer installed through the substation doors. Wider transformers may be installed from the top.

** Detailed selection of switchgears and their equipment is listed in chapters dedicated to individual devices in the catalogue.

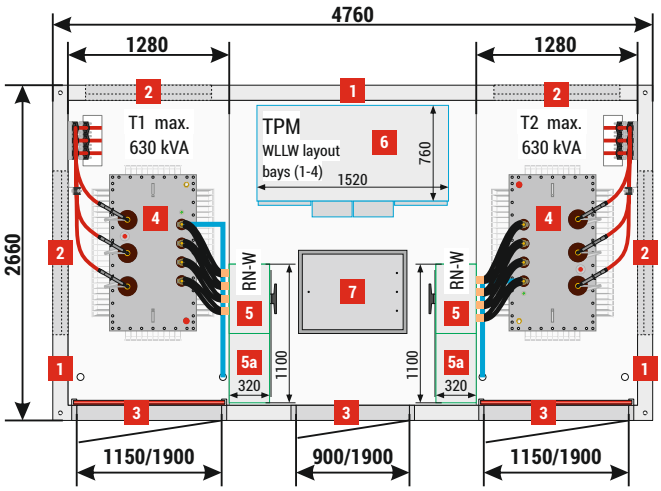
MRw-b(pp) type substation 20/2x630

External/internal height of the main structure of the substation:	
Standard	2250 mm / 2150 mm
Optional	2650 mm / 2450 mm or 3000 mm / 2800 mm

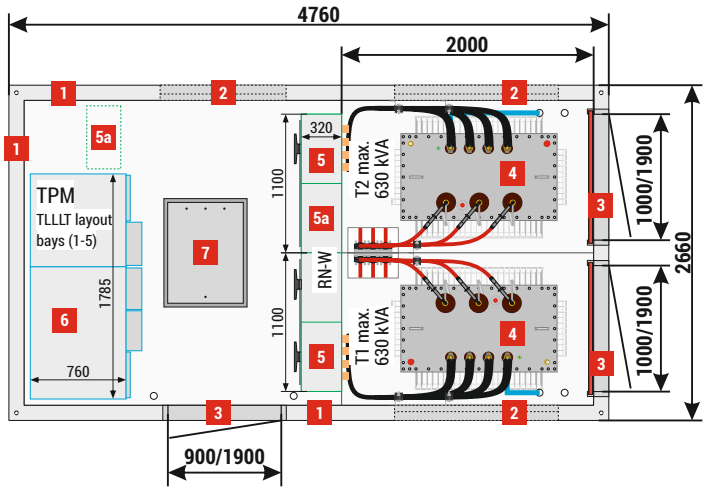
1	Walls, 120 mm thick - **standard**, 90 mm - **optional** Solid walls - REI 120 fire integrity class
2	Ventilation louvres IP 23D - **standard**, IP 43 - **optional** In ventilation louvres mounted in walls with fire integrity class, fire dampers are installed (e.g. EI 60 or EIS 120) - **optional**
3	Doors: solid or with ventilation louvres, without fire integrity class IP 23D - **standard**, IP 43 - **optional** Doors with fire resistance e.g EI 60 or EI 120 - **optional**
4	Transformer
5	LV switchgear
5a	AMI cabinet / telemetry / auxiliary
5b	Capacitor bank
6	MV switchgear
7	Cable duct hatch door

Placement of equipment

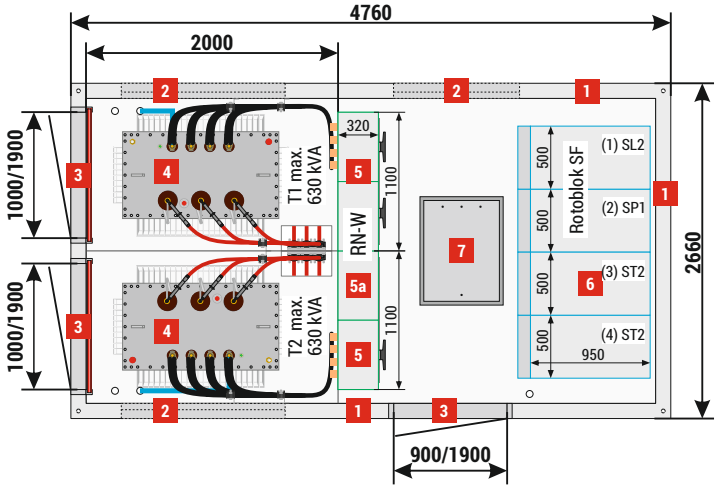
MRw-b(pp) 20/2x630-4"a"



MRw-b(pp) 20/2x630-4"b"/5 variant I



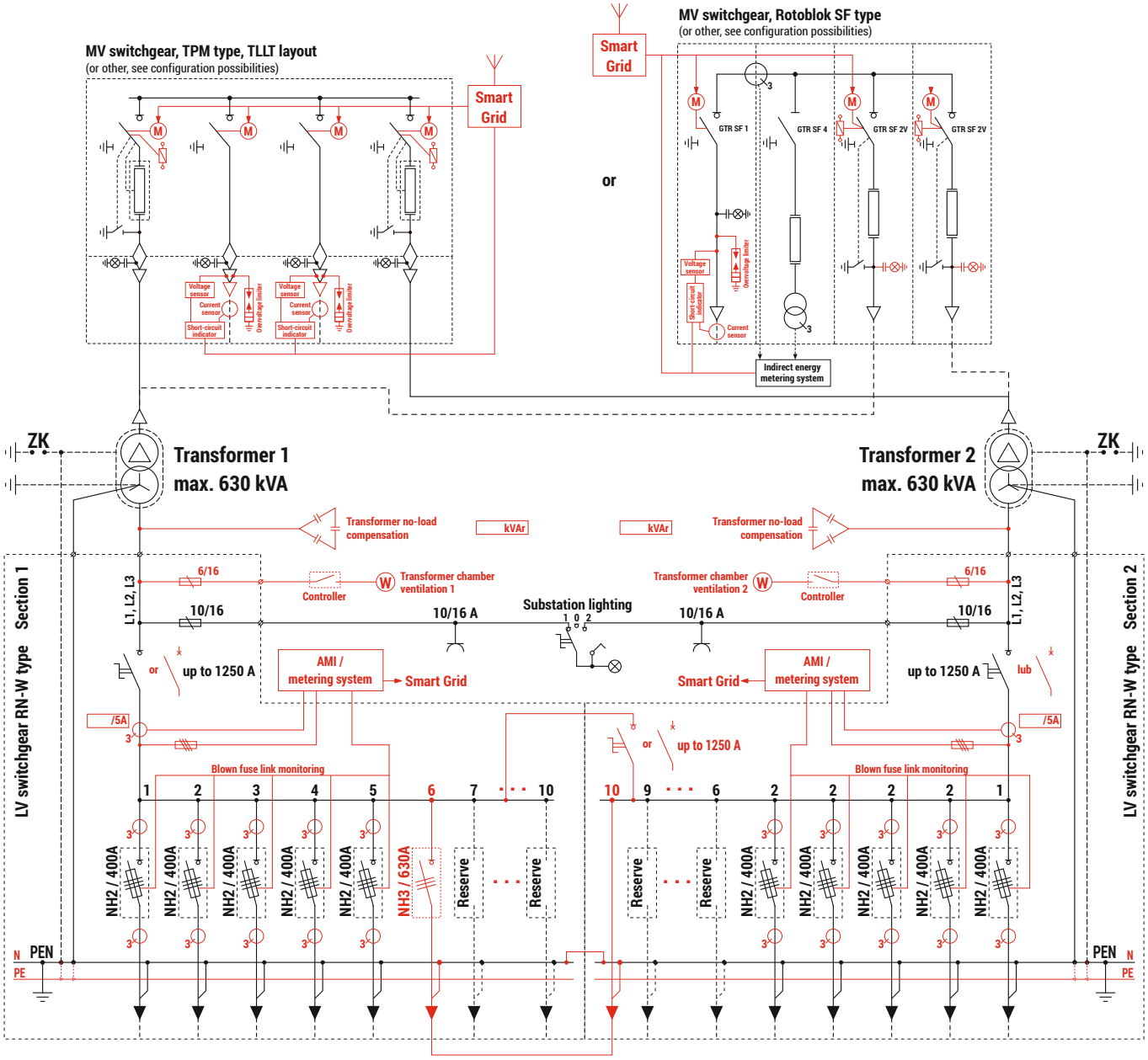
MRw-b(pp) 20/2x630-4"b" variant II



NOTE!

The catalogue presents example substation configurations.

Electrical diagram



Technical parameters / configuration possibilities		
Transformer (4) Maximum power / dimension	2x630 kVA / 980* x 1750 x 1850 [mm]	
Internal arc resistance classification	IAC-AB-16 kA-1s	
Enclosure class	up to 10 (depending on substation configuration)	
Electrical parameters of switchgears	**MV**	**LV**
Rated voltage	up to 25 kV	up to 0,69 kV
Rated current	630 A	up to 1250 A
Rated short-time withstand current	up to 20 kA (1s)	up to 25 kA (1s)
Rated peak withstand current	up to 50 kA	up to 52,5 kA

Switchgear**	Type	Maximum number of bays
LV (5)	RN-W	2 x 10
MV (6)	Rotoblok SF (500 mm / 375 mm)	4 / 5 (only for „b")
	TPM	4 (WLLW „a") / 6 (TLL+LLT - „b")

Mass / Area	
Foundation	6 500 kg
Main structure	14 000 kg
Concrete roof	4 500 kg
Metal roof	600-800 kg
Usable area	10,93 m^2

* Maximum width of the transformer installed through the substation doors. Wider transformers may be installed from the top.

** Detailed selection of switchgears and their equipment is listed in chapters dedicated to individual devices in the catalogue.

NOTE!

Optional equipment was **marked with red** on the electrical diagram.

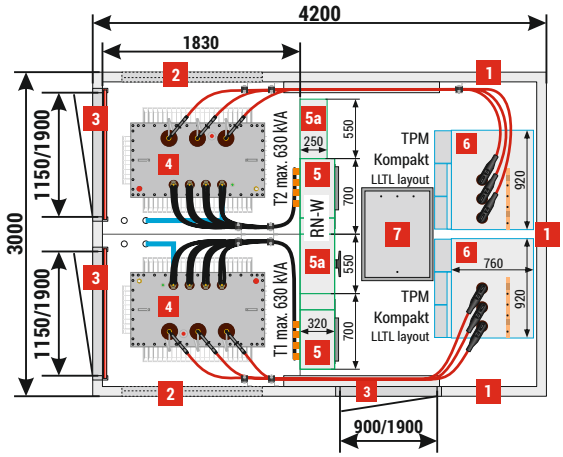
Special version of MRw-b type substation

External/internal height of the main structure of the substation:	
Standard	2350 mm / 2150 mm
Optional	2650 mm / 2450 mm or 3000 mm / 2800 mm

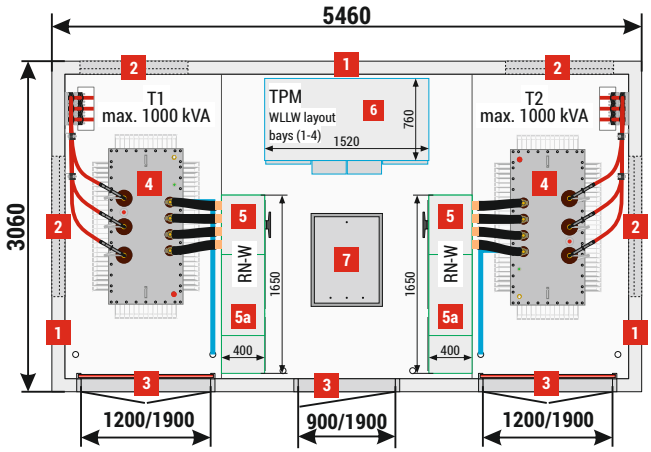
1	Walls, 120 mm thick - **standard**, 90 mm - **optional** Solid walls - REI 120 fire integrity class
2	Ventilation louvres IP 23D - **standard**, IP 43 - **optional** In ventilation louvres mounted in walls with fire integrity class, fire dampers are installed (e.g. EI 60 or EIS 120) - **optional**
3	Doors: solid or with ventilation louvres, without fire integrity class IP 23D - **standard**, IP 43 - **optional** Doors with fire resistance e.g EI 60 or EI 120 - **optional**
4	Transformer
5	LV switchgear
5a	AMI cabinet / Smart Grid / telemetry / auxiliary
5b	Capacitor bank
6	MV switchgear
7	Cable duct hatch door

Placement of equipment

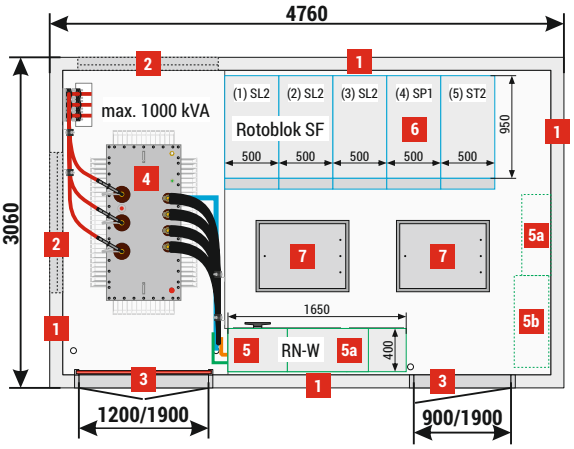
MRw-b(pp) (4,26x2,66) 20/2x630-8



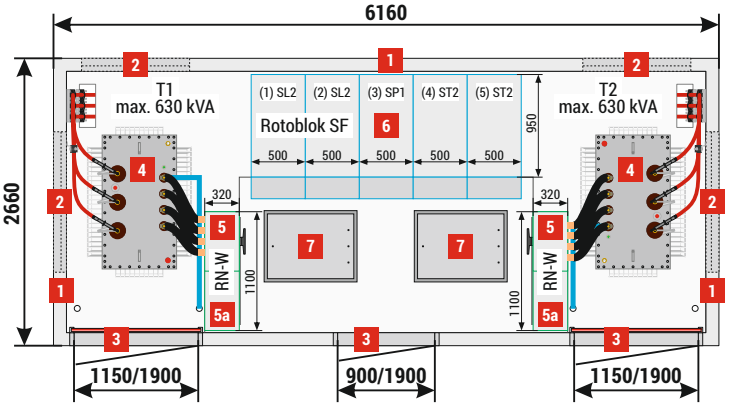
MRw-b(pp) (5,46x3,06) 20/2x1000-4



MRw-b(pp) (4,76x3,06) 20/1000-5



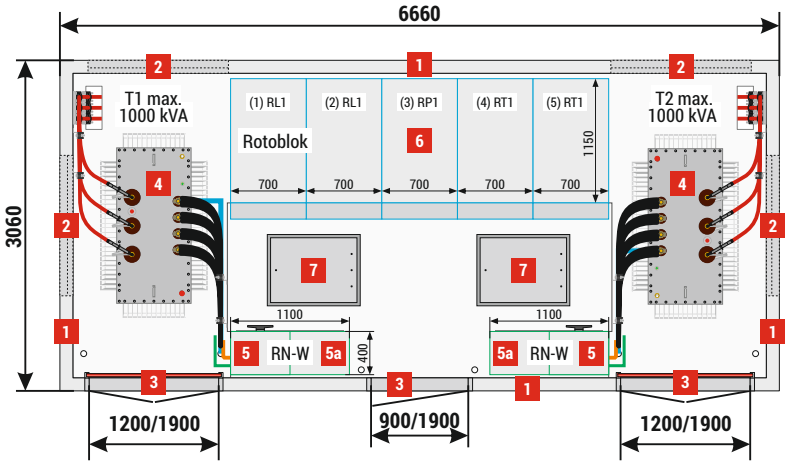
MRw-b(pp) (6,16x2,66) 20/2x630-5



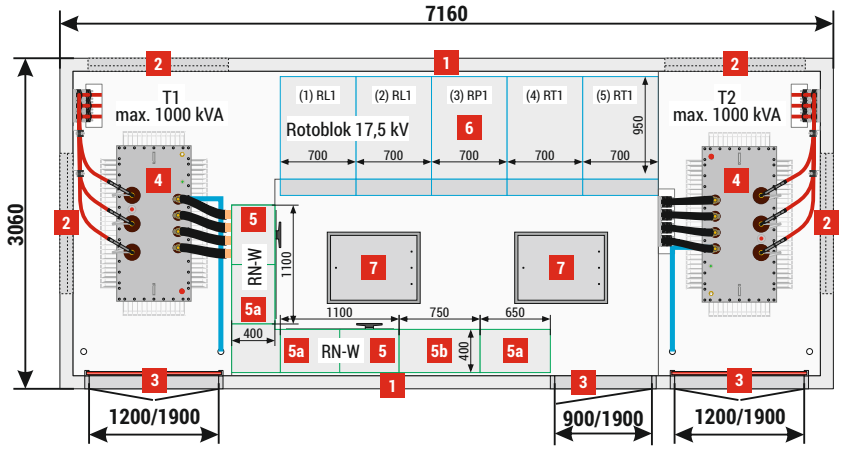
NOTE!

The catalogue presents example substation configurations.

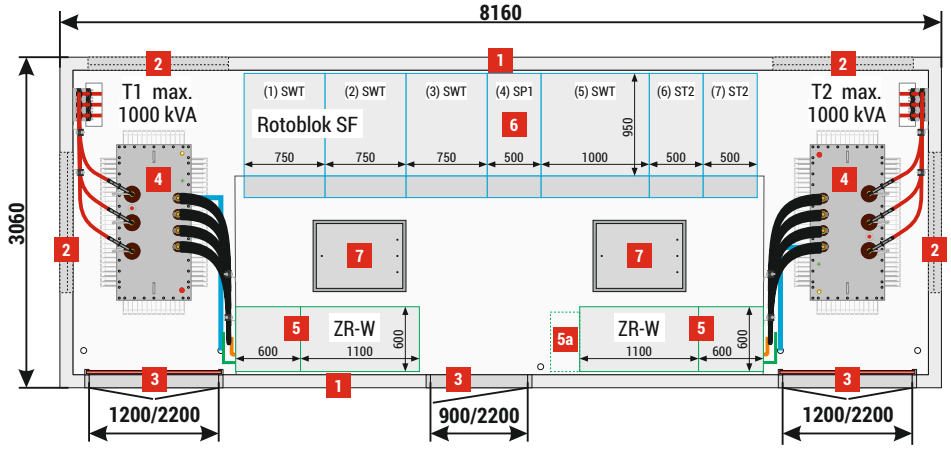
MRw-b(pp) (6,66x3,06) 20/2x1000-5



MRw-b(pp) (7,16x3,06) 20/2x1000-5



MRw-b(pp) (8,16x3,06) 20/2x1000-7



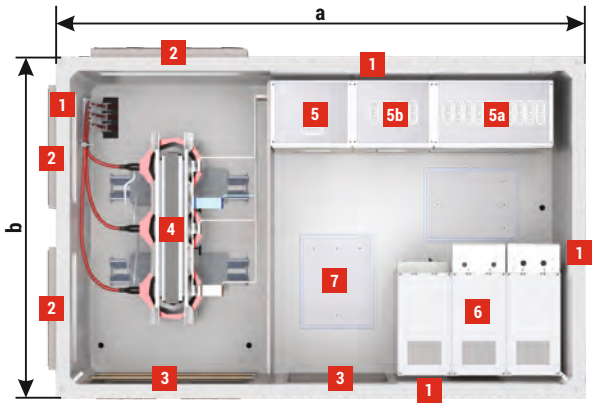
NOTE!

The catalogue presents example substation configurations.

Possibility of constructing enclosures

1	Walls, 120 mm thick - **standard**, 90 mm - **optional** Solid walls - REI 120 fire integrity class
2	Ventilation louvres IP 23D - **standard**, IP 43 - **optional** In ventilation louvres mounted in walls with fire integrity class, fire dampers are installed (e.g. EI 60 or EIS 120) - **optional**
3	Doors: solid or with ventilation louvres, without fire integrity class IP 23D - **standard**, IP 43 - **optional** Doors with fire resistance e.g EI 60 or EI 120 - **optional**
4	Transformer
5	LV switchgear
5a	AMI cabinet / SMART GRID / telemetry / auxiliary
5b	Capacitor bank
6	MV switchgear
7	Cable duct hatch door

MRw-bpp (5,46x3,06) 20/2000-3



Dimensions of concrete enclosures

a - Length [mm] \ b - Width [mm]	2410	2510	2660	3060	3560
4260	+	+	+	+	
4760	+	+	+	+	
4760					+
5460	+	+	+	+	
5460					+
6160		+	+	+	
6660		+	+	+	
7160		+	+	+	
8160		+	+	+	
Wall thick [mm]	**90/120***	**90/120***	**90/120***	**90/120***	**120**

Technical parameters**

Transformer (4) Maximum power / dimension	4000 kVA or multiple	
Internal arc resistance classification	up to IAC-AB-25 kA-1s	
Enclosure class	up to 10 (depending on substation configuration)	
Electrical parameters of switchgears	**MV**	**LV**
Rated voltage	up to 36 kV	up to 1 kV
Rated current	up to 4000 A	up to 6300 A
Rated short-time withstand current	up to 40 kA (3s)	up to 105 kA (1s)
Rated peak withstand current	up to 100 kA	up to 231 kA
Configuration of MV and LV switchgears* **		

NOTE!

* Table specifies enclosures with wall thickness of 120 mm. In case of enclosures with a wall thickness of 90 mm, subtract 60 mm from the external dimensions of the enclosure.
** Technical parameters are specified as maximum, they will depend on the configuration of the substation and on devices used.
*** Detailed selection of switchgears and their equipment is listed in chapters dedicated to individual devices in the catalogue.

Container transformer substations

1.3 / Transformer substations in concrete enclosures with external servicing

Mzb1 type substation 20/630

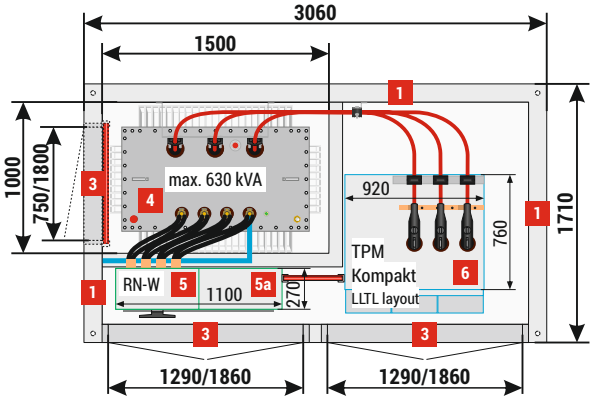
1	Walls, 120 mm thick - **standard**, 90 mm thick - **optional** Walls without holes - REI 120 fire integrity class
2	Ventilation louvres IP 23D - **standard**, IP 43 - **optional** In ventilation louvres mounted in walls with fire integrity class, fire dampers are installed (e.g. EI 60 or EIS 120) - **optional**
3	Doors: solid or with ventilation louvres, IP 23D - **standard**, IP 43 - **optional** Doors with fire resistance e.g EI 60 or EI 120 - **optional**
4	Transformer
5	LV switchgear
5a	AMI cabinet / SMART GRID / telemetry / auxiliary
6	MV switchgear

Height of the main structure of the substation:

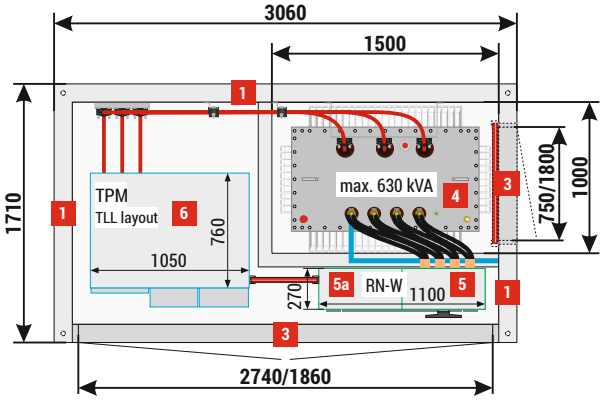
Standard	2850 mm

Placement of equipment

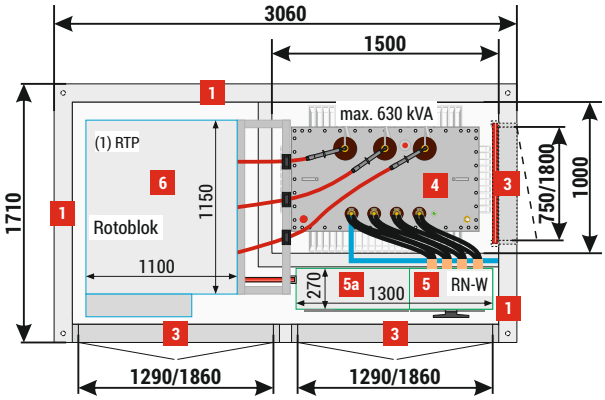
Mzb1 20/630-4"a"



Mzb1 20/630-3"b"



Mzb1 20/630-1"b"



NOTE!

The catalogue presents example substation configurations.

Mzb1 type substation (2,4x1,16) 20/160; Mzb (1,8x1,1) 20/250; Mzb2 (2,4x1,16) 20/400

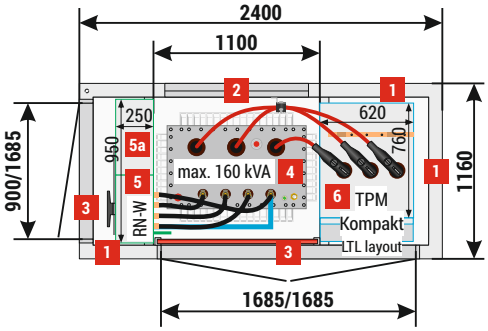
1	Walls, 90 mm thick - **standard** for 2,4x2,16 substation 60 mm thick - **standard** for 1,8x1,1 substation
2	Ventilation louvres IP 23D - **standard**, IP 43 - **optional**
3	Doors: solid or with ventilation louvres, IP 23D - **standard**, IP 43 - **optional**
4	Transformer
5	LV switchgear
5a	AMI cabinet / Smart Grid / telemetry / auxiliary
6	MV switchgear

Height of the main structure of the substation:

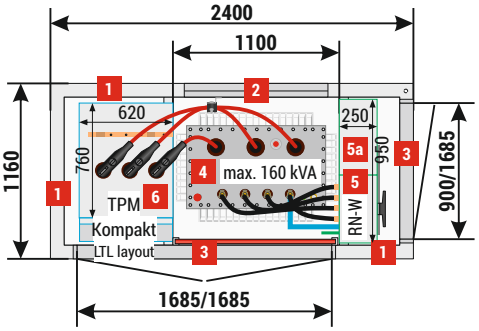
Standard	2850 mm

Placement of equipment

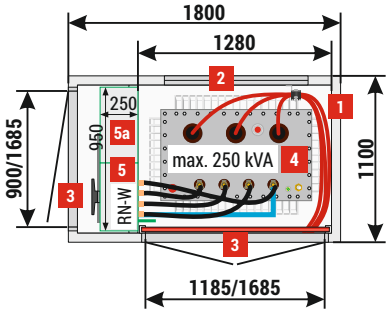
Mzb1 (2,4x1,16) 20/160-3"a"



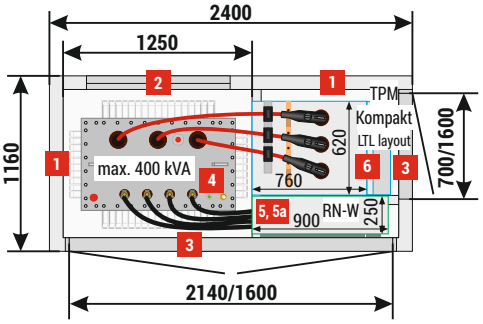
Mzb1 (2,4x1,16) 20/160-3"b"



Mzb1 (1,8x1,1) 20/250 version without MV switchgear



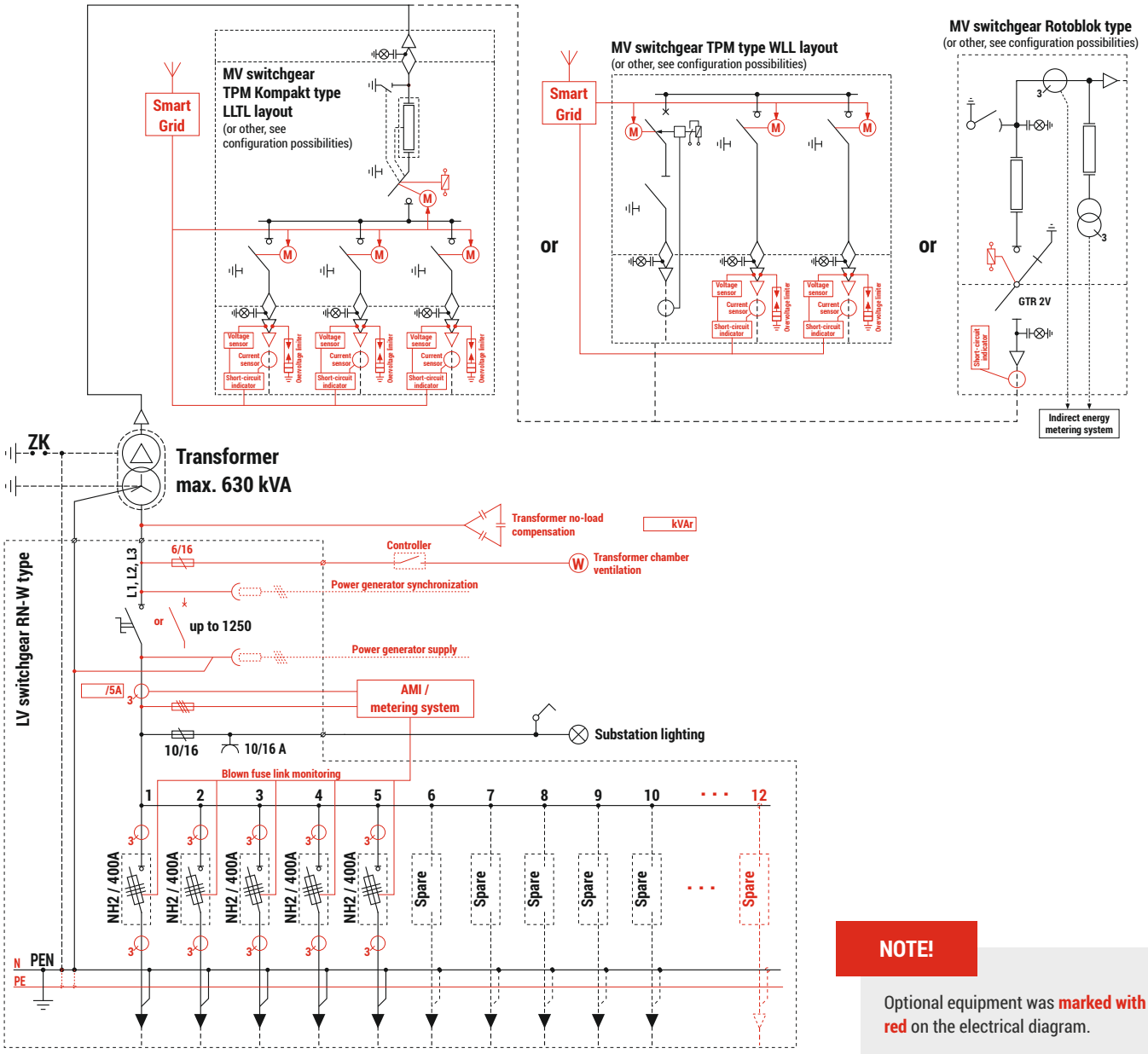
Mzb2 (2,4x1,16) 20/400-3"a"



NOTE!

The catalogue presents example substation configurations.

Electrical diagram



NOTE!

Optional equipment was **marked with red** on the electrical diagram.

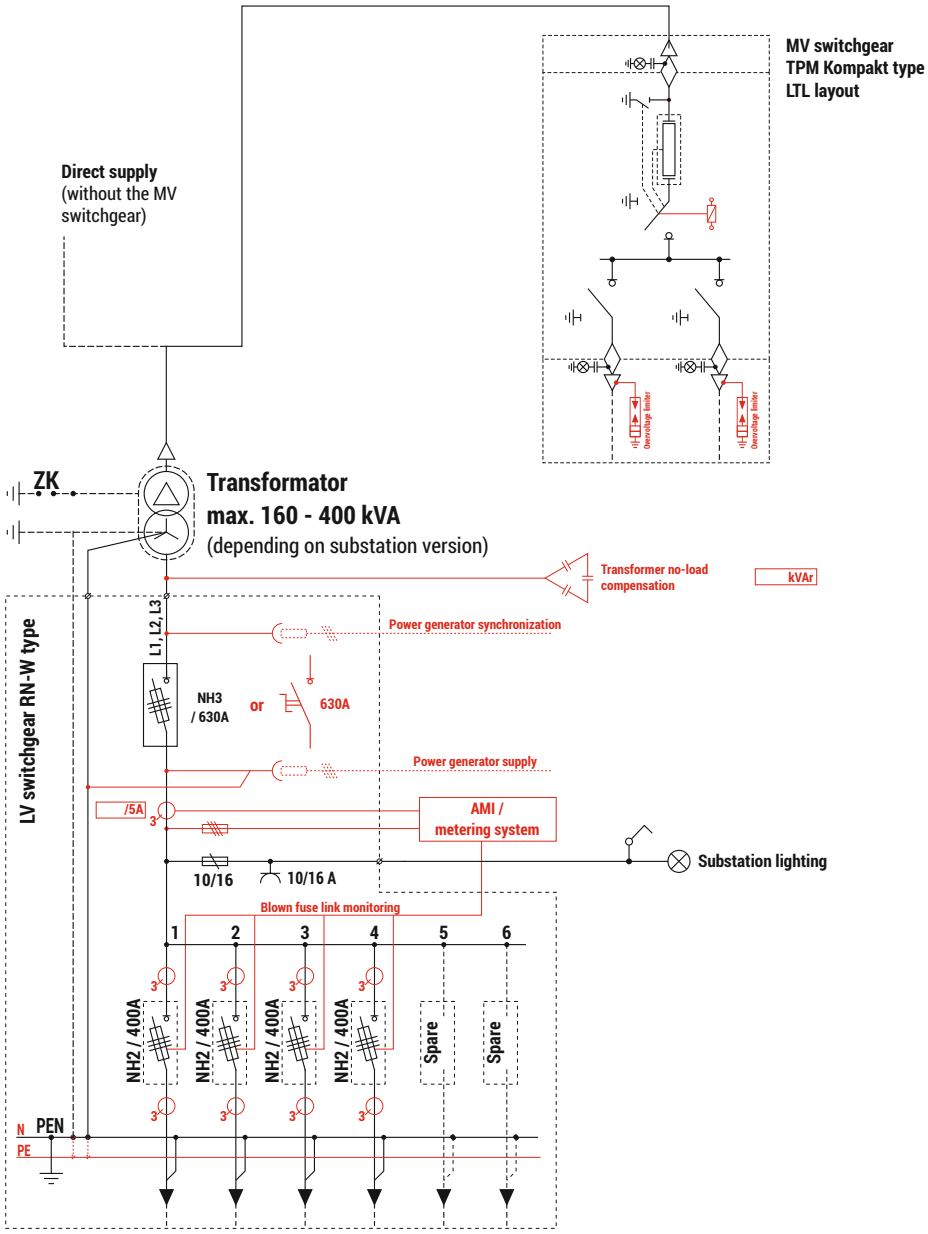
Technical parameters / configuration possibilities		
Transformer (4) Maximum power / dimension	630 kVA / 950 x 1550 x 1850 [mm]	
Internal arc resistance classification	IAC-AB-20 kA-1s	
Enclosure class	10	
Electrical parameters of switchgears	**MV**	**LV**
Rated voltage	up to 25 kV	up to 0,69 kV
Rated current	630 A	up to 1 250 A
Rated short-time withstand current	up to 25 kA (1s)	up to 25 kA (1s)
Rated peak withstand current	up to 63 kA	up to 55 kA
Switchgear**	**Type**	**Maximum number of bays**
LV (5)	RN-W	12
MV (6)	Rotoblok (1000 mm)	1 (possibility only in „b" version)
	TPM / TPM Kompakt	3 (TLL or WLL) / 4 (LLTL)

Mass / area 3,06x1,71 (3x1,65)	
Main structure	9 000 (8 000) kg
Concrete roof	2 000 kg
Usable area	4,06 m^2

* Transformer inserted from above, before the roof is attached.

