



ORLEN
BIOMETAN

Appendix 5

Scope of Instrumentation, Control and Automation I&C Requirements for the Detailed Design of the Biogas & Biogas Cleaning Plant Packages.

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1. Introduction

This document defines the scope, requirements, and expectations of the Employer's I&C (Instrumentation and Control) discipline towards the Contractor in connection with the execution of the detailed design, and aims to ensure a consistent understanding of the Employer's needs as well as to enable reliable pricing and evaluation of bids.

The document constitutes the basis for the preparation of bids by potential Contractors and will serve as a reference point during project execution, its scheduling, progress monitoring, and acceptance procedures.

2. General Section

2.1 Scope of the biogas plant installation

Design documentation must include following units:

substrate preparation system (feeders, dosing units, receiving stations)

- fermentation tanks and digestate tanks
- mixing and heating system of fermentation tanks
- biogas desulfurization and drying system
- flare and gas safety system
- process water and heating system
- engine-based cogeneration systems
- technological buildings and control room
- separation stations

3. Instrumentation Requirements

3.1 Measurement Instrumentation (minimum standard)

The standard analog sensor signal shall be 4-20 mA current output.

Cables between measurement transmitters and the electrical cabinet shall be shielded.

The design must define parameters and requirements for:

- level sensors: substrate, fermentation mass and digestate
 - measurement redundancy
- pressure sensors in fermentation tanks and in the biogas flow network
 - measurement redundancy
- flowmeters: substrate, fermentation mass and digestate, gas flowmeters (ultrasonic or thermal)
- temperature sensors for the fermentation process
 - measurement redundancy
 - temperature sensors must have a calibration certificate
- H₂S, CO₂, O₂ concentration sensors (analyzers or continuous sensors)
- foam presence and level sensors
- biomethane quality analysis
- analysis of electrical power quality parameters in the internal electrical network, including phase-to-phase parameters
- gas detectors (CH₄, H₂S)

In hazardous areas: ATEX II 2G / II 3G / SIL.

3.2 Process valves

The design must define:

- control valves (diaphragm, ball, pneumatic)
- safety valves
- quick shut-off valves (ESD)
- sequence valves for gas systems
- valve islands

Scope of I&C (Instrumentation and Control) Requirements for the Detailed Design of the Biogas Plant Package.

- approved valve islands: Festo
- actuators (pneumatic, electric, spring return).

3.3 Motors

Due to the harsh environment of a biogas plant: high humidity, chemically aggressive gases (H₂S, NH₃), organic dust, the presence of potentially explosive atmospheres (Ex zones), and continuous operation, specific requirements apply to motors:

1. Environmental conditions and motor design

Degree of protection

- Minimum IP55, often IP56/IP65 for equipment operating outdoors or near fermentation tanks.
- In hazardous areas - Ex motors in accordance with ATEX (most commonly Ex e or Ex d).

Chemical and mechanical resistance

- Class H varnish or special anti-corrosion coatings resistant to H₂S.
- Bearings with RS/2RS seals or special labyrinth seals

Cooling

- High energy efficiency, preferably IE3 / IE4.
- For applications with high continuous loads - IC411 or IC416 cooling (motors with forced ventilation)

2. Requirements for mixer motors

Mixer motors shall be designed for variable loads resulting from the density and viscosity of substrates and fermentation mass:

- High starting torque (often above 200% of the nominal value).
- Capability of operation at low speeds using inverters (e.g. 15-40 Hz).

Additional protections:

- PTC/NTC,

winding temperature sensors

- Capability of operation in overload mode up to 150% for 60 seconds (depending on the inverter class).
- High tightness of gearboxes and shafts
- Continuous operation S1 or intermittent duty S3/S4 depending on the biogas plant technology.

3. Requirements for motors driving blowers

- Stable operation in continuous duty S1.
- High efficiency - IE3/IE4 class motors
- ATEX certification required if the blower operates in hazardous areas.
- Operation with an inverter:
 - minimum operating frequencies >20 Hz or the use of a dedicated, independently powered cooling system
 - protection against air overload / filter clogging.

4. Wymagania dla silników napędzających sprężarki biogazu

- Silniki ATEX Ex d / Ex e.
- Zwiększona odporność na temperaturę.
- Praca z utrzymaniem stabilnego ciśnienia.
- Wysoki moment rozruchowy.

5. Motor selection

Motor selection shall be preceded by an analysis of motor duty cycles (S1-S9), followed by the selection of the appropriate IE3/IE4 efficiency class and IP rating..

3.4 Emergency power supply

During the design stage, power supply via two cable lines shall be considered. Two separate power supply sections shall be provided at the transformer station.

The basic section, supplied via cable line “II”, shall cover auxiliary power circuits and technological equipment whose shutdown in the event of power loss from a transformer supplied either from internal electricity sources (cogeneration units) or from the DSO power grid is not critical for the facility.

The guaranteed section, supplied via cable line “I”, shall be powered by a backup energy source (generator set). The guaranteed section shall supply: the transformer station system, membrane roof blowers of fermentation tanks, storage digestate tanks, as well as the control system, PLC I/O stations, HMI panels, fiber optic ring switches, and equipment in the liquefaction module required to maintain proper temperatures in bioLNG technological storage tanks.

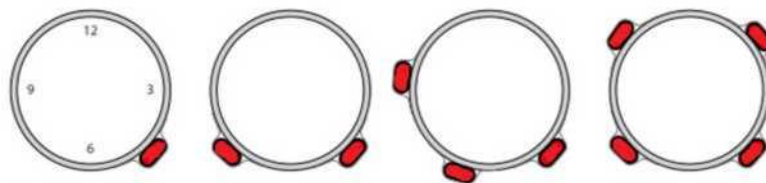
A manual bypass switch for the guaranteed section power supply shall be provided in the switchgear. Under normal conditions, the switch shall remain permanently set to position II - supply from the transformer station section.

3.5 Electric heating of pipelines

During the design stage, in order to optimize heat losses, the installation of electric heating for sections of technological pipelines shall be considered. The following shall be taken into account for calculations:

- heat loss per 1 meter of pipeline,
- pipeline diameter,
- outer diameter of the pipeline including insulation,
- thermal conductivity coefficient of the insulation material,
- maintenance temperature,
- ambient temperature
- safety factor

