



TENDER DOCUMENTATION FOR THE SELECTION OF THE CONTRACTOR

**Refurbishment of the Combined Heat and Power Plant
in Mladá Boleslav**

Business Package OB 2

BOILER HOUSES

VOLUME III

TECHNICAL REQUIREMENTS

Annex A 4.3 I&C

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1 APPLICATION OF THE SOLUTION IN THE TENDER DOCUMENTATION

The tender documentation specifies the functional specification of LOT OB 2, which must be fulfilled by the Bidder (OB 2 CONTRACTOR). The tender documentation for the tender represents the proposed technical solution for LOT OB 2, this solution may be modified by the Bidder in the application of its technical solution, in the design and selection of specific equipment according to its technical practice, experience and custom. The OB 2 CONTRACTOR may offer a more technically advanced and efficient LOT OB 2 in such a way that it meets the functional requirements set out in the tender documentation, including the links to other OBs and the requirements, statements, and opinions of the public authorities

The OB 2 CONTRACTOR is obliged to indicate the items that differ in the list of deviations.

Business Package 2 (LOT OB 2) is a separate part that is integrated into the Scada HMI system (application servers). HMI Scada is handled within Business Package 5 (LOT OB 5). Within the LOT OB 5 control system, OB 2 interacts with and receives the necessary data from LOT OB 4 (Automatic unloading machine), LOT OB 1 (Fuel Handling System), LOT OB 3 and LOT OB 6 (Rail Transport and Construction) and LOT OB 7 (SEP – Stable fire extinguishing system). This data is used by LOT OB 2 to coordinate and optimize processes throughout the system.

The subject of delivery OB 2_I&C will be:

- Delivery of HW + SW of the 800xA system for the AC800 process level (K20 control system cabinets)
- With regard to the extension of the technology enabling the combustion of wood chips in the K80/90 coal boilers, the OB 2 supplier must ensure the extension (HW+SW) of the existing Procontrol P14 control system for this part, or use the existing I/O reserves
- Process cabling
- Field instrumentation including cabling
- Continuous Emission Monitoring System (CEMS)

2 VALIDITY OF THE TENDER DOCUMENTATION

The tender documentation specifies the requirements for the I&C as well as the design of the technical solution to illustrate the technical concept. Within this technical concept, the flexibility of the OB 2 CONTRACTOR to apply its technical solution in the design and selection of a specific facility, following its good engineering practice, will be acceptable so that all requirements specified in the tender documents are met.

3 LIST OF ABBREVIATIONS

Note: Sorted alphabetically according to the Czech version.

AMS	Automated measuring system
ASME	International standard (The American Society of Mechanical Engineers)
I&C	Automated management of technological process
BMS	Burner management system
OHS	Occupational safety and health
CD	Compact disk for data storage

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CE	CE marking
CEMS	Continuous emission monitoring system
CPU	Central processing unit
CES	Central evaluation system
CR	Czech Republic
DCS	Distributed control system
DIN	German standards (Deutsche Industrie Norm)
DPP	Documentation for operation
DPU	Documentation for maintenance
DTM	Device time manager
DVD	Digital versatile disc
EMC	Electromagnetic compatibility
EC	European Community
EU	European Union
FAT	Factory acceptance test
FDT	Field device tool
FC	Frequency converter
FO	Fiber optic
GPS	Global Positioning System
HART	Highway addressable remote transducer
HAZOP	Hazard and Operability Study
HMI	Human machine interface
HW	Hardware
IEC	International Electrotechnical Commission
IEEE	Standard containing requirements for SW design (Institute of electrical and electronic engineers)
I/O	input/output
IP	Ingress protection
ISO	International organization for Standardization
IT	Information technology
ITS	Internal technical standard
LAN	Local area network
LCD	Liquid crystal display
MTBF	Mean time between failures
MTTR	Mean time to repair
MŽP	Ministry of the Environment
PM	Particulate Matter
NTP	Network time protocol
RLI	Regional Labour Inspectorate
OB	Business package

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OPC	Ole for process control
OS	Operator station
PBŘ	Fire safety solutions
PC	Personal computer
PLC	Programmable logic controllers
FP	Fire protection
CS	Control systems
SAT	Site acceptance test
SER	Sequence of events recording
SEE	Stable extinguishing equipment
SIL	Safety integrity level
SOE	Sequence of event
SW	Software
ŠE	ŠKO-ENERGO, s.r.o.
TIČR	Technical Inspection of the Czech Republic
TVOC	Total volatile organic compounds
SP	Solid pollutants
ÚNMZ	Office for Technical Standardization, Metrology and Testing
UPS	Uninterruptible power source
UTC	Coordinated universal time

4 GENERAL TECHNICAL REQUIREMENTS FOR I&C

This section covers the design criteria that will be used for all instrumentation and control equipment and work associated with the construction of the K20 biomass boiler. The OB 2 CONTRACTOR shall also provide an extension to the existing integrated distributed control system of the I&C (K80/90), including the emergency shutdown system and including all required field instrumentation, in full compliance with the requirements of this specification.

The I&C system must meet the requirements of all process systems and equipment, taking into account the conditions and specifications of operation, maintenance and environment.

The OB 2 CONTRACTOR shall be responsible for the system from its design, fabrication, installation, commissioning, to delivery of the WORK to the OB 2 CONTRACTOR. The scope includes the I&C section (process level control systems and field instrumentation equipment including cabling) for the new K20 boiler and all associated dedicated control systems.

5 CODES, STANDARDS AND REGULATIONS

The I&C equipment shall be designed, manufactured, installed, commissioned, and handed over in accordance with the relevant Czech national ČSN standards or other internationally recognized and approved standards: DIN, ISO, ASME, IEC.

The OB 2 CONTRACTOR shall fully respect the previous project preparation and the decisions and opinions of the competent authorities, and all conditions related thereto. The chosen materials used in the design of any building structures and technological equipment, or in the modification of their

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surfaces, must comply with the principles of occupational health and safety and fire protection, Act No. 22/1997 Coll., on technical requirements for products, Act No. 102/2001 Coll. with all related valid and later laws, government regulations, decrees and implementing regulations.

The OB 2 CONTRACTOR shall submit all certification documents and declarations of conformity for each material and supply.

The I&C systems shall be suitably sized and have the characteristics and capacities to ensure economic, safe, and trouble-free operation under all operating conditions and shall allow technically justified overloads within the meaning of the relevant standards and normal engineering practice. In the implementation of the supply of I&C, it will be necessary to comply with the prescribed technological procedures and application recommendations of the manufacturers of the materials used and the manufacturers of the technological equipment. The same applies to other technological procedures, standards, construction principles and installation that apply to individual specific construction activities or technological deliveries.

During the design and actual implementation of the project, it is necessary to take into account and comply with all applicable laws and regulations relating to OHS and FP for individual specific works and activities (Decree of the Czech Office of Labour Safety No. 48/1982 Coll., defining the basic requirements for OHS and safety of technical equipment, as amended in particular by Decree of the Czech Office of Labour Safety No. 324/1990 on OHS and safety of technical equipment during construction work, No. 207/1991 Coll., and all related regulations, standards and laws, as amended and amended).

The SI system of units will be used to denote measurements of physical quantities.

The OB 2 CONTRACTOR fully respects the data and operational characteristics specified in the Notification according to Annex 4 of Act No. 100/2001 Coll., as approved and commented by the Ministry of Environment as the initial characteristics for the selection of the equipment. The OB 2 CONTRACTOR shall be responsible for the preparation of any additional preparatory documentation in accordance with the applicable Czech and EU regulations concerning the characteristics of the installed work, its equipment and construction part, as well as for the discussion of such documentation.

The proposed equipment and products shall comply with the applicable occupational safety regulations and shall meet the requirements of the relevant laws, regulations, rules, and standards relating to the manner and technical design of products and equipment.

The OB 2 CONTRACTOR is obliged to respect the provisions of Act 22/1997 Coll., as amended, and the relevant government regulations. Emphasis is placed on §12 and §13 of Act No. 22/1997 Coll., which establishes the obligation of the manufacturer or importer to carry out an assessment and issue a declaration of conformity of the product with the technical regulations and compliance with the established conformity procedure before placing it on the market. The products shall bear the CE marking and, in specified cases, the number of the notified body. Certification according to the requirements of the European regulations and notified persons must also be ensured for foreign deliveries originating from outside the European Union.

Precedence of regulations relevant to the execution of the WORK

The priority of the regulations relevant to the execution of the WORK, which contain requirements for the design and execution of the I&C, is generally determined as follows (from highest to lowest):

- Czech legislation, i.e. laws and decrees, as well as government regulations,
- Czech technical standards (ČSN) and the OB 2 CONTRACTOR's internal control documentation,
- Technical standards of international organizations IEC and ISO,

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- IEEE general design criteria and technical standards related to ensuring the safety and quality of software for I&C s implemented on the basis of programmable digital technology resources.
- ITS Standards S.E. (1.05 Information Systems and Technology, 5.40 SLP Infrastructure Development, 5.20 Web/Application Server Setup, 5.30 Distribution Nodes-Technical Rooms Low Current.

