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This Internal Technical Standard (hereinafter referred to as the 'ITS') for Energy Measurement Concept is valid for all ŠKODA AUTO plants.

## Contents

<b>1. Introduction.....</b>	<b>4</b>
1.1. Regulations and standards.....	4
1.2. List of abbreviations and terminology .....	4
<b>2. General requirements.....</b>	<b>5</b>
2.1. Supplier's responsibility .....	5
2.2. Start of installation.....	5
2.3. Supplier's obligations .....	5
2.4. Operational resources and operation thereof .....	5
2.5. Technical meeting.....	5
2.6. Extension or change of equipment.....	5
2.7. Documentation of the actual design.....	5
2.8. Certification, approval, quality management .....	6
<b>3. Energy consumption measurement, MaRES systems and layers .....</b>	<b>7</b>
3.1. Basic diagram of the MaRES technical equipment of buildings at ŠKODA AUTO a.s. ....	7
3.2. Overview of layers and corresponding technologies/peripherals .....	8
3.2.1. Device layer.....	8
3.2.2. Regulator layer .....	8
3.2.3. Communication layer .....	8
3.2.4. Server layer .....	8
3.2.5. Client layer .....	8
3.3. Measurement and regulation systems – basic division.....	9
3.3.1. Monitoring and controlling of energy equipment .....	9
3.3.2. Energy consumption measurement – system superstructure .....	9
<b>4. Measurement of basic physical quantities – Device layer .....</b>	<b>10</b>
4.1. Technical processing of measuring points.....	10
4.1.1. Piping sets for meters and filters, Standard PHS No.: 1009.....	10
4.1.2. Register of energy data of buildings, organisational units, equipment and machines (Standard PHS. Nr.:1009) .....	10
4.2. Measurement of consumption of individual energies and media – accurate design.....	10
4.2.1. Thermal energy .....	10
4.2.2. Gases and air (natural gas, technical gases, compressed air) .....	11
4.2.3. Water (drinking, industrial, DEMI) .....	11
4.2.4. Cooling water.....	12
4.2.5. Oiled water.....	12
4.2.6. Electricity measurement.....	12
4.3. Pressure measurement.....	13
4.3.1. Manufacturers – recommendations.....	14
4.3.2. Measurement of differential pressures.....	14
4.3.3. Temperature measurement .....	14
<b>5. Specification of individual subsystems – substations, communication, visualisation.....</b>	<b>14</b>
5.1. Energy measurement – Mladá Boleslav production plant .....	14
5.1.1. CED/ENERGIS information measurement system .....	14
5.1.2. EBI information measurement system (HVAC units) .....	15
Distribution point protection system (microSCADA MB).....	17
5.2. Energy measurement – Kvasiny production plant.....	17
5.2.1. RC Ware information measurement system.....	17
5.3. Energy measurement – Vrchlabí production plant.....	18
5.3.1. Vrchlabí – energy information and control system – Johnson Controls.....	18
5.4. Direct energy measurement – ENERGIS .....	19
5.4.1. Direct energy measurement by the ENERGIS system .....	19
5.5. Measurement of electricity consumption of e-mobility charging stations.....	19
5.5.1. IS CPO – vehicle charging system.....	19
<b>6. Basic installation conditions.....</b>	<b>23</b>
6.1. Electrical equipment of the distribution board.....	23
6.2. Principles of PLC installation, including the aspect of electrical safety .....	23
6.2.1. Manufacturers – recommendations.....	23



6.2.2.	Power conductors: .....	23
6.2.3.	Binary inputs:.....	23
6.2.4.	Binary outputs:.....	23
6.2.5.	Analogue inputs and outputs:.....	23
6.3.	Cabling.....	24
6.4.	Rules for connection to the network of ŠKODA AUTO a.s.....	24
6.4.1.	Device connection to the network of ŠKODA AUTO a.s. ....	24
<b>7.</b>	<b>Change management and change request .....</b>	<b>24</b>
7.1.	Technical meeting .....	24
7.2.	Table of data points (TDP).....	24
7.3.	Creation of the project documentation .....	25
7.4.	Activation and handover of technological equipment (including the HW control equipment) .....	25
7.5.	Creation and activation of control programs (systems).....	25
7.6.	Creation and activation of the visualisation system .....	25
7.7.	Documentation generation.....	25
7.8.	Result of each change – handover of the CS, VS and handover reports .....	25
7.9.	Addendum .....	25
<b>8.</b>	<b>Metrology.....</b>	<b>26</b>
<b>9.</b>	<b>Scope of the documentation .....</b>	<b>26</b>
9.1.	Documentation of the construction realisation – minimum requirements: .....	26
9.2.	Documentation of the actual construction realisation – minimum requirements: .....	26
<b>10.</b>	<b>List of figures.....</b>	<b>27</b>
<b>11.</b>	<b>List of tables .....</b>	<b>27</b>



The latest updated version of this ITS is available at <http://cts.skoda-auto.com/>; the company is not obliged to notify its trading partners of an ITS update. Therefore, it is strongly recommended that everybody review the ITS regularly. These documents come into force on the date of their last update. For concluded contracts, the ITS validity at the time of making the order is determinative.

**Warning:** In case of any discrepancies between the Czech, English and German language versions of this ITS, the Czech version is deciding.

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1.	2020-06-12	Complemented with battery charging, change of IP addresses of CED servers, added AMIT and other control systems, change of the name and added departments of ŠE and ŠA.

## 1. Introduction

This Internal Technical Standard (hereinafter referred to as the 'ITS') concerns the conceptual processing and method of measurement mediums and energies in the production plants of ŠKODA AUTO, a.s. The energy measurement concept for consumption within the Energis system is submitted by the planning department PP. The following approval of the solution in question is carried out by the PS department in cooperation with ŠE. Project documentation (specification of meters, connection to the data collection system, etc.) must be prepared for the submitted solution. The ŠE energy department then handles the accounting distribution of consumption bills (measuring the energy at building entrances – recording level). This ITS describes all systems (monitoring and regulating) that are used in energy equipment (non-technological), defines the technical method of design of individual measuring points and sets the technical conditions for the supply, installation and commissioning of all monitoring and regulating equipment.

Any deviation from the content of this ITS must be justified and approved in writing by the technical department of ŠKO-ENERGO (hereinafter referred to as ŠE-TS).

It is forbidden to use materials that contain carcinogenic substances, substances whose surfaces are treated with varnish and containing silicone (crater-forming materials). If necessary, a material test can be performed (department of processes PPF-L/1). The supplier is obliged to submit a certificate of the product's grade and quality.

### 1.1. Regulations and standards

For conceptual energy measurement, it is crucial that the supplier comply with the ČSN, EN and ISO standards as well as the following regulations and standards valid as of the date of contract conclusion:

- ITS ŠKODA AUTO a.s., <http://cts.skoda-auto.com/>  
For electric machinery and equipment in particular:
  - ITS 1.01 General Technical Conditions
  - ITS 1.05 Information Systems and Technologies
  - ITS 1.09 Shut-off Valves, Shutting-off Devices
  - ITS 5.11 Electrical Assembly and Installation
  - ITS 5.13 Control Technology
  - ITS 6.22 Heating Equipment and Hot Water Heating
- Requirements and detailed specifications for the construction of equipment in the form of technical specifications issued for the relevant part of production or project.
- Risk assessment and minimisation according to ČSN EN ISO 12100 and the documents created here are part of the scope of the machine delivery.
- It is necessary to comply with regulations as defined in ČSN EN 60204-1 ed.2 and ČSN 33 2000-X-XX applicable to electronic equipment of machines, machinery and tools that are not manually portable during work, supplied from electrical sources with nominal voltage between conductors (phase) up to 1000V~ and 1500=.
- According to ČSN EN 60204-1 ed.2, the supplier must ensure in particular:
  - safety of persons and property
  - trouble-free production
  - durability and frugality during operation
  - easy maintenance
- All equipment for measurement and regulation energy systems (hereinafter referred to as the 'MaRES') are carried out in accordance with the applicable rules of technology and regulations on occupational safety. When assembling MaRES components, it is necessary to follow the advice and recommendations given by the manufacturers.
- This ITS must be fully in compliance with Methodical Guideline **MP.1.918 Energy Measurement Concept** and Organisational Standard **ON.1.018 Metrology Code**.

#### Technical standards and related regulations as amended:

- ČSN EN 61297 – Industrial process control systems – Classification of adaptive control units for evaluation purposes
- ČSN EN 61298-2 ed. 2 – Equipment for measurement and control of industrial processes – General methods and procedures for evaluation of properties – Part 2: Tests under reference conditions
- ČSN EN 61298-3 ed. 2 – Equipment for measurement and control of industrial processes – General methods and procedures for evaluation of properties – Part 3: Tests for determining the effects of influencing quantities
- EU Declaration of Conformity, including the CE marking pursuant to Act No. 22/1997 Coll., as amended by Act No. 91/2016 Coll.
- EU Directive 2014/30/EU on technical requirements for products with regard to their electromagnetic compatibility.
- EU Directive 2014/35/EU laying down technical requirements for low voltage electrical equipment.

**Compliance with all applicable standards of electrical engineering, fire safety and occupational safety is required!**

### 1.2. List of abbreviations and terminology

EBI	–	Enterprise Buildings Integrator	–	System for integration of buildings, structures and their systems
IED	–	Intelligent Electronic Device		
PHD	–	Process History Database	–	Database created by the EBI server
MaRES	–	Measurement and Regulation Energy Systems		
ŠA	–	Škoda Auto a.s.		
ŠE	–	ŠKO-ENERGO, s.r.o.		
ŠE-TS	–	ŠKO-ENERGO, s.r.o. – Energy Services and Management		
ŠA-PPB	–	ŠKODA AUTO – PPB – Construction and Infrastructure Planning		
PLC	–	Programmable Logic Controller		
CED	–	Central Energy Dispatch		
CPO	–	Charge Point Operator Platform	–	System for the operation of charging stations

## **2. General requirements**

### **2.1. Supplier's responsibility**

The supplier is responsible for the correct function of the delivered machine or equipment. The supplier must comply with all applicable EU directives, laws, government regulations, decrees and technical standards that are in force in the country of installation and that apply to the machine or equipment.

### **2.2. Start of installation**

Having received an order and before the start of installation, the supplier must in due time submit to the customer the relevant documents laid down in the specification or in the agreed extent, such as the installation plans, implementation plans, assembly plans, schedules and personnel deployment plans. If there are any changes in the equipment, then it is necessary to submit the amended documents again for written approval to the SE-TS/2 and ŠA-PPB departments.

Changes on the part of the supplier between the offer and the final solution do not justify an increase in unit prices. The supplier shall attach the list of technical connection values to the MaRES offer. The submitted technical documents must contain the design of the equipment, functional diagrams with description, cable routes, necessary technical data and a timetable showing the course of installation, test operation and handover.

### **2.3. Supplier's obligations**

**The supplier is obliged to stay informed about the applicable standards, local regulations and customs for the specified production equipment. When extending or changing the existing systems, the supplier is obliged to comply with the provisions that apply to the system type and is responsible for its overall function.** During the warranty period, the supplier's customer service must be available for maintenance work. The service period must be part of the offer as a binding commitment of a date. **In the event of any problems with complying with the technical specifications and local customs, the supplier is obliged to immediately inform the technical department ŠE-TS2/3 and to propose, consult and have a solution approved.**

Documents handed over by technical departments to the supplier may not be copied or made available to a third party or otherwise evaluated without the customer's permission. ŠKODA AUTO, a.s. shall acquire free, exclusive, irrevocable, spatially and temporally unlimited, sub-licensable user rights to the results of work performed by the supplier on the basis of this order for ŠKODA AUTO a.s.

In the project documentation, the supplier is obliged to offer the recommended components listed in this ITS or in its annexes. Other components or non-standard components may be used only with a written consent of ŠE-TS2/3 and ŠA-PPB.

### **2.4. Operational resources and operation thereof**

All operational resources may be operated only below the limit values specified by the manufacturer, and the nominal values of elements must not be permanently exceeded. This applies to the limit values for voltage, current, temperature, impact protection, vibration, oil mist, liquid fumes and other physical quantities.

No substances harmful to the environment or health may be used (e.g. FC-hydrocarbons, asbestos, etc.). Crater-forming substances may not be used in production facilities – no materials based on silicone or Teflon. Teflon-based products may only be used with a consent of ŠKODA AUTO a.s.

### **2.5. Technical meeting**

After the concept has been assigned and submitted, a detailed technical meeting between the supplier and the relevant technical department ŠE-TS2/3 must take place before the start. The supplier is fully responsible for the overall concept of the measurement design, including all related areas (emergency shutdown, protective grilles, starting circuits, etc.). The supplier is fully responsible for the realisation of the complete concept, its installation and functionality according to the applicable legislation.

