This document contains an English translation of selected parts of the Technical Specification and is provided for information purposes only. The complete Slovak version of the Technical Specification is binding. In the event of any discrepancy between this English translation and the Slovak version, the Slovak version shall prevail.

1. DFINITIONS OF TERMS AND ABBREVIATIONS

1.1 DEFINITIONS

Contractor (Supplier)

A natural or legal person with the required professional qualifications and a valid license to perform the activity who, upon conclusion of the contract, carries out the subject matter of performance for which the Technical Specification is being prepared.

As-Built Documentation (DSV)

Construction documentation (SO/PS/DPS) required for the safe operation of a structure, incorporating all changes that have occurred during the structure's operation, maintenance, or reconstruction. The as-built documentation reflects the actual condition as of the specified date.

As-Built Documentation for the Modification Project (DSV PZ)

The construction project documentation in which the Contractor has recorded all deviations and changes made during the construction process.

Project Manager

A designated employee responsible for managing the investment project (typically from the project management department).

Change Proposal (NZ)

An internal document describing a request for a change to the nuclear power plant project.

Online Update of DSV/STD Documentation

Updates to DSV/STD documentation performed by the project change implementer immediately after its completion, based on the submitted as-built documentation for the DSV PZ project change. The online update is coordinated by a representative of the NPP DSV Update Group.

Operational Documentation

This refers to the documentation and records contained in the "quality system" regulations, primarily technical regulations, procedures, instructions, and operational diagrams.

Operational Inventory

This is a set of machines, equipment, and inventory that performs a separate technological process of the core production technology or the complete technological process of auxiliary production and is put into operation at the same time.

Supporting Documentation

Documentation containing information about a given nuclear power plant facility for its safe operation, modifications, repairs, service life extension, and the like. The most important parts of the supporting documentation are the supporting calculations and reports demonstrating the facility's qualification.

Operator of a Facility, System, or Equipment

A person or department responsible for the operation and use of the relevant facility, system, and equipment.

Designer

A person with the appropriate education and qualifications for design work.

Design Documentation (DD)

A set of documents prepared for the approval, preparation, and implementation of technical changes to the current state of technological systems, structures, or software. This set of documents (implementation project, quality plans, quality and safety documentation, etc.) is prepared based on the requirements specified in the Change Proposal, in the change specifications within the Technical Specifications, and in accordance with applicable regulations.

Implementation Project

The documentation according to which the change is implemented. It is used for the purchase of materials, workshop production, and on-site assembly, and serves as the basis for conducting tests. It is the main part of the project documentation.

Accompanying Technical Documentation

A set of documents that certifies the quality of the delivered equipment, as well as the correctness, reliability, and safety of the equipment's operation (certificates of quality and completeness, reports on technical inspections of designated equipment, equipment passports, IPZK, technical specifications, etc.).

Construction site

For the purposes of establishing requirements for safety coordination and documentation coordination pursuant to Slovak Government Regulation No. 396/2006 Coll., a construction site is also defined as an area where civil engineering work is performed, as well as an area where excavation work, earthwork, structural modifications, demolition, reconstruction, and renovation work; the assembly and disassembly of structural elements; the disassembly and repair of technical, technological, and energy-related building equipment; drainage work; maintenance and upkeep, including painting and cleaning; and the cleanup of the construction site upon completion of the work.

Technical Specifications of the Project

A document, or set of documents, describing the proposed solution, the technical specifications of the project, and the specifications of all or selected components of the project. The technical specifications define the requirements for design, engineering, manufacturing, installation, commissioning, operation, maintenance, training, repairs, inspections, and even disposal at the end of their service life. The technical specifications for the project serve as the basis for the procurement process to select a contractor for the project.

Selected Equipment

A system, structure, component, or part thereof, including its software, that is important from the perspective of the nuclear safety of a nuclear facility, classified into safety classes (Decree No. 431/2011 of the Nuclear Regulatory Authority of the Slovak Republic) based on its significance for nuclear safety, as well as on the safety function of the system of which it is a part, and on the severity of any potential failure.

Designated Technical Equipment

A system, structure, component, or part thereof, including its software, that is significant in terms of its classification based on the level of risk as defined in Decree No. 508/2009 Coll. of the Ministry of Labor, Social Affairs and Family of the Slovak Republic.

Record

A document describing the results achieved or providing evidence of activities performed.

Change

A change is the replacement of the existing state of equipment, a system, a component, a structure, a building, software, documentation, etc., with a new, different state having different parameters or functional characteristics.

Configuration Change (CC)

Any change to the configuration of any system, component, structure, or software that requires a change in the design documentation (upgrade, modification, reconstruction, or repair involving the replacement of one component with another).

1.2 ABBREVIATIONS

A/D	Analog/Digital
AC	Alternating current
AKNT	Neutron flux monitoring equipment
AS	Archive server
AZ	Active Zone
BD	Block Control Room
BOZP	Occupational Safety and Health
BSP	Security Report
BT	Security Class
D/A	Digital/Analog
DC	Direct current
DNBR	Departure from Nucleate Boiling Ratio (heat transfer crisis margin, transition from nucleate to film boiling)
DPS	Sub-operating set
DPZ	Self-powered N-flow detector
DSS	As-Built Documentation
DSV	As-Built Documentation
EBO	Jaslovské Bohunice Power Plant
EMC	Electromagnetic Compatibility
FAT	Acceptance Tests Prior to Delivery of Equipment at the Manufacturer’s Facility
GO	General Outage
GPS	Global Positioning System
GW	Network Gateway
HMG	Schedule
HRK	Main Control Unit
HW	Hardware
ICS	Industrial and Control Systems
ICT	Information and Communication Technologies
IP	Internet Protocol
IPR	Investment Project
IPZK	Individual Quality Assurance Plan
IS	Isothermal State
I/O	Input/Output
JAVYS	Nuclear and Decommissioning Company
NPP	Nuclear Power Plant
JSP	Environmental Interface Unit
KKCÚJD	ÚJD Crisis Coordination Center
KP	Controlled Zone
KSMTR	Reactor Temperature Measurement Control System
KV	Comprehensive testing
KVRK	In-Reactor Control Complex