However, the priorities thus established have no absolute bearing on the determination of the applicability of a given regulation to the design and implementation of a definitive I&C system. In many cases, lower priority regulations are intended as alternatives or complementary regulations to higher priority regulations - see the section Applicability of Regulations Relevant to the Implementation of the WORK for more details.

5.1 Basic list of standards used

ČSN 33 2000-1 ed. 2 Low-voltage electrical installations - Part 1: Basic aspects, determination of basic characteristics, definitions

ČSN 33 2000-4-41 ed. 3 Low-voltage electrical installations - Part 4-41: Protective measures to ensure safety - Protection against electric shock

ČSN 33 2000-4-443 ed. 3 Electrical installations in buildings - Part 4-44: Safety - Protection against disturbing voltages and electromagnetic disturbances - Chapter 443: Protection against atmospheric or switching surges

ČSN 33 2000-5-51 ed. 3+Z1+Z2 Low-voltage electrical installations - Part 5-51: Selection and construction of electrical installations - General regulations

ČSN 33 2000-5-52 ed. 2 Low-voltage electrical installations - Part 5-52: Selection and construction of electrical installations - Electrical lines

ČSN 33 2000-5-54 ed. 3 Low-voltage electrical installations - Part 5-54: Selection and construction of electrical equipment - Earthing and protective conductors

EN 61140 ed. 3 Protection against electric shock - Common considerations for installation and equipment

EN 50174-2 ed. 3 - Information technology - Cable installation - Part 2: Design preparation and construction in buildings

ČSN EN 50174-3 ed. 2 Information technology - Cable installation - Part 3: Design preparation and construction outside buildings

EN 55032 ed. 2 Electromagnetic compatibility of multimedia equipment - Emission requirements

EN 60721-1 Classification of environmental conditions

IEC 60331 Tests on electric cables under fire conditions - integrity of circuits (parts 11, 21, 23, 25)

EN 60 754 Common test methods for cables under fire conditions - Tests for gases evolved during combustion of cable materials

EN 60332-2-1 Tests on electric and optical fibre cables under fire conditions - Part 2-1: Vertical flame propagation test for small cross-section conductors or cables with single insulation

EN 50266-2-2 Common test methods for cables under fire conditions - Vertical flame propagation test on vertically mounted bundles of conductors or cables

EN 61034-1,2 Measurement of smoke density during cable burning under defined conditions

ČSN 73 0804 Fire safety of buildings - production buildings

ČSN 73 0802 Fire safety in buildings - non-production buildings

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EN 60079-14 Electrical equipment for explosive gaseous atmospheres

ČSN EN 61508 ed. 2 Functional safety of safety-related electrical/electronic/programmable electronic systems

ČSN EN 61511 ed. 2 Functional safety - Safety instrumented systems for the industrial process sector

6 Documentation requirements for I&C

6.1 Hardware documentation

The HW documentation will contain detailed information relating to the instrumentation, cabinets, cabling etc. It will include all drawings produced specifically for this work including system configuration, layout, and use of individual modules, in particular:

- the final specification of all hardware supplied, including spare parts for commissioning, with all technical data and details necessary for the identification of equipment and ordering of spare parts,
- list of cables, including all data on lengths, cable types, location in cable routes with identification of the cable tray used, etc.,
- final and detailed layout drawings of the location of all equipment supplied, including frames for instruments, cable routes, etc.,
- frontal designs of control panels/counters and drawings of workstation layouts including identification of instruments and equipment,
- positional arrangement of units and terminals inside the cabinets,
- diagrams of internal wiring of panels and counters, tables of internal connections of system cabinets,
- circuit diagrams of individual sensors,
- line, overview/block and logic diagrams (see EN 61082-1) of individual systems and cabinets,
- drawings of the interconnection cabling between the individual components of the supplied equipment and the cabling to external equipment, including the terminal wiring,
- construction drawings of cabinets, frames, etc.,
- lists of measurements including the technological range,
- appliance lists indicating selected appliances with backup power supply,
- lists of inputs and outputs of process stations (signal exchange list),
- drawings of terminal blocks (terminals) of cabinets,
- principle schemes of earthing and protection against electric shock,
- device power supply diagrams,
- data on the HW calibration values needed to achieve the required operating parameters,
- designation of the equipment according to the KKS methodology used in the ŠE.

6.2 Software documentation

The SW documentation shall contain information about the application software of the systems in sufficient detail to enable persons other than the author to understand the programs and to modify the programs after the OB 2 CONTRACTOR's responsibility has expired. In particular, it shall include:

- a basic description of the programmes' objectives, their possibilities and limitations,

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- description of input data and output values, including variable ranges, normal values, signaling limits, fault values, etc,
- Functional block diagrams for measurement, signal conditioning, control, logic control and protection,
- control algorithms, their list and description (graphic algorithm showing control and control logic of the technological unit),
- design of technological screens for the operator workplace (OB 5),
- configuration of fault and status messages and events, including the design of a form for display and printing,
- design of historical data storage configuration,
- information about sampling periods, data storage periods, process cycles of individual variables and algorithms,
- information on the software setup (calibration) to achieve the required performance criteria,
- a list of all software applications in the project, including a description of how to use them,
- data model of all applications (lists of databases/files and description of what they are used for), documented data structure of all databases/files, in case the applications use relational databases - a list of tables with primary keys, a list of tables with foreign keys, a list of binding items between tables,
- list of input and output signals, list of variables, list of measured variables, their limit values and associated alarm levels,
- a list (database) of all calculated values - including indication of physical units and calculation principle,
- any other information about the software that has been specially created or adapted for this work,
- documentation of interfaces to other systems installed outside the boundaries of the work,
- annotated SW source texts,
- Signal designation according to the KKS methodology used in the ŠE.

Furthermore, the documentation must state:

- description of the method of information presentation on the operator station screens (assignment of colors to variable states, dynamic changes, etc.),
- success criteria for tests and exams,
- methodology and tools for maintaining SW products throughout their lifetime,
- a method of securing SW products against accidental disruption and unwanted or unauthorized interference.

7 PERFORMANCE REQUIREMENTS FOR THE I&C SECTION

7.1 Basic requirements for I&C

- Unified DCS (process level) for K20 boiler technology,
- maximum safety for operators and equipment,
- safe, reliable, and efficient operation under all conditions,

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- very high availability of 99.95%,
- high degree of automation,
- providing all the data needed for operation, maintenance, and performance optimization,
- hierarchical management structure,
- all open and closed loop control systems shall be based on distributed digital control with built-in redundancy and shall be interconnected by a redundant bus system,
- redundancy provided for the process and/or instrumentation shall be implemented in the DCS to further improve overall system availability, i.e. separate independent I/O cards shall be used for redundant signals from the process,
- the single failure criteria must be applied to the whole project,
- redundant UPS power supplies for all control functions,
- time stamps for SER (Sequence of Events Recording) must be supported within the DCS, therefore all components of DCS control systems and dedicated control systems (packaged units) must be synchronized with the main clock signal,
- The new part of the DCS with all its subsystems and, if applicable, black boxes must be operated, controlled, and alarmed on a common time basis. All computers and systems with logging or archiving functions shall be time synchronized. Hardware synchronization signals from the Master Clock shall be available for subsystems that cannot be synchronized over the LAN.
- Time stamps for all types of information in databases and logs shall be UTC (Coordinated Universal Times). Daylight saving/wintertime adaptation shall be supported.

Automated functions shall be designed so that all operating conditions, including start-up and shutdown, are performed by a single operator from a single operator station for both the K80/90 and the new K20 boilers.

The system must meet the following criteria:

- The system must be up to date in terms of technology, using current information and experience.
- The system must have high efficiency to ensure reliable operation at all levels of control.
- The system must have sufficient performance to allow seamless division of automation functions into sub-processes and automatic and smooth transition to a backup control element in the event of failure of the basic element.
- The system must have sufficient memory capacity and processing speed to ensure continuous process monitoring, reporting, data storage and execution of necessary operations.
- The system must be sufficiently resistant to electromagnetic and electrostatic fields generated by the part.
- The system will guarantee high reliability, ensuring maximum MTBF and minimum MTTR values.
- Expansion of the existing DCS must not cause deterioration of the existing DCS conditions (reliability, time response, system performance, transmission capacity...).
- The new part of the DCS for K20 will be fully implemented into the existing HMI K80 K90 operator level with full monitoring and control from the existing K80 and K90 operator stations.
- A microprocessor-based common distributed control system (DCS) will be used for the newly supplied technology. The general requirement for the system is redundancy at all levels, including uninterruptible power supplies (UPS).