** Detailed selection of switchgears and their equipment is listed in chapters dedicated to individual devices in the catalogue.
Example layouts of switchgears and corresponding substation configurations are specified in parentheses.
The possibility of installing other types and configurations of switchgears should be arranged every time with the substation manufacturer.

Electrical diagram



NOTE!

Optional equipment was **marked with red** on the electrical diagram.

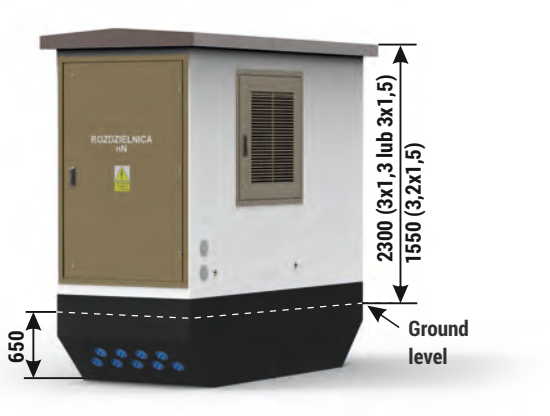
Technical parameters / configuration possibilities		
Transformer (4) Maximum power / dimension	do 160 kVA / 800 x 1050 x 1500 [mm] do 400 kVA / 900 x 1150 x 1600 [mm] (depending on substation type)	
Internal arc resistance classification	IAC-AB-16 kA-1s	
Enclosure class	up to 10 (depending on configuration)	
Electrical parameters of switchgears	**MV**	**LV**
Rated voltage	up to 25 kV	up to 0,69 kV
Rated current	630 A	up to 630 A
Rated short-time withstand current	up to 20 kA (1s)	up to 20 kA (1s)
Rated peak withstand current	up to 50 kA	up to 40 kA
Switchgear**	**Type**	**Maximum number of bays**
LV (5)	RN-W	6
MV (6)	TPM Kompakt / NONE	3 (LTL) / without MV switchgear

Usable area	2,4x1,16	1,8x1,1
Main structure	4 200 kg	3 800 kg
Concrete roof	1 000 kg	600 kg
Usable area	2,18 m^2	1,65 m^2

* Transformer inserted from above, before the roof is attached.

** Detailed selection of switchgears and their equipment is listed in chapters dedicated to individual devices in the catalogue.
Example layouts of switchgears and corresponding substation configurations are specified in parentheses.
The possibility of installing other types and configurations of switchgears should be arranged every time with the substation manufacturer.

Mzb2 type substation (3x1,3) 20/400 / Mzb2 (3x1,5) 20/630 / Mzb2 (3,2x1,5) 20/630



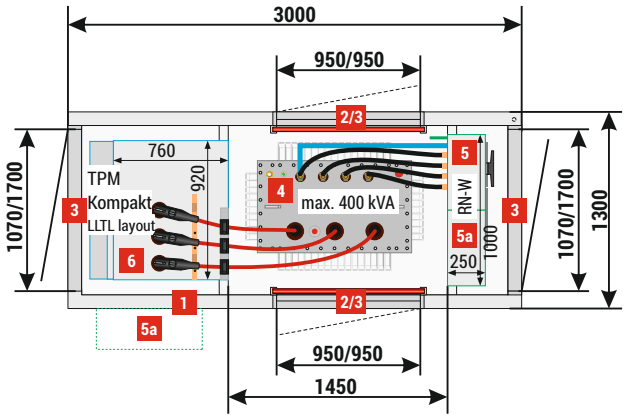
1	Walls, 90 mm thick - **standard**
2	Ventilation louvres IP 23D - **standard**, IP 43 - **optional**
3	Doors: solid or with ventilation louvres, IP 23D - **standard**, IP 43 - **optional**
4	Transformer
5	LV switchgear
5a	AMI cabinet / Smart Grid / telemetry / auxiliary
6	MV switchgear

Height of the main structure of the substation:

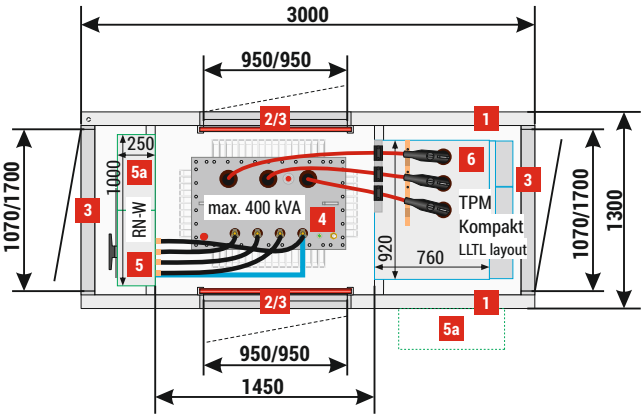
Standard	2850 mm (3x1,3 or 3x1,5) 2200 mm (3,2x1,5)

Placement of equipment

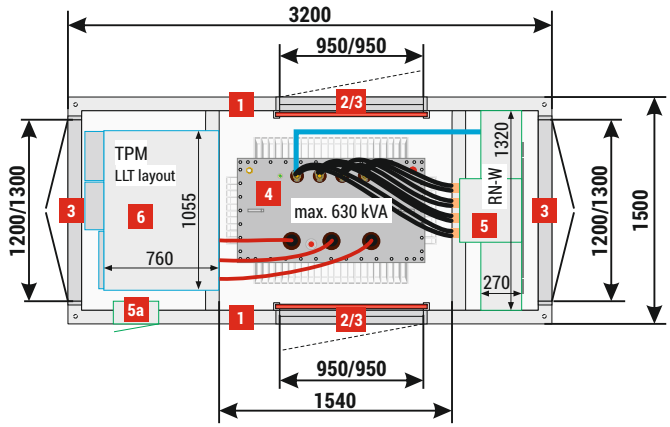
Mzb2 (3x1,3) 20/400-4"a"



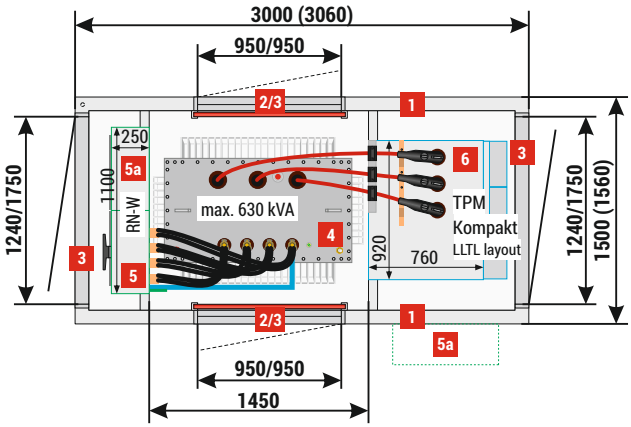
Mzb2 (3x1,3) 20/400-4"b"



Mzb2 (3,2x1,5) 20/630-3"a"



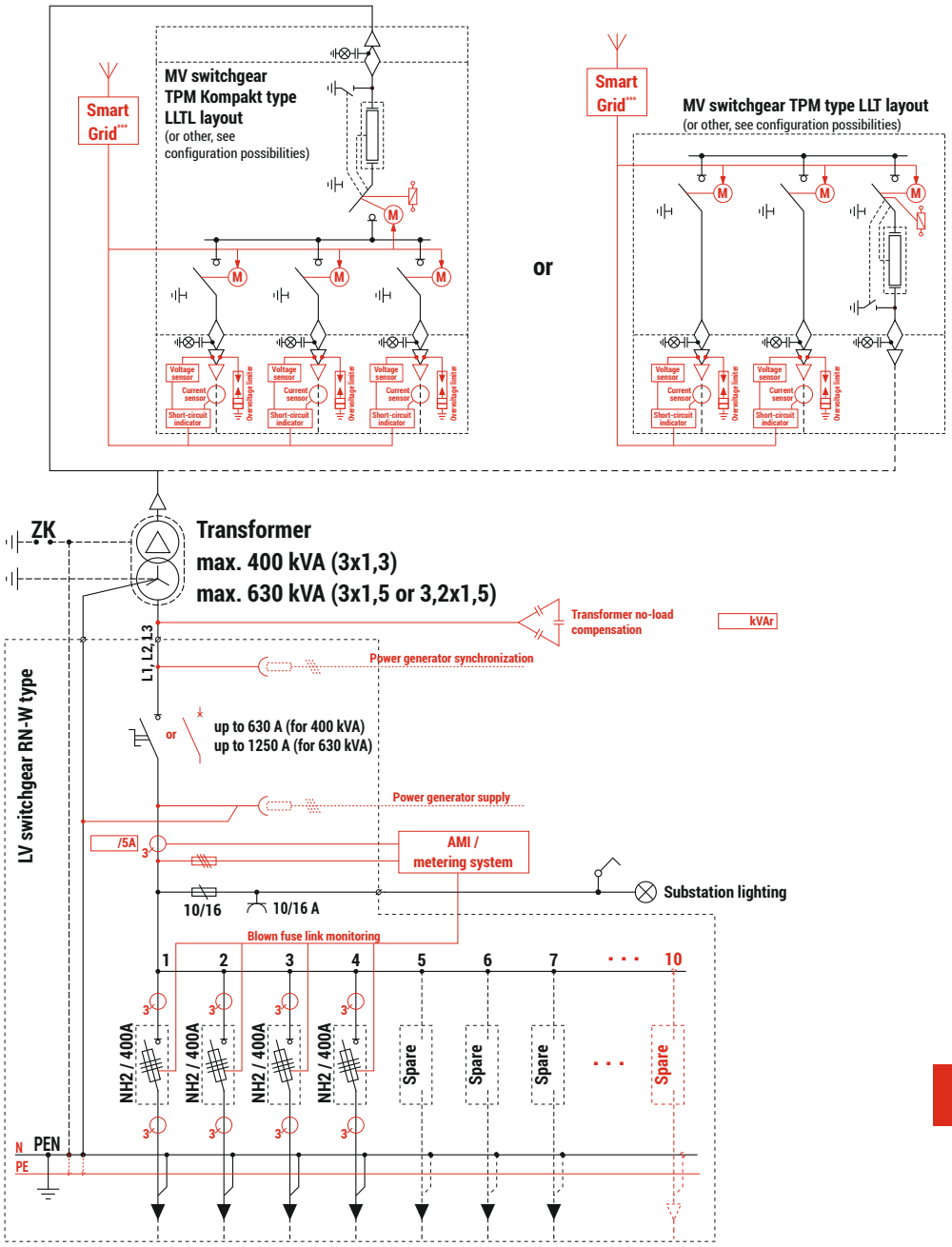
Mzb2 (3x1,5) 20/630-4"b"



NOTE!

The catalogue presents example substation configurations.

Electrical diagram



NOTE!

Optional equipment was **marked with red** on the electrical diagram.

Technical parameters / configuration possibilities		
Transformer (4) Maximum power / dimension	400 kVA / 900 x 1350 x 1700 [mm] (for width - 1300) 630 kVA / 980 x 1400 x 1750 [mm]	
Internal arc resistance classification	IAC-AB-16 kA-1s	
Enclosure class	up to 10 (depending on configuration)	
Electrical parameters of switchgears	**MV**	**LV**
Rated voltage	up to 25 kV	up to 0,69 kV
Rated current	630 A	up to 1250 A
Rated short-time withstand current	up to 25 kA (1s)	up to 25 kA (1s)
Rated peak withstand current	up to 63 kA	up to 55 kA

Switchgear**	Type	Maximum number of bays
LV (5)	RN-W	7 (3x1,3) / 10 (3x1,5 or 3,2x1,5)
MV (6)	TPM	3 (LLT or LLW - for 3x1,5 or 3,2x1,5)
	TPM Kompakt	4 (LLTL)

Mass / area 3x1,3 (3,2x1,5)	
Main structure	6 000 (7000) kg
Concrete roof	1 100 (1400) kg
Usable area	3,16 (3,99) m^2

Mass / area 3x1,5 (3,06x1,56)	
Main structure	6 500 (8500) kg
Concrete roof	1 300 kg
Usable area	3,72 m^2

* Transformer inserted from above, before the roof is attached.
** Detailed selection of switchgears and their equipment is listed in chapters dedicated to individual devices in the catalogue.
Example layouts of switchgears and corresponding substation configurations are specified in parentheses.
The possibility of installing other types and configurations of switchgears should be arranged every time with the substation manufacturer.
*** Smart Grid cabinet fitted outside.

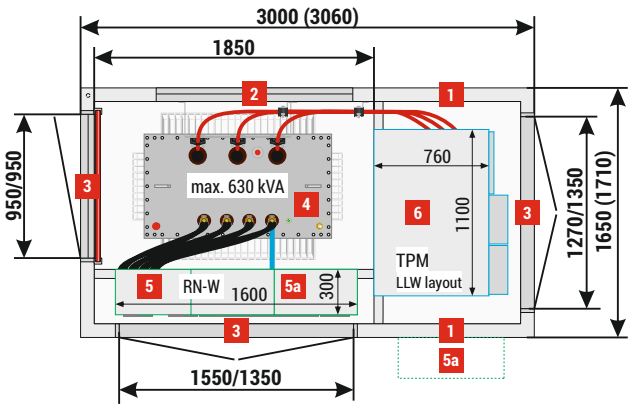
Mzb2 type substation (3x1,65) 20/630

1	Walls, 120 mm thick - **standard**, 90 mm thick - **optional**
2	Ventilation louvres IP 23D - **standard**, IP 43 - **optional**
3	Doors: solid or with ventilation louvres, IP 23D - **standard**, IP 43 - **optional**
4	Transformer
5	LV switchgear
5a	AMI cabinet / Smart Grid / telemetry / auxiliary
6	MV switchgear

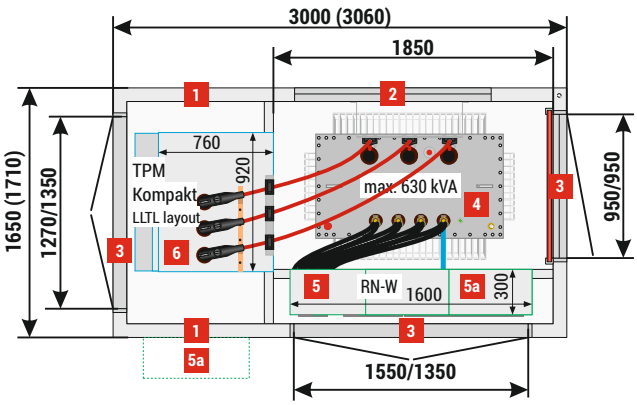
Height of the main structure of the substation:	
Standard	2400 mm
Optional	2250 mm / 2850 mm

Placement of equipment

Mzb2 (3x1,65) 20/630-3"a"



Mzb2 (3x1,65) 20/630-4"b"



NOTE!

The catalogue presents example substation configurations.

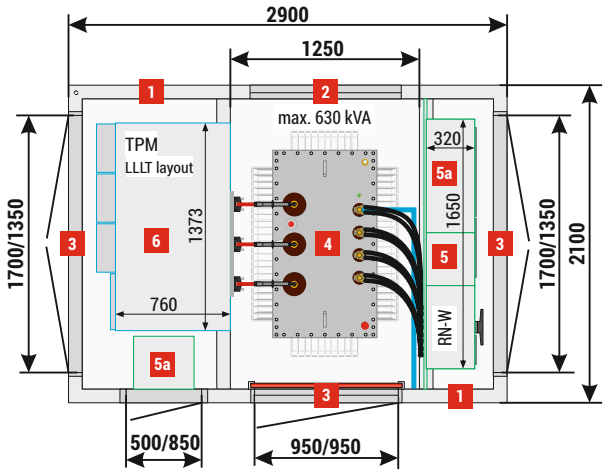
Mzb2 type substation (2,9x2,1) 20/630(1000)

1	Walls, 90 mm thick - **standard**
2	Ventilation louvres IP 23D - **standard**, IP 43 - **optional**
3	Doors: solid or with ventilation louvres, IP 23D - **standard**, IP 43 - **optional**
4	Transformer
5	LV switchgear
5a	AMI cabinet / Smart Grid / telemetry / auxiliary
6	MV switchgear

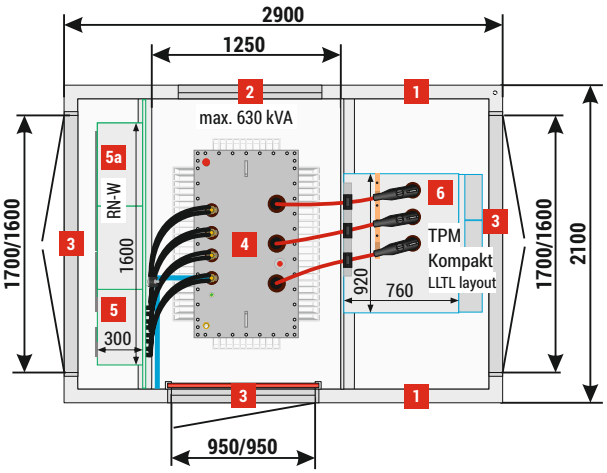
Height of the main structure of the substation:	
Standard	2300 mm
Optional	2650, 2850 mm

Placement of equipment

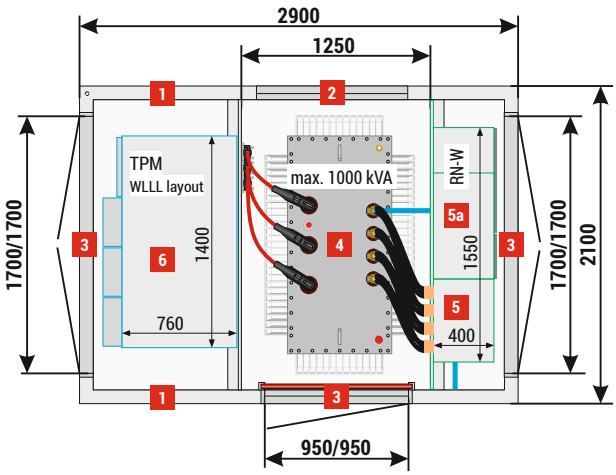
Mzb2 (2,9x2,1) 20/630-4"a"



Mzb2 (2,9x2,1) 20/630-4"b"



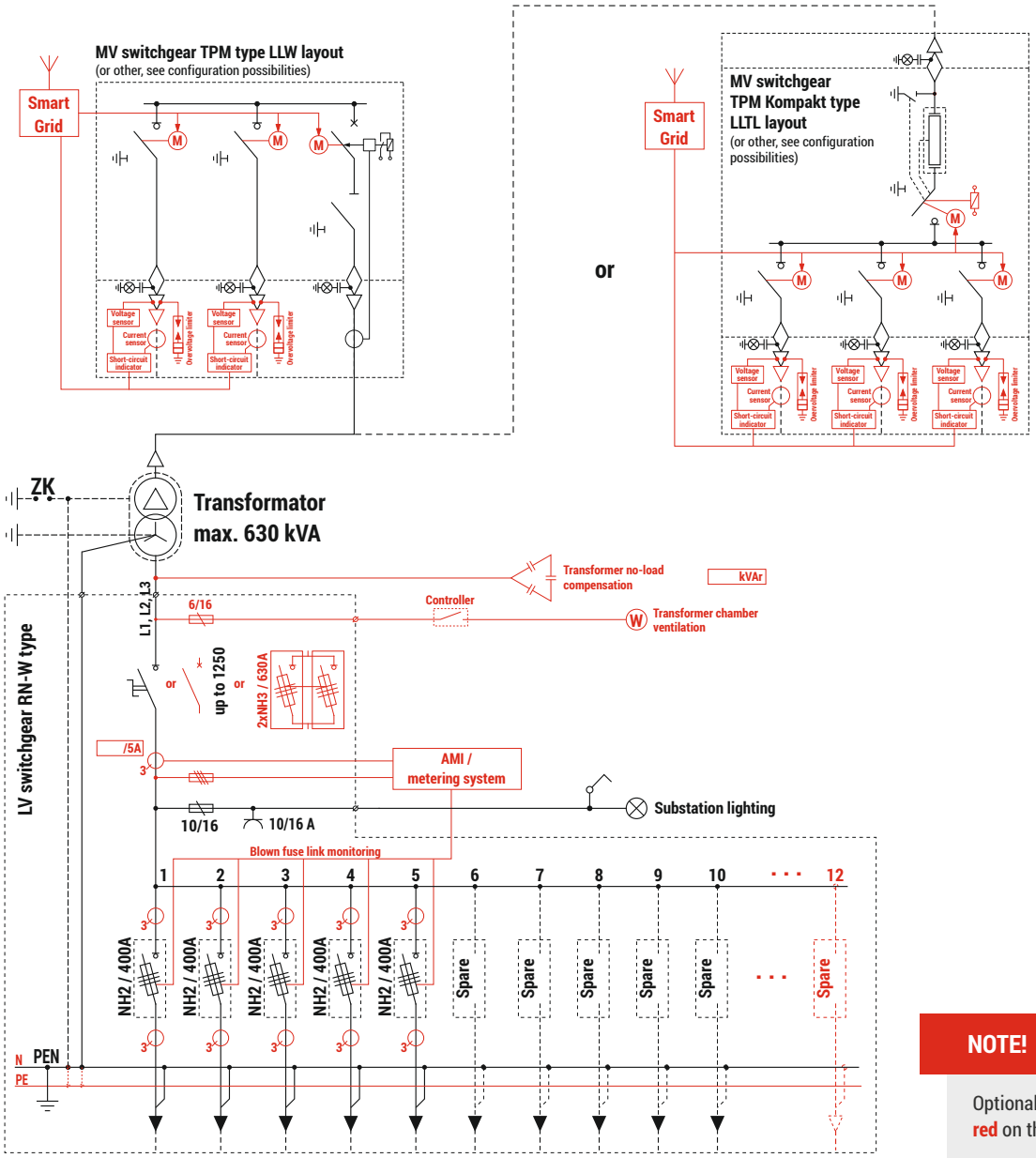
Mzb2 (2,9x2,1) 20/1000-4"a"



NOTE!

The catalogue presents example substation configurations.

Electrical diagram



NOTE!

Optional equipment was **marked with red** on the electrical diagram.

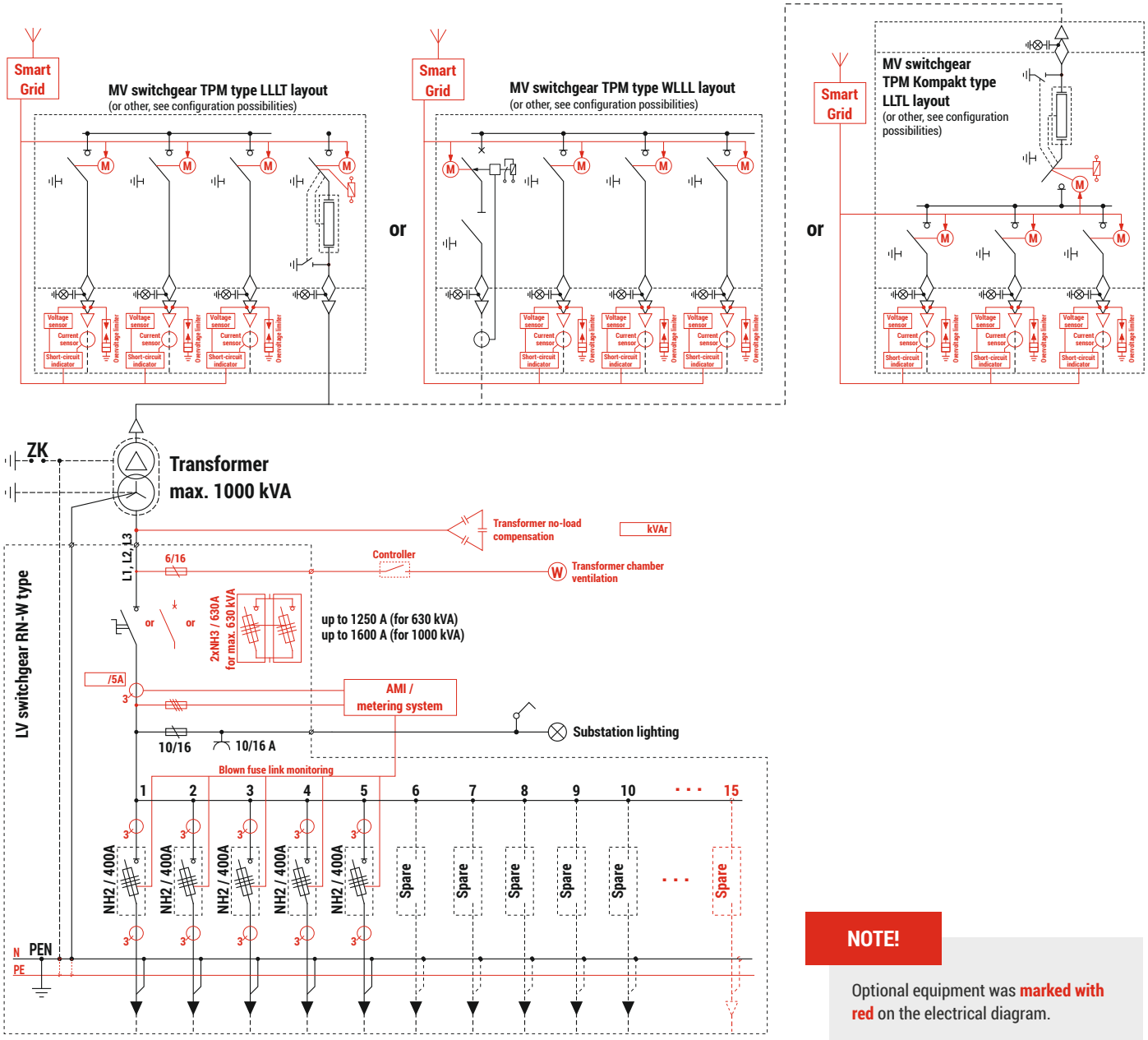
Technical parameters / configuration possibilities		
Transformer (4) Maximum power / dimension	630 kVA / 980 x 1550 x 1750 [mm]	
Internal arc resistance classification	IAC-AB-20 kA-1s	
Enclosure class	up to 10 (depending on configuration)	
Electrical parameters of switchgears	**MV**	**LV**
Rated voltage	up to 25 kV	up to 0,69 kV
Rated current	630 A	up to 1 250 A
Rated short-time withstand current	up to 25 kA (1s)	up to 25 kA (1s)
Rated peak withstand current	up to 63 kA	up to 55 kA
Switchgear**	**Type**	**Maximum number of bays**
nN (5)	RN-W	12
SN (6)	TPM	3 (e.g. WLL or LLT)
	TPM Kompakt (obly for h=2850)	4 (LLTL)

Mass / area 3x1,65 (3,06x1,71)	
Main structure	7 000 (8 500) kg
Concrete roof	2 000 kg
Usable area	4,06 m^2

* Transformer inserted from above, before the roof is attached.

** Detailed selection of switchgears and their equipment is listed in chapters dedicated to individual devices in the catalogue. Example layouts of switchgears and corresponding substation configurations are specified in parentheses.
The possibility of installing other types and configurations of switchgears should be arranged every time with the substation manufacturer.

Electrical diagram



NOTE!

Optional equipment was **marked with red** on the electrical diagram.

Technical parameters / configuration possibilities		
Transformer (4) Maximum power / dimension	1000 kVA / 1150 x 1750 x 1850 [mm]	
Internal arc resistance classification	IAC-AB-20 kA-1s	
Enclosure class	up to 10 (depending on configuration)	
Electrical parameters of switchgears	**MV**	**LV**
Rated voltage	up to 25 kV	up to 0,8 kV
Rated current	630 A	up to 1600 A
Rated short-time withstand current	up to 25 kA (1s)	up to 35 kA (1s)
Rated peak withstand current	up to 63 kA	up to 77 kA

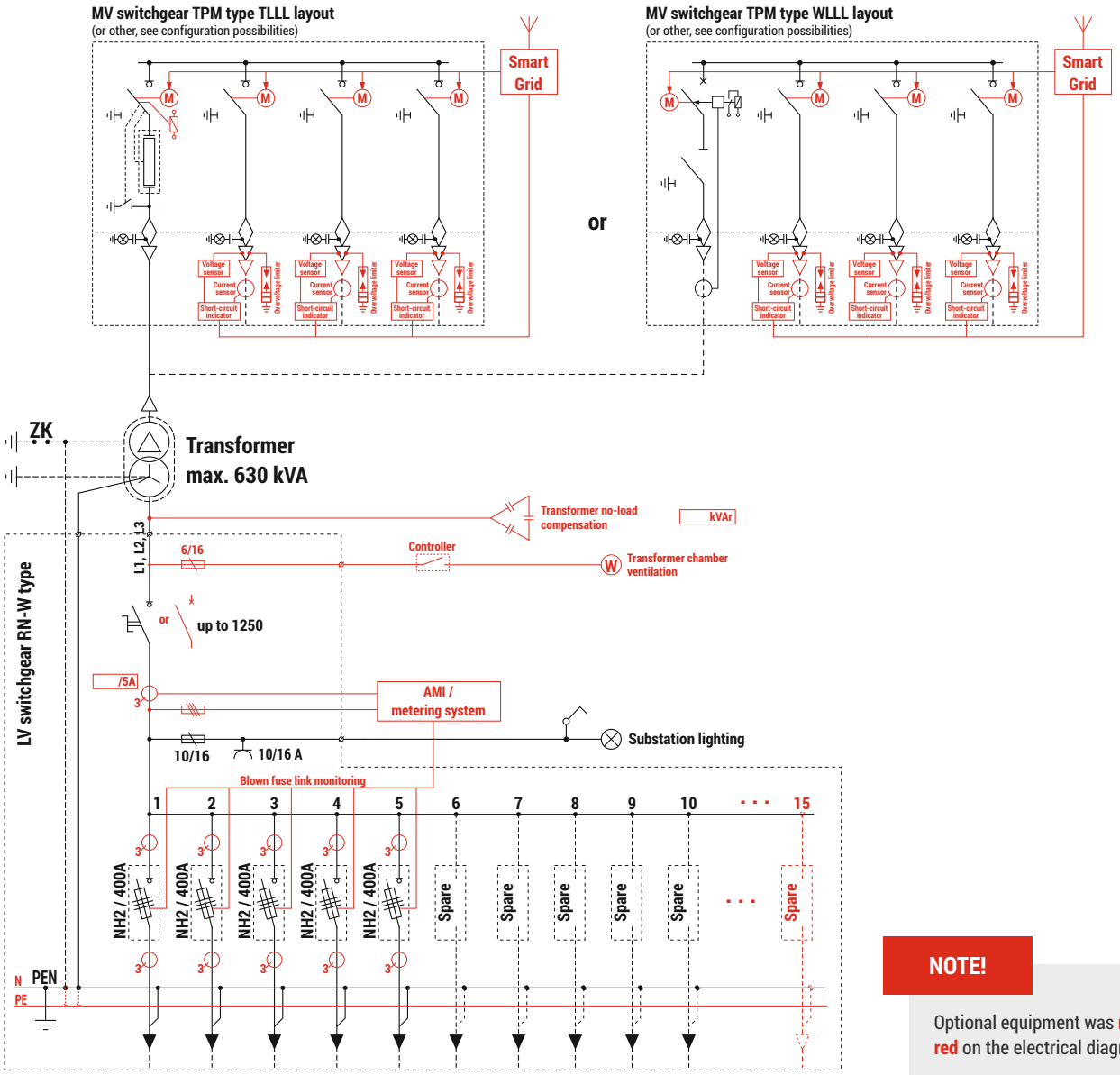
Switchgear**	Type	Maximum number of bays
LV (5)	RN-W	12 (for h = 2300) / 15 (for h = 2850)
MV (6)	TPM	4 (WLLL or LLLT)
	TPM Kompakt (only for h=2850)	4 (LLTL)

Mass / area 2,9x2,1x2,3 (2,9x2,1x2,85)	
Main structure	7 500 (8 600) kg
Concrete roof	2 200 kg
Metal roof	400 kg
Usable area	5,22 m^2

* Transformer inserted from above, before the roof is attached.

** Detailed selection of switchgears and their equipment is listed in chapters dedicated to individual devices in the catalogue. Example layouts of switchgears and corresponding substation configurations are specified in parentheses.
The possibility of installing other types and configurations of switchgears should be arranged every time with the substation manufacturer.

Schemat elektryczny



NOTE!

Optional equipment was **marked with red** on the electrical diagram.

Technical parameters / configuration possibilities		
Transformer (4) Maximum power / dimension	630 kVA / 980 x 1550 x 1850 [mm]	
Internal arc resistance classification	IAC-AB-20 kA-1s	
Enclosure class	20	
Electrical parameters of switchgears	**MV**	**LV**
Rated voltage	up to 25 kV	up to 0,69 kV
Rated current	630 A	up to 1 250 A
Rated short-time withstand current	up to 25 kA (1s)	up to 25 kA (1s)
Rated peak withstand current	up to 63 kA	up to 55 kA
Switchgear**	**Type**	**Maximum number of bays**
LV (5)	RN-W	15
MV (6)	TPM	4 (TLLL or WLLL)

Mass / area	
Main structure	4 800 kg
Concrete roof	1 800 kg
Metal roof	300 kg
Usable area	4,15 m^2

* Transformer inserted from above, before the roof is attached.
** Detailed selection of switchgears and their equipment is listed in chapters dedicated to individual devices in the catalogue. Example layouts of switchgears and corresponding substation configurations are specified in parentheses.
The possibility of installing other types and configurations of switchgears should be arranged every time with the substation manufacturer.