LaP	Limits and Conditions
LTSC	Long-Time Support Channel
MaR	Measurement and control
MMI	Human-Machine Interface
MNA	Methodological Guidelines
MPSVR	Ministry of Labor, Social Affairs, and Family
MTBF	Mean Time Between Failures, Operational Reliability
MV	Ministry of the Interior
NA	Instructions
NBÚ	National Security Authority
ND	Spare Parts
NN	Low Voltage
N-flux	Neutron flux
NR	National Council
OCR	Optical Character Recognition
OIP	Operational Engineering Support
OPaOS	Technical Inspection and Technical Test
OPC	Ole for Process Control (communication protocol)
OPP	Fire Protection
OS	Operating System
OST	Resistance Temperature Sensor
OT	Operating Technologies
OTe	Resistance thermometer
PC	Personal computer
PI	Operating Instructions
PLC	Programmable Logic Controller
PO	Primary circuit
PD	Project documentation
PK	Fuel assembly
PKS	Inspection and Test Plan
PKV	Comprehensive Testing Program
PKZS	Critical Infrastructure Service Operator
PLKVZ	Quality Plan for a Selected Facility
PP	Operating Procedure
PS	Operating File
PUK	Cable Layout Plan
PZ	Change Project
RAO	Radioactive Waste
RPS	Reactor Protection System
RRCS	Reactor HRK Group and Individual Control System
RSTD	Technical Documentation Registry Center
RZSMK	Change Management in the Quality Management System
SC	SCORPIO Station

SE	Slovak Power Plants, Inc.
SJZ	Unified Marking System
SKR	Control and Management Systems
SO	Building
SPDS	Safety Parameter Display System
SR	Slovak Republic
SS	Service Station
SSR	Secondary Control Service
ST	Seismic Class
STD	Accompanying Technical Documentation
STN	Slovak Technical Standard
SVRK	In-Reactor Monitoring System
SW	Software
TC	Thermocouple
TER	Reactor temperature standard
TG	Turbogenerator
TPP	Operating Procedure
TPS	Process Computer System
TS	Process Network
TST	Thermoelectric Temperature Sensor
TŠ	Technical Specifications
TVCS	Circulation Loop Water Temperature
ÚJD	Nuclear Regulatory Authority
VBŠ	General Safety Standards
VS	Computing Center
VTQ	Value-Time-Quality (VTQ)
VTPK	Fuel cartridge outlet temperature
ZoD	Contract for Work
ZI	Change Engineer
ZN	Guaranteed Power Supply

2. INITIAL SITUATION

2.1 OBJECTIVE AND PURPOSE OF THE PROJECT

The objective of the project is to ensure compliance with Decree No. 430/2011 of the Nuclear Regulatory Authority of the Slovak Republic (ÚJD SR), due to the requirement to classify and physically implement the KVRK SKR system among selected facilities in BT3, as well as to modernize it due to obsolescence and limited availability of spare parts.

The purpose is to ensure the network security of the KVRK system and to eliminate the potential risk of operational unavailability due to the unavailability of spare parts.

2.2 DESCRIPTION OF THE CURRENT STATUS AND CLASSIFICATION

The current KVRK technological system is classified as a BT4 safety class facility. Based on the approved conclusions of the "Analysis of the KVRK's Classification into a Safety Class in Accordance with the Classification Requirements of ÚJD SR Decree No. 430/2011 and the STN EN IEC 61226 Standard"—see Appendix No. 10—a reclassification of the KVRK system's security class is required, with the system to be classified as BT3.

KVRK system interconnections that need to be addressed:

1. The interconnection of the KVRK system with the TPS system (BT4), for which there is no requirement for classification among selected devices in BT3.
2. Connection routes of the KVRK measurement circuits that do not meet the required classification for BT3.

2.2.1 DESCRIPTION OF THE CURRENT STATUS

System Design Functions

The KVRK system is used to interpret measured in-reactor parameters for the purpose of comprehensively reconstructing all significant factors affecting the safe operation of the reactor during normal operation, and its accuracy (lower uncertainty in determining limit values), it contributes to the most efficient use of fuel. The KVRK system ensures control of power limitation parameters in the AZ and control of reactor power in accordance with the requirements of the document "Limits and Conditions" and the "Table of Permitted Reactor Operating Modes." If any parameter specified in the LaP is exceeded, a visual alarm will be triggered.

The KVRK monitors:

- reactor thermal power and coolant heating at the reactor (in the loops),
- relative power of the fuel assemblies,
- the relative power distribution across the volume of the core (Kv),
- the linear power of each fuel rod and the minimum margin to the linear power limit in the core, taking into account the dependence of the limits on fuel burnup,
- the relative linear power of the most heavily loaded fuel rods along the height of each assembly (Kv.Kk), taking into account the dependence of the limits on fuel burnup,
- the outlet temperature of the fuel assemblies and the coolant heating in all fuel assemblies, taking into account measured and calculated values of temperature and heating,
- margin to the saturation temperature in the hot flow of the core,
- the margin to the critical heat flux in the core.

To calculate these parameters, the SCORPIO system performs a three-dimensional reconstruction of the power distribution within the core volume. For this reconstruction, it uses measured values from thermocouples at the fuel assembly outlets, measured neutron flux values from the DPZ, and calculations from a simulator based on the MOBYDICK computational code. The thermohydraulic module then uses the reconstructed power values to calculate the heat gains and outlet temperatures from the PK and DNBR, as well as the outlet temperature from the subchannel. The system also handles the processing and validation of measured signals.

During the campaign, the KVRK system enables verification of the representativeness of the fuel loading design by comparing the design (calculated using computational programs) of the energy release distribution for assemblies and fuel rods with the distribution reconstructed based on data from the KVRK sensors.

Basic Description and Structure of the KVRK System

The KVRK system is a subsystem of the TPS unit's information system. Following the V2 upgrade, it became an integral part of that system, utilizing its hardware and software. However, due to its specific functions, it constitutes a separate logical unit, from the acquisition of input signals through processing to their presentation. For this reason, the KVRK system is divided into the following parts:

- Fully redundant interface units JSP-I1 and JSP-I2
- Fully redundant TPS-InCore VS3 and VS4 computing stations
- TPS – InCore visualization section (TPS-MMI station)
- Fully redundant SCORPIO 1 and 2 in-reactor measurement computing systems (operating in parallel mode or in Hot-Standby/Backup mode) with a terminal connected to the Main Control Room

Outside the TPS, a new KRUIZ system—currently classified as BT3—has been established to replace the SCORPIO system (while the SCORPIO system remains unchanged, fully functional, and on standby) and consists of:

- The KRUIZ1 and KRUIZ2 workstations (operating in parallel mode or in Hot-Standby/Backup mode) and the KRUIZ terminal on the BD.