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- The communication buses will be optical. In justified cases, metallic conductors can also be used, especially for shorter routes. For some secondary process parts (to be defined later) PLCs can be used. The control system shall be equipped with an independent fault monitoring station with 'first received fault' signaling in case of equipment failure. A uniform time signal shall be used for the whole system. The uniform time shall be common for the newly supplied part of the control system and for the current DCS ŠE control systems or the supplied PLC units.
- The new part of the control system of the K20 boiler will be fully implemented into the existing control systems of the ŠE, which form the Procontrol P14 control system (ABB). The existing Procontrol P14 control system is used for controlling the technology of the K80/90 boilers. The communication shall allow the transmission of time stamps. One HW analogue input and one HW analogue output must always be used for any communication with frequency converters. For modifications associated with the K80/90 technology, FCs must also be equipped with binary inputs and outputs.

7.2 Qualitative performance requirements DCS

The new open control system (DCS) and its architecture must provide the following required dynamic properties; reaction and response times:

- program cycle length (scan) for critical and rapidly changing variables (protection, selected binary variables, pressure measurement, electrical measurement, etc., will be up to 200 ms maximum; time resolution of the sequence of events (SOE) - up to 10 ms; shock-free switching up to 100 ms maximum;
- the CPU's operating memory reserve will be at least 30% - evenly distributed throughout the system;
- The margin in the processor power part will be at least 30% - evenly distributed throughout the HW architecture of the system;
- system execution time reserve of at least 30% evenly distributed throughout the system;
- accuracy of conversion and linearization of input analog signals: up to 0.25%;
- reserve in the number of installed free inputs/outputs - min. 10% for each type of input/output signal used, evenly distributed throughout the system;
- wire reserve in DCS cabinets for installation of additional I/O cards - min. 20% evenly distributed throughout the system.
- the time from the operator command to the response on the controlled device will be < 1 s,
- the time from a change in the state of an analogue or digital value on the system input to the display of this change on the operator station screen will be < 1 sec,
- time interval for updating all variables of the technological screens - the time for changing the display will be < 1.5 s,
- all major new HW components of the control system must meet the MTBF of at least 250,000 operating hours.
- the communication between the operator stations and between the CPU process cabinets must be at a speed (data flow) of at least 100 Mbit/s (FAST ETHERNET).
- the required service life of the newly supplied control system equipment must be at least 15 years including the provision of SP (to be evidenced by a declaration from the control system supplier).
- the system diagnostics and module design shall allow for a mean time to repair of no more than 1 hour.

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- Transfer of selected technological data to the system for further processing via OPC technology.

The above values will be verified at the latest during the comprehensive testing of the work. The tests shall be carried out by the OB 2 CONTRACTOR as part of the work and shall be included in the inspection and testing plan for the work.

For declaring "non-measurable" required (guaranteed) properties (e.g. MTBF), the OB 2 CONTRACTOR will be required to submit the approval statements of the manufacturers of the individual HW components.

Note: the required guaranteed service life is 15 years, not valid for HW operator stations, i.e.: server, monitor, keyboard, and positioning device.

7.3 Backup and separation requirements for systems, components, and structures of DCS

The high reliability of the entire system will be due to the redundant design of the processor, communication, and power supply parts of the system. The redundancy of the HW components must be especially in these parts of the control system:

- in the processor part of the new control system,
- in the communication of the process and visualization part of the new DCS; communication between individual CPUs and between CPUs and operator stations, including network elements and communication cabling,
- in the communication section between the CPU and I/O cabinets,
- in the complete power supply of the new control system up to the level of I/O modules,
- input and output cards ensure galvanic separation of signals.

All supplied HW components will be supplied in a version for industrial use.

The concept of redundancy will be implemented in the DCS so that the reliability and availability of the system is increased by using redundant hardware and software.

The following minimum criteria should therefore be taken into account.

- Functional redundancy of all workstations.
- The communication bus must be redundant by default. This means not only a redundant transmission medium (cables), but also separate communication processors and separate internal data paths on each of the modules (controllers, couplers, etc.).
- Redundant power supply.

In case of failure of any redundant function or component, an alarm must be sent to the operational level and a shock-free switchover to the redundant unit (card)/module must be guaranteed. In the event of a complete failure of both the master and slave control unit, the outputs to the end controllers shall remain at their last value or go to a predetermined default value.

DCS modules must include comprehensive internal self-checking and diagnostic capabilities. If a fault is detected or predicted, an alarm shall be sent to the operator's station and an automatic switchover shall occur.

The OB 2 CONTRACTOR shall clearly indicate in its technical proposal how it intends to meet the stringent availability and reliability requirements of the DCS by using redundant equipment.

The new DCS will be designed so that no single failure of any equipment or power source will interrupt or disrupt any system function, nor will any single failure cause any controlled equipment to change state.

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System outputs driving redundant or parallel process devices will be assigned to minimize the impact of output card failure. In cases of failure of a single system input transducer or input module serving only that transducer, the expected DCS control response to the failure shall be acceptable. However, all such failures shall be alarmed.

The concept of redundancy should be implemented in DCS so that the reliability and availability of the system is increased by using redundant hardware.

For redundant items, it must be possible to test or replace a single unit without disrupting process control. At the same time, care must be taken to ensure that the individual units of the pair are powered from different power sources.

Items without redundancy must remain on the last valid signal during a fault or enter a predetermined "safe state".

7.4 Operator workplace

The monitoring and control of the K20 boiler will be integrated into the existing HMI of the K80/90 boilers to a common control room where the OB 2 CONTRACTOR will install an operator's station for the K20 boiler as part of OB 5.

The operator station software will be installed on existing virtual servers. If necessary, the existing HW will be expanded with additional devices in 19" racks.

Operator workstations shall be equipped with Thin CLIENTs, LCD monitors, keyboard, and positioning device (optical mouse). Operator workstation LCD monitors shall be of industrial quality designed for continuous operation (eliminating memory effect) with sufficient resolution to safely control the K20 boiler technology.

Important: The HW architecture, SW equipment and IT security of the new control system must meet the current requirements for cyber security and the binding provisions of the applicable domestic and corporate legislation.

From the company legislation of Škoda Auto, a.s., this is mainly the internal technical standard 5.13 Control technology (Updated 2021-09-20).

7.5 Station for archiving data (Historian)

The existing data archiving station will be expanded within OB 5 with sufficient storage capacity for data archiving, at least for a period of one year.

7.6 Engineering workplace

The scope of supply includes the extension (installation of system software for DCS 800xA) of the existing engineering workstation for process and operator level management of the new K20 boiler. Main functions of the engineering workstation:

- monitoring of system operation, operational and fault diagnostics,
- detection of defective components,
- modifications of control algorithms, protection algorithms, display functions and printing protocols,
- backup of system and application software, its restoration in case of failure,
- support for SW upgrade.

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7.7 Requirements for operational diagnostics

The relevant HW and SW diagnostic equipment must be an integral part of the supplied equipment.

Faults in the control system, including faults in input and output signals, will automatically activate messages at the operator station and will be printed on the printer as required. In addition to faults entering the system via input cards from the technology, it is required for any faults originating in the control system itself, such as faults in circuit breakers and fuses used to power the control system, faults in duplicated parts of the control system, loss of communication capabilities within the control system, and other similar faults that must be signaled to the operator without fail

At a minimum, the operational self-diagnostics must allow:

- proper functioning of the systems control circuit (watchdog) to detect and prevent undesirable program conditions (e.g. algorithm errors, algorithm errors in relation to HW and errors due to HW malfunction),
- diagnostics of the correct functioning of data transmissions,
- Determining the cause of malfunctioning of a non-standard operating device,
- locating the damaged component so that the diagnosed part can be repaired or replaced in a short time,
- detection of sensor fault, checking for line breaks,
- monitoring of non-standard or incorrect operating states of the control system.

The configuration of the entire control system and related equipment must be designed with the principle of safety and availability in mind, i.e. any (even local) failure, loss of signal, loss of power supply or abnormal operation of any single component of the system must not lead to the following conditions:

- limitations in communication or other important system functions,
- unnecessary shutdown or long-term limited operation of the technology - sending false signals,
- the occurrence of dangerous or hazardous conditions.

7.8 Control system

At a minimum, the following functions must be provided:

- Automatic start-up, operation and shutdown of process equipment such as functional units or groups,
- the control of the operational equipment with the mutual backup function will be implemented in physically distinct groups,
- automatic backup in case of failure of the primary device,
- monitoring the status of the sequence (unfulfilled conditions, executed command, etc.),
- individual control of drives in manual mode while maintaining all protections.

Control of functional groups and functional units

The plant as a whole will be controlled by end process stations (automated machines) under the supervision of an operator.

