

INVESTMENT PROJECT:
**"CONSTRUCTION OF A HEAT ACCUMULATOR AND PUMPING STATION AT EC-4 IN
ŁÓDŹ"**

PROCEDURE No.: 2024/0278/P/NP

TERMS OF REFERENCE (ToR):
PART I TOR – INSTRUCTIONS FOR CONTRACTORS (IC)
PART II TOR – DESCRIPTION OF THE SUBJECT OF THE CONTRACT
PART III TOR – CONTRACT TEMPLATE

The contract covered by the procedure concerns the project "Construction of a heat accumulator and pumping station at EC-4 in Łódź" to be implemented under the Operational Programme European Funds for Infrastructure, Climate, Environment 2021-2027, FENX.02.01 Heating infrastructure, Project type: District heating infrastructure.

PART II TOR – DESCRIPTION OF THE SUBJECT OF THE CONTRACT

PART II TOR – DESCRIPTION OF THE SUBJECT OF THE CONTRACT

1. Name given to the contract by the Employer

Task: Construction of a heat accumulator and pumping station at CHP Plant No. 4 (EC-4) in Łódź.

2. Address of the civil structure to which the functional and utility programme relates

Street: Andrzejewskiej 5;
City: Łódź;
Commune: Łódź;
Administrative district: Łódź;
Voivodeship: Łódzkie.

3. Names and codes from the Common Procurement Vocabulary in accordance with the scope of the contract

45111200-0 Site preparation and clearance works
45112330-7 Site-reclamation works
45210000-2 Building construction works
45220000-5 Engineering and construction works
45200000-7 Construction works
45200000-9 Works for complete or part construction and civil engineering works
45223100-7 Assembly of metal structures
45233140-2 Road works
45233220-7 Surface work for roads
45230000-8 Construction work for pipelines, communication and power lines, for highways, roads, airfields and railways; flatworks
45251000-1 Construction works for power plants and heating plants
45259900-6 Plant upgrade works
45310000-3 Electrical installation works
45330000-9 Plumbing and sanitary works
45331000-6 Heating, ventilation and air-conditioning installation works
45350000-5 Mechanical installations
45400000-1 Building completion works
45442200-9 Application work of anti-corrosive coatings
45442300-0 Surface-protection works
71220000-6 Architectural design services
71000000-8 Architectural, construction, engineering and inspection services
71240000-2 Architectural, engineering and planning services
71248000-8 Supervision of project and documentation

4. Name and address of the Employer

Veolia Energia Łódź S.A.
ul. Andrzejewskiej 5
90-975 Łódź

5. Information on the authors

Full name	E-mail
Jerzy Szeleszczyk	jerzy.szeleszczyk@veolia.com
Jacek Trębacz	jacek.trebacz@veolia.com
Sylwester Szymczak	sylwester.szymczak@veolia.com
Marcin Piotrowski	marcin.piotrowski@veolia.com
Krzysztof Augustyniak	krzysztof.augustyniak@veolia.com
Sebastian Pawlak	sebastian.pawlak@veolia.com
Dominik Sierszeń	dominik.sierszen@veolia.com
Jerzy Różycki	jerzy.rozycki@veolia.com
Łukasz Drażczyk	lukasz.drazczyk@veolia.com
Jakub Beczkowski	jakub.beczowski@veolia.com
Mateusz Skórka	mateusz.skorka@veolia.com
Dawid Gomola	dawid.gomola@veolia.com
Tomasz Chmiel	tomasz.chmiel@veolia.com

6. List of appendices

Appendix No.	Document No.	Document name
1	WHAL-PML-00xxx00-PER-LAY-0001, WHAL-PML-VLD-PER-0001	Zoning conditions
1a	WHAL-VLD-07xxx00-LAY-BAT-0001	Construction site
1b	WHAL-VLD-07xxx00-LAY-BAT-0005	Plan of existing and designed underground networks
2	WHAL-VLD-07xxx00-LAY-BAT-0003	The interfaces with existing installations
2b	WHAL-VLD-07xxx00-PMT-BAT-0001	Table of terminal points
3	WHAL-VLD-07NDx00-TPM-PFD-0001	Schematic diagram of the DH water system for the WHAL
3a	WHAL-VLD-80xxx00-TPM-PFD-0001	Schematic diagram of the DH water system
3b	WHAL-VLD-80xxx00-TPM-DTS-0001	Control table for the DH network
3c	WHAL-VLD-80xxx00-TPM-DTS-0002	DH network data 2022-2024
3d	WHAL-VLD-07NDx10-TPM-UFD-0001	WHAL operation scenarios
3e	WHAL-VLD-80xxx00-TPM-TED-0001	Description of DH network control
4	WHAL-VLD-00xxx00-PMT-LAY-0006	Other projects and Small Lots at EC-4

Appendix No.	Document No.	Document name
8	WHAL-VLD-07UND10-TEL-SLD-0001	Block diagram of telecommunications for the WHAL
10	WHAL-VLD-07xxx00-PMT-LAY-0001	Supply to the utilities and laydown areas for the implementation stage
11	-	Geological documentation
12	-	As-is technical documentation
13	WHAL-PBM-07NDx00-PER-DLI-0001 WHAL-PBM-07NDx00-PER-DLI-0002	Building Design
14	WHAL-ILF-04xxx00-HSE-REP-0001	Report on environmental noise measurements
15	C2GL-VLD-00xxx00-PMT-PRO-0020	KKS Book
15a	C2GL-VLD-00xxx00-PMT-PRO-0001 WHAL-VLD-00xxx00-PMT-NOT-0001	AODocs Document and Business Process Management Platform
16	WHAL-VLD-07NDE10-TPM-NOT-0001	Daily changes in the water level in the WHAL
17	WHAL-VLD-00xxx00-PMT-GUI-0001	Requirements regarding the colour scheme and appearance of the logotype
18	WHAL-VLD-07xxx00-PMT-SCH-0001	Preliminary time schedule

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I. DESCRIPTIVE PART

1. GENERAL DESCRIPTION OF THE SUBJECT OF THE CONTRACT

The Subject of the Contract to design and construct a complete Heat Accumulator (WHAL) system to be implemented on a turnkey basis at Combined Heat and Power Plant No. 4 (EC-4) in Łódź, located at ul. Andrzejewskiej 5.

The Subject of the Contract includes in its scope an integration of the WHAL system with the existing process system at EC-4, and the interconnection of all components of the WHAL system with the existing infrastructure of the plant, as well as the implementation of all works, supply and services necessary for the implementation of the project, within to the limits (terminal points) specified in section 1.1. in Chapter I of this document. Activities not specified in the area of the Contract, i.e. from the terminal points to the existing EC-4 infrastructure, will be implemented by the Employer as part of separate investment tasks.

The scope of Works related to the project consisting in the installation of the WHAL system includes the performance of all activities necessary for the proper implementation of the task, including:

- A. Developing complete project documentation in accordance with the Ordinance of the Minister of Development and Technology of 20 December 2021 on the detailed scope and form of project documentation, technical specifications for the performance and acceptance of construction works and the functional-utility programme, as amended, with possible exclusions of works from the list below;
- B. Developing a multi-discipline Basic Engineering Design;
- C. Obtaining all administrative decisions required by law for the preparation and implementation of the Subject of the Contract, except for the Environmental Decision, the Decision on Zoning Conditions and the Building Permit Decision (if it will not be necessary to provide the Replacement Design) as these decisions have been obtained by the Employer;
- D. Developing a complete Building Permit Design in accordance with the Ordinance of the Minister of Development of 11 September 2020 (if a Replacement Building Permit Design will be required);
- E. Developing multi-discipline Detailed Engineering Designs;
- F. Developing the Quality Control Plan and having it approved by the Employer (for the stage of equipment and component manufacture, installation, acceptance, cold and hot commissioning);
- G. Arranging the site back-up facilities and construction site;
- H. Carrying out all necessary stock-taking works on site, all necessary geotechnical / geological surveys or their update (among others, Soil Testing Documentation, Geological-Engineering Documentation, Geotechnical Designs), technical expert opinions on buildings, civil structures, existing systems that will be connected to the WHAL system;
- I. Carrying out all legally required obligations related to the commencement, conduct and completion of the works, including, among others, the appointment of the site manager, or the preparation / update of the Health and Safety Plan; providing functional persons with the appropriate licenses prescribed by Polish law (including construction, energy,

- etc.) at all stages of the project implementation (including design, implementation and acceptance);
- J. Preparing the welfare, office and workshop camp for the implementation of the project including: connection of utilities from the locations indicated by the Employer;
 - K. Preparing the construction site as well as the storage and workshop areas, and including the completion of all dismantling, switching, demolition operations in terms of underground and aboveground infrastructure, necessary for the implementation of correct, complete installation of the WHAL system. The existing pumps in the summer-period pumping station will be dismantled by the Employer;
 - L. Construction, erection and installation works for the implementation of the WHAL system, including all ancillary works;
 - M. Interconnecting the system with the infrastructure that is existing, designed and implemented by the Employer to the full extent of the given discipline;
 - N. Integrating valving and measurements implemented by the Employer in the inlet/outlet of pipelines to/from the DHN water pumping station of the WHAL with the HAS (Heat Accumulation System) control system;
 - O. Developing full commissioning documentation;
 - P. Developing full operational documentation, including the operating manual of the WHAL system (in combination with the existing EC-4 part);
 - Q. Developing and providing quality documentation, including declarations of conformity in accordance with EU directives and national regulations, standards;
 - R. Providing personnel training;
 - S. Disposing of all waste in accordance with the requirements of the law and providing the Employer with relevant documents (e.g. waste transfer sheets).
 - T. Starting up the WHAL system, participating in the commissioning of the system, trial run and tuning run as well as the process of system operation optimisation;
 - U. Developing full as-built documentation (including Red Corex) and providing the Employer with the required number of hard copies and an electronic version;
 - V. Providing provisional acceptance of the WHAL system;
 - W. Preparing full formal and legal documentation necessary to obtain an occupancy permit, including the submission of an application for an occupancy permit on behalf of the Employer and obtaining an occupancy permit, preparing and submitting documentation and obtaining a decision of the Office of Technical Inspection (UDT) – if required;
 - X. Providing warranty servicing for the warranty period, including all planned works along with the delivery of all parts, materials and consumable fluids during the basic warranty period;
 - Y. Cooperation with the Employer, with the Contractors of Lots (separate smaller investment tasks necessary for the main task), the Contractor of the construction of the gas unit (gas turbines), the Contractor of the construction of the Energy Recovery Facility (ERF), the Contractor of the retrofit of the BFB unit and the Site Manager appointed by the Employer at the stage of design engineering, erection, acceptance, commissioning activities.

