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This Internal Technical Standard (hereinafter referred to as ITS) Heavy Current - HV applies to all ŠKODA AUTO plants.

Contents

1. Introduction.....	4
1.1. Regulations and Standards	4
1.2. List of Abbreviations and Terminology	4
2. General Requirements.....	5
2.1. The Contractor's responsibility	5
2.2. Starting Installation Works	5
2.3. The Contractor's Obligations	5
2.4. Operating the Equipment	5
2.5. Professional Consultation	5
2.6. Machinery Expansion/Modification	5
2.7. Documentation for Actual Project Implementation	5
2.8. Certification, Approval and Quality Management	6
3. Voltage Systems in Production Plants.....	6
4. Types of HV Networks Used and Their Installation	6
4.1. HV Line Operation.....	6
4.1.1. Circular/Loop Line	6
4.1.2. Radial Lines – Branches, Connections	7
4.2. Cable Down-Leads.....	7
4.2.1. Installation of Cable Down-Leads.....	7
4.2.2. Down-Lead Cables.....	7
4.3. Installing Cables and Markers	7
4.3.1. Installation of Cables.....	7
4.3.2. Principles for Laying Cables in the Ground	7
4.3.3. Principles for Installing Underground Cables in Open Trenches and in Buildings	8
4.3.4. Markers.....	8
4.3.5. Inspections and Tests During Installation Process	8
4.3.6. Selection of Construction Contractor	9
4.3.7. REGULATIONS FOR CONSTRUCTING HV CABLE NETWORKS	9
5. HV Substations, Transformer Stations and Switching/Disconnecting Elements.....	9
5.1. Standardised Platform Transformer Stations TS.....	14
5.1.1. LV Section (also Applicable to Switching Stations).....	15
5.1.2. REF6xx Terminal Equipment.....	17
5.1.3. Transformer Part (TR).....	18
5.1.4. LV Part.....	18
6. MicroSCADA System.....	19
6.1. System Structure.....	19
6.1.1. Central System.....	19
6.1.2. Communication System	19
6.1.3. Visualisation System	19
6.2. Communication between the Main System Parts.....	19
6.3. Communication with Processing Units.....	19
7. LV bus bar system	20
8. CENTRAL / TOTAL STOP.....	20
8.1. Uniform Design of CS and TS Cabinet	20
9. Measuring Electricity Consumption.....	20
10. Basic Installation Works Conditions.....	20
10.1. Electric Equipment in the Switchboard	20
10.1.1. Electrical Conductor	21
10.1.2. Binary Inlets.....	21
10.1.3. Binary Outlets.....	21
10.1.4. Analog Inlets and Outlets.....	21
10.2. Cabling.....	21
10.3. Rules for Connecting to ŠKODA AUTO, a.s. Network.....	22
10.3.1. Connecting the Equipment to ŠKODA AUTO, a.s. Network.....	22
11. Metrology.....	22
12. Scope of Documentation	22
12.1. Construction Implementation Documentation – Minimum Requirements.....	23
12.2. Documentation of actual project implementation– minimum requirements	23

13.	List of figures.....	23
14.	List of tables	23
15.	Comments / Additions.....	24



The latest updated version of this ITS is available at the "<http://cts.skoda-auto.com/>" website, the company is not obliged to notify their business partners on the ITS update.

Therefore, we strongly recommend that everybody checks the ITS regularly. These documents become valid on the date of their last update. For contract purposes is deciding the ITS validity at the time of issuing the order.

Note: In case of any differences between the Czech, English and German language version of this ITS, the Czech version takes precedence. The Czech version is available at <http://cts.skoda-auto.com/>.

First edition: 2019-06-27

Change - Number:	Date:	Note:
1.	2020-06-09	2 nd edition – ITS name change, entering changes and requirements of ŠE-TI and ŠA-PPB
2.		
3.		
4.		
5.		
6.		

1. Introduction

This internal technical standard (hereafter referred to as "ITS") deals with the power engineering profession as a part of all power-engineering devices of the company ŠKODA AUTO a.s. The power engineering concept within ŠKODA AUTO a.s. is fully in the competence of ŠKO-ENERGO, s.r.o. (the subsidiary of ŠA). From the above statement it follows that all the solutions in question must always be consulted with and approved by the representatives of the Š-E. Project documentation must always be prepared for the submitted subject of the solution (in accordance with the current legislation). This ITS describes the key areas and requirements in terms of the power engineering, determines the technical methods for installing specific technological departments and specifies the technical conditions for delivery, installation and putting into operation all equipment.

Any deviation from the content of this ITS must be justified and approved in writing by the ŠKO-ENERGO specialised department (hereinafter referred to as the "ŠE-TS/2 or ŠE-TI/4").

The use of materials containing carcinogenic substances, and silicone substances (crater forming materials) is prohibited. If necessary, material testing (PPF-L/1 Process dptm.) can be carried out. The Contractor is required to submit a certificate confirming the grading and quality of the product.

1.1. Regulations and Standards

In this area, it is essential for the Contractor to comply with the ČSN, EN, ISO standards and also with the following regulations and standards that are current on the day of signing the contract:

- ITS ŠKODA AUTO a.s., <http://cts.skoda-auto.com/>
For electric machinery and equipment, the following standards in particular:
 - ITS 1.01 General Technical Conditions
 - ITS 1.05 Information Systems and Technologies
 - ITS 1.09 Closures and Closing Equipment
 - ITS 1.11 Electricity
 - ITS 1.18 Occupational Safety
 - ITS 2.11 Fire Protection and Fire Safety in Buildings
 - ITS 5.11 Electrical Installations
 - ITS 5.13 Control and Management Technology
 - ITS 5.15 Energy Measurements Concept
- Requirements and detailed specifications for the construction equipment in the form of a technical specification issued for the relevant part of the production or the project.
- Assessment and minimising of risks according to the standard ČSN EN ISO 12100 and the documentation produced herein are included as part of the machinery delivery.
- It is necessary to comply with the regulations in terms of the standards ČSN EN 60204-1 ed.2 and ČSN 33 2000-X-XX applicable for electronic equipment of machinery, machinery equipment and preparations that are not manually portable during operation, powered from electrical sources with the nominal voltage between conductors (phase conductors) 1000 V ~ 1500 V=.
- In accordance with the standard ČSN EN 60204-1 ed.2, the Contractor is required to ensure in particular the following:
 - Safety of persons and property.
 - Defect-free production process.
 - Service life and economy of production process.
 - Easy and effective maintenance.
- All equipment is designed and installed in accordance with the current technology regulations and occupational safety and health protection regulations. When installing the components, it is required to follow the manufacturer's recommendations.

Compliance with all relevant electrical, fire and safety standards current at the time of preparing the project documentation (PD) is mandatory!

1.2. List of Abbreviations and Terminology

EBI	-	Enterprise Buildings Integrator	(System for integration of buildings, objects and their systems)
IED	-	Intelligent Electronic Equipment	
PHD	-	Process History Database	(Database created by EBI server)
MaRSE	-	Power supply Measurements and regulation systems of energy (power supply)	
ŠA	-	ŠKODA AUTO a.s.	
ŠA-PPB	-	ŠKODA AUTO a.s. – Construction and Infrastructure Planning	
ŠE	-	ŠKO-ENERGO, s.r.o.	
ŠE-TI	-	ŠKO-ENERGO, s.r.o. – Infrastructure and Other Energies	
ŠE-TS	-	ŠKO-ENERGO, s.r.o. – Energy Services and Management	
PLC	-	Programmable Logic Controller	
TR	-	Transformer	
TS	-	Transformer Station	

2. General Requirements

2.1. The Contractor's responsibility

The Contractor is responsible for the correct operation of the delivered machine/equipment. The Contractor must comply with all current EU directives, legal regulation, government directives, decrees and technical standards relating to the machine/equipment applicable in the country of installation.

2.2. Starting Installation Works

On receiving the order before starting installation works on the installation works site, the Contractor shall in due time submit to the Ordering Party the relevant documentation specified in the work specifications or within the construction works agreement, including, for example, installation projects, work execution plans, installation plans, schedules and staff deployment plans. The final design has to be approved at a technical meeting, where a part of the agenda will be implementation documentation and statement of acreage content. In case of any changes to the equipment and fittings, it will be required to submit the amended documentation for approval to be given in writing to the ŠE-TS/2 or ŠE-TI.

Changes made by the Contractor in the period between the tender submission and the final solution do not justify an increase in dptm. prices. The technical project documentation to be submitted shall include the equipment design plans, function diagrams with the descriptions, cabling routes, the essential technical data and the time schedule indicating the installation procedures, test operation and handover process.

2.3. The Contractor's Obligations

The Contractor is obliged to obtain information concerning the current relevant standards, local regulation provisions and practices for the specified production equipment. When extending or modifying existing systems, the Contractor is required to comply with the regulation provisions that apply to the given type of system and is responsible for its overall functioning. During the guarantee period, the Contractor's customer service must be available for maintenance works. The servicing period must be included in the tender as a binding promise of the deadline for delivering the works. **In case of problems of complying with the technical specifications and the local provisions, the Contractor is required to inform the specialised department of ŠE-TS/2 dptm. and the PPB dptm. of ŠKODA AUTO a.s., and to submit, consult, and get approved a proposal of a solution.**

The documents submitted by the specialised departments to the Contractor may not be copied or made available to a third party without the permission of the Ordering Party. ŠKODA AUTO a.s. acquires free, exclusive, irrevocable, rights unlimited in time to the Contractor's completed work on the basis of the order.

In the project documentation, the Contractor is required to make preferential offers regarding the recommended components specified in this ITS or in the relevant Attachments. Other components or non-standard components may only be used with the written consent of ŠE-TS/2.

2.4. Operating the Equipment

All equipment may only be operated below the limit values specified by the manufacturer and the nominal values of the components must not be continuously exceeded. This applies to limit values for voltage, current, temperature, as well as protection against impacts, vibrations, oil mist, liquid vapours and other physical values.

No substances harmful to the environment and health (e.g. FC-hydrocarbons, asbestos, etc.) may be used. No silicone- and Teflon-based materials, or more generally any material that contains crater-forming substances preventing paint-coating and damaging to pay-coats, should be used in production facilities. Teflon-based products can only be used in some cases solely with an approval of ŠKODA AUTO a.s.

2.5. Professional Consultation

After submitting an offer or work proposal, a detailed technical meeting between the Contractor and the relevant specialist ŠE-TS/2 dptm. and the PPB dptm. at ŠKODA AUTO a.s., which is responsible for technical construction supervision of all activities at ŠA premises, must take place before starting the construction works. The Contractor is fully responsible for the overall concept, including all related areas (emergency stop, protective grills, start-up circuits). The Contractor is fully responsible for the complete concept implementation, its installation and functionality in accordance with the relevant legislation.