The functional units will be controlled by end process stations and the start-up and shutdown of the K20 technology will be implemented in steps. Each step of the sequence will be executed only after the step conditions have been met and the previous command has been executed (continuous or discontinuous image of the input conditions). Controlled drives cannot be operated manually during the operation of

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the process station without the operator deliberately cancelling the operation of the process station by switching to manual operation. Most actuators or groups will have the capability to switch between manual operation and automatic control systems. Similarly, the process station will provide step time limit controls. Standard function control blocks will be used for the different types of actuators, resulting in increased operational safety.

The status of the functional units will be signaled to the operator in a standard way, and it is thus possible to inform operators easily and unambiguously about the status of the technology controlled by the process stations. Sequence monitoring is used for sequence analysis.

The sequencing system will be able to keep the entire technology as a complete system in continuous operation at the required values, both in steady and transient states. Basic monitored data (electrical output, steam pressure and temperature, etc.) will be automatically stored along with related data without the need for operator intervention. The control of electrical power or steam pressure will control each of the parameters according to the selected operating mode throughout the control range.

The control circuits will be able to ensure automatic operation in the full power range and in all operating modes during normal and transient conditions. Transitions between different operating modes will be shock-free and without the need for manual balancing.

In the event of limiting signals to the control circuits, the respective drivers are automatically stopped. In the event of a control circuit failure, the system automatically switches to a lower level or to manual mode.

7.9 Protection of technological equipment

The DCS will address the protection of the technological equipment by means of user (application) software or special hardware configurations and meets the following basic requirements:

- automatic decommissioning of the technology or part of it when conditions dangerous for operation occur,
- automatic execution of the user sequence, ensuring the transition of the technological device to a safe state,
- the protections shall be in continuous operation, regardless of the operating condition, and the operator shall not be able to disable the protections,
- The specified measurements use dual analogue sensors, and the contact sensors will be monitored for line failure where appropriate.

7.10 Safety stop

7.10.1 Emergency shutdown

Elements of emergency shutdown circuits, such as emergency shutdown buttons, rope switches, etc. must be designed in accordance with the operating regulations of the supplier - equipment manufacturer in accordance with ČSN-EN-ISO 13849-1.

The implemented elements used in the equipment shall be operationally tested, long-term, in similar operation, shall prevent restart after an emergency shutdown by handling only the elements intended for emergency shutdown and shall allow safe emergency shutdown. Each emergency shutdown device shall be signaled separately so that the point of operation of the emergency shutdown can be quickly determined. Emergency shutdown circuits designed in this way can be characterized as meeting the requirements of a Category 3 safety circuit.

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7.10.2 Shutdown on failure

Elements of fault tripping circuits, such as fault trip buttons, process sensors, etc., must be designed in accordance with the requirements specified in the HAZOP documentation (study) of the supplier of the process equipment and furthermore by analysis with the required level of assurance of the necessary operation, in accordance with SIL regulations according to IEC 61 508.

Note: The implemented design generally uses a doubling of the control path together with a tripling of the corresponding sensors, the entire circuitry is usually implemented in a special control system corresponding to the relevant SIL category. The principle wiring of the emergency shutdown circuits will be in quiescent current design, which means that any interruption of the activation circuits or control circuits will be judged as the operation of fault tripping circuits and will lead to disconnection - shutdown of the equipment. The fault trip path will be separate from the normal trip path up to the drive, e.g. for high voltage motors a neutral coil will be used for tripping.

7.11 Local control

The local control (deblocking boxes) is designed for service control of individual actuators and will be equipped with all conveyors. The local control will not be equipped with any automation function such as blocking or issuing commands to automated devices or guards. Local control functions (except for current indication) shall be released and terminated only from the operator's station in the control room (control room). Release or termination shall be done separately for each actuator by selecting 'remote/local'. In the case of electric conveyor drives, local control will have the following functions:

- issuing the on command,
- disable the command,
- status signaling on,
- status indication off,
- display of motor current for motors over 100 kW.

Within PS 208 I&C, only the option to control REMOTELY / LOCALLY will be provided. The power portion of the local control boxes will be handled within PS 210 Electrical Part with 230 VAC operating voltage. The local control cabinets will be equipped with conventional operator contact elements, simple logic within the electrical outlet control logic and appropriate wiring. The local control box shall be located at or on the drive for which it provides local control.

Example of the design of local control cabinets (debloking cabinets) in the operation of boiler room K90:



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7.12 Requirements for control system cabinets

The control system cabinets will be of robust construction, be of steel sheet construction and will be provided with a suitable protective coating.

- The cabinets will be manufactured in a design appropriate to the conditions of their location (in the case of open doors, IP 20 protection is required).
- IP 21 in rooms intended for installation of DCS cabinets, air-conditioned, where there is no risk of water splashing or steam saturation and where there is no dusty environment.
- IP 65 - Outdoor environment + boiler room.
- The cabinets will have appropriate grounding and ensure EMC compliance.
- The control system cabinets will be 2,200 mm high (recommended size is 2,200x800x600), with a basement if necessary to maintain a uniform height.
- Cable entries to the cabinets will be from below (unless the OB 2 CONTRACTOR notifies exceptional cases).
- The lockers will be locked with one identical key.
- The doors of the control system cabinets shall be all-metal; if the nature of the box equipment so requires, they shall be fitted with safety glass (in metal seals).
- The control system cabinets will be coated with the same paint material, of the same color shade, assumed to be light grey (RAL 7032).
- The control system cabinets must be installed in an air-conditioned space (sizing of the air-conditioning will be subject to the HVAC design). The total power dissipation of the control system cabinets is 3 500 W.
- The control system cabinets will be equipped with temperature contact sensors to signal exceeding the maximum permissible temperature (signaling to the control room for each room).
- The cabinets will be equipped with contacts for door opening signaling (signaling to the operator's workplace).
- The cabinets will be equipped with removable transport screws with eyelets.
- It is recommended to design the cabinet with access from one side, it can be equipped with hinged frames.
- The cabinets themselves and all cabinet equipment shall be carefully labelled and tagged and appropriate documentation containing (amongst other things) such labelling shall be placed in each cabinet.
- Environment in I&C rooms (+11.2m): normal without exposure to aggressive gases and vapors. Room temperature between +5 and +30 °C. Humidity will be between +20 and +70 %, without condensation.

With regard to the considered unification in the further development of control systems for the K80/90 and K20 boiler plant technologies, the DCS type 800xA (ABB) is specified below, which will be used for the control of the K20 boiler technology and will be a single platform for the integration of the boiler plant control systems (see Annex 2 - OB2_A113.002_Configuration diagram of the I&C).

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7.13 Technical description of the DCS 800xA system

7.13.1 AC800 process units



The AC 800 system can be defined as a hardware platform to which individual hardware modules can be connected that can be programmed to perform multiple functions depending on the specific module configuration and operating system selected.

The hardware platform will consist of processor modules, communication interfaces, power supplies and modules providing additional functionality such as an external battery module for memory backup.

The AC800 controller will be equipped with specific control software and can be used for all kinds of process and industrial automation applications. With the "Control Software", the controller can operate either as a stand-alone process controller or as a controller performing local control tasks in a control network consisting of many interconnected controllers.

The AC800M Controller is supplied without firmware. To equip the controller with Control Software, you must first load the firmware and create the application separately using the Control Builder M engineering tool.

The AC800M control unit modules will be installed on horizontal DIN rails that are placed in DCS racks. Most modules consist of a base mounting plate with a removable cover, which are attached to each other with screws. The base plate, which is always mounted on a DIN rail, carries most of the connections to the processor, power supplies and communication interfaces, as well as connections to external buses and systems.

Expected functionalities of the AC 800M system:

- FOUNDATION Fieldbus support,
- support for PROFIBUS-DP/V0 and DP/V1,
- Genius remote I/O support for discrete, analog and high-speed counters,
- support for TRIO/Genius,
- Support for the Field Device Tool (FDT) and Device Type Manager (DTM) concepts for routing HART tools,
- quick and easy fault-finding using LEDs on each module/channel,
- standard supply voltage - 24 V DC,
- hardware based on standards for optimal connectivity (Ethernet, PROFIBUS-DP),
- built-in redundant Ethernet,
- built-in RS232-C communication channels,
- fully EMC certified,
- mounting of modules on standard DIN rail,
- IP20 protection class without the requirement for cabinets,
- Built-in battery memory backup (min. 36 hours),
- redundant CEX-Bus using a BC810 pair,

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- SIL certification AC 800M for PM86X /SM812 controllers,
- redundant functions:
 - redundant network on MMS and TCP/IP using Redundant Network Routing Protocol (RNRP),
 - Cable redundancy or full redundancy (PROFIBUS-DP/V1) for AC 800M (interface module CI854B),
 - CPU redundancy AC 800M,
- communication interface:
 - RS-232C serial communication (CI853),
 - RS-485 serial communication (CI853),
 - PROFIBUS DPV1 (CI854B),
 - MasterBus 300 (master CI855),
 - interface to S100 I/O (CI856),
 - interface to INSUM (via Gateway Ethernet/LON) (master CI857),
 - DriveBus (CI858),
 - FOUNDATION Fieldbus HSE (CI860),
 - PROFINET (CI871),
- I/O support:
 - PROFIBUS-DP/V1 (master CI854B),
 - HART S800 I/O modules,
 - S800 I/O Sequence-Of-Events (SOE) modules,
 - S900I/O,
- drive support:
 - support of ABB inverters via PROFIBUS, ModuleBus and DriveBus,
- HART device configuration using tool routing and the concepts of Field Device Tool and Device Type Manager,
- the internal communication bus can be divided into sections.