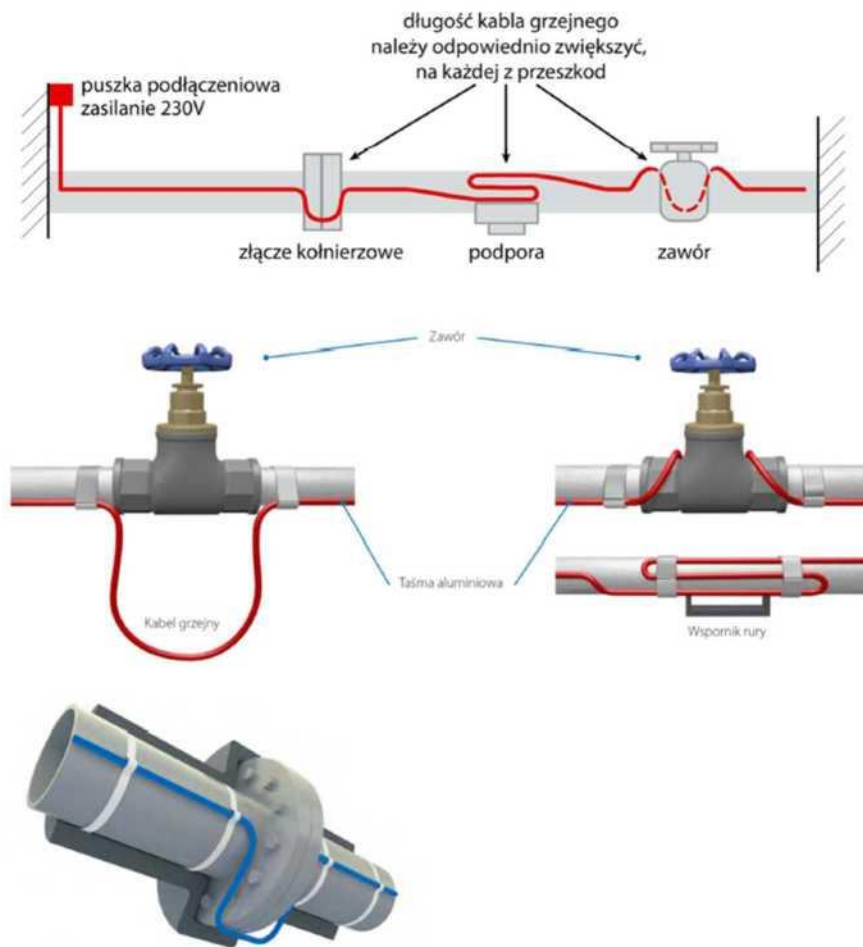
Permissible arrangement of heating sections on the pipeline



If elements such as valves, supports, flanges, or branches are present on the pipeline, the installation at the point of the obstacle should be carried out as shown below.

Scope of I&C requirements for the detailed engineering design of the biogas plant package.

in the drawings. Maintain the minimum bending radius in accordance with the manufacturer's guidelines.



The power supply cables for the heating cables shall be routed to an electrical junction box with a minimum ingress protection rating of IP65. The protective screen (shield) of the heating cable shall be connected to the protective conductor in the electrical installation. After completion of the installation, measurements of the heating cable resistance and insulation resistance shall be carried out. Warning labels indicating the presence of heating cables energized at 230 V shall be affixed to the pipeline in visible locations.

4. CONTROL SYSTEM EQUIPMENT REQUIREMENTS

PLC/DCS controllers are the fundamental component of the process automation system in the biogas section and are responsible for implementing control logic, process safety functions, communication with field devices, and data exchange with the SCADA system. The system

The control system should be consistent, reliable, and scalable, with the possibility of future expansion without the need to replace hardware or software. The equipment should be suitable for the environmental conditions of a biogas plant (e.g. resistant to dust, moisture, and vibrations).

4.1 PLC/DCS controllers

Minimum hardware requirements:

Parameter	Specification (minimum requirements)
Enclosure	Industrial, suitable for installation: - on a 35 mm DIN rail - in a 19-inch cabinet Protection rating: minimum IP20
CPU	Controller compliant with IEC 61131-3 Modular Programmable in the manufacturer's environment, e.g. TIA Portal or equivalent Preferred solution: redundant Siemens S7-1500 controller with ET200 distributed I/O stations
Frequency clock frequency	Minimum 1 MHz or an equivalent performance of 50 ns per instruction
Program memory	Min. 1 MB
Data memory	Min. 512 kB
Clock	Real-time clock (RTC) with battery backup NTP synchronization
MTBF	Min. 50 000 h
Communication interfaces	Min. 2 x Ethernet (10/100/1000 Mbps)

	Min. 1 x RS-485 / RS-232 Capability to expand with additional communication modules Adapters enabling direct connection to a fiber optic ring
Protokoły komunikacyjne	OPC UA Profinet Modbus TCP Support for communication redundancy (PRP/MRP)
Redundancy CPU	PLC controllers shall operate in a redundant architecture ensuring full continuity of operation. Support for dual CPU units in a Hot Standby configuration or equivalent is required. Switching between redundant units shall occur automatically, without data loss or process interruption. Control software and process data shall be synchronized in real time between the active and standby units. Redundancy operation shall be verified during FAT and SAT tests.
Power supply	24 VDC +/- 10% Short-circuit and reverse polarity protection Power supply fault indication Share your opinion on the BizChat program
Environmental conditions	Operating temperature: -20 to 50 °C Humidity: up to 95% non-condensing Vibration resistance: > 1 g (5-150 Hz) Shock resistance: > 15 g / 11 ms
Certificates	The controller must have CE declaration UL/cUL or equivalent certification Approved for use in industrial automation
Others	Restart time below 10 seconds Automatic restoration of configuration after restart (from non-volatile memory) Built-in diagnostic functions for CPU, I/O modules, and communication

	Memory card slots for program backup
Warranty	Minimum 24 months
Technical support	Availability of spare parts for a minimum of 10 years Availability of firmware updates Capability for remote service

PLC controllers and expansion I/O stations shall be equipped with an adequate number of digital and analog input/output modules to handle all process signals, with a minimum margin of 20% spare channels of each type (digital and analog) for future expansion.

Digital inputs and outputs shall be galvanically isolated from process equipment by means of interposing relays. Analog signals shall be protected against overvoltage.

4.2 HMI PANELS

Local HMI panels shall be installed on the front of the control cabinets, enabling the following operations at the local level:

- editing of process parameters and setpoints (e.g. pumping station, substrate storage),
- switching the operating mode of process equipment: manual / automatic / off,
- monitoring of the technological process of a given area.

4.3 SCADA servers

Preferred SCADA system: WinCC OA, WinCC UA

Minimum hardware requirements:

Parameter	Specification (minimum requirements)
Producent	• Approved manufacturers: DELL, HP

Redundancy	• Redundant servers
Enclosure	• Rack enclosure with capacity to install a minimum of 10 x 2.5" drives • Servers must be suitable for installation in a 19-inch rack cabinet. • A set of sliding rails enabling installation in a rack cabinet and extension of the server for service purposes. • Cable management arm facilitating the extension of the server for maintenance purposes.
Motherboard	• Motherboard with support for installation of a single processor • Support for processors with a minimum of 16 core
Chipset	• Processor dedicated by the manufacturer for use in dual-processor servers
Processor	• 1 x Intel® Xeon® Gold 5415+ 2.9 GHz processor installed, 8 cores / 16 threads, or equivalent with no worse parameters: 16 GT/s, 22.5 MB cache, Turbo Boost, Hyper-Threading (150 W), DDR5-4400, dedicated for use with the proposed server.
RAM	• Minimum 64 GB RDIMM, 4800 MT/s, Single Rank, configured using 16 GB memory modules
RAM features Memory features	• ADDDC or equivalent • Mirrored Memory. • Advanced ECC.
PCI slots	• Minimum 2 PCIe Gen5 slots and 1 OCP 3.0 slot
RAID controller	• Hardware disk controller with the following features: - minimum 4 GB of non-volatile cache memory - capability to configure RAID levels: 0, 1, 5, 6, 10, 50, 60 - support for drives: SAS, SATA, NVMe - Support for self-encrypting drives
Hard drives	• Installed: • 2 x SATA SSD drives with a minimum capacity of 480 GB, Read Intensive, 6 Gbps, Hot-Plug
Network / FC / SAS interfaces	• Minimum 4 x 1 Gb Base-T ports
Database compatibility	• Database compatibility: • SQL Server 2019 Datacenter, Standard, Enterprise • ExpressSQL Server 2022 Standard, Enterprise