2.6. Machinery Expansion/Modification

In case of expanding or modifying the existing machinery, the Contractor is responsible for the overall functioning of the equipment affected by the upgrading or modification process. When reconstructing the existing equipment, any no longer needed components have to be removed and project documentation amended accordingly. The scope of modifications made to the existing machinery and its character will be assessed by the professional ŠE-TS/2 dptm. In the event of the proposed modifications having the character of a reconstruction or the delivery of new machinery or additional components to an existing machinery, before putting the new or adjusted machinery into operation, the manufacturer or the authorised representative of the manufacturer shall draw up an ES declaration of conformity in accordance with Directive no. 2006/42/ES of the European Parliament and the Council in accordance with Attachment II, Part 1, Section A (corresponding to the Government Decree no. 176/2008 Coll.) and shall ensure that this declaration is attached to the machinery. **It is completely mandatory that the acceptance procedure will be carried out by the competent specialised department of ŠKODA AUTO a.s. or ŠE-TS/3, ŠE-TS/4, ŠE-TS/ (the acceptance procedure must be carried out in accordance with ITS 1.01.).**

2.7. Documentation for Actual Project Implementation

The technical documentation concerning the actual project implementation must be submitted sufficiently in advance by the Contractor, documenting the actual project implementation in the previously agreed number and manner of presentations (paper or electronic version). The documentation must include the following:

- the complete legible drawings documentation with the precise drawing showing HV cabling, HV switchboard drawings, HV/LV transformer drawings, drawings of related LV distributions and distribution boards, drawings of related distributions and auxiliary voltage circuits, including documentation for fire protection seals;
- wiring diagrams with function description;



- complete setting files for protection and communication installation sets in electronic form;
- table of permissible manipulations, including any blocking conditions;
- instructions for the delivered electrical equipment;
- description of function and instructions for the control system and visualisation;
- all commented source codes for specific PLCs (regulators), according to the system and the type of installation – these source codes must be freely editable in the future (unfolded/not compiled source code for controlling the functioning of the regulators);
- description of visualisation;
- a completed data points table (hereinafter referred to as "DTP"), including IP addresses and MAC addresses, which is stored on the SQL server;
- operating and maintenance instructions;
- a list of parts/components used and a list of fast wearing parts and a recommended interval for their replacement (if any);
- documents concerning training of operating personnel;
- relevant inspections;
- certificate of conformity;
- the Contractor's declaration concerning construction works (on materials used, avoiding use of silicones, waste disposal, etc.);
- the certification of fire protection seals;
- approving statement from TÍČR (Technical Inspection of the Czech Republic), if required;
- other relevant documentation according to the legislation of the Czech Republic.

2.8. Certification, Approval and Quality Management

All products and equipment that are subject to mandatory approval and certification in accordance with Act no. 22/97 Coll., including the related decrees, must be provided with relevant approval and certification documents in accordance with the legislation and the decrees referred to above. Without these documents, no installation these products and equipment is possible on the plant premises.

In the event of the Ordering Party finding that the products and equipment were installed without the appropriate approval and certification documents, all the costs of their removal and installation of new (approved and certified) products and equipment, including the subsequent damages, will be the borne by the Contractor.

Only the approval and certification documents issued by authorized testing laboratories (organisations) are to be accepted by the Ordering Party.

3. Voltage Systems in Production Plants

- Production plant in Mladá Boleslav
 - 110/22/0.4 or 0.69kV, 22/6.3kV
- Production plant in Kvasiny
 - 110/6.3/0.4 or 0.69kV
- Production plant in Vrchlabí
 - 35/0.4 or 0.69kV

4. Types of HV Networks Used and Their Installation

4.1. HV Line Operation

- Power supply to main energy circuits will be designed according to voltage levels; cf. Article 3 above.
- New HV electrical equipment and installations (HV switchboards, transformers and HV and LV switches, ultra capacitors, etc.) will be remotely connected to the ABB MicroSCADA control system and will be remotely controlled by visualization; with the blocking conditions (both the local and external) to be provided at the same time for these installations and equipment within the control system.
- Signalling and remote control of protective terminals and protective components will be resolved by using mainly at least 8-fiber optical cables (multimode 50/125 µm fibre cables or better), communication and remote-control optics will always be installed in trenches along with HV cables, in the buildings then in separate cable routes.
- HV wiring to be installed incl. cable grommets.
- All communication equipment and installations (switches, RTU applications, converters, etc.) must be compatible with the ABB MicroSCADA control system.
- HV power supply will be usually designed using three cables 1x240 mm² in fixed installation (**material Cu – e.g. CXEKVCEY!**). For HV power supply system it is always considered using cables firmly installed in "triangular shape", with VPE insulation, longitudinally waterproof with PE outer sheathing (for use in the ground, in the open, in the internal spaces and in cable channels). In the production plant in Kvasiny the cables will be installed "in flat formation", in justified cases and following the approval from ŠE Kvasiny / dptm. TS/4 in triangular shape; the HV line will always be looped.

4.1.1. Circular/Loop Line

It consists of one junction distribution line, which can supply a maximum of 10 DTS (Distribution Transformer Station). It starts in one HV junction box and is gradually connected to looped DTS. The line (each distribution line) must be dimensioned for the load of the entire area it supplies. Is usually operated as a disconnected line.

Main DTS power allows for parallel operation with connection engaged.

In case of HV distribution line failure, the power supply is interrupted until the defect is removed and the replacement power supply line installed. This type of line is required where the production process is under consideration, i.e. where there is a risk of restricting production process – the operation of **technological and production areas**.

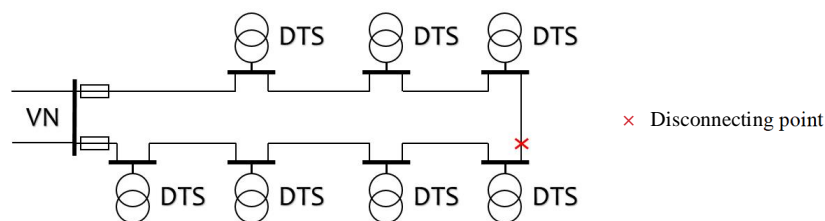


Fig. 1: Circular line with single junction distribution line

- The individual DTSs must allow disconnection of the HV loop.
- In the production plants of ŠA, the new HV lines will be exclusively designed as loop lines, in order to maintain the continuity of electricity supply during serious accidents and/or maintenance works.

4.1.2. Radial Lines – Branches, Connections

In this network, the outgoing line (beam) from the supply point (HV substation) supplies the specific DTSs.

It is used in areas with normal reliability requirements – **non-technological/non-production areas**.

In case of defect of HV or DTS distribution lines, the power supply is interrupted for at least the period time that is required to provide replacement power supply or to remove the defect.

- **In ŠA objects, installation of new HV distribution systems in the form of branches and connections is prohibited!**
Exceptions are possible after consultation with the responsible employee of ŠE and ŠKODA AUTO a.s.

4.2. Cable Down-Leads

This refers to the above-ground section of the cable line leading normally over supporting points (pole, mast, wall of a substation building, transformer station).

4.2.1. Installation of Cable Down-Leads

The cable down-leads will be always securely fixed with appropriate cable clips evenly spaced along the entire above-ground length of the cable.

At the point of entry into the ground, the cable down lead will be protected by mechanical protection from a depth of 0.5 m below the ground to a height of 2.5 m above the ground. The protection used will be corrosion resistant.

4.2.2. Down-Lead Cables

Down-lead cables are the same as the cables used in the cable route (type, material, diameter).

4.3. Installing Cables and Markers

4.3.1. Installation of Cables

This is carried out according to the prepared project documentation, in which the junctions and intersections with engineering networks and buildings are addressed in accordance with relevant regulations and standards. The installation of cables in the ground must correspond, among other things, with the standard ČSN 33 2000-5-52 ed.2 and their spatial arrangement must comply with the standard ČSN 73 6005. In general, when laying the cables, it is required to comply with the following conditions:

- Install the single core cables in triangular or flat formations. Preferably use a flat formation in which the cables have less thermal degradation of the insulation. In the case of a puncture, in the flat formation it is less likely for a ground fault to cause a two-phase or three-phase short-circuit.
- When selecting a cable route that is running along the local roads, it is preferable to install the cables in unpaved areas running along the road in parallel with the axis of the road. After making use of these areas, install the cables under the footpath or walkway.
- When installing a greater number of cables along one route, it is required to reduce loading or install the cables farther apart to prevent the soil drying out. Mark the cable installation routes on the cross-sections in the drawing documentation.
- When installing several types of cables above one another, adhere to the principle that high voltage cables should be installed at the bottom of the excavation with the low voltage and communication cables installed above the HV cables. The HV cables will be backfilled with a layer of sand and separated by concrete slabs so that other cables will not be damaged by electric arc in case of failure. In this configuration, the cable loading capacity is reduced due to the reciprocal heating and drying of the soil.
- All the installed cable line sets will be marked with labels specifying the cable line data and the registration number of the person who installed the cable lines along the entire cable route and will be positioned in accordance with the "Uniform Marking System" methodology.

4.3.2. Principles for Laying Cables in the Ground

- Cables must not be installed in soils containing salts and acids, in soils with rotting substances and in certain sandy and rocky soils. In this case, the cables will be installed in channels, tunnels, pipes, blocks or otherwise protected from mechanical and chemical attacks.
- The cables are installed in the excavated channel deeper by 0.2 m than the minimum permissible coverage (see the standards ČSN 33 2000-5-52, and ČSN 73 6005). Coverage is understood to be the distance between the ground surface and the cable surface. Where the specified depth cannot be maintained, the cable must be protected against mechanical damage. The distance of the outer side cable from the building (the regulation line) must be at least 0.6 m.



- Minimum permissible horizontal distances between cables running in parallel lines are given in the standard ČSN 73 6005. If these distances cannot be maintained, the cables are separated by an electric arc-resistant partition or installed in cable channels.
- When crossing the lines, the cables are to be separated by bricks or a concrete slab. If one of the crossing lines is installed in the concrete channel, the other line does not have to be protected by the channel or the other line can be installed in a plastic channel. The smallest vertical distances are given in the standard ČSN 73 6005.
- Single core LV cables are installed in the ground in the flat or the triangular formations (as agreed before the installation). When installing cables in a tight triangle formation, the two cables are first installed side by side and the third cable is installed on top of the two cables. The cables must be secured in the position by wrapping them with a plastic tape at a distance of 2 – 2.5 m apart.
- When installing single core cables in the flat formation, a 7 cm gap must be maintained between them.
- Before installing the cable clean the bottom of the excavated channel should be cleaned removing solid particles and stones and covered with a layer of 10-14 cm fine-grained sand, fraction 0-4 mm. When installing the cable, the end of the cable must be closed using a shrink cap to prevent the ingress of moisture. The installed cable is then backfilled with layer of sand of the same thickness and covered with concrete slabs or plastic boards. The height of the sand layer is measured from the cable surface. Instead of slabs or boards, it is possible to cover the installed cable with bricks laid flat or warning foil, but it must be laid 30 cm below the surface. The cover must overlap the cables by at least 4 cm. At the entrance to houses, garages, etc., the cables are protected with plastic pipes or plastic cable channels, or by concrete pipes with diameter at least 20 cm diameter or cement blocks with a hole min. 1.5D in diameter laid on a solid support. If plastic pipes or blocks are used to protect cables installed in the flat formation, it is recommended keep each cable core in a separate pipe or tube with of min. 1.5D (D = cable diameter above the jacket). Parallel cables installed in a channel, less than 20 cm apart, must be separated from one other by a partition made of concrete slabs or bricks laid lengthwise in length. It is forbidden to use perforated bricks.
- Marking labels of the design and in number according to the "Uniform Marking System" methodology will be attached to the cables. The contracted organisation is required to inform the relevant technician of the owner of the network of the commencement of the construction of the line and the time of installing the cables. Only the standardised cable types, cross-sections and the cable set types will be used. Any change must be consulted with the appropriate technician prior to installation and recorded in the building diary. Before backfilling the cables with sand and soil, the contracted installer must report commencement of backfilling operations and request the inspection and approval the relevant technician of the owner of the network.
- The cable route must be approved by the construction site supervision of ŠA-PPB and surveyed geodetically. When selecting an external contractor for installation works, preference should be given to contractors who are able to provide cable route data in digital form on a suitable medium (USB disc, CD) in a form compatible with the geo-information system for the management and maintenance of the company's cable network.