Principles of Input Signal Measurement in the JSP-I

The JSP-I interface unit collects, performs initial processing of, and transmits information about the reactor core, PO, and selected SO parameters to the higher-level TPS, Kruiz, and Scorpio systems. The connection between JSP-I and these higher-level systems is provided by the redundant VS3 and VS4 computing stations. The IS2 workstation with the corresponding hardware key is used to manage and monitor the JSP-I.

Types and numbers of signals measured using the JSP-I input section:

- 252 temperature measurements from thermocouples
- 55 temperature measurements from OT
- 288 neutron flux measurements from DPZ
- 46 selected standardized signals from the PO and SO
- 221 binary two-value signals
- 2 TG power measurements
- 2 frequency measurements

The existing thermocouples are of the chromel–alumel type with a grounded hot end.

The measured signals are converted in JSP-I to standardized values, divided into two fully redundant process sections, filtered, converted to discrete form, and adjusted to a physical quantity. The information processed in this way is transmitted from the JSP-I process section via the proprietary PerNet protocol over an Ethernet network using the TCP/IP protocol for further processing to the VS3 and VS4 computing stations.

Fig. 1: JSP-I Input Section Cabinets



From a software perspective, KVRK (or KRUIZ and SCORPIO) includes the AZ neutron-physical and thermohydraulic models. By synthesizing these models with in-reactor measurements, KVRK provides all parameters essential for monitoring the AZ from a safety perspective.

Via an Ethernet network, the KVRK system connects to the TPS block-level and above-block-level network and ensures data transfer to the AS1 and AS2 archive servers.

SCORPIO System

The system is designed as a unit-level system with full 100% redundancy. The system is based on two block workstations, SC1 and SC2. The workstations operate in independent parallel mode or in backup mode, in which one workstation is the primary (active) one and the other is on standby, ready to take over all system functions in the event of a failure of the primary workstation. In parallel mode, each SCORPIO station independently collects and processes data; this data is made available to the BD operator via an X-terminal, which is set by default to display data from station SC1.

The SC1 and SC2 monitoring stations do not have their own equipment for collecting signals from the technology but utilize the computational part of the TPS system, consisting of the JSP-I1 and JSP-I2 process stations and the VS3 and VS4 computing systems (virtual computing stations). Currently, the SCORPIO system is being retained as a backup limit system until new fuel (from a different manufacturer) is introduced or until the spare parts inventory for this system is depleted.

Operating system for SCORPIO Stations 1 and 2: HP UNIX

A diagram of the communication between the SCORPIO system devices (as a backup system) and the TPS is provided in Appendix 8.

KRUIZ System

The system is designed in the same way as the SCORPIO system. It shares the same foundation as the SCORPIO system. The stations operate in independent parallel mode or in backup mode; data is displayed on the database. The KRUIZ system monitoring stations (1 and 2) currently use the computing section of the TPS system (VS3 and VS4) to forward measured data from the JSP-I input section.

Operating system of KRUIZ stations 1 and 2: Linux

A diagram of communication between KRUIZ system devices and with the TPS is provided in Appendix 9.

InCore Emergency Subsystem – *TPS*

InCore is a standalone application within the TPS system and is therefore entirely composed of TPS software and hardware resources, including computational, operator, and archiving virtual stations. It currently processes data independently from VS3 and VS4 and other systems feeding into the TPS, such as RPS, RRCS, AKNT, and others, for its calculations regarding the AZ status. The purpose of the system is to provide basic information on the AZ status at the BD in the event of a failure of the main monitoring system (Kruiz/Scorpio). This is merely a redundant add-on that does not meet the accuracy requirements or the regulations of the Nuclear Regulatory Authority (ÚJD); therefore, the output is for informational purposes only and has only a partial impact on LaP (extending the time window to ensure reactor power reduction in the event of a main system failure). Currently, data from both the Scorpio and KRUIZ systems are sent to the TPS system archive.

The *KRUIZ (and SCORPIO)* and *InCore-TPS* systems operate continuously and, “independently of one another,” provide information on the reactor core status and selected parameters of the primary and secondary systems. However, the SCORPIO system currently forwards certain correction values to *InCore* to ensure proper operation, since the computational model in *InCore* is not as accurate and deviations in calculations would occur over time; therefore, it is not entirely independent of the Scorpio system.

Fig. 2: Current status of KVRK and TPS and their classification into BT.



KSMTR is a temperature standard for measuring temperatures in the primary circuit loops, and its purpose is as follows:

The KSMTR is a tool for the precise measurement of the temperature and heat of the primary coolant during nuclear reactor operation using designated temperature sensors. It provides unambiguous information on the status of temperature parameters (variables) important for both the safety and the economics of the power plant. A two-way exchange of data takes place between the KVRK and KSMTR systems.

The data measured by designated temperature sensors enable:

- Determining the quality of the quasi-IS and establishing the precise “reference” temperature for the reactor’s quasi-IS at the end of the fuel cycle, based on which the VTPK and TVCS correction constants are calculated in the KVRK, thereby ensuring their metrological traceability.
- At the reactor’s rated power, monitoring the accuracy and reliability characteristics of the VTPK and TVCS temperature measurements in the KVRK.
- Reduce the uncertainty in maintaining the reactor’s nominal power during the unit campaign.

The SPAS subsystem is an extension of the TER and is used to process and archive temperature data from the TER and KVRK (from the VTPK and TVCS components).

Fig. 3: KSMTR System Diagram



The TPS system consists of the following components:

The input level (TPS_DA) consists of:

- JSP integration cabinets for collecting process data, which are assembled from [redacted]system components and contain modules for processing process signals, as well as a processor cabinet with programmable process stations, including control processors and I/O boards,
- engineering stations

Process Section

The process section ensures the collection of process parameters via field interface units, which collect hardware-connected analog, discrete, and initiative signals from the process. The process section also includes gateways (GWs) for external systems, which collect process parameters and ensure the transmission of commands via communication buses to and from connected external systems. Connected to the process section are computing systems that form the computational and data interface between the Input and MMI sections of the TPS. The virtual computing systems VS1 and VS3 run primarily on the [redacted] host, and the virtual computing systems VS2 and VS4 run primarily on the [redacted]host. The computing systems are redundantly distributed in the sense that systems VS1 and VS2 process data from the JSP-P section, while systems VS3 and VS4 process data from the JSP-I section. Physically, the [redacted] and [redacted] virtualization hosts are located in racks [redacted] and [redacted]

The processing section consists of the following equipment:

- Computer racks with computing systems for the information section
- Hardware connections to devices in the Common Section (power and communication cabinet)
- Communication data connections to MMI section devices and connections to external systems (such as RLS, N-flow).

