NET4GAS, s.r.o

COMPRESSOR STATION JIRKOV 73 BAR

Station Control and ESD System - Specification

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ILF CONSULTING ENGINEERS

Werner-Eckert-Strasse 7, 81829 München, DE
Jirsíkova 5, 186 00 Praha 8, CZ

Phone: +49 89 25 55 94-0
+420 255 091 420
E-mail: info.muc@ilf.com
info.prg@ilf.com
Website: www.ilf.com

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1 GENERAL

1.1 Scope of the Document

This specification provides requirements for performance, selection, design, installation, operation, maintenance, training and test of system design and installations for the station control system and ESD system of the new compressor station Jirkov.

1.2 Definitions

Term	Explanation
Project	Compressor Station Jirkov 73 bar
Employer	NET4GAS
Consultant	ILF Consulting Engineers
Contractor	Company awarded to provided engineering, procurement, construction and commissioning of the scope of work
Operator	the person operating the plant local in the station
Dispatcher	the person operating the plant from the dispatching centre in Prague

1.3 Abbreviations

Term	Explanation
AMS	Asset Management Software
CPU	Central Processing Unit
DMZ	Demilitarized zone
DN4G	Dispatching Centre in Prague
DTM	Device Type Manager
EMCS	Electro Motor Compressor System
ESD	Emergency Shutdown

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Term	Explanation
EWS	Engineering Work Station
FAT	Factory Acceptance Test
FDI	Field Device Integration
FDT	Field Device Tool
HART	Highway Addressable Remote Transducer
HIS	Historical Archive Server
HVAC	Heating, Ventilation, & Air Conditioning
HAV	Historical Alarm Viewer
HP	High Pressure
ID	Identification
I/O	Input / Output
KVM-E	Keyboard – Video – Mouse Switch
LAN	Local Area Network, TCP/IP
MP	Medium Pressure
MTBF	Mean Time Between Failures
MTTR	Mean Time To Repair
NoBo	Notified Body (Technical Inspection of Czech Republic TIČR))
ODBC	Open Database Connectivity
OWS	Operating Work Station
OPC	OLE for Process Control
PLC	Programmable Logic Controller
PCS	Process Control System
PST	Partial Stroke Test
QRA	Quantified Risk Assessment

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Term	Explanation
RFO	Ready for Operation
RAMS	Reliability, Availability, Maintainability, Safety
SAT	Site Acceptance Test
SCADA	Supervision Control and Data Acquisition
SoE	Sequence of Events
SCS	Station Control System
SIL	Safety Integrity Level
SLD	Single Line Diagram
SoW	Scope of Work
SQL	Structured Query Language
UCS	Unit Control System
UPS	Uninterruptible power supply
VPN	Virtual Private Network

1.4 References

No.	Number	Title
1	C4G-JI73-ILF-GENER-MAR-SPC-901	General Requirements - Installation and Startup of Control System
2	C4G-JI73-ILF-KS007-MAR-DIA-100	Control System Architecture - Overall Block Diagram
3	C4G-JI73-ILF-GENER-MAR-DIA-103	Typical Loop Diagrams
4	C4G-JI73-ILF-GENER-TEL-TZP-911	Risk Analyse for Cyber Security
5	C4G-JI73-ILF-KS007-MAR-DIA-104	Instrumentation Cable Block Diagrams

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No.	Number	Title
6	C4G-JI73-ILF-KS007-MAR-SEZ-840	I/O List (hardwired)
7	C4G-JI73-ILF-GENER-TEL-SPC-800	Telecommunication System – Specification
8	C4G-JI73-ILF-KS007-TEL-DIA-100	Telecommunication System - Block Diagram
9	C4G-JI73-ILF-GENER-MAR-SPC-801	Instrumentation – Specification
10	C4G-JI73-ILF-GENER-ELE-VYK-002	Typical Earthing, Lightning Protection and Electrical Installation
11	C4G-JI73-ILF-GENER-PMA-MAN-902	Tagging and Numbering Philosophy
12	C4G-JI73-ILF-KS007-GEN-MAN-901	Geographical Climatic and Environmental Conditions
13	C4G-JI73-ILF-KS007-MAR-DIA-101	Cause and Effect Diagram
14	C4G-JI73-ILF-KS007-MAR-DIA-100	CS Architecture- Overall Diagram
15	C4G-JI73-ILF-KS007-STO-DIA-100	Gas Detection System - Block Diagram
16	C4G-JI73-ILF-KS007-STO-DIA-101	Fire Detection System - Block Diagram
17	C4G-JI73-ILF-KS007-GEN-MAN-902	Operation Philosophy
18	C4G-JI73-ILF-KS007-GEN-MAN-903	ESD Philosophy
19	C4G-JI73-ILF-GENER-ELE-SPC-806	Specification for Cables and Cable Laying
20	C4G-JI73-ILF-KS007-ELE-VYK-401	Administration and Control Building - Electrical Equipment Arrangement Drawing

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No.	Number	Title
21	C4G-JI73-ILF-KS007-ELE-VYK-411	Electrical Building - Electrical Equipment Arrangement Drawing

1.4.1 General Net4Gas References

Following company standards are relevant for design and implementation of a Control System.

No.	Number	Title
1	TP_T01_01_01_06	Design and implementation of Electrical, IC and PCS Systems
2	TP_T01_01_01_06 Addendum 1	Electrical Power Supplies
3	TP_T01_01_01_06 Addendum 3	HMI Operator
4	TP_T01_01_01_06 Addendum 2	Control System and IT Infrastructure
5	TP_T01_01_01_06 Addendum 4	Vendor List
6	TP_T01_01_01_06 Addendum 5	Installation and Panels
7	SM_F02_00	Operation of the NET4GAS, s.r.o. Transmission System Operation
8	MP_I04_04_01_01	Technical Protections system of Net4Gas Facilities
9	MP_I04_06_02_03	Methodical instruction IT SecPol for Control Systems
10	MP_F03_00_03	Communication of DN4G and Sub-Stations

1.5 Codes and Standards

All equipment must be designed, manufactured and installed according to the relevant regulations and standards as defined in the document “List of relevant Regulation, Standards and Specifications” C4G-JI73-ILF-KS007-GEN-SEZ-840-000.

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For the scope of this specification the codes and standards according to C4G-JI73-ILF-GENER-MAR-SPC-901 “General Requirements - Installation and Start-up of Control System” shall be especially considered.

Additional codes and standards according to Net4Gas documentation listed in the 1.4.1 “General Net4Gas References” shall be considered.

1.6 Environmental Conditions

Requirements of relevant paragraph in the specification C4G-JI73-ILF-GENER-MAR-SPC-901 “General Requirements - Installation and Start-up of Control System” shall apply.

1.7 Language

Requirements of relevant paragraph in the specification C4G-JI73-ILF-GENER-MAR-SPC-901 “General Requirements - Installation and Start-up of Control System” shall apply.

1.8 Conflicting requirements, exceptions

The Contractor shall notify the Employer of any conflict between this specification, the related datasheets, the Codes and Standards and any other specification included as part of the procurement documentation. In case of different views Employer’s interpretation shall be final.

Any exceptions to this specification and referenced documentation shall be raised by the Contractor and approved by the Employer in writing.

The precedence for application of codes, standards, design practices, tender documents and regulatory requirements for the project shall be as follows:

- Contract Documents
- International and National Codes and Standards
- Project Documents (e.g. this specification)
- Good engineering practice

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2 DESIGN CRITERIA

2.1 Scope of supply

The requirements indicated in this document are the minimum which shall be considered in the scope of supply. Contractor shall supply a complete and fully operable Station Control System and Emergency Shutdown System. If Contractor deems that the listed equipment is not complete in order to fulfil the required functionality, Contractor shall add the missing items accordingly.

