



ESE-ENERGIA OY

PURSIALA POWER PLANT

AUTOMATION SYSTEM UPGRADE

DISTRIBUTED CONTROL SYSTEM (DCS) TECHNICAL SPECIFICATION

VERSION	DATE	DESCRIPTION	BY	CHECKED	APPROVED
0	30.10.2024	For RfQ	ARos	CSte	
A	3.12.2024	Updated	ARos	CSte	



Table of Contents

- 1 GENERAL..... 3
 - 1.1 General Instructions 3
- 2 ORDERS, INSTRUCTIONS AND STANDARDS 4
 - 2.1 Standards 4
 - 2.2 Time schedule 5
 - 2.3 Testing equipment 5
 - 2.4 Cyber security..... 5
 - 2.5 Quality Program 6
 - 2.6 Legislation 6
 - 2.7 Language 6
- 3 SCOPE OF THE DELIVERY 6
 - 3.1 General 6
 - 3.2 Scope of work..... 7
 - 3.3 Scope of equipment and tools 7
- 4 TECHNICAL SPECIFICATION 8
 - 4.1 General requirements..... 8
 - 4.2 System structure and redundancy 8
 - 4.3 Signals 9
 - 4.4 Process stations and I/O's..... 10
 - 4.5 Control and Automation room equipment 11
 - 4.6 Engineering station 12
 - 4.7 Connections to other control systems 12
 - 4.8 Earthing and Screening 13
 - 4.9 Power distribution and UPS 13
 - 4.10 DCS network equipment 14
 - 4.11 DCS reserves..... 15
 - 4.12 Spare parts 15
 - 4.13 Identification 15
 - 4.14 Cabinets..... 15
 - 4.15 Process Information Management System 16
 - 4.16 Upper level controls and production optimization 17
 - 4.17 Software functionality..... 18
 - 4.17.1 Process Displays..... 18
 - 4.17.2 Alarms and events 19
 - 4.17.3 Trends..... 20
 - 4.17.4 Process data storing..... 20
 - 4.17.5 Control software 21
 - 4.17.6 Control loops..... 21
 - 4.17.7 Automatics, sequences 22
 - 4.18 Safety Related System (SRS) 22
- 5 Services..... 22
 - 5.1 General 22
 - 5.2 Hardware engineering 23
 - 5.3 Software engineering 23
 - 5.4 Factory Acceptance Test (FAT)..... 24
 - 5.5 Site Acceptance Test (SAT) and commissioning..... 24
 - 5.6 Training..... 25



1 GENERAL

The purpose of this technical specification is to specify minimum requirement of the Distributed Control System (DCS) for Mikkeli Power Plant to offer. The Supplier shall offer the system as total through the design and manufacture stage to commissioning and start-up.

Any possible missing of details in this DCS Technical Specification shall not relieve the bidder (Supplier) of obligation to furnish a complete, functional system. Requirement is to offer the fully and total functional system for the Power plant.

Any deviations and additions to this specification shall be highlighted in the offer with details and description.

The DCS system will be a complete package based on this specification and its appendices. Possible scope changes after the procurement's agreement will be handled according to unit prices given in the offer. The Supplier is asked to offer automation concept and equipment based on the following requirements, priorities, and preliminary technology selection.

1.1 General Instructions

The power plant's process control is integrated in plant wide DCS System. It will be the high-level automated system with automatic start/ stop functions as well the logic, interlocking and alarm functions which will minimize the operational staff at the process areas.

The DCS system shall be a modern control system with hierarchically structured functional stations. The degree of automation will be in accordance with today's normal practice with distributed control system. The control system shall be reliability, easy maintenance and easily expandable software and hardware.

Prototypes or equipment not proven in practice shall not be offered. Only the latest released version of the system and components shall be used, if not separately agreed otherwise.

The delivery of DCS shall include all the equipment, utility programs and licenses, which are necessary for the plant process operations.

The DCS system will be scalable and customizable for future expansions across the system functionality and connectivity including process measurements and controls, network, sub-systems, electric controls etc.

Level of automation shall be highly advanced for minimizing operator manpower and operator actions. All monitoring and controlling for the plant will be handled from the central control room using the operator workstations which enables to view and control the process and the plant status.



The DCS system performs real-time computations based on measurement data to form the setpoints which will be used directly to control the process with the valves and pumps.

The DCS system shall be possibility to provide the connection for wireless field instruments that might be used e.g., in non-critical areas (if applicable).

The Supplier shall describe what kind of built-in program modules the offered system has for anticipatory maintenance (operation time calculations, trends, follow-up of measurements and controls, follow-up of interlocks and sequences, loop function descriptions etc.).

DCS supplier is expected to compile a functional description of the plant automation as total, including operating sequence diagrams. Supplier is expected as well to be active in co-operation and communication with the Sub-system suppliers and engineering to ensure the proper connectivity, programming and functionality in DCS.

2 ORDERS, INSTRUCTIONS AND STANDARDS

2.1 Standards

All relevant laws and regulations in Finland, which are applicable in the location of the plant, shall be observed. The Purchaser's acceptance of Supplier's plans or procedures does not absolve Supplier from this responsibility.

The electrical equipment shall also comply with valid EN-standards, HD documents (harmonization documents) issued by Cenelec (European Committee for Electrotechnical), or IEC (International Electrotechnical Commission) standards and ATEX directives.