It also utilizes the following for its functions:

- Hardware connections to Common Section equipment (power and communication cabinets)

- Communication data links to devices in the Input Section, MMI Section, and super-block network, as well as links to external systems.

Overview of Main Functions:

- Data transfer between the system's Input Section (including inputs from interfaces with other systems) and the computing system.
- Data processing and calculations.
- Data transfer between the computing system and the MMI section of the system (including outputs to interfaces with other systems).

Computer Network Solution

Since the KVRK system is integrated into the TPS structure, it includes the following communication subsystems:

P_NET – a redundant, segmented communication network between the TPS input section for JSP-P and certain external systems, and the process section.

I_NET – a redundant, segmented communication network between the TPS Input Section for JSP-I (InCore) and the relevant external systems (PAMS, N-tok) and the JSP-I Process Section.

MMI_NET – a redundant, segmented communication network between the end processors of input/output and calculated nuclear power plant technology parameters, and the management and administration of the TPS system.

Communication Links

Communication both within and outside the TPS systems consists of the following types of lines and networks:

- Ethernet communication network (PERNET protocol) between the TPS_DA input level (process station) and the TPS_DP process level (computing systems).
- Ethernet communication network (TCP/IP protocol) between the TPS_DP process level (computing systems) and the TPS_MMI level.
- A communication link (synchronized time distribution) from the GPS control center.

MMI level (TPS_MMI)

The system also includes:

1. A 100MB Ethernet TCP/IP communication network with the Suite Link data transport protocol, which connects the TPS_MMI level to the TPS_DP process level. Since the JSP-I system is integrated into the JSP-P system at the MMI level, the JSP-I_DP level is also connected to this network,
2. A 100 MB Ethernet TCP/IP communication network with the PERNET data protocol, which connects the TPS_DP process level to the TPS_DA input level,
3. The communication cabinets, designated [redacted], contain optical and metallic ports and a switch for internal or external Ethernet communication.

Hardware equipment of the JSP input section

Types of JSP cabinets used:

1. Unification cabinets for processing analog signals
2. Discrete signal distribution cabinets
3. Galvanic isolator cabinets
4. D and A signal processor cabinets
5. Central power supply cabinets

The customer may, through trained employees, make modifications to the TPS:

- Modify HMI diagrams,
- modify collected and provided signals,
- modify calculated signals,

- modify archived signals,
- modify alarm signals.

The Client currently does not have the necessary resources to perform modifications to the existing TPS system. If work on the existing TPS system is required, the Contractor may perform such work using its own resources or through a subcontractor.

Current installation of cards and modules in the JSP-I section:

[redacted]cabinets

Cards: VZ 210 – N-flow measurement along AZ
VZ 224/4 – RTD-to-4-20 mA converter
VZ 220/4 – RTD-to-4–20 mA converter
VZ 220/5 – RTD-to-4-20 mA Converter

[redacted] Enclosure

Cards: VZ 410 – Active/Passive Current Loop

Enclosures: [redacted]:

Cards: DV 455B/1 – Unification (A/D) Cards
DV 456A – A/D cards – 100 V~ (frequency measurement)
DV 457A – A/D and D/A converters for measuring 4–20 mA current signals
DV 457A/1
DV 652 – digitizing (two-state and four-state)
DV 851 – Switching of medium-power loads

Other JSP-I technology enclosures:

[redacted] – Discrete signal distributor (WAGO terminals)
[redacted] – Galvanic Isolator Cabinet
[redacted] – Central power distribution panel.
[redacted] – U/I converters

The existing database lists the individual terminal blocks, terminals, and polarity of all incoming signals. Detailed wiring diagrams for individual signal types (both binary and analog) are provided in the DSV drawing section—Standard Schematics of the System's Internal Wiring.

The principle of input signal wiring has been retained from the original system (Uran), and therefore it is not possible to unambiguously define the rules for connecting individual signal types to the terminal blocks.

To unambiguously determine a signal connection, it is therefore always necessary to use information from the database.

The KVRK system has been gradually expanded and modified in accordance with the requirements of EBO and ÚJD. Various modifications have led to a situation that requires standardization, as well as an upgrade of its input section, JSP-I.

Therefore, the new logical unit—renamed SVRK—will include the KRUIZ system, for which we do not require any changes. It will also include the JSP-I input section, which we intend to replace with a new one. By separating the currently interconnected TPS system, SVRK will become independent of TPS; however, it is necessary to maintain the reception of "raw" data from JSP-I in order to preserve the functionalities of TPS, its archive, and the SCORPIO backup system, all of which we wish to retain.

Power Supply

The input section of the JSP-I is powered from the [redacted] secondary switchboards for Unit 3 (located in [redacted]) with the following system:

- 3/PEN AC 400/230, 50 Hz, TN-C
- 1/N/PE AC 50 Hz 230 V/TN-S
- 1-230 V AC/TN-S
- 2-48 V DC/PELV

And for Unit 4 (located in [redacted], a [redacted] switchgear with the following configuration:

- 3PEN AC 50 Hz 400/230 V/TN-C
- 1/N/PE AC 50 Hz 230 V/TN-S
- 1-230V AC/TN-S Control and signaling voltage from 2DR05
- 2–48 V DC/PELV General fault indication from BD, H110

and the [redacted] distribution panel with the following system:

- 3/PEN AC 400/230, 50 Hz, TN-C-S
- 3/PEN AC 400V/230V, 50 Hz, TN-C
- 1-230V AC/TN-S Control and signaling
- 2-48V DC/PELV Summary fault signaling

The listed switchgear panels are powered via feeders from the 4th Category I secured power supply system ([redacted] sectional switchgear classified as BT4). The total current power consumption of the JSP-I section for a single reactor unit is 6 kW. Switchgear units [redacted] are not classified as BT.

The **KRUIZ** and **SCORPIO** systems are currently connected via two feeders from switchgear units [redacted] for Unit 3 and [redacted] for Unit 4, which are also powered by the 4th Category I backup power supply system ([redacted] switchgear). The [redacted] switchgear are not classified as BT.

2.2.2 CLASSIFICATION/QUALIFICATION

The equipment must be capable of fulfilling the requirements for performing its functions throughout its operational life, taking into account the influence of environmental conditions during its service life with regard to aging, wear and tear, and the impact of events. The table below shows the current classification.