1.1. LIMITS OF WORKS, SERVICES AND BATTERY LIMITS

1.1.1. Process-related part

Table 1.1.1.1 Battery Limits for the process-related part

No.	System	Start	End
1	District heating water system	Connection to DH supply pipelines: <ul style="list-style-type: none"> • AP-TG-01 • AP-TG-03 	new connection with the entire internal WHAL system within the scope of supply
2	District heating water system	Connection to DH return pipelines: <ul style="list-style-type: none"> • AP-TG-02 • AP-TG-04 	new connection with the entire internal WHAL system within the scope of supply

Pipelines connecting the accumulator system from the terminal points to the pipelines of the district heating network supplying the city are to be implemented by the Employer as part of a separate task and technical design.

The planned places (terminal points) where the Contractor's scope begins are specified in: **Appendix 2** and **Appendix 3 to this document**.

1.1.2. Civil engineering part

The Battery Limits for the civil engineering part are presented in the graphic part of **Appendix 2** to this document (for civil engineering systems), the scope of the application for the Decision on Zoning Condition (**Appendix 1** to this document) and the scope of the Building Permit Design (**Appendix 13** to this document). The civil structures shall be equipped with complete general civil systems. The Battery Limits also include all earthworks related to the foundation system of facilities in the area and the foundation system of equipment in existing facilities. The Battery Limits for the road and pedestrian areas are the tie-in points to the existing infrastructure.

1.1.3. System-related part

Table 1.1.3.1 Battery Limits for the system-related part

No.	System	Start	End
1.	Stormwater system	connection to the existing stormwater system in the following points: <ul style="list-style-type: none"> a) AP-WS-01 – to the Ko D400 sewage system – for HAS facilities (except for the existing summer-period pumping station building) including the construction of manholes in the existing networks.	new connection with the entire internal system within the scope of supply
2.	Industrial wastewater system (process water from	connection to the existing stormwater and industrial wastewater system in the following points:	new connection with the entire internal

	drainage of DH water pipelines)	a) AP-WS-04 – to the kd 160 sewage system – for HAS facilities (except for the existing summer-period pumping station building) including the installation in the existing manhole in the existing networks.	system within the scope of supply
3.	Wash water system (floor washing water)	connection to the existing potable water network in the following points: a) AP-WS-05 – to the woD 150 potable water network, south of the K-B gate valve chamber – for HAS facilities. including the connection and installation of gate valves in the existing networks.	new connection with the entire internal system within the scope of supply
4.	Fire water system (in case of the need to expand the existing fire water network for the needs of the hydrant system or other fire extinguishing equipment).	connection to the existing fire water network. in the following points: a) AP-WS-06 – to the woD 250 fire water network in the area of the K-B gate valve chamber – for the electrode boiler and HAS facilities. including the connection and installation of gate valves in the existing networks. If necessary.	new connection with the entire internal system within the scope of supply

1.1.4. Electrical part

Table 1.1.4.1 Battery Limits for the electrical part

No.	System	Battery limits and limits of works	Comments
1.	Power supply on the 6 kV side	Bay No. 14 in the 6 kV R01 switchgear and Bay No. 12 in the 6 kV PR2 switchgear, with the adaptation of these bays to the increased load	Provision of additional equipment in both bays, MV power cables and LV control cables within the scope of supply
2.	Existing cooling tower systems	Existing cabling of the cooling tower equipment from the terminal side in switchgears and control cabinets	Supply outgoing feeders in 0.4 kV switchgears within the scope of supply
3.	Power supply for the LV system of the electrode boiler*	Outgoing terminals of two 400 A outgoing feeders in the designed LV switchgears	Bay to be equipped within the scope of supply
4.	Earthing systems	Existing building earthing systems	connection to the existing earthing network within the scope of supply
5.	Cable routes for MV power cables	The designed cable trough between the main EC-4 building and the manhole next to the biomass route	Route to be used for laying MV and control cables

No.	System	Battery limits and limits of works	Comments
6.	Power supply of 0.4 kV shut-off valves provided by the Employer as part of systems related to the WHAL	0.4 kV switchgear of the Heat Accumulator	Terminals of shut-off gate valve drives

*The electrode boiler will be constructed under a separate project at a later date.

1.1.5.I&C part

Table 1.1.5.1 Battery Limits for the I&C part

No.	System	Start	End
1.	DCS	Communication device ports on the DCS side of the WHAL Contractor	DCS for the WHAL within the scope of supply
2.	Telecommunications ducting	Telecommunications manhole at the AP-IP-01 terminal point	Routing system inside the WHAL buildings and telecommunications ducting within the scope of supply
3.	Internal telecommunication network	Scope of supply and battery limits indicated in Appendix 8 to this document – Telecommunications diagram	Internal backbone within the scope of supply
4.	Fire alarm system	Communication ports of the Fire Alarm System control panel of the Contractor	Fire Alarm System within the scope of supply
5.	Valving and measurements provided by the Employer as part of systems related to the WHAL	Terminals on the I/O module blocks of the Contractor's DCS in the Contractor's DCS cabinets	DCS for the WHAL within the scope of supply
6.	Communication reserve for the electrode boiler*	1 redundant connector	-

*The electrode boiler will be constructed under a separate project at a later date.

1.2. CURRENT IMPLEMENTATION-RELATED CONDITIONS FOR THE SUBJECT OF THE CONTRACT

1.2.1.Project site

The Project in question will be implemented in one stage within plot No. 56/228 at ul. Andrzejewska 5, 90-975 Łódź at CHP Plant No. 4 (EC-4) in Łódź. Veolia Energia Łódź S.A. is the owner of the area intended for the project and the Employer.

Table 1.2.1.1 Cadastral unit, section and plot register number

No.	Voivodeship:	Administrative district:	Commune:	Precinct	Plot No.	Cadastral unit	Cadastral section	Register No.
1	łódzkie	Łódź	Łódź (city)	W-32	56/228	106106_9	W-32	56/228

1.2.2. Description of the area envisaged for the implementation of the project

The area covered by the scope of the investment project is an area for industrial purposes. The site is levelled to an elevation of approximately 222 metres above sea level. The entire EC-4 area in Łódź is fenced off and access is controlled. The area where the investment project will be carried out is located between the areas dedicated to the construction of a gas unit to the east and the construction of a Waste-to-Energy Plant to the west.

The area where the investment project will be carried out is not listed in the register of monuments and is not subject to protection based on other administrative decisions. It is also not included in the Local Spatial Development Plan, therefore the Employer will obtain a Decision on Zoning Conditions for the purposes of the Investment Project. The planned project area is presented in **Appendix 1** to this document. A map showing the remaining investment projects at EC-4 that will be carried out in the corresponding period (**Appendix 4** to this document) is also included.

1.2.3. Climatic conditions

In the area of the investment project, there are climatic conditions presented in Tables 1.2.3.1, 1.2.3.2 and 1.2.3.3 (from the period 2014–2018).

Table 1.2.3.1 Climatic conditions and design parameters

Atmospheric pressure	987 hPa
average annual air temperature	+ 9.8°C
average monthly air temperature range	-1.4°C (I) to +19.5°C (VII)
extreme temperature range	- 20°C to +30°C
speed and prevailing wind direction	3.3 m/s (48.6% from directions W+SW+SE)
average annual relative humidity	75% (range: 0.8 to 100%)
average annual precipitation	570 mm/year
maximum / minimum monthly precipitation	96 (VII) / 44 (II) mm/month

Table 1.2.3.2 Outdoor air design parameters for the summer period: acc. to PN-76/B-03420

Climatic zone:	III
Outdoor temperature:	30°C
Air enthalpy:	60.6 kJ/kg
Moisture content:	11.9 g/kg
Relative humidity:	45%

Table 1.2.3.3 Outdoor air design parameters for the winter period: acc. to PN-76/B-03420

Climatic zone:	III
Outdoor temperature:	-20°C

Air enthalpy:	-18.4 kJ/kg
Moisture content:	0.8 g/kg
Relative humidity:	100%

For the design of building structures, climatic impacts should be assumed in accordance with PN-EN standards (Eurocodes).

1.2.4. Seismic conditions

The area where the investment project will be implemented lies outside the mining area within the meaning of Article 6 (9) of the Geological and Mining Law and is not covered by seismic impacts.

1.2.5. Geological and hydrological data

As part of the Subject Matter of the Contract, the Contractor shall calculate the costs related to the so-called soil risk. These costs shall be incurred in full by the Contractor. The Employer has at its disposal:

- A. Geological and Engineering Documentation – GEOTEKO W-wa - February 2024;
- B. Soil Testing Documentation – GEOTEKO W-wa – March 2024;
- C. Report on the installation of boreholes (piezometers) within the C2G CCGT area on the premises of EC-4 in Łódź – in the vicinity of the planned Investment Project – Geoconsult W-wa – November/ December 2023;
- D. Geotechnical Documentation to determine the conditions for the foundation system of a dry cooling tower, switchgear and pumping station at CHP Plant No. 4 (EC-4) at ul. J. Andrzejewskiej 5 in Łódź – Geotechnika Łódź – February 2001

NOTE: The above-mentioned documentation sets can be found in **Appendix 11 to this document**. The responsibility for the use of the above-mentioned documentation prepared by the Employer or its updating lies with the Contractor. In case of doubt, the Contractor shall be obliged to perform its own supplementary geotechnical / geological surveys.

1.2.6. Conditions for carrying out Works

All Works related to the implementation of the investment project will be carried out under conditions of an operating CHP plant.

The technology for the performance of these Works shall meet the following basic conditions:

- A. maintaining the continuity of CHP production (except for periods when individual process-related systems specified in the Detailed Milestone Schedule, which must be approved with the Employer, are excluded from operation);
- B. possibility for the Employer to perform maintenance and investment works on facilities and equipment located near the Investment Project;
- C. maintaining safe working conditions for the rest of the CHP plant.

Carrying out Construction Works at the separated Construction Site shall be in accordance with applicable regulations on occupational health and safety as well as environmental

protection, especially with regard to noise protection, discharge of wastewater into sewage systems, soil contamination and waste management.