Contractor shall provide the complete SCS and ESD as follows, but not limited to:

- Fully equipped SCS and ESD cabinets
  - system cabinets with controllers including CPU's, I/O modules, power supplies, communication modules;
  - marshalling cabinets for termination, isolation and field signals protection;
- Operator and engineering workstations, including KVM-E;
- SCS Servers and server cabinets;
- Wall monitor in control room;
- All necessary communication equipment (switches, routers, gateways, etc.);
- System cables;
- Software for operating systems and controllers with all necessary licenses;
- Antivirus software; firewalls equipment;
- Matrix ESD panel;
- Complete system documentation
- Spare parts;

Including following engineering and services:

- Project Management, including meetings with Employer and coordination of all system interfaces;
- Complete hardware and software engineering;
- Programming control sequences and functions;
- Definition and implementation of cyber security concept;
- Execution of Factory Acceptance Test;
- Execution of Site Acceptance Test and Performance Test;
- Loop testing and system functional testing;

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- Cold and Hot commissioning;
- Acceptance with Employer and NoBo;
- Training.

All components / activities not literally mentioned in this specification but necessary to fulfil the requirements shall be considered in the scope of work by Contractor.

The architecture diagram of the SCS and ESD system is available in the document C4G-JI73-ILF-KS007-MAR-DIA-100 “CS Architecture- Overall Diagram”.

The SCS shall be based on equipment type Siemens PCS7 (CPU 400H), with I/O modules type ET200M and visualisation system WIN CC or equivalent. The operational department of Employer is skilled with this kind of equipment since already installed in similar plants. Furthermore the SCS shall be integrated with the UCS in order to provide a common base system for operation, therefore UCS and SCS shall be of the same type.

The ESD system shall be based on component type HIMA Planar 4 or equivalent, not programmable type (only by hardware), that cannot be affected by cyber-attacks.

The comparability must be presented by the Contractor with the bid, otherwise the listed components shall be used.

All applicable requirements according to documents listed in the par 1.4.1 “General Net4Gas References” shall be considered in the design.

2.2 Integration of EMCS

The UCS project including HMI in scope of work by EMCS Vendor shall be integrated in the SCS system providing a common base for the operation of the plant. This shall be according to feature of multi-projects in the PCS7 configuration.

It shall be possible to show all HMI screens of the EMCS in the operator workstations of the SCS. All alarms and events and historical/trend functions of the EMCS shall be available in the SCS. The data shall be kept by the SCS workstations direct from the EMCS servers, respective UCS.

Over the engineering station of the SCS it shall be possible to access to EMCS with fully services. The program of the EMCS shall be hand over by the EMCS vendor to Contractor for implementation in the SCS at a certain point of commissioning, in agreement with Employer.

The interfaces between SCS and EMCS shall be over redundant terminal bus and control bus of the PCS7.

All necessary agreements shall be taken between Contractor and EMCS-Vendor under the coordination of Employer in order to obtain this requirement.

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At least version of the HMI software WIN CC, operating system of PCS7, the resolution of the screens and the headers of the screens shall be common.

The operator workstation of EMCS of the administration building shall be installed by Contractor under the supervision of EMCS-Vendor, including place in the server cabinet, interface cabling, power supply, etc..

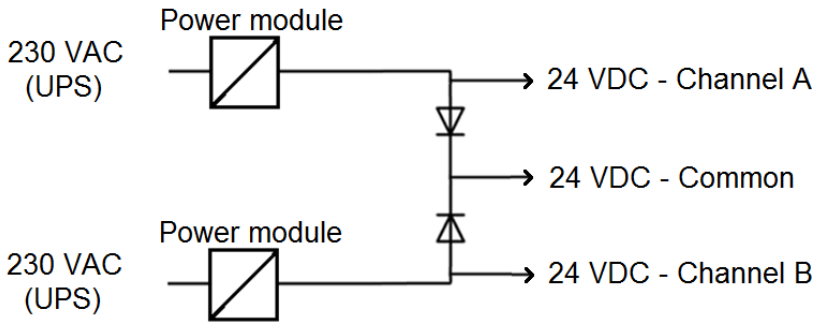
2.3 Power supply

Requirements of relevant paragraph in the document C4G-JI73-ILF-GENER-MAR-SPC-901 “General Requirements - Installation and Startup of Control System” shall apply.

Independent 230 VAC power supplies from UPS shall be considered for:

- SCS located in administration building (redundant)
- ESD located in administration building (redundant)
- Server cabinet located in the administration building (redundant)
- Monitors and printers located in control room and printer rooms
- SCS located in electrical building (redundant)

Internal 24VDC shall be provided by means of power supply modules, according to the following diagram:



All equipment with redundant power supply available shall be supplied accordingly (Channel A/B). For equipment with single power supply the redundant power supplies shall be used by means of coupling diodes (24VDC – Common).

Fuses and circuit breakers for incoming power supply and internal distribution shall be used according to C4G-JI73-ILF-GENER-MAR-SPC-901 “General Requirements - Installation and Startup of Control System”.

230VAC from grid shall be used only for internal cabinet lighting and service plugs.

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2.4 Safety requirements

SIL Assessment shall be verified by Contractor in order to comply with requirements of IEC 61508 and IEC 61511.

All safety classified functions shall be implemented in an ESD subsystem assigned and certified for safety functions. All auxiliary components including sensors and actors forming part of the safety instrumented functions shall be compliance with the SIL requisition as well. SIL certification for said components is required.

SIL calculation shall be provided by Contractor in order to demonstrate that the safety instrumented functions (SIF) have been implemented according the SIL level required. Acceptance by NoBo shall be considered in the scope of supply.

The system and devices shall be designed considering application in low demand mode. Devices and components shall be selected in order to allow Tproof interval of 1 year or more.

Final definition of the SIF function and level is defined in C4G-JI73-ILF-KS007-BOZ-TZP-002-SIL Evaluation Report.

The ESD system will monitor the critical process alarms and, in case of process troubles, will shut down the main equipment keeping the plant in safe condition. The ESD system will be designed to minimize the impact of shutdowns on unrelated equipment and reduce the risk of spurious shutdown. It shall be designed in accordance with fail-safe criteria and fault tolerant philosophy, so that in case of system failure or power supply failure, the protected equipment or the relevant plant section will be brought to safe conditions. The software shall be verified and approved by NoBo. The ESD system shall be protected against unauthorized revisions by management procedures and by software and firmware protection techniques.

For the ESD Station a hardware-programmable safety system (e.g. HIMA Planar 4 or equivalent) shall be foreseen to reduce the risk of cyberattacks.

2.5 Cybersecurity requirements

According to the regulation No: 316/2014 on Security Controls, Cyber Security Incidents, Reactive Actions and on the Determination of the Requirements for the Applications in the Field of Cyber Security (Regulation on Cyber Security), a risk analysis is foreseen as stipulated in the annex of the same Regulation.

The Risk Analysis will be performed during the Basic Design phase according to ISO/IEC 27004 (C4G-JI73-ILF-GENER-TEL-TZP-911-Risk Analyse for Cyber Security). The main concept of cyber security will be developed according to the requirements of the risk analysis.

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The Contractor shall submit a cybersecurity concept according the requirements from the Risk Analysis. Specific company policies regarding information management, network security etc. shall be considered during all the stages of this project. The recommendations of the concept are to be implemented by the Contractor in the detailed planning and execution phase of the project.

For further details regarding control architecture and telecommunication please refer to C4G-JI73-ILF-KS007-TEL-SPC-800 “Telecommunication System – Specification” and C4G-JI73-ILF-KS007-MAR-DIA-100 “Control System Architecture - Overall Block Diagram”.

Also refer to MP_I04_06_02_03 “Methodical instruction IT SecPol for Control Systems”.

The compressor station shall be regarded as a critical infrastructure. All requirements according to the ‘Regulation No 316/2014 Coll. on Security Controls, Cyber Security Incidents, Reactive Actions and on the Determination of the Requirements for the Applications in the Field of Cyber Security (Regulation on Cyber Security)’ must be fulfilled.

In addition, the following standards and regulations shall be taken into account:

- ISO/IEC 27001 Information technology – Security techniques – Information security management systems – Requirements
- ISO/IEC 27002 Information technology — Security techniques — Code of practice for information security controls
- ISO/IEC 27004 Information technology — Security techniques — Information security management — Monitoring, measurement, analysis and evaluation
- BDEW Whitepaper Requirements for Secure Control and Telecommunication Systems

The cyber security of the station control system must be designed and implemented in such a way that all threats from a cyber-attack (locally or remote) are detected in time, so that the effects of a cyber-attack can be minimized.

