CLOSER THAN YOU THINK

zpue®
Koronea group

SPS®

SMART POWER STATION


Koronea
Nowy Nissan LEAF
SIMPLY AMAZING
TK 6563U


ZPUE
Koronea


ZPUE
Koronea


Stop-Stop
Alarm-Error

ZPUE S.A. OFFER

CLOSER THAN YOU THINK

We have commenced the fourth decade of **ZPUE SA's** operations. We have not slowed down the pace in the search for new solutions. While appreciating our achievements, we still aim high and take up the challenges of modern power engineering. At the same time, we draw on the best traditions of our company, opening up to the needs of customers and the entire sector. Our products are used not only in many places in Poland, but all over the world - from the Andean slopes in Chile to far east Asia. Wherever you are, we're close. Closer than you think.

Our company's DNA code includes continuous improvement of our products and our corporate organisation. We believe that courage in the search for new solutions will stay with us for the coming decades. With it we constantly increase the scale of orders and production, and thus - the scale of the company's business.

Today, in addition to Włoszczowa, we own production plants in Katowice, Gliwice, Raciąż and St. Petersburg, and ZPUE products are shipped to 30 countries across the world. Through these operations, we have influenced not only Polish industry, but also our immediate environment: we are the largest business in the western part of the Świętokrzyskie region and we contribute to the lives of our neighbours.

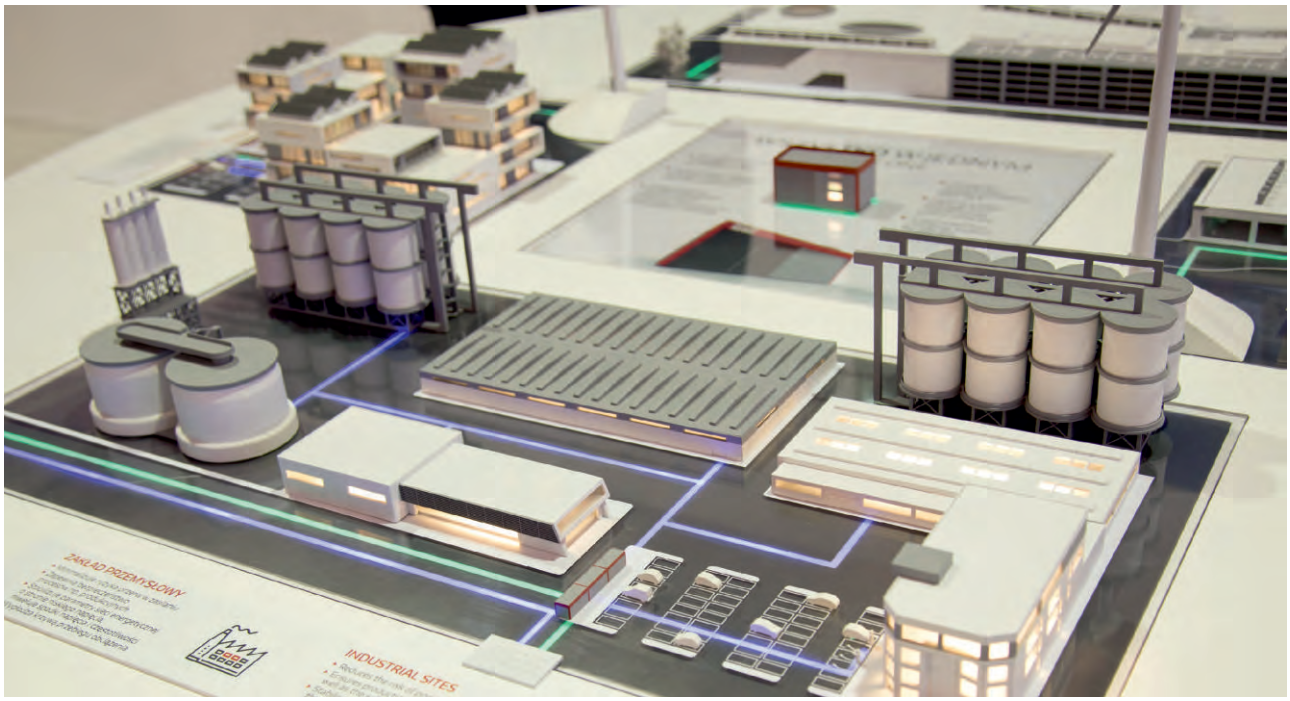
We are now developing our sales market, by improving the products and the plant's capacity. We are also looking for technical innovations that can revolutionise the market, and which - it is our ambition - we want to be the first to discover for Poles.

One of the latest new ZPUE SA products is the SPS Smart Power Station with underground energy storage. Its launch at the 31st International Power Industry Fair ENERGETAB 2018 in Bielsko Biała was received with great interest from the market and the mass media alike, becoming the most media-covered novelty at the September event. Since then, our SPS has been awarded many valuable prizes.

Plans for the future

We keep up with megatrends...

One decade of the 21st century was enough to shake the foundations of the power industry that had been based on fossil fuels and a relatively simple grid architecture for more than 50 years. The emergence of renewable energy sources (RES) and so-called smart grids can be compared to the invention of the steam engine by James Watt. While the Scotsman's invention led to significant development in industrial production and transport, the current energy revolution is making an overarching contribution to the increasingly sustainable develop-ment of the areas that had once benefited from Watt's invention.



SPS - an answer to our clients' needs

The basic factor determining the development of modern power systems is the availability of technology and the safety of equipment. Therefore, using our knowledge of megatrends, we are constantly developing our products to meet the needs of the sector.

As a leading manufacturer of power grid facilities and equipment, we also know that the safety and comfort of anyone who has used electricity at least once are invaluable. Our devices meet all safety standards and are also adapted to operate in smart grids. The latest results of our work include a modern SPS (Smart Power Station) and a ring switchgear with air insulation (TPM Air).

SPS is a solution which, apart from classical power substation features, contains an energy storage facility (typically up to 750 kWh, with extension options) and, depending on the customer's needs, can be equipped with a fast electric vehicle charger (over 250 kW) or an inverter to connect to renewable power sources.

The substation operation is controlled by dedicated software.

The fundamental advantage of the SPS substation stems from its capablity to greatly increase the security of supply of grid nodes, industrial plants or hospitals, as well to allow for optimisation of power consumption and costs. All this combined makes our SPS perfectly corresponding with global megatrends in the broad power sector.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General information about the SPS Smart Power Station transformer substation

Recent years have brought new challenges in the power industry. High-rate growth of the electric car market, continuous development of uncontrollable renewable sources (RES), increasingly common energy quality problems and ensuring continuity of supply are some of the challenges of today's power sector. Without the right tools, there is a considerable risk that these challenges will become a serious problem that without a proper solution will significantly reduce our development. On the other hand, EU legislators impose new obligations in their climate policies, consisting of an increase in the share of renewable energy in total energy consumption, as well as reducing greenhouse gas emissions.

One of the solutions to the problems of today's power sector is the SPS - the first in Poland, it is a combination of a smart transformer substation with energy storage, connections to RES sources, and electric vehicle chargers.

The SPS is a smart transformer substation with energy storage, connections to RES sources, and electric vehicle chargers. A solution that integrates the functionality of a remotely managed, distribution transformer substation in a Smart Grid system with a bidirectional inverter (charge / discharge) of energy storage, for concurrent charging of electric vehicles, cars and buses alike. The system is complemented by the option to power the energy storage or consumers directly from RES, such as by solar or wind farms.

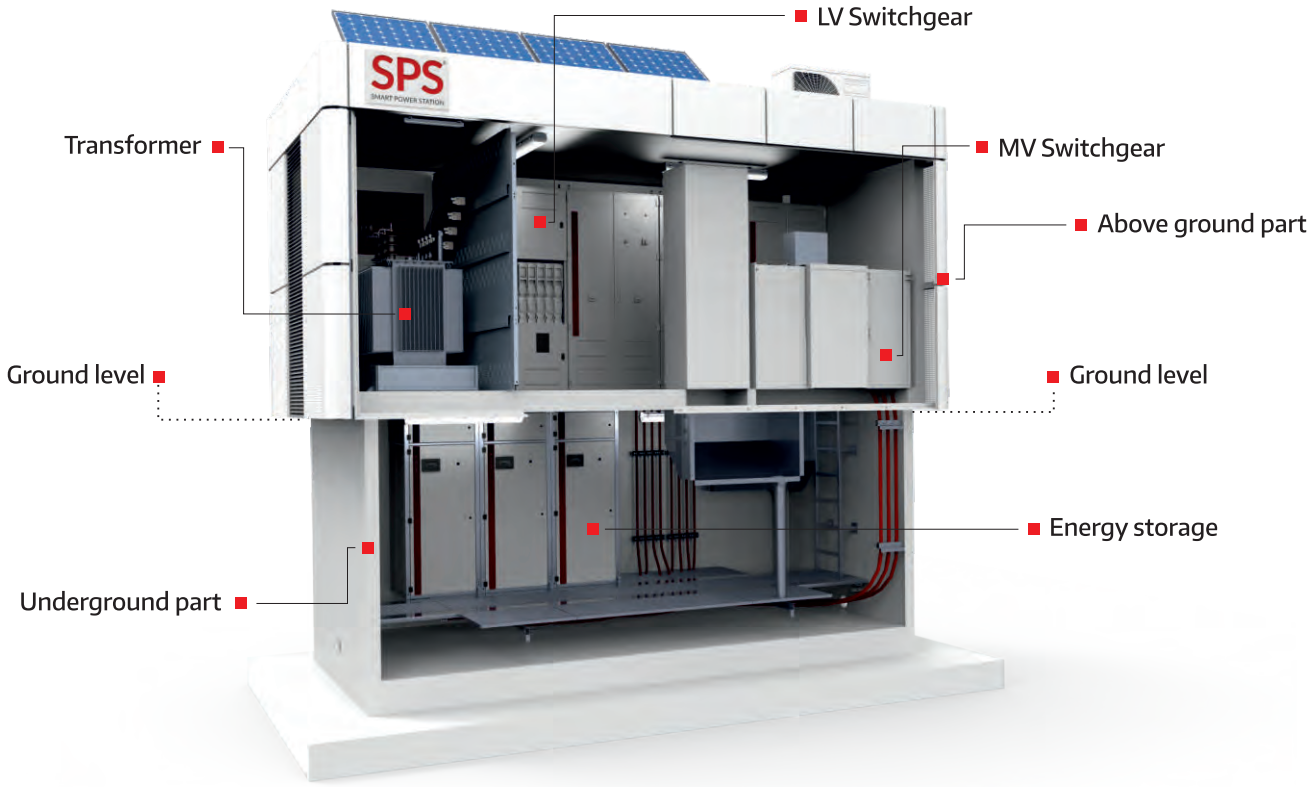
Individual components can make up independent installations or, managed by SPS-Control, can work as a single advanced system that effectively improves power facilities' supply reliability, and optimises the demand for electricity and related financial outlays.

Electricity storage is a facility for controlled energy charge and discharge from and to the power system. There is a number of different storage technologies available. The most developed is the storage of energy in electrochemical batteries. Apart from the batteries, such a system must contain a device enabling a two-way, fully controlled energy flow. An example of this type is the bi-directional AC / DC converter.

Design

SPS is a fully scalable station. This means that we can respond to every request from our clients, trying to create a facility that is fully optimised and tailored to the specific needs of the user. A common feature of the SPS station is its two-part design: an over ground part and an underground part.
In the above-ground part all typical transformer substation components are installed, such as:

- MV/ LV transformer.
- MV switchgear and control gear assembly.
- LV switchgear and control gear assembly.
- Bidirectional inverter for energy storage.
- SPS-Control control cabinet.
- Optional components: fast charger for motor vehicles, inverter for RES interconnection.
- The underground part is mainly intended for energy storage. Placing the batteries in the underground part ensures the cells' optimal working temperature without an extensive HVAC system. Another advantage of the underground location is fire safety. Placing the enclosure with batteries below the ground level creates natural barriers to fire, which significantly improves the entire station's fire resistance. Also, this solution needs only half of the footprint requires for the traditional over ground solution.



Features and main advantages

Safety and the highest quality

- Stabilisation of power grid parameters and improvement of power supply reliability.
- Smoothing the daily load curve.
- Reactive power compensation.
- Elimination of uneven loads, voltage and frequency drops.
- Increasing the security of supplying public facilities, hospitals and the continuity of technological processes in industrial plants.
- Energy storage system based on lithium-ion technology that warrants a lifetime of up to 5000 full cycles, which translates into a life span of up to 20 years..

Smartness

- Fit for remote monitoring and control in the Smart Grid system, interoperability with SCADA dispatching systems.
- DC or AC charging of electric vehicles, integrated high capacity charger.

Flexibility

- Modular and scalable solution based on components of own production.
- Flexible configuration that allows optimal selection of functionalities tailored to individual customer needs.
- Modern design for the station's adaptability to architectural conditions on-site.

Economisc

- Storage of energy from the distribution grid (e.g. cheaper at night) or from RES for availability beyond the generation time.
- Optimisation of demand for energy from the power grid.
- Minimum footprint by integration of distributed power supply systems.

Area of application

- Power system operators.
- Local EV charging system.
- Public facilities (offices, hospitals, office buildings, hotels, supermarkets or sports facilities, etc.).
- RES.
- Housing estates.
- Industrial plants.
- Fuel stations.

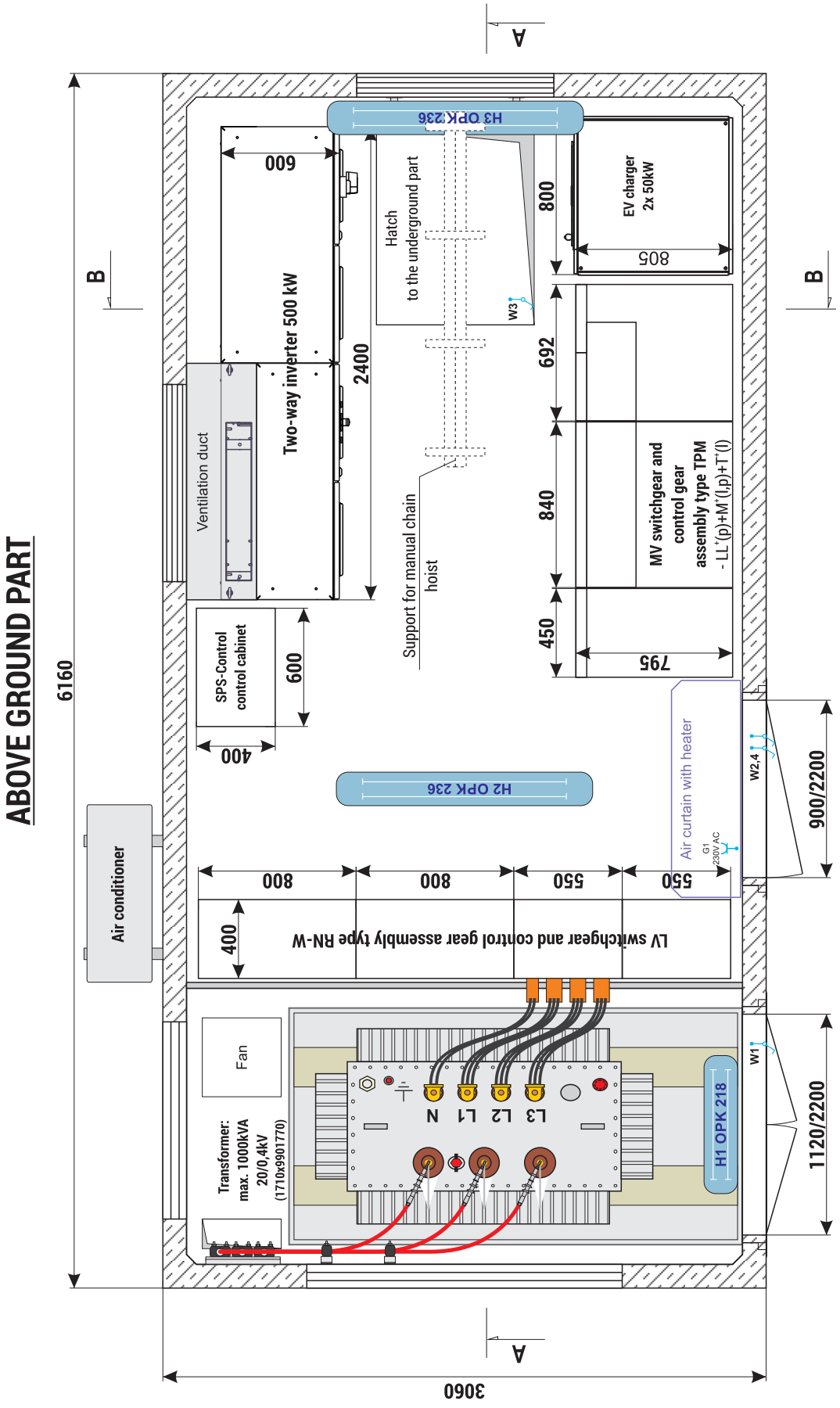
Rated parameters

Rated data	
Transformer capacity	1000 kVA
MV / LV rated voltages	25 kV / 1 kV
EV DC charger capacity	100 kW
Energy storage max. power / capacity	500 kW / 500 kWh
Rated continuous switchgear (MV / LV) current	630 A / 1600 A
Rated short-time withstand (MV / LV) current	16 kA (3s); 20 kA (1s) / 35 kA (1s)
Rated peak withstand (MV / LV) current	50 kA / to 77 kA
Internal arch classification	AB-20 kA – 1s
protection degree	IP 23D
External dimensions (length / width / height from the ground)	6360/3260/2880 mm

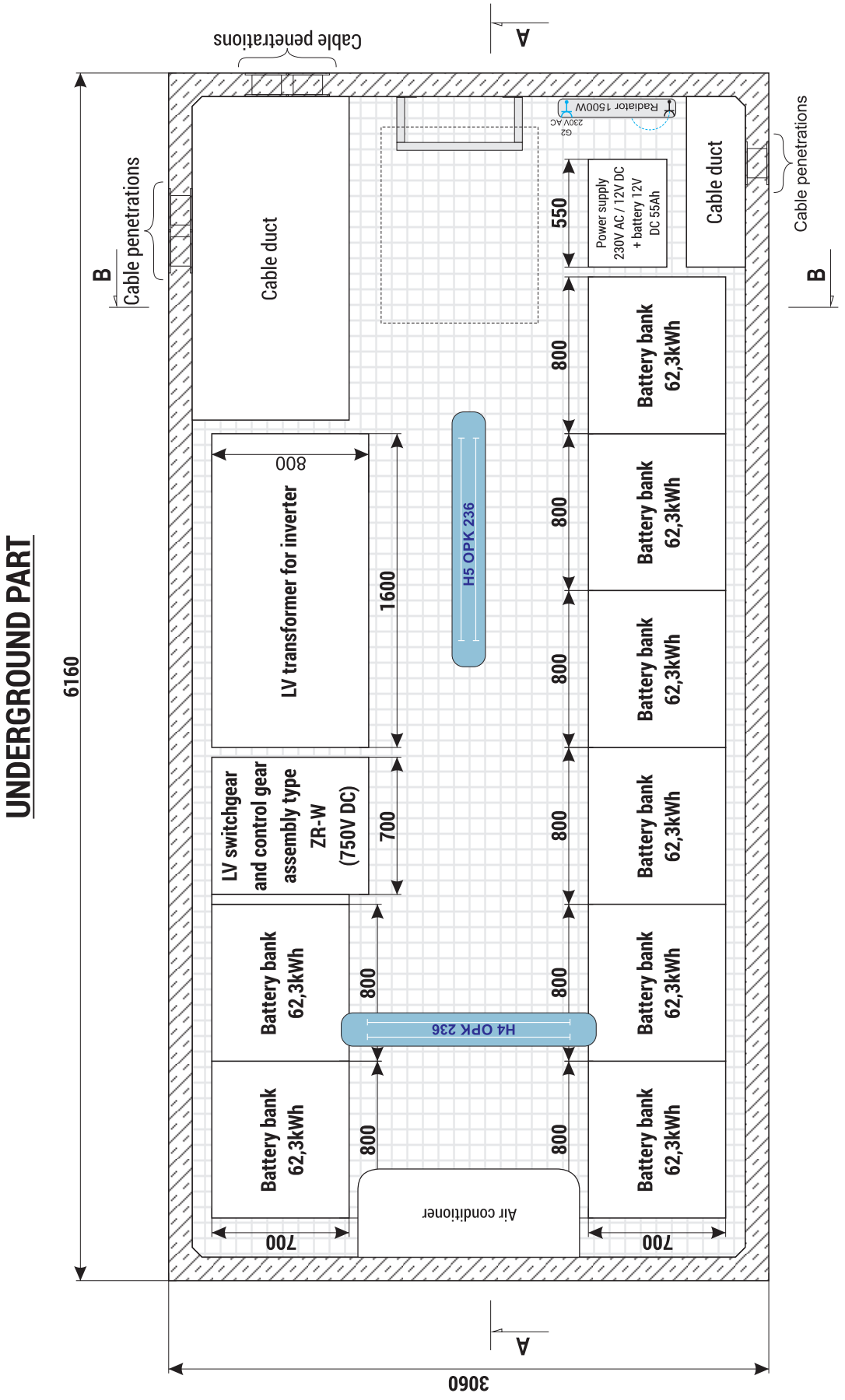
NOTE

1. This study is just a concept for acceptance.
2. Station made to PN-EN 62271-202, calculated enclosure class 20.
3. This study assumes the maximum transformer size 1000kVA 20kV/0.4kV with dimensions (LxWxH) 1710mm x 990mm x 1770mm. With other transformer dimensions, the station dimension may change.