At the same time, other investment tasks are planned to be implemented in the EC-4 area at adjacent separated construction sites and in the area of water boilers in the EPC mode: on the eastern side of the WHAL – construction of the “Gas Unit”, on the western side of the WHAL – construction of the “Energy Recovery Plant” (ERF), in the area of the boiler house of water boilers – retrofit of the steam boiler of type BFB-180 (K-3). The Contractor of the Subject of the Contract shall be obliged to make ongoing detailed arrangements as well as coordinate works and transport operations with the contractors of the above-mentioned tasks.

2. AS-IS DESCRIPTION

2.1. Process-related part

2.1.1. Primary generating units and main auxiliary systems of the CHP plant

The EC-4 process system includes the basic CHP plant generating equipment, i.e. three heating power units (No. 1, No. 2 and No. 3), primary heat exchangers XA and XB and backup/start-up ones OXR1 and OXR2, which constitute the first stage of DH water heating, three water boilers of type WP-120 (K-4, K-5, and K-6) constituting the second stage of DH water heating (peak load) and DH water pumps of the first and second stage supplying DH water to heat consumers. The first stage of pumps (primary DH pumps) is located upstream of the primary heat exchangers, the second stage of pumps (primary DH pumps) located downstream of the turbine primary heat exchangers, EOG35 (K8) steam boiler (generator) supplying process steam consumers.

District heating unit No. 1 (BC-50) consists of:

- A. steam boiler of type OP-230 (K-2) fired with pulverized coal, extraction and back-pressure steam turbine of type 13UP55;
- B. GTH 63 type generator;
- C. ORS1 pressure reducing and desuperheating station.

District heating unit No. 2 (BC-50) consists of:

- A. steam boiler of type BFB-180 (K-3), with fluidised grate, biomass-fired;
- B. 13UCK60 type steam turbine;
- C. GTH 63/2 type generator;

District heating unit No. 3 (BC-100) consists of:

- A. steam boiler of type OP-430 (K-7), fired with pulverised hard coal;
- B. 13UC105 type steam turbine;
- C. GTH-125 type generator;
- D. 3RS1 pressure reducing and desuperheating station.

The unit is equipped with pre-pumps and main pumps. Technical data of the pumps:

- pre-pump:
 - pump type: 40B75
 - capacity: 3000 m³/h
 - head: 0.8 MPa
 - temperature of the pumped medium (max): 150°C
 - number of stages (two-stream type): 1
 - manufacturer WFP
 - type of the drive motor: SCDdm-136t
 - motor power: 1000 kW
 - stator voltage: 6000 V
- pre-pump:
 - pump type: 40B80-C
 - capacity: 3000 m³/h
 - minimum flow: 600 m³/h
 - maximum flow: 3000 m³/h
 - head: 0.8 MPa
 - temperature of the pumped medium (max): 35 to 90°C

- number of stages (two-stream type): 1
- manufacturer WFP
- type of the drive motor: SCDdm-136t
- motor power: 1000 kW
- stator voltage: 6000 V
- main pump:
 - pump type: 40B61
 - capacity: 2800 m³/h
 - head: 1.2 MPa
 - temperature of the pumped medium (max): 150°C
 - number of stages (two-stream type): 1
 - manufacturer WFP
 - type of the drive motor: SCDdm1344
 - motor power: 1250 kW
 - stator voltage: 6000 V

Table 2.1.1.1 Existing power units at EC-4

EC-4									
Power Unit	Designation / Year of commissioning and type of boiler		Fuel	Output [t/h]	Thermal output at boiler outlet [MW]	Including:		Electric output of the turbine-generator unit [MW]	Designation and type of turbine
						Thermal output in DH water [MW]	Electric output [MW]		
Unit No. 1	K-2 / Year 1977	OP-230	Coal	230	165	105	50	50	Extraction and back-pressure turbine, 13UP55
Unit No. 2	K-3 / Year 1978	BFB-180	Biomass	180	130	90	40	48	Extraction and condensing turbine, 13UCK60
Unit No. 3	K-7 / Year 1992	OP-430	Coal	430	315	205	100	100	Extraction and back-pressure turbine, 13UC105
Water boilers	K-4 / Year 1979	WP-120	Coal	120	140	140	-	-	-
	K-5 / Year 1982	WP-120	Coal	120	140	140			
	K-6 / Year 1984	WP-120	Coal	120	140	140			
Steam boiler	K-8 / Year 1999	EOG-35	Light fuel oil	35	23.3	23.3	-	-	-
TOTAL					1030	843.3	190	198	

2.1.2.Operational description of the district heating network

The district heating system of the city of Łódź is a system of interconnected main heating lines radially extending from individual heat sources, operating in separate areas assigned to individual heat sources. The Łódź heating system currently consists of two combined heat and power plants, EC3 and EC-4, located at opposite ends of the city.

The district heating network in Łódź consists of pipelines with diameters ranging from DN25 to DN900. The network consists of both underground pipelines constructed using the trenchless and pre-insulated technologies, and overhead pipelines constructed using the traditional and pre-insulated technologies. The total length of the DHN currently exceeds 870 km.

Table 2.1.2.1 Average DH network data (excerpt from **Appendix 3c** to this document)

2024	Ambient temperature	Flow		Temperature		Pressure	
		supply	return	supply	return	supply	return
	[°C]	[t/h]	[t/h]	[°C]	[°C]	MPa	MPa
January	-0.01	11970.5	11915.9	78.7	51.5	1.2	0.2
February	6.26	10776.7	10717.3	68.3	47.1	1.2	0.2
March	7.27	9760.9	9739.6	67.8	47.2	1.1	0.2
April	11.43	6189.2	6171.0	67.0	47.6	1.0	0.2
May	17.56	4783.3	4759.6	65.9	50.1	1.0	0.2
June	19.63	7118.1	7081.4	62.8	51.0	1.0	0.2
July	21.69	5162.1	5132.5	64.0	51.6	0.9	0.2
August	21.22	4067.7	4029.8	68.8	52.0	0.9	0.2
September	18.00	5375.2	5344.9	63.5	50.8	0.9	0.2
October	10.54	7414.0	7387.1	65.6	46.1	1.0	0.2
November	3.57	10699.1	10668.8	70.6	48.2	1.1	0.2
December	2.66	11940.3	11906.0	71.0	48.6	1.2	0.2

Operating data for the DHN supplied from the EC-4 area for 2022 **Appendix 3c** to this document.

Basic hourly operating data includes such values as:

- A. outdoor air temperature;
- B. DHN supply water temperature;
- C. DHN supply water pressure;

- D. DHN supply water flow rate;
- E. temperature of return water from the DHN;
- F. pressure of return water from the DHN;
- G. thermal output dispatched from EC-4.

The data contained in **Appendix 3c** to this document until the end of 2023 are based on the previous DHN control table, which has been replaced by **Appendix 3b** to this document.

2.1.3.Functional description of the district heating network

Table 2.1.3.1 Basic parameters of DH water in the Łódź DH system supplied with heat from EC-4

Stabilisation pressure maintained at the CHP Plant	0.20 to 0.23 MPa
Maximum supply line pressure (at terminal point)	1.4 MPa
Minimum return line pressure (at terminal point)	0.17* MPa 0.19 MPa
Average return line pressure (at terminal point)	0.20 MPa
Maximum available pressure in the heating season**	80 to 105 mH ₂ O (0.78 to 1.03 MPa)
Maximum available pressure beyond the heating season**	60 to 85 mH ₂ O (0.59 to 0.83 MPa)
DH water (plant water) flow in the heating season	3 500 to 14 000 t/h
DH water (plant water) flow beyond the heating season	1 800 to 7 500 t/h
Actual DH water temperatures during the heating season	119°C / 69°C
DH water design temperatures during the heating season	150°C / 70°C
Actual DH water temperatures during the summer period	66°C / 46°C (variable temperatures depending on operating conditions)

*occurs for several hours a year

**pressure difference between supply and return

Heating season

For example, in the calendar year 2022, the average thermal output amounted to approx. 635 MW_{th} with a DH water flow of approx. 10 000 Mg/h. The average supply and return water temperatures were 80°C and 51°C, respectively. In the heating season, most generating equipment operates, so in the event of large daily fluctuations in thermal output (up to approximately AQ_S = 150 MW_{th}) and DH water flows, EC-4 has sufficient capacity to control thermal output.

Transitional period:

An analysis of the thermal output demand indicates that the greatest daily fluctuations occur at the beginning and end of the heating season, i.e. in the transitional period (spring and autumn). The average thermal output was about 300 MW_{th}, and the daily output changes amounted to AQ_S = 250 MW_{th}, flow changes amounted to approx. AMS = 7 100 Mg/h.

Summer period

In the summer, the average thermal output was about 132 MW_{th}, and the daily output fluctuations were in the range of 67 to 137 MW_{th}. DH water flows were in the range of M_s = 1 800 to 5 000 Mg/h, and the average temperatures of supply and return water were 75°C and

50°C. During this period, the demand for thermal output is usually satisfied by one heating power unit. Despite small changes in output and flows, the EC-4 controllability is limited due to the operation of a few generating equipment units in connection with the shutdown of equipment to be overhauled.

Appendix 3b to this document contains the control table updated for 2024 (valid at EC-4).

2.1.4.DH water parameters

The heat accumulator system will constitute a closed intermediate storage tank for DH water circulating in the DHN system. It is required that this water be oxygen-free and meet the chemical composition requirements of the Polish Standards. Exceeding the oxygen content in the DH water will corrode the inner surface of the tank. With the correct composition of DH water and properly maintained steam cushion pressure, the durability of the tank shall be no less than that specified in Table 2.1.4.1.

Table 2.1.4.1 Durability

Facility	Durability
heat accumulator	200 000 h, but not more than 25 years,
main pipelines	200 000 h,
buildings and civil structures	50 years of use.