It shall be possible to restart or even to restore (disaster recovery) the station control system, the UCS and all other critical systems of the compressor station within 8 hours, or less.

For the definitions of the security architecture, e.g. network segments, zones, conduits, etc. the standard IEC 62443 shall be applied. As the basis concept for the cyber security related to the station control system the following zones as per IEC 62433 shall be used as minimum:

- Station Control System SCS, incl. Operator workstations and servers, Station Safety-related ESD, EMCS control system (UCS), incl. Operator workstations and servers, EMCS Safety-related ESD

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- Dispatching Centre DN4G in Prague.

All required devices, hardware and software to connect the different zones shall be provided.

Following measures shall be considered for network security, as minimum:

- All relevant equipment shall be installed in lockable cabinets.
- Multiple access levels shall be provided. The command power will be clearly defined.
- Firewalls, or equivalent, shall be used to restrict and control traffic between different zones.
- Access to the management systems shall be restricted.
- Unused ports shall be disabled.
- Central log server, automated log file analysis and alarming in case of a detected event to the Operator
- A communication matrix with information about the communication relationships (source and destination, protocols, ports (physical, UDP, TCP), IP addresses, etc.) has to be created.
- Restore, automatic restart and disaster recovery procedures of the control equipment shall be implemented.

The cyber security concept for the compressor station will be coordinated with the Employer according Employer's overall guidelines, based on the risk analysis according to the standards listed above.

The IT/SECPOL Security Policy (SM_I04_06_02) and the IT/SECPOL Methodology for Control Systems (MP_I04_06_02_03) shall be considered

The Contractor shall appoint a central coordinator for IT and cybersecurity for the coordination and communication of all aspects of cyber- and IT security during the execution phase of the project.

2.6 Control functions

Control functions as defined in the following documents shall be implemented in the system:

- C4G-JI73-ILF-KS007-GEN-MAN-902 - Operation Philosophy
- C4G-JI73-ILF-KS007-GEN-MAN-903 - ESD Philosophy
- C4G-JI73-ILF-KS007-MAR-DIA-101 - Cause and Effect diagram

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All control functions shall be documented in detail by Contractor, supported by relevant HMI screens and logic diagrams and submitted for approval by Employer.

2.7 Maintainability

Generally the SCS shall be designed to the latest state of the art and for a life time of at least 15 years with latest software available version.

The Contractor shall guarantee that the SCS with its components is available for the next 10 years and all spare parts and software support for the next 15 years, including security patch.

See also requirements of relevant paragraph in the document C4G-JI73-ILF-GENER-MAR-SPC-901 “General Requirements - Installation and Startup of Control System”.

2.8 Availability

Requirements of relevant paragraph in the document C4G-JI73-ILF-GENER-MAR-SPC-901 “General Requirements - Installation and Startup of Control System” shall apply.

Loss of operation shall be considered in case:

- Failure of both operator workstations SCS in control room simultaneous with loss of communication to DN4G;
- Operation of the plant is not possible because of failure both CPUs in SCS;
- Operation of the plant is not possible because of failure of ESD.

2.9 Redundancy

The redundancy concept of the SCS shall ensure that the availability requirements are met.

- The control system CPU, Servers, Networks, fieldbus shall be hot standby.
- Selected critical process transmitter shall be 2oo3.
- Any kind of redundancy loss shall be alarmed.
- A single point of failure of the SCS shall not cause any restriction on station operation. A single point of failure is defined as failure of redundant SCS equipment: network element, network connection, software component, PLC or server.
- All server functions shall automatically start up and be fully operational after restart without manual interference. In case a redundant connection or application failed and returns to normal (e.g. a reconnection of a LAN cable) the SCS system shall

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automatically restore all the functionality as it was before the failure of the redundant component.

- Any failover (from a failed component to the standby component) shall be seamless and finished within maximum of 60 sec.
- Status of failover shall be registered in the event list. All failures shall be indicated in the alarm list.

2.10 System Diagnostic

Error detection and handling is an essential part of a secure SCS and ESD system.

Auto diagnostic and engineering diagnostic tools shall be available as following:

Auto diagnostic

This level of the self-diagnostic shall operate in continuous and automatic way without any intervention by the operator.

The integrity of the system shall be ensured by a self-contained, automatic, hardware implemented functional test system. Faults in individual circuits shall be automatically detected and enunciated by alarms. The diagnostic system shall make possible the complete identification of any malfunctioning module (malfunctioning node, module, function and I/O card entire address). Dedicated video pages/HMI screens on the supervision system shall allow the operator to verify the cause of the malfunction.

All functions of the systems and communication interfaces shall be supervised by a watchdog function.

The automatic diagnostic over AMS shall cover the instrumentation and actuators in the field.

Engineering diagnostic

This diagnostic level shall operate on maintenance technician demand from the engineering stations apart from the operation conditions. Off line and on line diagnostic functions shall permit the accomplishment of a test for each component and particularly for:

- Controllers
- I/O cards
- Memories
- Microprocessors and communication cards
- Power supply

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2.11 Management of Change

The SCS system shall be easy to adapt to station operational requirements. This includes but is not limited to:

- Changing of the HMI (displays, symbols etc.)
- Changing of the Databases (process and historical databases)
- Adding users and changing user rights, creating user profiles
- Establishing of station specific sequences, automatically or manually initiated
  Changing of system parameters shall be logged with date and user name.

2.11.1 Release management

Changes shall be applied offline; previous version shall be archived before impending changes are applied.

- If possible, the SCS system shall automatically archive the latest configuration before a change is applied. Otherwise the last configuration shall be archived by the Operator.
- It shall be possible to fall back to a previous version, i.e. to undo the applied changes.
- It shall be possible to add release notes to new versions

2.11.2 Permission of changes

SCS administrators shall be capable of doing such system changes. All system changes shall be logged (e.g. via SIMATIC Logon) and only be allowed by users with the relevant permission.

2.12 Remote service

The maintenance of the SCS shall be done from the existing engineering workstation, and shall also be possible via a VPN from remote. Due to cybersecurity requirements, the remote access connection to the EWS shall only be available during the remote maintenance time. After the maintenance works are completed, the communication cable will be unplugged. Access to the system from remote shall comply with IT-requirements of Employer.

2.13 Expandability

The SCS shall be configured in order to facilitate changes and additions. The following shall be considered, at least:

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- Generally an expansion by 30% (I/O cards) shall be possible without changing the system structure or the network architecture.
- Changing redundant CPU shall be possible by hot insert.
- Changing of one I/O card shall be possible without interruption of overall plant operation.
- Download of parts of software shall be possible without interruption of overall plant operation.
- 50% Memory space for program extensions (on memory card and CPU) must be available after final acceptance.

In general extensions shall be possible without replacement of existing components.

2.14 Licences

Permanent and transferable licenses for all computers of the system shall be provided. All required licenses shall be written out on behalf of the Employer and shall be submitted latest after installation of the system/licences on site. All required licences shall be listed in the bid documentation.

Licenses shall be provided also for the spare I/Os in the scope of work, including for example historian.

2.15 Requirements for programming

a) Only programming software tools in the latest edition shall be used.

b) Programs shall be modular structured, system wide the same functions, procedures and names shall be used.

c) Programs shall be well documented; Czech shall be used for program comments.

d) Programs should not have functions or unused source code, which are not required for this project. Such code shall be preferably be deleted or as a minimum well documented that such parts are not required for this project.

e) Programs shall provide extensive support for debugging and trouble shooting. Especially concerning the communication, statistics shall be recorded.

f) Programs shall use the exact same data point naming and unit as used for the HMI, I/O list and P&IDs.

g) Programs shall provide easy access to set points. Set points must be readable in SI units (human readable) and shall be programmed as input parameter of functions or procedures.

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h) Function block diagram (FBD), graphical programming shall be used as far as possible.

i) Contractor shall hand over the source code, without restrictions (i.e. password).

j) Contractor shall describe control algorithms in detail according to TP_T01_01_01_06, “Design and implementation of Electrical, IC and PCS Systems”, chapter D.5.4.1.