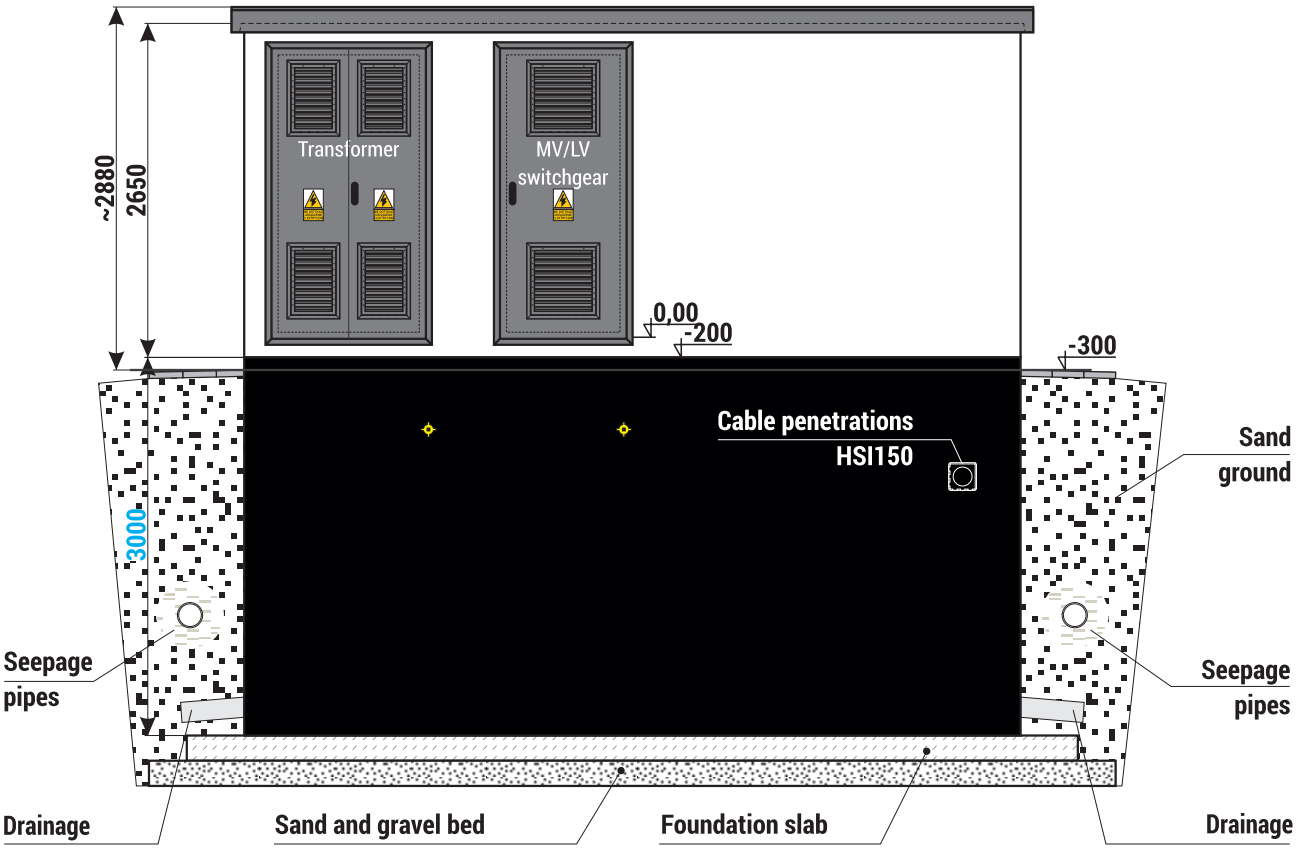
Top view / equipment layout – Above ground part



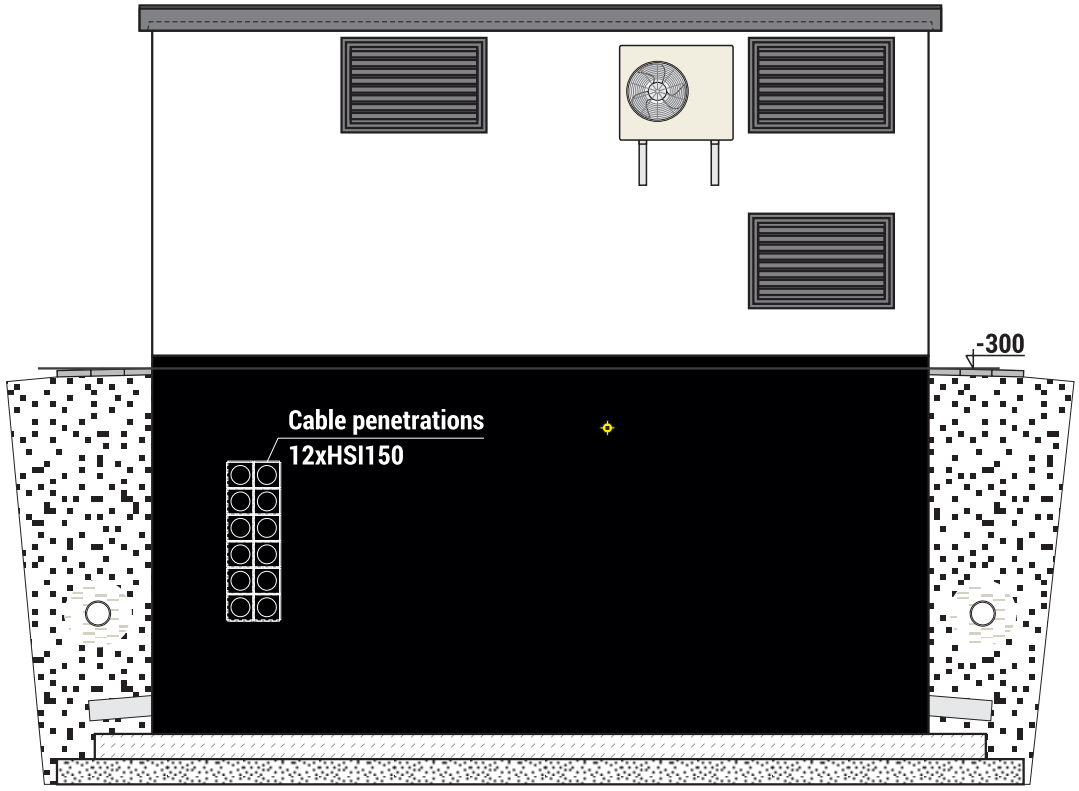
Top view / equipment layout - Underground part