All the electrical and electronic equipment shall comply with the following EU directives:

- EU-directive 2014/30/EU (Electromagnetic Compatibility Directive)
- EU-directive 2014/34/EU (ATEX)
- EU-directive 2014/35/EU (Low Voltage Directive)
- EU-directive 2006/42/EC (machinery directive)
- EU-directive 2024/NIS2

All the electrical and electronic equipment shall comply with the following standards:

- IEC, EN, NEC, VDE standards for Electrical equipment and installations
- IEC, ATEX, IP, API, NFPA, NEC, SFS 60079-10 Classification of explosion hazardous areas
- IEC 61508 Functional safety of electrical/electronic/programmable electronic safety-related systems
- IEC 61511 Safety instrumented systems for the process industry sector
- SFS-EN 61511:2017 Functional safety. Safety instrumented systems for the process industry sector.



- SFS 6000 Low voltage electrical installations
- Fingrid VJV 2024 -requirements
- Finnish Electrical Safety Act and Decrees

All electrical equipment and systems shall comply with EN/IEC 61000-6 standard series. The electrical equipment shall comply with EMC requirements of the EN standards in industrial environment concerning the electromagnetic emission (EN 61000-6-4) and electromagnetic immunity (EN 61000-6-2).

The Supplier is responsible for all documents and procedures requested by authorities for the official inspection and acceptance of the equipment.

The system must have a CE-marking: this applies both to electrical and machine directives (low-voltage, EMC and machine directive: certification of conformity).

Where applicable, the system shall follow IEC 62443 standard, to support safety and cyber resilience.

2.2 Time schedule

Time schedule and number of documentation copies during project shall be agreed during contract negotiations. The Supplier shall give a proposal of documentation time schedule. The preliminary project schedule is shown in Appendix 2 and the preliminary document schedule in Appendix 8.4.

2.3 Testing equipment

If any special tools or testing equipment is needed to make system work properly, those shall be included in the delivery.

2.4 Cyber security

Supplier must follow cyber security policy of Purchaser (U13 Automation Standard) and ISO 27001, ISO 27002 and IEC 62443. Systems shall have security level of at least defined in IEC 62443 level 2.

Supplier and Purchaser shall make risk analysis for cyber security threats of ICS. System provides capabilities required for compliance to NIS2 directive. Supplier must list all hardware and software components so that cyber security rules can be agreed in advance. ICS shall have asset management software tools for collecting information of hardware and software system. This asset management tool can be supplied by Purchaser or Supplier shall have their own tools that can be integrated with Purchaser asset management database.



All cyber security material and settings should be considered as confidential material and distribution of documentation and information must be agreed with the Purchaser.

The requirements related to cyber security are described more detailed in Appendix 3.6.

2.5 Quality Program

The Supplier must provide complete information and description of his Quality Assurance, Quality Control and Testing Programs.

2.6 Legislation

The equipment shall fulfil the orders of authorities concerning safety.

2.7 Language

Official project communication language in project phase is Finnish. All technical documentation and correspondence during the project shall be in Finnish. All safety, operation and maintenance related information shall be in Finnish.

3 SCOPE OF THE DELIVERY

3.1 General

DCS delivery is as so called “turn-key” package including the designing, manufacturing, testing at the factory and transportation as well the system installation and commissioning at the plant.

Delivery of DCS includes all the equipment and utility programs, which are necessary for the operations presented in this specification. If the construction or architecture of the proposed system differs from this specification in some way, the system shall be offered so that at least the corresponding minimum requirement level is attained. All deviations shall be reported in the offer.

The Supplier is responsible for the correct dimensioning and selection of systems and applications for proper function and compliance against the requirements stated by the Purchaser.

The DCS shall include all the components and configurations of the system, including spare parts, installation and documentation needed to perform plant quality and fully functionality of the process control, even if not specified in this specification.

If any special tools or testing equipment is needed to make system work properly, those shall be included in the delivery.

The basics of DCS delivery limit is shown in Appendix 3.1.

3.2 Scope of work

The following work activities shall be included in delivery (but not limited):

- Co-operation and the DCS scope definition process (meetings etc.)
- Complete engineering and configuration of the DCS, SRS and Process Information Management System
- Engineering services, coordination with other contractors, installation, testing, commissioning, training, remote and emergency technical support
- Manufacture and supply of all hardware and software necessary to meet the specified functional requirements including system configuration, system integration, factory testing and acceptance of the system
- Transportation, installation, cabling and connection of the DCS system, including installation materials
- Planning and performing of all needed installations and dismantling related to the automation system upgrade (incl. grounding, electrical feed, needed changes for fieldbuses)
- Planning and performing all needed changes to the existing control system during the system upgrade to make sure that it is possible to follow the operating plan made by the Purchaser.
- Links to sub-systems including coordination and integration to DCS. This requires all necessary actions and documentation to complete data transfer, functionality and connections
- Full Factory Acceptance Test (FAT) of the software application including testing of the connected I/O-wiring
- Testing and commissioning the system and it's interfaces and start-up of processes connected to the DCS
- Training, including training material and operation manuals for Purchaser's operators and maintenance personnel

3.3 Scope of equipment and tools

The following DCS equipment and tools shall be included in delivery (but not limited):