Table 1: Current Classification of Equipment

Function / System	**Decree of the Nuclear Regulatory Authority of the Slovak Republic No. 430/2011 Coll.**		**MAAE50-SG-D15**	**STN EN IEC 61226**	**Decree of the Ministry of Labor, Social Affairs and Family No. 508/2009**	**Decree No. 227/2025 Coll.**	**EN 61326-1**
	BF	**BT**	**ST**	**Category**			
KRUIZ	j	3	Non-seismic (2)	C	III.B	OT	Yes
SCORPIO	-	4	Non-seismic (2)	C	III.B	OT	Yes
JSP-I (TPS)	-	4	See below	C	III.B	OT	Yes

Additional information:

- Some of the KVRK system's measurement circuits are currently classified as BT4 and have seismic categories of ST 1-I, ST 1-FA, ST 2, and ST 2a (detailed in Appendix No. 6)
- Switchgear units [redacted] are classified in seismic category ST 2a
- Switchgear units [redacted] are classified in seismic category ST 2
- Certain components related to the nuclear power plant's safety systems and technological information systems are classified as safety-related systems.
- The majority of the TPS system itself is located in Rooms [redacted] and is classified as ST-2. The portion of the TPS in Rooms [redacted] is classified as ST-2a.

Operation during emergency conditions is not required. The conditions for operation and operability of the systems are specified in Section 4.1.3.9 of this Technical Specification.

The KVRK system is related to the following LaPs:

3.1.1. Subcriticality safety margin
3.2.1. Linear power of a fuel rod
3.2.2. Fuel rod power
3.3.6. In-reactor monitoring system instruments
3.4.1. Ensuring Reliable Heat Removal from the Core

Affected chapters of 6-BSP-001:

[redacted]

2.3 PLACE OF DELIVERY

The delivery is for Slovenské elektrárne, a.s., Bohunice Nuclear Power Plant, 919 31 Bohunice. The Bohunice Nuclear Power Plant is located in the southwestern part of the Slovak Republic (Trnava District) near the Váh River, approximately 15 km north of the city of Trnava and 70 km from the capital city of Bratislava. The distance from the D1 highway exit is approximately 10 km. The power plant is connected to the rail network via a rail spur owned by JAVYS a.s., leading to the Veľké Kostoľany railway station, located approximately 5 km from the power plant. Access to the EBO power plant is via Class I and II public roads, by rail within the plant grounds, and via internal roads leading to the facility in question.

2.3.1 TRANSPORT ROUTES WITHIN THE PLANT PREMISES

The EBO site is fenced and guarded under a special security regime, where safety instructions and regulations govern the movement of people, vehicles, and material deliveries. Vehicle and pedestrian access to the site is possible through the EBO gatehouse. After passing through the gatehouse, the transport route continues along the on-site road.

2.4 ENVIRONMENTAL CHARACTERISTICS

The relevant technological equipment of the affected systems is located:

- In Section 3 of Block [redacted] at an elevation of [redacted] the power supply and logic components (JSP-I rack cabinets) are located in Rooms [redacted].
- In Block 4, [redacted], at an elevation of [redacted], the power supply and logic components (JSP-I rack cabinets) are located in rooms [redacted].
- In Block 3 of [redacted], at an elevation of [redacted], Room [redacted] houses TPS system racks, as well as PCs and the SCORPIO and KRUIZ systems.
- In Block 4 of SO807, at elevation +[redacted], Room No. [redacted] houses TPS system racks, as well as PCs and the SCORPIO and KRUIZ systems.

The characteristics and parameters of the environment in the affected areas are specified in the environmental assessment reports prepared by the expert commission (see Appendix No. 7).

2.5 LEGAL REQUIREMENTS

The submitted project documentation must be prepared in accordance with EU and Slovak legislation, as well as the relevant standards and regulations.

Table No. 2: List of Required Legislation.

1.	Decree of the Ministry of the Interior of the Slovak Republic No. 121/2002 Coll. on Fire Prevention, as amended.
2.	The occupational safety and health section will be prepared in accordance with Act No. 124/2006 Coll. on Occupational Safety and Health and on Amendments to Certain Acts.
3.	Act No. 114/2022 Coll., amending Act No. 124/2006 Coll. on Occupational Safety and Health and on Amendments to Certain Acts, as amended, and amending certain acts.
4.	Act No. 125/2006 Coll. on Labor Inspection and amending Act No. 82/2005 Coll. on Illegal Work and Illegal Employment and amending certain acts.
5.	Act No. 314/2001 Coll. of the National Council of the Slovak Republic on Fire Protection, as amended.
6.	Act No. 69/2018 Coll. on Cybersecurity and on Amendments to Certain Acts.
7.	National Security Authority Decree No. 227/2025 Coll. on Security Measures.
8.	Act No. 355/2007 Coll. on the Protection, Promotion, and Development of Public Health and on Amendments to Certain Acts
9.	Slovak Government Regulation No. 387/2006 Coll. on Requirements for Ensuring Safety and Health Signage in the Workplace.
10.	Slovak Government Regulation No. 391/2006 Coll. on Minimum Safety and Health Requirements for the Workplace.
11.	Slovak Government Regulation No. 392/2006 Coll. on Minimum Safety and Health Requirements for the Use of Work Equipment.
12.	Slovak Government Regulation No. 395/2006 Coll. on Minimum Requirements for the Use of Personal Protective Equipment.
13.	Slovak Government Regulation No. 396/2006 Coll. on minimum safety and health requirements for construction sites.
14.	Act of the National Council of the Slovak Republic No. 56/2018 Coll. on product conformity assessment, the making available of a specified product on the market, and on amendments to certain acts, as amended by Act No. 259/2021 Coll.
15.	Act No. 79/2015 Coll. on Waste and on Amendments to Certain Acts, and its implementing decrees of the Ministry of the Environment of the Slovak Republic No. 365/2015 Coll. and Decree No. 371/2015 Coll.
16.	Slovak Government Regulation No. 127/2016 on Electromagnetic Compatibility, as amended by Slovak Government Regulation No. 331/2019 Coll.
17.	MPSVRof the Slovak Republic No. 147/2013 Coll., laying down details for ensuring occupational safety and health during construction work and related activities, and details regarding professional qualifications for performing certain work activities, as amended by Decree of the Ministry of Labor, Social Affairs and Family of the Slovak Republic No. 100/2015 Coll.
18.	Decree of the Ministry of Labor, Social Affairs and Family of the Slovak Republic No. 508/2009 Coll., which establishes details for ensuring occupational safety and health when working with pressure, lifting, electrical, and gas equipment, and which specifies the technical equipment considered to be designated technical equipment, as amended by Decree No. 398/2013 Coll. of the Ministry of Labor, Social Affairs and Family of the Slovak Republic and Decree No. 234/2014 Coll. of the Ministry of Labor, Social Affairs and Family of the Slovak Republic.
19.	Decree of the Nuclear Regulatory Authority of the Slovak Republic No. 204/2025 Coll., amending Decree of the Nuclear Regulatory Authority of the Slovak Republic No. 431/2011 Coll. on the quality management system, as amended