### **2.6. Extension or change of equipment**

In the event that the existing machinery is extended or changed, the supplier is responsible for the overall functionality of the equipment affected by the extension or change. When refitting the existing equipment or machinery, all unnecessary components are to be dismantled and the documentation corrected accordingly. The extent of modifications to the existing machinery and their nature shall be assessed by the technical department ŠE-TS2/3. If the proposed modifications have the nature of a reconstruction or new delivery of machinery and partly completed machinery to the existing machinery, the manufacturer or its authorised representative shall draw up the EC declaration of conformity in accordance with Directive 2006/42/EC of the European Parliament and of the Council (corresponds with Government Decree No. 176/2008 Coll.) pursuant to Annex II, Part 1, Section A, before recommissioning the machinery and shall ensure that this declaration be attached to the machinery. **The acceptance by a competent technical department of ŠKODA AUTO a.s. or ŠE-TS3 is absolutely necessary (the acceptance must be carried out in accordance with ITS 1.01.).**

### **2.7. Documentation of the actual design**

The MaR supplier shall submit technical documentation showing the actual condition in the agreed number and method of execution (paper or electronic version) no later than at the moment of acceptance. The documentation must contain:

- implementation drawings with the precise layout of the placement of the meters, control elements, cabling and sensors, including their designation
- wiring diagrams with function description
- description of the control system
- all annotated source codes for individual PLCs (controllers), according to the system and the reason for implementation – these source codes must be freely editable in the future (untranslated/uncompiled source code for commanding the functionality of the controllers)
- description of visualisation
- filled-in table of data points (hereinafter referred to as the 'TDP'), which is stored on the SQL server



- operating instructions for operators and maintenance workers
- list of used parts and a list of consumable parts and the recommended replacement interval (if any are expected)
- proof of operators' training
- relevant revisions
- certificate of conformity
- calibration reports

#### **2.8. Certification, approval, quality management**

All products and equipment that are subject to mandatory approval and certification as defined by Act No. 22/97 Coll., including related decrees, must be equipped with the relevant approval and certification documents under these laws and decrees.

Without these documents, no installations of these products and equipment may be carried out on the production plant premises.

In the event that the customer discovers installed products or equipment without the relevant approval and certification documents, all costs for their removal and installation of new products and equipment (approved and certified) must be fully covered by the contractor, including any consequential damages.

Only approval and certification documents prepared by authorised testing laboratories (organisations) are recognised by the customer.

### 3. Energy consumption measurement, MaRES systems and layers

#### 3.1. Basic diagram of the MaRES technical equipment of buildings at ŠKODA AUTO a.s.

Energy consumption meters must be installed at the entrance of each building. Data is transferred to the ENERGIS system either directly or via energy information systems (see chapters below).

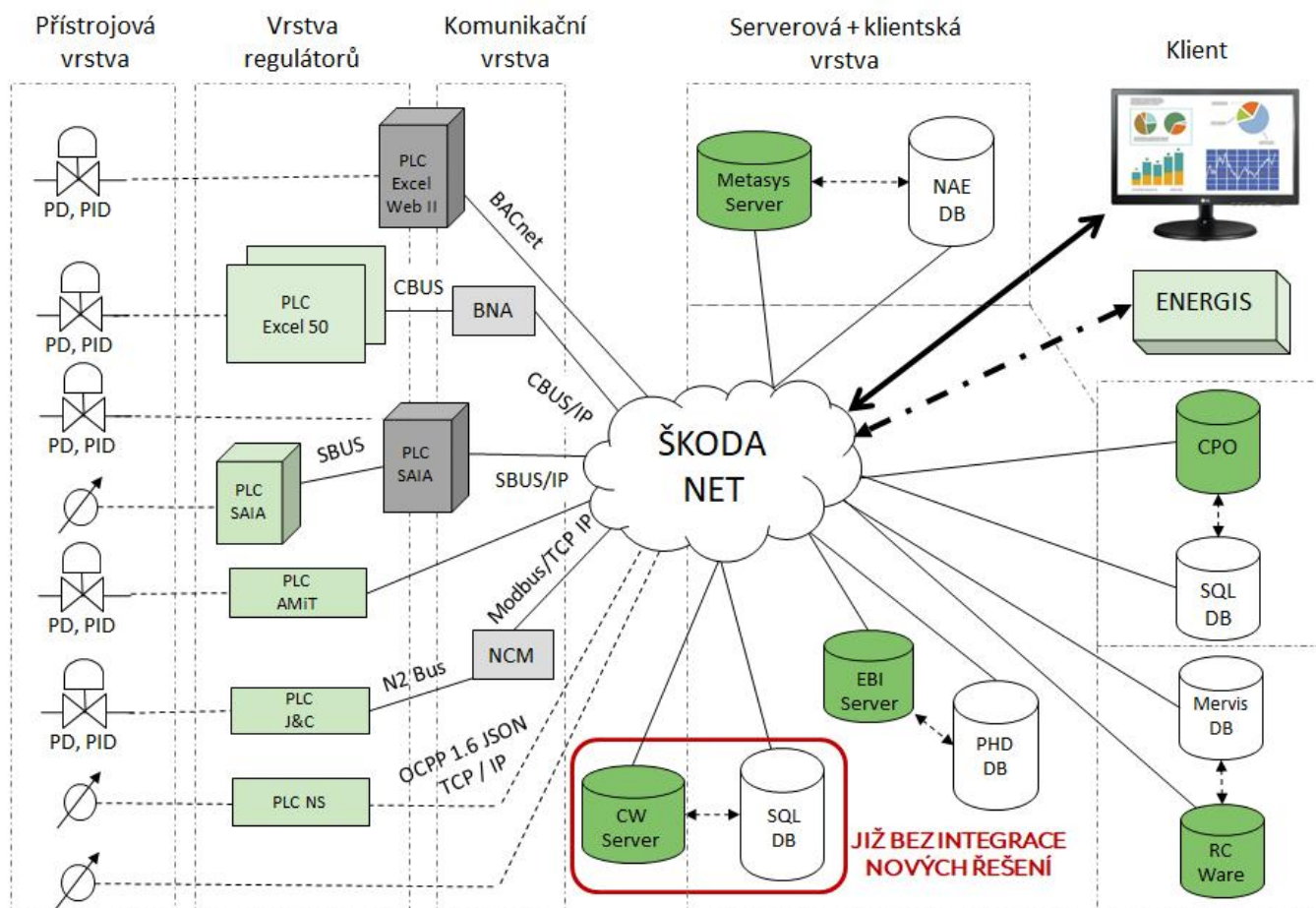


Figure 1: The MaRES technical equipment of buildings at ŠKODA AUTO a.s.





### 3.2. Overview of layers and corresponding technologies/peripherals

Measuring and control systems can be divided into five layers, between which data communication takes place.

		MaR MB		HVAC MB	microSCADA MB	Vrchlabí	Kvasiny	Charging station
V.	Client layer	CED client		Client EBI	MicroSCADA Pro client	Client Metasys	Client RCWare	Dispatcher module
						↕		
IV	Server layer	CED/ENERGIS		EBI	microSCADA Pro	Metasys	RC Ware	CPO - ŠE
						↕		
III.	Communication layer	PCD2, PCD3	Amit, Triton, Gnome, Comet, LoRa, etc.	BNA	Pro SYS 600C	NCM 4510-2	PCD2, PCD3, SAUTER	Charging station PLC
						↕		
II.	Regulator layer	PCD2, PCD3	Amit	EAGLE	IED	DX-9200	PCD2, PCD3, SAUTER	Charging station PLC
						↕		
I.	Device layer	Thermometers, manometers, flow meters, calorimeters, electricity meters,... Sensors of position, level, humidity, Ph, conductivity,...						

Table 1: Overview of layers and corresponding technologies/peripherals

#### 3.2.1. Device layer

This layer is common to all the mentioned systems and is described in Chapters 7 and 8.

#### 3.2.2. Regulator layer

Data is collected in this layer from individual peripherals connected to the regulator (PLC). Data collection is done analogically or digitally (according to the selected input/output and the exact need for use). The description of this layer is made within the individual systems below.

#### 3.2.3. Communication layer

The communication elements of this layer differ according to the system that is to be used. In the case of MaR in MB, the PLC regulator PCD2 is used as a gateway. In case of deploying the MB VZT system, the BNA network adapter is used, and in case of deploying the energy system in the Vrchlabí plant, the NCM 4510-2 network control module is used. All communication elements must be assigned with a username and IP address and must comply with the requirements of ITS 1.05. The description of this layer is made within the individual systems below. The rules for connection to the network of ŠKODA AUTO a.s. are given in Chapter 6.4.

#### 3.2.4. Server layer

The servers under construction communicate with PLC regulators and databases via an Ethernet network and provide data for clients and the ENERGIS add-on system.

#### 3.2.5. Client layer

The client layer is used for visualisation and control of energy devices. Full-fledged clients are preferred for dispatching visualisations (control). Displaying via a web interface is sufficient for informative visualisation.



### 3.3. Measurement and regulation systems – basic division

#### 3.3.1. Monitoring and controlling of energy equipment

The following systems are used for monitoring and control (visualisation) of energy equipment:

PLANT	Mladá Boleslav	Kvasiny	Vrchlabí
<b>Sub-switchboards</b>	Honeywell (VZT) SAIA (MaR MB) IED (HV distribution points)	SAIA, SAUTER	J&C SAIA
<b>SW visualisation</b>	EBI Honeywell (VZT) microSCADA (HV distribution points)  CED	RC WARE (MaR KV)	Metasys J&C Energomat
<b>Superordinate system for data visualisation</b>	ENERGIS / CED	ENERGIS	ENERGIS

**Table 2:** Measurement and regulation systems

In the case of constructing of a new energy facility, it must be integrated into the existing systems designed for monitoring and control.

**EBI Honeywell** – visualisation of HVAC units in the Mladá Boleslav plant

- **All HVAC units whose power exceed 10 000 m<sup>3</sup> per hour must be visualised in this environment.**
- **Smaller units must be at least equipped with contacts for HVAC unit operation and failure – their connection is at the discretion of the ŠKO-ENERGO technical department.**

**microScada** – a system for controlling and monitoring of distribution points (SCMS) in the Mladá Boleslav plant

- **All installed IED units (Intelligent Electronic Devices) which are reserved for protection, control, monitoring and measurement of individual outlets must be included in the microSCADA system.**

**CED** – a system for controlling and monitoring of energy equipment (except for the first two mentioned) in the Mladá Boleslav plant

- **The system is designed for monitoring and regulation of energy equipment such as a heating engine room, compressor station, cooling station, pumping station, neutralisation station, pipeline networks, boiler room, etc.**

**RC WARE** – a system for controlling and monitoring of energy equipment in the Kvasiny plant

**Metasys J&C** – a system for controlling and monitoring of energy equipment in the Vrchlabí plant.

#### 3.3.2. Energy consumption measurement – system superstructure

The ENERGIS system is a superstructure system that serves mainly for data concentration, recording, archiving of selected data and creation of supporting documents for invoicing purposes.

## 4. Measurement of basic physical quantities – Device layer

### 4.1. Technical processing of measuring points

General requirements according to ITS 1.14., setup records (constants, ranges, any data addresses, etc.) must be delivered with all meters.

#### 4.1.1. Piping sets for meters and filters, Standard PHS No.: 1009

Assemble a filter set and meters for flow, temperature and pressure at each pipe inlet to the building. The meters must be delivered with their calibration report, they must be readable on site and they must be also transferable to the measurement system of ŠKODA AUTO a.s. The meters and filters (compressed air, water – drinking, industrial, cooling, oiled, DEMI) are to be fitted with bypasses, which will guarantee a continuous supply of medium to the building in the event of a meter failure or filter clogging or when replacing the filter insert.

#### 4.1.2. Register of energy data of buildings, organisational units, equipment and machines (Standard PHS. Nr.:1009)

Energy consumption in the buildings of organisational units or on equipment and machines are to be unambiguously assigned and transparent through the installation of stable measuring devices or the establishment of access measuring points. This will enable the collection and documentation of consumption data and the identification and evaluation of energy saving potentials. **Requirements:** Installation of stable measuring devices or access measuring points depending on the type of energy and input power according to Tables 1 and 2. Implementation for new devices or replacements or restructuring measures.

Stable measuring points should allow the safe placement of continuous measuring without restricting the running operation.

#### Stable measuring points

Stable measuring points should allow the safe placement of continuous measuring without restricting the running operation of the facility.

#### Access measuring points

Access measuring points must allow the safe placement of temporary measuring without restricting the operation, even without the necessary modifications (rebuilding) in the distribution systems when measuring the media.

Type of energy	Stable measuring	
	Installed/nominal input power	Usual connection size
Electricity	100 kW	---
Heat	500 kW	DN 50
Cooled water	400 kW	DN 80
Cooling water	100 m <sup>3</sup> /h	DN 125
Natural gas	All consumption	---
Compressed air of 12 bar	500 Nm <sup>3</sup> /h	DN 50
Compressed air of 12 bar	300 Nm <sup>3</sup> /h	DN 32

Table 3: Stable measuring

Type of energy	Access measuring point	
	Installed/nominal input power	Usual connection size
Electricity	30 kW	---
Heat	50 kW	DN 15
Cooled water	100 kW	DN 50
Cooling water	14 m <sup>3</sup> /h	DN 50
Compressed air of 12 bar	100 Nm <sup>3</sup> /h	DN 20
Compressed air of 12 bar	100 Nm <sup>3</sup> /h	DN 15

Table 4: Access measuring point

### 4.2. Measurement of consumption of individual energies and media – accurate design

#### Measured energies:

- Thermal energy (kWh)
- Natural gas (Nm<sup>3</sup>)
- Technical gas (Nm<sup>3</sup>)
- Compressed air of 6 and 12 bar (Nm<sup>3</sup>) – according to ISO 2533 – at a pressure of 101 325 kPa (760 torr) and a temperature of 15 °C
- Drinking water (m<sup>3</sup>), industrial water (m<sup>3</sup>), demi water (m<sup>3</sup>), cooling water (m<sup>3</sup>)
- Electricity (kWh)

#### 4.2.1. Thermal energy

Measurement of heat or cold consumption is performed as standard in control substations. Consider the working range of the flow meter to ensure correct measurement at the set operating points when creating a proposal. It is necessary to install cool-down sections in the machine part according to the requirements of the manufacturer of the flow meter.