4.3.3. Principles for Installing Underground Cables in Open Trenches and in Buildings

- Cables can also be permanently installed in the open air in cable channels, tunnels and collectors, on footbridges or on the supports. Only cables with flame retardant sheathing and conforming to fire-prevention standards may be used. In special cases, e.g. when the cable installed in the ground is taken through the inlet channel into the building, it is possible to use a cable with the external PE sheathing but the sections installed in the open air must be provided with a non-flammable coating.
- With regard to thermal loading and dynamic stressing in the event of short-circuit, it is best to install these cables in the open air side by side with a minimum gap of 20 mm between the cores. The cables installed in this fashion will be attached to the substrate with clips at a maximum distance of 0.8 m. The clips will provided with a flexible insert to prevent the cable deformation during operation. The single-core cables can be attached using only with non-magnetic clips. When using ferromagnetic clips, their magnetic circuit must be interrupted.
- Horizontal cables on catwalks attached by 2-ply PPV cord with 6mm diameter ended with knots ca 60-80cm apart (every second crossbeam of the catwalk) is considered sufficient fixation.
- The gap between the cable lines installed in parallel is specified in the standard ČSN 33 2000-5-52. When taking the cable from ground on the mast, the cable must be protected against mechanical damage by a strong cover. Single core cables forming a single current circuit are regarded to be a single cable when assessing the distance to other cables. The same conditions apply for crossing the cables as for the cables installed in parallel.
- Cables running from the ground to buildings and channels are installed in concrete pipe or cement block. The diameter of the holes must be at least 1.5D. To prevent fire spreading, cables will be sealed on the outside by sand. To prevent water leaking. The cables will be sealed with a cuff or suitable sealant.
- The installed cables will be marked with labels at the points of crossing and branching and at the both ends. It is recommended to mark the cable lines with labels at a distance of at least 20 m.
- Cables must be protected against mechanical damage at points of crossing and branching (e.g. using suitable padding or pipes), as sharp edges can push through the insulation after some time.

4.3.4. Markers

They are passive electronic tags with a tuned circuit with a minimum range of 1.5 m, which will not be dependent on the position in the trench. The tuning of the marker circuits is different for various types of underground lines (e.g. for gas, water piping, communication lines, etc.) – the red marked marker with a frequency of 169.8 kHz must be used for marking heavy current lines.

At important places on the cable route, such as the following, markers have to be placed:

- positions of couplings, including those at intersection points;
- intersections with other underground installations/lines;
- beginnings and ends of used and reserve cable grommets;
- reserve cable loops for installation in the later built stations.

4.3.5. Inspections and Tests During Installation Process

- Inspection will be carried out for the first time after installation works and for the second time after backfilling with sand and laying the cover slabs and boards. In particular, the positioning of markers and the installation of cables in passages and other exposed locations will be checked. When finding defects, the cables will not be backfilled until the defects are removed – the defect removal and acceptance of the backfill must be approved by the representative of ŠE TI/4 od ŠA-PPB dptms.



- The quality of cable laying and sets installation will be verified by:
 - sheathing test (for all plastic cables only);
 - voltage test of working insulation;
 - using the diagnostic method (this is not done immediately after laying and installation of cable sets, but at the nearest scheduled date for cable diagnostics according to ŘPU – Preventive Maintenance Code);

If the sheathing is found to be damaged, the cable will not be backfilled until it is repaired. It is required to check whether, besides the sheathing, the insulation has also been damaged. If the insulation is damaged, it is necessary to repair not only the sheathing, but also the insulation of the cable using a coupling. If water has penetrated under the damaged sheathing, the damp section of the cable will be cut off and the required length of the new cable will be connected using coupling.
- If a defect is found at any stage of preparation and installation performance right until the commissioning, it is required to start the damage removal procedure.
- Operational tests of high-voltage cable lines in the distribution network up to 35 kV must always be carried out after the installation of a new HV line and always before it is put into operation (this is required in order to verify the correct and flawless operation of HV lines).
 - The operational test must be carried out using a diagnostic method to determine the condition of insulation by means of the non-destructive method by measuring the values of the physical parameters of the insulation that carry the information concerning the condition of the insulation.
 - The operational test will be carried in accordance with the standards PNE 34 7626 and ČSN EN 60060-1.

4.3.6. Selection of Construction Contractor

Any organization applying for a cable line installation project will have to demonstrate the ability to install cables and sets of the required quality by submitting the following:

- list of installation materials;
- information in writing concerning the number and qualifications of personnel designated to carry out the installation of cables and cable sets;
- a certificate or other official document confirming training in installation of standardised cable sets;
- a statement in writing on whether the organisation is able to carry out geodetic surveying of the cable routing in digital form for recording in a digital chart.

4.3.7. REGULATIONS FOR CONSTRUCTING HV CABLE NETWORKS

ČSN 33 2000-5-52
ČSN 73 6005

Electrical equipment – Part 5: Selection and installation of electrical equipment
Spatial arrangement of technical equipment networks

5. HV Substations, Transformer Stations and Switching/Disconnecting Elements

- **Newly built substations will be situated on the ground floor with access from outside the building.**
- **FOR EACH HALL AND SUBSTATION, A SIMPLE PROCEDURE FOR TURNING OFF ELECTRICAL POWER SUPPLY ELEMENTS WILL BE DEvised, INCLUDING A WARNING NOTICE PROVIDING INSTRUCTION WHICH PARTS OF THE BUILDING REMAIN UNDER VOLTAGE AND HOW TO PROCEED WHEN IT IS REQUIRED TO TURN THE POWER SUPPLY OFF. THE INSTRUCTION CONCERNING THIS PROCEDURE WILL BE LOCATED IN THE BOX WITH THE CS AND TS PUSH BUTTONS WHICH MUST REMAIN PERMANENTLY ACTIVATED.**
- **THE HV AND LV SUBSTATIONS MUST BE SEPARATE FIRE ZONES WITH FIRE RESISTANCE OF 90 MINUTES, INCLUDING THE ADDITIONAL AUTOMATIC FIRE FIGHTING EQUIPMENT.**
- **SF6 gas must not be used ANYWHERE!**
- Switching and disconnecting device;
- Principles of selecting and positioning of switching and disconnecting components;
- Remotely operated and automatic switches;