Built-in ports	• Minimum 3 x USB ports, including at least 1 x USB 3.0. • Min. 1 VGA.
Video	• Integrated graphics card capable of displaying a minimum resolution of 1920 x 120
Power supplies	• Redundantne, Hot-Plug Fully Redundant(1+1), min. 700W klasy Titanium.
Mounting components	• A set of sliding rails enabling installation in a rack cabinet and extension of the server for maintenance purposes • Cable management arm facilitating the extension of the server for maintenance purposes
Security	• Top cover latch and a key lock to protect against unauthorized access to hard drives • Ability to disable accidental power button activation via BIOS/UEFI settings • Integrated chassis intrusion detection sensor cooperating with BIOS and the management controller. • TPM 2.0 module • The server must be equipped with a solution ensuring protection of firmware against malicious tampering. This protection must comply with NIST SP 800-147B and NIST SP 800-155 guidelines. Additionally, the Purchaser requires that the supplied server include hardware-implemented cryptographic mechanisms ensuring the integrity of BIOS firmware (Root of Trust).
• Independent of the operating system installed on the server, equipped with a dedicated Gigabit Ethernet RJ-45 port, and enabling: • remote access to the graphical web interface of the management controller • remote monitoring and reporting of the server status (including fan speeds,	
server configuration)	
• secure TLS-encrypted connection with user authentication and authorization • capability to mount remote virtual drives • virtual console providing access to mouse and keyboard • support for IPv6 • support for SNMP, IPMI 2.0, SSH, and Redfish, with the capability to	

Management	
	remotely configure power consumption limits for an individual server controller
	- integration with Active Directory - capability for simultaneous access by two administrators - support for dynamic DNS • sending email notifications to the administrator about failures or hardware configuration changes - capability for direct management via a dedicated USB port on the front panel of the server - capability for real-time remote monitoring of the server's power consumption

Certificates	• The server must be manufactured in accordance with ISO 9001:2015, ISO 50001, or ISO 14001 standards. • The server must have a CE declaration. • The offered products must include information regarding reuse and recycling and must not contain paints or coatings on large plastic parts that cannot be recycled or reused. All products containing electronic components and hazardous materials shall be safely and easily identifiable and removable. Compliance with the above requirement shall be confirmed by a printout from the website www.epeat.net demonstrating compliance with at least the EPEAT Bronze standard in accordance with the standard introduced in 2019. The Contractor shall submit a document confirming compliance with the above requirement. • The offered server must be listed in the Windows Server Catalog and have the status “Certified for Windows” for Microsoft Windows Server 2019 and Microsoft Windows Server 2022.
User documentation	• The Purchaser requires documentation in Polish or English.

Warranty terms	• The Purchaser requires a Manufacturer's warranty for the implemented technology for a period of 5 years. • The Purchaser requires warranty service to be provided by the manufacturer's local support, available in, among others, the following countries: Poland, Czech Republic, Lithuania, Germany, Austria. • The Purchaser expects the possibility to report service incidents on a 24/7/365 basis via the following channels: by phone and through a web portal. • The Purchaser requires the possibility to extend the manufacturer's warranty up to 7 years. • Capability to extend the manufacturer's warranty with on-site hardware diagnostics service in the event of a failure. Service characteristics: • Upon arrival at the Purchaser's site, the service engineer shall proceed to resolve the issue. If additional diagnostic support or spare parts are required to resolve the problem, the service engineer may, on behalf of the Purchaser, contact the manufacturer to obtain the necessary assistance. • On-site response at the Purchaser's premises shall be provided within a time period consistent with the response time of the response time assigned to the device covered by the purchased service agreement, • The service engineer should, for the purpose of verifying the service request, establishing a schedule, and confirming all information necessary to carry out the on-site technician visit, • If, during the initial troubleshooting process at the site of the failure, it is determined that a component is required to perform the service, the on-site service engineer shall order the necessary part and submit an additional request to the technical support department. The on-site technician shall return to the Purchaser's premises to replace the supplied part within the response time specified in the service agreement for the purchased product. • A Manufacturer's statement confirming that servicing of the equipment will be performed directly by the Manufacturer shall be provided after FAT acceptance. • The service provider must hold ISO 9001:2015 and ISO 27001 certifications for the provision of service activities - supporting documents shall be attached to the offer.
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• Minimum software requirements

The operating system and SCADA software shall comply with current standards and be supported by the manufacturer. The servers, together with the Windows Server software, shall remain within the manufacturer's active support lifecycle for the duration of the warranty period. Compatibility with operating systems:

- Microsoft Windows 10 SAC (Professional, Enterprise, IoT Enterprise) (64 bit);
- Microsoft Windows 11 SAC (Professional, Enterprise, IoT Enterprise);
- Microsoft Windows 2019 Server LTSC (Standard - Desktop Experience; Data Center - Desktop Experience; Essential - Desktop Experience; IoT - Desktop Experience) (64 bit);
- Microsoft Windows 2022 Server LTSC (Standard - Desktop Experience; Data Center - Desktop Experience; IoT - Desktop Experience) (64 bit);

Capability to be installed on both physical and virtual platforms (e.g. VMware, Hyper-V).

Compatibility with virtualization systems:

- Microsoft Hyper-V: w oparciu o wersję systemu Windows
- vSphere 8.0.

4.4 Engineering Workstation

Configuration of the engineering workstation on the server enabling modification, diagnostics, and upgrades. The engineering workstation shall be configured taking into account the current hardware used to build the control system.

The engineering workstation shall be equipped with the following:

- a complete set of PLC/HMI/SCADA software source codes with the capability for modification, diagnostics, and further development
- appropriate perpetual licenses, including licenses allowing programming activities for future system expansion
- final backup of PLC/HMI/SCADA systems and a disaster recovery procedure

4.5 Rack cabinet

- 19-inch rack cabinet with ventilation
- Air conditioner

4.6 Operator stations

- min. 2 units per location, including Windows 11 LTSC or IoT LTSC software
- **Operator workstations equipped with two monitors of at least 24 inches**
- **At least one of the operator workstations at a given location should be capable of connecting two additional monitors, enabling visualization of the production process, each with a minimum size of 55 inches.**

4.7 Industrial network

The industrial fiber-optic OT network must ensure deterministic, secure, and resilient communication for automation devices—PLC and DCS controllers, I/O systems, HMI, SCADA, measurement devices, and safety systems. The use of managed switches is required to enable the separation of appropriate VLAN networks in accordance with the requirements. The managed switches will serve as access points enabling data exchange—via the main technological fiber-optic ring—between local devices (HMI panels, power quality analyzers) and the PLC controller and SCADA system.