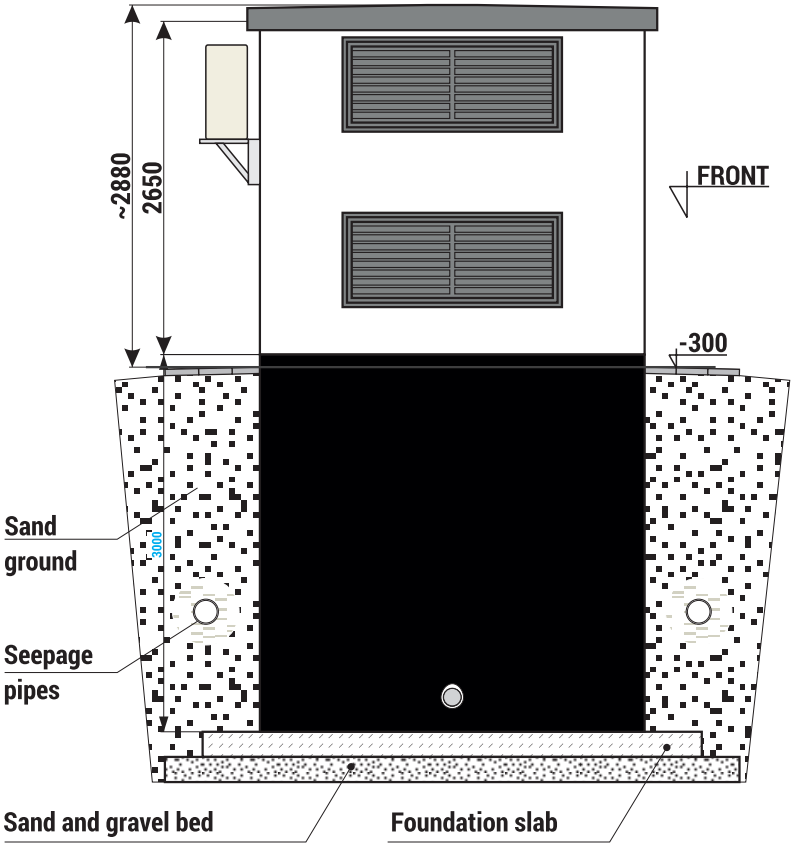
Front elevation



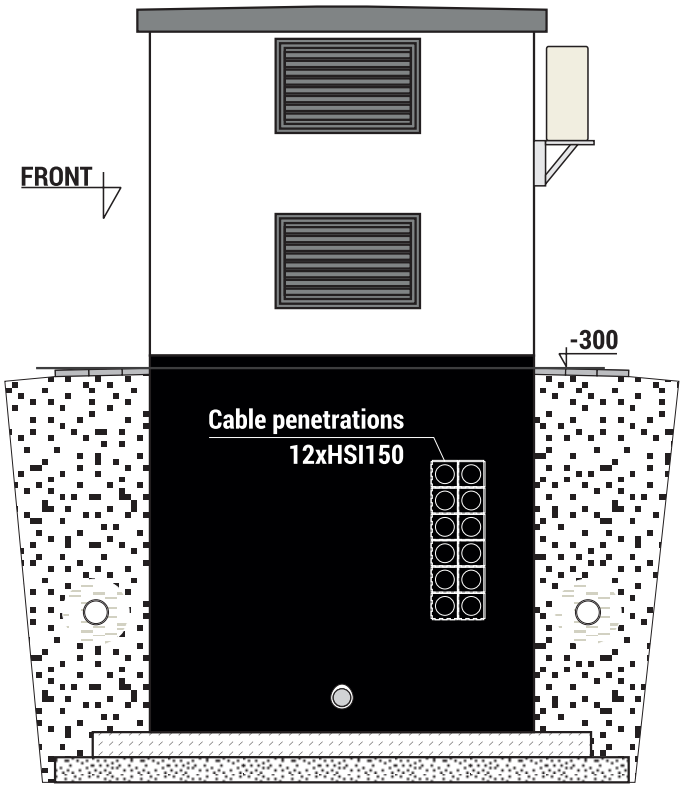
Rear elevation



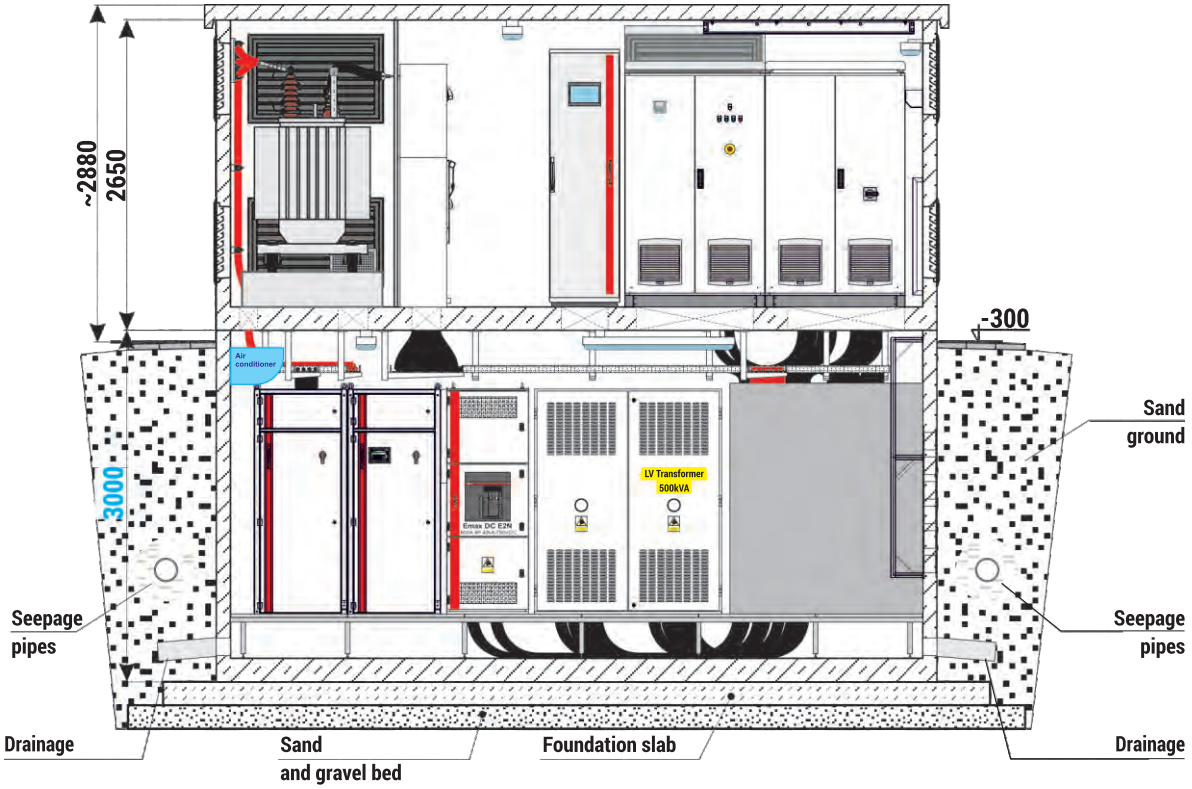
Left side elevations



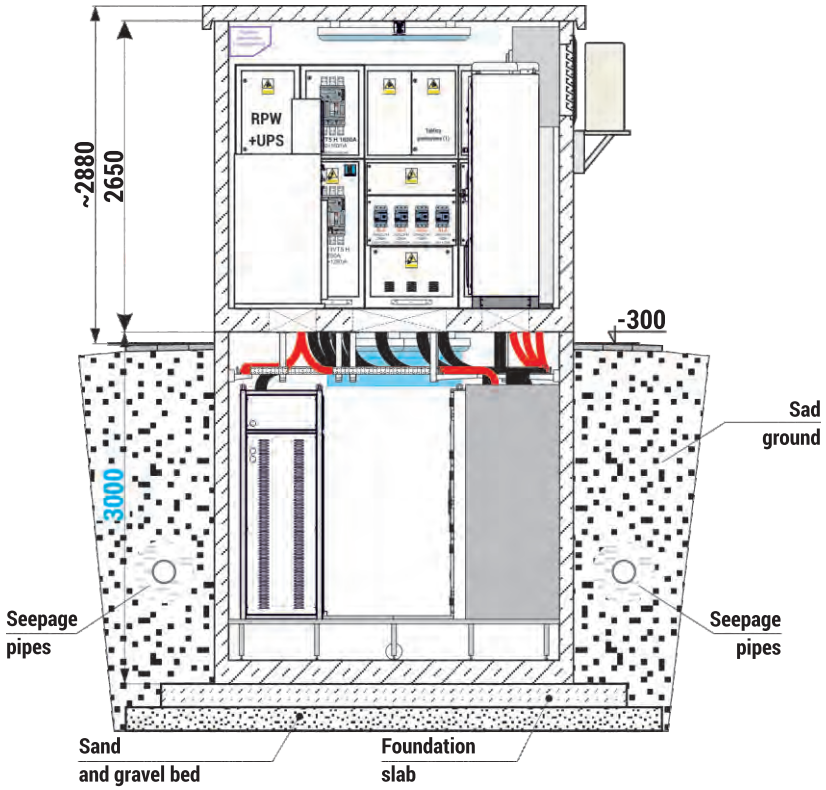
Right side elevations



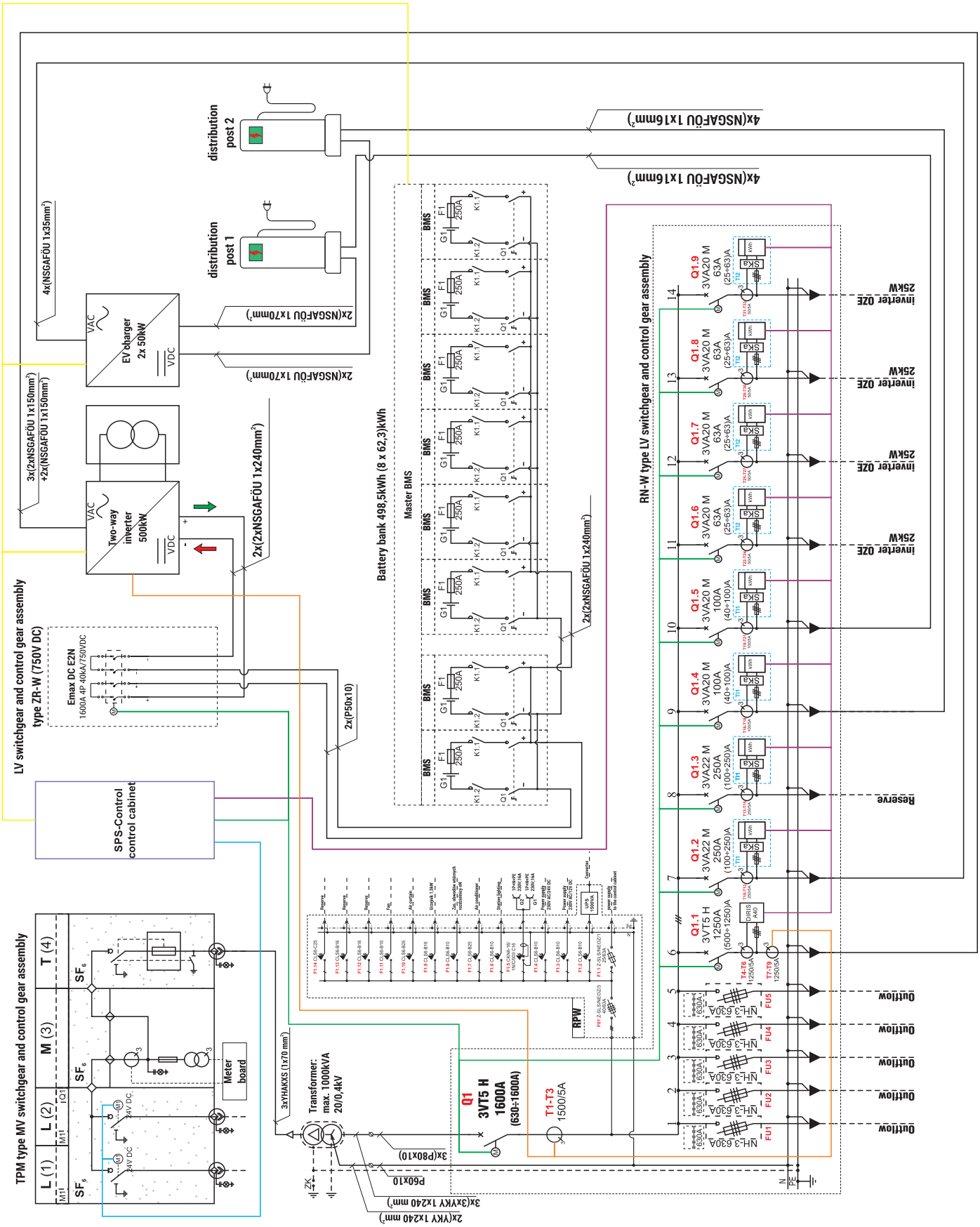
A-A section of the station



B-B section of the station



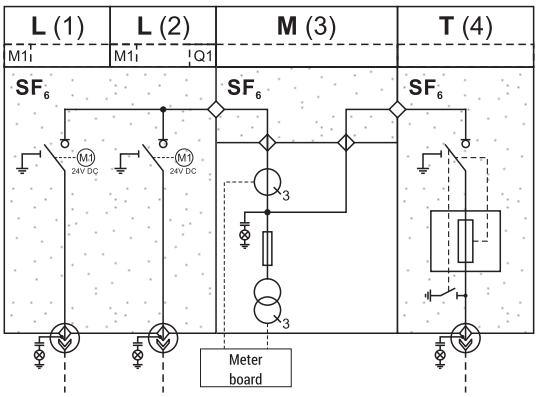
Simplified wiring diagram



TPM type MV swithgear and control gear assembly

TPM type medium voltage up to 25kV ring switchgear is a small compact assembly, the basic element of which is a stainless-steel tank filled with SF_6 gas, which contains the MV switching elements such as switch, disconnector, circuit breaker and earthing switch. It is dedicated to the distribution of energy in secondary distribution grids. With its wide range of available configurations and additional versions with expansion options on either the right or left side, the assembly can be used in even the most complex grid systems, and its robust design and advanced mechanical locking system ensures the highest level of operational safety and reliability of power supply.

DIAGRAM



TPM type MV switchgear and control gear assembly
configuration LL+(p)+M+(l,p)+T+(l)
by ZPUE S.A.

U_r = 25 kV
I_r = 630 A
I_k = 20 kA(1s)
I_p = 50 kA

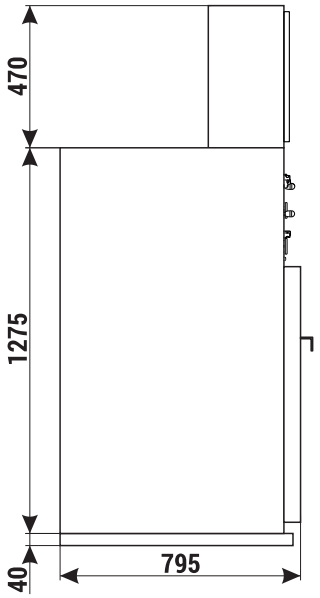
FRONT

TPM type MV switchgear and control gear assembly - LL⁺(p)

TPM type MV switchgear and control gear assembly - M⁺(l,p)

TPM type MV switchgear and control gear assembly - T⁺(l)

SIDE



TPM switchgear and control gear assembly rated data

Number of phases	3
Rated voltage Sn	25kV
Rated frequency	50 Hz
Withstand voltage at mains frequency	50 kV / 60 kV
Lightning surge withstand voltage (1,2/50 μs)	125 kV / 145 kV
Rated continuous main busbar current	630 A
Rated short-time withstand main circuits current	16kA(3s) / 20 kA (1s)
Rated peak withstand main circuits current	40 kA / 50 kA
Resistance to internal arcing	20kA (1s)
IAC class	AFLR
IP protection	IP4X (IP54 option)
Resistance to mechanical impact	Ik10

Equipment

The switchgear and control gear assembly is provided with an M type indirect energy measurement module. Current and voltage transformers for energy billing measurement are installed in this module. The transformers' specifications match those of the grid and transformer. Switches in the line bays are motor-driven, which makes them remotely operable. The assembly also includes:

- Switch with an arc quenching system, which, combined with a very fast mechanism for its quick closure, warrants a safe and quick circuit break.
- Capacitive voltage dividers.
- Voltage on cable indicator.
- Transformer bay blown fuse indicators.
- Fast earthing switch in the line bay.
- Fast earthing switch for both-ends earthing of the transformer bay fuse.

Compliance with standards

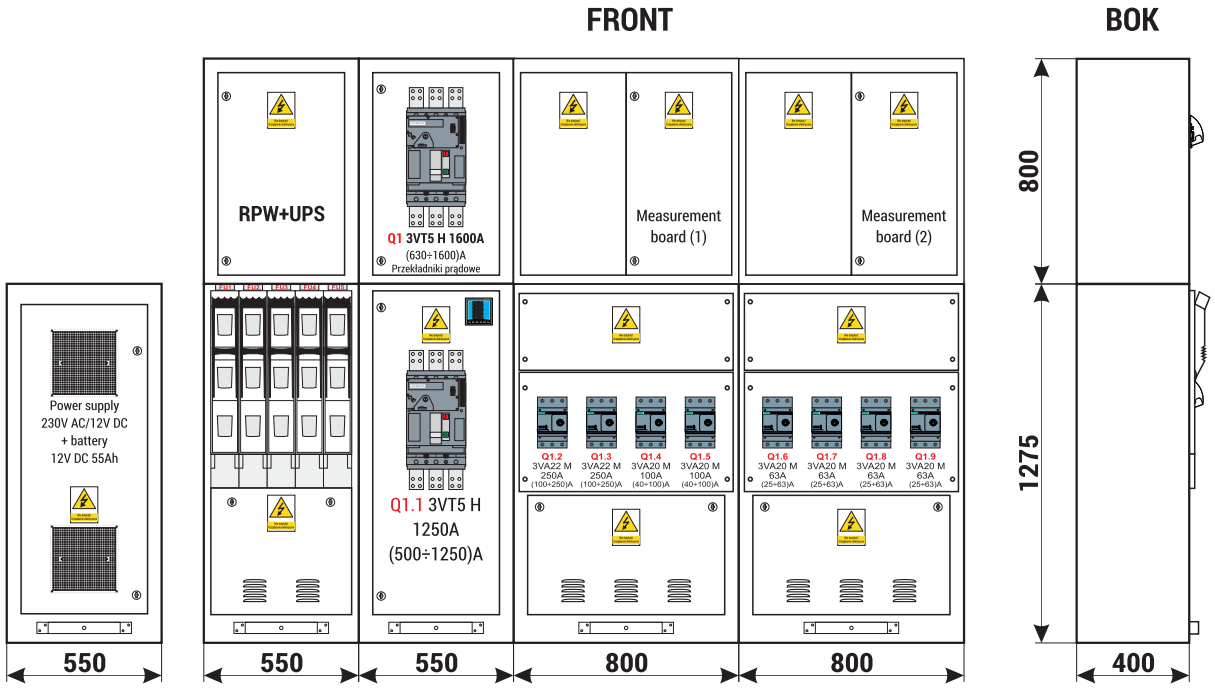
The TPM switchgear and control gear assembly meets the requirements of the following standards:

- **PN-EN 62271-1** - "High-voltage switchgear and control gear - Part 1: Common specifications.".
- **PN-EN 62271-200** - "High-voltage switchgear and control gear - Part 2: AC metal-enclosed switchgear and control gear for rated voltages above 1 kV and up to and including 52 kV".
- **PN-EN 62271-100** - "High-voltage switchgear and control gear - Part 100: Alternating-current circuit-breakers".
- **PN-EN 62271-102** - „High-voltage switchgear and control gear - Part 102: Alternating current disconnectors and earthing switches".
- **PN-EN 62271-103** - „High-voltage switchgear and control gear - Part 103: Switches for rated voltages above 1 kV up to and including 52 kV".
- **PN-EN 62271-105** - „High-voltage switchgear and control gear - Part 105: AC switch-fuse combinations".

The assembly has a certificate from the Electrotechnical Institute.

RN-W type LV 400 VAC switchgear and control gear assembly

RN-W LV switchgear and control gear was designed for supplying LV electrical equipment. They are widely used in urban transformer stations, in industrial plants, department stores and other facilities.



Features

- All cable connections are at the bottom of the assembly.
- Small size, compact design.
- Current measurements available in outflow circuits.
- Safe replacement of a faulty disconnector is possible without switching off the assembly.
- Cable connection without lug crimping.
- Suitable for LV cable grids of TN–S, TN–C, TN–C–S, TT, and IT types.
- Option to output outflow cables over the top.
- Fuse holder, powered upstream of the connector, built-in the power supply unit housing as standard.

Safety

High safety due to:

- Lock that allows the replacement of fuses only in their potential-free state after disconnecting the circuit.
- No need to use special holders.
- Solid earthing of the apparatus' bottom terminals (outflows) by setting earthing devices.
- The entire switchgear's fast disconnection from supply under full load with the circuit breaker.

Switchgear and control gear design

The switchgear housing is made of elements moulded from Aluzinc sheet and riveted to each other, which ensures potential equalisation. The switchgear is an assembly of independent segments (feed, outflow, measuring, etc.) which:

- Facilitates extension of existing assemblies and design of new ones.

Equipment

Feed

- Feed circuit breaker Q1 3VT5 H 1600A with electronic protection, releases, and motor drive by Siemens.

Outflow

- The following devices are installed in the outflow bays:
  - Fuse switches FU1 ÷ FU5 ARS gr.3 by Apator S.A.
  - Outflow circuit breaker Q1.1 3VT5 H 1250 with electronic protection, motor drive and release mechanisms by Siemens.
- Wyłączniki odpływowe Q1.2 ÷ Q1.3 3VA22M 250A, wyposażony w zabezpieczenie elektroniczne, napęd silnikowy i wyzwalacze prod. Siemens.
- Outflow circuit breakers Q1.4 ÷ Q1.5 3VA20M. 100A with electronic protection, motor drive and release mechanisms by Siemens.
- Outflow circuit breakers Q1.6 ÷ Q1.9 3VA20M. 63A with electronic protection, motor drive and release mechanisms by Siemens.

- Power supply unit and 12 V/55 Ah battery bank.
- Measurement boards.
- RPW auxiliary switchgear + modular equipment.
- Buses are made of copper flat bars with cross sections appropriate for the respective rated currents.

Technical specification	
Rated insulation voltage	690 V
Rated switching voltage	400 V / 690V
Withstand surge test voltage	8 kV
Rated frequency	50 Hz
Rated switchgear current	1600A
Rated short-time withstand (MV / LV) current	35kA
Rated peak withstand (MV / LV) current	do 77kA
IP protection	IP2X
Dimensions	as per the drawing
Average ambient temperature	-5°C do +35°C

Compliance with standards

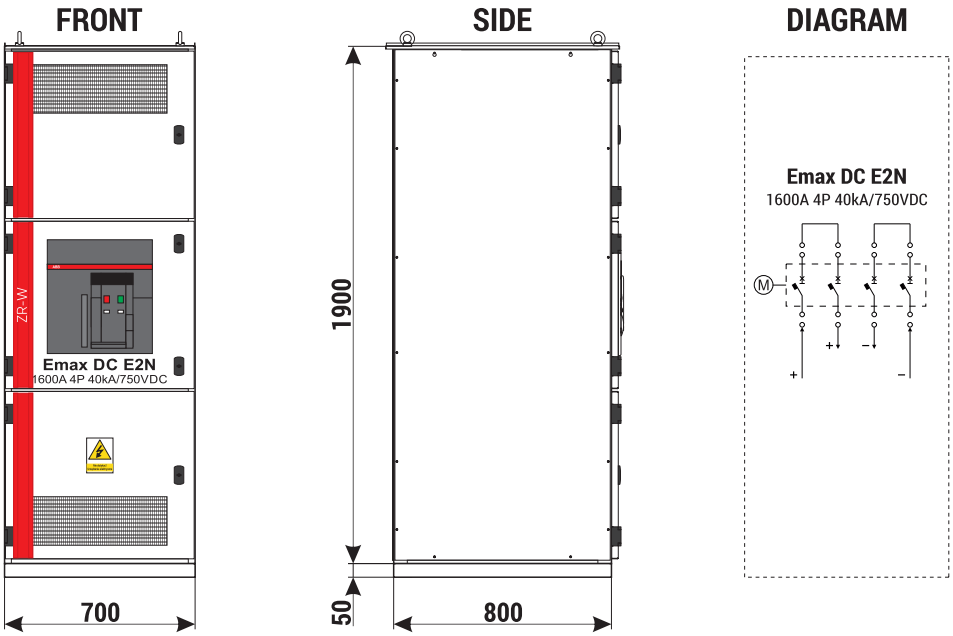
RN-W switchgear and control gear assembly meets the requirements of the following standards:

- **PN-EN 61439-1** - „Low-voltage control gear and switchgear assemblies. Part 1: General specifications.”.
- **PN-EN 61439-2** - „Low-voltage control gear and switchgear assemblies. Part 2: Switchgear and control gear assemblies for power
- distribution”.
- **PN-EN 61439-5** - „Low-voltage control gear and switchgear assemblies. Part 5: Assemblies for power distribution in public grids”.
  PN-EN 50274 - „Low-voltage control gear and switchgear assemblies - Protection against electric shock - Protection against
- unintentional direct contact with dangerous active parts”.
  PN-EN 62262 - „Degrees of protection against external mechanical impacts provided by electrical equipment enclosures (IK code)”.
- **PN-EN 60529** - „Degrees of protection provided by enclosures (IP code)”.

The assembly has a certificate from the Electrotechnical Institute.

ZR-W type LV 750 VDC switchgear and control gear assembly

The ZR-W assemblies were designed for distribution of electricity at every level of distribution, control and protection of electrical devices against the effects of short-circuits and overloads. They can be operated as main or branch switchgears, or as control cabinets.



With its universal set-up options, ZR-W switchgear is fit for use in the following industries:

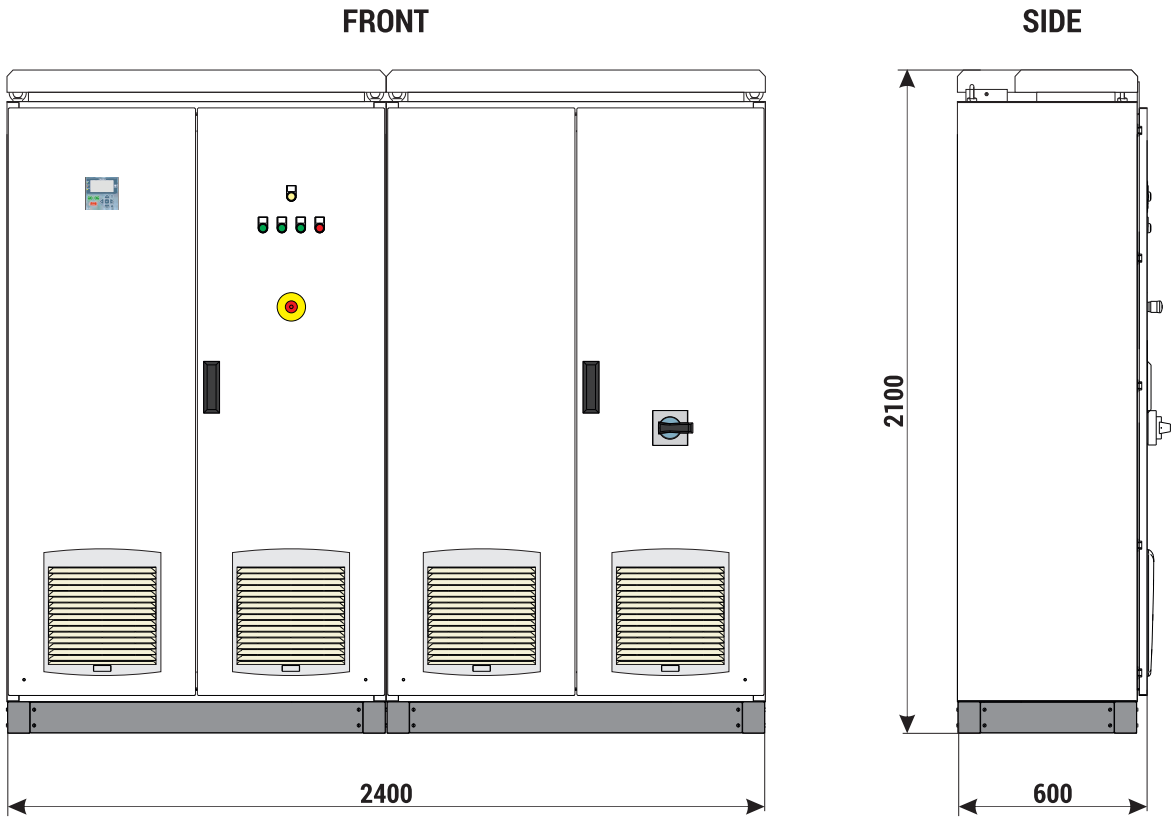
- Chemical / petrochemical.
- Pharmaceutical.
- Power and combined heat and power plants.
- Heavy industry: mines, steel mills, coking plants.
- Light industry: paper, textile, household appliances.

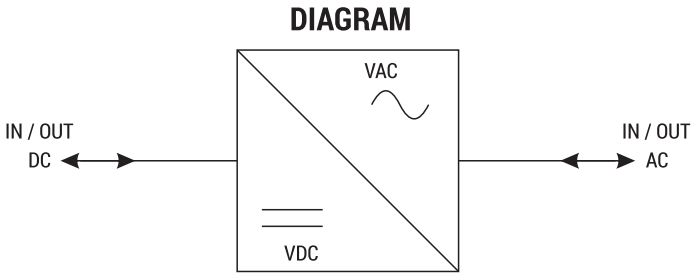
As well as in infrastructural projects:

- Server rooms.
- Airports.
- Office buildings.
- Shopping centres.
- Hospitals.

Technical specification	
Rated insulation voltage	1000 VDC
Rated switching voltage	750 VDC
Withstand surge test voltage	12 kV
Rated switchgear current	1600 ADC
Rated short-time withstand (MV / LV) current	40kA
Rated peak withstand (MV / LV) current	to 100kA
IP protection	IP 41
Dimensions	as per the drawing
Average ambient temperature	-5°C to +35°C

Two-way AC / DC converter





Urządzenia umożliwiają przepływ energii (magazynowanie oraz oddawanie) pomiędzy systemem elektro-energetycznym (siecią AC 3x400V) a baterią akumulatorów DC. Zarządzanie (kontrola) może odbywać się na podstawie z góry założonych scenariuszy pracy lub poprzez nadrzędny układ sterujący wykorzystujący protokół Modbus TCP/IP.