Table 2.1.4.2 Physical and chemical parameters of DH water

Parameter	Unit	Value
p alkalinity	German deg. mval/dm ³	≤ 0.5 ≤ 0.17
p alkalinity	mval/dm ³	≤ 0.5 to 1.0
m alkalinity	mval/dm ³	≤ 2.5
pH	pH	8.6=<pH=<9.2
Sulphate content SO ₃ ²⁻	mg/dm ³	3 to 5
Chlorine content	mg/dm ³	≤ 15
Oil content	mg/dm ³	≤ 1
Other	Acc. to PN-85/C-04601	

2.2. Civil engineering and road part

The area intended for the implementation of the Subject of the Contract is free of enclosed structures, except for the existing summer-period pumping station building and the electrical switchgear building, which are envisaged for adaptation (alteration and expansion) as needed to implement the Subject of the Contract. In the vicinity of the designated area outside the existing summer-period pumping station building (the pumps are not currently in operation), there are process-related bridges, some of which will be adapted for the WHAL district heating water pumping station, an electrical switchgear building and a dry cooling tower.

The area is well-connected by a system of plant roads with concrete and asphalt surfaces, as well as a railway siding that ends near the area of the planned Project.

Detailed data on the existing summer-period pumping station building and the electrical switchgear building are included in the facility design documentation in **Appendix 12** to this document.

2.2.1. Summer-Period Pumping Station Building

The existing facility consists of a hall part (pump hall) with dimensions in the axes of 7.9x18.6 m. The hall is a one-storey building. The maximum height of the hall part is about 5.70 m, the minimum height is 5.50 m. The roof of the building has a slope of about 5°. The supporting structure of the pumping station in the transverse direction consists of rigid frames with joint fixing in the foundation. In the longitudinal direction, the joint system braced in the axes in the edge area. Roof covering of the pumping station building: mineral wool sandwich panels (METALPLAST ISOTHERM DW-140) on purlins, horizontal bracing. Two travel girders for hoists are suspended from cross beams. Roof covering the electrical building: mineral wool sandwich panels (METALPLAST ISOTHERM DW-140) on purlins supported on cross beams fixed to the tie beam. Sandwich walls shall be fastened to steel structure members. Additional posts are provided for fixing the gate and enclosure. Fixing the door poles to the foundations with Hilti HVU-HAS M16x190 bonded anchors. Materials used – St3SX profile steel; St3SY.

2.2.2. Switchgear building

The existing facility consists of a one-storey masonry building with dimensions in the axes of 5.6 x 18.6 m. The building accommodates rooms for transformers, an electrical switchgear and a room with system cabinets. In the part of the electrical switchgear and system cabinet room, there is an underfloor cable space covered with a raised floor.

2.3. System-related part

On the premises of EC-4, an in-house fire water network supplied by a fire water pumping station is in operation. The network is equipped with DN80 and DN100 above-ground hydrants. The fire water network is also used to supply water for utility purposes. The designed facilities will be protected with the use of existing above-ground hydrants (**Appendix 13** to this document). Currently, the process of retrofit of the existing fire protection system is being prepared by the Employer.

The Contractor shall be obliged to specify in the offer the requirements for the fire protection network for the investment project in question for the HAS system (including the required amount of water for fire protection purposes, the necessary location of hydrants, etc.) in accordance with the arrangement and technology proposed by the Contractor. It is the Contractor's responsibility to confirm whether the existing fire protection systems meet the fire protection requirements for new and adapted buildings and process systems planned by the Contractor, and if they are not met, to adapt the fire protection system accordingly.

In the area of the planned location of the Heat Accumulator tank, there is a section of the fire water system for the HP10 hydrant located on the southern side. During the design and implementation, attention should be paid to the conflict-free location of the newly designed investment project elements as well as to the appropriate protection of the hydrant during the implementation works.

In the area of the planned construction, there is a combined sewage system (for stormwater and industrial wastewater).

The existing summer-period pumping station building with a switchgear is equipped with the following systems:

- A. ventilation system of the pumping station, transformer station, electrical switchgear, room with system cabinets;
- B. emergency electrical heating system of the pumping station, and heaters along ventilation ducts for the electrical switchgear and the room with system cabinets;
- C. air-conditioning system of the room with system cabinets;
- D. floor drainage in the pumping station building;
- E. condensate discharge from the air conditioner;
- F. drainage of the pumping station and electrical building roofs;
- G. lightning protection and earthing systems;
- H. communications;
- I. with ABC powder extinguishers.

Detailed data are included in **Appendix 12** to this document containing the design engineering documentation of the summer-period pumping station.

2.4. Electrical part

The existing electrical rooms of the summer-period pumping station will be used to supply the heat accumulation system. There are currently two 6.3/0.4 kV TWW1 and TWW2 transformers with a power of 800 kVA each, operating together with 0.4 kV switchgears – RWW1 and RWW2, respectively. These switchgears are connected by a coupler – busbar bridge. These switchgears are used to power fans of the summer cooling tower, valving, lighting, ventilation and service outlet systems. Free-standing switchgears, withdrawable, rated current 1250 A each.

The TWW1 and TWW2 transformers are powered from 6 kV switchgears, PO1 bay No. 14 and PR2 bay No. 12, respectively, using YAKYFtly 3 x 120 mm² 3.6/6 kV cables laid in the ground. The 6 kV switchgears are located in the electrical rooms of the main building at the CHP plant.

The existing systems and consumers of the summer cooling tower will be supplied from the designed systems. The current load of the switchgears is about 150 kW per section. The existing transformers will be replaced according to the designed load. For the power supply on the 6 kV side of the transformers, new 6 kV cables with cross-sections adapted to the load should be laid.

2.5. I&C part

At EC-4, three district heating units are supervised and controlled by DCS systems from the unit-related control rooms. Units 1, 2 and 3 are operated using Valmet's DNA-type DCS systems. All measurement and control signals from facilities and electrical switchgears are routed into DCS systems, and there is communication with control systems of autonomous devices or systems in signal exchange mode.

The Employer requires that the designed control system for the Heat Accumulator should be a separate autonomous control system connected or integrated with the existing DCS network – a detailed description of technical requirements can be found in section 4.8 of this document.

3. DISMANTLING, DEMOLITION AND RELOCATION WORKS

3.1. Scope of the process-related discipline

The Employer shall carry out dismantling works related to the dismantling of 2 units of summer pumps (except for foundations) in the existing summer-period pumping station and the dismantling of sections of pipelines connecting the suction and discharge sides of the above-mentioned pumps with the existing pipeline infrastructure and valving in order to free up space for the accumulator pumps.

Other unnecessary items, e.g. cables, ventilation ducts, other pipelines, etc. shall be dismantled by the Contractor and handed over to the Employer's warehouse. The Contractor shall calculate the transfer costs in the contract price. The Contractor shall adapt and relocate the pipeline infrastructure to the needs of the new process system of accumulator cold water pumps planned to be built in this part of the pumping station, the mixing pump and pressure stabilisation pumps. The limits of the Contractor's activities related to dismantling, relocation and installation end in the area of the pipe bridge pole, designated as point AP-TP-02.

The Contractor's activities shall be limited to the above-mentioned point where the Contractor shall connect new pipelines connecting the accumulator to pipelines (designed separately by the Employer) connecting the accumulator infrastructure to the district heating network of the existing EC-4 DH water system (**Appendix 2** to this document). These changes will also necessitate adaptations in the civil engineering, electrical and I&C disciplines.

3.2. Scope of civil engineering and road disciplines

As part of the demolition works in the civil engineering and road disciplines, in the event of such a need, it is planned to demolish the existing road surface (made of road slabs and other types, if necessary) of the section running in the area of the designed accumulator or its integration into the newly designed road system by the Contractor.

It may also be necessary to relocate the walls of the existing summer-period pumping station (including changes to its openings – making new openings and closing existing ones) in connection with a change of location and the need to expand the pipelines in the pumping station, which depends on the arrangement suggested by the Contractor.

The scope of Contractor's works shall also include the demolition of existing building support structures along with the foundations of existing building structures (including pipe bridges, cable ducts, machine foundations and other civil structures) and replacement of building members (such as joinery) in the event that the technology offered by the Contractor or current legal regulations require it.

3.3. Scope of the system-related discipline

3.3.1. Heating system

No dismantling or relocation works are envisaged for the heating system. However, it may be necessary to change the location, connection and adaptation of the electrical heating system of the existing facilities to the new conditions and the current legal status.

3.3.2. Ventilation and air conditioning system

No works related to dismantling or relocating the ventilation and air conditioning system are envisaged. However, it may be necessary to dismantle and replace existing ventilation and air conditioning systems in existing facilities with new ones or to connect and adapt them to the new operating conditions of the system and the current legal status.

3.3.3. Water supply and sewerage networks

Alternation of the existing operating sewage system (stormwater and industrial wastewater) should be carried out in connection with the construction of a new pumping station and the accumulator tank (including two “kdpn” sewage chambers near the decommissioned section of the railway track No. 440). However, it may also be necessary to connect and adapt the water supply and sewerage system of the existing facilities to the new conditions and the current legal status.

3.4. Scope of the electrical discipline

In the scope of the electrical discipline, the following should be dismantled:

- A. existing TWW1 and TWW2 transformers;
- B. existing 0.4 kV RWW1 and RWW2 switchgears with busbar bridges;
- C. other LV switchgears and patch cabinets;
- D. existing 6 kV cables and control cables to the summer-period pumping station building, only along the section from the cable entry to the cable room of the EC-4 electrical building to the terminals of the 6kV switchgears and at the WHAL Construction Site.
- E. conflicting electrical systems, including lighting and plug-in socket systems.

The dismantled items indicated above will be handed over to the Employer's warehouse. The Contractor shall calculate the transfer costs as part of the Remuneration.

3.5. Scope of the I&C discipline

As regards the I&C discipline, dismantling works are envisaged for instrumentation, field cabinets, main automation cabinets in the I&C room and I&C cabling in the summer-period pumping station as well as the installation of relocations in the in-house communication network in the I&C room of the summer-period pumping station.

The dismantled items indicated above will be handed over to the Employer's warehouse. The Contractor shall calculate the costs of dismantling and transfer as part of the Remuneration.