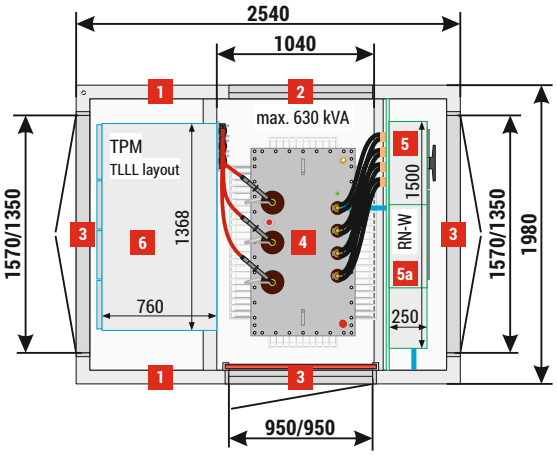
Mzb2 type substation (2,54x1,98) 20/630 (old name - Minibox 20/630)

1	Walls, 90 mm thick - **standard**
2	Ventilation louvres IP 23D - **standard**, IP 43 - **optional**
3	Doors: solid or with ventilation louvres, IP 23D - **standard**, IP 43 - **optional**
4	Transformer
5	LV switchgear
5a	AMI cabinet / Smart Grid / telemetry / auxiliary
6	MV switchgear

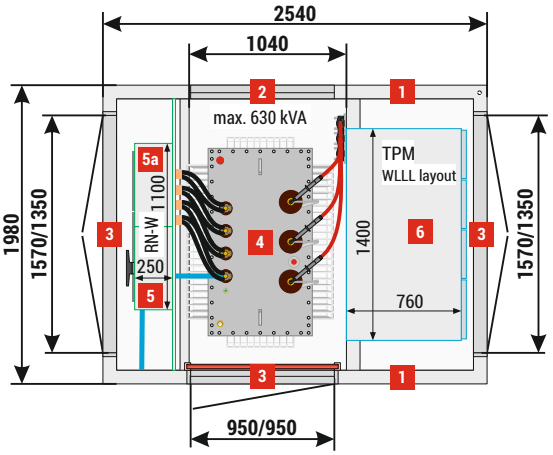
Height of the main structure of the substation:	
Standard	2400 mm
Optional	2850 mm

Placement of equipment

Mzb2 (2,54x1,98) 20/630-4"a" (Minibox 20/630)



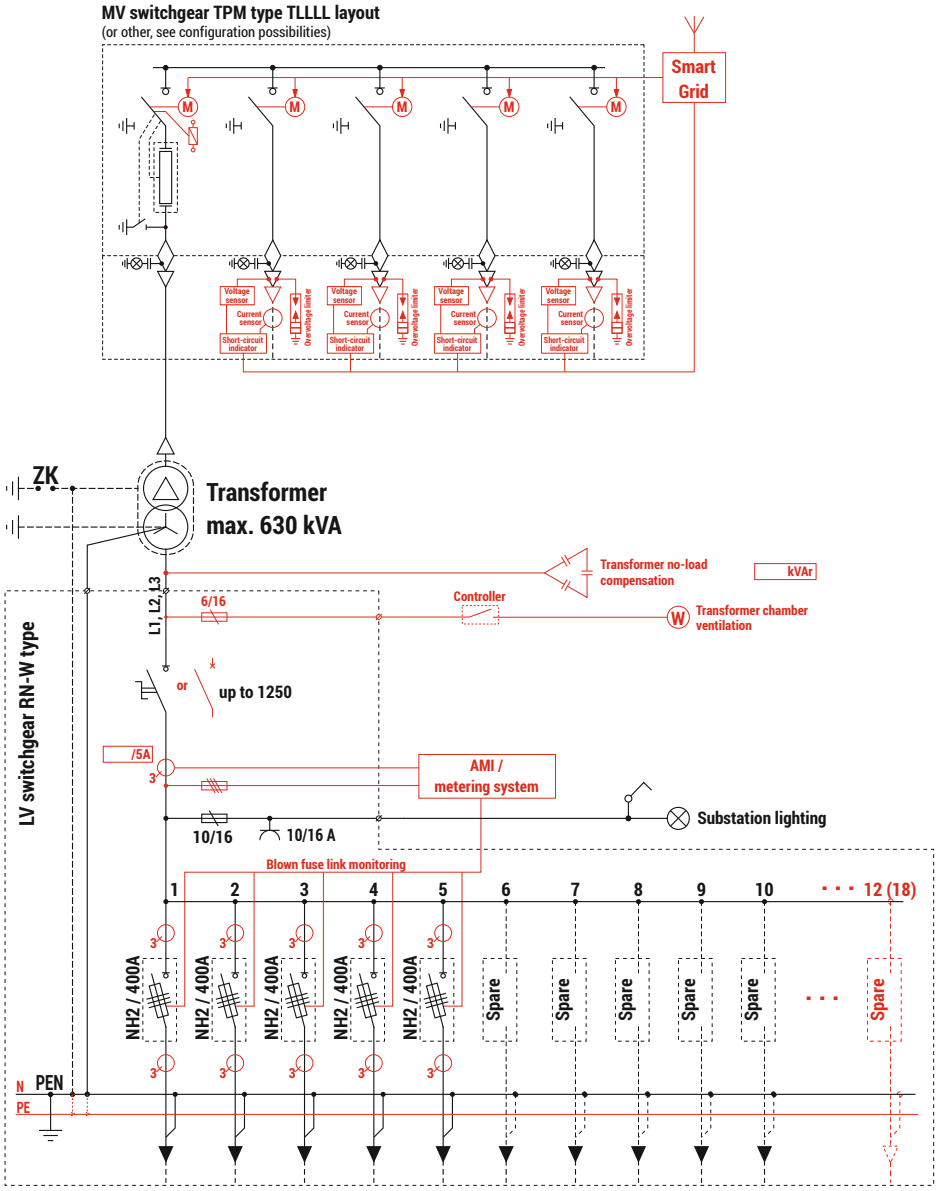
Mzb2 (2,54x1,98) 20/630-4"b" (Minibox 20/630)



NOTE!

The catalogue presents example substation configurations.

Electrical diagram



NOTE!

Optional equipment was **marked with red** on the electrical diagram.

Technical parameters / configuration possibilities		
Transformer (4) Maximum power / dimension	630 kVA / 980 x 1550 x 1850 [mm]	
Internal arc resistance classification	IAC-AB-20 kA-1s	
Enclosure class	10	
Electrical parameters of switchgears	**MV**	**LV**
Rated voltage	up to 25 kV	up to 0,69 kV
Rated current	630 A	up to 1250 A
Rated short-time withstand current	up to 25 kA (1s)	up to 25 kA (1s)
Rated peak withstand current	up to 63 kA	up to 55 kA
Switchgear**	**Type**	**Maximum number of bays**
LV (5)	RN-W	12/18 (if Smart Grid with AMI)
MV (6)	TPM	5 (TLLLL or WLLLL)

Mass / area	
Main structure	8 000 kg
Concrete roof	2 450 kg
Metal roof	300-500 kg
Usable area	5,49 m^2

* Transformer inserted from above, before the roof is attached.
** Detailed selection of switchgears and their equipment is listed in chapters dedicated to individual devices in the catalogue. Example layouts of switchgears and corresponding substation configurations are specified in parentheses.
The possibility of installing other types and configurations of switchgears should be arranged every time with the substation manufacturer.

Mzb2"b" type substation 20/630

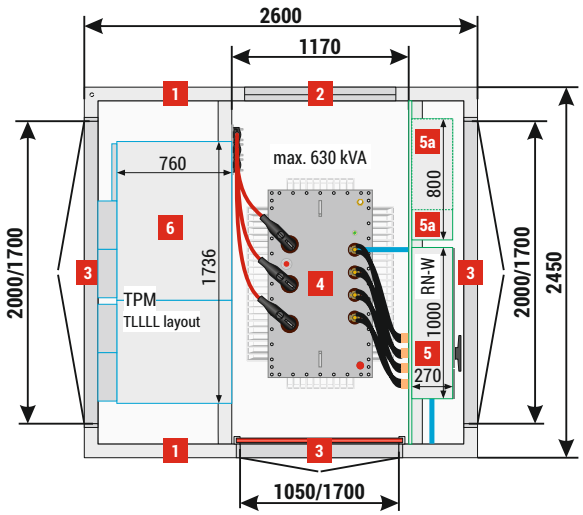
1	Walls, 90 mm thick - **standard**
2	Ventilation louvres IP 23D - **standard**, IP 43 - **optional**
3	Doors: solid or with ventilation louvres, IP 23D - **standard**, IP 43 - **optional**
4	Transformer
5	LV switchgear
5a	AMI cabinet / Smart Grid / telemetry / auxiliary
6	MV switchgear

Height of the main structure of the substation:

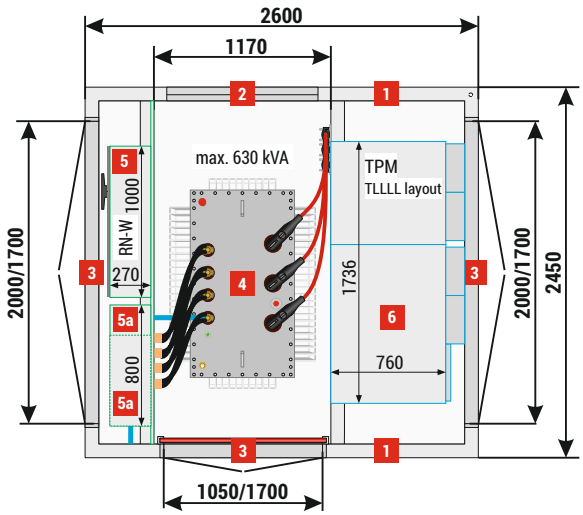
Standard	2650 mm

Placement of equipment

Mzb2"b" 20/630-5"a"



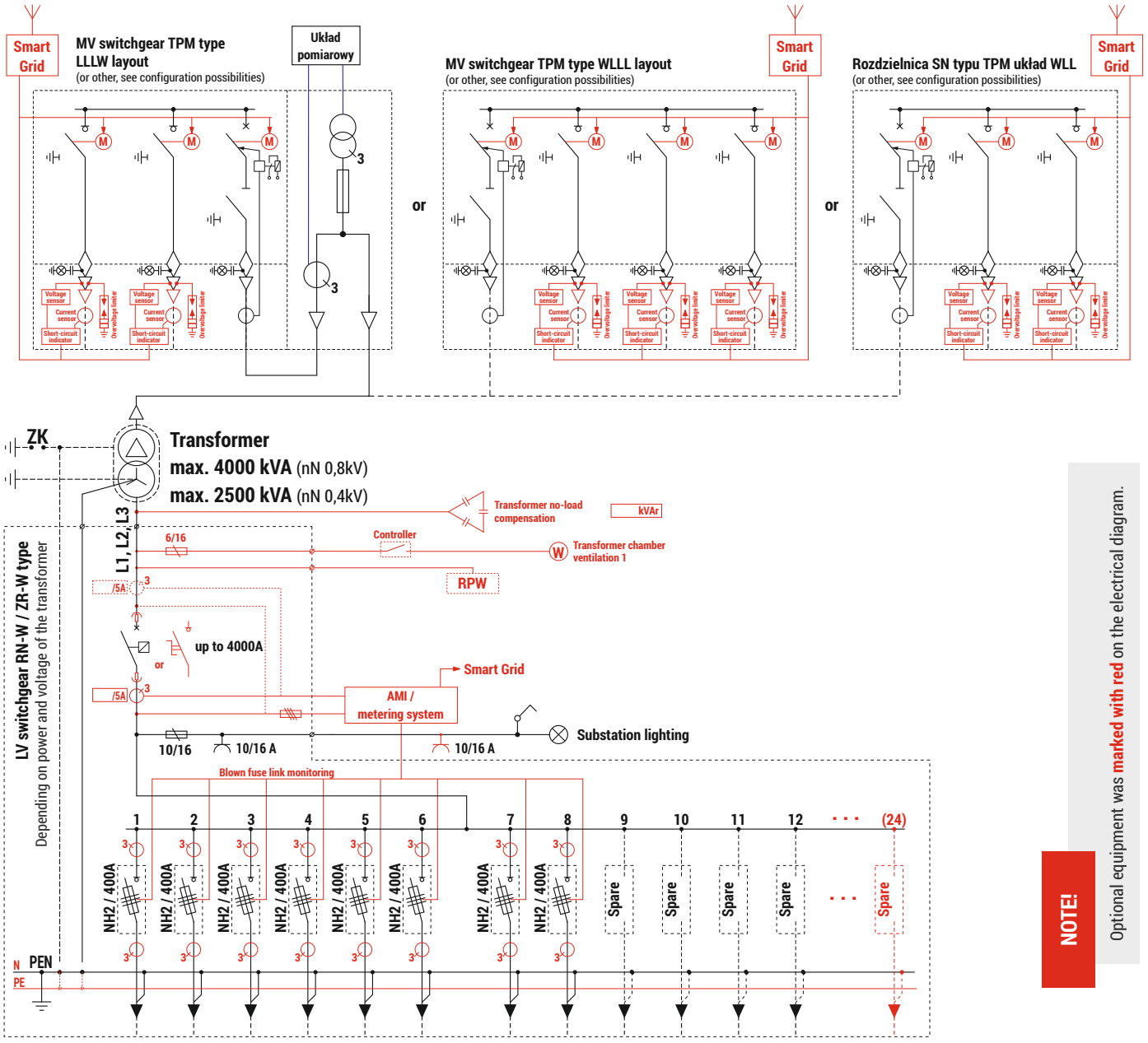
Mzb2"b" 20/630-5"b"



NOTE!

The catalogue presents example substation configurations.

Electrical diagram - single transformer version



NOTE!

Optional equipment was **marked with red** on the electrical diagram.

Technical parameters / configuration possibilities		
Transformer (4) Maximum power / dimension	4000 kVA (nN 0,8 kV) 2500 kVA (nN 0,4 kV)	
Internal arc resistance classification	IAC-AB-20 kA-1s	
Enclosure class	up to 10 (depending on configuration)	
Electrical parameters of switchgears	**MV**	**LV**
Rated voltage	up to 25 kV	up to 0,8 kV
Rated current	630 A	up to 4 000 A
Rated short-time withstand current	up to 25 kA (1s)	up to 85 kA (1s)
Rated peak withstand current	up to 63 kA	up to 187 kA

Switchgear**	Type	Maximum number of bays
LV (5)	RN-W	20 (width 2600) / 24 (width 3000)
	ZR-W	16 (width 2600) / 20 (width 3000)
MV (6)	TPM	6 (e.g. LLLLLW for width 2600) 7 (e.g. TLLLLLL for width 3000)
	Rotoblok SF (500)	4 (width 2600) / 5 (width 3000)

Mass (without transformer) / Area	
Main structure	9 500 - 22 000 kg
Concrete roof	3 200 - 5 200 kg
Metal roof	350 - 800 kg
Usable area	7,19 - 12,75 m^2

* Transformer inserted from above, before the roof is attached.

** Detailed selection of switchgears and their equipment is listed in chapters dedicated to individual devices in the catalogue. Example layouts of switchgears and corresponding substation configurations are specified in parentheses.
The possibility of installing other types and configurations of switchgears should be arranged every time with the substation manufacturer.

Mzb2 type substation (3,15x2,6 do 4,76x3,06) - single transformer variant

1	Walls, 120 mm thick - **standard**, 90 mm - **optional**
2	Ventilation louvres IP 23D - **standard**, IP 43 - **optional**
3	Doors: solid or with ventilation louvres, IP 23D - **standard**, IP 43 - **optional**
4	Transformer
5	LV switchgear
5a	AMI cabinet / Smart Grid / telemetry / auxiliary
6	MV switchgear

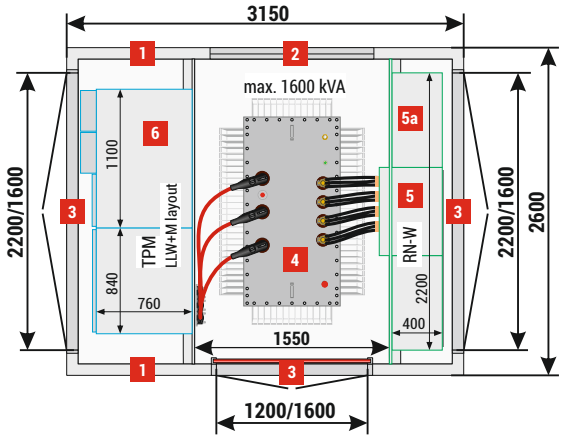
Height of the main structure of the substation:	
Standard	2650 mm
Optional	2400, 3000 mm

Substations may be made in variants:	
Length	3150 mm / 3800 mm / 4200 mm / 4700 mm
Width	2600 mm / 3000 mm

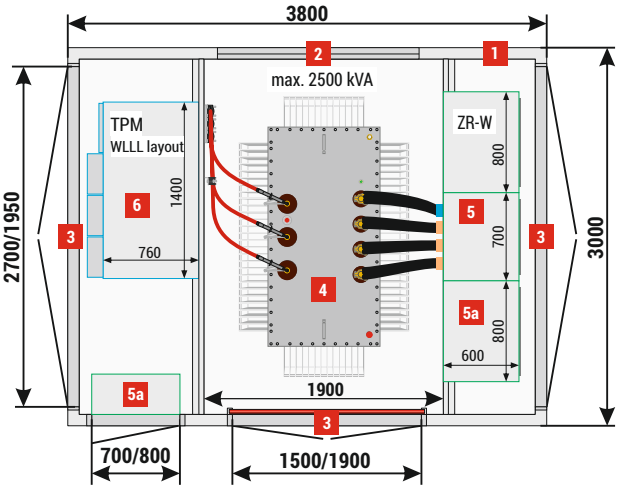
Above dimensions are valid for 90 mm thick walls,
For 120 mm walls, for every dimensions 60 mm should be added.

Placement of equipment

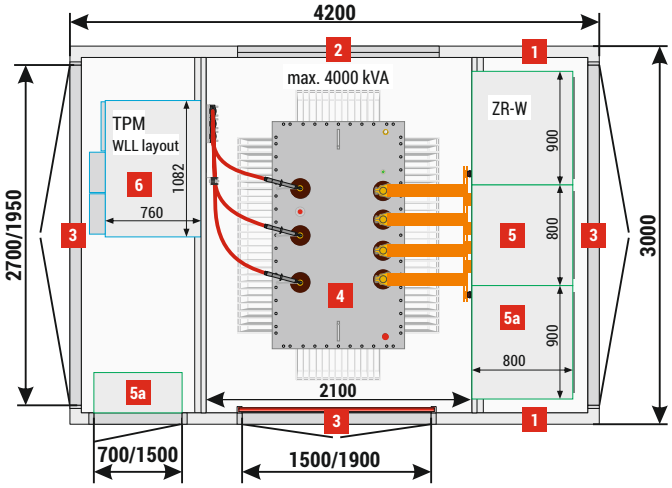
Mzb2 (3,15x2,6) 20/1600-4



Mzb2 (3,8x3) 20/2500-4



Mzb2 (4,2x3) 20/4000-3



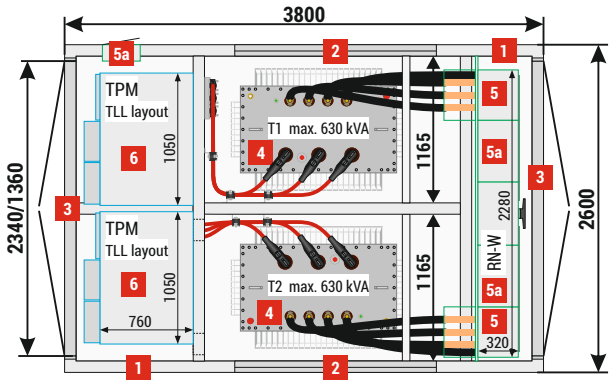
NOTE!

The catalogue presents example substation configurations.

Mzb2 type substation (3,15x2,6 do 4,76x3,06) - double transformer version

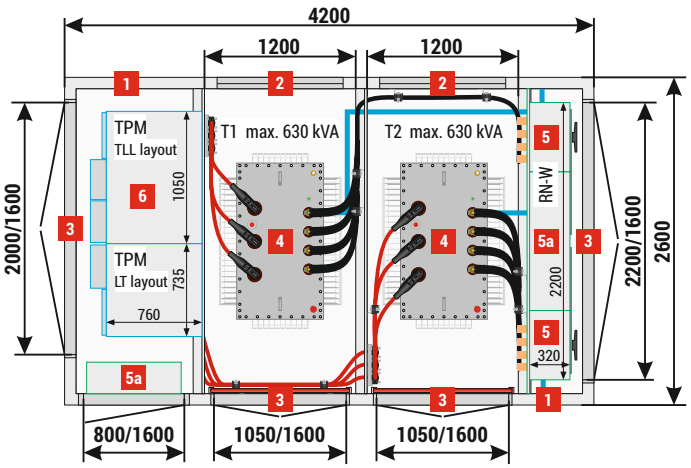
Electrical diagram

Mzb2 (3,8x2,6) 20/2x630-6



1	Walls, 120 mm thick - **standard**, 90 mm - **optional**
2	Ventilation louvres IP 23D - **standard**, IP 43 - **optional**
3	Doors: solid or with ventilation louvres, IP 23D - **standard**, IP 43 - **optional**
4	Transformer
5	LV switchgear
5a	AMI cabinet / Smart Grid / telemetry / auxiliary
6	MV switchgear

Mzb2 (4,2x2,6) 20/2x630-5

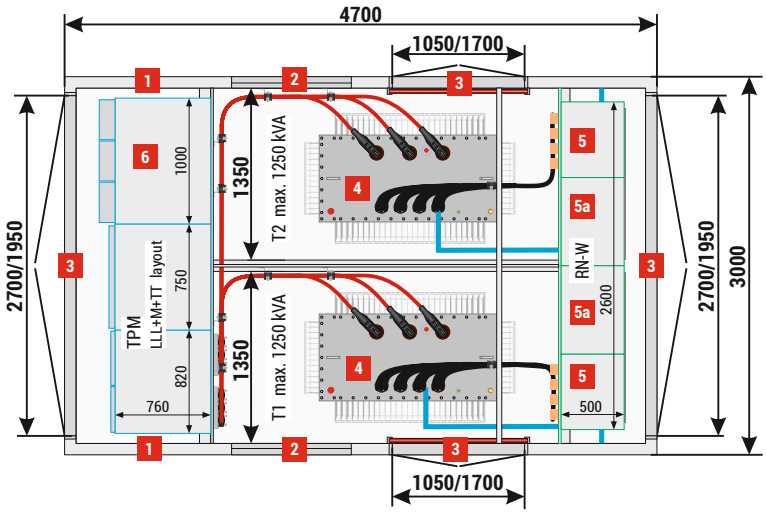


Height of the main structure of the substation:	
Standard	2650 mm
Optional	2400, 3000 mm

Substations may be made in variants:	
Length	3150 mm / 3800 mm / 4200 mm / 4700 mm
Width	2600 mm / 3000 mm

Above dimensions are valid for 90 mm thick walls, For 120 mm walls, for every dimensions 60 mm should be added.

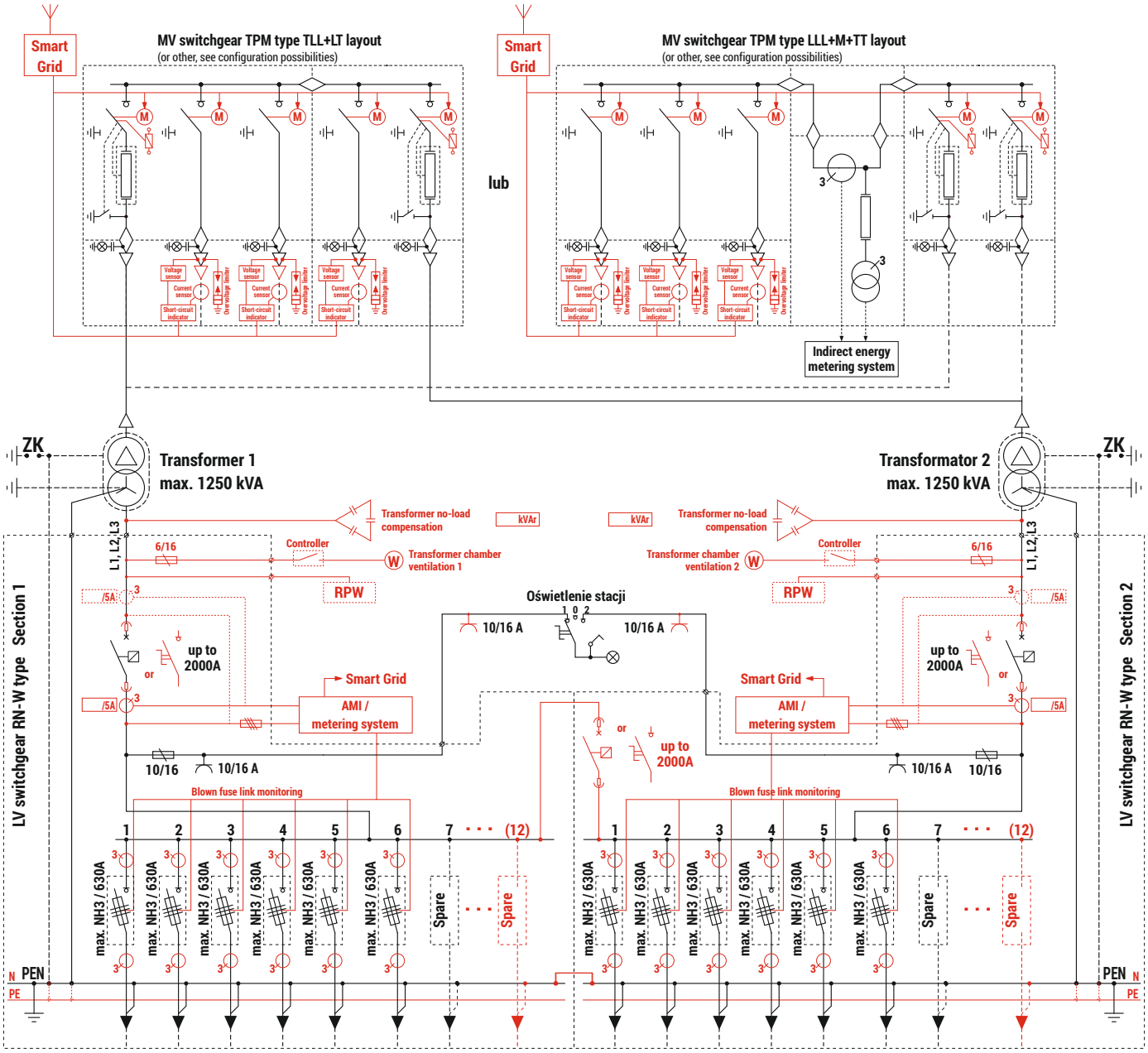
Mzb2 (4,7x3) 20/2x1250-6



NOTE!

The catalogue presents example substation configurations.

Electrical diagram - double transformer version



Technical parameters / configuration possibilities		
Transformer (4) Maximum power / dimension	2 x up to 1250 kVA	
Internal arc resistance classification	IAC-AB-20 kA-1s	
Enclosure class	up to 10 (depending on configuration)	
Electrical parameters of switchgears	**MV**	**LV**
Rated voltage	up to 25 kV	up to 0,8 kV
Rated current	630 A	up to 2 000 A
Rated short-time withstand current	up to 25 kA (1s)	up to 35 kA (1s)
Rated peak withstand current	up to 63 kA	up to 77 kA

Switchgear**	Type	Maximum number of bays
nN (5)	RN-W	do 2 x 12
SN (6)	TPM	6 (e.g. TLL; TLL or LLL+M+TT)
	Rotoblok SF (500)	5

NOTE!

Optional equipment was **marked with red** on the electrical diagram.

Mass (without transformer) / Area	
Main structure	9 500 - 22 000 kg
Concrete roof	3 200 - 5 200 kg
Metal roof	350 - 800 kg
Usable area	7,19 - 12,75 m^2

* Transformer inserted from above, before the roof is attached.

** Detailed selection of switchgears and their equipment is listed in chapters dedicated to individual devices in the catalogue. Example layouts of switchgears and corresponding substation configurations are specified in parentheses.
The possibility of installing other types and configurations of switchgears should be arranged every time with the substation manufacturer.

Container transformer substations

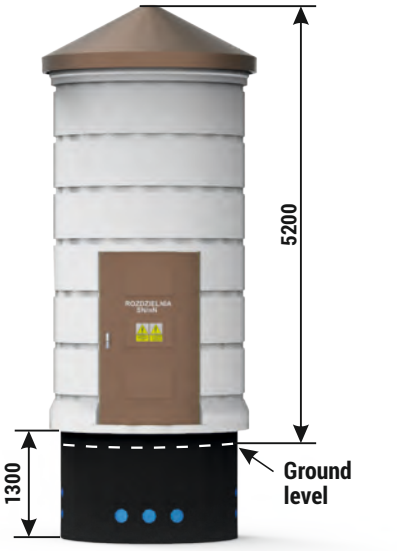
2 / WST “Advertising pole”.
Compact transformer substation in concrete enclosure

INTRODUCTION

The WST type substation may be used in every situation where the placement of typical transformer substations is not possible due to architectural constraints. Since it occupies a very small area, it fits perfectly into landscapes of old towns, markets and squares surrounded by dense, old buildings, and it has a stylised façade which enables adapting it to the architecture of existing buildings.

The station is a building composed of four monolithic reinforced concrete castings with a circular cross-section, which include: foundations, main structure with MV and LV switchgears, main structure with transformer chamber, and roof.

WST type substation 20/630



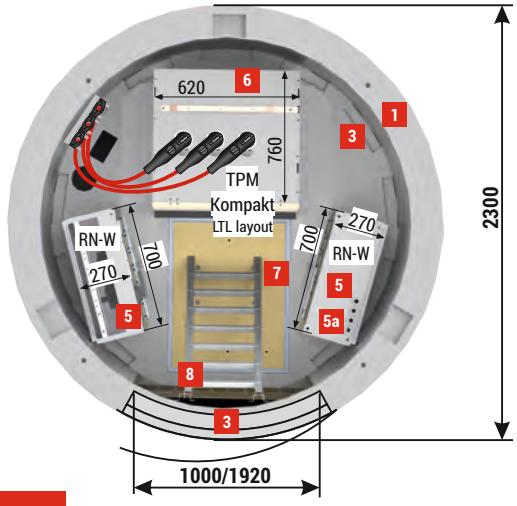
1	Walls, 130 mm thick – **standard** Fire integrity class REI 120
2	Ventilation grating IP 23D - **standard**, IP 43 - **optional**
3	Doors: solid or with ventilation louvres without fire integrity IP 23D - **standard**, IP 43 - **optional** Doors with fire resistance e.g EI 60 or EI 120 - **optional**
4	Transformer
5	LV switchgear
5a	AMI cabinet / Smart Grid / telemetry / auxiliary
6	MV switchgear
7	Cable duct hatch door
8	Hatch / ladder to the transformer chamber

Substation height is specified as total above the ground level, with concrete roof

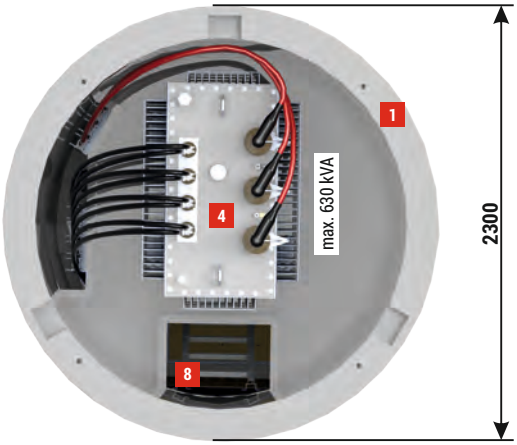
Height	5200 mm

Placement of equipment

Switchgear structure



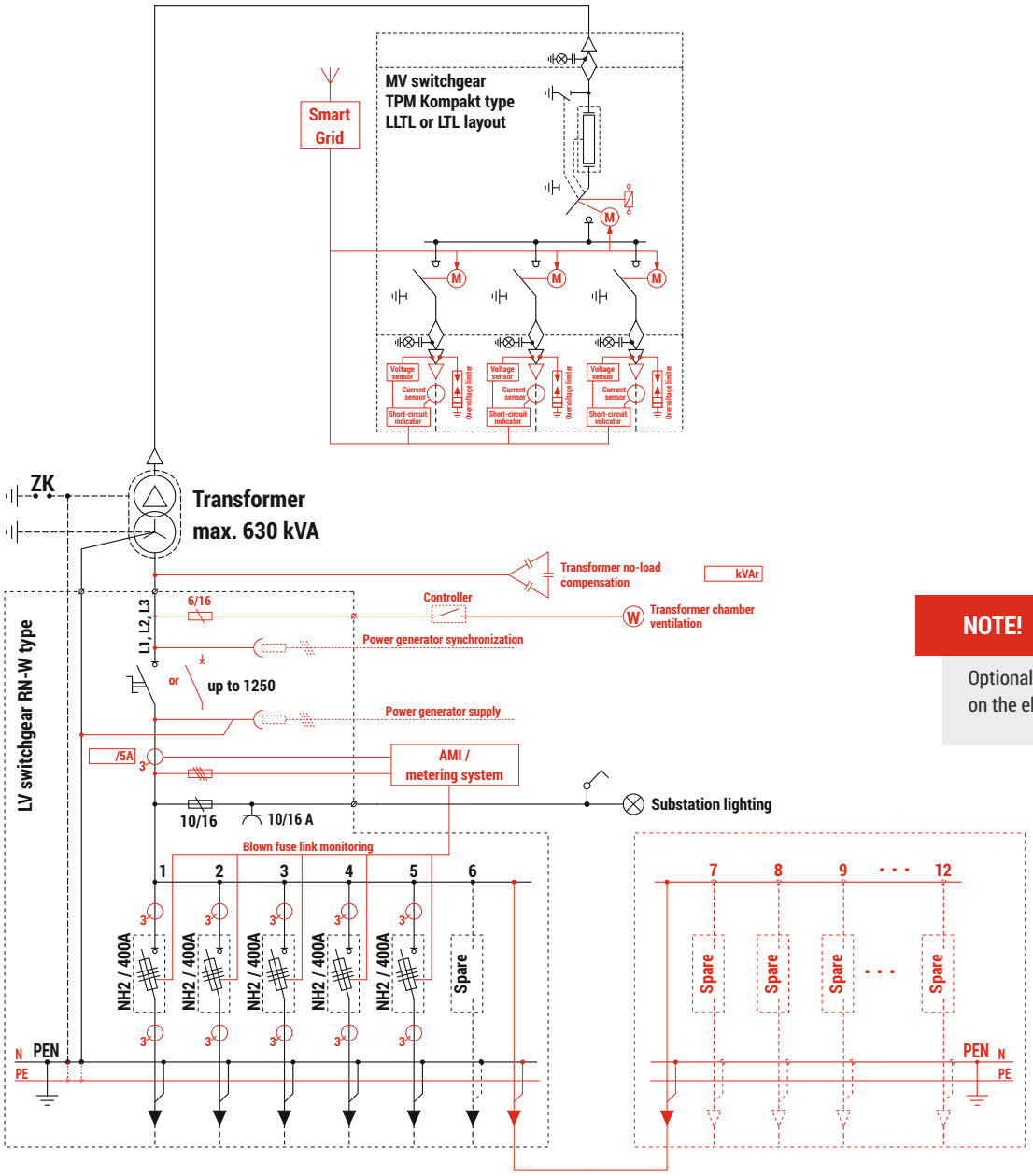
Transformer chamber structure



NOTE!

The catalogue presents example substation configurations.

Electrical diagram



NOTE!

Optional equipment was **marked with red** on the electrical diagram.

Technical parameters / configuration possibilities		
Transformer* (4) Maximum power / dimension	630 kVA / 950 x 1400 x 1650 [mm]	
Internal arc resistance classification	IAC-AB-20 kA-1s	
Enclosure class	20	
Electrical parameters of switchgears	**MV**	**LV**
Rated voltage	up to 25 kV	up to 0,69 kV
Rated current	630 A	up to 1250 A
Rated short-time withstand current	up to 25 kA (1s)	up to 25 kA (1s)
Rated peak withstand current	up to 63 kA	up to 55 kA
Switchgear**	**Type**	**Maximum number of bays**
LV (5)	RN-W	12 (for TPM Kompakt - LLTL or TPM C - LTL)
MV (6)	TPM Kompakt	4 (LLTL)

Mass / Area	
Foundation	3 600 kg
Switchgear structure	5 200 kg
Transformer structure	5 100 kg
Concrete roof	1 500 kg
Metal roof	350 kg
Usable area	3,46 m^2

* Transformer inserted from above, before the roof is attached.

** Detailed selection of switchgears and their equipment is listed in chapters dedicated to individual devices in the catalogue. Example layouts of switchgears and corresponding substation configurations are specified in parentheses.
The possibility of installing other types and configurations of switchgears should be arranged every time with the substation manufacturer.

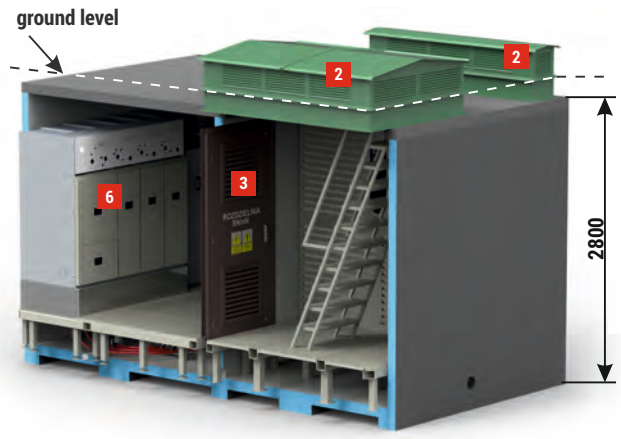
Container transformer substations

3 / PST-b
Underground transformer substation

INTRODUCTION

In every place where it is not possible to place any "conventional, above ground" substation due to architectural considerations and lack of space, underground substations are the only solution. The station is constructed as a sealed, monolithic concrete container to be placed under ground level, with medium and low voltage switchgears installed inside.
The used MV switchgear (TPM, Rotoblok SF) and LV (RW-N) form independent elements of the station. The station may be placed under walkway, square etc.
A bilge between two floors ensures correct operation even in case of surface rainwater infiltration through ventilation openings. Water-tight cable entries and sealed concrete enclosure ensure many years of reliable operation.