7.13.2 I/O Modules S800



The S800 I/O is a distributed, highly modularized, and flexible I/O system that allows easy installation of I/O modules, process cabling and cabling connections from the technology.

Expected functionalities of the supplied I/O S800 system:

- Communication via PROFIBUS DP or Advant Fieldbus 100.

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- Communication directly with the AC 800M CPU unit.
- Quickly find faults with LEDs on each module and channel.
- Extensive portfolio of digital input/output modules and analog input/output modules.
- Digital input/output modules and analog input/output modules with Intrinsic Safety and HART interfaces.
- Mounting on standard DIN rails.
- Support dual power redundancy, fieldbus, and I/O channel connections
- Set all outputs to predefined values.
- Connection to frequency converters.
- All modules will be in plastic injection molded cabinets that provide IP20 protection according to IEC 529. The plastic used is halogen free.
- I/O modules will be protected from destruction by mechanical keying if an attempt is made to insert the module type into a position with a key code other than the factory set I/O module code. End units will have keys that will be set to the key code of its I/O module's key code. (S800L I/O modules do not use terminating units).
- Hot-swap S800 I/O modules (except S800L modules) to replace defective modules without disconnecting field power or system power from the I/O station.
- I/O modules will operate at an ambient temperature of 55 °C
- Support for PROFIBUS and Advant Fieldbus 100 media redundancy.
- Support for redundancy of PROFIBUS and Advant Fieldbus 100 units.
- Support for connection to external intrinsic safety barriers.
- Safety I/O modules, IEC 61508 SIL3 certification.

7.13.3 Process stations with safety modules

Process safety stations



The range of safety control units will comply with the relevant safety standards (IEC 61508). Based on the proven features of double and triple redundant safety controllers, the system will provide a common engineering and operational environment for safety functions.

For safety applications, the AC 800M HI controller will be used - it offers a SIL3 TÜV certified control environment to combine the control of safety and critical processes in a single controller without sacrificing safety integrity. The AC 800M High

Integrity controller will be implemented by combining a processor module with a co-processor, flexible redundancy schemes allow controller configurations up to and including "Quad" configurations. For embedded safety and control applications, all functions/types will be marked non-SIL or SIL in the standard libraries to indicate their applicability. Built-in safety measures prevent unintentional degradation of safety applications. The SIL selection activates the appropriate restrictions and limitations, for example, only SIL marked features can be used in SIL applications. In SIL rated applications it is possible to choose between three IEC 61131-3 languages, namely Functional Block

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Diagram, Structured Text, and Sequential Functional Diagram. For applications without SIL, all five IEC 61131-3 languages can be used.

Security Process Interface

High Integrity I/O - S800 I/O is a distributed, highly modular, and flexible I/O system that provides easy installation of I/O modules and process cabling. S800 I/O modules and its termination units can be assembled and combined in many different configurations to meet any space requirement or suit any application. An extensive range of I/O modules and accessories are available for safety critical and non-critical applications.

SIL3-compliant modules will be available within the S800 I/O module family that can be used for safety-critical applications. These I/O modules will include modules for 4-20 mA analog inputs, 24 V DC digital inputs and 24 V DC digital outputs. The digital output module provides normally energized and normally de-energized outputs. The analog inputs will support HART routing for easy calibration checking and diagnostics with configurable access, while the digital inputs support local timestamping of signal changes for highly accurate event sequence logging.

Example of the 800xA control system cabinet including safety modules (see yellow).



8 FIELD INSTRUMENTATION

The process equipment of the K20 boiler shall be equipped with standard measurements for monitoring of the technology condition according to the approved I&C design. The number and selection of the sensed variables shall be optimally chosen to serve for economical and safe control and monitoring of

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the process under all operating, transient and fault conditions. The values of all relevant sensed variables must be available to the operators at the relevant control points.

The accuracy class of physical variable sensors shall be 0,15 % or better. The instrumentation shall be selected from proven components according to their accuracy and operational reliability. The sensors and transducers used shall be suitable for the local operating and environmental conditions in which they are to be located. The number of types (manufacturers) of instruments and accessories shall be limited to the maximum extent possible to facilitate maintenance. Measuring instruments shall be either local or remote. Local measurements will be included in the supply of the technology.

Measuring circuits with remote transmission: 24 V DC is used for binary signals. For analogue instruments, the transmission signal from the remote measuring instruments to the control system must be 4-20 mA. The instruments (transmitters) either produce the required signal directly or the corresponding measuring circuits on the sensor side are equipped with transmitters for the 4-20 mA signal. All transducers shall be of the SMART type to allow setting of detailed parameters via a communicator directly from the control system jumper or from the control system via an I/O card.

For operationally important measurements, devices with an analogue signal are preferred.

The following principles apply to the instruments and equipment supplied:

- the accuracy of the entire measuring circuit (from the sensor to the analogue input card inclusive) must be better than 0.5% of the measuring range,
- when changing the load impedance from zero to maximum, the current source must ensure that the change in output current is less than 0.5% of the measuring range,
- Unless explicitly stated otherwise, all measuring transducers shall provide a consistent trend of increasing output signal with increasing measurand,
- all converters will be supplied with a 4 - 20 mA output signal,
- the output of the converter will be ungrounded so that the signal line can be grounded uniformly to avoid additional errors,
- instruments for the same types of measurements (thermometers, pressure gauges, etc.) will be designed to be of a single type and manufacturer,
- where the nature of the medium to be measured implies a risk of fouling the measuring instruments, probes or their supply lines, the instrument will be supplied with a cleaning device (washing, purging); this device will operate automatically.

8.1 Signal transmission

The output signals of the converters will be uniform current with a range of 4 - 20 mA. The natural signals of the resistance thermometers and thermocouples will preferably be fed directly into the control system where compensation and digitization will take place. Except for these temperature measurements, no voltage input cards will be used.

Logic PLCs will be connected to the system via a communication link; in justified cases, for simpler devices, the Customer may allow their replacement by hardware signal transmission.

For selected intelligent field instrumentation devices, HART digital communication will be used as a priority

8.2 Measured units and ranges

For technological measurements, SI units will clearly be used. Pressures will be measured in absolute values.

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The following units will be used:

- flow kg/h, t/h, m³ /s, m³ /h, Nm³ /h,
- temperature °C,
- pressure kPa, MPa, bar
- level 0 - 100 %, m,
- analytical values %, pH

The ranges of sensors, transducers and measuring instruments will be chosen so that the nominal value of the measurand is within approximately 2/3 of the range.

8.3 Temperature measurement

Due to the expected range of measured temperatures in the technology, it is assumed that Pt 100 resistance thermometers and K-type thermocouples with a transducer and compensation in the thermometer head are used for temperature measurement.

Thermocouples (type J, K and S) can only be used in justified cases. Compensation for cold ends of thermocouples, if used, will be done electronically in the control system. The use of thermostats is not permitted.

Resistance thermometers will be brought to the inlet side in a three-wire fashion. If the control system does not allow direct connection of resistance thermometers, temperature transmitters will be used to convert the temperature to a unified 4 - 20 mA signal. These transducers will preferably be placed in the heads of the RTDs, exceptionally they may be placed outside the heads of the transducers, but with the shortest possible wiring between the RTD and the transducer.

The accuracy of the temperature transmitters will be 0.1% or better.

Temperature sensors will be equipped with a standard terminal block corresponding to the relevant ČSN standard.

Resistance thermometers will be supplied in a "higher mechanical resistance" version. Bearing resistance thermometers will be supplied with a double insert. The customer requires all resistance thermometers to be supplied with silver leads.

The use of thermistors is permitted for measuring the winding temperatures of electrical machines.

8.4 Pressure measurement

The supplied small pressure sensors will be equipped with SMART type electronics with HART communication protocol for remote testing and sensor configuration.

Sensors including integrated converters to a 4 - 20 mA unified signal shall have an accuracy of better than 0.1%.

If the medium to be measured is of such a nature that it may settle and thus cause malfunction of the instrument, the sensors shall be equipped with a separation membrane made of material resistant to the effects of the medium to be measured.

The connection to the technology will be made in such a way that the device can be dismantled without shutting down the relevant technology.

The instruments will be equipped with instrument valves with M20x1.5 test instrument connection.