4. GENERAL FUNCTIONAL-UTILITY REQUIREMENTS

4.1. Basic functions of the heat accumulation system

The Heat Accumulator in the form of a cylindrical insulated hot water storage tank will be added to the EC-4 heating system. The basic tasks of the Heat Accumulator in the CHP plant heating system include:

- A. balancing the heat source load at variable energy demand by customers;
- B. satisfying peak heat demand;
- C. reducing fuel consumption as a consequence of stable operation under balanced load;
- D. reducing pollutant emissions as a consequence of lower fuel consumption and stable operation at balanced load;
- E. possibility of avoiding the temporary start-up of additional generating units to satisfy variable heat demand;
- F. reducing pollutant emissions as a consequence of avoiding the temporary start-up of additional generating units (peak boilers) to satisfy variable heat demand;
- G. capability of the heat source to operate in periods when the customers' instantaneous heat demand is lower than the technical minimum of generating equipment;
- H. possibility of intensifying electricity production at demand peaks due to the capability of accumulating heat generated in cogeneration units;
- I. reducing losses of DH water and energy contained in DH water. The Heat Accumulator should additionally act as a large expansion vessel in the system and allow pressure stabilisation in the hot water return pipelines to the CHP plant.
- J. The Heat Accumulator should be an emergency tank enabling the replenishment of DH water in the event of a failure of the DH network (leakage in the DHN).
- K. The Heat Accumulator shall be operated together in the future with the electrode boiler (planned for construction at a later date as part of a separate investment task). The operation of the boiler will take place in a cascade or in parallel with the existing power units.
- L. recovering energy using one pump in the PAT system on the cold water side.

4.2. Description of the intended state

4.2.1. Basic technical parameters of the Heat Accumulator system with a pumping station

Table 4.2.1.1 Parameters of the Heat Accumulator

Usable capacity* (effective volume between the maximum position of the upper nozzle and the lower nozzle measured at a water temperature of 50°C)	33 000 m ³ +1% -0.5%
Amount of stored heat* (at supply water temperature of 95°C and return water temperature of 45°C)	1 750 MWh
Charging / discharging capacity	300 m ³ /h to 2 800 m ³ /h
Maximum height resulting from formal and legal decisions (the highest point from the ground level, taking into account the installed devices and structures on the roof)	80 m
Maximum diameter resulting from formal and legal decisions (taking into account insulation and foundation)**	28 m
Operating temperature	98°C / 40°C

Design temperature	100°C
Design pressure	hydrostatic, non-pressurised tank filled with water

*The Contractor shall design and construct the Heat Accumulator assuming that the input for the design is the usable capacity and the amount of stored heat will be the resultant

**The diameter of the foundation shall be designed by the Contractor, taking into account the widest possible service corridor

4.2.2. Description of operation

The Heat Accumulator will be an unpressurised steel tank filled with hot water. In the Heat Accumulator, hot water accumulates in its upper part. When the heat accumulator is charged, hot water from the existing heat exchangers of the heating power units, the gas unit currently under construction and the electrode boiler planned for the future (no date has been set yet) is displaced downwards by cold water (the accumulator will be charged using network pumps). Cold water then flows through the return pipelines to the heat exchangers at the power units and to the electrode boiler, as long as it is constructed in the future.

When discharging, cold return water from the district heating network displaces hot water upwards in the tank by means of cold water pumps, and this water further flows to the main pipelines of the district heating network supplying the city using hot water pumps.

The level of water in the Heat Accumulator changes due to the change in the volume of water in the accumulator tank. In addition, the Heat Accumulator shall perform the function of a buffer tank stabilising the pressure along the return pipelines to EC-4 and in the district heating system when changing the volume of water in the system and the function of an emergency water tank for the district heating network.

Initially, the following changes are expected:

- A. By about 1.8 m resulting from a change in the amount of hot water in relation to cold water when charging and discharging the tank – the proportions between the amount of hot and cold water in the Heat Accumulator (i.e. the location of the thermal boundary layer) change;
- B. By about 1 m using the accumulator as a buffer for the district heating network (the daily change in the volume of water in the EC-4 district heating system in the winter period is estimated at about 500 m³);
- C. the total level change related to the emergency make-up of the network envisaged by the Employer is approximately 3 m (to be confirmed by the Contractor at the design stage).

The Heat Accumulator shall make up water in the DH network in case of leakage in the network infrastructure. Emergency supply of the DH network means additional make-up of the DH network with a water flow of 200 m³/h for a period of about 1 to 2 hours until the leak is cut off by the network services. It is assumed that in such a mode of operation the accumulator will not be supplied with hot water (interrupted charging process), but only will be supplied with the medium producing the steam cushion. The water level may fall below the designed minimum level for the normal operation of the accumulator, however, it must be within the operating

range of the system producing the steam cushion. The movable upper diffuser must feature an adequate protection to lower the water level below the extreme lower position of the diffuser. If this is the case, the accumulator will be deactivated in terms of the charging and discharging functions. In order to avoid the impact of atmospheric air on the inner surface of the tank, it is planned to keep the steam cushion in the tank above the water surface in the emergency mode. The water intake system for the steam cushion generator must ensure the maximum change in the water level in the tank related to the thermal expansion of water when the position of the thermal boundary layer changes, change in the volume of water in the district heating system and enable emergency supply of the district heating network.

The maximum temperature of charging water of the Heat Accumulator shall be about 98°C and, in emergency situations, it shall be possible to increase the temperature of the water in the charging cycle to up to 110°C for a maximum of 2 to 3 minutes, for example in the event of a failure of the hot water cooling system to the Heat Accumulator.

If water used to charge the tank has a temperature higher than 98°C (for operation under normal conditions), a mixing system (mixing pump – MP) with return water should be used to lower this temperature to 98°C. The mixing pump shall also provide additional support for the cold mixing system in the WHAL discharge mode to enable precise control of the cold mixing water flow in order to maintain the temperature on the supply side of the district heating network. If this is the case, the additional cold water flow from the mixing pump shall be routed to the suction of the hot water pumps. The temperature of cold water in the accumulator is the temperature of return water from the district heating network.

Operating pressure of the Heat Accumulator shall be similar to atmospheric pressure. A slight overpressure of $500 \text{ Pa} \pm 400 \text{ Pa}$ should be maintained above the water surface in the accumulator tank, which results from the operation of the cushion system (the final pressure value shall be determined by the Contractor during the design of the tank). Pressure of the steam cushion shall be variable in the Heat Accumulator tank and shall increase as it goes downwards due to the hydrostatic pressure of the water, reaching a pressure value similar to the height of the cylindrical part of the tank, calculated in $[\text{mH}_2]$.

DH water in the accumulator may come into contact with atmospheric air through a breathing valve (vacuum breaker), therefore water steam is injected above the water surface in the tank to insulate the surface of the tank and the water surface from the absorption of oxygen. The role of the steam supply shall be performed by the steam cushion system.

The buffer layer, at the first start-up of the accumulator, shall be generated by supplying steam from the steam generator (over a longer period of time) and generating the so-called steam fall over the water surface in the accumulator tank. Then, the cushion shall be durable, but may be subject to temporary disturbance, i.e. several hours of disturbance, especially at strong water flows charging or discharging the Heat Accumulator or the emergency operation mode described above. The backup solution in the case of the steam cushion system shall be the backup steam generator (2 x 100% system). Supply water for the steam generator shall be sourced from the buffer layer located directly under the water surface in the accumulator tank. This water with a temperature of approx. 75°C to 98°C shall be superheated in the generator to a temperature above 100°C, and then injected through a nozzle into the space of the steam

cushion above the water surface in the tank and the so-called steam fall shall be generated – steam and water in the saturation state.

In the situation of operation of the Heat Accumulator in the emergency mode of network make-up operation, parallel operation of two steam generators is allowed to enable the correct positive pressure of the steam cushion.

The quality of water collected in the Heat Accumulator should correspond to the required quality of DH water, which will have a positive impact on the service life of this device and the DH water system.

Characteristics of the planned charging and discharging of the Heat Accumulator and basic schematic diagrams are included in **Appendix 3d** to Part II of the ToR.

4.2.3. Basic equipment of the Heat Accumulator system

The Heat Accumulator shall be equipped with:

- A. a tank with a useful capacity of approximately 33 000 m³;
- B. hot water pumps in the following configuration: 3 x 33%, 3 x 900 m³/h;
- C. cold water pumps – 3 x 33%, 3 x 900 m³/h (including one adapted on the hydraulics side and on the supply side – electricity recovery for operation in the PAT system);
- D. pressure stabilisation pumps on the return side from the district heating network – 2 x 100%, 2 x 60 m³/h;
- E. mixing pump – 1 x 100%, 1 x 540 m³/h;
- F. cold mix pumps for EC-4 – 2 x 50%, 2 x 1100 m³/h;
- G. steam cushion circulation pumps – 3 x 50% (for two steam generators);
- H. steam generators for the steam cushion – 2 x 100% (capacity to be determined by the Contractor);
- I. hot water pipelines;
- J. cold water pipelines;
- K. water pipelines for supplying the steam cushion;
- L. pipelines within the steam generator area to the steam cushion;
- M. overflow and drain pipelines of the WHAL tank;
- N. pipelines in the area of cold water pumps;
- O. pipelines in the area of the mixing pump;
- P. pipelines in the area of pressure stabilisation pumps on the return side from the district heating network;
- Q. pipelines in the area of cold mixing pumps;
- R. pipelines in the area of hot water pumps;
- S. drain, vent and bleed pipelines in the area of the pumping station.

The parameters of the pumps are approximate (preliminary) as results from the concept – to be verified when designed by the Contractor.

All pipelines shall be equipped with the necessary shut-off, control, return vent and drain valving as well as safety valving to enable stable process management in the variable accumulator operating conditions assumed by the Employer (control bypasses for small flows and conditions where cold and hot water pumps will be outside the control range in accordance with the control curves of these pumps should be taken into account).

For the pump in the pumping system – PAT, additional control valves will be necessary to enable operation in the full control area during turbine operation and check valve bypass valves (**Appendix 3** to this document).