If there is a requirement to install a calorimeter (**use only in cases of billing measurement of external customers**), the signals from the temperature sensors and the flow meter are introduced into it (always consult ŠKO Energo). The consumption signal is then transmitted together with the instantaneous flow signal to the control substation via a communication line (e.g. RS485, M-Bus).



#### Technical design of the measuring point

Thermal energy is measured by a combined measurement of the flow and the temperatures of the supply and the return ducts of hot (cooling) water (two coupled temperature sensors must be installed for the calculation, always one on the supply and the other on the return). A flow meter of induction or ultrasonic type and sized to the parameters of the measured medium (DN, PN, Q, t) will be installed. The flow meter is installed in the supply duct of the hot water pipeline. The flow meter will be equipped with a display. If the flow meter is mounted in an inaccessible position, a separate display will be used. Thermal energy (for operating specified meters) is calculated by a mathematical element of the set (e.g. Inmat). There must always be the minimum cool-down sections before and after the flow meter, **always according to the manufacturer's specifications and recommendations – in these cases, the product technical data sheets must be documented** (an induction flow meter of at least 5D and 3D; an ultrasonic flow meter of 10D and 5D). For acceptable accuracy, the minimum flow rate must be maintained, the induction flow meter of 0.25 m/s and the ultrasonic flow meter of 0.5 m/s and the maximum flow rate of 4 m/s or according to the manufacturer's requirements. Reductions will be used to achieve the optimum flow rate of hot water.

- The analogue output of the flow meter has a value of 4–20 mA (instantaneous flow); set the pulse output (total flow) to the maximum frequency of 3Hz
- Separate the flow meter on both sides with shut-off valves
- Fit the meter with a bypass for its easy disassembly

#### Manufacturers – recommendations

KROHNE, ZPA, SIEMENS, KAMSTRUP, COMACAL, E+H – others after written approval by the responsible person of ŠE.

#### 4.2.2. Gases and air (natural gas, technical gases, compressed air)

Measurement of gas consumption is done by combined measuring of fitted sensors of temperature (with an output of 4–20 mA, fitted with display), pressure and flow in the pipeline of the measured medium. The sensor parameters are determined by the properties of the measured medium. The flow is measured with a quantometer (equipped with a display) with an output signal of 4–20 mA (instantaneous flow) and a pulse signal (total flow) with a maximum pulse frequency of 3Hz. If the flow meter is mounted in an inaccessible position, a separate display will be used. It is necessary to install cool-down sections in the machine part according to the requirements of the flow meter manufacturer. When using MaR components on natural gas pipelines, it is necessary that they be in the Ex design for the relevant zone according to the technology specification! If appropriate, it is possible to use the communication interface RS485 or M-Bus.

#### Technical design of the measuring point

The flow is measured with a quantometer with a pulse output of a maximum frequency of 3 Hz. A filter of accuracy class 5  $\mu$  m or better is mounted before the gas meter to collect dirt. There must always be the minimum cool-down sections before and after the gas meter – **always according to the manufacturer's specifications and recommendations – in these cases, the product technical data sheets must be documented**. In case of two or more inlets to one common internal building distribution, a non-return valve is mounted before the gas meter.

- Separate the gas meter on both sides with shut-off valves and fit it with a bypass for its easy disassembly
- When replacing the filter, it is recommended to dismount the device from the piping once a year and visually check the condition of the turbine

#### Manufacturers – recommendations

ELSTER, TESTO, E+H, Krohne, Siemens - others after written approval by the responsible person of ŠE-TS.

#### 4.2.3. Water (drinking, industrial, DEMI)

Water consumption measurement is performed with water meters with pulse output (standard measuring – 1 pulse per 1 m<sup>3</sup> – possible constant 10, 100 or 1000 l per pulse) or RS485 or M-Bus. The drinking water supply will be equipped with a temperature and pressure sensor with an output of 4–20 mA and a display. The digital and analogue signal is fed to the control substation, where the temperature and consumption value is recorded.

#### Technical design of the measuring point

A filter to collect dirt is mounted before the water meter. There must always be the minimum cool-down sections before and after the water meter, **always according to the manufacturer's specifications and recommendations – in these cases, the product technical data sheets must be documented**. In case of two or more inlets to one common internal building distribution, a non-return valve is mounted before the water meter. The measurement path must be separable by shut-off valves (flaps) and the meter is to be fitted with a bypass for its easy disassembly. The turbine water meters are equipped with a pulse transmitter with a constant of 1 pulse per 10, 100 or 1000 litres. Select the water meter constant so that the pulse frequency does not exceed the threshold of 3 Hz at the maximum flow rate. **For large dimensions (over DN 100) on industrial and demineralised water, consider the use of induction or ultrasonic flow meters.**

#### Applicable types of meters

- Combined water meters – for consumption with a large maximum-minimum ratio (e.g. lavatories, buildings equipped with fire hydrants, etc.)
- Simple water meters of type MeiStream (SENSUS) for technological withdrawals with a more-or-less constant flow
- Water meters of type 420 SENSUS for buildings with low water consumption

#### Manufacturers – recommendations

SPANNER POLLUX – PREMEX, SENSUS, ITRON, KROHNE, Prema – Meinecke, Elster – others after written approval by the responsible person of ŠE-TS.



#### 4.2.4. Cooling water

Cooling energy is measured with combined measuring of the flow, pressure and temperatures of the supply and the return heated ducts of cooling water.

##### Technical design of the measuring point

An induction or ultrasonic flow meter is installed in the supply duct of cooling water – there must always be the minimum cool-down sections before and after the flow meter, **always according to the manufacturer's specifications and recommendations – in these cases, the product technical data sheets must be documented** (an induction flow meter of at least 5D and 3D, an ultrasonic flow meter of 10D and 5D). The minimum flow rate, the induction flow meter of 0.25 m/s and the ultrasonic flowmeter of 0.5 m/s must be maintained. Reductions will be used to achieve the optimum flow rate of cooling water. The analogue output of the flow meter has a value of 4–20 mA; set the pulse output to the maximum frequency of 3 Hz. Separate the flow meter on both sides with shut-off valves (Boax shut-off flaps) and fit it with a bypass for its easy disassembly.

##### Manufacturers – recommendations

KROHNE, Siemens, E+H – others after written approval by the responsible person of ŠE-TS.

#### 4.2.5. Oiled water

The pumping station is always implemented according to the project, though in principle it should contain a tank (or tanks) in which there is a stirrer and a couple of (or multiple) pumps (100% backup with automatic trigger).

##### Technical design of the measuring point

The level is registered by an ultrasonic sensor (4–20 mA output, power loss signalling). Reaching the operating maximum first starts the stirrer (or stirrers) in the tank, and after about 15 minutes the transfer pump is started. The recommended type of the sensor is OPTIFLEX. When the level drops to the "stirrer blocking" level, the stirrer switches off. A drop to the operating minimum switches off the pump. The emergency maximum level immediately starts the pump and triggers the optical and acoustic signalling. The maximum blocking level stops the pump (even when switched to manual control) and triggers the optical and acoustic signalling. If the level rises above the "stirrer blocking" level, the stirrer is started according to the time schedule even if the pump is not running. The pumping instruction (before reaching the operating maximum) can be given from the control system of the Z25 waste-water treatment plant. The amount of water pumped to the Z25 waste-water treatment plant is measured with an induction flow meter.

##### Manufacturers – recommendations

PROBE, KROHNE – e.g. Krohne UFM 3400 – others after written approval by the responsible person of ŠE.

#### 4.2.6. Electricity measurement

Electricity meters must be equipped with an interface, preferably the Modbus interface or RS485, M-Bus or Ethernet. In the case of serial communication, it is necessary to consider the need to install a converter, e.g. RS485 or Ethernet. The use of individual electricity meters (e.g. electronic ones) must be consulted with ŠE-TS.

##### Direct measurement

Direct measurement can be performed up to a current value of 100 A. The electricity meters are connected directly to the distribution line with a **ballast fuse of the same current value** as the electricity meter.

##### Indirect measurement

Indirect measurement can be performed from a current value of 63 A. The electricity meters are connected via current measuring transformers (CMT) with a conversion of  $x/5A$ , in an accuracy class of at least 0.5 S. The current measuring transformers can be mounted in plug-in designs or integrated into devices (circuit breakers, fuse switch disconnectors). Due to the limitation of the minimum consumption of devices, it is necessary to consult the proposed measurement set with ŠE-TS/2 and ŠA-PPB in advance. Short-circuit terminal blocks must always be installed in the secondary outlets to prevent injuries caused by electric shock generated by high voltage when the meter is disconnected. The voltage input is protected by a fuse switch disconnector.

To measure electricity consumption in networks with a combined voltage higher than 400 V, it is necessary to use the voltage measuring transformers (VMT) at voltage inputs with voltage conversion on the secondary side up to and including 400 V.

The constant of electricity meters is given by the conversion of current and voltage measuring transformers according to the formula

$$K = \frac{U \cdot I}{\text{počet impulsů/kWh}} \quad U - \text{transformer ratio of the voltage converter} \\ I - \text{transformation ratio of the current converter}$$

**! If no current or voltage converter is used, the value is equal to 1!**

##### Recommended parameters of measuring devices

Class 1 (kWh) in accordance with Standard ČSN EN 62053-21

Class B (kWh) in accordance with Standard ČSN EN 50470-3

Class 2 (kWh) in accordance with Standard ČSN EN 62053-23

Accuracy of 0.5–2%

Meter – the measuring device must always have the MID certificate



#### Measuring on the HV side

Measuring the electricity consumption in HV distribution systems is done with electricity meters with transmission to the Ethernet network, connected directly or via a converter in case of larger numbers. The connection of electricity meters is done via suitable voltage and current measuring transformers.

The ABB MicroSCADA PRO system with internal Ethernet communication without connection to the network of Škoda Auto a.s. is installed for monitoring, control and automation of HV distribution points in the Mladá Boleslav and Kvasiny plants. The individual REF 6xx ABB terminals are connected to the closed system by using communications. All interventions and extensions of the system must be consulted with the network administrator (ŠKO Energo).

#### Measuring on the LV side

Measuring the electricity consumption in LV distribution points is done with electricity meters on the DIN rail in distribution boards. Electricity meters must be equipped with an interface, preferably Modbus or RS485, M-Bus or Ethernet. It is possible to use the existing communication lines in individual buildings and connect electricity meters to them. This means the connection of several electricity meters (1–5).

When installing a larger number of electricity meters (6 and more), there is a requirement to connect them to the Ethernet network via a converter (e.g. TRITON – manufactured by Papouch). The converter must be able to transmit data to the **ENERGIS** energy monitoring system.

The voltage coils of electricity meters are connected directly, the current coils with current converters with 5 A output or directly (according to the size of the maximum possible value of consumption).

#### The necessity to measure voltage and frequency must always be consulted with the ŠE-TS/2 and EI/4 departments.

The status of "Distribution point energised" or "Distribution point not energised" is monitored by means of an installed relay on distribution points that are not equipped with voltage converters. If the voltage drops below 85% of the nominal voltage, it is considered as a distribution point not energised, and the relay shuts off.

Maintenance consists of tightening the screws and checking the voltage at which the relay shuts off (85% of the nominal voltage). It is performed together with the maintenance of the distribution point. Calibration of devices is performed only if erroneously measured values are suspected. It is always necessary to verify the compatibility of the electricity meter and the data concentrator. **If there is a request to measure frequency, power factor, symmetry, etc., multifunctional measuring devices (multimeters) will be installed – especially in operations where great emphasis is placed on the condition and quality of energy. The request must be made or approved by the responsible department of ŠE-TS or ŠE-EI/4.**

#### Energy consumption for charging batteries during their production

The production of battery-powered vehicles that are delivered to customers is growing ever stronger. As a new vehicle is filled with fuel, it is necessary to partially or completely charge the car battery before handing the vehicle over to the customer.

The first time the battery is charged does not count as the energy consumption related to the vehicle production. Energy consumption for charging must be measured separately, cleaned of the measurement of the building's consumption – it must have its own data node within the ENERGIS system.

#### Measuring will always be installed in the distribution board for the battery charging.

#### Recommended electricity meter manufacturers

AEG, ABB, Schneider Electric, SAIA, ZPA, Siemens, KMB, ACEAN

**For LV e.g.:** ACEAN DVH 5261 (direct measuring)  
SAIA-BURGESS AWD3D5WD00C3A00 (indirect measuring)  
always including RS485/Ethernet (Papouch)

**For HV e.g.:** ABB A44 352-100 including RS485/Ethernet (Papouch)

**Multimeter e.g.:** Siemens SENTRON PAC3200

### 4.3. Pressure measurement

Pressure is measured by sensors with a current output of 4–20 mA and two-wire connection. Each sensor is separated from the piping by a manometric valve and if the temperature of the medium exceeds 100 °C, a cooling loop is added. The ranges of sensors must be designed according to the specific application (process pressure); below are the basic recommended ranges:

hot water – primary	0–1600	kPa
hot water – secondary	0–1000	kPa
hot water for central heating – secondary	0–600	kPa
drinking water, industrial water, cooling water, demi	0–1000	kPa
compressed air of 6 bar	0–1000	kPa
compressed air of 12 bar	0–1600	kPa
natural gas of 20 kPa	0–40	kPa
natural gas of 170 kPa	0–250	kPa

**Table 5:** Recommended ranges of pressure sensors for energy measurements



#### 4.3.1. Manufacturers – recommendations

**JUMO, BD Sensors, Cresssto, REM, SENZIT, E+H, JSP, ZPA** – others after written approval by the responsible person of ŠE.