Differential pressure gauges and transmitters will be equipped with a five-way valve.

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8.5 Measurement of quantity

Ultrasonic flow meters with an accuracy of up to 0.3% of the measured value will be used to measure the flow or heat of the water. Vortex flowmeters with an accuracy of up to 1,4 % for gases will be used to measure steam flow. Where justified, throttling bodies with differential pressure sensors or inductive flow meters will be used.

The same requirements apply to pressure differential transducers as to pressure transmitters.

The supplied sensors will be equipped with SMART type electronics with HART communication protocol for remote testing and sensor configuration.

8.6 Measuring levels

The same requirements apply to pressure differential transducers as to pressure transmitters. Transducers with a current output of 4-20 mA will be used.

The sensors will be equipped with SMART type electronics with HART communication protocol for remote testing and sensor configuration.

Radar sensors will preferably be used to measure the level in non-pressure tanks and sumps.

8.7 Physical-chemical measurements

All operational analytical measurements will be performed automatically and continuously

The OB 2 CONTRACTOR shall design the types of instruments in relation to the requirements of the proposed technology. Preference will be given to types with minimized consumption of media and sampling substances.

For the measurement of the pH value, the measuring node will be equipped to perform the calibration remotely automatically.

8.8 Contact sensors

The contact sensors will be wired so that the control system can be used to evaluate circuit interruption.

The contacts will be powered from the control system.

8.9 Measurement of mechanical quantities

The OB 2 CONTRACTOR shall design the appropriate instruments taking into account the requirements of the relevant technology. Preferably non-contact sensors will be used. The sensors will preferably be connected directly to the control system, only in exceptional cases will the use of pulse/4-20 mA transmitters be permitted.

Positions of moving parts:

The positions of the analog regulators will be measured by sensors with a current output of 4 - 20 mA. The use of resistive position sensors is not permitted.

8.10 Expanding the industrial network

When designing the extension of the industrial network, it is necessary to respect the safety conditions specified in ITS 1.05C Information Systems and ITS 5.40C Cabling

A new connection of a separate industrial network will be installed in the room I&C OB2 (boiler room K20), located in the building SO201 (+11.20 m). The main node of the industrial network, which is located in building E1A, contains a network switchboard DR1 with a manageable switch with sufficient capacity to connect other communication points in the technology. Redundant FO 24vl SM cables will

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be installed for the industrial network connection. An optical switchboard will be installed in the I&C substation to terminate the FO cable. The optical switchboard located in building SO 201 (+11.20 m) will be installed at the end of a row of control system cabinets of the same size as the control system cabinets.

Optical cabling will be routed in separate routes in the affected buildings and along steel structures. For outdoor routes, the fiber optic cables will be laid in steel pipes. The conditions for the extension of the technological network will be consulted and coordinated in detail with the technological network administration during the implementation (project) phase. The picture below shows the network switchboard DR1 located in the area next to the control room.

DR1 - the highest switchboard in the picture



Example of installation of an industrial network in an HV substation (wall-mounted optical switchboard DR2).



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8.11 Electrical power supply

The control system cabinets will be powered from two independent sources of assured power supply /PE-220 V DC. In the I&C cabinets, a fail-safe backup will be implemented. For important appliances, a fail-safe backup will be implemented within the I&C, i.e. important AC powered equipment must be powered via UPS (Uninterruptible Power Supply). The power supply to the I&C equipment will be designed in such a way that control of the process equipment is possible even if anyone power supply fails.

Transducers and sensors will preferably be designed and designed to be powered from the control system.

Where the design of the sensors and transducers does not allow this, the OB 2 CONTRACTOR shall provide power from suitable sources which he shall include in his supply.

8.12 Frequency converters and soft starters

For communication between frequency converters/softstarters and DCS standard protocols Modbus RTU, Profibus DP, Profinet PN will be used. For the 6 kV frequency converters, HW interconnection cabling will also be installed (status information to DCS).

SW configuration of frequency converters will be solved within PS 208 (I&C). Power supply of frequency converters/softstarters will be solved within PS 210 (Electrical part).

8.13 Cabling and cable routes

To optimize operation and maintenance, equipment should be used for a minimum number of types of encoders, transducers, actuators, control and junction boxes and instrument support frames. Thermometers will be installed with double inserts. Both inserts shall be connected (wired) to the appropriate junction box even if the signal from only one insert is to be used. If both inserts are to be used, each must be wired as a separate sensor. Compensating wiring shall be used for thermocouple wiring up to the compensation box.

Cabling for sensors and transducers located at thermal displacement equipment shall be looped to provide the necessary margin for sensor movement. All cables and wires shall be selected and sized with regard to the type of signal to be transmitted and the relevant operating conditions. Particular attention shall be paid to ambient operating temperature, economic aspects and sufficient mechanical resistance of the wires and cables during normal operation and maintenance. The cabling will be installed in a fire-retardant design (Decree 23/2008 Coll., Technical Conditions for Fire Protection of Buildings) in accordance with the requirements specified in the Fire Safety Regulations. The types, dimensions and design of the supporting cable system, i.e. cable trays and cable trays, must comply with ČSN 38 2156. Spatial margin in the routes shall be 20% of the design data.

The cable installation project must be designed in such a way that the transmitted signals cannot interfere with each other. The I&C cabling will be installed in separate cable routes (troughs, protective pipes).

Cable ducts, sections and risers shall be divided by fire partitions into appropriate fire sections according to ČSN 73 0804, in particular:

- inputs to cable channels,
- cable entrances.

Exits from cable ducts and cable spaces shall be properly sealed to achieve the same fire resistance as required for the building structure. The vault shall form a separate fire compartment; cable ducts through floors and walls and cable entrances to switchboards shall be designed in accordance with ČSN 33 2000-5-52 ed. 2.

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The following points must be observed when installing cables:

- 15 % margin in the number of individual cores in the cable for each signal path,
- signals with different voltage levels must not be routed through the same cable,
- Cable ends must be properly protected against environmental conditions (moisture, dirt, chemicals),
- Cables must not run directly across the surface of any combustible objects and equipment.

The following principles must be observed for cabling:

- both ends of any cable must be fitted with approved data labels,
- number of cables,
- connection points for both ends,
- cable type.

These data must correspond to the specifications of the project documentation.

The color marking of individual conductors will be made according to the applicable ČSN standard.

Wiring requirements

- for analogue signals - copper conductors, screened individually or in pairs, fire retardant design according to IEC 60332-1 and IEC 61034-2, cable design 2x2x0,5 to 48x2x0,5
- for digital signals - copper conductors, individually shielded, fire retardant design according to IEC 30332-1 and IEC 1034-2, cable design 2x0.5 to 30x0.8

In the case of cable lines buried underground and cables running in routes with a higher possibility of damage, armored cables shall be used. Cables for current and low-voltage signals shall have twisted pair conductors. Shielding shall be grounded on the control system side. The cabling shall be run in single conductors, sufficiently separated from the power lines. Cable routes shall consist of cable trays and trays in the case of multiple cables running in parallel and conduits in the case of single cables. Cable trays and cable trays shall comply with the regulations applicable to industrial substations.

Cable routes must comply with ČSN 38 2156, as well as operational requirements and fire regulations.

The cabling and cable routes will be designed in accordance with the requirements specified in the WFD documentation. Cable trays shall be provided with perforations with integrated cover or cable ladder. The cover shall be provided as removable. The surface shall be provided with enhanced corrosion protection.

9 CONTINUOUS EMISSION MONITORING SYSTEM

The continuous emission monitoring system (CEMS) must be in accordance with Act No. 201/2012 Coll. and Decree No. 415/2012 Coll.

The CEMS will be installed on the flue of the K20 boiler, including all connections to the central evaluation system of the CHP. It is assumed that the following quantities will be measured:

- Oxygen (O₂),
- Water (H₂O),
- Sulphur dioxide (SO₂),
- carbon monoxide (CO),
- carbon dioxide (CO₂),
- oxides of nitrogen (NO and NO₂),
- chloride gas, expressed as HCl,
- PM

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- Ammonia NH₃.

Analyser ranges must be set according to the current legislation in force, with the possibility of changing the settings to take account of decreasing emission limits in the future. The CEMS shall be capable of determining mass concentrations of gaseous pollutants at least in the range of 10 % to 250 % of the emission limits. Together with the pollutant concentration values, the reference quantities used for conversion to the reference conditions under which the emission limit is set according to Decree No 415/2012 Coll. of the Ministry of Environment of the Czech Republic must be determined continuously by measurement within the scope of the emission monitoring system (EMS).

9.1 Signal transmissions from CEMS to the higher control system of boiler K80 and K90

It is required to transmit at least the following signals:

- analog signals of measured components without conversions: 4 - 20 mA,
- fault (maintenance, calibration) signaling CEMS - binary signals (potential-free contact 24 V DC).