- Network active components
- DCS network controlling and diagnostic tools
- System software and hardware diagnostic tool
- Signal diagnostic tools for HART, PROFINET etc. devices
- Engineering station for programming the software application and the operator screens visualization
- Individual pop-up windows for the interlockings (release and locking signals) in the operator screens
- Remote connection (VPN according to purchaser instruction) to Supplier's service
- Process information management system
- Communication to the third-party equipment including necessary components for the signal separation



- Backup/restore system for the software and process parameters
- Field instrument management system
- Condition Monitoring system (Purchaser's decision later phase of project - OPTION)
- System firewalls and virus protection
- Separate Safety Related System (SRS), when needed
- System maintenance and the lifecycle management agreement
- Spare part (for two years) recommendation
- Cables and all needed installation material related to automation system upgrade

4 TECHNICAL SPECIFICATION

4.1 General requirements

Supplier shall guarantee that all devices are suitable and reliable in the function and ambient conditions where they will be used.

The control system shall have functions that guide and support the operator to operate correctly in correct order.

Coding system as used by the Purchaser shall be applied for all instrument and loop and electrical circuit coding and numbering, as well as in all configuration and documentation realized in the DCS, including the operator interface.

Supplier is responsible for the operation and capacity of the system so that the system performs the functions specified in this specification, taking also notice of the demanded reservations and spare spaces.

Initial data for application engineering will be e.g. in the form of static loop functional descriptions from all DCS-loops provided by the Purchaser. The DCS Supplier will be responsible of updating complete loop (included dynamics) from the beginning of the factory acceptance test (FAT) to the delivery assignment of the system.

Base solution for instrumentation process connections is traditional concept with distributed I/O-cabinets inside the electrical rooms.

4.2 System structure and redundancy

The system shall be robust so that no single failure or momentary overloading of a neither processor nor bus can halt the whole system or disable operating.

As necessary, the stations and the network buses of the control system shall be redundant to ensure safety and reliable process control and monitoring. Single failure of any system module shall not derive to process shutdown. Redundancy covers in critical process parts the wholeness from the field instruments via the process I/O-cards into the controllers and monitoring in the centralized control room.

The system shall keep the latest set points, tuning parameters and any configuration modifications during a power break down. After a longer power break down or maintenance actions the system can be restarted without



uncontrolled actions with the same parameter values as before the break down. The system operation and maintenance documentation shall include description of the system restart functions. Also, the maintenance personnel training session shall include handle of this kind situations.

All systems, workstations and servers shall be synchronized to time server with NTP (Network Time Protocol). UTC time must be used in as internal time stamping for data. The required NTP-clients shall be included in the systems. The network time server (NTS) will be part of the DCS systems if it shall not provide by the Purchaser.

Fiber optic multi/single-mode multicore cables shall be used in backbone cabling and in cabling between the different rooms. Network cabling shall follow network standards and cables shall have certification. Cabling must be tested, and test reports must be handed to Purchaser after installation before inspection.

DCS including I/O's as well all critical fieldbus devices shall be powered by UPS having minimum 30 minutes battery backup. The power reconnection after a short power cut shall not cause any uncontrolled actions and the system shall be able to reboot automatically.

Process controllers and I/O- cabinets are located in the electrical room at the process areas. This scope includes controllers (process stations), I/O cards and cross-connections. Controllers are managing all the process signals including controlling, interlocking, sequencing, alarming, calculating and data handling features.

The IO card rack panels are installed either into I/O-cabinet in electrical room or in the field located I/O-boxes. When using I/O-boxes, the connection to the DCS shall be implemented through redundant fieldbus (Profibus).

4.3 Signals

The system must monitor the state of process measurements, signal levels and indicate the faults.

The I/O connections must be secured in case of current overflow, voltage overflow and short circuit. In case of short circuit, the card must recover automatically.

The DCS system shall be able to supply redundant 24 VDC to the field instruments.

Field devices are interfacing the automation system using 4-20mA current signals for both measurements and controls. These devices shall support HART (latest proven version) communications superimposed upon the 4-20mA signal. HART communication is used for diagnostics and calibration.

Utilization of field, HART and PROFINET device diagnostics shall be done by the DCS. PROFINET diagnostic structure and parameters shall be possible to be restored from DCS. The Offer shall include the description of network controlling and diagnostic tool to be utilized from operation stations.



Digital input and output signals must be galvanic isolated. Analogue input and output signals must also be galvanic isolated.

The 24 VDC 2-wire connections (DI/DO), which are powered directly from the system to the field and vice versa, are provided with the operating voltage from the I/O cards. Solenoid valves are equipped with 24 VDC/3W-coils.

Motors and variable speed drives will be connected to the system using Profibus DP or hard wired.

Instrumentation standard signals are:

- Analog signals 4 ... 20 mA with HART (latest proven version)
- Digital signals 24 VDC
- Motor control connection PROFIBUS for most VFD's (10% HW), HW for most DOL-motors (10% Profibus Simocode)

Field equipment and automation I/O channel programming must be done so that system gives alarm when signal goes over or under of the measuring range. For an example the following fault indication should be occurs:

- Transducer failed low (signal ≤ 3.6 mA)
- Measurement under-range (signal < 4.0 mA)
- Measurement over-range (signal > 20.5 mA)
- Transducer failed high (signal ≥ 21.0 mA)

The DCS system shall be able to process I/O signals such as:

- Filtering
- Linearization (e.g. square root)
- Compensation (e.g. P and T compensation of a flow measurement)
- zero covering and freezing
- Alarming
- Input signal bad quality check

The overall accuracy of the DCS analogic measuring, conversion, and display values shall be better than 0.1% of the span.