#### 4.3.2. Measurement of differential pressures

Differential pressure is measured by sensors with a current output of 4-20 mA, power supply of 24 V/DC, IP67 and two-wire connection. The sensor is connected to the pipeline via a manometric valve enabling the sensor to be replaced and the desludging and maintenance of the supply pulse line (five-way valve set).

##### 4.3.2.1. Manufacturers – recommendations

for differential pressure sensors: **BD – Sensors, ZPA**

five-way fittings: **ZPA, Huba Control, REM, SENZIT, E+H, JSP, ZPA** – others after written approval by the responsible person of ŠE-TS

#### 4.3.3. Temperature measurement

Temperature is measured with Pt 100 or Pt 1000 temperature sensors with converter either separate or in the head. Stem length 50, 100, 150, 200, 250 mm. NTC thermistors of 20 kΩ at 25 °C can be used in HVAC applications.

It is recommended to use programmable two-wire temperature converters with digital indication of type PT-02(020) in heating engine rooms, with possible programmable range of -30 up to 200 °C. The converters have a current output of 4–20 mA and two-wire connection. The ranges of sensors must be designed according to the specific application; below are the basic recommended ranges:

hot water – primary	0–150	°C
heating water for central heating – secondary	0-130	°C
non-potable hot water – secondary	0-100	°C
room temperature – interior	0–50	°C
outside temperature	-30→+50	°C
compressed air of 6 or 12 bar	0–50	°C
natural gas	0–50	°C

**Table 6:** Recommended ranges of temperature sensors for energy measurements

##### 4.3.3.1. Manufacturers – recommendations

**ZPA EKOREG, JSP, SENZIT, REGMET, COMET, E+H** – others after written approval by the responsible person of ŠE-TS.

## 5. Specification of individual subsystems – substations, communication, visualisation

**If the technological network is not available at the place in question, it is necessary to purchase additional equipment according to the requirements of FIO/34 – already within the design is it necessary to include this in the list of activities!!!**

### 5.1. Energy measurement – Mladá Boleslav production plant

#### 5.1.1. CED/ENERGIS information measurement system

##### System description

The energy measurement and control system is implemented on the basis of the PLC substations SAIA and AMIT (currently around 150 units), connected to the data concentrator via the primary cable network. The priority is now to use the Ethernet interface. In the case of already implemented communication structures, the S-BUS communication protocol can be used in exceptional cases.

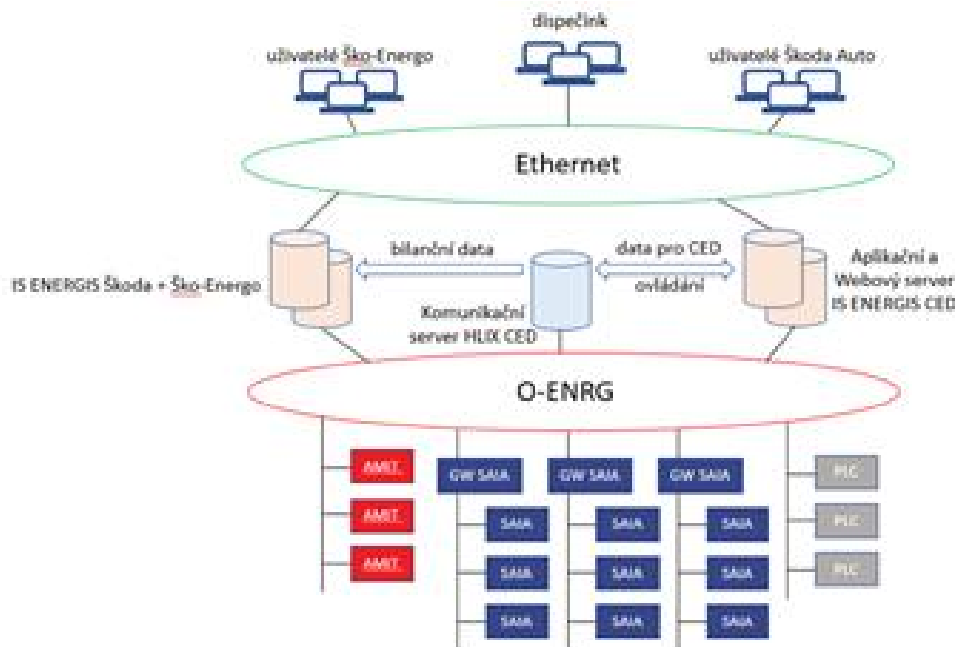
The PLCs are designed for data collection and calculation for the energy consumption information system (electricity, natural gas, compressed air, technical gases, drinking, industrial, demineralised, oiled and waste water, heat), but also as regulators (non-potable hot water regulation and central heating, pumping regulation of oiled water, regulation of cooling circuits and control of neutralisation stations).

The PLCs are connected to data points (sensors, actuators) by the secondary cable network. The PLCs can work independently without a superordinate level (in case of loss of communication). The actual measurement is performed by meters as needed with an output through the current loop (4–20 mA), pulses or the communication interface.

All present branches of the S-BUS network (+ Ethernet) from the PLC SAIA and AMIT lead to the HLIX server for the dispatching centre (ŠE), which is the communication server of the CED ENERGIS system. Data from the existing or new SAIA PCDx PLCs (which are located on the premises of ŠKODA Auto a.s.) will be available through the installed GATEWAY SAIA or through direct communication in the ŠKODA AUTO LAN. GATEWAY and separate SAIA PCDx PLCs will provide communication via LAN of ŠKODA AUTO in a separate network segment. GATEWAY will also provide communication with PLCs located within the given GATEWAY by using S-Bus communication. The newly installed AMIT PLCs will also be directly communicated via LAN to the ŠKODA AUTO network. The HLIX communication server (virtual) will communicate with GATEWAY. The HLIX



communication server is used for the location and management of primary data warehouses. Data pumps are installed on this server, which ensure data communication with data sources. Another essential function of the communication server is to prevent data loss due to a malfunction of the infrastructure. The CED ENERIGS license is operated on a new virtual central server CED, which with the help of a standard client (e.g. IE or Mozilla in the currently verified versions) enables work with technological information and parameters of individual stations in graphical or tabular form.



**Figure 2:** Topological diagram of the CED system

#### Hardware specification and visualisation

It is recommended to use SAIA PCD2.M5XXX, AMIT and PCD3 PLC stations in the CED/ENERIGS system (Ethernet communication – exceptionally via S-BUS when integrated into old solutions).

The number and type of input and output cards depend on the number and type of connected sensors (signalling contacts) and the type of regulated quantities or control. The SAIA basic unit is mounted on a pair of DIN rails in a vertical position in the MaR distribution board.

Display and command industrial terminals must be equipped with a graphic display (type e.g. WEINTEK 6051iP) which will be mounted on the door of the MaR distribution board (for more complex modifications use a larger diagonal) – another type after written approval by the responsible person of ŠE.

- In cooperation with the designer and the supplier of the control system, ŠE is the contracting party of hardware and software functions.

**In exceptional cases, PLCs by other manufacturers can also be integrated into the system. The connection of any PLC must be consulted with the system administrator at ŠE – department TS/3 and EI/4.**

Visualisation of technologies (compressor station, cooling station, heating engine room,...) is in the **CED** environment. It is necessary to use the virtual server IP 172.29.2.32 for data collection (reading from PLC). Each new "screen" must be visible on other existing CED clients at the Mladá Boleslav plant. The CED must also communicate the data on energy consumption (heat, electricity, compressed air, water, natural gas,...), which is forwarded from the **ENERIGS** system.

#### Energy equipment communication network:

Activate the equipment in the technological network: see Annex 1

The CED application is registered under ID 182654 (information on the Škoda Auto Intranet): <https://ums.skoda.vwg/SkoNetInfo/Application.aspx?appId=182654>

Virtual application server	smbegc4t1.mb.skoda.vwg	172.29.2.31
HLIX virtual communication server	smbegh4t1.mb.skoda.vwg	172.29.2.32

**Table 7:** CED communication network

#### Operator guarantor:

Brabec, Oto 2 (ŠE TS/3) [Oto.Brabec2@sko-energo.cz](mailto:Oto.Brabec2@sko-energo.cz); +420 326 812 702

#### Service organisation contact

Tesycy - Zdeněk Křížek; [krizek@tesyco.cz](mailto:krizek@tesyco.cz); +420 605 245 666

#### 5.1.2. EBI information measurement system (HVAC units)

##### System description and general rules

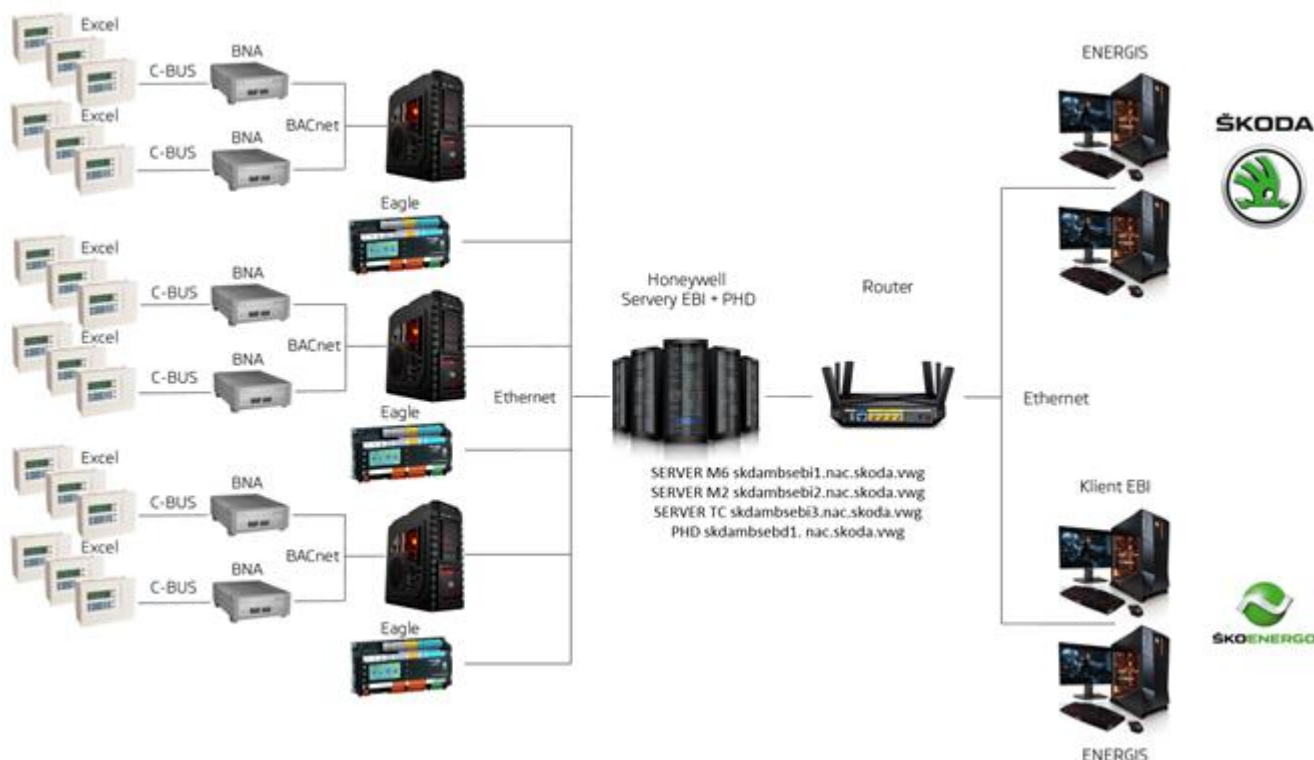


In the case of implementation of HVAC units, a distinction must be made between two basic types according to their performance:

- 1) HVAC equipment up to and including 10 000 m<sup>3</sup> per hour
- 2) HVAC equipment over 10 000 m<sup>3</sup> per hour

**MaR autonomous control units can be used for HVAC units of Group 1).** Such systems, however, must allow the connection of collective fault and run signals to the visualisation system.

**For devices over 10 000 m<sup>3</sup>/h, the control will be done by freely programmable controllers (regulators) by HONEYWELL, SIEMENS or SAIA.** The overall concept of major actions will always be done with the Ško-Energo department – TS. **All requisites and precise requirements concerning HVAC units (including MaR) are included in ITS 1.21 Heating, Ventilation and Air Conditioning**



**Figure 3:** Topological diagram of the EBI system

#### Hardware specification and visualisation

The system is primarily based on Honeywell Eagle PLC (Excel 5000). Data communication to the server takes place via serial lines (C-Bus) which are terminated by a converter to Ethernet, the so-called BNA (Building Network Adapter). The data is communicated to the server via the Škoda Auto network.

New PLC can be integrated into the communication either by including it in the existing serial lines or by connecting it directly to the Škoda Auto Ethernet network via BNA.

In exceptional cases, PLCs by other manufacturers can also be integrated into the system. The connection of any PLC must be consulted with the system administrator at the ŠE-TS department.

HVAC units are visualised in the **EBI Honeywell** system. It is necessary to use the virtual server EBI2 IP 10.220.119.56 for data collection. Each new "screen" must be visible on other existing EBI clients at the Mladá Boleslav plant. As part of the EBI system, it will be necessary to purchase a database extension by the appropriate number of data points.