2.16 Time synchronization

The SCS of the plant shall be connected with the Main Control Centre in Prague (DN4G) for the time synchronization of all CPUs and alarms. Time synchronization shall be via IEC Gateway, feature of IEC 60870-5-104 protocol. Gateway will provide time for PCS7 servers. Servers shall synchronize the rest of the Station CPUs and PC via standardized PCS7 procedures.

Time stamp of alarms has to be given from the I/O card to the processor to obtain the required time chronological resolution.

The SCS shall distribute the time synchronisation signal to all other applicable subsystems of the station (i.e. UCS, Fire Detection System or other control panels) over Ethernet or hardwired signals.

2.17 Station Control System

Control systems are based on programmable logic controllers except for the ESD Station safety control system.

The control system model shall be selected and scaled with sufficient reserves for program memory and safe program cycle times. All control system shall have at least 50 % memory reserves application programs. The CPU program cycle time shall be 25% below task overrun. The programming cycle time in safety related application shall not exceed 500 ms. The switch over times of the redundant CPUs shall be bumping free. The CPU cycle times and the fieldbus scan times shall be documented. The request and reaction times from other systems shall be documented. Software shall be implemented according to IEC 61131-3.

Hardwired signals will be connected to a remote I/O (as per C4G-JI73-ILF-KS007-MAR-DIA-100-Control System Architecture - Overall Block Diagram) and from there to the SCS using BUS (Profibus) communication.

Between Electrical building and Administration building FOC is foreseen.

CPUs, I/O cards, and other equipment forming part of safety instrumented functions (SIF) loops shall be certified SIL in order to comply with SIL assessment report.

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It shall be possible to replace individual circuit modules without process shutdown (hot replacement functions).

Reference is made to C4G-JI73-ILF-KS007-MAR-SEZ-840-I/O List.

The list shows all hardwired I/Os and distinguishes between IS, non IS, standard PLC and ESD. Contractor shall offer 20% additionally wired spare which might be used during commissioning.

2.17.1 Central Processing Unit (CPU)

The “Central processing unit” shall be based on redundant configuration processor and shall be capable of performing the following basic logic and sequence functions:

- Processing of the instrumented functions as per project application program;
- Shall be able for multitasking with task handler. Different programs in different parametrizeable task.
- Performing all central functions including communication;
- Handling redundancy with the second CPU unit;
- Creating and storing CPU events and alarms;
- Storing events and alarms created by I/O modules.

The used CPU shall provide the best performance available at that time with following minimal but not limited specifications:

- Watchdog and self-test functionality;
- Ethernet interfaces for external communication (1000BaseT, full duplex, with auto negotiation and auto crossover, TCP/IP protocol);
- Configurable alarm and events that are stored in the non-volatile memory (e.g. Boolean events, scalar events with configurable hysteresis function);
- Recording events capacity: 10000 events;
- Selectable I/O scanning and setting times;
- Time stamp feature at CPU or I/O level;
- Communication module with Ethernet interface for communication (e.g. IEC 60870-5-104, Modbus TCP/IP);
- Communication module with BUS interface for communication (e.g. Profibus);

2.17.2 Network and Communication Processor

The network and communication processors shall have a programmable telegram routing based on task modelling with following minimum features:

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- Shall be redundant.
- Shall detect network errors.
- Shall be able to program deterministic and asynchron functions.
- Shall alarm and warn on task overrun.

2.17.3 Industrial switches

- Industrial switches Level 2 shall be managed type with routing controls.
- Industrial switches with CU and FOC connections shall be used.
- The industrial switches shall report on traffic violations.
- Unused ports on the industrial switches shall be disabled.
- Industrial switches shall have diagnostic features, accessible form the ESW.
- Industrial switches for Control and Terminal network shall support Ring topology.
- Industrial switches shall be powered 24VDC from the SCS cabinets
- Industrial switches shall be rail mount.
- To ensure full compatibility, Industrial switches should be from the same manufacturer as SCS.

2.17.4 Input and output cards

The input/output cards shall be of module type, equipped with connectors and LED signalling for their status visualization. It shall be easy to replace input/output cards under operation and with functioning plant.

Redundant or 2oo3 functions shall be realized with different input/output cards.

Galvanic isolation shall be provided between field and I/O cards by using active barriers (analogue) and signal conditioners (digital).

Each card power supply feeder shall be protected by circuit breakers if not protected by the board itself. Trip status of the protections shall be monitored.

Wires incoming from another Lightning Protection Zone shall be protected with overvoltage protectors, in accordance with C4G-JI73-ILF-GENER-MAR-DIA-103 „Typical loop diagrams“ and TP_T01_01_01_06 “Design and implementation of Electrical, IC and PCS Systems”.

Cards for analogue inputs and outputs shall support HART protocol directly embedded in the system. It shall be possible to communicate with HART devices without using external devices. Cards capable of handling intrinsic safety DI, DO, AI, AO signals shall be used, whenever applicable.

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Cards for analogue inputs

The acquisition channels shall be freely configurable for the different kind of input signals required with resolution of minimum 12 bits. The direct acquisition of signals coming form thermocouples, thermo-resistances or in mV shall be possible.

Analogue inputs shall be both of kind to feed and to be fed by other systems. The analogue signal feed, where required, will be 24VDC.

The analogue input cards shall assure:

- Filtering of spurious signals and/or perturbations
- Zero Correction and slipping;
- Cold joint compensation and signal lining;
- Self-testing capacity
- Conversion time <15…20ms 4 Chanel AI 50 Hz for pressure control
- Conversion time <50…100ms 8 Chanel AI 50 Hz for temperature, flow, level control
- 12..16 bit resolution
- Alarm condition remarks for interruption of electrical connection with the field or short-circuit
- Range of current inputs 0 / 4 - 20 mA
- Support for HART protocol
- Accuracy ± 0,25 % in all working temperature scale
- resolution 0,024 %, means at least 12 bit
- max. 200 Ohm for current inputs
- indication of status of I/O module
- galvanic insulation input – system 1 kV
- CMR ratio DC > 70 dB
- Min admissible voltage between inputs ± 35 V
- Noise reduction > 60 dB

Cards for analogue outputs

The outputs shall have a working field of 4÷20 mA with resolution of minimum 12 bit.

The cards for analogue outputs shall assure:

- Filtering of spurious signals and/or perturbations
- Self-testing capacity

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- Alarm condition remarks for interruption of electrical connection with the field or short-circuit
- Range of analogue output 0 / 4 ÷ 20 mA,
- Accuracy ± 0,3 %,
- Load impedance at least 500 Ω,
- Galvanic insulation between channels 1500 V / DC,
- Galvanic insulation between output – system 1,5 kV
- Optical indication of status (failure) of every output and module

Cards for fieldbus

For field instrumentation, actuators and other devices supporting HART , Profibus DP, Modbus protocol dedicated card shall be considered. The cards for fieldbus devices shall enable several IO modules or/and instruments to be connected on the same pair of wires in a multidrop network configuration.

When the fieldbus scan time and the field bus slave number becomes too big (>32 slaves), several fieldbus lines shall be used.

In Hazardous Areas, in case of intrinsically safe loops, particular attention shall be provide to the maximum number of devices that can be connected in multidrop in order to respect the requirement of EN 50039 / EN60079-25 (see also Eex i loop calculation). When the fieldbus is passing EX zones, Ex certificated fieldbus types (such as Profibus PA, FF) shall be used.

In addition card for fieldbus interfacing shall support the FDT for Asset Management Systems for Automated Test Procedures provided from remote control system.

The system also shall support Modbus TCP for auxiliary systems as F&G etc.