Field cables (multicore) coming from the field will be connected to cross connection cabinets. In all cases all wires of the cables shall be connected to the terminals. Cross connection will be done between field cable terminals and I/O-card connection unit terminals. Cross connection wiring will be included in the Supplier's scope of supply.

The Supplier will be responsible for implementation/integration of motor controller drivers to the system. Utilization of diagnostics and configuration of intelligent motor controllers will be done directly from operator stations.

4.4 Process stations and I/O's

The Supplier will be fully responsible of the capacity of the system to perform specified functions, inputs, and outputs.



The capacity of stations shall be considered in respect of future modifications and expansions. Capacity of CPUs shall be dimensioned efficient enough and in number of I/O-cards as well as cable connections in cross connection cabinets shall have spare for extensions. Reservations for future extensions are described in section 4.11.

When calculating capacity of process stations, cycle times of each kind of function shall be taken into consideration as follows:

Loop type / Cycle time	0,2 s	0,5 s	1 s	2 s
measurement loops		40%	50%	10%
control loops	5%	50%	40%	5%
on-off valves	20%	20%	60%	
motors	20%	20%	60%	

The Supplier shall specify system cabinets' amount, dimensions and dimensioned assembly drawings shall be attached in the Offer.

The delivery shall include for the process stations:

- Cabinets with required mounting racks
- CPU`s, A/D-, D/A- etc. processing units and media converters
- I/O-cards and required terminals
- Power supply, ventilation, etc. units
- Internal data, power supply and grounding cabling
- Back-up and restore facilities

The IO-amounts can be seen in Appendix 3.2 - IO-määrät.

The system shall be quoted so that 10% spare capacity is included in the pricing.

4.5 Control and Automation room equipment

Operator stations in the Control room monitor the status of the processes including applications and interface that enable operator to control and observe the operations of the Plant as well view process warnings and alarms.

Operator workstations located in main control room shall be divided according to the order of Plant processes. The structure of the control system, as such, shall allow unrestricted operation from any of the operation points for the desired unit process, but this functional sharing shall clarify the Plant control. Due to redundancy requirements at least two separate operator stations with double monitors are recommended to equip for each selected process area.

The Supplier scope for the equipment in Control and Automation room shall comprise of the following but not limited to:

- Operator workstations (5-6 DCS) with high-resolution double flat screens, keyboard and mouse
- Wall-mounted large screens (2 DCS)
- Alarm and reporting printers
- Centralized acoustic alarming unit



- Cabling between the control room and automation room
- Necessary electronic equipment, e.g. KVM-extenders for the operator stations (if needed)
- Information and reporting system, engineering station, servers, processors, firewalls etc. to be installed in automation room next to control room

The whole control room network structure should be based on a fault tolerant Ethernet design with fiber optic cables.

Display technique will be based on windows technology and it shall be based on general approved standards.

Hardcopy devices (color laser printers) shall be network operable to provide service for all network connected systems. Separate print server shall be included in delivery if needed.

Each operator workstation shall be equipped with two flat screens (min. 27") and with alarm horn control.

The delivery shall also include two large screens (min. 75") It shall be possible to pick up own process display for the large screen (not parallel screen of operator station) or displays from other systems like process monitoring cameras.

Control and Automation room is ventilated and air-conditioned.

4.6 Engineering station

The delivery shall include all necessary programming (application programming) equipment, programs and software licenses required to:

- Make system configuration during the implementation of the project
- Make system modifications, final tuning etc. during the commissioning and start-up phases
- Make the system maintenance after start-up

Key lock or password protection is required to avoid unauthorized access to the ICS configuration mode.

If any license is limited to certain amount of I/O, it shall include minimum 20% spare capacity after start-up.

4.7 Connections to other control systems

When needed information from the plant's other systems in DCS they will be connected to each other's using Profibus, PROFINET or Ethernet.

Information exchange over Ethernet-network will be done by latest certified OPC UA standards. The delivery shall include also latest versions of OPC-servers and needed clients.

There shall not be the direct access to the DCS from the outer network. These connections must be done via DMZ services included in DCS network. Additionally, supporting services as printer services, history collection etc. shall be installed in DMZ zone. The servers of DCS which are providing services or



are connected for both the control system and office users shall be located at the automation DMZ (Demilitarized Zone).

The Supplier is responsible of connection units, internal cabling, and termination and information exchange application. The Supplier shall also, without separate instructions or control, co-operate and work together with other Suppliers.

Network cabling shall follow network standards and cables shall have certification. Cabling must be tested, and test reports must be handed to Customer after installation before inspection.

The communication links shall have watchdogs to monitor the status of the link. Link failures shall be detected and indicated by high priority alarm. Link status and maintenance software shall be included.

The links shall be able to recover automatically when the connection has been re-established.

The communication links between systems will be tested in FAT. Any services and equipment needed for testing shall be included in the scope.

Real-time measurements from the power plant must be delivered from the DCS to the balance responsible (Volue) and Fingrid. Currently, the measurements are delivered from the TOPi system, which will be replaced with a new DCS system.