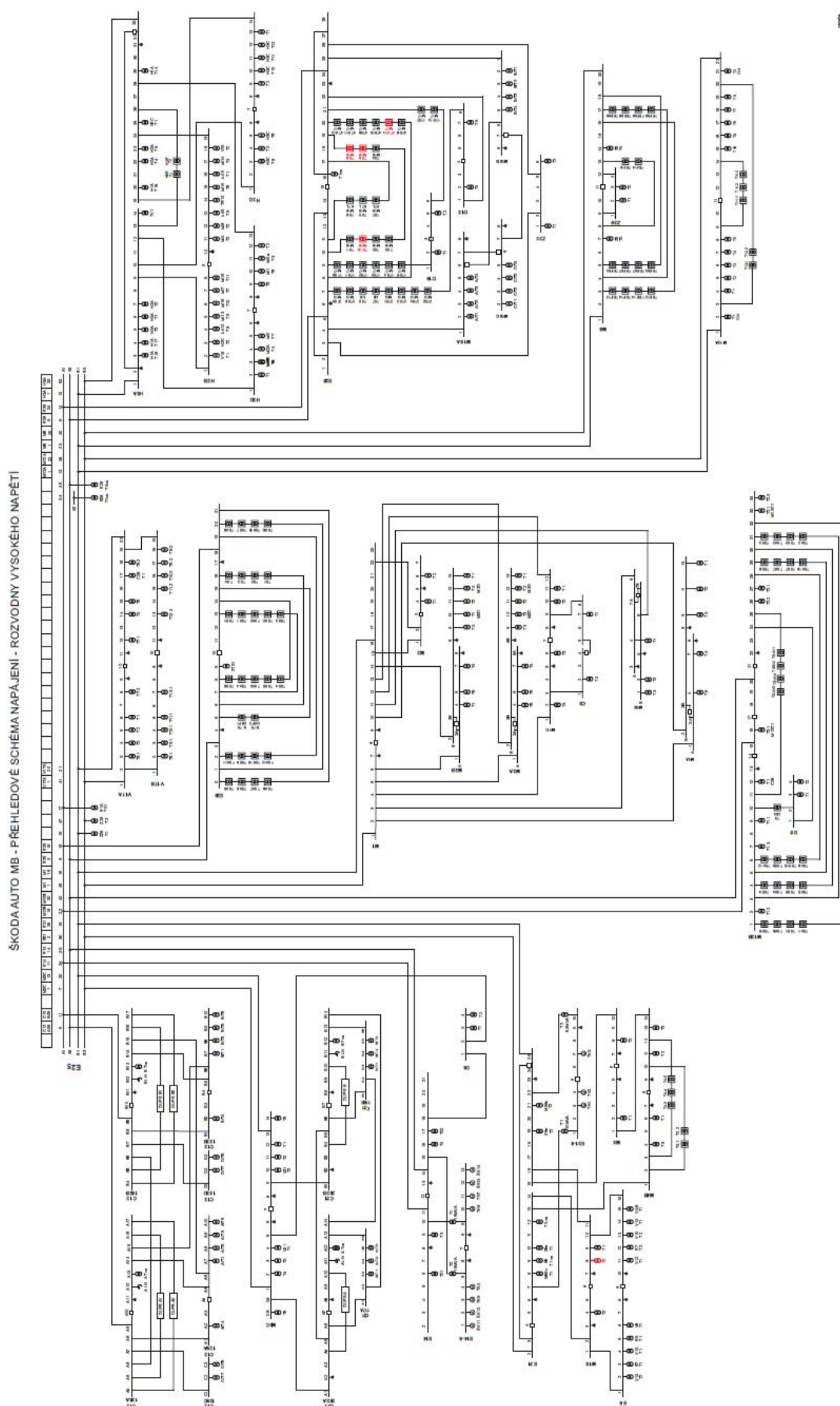


Fig. 2: Diagram of HV 22kV distribution lines in the plant in Mladá Boleslav

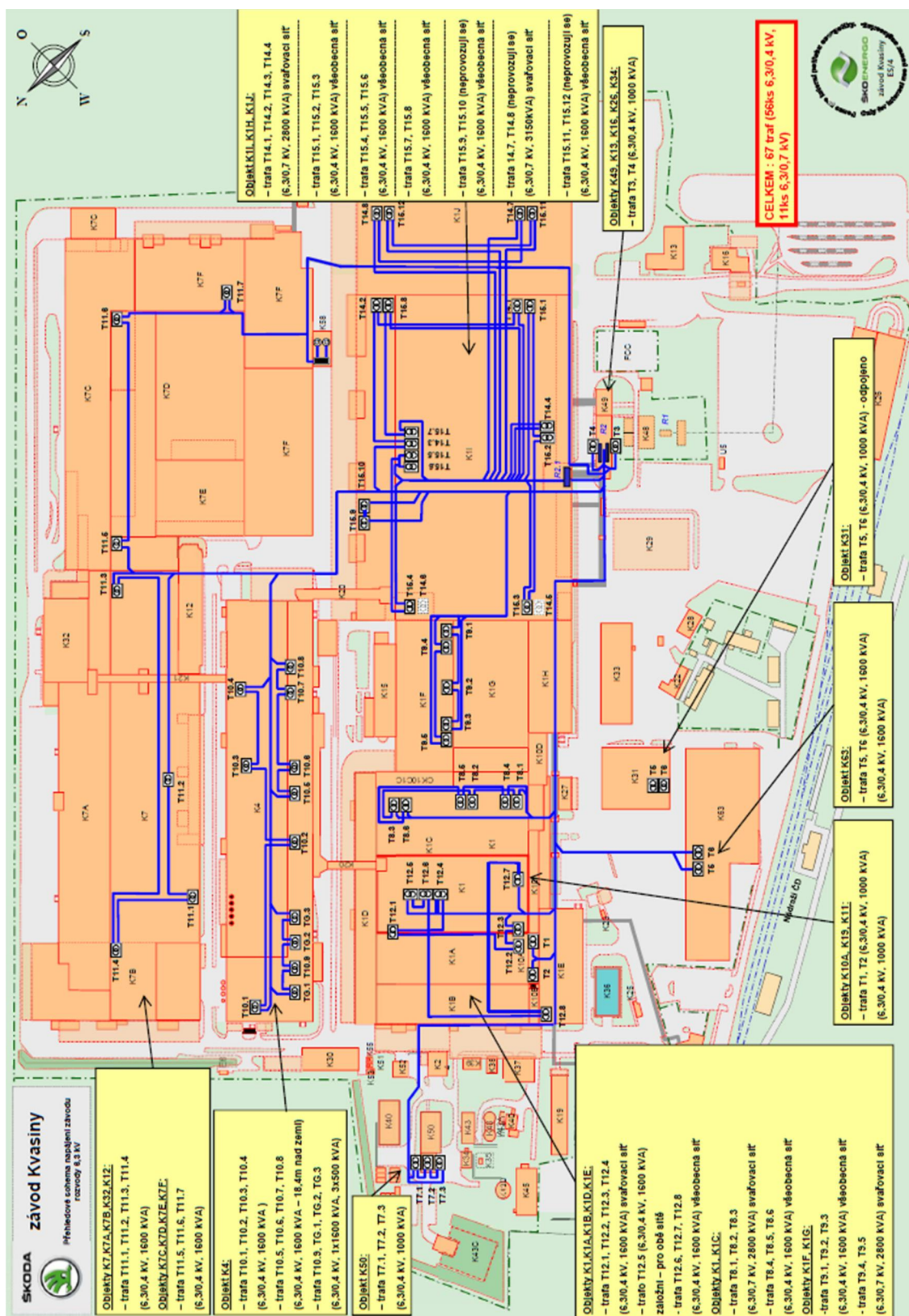


Fig. 3: Diagram of HV 6.3kV distribution lines in the Kvasiny plant

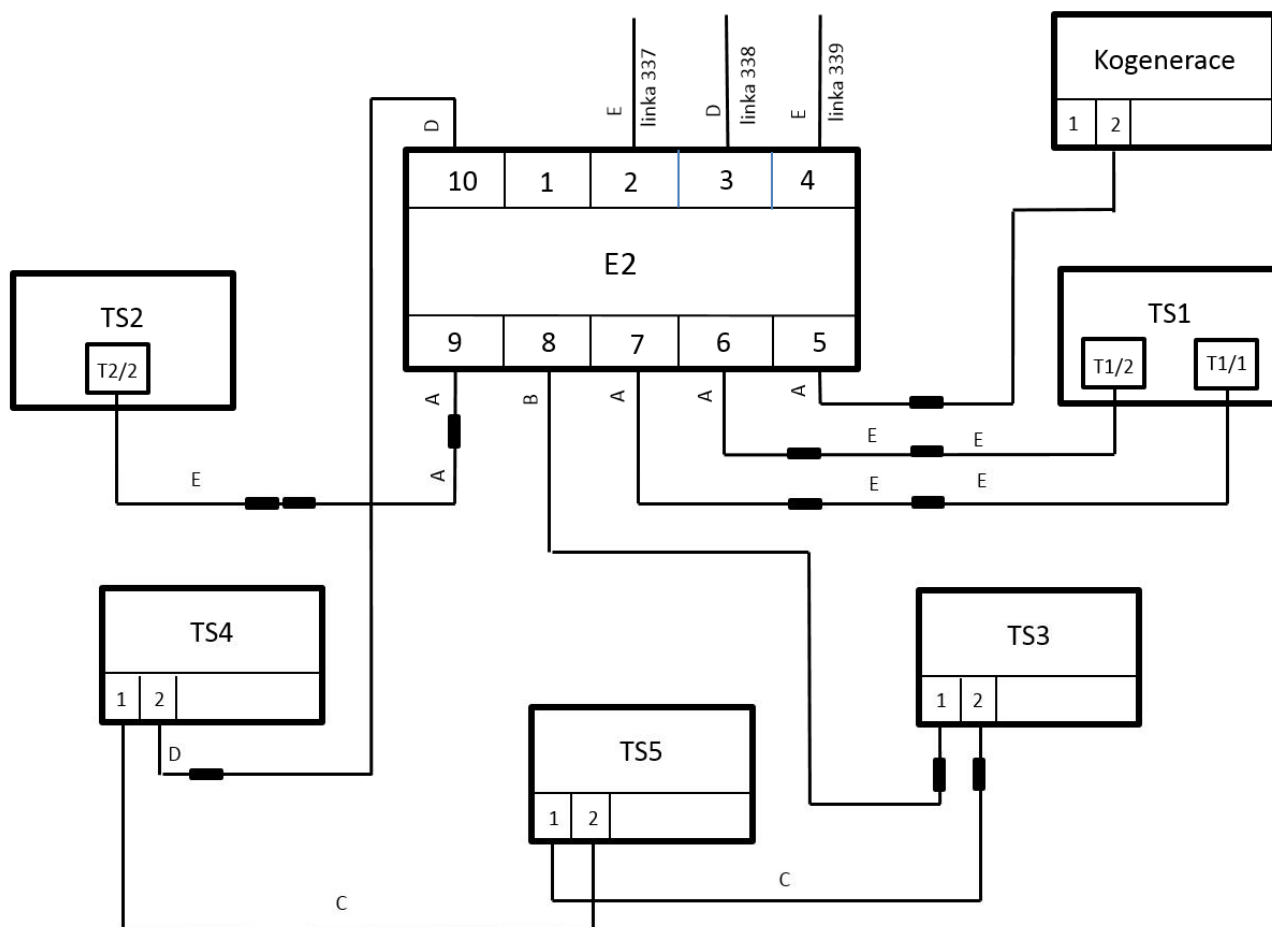


Fig. 4: Diagram of HV 35 kV distribution lines in the Vrchlabí plant

HV switchboards of standard substations and switching stations will be constructed according to the following standard:

- A back-up auxiliary voltage of 110 V DC or 230 V AC.
- Signalling to and remote control for protective terminals and protection elements will be solely solved by at least 8-fiber optical cables type multimode fibre 50/125µm or better, communication and remote control optics will always be installed in the trenches together with LV cables, then in separate cable routes in the buildings.
- Each standard HV supply lead will be fitted with a trolley vacuum switch (QM1), which will also serve as a disconnecter, short-circuit component (QE1), surge arrester (LA1,2,3), KUVAG voltage indicator (PU1), P1,2, 3 current sensors (TA1,2,3), REF6xx protection with the option for visualising the outlet state on the display and REAxxx protection, indirect ABB electrometer with MODBUS communication (MID certification).

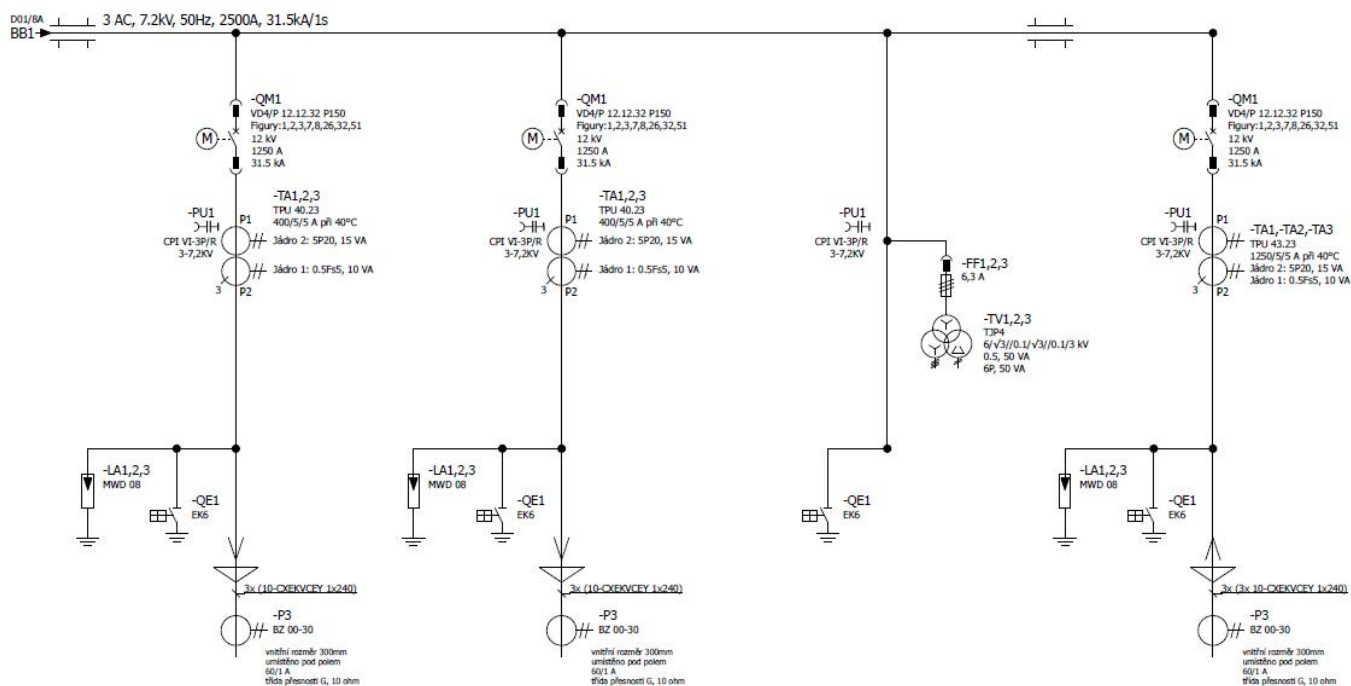


Fig. 5: Illustration linear diagram of standard HV inlet/outlet

- Each standard HV outlet will be fitted with a trolley vacuum switch (QM1), which will also serve as a disconnector, short-circuit (QE1), surge arrester (LA1,2,3), KUVAG voltage indicator (PU1), P1,2,3 current switches (TA1,2,3), REF6xx protection with the option of visualization of the outlet state on the display, indirect meter ABB with MODBUS communication (MID certification). Preferred type: electrometer ABB type 2CMA170537R1000 with MODBUS 485 communication.
- Each standard HV field of measurement will be fitted with a measurement trolley (TV1,2,3) with HV fuse protection (FF1,2,3), which will also serve as a disconnector, short-circuit component (QE1), which will allow short-circuiting the entire Wx bus bar, the KUVAG voltage indicator (PU1), REU6xx protection with the option for visualising the outlet state on the display.
- Pull-out vacuum LC circuit breakers (QM1) will be fitted with a switch drive to enable remote control.
- Standard blocking conditions, both the safety and operational conditions, will be incorporated into the field control; all will be consulted in advance with the responsible ŠE employee.