The system must support the simultaneous use of multiple protocols within a single SCADA instance. Support for communication standards typical for industrial automation is required:

Profinet

Modbus TCP

Modbus RTU

EtherNet/IP

OPC UA

REST API

For Ethernet connections inside control cabinets, copper FTP category 5e cables should be used. For Ethernet connections with devices outside the cabinet, FTP category 6 cables suitable for outdoor use should be applied. Network devices must be adapted to the environmental conditions of a biogas plant (e.g., resistance to dust, humidity, and vibrations).

Networks between vendor systems—covering the biogas section, biogas upgrading, and the weighing system—should be separated, for example by using a coupler.

4.8 Power supply

- 24 VDC power continuity

Redundant 24 V DC UPS power supply for each control cabinet

In Ex zones, use 24 V DC power supplies suitable for hazardous (Ex) areas

Use a phase sequence monitoring device to protect equipment operation

4.9 Inverters (VFDs / frequency converters)

Inverters equipped with network communication (e.g., Profinet, Modbus TCP, EtherNet/IP). Industrial-grade design for heavy-duty operating conditions (HD/ND), with full capability to read operating parameters (current, voltage, frequency, torque, power, temperature), statuses, error codes, and alarms over the network. A function for detecting and diagnosing torque loss (torque break) or low torque (under-torque) is required. Parameters and diagnostics must be available in the form of Profinet

telegrams or Modbus registers. The inverters must support an overload capacity of at least 150% in HD mode and include complete documentation for communication and error handling.

4.10 Electrical cabinet

Explosion-hazard-area measurement signal circuits must be isolated using dedicated intrinsically safe isolators.

Analog signals must be protected against the effects of surges by using surge protection devices.

A document pocket for electrical schematics of the switchboards should be installed on the inner side of the process cabinet doors.

Connection nozzles, measurement transmitters, cable trays, process pipelines, and metallic elements of the facility such as platforms and handrails must be connected to the building's equipotential bonding system. The grounding and equipotential bonding system shall be implemented in accordance with a separate electrical design.

Grounding and equipotential bonding for handrails and platforms shall also be implemented according to a separate electrical design.

5. PLC and SCADA Programming Requirements

5.1 General requirements for automation

The detailed design must ensure:

full control and monitoring of fermentation processes

full control and monitoring of substrate feeding

supervision of gas safety

automatic control of technological lines

- recording and archiving of process data
- integration of all equipment manufacturers into a single supervisory system
- full redundancy for critical processes
- implementation of technological safeguards and critical alarms
- local control from HMI panels
- archiving of emergency states and controller errors
- capability to operate in automatic, semi-automatic, and manual modes

5.2 Software requirements

The control software must be developed in the manufacturer's programming environment for the controllers (e.g., Siemens TIA Portal, etc.).

The program must be clear, modular, and documented with comments—each function block, variable, and program section must be uniquely named and described.

The control logic should be based on structured functional blocks, allowing for easy modifications and maintenance.

The code must include diagnostics for communication errors, module failures, abnormal input/output states, and the status of inverters and other measurement devices.

5.3 Control algorithms and key control functions

The design must define the control logic and algorithms for:

Fermentation and mixing

- control of mixers (time-based, power-based, frequency-based, and cycle-based)
- maintenance of optimal fermentation temperature (PID control)
- monitoring of fermentation mass levels in fermentation and post-fermentation tanks
- monitoring of pressure in fermentation and post-fermentation tanks

Control of the SOFT-START system and emergency scenarios for fermentation tanks

- procedures for the “slow start-up of fermentation tanks”
- emergency sequences (e.g., loss of heating, loss of mixing)
- automatic protection against overgassing

Biogas technology

- control of desulfurization processes (chemical, biological, and activated carbon)
- automatic regeneration of sorbents (if applicable)
- control of biogas compressors and blowers
- automatic dewatering and drying

Biogas upgrading to biomethane

- bypass and recirculation logic

Safety Instrumented System (SIS)

- methane detection
- H₂S detection
- detection of CO and O₂
- activation of quick shut-off valves
- emergency procedure for diverting gas to the flare system
- automatic facility shutdown

Biogas flare system

- ignition control
- flame monitoring
- explosion protection measures
- control of bypasses and shut-off valves

5.4 Program structure

- division into blocks (FB/FC/OB)
- naming standards
- comments and description of logic
- lists of alarms and parameters

5.5 Code quality standards

- no unused variables
- robustness against signal errors
- handling of extreme and erroneous values
- event logging

6. SCADA and HMI Requirements

6.1 Scope of visualization

Development and design—carried out jointly with the Client’s team—of ergonomic, clear, and ISA-101-compliant visualization screens for operator workstations. The scope includes preparation of synoptic screens and operator interfaces that accurately reflect the biogas plant’s technological processes, including equipment structure, media flows, operating parameters, and the alarm signaling system, for the following technological areas:

- Fermentation tanks
- Post-fermentation tanks
- Upgrading (biogas upgrading / purification)
- Biogas network
- Flare
- Heat management
- Substrates and feeding system
- Gas detection system
- Electrical energy sources (cogeneration units, backup generator, transformer)

6.2 SCADA functions

- full trending of all process parameters
- monitoring of critical parameters
- continuous archiving for a minimum of 12 months
- synchronization of archived data with the central system
- alarm hierarchy (A1/A2/A3)
- daily and weekly reports
- production reports: biomethane, CO₂, bioLNG, bioLCO?

- logging of technological events
- interlock and blocking logic
- integration with higher-level systems (MES/BMS/ERP)
- integration with other systems (Historian, CMMS, PI System)
- integration with other disciplines (sanitary systems, BMS, fire protection systems)

6.3 Access and user management

- The system shall be based on a multi-level role and permission model (RBAC), with the ability to assign different access levels for local and central users.
- support for multiple user accounts with the ability to define roles (e.g., operator, automation engineer, administrator, service)
- user authentication via login and password, with the possibility of integration with Active Directory
- user activity logging (audit trail) with date, time, and description of actions
- the ability to manage user accounts centrally or locally (depending on the access level)
- web-based access to the current list of licenses, including their usage status, with the ability to manage them
- reservation of licenses for a specific user/device

6.4 System operating modes

The SCADA system must include schedules for substrate dosing, circulation of fermentation mass and post-fermentation mass, as well as discharge of post-fermentation mass, depending on the installation's technical capabilities, in the following modes:

automatic
semi-automatic
manual

Automatic mode

In automatic mode, all devices (pumps, valves, mixers, etc.) start up automatically.

- Automatic mode allows for dosing of substrate, circulation of fermentation mass and post-fermentation mass in 24 cycles per day, in accordance with the quantities forecast in the 24-hour dosing schedule.
- Mixers should start before dosing, operate during dosing, and continue operating after dosing. The start time of the mixers before dosing and the shutdown time after dosing must be adjustable and configurable in minutes (both before and after dosing).
- Additionally, it should be possible to configure the operation time between dosing cycles: the number of cycles and the mixer operating time.
- Scheduling / cycle setup: the first dose is defined in Mg or m³ for the first dosing cycle and is then replicated for the remaining 23 dosing cycles. It should be possible to adjust the substrate dosing amount for any individual cycle (e.g., the first...). dose and the subsequent 23 cycles are set to 10

Mg, and then it should be possible to change the dose in cycle 11 to 15 Mg and in cycle 20 to 12 Mg).