Cards for digital inputs

The input reading tension will be 24 VDC. The cards for digital inputs shall assure:

- Filtering of spurious signals and/or perturbations
- Self-testing capacity (wire break Namur)
- Alarm condition remarks for field devices faults (e.g. NAMUR);
- For safety loops the alarm condition shall be implemented by means of field resistances (open circuit and short circuit detection is required)
- Base voltage level of a module - 24 V / DC, (possible range 18-30 V / DC)
- Galvanic insulation 1 kV / DC/1 min inputs/system
- Galvanic. Insulation of channels group min 1 kV / DC/1 min

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- Input current in „H“ state max. 6 mA
- Input filtering with possibility to set the length of input pulse
- Ability to catch and evaluate Binary input min. 3 Hz for minimum 4 inputs on a card, min. 1 Hz the rest (possible to parametrize other inputs)
- Status indication of „H“ status and operation of a module

Cards for digital outputs

Moreover the cards for digital outputs shall assure:

- Alarm condition remarks for interruption of electrical connection with the field; (short circuit and wire break)
- Self-testing capacity
- Alarm condition remarks (solenoid integrity check)
- Suitable PLC relays shall be used for current loads
- Nominal switching voltage 24 V / DC (range 18-30 V / DC)
- Protection against short-circuit, inductive load
- Indication of failure
- Galvanic insulation outputs/system min. 1 kV / DC / 1 min
- Possibility to have min. 2 galvanic. Separated groups within module with separate ground, galvanic insulation of groups min 1 kV / DC / 1 min
- Optical indication of status „H“
- Switching 24 V / DC / 1,5 A, resistance load, potential-free contact

Solenoid valve / Actuators

Command circuits for main valves are realized with double solenoid, separate circuits and components. The integrity check of external circuit shall be performed continuously, by means of monitoring min/max. current threshold, when the command is present (solenoid energized). Solenoid integrity checks shall be performed also where command is not present, (solenoid de-energized) by a voltage impulse test and resistance check.

Pulse inputs or fast inputs cards

Up to 10 kHz, base voltage of a pulse 24 V / DC, comparation set from program, noise filtration, galvanic insulated

Safety in/outputs cards

Digital and analogue in/output cards for safety functions shall be considered for critical controls and safety applications according to the cause and effect diagram and the SIL assessment report. Each in/output channel shall include a QBad (Bad Signal quality)

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evaluation. All safety applications shall be programmed by certified safety programming task blocks.

- SIL relays shall be used for SIF loops.

2.17.5 ESD Station

The PLC provided shall be self-contained unit capable of collecting and processing data from intelligent devices such as:

- Interfaces from third party equipment (e.g. SCS PLC) through BUS communication;
- Dry contacts, Namur contacts, 4-20mA current signals and contact-making pulsing devices from field devices (Manual Call Points and ESD safety instrumented loops) or utility package instrumentation.

All process signals shall be interfaced to the fail-safe system potential free.

All I/O loops shall be safety I/O loops, line monitored and shall be also equipped with over voltage protection.

The PLC shall be implemented on Fault tolerant architecture which shall allow ESD to continuously operate during single module failure & hot replacement of any failed component without loss of system performance.

To avoid compromising the system by any cyber-attack, hardware-programmable PLC shall be foreseen (e.g. HIMA Planar 4 or similar).

All logic diagrams of the ESD Station shall be a topic of SIL certification.

2.18 IEC Gateway

IEC Gateway PLC based system for communication with D4NG via IEC 60870-5-104 protocol, in accordance with MP_F03_00_03 “Communication of DN4G and sub-stations” shall be provided.

List of variables with addresses transmitted to DN4G, shall be created by Contractor together with SCADA department of the Client. Source variables shall be communicated from SCS CPU via communication protocol.

2.19 Supervision – Human Machine Interface

The supervision of the station shall be in accordance with TP_T01_01_01_06 “Design and implementation of electrical, IC, and PCS systems”. Standard PCS7 Library for WinCC display could be used.

The supervision of the station will be shown on screens and handled by an operator. The operator (also at DN4G) has access to HMI’s of SCS, ESD, F&G, HVAC, etc.

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The ESD push buttons are located on a dedicated matrix panel in control room.

The synoptic will be dynamic; the visualized data will reproduce the actual status and permit to manage the functions and alarms from the field, modify regulator set-point and all parameters necessary for the operation.

The system shall provide a hierarchy among the graphic pages, and the possibility to surf through this hierarchy (general graphic pages - overview, details, groups or about single regulation loop, start and shutdown sequences).

The system shall make available graphic temporary representation for regulator tuning, for input signal monitoring, etc. Faceplate and help on-line facilities shall be available.

Any kind of operation such as calling up trends, global interrogations, printing etc. shall not noticeably interrupt the performance of system for the Operator.

2.19.1 Signal and scan times

The Contractor shall provide calculation online and information of the systems scan and signal times.

Figure: System time modelling and time stamping

Early time stamping shall occur

A: CPU

B: Fieldbus

C:IO Module

The Contractor shall optimize the program cycle task. Following basic program cycle are forseen.

High task: 5ms……50ms (ESD, Safety, Pressure and critical IO)

Normal task: 50ms….100ms (Process Task)

Middle task: 100ms …150ms (Electrical and switch gears)

Low task: 150ms…..1s (Temperature, Interfaces etc)

The system shall guarantee the following response times:

- Analogue signal acquisition: 10ms..20ms for 4 channel AI
  50..100ms for 8 channel AI
- Digital signal acquisition: 100…. 120ms
- New screen page recall: 1,0 sec. before Firewall
- New screen page recall: 1,5…2 sec. after Firewall

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- Screen page updating: 1 sec.
- Trend display: scalable ranges
- Alarm time chronological resolution Close to IO scan time

Messages, Events and Data Storing

The system shall be able to manage process, safety and system alarms from any operator station. Moreover it shall be possible to:

- Split alarms depending on their priority. Different levels of alarm priorities (3 minimum) shall be distinguished by audible and visual means.
- Generate at least 2 absolute alarms and 2 deviation alarms for each analogue variable.
- Display the status of each digital signal.
- Display alarms; in addition an indication of the alarm status shall appear on the current display to provide a cross-reference to the alarmed page.
- Display a chronological summary of all alarms on pre-defined pages. The alarm summary display shall give for each alarm the following information as a minimum: time and date of occurrence, tag number, tag description and type of alarm (high, low deviation, trip, etc.).

Time and date of alarm occurrence shall be generated by the control logic with time chronological resolution close to the minimal program cycle task.

Supplier will specify the resolution time for all the other events. Store the alarm history on the mass memory for future analysis. It shall be possible for the operator to query and print out the list of selected alarms.

The alarm history shall display and printout a list of the following information as a minimum: priority, time and date of occurrence, tag number, tag description, active or quitted, time and date of return to normal and the detail description of the alarm, (high, low, deviation, trip etc.)

Display of all events and operator actions (e.g. start/stop command, set-point changes, etc.), including as a minimum: time and date of occurrence, event description.

It shall be possible for the operator to query and print out the list of selected events. The event history shall display and printout a list of the following information as a minimum:

- Time and date of occurrence and event description.
- Allow a quick identification of the alarm priority level and a easy way to call up graphic or alarm summary display for acknowledgement. The possibility to inhibit alarm on each operator station shall be protected by the access control.

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Alarm acknowledgement must allow, by a unique key stroke, acknowledging an alarm on all operator stations belonging to the same area.

The programming system of the Historical Alarm Viewer (HAV) shall classify following type of messages:

Message Type	Description	Tag
Alarm, Failure or Malfunction	Switch off, Regulation or ESD function	-AM
Warning	Warning for the operator	-WM
Maintenance	Message for the maintenance staff	-MM

Data stored in the Operating workstation will be rewritten in a daily basis. For historical data, it will be called from the long-term data storage on server.

2.19.2 Sequence indication

The SCS shall have graphical interfaces for the plant sequence procedures showing its status, logical interlocks and interfaces. Features to hold sequences or switch to manual steps shall be available.

At least following shall be considered:

- Start/stop of the station
- Start/stop of a compressor unit
- ESD with depressurization (HOLD – Venting philosophy)

2.19.3 Authority restricted user level

Depending on the task or authority of a user, such as administration and maintenance activities, process system operation or viewing only the authority configuration levels shall be configurable. It shall be possible to assign an individual authority level for each type of user.

2.19.4 Login and Logout

The SCS system shall only permit access via a password protected login. Login and Logout shall be logged in the event list together with user and workstation identification. Unsuccessful logins shall also be logged.

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Every action of an user, such as commands, setpoints, quitting of events/alarms, SCS system configuration changes shall be logged with an user specific identification tag and shall generate an event. Passwords shall be protected (encrypted) by the SCS system.