PST-b type substation (4.7x3) 20/630

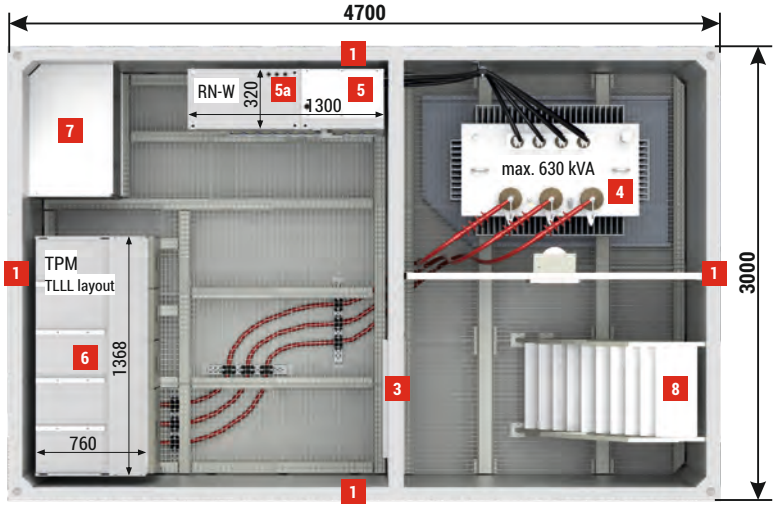


1	Walls, 120 mm thick - **standard**, 90 mm - **optional**
2	Ventilation louvres IP 23D - **standard**, IP 43 - **optional**
3	Doors: solid or with ventilation louvres without fire integrity IP 23D - **standard**, IP 43 - **optional**
	Doors with fire resistance e.g EI 60 lub EI 120 - **optional**
4	Transformer
5	LV switchgear
5a	AMI cabinet / Smart Grid / telemetry / auxiliary
6	MV switchgear
7	Cable duct hatch door
8	Hatch / ladder to the transformer chamber

Height of the main structure of the substation:	
External height	2800 mm
Internal height	2050 mm

Placement of equipment

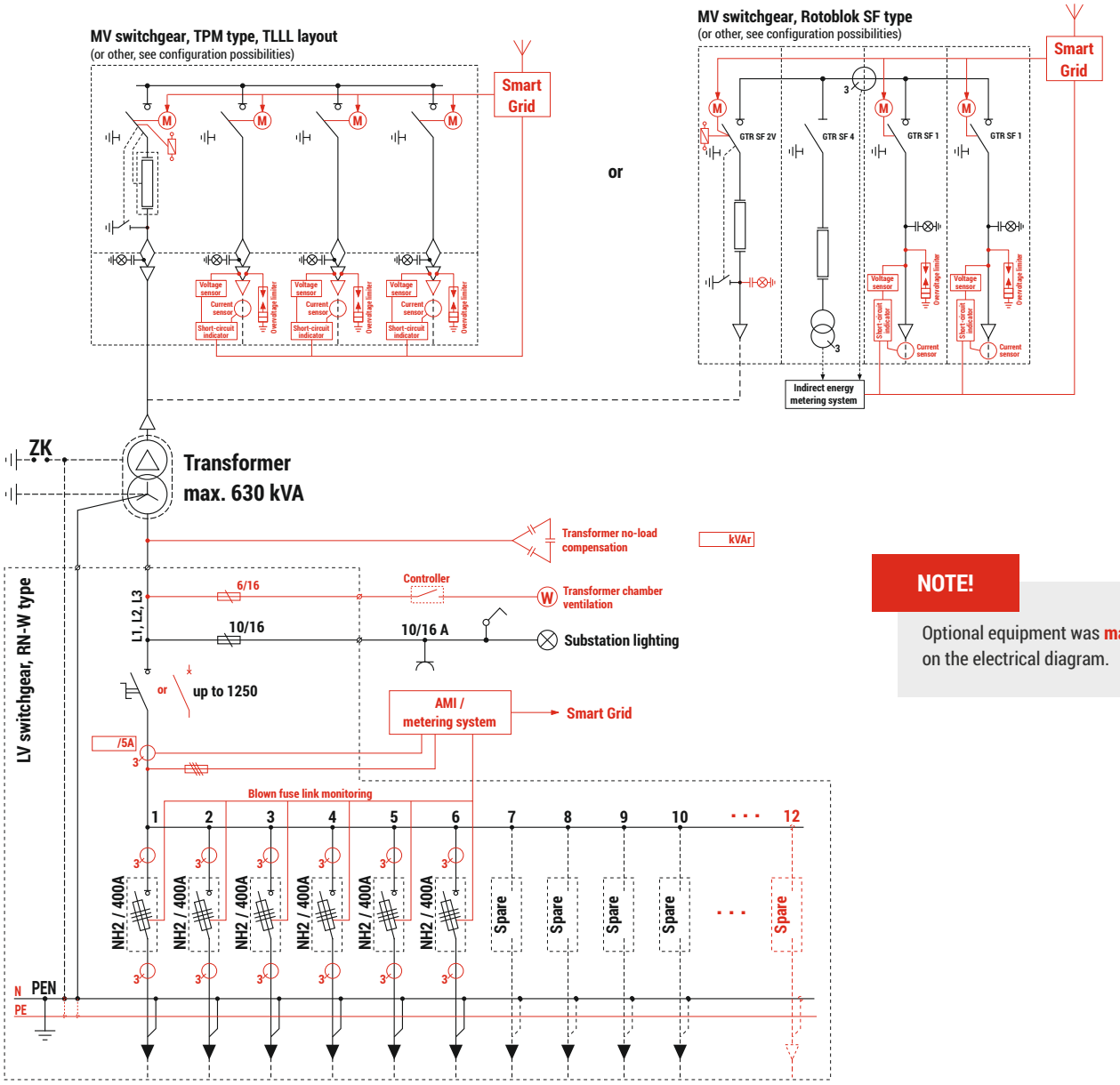
PST-b (4,7x3) 20/630-4



NOTE!

The catalogue presents example substation configurations.

Electrical diagram



NOTE!

Optional equipment was **marked with red** on the electrical diagram.

Technical parameters / configuration possibilities		
Transformer* (4) Maximum power / dimension	630 kVA / 980* x 2000 x 1850 [mm]	
Internal arc resistance classification	IAC-AB-16 kA-1s	
Enclosure class	20	
Electrical parameters of switchgears	**MV**	**LV**
Rated voltage	up to 25 kV	up to 0,69 kV
Rated current	630 A	up to 1250 A
Rated short-time withstand current	up to 20 kA (1s)	up to 25 kA (1s)
Rated peak withstand current	up to 50 kA	up to 52,5 kA
Switchgear**	**Type**	**Maximum number of bays**
LV (5)	RN-W	12
MV (6)	TPM	4 (TLLL or WLLL)
	Rotoblok SF (500 mm)	4

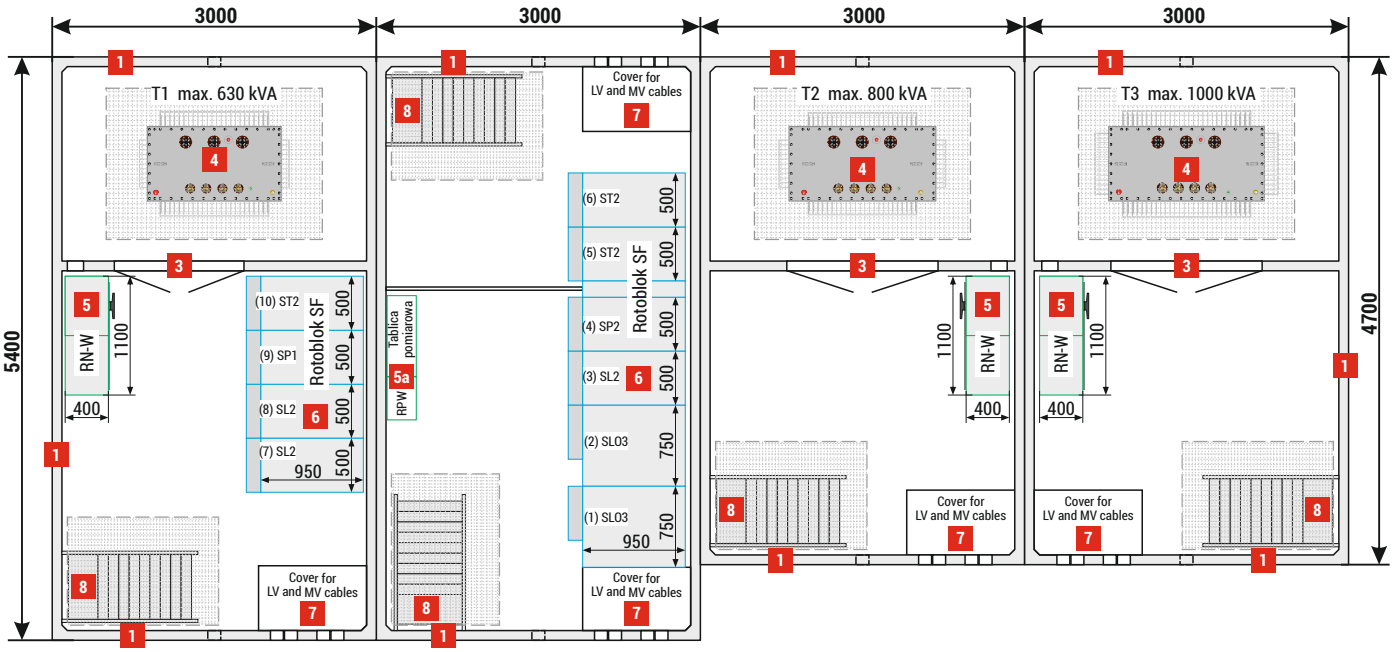
Mass / Area	
Main structure	25 000 kg
Usable area	12,32 m^2

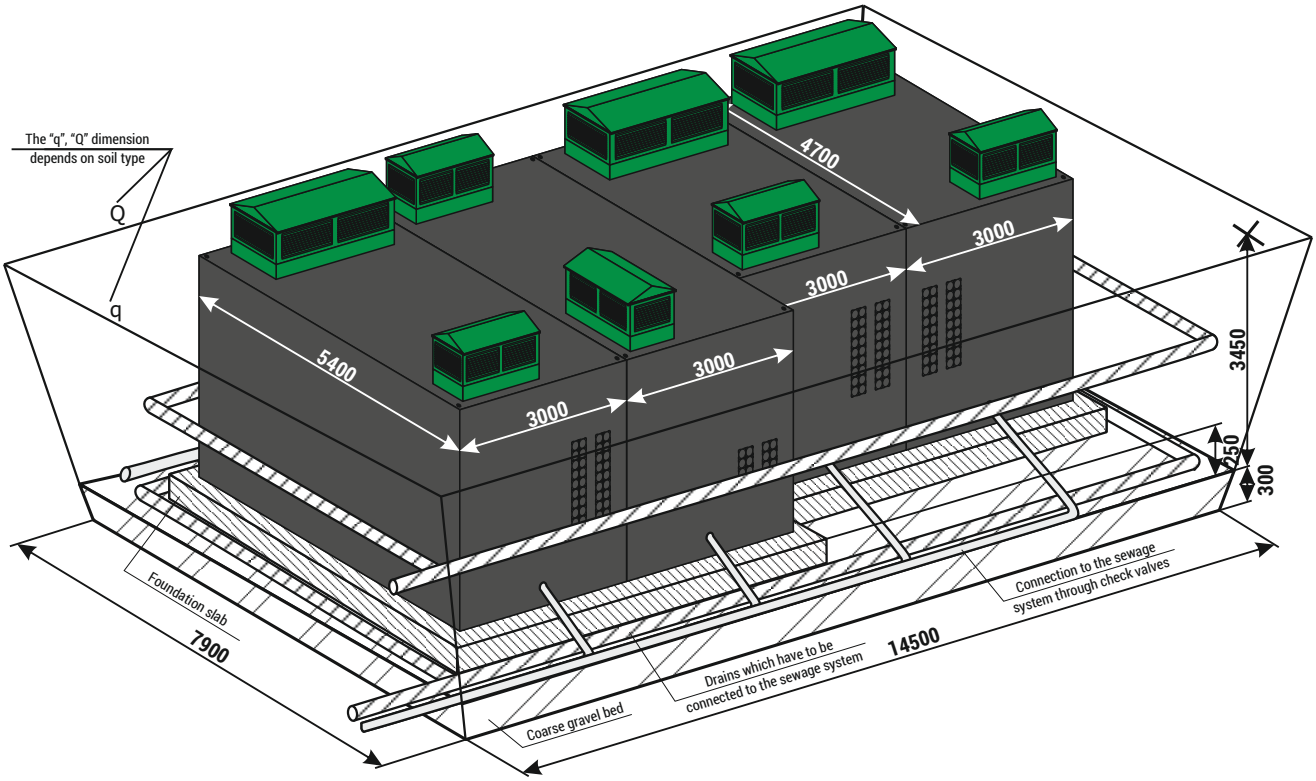
* Transformer inserted from above, before the roof is attached.

** Detailed selection of switchgears and their equipment is listed in chapters dedicated to individual devices in the catalogue. Example layouts of switchgears and corresponding substation configurations are specified in parentheses. The possibility of installing other types and configurations of switchgears should be arranged every time with the substation manufacturer.

Placement of equipment - example custom design solution.

PST-bS 20/630+800+1000-10





NOTE!

The catalogue presents example substation configurations.

Container transformer substations

4 / MRw-bS type substations in concrete enclosure

INTRODUCTION

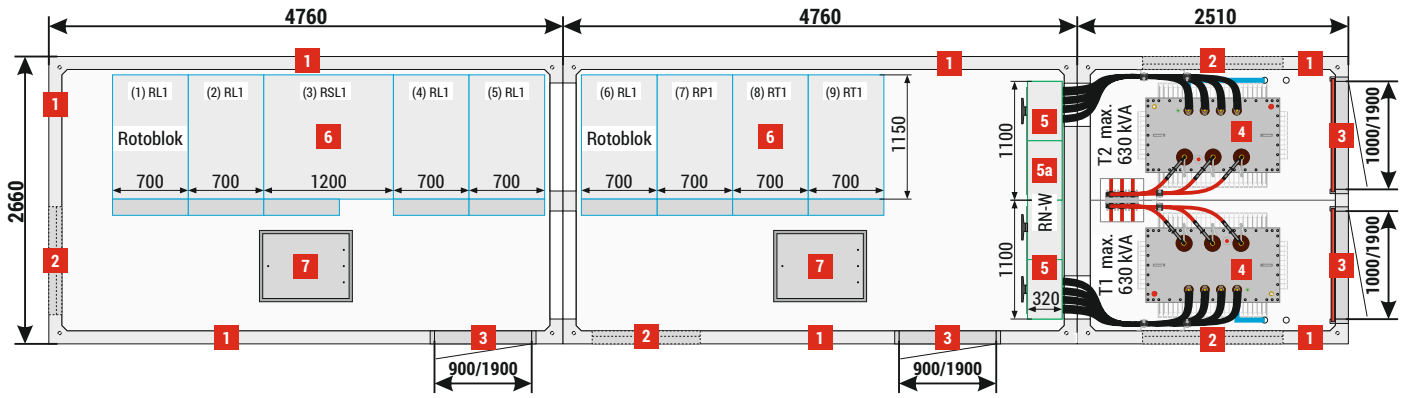
Frequently, much more complicated designs consisting of a large number of MV/LV switching devices, transformers, power generators etc. do not fit even within the largest structures (8160 mm x 3060 mm). The ZPUE S.A. company is one of few on the market which has in its offer a system for connecting typical concrete containers, under the name of "MRw-bS" prepared for individual adaptations, to meet the needs of customers. In order to reduce the investment costs for facilities with a significant demand for installed power, "MRw-bSP" multi-floor substations may be used. Their main advantage is concentrating significant transformer unit power over a small area of construction. The catalogue only presents examples of manufactured substations. It is possible to manufacture many other solutions to meet individual needs. Including substations with multiple transformers with a power up to 4000 kVA, or substations with power generators with a power up to 2000 kVA.

MRw-bS type substation

1	Walls, 120 mm thick - **standard**, 90 mm - **optional** Solid walls - fire integrity class REI 120
2	Ventilation grating IP 23D - **standard**, IP 43 - **optional** In ventilation louvres mounted in walls with fire integrity class, fire dampers are installed (e.g. EI 60 or EIS 120) - **optional**
3	Doors: solid or with ventilation louvres, without fire integrity class IP 23D - **standard**, IP 43 - **optional** Doors with fire resistance e.g EI 60 or EI 120 - **optional**
4	Transformer
5	LV switchgear
5a	AMI cabinet / Smart Grid / telemetry / auxiliary
6	MV switchgear
7	Cable duct cover

Placement of equipment - Example solutions

MRw-bS 20/2x630-9

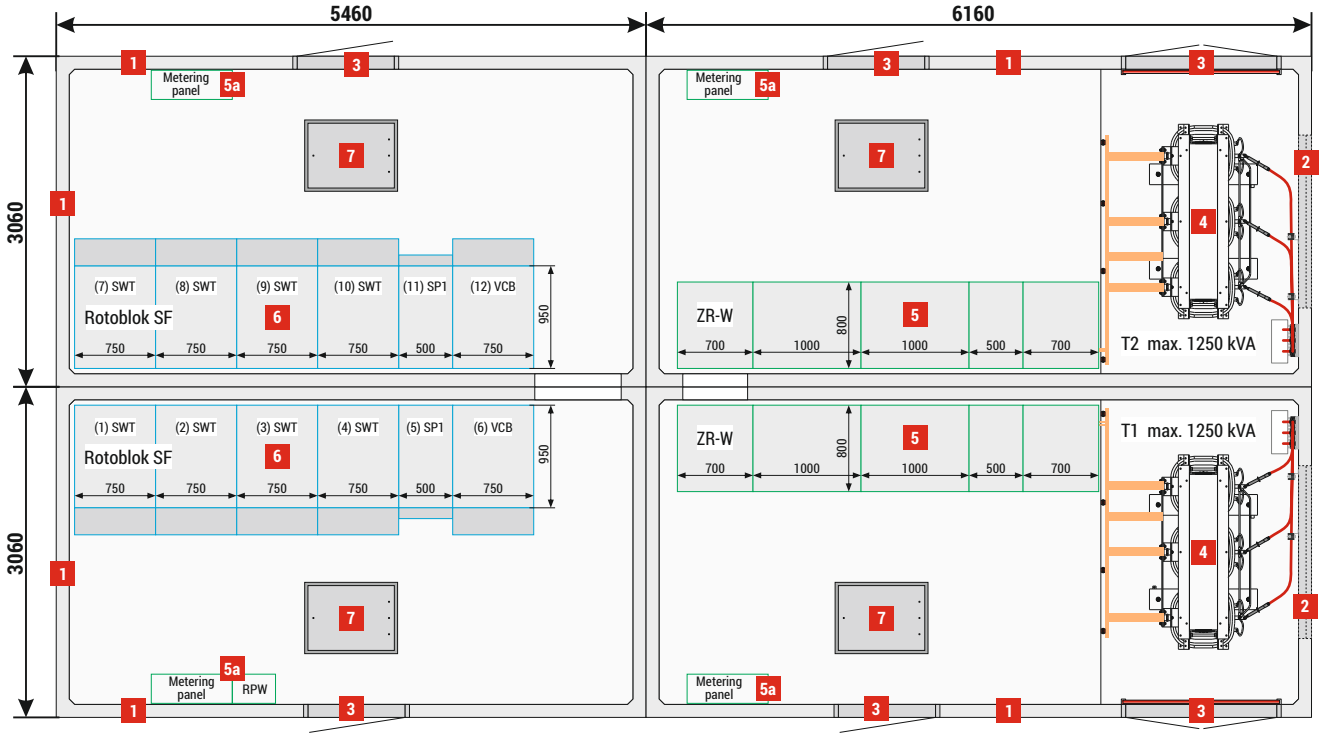


NOTE!

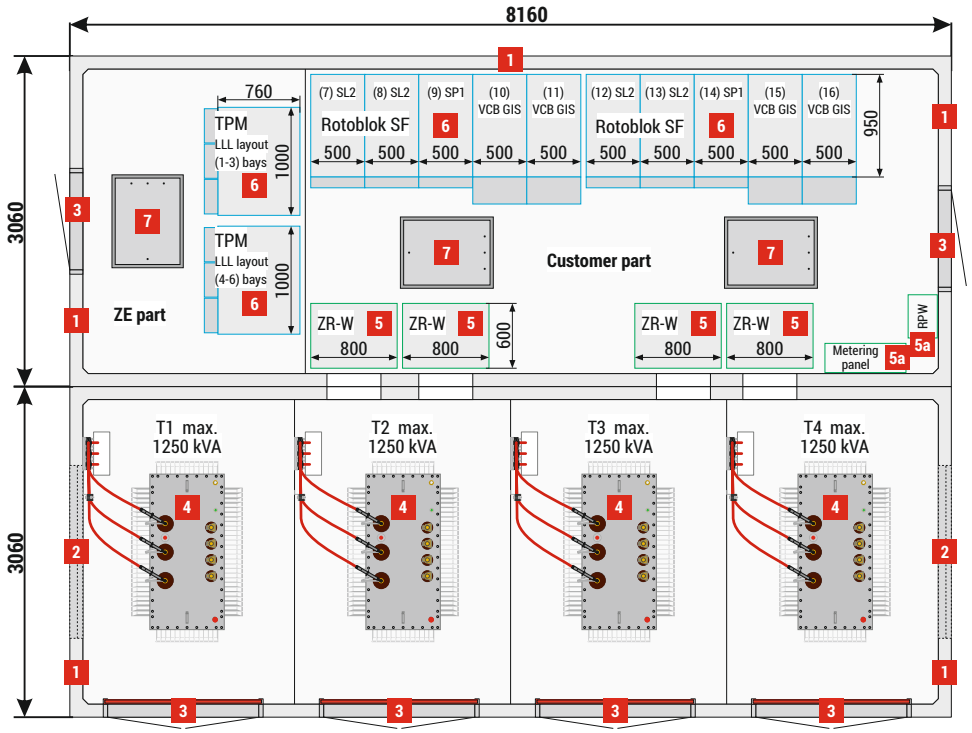
The catalogue presents example substation configurations.

Placement of equipment - Example solutions

MRw-bS 20/2x1250-12



MRw-bS 20/4x1250-16



NOTE!

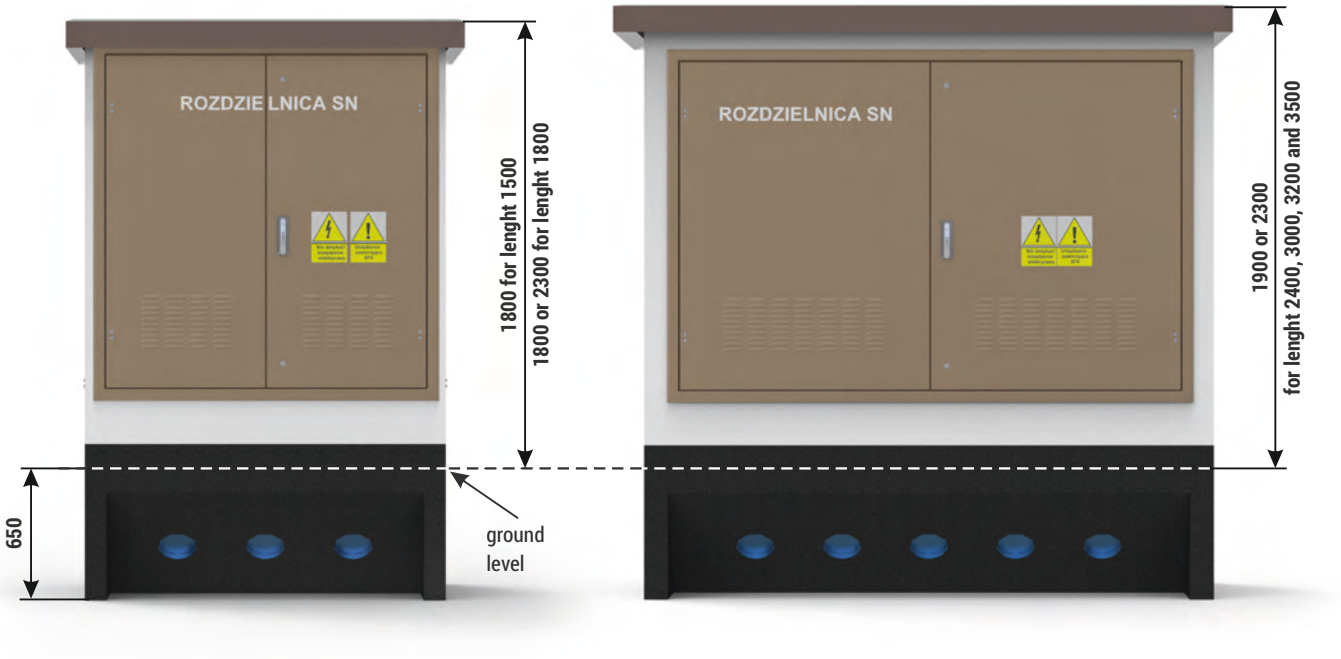
The catalogue presents example substation configurations.

Container transformer substations

5 / ZK-SN MV connection box in concrete enclosure with an SF_6 gas insulated switchgear

TECHNICAL DATA

Connection box in concrete enclosure with external servicing, ZK-SN type is intended for free-standing placement and adapted to work with medium voltage underground grids or underground and overhead grids, in a ring or star system.



TECHNICAL DESCRIPTION

The ZN-SN enclosure is composed of two monolithic elements:

- main structure – constructed with C30/37 class reinforced concrete,
- roof – constructed with C30/37 class reinforced concrete,

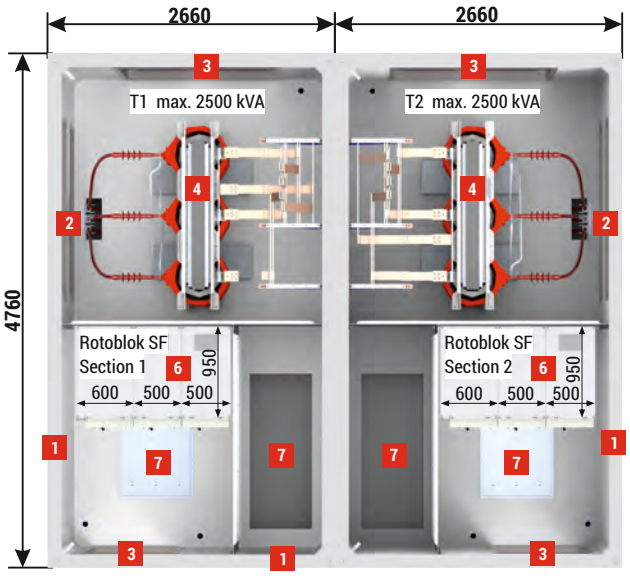
The central element of the connection box is a TPM type MV switchgear in SF6 insulation placed inside the enclosure, which is operated from the outside, after opening the metal doors. The foundation part of the connection box is made of concrete, with process openings for feeding the cables (placed below the MV switchgear).
Heads made by all leading manufacturers (CELLPACK, Euromold, Raychem etc.) may be connected to the switchgear.

Placement of equipment - Example solutions

MRw-bSP 20/2x2500-6

1	Walls, 120 mm thick - **standard**
	Solid walls - fire integrity class REI 120.
2	Ventilation louvresIP 23D - **standard**, IP 43 - **optional**
	In ventilation louvres mounted in walls with fire integrity class, fire dampers are installed (e.g. EI 60 or EIS 120) - **optional**
3	Doors: solid or with ventilation louvres without fire integrity IP 23D - **standard**, IP 43 - **optional**
	Doors with fire resistance e.g EI 60 or EI 120 - **optional**
4	Transformer
5	LV switchgear
5a	AMI cabinet / Smart Grid / telemetry / auxiliary
6	MV switchgear
7	Cable duct hatch door / cable duct cover
8	Staircase to the LV switchgear compartment – 1st floor

Ground floor



First floor

NOTE!

The catalogue presents example substation configurations.

TECHNICAL DATA

Dimensions of ZK-SN connection boxes and possible MV switchgear layouts to be used						
Length* [mm]	1500	1800	2400	3000	3200	3500
Width [mm]	1100		1160 / 1300 / 1500	1300 / 1500 / 1650		
Height [mm]						
- main structure without roof	2350	2350 / 2850	2450 / 2850			
- main structure with roof	2450	2450 / 2950	2550 / 2950			
- from ground surface with roof	1800	1800 / 2300	1900 / 2300			
Usable area [m^2]	1,35	1,65	2,18 - 2,93	3,16 - 4,15	3,38 - 4,44	3,72 - 4,88
Total weight [kg]	2900	3400 / 4100	5000 - 6500	6300 - 7900	6500 - 8300	7000 - 8800
Total weight of main structure with devices [kg]	2400	2800 / 3500	4150 - 5400	5100 - 6400	5250 - 6750	5650 - 7100
Roof weight [kg]	500	600	850 - 1100	1200 - 1500	1250 - 1550	1350 - 1700
MV switchgear*, maximum number of line bays**						
- system without TPW	3	4	5	7	8	9
- system with TPW	—	3	4	5	6	7

Parameters of the ZK-SN** connection box (as maximum values)	
Power of the auxiliary transformer (TPW)	2,5 kVA (higher power — on arrangement with the manufacturer)
Rated frequency	50 / 60 Hz
Ingress protection rating	IP 43
Enclosure mechanical impact resistance	IK10 (20J)
Internal arc resistance classification	IAC-AB-20 kA-1s
Rated short-time withstand current / peak earthing circuits current	20 kA (1s) / 50 kA

Parameters of the SN switchgear** (as maximum values)	
Rated voltage	24 (25) kV
Network frequency withstand voltage (1 min)	50/60 kV
Withstand lightning surge voltage (1.2/50 μs)	125/145 kV
Busbar rated continuous withstand current	630 A
Continuous rated current for bays with switch disconnectors and circuit breakers	630 A
Continuous rated current for bays with fuse switch disconnectors	250 A
Rated short-time withstand current	20 kA (1s)
Rated peak withstand current	50 kA

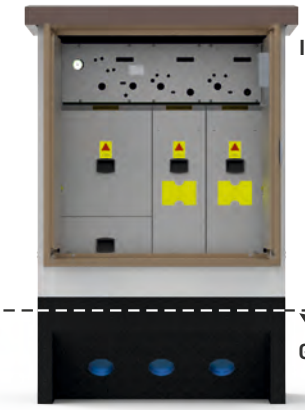
NOTE!

* The dimensions concern the main structure of the connection box, the outline of the roof is larger than the outline of the structure by 100 mm on each side.

** Technical parameters are specified as maximum, they will depend on the connection box configuration and used equipment.

*** Detailed selection of switchgears and their equipment is listed in chapters dedicated to individual devices in the catalogue.

Connection box ZK-SN

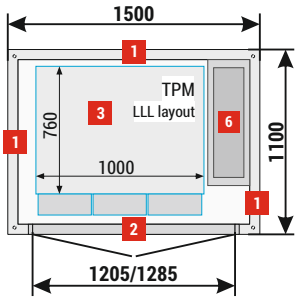


1	Walls, 60 mm thick – length 1500 and 1800 mm Walls, 90 mm thick – length 2400, 3000, 3200 and 3500 mm
2	Doors: solid or with ventilation louvres, without fire integrity class IP 23D - **standard**
3	MV switchgear

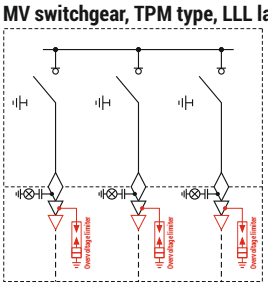
Placement of equipment

Electrical diagram

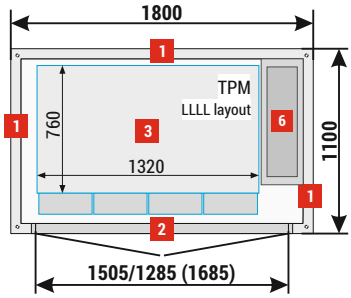
ZK-SN (1,5x1,1)/3



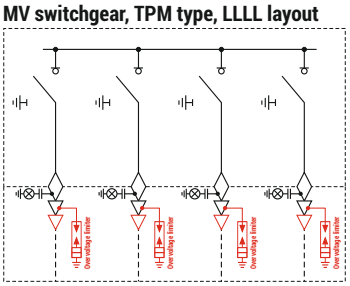
MV switchgear, TPM type, LLL layout



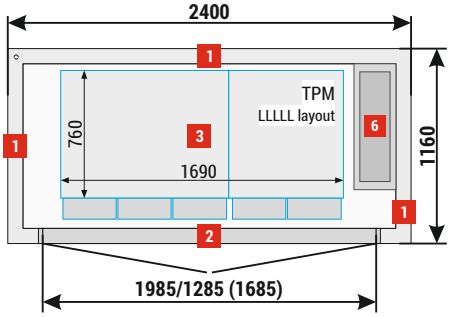
ZK-SN (1,8x1,1)/4



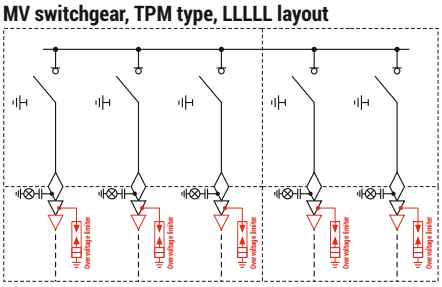
MV switchgear, TPM type, LLLL layout



ZK-SN (2,4x1,16)/5



MV switchgear, TPM type, LLLLL layout



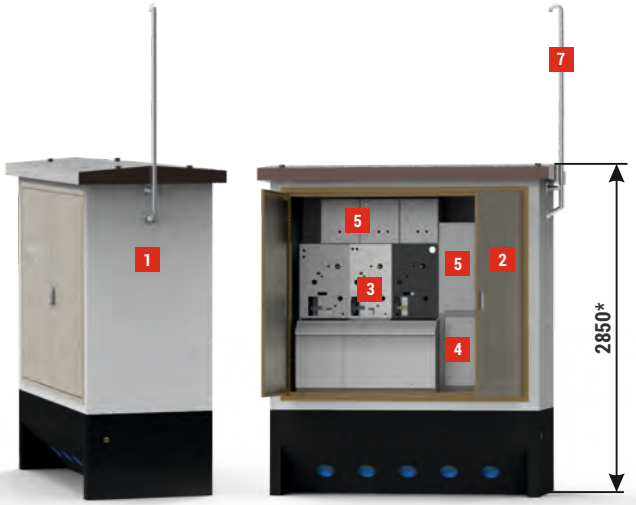
NOTE!

Optional equipment was **marked with red** on the electrical diagram.
The catalogue presents example connection box and MV switchgear configurations. Detailed selection of MV switchgears and their equipment is listed in chapters dedicated to individual devices in the catalogue.

Connection box ZK-SN - version with TPW

ZK-SN connection boxes do not serve only distribution purposes in a power grid. Equipped with modern, compact MV switchgears with remote monitoring and control systems, current and voltage sensors and connected short-circuit indicators, they enable cutting off damaged sections of the grid and shortening the time of power supply interruptions for the customers. This undoubtedly has a direct impact on the quality of services provided by distribution companies, which translates directly into user satisfaction.