20.	Decree of the Nuclear Regulatory Authority of the Slovak Republic No. 58/2006 Coll., which specifies details regarding the scope, content, and method of preparing the documentation for nuclear facilities required for individual decisions, as amended by Decree No. 31/2012 Coll. and Decree No. 102/2016 Coll.
21.	Decree of the Nuclear Regulatory Authority of the Slovak Republic No. 430/2011 Coll. on nuclear safety requirements, as amended by Decree of the Nuclear Regulatory Authority of the Slovak Republic No. 103/2016.
22.	Decree of the Nuclear Regulatory Authority of the Slovak Republic No. 431/2011 Coll. on the Quality Management System, as amended by Decree of the Nuclear Regulatory Authority of the Slovak Republic No. 104/2016
23.	Act No. 541/2004 Coll. on the Peaceful Use of Nuclear Energy (Atomic Act) and on Amendments to Certain Acts.
24.	Act of the National Council of the Slovak Republic No. 350/2011 Coll., amending Act No. 541/2004 Coll.

Table No. 3: List of standards in accordance with which the technical solution will be designed

1.	**STN 33 2000-1:2009**	Low-Voltage Electrical Installations. Part 1: Basic Principles, General Characteristics, Definitions.
2.	**STN 33 2000-2:2004**	International Electrotechnical Vocabulary. Chapter 826: Electrical Installations in Buildings.
3.	**STN EN 50110-1:2024**	STN EN 50110-1 Operation of electrical installations. Part 1: General requirements.
4.	**STN 33 2000-4-41:2019**	Low-Voltage Electrical Installations. Part 4-41: Safety Measures. Protection Against Electric Shock.
5.	**STN 33 2000-4-43:2024**	Low-voltage electrical installations. Part 4-43: Safety measures—Protection against overcurrent.
6.	**STN 33 2000-4-444:2011**	STN 33 2000-4-444 Low-voltage electrical installations. Part 4-444. Safety measures. Protection against transient overvoltages and electromagnetic interference.
7.	**STN 33 2000-4-473:1995**	Electrical equipment. Part 4: Safety. Chapter 47: Application of protective measures to ensure safety. Section 473: Measures for protection against overcurrent.
8.	**STN 33 2000-5-51:2010**	Electrical installations in buildings. Part 5-51: Selection and construction of electrical equipment. General rules.
9.	**STN 33 2000-5-52:2012**	Low-Voltage Electrical Installations. Part 5-52: Selection and Construction of Electrical Equipment. Electrical Distribution Systems.
10.	**STN 33 2000-5-53:2023**	Electrical Installations in Buildings. Part 5-53: Selection and Construction of Electrical Equipment. Switching and Control Equipment.
11.	**STN 33 2000-5-54:2012**	Low-voltage electrical installations. Part 5-54: Selection and installation of electrical equipment. Grounding systems and protective conductors.
12.	**STN 33 2000-6:2018**	Low-voltage electrical installations. Part 6: Inspection.
13.	**STN 33 2130:1983**	Electrical regulations. Indoor electrical wiring.
14.	**STN 34 3100:2001**	Safety requirements for operation and work on electrical installations.
15.	**STN 33 3210**	Electrical regulations. Distribution equipment. General provisions.
16.	**STN EN 60445:2018**	Basic and safety principles for human-machine interfaces, marking, and identification. Identification of equipment terminals and conductor and wire connections.

17.	**STN EN 60447:2005**	Basic and safety principles for human-machine interfaces. Control principles.
18.	**STN EN 60529:1993 + A1**	Degrees of protection provided by enclosures (IP code).
19.	**STN EN 60780-323:2018**	Nuclear facilities. Electrical equipment critical to safety. Qualification.
20.	**STN EN IEC 60870-5-104:2007 +A1/AC:2023**	Remote control equipment and systems. Part 5-104: Transmission protocols. Network access for IEC 60870-5-101 using standardized transmission profiles.
21.	**STN EN IEC 60880:2010**	Nuclear power plants. Safety-critical instrumentation and control. Software aspects for computer-based systems performing Category A functions.
22.	**STN EN IEC 62138:2020**	62138 Nuclear power plants. Safety-critical instrumentation and control systems. Software aspects for computer-based systems performing Category B and C functions.
23.	**STN EN 61000**	Electromagnetic Compatibility (EMC). 61000 Series of Standards
24.	**STN EN 61082-1:2015**	Preparation of documents used in electrical engineering. Part 1: Rules.
25.	**STN EN 61140**	Protection against electric shock. General requirements for installations and equipment.
26.	**STN EN IEC 61226:2021**	Safety-critical instrumentation and control systems. Classification of instrumentation and control functions.
27.	**STN EN IEC 61293:2021**	Marking of electrical equipment with rated data relating to electrical supply. Safety requirements.
28.	**STN EN 61326-3-1:2018**	Electrical equipment for measurement, control, and laboratory use. Electromagnetic compatibility requirements. Part 3-1: Immunity requirements for safety systems and equipment intended to perform safety functions (functional safety).
29.	**STN EN 61340-5-1:2017**	Protection of electronic components against electrostatic phenomena. General requirements.
30.	**STN EN IEC 62003:2020**	Nuclear power plants. Instrumentation, control systems, and power supply systems. Requirements for electromagnetic compatibility testing.
31.	**STN 73 6005:1985 + amendments**	Spatial arrangement of technical equipment wiring.
32.	**STN EN 50085-2-2:2009 (37 0010)**	Electrical installation conduits and electrical installation troughs. Part 2-2: Electrical installation conduits and enclosed electrical installation troughs intended for installation under the floor, for embedding in the floor, or for mounting on the floor
33.	**STN EN 61537:2007 (37 0002)**	Cable accessories. Cable tray systems and cable grating systems.
34.	**STN EN 60947-1:2021 (35 4101)**	Low-voltage switchgear and controlgear. Part 1: General rules.
35.	**STN EN 60960:2000**	Functional design criteria for safety parameter reporting systems for nuclear power plants.
36.	**STN EN IEC 60987:2021**	Nuclear power plants. Safety-critical instrumentation and control. Hardware requirements

Note: If, between the approval of the Technical Specification and the preparation of the project documentation or the actual execution of the work, a new version of the aforementioned normative documentation or legislation is issued, this project documentation and the execution of the work shall comply with the currently issued and valid version.