Example application

a) Grid quality and stability Improvement.
b) Optimal use of RES for auxiliaries.
c) Reactive power compensation.
d) Reactive power compensation with concurrent battery active power charge / discharge of (division configurable on the fly).
e) Disposal of stored energy at better price.
f) Uninterrupted power supply.

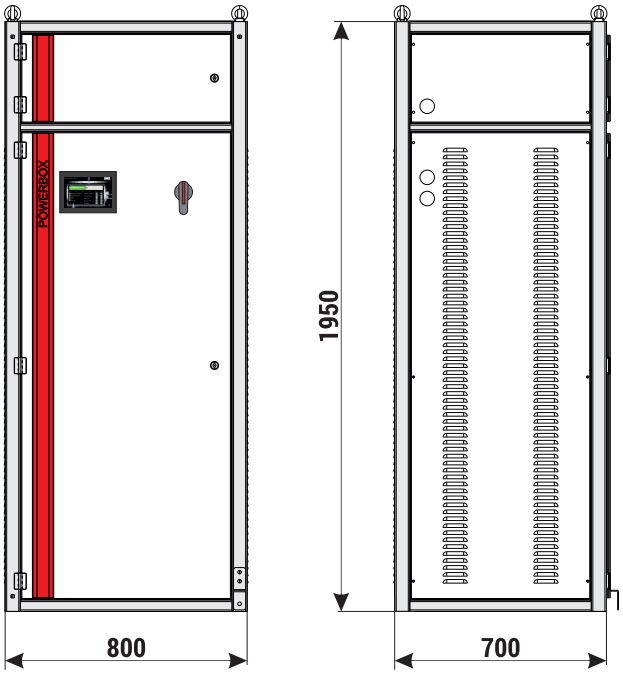
The system requires a connection to the AC grid only, DC battery bank and control signals. Other components essential for the system operation (RFI filter, transformer, LCL filter, contactors, DC reactor, etc.) are built into the supplied industrial cabinet.

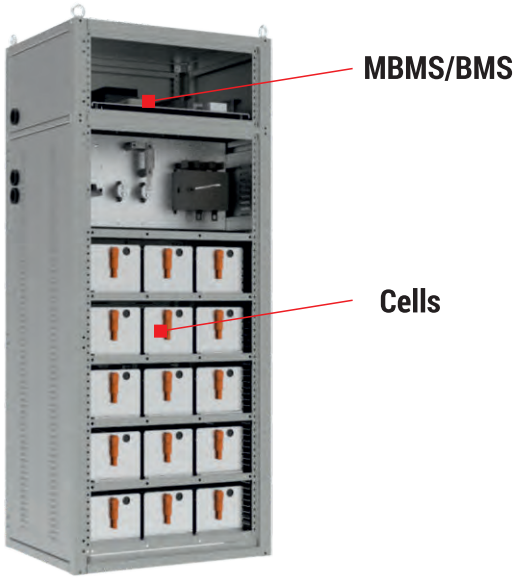
Technical specification of the AC / DC converter	
AC	
Rated voltage	3x400 VAC
Frequency range	45 ÷ 66 Hz
Rated current	760 A
Rated power	500 kW
DC	
Battery voltage	480 ÷ 750 VDC
Max. DC bus voltage	800 VDC
DC output current	1040 A
Communication	
Communication protocol	Modbus RTU: functions: 3, 6 Modbus TCP/IP: functions: 3, 6
RS-485 transfer rate	2400, 4800, 9600, 19200, 38400, 57600,115200 bit/s
Protections	
Short-circuit	Short circuit at the system output
AC overcurrent	Instantaneous value 3.5 I_N, effective value 2.5 I_N
DC overcurrent	Instantaneous value 2,0 $I_{DC\text{-}MAX}$
AC / DC over-voltage	1,1 Uin (Uin = 400V) AC; 800V DC)
Undervoltage	0,85 Uin
Thermal of the system	Radiator temperature sensor
Analogue input control	"Living zero" control in modes 2 ... 10V and 4 ... 20mA
Short-circuit protection	Quick fuse links
Other specifications	
Overload	150% for 30s 120% for 10 minutes
Short-circuit withstand (side AC)	5xIn t>=100ms
IP protection	IP 21
External dimensions (width / height / depth)	2400 / 2100 / 620 [mm]
Current harmonic level	THDI<3%
Working temperature	-10°C ÷ +40°C for 100% IN -10°C ÷ +50°C for 70% IN

- Two-way operation mode: charge or discharge.
- On-grid / off-grid operation with uninterrupted switching between the two modes.
- Voltage limit, current limit and power limit regulation on the DC side.
- It is a product made to order by a customer as part of a whole assembly, which is why we are not responsible for results of any tests to check compliance with EMC standards.

Li-ion battery bank with BMS system

FRONT SIDE





The battery bank mounted in the rack is made up of modern and reliable Li-Ion cells, which are one of the best options available on the market. Besides the reliable cells, the batteries include other durable components that on the one hand warrant good product quality and, on the other, ensure long life. The product is intended for indoor applications that require energy storage, e.g. in case of power supply interruption. The 180S01P rack-mount system with 12S01P Li-ion modules is a modular system and can be used to store energy in smart buildings and smart distribution grids. The battery communicates with external devices using the Modbus protocol and is provided with all necessary protections that protect it against harmful conditions such as: overload, excessive discharge and other instances dangerous for both the user and the battery itself.

Technical specification of the battery bank	
Number of modules (cabinets)	8 pieces
Rated capacity at 25°C	498,5 kWh
Maximum voltage	747 VDC
Rated voltage	662 VDC
Minimal voltage	486 VDC
Maximum discharge current at 25°C	1840 A
Rated discharge current	1000 A
Maximum charge current at 25°C	800 A
Useful life	up to 5000 cycles
Working temperature	0°C up to +50°C

Technical specification of the basic battery module	
Topology	180S01P connection (15 12S01P modules)
Housing	RACK type cabinet
Overall dimensions (width / depth / height)	800/700/1950 [mm]
Rated capacity at 25°C	62,3 kWh (94Ah)
Maximum voltage	747 VDC
Rated voltage	662 VDC
Minimum voltage	486 VDC
Maximum continuous discharge current at 25°C	230 A
Maximum charge current at 25°C	100 A
Cycle lifetime EOL80% / EOL70%	3200/5200 cycles
Working temperature	0C up to +50°C
Capacity loss at 25°C when not in use	2% each year
Application	Energy storage systems
Expandable	up to 80 cabinets
Cell type	Samsung SDI 94 Ah
Cell design	NMC structure (nickel, manganese, cobalt)
Minimum cell voltage	2,7 V
Rated cell voltage	3,68 V
Maximum cell voltage	4,2 V
Maximum charge voltage	4,15 V

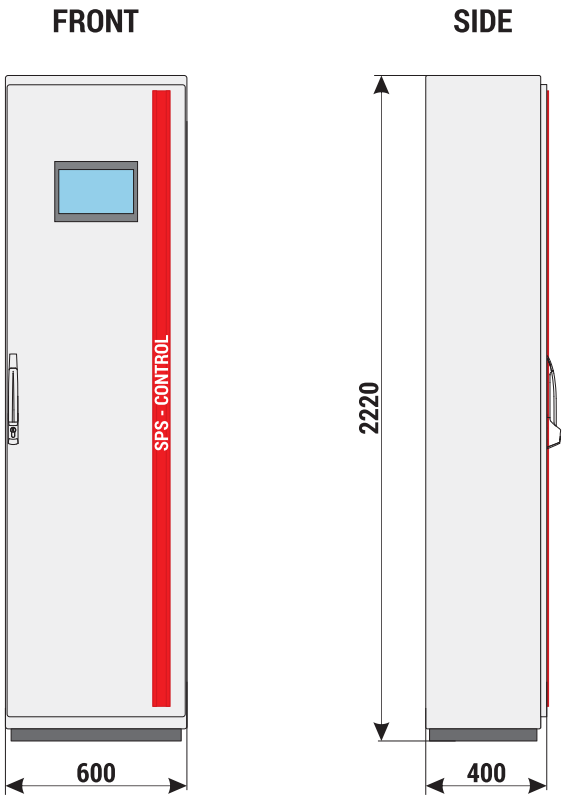
BMS functionality

Control of a battery bank of up to 80 units connected in parallel.

Providing real-time information on the battery bank's operating status:

- Maximum possible charge current.
- Maximum possible discharge current.
- SOC (State of Charge).
- Number of active batteries.
- Current (charge / discharge).
- Voltage.
- Remaining of battery bank capacity (in Ah).
- Energy consumption meter.
- Average temperature.
- Highest temperature.
- Lowest temperature.
- Warnings / Errors.
- Current operational status (charge, discharge, standby).
- Communication with the application over MODBUS TCP protocol.
- Remote monitoring - cyclical collection of the battery bank data and saving on the manufacturer's servers.
- Upgradable pre-owned original modules.
- Digital outputs can be used to integrate battery bank with converter system.

"SPS-Control" automatic system of SPS station control



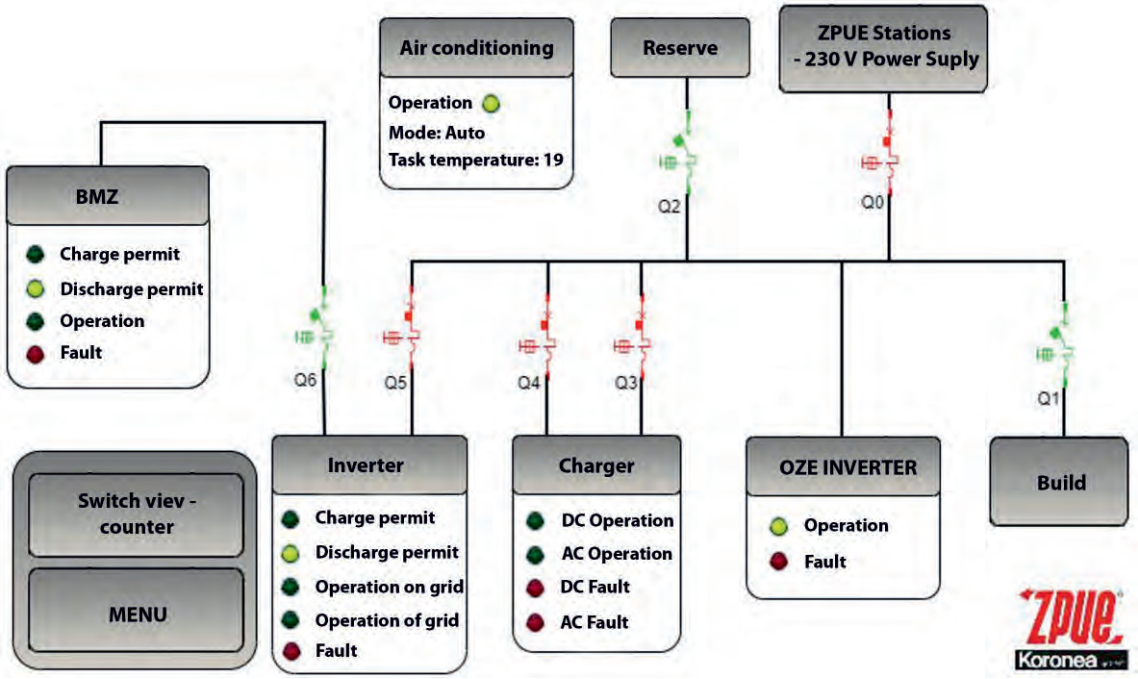
The main components of the control cabinet of the SPS control system are a PLC controller and an operator panel accommodated in a control cabinet. The controller is used to monitor the condition the substation and switchgear devices. The control uses digital signals as well as communication modules that enable communication with multiple devices using the Modbus RTU and Modbus TCP protocols. Using these protocols, information is collected from grid parameter analysers and energy meters, as well as from devices that support SPS system functions.

These devices are:

- LV switchgear.
- MV switchgear.
- Energy meters and analysers.
- AC and DC chargers.
- Two-way inverter.
- MBMS battery bank controller.
- Air conditioning.

The controller supports several other protocols such as DNP3.0, which is used in power control and supervision systems and OPC UA. These protocols significantly streamline the exchange of information between the controller and SCADA master systems available on the market.

Local control within the substation is provided from the operator panel on the automation cabinet's wall. The panel displays visualisation provided by the PLC over HTTP protocol. It should be noted that the visualisation made available in this way ensures limited functionality (among others: lack of long-term data archiving and reporting) in comparison to the superior SCADA system. The visualisation device displays parameters, allows them to be altered, and controlled locally. The screen below shows a simplified wiring diagram and all devices.



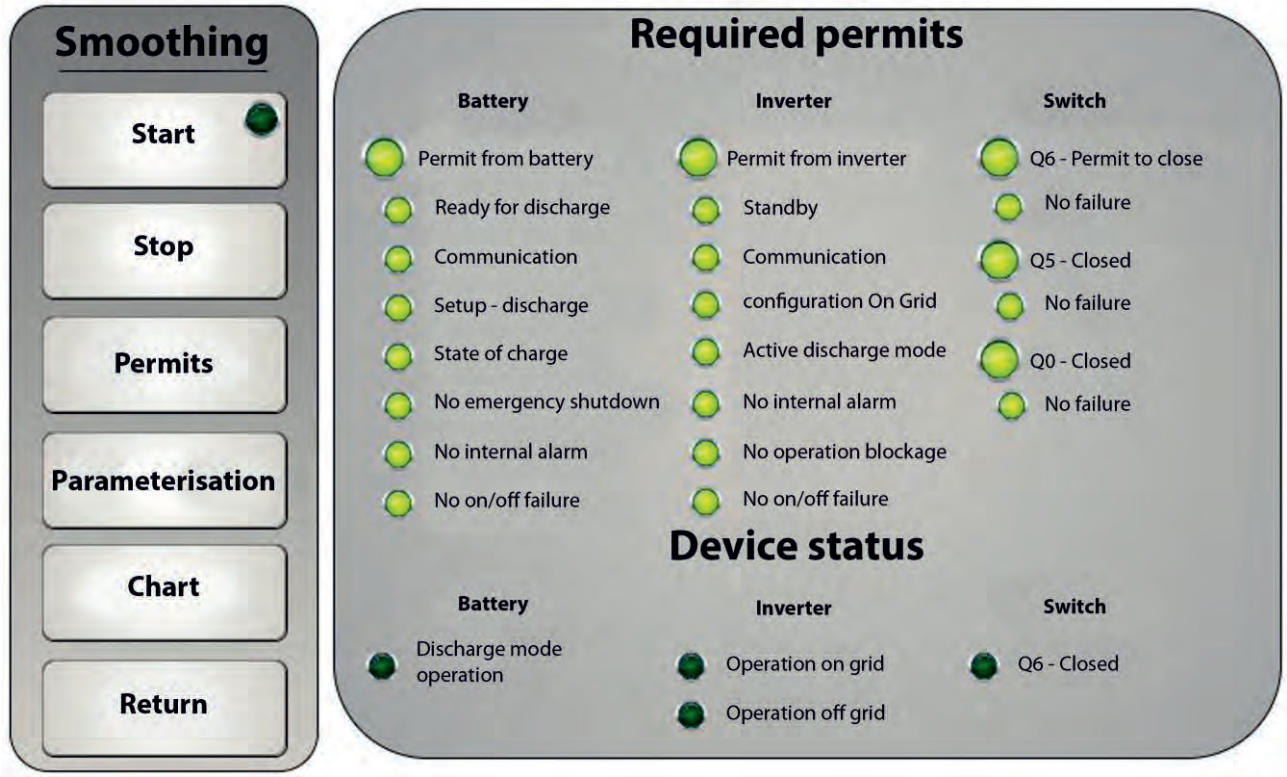
Example screen of the device operator panel in the SPS station.

Devices can be controlled individually or collectively in a group, in automatic mode, to perform the SPS station's individual functions.

Available functions

- Load curve smoothing.
- Grid's LV parameter stabilization.
- Reactive power compensation.
- EV charge from energy storage only.
- EV charge from mains only.
- EV charge from mains and energy storage.
- Energy storage charge from the grid outside the peak.
- Energy storage charge from the grid anytime.
- Energy storage charge from RES.
- Prohibited return of energy to the distribution grid.
- SPS station's OFF-grid operation.

There is a separate screen for each function:

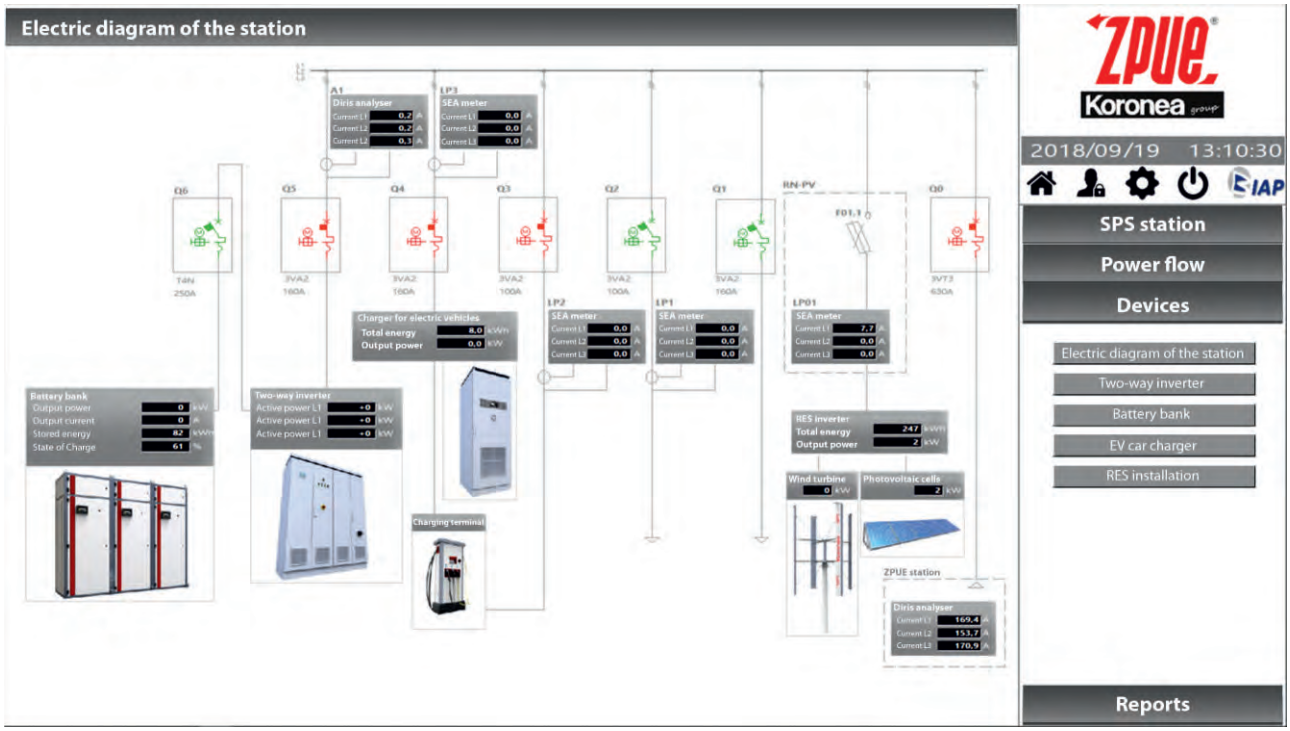


Example screen of the device operator panel for SPS station functions setup

With the menu bar buttons one can navigate to the screens, where functions are parameterised (incl.: set limits, controller settings) and the current grid and device parameters displayed in a graph.