- If the schedule is defined at 8:00 and then modified at 14:30 by changing the first dose, the system should treat this change as a new schedule for the next 24 hours.
Przekaż swoją opinię na temat programu BizChat
- In automatic mode, all safety protections, alarms, and related functions must remain fully active and operational.

Semi-automatic mode

- Semi-automatic mode allows for single dosing of substrate at any time, with automatic opening of the process path/sequence of device operation from facility A to B, after which the system returns to automatic mode and continues dosing according to the established schedule.
- In semi-automatic mode, all safety protections, alarms, and related functions must remain fully active and operational.

Manual mode

- In manual mode, all devices (pumps, valves, mixers, etc.) as well as the amount of substrate dosing are operated manually. Opening of process paths and the sequence of device operation are performed manually.
- Operation in manual mode allows all devices to operate despite active alarms indicating exceeded threshold values.
- Operation in manual mode should be indicated on all SCADA screens.
- There should be an option on each screen to switch from manual mode back to automatic mode. Switching to manual mode requires additional authentication (login).

6.5 Alarm and event handling

- configurable alarm thresholds: HI, HIHI, LO, LOLO with assigned priority levels
- local alarms, with the capability to be transmitted to a central system
- ability to acknowledge alarms, add comments, and escalate alarms
- logging of all alarms and events in a database with the ability to search and filter
- alarm notifications via e-mail, SMS, or other communication channels
- creation of statistical alarm reports (quantitative, time-based, and source-based)

6.6 Reporting

- operational reports: substrate consumption, production of biogas, biomethane, CO₂, bioLNG, bioLCO₂, and generation of electrical and thermal energy
- generation of time-based charts and historical analyses (operating parameters, alarm values, KPIs)
- export of data to PDF, Excel, and CSV formats
- ability to use ActiveX and .NET controls (including those from third-party vendors)
- A library of advanced, configurable graphical objects available as part of a software license, commonly used in industry.
- The ability to create libraries of graphical objects that can then be reused across multiple projects.
- The ability to design an application layout using ready-made components without the need for scripting.
- A wizard for designing and configuring multi-monitor visualizations for screens of different resolutions within a single multi-monitor application.
- Support for multi-touch functionality and gestures (panning, rotating, zooming) on touch screens.
- Built-in responsiveness of the visualization application - automatic adjustment of the visualization window layout depending on the screen resolution of the device on which the visualization is launched.
- Browsing synoptic screens refreshed based on historical data, with the ability to select a time range and playback speed.
- The ability to migrate older versions of visualizations or individual graphical objects to the latest versions.
- The ability to upgrade the license to higher licensing tiers.
- Scalable vector graphics.
- An advanced tool for creating graphics.

6.7 Data analysis

- The ability to create charts/trends:
 - Plotting historical trends of one or multiple variables with the ability to:
 - Selection of any time range
 - Using predefined time ranges
 - Selection of a specific data retrieval mode: Cyclic, Delta, etc.
 - Plotting real-time trends of one or multiple variables with the ability to:
 - Defining the refresh rate
 - Modifying trace (pen) colors
 - The ability to save chart templates.
-

Appendix 5

- The ability to manipulate chart scales, including: auto-scaling for all Plotted parameters, with the ability to individually adjust scales, shift the chart up/down, and display plotted variables in a stacked view (one below another).
- ~~• The ability to open multiple program windows simultaneously with different charts.~~
- X and Y cursors enabling the reading of values and differences of a variable directly from the

chart.

- The ability to add annotations to charts (stored in an industrial database) and use them for subsequent reporting.
- A user interface of a program enabling the creation of reports in tabular form.
- An add-in menu extending the functionality of Microsoft Excel, enabling:
 - Retrieving current and historical data (from any selected time period) into a worksheet.
 - The ability to embed direct database queries within a worksheet.
 - Performing time-based, X-Y, and dependency (correlation) analyses between different analog parameters, as well as between analog and digital (binary) parameters.
- A web-based data analysis tool available through a web browser.
- The ability to define charts based on selected variables.
- The ability to define which parameters are displayed on the chart (including the option to show or hide individual trend lines).
- Compatibility with web browsers supporting HTML5.
- The ability to change the chart type.
- The ability to export data to CSV files.
- The ability to configure encrypted access to data.

6.8 Zdalny dostęp

- Zapewnienie pełnej funkcjonalności systemu wizualizacyjnego dostępna zdalnie.
- Dostęp z poziomu przeglądarki internetowej obsługującej HTML5 lub przez RDP.
- Dostęp do aplikacji wizualizacyjnej z poziomu urządzenia mobilnego (Android, iOS).
- Komunikacja internetowa za pomocą szyfrowanej komunikacji HTTPS.
- Automatyczne dostosowywanie wielkości aplikacji do rozdzielczości ekranu.

6.9 Requirements regarding integration with other IT/OT systems

- The ability to integrate with CMMS (e.g., automatic service requests based on alarms or operating hours).
- The ability to integrate with a weighing system and substrate delivery tracking.
- The ability to integrate with a Historian database (e.g., OSIsoft PI System) or other analytical tools.
- Support for standard communication protocols: OPC UA/DA, MQTT, Modbus TCP, REST API.

6.10 Requirements for an industrial database.

- Automatic collection of data from various sources using OPC DA/UA and DDE protocols.
- Support for logging up to 1,000 events/alarms per second.
- Automatic data collection in two modes:

- cyclically, i.e., at fixed time intervals, e.g., every 1 second
- event-based (delta), i.e., values are written to the database when they change, with the ability to define a deadband (insensitivity range)
- modes can be individually defined for each parameter whose values are being archived
- the data collection system should support high availability for users by:
 - redundancy mechanism - switching to a backup database server to enable client tools to read data from an alternative server without requiring reconfiguration
 - data replication mechanism to enable building systems with a hierarchical structure of multiple database servers
 - availability of system functions that enhance performance (e.g., mechanisms accelerating data write operations to disk and more efficient compression of stored data)
 - redundancy mechanism - switching to a backup data provider (e.g., a backup communication driver for controllers)
- mechanism for local data collection in the event of loss of remote connection from the Computer with the main database server, and their transfer once the connection is restored upon restoration of the connection
- importing data from .CSV text files, manually created, e.g., based on manual measurements
- fast and efficient system operation — recording and providing access to data with an accuracy of up to 1 ms
- scalability of the database system enabling logging of up to 100,000 variables at a rate of 100,000 variables per second
- definition of automatically calculated summaries, i.e., calculation of values such as arithmetic averages, sums, maximums, and minimums over any time interval (minutes, hours, weeks, months, years, etc.)
- tracking exceedances of defined values (e.g., alarm thresholds) and executing predefined actions, such as launching a program or performing SQL queries
- support for recording in the database server using double-precision floating-point format (64-bit)
- collection of values of selected variables at the moment when another variable exceeds a defined threshold
- the system should be a relational database system, enabling fast and open access to data for external client applications
- the system should provide access to data using SQL queries
- the system should allow data from different systems to be written to disk without requiring time synchronization between those systems (e.g., across different time zones)
- the server can be configured, monitored, started, and stopped locally or remotely (via a TCP/IP network)
- the console enables management of multiple servers from a single location
- changes to the system configuration must be performed while the server is running, without stopping

it and without affecting ongoing data collection and storage

- the database provides a range of tools for importing/exporting its configuration, including the configuration of archived variables
- ability to operate in a virtualized environment supporting HA/FT (High Availability / Fault Tolerance) functionalities