4.2.4. Basic tank equipment

Table 4.2.4.1 Expected basic external equipment of the tank

No.	Equipment	Minimum quantity
1	breather valve with water closure,	1
2	safety valves in the form of flap valves acting simultaneously as inspection hatches,	2
3	venting valve,	1
4	hot water pipeline within the accumulator area,	1
5	cold water pipeline within the accumulator area,	1
6	overflow pipeline with U-bending,	1
7	discharge pipeline,	1
8	nozzles for measuring the pressure on the roof and in the lower part of the shell,	4
9	thermowells for measuring water temperature – measurements every 1 m along the cylindrical surface of the tank	depending on the height
9a	thermowells for measuring the temperature of the steam cushion space	2
10	radar measurements of water level in the tank,	3
11	gutters and downpipes draining water from the roof,	to be determined by the Contractor*
12	spiral stairs enabling access to the tank roof,	1
13	roof platform with railing so that it provides permanent access to handle devices installed on the roof,	to be determined by the Contractor*
14	inspection hatches in the lower part of the shell,	1
15	thermal insulation of the tank with a minimum thickness of 500 mm and waterproof insulation of the upper bottom (hard mineral wool) ensuring adequate durability even in the case of occasional movement of service personnel	to be determined by the Contractor*
16	earthing and lightning protection system	to be determined by the Contractor*
17	Steam cushion system along with components:	-
	suction pipeline outside the tank	1
	discharge pipeline outside the tank	1
	measuring nozzle for water flow in the steam generator	1
	welded thermowells for temperature measurement,	1
	valving,	2
	other elements of the system indicated by the Bidder for the proper operation of the system	to be determined by the

		Contractor*
18	lighting of circulation routes in accordance with standards,	to be determined by the Contractor*
19	I&C devices,	to be determined by the Contractor*
20	other accessories, valving and equipment – if the Contractor deems it necessary for the proper operation and servicing of the accumulator	to be determined by the Contractor*

*the quantity shall be determined by the Contractor at the stage of the detailed engineering design, which will require the Employer's approval.

Table 4.2.4.2 Expected basic internal equipment of the tank

No.	Basic internal equipment of the tank	Minimum quantity
1	upper diffuser (upper orifice with that can move with a change in the water level in the accumulator with a variable level of operation – the total level change is 3 m to be confirmed by the Contractor), along with a floater, guide, central pipe and a part of the hot pipeline,	1
2	bottom diffuser with a part of the cold pipeline,	1
3	anchoring points for investment works and inspections of the tank, in the area of top hatches	2
4	list of nozzles (minimum quantity expected by the Project Owner):	N/A
4.1	water level measuring nozzle	3
4.2	breathing valve nozzle	1
4.3	venting valve nozzle	1
4.4	steam cushion pressure measuring nozzle	3
4.5	shell temperature measurement nozzle (regardless of the height of the tank, the Employer assumes installation in the height scale every 1 m)	(quantity to result from the height – to be determined by the Bidder)
4.6	steam cushion temperature measuring nozzle	2
4.7	injection lance nozzle	2
4.8	water intake nozzle for the steam generator	1
4.9	water nozzle from the generator – steam injection	2
4.10	cold water nozzle	1
4.11	hot water nozzle	1
4.12	emergency overflow nozzle	1
4.13	drain nozzle	1
4.14	hatch nozzle in the shell	1
4.15	safety valve nozzle on the roof (also acting as an inspection hatch for the tank)	2
4.16	other nozzles necessary according to the Bidder's suggestions	to be determined by the Contractor*

5	steam cushion system along with internal equipment components:	N/A
5.1	movable internal suction pipeline with a floater	1
5.2	internal discharge pipeline with a spray nozzle	2
5.3	other elements of the system indicated by the Bidder for the proper operation of the system (1 set)	to be determined by the Contractor*

*the quantity shall be determined by the Contractor at the stage of the Detailed Engineering Design, which will require the Employer's approval.

4.3. Connection of the Heat Accumulation system with the existing infrastructure

4.3.1. Scope of the process-related discipline

In the scope of the process-related discipline, the connection with the infrastructure existing and designed by the Employer shall be provided by:

- A. connection of cold water to the pipeline (AP-TG-02) in the area of the pipeline pole located by the road before entering the building of the existing summer-period pumping station to be adopted for the function of the cold DH water pumping station;
- B. connection of cold water to the pipeline supplied and made available by the Employer (AP-TG-04) in the location of the construction site behind the road towards the planned location of the DH water pumping station building in order to supply cold mixing pumps;
- C. connection of hot water used for charging the accumulator to the pipeline (AP-TG-01) routed and made available by the project owner in the location of the construction site behind the road in the direction of the planned location of the hot DH water pumping station building;
- D. connection of hot water after cold mixing in the pipeline (AP-TG-03) routed and made available by the project owner in the location of the construction site behind the road in the direction of the planned location of the DH water pumping station building – at the outlet from the DH water pumping station after mixing (the pipeline shall be connected to the DH network pipelines at the exit to the city);
- E. connection of the emergency overflow pipeline to the existing stormwater and industrial wastewater system. The emergency overflow (hot water) pipeline from the heat accumulator shall be equipped with a U-bend. The pipeline, through the U-bend, shall discharge hot water from the accumulator overflow using a connection with the existing stormwater and industrial wastewater system;
- F. connection of the drain pipeline from the Heat Accumulator – the Heat Accumulator shall be equipped with a drain pipeline (cold water) from the bottom of the tank. The pipeline shall discharge water into the existing stormwater and industrial wastewater system.

Key information on the connection of the WHAL with the existing DHN infrastructure:

- A. Hot water pipelines:
 - a. DN 700 hot water pipeline supplying the DH water supplying the Heat Accumulator from the steam power units and the gas unit at EC-4 through the Heat Accumulator pumping station – the place where the pipeline is connected

to the nozzle installed in the area of the hot water pumping station. Temperature of hot water temperature entering the Heat Accumulator:

- should be maintained at the level of 75°C to 98°C; the Employer envisages the operation of the accumulator at different charging temperatures at different times of the year. In the winter, these temperatures will be close to 98°C, in the transitional period the temperatures will be about 85°C, and in the summer the temperatures will be 75°C.

In the case of a reduced charging temperature, the steam consumption for maintaining the air cushion will be much higher than for the 98°C state. The Contractor shall envisage increased steam consumption in the summer period in the process of selecting the output of the steam generation system for the steam cushion. The hot water pipeline to the pumping station should be connected to the DN 700 nozzle routed by the Employer – terminal point AP-TG-01.

- b. DN 800 hot water pipeline discharging hot DH water supplying the DH water main line at EC-4 from the Heat Accumulator through the Heat Accumulator pumping station where the process of mixing with return water takes place, carried out by cold mixing pumps in order to achieve the desired temperature of DH water at the exit to the city – the place of connection of the pipeline to the nozzle installed in the area of the hot water pumping station of the WHAL. Temperature of hot water flowing from the Heat Accumulator, maintained in accordance with the assumptions for the summer, transitional or winter season at the level of 75°C to 98°C, respectively, and after cold mixing corresponding to the DH water control table. The hot water pipeline from the pumping station should be connected to the DN 800 nozzle routed by the Employer (AP-TG-03, DN 800).
 - c. for a separate possible investment project to construct an electrode boiler – as planned in the future, it will be possible to connect the electrode boiler in a series with the supply system of the Heat Accumulator from the heating power units. In this case, the boiler shall heat DH water and increase the value of the accumulator charging temperature (at times when electricity is inexpensive and the cost of generating heat in the electrode boiler is competitive with the cost of heat from other units);
- B. cold water pipelines – DN 800 cold water pipeline connected on one side to the pipelines returning from the city shall supply cold water to both the cold water pumping station and the hot water pumping station in the direction of cold mixing pumps (the second connection is necessary due to the planned location of the above-mentioned pumps in the hot water pumping station):
- a. The cold water pipeline (DN 800) shall supply and discharge cold DH water from the heat accumulator through the cold water pumping station of the Heat Accumulator to the place of connection. The pipeline should be connected to the DN 800 nozzle routed by the Employer in the location of the WHAL cold water pumping station (AP-TG-02, DN 800). In addition, this pipeline shall be connected to the dry cooling tower pipeline system located on the western side of the cold pumping station.

- b. A branch of the cold water pipeline (DN 800) shall supply return DH water to cold mixing pumps located in the hot water pumping station. Places where the pipeline is tied-in to the nozzle installed by the Employer in the area of the hot water pumping station of the WHAL (AP-TG-04, DN 800). The temperature of cold water routed by the cold water pumps to the accumulator or to the suction side of the cold mixing pumps is the resulting temperature of return water from the district heating network (according to the control table).

4.3.2. Scope of civil engineering and road disciplines

As regards the civil engineering discipline, the connection to the existing civil engineering infrastructure is envisaged by using the existing buildings: the summer-period pumping station, which will be adapted to serve as a cold water pumping station, the existing switchgear building, which will be adapted to supply the process systems with more electricity, and the road-related part. In the Offer, the Contractor shall present a solution for connecting the existing road system with the newly designed investment project and its road system enabling the operation of the investment project that is the subject of this ToR, as well as the connections of the investment project in question with the elements of the railway infrastructure (the buffer block which marks the end of the partially shortened (existing) track No. 440).

The scope of civil engineering and road disciplines is identical to **Appendix 13** (Building Permit) attached to this ToR, prepared at the request of the Employer (except for the scope related to the electrode boiler building).

4.3.3. Scope of the system-related discipline

The Employer provides, in **Appendix 12** to this document, as-built documentation of the HVAC systems existing in the buildings. On this basis, the Employer confirms the need to replace the existing HVAC systems. The Contractor shall include the above scope in the Remuneration.

4.3.3.1. Heating system

No connections are envisaged between the heating system and the existing infrastructure. However, in the case of the existing summer-period pumping station building (together with the electrical switchgear and I&C rooms), it may be necessary to connect and adapt the heating system of the existing facilities to the new conditions and the current legal status. The Contractor shall present such a solution in the Offer.

4.3.3.2. Ventilation and air conditioning system

No connections between the ventilation and air conditioning system and the existing infrastructure are planned. However, in the case of the existing summer-period pumping station building (together with the electrical and I&C switchgear rooms), it may be necessary to connect and adapt the ventilation and air conditioning systems of existing facilities to the new conditions and the current legal status. The Contractor shall present such a solution in the Offer.

4.3.4. Water supply and sewerage networks and systems

In the scope of the water supply and sewerage discipline, the designed facilities should be connected to existing networks to the extent in accordance with point 1.1.3 of this document. The designed facilities shall be within the protection range of the existing fire water network with external hydrants. No extension of the fire water network is envisaged for the purposes of fire protection of the designed facilities. Currently, the process of retrofit of the existing fire protection system is being prepared by the Employer.

The Contractor shall be obliged to specify in the offer the requirements for the fire protection network for the investment project in question for the HAS system (including the required amount of water for fire protection purposes, the necessary location of hydrants, etc.). It is preferable to use the existing elements of the network in its current location.