Visual rendering of SPS-SCADA station performance

The superior SCADA system of the SPS station is used for remote monitoring, control, full parameterisation and recording of all parameters, events and alarms from all SPS station devices. Positions of the main circuit breakers on each outlet and protection activation signalling in the LV switchgear assembly are monitored. In addition, each outflow is metered by energy meters or grid analysers, data from which is transferred to the SCADA system and presented in the form of current values, historical charts or as an option as periodic reports in an external reporting system. Circuit breakers at individual outflows can also be remotely controlled from the SCADA system level.



SCADA system screen for monitoring the station's electrical parameters

The operational status, warning and alarm signals as well as set and current operational parameters of each devices is monitored.

Example SCADA system screen for active function monitoring

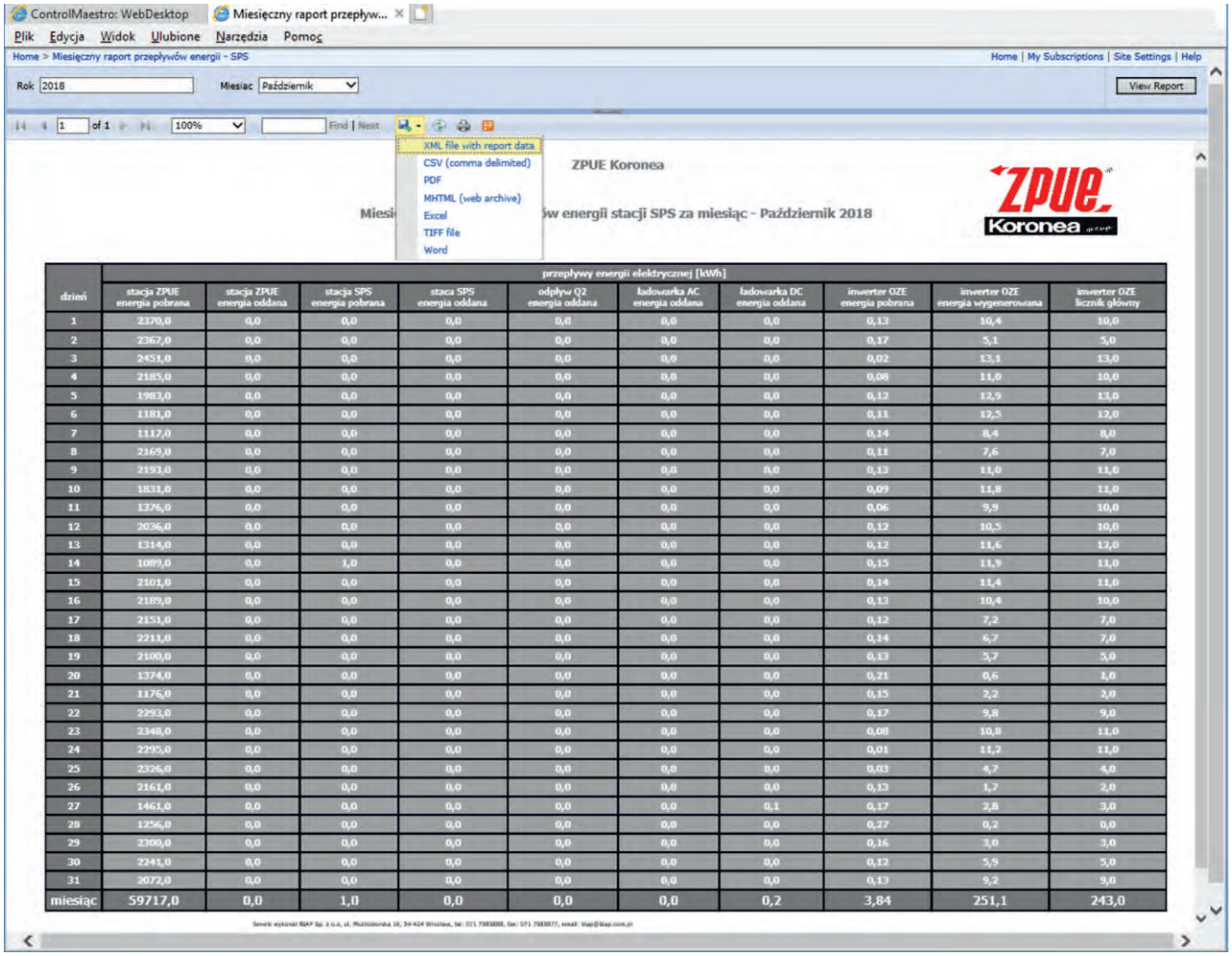
Devices can be remotely controlled (switched on / off, operating modes altered), and their operational parameters changed.

With the SCADA system, the station's individual functions can also be parameterised and controlled (battery charge / discharge, power flow control in the station, etc.). Access to the functions can be individually controlled via the built-in authorisation system.

All parameters read from devices via the SCADA system can be recorded in a local or external SQL database. Historical data can be displayed as time charts or individual and collective parameter listings. In the event of a failure or warning from the devices, the system reports it in a pop-up window. In addition, all events are recorded in a local or remote SQL database and then displayed as an alarm log. The SCADA application also has a built-in web-server that provides access to the visualisation from anywhere using a web browser with JavaScript applets (optionally HTML5). Through the web server, full functionality of the SCADA station is available, including authorization, control and parameterization. Also, time charts and alarm logs are available for review. The offer includes a license for one user access to the web server. The license can be extended to more concurrent users.

System of SPS-R station performance's online reporting

Recording of selected parameters in an external MS SQL Server facilitates data integration with the end customer's other databases (MES, ERP class systems). With the MS Reports Services environment, advanced reports and data analyses can be prepared and made available through web browsers, as well as exported to files, e.g.: .xls, pdf.



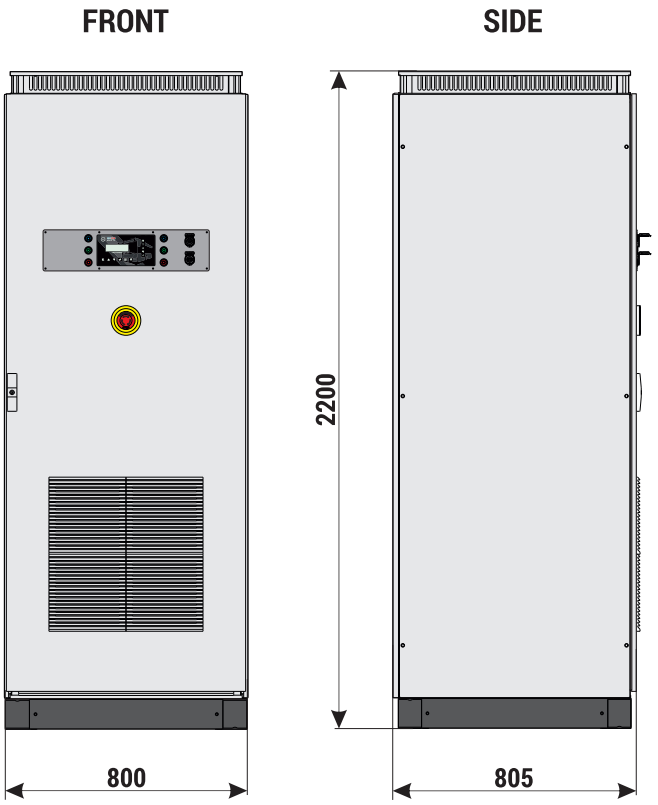
dzień	przepływy energii elektrycznej [kWh]									
	stacja ZPUE energia pobrana	stacja ZPUE energia oddana	stacja SPS energia pobrana	staca SPS energia oddana	odpływ Q2 energia oddana	ładowarka AC energia oddana	ładowarka DC energia oddana	inwerter OZE energia pobrana	inwerter OZE energia wygenerowana	inwerter OZE licznik główny
1	2370,0	0,0	0,0	0,0	0,0	0,0	0,0	0,13	10,4	10,0
2	2367,0	0,0	0,0	0,0	0,0	0,0	0,0	0,17	5,1	5,0
3	2451,0	0,0	0,0	0,0	0,0	0,0	0,0	0,02	13,1	13,0
4	2185,0	0,0	0,0	0,0	0,0	0,0	0,0	0,08	11,0	10,0
5	1983,0	0,0	0,0	0,0	0,0	0,0	0,0	0,12	12,9	13,0
6	1181,0	0,0	0,0	0,0	0,0	0,0	0,0	0,11	12,5	12,0
7	1117,0	0,0	0,0	0,0	0,0	0,0	0,0	0,14	8,4	8,0
8	2369,0	0,0	0,0	0,0	0,0	0,0	0,0	0,11	7,6	7,0
9	2193,0	0,0	0,0	0,0	0,0	0,0	0,0	0,13	11,0	11,0
10	1831,0	0,0	0,0	0,0	0,0	0,0	0,0	0,09	11,8	11,0
11	1376,0	0,0	0,0	0,0	0,0	0,0	0,0	0,06	9,9	10,0
12	2036,0	0,0	0,0	0,0	0,0	0,0	0,0	0,12	10,5	10,0
13	1314,0	0,0	0,0	0,0	0,0	0,0	0,0	0,12	11,6	12,0
14	1089,0	0,0	1,0	0,0	0,0	0,0	0,0	0,15	11,9	11,0
15	2101,0	0,0	0,0	0,0	0,0	0,0	0,0	0,14	11,4	11,0
16	2189,0	0,0	0,0	0,0	0,0	0,0	0,0	0,13	10,4	10,0
17	2151,0	0,0	0,0	0,0	0,0	0,0	0,0	0,12	7,2	7,0
18	2211,0	0,0	0,0	0,0	0,0	0,0	0,0	0,14	6,7	7,0
19	2100,0	0,0	0,0	0,0	0,0	0,0	0,0	0,13	5,7	5,0
20	1374,0	0,0	0,0	0,0	0,0	0,0	0,0	0,21	0,6	1,0
21	1176,0	0,0	0,0	0,0	0,0	0,0	0,0	0,15	2,2	2,0
22	2293,0	0,0	0,0	0,0	0,0	0,0	0,0	0,17	9,8	9,0
23	2348,0	0,0	0,0	0,0	0,0	0,0	0,0	0,08	10,8	11,0
24	2295,0	0,0	0,0	0,0	0,0	0,0	0,0	0,01	11,2	11,0
25	2326,0	0,0	0,0	0,0	0,0	0,0	0,0	0,03	4,7	4,0
26	2161,0	0,0	0,0	0,0	0,0	0,0	0,0	0,13	1,7	2,0
27	1461,0	0,0	0,0	0,0	0,0	0,0	0,1	0,17	2,8	3,0
28	1256,0	0,0	0,0	0,0	0,0	0,0	0,0	0,27	0,2	0,0
29	2300,0	0,0	0,0	0,0	0,0	0,0	0,0	0,16	3,0	3,0
30	2241,0	0,0	0,0	0,0	0,0	0,0	0,0	0,12	5,9	5,0
31	2072,0	0,0	0,0	0,0	0,0	0,0	0,0	0,13	9,2	9,0
miesiąc	59717,0	0,0	1,0	0,0	0,0	0,0	0,2	3,84	251,1	243,0

Example report sheet of the SPS reporting system

The offer includes the provision of:

1) SPS energy balance report, daily by hour, based on readings from the meters and analysers.
2) SPS energy balance report, monthly by day, based on readings from the meters and analysers.
3) SPS energy balance report, yearly by month, based on readings from the meters and analysers.

EV charger

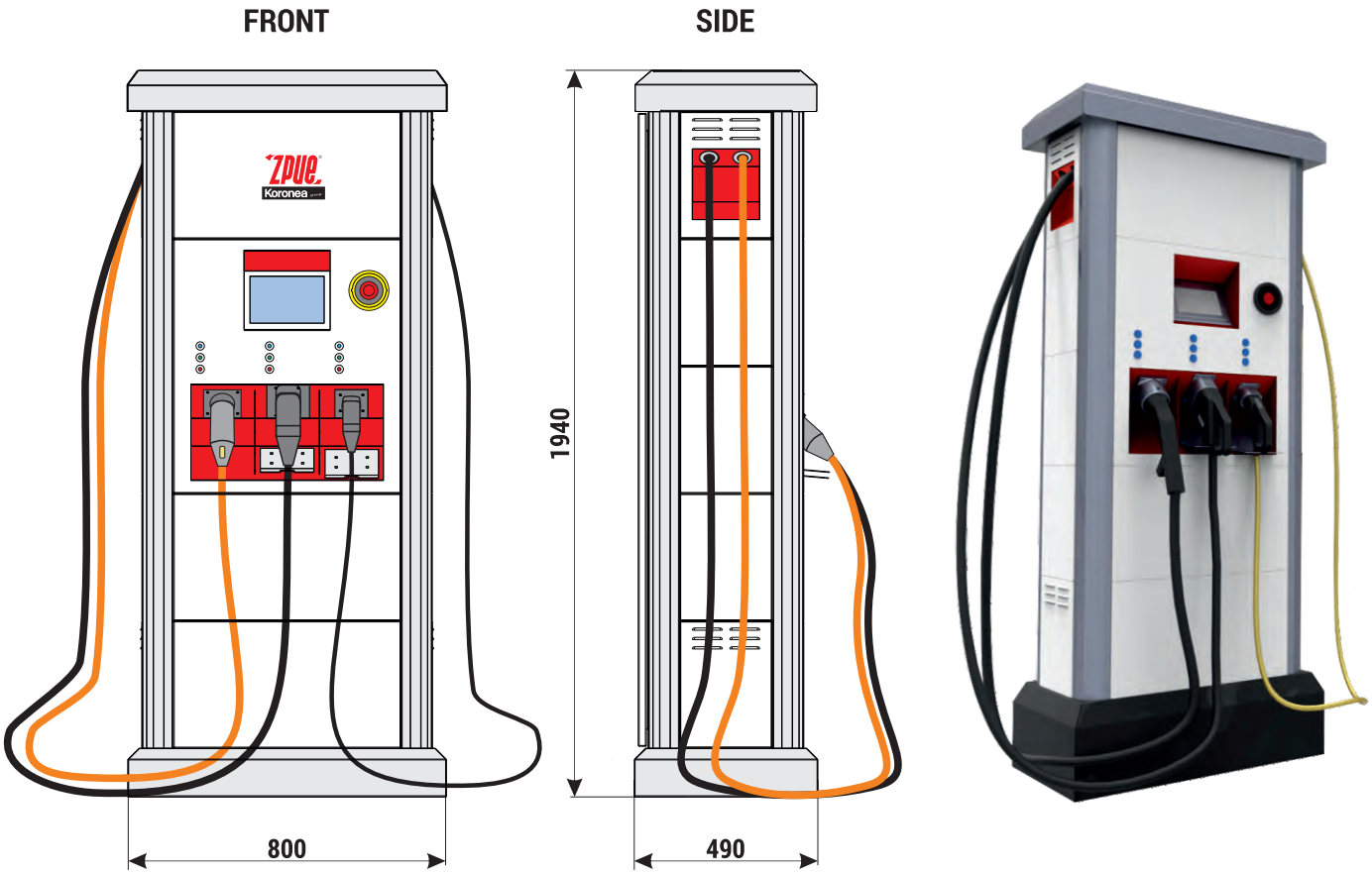


The EV charging station, consists of a charger and a distribution post. The charger powers the distribution post from which e-vehicles can be charged via connectors of three types: CHAdeMO, CCS Typ 2, AC typ 2. The charger is suitable for charging from a DC connector (CHAdeMO, CCS Type 2) and an AC Type 2 connector at the same time. The device can be distanced from the distribution post by up to 200 m and can be charged from two distribution posts simultansously. It is possible to communicate with the charger via Wi-Fi, LTE. Supervision capability is through mobile applications by saving data in the cloud, reporting, archiving over OCPP 1.6 or MODBUS TCP protocols.

MODBUS TCP supervision system is an application for comprehensive management of fast charging stations. It provides remote control, monitoring, and logging of the loader's operating status

Technical specifications of charger	
Catalogue designation	EBC
Charge type	Direct current
Charger power rating	2×50 kW/1×100 kW
Maximum charging current	2×100 A/1×200 A
Rated charging voltage	50-500 VDC
Efficiency	≥ 94[%]
THDi	≥ 5[%]
Active power factor cos ϕ	≥ 0,99
Working temperature	-25°C up to + 45°C

Vehicle charger / distribution post



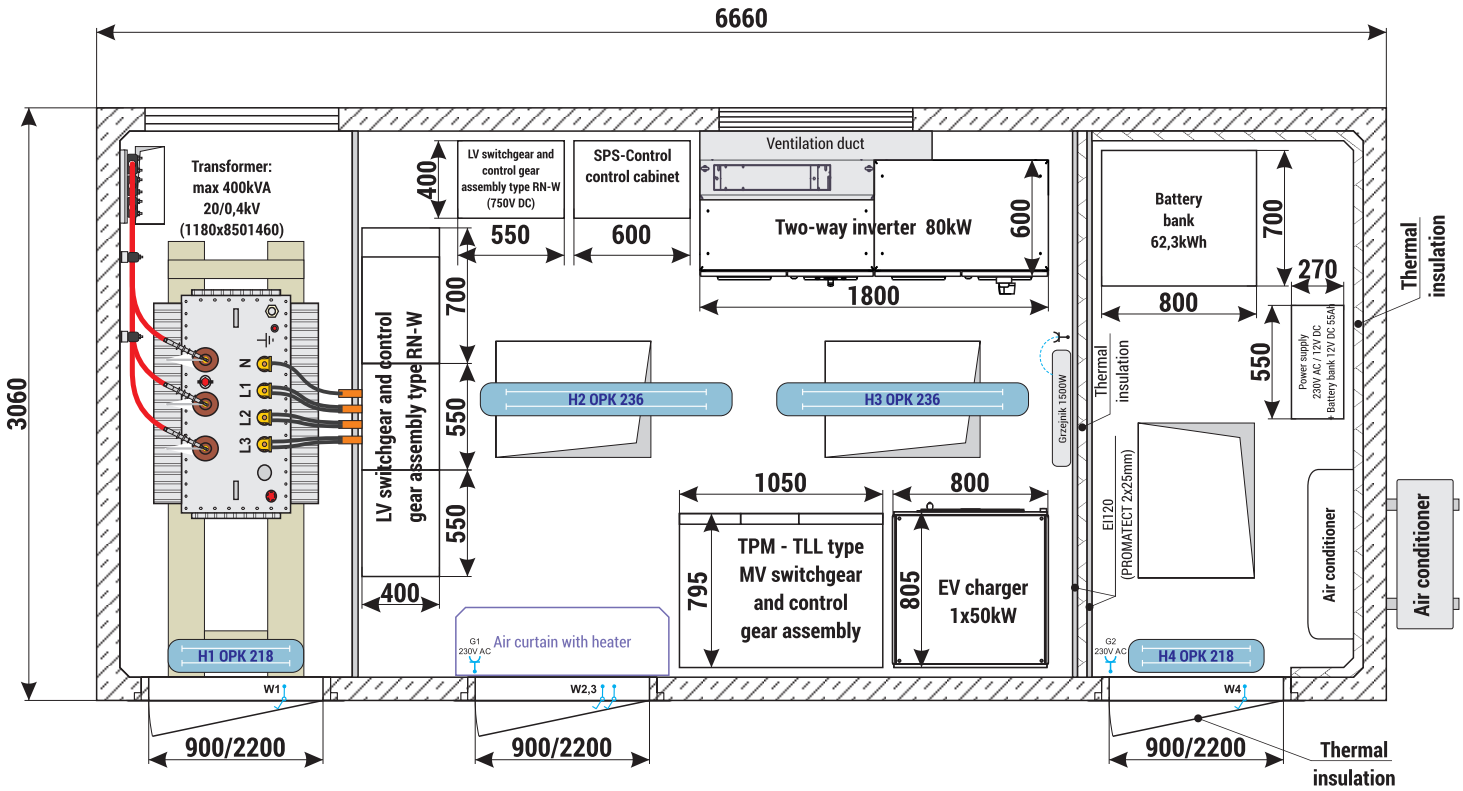
Technical parameters of charger/ distribution post	
Oznaczenie katalogowe	EBC - SC
Connector mode	CCS Typ 2, CHAdeMO, AC Typ 2
Rated power output CCS Type 2	100 kW
Rated power output CHAdeMO	62,5 kW
Rated power output AC Type 2	22 kW or 44 kW
Maximum charging current output CCS Type 2	200 A
Maximum charging current output CHAdeMO	125 A
Maximum charging current output AC Type 2	3x32 A or 3x63 A
Rated voltage, CCS Type 2 and CHAdeMO	50-500 VDC
Rated voltage, CCS Type AC Typ2	3x400 VAC
Working temperature	-25°C up to +45°C
Housing protection degree	IP 54