6.11 Other functions

- mobile access to process visualization (application for smartphone/tablet)
- possibility of integration with CCTV systems for monitoring and security purposes
- support for predictive algorithms (e.g., failure prediction based on trends)
- openness to future system expansion (e.g., additional biogas plants, new technological lines, or additional data sources)

6.12 Technological compliance

- all components (hardware and software) must be sourced from manufacturers that provide technical support and guarantee a lifecycle of at least 5 years
- all SCADA systems must be based on the same technological platform (the same SCADA software family, compatible version), enabling standardization and centralized management
- the user interface language must be Polish and provide multilingual functionality within graphical objects and alarm messages

6.13 Archiving and backup

- process data must be continuously archived with the capability to store at least 12 months of online data and 5 years of historical archive (e.g., on external storage media specified by the Client)
- automatic backup mechanisms must be implemented for system configuration, database, and user settings

6.14 Availability and reliability

- the system should ensure a minimum availability level of 99.9% (on a monthly basis)
- critical system components (e.g., servers, PLCs) must be protected by redundancy solutions

7. COMMUNICATION REQUIREMENTS AND NETWORK ARCHITECTURE

The detailed design must include:

- control network topology (ring + dual ring in critical zones)
 - list of communication devices and their protocols
-
- definition of addressing scheme and tag naming conventions

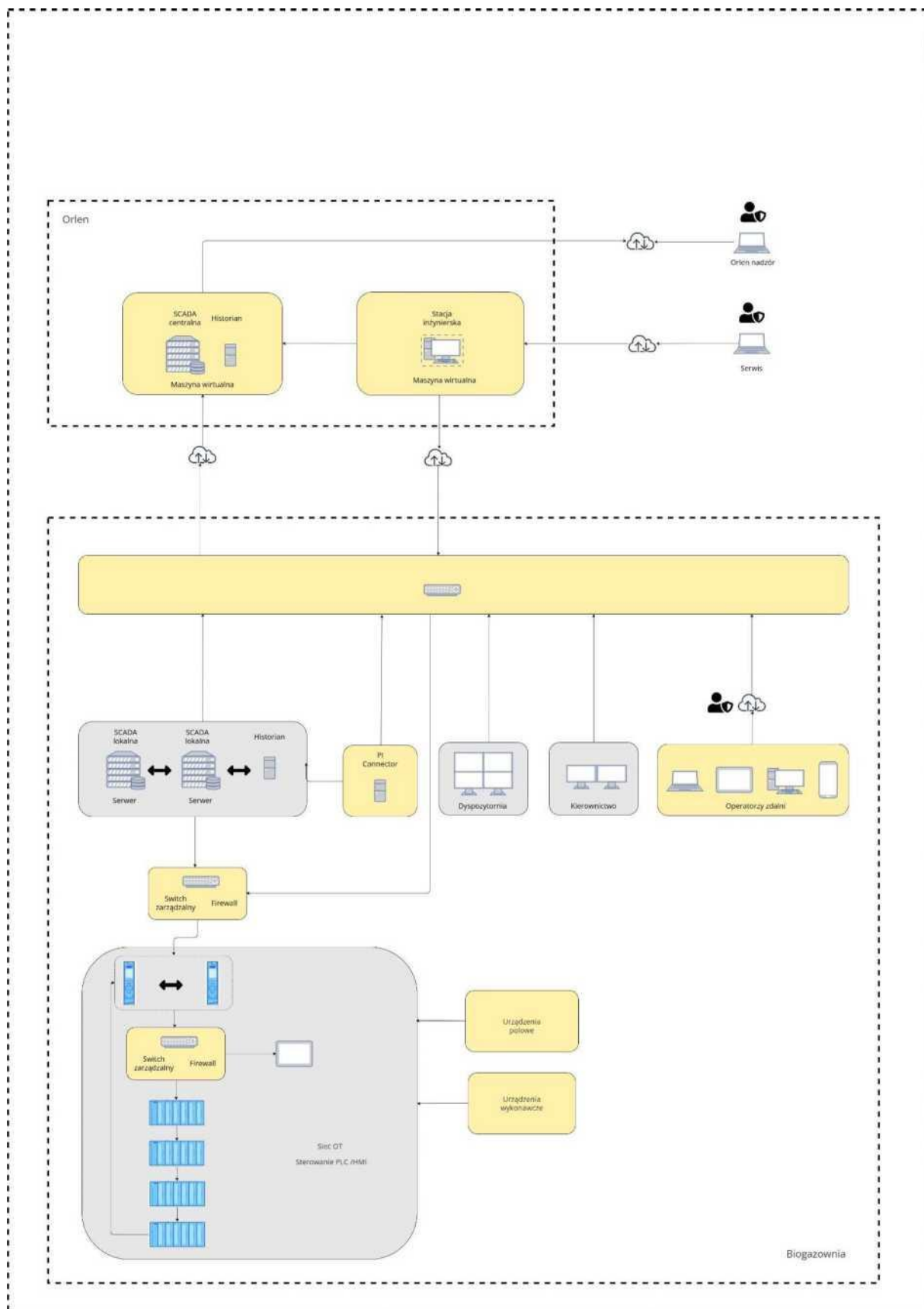
- connection redundancy (PRP/HSR/MRP)
- separation of the process network from the investor's IT network
- industrial firewalls
- cybersecurity policy (in accordance with PN-EN IEC 62443)
- the investor's IT policy

7.1 Solution architecture

- The SCADA system shall be designed in a two-level architecture: a local SCADA system at the biogas/biomethane plant and a central supervisory system at the Client's headquarters.
- object-oriented system structure—facilitating work for users, administrators, and application developers, including inheritance mechanisms, etc.
- the application project is stored in a single location, rather than on individual workstations
- high reliability and the use of modern IT virtualization technologies — support for the most popular environments, e.g., Microsoft Hyper-V, VMware
- built-in mechanisms supporting distributed systems
 - ability to communicate and exchange information between two independently operating systems
 - communication redundancy with control devices (both within a single computer and between computers)
 - built-in mechanism for local buffering of historical data (Store & Forward or equivalent)
 - application logic and data processing redundancy mechanism
- possibility to diagnose and archive the operation of all computers within the system from a single workstation
- ability to perform version updates and functional upgrades of the system without stopping the operation of control logic and process visualization
- a single engineering tool for developing the entire application, regardless of its size
- possibility to distribute the application across any number of machines (flexibility in transferring objects and managing application operation within a distributed network)
- archiving of historical information related to alarms and events
- the ability to introduce time delays in the visualization of generated alarms and events, as well as to suppress alarm notifications for specific system operating states
- the ability to use mechanisms for automatic variable addressing within the HMI/SCADA system
- object-oriented graphics — graphical symbols available in the application as separate objects, with the ability to easily distribute them between applications by exporting/importing individual objects or entire libraries
- ability to create advanced graphics through multi-level embedding of graphical objects within other graphics
- graphical objects can be linked to logical objects representing actual machines and devices
- graphical objects can be linked to logical objects representing actual machines and devices