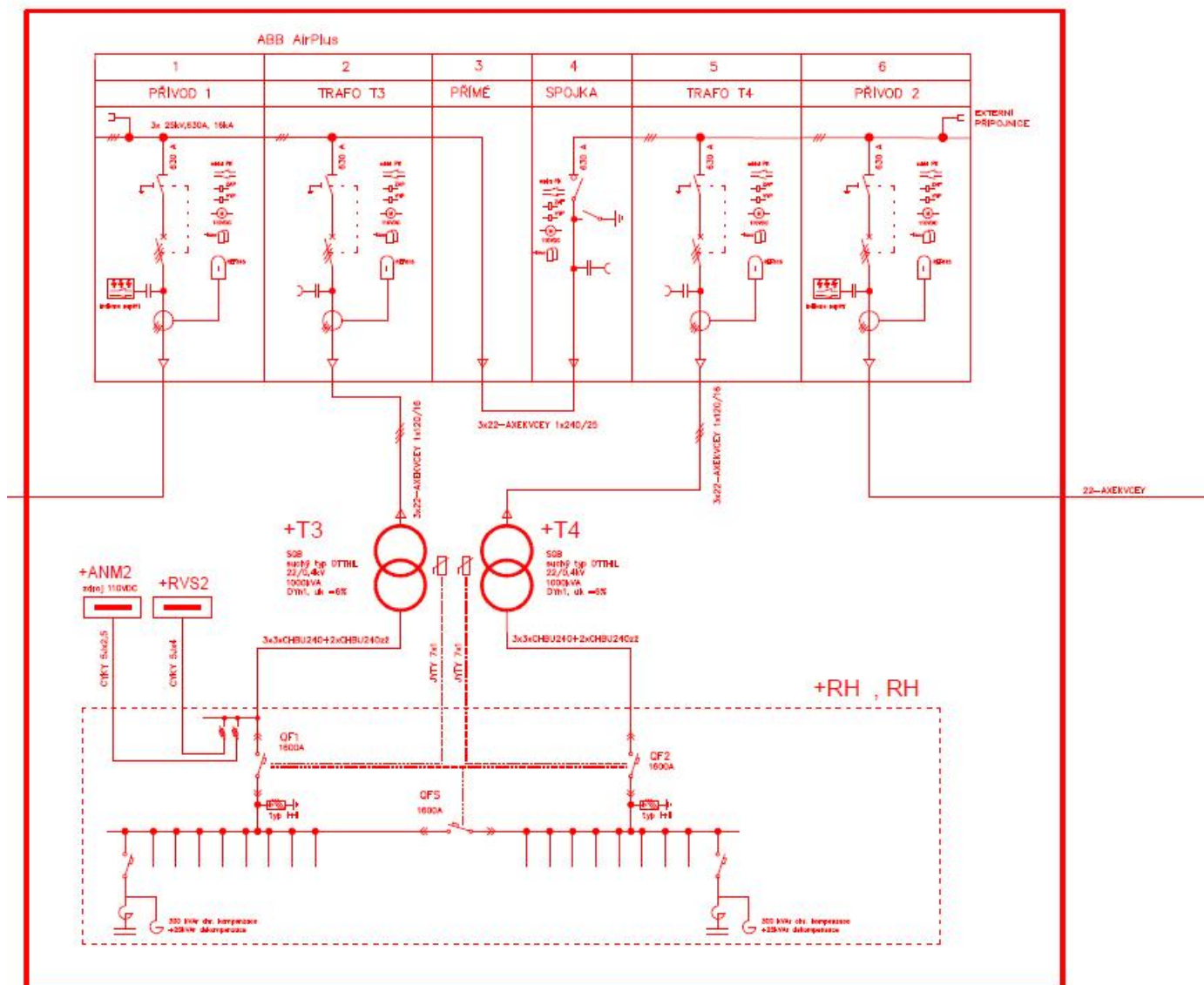


Fig. 6: Illustration concept diagram of TS

Recommended suppliers: ABB, EATON, Schneider Electric

5.1. Standardised Platform Transformer Stations TS

All transformers must be designed and installed in a minimum number ($n + 1$) to allow a backup in case of failure of one of the transformer stations – this requirement applies to production buildings.

Layout – field (description)

Inlet/outlet field

Isolating – air, typifying, blocking the opening, LV power sections, LSC2B partition

LV instrument sections

REx6xx terminals

Voltage indicators (presence indicators)

Technical parameters of LV field must correspond with the amount of transmitted power and the environment in which it will be operated.

Blocking/locking LV circuit breaker

HV equipment

Vacuum circuit breakers, current LV measuring transformers, and earthing switches.

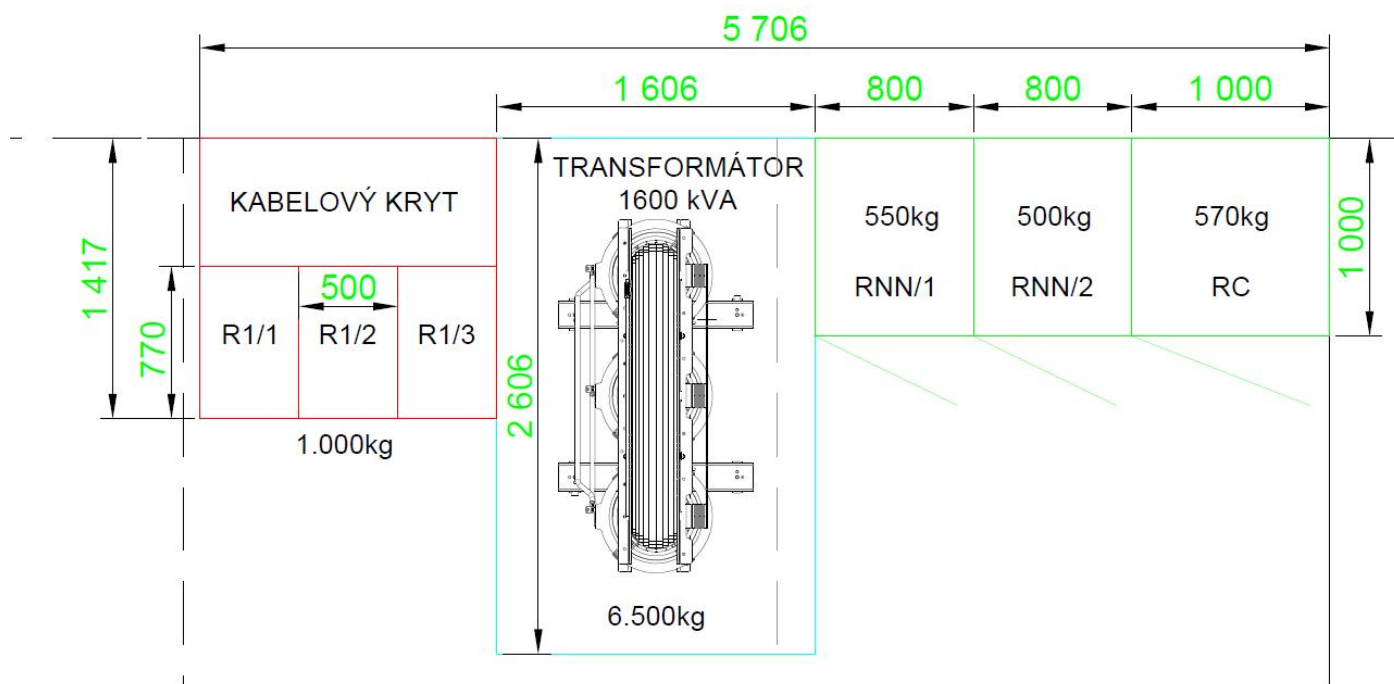


Fig. 7: Plan view of standardised platform transformer station

5.1.1. LV Section (also Applicable to Switching Stations)

- For the 6.3 kV, 22 kV and 35 kV levels, the LV switchboard spaces must always be made up of an ecological insulation option, i.e. air-insulated HV switchboards resistant to internal arc short-circuit, classified as LSC-2B PM (non-continuity category) or HV switchboards with a mixture of environmentally friendly insulating gas-dried consisting of dried-up air and C5 FK (Fluor ketone). The GWP index is <1 provided that the space where the LV switchboards are to be installed is limited.
- SF6 gas must not be used ANYWHERE!**
- The switch will always be equipped with auxiliary contacts, trip coil and motor drive. Control voltage and inverter voltage 110V DC.
- Local control of the HV circuit breakers must enable the REF6xx control terminals located in the doors of the LV extension LV of the relevant HV field. For the purpose of remote monitoring of the condition, all IED units (Rxx.6xx) are always connected via Ethernet to the technological network of ŠKODA AUTO a.s. and integrated in SCADA system.
- Power supply for protection and control of HV switchboard is always fitted with back-up power supply with 110V DC batteries (ANM 1).
- The input fields will be equipped with a voltage indicator on the terminals with an auxiliary contact and fitted with a meter to measure the electricity consumption.
- Transformer primary and secondary side will be fitted with a ball connection points D25 for short-circuit set.
- Compensation distributors will be fitted with two thermostats – ventilation temperature and emergency temperature switch
- For distributors and transformer stations a project verification in accordance with the ČSN EN 61439 will be submitted. In the project verification – Summary, the manufacturer of the distributor will list all verifications as per ČSN EN 61439-1 ed. 2 parts 10.2-10.13 with naming the person who performed them. Corrosion resistance verification, cabinet thermal stability, UV rays resistance, casing firmness, etc. will be listed in the report of the cabinet manufacturer – original manufacturer. Air distances, ground roads, continuity of protection circuit, integration of devices, clamps will be in the report(s) of manufacturer of the distributor.

HV switchboards of standard platform transformer stations will be constructed according to the following standard:

- A back-up auxiliary voltage of 110VDC or 230VA
- Signalling to and remote control for protective terminals and protection elements will be solely solved by at least 8-fiber optical cables type multimode fibre 50/125µm or better, communication and remote-control optics will always be installed in the trenches together with LV cables, then in separate cable routes in the buildings.

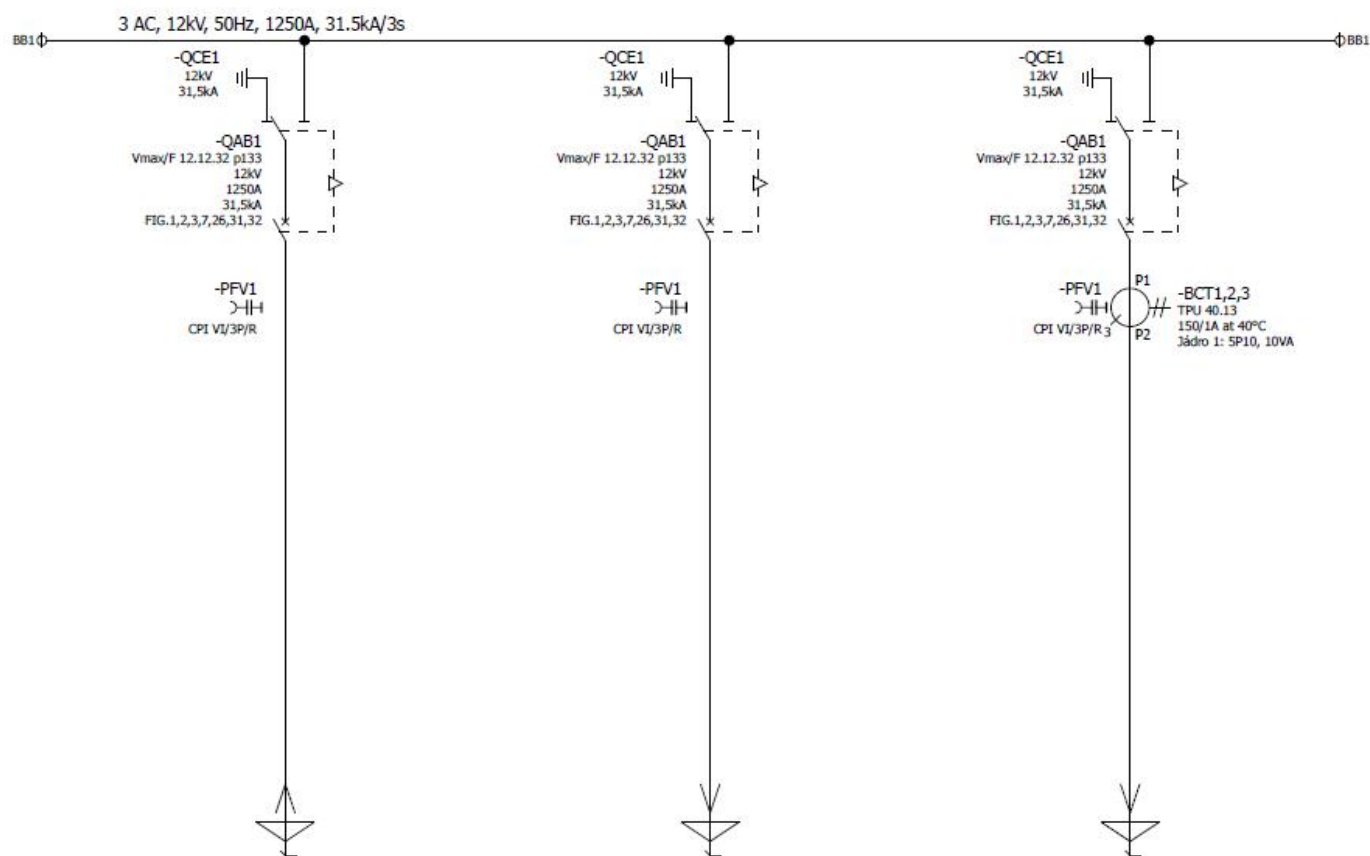


Fig. 8: Linear diagram of the standard HV inlet/outlet of the platform transformer station