#### Energy equipment communication network:

Activate the equipment in the technological network: 172.29.2.0/24

Application: <https://ums.skoda.vwg/SkoNetInfo/Application.aspx?apld=129849>

List of the EBI Honeywell system servers

Server M6	SKDAMBSEBI1	172.29.2.11
Server M2	SKDAMBSEBI2	172.29.2.12
Server TC	SKDAMBSEBI3	172.29.2.13

**Table 8:** List of the EBI Honeywell system servers



#### Operator guarantor

Slavik, Vladimír (ŠE TS/3) [Vladimir.Slavik@sko-energo.cz](mailto:Vladimir.Slavik@sko-energo.cz); +420 734 264 508

#### Service organisation contact

Honeywell – Luboš Chasák; [lubos.Chasak@honeywell.com](mailto:lubos.Chasak@honeywell.com); +420 602 382 821

#### Distribution point protection system (microSCADA MB)

The ABB MisroSCADA PRO "Distribution Point Protection" system is designed for the monitoring, control and automation of distribution points at the Mladá Boleslav and Kvasiny plants. Data communication takes place via a closed local Ethernet network. The system is not connected to the Škoda Auto corporate network. Data from individual REF 54x ABB Vaasa Finland terminals are communicated to the system.

A specific extension of the system must be consulted with the system administrator at ŠE-TS.

## 5.2. Energy measurement – Kvasiny production plant

### 5.2.1. RC Ware information measurement system

#### System description

The energy measurement and control system is implemented on the basis of the PLC substations SAIA (280 units) and SAUTER (20 units), connected to the server via the data network. This network transmits data to the server and back by using the S-BUS, RS323 communication protocol and an optical network with MOXA converters.

The overall topological diagram and functions of the whole system are evident from Figure 1 (below). The PLCs are designed for data collection and calculation for the energy consumption information system (electricity, natural gas, compressed air, technical gases, drinking, industrial, demineralised, oiled and waste water, heat), but also as regulators (regulation of non-potable hot water and central heating, pumping regulation of oiled water, regulation of cooling circuits – HVAC).

The PLCs are connected to data points (sensors, actuators) by the secondary cable network. All current branches of the data network lead to the RCWare server and further on to the dispatching centre (ŠE). The server obtains data from all PLCs and stores them in database files on an external disk array where they are archived for 3 months. The data can be visualised by dispatching computers. The dispatching computers that are connected to the network with the communication and information server, visualise real data and enable commands. Other computers (including computers in the corporate network) enable visualisation of real and historical data according to user permissions. Trending of measured quantities can be done from all computers with allowed access to the server. The server also ensures data transfer to the ENERGIS external superstructure system. The server can be accessed remotely via a modem (remote monitoring and service).

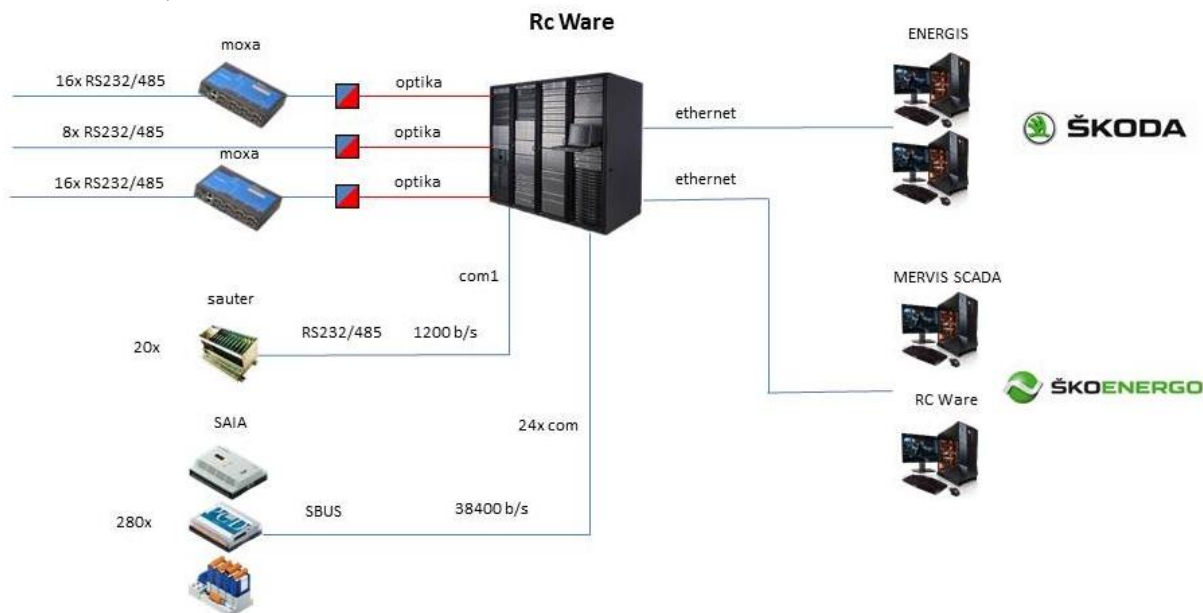


Figure 4: Topological diagram of the MaR Kvasiny system

#### Hardware specification and visualisation

text terminals: PCD7.D8xxx, PCD7.D7xxx, PCD7.D2xxx  
touch terminals: MT61.00, MT81.00

A separate DMZ network for energies has not yet been built in the Kvasiny production plant. Equipment in the number of units is handled by FIO individually. In the event of a systematic increase in individual communication devices, a separate DMZ would have to be created.

#### Energy equipment communication network:

Kvasiny system – RCWare

**individually with FIO**
**Operator guarantor:**

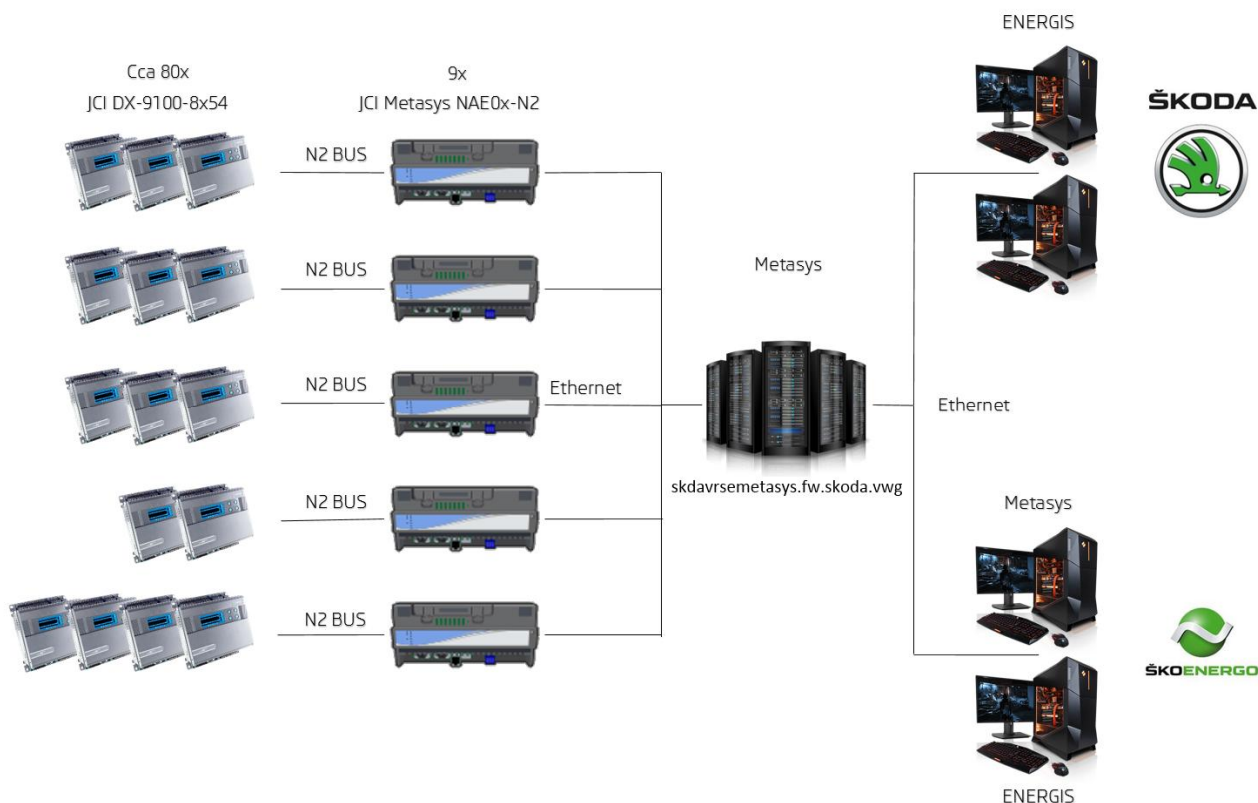
Kubec, Martin (ŠE TS/4 – MaR and IS technology); [martin.kubec@sko-energo.cz](mailto:martin.kubec@sko-energo.cz); +420 734 783 516

**Service organisation contact:**

ENERGOCENTRUM PLUS, s.r.o. - Muchna, Luboš; [muchna@energocentrum.cz](mailto:muchna@energocentrum.cz); +420 606 166 279

**5.3. Energy measurement – Vrchlabí production plant**
**5.3.1. Vrchlabí – energy information and control system – Johnson Controls**

The system is intended for the monitoring and controlling of energy equipment in the Vrchlabí plant. The system consists mainly of the DX8451 and DX8454 regulators by JC, which are connected to individual serial lines (currently the system has 9 lines) communicating with the NAE35 network control units via the communication protocol (N2-Bus). These network control units further communicate via the ETH Š-A connection one with another and with the virtual server that is physically located in the Š-A data centre in MB.


**Figure 5:** Topological diagram of the JCI Vrchlabí system

**Energy equipment communication network:**

Vrchlabí – Metasys system

**10.221.161.117**
**Operator guarantor:**

Štefan, Jaromír (ŠE TS/5); [jaromir.stefan@sko-energo.cz](mailto:jaromir.stefan@sko-energo.cz); +420 734 264 525

**Service organisation contact:**

PMNP - Petr Mach; [mach@pmnp.cz](mailto:mach@pmnp.cz); +420 603 894 946

Technological part.

Network control units: **NAE 1 – NAE 9**

IP addresses and DNS names of network control units: **ON REQUEST**

Virtual server	skdavrsemetasys.fw.skoda.vwg	10.220.111.66
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**Table 9:** IP address of the virtual server of the Metasys – Vrchlabí system

User workstations: **ON REQUEST**



#### 5.4. Direct energy measurement – ENERGIS

##### 5.4.1. Direct energy measurement by the ENERGIS system

ENERGIS is a superstructure system, which is used mainly for recording and invoicing of energies, and it is also used for the archiving of selected data from other systems.

**The measurement of energy consumption (electricity, heat, natural gas, water. ...) which is not directly related to the visualisation of HVAC technology in MB, visualisation in the Metasys or RC Ware systems is required to be communicated via the Ethernet interface directly to the ENERGIS system – the server in the O-ENRG network segment. The method of transmission must be consulted with the system administrator at the ŠE-TS department.**

##### Energy equipment communication network:

The new subnet is O-ENERG (172.29...) see Annex – Availability of the O-ENRG Networks.

Application: <https://ums.skoda.vwg/SkoNetInfo/Application.aspx?appld=114541>

IS ENERGIS HLIX MB data collection	msehlix1.enrg.skoda.vwg	172.29.10.136
IS ENERGIS HLIX KV data collection	skdakvwz0074.kv.skoda.vwg	10.221.214.23
IS ENERGIS HLIX VR data collection	mvrz0029.fw.skoda.vwg	10.221.161.18
IS ENERGIS Škoda Auto a.s.	smbegs1a.mb.skoda.vwg	172.29.2.15
IS ENERGIS Ško-Energo, s.r.o.	ENERGIS.enrg.skoda.vwg	172.29.2.22
Virtual server for the migration of the application IS ENERGIS Ško-Energo, s.r.o. (2020)		172.29.2.33

**Table 10:** IP addresses of the ENERGIS system servers

##### Operator guarantor – Mladá Boleslav plant:

Vrba, Premysl (ŠE TS/1) [Premysl.Vrba@sko-energo.cz](mailto:Premysl.Vrba@sko-energo.cz); +420 326 819 318

##### Operator guarantor – Kvasiny plant:

Krassek, Petr (ŠE TS/4); [petr.krassek@sko-energo.cz](mailto:petr.krassek@sko-energo.cz); +420 734 264 547

##### Operator guarantor – Vrchlabí plant:

Vrba, Premysl (ŠE TS/1) [Premysl.Vrba@sko-energo.cz](mailto:Premysl.Vrba@sko-energo.cz); +420 326 819 318

Štefan, Jaromír (ŠE TS/5); [jaromir.stefan@sko-energo.cz](mailto:jaromir.stefan@sko-energo.cz); +420 734 264 525

##### Service organisation contact:

INSTAR ITS Ostrava, a.s. – Hahn, Michael; [michael.hahn@instar.cz](mailto:michael.hahn@instar.cz); +420 737 208 029

#### 5.5. Measurement of electricity consumption of e-mobility charging stations

##### 5.5.1. IS CPO – vehicle charging system

##### System description

**IS CPO** is a system for the operation, management and maintenance of the charging infrastructure for vehicles with electric or hybrid drive at ŠKODA AUTO a.s. (IS CPO system). The complete system is implemented on the basis of PLC substations, which read data from individual electricity meters. Each charging connector included in a charging station must be equipped with an electricity meter. It is not possible to aggregate consumption measurements through multiple connectors within individual charging stations. The mentioned PLC substations are connected to the internal technological network (primarily by cable – metallic or optical connection; or by via GSM in justified cases and as per recommendation of FIO). The only possible way of metallic or optical connection is through the Ethernet interface.