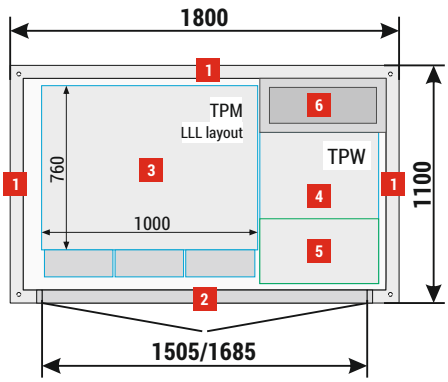
In order to enable such functionality, the connection boxes have to be equipped with auxiliary systems supplied from an independent auxiliary transformer, supplied in turn by the MV switchgear. This solution is dedicated to Smart Grid systems, and fits perfectly in the market trends of power grid development and modernisation.

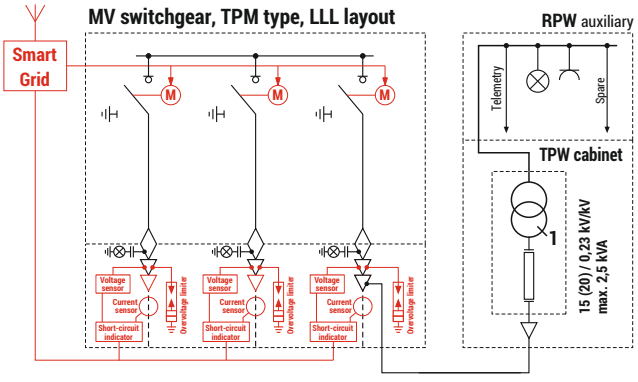


1	Walls, 60 mm thick – length 1500 and 1800 mm Walls, 90 mm thick – length 2400, 3000, 3200 and 3500 mm
2	Doors: solid or with ventilation louvres, without fire integrity class IP 43 - **standard**
3	MV switchgear
4	TPW - auxiliary transformer cabinet
5	AMI cabinet / Smart Grid / telemetry / auxiliary
6	Gas cooler
7	Smart Grid antennas mast for GSM/TETRA system

Placement of equipment and electrical diagrams of ZK-SN with TPW

ZK-SN (1,8x1,1)/3-tpw





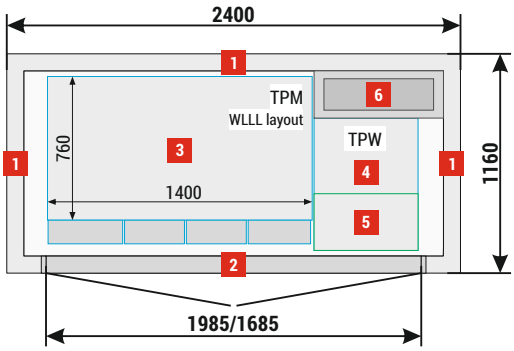
NOTE!

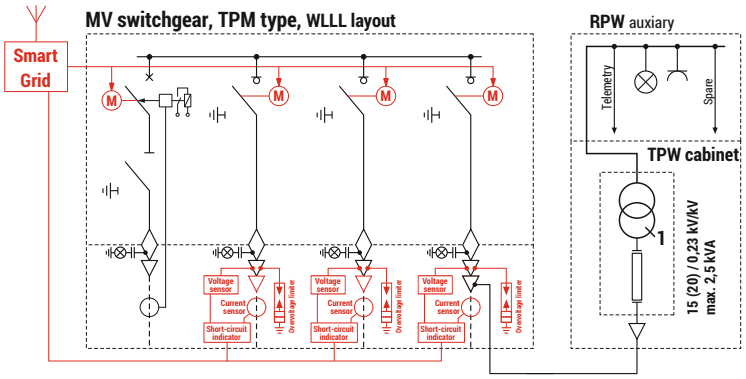
The catalogue presents example substation configurations. Optional equipment **was marked with red** on the electrical diagram. Detailed selection of MV switchgears and their equipment is listed in chapters dedicated to individual devices in the catalogue.

* Due to the installation of TPW, auxiliary power supply, telemetry cabinets, short-circuit indicators etc., the height of Smart Grid adapted connection boxes is higher than standard, and amounts to 2850 mm.

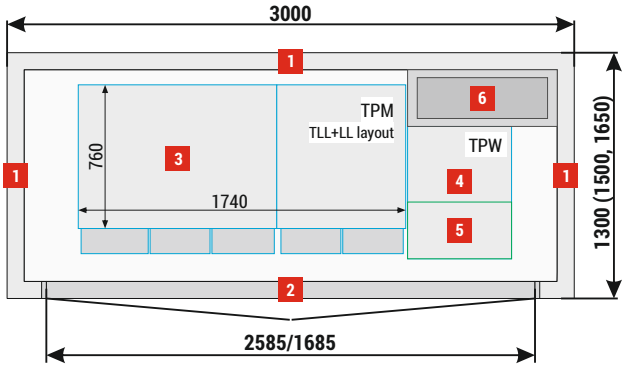
Placement of equipment and electrical diagrams of ZK-SN with TPW

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

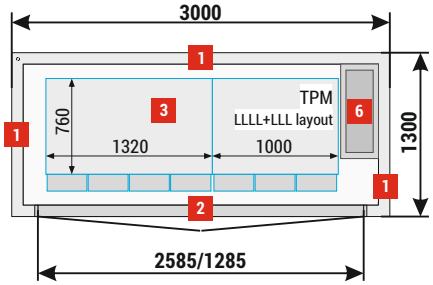


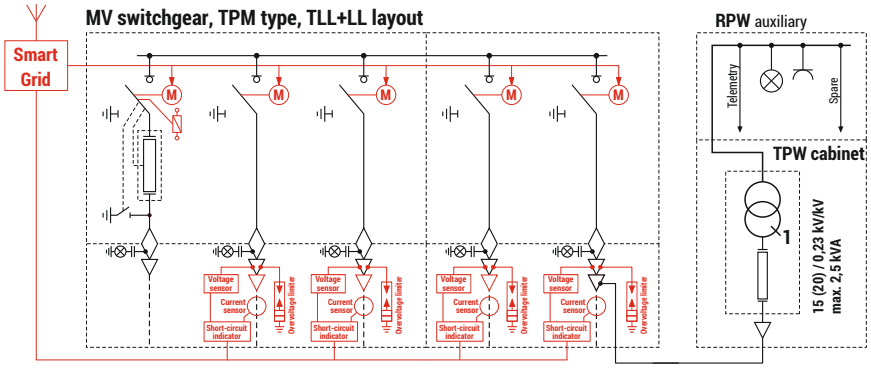


ZK-SN (3x1,3)/5-tpw



ZK-SN (3x1,3)/7 (Wariant bez TPW)



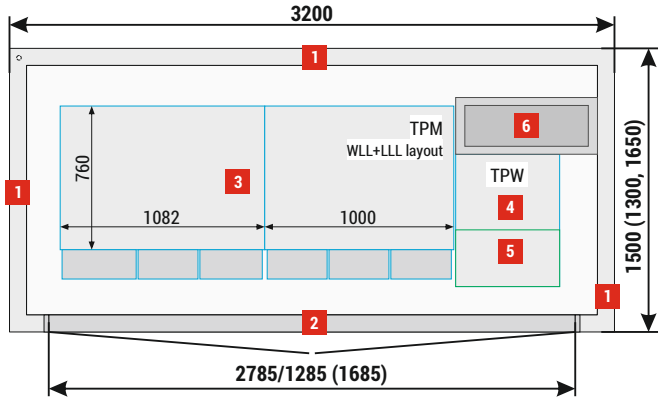


NOTE!

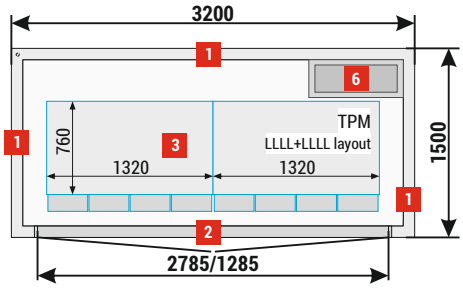
The catalogue presents example substation configurations. Optional equipment **was marked with red** on the electrical diagram. Detailed selection of MV switchgears and their equipment is listed in chapters dedicated to individual devices in the catalogue.

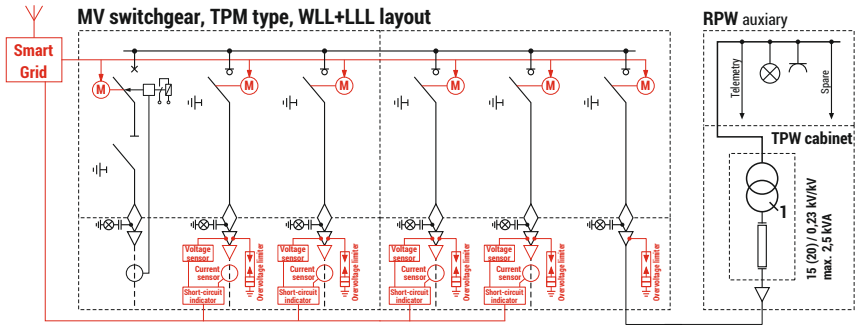
Placement of equipment and electrical diagrams of ZK-SN with TPW

ZK-SN (3,2x1,5)/6-tpw

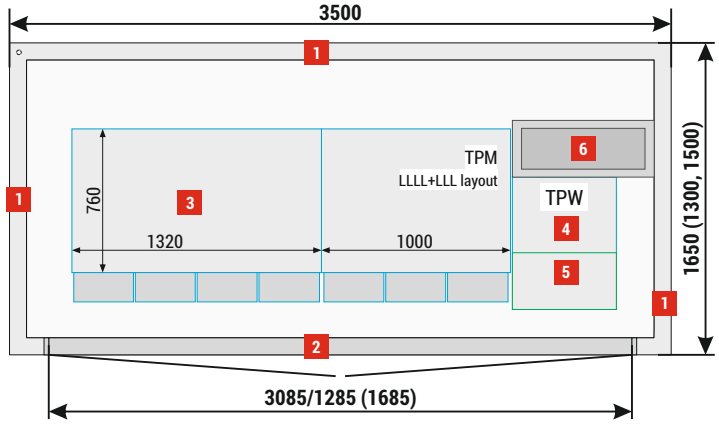


ZK-SN (3,2x1,5)/8 (version without TPW)

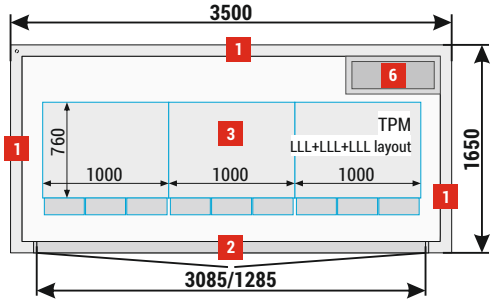


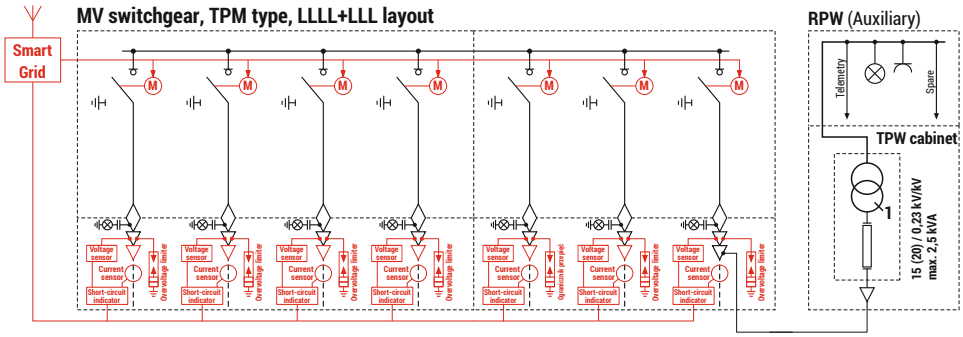


ZK-SN (3,5x1,65)/7-tpw



ZK-SN (3,5x1,65)/9



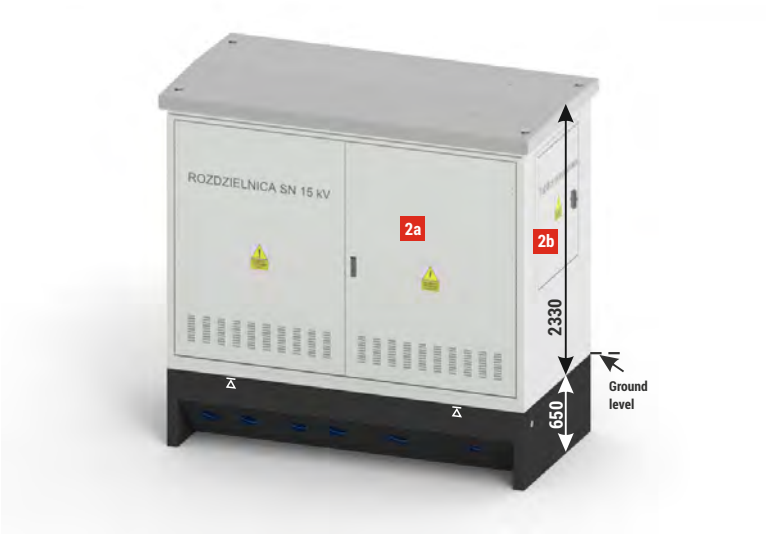


NOTE!

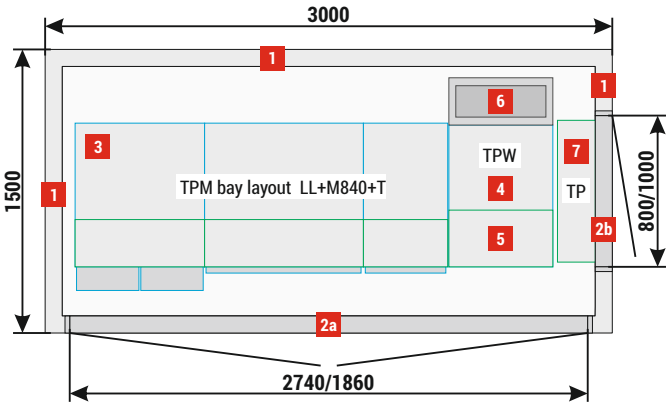
The catalogue presents example substation configurations. Optional equipment **was marked with red** on the electrical diagram. Detailed selection of MV switchgears and their equipment is listed in chapters dedicated to individual devices in the catalogue.

Cable connection ZK-SN - option with voltage measurement and TPW

The main element of the connector equipment in the variant with measurement and TPW is MV switchgear in SF_6 insulation, TPM type, with a built-in measuring field and a metering system (independent access from the outside). Such a solution offers new possibilities for the configuration of the MV network, as well as the construction of subscriber stations, to which free access may be difficult or even impossible (plot ownership, only remote monitoring of facilities or strategic facilities). It enables distribution and settlement companies to have full control over the measurement system, increasing the quality of their services and user satisfaction.

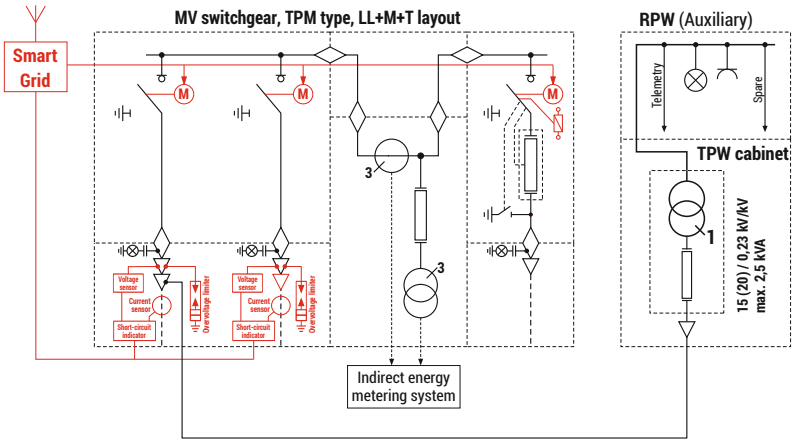


Placement of equipment - ZK-SN (3,0x1,5)/4-tpw_p example solutions



1	Walls, 90 mm thick - **standard**,
2a	MV switchgear compartment doors, solid or with ventilation louvres, without fire integrity class IP 43 - **standard**,
2b	Metering panel doors, solid without fire integrity class IP 43 - **standard**,
3	MV switchgear
4	TPW - auxiliary transformer cabinet
5	AMI cabinet / Smart Grid / telemetry / auxiliary
6	Gas blow-out system
7	Metering panel

Electric diagram



Height of the main structure [mm]	2850
Usable area [m^2]	3,72
Total weight with roof [kg]	6500

NOTE!

The catalogue presents example substation configurations. Optional equipment **was marked with red** on the electrical diagram. Detailed selection of MV switchgears and their equipment is listed in chapters dedicated to individual devices in the catalogue.

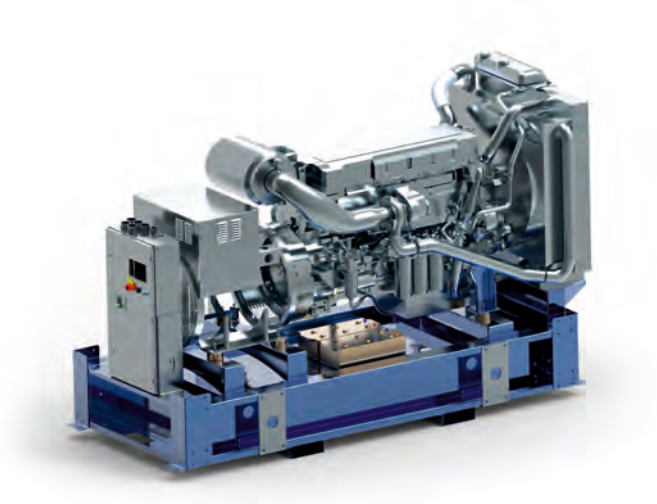
Container transformer substations

6 / Substations with generator units

INTRODUCTION

ZPUE S.A. designs, manufactures, delivers, assembles and commissions emergency power supply systems based on concrete or metal enclosures of its own manufacture, using power generator units made by leading global manufacturers. In the projects performed so far ZPUE S.A. has used power generator units with a power up to 2000 kVA. An open unit is installed in specialist concrete containers, with a full set of MV and LV switchgear, transformers and an ATS system. Stations with power generators are adapted for operation both in indoors and outdoors condition, in accordance with their intended use. In standard version they may be used in temperate climate conditions, that is, within a temperature range of -25°C to 40°C, at an installation height up to 1000 m ASL. It is possible to manufacture substations with power generator units installed and operated in other climate zone conditions – such solutions should be arranged with the manufacturer every time.

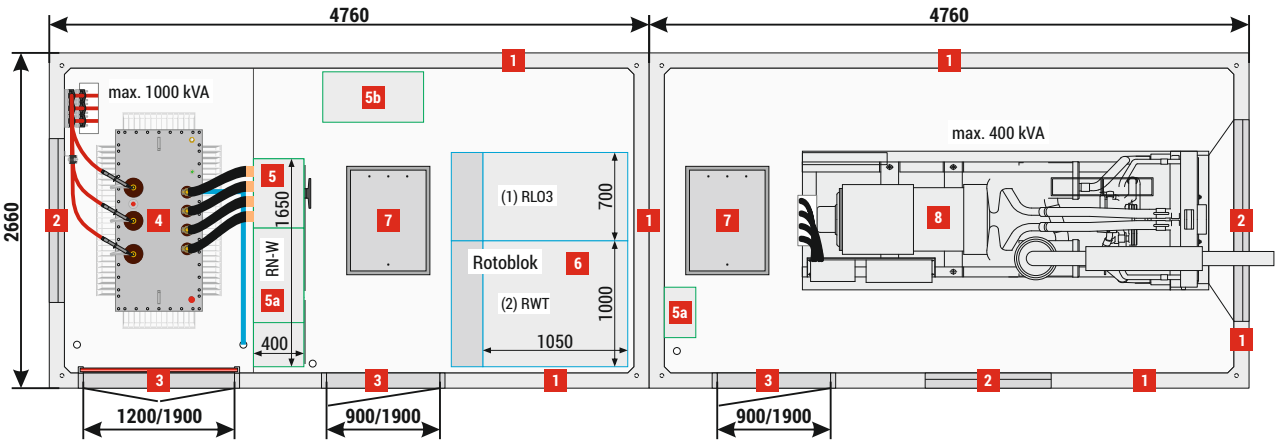
The use of prefabricated reinforced concrete enclosures enables designing of rooms which allow for the installation of additional fuel tanks. This allows the generator unit to operate continuously even up to 24h while meeting fire safety and noise emission requirements. ZPUE S.A. realises orders based on individual customer requirements. Appropriate selection of the power generator unit guarantees correct operation.



1	Walls, 120 mm thick - **standard**, 90 mm - **optional** Solid walls - fire integrity class REI 120
2	Ventilation grating IP 23D - **standard**, IP 43 - **optional** In ventilation louvres mounted in walls with fire integrity class, fire dampers are installed (e.g. EI 60 or EIS 120) - **optional**
3	Doors: solid or with ventilation louvres, without fire integrity class IP 23D - **standard**, IP 43 - **optional** Doors with fire resistance e.g EI 60 or EI 120 - **optional**
4	Transformer
5	LV switchgear
5a	AMI cabinet / Smart Grid / telemetry / auxiliary
5b	Capacitor bank
6	MV switchgear
7	Cable duct cover
8	Generator unit

Placement of equipment – example solutions

MRw-bS 20/1000+400-2

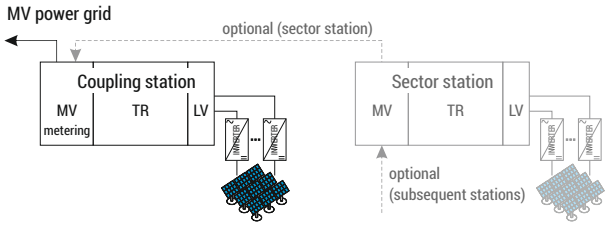


NOTE!

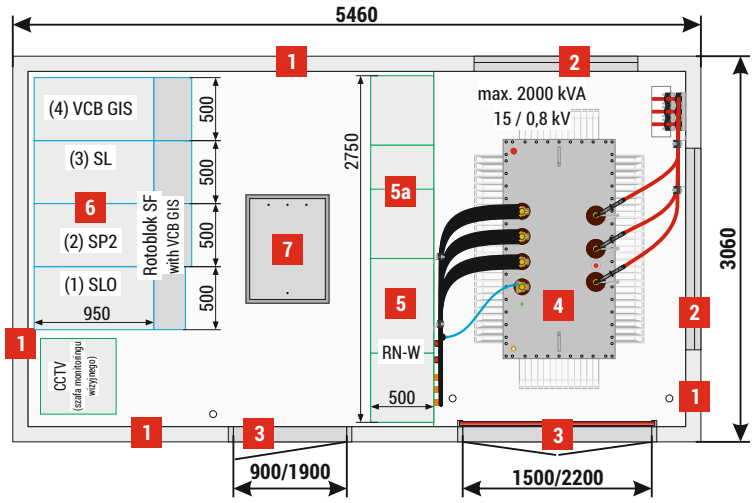
The catalogue presents example substation configurations.

MRw-b (5,4x3) 20/2000-4 - Substation with an internal service corridor, designed to work with PV installations with a capacity above 1MWp (string inverters) with a metering billing system, connected to the MV network

In terms of connection to the MV grid, as well as electricity billing, a solution similar to an installation up to 1 MWp. The main difference is the power of the installation (usually no more than 20 MWp) and the configuration of the system, which includes a coupling station containing measuring systems and / or one or several sector stations without measuring systems. The power of individual stations does not exceed 7 MW.

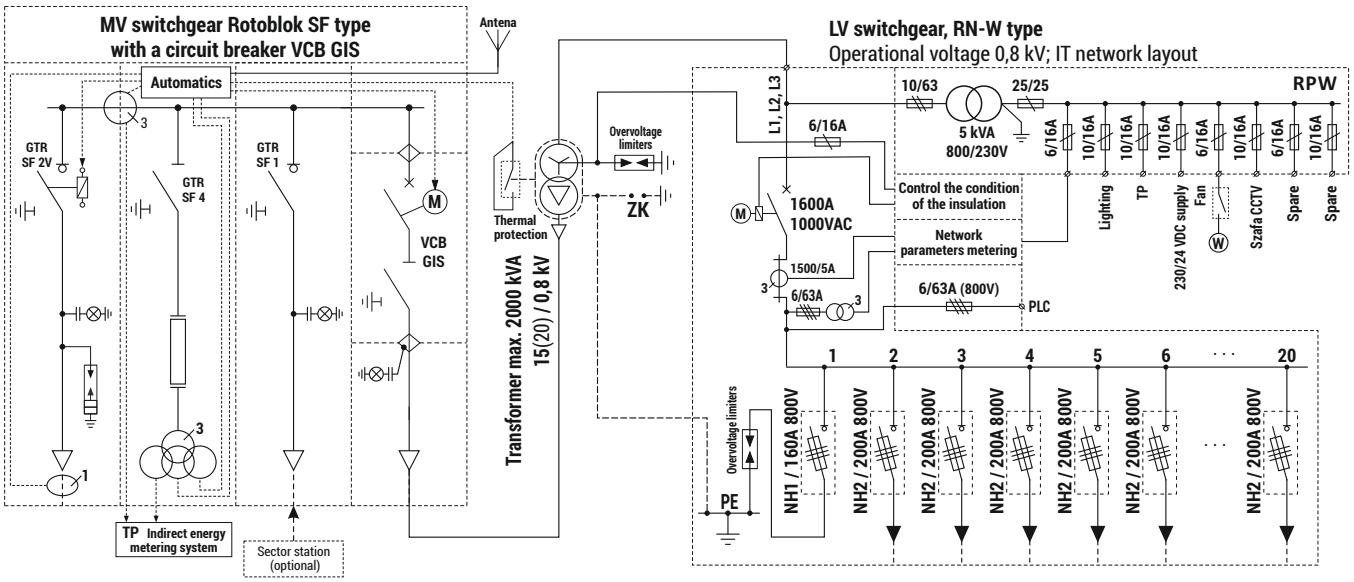


Placement of devices



1	Walls, 90 mm thick - **standard**, 120 mm - **optional** Solid walls - fire integrity class REI 120
2	Ventilation grating IP 23D - **standard**, IP 43 - **optional** In ventilation louvres mounted in walls with fire integrity class, fire dampers are installed (e.g. EI 60 or EIS 120) - **optional**
3	Doors: solid or with ventilation louvres, without fire integrity class IP 23D - **standard**, IP 43 - **optional** Doors with fire resistance e.g EI 60 or EI 120 - **optional**
4	Transformer
5	LV switchgear
5a	AMI cabinet / Smart Grid / telemetry / auxiliary
6	MV switchgear
7	Cable duct cover

Electrical diagram



NOTE!

The catalogue presents example substation configurations. More solutions are available in the catalog with dedicated solutions to cooperation with renewable energy sources.
The LV side of the station can be made in a variant prepared for cooperation in the IT network, as well as in the TN-C network.
For an operating voltage of 0.4 kV, a LV switchgear of the ZR-W type should be used.

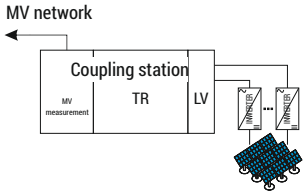
Container transformer substations

7 / Dedicated substations for renewable energy sources

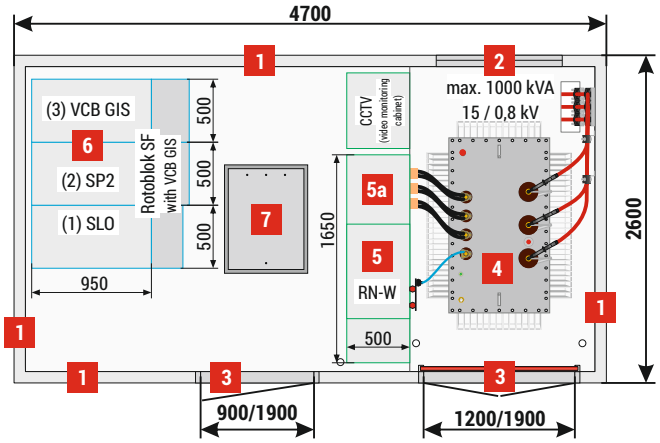
Currently a significant amount of energy generated globally by power plants comes from fossil fuels. Renewable energy sources present an alternative. They are continuously renewed by natural processes, and thus may be treated as practically inexhaustible.
Energy from renewable sources includes energy obtained directly from sunlight (converted into heat or electricity), wind, geothermal resources (from the Earth's mantle), hydropower, biomass, biogas and liquid biofuels.
The ZPUE Group participates actively in renewable energy projects.

SUBSTATIONS FOR PHOTOVOLTAIC POWER STATIONS

MRw-b (4,7x2,6) 20/1000-3 - Substation with an internal service corridor, designed to work with PV installations up to 1MWp (string inverters) with a metering billing system, connected to the MV network.

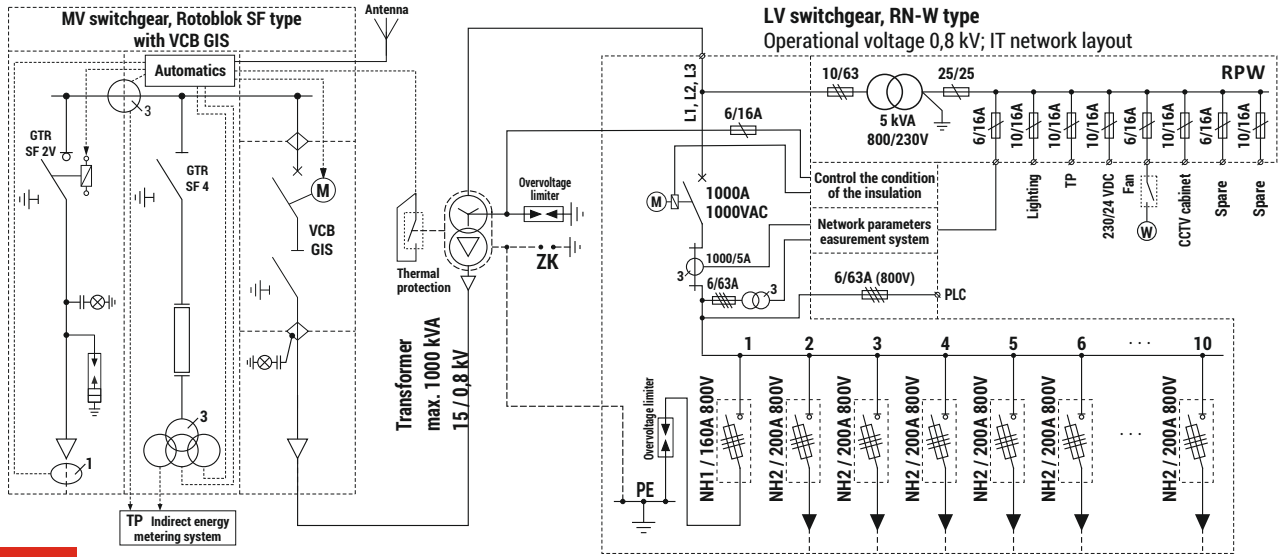


Placement of devices



1	Walls, 90 mm thick - **standard**, 120 mm - **optional** Solid walls - fire integrity class REI 120
2	Ventilation grating IP 23D - **standard**, IP 43 - **optional** In ventilation louvres mounted in walls with fire integrity class, fire dampers are installed (e.g. EI 60 or EIS 120) - **optional**
3	Doors: solid or with ventilation louvres, without fire integrity class IP 23D - **standard**, IP 43 - **optional** Doors with fire resistance e.g EI 60 or EI 120 - **optional**
4	Transformer
5	LV switchgear
5a	AMI cabinet / Smart Grid / telemetry / auxiliary
6	MV switchgear
7	Generator unit

Electrical diagram

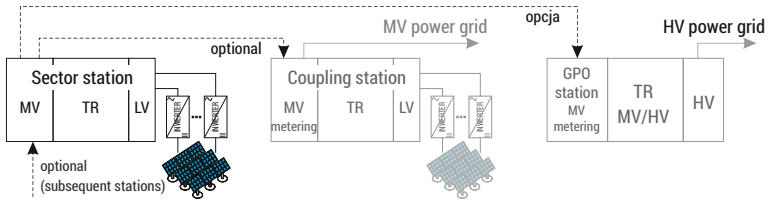


NOTE!

Optional equipment was **marked in red** on the electrical diagram. The catalogue presents example substation configurations.
More solutions are available in the catalog with dedicated solutions to cooperation with renewable energy sources.
The LV side of the station can be made in a variant prepared for cooperation in the IT network, as well as in the TN-C network.

Sector stations designed to work with PV installations with a capacity above (string inverters) connected to the MV network through coupling stations or to the HV network through GPO stations

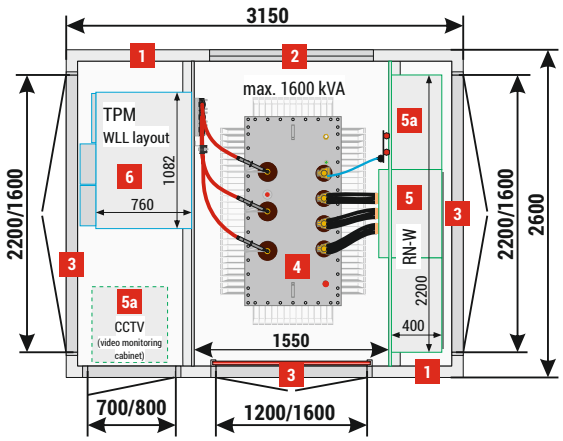
Large-scale photovoltaic farms with a capacity of tens (e.g. 40-50 MWp) or even hundreds of MWp require extensive energy infrastructure. In such extensive PV farms, the energy infrastructure is divided into sectors. Depending on the scale of the project and the type of inverters used, the powers of the sectors, and thus individual stations, are usually from 1 MW to 4 MW (max. 6-7 MW). Stations of this type are connected to a common MV bus via interconnecting stations equipped with billing metering for the entire farm, as well as control and protection automation ensuring the stability of the parameters of electricity transferred to the commercial power grid.