The reports in TOPi must be changed to the DCS system provided by the supplier. The history data from TOPi shall be stored to the new system as follows:

- **Process data from two previous whole years**
- **Data related to environmental permit – five previous whole years**

4.8 Earthing and Screening

Each automation room and electrical room will be provided with the protective earthing (PE) and signal earthing (FE) bars by the Purchaser. The Supplier shall connect system grounding earthing cables to these bars. Separate FE-earthing network is not used. FE will be connected to the PE-earth bar inside the rack.

If for some reason the DCS system will need a separate earthing system, it can be made only after the Purchaser accepts these Supplier's earthing and screening plans.

4.9 Power distribution and UPS

The purchaser will supply the necessary Uninterruptible Power Supply (UPS) to the DCS system stations located in the automation and electrical rooms. For power outages, the DCS supplier shall determine the power requirements of the UPS supply for thirty (30) minutes of operation with I / O units and field devices fed through I / O cards, and 60 minutes for operator stations and processors.



All the needed changes to the existing power distribution should be clearly documented to the Purchaser.

Power distribution cabinets for the DCS will be delivered and installed by the Supplier. The power reconnection after a short power cut shall not cause uncontrolled actions.

Process stations and other electronic cabinets shall be equipped with redundant power supply units. Power supply arrangement shall be described in the offer.

The delivery shall include:

- Power supply for each electronic cabinet
- Necessary switches, fuses and/or miniature circuit breakers and terminals for AC power distribution and grounding of each cabinet
- Necessary switches, fuses and/or miniature circuit breakers, power supply units and terminals for internal DC power distribution (if not included in other cabinets)
- Internal wiring and grounding

Commissioning inspection must be done, and relevant documents (e.g. commissioning report) must be handed over to the Purchaser before connecting power on to the system.

4.10 DCS network equipment

The network (buses between DCS-stations) shall all be redundant. The changeover of the bus in case of failure shall be automatic and DCS is alarming about the interchanging. Redundant buses and stations are all the time under system diagnostics for maximizing availability in changeover events.

Fiber optic cables are preferable especially in long distances between process areas and in outside installations. Coaxial cable and twisted pair connections are applicable installations internally.

The supplier defines the system requirements for active devices. The delivery must include all active components required for the internal local area network of the systems (installed in the Supplier's system cabinet).

The Ethernet adapter cards shall be 100/1000 Mb/s (auto sensing) and cabling with RJ45 twisted pair connectors.

TCP/IP protocols shall be mainly used as network protocols.

All network devices should support SNMP (Simple Network Management Protocol) network management. If special protocols are used in the supplier's sub network, a network management system shall be provided by the supplier.

Delivery shall include a management system for managing active devices providing alarms, remote management, configuration management and configuration backups. Where possible, system features include delivery of alarms via SMS and email.

All active devices shall be placed in separate management networks where the management and configurations are done. Management traffic must be separated VLAN from production network.

4.11 DCS reserves

After the start-up there must be in installed I/O cards at least 10% free capacity, as well as minimum of 30% empty card space in the I/O card racks.

Memory capacity for extra programs should be at least 40% without CPU update or memory card increase.

Reserve capacity for back-up station and configuration station hard disc should be at least 50%.

Fill-up rate of 70% will be used as a general guideline when assigning signals in junction boxes.

4.12 Spare parts

During guarantee period, the Supplier must issue a spare part storage to the Purchaser's use. Spare parts which are essential for uninterrupted use should be included in this storage. If any part has been taken in use, new spare part needs to be added to the storage immediately without any extra cost.

The supplier will deliver the consumable spare parts free of charge for at least six months operation period of use after the system commissioning. The availability of spare parts and maintenance support must be guaranteed for 20 years.

4.13 Identification

All automation equipment, wiring and cabling- shall be given designations and they shall be marked with labels. These item designations shall be marked also on the drawings and documents.

4.14 Cabinets

The existing cabinets should be used in all possible areas.

DCS system cabinets must protect system equipment from external mechanical and electrical interference. Cabinets' doors must be lockable, and all cabinets shall have individual tag number and name plate in the top of the cabinet.

Cabinets are made of sheet steel and have partitions between the cabling and the equipment parts. Cabinets' cabling is possible to do from both below or above the cabinet. The cable entry slots are be insulated with fire protection after cabling.

Cabinets shall have a good air ventilation and changeable filter to ensure faultless operation of the equipment inside the cabinet. If the cabinet is located in a space without air cooling, the system cabinet must be equipped with its own cooling unit if needed to keep temperature inside the cabinet low enough.

Cabinets must include redundancy power supply and automatic voltage change over between the power units as well as the alarm when the function is activated.

4.15 Process Information Management System

Process Information Management System shall be included in the scope of supply. The purpose of this system as a whole is to store and report basic measured and calculated information of the plant as well as alarms and events, and to provide the power plant management, engineering, operation, and maintenance as well as their asset management with the necessary information to efficiently monitor the condition of main equipment and to improve plant performance.

The process information system shall consist of both process history and alarm/event history. The concept for the data storing and archiving shall be described in detail in the Inquiry.