EXAMPLE SPS SUBSTATION OPTIONS -

Example 1 - SPS 20/400-3 substation with ground energy storage and DC charger

Rated parameters

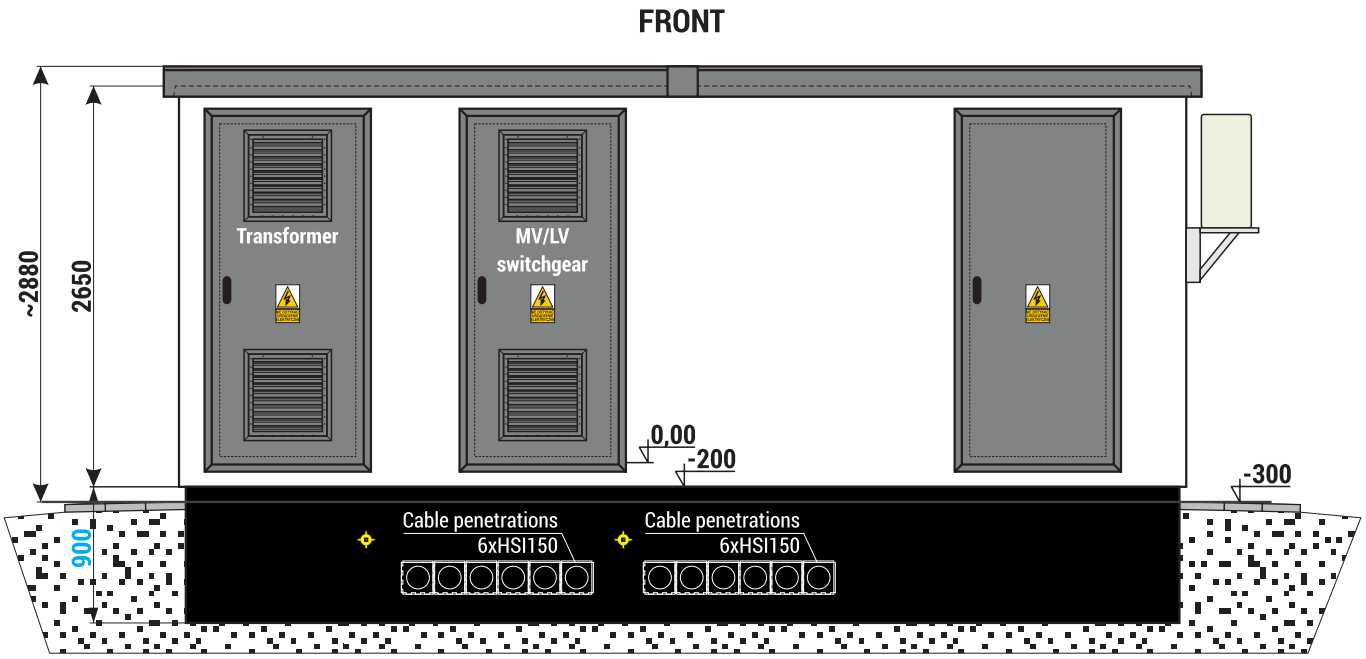
Substation rated data	
Transformer capacity	400 kVA
MV / LV rated voltages	25 kV / 0,4 kV
EV DC charger capacity	50 kW
Energy storage max. power / capacity	80 kW / 62,3 kWh
Rated continuous switchgear (MV / LV) current	630 A / 630 A
Rated short-time withstand (MV / LV) current	16 kA (3s); 20 kA (1s) / 20 kA (1s)
Rated peak withstand (MV / LV) current	50 kA up to 50 kA
Internal arch classification	AB-20 kA – 1s
Protection level	IP 23D
External dimensions (length / width / height from the ground)	6860/3260/2880 mm

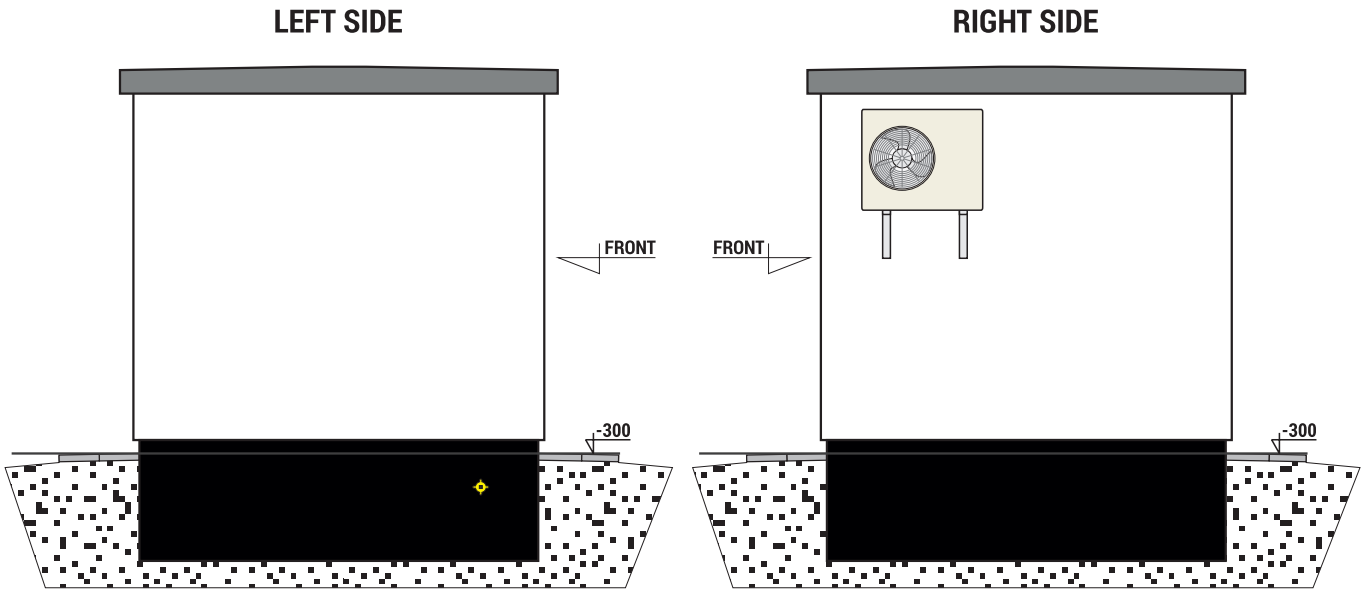


Note:

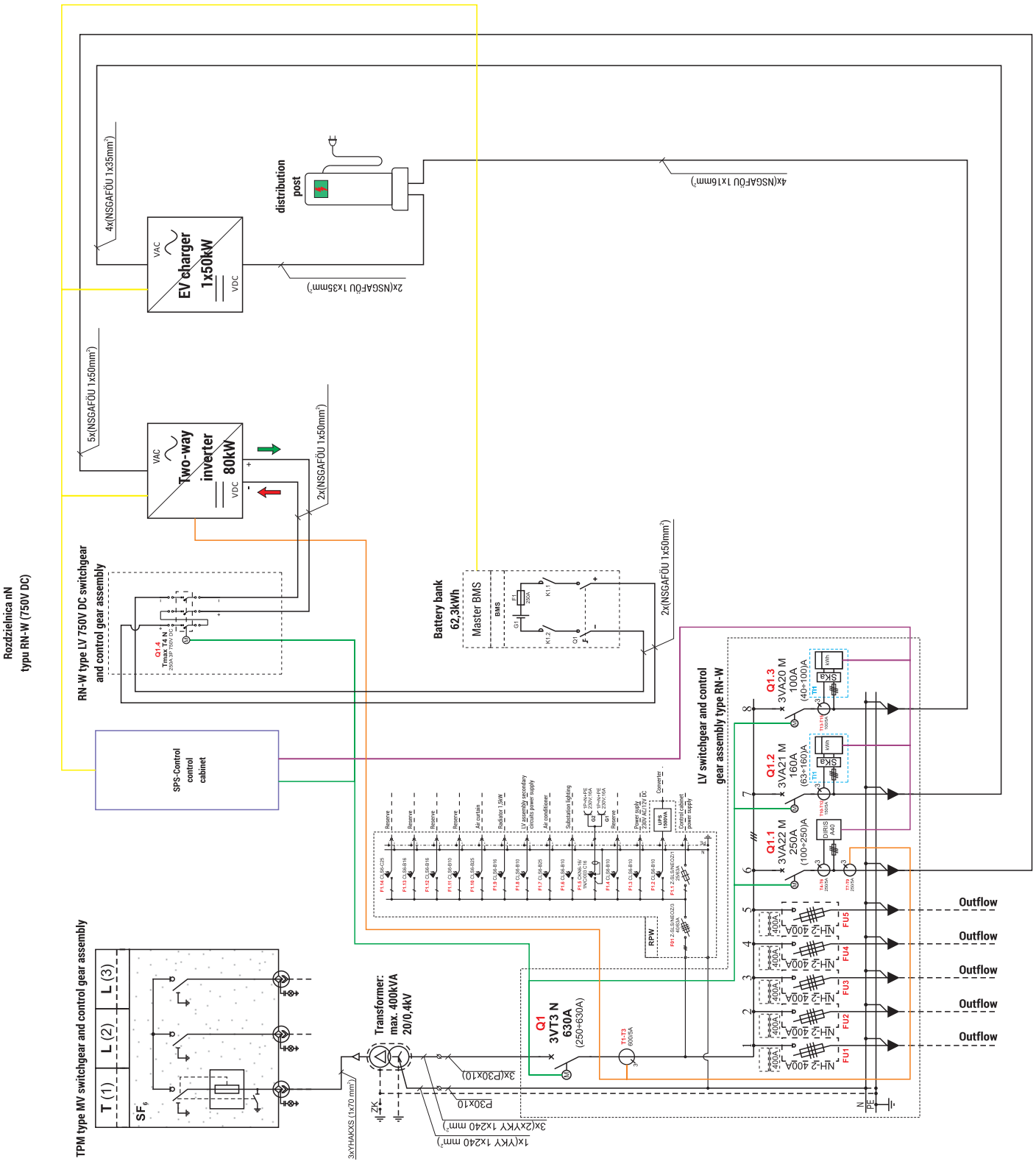
1) This study is just a concept for acceptance.
2) Station made to PN-EN 62271-202, calculated enclosure class 15.
3) This study assumes the maximum transformer size 400kVA 20kV/0,4kV with dimensions (LxWxH) 1180mm x 850mm x 1460mm. With other transformer dimensions, the station dimension may change.

Substation facade



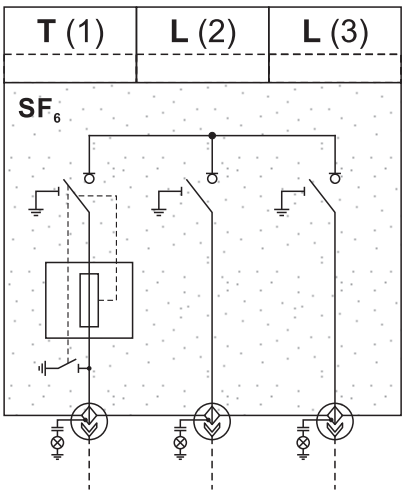


Simplified wiring diagram



TPM type MV switchgear and control gear assembly

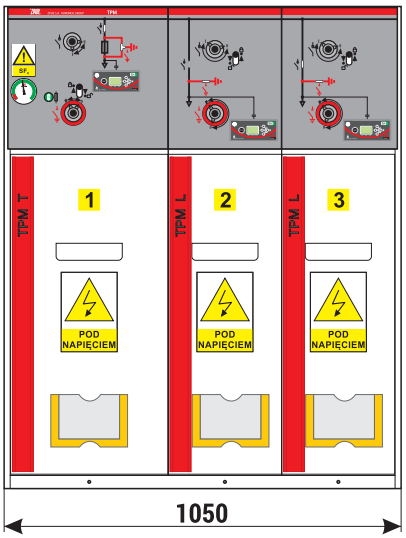
DIAGRAM



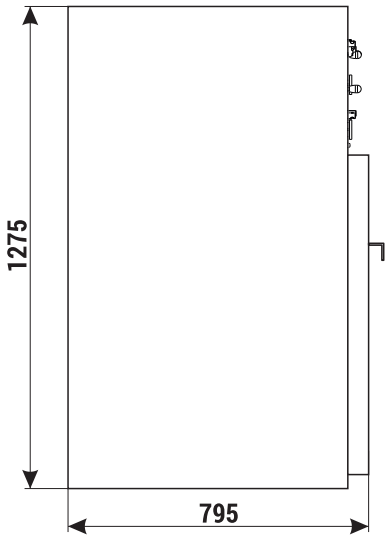
TPM type MV switchgear and control gear assembly
configuration TLL
by ZPUE S.A.

U_r = 25 kV
I_r = 630 A
I_k = 20 kA(1s)
I_p = 50 kA

FRONT



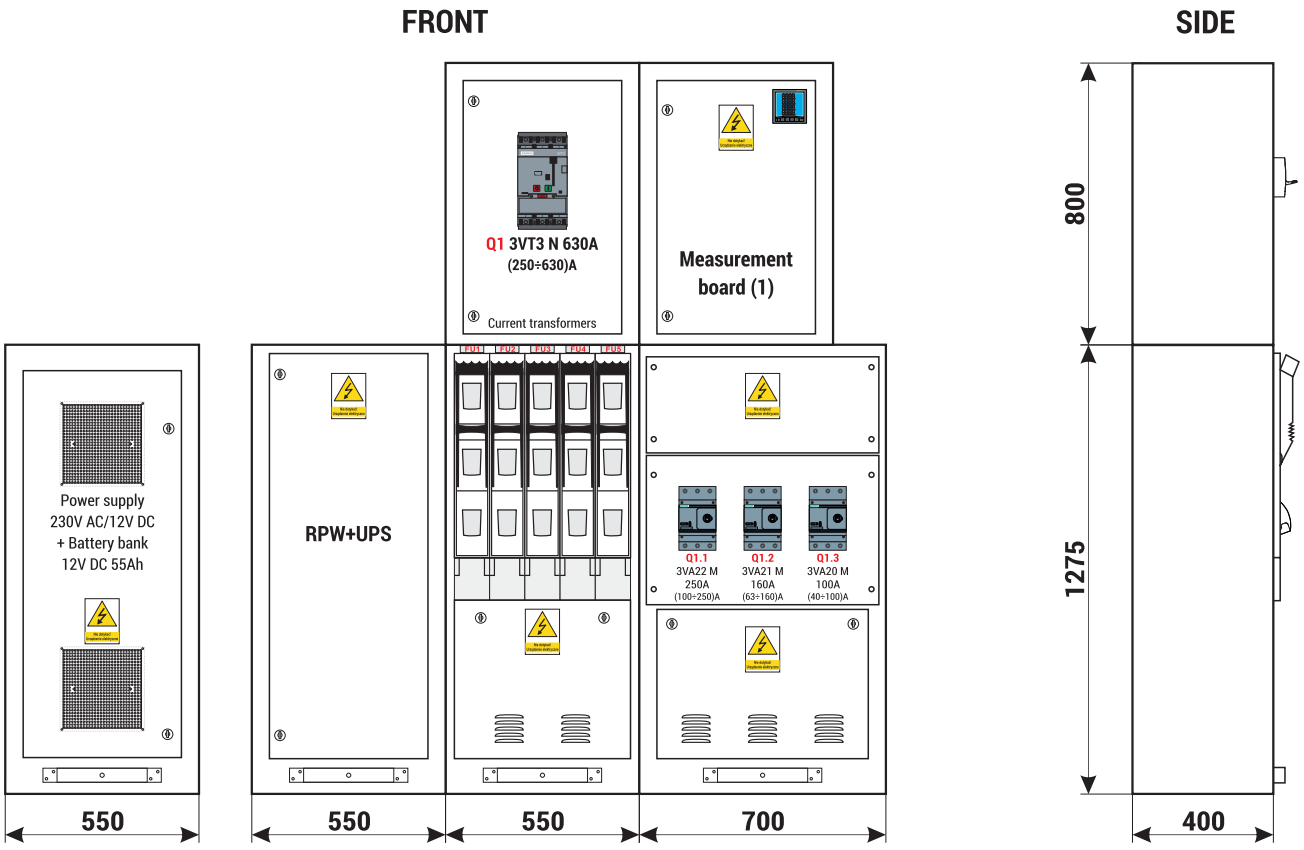
SIDE



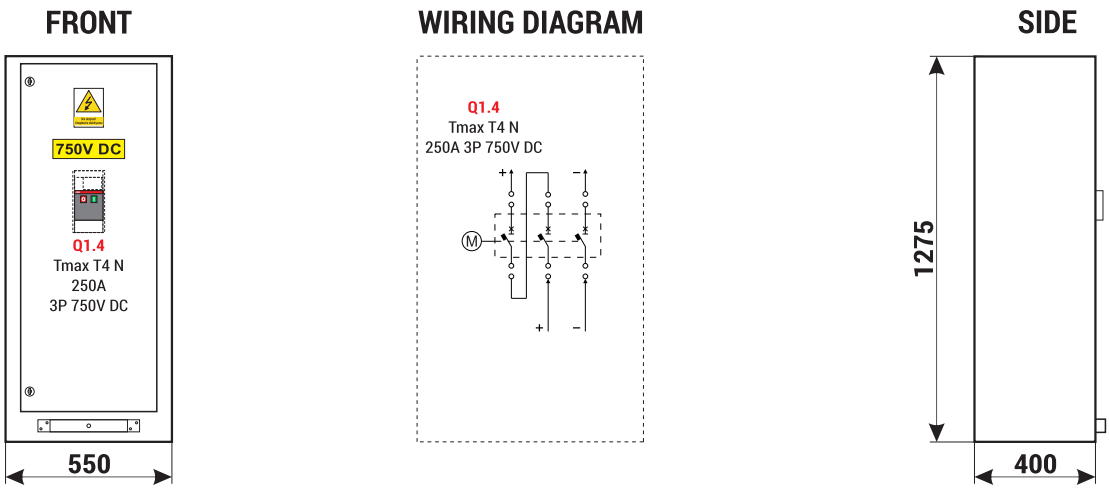
Note:
A detailed technical specification, available configurations and equipment are set out in the summary catalogue of ZPUE S.A. products "Catalogue for design" in the MV/TPM Switchgear and Controlgear Assemblies tab.