Level of user shall be defined in detail design phase in agreement with Employer.

2.19.5 Consistency of appearance and handling

The appearance and the handling (look and feel) of the SCS system shall be consistent over all applications and locations. This requires:

- Consistent sequences of action
- Identical terminology shall be used in prompts, menus, help screens and dialogs
- Consistent color, layout, capitalization and fonts
- Consistent layout of process views and symbols
- Each block icon shall have own faceplate
- No language mixing, everything shall be presented strictly in Czech

2.19.6 Error prevention

The system shall be designed to prevent user errors.

- Commands and menu items, which cannot be selected, shall be greyed out.
- Commands shall be issued via faceplates, which should be invoked after block icon click.
- The system shall not accept wrong input
    - Feedback shall be provided in case of commands which are inhibited
    - Feedback shall be provided in case of wrong data is typed in, recovery shall be simple
    - Do not allow alphabetic numbers in numerical input fields

2.19.7 Data consistency

A change of the status shall be updated in the HMI-display in minimum 1 (one) second within all equipment in the screen.

A screen freeze (no data update) shall be avoided by all means and be possible to be easily recognised by the operator.

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2.19.8 Access to the Operating System

Under normal SCS operation it shall not be possible to access the interface of the operating system of the workstations and servers.

Only authorized users shall be allowed to access the operating system or to shut down the SCS system by the EWS.

2.19.9 Lists, reports and tables

The SCS shall be to produce list and reports in CSV and Excel format.

Each list/table shall support filtering for each column. The filtering shall support Wildcards.

Each column of a list/tablet - except the real-time event and alarm lists - shall support sorting. The real time event and alarm list shall always be ordered by timestamp, the latest alarm shall be on top of the list.

Activated filtering and sorting shall be clearly indicated.

Each list/table shall support printing of the whole list/table content. Appropriate print menus shall be provided.

Each list/table shall support export of the whole list/table content. Appropriate export menus shall be provided.

2.19.10 HMI Menus

Please refer to Net4Gas company standards chapter 1.4.1.

User specific menu shall be configurable by administrators. It shall be of pull down type placed on top of a screen. It must be possible to configure keyboard shortcuts. The main menu shall be configurable for the full range of actions which can be carried out within the control and monitoring system. It shall support cascading.

For symbols a free configurable context menu (command dialog) should be used to be open via mouse click. It shall be of pull down type. Scrolling for commands within the dialog is prohibited i.e. must not be necessary. The operator must see all the symbols related commands by only one click on the device symbol. If the number of commands exceeds a certain number (e.g. 20) cascading shall be used.

2.19.11 Feedback to operator commands and inputs

Each command must be visually echoed by the system if its execution is permitted.

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In case of wrong operator commands or inputs the system shall provide clear feedback to inform the operator about the specific reason a command or action cannot be executed. The reasons can be as follows but are not limited to:

- The operator is not authorized for operation “action not authorized”
- The device is blocked by the SCADA system “device is blocked”
- The device is engaged in an automatic sequence “automatic mode"

Each input must have a feedback within minimum 2 sec.

2.19.12 Summary status indication

All navigation buttons and process items must indicate the summary (composite) status referring to the data point attributes “alarm”, “warning”, “manual”, etc.. All signals of a display and its sub displays are summarized in one item and change its navigation button’s colour to the respective colour if the status is active.

Communication lost attributes of the data points are summarized to one message which changes the button to a (to be defined) colour.

2.19.13 Blinking

Symbols (and buttons connected to a summary alarm) shall blink according to the process status. It shall be possible to configure different blinking sequences for certain status combinations. For example:

- Device in alarm and not acknowledged: fast blinking, red
- Device in alarm and acknowledged: not blinking, red
- Device not in alarm and not acknowledged: slow blinking, red
- Device not in alarm and acknowledged: not blinking, colour according to status

2.19.14 Acoustic

Alarms shall be acoustically announced until they are acknowledged. The signal shall be configurable. For different type of alarms different acoustic signals shall be configurable.

Loudspeakers shall be located in the main desk of control room and connected to the operator workstations accordingly.

2.19.15 Display of Analog Values

The number of decimal places must be configurable, depending on the application the Analog value is displayed in.

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An Analog value must always be displayed with its physical value, following the SI unit standard.

In case of minus, the algebraic sign must be displayed.

2.19.16 Printing

Every application within the monitoring system shall support printing to print out trends, displays, lists, reports etc. via:

- A print icon, short key or context menu for immediate printing by using a user pre-defined default configuration, without printing dialog. If the default printer is not available the backup printer shall be selected automatically.

A printing dialog for individual configuration of the printout:

- It must be possible to redirect printouts into files such as pdf, txt, jpeg, png etc.
- Page size and printer must be selectable.
- Number of pages shall be selectable.
- Printing of current view shall be possible
- Colour inversion must be possible.

2.20 Process Displays

For HMI process displays and alarms details please refer to TP_T01_01_01_06 “Design and implementation of Electrical, IC and PCS Systems”.

2.20.1 HMI screen Completeness

The HMI process displays in the OWS shall cover as a minimum:

- All P&IDs with all the related data points
- Station process overviews
- Cause and Effect Matrix
- The Fire and Gas detection system with alarms and warnings
- Electrical systems (LV, MV, UPS, distribution, etc.)
- Building with HVAC and intruder alarms
- Overview display for other auxiliaries i.e. PA/GA, Instrument air system, etc.
- Overview for signals from/to DN4G
- Diagnostic of SCS

At least 50 displays shall be considered in the scope of work of Contractor.

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Additionally all display of the EMCS shall be integrated in the SCS. Additional 40 trends shall be configured by Contractor.

Each status of the process, which is represented by a data point, must be reflected within or by a symbol.

2.20.2 Process display performance

Each Process-display call up must be completed within 1 second, independently of the number of objects within a display and independently of the number of displays already opened. I.e. all data visualized within the display are updated and full usability is provided.

2.20.3 Blocking of display elements

Each symbol, button, set-point etc. which offers a command or input, shall provide the possibility to be blocked by the operator. I.e. it is visually marked (e.g. with a frame) and instead of offering the command dialog an editable note shall pop up. The note shall be time stamped each time it is edited; at least 500 characters for a comment shall be allowed. The note shall be stored until the display element is unblocked.

2.20.4 Device Symbols

For each device of the process a specific dynamic symbol shall be available. All symbols are subject to Employer´s approval and shall follow to the Employer familiar symbol conventions. All symbols shall support blinking (with at least two different frequencies) and shall be capable of changing appearance (shape, colour, position, visibility) according to the actual device status.

2.20.5 Display Hierarchy

The screen hierarchy that matches the process topology must be designed. Not more the three levels of displays shall be applied.

1. Level: Pipeline system
2. Level: Stations, diagnostic displays
3. Level: Sub-areas and unit controls

Navigation buttons must be provided to navigate within a level (along the process) or to change the level.

2.20.6 Location of Symbols, Objects and Data Points

The system must support the search for data points and/or related objects/symbols in the process displays within a minimum number of operating steps.

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2.20.7 Process Display Types

2.20.7.1 Display according P&IDs

Show process according to P&IDs. Passive elements are not necessarily part of the displays.

For pipes and piping:

- Reduce cluttering: Avoid crossings and corners of pipes whenever possible.
- In case more than one flow path is possible within a display indicate active flow path e.g. with a thicker line. (Flow tracking)
- Flow direction of a pipe within a display must be always from left to right and from top to down.
- Colour of pipes shall be according to the medium
- Passive components such as for example check valves or similar shall be available if relevant for the process

2.20.7.2 Schematic Overview Screen

The Operator must see and assess the status of the plant on this overview. Therefore the complete flow path (from beginning to the end) of the whole system with all

- relevant valves,
- temperatures,
- pressures,
- and values for flow,

must be shown on this display.

2.20.7.3 Display for sub-systems

Sub-system shall display status of facilities, regulation loops, sequences, status of technology or devices controlled by dedicated control systems like HVAC, Instrument air system, power distribution systems etc. The display shall be designed in a good manner, to give the operator best station and facilities overview.