The main tasks and functions of the system are:

- To produce sophisticated and valuable real time and historical information from the process and from the equipment by using graphic process displays, trend curves and numerical presentations.
- To produce different kinds of reports regarding the power plant operation (daily, monthly-, yearly reports)
- Automatic process data acquisition from the process (via the ICS and possible other control systems)
- Manual input data acquisition (e.g., results of a manual analysis)
- Process database management
- Alarm management and troubleshooting
- Process calculations:
 - o energy and mass balances
 - o efficiencies and heat rates
 - o Efficiency for each plant (ESE1, ESE2, FLK2, electric boiler plant)
 - o Efficiency for each boiler (ESE1, ESE2, FLK2, electric boiler)
 - o Total efficiency of the power plant
 - o District heating network efficiency
 - o Efficiency for electricity production and usage
 - o Efficiency for turbines (ESE1 and ESE2)
 - o Efficiency for back-pressure energy production and auxiliary cooling energy production
 - o The fuel consumption ratio for each plant
 - o equipment performances
 - o emission calculation and reporting
 - o running hours of the main components
- Cost calculations:
 - o fuel and other variable cost



- production cost for electricity and process steam
- start-up and shutdown costs
- Plant operation monitoring
- Main equipment condition monitoring (Option)
- Plant availability monitoring
- Reporting (including customized graphic and numeric displays, trends and reports)
- Interface to office PC's and external applications, such as Microsoft Excel

The Supplier shall submit documentation including the principles of the calculations and the layout of all customized displays and reports for the approval of the Purchaser before programming and configuration work.

The database and system hard disc capacity shall be dimensioned with following criteria:

- Number of collected tags to be defined
- Average sampling frequency for analog values and digital signals: 10 s.
- Average sampling frequency for profiles: 20 s.
- Storing time: 2-5 years

The communication between DCS and the process info shall be redundant and bi-directional, and it shall preferably be based on Ethernet TCP/IP protocol. The DCS shall include a watch dog monitoring function for the communication path. The communication between DCS and process info shall never block or prevent the internal communication of the DCS. All DCS operability variables shall be collected to the history database.

All incoming and calculated process variables in the DCS shall be available for the process info system. The archived or historical data shall be available seamlessly on the operator workstations and/or across the Ethernet LAN local personal computers/mobile devices. It shall be possible to retrieve and view all process history data and variables also from all office PC's connected to the plant network. It is preferred that standard Internet browsers are used as the office user interface of the process information system.

The system shall provide the necessary tools to analyze query and produce reports of real time and historical data. The Supplier shall provide general purpose report definition and execution facility that provides configuration, scheduling, execution and archiving of reports via operator workstations and/or other computers/mobile devices.

It shall also be possible to import data from the process info to external applications, such as Microsoft Excel.

4.16 Upper level controls and production optimization

The supplier shall provide solutions for upper level controls and production optimization. The offered solutions shall be documented products with clear definitions of each product.

The controls should be provided at least for:

- Boiler minimum and maximum loads
- Controlling net electrical power
- Optimization for fuel and air symmetry
- O₂-setpoint optimization
- Urea supply optimization
- Steam temperature optimization
- Fuel calorific value calculations
- Energy management
- District heating network controlling and optimization

4.17 Software functionality

4.17.1 Process Displays

At least the following displays shall be designed:

- Main display for the plant (all process areas)
- Displays for the main process units
- Individual process display based on the PI-drawings
- Individual display for the main equipment
- Display for the plant main electrical system (LV, MV)

It shall be possible to arrange the dynamic process display pages into a hierarchy or tree. The operator station shall be provided with easy and logical navigation both horizontally and vertically in the display hierarchy.

Viewing of all process areas shall be possible from any operator terminal, but control actions shall be limited if Purchaser defines areas for each operator terminal.

Tuning and engineering modes shall be protected by a multi-level security system.

The dynamic process displays shall have color coding according to the Purchaser's specification for the pipelines, valve and motor states, graphical indication of tank levels, indications of analogue values, etc. It shall be possible to make dynamic any part of the graphic display (e.g. pipelines).

The users shall be able to see from the control object display the status of the object, i.e. any faults, pending interlocks and the interlock that caused the tripping. Analogue measurement values are displayed as numerical values and or columns on the process displays. The status of On-Off valves is displayed with colors (e.g. green/open, red/closed) and valve's moving with a blinking

symbol. Position of a control valve is presented as a percentage (when the valve is equipped with the position transmitter).

Alarms shall be displayed with a different alarm color. In example the active analogue measurement alarm must be presented in graphic display by changing the measurement symbol to red color.

The displays shall show at least the following status information for the different situations of the process and controlled devices:

- Valve open
- Valve closed
- Valve in intermediary position
- Control selection On/Off (closed loops, automatics, motors etc.)
- Closed loop control mode selection L/R (local, remote)
- Motor running
- Motor stopped
- Measurement signal fault (sensor fault)
- Analog measurement signal High and Low alarms (H/HH – L/LL)

Individual information pop-up windows shall be provided if the status is not available on control object display. The users shall also be able to see all system graphic diagnostic displays with status of system main/reserve process station load, status, e.g. Profibus diagnostics, cabinet temperatures, 24 VDC power status etc. system diagnostic items.

All the information available from the intelligent MCCs shall be indicated on motor object displays, or on separate diagnostic windows.

From loop operation window it must be possible to launch loop descriptions. Needed web browser components will be included in the scope.

4.17.2 Alarms and events

All the alarms shall be transferred into the process historian database for permanent storage and further analysis.