The PLCs are designed for data collection, remote monitoring and the activation of charging connectors from the superstructure information system. All data are therefore aggregated within IS CPO and subsequently distributed to the ENERGIS recording system for the energy consumption monitoring (electricity, natural gas, compressed air, technical gases, drinking, industrial, demineralised, oiled and waste water, heat).

The PLCs are connected to individual data points within IS CPO by the primary cable network. The PLCs must enable independent autonomous activity without a superordinate level (in case of loss of communication). The actual measurement is performed by meters as needed with an output through the communication interface.

The dispatching centre (ŠE), which includes the communication, information and database server, works in the ŠA environment. In the event of a failure, the charging stations log all records to the internal cache memory and then (after connectivity has been restored) they are sent to IS CPO, where they are evaluated and archived. IS CPO therefore obtains data from all PLCs and stores them in database files on an external disk array where they are archived. The data can be visualised within the dispatching interface. The dispatching computers that are connected to the network with the communication and information server, visualise real data and enable commands, including the options of reporting and charging consumption records. Other computers (including computers in the corporate network) enable visualisation of real and historical data according to user permissions. Trending of measured quantities can be done from all computers with allowed access. The server also ensures data transfer to the ENERGIS external superstructure system. The server can be accessed remotely on the basis of compliance with all security restrictions and authorisations by FIO ŠA and ŠE.

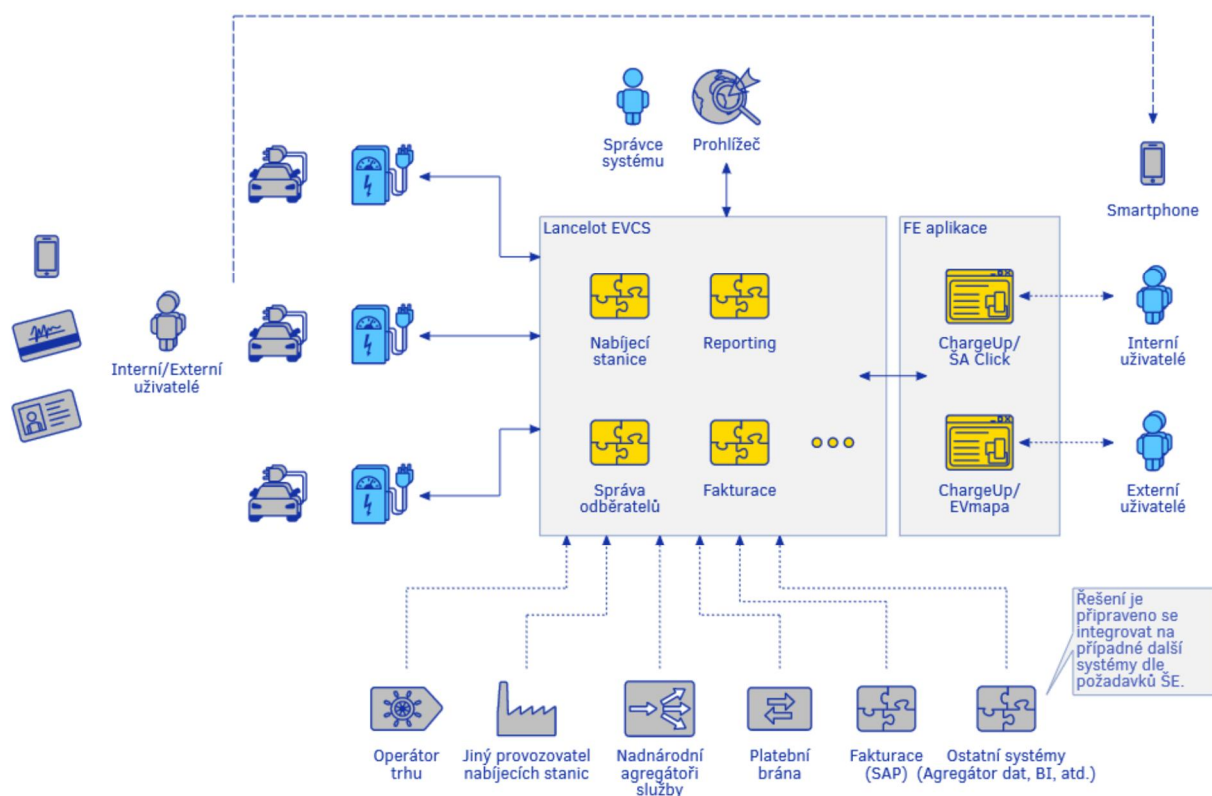


Figure 6: Topological diagram of the IS CPO – LANCELOT EVCS system

#### Hardware specification and visualisation

It is recommended to use stations with PLC in the system according to the specification given in **Lastenheft\_1B\_v1.4\_Ladestationen\_MINIMAL\_Technische\_spezifikation\_für\_SKODA\_AUTO\_CZE**, where the basic condition is to meet the minimum requirements for the communication protocol OCPP 1.6 in the JSON version or higher.

The number and type of input points depend on the number and type of connected stations/connectors (communicated charging points / connectors) and the supplied charging station technology. The basic PLC unit is mounted on a DIN rail integrated inside the charging station.

Display and command terminals can be equipped with a graphic display (outdoor version with IK 10) which will be mounted on the central charging station – "MASTER" type (for more complex modifications use a larger diagonal).

- In cooperation with the investor, ŠE is the contracting party of hardware and software functions.

**In exceptional cases, PLCs by other manufacturers which are not approved by the department of TS/1 Energy Management – Charging Infrastructure and the BA department at Škoda Auto a.s. may be included in the system but **all costs associated with integrating the equipment into IS CPO are borne by the supplier of the equipment**. The connection of any PLC must be consulted with the system administrator at ŠE – department TS/1.**

The technologies can be visualised in the environment of the Dispatcher Map module, which the IS CPO system is equipped with. It is necessary to use the virtual server IP 172.25.128.204:8715 for data collection (reading from PLC). Each new charging station (a group of charging stations in the MASTER/SLAVE mode) must also be visible to other existing clients in the Mladá Boleslav plant. IS CPO must also communicate data on energy consumption, forwarding them to the **ENERGIS system – the introduction of a new charging station must always be consulted and approved by the department TS/1 – Energy Management – Charging Infrastructure**.

#### Energy equipment communication network:

LANCELOT EVCS is registered under ID (information on the Škoda Auto Intranet):

Application:

Virtual server – communication of stations (OCPP 1.5)	skdambselanc.emo.skoda.vwg	172.25.128.204:8715
Virtual server – communication of stations (OCPP 1.6 SOAP)	skdambselanc.emo.skoda.vwg	172.25.128.204:8716
Virtual server – communication of stations (OCPP 1.6 JSON)	skdambselanc.emo.skoda.vwg	172.25.128.204:2567
Virtual server – issued APIs (including the swagger)	skdambselanc.emo.skoda.vwg	172.25.128.204:666
Databases	skdambsql01.skoda.pd	10.220.124.110

Table 11: Interface for the communication of the charging station with IS CPO





#### Operator guarantor:

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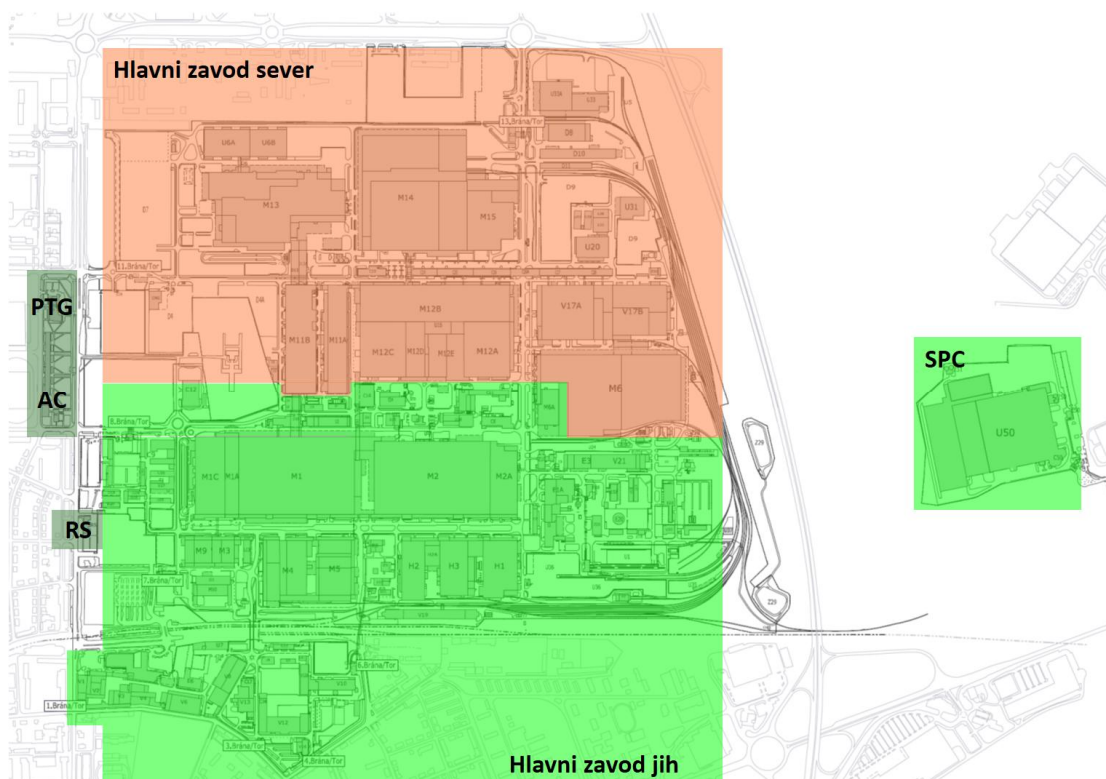
#### Service organisation contact

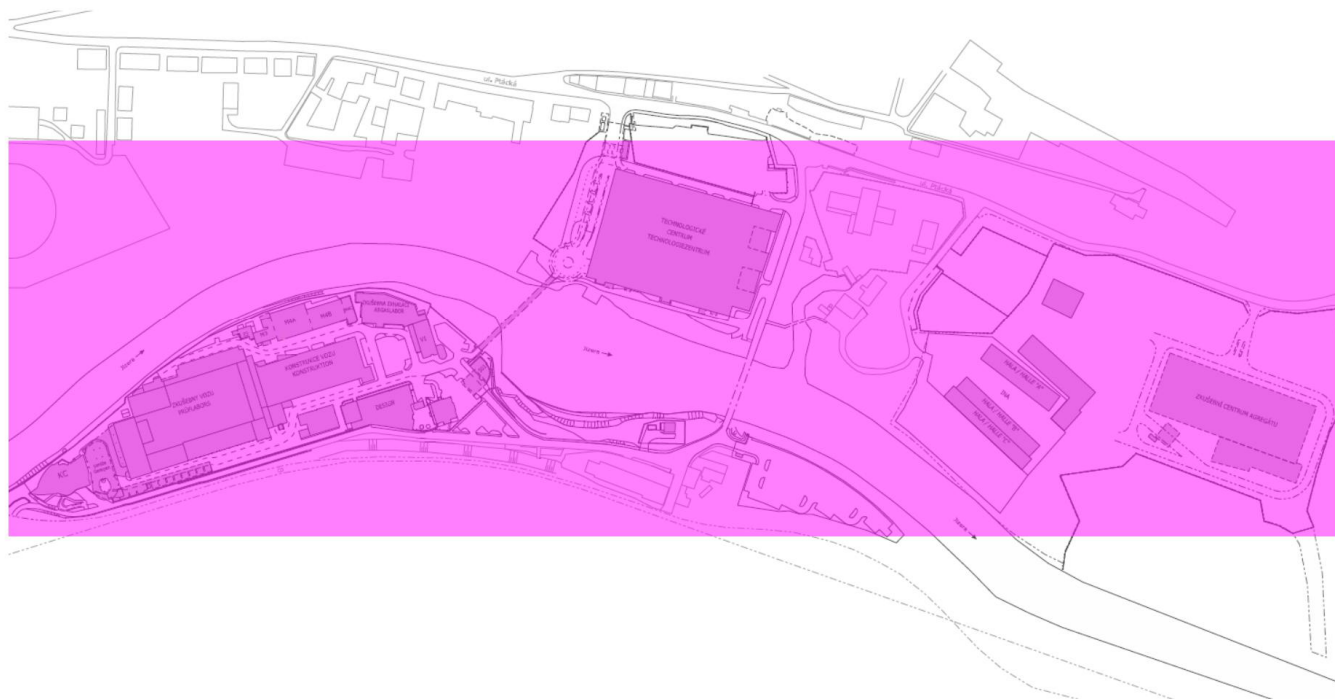
UNICORN – Tomáš Hejna ; tomas.[hejna@unicorn.com](mailto:tomas.hejna@unicorn.com)@unicorn.com; +420 777 692 190

## Dostupnost sítí pro O-EMO (E-mobility)

Boleslav	Koncová zarizeni oblast ACE-PEN MB-A01  O-EMO-MB-A01 172.25.132.0/23	Koncová zarizeni oblast V8-INCC MB-A02  O-EMO-MB-A02 172.25.134.0/23	Koncová zarizeni oblast V1-510 TV-A03  O-EMO-TV-A03 172.25.136.0/23	Koncová zarizeni oblast M11-M12 MB-A04  O-EMO-MB-A04 172.25.138.0/23
	Vrchlabi		Koncová zarizeni Kvasiny KV-A01  O-EMO-KV-A01 172.25.142.0/23	Kvasiny
	Ostatní vzdálené lokality	Koncová zarizeni Remote locations LR-A05  O-EMO-LR-A05 172.25.130.0/23	Koncová zarizeni Síť GSM  O-EMO-GSM-APN 172.25.156.xx	

- Kosmonosy
- Bondy
- Autosalon
- VS - Na Karmeli
- TV - Cesana









## 6. Basic installation conditions

During electrical installation, it is necessary to observe all applicable safety regulations and binding provisions of the ČSN Czech technical standards, including electromagnetic compatibility (EMC).