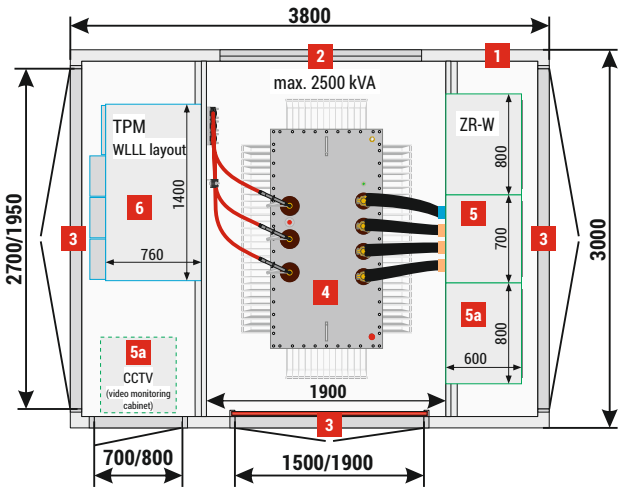
1	Walls, 90 mm thick - **standard**
2	Ventilation grating IP 23D - **standard**, IP 43 - **optional**
3	Doors: solid or with ventilation louvres, without fire integrity class IP 23D - **standard**, IP 43 - **optional**
4	Transformer
5	LV switchgear
5a	AMI cabinet / telemetry / auxiliary
6	MV switchgear

Placement of devices (sample solutions)

Mzb2 (3,15x2,6) 20/1600-3

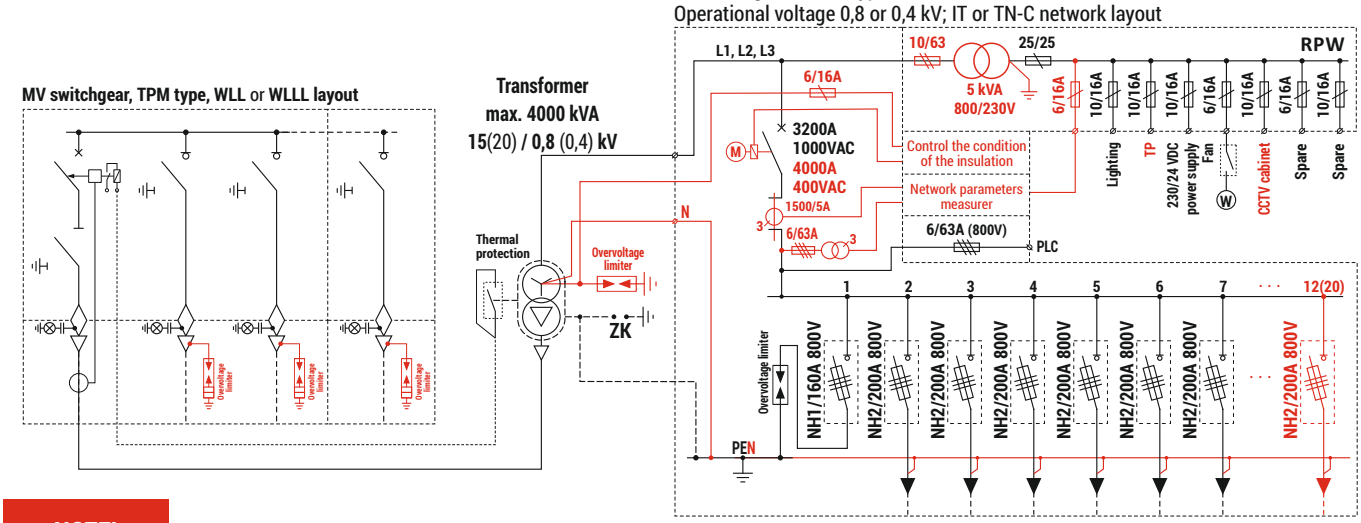


Mzb2 (3,8x3) 20/2500-4



Electrical diagram

LV switchgear, RN-W type to the 2000 A currents or **ZR-W** to the 4000A currents;
Operational voltage 0,8 or 0,4 kV; IT or TN-C network layout

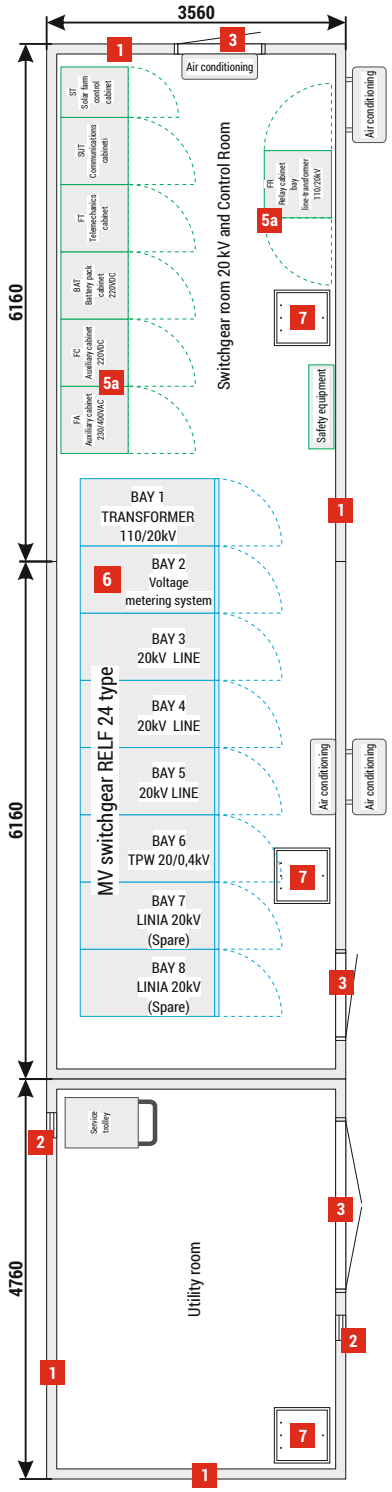


NOTE!

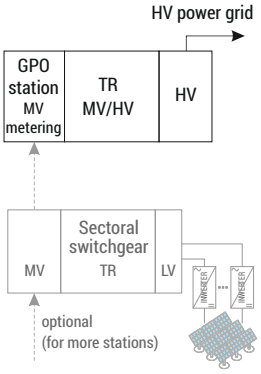
Optional equipment was **marked in red** on the electrical diagram. The catalogue presents example substation configurations. More solutions are available in the catalog with dedicated solutions to cooperation with renewable energy sources.

[redacted]

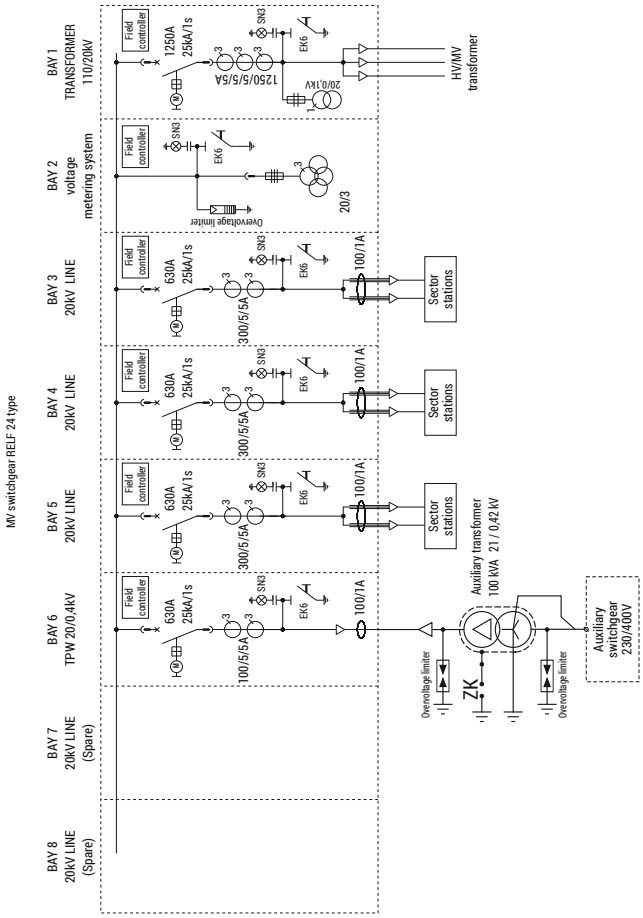
Placement of devices



1	Walls, 120 mm thick - **standard**
2	Ventilation grating IP 23D - **standard**, IP 43 - **optional**
3	Doors: solid or with ventilation louvres IP 23D - **standard**, IP 43 - **optional**
5a	Automation / auxiliary
6	MV switchgear
7	Cable duct cover



Electric diagram



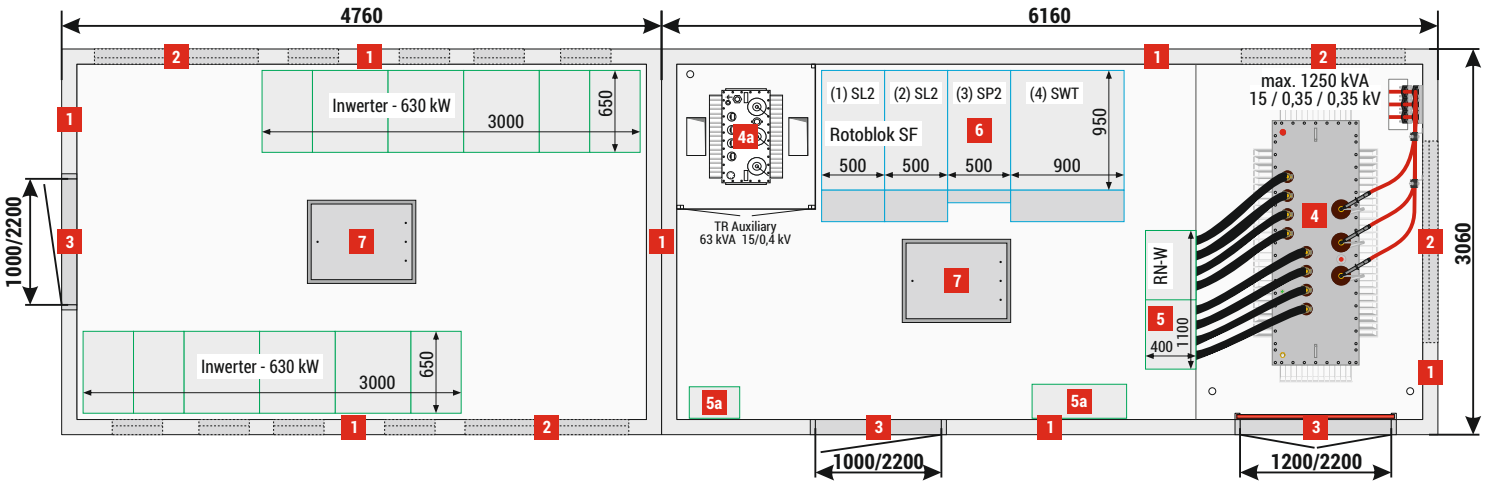
NOTE!

The catalogue presents example substation configurations. More solutions are available in the catalog with dedicated solutions to cooperation with renewable energy sources.

SUBSTATIONS FOR PHOTOVOLTAIC POWER STATIONS – central inverters

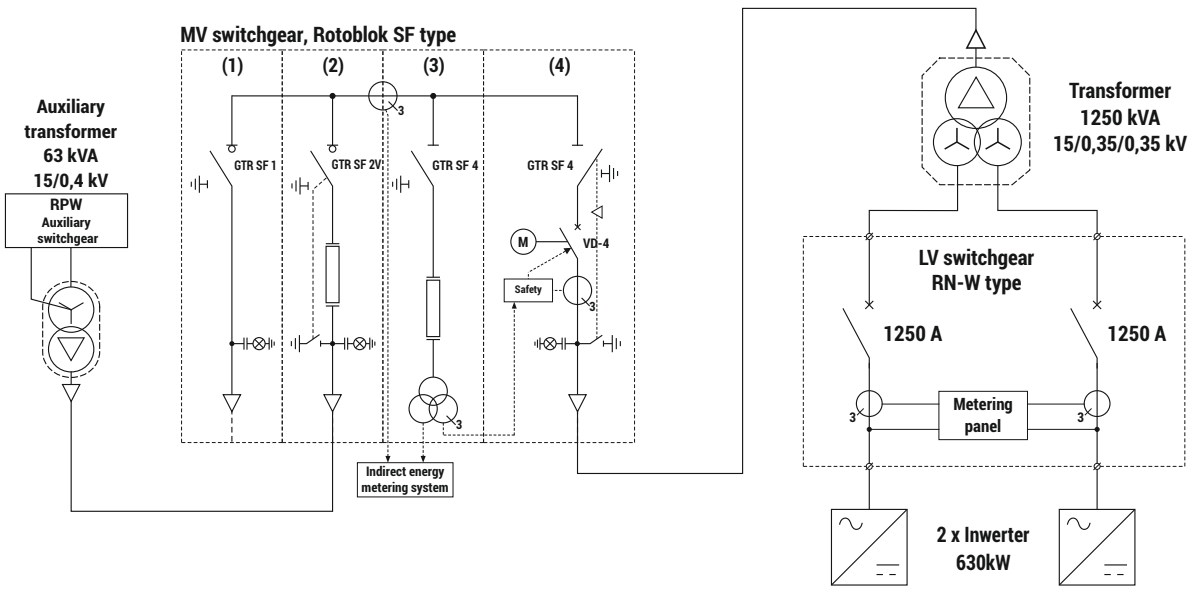
MRw-bS 20/1250-4

Placement of devices



1	Walls, 120 mm thick - **standard**, 90 mm - **optional**
2	Ventilation grating IP 23D - **standard**, IP 43 - **optional**
3	Doors: solid or with ventilation louvres IP 23D - **standard**, IP 43 - **optional**
4	Transformer
4a	Auxiliary transformer
5	LV switchgear
5a	AMI cabinet / telemetry / auxiliary
6	MV switchgear
7	Cable duct cover

Electrical diagram



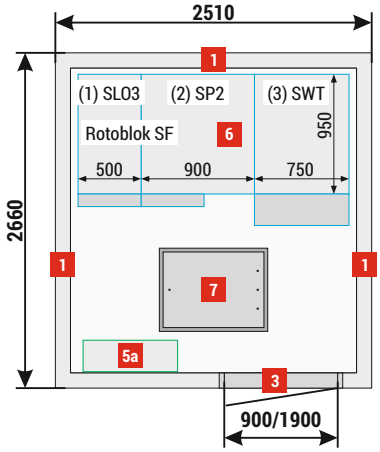
NOTE!

The catalogue presents example substation configurations.

EXAMPLE OF A SUBSTATION DEDICATED FOR WIND POWER STATION

MRw-b1 20-3

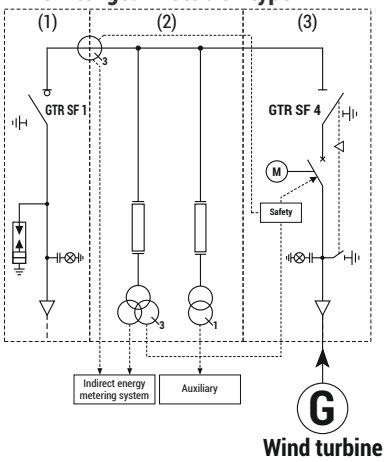
Placement of devices



1	Walls, 120 mm thick - **standard**, 90 mm - **optional**
2	Ventilation grating IP 23D - **standard**, IP 43 - **optional**
3	Doors: solid or with ventilation louvres IP 23D - **standard**, IP 43 - **optional**
4a	Auxiliary transformer
5a	AMI cabinet / telemetry / auxiliary
6	MV switchgear
7	Cable duct cover

Electrical diagram

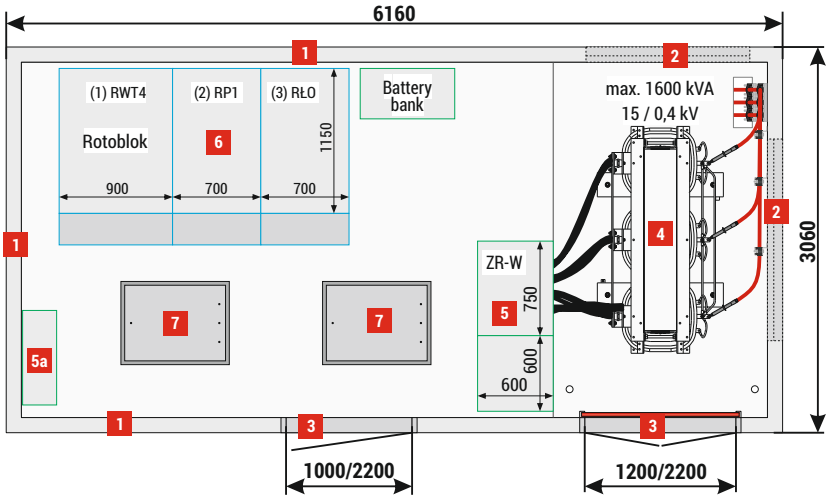
MV switchgear Rotoblok type



EXAMPLE OF A SUBSTATION DEDICATED FOR A BIOGAS POWER STATION

MRw-b (6,16x3,06) 20/1600-3

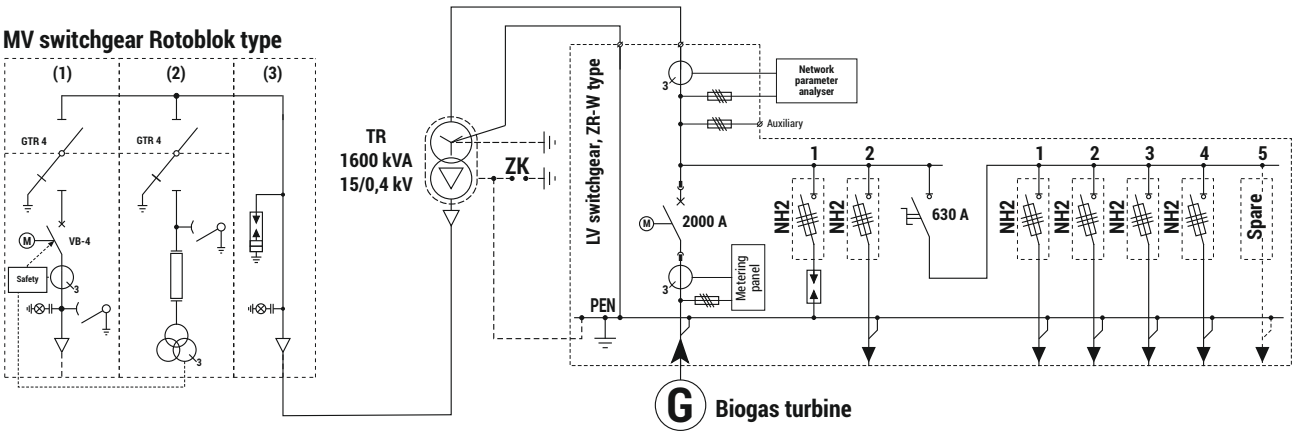
Placement of devices



1	Walls, 120 mm thick - **standard** Walls, 90 mm thick - **optional**
2	Ventilation grating IP 23D - **standard**, IP 43 - **optional**
3	Doors: solid or with ventilation louvres, IP 23D - **standard**, IP 43 - **optional**
4	Transformer
5	LV switchgear
5a	AMI cabinet / telemetry / auxiliary
6	MV switchgear
7	Cable duct cover

Electrical diagram

MV switchgear Rotoblok type



NOTE!

The catalogue presents example substation configurations.

Container transformer substations

8 / Reactive power compensation substation

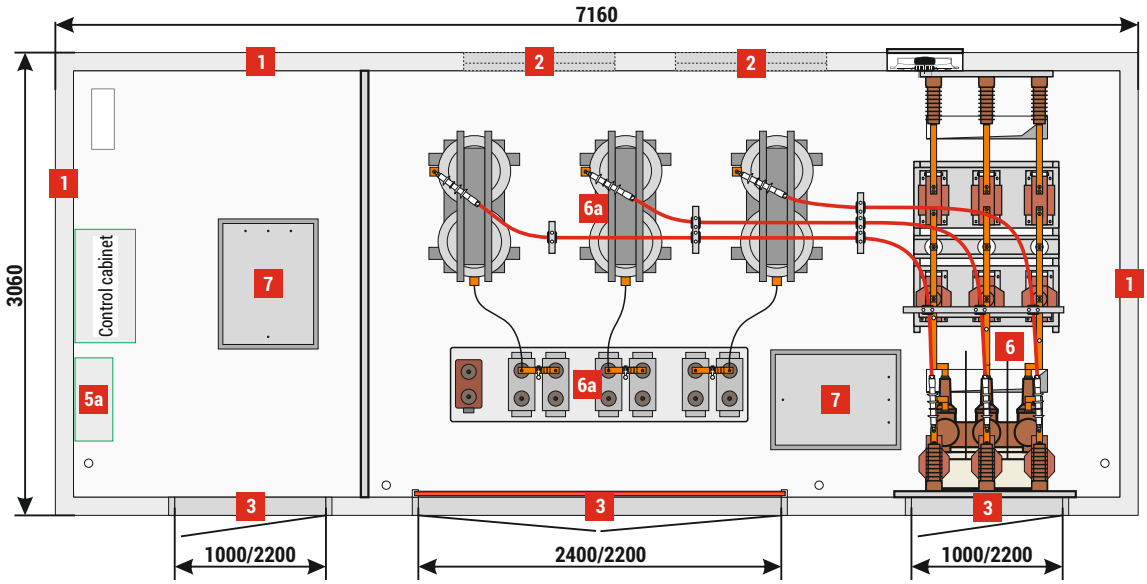
INTRODUCTION

The transmission of reactive power in a power grid system reduces the quality of power grid parameters and causes voltage and active power losses in electrical systems. In order to prevent the adverse phenomena related to the transmission of reactive power in power grids, reactive power compensation systems are used near the locations where reactive power is generated.

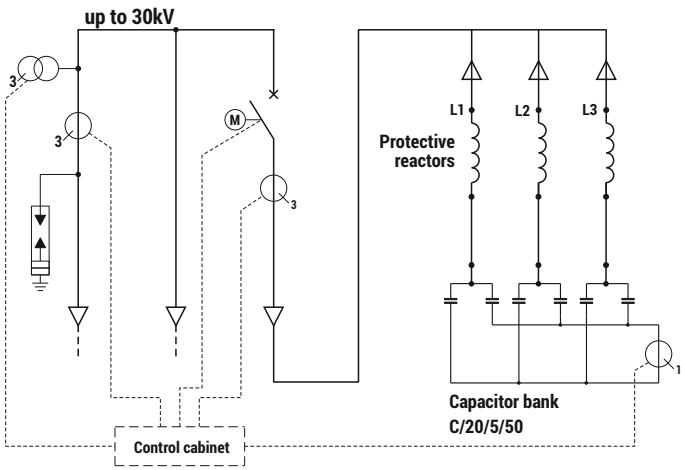
The ZPUE S.A. company provides solutions for reactive power compensation in its offer. One of them is a concrete container station equipped with a set of protections and an MV capacitor bank with protective reactors.

MRw-b (7,16x3,06) MV reactive power compensation up to 5 MVAr

Placement of devices



Electrical diagram



1	Walls, 120 mm thick - **standard**, 90 mm - **optional**
2	Ventilation grating IP 23D - **standard**, IP 43 - **optional**
3	Doors: solid or with ventilation louvres, without fire integrity class IP 23D - **standard**, IP 43 - **optional**
4	Transformer
5	LV switchgear
5a	AMI cabinet / telemetry / auxiliary
6	MV switchgear
6a	Capacitor bank with MV reactors
7	Cable duct cover

NOTE!

The catalogue presents example substation configurations.

Container transformer substations

9 / Solutions for main power supply stations.

INTRODUCTION

GPZ (main power supply station) is a power station which supplies the MV grid, composed of HV and MV switchgear and power transformers.

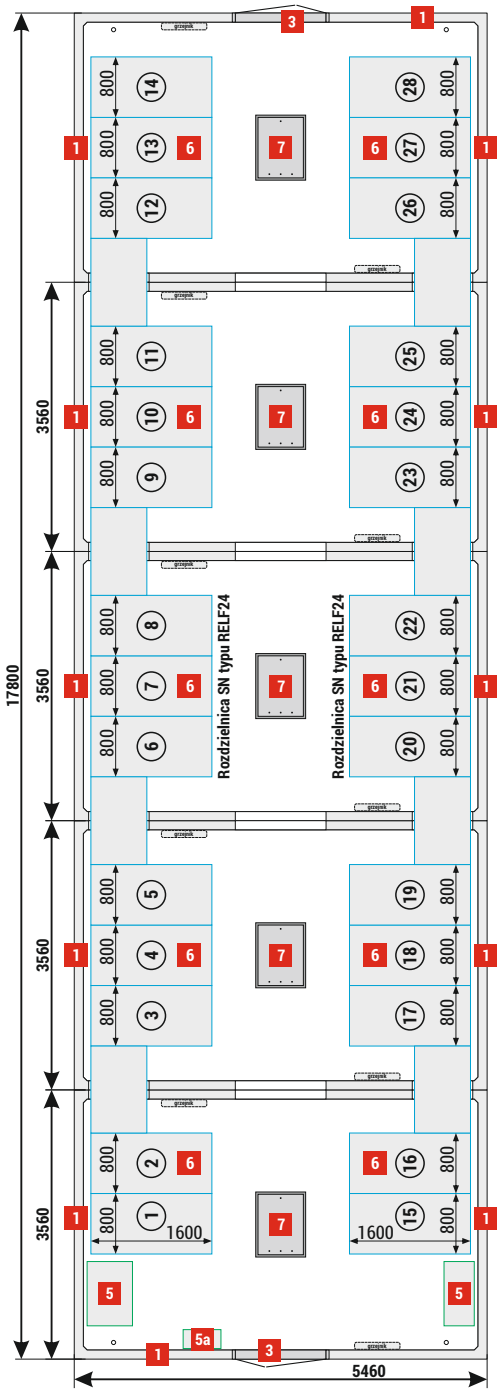
ZPUE S.A. provides in its offer solutions dedicated to such specialised facilities, as a manufacturer of MV and LV switchgears and prefabricated concrete enclosures. One of such solutions is modular, compartmentalised MV switchgears for primary circuits, with high short-circuit strength. Compartmentalisation of the switchgear and a series of protections and interlocks ensure high safety and ease of operation. Another solution is LV switchgear used to supply station auxiliaries, such as control rooms, battery rooms etc.

A wide range of prefabricated concrete enclosures allows ZPUE S.A. to manufacture even very complex substation designs. Many years of experience with complex projects based on prefabricated concrete components and preparation of the station in the factory prevents assembly errors during installation at the facility. Station installation time at the facility is minimised to just a few days even in very complex projects. Moreover prefabrication of concrete modules enables repeatability of projects, which significantly reduces time and expenses.

MV PRIMARY DISTRIBUTION SUBSTATION

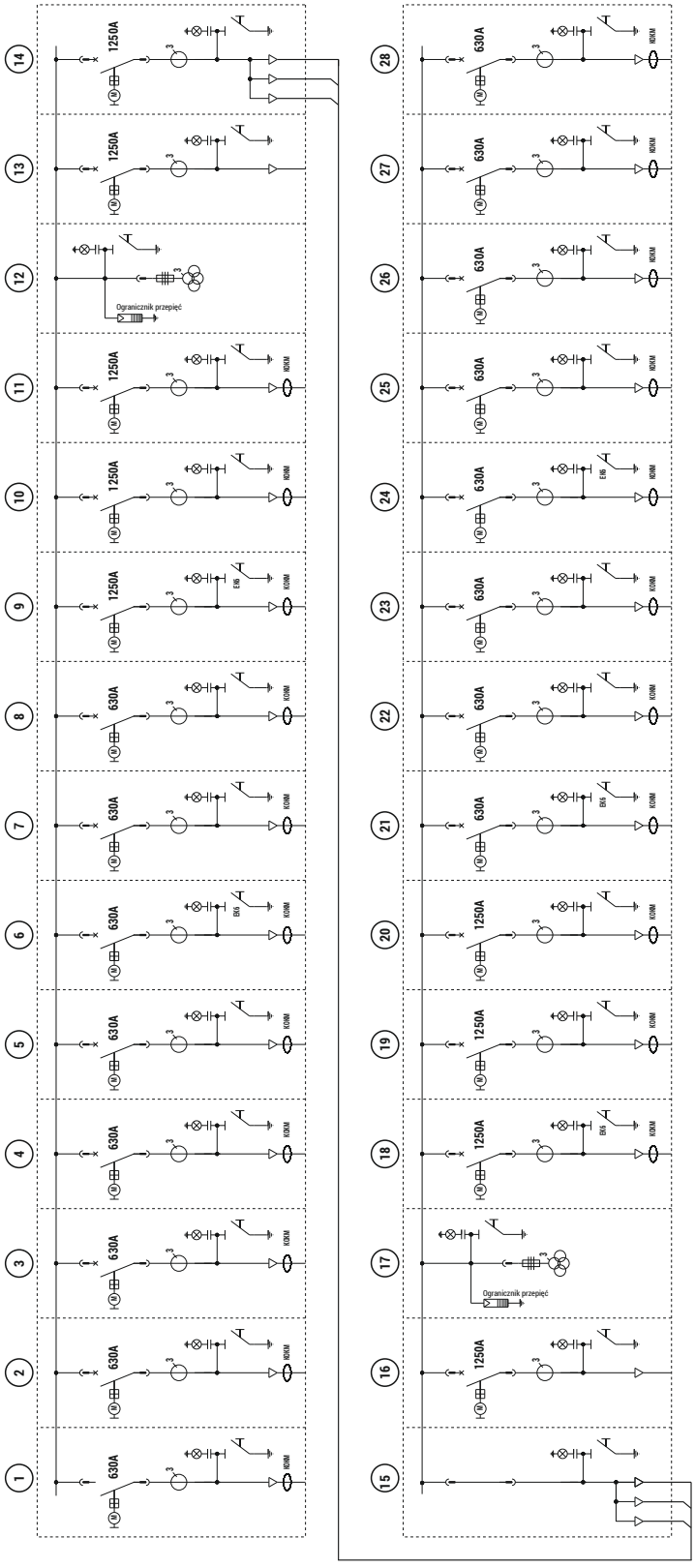
MRw-bS 20-28

Placement of equipment



1	Walls, 120 mm thick - **standard**, 90 mm - **optional** Solid walls - fire integrity class REI 120
3	Doors: solid or with ventilation louvres, without fire integrity class IP 23D - **standard**, IP 43 - **optional** Doors with fire resistance e.g EI 60 or EI 120 - **optional**
5	LV switchgear
5a	AMI cabinet / Smart Grid / telemetry / auxiliary
6	MV switchgear
7	Cable duct cover

Electrical diagram



NOTE!

The catalogue presents example substation configurations.

SYSTEM FOUNDATIONS

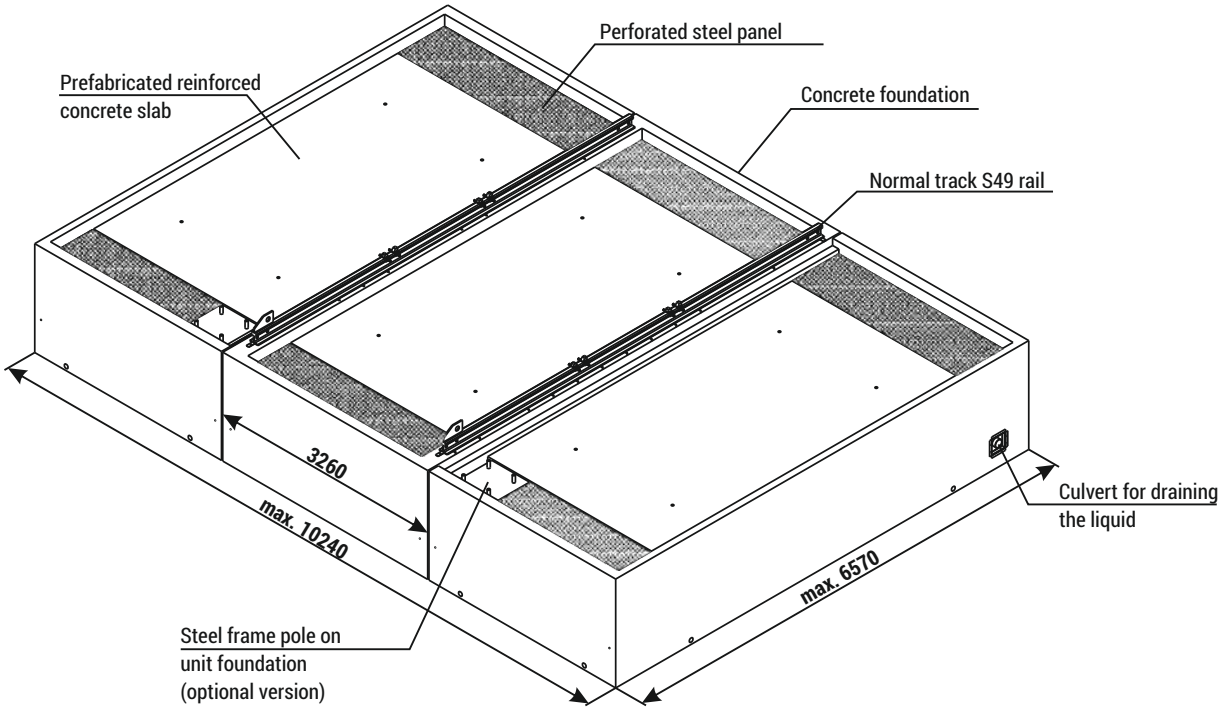
Each HV/MV GPZ has a transformer with a power of a few to a few dozen MVA. The transformers, filled with mineral oil insulation may create a significant environmental hazard in case of a failure. When designing and placing the transformer solutions which prevent oil from seeping into the ground have to be used.

Taking this into account, ZPUE S.A has introduced into its offer a range of prefabricated reinforced concrete foundations, on which power transformers are placed. In case of a transformer failure the leak of burning oil is extinguished, and then collected in the foundations which form an oil-tight sump.

The complete structure is formed by connected foundation basins, which form a system of connected vessels. Foundation basins are made of C35/45 concrete. Each of the foundation basins is covered by a prefabricated reinforced concrete slab and perforated steel platform panels. Perforated steel panels are intended to allow rainwater and transformer oil to drain into the foundation basins, collecting environmentally hazardous liquid.

High power transformers are placed on railway rails. Normal track S49 railway rails are placed on the walls of the centre foundation. Due to the significant weight of the transformer its placement at the centre of the substation is performed by sliding.

The view of the system foundation for power transformers



NOTE!

The catalogue presents example substation configurations.

Container transformer substations

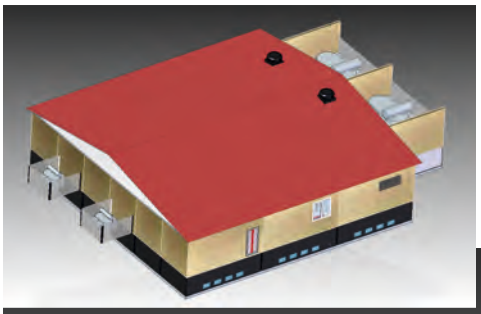
10 / Stations dedicated to the needs of the railway industry
Traction substations made of precast concrete elements

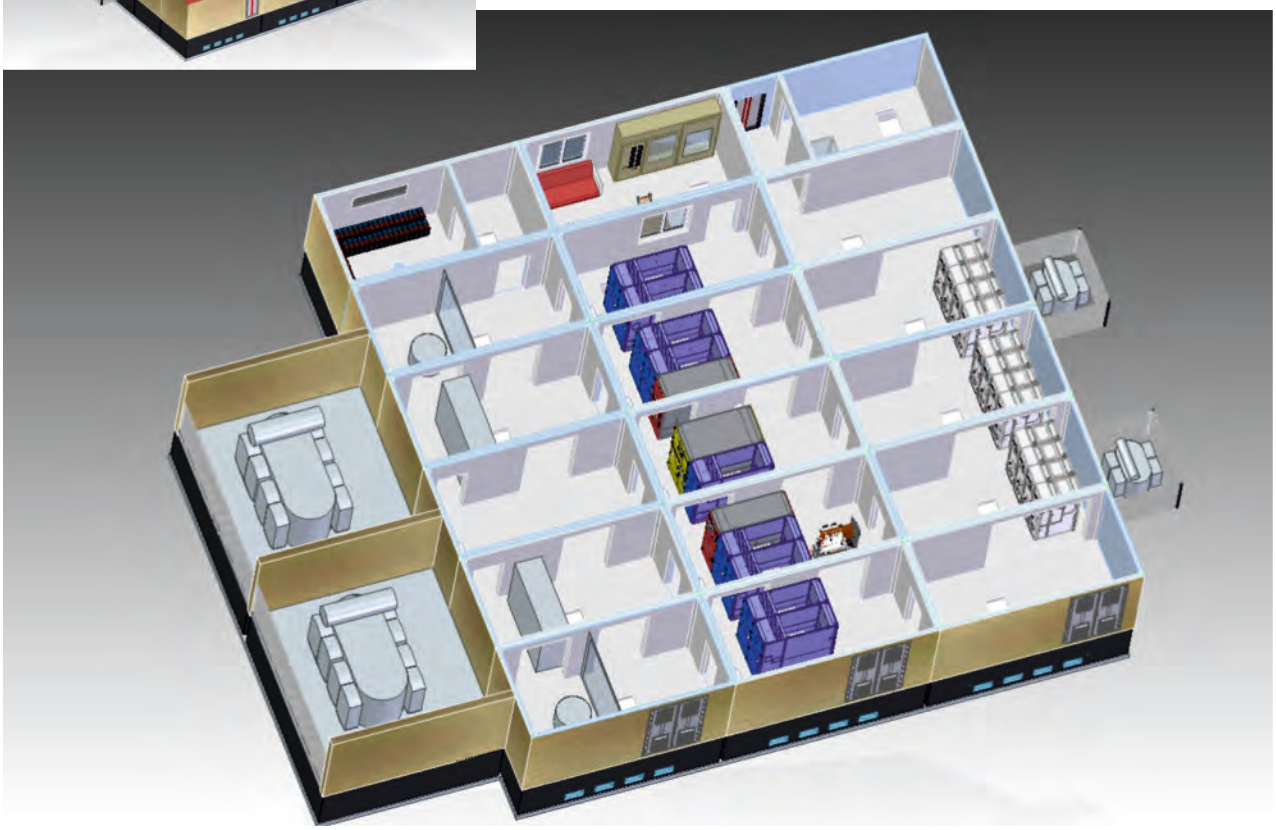
INTRODUCTION

A traction substation is a traction power facility in which the electricity supplying the substation (HV or MV) is converted into electricity with parameters (type and voltage level) appropriate for a given electric traction supply system. Due to the DC power supply system used in Poland (railway lines - 3 kV, tram lines 600 V), traction substations are transformer-rectifier stations. They convert three-phase alternating current with a voltage used in the power industry (usually 15 kV) into direct current, which supplies the overhead line and traction vehicles with it. Additionally, traction substations can be used to supply other loads (non-traction, auxiliary devices - auxiliary devices) and to return electric regenerative braking energy of vehicles to the power grid.