All alarms need to have own levels for priority. If more than one alarm is reported at the same time the triggering event must be shown. It must be possible to mask a lower priority alarm or event from the list.

Depending on the certain operator (user) rights it is possible to change alarm limit settings (H/HH and L/LL) when needed during the use of plant.

All interlockings of the current process must be shown on operation displays. All loops and operator functions must be displayed with interlocking and alarm signals.

All alarms, warning signals, violations of limits and operating reports etc. will be stored in event database with exact timestamp where the alarms and events can be filtered according to different criteria, such as date and time etc.

Alarm and event functions shall include at least the following features:

- Priority levels to alarms

- Group alarms
- Divided alarms according to sub-processes and control areas
- Filtered alarms based on process context (e.g., mask alarms during a start-up or process stand-still)
- Possibility to reduce alarm storms by using cause-effect relationships.
- Divided alarms into system, power distribution and process alarms
- Time stamped alarms (date and time)
- Indication the alarms which are not acknowledged or not active any more

The alarms shall be indicated on graphic displays, alarm displays and with alarm horn; printers shall also be included in the delivery.

From alarm display it must be possible to jump to operation display where the loop that caused alarm is located.

4.17.3 Trends

The system shall provide real-time trending of a group of selectable variables using selectable sample time. The display format of trends shall be user definable (e.g., date range, scale, etc.).

Both fixed and user configurable trend displays shall be available.

Each real-time trend display shall show the freely selectable among process variables, outputs, set points and the other attributes.

The trend scan rates shall be selectable as well as the value of the variable amplitude within its range.

The process data (measuring values, set points, controls, valves position, motors status etc.) stored in the process information management system shall be possible view by the long-term trends.

4.17.4 Process data storing

The Process data storing is based on history database system which store and report basic measured and calculated information of the plant as well as alarms and events. History database is also to provide necessary information to plant management and personnel to monitor efficiently the condition of main equipment and to improve process performance.

The process history database shall consist of both process history and alarm/event history.

All data available in the DCS shall be archived at the full DCS resolution. This shall include values of all measurements within the DCS, all calculated parameters, all alarms and events and all logs. It should be possible to return in any previous operating event with full history data from the operating display.

Detailed information of database and system hard disc capacity limits shall be defined later during detail engineering stage. The offer shall include the recommendation of each available sampling frequency and storage period as well the influence of possible data compression.



The system shall provide the necessary tools to analyze, query and produce reports of real time and historical data. It shall also be possible to import data from history database into external applications, such as Microsoft Excel.

Reporting and long-time process data handling will be done in the Process Information Management System (see chapter 4.15).

4.17.5 Control software

Each loop shall have a variable/selectable execution time and all loops shall have the ability to be set at a maximum execution time.

Some critical loops shall be equipped with event triggering and recording function to catch the first interlock/event that tripped the equipment. The status of all the incoming interlock signals shall be captured and the first signal that caused the interlocking shall be indicated by a cursor or color on the control object display.

It shall be possible to configure the controls from ready-made function blocks so that each loop is contained in one software module. Control algorithms, encapsulated in function blocks, shall be available for all motors, on-off valves, PID and other control loop types.

The system shall support advanced control functions such as fuzzy control, and the use of neural networks.

The system shall be off-line and on-line programmable/configurable. On-line programming or downloading of software modules shall never disturb other (running) functions.

Program diagrams, reports and display templates must be able to be viewed with web-based browser from any PC or mobile device connected to the plant network agreed with Purchaser.

4.17.6 Control loops

A software package for tuning of the PID control loops shall be included in the delivery. The tuning package shall aid in process model identification and calculation of optimal controller parameters.

To minimize the effort of configuration, the PID control module shall have as many pre-configured parameter and control algorithms as possible.

Tuning history of control loops must be able to be stored into the process historian database. Development of tuning parameters must be able to be reviewed e.g., in trend form.

Control module shall have at least the following parameters:

- Mode selection A/M (auto/manual)
- Control mode selection L/R (Local/Remote)
- Regulator control algorithm (PI, PID, P)
- Dead time compensation algorithm
- Adaptive control algorithm (at least the gain-scheduling algorithm)
- Signal-conditioning algorithm (filtering, saturation, threshold, etc.)



4.17.7 Automatics, sequences

All needed automatic and sequences for operating the boilers efficiently shall be provided.

4.18 Safety Related System (SRS)

Safety Related System (SRS) shall be used if the automation functions are defined in the handling of safety issues (Hazop). These demands for the process safety must be assured using independent system from the automation system (DCS or PLC).

Certified safety system shall be prepared according to standards IEC61508/IEC61511 and approved for SIL 3 level. Risk graph calculations shall be used for specifying safety integrity levels (SIL). Safety loops designing and documentation must follow these calculations and defining to reach the specified safety level of the safety functions. Instructions for the testing methods of safety loops shall be included in supply.

When a dangerous situation for human life or the environment occurs in the process, the SIS system performs automatic control measures and forces the process into a safe state defined according to the events.

The safety system shall be able to distinguish separate trip signals and inform the first signal which has caused the trip action. Resolution of the signals shall be at least 1 millisecond.

The SIS system shall design and configure so that all critical components are redundant, and that failure of a single component shall not impact operation of the controlled process and shall not degrade system safety or functionality.

The SIS system must be based on a classified, reliable and fault-tolerant system (e.g., PLC) with self-testing and self-diagnostic capabilities.