- Each standard HV supply will be fitted with a vacuum circuit breaker (QAB1), a combined disconnector (QAB1), a short-circuit generator (QCE1), a KUVAG voltage indicator (PFV1), a RIO6xx protection when required to extend REF6xx binary inputs.
- Each standard HV outlet for the transformer station will be fitted with a vacuum circuit breaker (QAB1), a disconnector (QAB1), a short-circuit generator (QCE1), a KUVAG voltage indicator (PFV1), P1.2 current switches (TPU xxx), a REF6xx protection, an indirect ABB meter with MODBUS Communications (MID certification). ABB electrometer type 2CMA170537R1000 with MODBUS 485 communication.
- The main WAX bus bar will be dimensioned for 1250A and will have a short-circuit resistance of 31.5kA. For 22 kV, is sufficient In bus bar 630 A, stabilised short-circuit current 16 kA / 1 s and dynamic short-circuit current 40 kA.
- Vacuum HV circuit breakers (QAB1) will be fitted with drives for remote control.
- Standard blocking conditions, both the safety and operational conditions, will be incorporated into the field control; all will be consulted in advance with the responsible employee of ŠE-TI/4.

Recommended suppliers and equipment: ABB, EATON, Schneider Electric

HV switchboards with air-insulated modular (each inlet or outlet will be a separate cabinet), e.g. from ABB, type UniGEAR ZS1, UniGEAR 500R or UniGEAR 550R), other types of HV switchboards may be used subject to approval.
line diagram of standard HV inlet/outlet

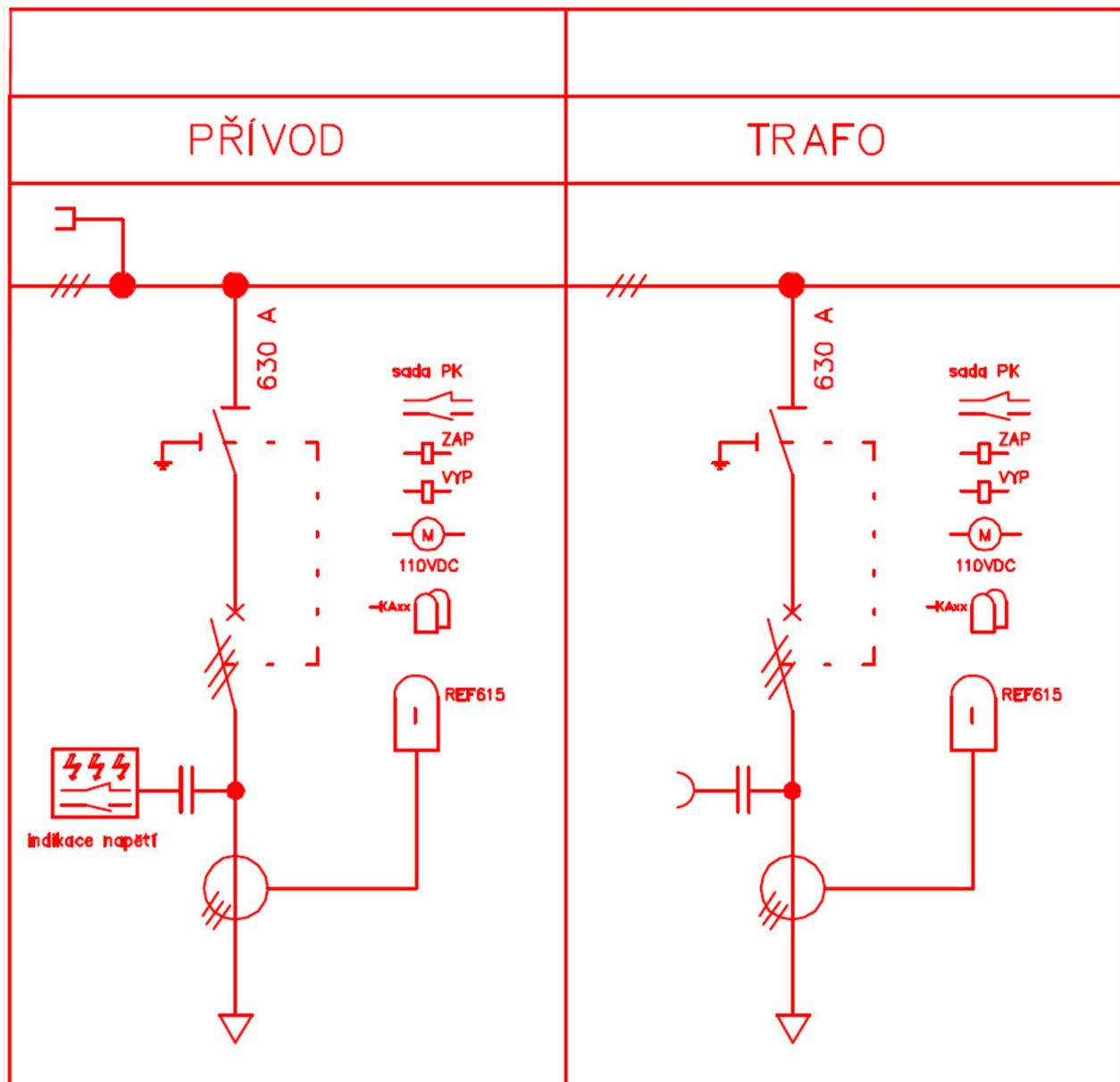


Fig. 9: Minimum installations for HV lead-in/outlet

5.1.2. REF6xx Terminal Equipment

- For protection functions and measurements, the terminals are equipped with analog input cells for measuring:
 - nominal current IL1, IL2, IL3.
- For control functions and signalling, the terminals are equipped with binary inputs and output contacts:
 - a set of power contacts operating switches (PO);
 - a set of alarm contacts (SO);
 - a set of binary inputs (BI).
- REF615 terminal access interface
 - Local control interface includes a graphical display, control keypad – buttons, LED indicators and a communication port.
- Input analogue values for protection in outlets will be as follows:
 - IN - 3f rated current of the relevant outlet (MTP – 1A protective core, class 5P10, loading capacity 10VA).
- The disconnecting circuit of the HV switches/circuit breakers is controlled for breaking the disconnection path. The calculation of the settings and parameterisation of the REF terminals must always be part of the entire installation process (the equipment supplier will calculate the settings for the protection of the entire hall/TS group).

Recommended suppliers: HV protection and main secondary switches of LV transformer stations from ABB company; HV protection type REx6xx or newer types and switches type EMAX with touch module and EKIP communication module (optics or MODBUS with MODBUS/Optics converter), including the power supply module; in justified cases, another type of electrical equipment may be used subject to the approval by the ŠE dptm.



5.1.3. Transformer Part (TR)

- When designing HV and transformer station operations, it is required to consider their parallel operation, thus ensuring continuous power supply (n + 1 mode) in the event of one transformer station failure, which is always required for the production premises.
- Types of transformer stations
 - At the levels of 6.3kV, 22kV and 35 kV, are **always** used dry transformer stations with minimum losses; the stations must comply with Commission Regulation (EU) No. 548/2018 – transformer losses according to Ecodesign (Directive 2009/125 / EC).
- For the newly built general network (VS), dry 6.3kV, 22kV, or 35 / 0.4 kV transformer stations with nominal output of 1600kVA will be primarily used.
 - Nominal outputs are standardly selected from the 1000, 1600, 2000 or 2500 kVA series.
 - Design in accordance with the standard ČSN EN 60726-1.
 - For indoor installation.
 - Classes E2, C2, F1.
 - Branches $\pm 2 \times 2.5 \%$.
 - Dyn5 wiring group.
 - Turn ratio 6.22,35/0.4 kV or 6.22,35/0.4 kV.
 - Insulation levels 25/50/125 kV
 - Short-circuit voltage u_k [%] 6.
- For the newly built welding network (SS), dry 6.3/0.69 kV transformer stations with a nominal output of 2800 kVA or 3150 kVA will be used exclusively – valid for Kvasiny only.
- In case of a newly built general electro-mobility network (VŠEM) connected from the internal HV network of the plant, dry 6.3/0.4 kV transformers with the nominal type output 630 kVA and above will be used exclusively.
 - Transformer stations will be installed in standard outdoor kiosk-style transformer stations with equipment from ABB and with air-insulated HV switchboards.
- In case of a newly built general electro-mobility network (VŠEM) connected from an outside HV 35kV network, dry 35/0.4 kV transformers with the nominal type output 630 kVA and above will be used exclusively.
 - Transformer stations will be installed in standard outdoor kiosk-style transformer stations with internal equipment from ABB and with air-insulated HV switchboards.
- Transformer primary and secondary side will be equipped with ball connection points D25 for short-circuit set.

Recommended suppliers: SGB, ABB

5.1.4. LV Part

- Layout – field (description) supply from TS, LV junction NN, compensation
 - IP40/20 box switchboards. Boxes with a width of 1.0 m or more will be installed in the double wing doorway.
 - Technical parameters – pattern:
 - $I_n=2500A$, $I_{cw}=110kA$, $ipk=143kA$, IP 40/20 cover,
 - system: 3 + PEN/N+PE, 50Hz, 400V/230V, TN-C-S, 110V or 230V DC/IT voltage control.
- LV equipment
 - LV input switch (overcurrent release, MODBUS communication, measurement function module), optical signalling, transparent cover, condition monitoring, control buttons, signalling test, network analyser (main field), TP 0.5 electrometer with communication (main field and individual outputs), signalling, lighting, ventilation, compensation switch, surge arrester.
- Supply from transformer station
 - Overload protection of the transformer station is provided by the overcurrent release of the main LV circuit breaker.
 - Overheating protection is provided by 2° thermistor relay, e.g. TS01 (1° signalling, 2 ° switching off main LV circuit breaker).
- Compensation field
 - **Network analysis, including the enhanced harmonised networks, should always be carried out before starting the design, and the compensation field should be designed design including the enhanced harmonised filters – if required, of course.**
 - Commonly used is the protected RCx compensation type 242 kVAr. Before designing the protected compensation, it is **required** to carry out the analysis of the network.
- Blocking/locking LV circuit breaker:
 - In the HV switchboard (transformer outlet), it is required to install a circuit for blocking/locking the main LV circuit breaker. The circuit consists of a potential-free auxiliary contact of the LV circuit breaker, which activates on the switching coil of the main RH circuit breaker. The main supply RH circuit breaker can only be connected when the main HV switch is blocked (locked).
 - When the HV switch is turned off/disconnected, the LV switch will be blocked (locked).