ZPUE S.A. as a manufacturer of MV and LV switchgears and prefabricated concrete enclosures, it is able to implement a turnkey substation. Employees of technical departments are actively involved in the design of substations. The works consist in the preparation of a design for a railway traction substation with the use of switchboards and concrete prefabricates manufactured at ZPUE S.A.

Visualization of the traction substation





NOTE!

The catalogue presents example substation configurations.

Container transformer substations

11 / Transformer substations in metal enclosures

INTRODUCTION

ZPUE S.A has been manufacturing MRw type substations in metal enclosures for over 30 years. The solutions are designed to meet the individual requirements of customers. Highly specialised substations are sold both on the domestic market and to the farthest reaches of the globe.
Our offer includes substations for the commercial power sector, industry, and special versions for open-pit mines of aggregates and minerals, for rail transport, wind farms, solar farms and biogas plants. With our own transport fleet we can deliver completely equipped substations to the assembly site.

SUBSTATION DESIGN

A load bearing element of the MRw substation is a robust frame of structural steel, protected against corrosion with paint coatings. All external elements: roof, side walls, gutters, flashings and doors of the station may be constructed in various
versions, e.g. from aluminium, zinc-coated steel or Aluzinc sheets. To ensure durability and appearance for many years of operation, all external elements are covered by polyester powder paints in accordance with the RAL palette. Colour scheme and type of façade is offered in standard version, as well as according to individual architectural designs, taking into account all available methods and materials for the finishing of metal surfaces.

Oil-tight oil sumps are installed in the transformer chambers, with transformer transport rails above them. Sealed cable entries are installed in the floor or side walls, for feeding of the MV and LV cables. MV and LV switchgear floors are segmented and removed, which significantly facilitates cable installation. Ventilation is provided through ventilation louvres located in the doors and
walls of the station. In standard version the station roof is equipped with drip caps, and a gutter system may be additionally installed in accordance with the customer's requirements.

On arrangement with the manufacturer it is possible to construct any version of the station, in which the customer will specify a different shape of the roof, type of flashings, construction of the facade, placement of the doors etc. It should be however kept in mind that this will result in a longer order delivery time and an individual technical and price offer.

ELECTRICAL EQUIPMENT

Depending on intended use, MV switchgears of our own manufacture are installed in the substations:
• primary distribution of power: RELF, RELF ex, RELF 2S, RXD, RXD 36.
• secondary distribution of power: Rotoblok, Rotoblok SF, Rotoblok VCB, TPM.
The following switchgears are used on the LV side:
• distribution: RN-W, Instal-Blok,
• industrial: ZR-W, Sivacon,
On arrangement with the substation manufacturer, it is possible to install MV or LV switchgears by other companies.

Substation parameters		
	Switchgear	
	MV	LV
U_r - rated voltage	up to 36 kV	up to 1000 V
I_r - Continuous rated current	up to 4000 A	up to 6300 A
I_k - Rated short-time withstand current	up to 40 kA (3s)	up to 105 kA (1s)
I_p - Rated peak withstand current	up to 100 kA	up to 231 kA
f_r - Rated frequency	50/60 Hz	
Maximum transformer power	up to 4000 kVA	
Ingress protection rating	IP 23D up to IP 43 (IP 55)	

STANDARD COLOUR SETS

Enclosure, doors, louvres and roof colour

RAL 9016	RAL 7032	RAL 7023	RAL 5010
RAL 9017	RAL 7016	RAL 7024	RAL 6005

NOTE!

Presented colours may differ from reality. When selecting colours always compare with the original colour chart.

SUBSTATION PLACEMENT

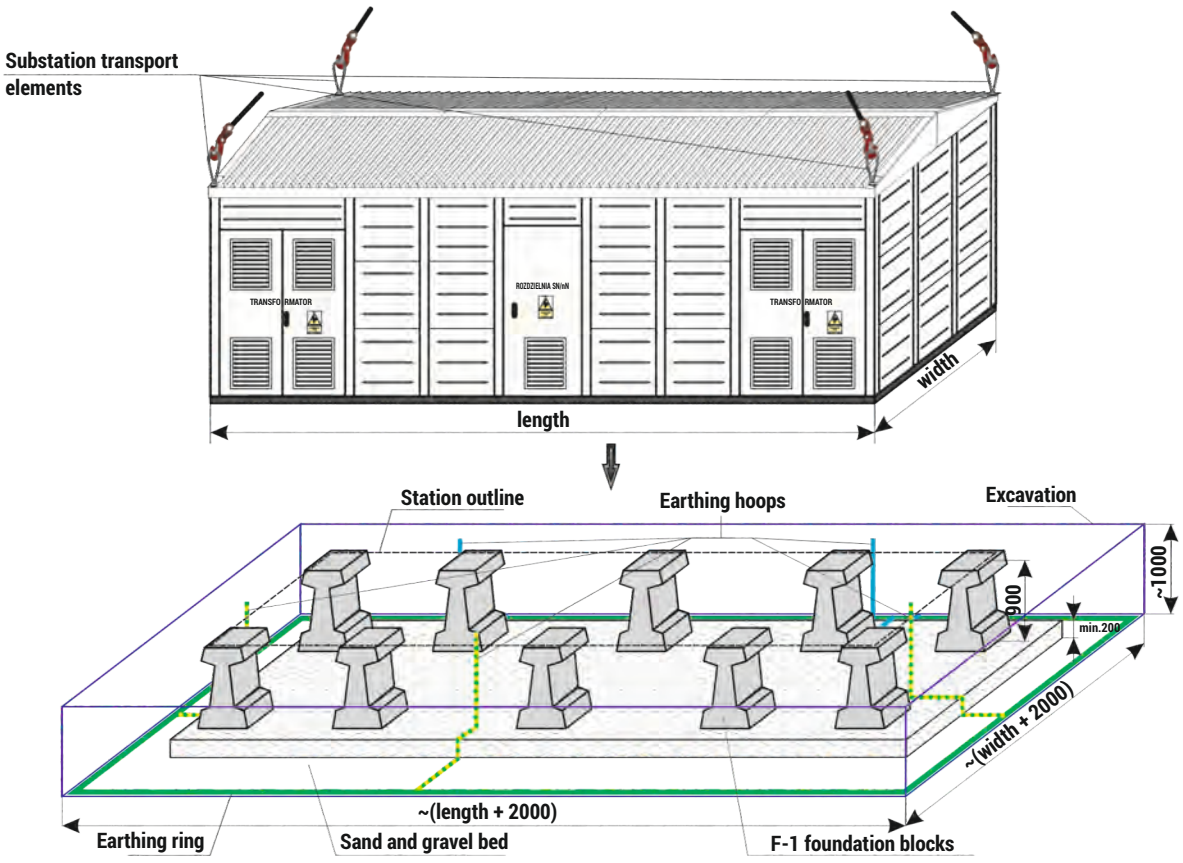
Substation placement is presented using an example of a MRw 20/2x630-6P substation.

The station is transported assembled whole to its installation site (for versions with dimensions of 8 m x 3.5 m). With larger dimensions, the station is transported to the destination in modules and assembled at the site. All works related to substation placement should be performed in accordance with a technical design drawn up on the basis of current standards and industry regulations and local guidelines, taking into account geotechnical conditions. The guidelines specified below should be treated as examples, which should be verified every time using data at the given station location.

The station should be placed on F-1 type prefabricated foundation blocks manufactured by ZPUE S.A or on a cast strip footing. The first stage of substation placement on F-1 type blocks is the excavation of a trench. Place the external earthing system of the substation in the form of an earthing ring (or other in accordance with local earthing requirements) in the prepared trench.

A sand and gravel bed with a final thickness (after compaction) of at least 20 cm should be constructed under the F-1 foundation blocks. The thickness of the sand and gravel bed should be adapted to the local water and soil conditions and the local freezing zone. The surface of the sand and gravel bed should be level in the substation placement plane, and the quality of bed preparation in the excavation confirmed in the acceptance report. The F-1 foundation blocks should be placed in the prepared location, and then the substation should be evenly placed. Covering the F-1 foundation blocks should be performed by stages, with 20 cm layers of compacted filtering soil. Pay special care in the location where cables are fed into the cable entries, since mechanical compaction may cause damage to the cables. It is important that the F-1 foundation blocks protrude by no less than 10 cm above the final ground level.

Placement in complex and complicated water and soil conditions, in mining areas and post-mining areas is recommended after a separate, individual design is prepared by a certified design body, with required geological and engineering documentation, under supervision performed by duly authorised personnel.



NOTE!

The catalogue presents example substation configurations.

MRw-m TYPE SUBSTATION. Mobile substation on a transport chassis

Failures or overhauls of transmission grid or transformer substation, the need for temporary supply to the customers and for rapid supply of power, without the option of connection to an MV grid, with the use of a power generator unit are a few examples of factors which resulted in the design of a light substation in a metal enclosure, on a transport chassis with a gross vehicle weight rating GVWR of 3.5T, which can be towed by a truck, for example. The substation enclosure is formed by a light, spatial, self-supporting metal structure made of structural steel connected by welding and bolting. The entire structure is protected against corrosion and powder painted.

Stations use state of the art TPM type MV switchgear in gas insulation and RN-W type LV switchgear with the possibility of connecting a power generator unit, operated from the outside, after previously opening the doors to an appropriate compartment. These switchgear are commonly used in the commercial power sector as elements which provide power supply and protection to transformer units.

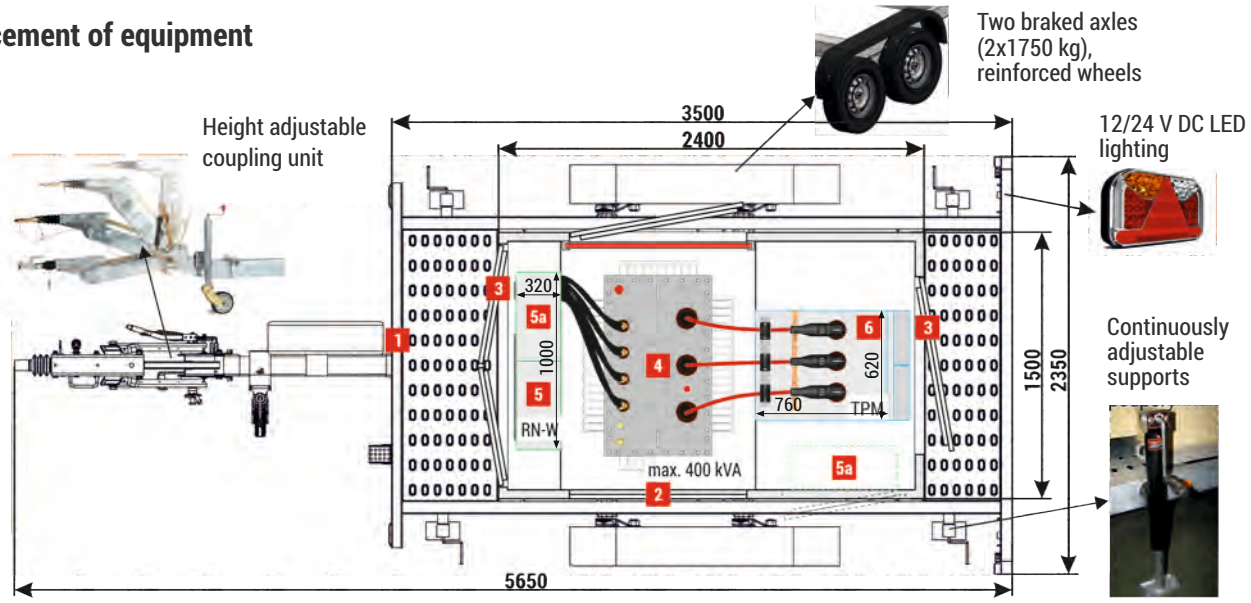
The station may house a transformer with a maximum power up to 400 kVA (with gravity ventilation), installed after roof removal. The transformer is permanently installed in the substation, which enables it to be transported without the need to remove the transformer.

The presented solution should be considered an example. ZPUE S.A. has in its offer a very wide range of transformer substation and MV and LV switchgear solutions, which enable the performance of very advanced control and protection functions, including automation logic which enables uninterrupted restoration or reconfiguration of the power supply. These solutions are selected individually and may differ from the one presented in the publication.

1	Transport chassis - **trailer**
2	Ventilation grating IP 23D - **standard**, IP 43 - **optional**
3	Doors: solid or with ventilation louvres IP 23D - **standard**, or IP 43
4	Transformer
5	LV switchgear
5a	AMI cabinet / Smart Grid / telemetry / auxiliary
6	MV switchgear

MRw-m 20/400-3

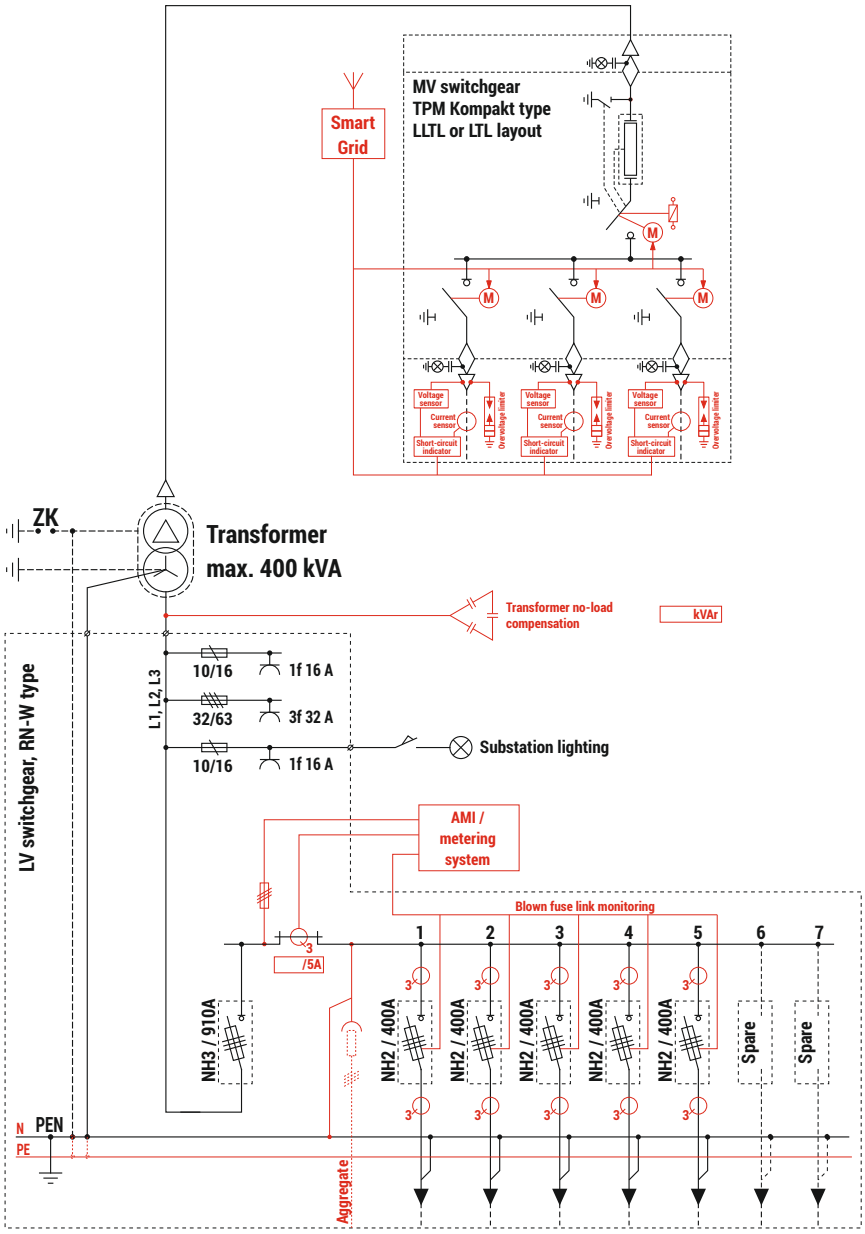
Placement of equipment



NOTE!

The catalogue presents example substation configurations.

Electrical diagram



NOTE!

Optional equipment was **marked with red** on the electrical diagram.

Technical parameters / configuration possibilities		
Transformer* (4) Maximum power / dimension	400 kVA / 850 x 1200 x 1450 [mm]	
Transformer (4) Maximum mass	1300 kg (because of DMC 3,5t set)	
Internal arc resistance classification	IAC-AB-16 kA-1s	
Enclosure class	20	
Electrical parameters of switchgears	**MV**	**LV**
Rated voltage	up to 25 kV	up to 0,69 kV
Rated current	630 A	up to 630 A
Rated short-time withstand current	up to 20 kA (1s)	up to 20 kA (1s)
Rated peak withstand current	up to 50 kA	up to 50 kA
Switchgear**	**Type**	**Maximum number of bays**
LV (5)	RN-W	7
MV (6)	TPM Kompakt	4 (LLTL)

Mass / Area	
Trailer	do 800 kg
Transformer substation	2 600 kg
Unit's GVWR	3 500 kg
Usable area	3,22 m^2

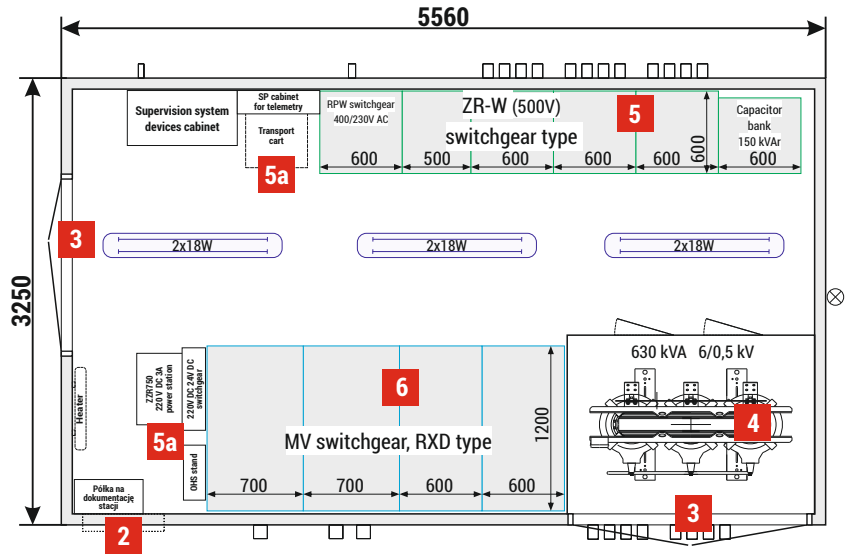
* Transformer inserted from above, before the roof is attached.

** Detailed selection of switchgears and their equipment is listed in chapters dedicated to individual devices in the catalogue. Example layouts of switchgears and corresponding substation configurations are specified in parentheses

MRw “PONTOON” TYPE SUBSTATION DEDICATED FOR OPEN-PIT MINES

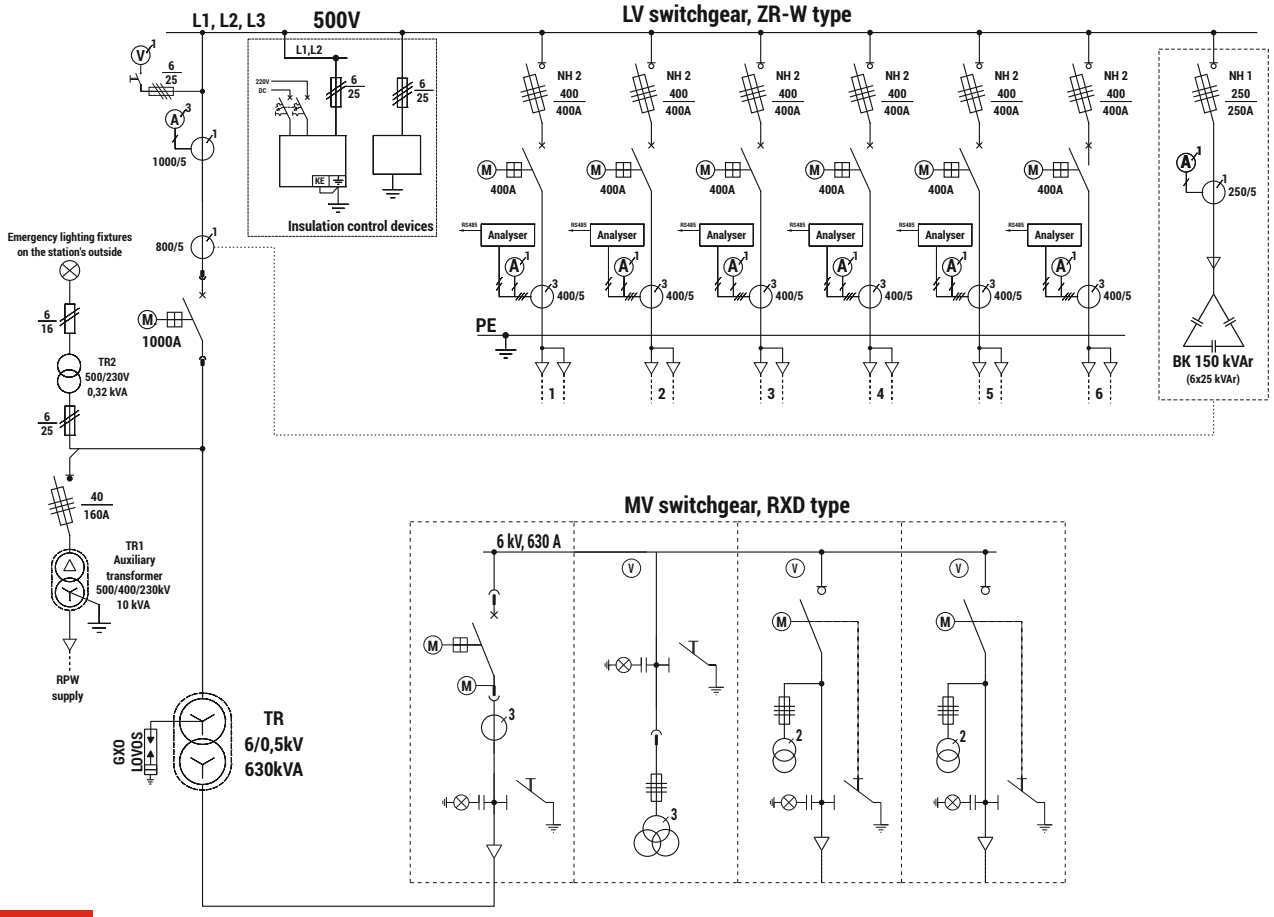
MRw-P 20/630-4

Placement of equipment



1	Substation placement part
2	Ventilation louvres IP 23D - **standard**, IP 43 or IP 55 - **optional**
3	Doors: solid or with ventilation louvres, IP 23D - **standard**, IP 43 or IP 55 - **optional**
4	Transformer
5	LV switchgear
5a	AMI cabinet / telemetry / auxiliary
6	MV switchgear

Electric diagram

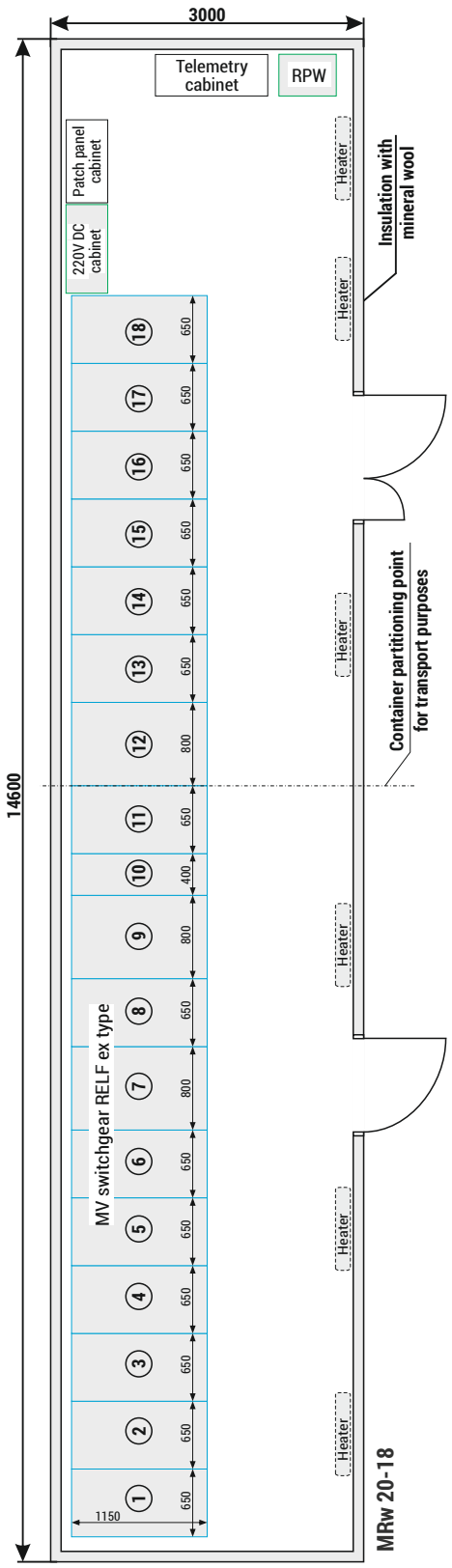


NOTE!

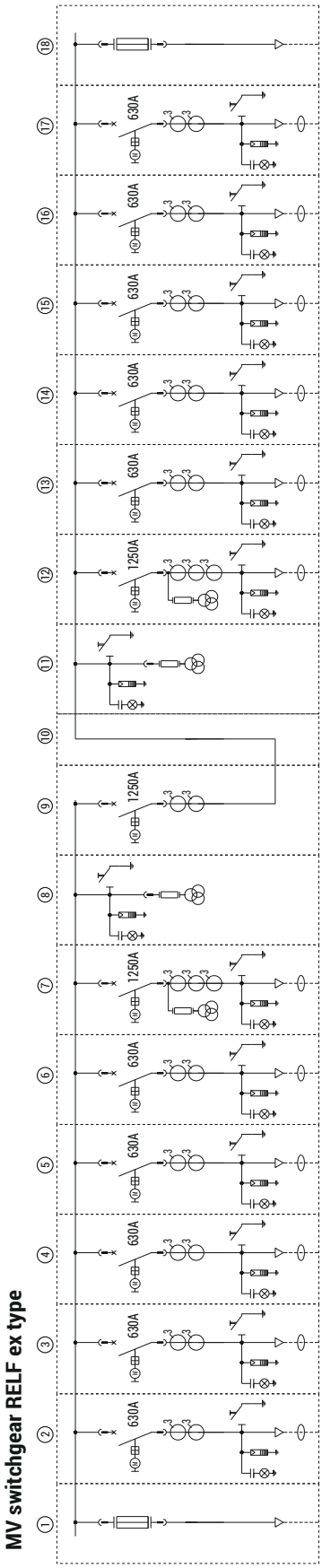
The catalogue presents example substation configurations.

SUBSTATIONS WITH A NETWORK GRID

Placement of equipment



Electric diagram



NOTE!

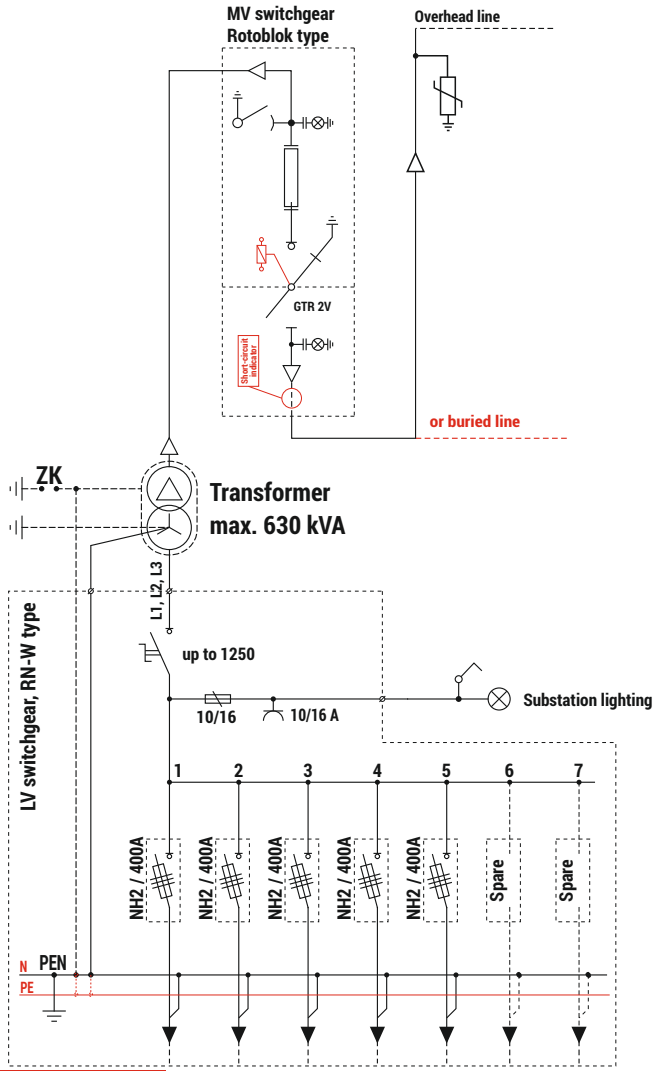
The catalogue presents example substation configurations.

MRw TYPE SKID-MOUNTED SUBSTATION

Substation dedicated for emergency power supply, with the possibility of being supplied from an overhead or buried line.

MRw 20/630-1

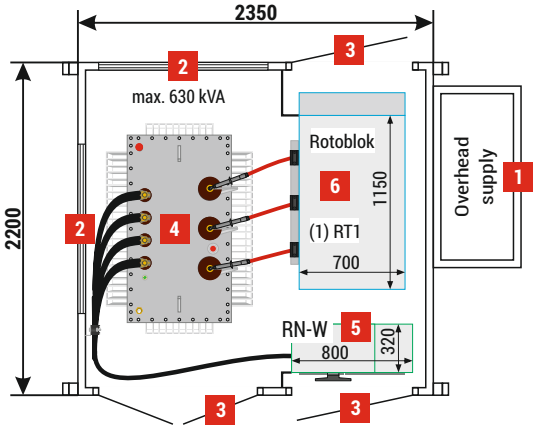
Electric diagram



NOTE!

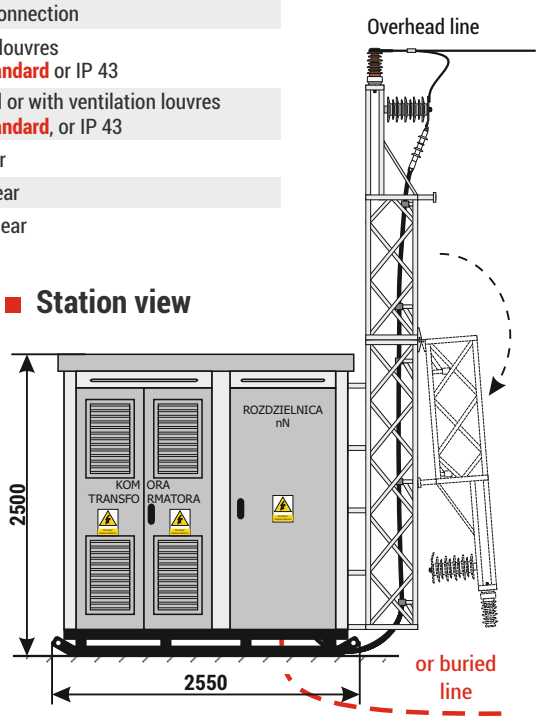
Optional equipment was **marked with red** on the electrical diagram.

Placement of equipment



1	Overhead connection
2	Ventilation louvres IP 23D - **standard** or IP 43
3	Doors: solid or with ventilation louvres IP 23D - **standard**, or IP 43
4	Transformer
5	LV switchgear
5a	MV switchgear

Station view



Technical parameters / configuration possibilities		
Transformer (4) Maximum power / dimension*	630 kVA / 1000 x 1800 x 1850 [mm]	
Internal arc resistance classification	IAC-AB-16 kA-1s	
Enclosure class	20	
Electrical parameters of switchgears	**MV**	**LV**
Rated voltage	up to 25 kV	up to 0,69 kV
Rated current	630 A	up to 1250 A
Rated short-time withstand current	up to 20 kA (1s)	up to 20 kA (1s)
Rated peak withstand current	up to 50 kA	up to 50 kA
Switchgear**	**Type**	**Maximum number of bays**
LV (5)	RN-W	7
MV (6)	Rotoblok (700)	1 (RT1)

Mass / Area	
Main structure	2 400 kg
Usable area	4,73 m^2

* Maximum width of the transformer installed through the substation doors.

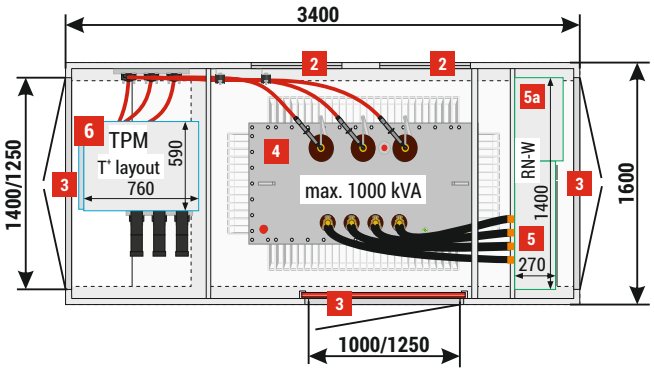
** Detailed selection of switchgears and their equipment is listed in chapters dedicated to individual devices in the catalogue. Example layouts of switchgears and corresponding substation configurations are specified in parentheses.

STATIONS DEDICATED TO PV INSTALLATIONS

MRw (3,4x1,6) 20/1000-1(3) Large-scale PV installations, sector station

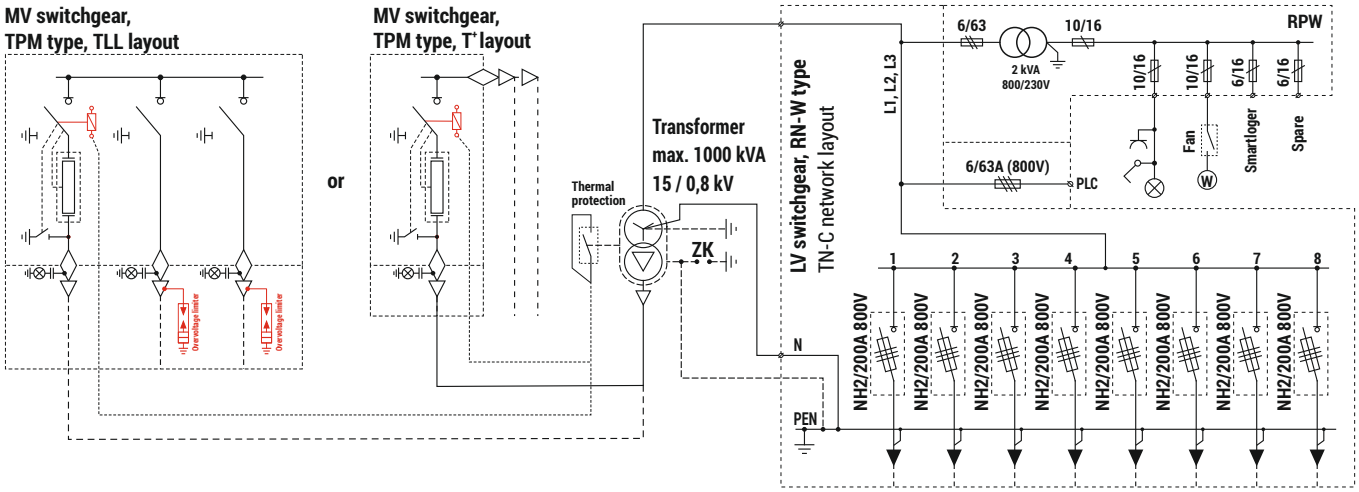
Due to the design and dimensions - the height above the ground level is only 1700 mm and the low weight - including the ~ 8T transformer, a station dedicated to large-scale photovoltaic installations - **installation between the tables with panels.**
The station is mounted on a concrete foundation and can be transported as a whole, including the transformer.