9.2 Central Evaluation System (CES)

The output signals from the analyzers will be fed into the CES for collection, evaluation, display, classification of the measured values and their registration, distribution, and storage. The CES must comply with legal requirements. Currently, the CES for measurements is provided by the PROMOTIC system of ORGREZ, a.s. (Air Protection Technology Division).

The new CEMS of the K20 boiler is planned to be connected to this CES system with all the necessary continuity (corresponding extension of the application, all necessary licensing arrangements and supplies, SW and HW activities, upgrade to the current version, valid application support, etc.).

Near the analyzer cabinets, a switchboard cabinet will be installed with a PLC automation and with analog and binary sensing cards that will provide analog and binary signal sensing. Communication between the PLC and the master server will be via LAN.

9.3 Laws, standards, and other requirements

The emission monitoring system will comply with all legal requirements, implementing regulations and standards that will be in force in the Czech Republic during the commissioning of the AMS. The accuracy of any instrumentation supplied must also comply with this. The results of the continuous emission measurements will be continuously recorded, evaluated, and stored to the extent and in the manner prescribed by Act No 201/2012 Coll. and Decree No 415/2012 Coll. The data collected by continuous measurement shall be protected against alteration and shall be provided in the form laid down in Decree No 415/2012 Coll.

A reference to a list of all laws and standards to be applied shall be included in the relevant bidder's specification. The starting document for the design of sampling and instrumentation for emission measurement is the technical standard EN - 15259 - Air quality - Measurement of emissions from stationary sources - Requirements for measurement sections, sites, measurement objective, measurement plan and measurement report.

Furthermore, Czech technical standards published in the Journal of the Ministry of Industry and Trade of the Czech Republic 12/2013 as standards designated according to Act No.22/1997 Coll., in particular: ČSN EN 14181, ČSN ISO 10849, ČSN EN 12619, ČSN 83 4711-7, ČSN EN 15058, ČSN EN 14789, ČSN EN 1911, ČSN P CEN/TS 17340.

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Calibration of the AMS will be performed by an authorized laboratory accredited according to ČSN EN ISO/IEC17025 for automated measuring system (AMS) in the QAL2 range of ČSN EN 14181. The supplier shall design the location of the sampling flanges for the AMS including the single sampling points. All installation work shall be carried out in accordance with the approved technical documentation. The AMS will include a test run of 3 months from handover during which an initial QAL2 calibration to EN 14181 will be carried out.

9.4 Technological parameters of the K20 boiler

Biomass operation - wood chips	K20 boiler
Nominal steam output	80 t/h
Nominal steam temperature	535 °C
Rated superheated steam pressure	12,5 MPa
Nominal boiler efficiency	91 %
Rated power	57,2 MW
Heat input at rated output	63 MW
Fuel consumption 10 MJ/kg	23,4 t/h

10 ELECTRICAL PROTECTION

The electrical protection of the 6 kV switchboard will be connected via IEC 61850 communication protocol to the existing electrical control system.

11 BURNER AUTOMATION (BMS)

The burner automation system will be supplied as a separate control system compliant with EN 298 ed2 (061805)

European Standard EN 298 ed2 (061805) specifies requirements for the safety, design and performance of burner automation, programming units and flame guards for fanned and unfanned burners and appliances for gaseous and liquid fuels and similar applications. This European Standard applies to burner automation systems that include other additional functions.

12 ELECTROMAGNETIC IMMUNITY

The work, as a whole, must meet the requirements for electromagnetic immunity to interference in accordance with the applicable EMC standards and other applicable legislation (Directive 2004/108/EC, Regulation 616/2006 Coll., applicable standards of the ČSN EN 61000-4 Electromagnetic Compatibility (EMC) series).

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13 CYBER SECURITY

The new control system of the K20 boiler must be resilient to cyber-attacks and threats with regard to its integration into the existing control system network. The entire set of technical measures will be designed in accordance with ISO/IEC 27001 and respect the Cyber Security Act 181/2014 Coll.

The implementation of the control system will include meeting the requirements of the hardening policy, i.e. the system security policy, which will describe the requirements for setting up the control and information systems in order to reduce the risks associated with its operation. The operating instructions will define nominal operation, emergency conditions and archiving procedures. Maintenance guidelines will define guidelines for extended diagnostics, system services and equipment installation.

13.1 Active Cyber Defense

- A set of measures to detect, analyze, identify, and mitigate threats in or emanating from cyberspace, in real time, along with the capability and resources to take proactive or offensive action against threat actors on the threat actors' home networks.
- A proactive measure to detect or obtain information about a cyber intrusion, cyber-attack, or impending cyber operation, or to determine the origin of an operation, which includes launching offensive, preemptive, or counter operations against the source.

13.2 Technical controls

All activities and procedures in the area of technical controls for operational systems must be planned, approved and executed by the responsible person (DCS Systems Engineer) with an emphasis on minimizing potential impacts on the functionality of the I&C systems and supported business processes.

- the requirements and scope of technical controls for access to I&C systems and data must be approved by the responsible ŠE
- technical controls are limited to read-only access to the I&C software and data
- the specific requirements of the technical controls must be described and approved by the responsible person according to the internal instruction of the ŠE
- technical checks must not affect the availability of the I&C systems and supported business processes during working hours. In the event of potential impacts on the availability of I&C technologies, these checks may only be performed during technology downtime
- all activities during the technical inspection are logged and monitored.

Inspection plans for I&C equipment will be specified in the relevant DPP and DPU manuals.

13.3 System control and security

Software security means ensuring that information and data are protected in such a way that unauthorized persons and systems cannot modify the software or its data and gain access to system functions, while ensuring that authorized persons and systems are not prevented from doing so.

The overall security plan specifies the methodical and technical measures to be implemented to protect the system from deliberate and intelligent attacks that may compromise safety-critical functions.

13.4 Threat and vulnerability analysis

The security of SW in terms of misuse and modification of data and penetration into the system is defined by the following requirements:

- data security against misuse,

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- protection against penetration from other systems via communication channels,
- protection against abuse from within.

Risks arising from unauthorized access to the system and changes to data are systematically evaluated and eliminated during all phases of the control system life cycle.

13.5 Principles of security against unwanted interference by persons

13.5.1 Regime measures

The WORK equipment is located in a guarded or protected area of the plant. These areas are subject to the ŠE regime measures.

Persons with an identification card issued on the basis of meeting the requirements of an application for an identification card approved by the Physical Protection Department may enter the guarded and protected area independently. Actions related to the I&C part may only be performed by an authorized person of the ŠE.

13.5.2 Key security

Each element of the I&C device shall be secured in such a way as to prevent unauthorized interference, changes to settings, damage, etc.

For equipment installed fully inside the DCS cabinet, this requirement will be met by ensuring that the DCS cabinet door is suitably locked. DCS cabinet doors shall be fitted with a cylinder lock. All locks shall have a single key.

The doors of the K20 boiler control system switchboards will be equipped with suitable locks and opening signals at the K20 operator's workstation. The key order follows the internal instruction of the ŠE. As part of the delivery, a set of keys (switchboard /2 keys) will be handed over, indicating the person responsible for taking over (DCS system engineer).

The security of objects and premises (rooms) of the I&C facility and their access is defined by the internal security policy of the ŠE.

13.5.3 Measures for computer-based service and maintenance stations

Each workstation and its functions will be password protected against unauthorized access.

User accounts are personalized. Shared accounts will only be allowed on a 24/7 manned OS, these accounts may not have elevated permissions.

13.6 Network security requirements

Description of basic assumptions:

- Network security zones will be separated from each other, and network traffic must be controlled between them.
- Demonstrably approved and allocated communication paths between different network security zones will be used.
- Connected I&C systems do not use unapproved data paths in the network.
- Technological control systems allow connection to external entities only when it is strictly necessary for operational reasons. This connection is only made at points that will be safely operated and monitored.

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- The type and extent of network communication will be pre-defined and approved. Any other type of communication is blocked by the use of filtering devices e.g. gateway, proxy, application firewall etc.

13.7 Communication

The network security zone is considered to be the "island" of the K20 boiler. All external communication links will be separated by a firewall for security purposes.

The HMI Operator Network devices will be connected to a redundant communication network using industrial-grade switches and firewalls.

The individual technological networks will be separated on the physical layer (own cabling). All networks will have their own address range, addresses will be assigned statically, none of the automatic address allocation services will be running in the networks.

The system will be completely redundant. Redundancy is solved by dividing the communication into two independent communication branches.

The uniform time will be provided from the GPS in the DCS by the NTP server. The server is the source of the uniform time and the uniform time is distributed over Ethernet communication networks to all communication connected devices.

13.8 Antivirus protection

Antivirus protection is an important part of any LAN. However, its role is complementary in the ŠE technology network because the network is autonomous and there is no direct access to it from other networks except the related DCS network for the control of the chip transport and storage technology, including the transfer station.