- RNN_TSA and RNN_TSS switchboards on internal transformer stations will be realized in accordance with the following standard:

TYPE OF THE BOX	3x RAK2080	TYP SKŘÍNĚ	: 2x RAK2080
SWITCHBOARD DIMENSIONS	2400x2000x1000	ROZMĚR ROZVÁDĚČE	: 1600x2000x1000
TYPE OF SWITCHBOARD	BR-NA	TYP ROZVÁDĚČE	: RH6000
COVER	43/ 00	KRYTÍ	: 43/ 00
INLET	bokem	PŘÍVOD	: bokem
OUTLETS	horem	VÝVODY	: horem
NOMINAL CURRENT	2500A	JMENOVITÝ PROUD	: 2500A
SHORT-CIRCUIT CURRENT	110kA	ZKRATOVÝ PROUD	: 110kA
CONTROL VOLTAGE	230V AC	OVLÁDACÍ NAPĚTÍ	: 230V AC
VOLTAGE SYSTEM	3PEN- 50Hz 400V/ TN-C	NAPĚŤOVÁ SOUSTAVA	: 3PEN-50Hz 690V/ TN-C

- On the front panel of the RNN switchboard, the condition of the equipment will be signalled by the control lights; for safety reasons it will be possible to control the switching on and off of the secondary transformer station using the push buttons.

- The RNN switchboard will be equipped with a regulator for controlling the tangential cooling and the protection relay of the transformer station.

Recommended suppliers: Rittal – The System, Schrack Technik, OEZ, Schneider Electric, Brema, ESB

6. MicroSCADA System

The MicroCADA Pro system ensures the functions of connection, collection, processing and presenting information from substation technology, and possible transfer of these data to other systems. Individual functions are implemented by one or more parts of the system, which has been designed as distributed, operating on a number of technical elements interconnected by communication system for information transfer and control. It carries out its own system functions as well as remote control, administration and maintenance functions both of itself, and of technology connected to it.

The system is designed for the independency of functions to be preserved as is sensibly feasible in case of emergencies both in the system itself and in the connected parts (connection to technology, local control).

All newly-designed LV parts (at least secondary transformer switches) have to be connected to the MicroSCADA system.

6.1. System Structure

The system consists of parts that ensure contact with substation technology (communication system), a system core (central system), and visualisation (displaying system).

6.1.1. Central System

The core part of the system consists of a central computer (server) with a MicroSCADA Pro system core installed. This server runs on Microsoft Windows OS and provides the main computing output of the whole system. The central computer (server) may be installed separately, using the HW server directly, or as a virtual computer, where several parts of the system, such as central and communication systems, may coexist. Other parts are connected to the system using interface (LAN, serial).

6.1.2. Communication System

The communication system provides contact with the substation technologies. It may operate within the central system, where the system is implemented through the central computer, or may be implemented on an independent computer, the so-called communications computer. The communications computer runs on the Microsoft Windows OS. The communication system may be installed separately, using the HW of the computer directly, or as a virtual computer, where several parts of the system, such as central and communication systems, may coexist.

Other parts are connected to the system using interface (LAN, serial).

6.1.3. Visualisation System

The visualisation system provides the operator with contact to other system parts. It may operate within the central system, where the system is displayed on the central computer, or it may be implemented to an individual computer, the so-called workstation. The workstation computer operates on the Microsoft Windows OS and has no marked impact on function of other parts of the system, as it only displays the core processes of the MicroSCADA Pro system, which runs on the central system.

The visualisation systems are connected to the central system using interface (LAN).

The substation crew uses directly only the visualisation system. The visualisation system is used to display prepared images of technology (drawings/substations), auxiliary devices, and also status of MicroSCADA Pro system itself. If there is remote control for an element (disconnecter, switch), it is possible to also use the technology images to enter commands or change automatic parameters.

6.2. Communication between the Main System Parts

Communication between the central, communication and visualisation parts of the system is provided using local ethernet LAN network using the TCP/IP protocol.

Looped optical communication will be laid to the rail switches and will be equipped with MODBUS/Optic converter.

With virtual computers, it uses virtualised network elements, such as virtual adapters, switches, routers, firewalls, etc.

Signalisation of rail switches will be carried out solely in at least 8-fiber optical cables of the multimode fiber type 50/125 µm or better.

6.3. Communication with Processing Units

The MicroSCADA system allows for communication with processing units and using them, it runs its own process monitoring and control. The purpose of the process communication is to create a communication tie between the system server SYS600 and other process devices, such as IED, RTU, PLC, et al.

MicroSCADA Pro has implemented a number of communication protocols for these purposes:

- IEC 61850-8-1 Client
- LON/LAG
- IEC 60870-5-101/103/104 Master
- DNP 3.0 LAN/WAN/Serial Master
- Modbus RTU/TCP Master
- RP 570/571 Master
- ANSI X3.28 FD/HD Master
- P214 Master
- ADLP 180 Master
- IEC 61107 (metering)
- Alpha Meter protocol
- RCOM Master

Every communication protocol has its own specific characteristics, usable physical media and interfaces.

Process communication may be integrated in the central system or implemented within an independent communication system.

7. LV bus bar system

When installing a central power distribution system in production buildings, it is required to use first of all the encapsulated bus bar system type 3L + N + PE (WAX bus bar), which will be dimensioned for 2500 A and will have a short-circuit resistance of 31.5 kA for the general LV network, It must be possible to install branching boxes for currents 160 A to 1000 A on this bus bar system.

8. CENTRAL / TOTAL STOP

The cable routes are designed so as to ensure safe shutting (disconnection) of the electricity in the building, thereby allowing the efficient and safe intervention of the fire brigade dptm.s. In the event of a fire, it must be possible to centrally shut down all the electrical equipment in the building from a central position or only in a section of the building where the continuing functioning of electrical equipment is not required. By activating the CENTRAL STOP button, the power supply for the fire safety equipment and the equipment that must remain functional in the event of fire must be maintained from two (independent) sources.

Cable routes used for controlling the CENTRAL STOP and TOTAL STOP switch buttons must comply with the requirements for cable routes with functional integrity and they must be designed in accordance with the standard ČSN 73 0848. Whenever required, it must be possible to switch off all equipment in the building or a section of the building, including the fire safety equipment controlled by the TOTAL STOP button; this shutdown option must be protected against unauthorised or unintended use. Once the TOTAL STOP button is fitted, there must be no section of VN and LV conductors remaining live in the building (the UPS will be disconnected at the exit).

The CENTRAL STOP or TOTAL STOP switch buttons must be provided with a label with the text "CENTRAL STOP" and "TOTAL STOP" and should be installed in position so as to be easily accessible in the event of a fire, e.g. at the entrance to the building, in the place of permanent service, etc.

In case the HV substation is located in the building and also supplies power to other building besides the one in which it is installed, the CENTRAL STOP and TOTAL STOP switch buttons will be connected so that the whole building will be disconnected with the exception of the LV substation, which will remain energised including the main circuit breaker of the LV substation. **The LV substation will be switched off when necessary by the permanent service ŠKO-ENERGO, unless it will be possible to secure this function by activating the CENTRAL STOP switch button.** Warning signs will be positioned on the substation entrance doors to indicate that the substation remains energised even when the TOTAL STOP switch button is pressed.

For the heavy-current LV distribution lines, the CENTRAL STOP and TOTAL STOP switch buttons are designed and positioned in the location specified in accordance with the requirements of PBR (Fire Safety Project)..

The CENTRAL STOP button switches off the main circuit breakers in the inlet fields of RHx switchboards, all the outlets for the SOZ equipment (ventilators, electric drives of inlet ventilation louvres, electric drives of flaps in the smoke extraction ducts and the drives of relevant gates) remain energised even when the CENTRAL STOP switch button is pressed, unless the PBR specifies otherwise.

In addition, besides the CENTRAL STOP button, the TOTAL STOP button also switches off the supply to the switchboard serving the SOZ equipment, switching off the emergency lighting and also the equivalent source, i.e. the diesel generator.

The routing from the CENTRAL STOP and TOTAL STOP buttons is carried out by cable routes while maintaining functionality even in the event of a fire.

The cable lines were installed for the CENTRAL STOP and TOTAL STOP buttons with their functionality maintained even in the event of fire.

Each building is also equipped with the TOTAL STOP and CENTRAL STOP buttons for disconnecting the main line from the network; the relevant equipment may be provided by a person authorised to administer the building or a person authorised conducting operations in emergency situations (the fire brigade commander, emergency dptm. commander, etc.).

In case of power failure, it is required to provide the backup power supply for the CS and TS equipment. The CS and TS circuits should be directly connected to the shut-off equipment "safety circuit" in the switchboard. In the case of defect to the safety circuit, it should not be possible to restart this particular switchboard. If the switching contacts will be used, the equipment must immediately send a report to the control centre ŠKO-ENERGO and HZSp ŠA. The equipment must have a non switchable acoustic and optical signal that will be activated in the CS and TS equipment space.

ITS 2.11 has to be followed in designing the CS and TS.

8.1. Uniform Design of CS and TS Cabinet

The specialised ŠA-PPB dptm. (the specialists for fire protection projects) is required to provide a uniform design for CS and TS box.

Manufacturer and type: Schneider Electric - NSYS3D32 15P.

Uniform key for HZSp: DIRAK 1242E lock with the key.

9. Measuring Electricity Consumption

See ITS 5.15 Energy Measurement Concept – switchboards are fitted with meters with remote transmission to the up-to-date assessment system. The requirement for measurement in a given section of the building is determined by the representative of ŠKODA AUTO a.s. A network analyser (main field) and electrometer at least TP 0.5S (main field and individual outputs) have to be installed in the distributors.

10. Basic Installation Works Conditions

During the electrical installation it is required to comply with all relevant current safety regulations and binding provisions of the standard ČSN, including the regulations concerning electromagnetic compatibility (EMC).

10.1. Electric Equipment in the Switchboard

- **All distribution and connection of the plants must be designed and executed with at least 20% reserve, both spatial and power!!!**
- Lighting with the switch (door contact) – in all the fields, min. 1 x 230V/16A service socket for the field – the power supply for the service socket in front of the main switch (safety regulation must be observed).
- Selected MaR switchboards, which are installed in the LV substations, will be connected to a continuous uninterrupted power supply.
- TN-S 1+N+PE 230V/50Hz system will be used to power MaR equipment.
- The MaR switchgear must be equipped with the CENTRAL STOP switch button (the emergency switch-off) positioned on the switchboard door. In the closed locked engine rooms, it is possible to use the STOP buttons of the XAL-K174E - SCHNEIDER type with a lock with a protective basket to prevent an accidental switch-off. If the switchboard are located in unlocked spaces, the STOP button under the glass type GW 42201 GEWISS will be used. Under this box it is required to install a yellow frame with 5 cm overlap. An indicator light indicating a summary defect will be installed on the switchboard door.



- Protection against dangerous contact voltage will be provided by automatic disconnection from the power supply or by the low voltage PELV or SELV in accordance with the standard ČSN 33 2000-4-41, ed. 2.
- RAL 7035 switchboards will normally be used; RAL 9010 switchboard will be used in the unlocked rooms.
- Minimum IP54 cover, MaR switchboard – labelled BA, heavy-current switchboards – labelled RM.
 - Labelling of the switchboards in the plant in Kvasiny:
 - RA xxx – number of the equipment (MaR) according to the building;
 - RM xxx – number of the equipment (ET or ET/MaR) according to the building.
- Switchboard dimensions for larger applications: 800 (600) x 400 x 2000 mm (box-type switchboard including 100 mm stand).
- Switchboard dimensions for smaller applications: 800 (600) x 400 x 2000 mm (mounted on the wall).
- If the switchboard is installed in a single block of boxes with heavy-current, use the side separator plate.
- The switchboard must be equipped with a lock with universal insert for the entire system (1333 lock).
- The switchboard must be labelled in accordance with the project documentation and TDB.
- The box-type switchboard must be equipped with a base.
- Descriptions must be provided on engraved labels, the necessity of labelling and installing the switchboard.
- In case of a risk of mechanical damage to the switchboard, steel barriers must be installed.
- It must be possible to open the switchgear at an angle of 95°. When the switchboard door is opened, there must be at least 1 m wide free space in front of the cabinet from the nearest live part of the switchboard.