2.6 SUPPORTING DOCUMENTS OF SLOVAK POWER PLANTS

All information necessary for preparing a bid is contained in these Technical Specifications and their appendices.

The documentation provided reflects the actual condition; however, we recommend that the contractor verify the actual condition of the equipment on-site during an inspection.

2.6.1 LIST OF DPS AFFECTED BY THE CHANGE

Table No. 5: List of PCBs Affected by the Change

PS / DPS	PS / PCB Name
[redacted]	Primary Circuit – Unit 3 and Its Auxiliary Systems in the Reactor Building
[redacted]	Primary circuit SKR in the reactor building
[redacted]	Central Electrical Equipment – Unit 3
[redacted]	Control system, Unit 3
[redacted]	Computer System
[redacted]	Primary Circuit – Unit 4 and Its Auxiliary Systems in the Reactor Building
[redacted]	Primary circuit SKR in the reactor building
[redacted]	Central Electrical Equipment – Unit 4
[redacted]	Control System, Unit 4
[redacted]	Computer System

2.6.2 LIST OF STRUCTURES AFFECTED BY THE CHANGE

Table No. 6: List of Structures Affected by the Change

SO Number	SO Name
[redacted]	Cross-Section Shelving Unit, Block 3
[redacted]	Transverse shelving unit, Block 4
[redacted]	Long Shelving Unit

2.6.3 LIST OF TECHNICAL LOCATIONS AFFECTED BY THE CHANGE

Due to the large number of technical locations, they are listed in Appendix 6, where they are divided into technical locations of SVRK measurement circuits (784 locations) and technical locations of the TPS, SCORPIO, KRUIZ, and JSP-I systems (114 locations).

3. SCOPE OF WORK AND OPTIONS

3.1 SCOPE OF WORK

The scope of work will include the preparation of legislative documentation, the detailed design, and its complete implementation, including the dismantling of the old JSP-I system and the installation and testing of the new JSP-I system for both EBO V2 units. The newly delivered equipment will form a system with the new name SVRK, which will consist of the JSP-I input section, a computing station, a GW, and the existing KRUIZ computer stations for in-reactor calculations. The entire implementation will be divided into two outages of the EBO V2 units; however, a complete decommissioning of the existing system during operation is not acceptable, as information on the reactor core status is one of the conditions for the nuclear safety of reactor unit operation.

The entire SVRK system, including its hardware and software components, will be supplied in accordance with BT3 classification as defined by ÚJD Decree No. 430/2011 Coll. Power supply lines to BT4.

The overall project solution will be achieved through the following tasks:

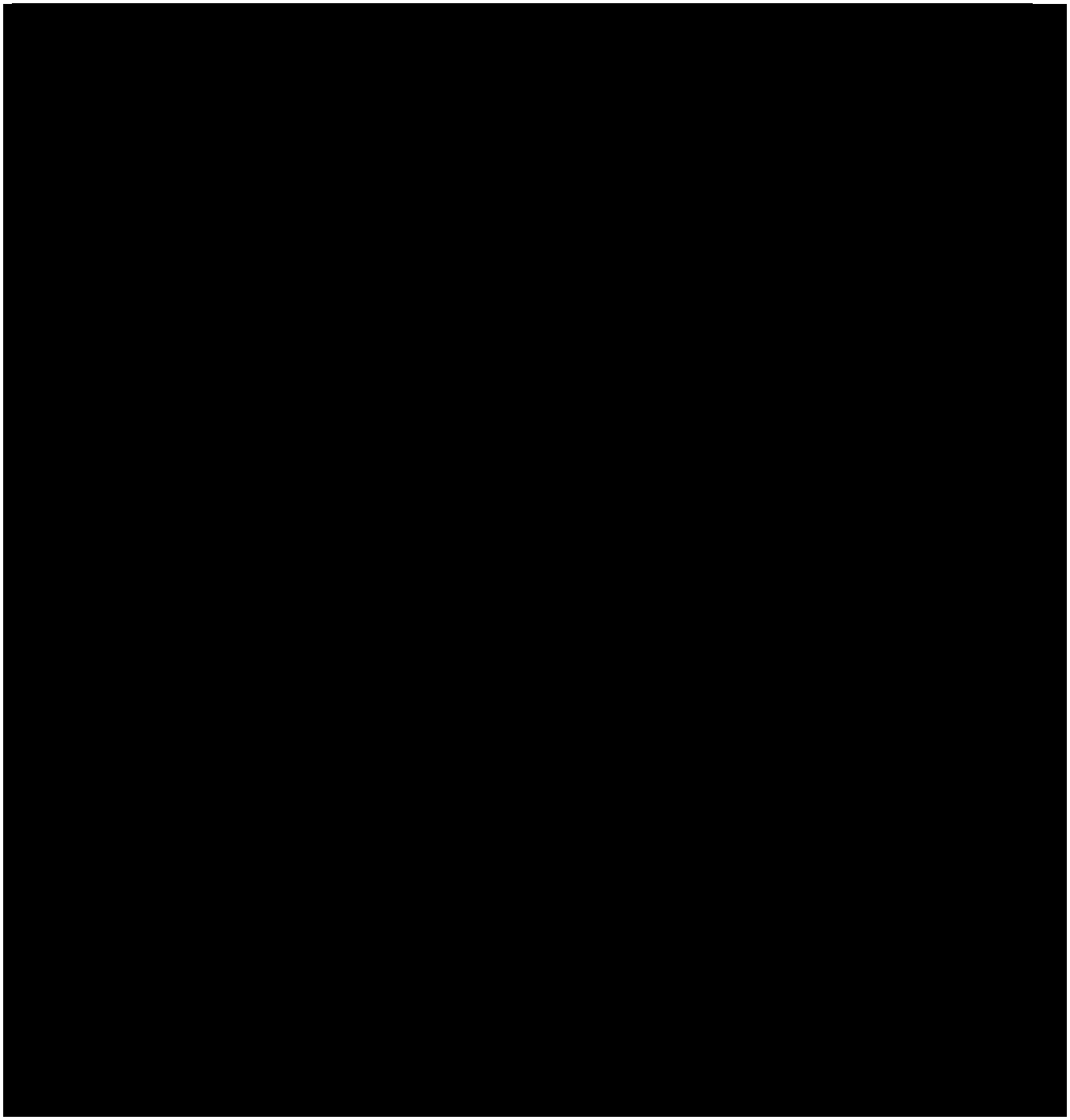
- Separate the JSP-I component and all inputs from external systems required for SVRK calculations from the TPS system.
- Design and delivery of a new JSP-I classified as BT3.
- Ensure that the SVRK system reads data from JSP-I and forwards it to KRUIZ and TPS. For these purposes, it is recommended to use a new computing or service station and the SVRK system's gateway (GW).
- Ensure that the measurement circuits are reclassified to BT3.
- Design and delivery of a new internal SVRK communication network.
- The SVRK will collect data from selected external security systems and forward this data to the TPS via new gateways.
- Configuration within the TPS system to ensure communication with the new SVRK.
- Management, maintenance, configuration, and diagnostics will be handled by proprietary software running on the TPS SS hardware or via the new SS
- Ensure continuous functionality during unit operation and a smooth transition to the new SVRK system.