### 6.1. Electrical equipment of the distribution board

- Lighting with a switch (a door contact) – in all fields, at least 1 service socket of 230 V / 16 A per field – power supply of the service socket before the main switch (safety must be observed)
- Signalling of the distribution board opening by a door contact with leading into the PLC – in all fields
- Signalling of a fuse failure to the PLC
- In the case of selected MaR distribution boards which are located in HV distribution points, an uninterruptable power supply is also in place
- Use the TN-S 1+N+PE 230 V / 50 Hz system to supply the MaR equipment
- The MaR distribution point must be equipped with a safety STOP button (emergency shut-down) located on the door of the distribution board. In closed locked engine rooms, it is possible to use the STOP buttons of type XAL-K174E – SCHNEIDER with locking and protective basket against accidental shut-down. If the distribution boards are located in unlocked rooms, the STOP button under the glass of type GW 42201 GEWISS will be used. It is necessary to make a yellow frame with an overlap of 5 cm under such box. Signalling representing a general failure will be placed on the door of the distribution board
- Carry out protection against dangerous touch voltage by automatic disconnection from the source or by PELV or SELV according to ČSN 33 2000-4-41 ed. 2
- Design of RAL 7035 distribution board; in unlocked rooms: RAL 9010

### 6.2. Principles of PLC installation, including the aspect of electrical safety

If it is needed to install a PLC (a regulator), it is necessary to follow all the information given herein. The PLC is mounted in the MaR distribution board which must meet the following criteria:

- Protection of at least IP54, MaR distribution board – designation BA, HV current distribution boards – designation RM
  - Designation of distribution boards in Kvasiny: RA xxx – device number (MaR) as per building  
RM xxx – device number (ET or ET/MaR) as per building
- Distribution board dimensions for larger applications: 800(600) x 400 x 2000 mm (cabinet on the floor, including a 100 mm stand)
- Distribution board dimensions for smaller applications: 800 x 600 x 800 mm (suspended on the wall)
- If the distribution board is integrated in one block of HV current cabinets, use a side partition plate
- The distribution board must be equipped with a lock and universal insert for the entire system (lock 1333)
- The distribution board must be marked in accordance with the project and the table of data points (TDP)
- The distribution cabinet must be equipped with a stand
- Descriptions must be made on engraved labels; it is needed to indicate the designation and connect the distribution board
- If there is a risk of mechanical damage to the distribution board, steel barriers must be installed
- It must be possible to open the distribution board to an angle of 95°. After opening the door of the distribution cabinet, there must be a free space of at least 1 m in front of the distribution cabinet from the nearest live part.

#### 6.2.1. Manufacturers – recommendations

Rittal – The System, Schrack Technik, OEZ

#### 6.2.2. Power conductors:

Back up the power supply of the PLC system from two independent sources (from two different distribution points or transformer stations or use an emergency source or UPS) – **always consult the necessity and method of power backup with the SE-TS department**. It is always necessary to install a power filter and a surge protector at the input of the supply voltage for the PLC in the MaR distribution board. It is not allowed to connect the live parts of the circuit behind the supply transformer to the PE or the N conductor. The supply conductors behind the power filter and the transformer must no longer overlap with the supply cables before the filter. The PLC cover must be conductively connected to the PE conductor with a minimum cross-section of 4 mm<sup>2</sup>. If a UPS is requested, the UPS must be connected to the TOTAL STOP circuit of the building, according to ITS 2.11, ČSN 73 0802, ČSN 730804. The PLC memory must be backed up by its own battery due to the risk of data loss in the event of a UPS failure.

#### 6.2.3. Binary inputs:

Only in the case of a thorough separation of input cables from power and supply conductors is it allowed to use unshielded wiring; if this cannot be observed, it is necessary to use shielded conductors with earthing at the input to the distribution board. The other end of the shielding remains unconnected.

#### 6.2.4. Binary outputs:

Inductive loads must always be equipped with a suppressor. The semiconductor components at the outputs are particularly prone to breakdown during the switch peak.

#### 6.2.5. Analogue inputs and outputs:

Always use only shielded cables. Ground the shielding outside the distribution board at the input to the distribution board, ground the shielded wiring in the distribution board at the PLC terminal block. Overlapping with power or supply wiring is not permitted. Preferably use sensors with **current** output for the measurement.

### 6.3. Cabling

When assembling MaR components, it is necessary to comply with ITS 1.11 Electrics and 5.11 Electrical Assembly and Installation. The following principles must be observed for the correct installation of MaR cables.

- The measuring cables from sensors to the sub-switchboard – shielded double wire 2 x 1 mm<sup>2</sup>, ground the shielding only on the sub-switchboard side (JYTY cable)
- For the RS 485 communication bus (S-BUS) – use a shielded data pair cable (LAM DATAPAR 2 x 2 x 1 mm<sup>2</sup>). The cable must not be connected
- When multiple cables with a length of more than 50 m overlap, it is possible to group them through a junction box into one shielded multi-core cable, the so-called multi-cable (JYTY X x 1 mm<sup>2</sup> cable). The S-Bus cable is not grouped with any other cables. Analogue and pulse signals must be grouped separately and led via two cables
- The cables are laid in trays made of galvanised sheet metal / wire (e.g. MARS and MERKUR 2 cable trays) or even in plastic in the case of wiring inside the building
- The routes of measuring and control cables are led separately from the routes of supply cables (a minimum distance of 250 mm)
- After consultations with the ŠE-TS department, it is also possible to use a common MARS cable tray with a separating partition for cable routes for measurement and regulation
- In the space between the tray and the sensor on cable route sections, the cables must be protected with a steel conduit (cable protection against damage) – required only in production shops. In the administration areas, they are led in a plastic pipe or skirting board – wiring in the wall
- The cable shielding must not be conductively connected to live or non-live parts of the system outside the MaR distribution board; it must not be connected to structures. The cable shielding is connected in the MaR distribution board to a special terminal block that is connected to the PE wire with a cross-section of at least 4 mm<sup>2</sup>
- The wires leading to sensors are not allowed to be conductively connected to structures. If the system requires a connection to the PE, it is done only in the distribution board by leading the PE conductors from the sensors to a special rail where they are connected, and the rail is connected to the PE with only one sufficiently dimensioned conductor (at least 4 mm<sup>2</sup>)
- After laying all the cables, the individual cores will be inspected for conductivity (buzzed), terminated in terminals and marked with indelible descriptive labels

### 6.4. Rules for connection to the network of ŠKODA AUTO a.s.

Regulators (PLC), data concentrators, converters and other devices that transmit data to the servers of the respective measurement systems must be connected to the Škoda Auto Ethernet network. It is necessary to build an Ethernet socket for their connection. The construction of the socket is supervised by the FIO/34 department (financial coverage must be provided by the investor), which entrusts the implementation to the relevant authorised company. Each data socket is assigned a unique number when created. After a socket has been built, it is necessary to request its activation. The request is sent by email to the call centre.

If possible, it is necessary to activate the sockets in the technological network – then it is not needed to request network permissions through the firewall. Individual numbers of networks for the communication of energy equipment are given in Chapter 5.

#### 6.4.1. Device connection to the network of ŠKODA AUTO a.s.

You need the following for the connection:

- Request to assign a name to the device and to be registered in SAP – Form 8028
- Request to assign an IP address in DNS, see the Škoda Auto Intranet – Form 9038
- Request to pass through the FIREWALL to the DMZ server (if necessary) – Form 9031. It is necessary to enter the required ports. It is necessary to enter the network names of clients and servers. Approval takes about 1 week, activation takes place once a week – FIO/2 department

## 7. Change management and change request

The term 'change management' is understood as any activity whose scope is to add or cancel a data point at an existing PLC. Another case is the addition or removal of a data point in the ENERGIS system. An understandable option is to combine both previous options. Each of the mentioned options may have certain solution peculiarities in change management, and therefore a technical meeting during which these peculiarities must be discussed and precisely explained is absolutely necessary.

### 7.1. Technical meeting

The subject of a technical meeting is to clearly define the content and scope of the project documentation. Representatives of the investor, the equipment supplier, the MaR supplier and the equipment user (ŠE-TS and ŠE-EI) must be present at each technical meeting. The project documentation must contain all measured and regulated quantities (new, added or cancelled). All measured and regulated quantities must be approved by the investor's responsible department (ŠE-TS and ŠA-PPB).

### 7.2. Table of data points (TDP)

The table of data points (hereinafter as TDP) is a place to store identifiers, topology, technological constants, limits and requirements for communication, visualisation and archiving of data (measured and subsequently calculated) to a specific data point. The data point is defined in the graphical part of the screen.

After preparing the project documentation and its subsequent approval, it is necessary to fill in the TDP. When filling in the TDP, the designer works with calculation formulas and texts, with the connection of the measuring point and the table of data points. If there is interference in a data point, the designer is obliged to delete the data about the terminal numbers on the SAIA PLC and must prohibit the transmission to the SAIA monitor (including the transmission to the data centre and to the ENERGIS superstructure system).

**Day the implementer makes the change = day of the last update.**



#### 7.3. Creation of the project documentation

The project documentation created by the responsible designer must be approved by the ŠE technical department. The ŠE technical department determines which quantities will or will not be transmitted to the centre as well as the authorisation of commands and transfer to the ENERGIS superstructure system. If it is considered to create a visualisation, the investor together with the implementer are responsible for its design (**it is realised through a joint design!!!**). The investor submits the approved project documentation and the visualisation proposal to the implementer (the supplier).

**!!! CHANGING THE CONTENT OF THE EXISTING DATA POINTS OR CANCELLING THE EXISTING ID\_KB AND EKOD IDENTIFIERS IS NOT ALLOWED. IT IS ALSO NOT POSSIBLE TO CHANGE THEIR EXISTING LINK !!!**

#### 7.4. Activation and handover of technological equipment (including the HW control equipment)

Assembly or disassembly, activation and subsequent handover of the delivered equipment must be carried out by the supplier only on the basis of approved project documentation. The MaR supplier is obliged to activate the HW control system.

#### 7.5. Creation and activation of control programs (systems)

In order to guarantee the correctness of the creation and the result of the software design of control programs, the project must always include:

- Complete list of input and output connections of the control system, including their technical parameters
- Control algorithms, including functionality description
- Complete description of communication protocols of all connected devices
- Description of links to the cooperating control or measuring systems, including the addresses of transmitted channels
- Description of the required behaviour of the control panel, including the links to the TDP
- Feasible graphic designs of technological diagrams for visualisation
- Description of the connection of dynamic elements to the variables in the TDP
- Description of the behaviour of non-standard dynamic elements in visualisation
- Texts of fault messages with their connection to the variables in the TDP
- Description of other non-standard visualisation requirements
- The project must be approved by the customer
- The supplier/implementer will create software for the control system based on the project documentation and TDP
- The implementer activates the SW of the control system
- The supplier/implementer must submit all commented source codes in an uncompiled and freely editable form

#### 7.6. Creation and activation of the visualisation system

The implementer creates and then activates the visualisation SW.

#### 7.7. Documentation generation

After activating the visualisation system and starting the documentation generator, the current table is saved to the SQL server. The implementer generates '\*.LST' files (**PlatneDefiniceSA** or **PlatneDefiniceSE** files) and sends them to the investor in electronic form.

#### 7.8. Result of each change – handover of the CS, VS and handover reports

The result of each change is a complete handover of the control system and the visualisation system, including the handover reports.

**The following points are part of the SW handover from the supplier:**

- Functional control system at the PLC level (including all source codes for the possibility of future modification of the regulator functionality – original source codes in an uncompiled form)
- Functional visualisation system
- Newly generated documentation by the documentation generator
- Upgrade of the measuring point table in the documentation system
- \*.LST files for the ENERGIS system (the supplier will copy them to the ENERGIS server disk)
- Draft of the handover report
- Current version of the commented source code and the executable files for the PLC

**!!! The result of each change is a complete handover of the ENERGIS system, including the handover reports!!!**

#### 7.9. Addendum

The entire course of individual steps must take place according to the schedule approved by the investor, and partial implementation must be approved by the investor's supervision!



## 8. Metrology

According to the Škoda Auto Metrology Code (ON 1.018), all new meters are classified in the category of operational undefined measuring instruments, i.e. according to the requirements of ČSN EN ISO/IEC 17025 and internal regulations; the calibration reports will be documented (as part of the Palstat system; the reports are not required for the electricity meters with MID certification). External calibration of meters must comply with the requirements of IS 028/11 FK as of 12 December 2011. Operation and maintenance of other meters that are not part of the energy measurement systems are provided by the meter owner.