In the area of the planned location of the Heat Accumulator, there is a section of the fire water system for the Hp10 hydrant located on the southern side. The location of the existing hydrants together with their range of operation is shown in **Appendix 13** of the Building Permit Design (Volume I – PZT – Dwg. No. WHAL-PBM-07NDx00-PER-LAY-0002).

During the design and implementation, attention should be paid to the conflict-free location of the newly designed investment project elements as well as to the appropriate protection of the hydrant during the implementation works.

4.3.5. Scope of the electrical discipline

The scope of the Contractor's Supply, Services and the Contractor's liability shall include:

- A. preparation of the concept, building permit designs, technical designed, detailed engineering and as-built designs;
- B. adaptation of 6 kV supply bays in the PO1 switchgear – bay No. 14 and PR2 bay No. 12 – to increased load;
- C. power and control cables between the above-mentioned switchgears, transformers and LV switchgears.
- D. two 6 kV/LV dry transformers with power adapted to the designed load, Dyn5 connection group each (transformer chambers should be altered for the foundation system of new transformers);
- E. busbar bridges between the transformers and the main LV switchgear, with a rated current adapted to the rated currents of the transformers;
- F. LV switchgear for the purposes of the HAS system and the electrode boiler; two-section, free-standing, with coupling and ATS, two-section with compact circuit breakers in withdrawable sections in the supply bays and coupling with a rated busbar current adapted to the rated currents of the transformer, including an outgoing feeder for existing and planned equipment and spare capacity;
- G. complete electrical system for the subject of the contract along with the selection of individual elements of this system, in accordance with the requirements presented below;

- H. control of the power supply system of the switchgears and customers in the Heat Accumulator system;
- I. connection and start-up of the existing summer-period cold storage system;
- J. primary, emergency and obstruction lighting systems, plug-in socket system, HVAC power supply and control systems;
- K. earthing, equipotential bonding and lightning protection systems;
- L. complete cable routes for MV, LV control and measurement cables;
- M. protection of the existing MV and LV cables located in the ground on the eastern side of the electrical building;
- N. tests, measurements, trials, start-up operations and quality documentation.

4.3.6. Scope of the I&C discipline

For remote operation of all process and measuring devices in the Heat Accumulator system, a complete control system, control and instrumentation, the interface for local and remote operation and the communication interface should be provided. The control system should ensure full control over the process, control functionality and joint operation with existing control systems related to heat accumulation (DH network, power units, electrical system, water systems).

The Contractor shall be responsible for the complete automation of all new systems related to the construction of the Heat Accumulator and the preparation of the conditions of its connection with the control systems of the power units.

A detailed description of the I&C discipline is provided in chapter 4.8 of this document.

4.4. DETAILED DESCRIPTION OF THE PROCESS-RELATED DISCIPLINE

4.4.1. Heat Accumulator

Table 4.4.1 Basic technical data of the Heat Accumulator

Model:	Heat Accumulator for storing thermal energy in the form of hot DH water, stratification type with a thermal boundary layer
Quantity	1 piece
Type and design	<p>Steel tank with sheet metal welded panelling, cylindrical with vertical axis with roof, fixed bottom, thermally insulated:</p> <ul style="list-style-type: none"> A. bottom ring and bottom panelling on an insulated concrete foundation; B. tank shell with DN 1000 hatch and stiffening rings; C. roof (roof ring, girders and load-bearing beams as well as panelling sheets, DN 800 ventilation hatches on the tank roof); D. thermal insulation of the shell and the roof (the roof is to be sealed with PVC coating against precipitation). <p>The basic dimensions are given in Table 4.2.1.1 Parameters of the Heat Accumulator</p>

Quality requirements for DH water	Minimum: PN-C-04601:1985 “Water for energy purposes. Water quality requirements and tests for water boilers and closed district heating circuits”
Thermal insulation	The optimal method of selecting thermal insulation and the shell of the Heat Accumulator will be suggested by the Contractor (min. 500 mm). Detailed information on the selection, calculation and installation of thermal insulation shall be provided by the thermal insulation contractor in separate preliminary documentation, and later in detailed engineering and as-built documentation.
Temperature of DH water charging the accumulator	Variable 75°C to 98°C
Mixing system for adjusting the temperature of water supplying the Heat Accumulator from the DH network (max. 110°C)	Yes (mixing with cold return water to maintain a maximum temperature of 98°C)
Steam cushion system	Yes (2 x 100% steam cushion generator)
Corrosion protection	Heat Accumulator tank on the inside and outside – sheet metal cleaning: A. mechanical cleaning of welds; B. surface cleaning to obtain the cleanliness required by the standards.
	Internal coating The Heat Accumulator tank on the inside as well as the materials installed inside the tank do not require typical corrosion protection. On the other hand, the sheets should be temporarily protected against corrosion during transport, storage and installation with a suitable primer, e.g. Unikor or equivalent. Before installation, the shell sheets, bottom and roof dome should be cleaned before filling the tank, the materials installed inside the tank should have a clean surface in accordance with the Contractor's standard and after the Employer's acceptance of the cleaning technology at the Basic Engineering Design stage. The Heat Accumulator tank is used for storing DH water which should meet the quality requirements not causing corrosion of the tank structure.

	<p>External coating of the tank under insulation</p> <p>The painting system designed to provide corrosion protection of an insulated heat accumulator should meet the following requirements:</p> <ul style="list-style-type: none"> A. corrosion class C3 in its entire area, according to PN-EN ISO 12944-2; B. durability period High (H) from 15 to 25 years according to PN-EN ISO 12944-1; C. paint designed for insulated surfaces operated at a temperature of up to 120°C; D. epoxy paint system – according to PN-EN ISO 12944-5; E. system designed to prevent corrosion under insulation (CUI); F. the system must take into account the effect of moisture which, despite tight insulation, will occur, for example, due to temperature changes during the day-night period, summer and winter, or during the standstill period (e.g. in the case of maintenance works).
	Other system may be accepted, but with equivalent or better parameters.
	<p>Corrosion allowance for the tank</p> <p>In addition, a corrosion allowance (C) of at least 0.5 mm is required for sheet thickness according to PN-EN 14015.</p>
Steam cushion spraying system	Yes (3 x 50% pumps)
Steam cushion pressure	500 Pa ± 400 Pa
Internal / external equipment	<p>Water distribution system:</p> <ul style="list-style-type: none"> A. upper orifice with cap, guide, central pipe and a part of the hot pipeline. Upper orifice, vertically movable up to 2 m due to assumed accumulator functions; B. bottom orifice with a part of the cold pipeline.
Steam cushion system	Table 4.2.4.1
Internal / external equipment	Table 4.2.4.2
Back-up water heating for the steam cushion system	Yes (100% back-up steam generator)
Emergency overflow (hot)	Yes (protection, as a U-bend) – routing to the sewage system
Service drain (cold)	Yes (with double shut-off valving) – routing to the sewage system
I&C equipment	Linear temperature measurement along the height of the tank, thermometer nozzles, nozzles for measuring pressure, valving.
Permissible pressure changes under the roof of the Heat Accumulator tank	500 Pa ± 400 Pa
Design pressure – positive pressure	Approx. 500 Pa (for a spherical roof)

Design pressure – negative pressure	Approx. 100 Pa (for a spherical roof)
Design temperature	100°C
Operating temperature	98 to 40°C
Minimum / maximum expected charging and discharging flow of the Heat Accumulator	300 m ³ /h to 2 800 m ³ /h
Thermal capacity	1750 MWh +5% for tp = 45°C, tg = 95°C (tp – hot water temperature; tg – cold water temperature);
Calculation conditions (assumed)	Non-pressurised tank, filled with water, design pressure – hydrostatic
Safety valves	Yes – direct acting (mechanical)
Breather valve	Yes
Water load	The load shall be determined by the Contractor depending on the suggested technology and design, including the height of the Heat Accumulator.
Snow load	To be determined by the Contractor at the design engineering stage
Wind load	To be determined by the Contractor at the design engineering stage

4.4.2. Equipment of the hot and cold water pumping station of the Heat Accumulator

The basic process-related equipment of the DH water pumping station for the needs of the Heat Accumulator system shall be DH water pump units. It is planned to install, respectively: hot water pumps in the hot water pumping station and cold water pumping station in the 3 x 900 m³/h configuration. The nominal flow through the hot water and cold water pumps system shall be about 2 000 m³/h, with a maximum of 2 800 m³/h.

In addition, in the hot water pumping station, cold mixing pumps shall be installed to lower the temperature of hot water from the Heat Accumulator to the district heating network (according to the control table) in the 2 x 1100 m³/h configuration, while in the cold water pumping station, the following will be installed: a mixing pump to lower the temperature of hot water to the accumulator to 98°C in the 1 x 540 m³/h configuration and a return pressure stabilisation pump – 2 x 60 m³/h.

As part of the completion of the pumping station equipment, it is also planned to install 2 x 100% steam generator in the hot water pumping station (the power shall be selected by the Contractor at the design stage as appropriate for the maximum speed of lowering the water surface, the minimum power expected by the Employer of one generator is 200 kW – to be verified by the Contractor) for the production of steam cushion.

The water circulating in the Heat Accumulator system will be transported through the system of district heating headers installed in the pumping stations. Each pump in the pumping station shall be equipped with an electric motor and an inverter system for smooth speed control. Three pumps on the cold side of the supply water pumps shall be adapted to the PAT system, of which one pump shall operate in this system, therefore the inverters for the pump in the PAT system must enable energy recovery in the mode of operation of the pump in the turbine system, and the remaining inverters shall enable expansion with an energy recovery segment in the future.

As shut-off valving, it is planned to install butterfly valves with drives: electric ones on the discharge and (minimum requirement), manual ones with position indicators (open-close) on the suction side of the pumps.

The hot water pipeline AP-TG-01 shall supply DH water from the DH units to the heat accumulator through the Heat Accumulator pumping station from the place of connection, which shall be located in the northern direction from the entrance of the hot water pumping station of the Heat Accumulator.

The hot water pipeline AP-TG-03 shall discharge hot DH water supplying the DH water main line at EC-4 from the accumulator pumping station, where the process of mixing with return water shall be carried out by cold mixing pumps in order to achieve the desired parameters of DH water at the exit to the city (in accordance with the control table **Appendix 3b to this document**) to the place of connection of the pipeline, which shall be prepared by the Employer in the northern direction at a height of not less than 5.5 m (to be specified in more detail at the design stage). The temperature of the hot water flowing from the Heat Accumulator shall be maintained at the level set by the operators, for example, about 98°C (during the winter), and below this temperature, for example: 85°C (in the transitional period) and at the level of, for example, 75°C (in the summer), and after cold mixing, it will correspond to the water temperature in accordance with the control table.