- scalability of the application and ease of expansion during system operation
- ability to operate in a client/server mode for OPC DA/UA protocols
- the software supports communication via the MQTT protocol in reverse connect mode

Example solution architecture for the contractor responsible for a given part of the project:



8. Cybersecurity

8.1 System security

- implementation of cybersecurity practices in line with best practices (including data transmission encryption, user authentication, RBAC) and internal OT cybersecurity standards within ORLEN

Group

- User access control:
 - ability to create and manage user accounts with different permission levels (e.g., operator, service technician, administrator)
 - authorization based on roles (RBAC) or an equivalent system
 - enforcement of password policies in accordance with the Client's security requirements (minimum length, complexity, validity period)
- Protection against unauthorized access:
 - blocking of ports and communication interfaces not used in the system
 - ability to restrict access to the PLC controller from specific IP addresses (so-called whitelisting)
 - encryption of communication in network protocols (TLS 1.2 or newer, SSH, HTTPS)
- protection of the integrity of the controller program
 - capability to sign and verify the integrity of the PLC program
 - write protection mechanism and control of configuration changes
 - logging of unauthorized access attempts in the event log (audit log)
- Backups and system recovery:
 - regular automatic creation of backups of configuration and operational data
 - automatic creation of backups of PLC configuration and program in non-volatile memory
- PLC software updates
 - the ability to securely update the PLC controller firmware from an authorized source
 - ensuring access to security updates from the manufacturer for a minimum period of 5 years
- hardware and software redundancy ensuring continuity of system operation
- monitoring and logging of security events

8.2 OT cybersecurity configuration

- ensuring mechanisms for data archiving and centralized reporting
- configuration of user accounts and access authorization systems in accordance with IT/OT security requirements
- ensuring a secure connection between the headquarters and biogas plants (VPN configuration and the dedicated network are the responsibility of the Client)
- All system components must comply with IT/OT security requirements:
 - role-based access control (RBAC)
 - communication encryption (TLS 1.2)
 - event logging mechanisms (audit trail)
 - protection against unauthorized modifications
 - support for security updates
 - internal cybersecurity guidelines of the ORLEN Group

- The Contractor is required to develop a security policy and implement the necessary protective measures.
- The software manufacturer tests its products systematically and regularly for compatibility with Windows updates published in the Microsoft Security Bulletin.
- The software manufacturer provides users with reports on product compatibility testing with Windows updates, along with appropriate recommendations aimed at improving the security level of the application.
- The level of detail of the reports refers to specific versions of the Windows operating system and specific versions of the tested products.
- The software manufacturer systematically develops and publishes its own security bulletins, containing recommendations regarding the implementation of software patches or changes in application configuration.
- The software manufacturer develops and provides software updates that enhance the security of the application.
- the manufacturer should hold an SDLA (Security Development Lifecycle Assurance) certificate, version 3.0 or later

9. CABLE REQUIREMENTS

9.1 Power supply and cabling

- Power supply: 400 V AC / 230 V AC / 24 V DC
- Switchboards and control cabinets
- UPS and backup power supply systems
- Cable routing
- Shielding and grounding
- separation of signal and power cables

9.2 Installation and assembly guidelines

- method of installation of equipment (control cabinets, field devices, junction boxes)
- environmental operating conditions for equipment (IP rating, ATEX compliance, temperature, vibrations)
- Minimal installation heights
- Cable routing rules
- Rules for introducing cables into the cabinet

10. Electrical energy balance

To ensure the correct selection of connection/contracted power, protections, and conductor cross-sections, as well as to limit the costs of ordered power and fees for exceeding it, the contractor shall prepare an electrical power and energy balance for the entire facility and the group of facilities, including:

- List of loads and functional groups
- Division into categories/classes of load importance (critical / priority / comfort / other)
- Simultaneity (and/or diversity) factors at the load, group, and switchboard levels, adopted based on developed operation schedules (cyclograms) of electrically powered equipment
- Determination of peak power, contracted power, and electrical energy [kWh] in

daily/monthly/annual intervals, based on developed operation schedules (cyclograms) of electrically powered equipment

- Assumptions and design of the Power Guard: algorithm, thresholds, load-shedding priorities, interfaces, tests

11. DRAWINGS SECTION OF THE DETAILED DESIGN

11.1 Functional P&ID diagrams

- Instrument designation
- Signal lines

11.2 schematic diagrams (control and instrumentation)

- Control system diagrams
- 24 VDC power supply diagrams
- Relay and protection diagrams
- Safety system diagrams
- Gas detection system diagrams

11.3 Control cabinet drawings

- Plans and elevations (views)
- Electrical schematics
- Equipment layout
- Marking of internal equipment
- Descriptions of components
- Terminal block and signal terminal schematics
- Power and cooling balance
- Cable trays, grounding, 24 V DC power supply, UPS

11.4 Field equipment layout

- Installation plans
- Sensor and flowmeter locations
- Location of junction boxes
- Cable routes (routes, trays, conduits)
- List of equipment in ATEX zones
- Installation requirements (service access, mounting heights)

12. Lists and tabular summaries

12.1 Signal list - I/O list

Broken down into:

- digital inputs/outputs
- analog inputs/outputs
- communication signals
- safety signals
- external signals to other systems

Each signal should include the following columns:

- Tag
- Description
- Signal type
- Measurement range
- Unit
- PLC address
- SCADA address
- Notes

12.2 Equipment specification

- Name
 - Type
 - Manufacturer
 - Range
 - Accuracy class
 - Required ATEX/SIL/IP environmental rating
 - Medium
- Operating conditions

12.3 Cable schedule

- Cable number
- Measurement, power, telecommunications type
- Cross-section
- Length
- Route

- From-To
- Connectors and accessories
- Notes

12.4 Bill of materials (BoM)

- Equipment
- Accessories
- Mounting elements
- Cabinets and enclosures

13. Testing, FAT, SAT, Commissioning

13.1 FAT

- automation logic testing
- I/O signal simulation
- SCADA screen testing
- PLC program testing

13.2 SAT

- equipment testing
 - gas detector testing
 - ESD safety system testing
 - gas purification and gas quality testing
- integration tests with the gas network

13.3 Commissioning tests

- fast startup process
- fermentation stability testing
- gas balance testing
- PID controller optimization

14. As-built documentation, O&M manuals, instructions, certificates

After completion of the project, the Contractor shall provide a complete set of materials in both editable electronic format and PDF version, in the Polish language:

- up-to-date as-built documentation
- FAT/SAT reports

- ATEX/SIL/CE protocols
- electrical measurement protocols
- operation and maintenance manual for I&C (Instrumentation and Control) systems, including manufacturer documentation (DTR) for the installed components (if available in Polish, the Polish version should be provided)
- safety instructions
- user manual
- service manual

15. Requirements for documentation and source code handover

The Contractor is required to provide complete documentation and deliver the source code to ensure full control and enable further operation, development, and maintenance of the SCADA system, PLC controllers, and HMI panels by the Client.