The system diagnostics must include sensors and programs that detect and warn the user of all weaknesses and faults related to safety functions and, if necessary, prevent the use of the process unit or equipment in serious fault situations.

Safety related system's displays shall be implemented in the DCS systems operator displays.

5 Services

5.1 General

The delivery will include all basic programs, application software, help functions, instructions, training, application Factory Acceptance Test (FAT) before delivery to the site, installation and Site Acceptance Test (SAT) and commissioning in order to secure the system function as specified including tuning of the control loops.



Services shall include execution and documentation of all necessary phases including e.g., validation planning and validation as defined in IEC 61508.

The Supplier shall offer 24/7 on-call service support for the system during and after the project execution in Finnish language.

5.2 Hardware engineering

The delivery shall include, but not limited to:

- Basic definition of the system
- System diagrams and layouts
- Cabinet layouts according to Supplier's and Purchaser's agreed principles
- System voltage distribution diagram
- System grounding and screening schema
- I/O-card and I/O-channel distribution in cabinets, as well as related cross-connection design
- System internal wiring and cabling design and diagrams
- System network design and diagrams
- Installing and testing the system utility programs
- Configuration and coordination of communication links to other systems

Updating instrumentation circuit diagrams should be included in the delivery.

Documentation must comply with the requirements represented in the Invitation to Tender and shall be approved by the Purchaser before delivery.

5.3 Software engineering

The Supplier shall make the application software programming according to the information and documents provided by Purchaser.

The process descriptions and operating principles are discussed in the process driving negotiations held with the customer and their representative, in which the supplier's designers and responsible persons also participate.

Before starting the application programming commences Supplier will do various model solutions for the typical loops and will test them thoroughly with Purchaser and their representative.

Initial data for application engineering will be given in the functional descriptions of the loops, provided by the Supplier and the Purchaser in the basic engineering phase of the project. The Supplier will be responsible of writing the descriptions based on the software from the current PCS7 automation system and updating them after the control reviews and if needed after the factory acceptance test (FAT) and site acceptance test (SAT).

The delivery shall include, but not limited to:

- Basic programs and necessary documentation according to the Purchaser's instructions
- Complete system configuration
- Complete application programs according to documentation provided by Purchaser during the project.

- Implementation of loop descriptions in the ICS before the FAT tests, including dynamic links for interlocking signals.
- Loop wise descriptions in dynamic HTML-format. All alarm and interlocking limits must be dynamic value from active process station.
- Application programs, loop wise descriptions and service and maintenance documentation.
- Interlocking windows with first-in first-out function for all loops
- Complete display design
- Documentation related to possible safety instrumented system shall be clearly separated and collected to separate folder.

5.4 Factory Acceptance Test (FAT)

The Supplier shall arrange a wide and detail Factory Acceptance Test (FAT) at their own factory for the scope of automation to be delivered. FAT testing shall be performed together with Supplier, Purchaser and their representative (e.g. process specialists).

The purpose of the DCS factory approval test is to verify the correctness of the DCS assembly (both software and hardware) before delivery to the plant. The scope of FAT covers testing of all software applications, process screens and the wiring of the reserved I/O channels.

Whole system configuration shall be tested together and to show the functionality of the system and I/O-signals simulated as well as possible.

Defects or reparation needs identified shall be write up in the test record. The Supplier will make these corrections as soon as possible and when the correction is done, they will be retested until the Purchaser has approved the function.

After all testing has been completed and approved in accordance with the agreement, the equipment can be delivered to the installation site.

5.5 Site Acceptance Test (SAT) and commissioning

After the system installation work has been completed and inspected on site and the entire system with all its subsystems are running, the Site Acceptance Test (SAT) may be performed.

The SAT is performed together with the Supplier and the Purchaser. During the test, the testing report shall be filled up stating the defects or reparation needs. the Supplier shall correct them immediately without repayment and delay. If needed, the Supplier will do a correction plan and timetable for the bigger modifications which will be separately agreed by Purchaser.

The customer announces the time table for the Site Acceptance Tests and the supplier prepares detailed testing program and schedule for the tests based on this time table and delivers it to the customer latest one month before starting the tests (in site timetable marked date).

The tests will be performed according to the agreed site schedule. The supplier shall notify the purchaser when the tests are ready to begin well in advance to arrange needed personals for the tests. If the tests are not ready to start

according to the agreed schedule, it must be announced at least two weeks before the agreed start time.

5.6 Training

The Supplier is responsible for training the Purchaser's operation and maintenance personnel, providing them with basic knowledge for operation and maintenance. Training is possible to take place in classrooms at the Supplier's factory and/or at the Plant during the commissioning and start up. Training also includes the necessary training material.

The offer must include a training plan for the various personnel groups (operation, maintenance, design, management) and at what stage of the project what training is required. The plan shall include description of the training duration, amount, quality and training location. The supplier may also propose other necessary trainings or arrangement possibilities.

The supplier shall provide the written material for each part of the training. In addition, the training shall include practical training especially for maintenance personnel with the equipment installed.

The training and training documentation shall be in Finnish.

The scope and schedule of the training based on the supplier's proposal will be agreed later in the project implementation phase.

NOTE! A process simulation and training system is offered as an option. The system should cover all essential production process units for the operation and maintenance personnel training before the plant's start-up as well as during the use of plant.