2.20.7.4 Display for Communication with DN4G

All signals from / to DN4G in Prague shall be available in this display as overview. It shall be possible to override parameters in case of maintenance activities (through Engineering Station). Overrides shall be possible only with special password, monitored in the event list and indicated in the screens over summery symbols related to this display.

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2.20.7.5 Displays for System Diagnostic

The status of the SCS shall be shown in these displays, including networks, work-stations, servers, CPUs, I/O cards, etc.

Every connection error to a connected device shall be indicated in the communication overviews. Each hardware failure, component failure or warning must be indicated in the hardware views.

Overview of the relevant parameters shall be available, for example CPU scanning time, workload, etc.

Dedicated display shall be available for the ESD system.

2.20.7.6 Displays for Asset Management

The displays of the AMS shall be accessible by EWS with a maintenance login access.

The AMS shall display all sensor, actor and control system function.

Features of the proposed software shall be provided with the bid documentation.

2.20.8 Trend Display

2.20.8.1 General

The trends shall be configurable by a trend editor, e.g. via standard WinCC tool. All possible field device data points shall be freely edited.

A number of selected control loops for the station and units shall be preconfigured.

Signal trends shall display the trend of one or more signal graphs against time. It shall be possible to display each signal trend in one window as far back as the archiving function for this signal was activated. The scale, the time domain and the range of values shall be adjustable online while the signal trend is selected.

Signal trends shall be shown as line charts with up to 6 graphs in a common time domain but in different ranges of values. It shall be possible to save trend selections.

It shall be possible to select if interim values between real values are interpolated or not (steps).

Process values shall be shown in trends even if there was no change over a longer period of time.

Thresholds, out of limit values or other non-regular statuses shall also be marked in trends accordingly.

It shall be possible to select points on the time axis in line charts by mouse and get the related value displayed alphanumerically.

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It shall also be possible to define a set of graphs and to save them as one file under a certain name. By help of a search function it shall be possible to recall these files in a comfortable way.

It shall be possible to freely manipulate the time domain and the range of values.

It shall also be possible to shift the time axis of two different trends relatively to each other.

It shall be possible to define a comment text to each point of a signal curve. This comment text shall relate to this particular point of the signal curve and shall not be eliminated by compression algorithms for archival. It shall be possible to define 60 up to 100 characters as such a comment text. Upon each call of a signal trend this comment text shall be displayed with clear assignment to the point in time.

It shall be possible to select via mouse a zoom area for zooming in the view and to return to the latest zoom-level per mouse click. At least three zoom levels shall be supported. Each zoom must be finished within 1 second.

It shall be possible to select two points of the chart by mouse and to get the difference of the x coordinate (physical value) and y coordinate (time) displayed alphanumerically. The selection within the trend shall be visible until operator reset.

2.20.8.2 Mini Trend

For Analog values a command dialog within a context Menu shall be provided, which opens immediately a Mini Trend, without further selections and user entries.

It shall also be possible to include mini trends into the project specific process displays.

2.21 Data storage, historian

Data originated in the local control systems, HMI and the result of mathematical operations will be stored in a local SCS storage server (historian) as well as in the N4G local data storage server. The data will be transmitted to the central SCADA system by IEC60870-5-104. The N4G data storage server is not part of the scope of Contractor and will be provided by the Employer.

The Contractor shall fully assist the Employer in establishing the interfaces to the data storage server, including hardware such as cables, place for the data storage in the server cabinet, software signal exchange, testing and commissioning as minimum.

2.22 Equipment Statistics

For the gas compressors, engines in general, metering, valves, filters it shall be possible to collect statistics.

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- Count of operation hours of all equipment (overall counter and manually started counter, reset after maintenance)
- Count of status changes statistics (open, close, start, stop)
- Count of passing thresholds by analog values or counters

For alarming purposes, time counters with a threshold shall be configurable.

The configuration shall be possible over specific statistic HMI-screen or pop-up.

2.23 Alarm- and Event Management

2.23.1 Alarm Management

During project execution alarm management shall be assessed. For this scope a meeting shall be organised and lead by Contractor with the attendance of Employer and his representative.

Alarms and event shall be discussed and classified as follows:

- Critical alarms
- Warnings
- Events
- System failures
- Alarms for local acoustic indication at operator workstations

The classification shall be documented and accordingly implemented in the system by Contractor.

All signals shall be considered, also those from the serial interfaces and those to the remote DN4G.

2.23.2 Alarm and Event window

The alarm and event window is presented in a list, sorted in a strict chronological order; the latest alarm and event is listed on the top of the list according to the Sequence of Event (SoE).

Each alarm or event shall have priority configuration.

All alarms and events shall be archived. The depth of the archive shall be minimum 5 years and shall be only limited due to hardware limitations. To access archived Alarms and Events as new Alarm and Event window shall be opened.

The Alarms and Events shall be presented according to their severity level in different colours.

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An area filter shall be available, i.e. only events and alarms of a certain area shall be visible. A clear indication must be provided that the area filter is active.

Each alarm and event entry is listed with the following attributes and descriptions

- Data point key with textual description
- Nature of event or alarm (LL, L, H, HH etc)
- Point of origin (which application generated the alarm)
- Value and corresponding unit
- Timestamp of alarm or event
- Acknowledgement status (alarms only)
    - Timestamp of alarm acknowledgement
    - Tag of Operator who acknowledged

It shall be possibly to add a comment text for each entry in the event-report by an operator. The related text line shall be marked accordingly. The comment text shall have a fixed relation to the particular event and shall be visible to all other users.

The Bid documentation shall describe how the system supports the operator to navigate from an event or alarm entry to the corresponding display(s).

2.23.3 Alarm Window

For immediate visualisation of the latest alarm a separate Alarm Window shall be applied. The alarm window shall represent a subset of the alarm and event window and only contains unacknowledged alarms. The layout and functionality shall be according to the event and alarm window.

2.23.4 Alarm and Event Archive

The system shall archive the alarms and events

Short time archive : the alarms and events of the last 2 month, without compression or reduction.

Long-time archive : the alarms and events of the last 10 years, with compression and reduction.

The Event and Alarm archive is a part of the Historical data archive server (HIS) which is be based on a relational data base. It shall be possible to retrieve 100 archived events/alarms within 1 second. A separate Alarm and Event window shall be used to access archived data.

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2.24 Workstations

The SCS shall be provided with a HMI supervision system based on:

- Two SCS operator workstations in the control room
- One engineering workstation in the control room
- One SCS operator workstation in the electrical building

see also C4G-JI73-ILF-KS007-MAR-DIA-100 “CS Architecture- Overall Diagram”.

2.24.1 Operator Workstations

The Contractor shall provide workstations for the operation of the plant. The access to the engineering applications shall be restricted by operator passwords.

The following software shall be preinstalled, at least:

- Programming software for all PLCs and HMI visualisation system
- Antivirus according to standard by Employer

Monitors shall be 24” high definition with same resolution of the EMCS monitors, designed for 24/7 hours of operation.

The computers shall be of high quality industrial standard, suitable for installation in the server cabinet, processor of the last generation with large memory and graphic capacity sizing.

Operator workstations shall be provided with facilities for local acoustic indication in case of critical alarms / events.

2.24.2 Engineering Workstation

The Contractor shall provide an engineering workstation for development, modifications, administration and maintenance of the SCS. The access to the engineering applications shall be restricted by special passwords.

The following software shall be preinstalled, at least:

- MS™ Office 2016
- Programming/development software for all PLCs and HMI visualisation system
- Antivirus according to standard by Employer

Monitors of the engineering workstation shall be 24” high definition with same resolution of the EMCS monitors, designed for 24/7 hours of operation.

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The computer shall be of high quality industrial standard, suitable for installation in the server cabinet, processor of the last generation with large memory and graphic capacity sizing.

2.24.3 Servers

The SCS servers shall be provided with processors of the last generation and large memory and graphic capacity sizing.

At least the operating system for the HMI visualisation, the historian database software and the antivirus according to standard by Employer shall be installed.

Hard disks for historian scope shall be of big capacity, sized according storage requirements. RAID back-up system shall be in place to avoid loss of data in case of failure of one hard disk.

Access to the servers shall be over engineering station, selectable.