Required modifications to the TPS:
- Modification of the network configuration resulting from the change in the solution
- Configuration of communication and security in the TPS
- Other tasks resulting from the contractor's solution.

Prepare the regulatory documentation in accordance with Decree No. 431/2011 Coll. of the Nuclear Regulatory Authority of the Slovak Republic

The entire modification will be carried out in accordance with the Implementation Project Documentation prepared by the Contractor.

Fig. 4: Block diagram of the required SVRK and TPS solution



3.1.1 DOCUMENTATION

- Project Implementation Documentation, including drawings
- Documentation verifying the qualification of products used in the project on selected equipment
- PLKVZ
- RZSMK §9, letters a through g
- OPP, supporting documents for the OSH plan
- Safe work procedures and risk assessment pursuant to Decree No. 124/2006
- Installation procedure
- Assembly log
- Waste Management Plan
- PKS, PUK
- List of new technical locations with classification indicated
- List of Selected Equipment
- Schedule and Plan for Deliveries and Work (HMG Equipment Deliveries and Implementation During General Overhaul)
- Project documentation for the construction of the work in red pencil
- Accompanying technical documentation (STD), including reports on inspections and tests performed
- Report on the designer’s declaration of responsibility pursuant to STN 33 2000-6:2018, Section 6.4.4.4
- FAT, PKV, and KV test programs
- Software validation and verification program for equipment
- As-Built Documentation (DSV-PZ)
- Incorporation of DSV-PZ into the DSS
- Network topology diagram in accordance with the ATŠ reference network architecture
- OT architectural and technological standards with anonymized information on network connections
- Documentation for the Operation and Maintenance of the Project (TPP, PI, Operating, User, and Maintenance Manuals, etc.)
- Technical inspection and technical testing by OPaOS (new and modified equipment)
- Report on the Individual Functional Test of the Equipment
- Installation Completion Report

The above-mentioned documentation is binding, and additional requirements for the project documentation to be provided by the contractor are specified in Sections 4.1.3.8, 5.1, and 5.3 of these Technical Specifications.

3.1.2 DELIVERY OF EQUIPMENT

The contractor shall procure all components and other materials necessary for the project's implementation in accordance with the prepared documentation, along with the required certifications under applicable legislation.

3.1.2.1 MACHINERY

- Not required.

3.1.2.2 ELECTRICAL

- Switchgear
- Electrical power cabling
- Circuit breakers, fuses, protective devices
- Small installation materials as required by the project (terminal blocks, wires, ferrules, heat-shrink tubing, labels, markings, etc.)

3.1.2.3 SKR

- Racks (JSP-I cabinets) – approximately 10 per block
- JSP-I power supplies
- Input cards and signal processing modules from sensors using the technology
- Communication modules and processor units
- Network gateway – GW
- Computing station for reading and managing data from JSP-I to the KRUIZ and TPS systems
- JSP-I Input Section Calibrator (modules and cards)
- Data cabling
- Miscellaneous installation materials required by the project (terminal blocks, busbars, wires, outlets, connectors, ferrules, heat-shrink tubing, labels, markings, etc.).

The specifications for the supplied equipment are defined in Section 4.1.3 of this Technical Specification.

3.1.2.4 CONSTRUCTION

- Creation and sealing of an opening between rooms equipped with TPS and JSP-I technology, with cable conduits passing through the floor, and insulation of the openings in accordance with fire safety measures

3.1.3 WORK EXECUTION

- Dismantling of the existing JSP-I system
- Installation of the new complete SVRK unit (JSP-I, GW, Computing or Service Station)
- Installation and connection of SVRK power and data cabling
- Connection of existing cabling to the JSP-I
- Configuration of communication in the TPS and SVRK
- Commissioning and configuration of SVRK equipment, including JSP-I
- Testing of equipment to verify functionality and measurement accuracy

- Verification of calibrator functionality

3.1.4 SOFTWARE WORK

Required:

- Delivery of system and application software for the SVRK system and the (engineering) service station
- Delivery of software for the GW
- Installation and configuration of software for system management and diagnostics at the SS
- Ensure data retrieval from the JSP-I in the SVRK system and forwarding of data to the TPS. The computing station will handle other functions within the SVRK system.
- Modifications and configuration of communication within the TPS system
- The software will be transferred to the ownership of SE a.s.

3.1.5 OTHER SERVICES

- Transportation of materials and components
- Removal of waste generated by the contractor's activities; the client will determine the waste disposal site
- Training for the client on equipment maintenance and operation
- Training of the client's operators on the operation, use, and maintenance of the new system

3.1.6 TESTING

- Conducting individual and functional tests in accordance with the prepared documentation
- OPaOS of electrical equipment affected by the modification
- Conducting FAT tests
- Conducting PKV and KV tests

Requirements for inspections and tests are specified in Chapter 7 of this Technical Specification.

3.2 OPTIONS

Not required

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The complete Technical Specification, including its appendices, will be made available only to interested parties/tenderers who submit a signed "Confidential Information Non-Disclosure Agreement" in accordance with Section 5.1.1 of the Tender Documents.

The English translation of the Technical Specification is provided for information purposes only; the Slovak version is binding and shall prevail in the event of any discrepancy. The appendices to the Technical Specification are provided in Slovak only and will not be translated into English.