15.1 Technical documentation for the SCADA and PLC system

- Detailed description of the SCADA system architecture, including block diagrams, network topologies, and device configurations.
- Functional description of all system modules and their interdependencies
- Specifications of communication protocols and interface configurations
- Instructions for installation, configuration, and software updates
- Security procedures and user management
- Documentation regarding backup, redundancy, and data recovery mechanisms

15.2 User documentation and operating instructions

- Clear and detailed operating instructions for system operators and administrators,
- Description of typical usage scenarios, alarm management, report generation, and data analysis.
- Training materials used during training, provided in electronic form
- FAQ and procedures for handling the most common issues,
- Screenshots

15.3 System configuration and parameter documentation

- Complete list and description of all tags, measurement points, and control points in the system,
- Detailed configurations of alarms, limits, rules, and control logic,
- Configurations of databases and process data archiving,
- List of utilized licenses and activation keys

15.4 Transfer of access rights and source codes for PLC programs and SCADA systems

- Transfer of the complete set of PLC/HMI/SCADA software source codes, including the ability to modify, diagnose, and further develop the system
- Transfer of copyrights or licenses allowing unrestricted use, modification, and further development of the software
- Source code documentation with descriptions of functions and modules
- Transfer of appropriate licenses into ownership, including licenses enabling programming work for future expansions
- Final PLC/HMI/SCADA backup and disaster recovery procedure
- Handover of as-built drawings in PDF format and in an editable source format (EPLAN, WSCAD)
- In the case of components supplied by third parties, provision of information on licenses and terms of use.

16. Training

The Contractor shall be required to conduct comprehensive training for various groups of users of the new SCADA system. The training must be delivered in a practical manner and tailored to the participants' level of knowledge and scope of responsibilities.

16.1 SCADA system operator training

The training should cover operation of the SCADA system in a production environment, including:

- navigation through the user interface,
- operation of visualization screens,
- interpretation of alarms, trends, and reports,
- basic procedures for responding to system events.

The training should be practical in nature, using either a test environment or the live system.

16.2 Training for administrators and technical staff

The authorized training for personnel responsible for the configuration and maintenance of the SCADA system should include:

- user management and permissions,
- configuration of alarms and measurement points,
- service and diagnostic procedures.

The training should be practical in nature, using a test environment.

16.3 Training for the IT department (maintenance and integration)

The authorized training should be intended for the IT team responsible for:

- system monitoring,
- maintenance of server and network infrastructure,

- integration with other systems (ERP, CMMS, PI System),
- management of communication (OPC UA, MQTT, etc.),
- configuration of backup and system recovery.

The training should also include information on cybersecurity principles in SCADA systems.

The training should be practical in nature, using a test environment.

17. Requirements for service and post-implementation support

The Contractor shall be required to provide technical support and servicing of the control system after the completion of implementation, ensuring stable and uninterrupted system operation during the operational period.

17.1 Warranty period and warranty conditions

- Minimum warranty period for the supplied software and hardware: 12 months from the date of final acceptance,
- The warranty should cover repair or replacement of defective components as well as correction of software errors,
- The warranty also covers the proper functioning of all features and integrations.

17.2 Service availability requirements (options/variability)

The Client allows the submission of alternative bids in the scope of service and technical support. The Contractor shall be required to present at least one service provision option.

Each option will be evaluated separately. The Client reserves the right to select the option that is most advantageous in terms of functionality and price.

17.3 Response and fault rectification time for the control system

Category	Maximum response time	Maximum time to restore operation / provide a workaround
Critical	1 hours	8 hours
High	1 hours	16 hours
Standard	8 hours	10 days

For lower-priority requests, these times may be longer, in accordance with the contractual arrangements agreed for a given request with the Client,

Critical	Total loss of communication with devices, no process visualization, no ability to control or generate alarms. No workaround available.
High	Partial loss of process data, delays in data acquisition, incorrect readings, unavailability of individual operator stations.
Standard	Other reports concerning errors and faults that do not affect business processes, as well as other user requests, e.g. (new measurement points, screen modifications, reports, etc.).

The Contractor should have procedures in place for reporting, escalation, and resolution of issues.

17.4 System update availability and development

Provision of access to software updates (fixes, security patches, new functionalities) during the warranty period and thereafter (under a service agreement),

Provision of documentation regarding new versions and changes during the term of the service agreement.

18. FORMAL AND REGULATORY REQUIREMENTS

The design should be carried out in accordance with:

- **IEC 61508 / IEC 61511** - Functional safety in the process industry
- **PN-EN 61131** - Programmable controllers
- **PN-EN 60204** - Electrical safety of machinery
- **PN-EN ISO 13849** - Machinery safety systems
- **PN-EN 60079** - Explosion-proof equipment
- **ISA-95** -Integration of automation systems and production management systems
- **ISA S5, ISA S88,**
- Investor guidelines
- Coordination with technological and electrical disciplines

Compliance with standards is a mandatory requirement for the approval of the system for operation.

19. Definitions and abbreviations

Abbreviation / Term	Definition / Description
CE / UL	Certificates of conformity confirming approval of equipment for industrial use in the EU (CE) and North America (UL).
CMMS	Computerized Maintenance Management System
CPU	Central Processing Unit
ERP	Enterprise Resource Planning
FAT	Factory Acceptance Test
HMI	Human Machine Interface
Historian	Real-time process data archiving system.
I/O	Input/Output
ISA	International Society of Automation
IEC	International Electrotechnical Commission
IEC 61508	Standard for the functional safety of electrical, electronic, and programmable systems (defines Safety Integrity Levels - SIL).
IEC 61511	Standard for functional safety of industrial automation systems in process industries (SIS - Safety Instrumented Systems), based on IEC 61508.

IEC 62443	Standard for cybersecurity of industrial automation systems (ICS/OT).
ISA-95	Standard describing the architecture of integration between production and business systems (MES-ERP).
IT/OT	Integration of IT systems with operational systems (OT - Operational Technology).
MBTF	Mean Time Between Failures - average time between failures; a measure of equipment reliability.
Modbus TCP	An open communication protocol used in automation systems for data exchange between devices.
MRP / PRP	Media/Parallel Redundancy Protocol - protocols ensuring redundancy of industrial networks.
NTP	Network Time Protocol - a protocol for time synchronization in a computer network.
OPC UA	Open Platform Communications - Unified Architecture - an industrial communication standard enabling data exchange between SCADA and PLC systems.
PLC	Programmable Logic Controller - a programmable logic controller, a device used to control technological processes.
Profinet	Industrial Ethernet communication standard used in automation (IEC 61158, IEC 61784)
Profibus	Process Field Bus - an industrial communication bus (predecessor to PROFINET).
RBAC	Role-Based Access Control - a user access management system based on roles.
SAT	Site Acceptance Test - acceptance tests conducted at the Client's installation site.
SCADA	Supervisory Control and Data Acquisition - a system for monitoring, visualization, and acquisition of process data.
SIL	Safety Integrity Level - a level of safety integrity defined by the IEC 61508 and IEC 61511 standards.
SSH	Secure Shell - a protocol for secure remote administration.

TLS	Transport Layer Security
VLAN	Virtual Local Area Network