LV switchgear and control gear assembly type RN-W

RN-W 400 VAC



RN-W 750 VDC



Note:

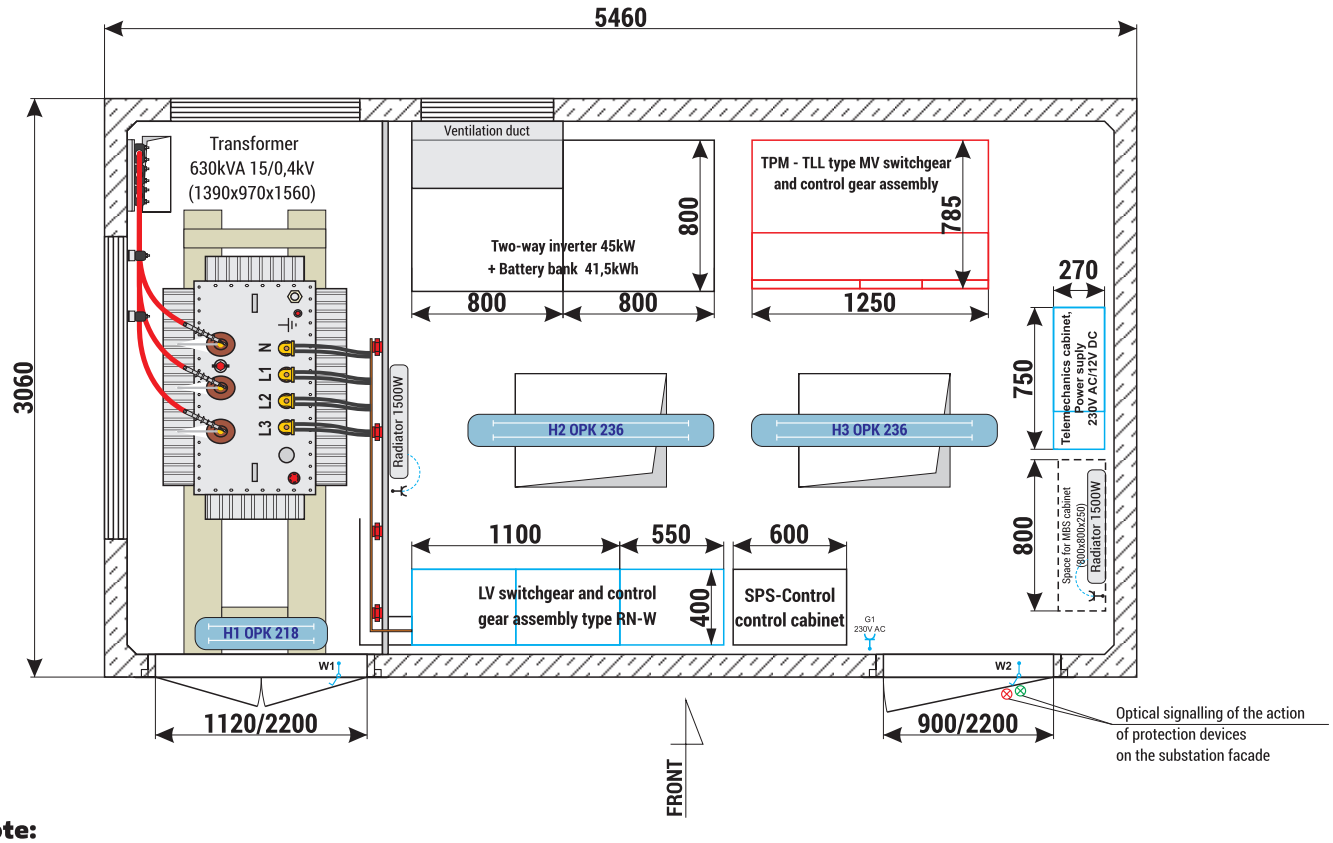
A detailed technical specification, available wiring configurations and equipment are set out in the summary catalogue of ZPUE SA products "Catalogue for design" in the RN-W/ Low Voltage Switchgear and Controlgear Assemblies tab.

Example 2 -

SPS 15/630-3 substation with ground energy storage

Rated parameters

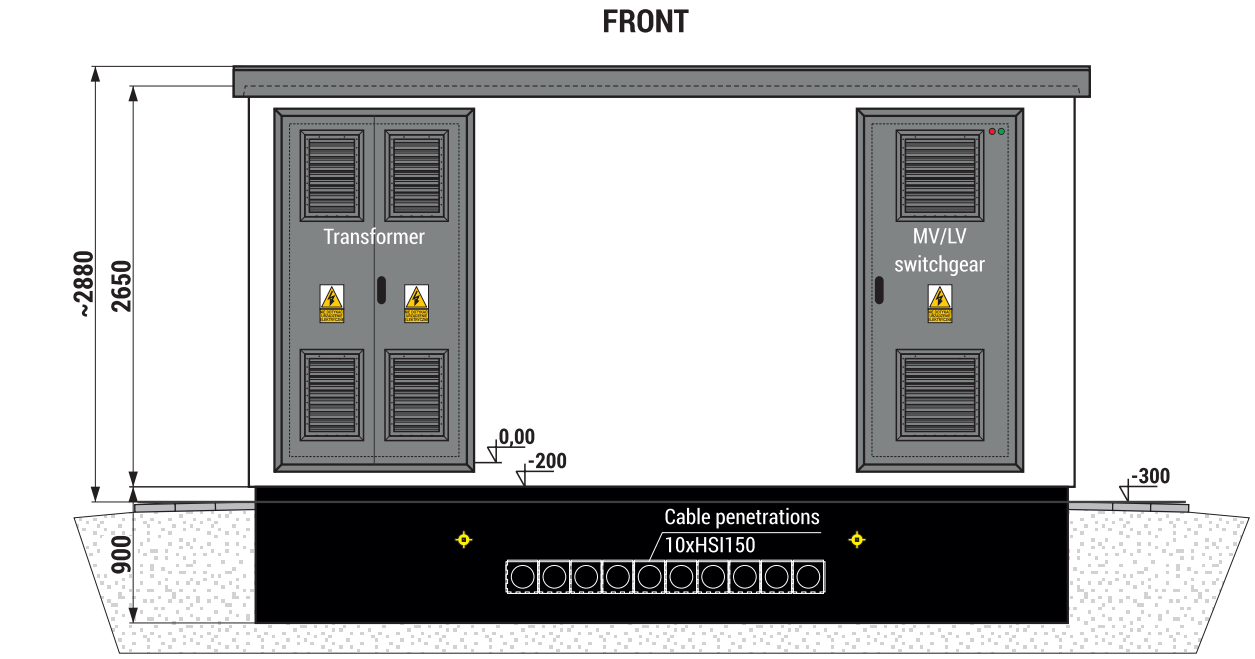
Substation rated data	
Transformer capacity	630 kVA
MV / LV rated voltages	25 kV / 0,4 kV
EV DC charger capacity	-
Energy storage max. power / capacity	45 kW / 41,5 kWh
Rated continuous switchgear (MV / LV) current	630 A / 1000 A
Rated short-time withstand (MV / LV) current	16 kA (3s); 20 kA (1s) / 20 kA (1s)
Rated peak withstand (MV / LV) current	50 kA up to 50 kA
Internal arch classification	AB-20 kA – 1s
Level protection	IP 23D
External dimensions (length / width / height from the ground)	5660/3260/2880 mm

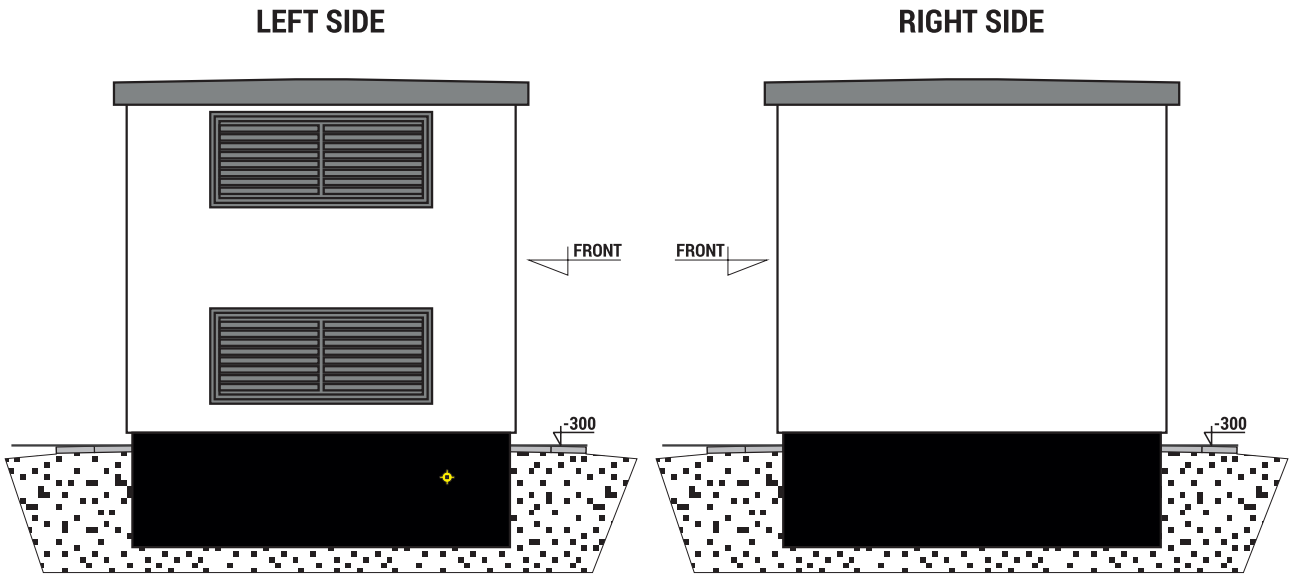


Note:

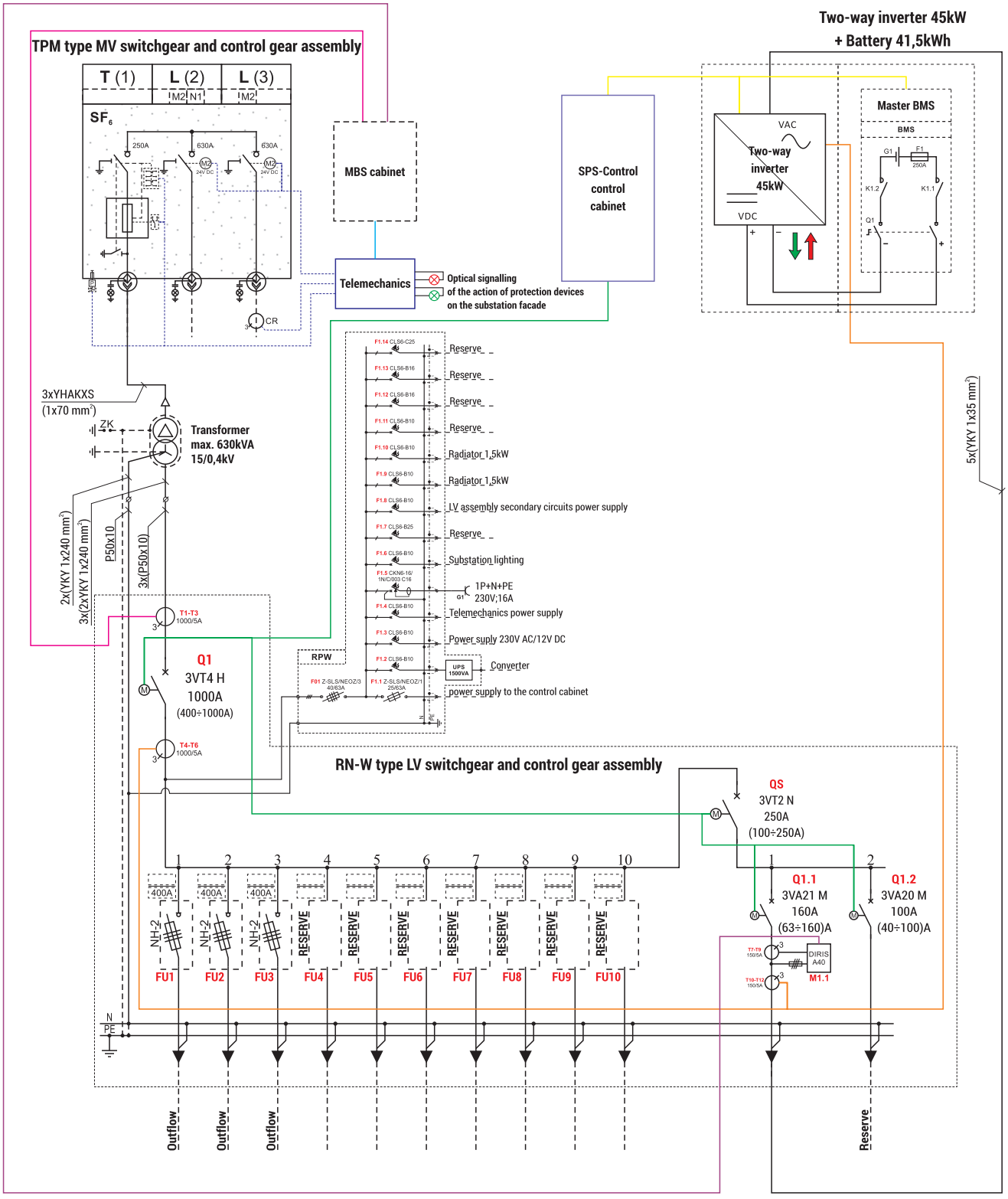
1) This study is just a concept for acceptance.
2) Station made to PN-EN 62271-202, calculated enclosure class 15.
3) This study assumes the maximum transformer size 630kVA 15kV/0,4kV with dimensions (LxWxH) 1390mm x 970mm x 1560mm. With other transformer dimensions, the station dimension may change.

Substation facade



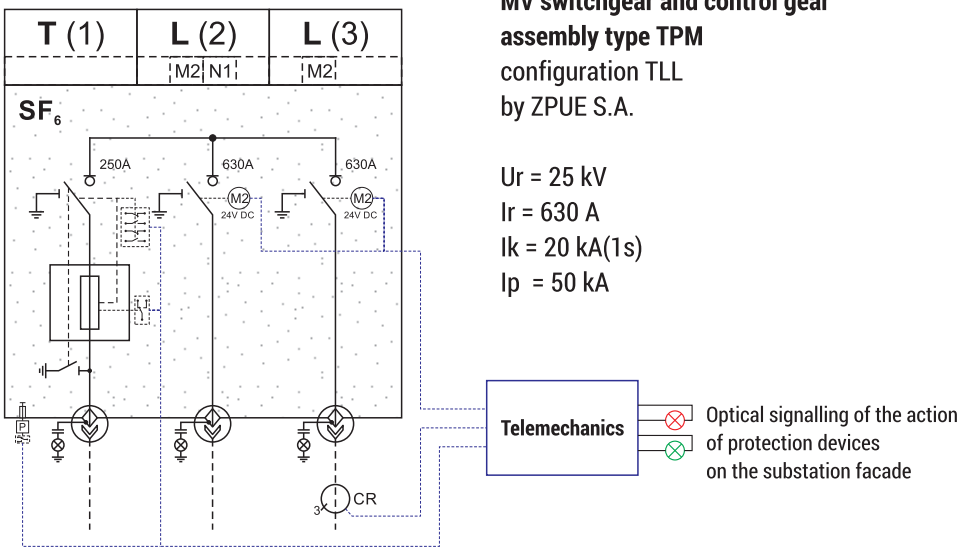


Simplified wiring diagram



MV switchgear and control gear assembly type TPM

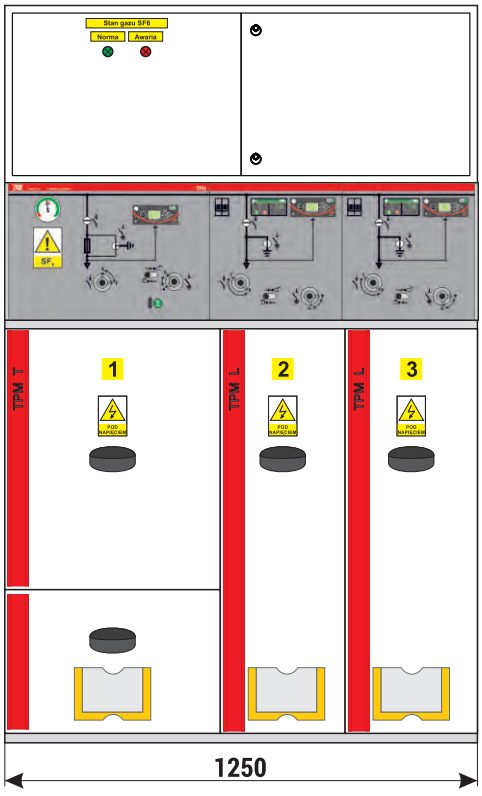
DIAGRAM



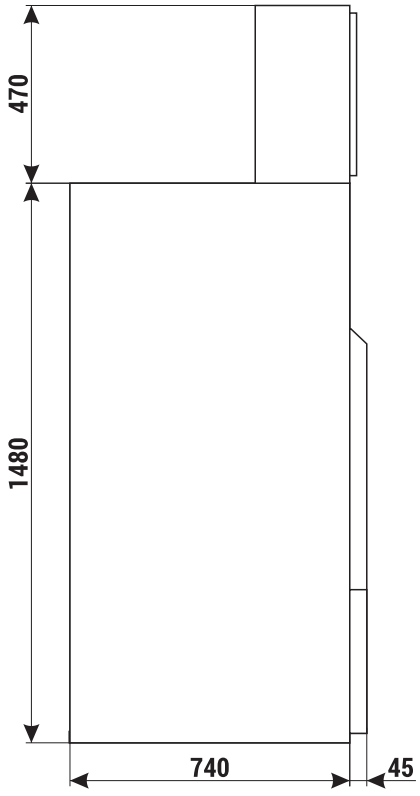
MV switchgear and control gear assembly type TPM
configuration TLL
by ZPUE S.A.