2.24.4 KVM-E

KVM-extenders shall be of high industrial quality for interface of keyboard, video (also 2 monitors) and mouse with the PC installed in the server cabinets. The interface shall be preferably over fibre optic cable, products BellEquip DVXi/ME or equivalent.

2.24.5 Switches and networks cabling

Industrial switches for control and Terminal network shall be supplied by the Contractor. Requirements are described in chapter 2.17.3.

Network cabling shall be according to specification C4G-JI73-ILF-GENER-ELE-SPC-806 “Specification for Cables and Cable Laying”. Different networks shall be clear identifiable from the colour, which shall be defined in agreement with Employer.

2.24.6 Wall monitor

The wall monitor (Flat screen) for installation in the main control room as indicated in the document document C4G-JI73-ILF-KS007-ELE-VYK-401 “Administration and Control Building - Electrical Equipment Arrangement Drawing” shall be approx.. 60 inch Ultra High Definition (UHD) type.

The wall monitor shall be used for display of view from different systems/sources as follows:

- Displays of SCS / EMCS
- Displays of the engineering workstation or SCS servers
- Displays of CCTV system

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A switch shall be available within the main desk to select the desired input.

One HDMI-radio devices shall be provided for the interfaces with laptops video and audio, including adapters.

2.24.7 Printers

SCS and EMCS printers will be provided by Employer and must be fully installed, connected and configured by Contractor under the supervision of Employer.

2.25 Cabinets, Panels

Reference is made to the document C4G-JI73-ILF-KS007-ELE-VYK-401 “Administration and Control Building - Electrical Equipment Arrangement Drawing” and C4G-JI73-ILF-KS007-ELE-VYK-411 “Electrical Building - Electrical Equipment Arrangement Drawing”, which show the location of the cabinets for the SCS system. The required number for the SCS system is estimated and shall be validated by Contractor prior to BID.

The concept is considering the following type cabinets, but not limited to:

- Server cabinets
- System cabinets for power supply
- System cabinets for CPUs
- System cabinet for I/O modules
- Marshalling cabinets

Each system cabinet is installed with the respective marshalling in the rear side, back to back. Server cabinet have access on both side.

One ESD cabinet is considered to be sufficient at this stage (to be confirmed by Contractor) including power supply, controllers and I/Os. Also the ESD cabinet is provided with respective marshalling on the back.

For detailed requirements about cabinets and panel refer also to TP_T01_01_01_06 “Design and implementation of Electrical, IC and PCS Systems” and C4G-JI73-ILF-GENER-MAR-SPC-901 “General Requirements - Installation and Startup of Control System”.

Marshalling loops shall generally comply with C4G-JI73-ILF-GENER-MAR-DIA-103 “Typical Loops Drawings”.

Server cabinets shall be provided in the administration building for installation of all servers and industrial computers of the operator and engineering workstations as well as SCS servers. Additionally place shall be left free for installation of the workstation PC

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and auxiliaries by EMCS-Vendor. Server cabinets shall be 19" rack based with access from both sides.

Dedicated area of the system cabinets shall be provided for installation of the network equipment such as hubs, switches and converter for FOC or fieldbus.

The interface between cabinets located in different building will be over FOC and dedicated patch panels. Components shall be suitable for interfacing with the network FOC infrastructure.

2.26 Spares

Spares in control cabinets and marshalling panels shall be considered after commissioning, as follows:

- Spare place for additional terminals minimum 20%
- Additional spare place for devices: minimum 20%
- Spare place for additional I/O modules minimum 20%
- I/O spare ready with all auxiliary, complete wired minimum 20%

2.27 Furniture

All furniture shall be according to local regulation for labour protection. All material shall be of high quality and durability.

2.27.1 Main desk control room

The main desk in the control shall be supplied to install all workstations according to disposition drawing C4G-JI73-ILF-KS007-ELE-VYK-401 "Administration and Control Building - Electrical Equipment Arrangement Drawing".

The main desk shall be provided with channels for hide and efficient connecting cables and housing with socket for equipment power supply and networks. KVM-E extender receiving units shall be installed in the back side of the table. Proper access to equipment shall be guarantee.

A system shall be provided for ergonomic fixing of the monitors, 3D bracket or equivalent.

Chairs for the desk in main control shall be office professional type, according to number indicated in the drawing. Document containers shall be provided.

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2.27.2 Printer racks

Printer racks shall be provided for the SCS and EMCS printers installed in the administration and electrical buildings as indicated in the drawing C4G-JI73-ILF-KS007-ELE-VYK-401 “Administration and Control Building - Electrical Equipment Arrangement Drawing”.

2.27.3 Facilities in electrical building

Desk and chairs, including document containers shall be provided as indicated in the drawing C4G-JI73-ILF-KS007-ELE-VYK-401 “Administration and Control Building - Electrical Equipment Arrangement Drawing” for the operator SCS and EMCS workstations.

2.28 Cabling and installation

The complete cabling and installation of the system is the scope of the Contractor.

The cabling must be carried out according to C4G-JI73-ILF-GENER-ELE-SPC-806 "Cables and Cable Laying – Specification".

3 SERVICE CONTRACT

Proposal for service contract shall be provided with the offer.

The service contract shall be a supporting tool for the operational department of the Employer in case of system failure and be available 365 (resp. 366) days per year and 24 hours a day.

Following reaction time by competent skilled technician familiar with the plant shall be considered:

- maximal 2 hours over remote access;
- within 24 hours at the site.

For remote access see requirements of par. 2.12 “Remote service”.

4 FACTORY ACCEPTANCE TEST (FAT)

Requirements of relevant paragraph in the specification C4G-JI73-ILF-GENER-MAR-SPC-901 “General Requirements - Installation and Startup of Control System” shall apply.

Prior to the execution of the FAT an internal pre FAT shall be carried out by Contractor. The pre-FAT shall ensure that the FAT can be carried out without interruptions > 0.5h

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caused by system malfunctions. The protocols of the pre-FAT shall be handed over to the Employer prior to the execution of the FAT.

The Employer will witness FAT with 4-6 representatives. Contractor shall provide 3 desks with internet access for the Employer.

For the FAT, at least 10 working days shall be foreseen (working hours: 100h). Employer shall be entitled to do free tests, which are not part of the approved FAT procedure, for at least 1 day.

Contractor shall provide enough man power and testing facilities that the test can be completed within the a.m. mentioned 10 days. Contractor shall reserve enough resources for regular meetings during FAT, regular testing during that meetings should not be interrupted.

Automatic simulation of valves in the main flow path shall be provided for FAT. Analog values within the main flow path shall be all connected to a simulation panel.

The Employer is entitled to stop or interrupt the FAT if the deficiencies do not allow meaningful continuation of the FAT. In this case Employer can demand a new FAT at the cost of the Contractor. Examples for interruption are

a) Missing documentation or hardware

b) Missing functions as described in the specification

c) Errors or mal functions, which cannot be explained to Employer’s satisfaction

d) Unstable system

e) Interruptions, which are caused by Contractor of more than 2h

The FAT is finished when everything is tested and the Employer has approved the test results when all items in the punch lists are signed off and the FAT certificate is signed by all participants and Employer.

5 INSTALLATION, COMMISSIONING, ACCEPTANCE

Requirements of relevant paragraph in the specification C4G-JI73-ILF-GENER-MAR-SPC-901 “General Requirements - Installation and Startup of Control System” shall apply.

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6 SPARE PARTS

Requirements of relevant paragraph in the specification C4G-JI73-ILF-GENER-MAR-SPC-901 “General Requirements - Installation and Startup of Control System” shall apply.

7 TRAINING

Requirements of relevant paragraph in the specification C4G-JI73-ILF-GENER-MAR-SPC-901 “General Requirements - Installation and Startup of Control System” shall apply.

The Contractor shall provide specialised training for the personnel of Employer, including operation and maintenance of the system.

8 DOCUMENTATION

Requirements of relevant paragraph in the specification C4G-JI73-ILF-GENER-MAR-SPC-901 “General Requirements - Installation and Startup of Control System” and of the contract shall apply.

For the scope of SCS and ESD following additional documentation in the design phase shall be considered:

- Disposition layout furniture in control room

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