Placement of equipment



1	Substation placement part – concrete foundation
2	Ventilation louvres IP 23D - **standard**, IP 43 - **optional**
3	Doors: solid or with ventilation louvres IP 23D - **standard**, IP 43 - **optional**
4	Transformer
5	LV switchgear
5a	AMI cabinet / telemetry / auxiliary
6	MV switchgear

Electric diagram



Technical parameters / configuration possibilities		
Transformer* (4) Maximum power / dimension	1000 kVA / 1150 x 1600 x 1950 [mm]	
Enclosure class	10	
Electrical parameters of switchgears	**MV**	**LV**
Rated voltage	up to 25 kV	up to 0,8 kV
Rated current	630 A	up to 1000 A
Rated short-time withstand current	up to 25 kA (1s)	up to 35 kA (1s)
Rated peak withstand current	up to 63 kA	up to 77 kA
Switchgear**	**Type**	**Maximum number of bays**
LV (5)	RN-W	8
MV (6)	TPM	1 (T+) / 3 (e.g. WLL or TLL)

Mass / Area	
Concrete foundation	3 000 kg
Metal main structure	1 500 kg
Metal roof	200 kg
Usable area	5,44 m^2

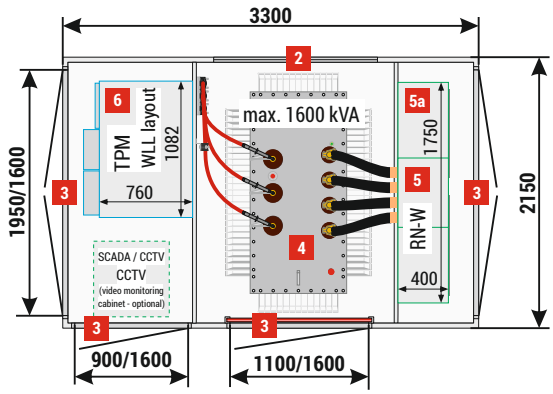
* Transformer inserted from above, before the roof is attached.
** Detailed selection of switchgears and their equipment is listed in chapters dedicated to individual devices in the catalogue. Example layouts of switchgears and corresponding substation configurations are specified in parentheses.
*** LV station side may operate with TN-C and IT type low voltage cable grids.

NOTE!

The catalogue presents example substation configurations.
Optional equipment was **marked in red** on the electrical diagram.

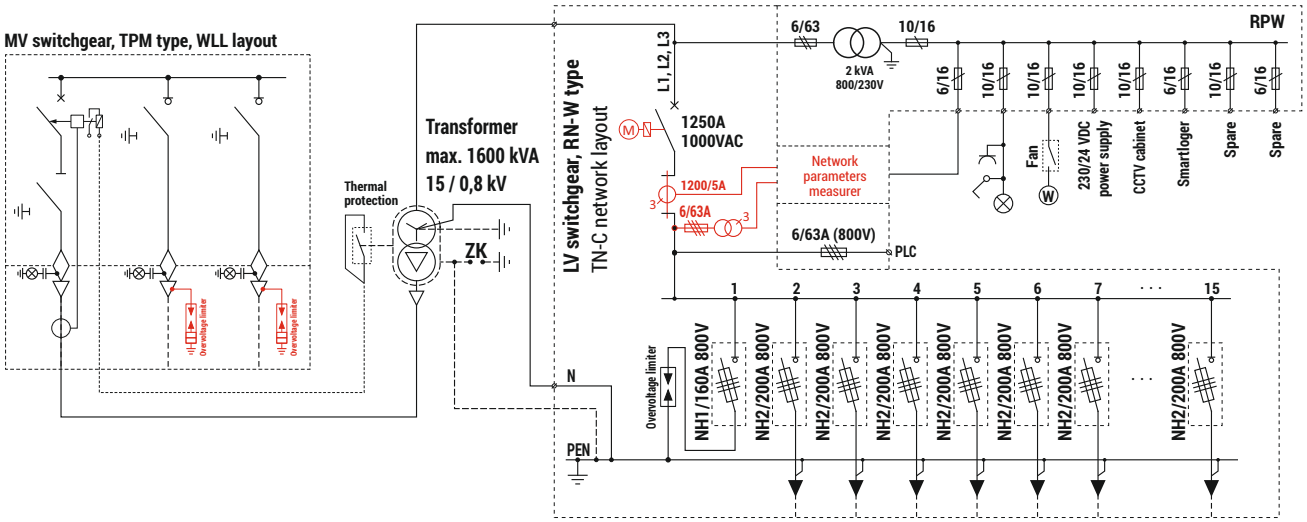
The station is dedicated to large-scale photovoltaic installations, the main body is integrated with a metal foundation - **low weight ~ 7.5T** with an installed transformer. The station can be transported as a whole, including the transformer.

Placement of devices



1	Substation placement part — metal foundation
2	Ventilation louvres IP 23D - **standard**, IP 43 - **optional**
3	Doors: solid or with ventilation louvres IP 23D - **standard**, IP 43 - **optional**
4	Transformer
5	LV switchgear
5a	AMI cabinet / telemetry / auxiliary
6	MV switchgear

Electrical diagram



Technical parameters / configuration possibilities		
Transformer* (4) Maximum power / dimension	1600 kVA / 1300 x 1900 x 1950 [mm]	
Enclosure class	10	
Electrical parameters of switchgears	**MV**	**LV**
Rated voltage	up to 25 kV	up to 0,8 kV
Rated current	630 A	up to 1250 A
Rated short-time withstand current	up to 25 kA (1s)	up to 35 kA (1s)
Rated peak withstand current	up to 63 kA	up to 77 kA
Switchgear**	**Type**	**Maximum number of bays**
LV (5)	RN-W	15
MV (6)	TPM	3 (WLL)

Mass / Area	
Total mass with transformer	7 500 kg
Metal main structure	2 800 kg
Metal roof	500 kg
Usable area	7,1 m^2

NOTE!

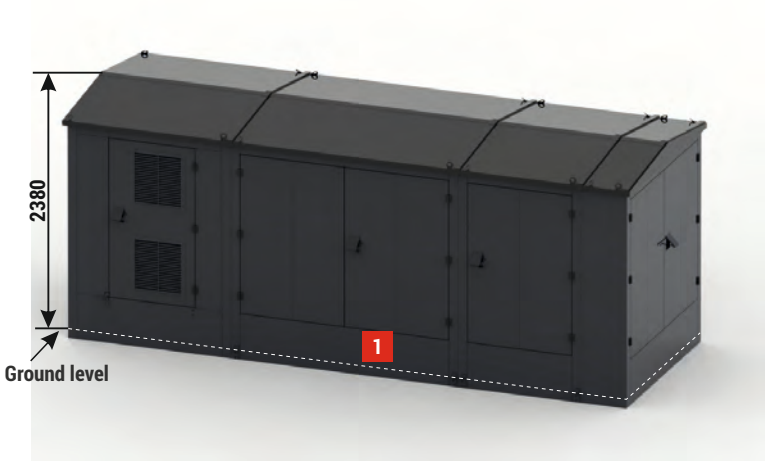
The catalogue presents example substation configurations.
Optional equipment was **marked in red** on the electrical diagram.

MRw-k type substation – modular design

Due to the modular design, it is possible to create a wide range of substation configurations based on standard modules, complex configuration based on MV switchgears (in air or gas insulation) and LV switchgears of our own manufacture.

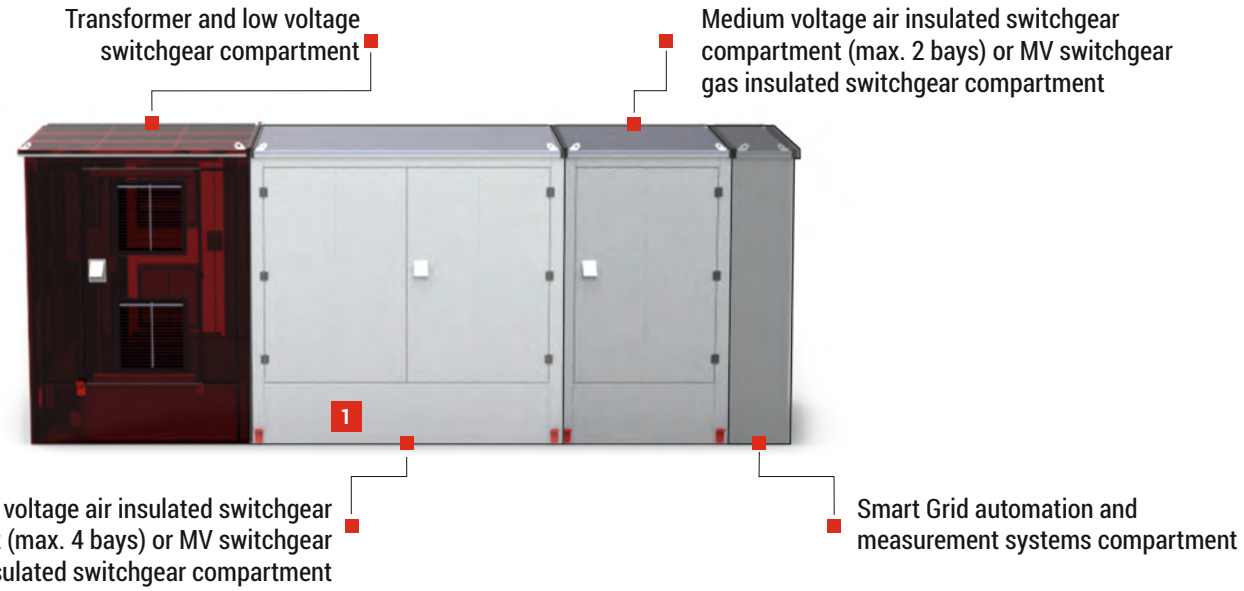
Modular substations are based on a light, self-supporting metal structure. This design enables placement of the station directly on the ground or on previously prepared base, without the need to prepare additional foundations. This shortens the installation time and cost compared to traditional solutions built of brick.

Example view of station with RXD switchgear



Substation parameters		
Maximum transformer power	up to 1000 kVA	up to 2000 kVA
MV/LV rated voltage	up to 24 kV / 0,4 kV	
Switchgear continuous rated current (MV/LV)	up to 630 A / 1600 A	up to 630 A / 3200 A
Rated short-time withstand current (MV/LV)	up to 25 kA (3s) / 35 kA (1s)	up to 25 kA (3s) / 85 kA (1s)
Rated peak withstand current (MV/LV)	up to 63 kA / 77 kA	up to 63 kA / 187 kA
Internal arc classification	up to AB-20 kA – 1s	
Ingress protection rating	IP 23D or IP 43	

DESIGN / MODULARITY - Main functional compartments



1 Substation placement part, metal foundation

NOTE!

The catalogue presents example substation configurations.

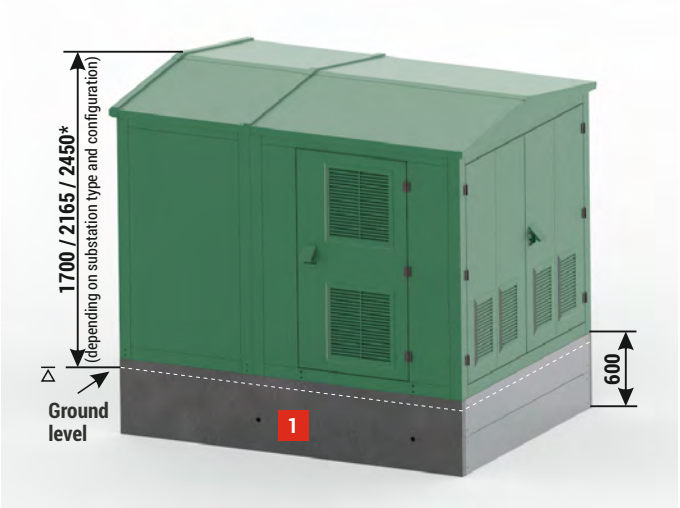
EXAMPLE CONFIGURATIONS OF MODULAR SUBSTATIONS WITH TPM AND ROTOBLOK SF TYPE MV SWITCHGEARS

Technical parameters / Configuration options

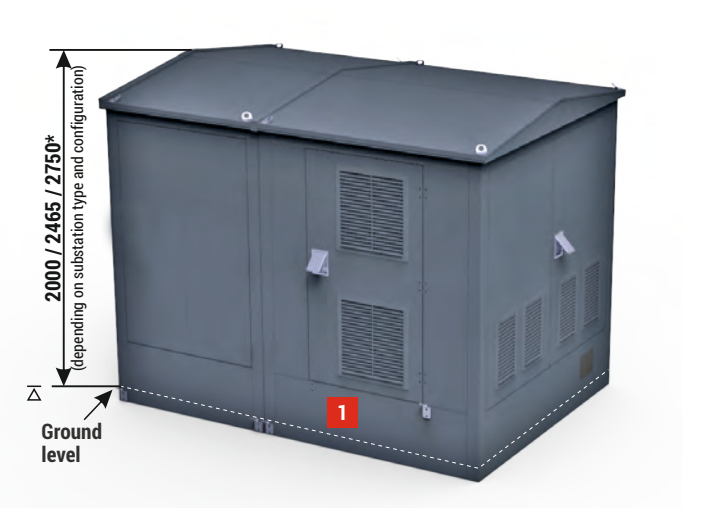
Station		Transformer (4)	Switchgear - type / max. bay amount	
Type	Dimensions	Maximum power	MV (6)	LV (5)
MRw 20/160	2,35 x 1,6 x 1,7	160 kVA	NONE	RN-W / 7
MRw 20/250	2,7 x 1,8 x 2,16 or 2,46	250 kVA	TPM / 4 or 2 + M	RN-W / 8
MRw 20/250	2,9 x 2,6 x 2,45 or 2,75	250 kVA	Rotoblok SF / 4	RN-W / 14
MRw 20/1000	2,8 x 2,2 x 2,16 or 2,46	1000 kVA	TPM / 5 or 3 + M	RN-W / 12
MRw 20/1000	2,8 x 2,6 x 2,16 or 2,46	1000 kVA	TPM / 6 or 4 + M or 5 + S	RN-W / 16
MRw 20/1000	3,1 x 2,2 x 2,45 or 2,75	1000 kVA	Rotoblok SF / 3	RN-W / 12
MRw 20/1000	3,1 x 2,6 x 2,45 or 2,75	1000 kVA	Rotoblok SF / 4	RN-W / 16
MRw 20/1600	3,4 x 2,6 x 2,45 or 2,75	1600 kVA	TPM / 6 or 4 + M or 5 + S	RN-W / 16
MRw 20/1600	3,7 x 2,6 x 2,45 or 2,75	1600 kVA	Rotoblok SF / 4	RN-W / 16
MRw 20/2000	3,7 x 2,2 x 2,45 or 2,75	2000 kVA	TPM / 6 or 4 + M or 5 + S	ZR-W / 16
MRw 20/2000	4,0 x 2,6 x 2,45 or 2,75	2000 kVA	Rotoblok SF / 4	ZR-W / 16

External view

Version with concrete foundations



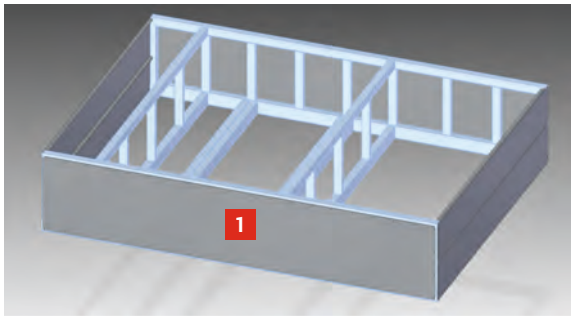
Versions with integrated metal foundations



Concrete foundation

Dimensions in accordance with the substation size

Metal foundation



1 Substation placement part – concrete or metal foundation

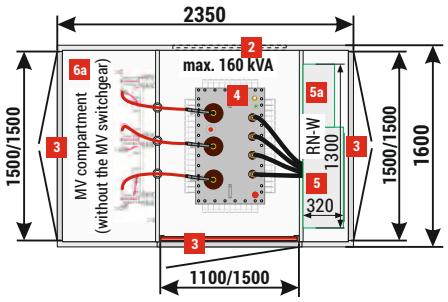
NOTE!

The catalogue presents example substation configurations.

* Station height depends on the station configuration.

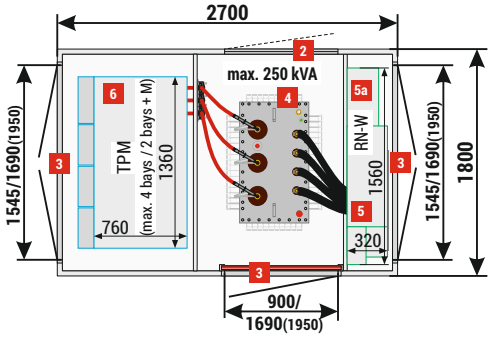
Placement of devices

MRw (2,35x1,6) 20/160 - final substation (simplified)

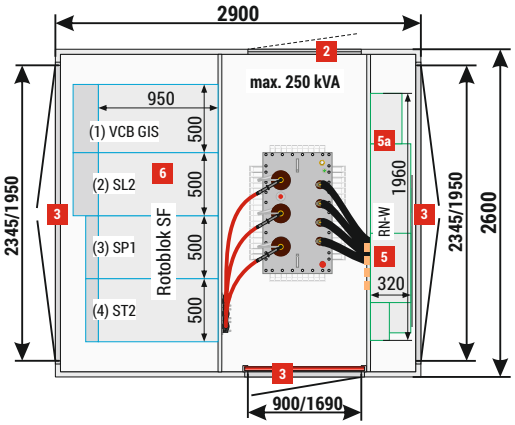


2	Ventilation louvres - **optional**
3	Doors: solid or with ventilation louvres, IP 23D - **standard**, IP 43 or IP 55 - **optional**
4	Transformer
5	LV switchgear
5a	AMI cabinet / telemetry / auxiliary
6	MV switchgear
6a	MV compartment without the MV switchgear

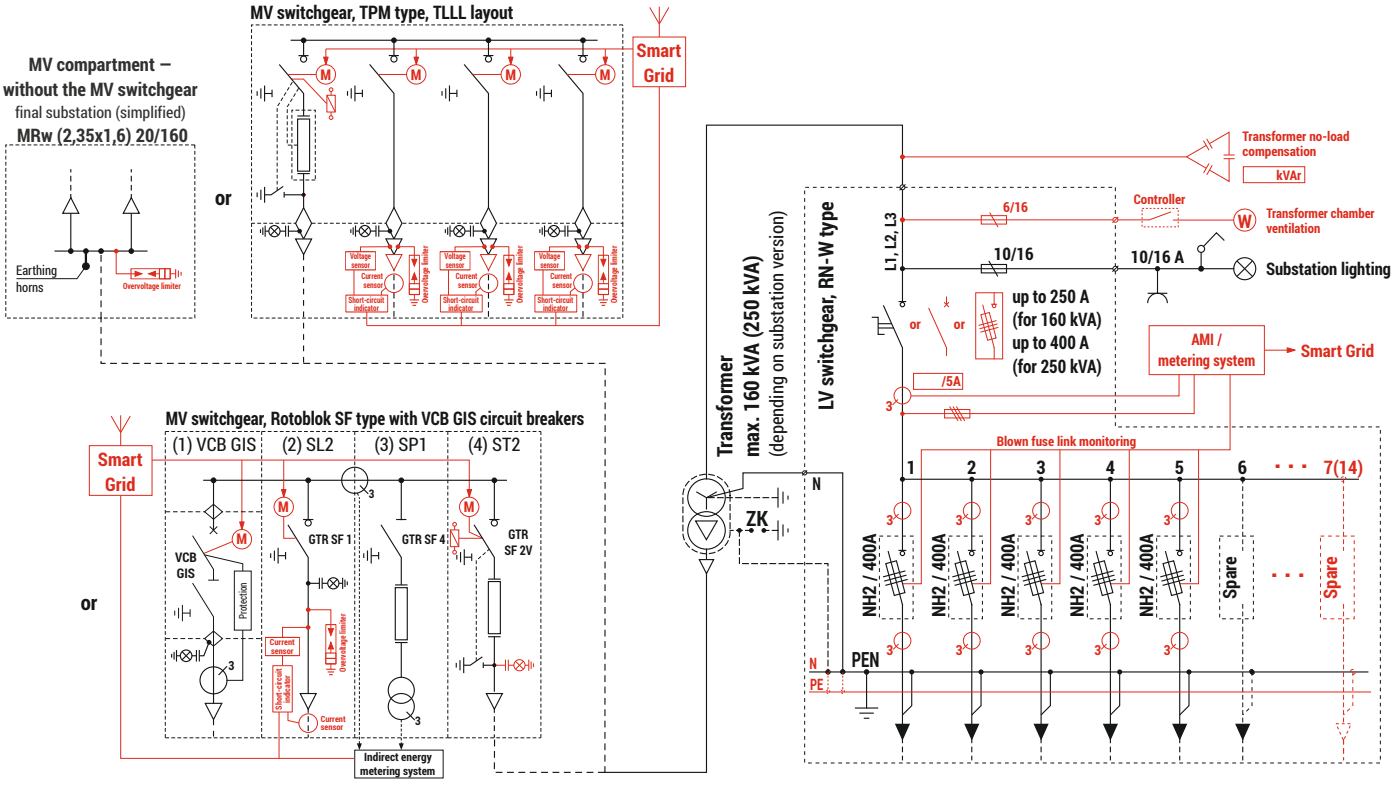
MRw (2,7x1,8) 20/250-4



MRw (2,9x2,6) 20/250-4



Electrical diagram

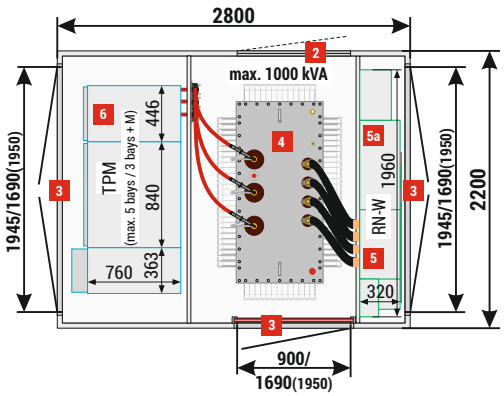


NOTE!

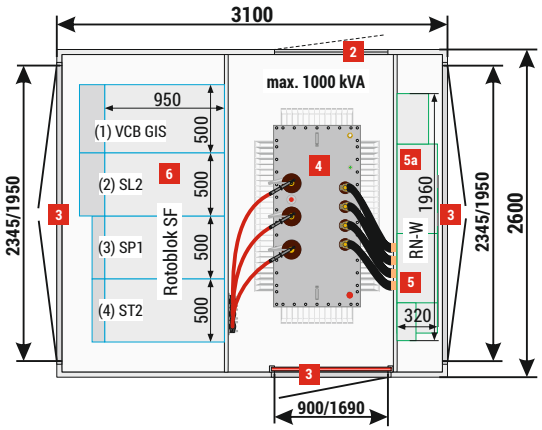
The catalogue presents example substation configurations.
Optional equipment was **marked in red** on the electrical diagram.

Placement of devices

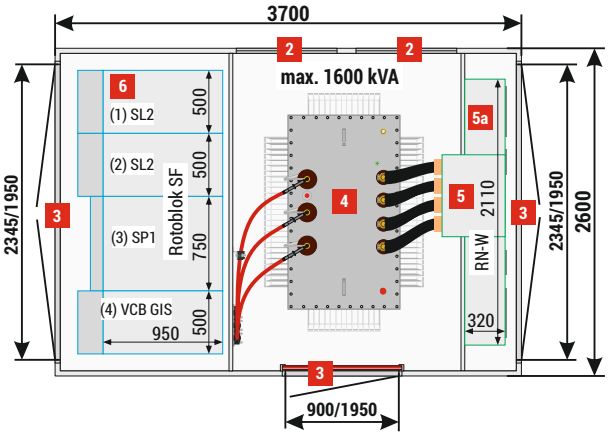
MRw (2,8x2,2) 20/1000-3



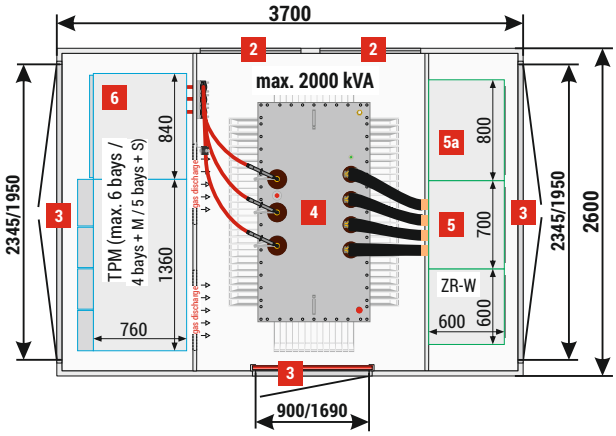
MRw (3,1x2,6) 20/1000-4



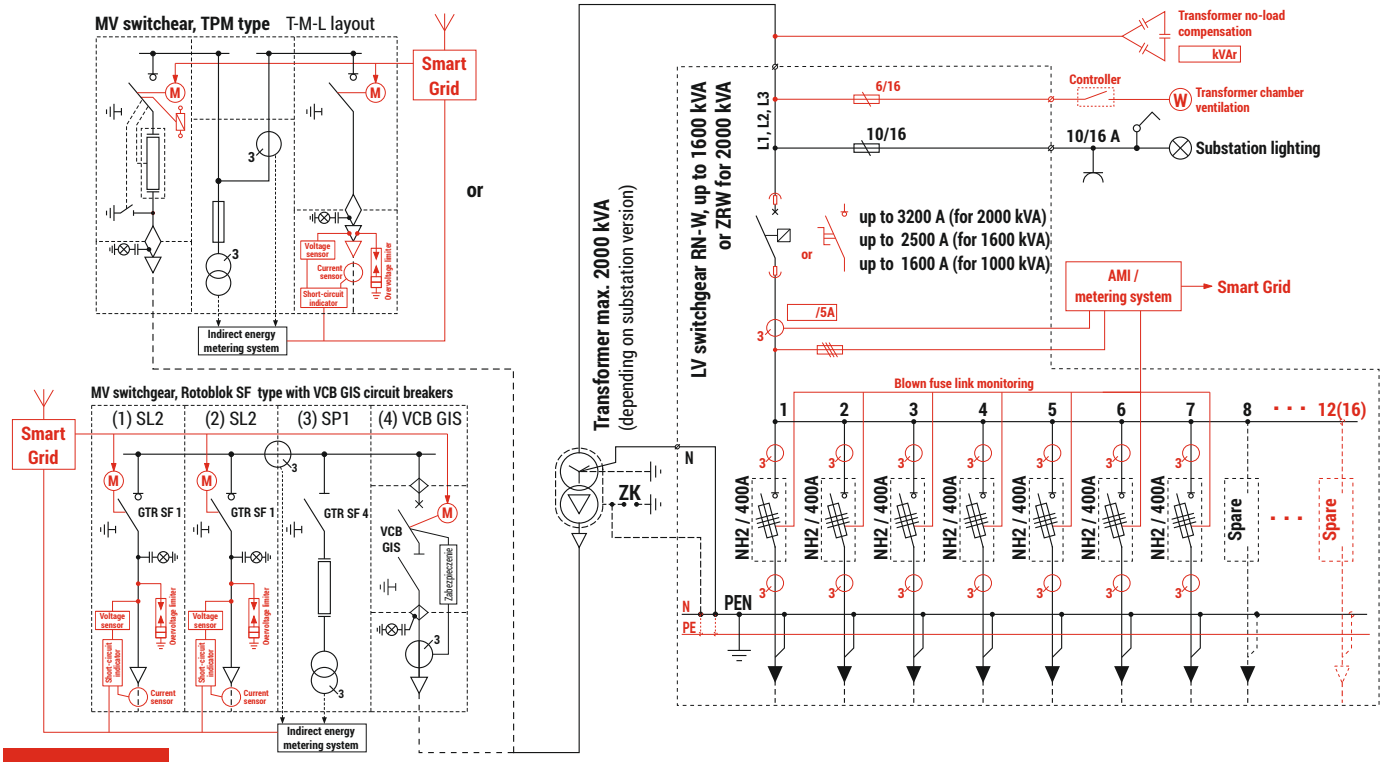
MRw (3,7x2,6) 20/1600-4



MRw (3,7x2,6) 20/2000-5



Electrical diagram

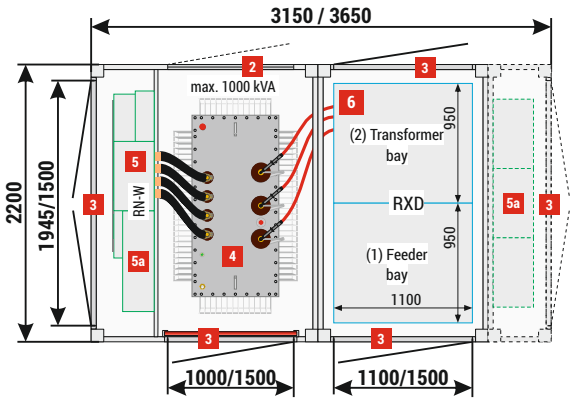


NOTE!

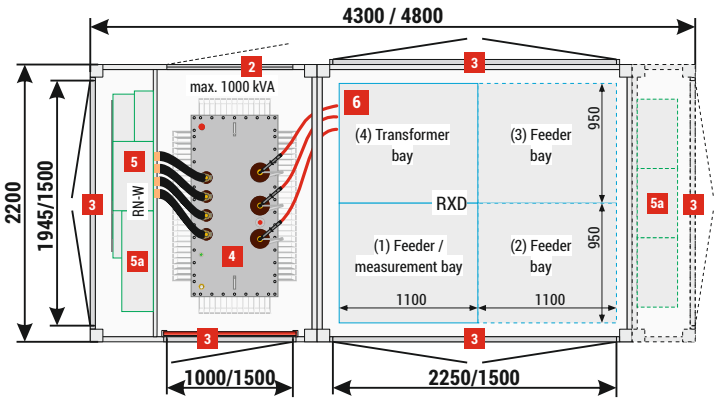
The catalogue presents example substation configurations.
Optional equipment was **marked in red** on the electrical diagram.

EXAMPLE CONFIGURATIONS OF SUBSTATIONS WITH RXD TYPE AIR INSULATED SWITCHGEARS

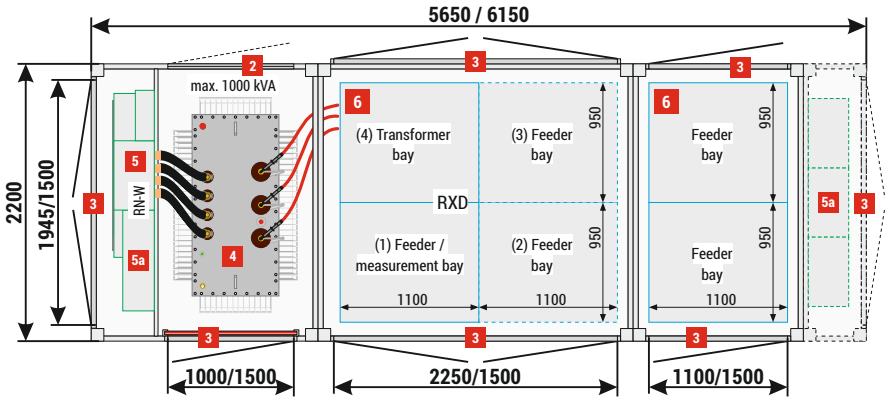
MRw configuration no.1 **max. 1000 kVA**



MRw configuration no.2 **max. 1000 kVA**

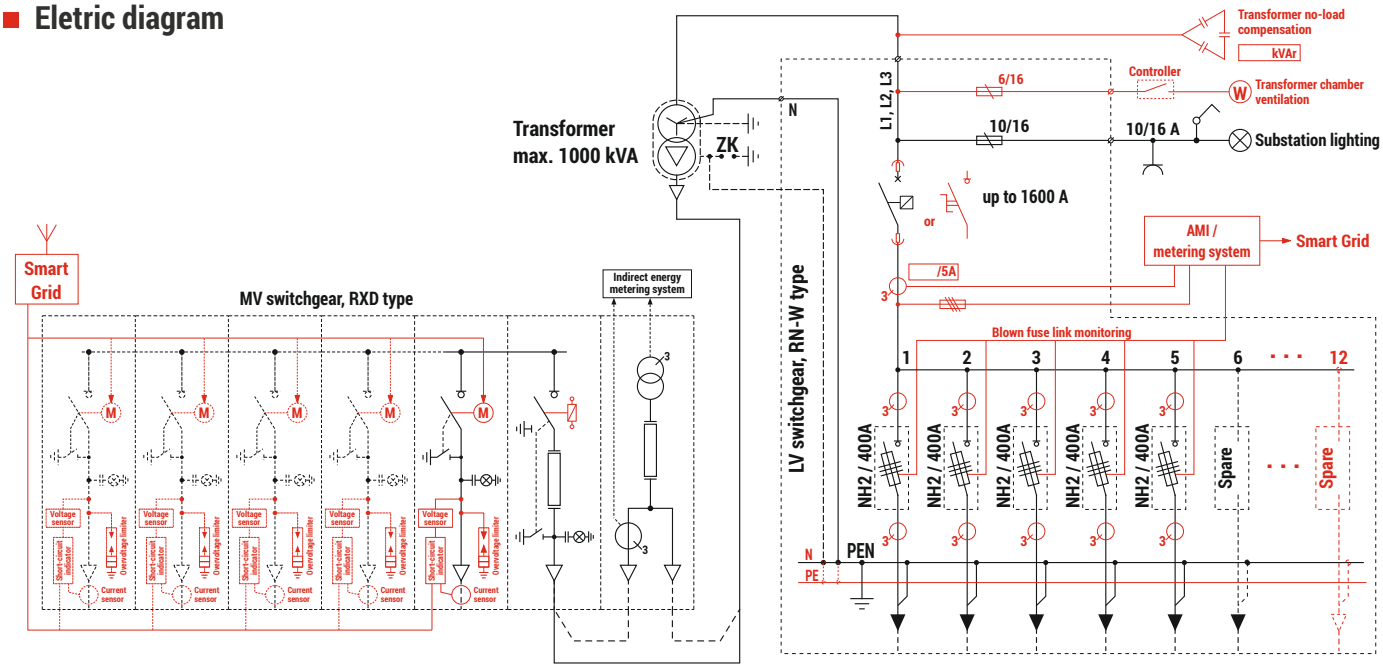


MRw configuration no.3 **max. 1000 kVA**



2	Ventilation louvres - **optional**
3	Doors: solid or with ventilation louvres IP 23D - **standard**, IP 43 or IP 55 - **optional**
4	Transformer
5	LV switchgear
5a	AMI cabinet / telemetry / auxiliary
6	MV switchgear

Eletric diagram



NOTE!

The catalogue presents example substation configurations.
Optional equipment was **marked in red** on the electrical diagram.

Advantages of substations