## 9. Scope of the documentation

### 9.1. Documentation of the construction realisation – minimum requirements:

- List of submitted documentation
- Technical report
- List of devices – energy requirements
- List of the control system inputs and outputs
- List of cabling
- Regulation diagram
- Layout – including the physical drawing of conductors, cables, system elements
- Line single-pole connection of the distribution board
- Documentation of the construction realisation must be in the 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 EPLAN, for example)

### 9.2. Documentation of the actual construction realisation – minimum requirements:

- List of submitted documentation
- The documentation of the actual construction realisation must be in the Czech language (including the comments in Czech for the supplied software – see 5.3 and 5.5)
- The drawing documentation corrected according to the actual design in three copies (hard copies) and one digital on a CD (drawings in the pdf format)
- Current software backup from PLC, displays and all other programmable devices, source code described in detail and readable in a text editor
- Map of data points – processed in a table (xls format), containing a detailed description of the communicated data points of the PLC program in connection with the controlled technology (ranges, ports, etc ..), one USB stick or a CD
- General operating instructions + for individual devices
- Wiring drawings of individual circuits (dwg., dgn., EPLAN P8 ver. 2.0 and higher)
- Lists of items and their basic parameters by individual circuits, lists of connections and lists of spare parts for two-year operation
- Instructions for disassembly, repair, adjustment, calibration, installation and operation of all devices within the delivery
- Operator training report
- Equipment commissioning and test report
- Colour diagram of the device in the A3 format, sealed in laminated film – 1 piece
- Inspection report (initial electrical inspection of the M&R equipment that is subject to the standard on protection against hazardous touch voltage and others, especially those related to safety) and calibration reports.

## 10. List of figures

Figure 1: The MaRES technical equipment of buildings at ŠKODA AUTO a.s.....	7
Figure 2: Topological diagram of the CED system.....	15
Figure 3: Topological diagram of the EBI system.....	16
Figure 4: Topological diagram of the MaR Kvasiny system .....	17
Figure 5: Topological diagram of the JCI Vrchlabí system .....	18
Figure 6: Topological diagram of the IS CPO – LANCELOT EVCS system.....	20

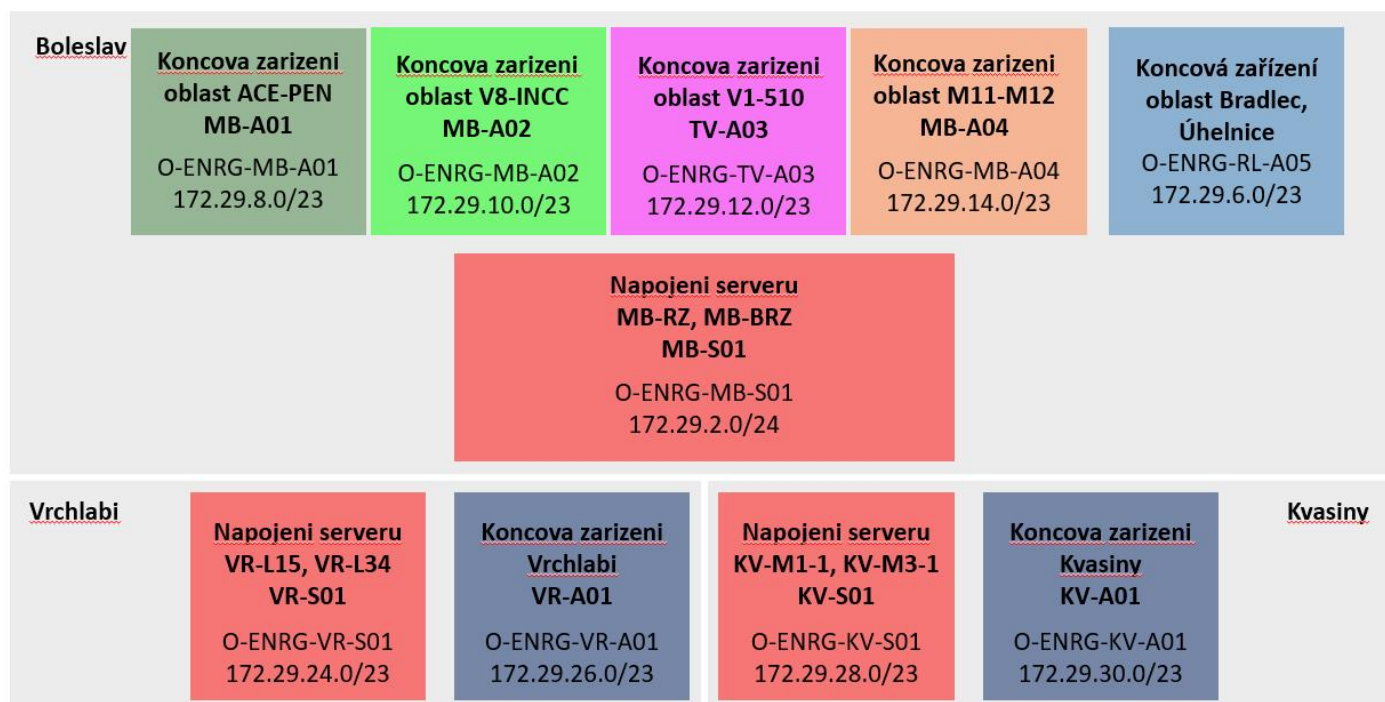
## 11. List of tables

Table 1: Overview of layers and corresponding technologies/peripherals .....	8
Table 2: Measurement and regulation systems .....	9
Table 3: Stable measuring.....	10
Table 4: Access measuring point .....	10
Table 5: Recommended ranges of pressure sensors for energy measurements .....	13
Table 6: Recommended ranges of temperature sensors for energy measurements.....	14
Table 7: CED communication network.....	15
Table 8: List of the EBI Honeywell system servers.....	16
Table 9: IP address of the virtual server of the Metasys – Vrchlabí system.....	18
Table 10: IP addresses of the ENERGIS system servers .....	19
Table 11: Interface for the communication of the charging station with IS CPO .....	20

## Annex 1:

**Communication to superordinate CMS systems**

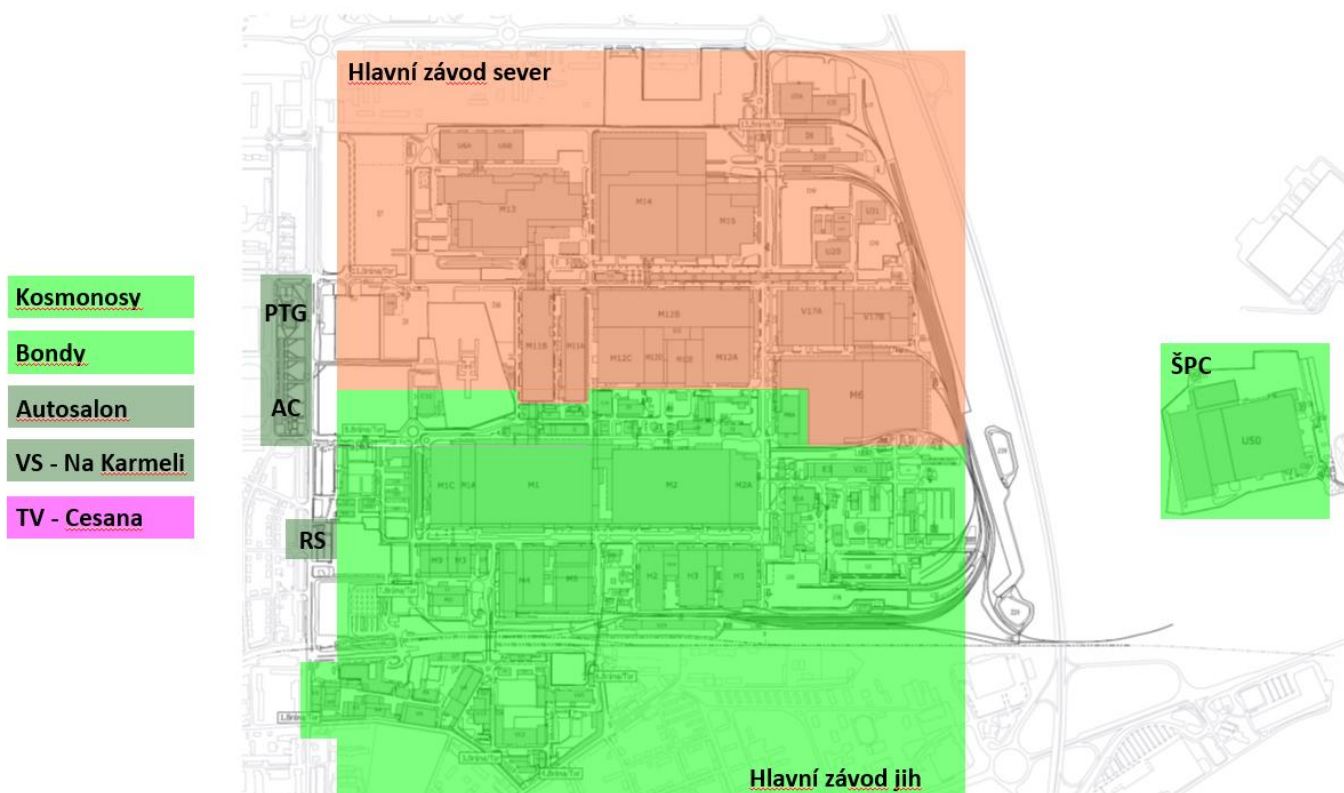
Communication to a superordinate CMS system is addressed via data transfer from individual DDC stations to the SQL database and server. The user-installed TCP-IP network is used for data transmission. The method of connection must always be discussed with the responsible representative of the customer. They will also specify the procedure for addressing the connection request in the given location. See the following graphics for network availability and distribution for data transfer to the ENERGIS recording system.

**Network availability for O-ENRG:**
**Mladá Boleslav:**


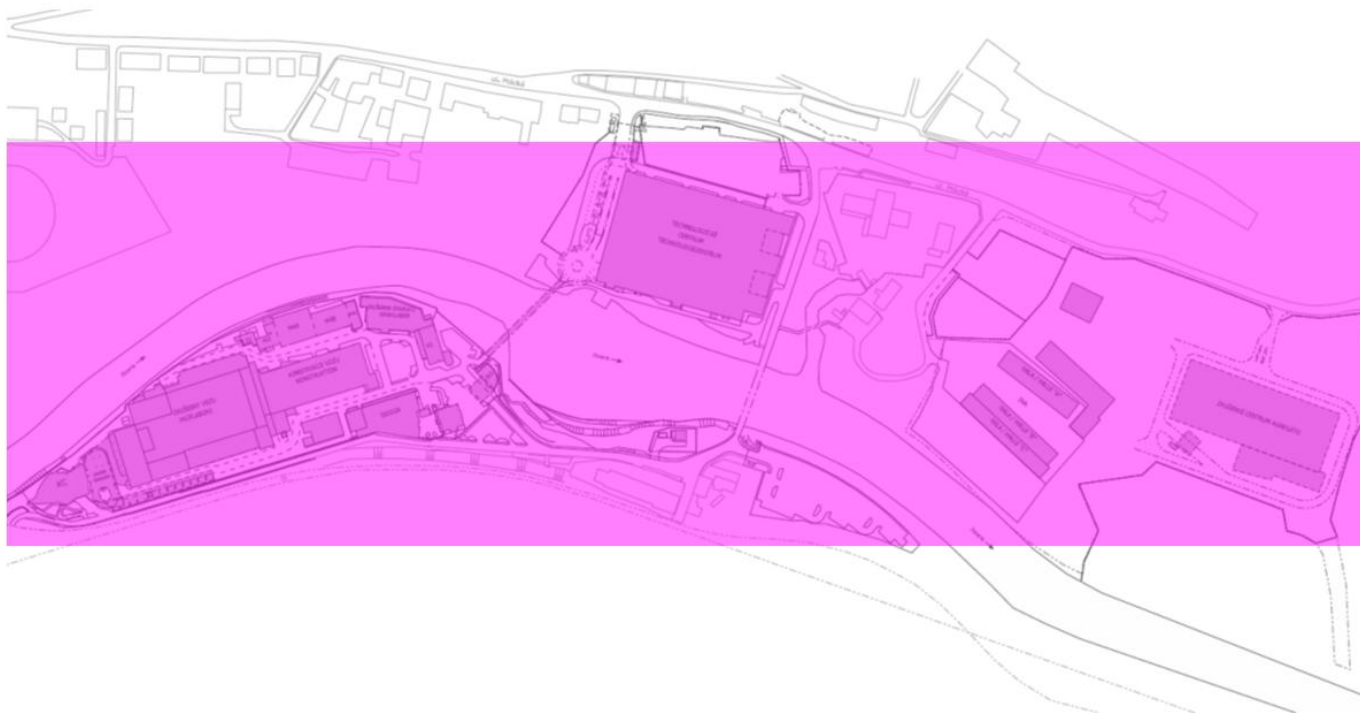




Distribution map: new diagram





**Vrchlabí:**

Server connection  
VR-L15, VR-L34  
VR-S01  
O-ENRG-VR-S01  
172.29.24.0/23

Terminal equipment  
Vrchlabí  
VR-A01  
O-ENRG-VR-A01  
172.29.26.0/23

**Kvasiny:**

Server connection  
KV-M1-1, KV-M3-1  
KV-S01

O-ENRG-KV-S01  
172.29.28.0/23

Terminal equipment  
Kvasiny  
KV-A01

O-ENRG-KV-A01  
172.29.30.0/23