The virus infection can therefore only be transmitted by flash and CD/DVD.

The checking of PC disks will be carried out in a network form, the frequency of updating and checking the virus database is governed by the current regulations of the customer.

14 TESTING AND COMMISSIONING

If the equipment is found to be inoperative during testing of any part of the equipment, then the OB 2 CONTRACTOR shall make modifications to the equipment to ensure proper operation of the equipment. Such modifications shall be made by the OB 2 CONTRACTOR free of charge, whether or not the equipment is under warranty.

During the fabrication, installation and commissioning of the WORK, the following tests and activities shall be performed on the equipment by the OB 2 CONTRACTOR:

- OB 2 CONTRACTOR's tests (FAT),
- on-site tests (SAT).

On-site tests - these are SAT tests consisting of:

- tests during assembly,
- Individual tests. This is a test of the functionality of a specific measuring or control circuit;
- tests during commissioning

Tests with technologies

- setting of variable constants and quantities (with the possibility of setting parameters) of the control system;

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- complete testing, including a final test (comprehensive exam).

14.1 DCS tests

In addition to the standard FAT and SAT tests, the content of which will be determined by the control system vendor, the following SAT tests will be required as a minimum.

FAT includes at least the following activities:

- complete hardware check,
- Functional test of at least 5% of randomly selected inputs and outputs to the station operator level,
- Backup device test - this test will demonstrate automatic switching to the backup bus, power supply, processor, etc.

A 72-hour continuous operation test will be conducted as part of the SAT. If any malfunction or failure occurs during this test, this part of the test will be cancelled and the whole test will be repeated after the malfunction has been corrected.

In the event that the CLIENT finds any protective function insufficient or more than 5% unsatisfactory during the SAT, or if any parameter is in violation of the CONTRACT, the entire test shall be repeated after the defect has been corrected. defect, entirely at the expense of the OB 2 CONTRACTOR, including the cost of the new participation of the CLIENT's representatives.

Upon completion of the tests, a test report will be drawn up containing the results of the tests and the corresponding conclusions. The report shall be signed by representatives of both the OB 2 CONTRACTOR and the CLIENT.

The SAT will include at least the following activities:

- complete hardware check and installation;
- A physical visual inspection confirming that the equipment conforms to the final drawings, specification and the latest applicable standards and regulations;
- test of backup functions by simulating busbar failure, external communication failure, power supply, control processors and operator station; automatic operation of the backup unit and automatic display of the relevant fault message will be tested and demonstrated for all units involved;
- Presentation of system diagnostic functions through simulation of the corresponding fault; during this process, the technology of system fault reporting will be demonstrated;
- presentation of data collection, presentation and archiving functions, display of the sequence of events in the log and graphical display of functions;
- tests for loss of information due to signal interference on the cabling system
- recovery test after power failure.
- The test consists of switching off the individual parts of the control system and reactivating them.

The positive result of this test is that the deactivated and reactivated parts of the control system are automatically put into the operating state. The recovery time of the individual parts of the system will be determined according to the technical capabilities of the system and the needs of the control system (this issue applies to live parts without backup function or live parts with backup after their simultaneous loss).

- Power failure test on I/O control systems - I/O line interruption test.

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The positive result of the test is that the faulty circuit is identified, and the circuit is automatically put into working order after repair.

This test reasonably applies to both analog and binary I/O.

- Invalid variables.

The test consists in dropping the input information from the traffic. In this case, it should be identified that the variables attached to this part of the DCS cannot be processed and should subsequently be marked as 'non-valid variables'.

- Electromagnetic compatibility tests;
- Operational availability test of the control system.

High system availability, expressed as a percentage, is required for the control system including peripherals. It is the ratio of the time the equipment is operational to the total time the equipment is operational. The value of the operational capacity can be influenced in several ways, namely:

- Appropriate duplication of some system components;
- Thanks to the high reliability of the system components;
- Maintenance intensity, i.e. immediate availability of spare parts and immediately available personnel for repair.

14.2 Field instrumentation tests

The OB 2 CONTRACTOR shall inspect and document prior to commencement of testing:

- all measuring, control and indicating instruments, including auxiliary and sampling equipment, are operational and have been adjusted, calibrated and metrologically verified to be ready for stable operation.
- at least the following aspects of the field instrumentation equipment will be checked:
- marking of tools,
- integrity of cables and wires,
- insulation,
- cable markings (cable labels),
- description of terminals,
- interconnection of interconnection switchboards,
- function of backup power supplies, UPS units.

14.3 Individual tests

Before the start of individual tests, it is necessary to prepare a protocol on the initial inspection of electrical equipment for the corresponding part of the WORK according to ČSN 33 15 00 and ČSN 33 20 00-6-61. The OB 2 CONTRACTOR himself will ensure the related procedure and cooperation with the TIČR (Technical Inspection of the Czech Republic) and RLI (Regional Labour Inspectorate). The tests will be carried out under the full responsibility of the OB 2 CONTRACTOR and the CLIENT will also ensure all coordination activities between the other entities involved in the tests.

Individual tests shall be carried out on each piece of equipment and shall be of such a scale as to verify that the equipment will not be damaged during transport to the site or during installation by defects preventing its proper and safe operation. function and use and that the cable connections are functional and properly connected.

They will include in particular the following tests:

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- the entire measuring and signaling circuits from the sensor to the display of the relevant quantity on the operator station screen.
- the entire control and regulation circuits starting from the commands from the operator station of the power equipment up to the level of individual servomotors.

Completion of the individual tests is also considered as completion of assembly.

14.4 Commissioning tests

The OB 2 CONTRACTOR is responsible for coordinating all commissioning activities with the participation of the CLIENT.

The OB 2 CONTRACTOR shall respect and comply with all applicable ČSN standards and other binding regulations when performing tests.

14.5 Tests with technology

The OB 2 CONTRACTOR shall design a test program for the control systems such that it can be demonstrated that:

- the equipment is complete, ready, and capable of safe operation under all operating conditions
- the actual systems and other electronic equipment and systems are resistant to electromagnetic interference at the power plant and other interfering factors
- the actual systems and other electronic equipment and systems are not a source of electromagnetic interference
- all control, regulation and protection functions are fully tuned;
- all signaling, diagnostic, archiving, analytical and other functions of the system are fully functional according to the Project
- the device has achieved the required dynamic characteristics
- the other parameters specified in the CONTRACT have been achieved, in particular those parameters to which warranties and penalties are attached;
- interfaces for operators are ergonomically acceptable.

The individual commissioning steps will be hierarchical from the bottom up, meaning that the higher level can only be tested if the lower level is working perfectly.

The OB 2 CONTRACTOR shall submit a clear test schedule in the form of a network diagram to the CLIENT for approval in accordance with the schedule prior to the commencement of the relevant test.

A detailed commissioning test program shall be drawn up by the OB 2 CONTRACTOR and submitted to the CLIENT for approval within 20 days (at the latest) prior to the commencement of each test. The program shall include any requirements for the OB 2 CONTRACTOR's and/or other OB 2 CONTRACTORS' activities and for the supply of materials.

For switching of substations, testing of motors and other power equipment of the OB 2 CONTRACTOR, the OB 2 CONTRACTOR's testers shall submit a written request on a mutually agreed form to the Employer.

14.6 Optimizing

After the completion of the tests with the technologies, optimization will be carried out with respect to the required guaranteed values of the equipment. This will include, among other things, optimization of the dynamics of the protections, control, and HMI characteristics.

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In addition, the OB 2 CONTRACTOR shall, together with the suppliers of the K20 boiler technology and the Customer's personnel, optimize the K20 boiler technology during start-up, shutdown, steady-state operation, and fault conditions as well as during power changes.

14.7 Comprehensive testing

The proposed tests must demonstrate, inter alia, that:

- The I&C system is complete, ready and capable of safe operation under all operating conditions;
- The electronic equipment and the signal transmission system are not sensitive to the electric and magnetic fields identified in the ŠE plant or to other fault factors;
- Manual, sequential and analogue control modes have been fully operational in terms of their performance;
- Functional performance of alerting, data analysis, archiving and other systems has been achieved;
- The requirements for static and dynamic behavior of the measures have been met

15 TRAINING

Training of operators, maintenance staff including system engineers and operators on the supplied I&C system will be included in the delivery price. The OB 2 CONTRACTOR shall provide certified training on the current version of the control system for a minimum of ten days for three persons in the Czech language. The OB 2 CONTRACTOR shall prepare sufficient training documentation in the Czech language for training purposes and the documentation shall be provided to the individual participants no later than 10 days before the training.

16 ATTACHMENTS

- 1) OB2_A113.01_Conceptual scheme of I&C
- 2) OB2_A113.02_Configuration diagram I&C
- 3) OB2_A113.03_Scheme of control system - K20 boiler system
- 4) OB2_A113.04_Disposition of room I&C +11,20 m