Ur = 25 kV
Ir = 630 A
Ik = 20 kA(1s)
Ip = 50 kA

FRONT

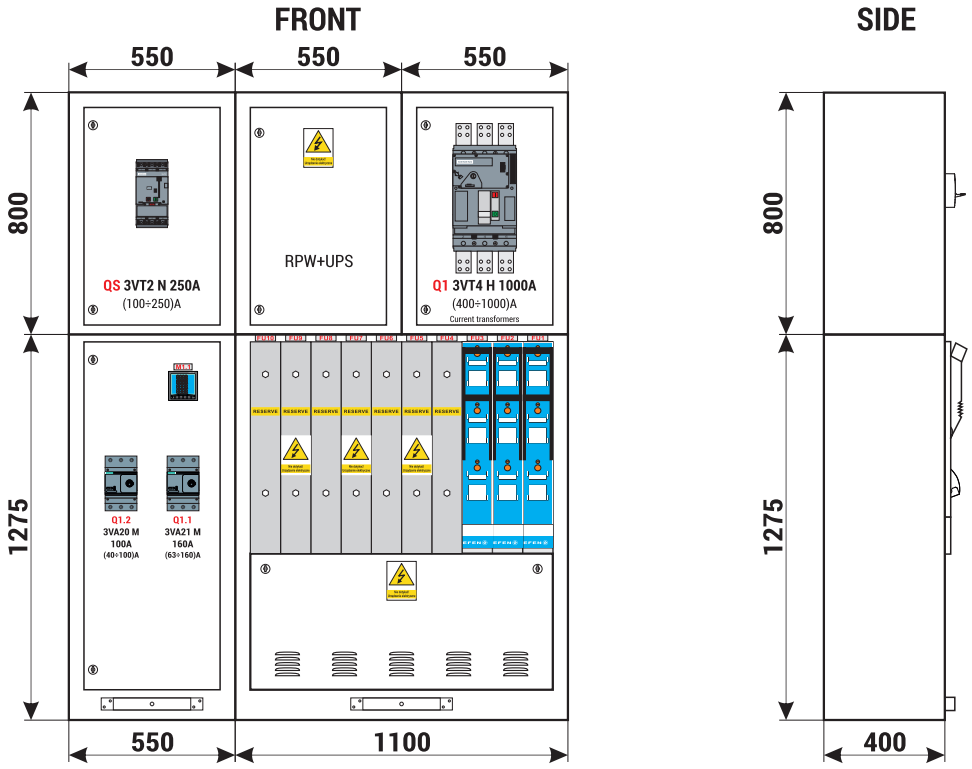


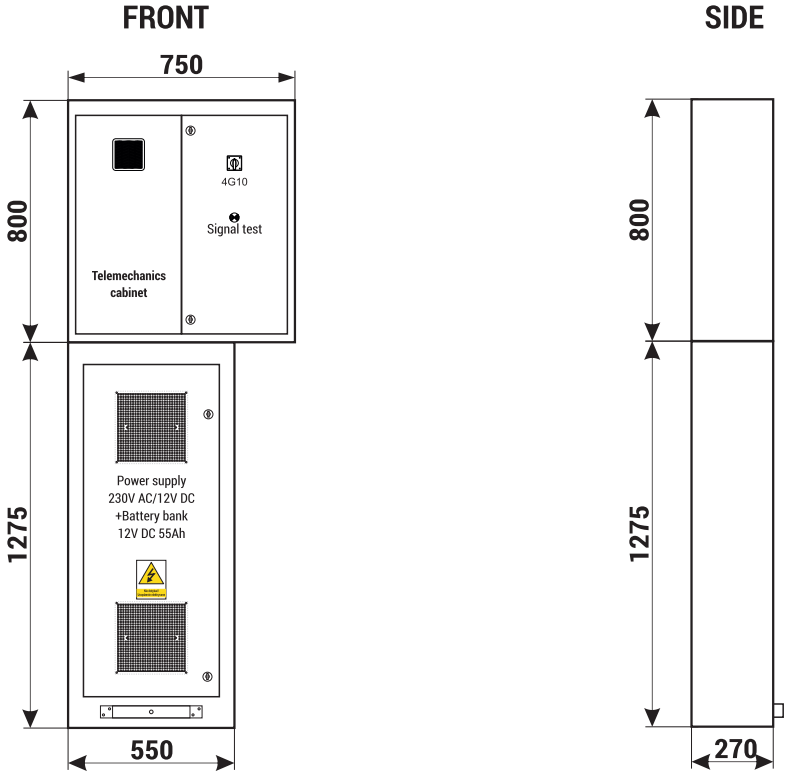
SIDE



Note:
A detailed technical specification, available configurations and equipment are set out in the summary catalogue of ZPUE SA products "Catalogue for design" in the MV/TPM Switchgear and Controlgear Assemblies tab.

LV switchgear and control gear assembly type RN-W

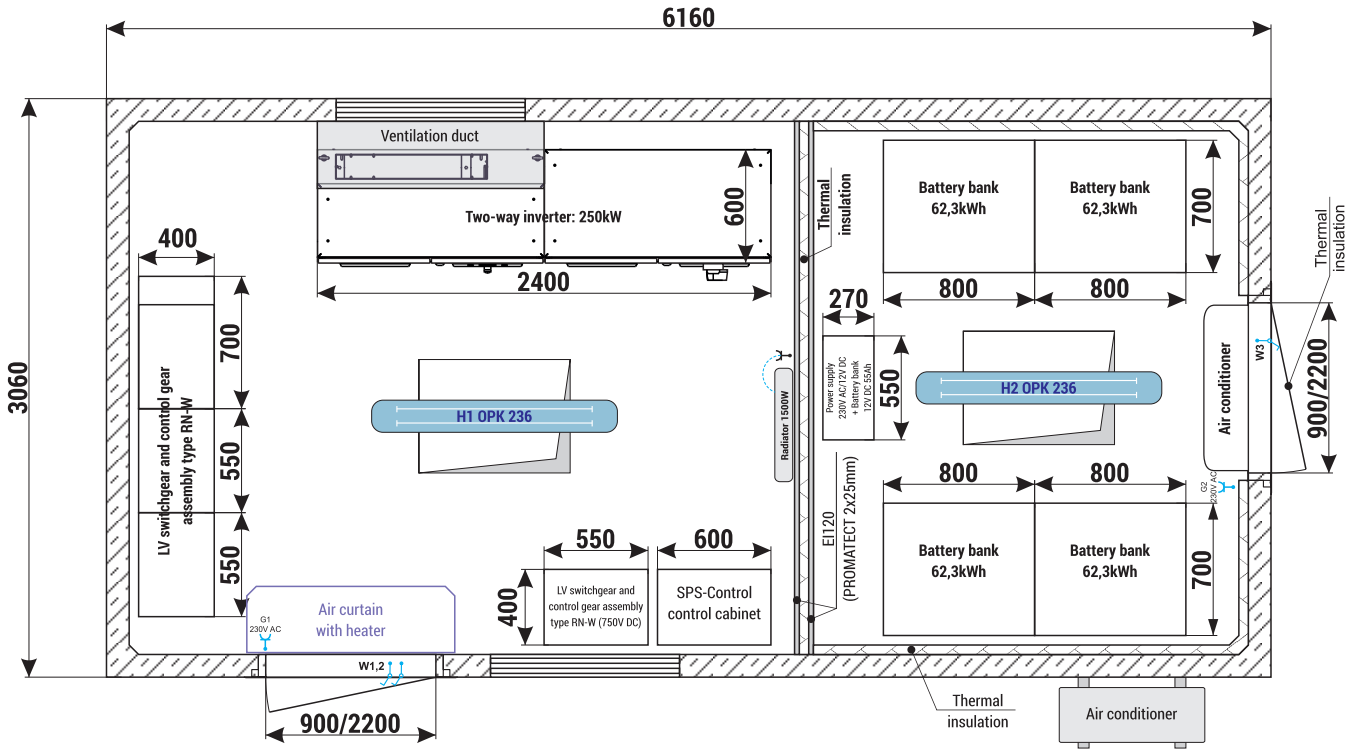




Example 3 -
SPS-R250 Retrofit substation with ground energy store

Rated parameters

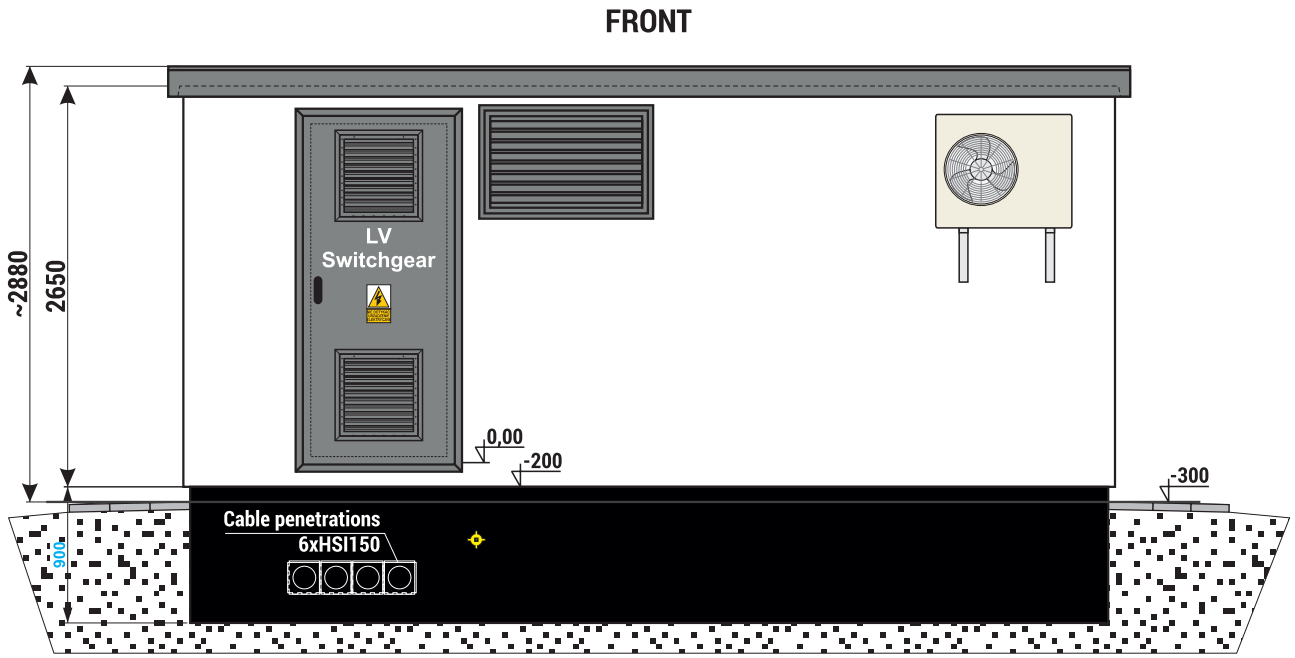
Substation rated data	
Transformer capacity	-
MV / LV rated voltages	- / 0,4 kV
EV DC charger capacity	-
Energy storage max. power / capacity	250 kW / 249,2 kWh
Rated continuous switchgear (MV / LV) current	- / 630A
Rated short-time withstand (MV / LV) current	- / 20 kA (1s)
Rated peak withstand (MV / LV) current	- / up to 50 kA
Internal arch classification	AB-20 kA – 1s
Protection level	IP 23D
External dimensions (length / width / height from the ground)	6360/3260/2880 mm

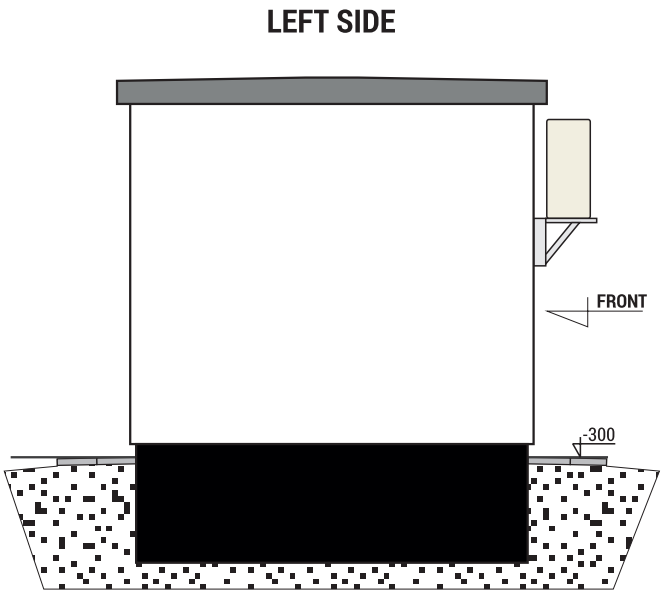


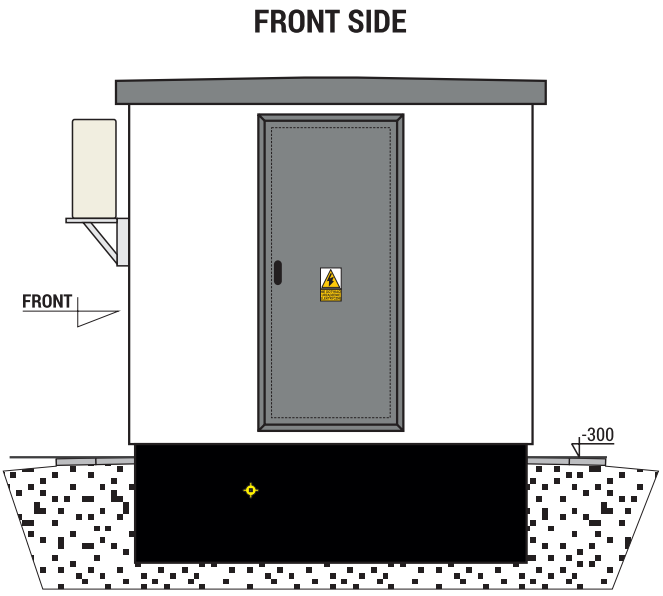
Note:

1) This study is just a concept for acceptance.
2) Station made to PN-EN 62271-202.

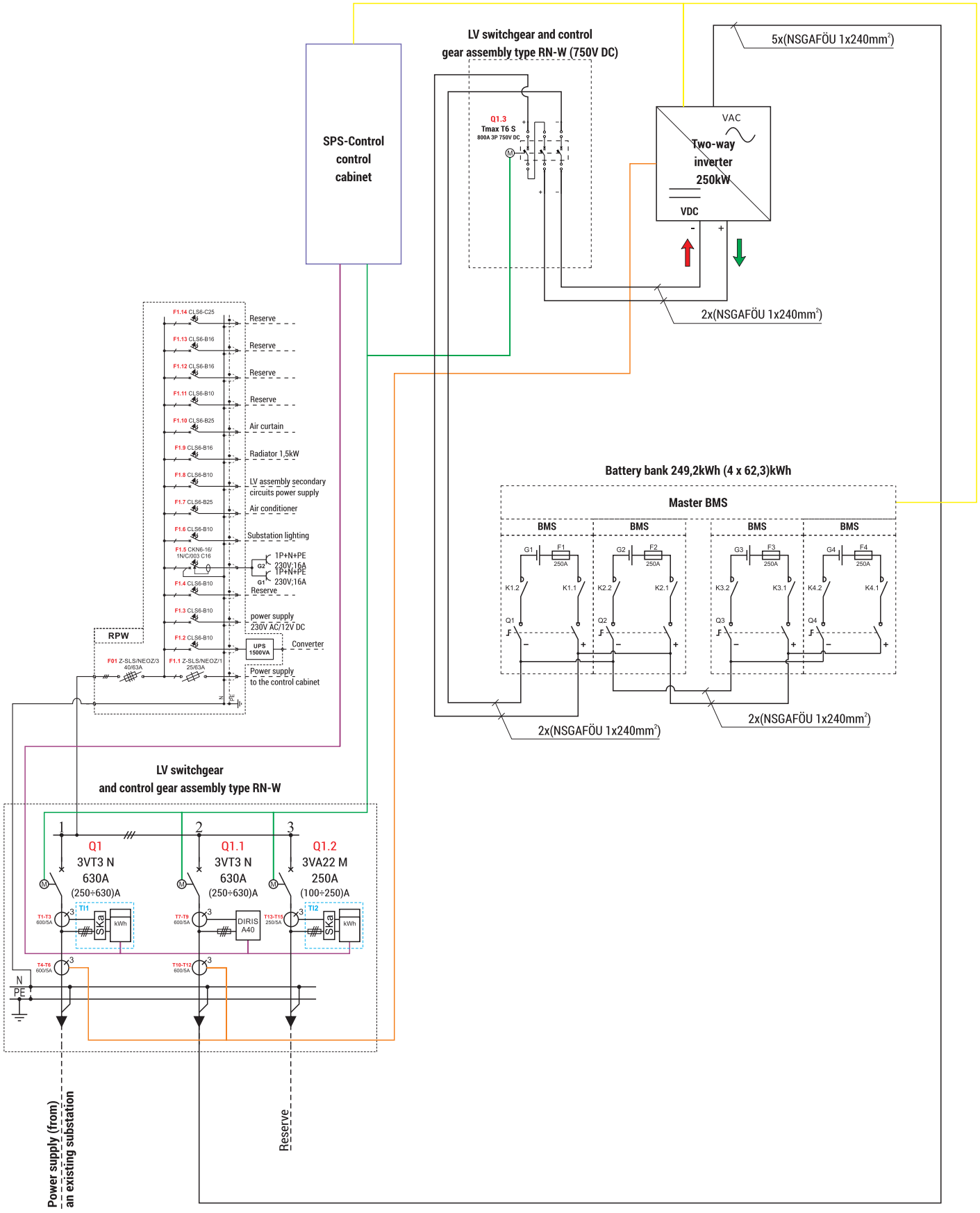
Substation facade





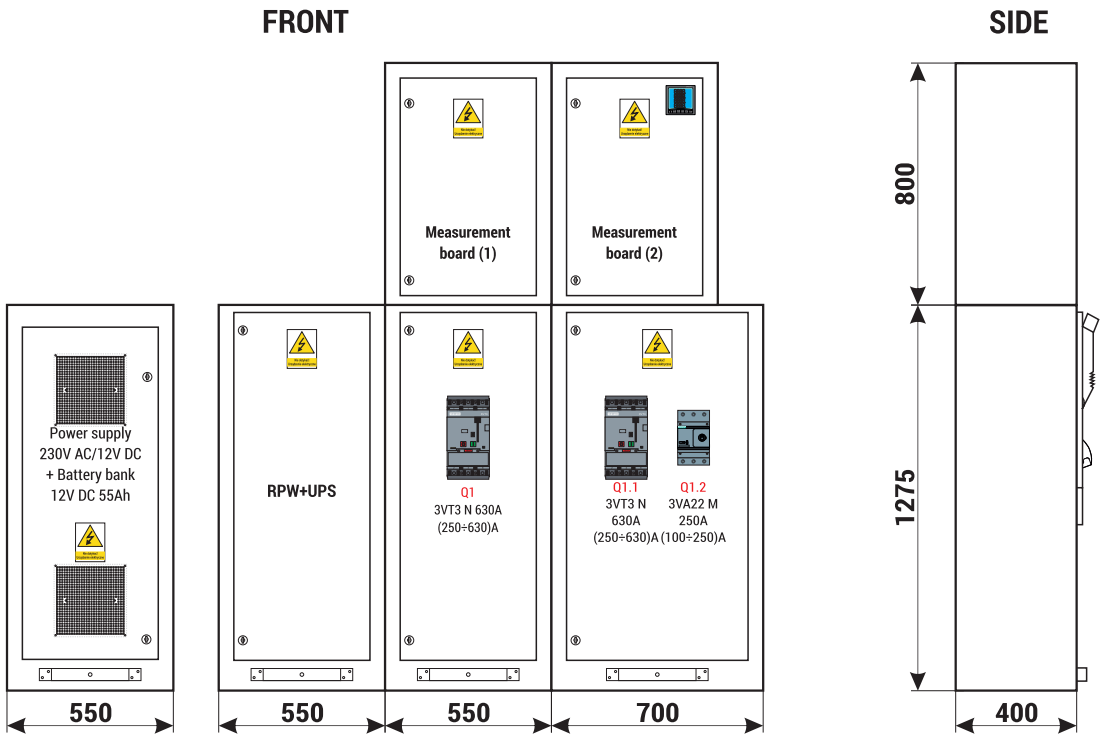


Simplified wiring diagram

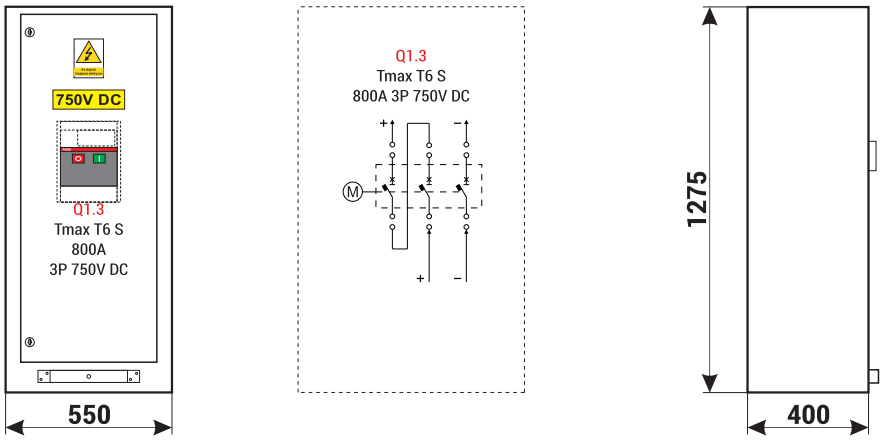


LV switchgear and control gear assembly type RN-W

RN-W 400 VAC



RN-W 750 VAC



Note:

A detailed technical specification, available wiring configurations and equipment are set out in the summary catalogue of ZPUE SA products "Catalogue for design" in the RN-W/ Low Voltage Switchgear and Controlgear Assemblies tab.

Notes

Notes

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