Recommended suppliers and equipment: Rittal – The System, Schrack Technik, OEZ, D&D

10.1.1. Electrical Conductor

The power supply will be provided to the PLC system from two independent sources (from two separate substations, transformer stations or using an emergency source or the UPS (Uninterruptible Power Supply) – **the necessity and the method of providing the power supply must be consulted with the ŠE-TS/2 dptm. and ŠKODA AUTO a.s.** For the input of the supply voltage for the PLC it is required to install the low-frequency filter and overvoltage protection in the MaR switchboard. It is not allowed to connect live parts of the circuit behind the power transformer using the PE or LV conductor. The electrical conductor wires behind the low-frequency filter and the transformer must not be joined with any electrical conductors before the filter. The PLC cover must be connected to the PE conductor with a minimum cross-section of 4mm². If a UPS should be provided, it is required to connect the UPS to the TOTAL STOP circuit in the building on accordance with ITS 2.11, ČSN 73 0802, and ČSN 730804. The PLC memory must be backed up by its own battery, due to the risk of data loss in case of the UPS failure.

10.1.2. Binary Inlets

Only in the case of strict separation of the inlet cables from the power conductors and power supply conductors is it possible to use unshielded cables; if this is not possible, it is necessary to use shielded conductors with earthing at the inlet to the switchboard. The other end of the shielding remains unconnected.

10.1.3. Binary Outlets

Inductive loads must always be equipped with an interference suppressor. The semiconductor components on the outlets are particularly susceptible to breakdown during the switching current peak.

10.1.4. Analog Inlets and Outlets

Always use shielded cables. Earth the shielding outside the switchboard to the switchboard inlet, earth the shielded line in the switchboard at the PLC terminal plate. Concurrent tracking with the power lines or power supply lines is not allowed. For measuring use preferably sensors with current outlet.

10.2. Cabling

During the installation of components it is required comply with the requirements of ITS 1.11 Electricity and 5.11 Electrical Assembly and Installations. For proper installation of MaR cables, it is required to follow the guidelines below.

- Measuring cables from sensors to sub-centre – shielded double wire cable 2 x 1 mm², earth the shielding only on the sub-centre side (JYTY cable).
- For RS 485 communication bus bar (S-BUS) – use shielded data cable (LAM DATAPAR 2 x 2 x 1 mm²). The cable must not be connected.
- When concurrently tracking cables more than 50 m long, the cables can be joined together and passed through a junction box to a single shielded multicore cable (JYTY X x 1 mm² cable). The S-Bus cable cannot be joined with any cables. Analogue and pulse signals must be joined together and routed through two cables.
- The cables are installed in galvanised steel channels/wire trays (e.g. MARS and MERKUR 2 channels) or in plastic channels when installing the lines inside the building. Connect the metal channels to the earthing system of the building and connect with one another.
- The measuring and control cables should be installed routed separately from the power supply cable (the minimum distance is 250 mm).

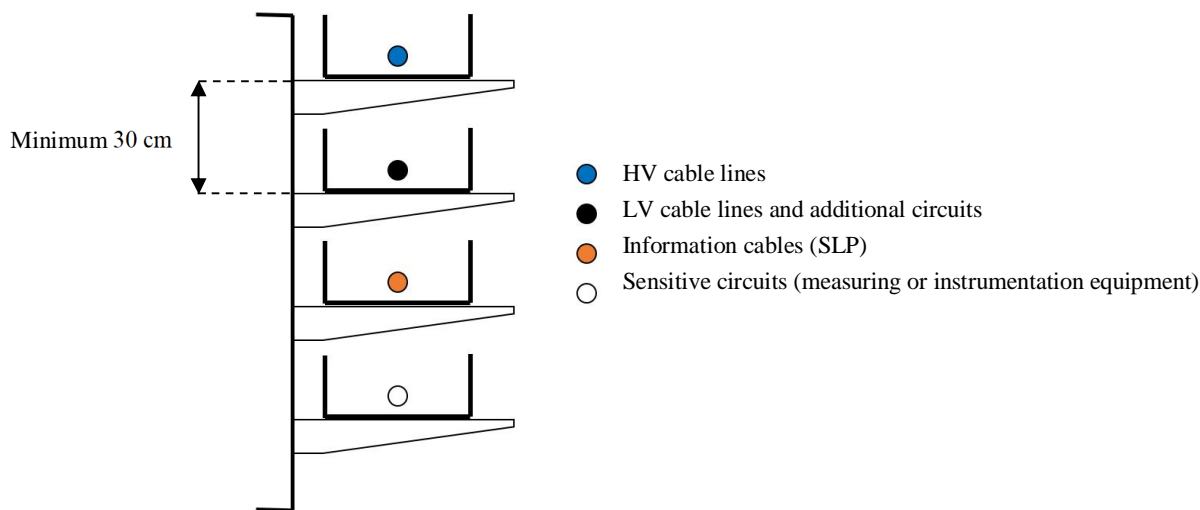


Fig. 10: Measurement, control and power lines - installation

- After consulting with the ŠE-TS/2 department, it will also be possible to install measurement and control cables in the common channel with separating partition, a common trough with a separating partition.
- In cable line sections between the channel and the sensor, the cables must be protected by a steel pipe (cable protection against damage) – this is required only in production halls/workshops). In the administrative areas, the lines will be installed in a plastic pipe or under a timber moulding – the lines will be installed in wall.
- The cable shielding must not be conductively connected to live or inert parts of the system with the exception of the MaR switchboard, and it must not be connected to constructions. The cable shielding is connected in the MaR switchboard to a special terminal plate, which is connected with the PE wire with the diameter of at least 4 mm².
- Conductors leading to sensors must not be conductively connected to the structures. If the system requires connection using PE conductor, this may be done only in the switchboard; it is done by running the PE conductors from the sensors to a special moulding in which they are joined together and this moulding with joined conductors is then connected to the sufficiently dimensioned conductor (minimum diameter 4 mm²).
- After all cables have been laid, the individual cores will be conductively checked ("ringed through"), connected to the terminal plates in terminals and marked with indelible descriptive labels.

10.3. Rules for Connecting to ŠKODA AUTO, a.s. Network

PLCs, data concentrators, converters and other equipment that transmit data to the servers of the relevant measurement systems must be connected to the Ethernet network of the ŠKODA AUTO. For their connection to the network it is required to install the Ethernet plug socket. The installation of the socket will be supervised by the FIO/34 Dptm. (the cost of the installation is the responsibility of the Investor) which will also select an appropriately authorised company to install the sockets. Each data socket will be assigned a unique number after its installation. It is necessary to apply for activation after the socket has been installed. The application is sent by email to the call centre.

If possible, the sockets need to be activated to allow access to the technology network – then there is no need to apply for access to the network through the firewall.

10.3.1. Connecting the Equipment to ŠKODA AUTO, a.s. Network

The following is required:

- Application for assignation of the equipment name and registration in SAP;
- Application for assignation of the IP address in DNS, see ŠKODA AUTO intranet, form 9038;
- It is required to give the MAC address or actually enter the IP, then it is required to give the location. The approval of the application takes about 1 day.
- Application for accessing through FIREWALL to DMZ server (if necessary), form 9031. It is necessary to enter the required ports. It is necessary to enter the network names of Ordering Parties and the servers. Approval takes about 1 week, activation takes place once a week – FIO/2 dptm.

11. Metrology

According to the ŠKODA AUTO Metrology Code (ON 1.018), all new measuring instruments (with the exception of intake measuring devices) will be classified as unspecified measuring instruments, i.e. the calibration records will be submitted (in Palstat system) in accordance with ČSN EN ISO/IEC 17025 and internal regulations; for electric meters with MID certification it is not required to submit the records. The external calibration of measuring instruments must comply with the requirements of IS 028/11 FK of 12 December 2011. The operation and maintenance of other measuring instruments that are not part of the energy measuring systems is the responsibility of the owner of measuring instruments.

12. Scope of Documentation

Project documentation must always be based at least on the following:

- ČSN;
- Record concerning the determination of external effects;
- PBŘ (Fire Safety Project);
- Building documentation;

- Technical documentation of other technological professions;
- Investor's requirements for building and technological electrical installations including backup;
- Technical consultations with Investor;
- ITS of ŠKODA AUTO a.s.

12.1. Construction Implementation Documentation – Minimum Requirements

- Technical report;
- Diagram of electric power distribution lines;
- List of equipment – energy requirements;
- List of inlets and outlets of the management system;
- List of cables;
- Control scheme;
- Floor plan – including drawings of conductors, cables and system components;
- Linear single-pole connection of switchboard;
- Construction documentation must be in Czech language;
- All documentation must be submitted in electronic form (it must be submitted in commonly used formats – pdf, doc, docx, xls, xlsx, dwg, dgn or e.g. EPLAN).

12.2. Documentation of actual project implementation– minimum requirements

- Documentation of actual project implementation must be in the Czech language (including the comments in Czech concerning the software supplied).
- Drawing documentation corrected according to the actual implementation in three copies (paper pare) and 1 CD (the drawings to be submitted in commonly used formats – pdf, doc, docx, xls, xlsx, dwg, dgn or e.g. EPLAN).
- Up-to-date SW backup from PLC, display and all other programmable devices, detailed description of source code, legible in text editor.
- Chart of data points – provided in table form (xls format), containing detailed description of communicated data points of PLC program in relation to the controlled technology (ranges, ports, etc.), 1 USB or CD carrier.
- Instruction manual for general operation + specific instruments.
- Drawings of connecting specific circuits (dwg, dgn, EPLAN P8 version 2.0 and higher).
- Lists of items and their basic parameters in specific circuits, lists of connections and lists of spare parts for 2-year operation.
- Instructions for removals, repairs, adjustment, calibration, installing and operating all instruments delivered.
- Record concerning training of operating personnel.
- Record of putting into operation and testing the equipment.
- Colour scheme of equipment in A3 format, sealed in laminating foil – 1 sheet.
- Inspection report (initial inspections of electrical equipment and installations according to the standards concerning the protection against dangerous contact voltage electrical revisions and other standards, especially the standards concerning safety).
- For distributors and transformer stations a project verification inn accordance with the ČSN EN 61439 will be submitted. In the project verification – Summary, the mannuufacturer of the distributor will list all verifications as per ČSN EN 61439-1 ed. 2 parts 10.2-10.13 with naming the person who performed them. Corrosion resistance verification, cabinet thermal stability, UV rays resistance, casing firmness, etc. will be listed in the report of the cabinet manufacturer – original manufacturer. Air distances, ground roads, continuity of protection circuit, integration of devices, clamps will be inn the report(s) of manufacturer of the distributor

13. List of figures

Fig. 1: Circular line with single junction distribution line.....	7
Fig. 2: Diagram of HV 22kV distribution lines in the plant in Mladá Boleslav	10
Fig. 3: Diagram of HV 6.3kV distribution lines in the Kvasiny plant	11
Fig. 4: Diagram of HV 35 kV distribution lines in the Vrchlabí plant.....	12
Fig. 5: Illustration linear diagram of standard HV inlet/outlet	13
Fig. 6: Illustration concept diagram of TS	14
Fig. 7: Plan view of standardised platform transformer station	15
Fig. 8: Linear diagram of the standard HV inlet/outlet of the platform transformer station	16
Fig. 9: Minimum installations for HV lead-in/outlet	17
Fig. 10: Measurement, control and power lines - installation	22

14. List of tables

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5.05 Power Engineering

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