The cold water pipeline to point AP-TG-02 shall supply and discharge cold DH water from the heat accumulator through the cold water pumping station of the Heat Accumulator to the place of connection to the return pipelines, which shall be prepared by the Employer in the northern direction at a height of not less than 5.5 m (to be specified in more detail at the design stage).

Through the branch of the cold water pipeline AP-TG-04 DN 800, DH water shall be supplied from the place of connection, which shall be prepared by the Employer in the northern direction from the hot water pumping station at a height of not less than 5.5 m (to be specified in more detail at the design stage).

The temperature of cold water in the Heat Accumulator is the temperature of return water from the DH network. Hot and cold water pipelines as well as pumping headers shall be well insulated to reduce heat transfer losses. Similarly, the pipelines of the mixing system for controlling the temperature of the DH water supplied to the Heat Accumulator and the pipelines in the system of cold mixing pumps shall be insulated.

The venting for the pipelines are to be equipped with automatic vents.

Service drains and hot drainage from the Heat Accumulator are planned to be connected to the sewage system through AP-WS-04. In order to cool the water volume in the system to the level of 35°C, water shall flow through the duct to the existing cooling tank located on the western side of the EC-4.

The remaining drains from the pipelines located in the pumping stations shall be routed to the ducts in the floor of the service level and then through (AP-WS-04) also to the above-mentioned existing tank.

Maintenance of the pumps and valving in the pumping stations shall be implemented using:

- existing electric hoists located in the adapted cold water pump room (**Appendix 12** to this document);
- new hoists (or crane) planned to be installed in the hot water pumping station.

The preliminary parameters of the pumps are shown below. The Contractor shall be responsible for the final selection of pumps controlled by inverters and operated in a parallel system.

4.4.3.Preliminary parameters of pumps

Remark: The assumed pump parameters should be verified at the detailed engineering design stage once the final WHAL solution has been selected and the actual piping geometry has been established.

4.4.3.1. Hot water pumps (HWP)

Table 4.4.3.1.1 Parameters of hot water pumps

Version:	Hot water pumps
Quantity	3 pieces
Configuration	Three pumps providing full coverage of the required accumulator flow. The range of the most common flows lies within the control area of 2 pumps. Minimum flows of 500 to 1200 m ³ /h are provided by one pump. If one pump fails, the accumulator can still operate at a capacity of 1800 to 2500 m ³ /h, depending on the current parameter-related status.

Type and design	<p>A. Horizontal single-stage impeller pump, sizes 250-500, on a common frame with an Omega-type flexible coupling motor with console-type impeller suspension (pump shaft mounted on its own bearing housing) with accessories: pressure gauge on discharge (1 pc) and suction (1 pc) with pressure taps (2 pcs) and fasteners – “local measurement”, thermometric nozzles, pressure gauge connections;</p> <p>B. Geometric (common, horizontal) axis of the pump and the motor;</p> <p>C. The design must enable disassembly of the impeller without the need to unscrew the pump nozzles from the pipeline and without the need to move the motor away;</p> <p>D. Material: pump body and gland (cast steel), impeller (cast steel). Cast iron body and rotor are not allowed;</p> <p>E. Pump connection nozzles: PN25;</p> <p>F. Mechanical sealing;</p> <p>G. Bearings on the pump shaft without cooling with service water.</p>
Medium	Table 2.1.4.2 Physical and chemical parameters of DH water
Nominal capacity	Q = 900 m ³ /h
Nominal pump head	H = 80 mH ₂ O (0.78 MPa)
Nominal rotational speed	1 500 rpm
Motor rated power	315 kW
Maximum capacity	1320 m ³ /h
Efficiency for Q _{nom}	83% acc. to PN-EN 9906 class 2B
Vibration	acc. to ISO 10816-7:2009E cat. I (>200 MW)
Noise	acc. to PN-EN 12639:2002
Medium operating temperature	Max. 120°C
Maximum suction pressure	8 bar (0.8 MPa)
Electric motor supply voltage	400 V AC / 690 V AC
Control	Yes / Inverter – special design with the possibility of adding an energy recovery component in the future, 3 items

Acceptance requirements relating to pumps	<p>The pumps must meet the parameter, material and pressure conditions specified in the concept (will be provided after the selection of the Contractor) and include:</p> <ul style="list-style-type: none"> A. energy performance of the pumps should be in accordance with the characteristics presented in the document, after verification at the final design stage, and accepted by the Employer; B. the complete pump-motor-inverter combination should enable operation with the parameters resulting from these characteristics also at $f > 50$ Hz (the range will be specified by the manufacturer); C. each pump must undergo a parametric acceptance test with full energy performance at the pump manufacturer's factory testing station, according to PN-EN ISO 9906, class 2B; D. additional testing of pump-motor-inverter combinations is required (at the user's site) and to determine the actual control curves; for the precise construction of control algorithms and to determine the actual control limits;
	<ul style="list-style-type: none"> E. pump vibration according to PN-ISO 10816-7, cat. I (> 200 kW); F. the pumps must be brand new, as confirmed by material and casting certificates; must have complete technical documentation to adapt them to the essential requirements, applicable EU regulations and directives (Machinery Directive 2006/42/EC), must have an Operating Manual and the EC Declaration of Conformity issued, and must be CE marked.

4.4.3.2. Cold water pumps (CWP) – one of the pumps in the PAT system

Table 4.4.3.2.1 Parameters of cold water pumps

Version:	Cold water pumps
Quantity	3 pieces (including one in the PAT system and 2 adapted to the PAT system – to be implemented later)
Configuration	The entire range of required flows is in the control area of the pump system. One pump shall operate in the PAT system, the remaining pumps shall be hydraulically and structurally adapted to this system. The dominant flows shall be within the operating area of 2 pumps. The third pump must be provided for flows greater than approx. 2200 to 2300 m ³ /h. The control range of the units shall be smaller here than in the case of hot water pumps due to the more stable pressure parameters (constant water level in the Heat Accumulator and stabilised return pressure).

Type and design	<p>A. Single-stage centrifugal pump, sizes 250-500, on a common frame with an Omega-type flexible coupling motor, if the PAT system is implemented, the pump supplier must take into account the two-way operation of the machine (operation with right and left rotations); with accessories: pressure gauge on discharge (1 piece) and suction (1 piece) with pressure taps (2 pieces) and fasteners – “local measurement”, thermometric nozzles, pressure gauge connections;</p> <p>B. Geometric (common, horizontal) axis of the pump and the motor;</p> <p>C. The design must enable disassembly of the impeller without the need to unscrew the pump nozzles from the pipeline and without the need to move the motor away;</p> <p>D. Material: pump body and gland (cast steel), impeller (cast steel). Cast iron body and rotor are not allowed;</p> <p>E. Pump connection nozzles: PN25;</p> <p>F. Mechanical sealing;</p> <p>G. Bearings on the pump shaft without cooling with service water.</p>
Medium	PN-C-04601:1985 Water for energy purposes. Water quality requirements and tests for water boilers and closed district heating circuits”
Nominal capacity	900 m ³ /h
Pump head	H = 65 mH ₂ O (0.64 MPa)
Nominal rotational speed	1 500 rpm
Motor rated power	250 kW
Maximum capacity	1220 m ³ /h
Efficiency for Q _{nom}	82% acc. to PN-EN 9906 class 2B
Vibration	acc. to ISO 10816-7:2009E cat. I >200 MW
Noise	acc. to PN-EN 12639:2002
Medium operating temperature	Max. 100°C
Maximum suction pressure	4 bar (0.4 MPa)
Electric motor supply voltage	400 V AC / 690 V AC
Control	Yes / Inverter – special design with the possibility of energy recovery (regenerative) – 1 item and the possibility of adding an energy recovery component in the future, 2 items

Acceptance requirements relating to pumps	<p>The pumps must meet the parameter, material and pressure conditions specified in the concept (will be provided after the selection of the Contractor) and include:</p> <ul style="list-style-type: none"> A. energy performance of the pumps should be in accordance with the characteristics presented in the document, after verification at the final design stage and accepted by the Employer; B. the complete pump-motor-inverter combination should enable operation with the parameters resulting from these characteristics also at $f > 50$ Hz (the range will be specified by the manufacturer); C. each pump must undergo a parametric acceptance test with full energy performance at the pump manufacturer's factory testing station, according to PN-EN ISO 9906, class 2B; D. additional testing of pump-motor-inverter combinations is required (at the user's site) and to determine the actual control curves; for the precise construction of control algorithms and to determine the actual control limits; E. pump vibration according to PN-ISO 10816-7, cat. I (>200 kW); F. the pumps must be brand new, as confirmed by material and casting certificates; must have complete technical documentation to adapt them to the essential requirements, applicable EU regulations and directives (Machinery Directive 2006/42/EC), must have an Operating Manual and the EC Declaration of Conformity issued, and must be CE marked.
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4.4.3.3. Mixing pump (MP)

The mixing pump (MP) control DH water temperature at the inlet of the Heat Accumulator.

Table 4.4.3.3.1 Parameters of the mixing pump

Model:	Mixing pump for controlling the supply temperature of the heat accumulator
Quantity	1 piece
Configuration	The pump should be connected to the system directly upstream of the accumulator, then its head value will be the lowest because it will be loaded with the same hydrostatic pressure both on the suction and discharge side. Its head value will therefore only depend on inherent resistance of the system.
Type and design	<ul style="list-style-type: none"> A. Single-stage centrifugal pump, sizes 200-315, the "in-line" pump design is allowed, mounted directly on the pipeline, on a light foundation with a centrifugal impeller with accessories, pressure gauge on discharge side (1 piece) and suction (1 piece) with pressure taps (2 pieces) and fasteners – "local measurement", thermometric nozzles, pressure nozzles; B. Geometric (common, vertical) axis of the pump and the motor; C. The design must enable disassembly of the impeller without the need to unscrew the pump nozzles from the pipeline; D. Material: pump body and gland (cast steel or ductile cast iron), impeller (cast steel). Gray cast iron body is not allowed; E. Pump connection nozzles: PN16 / PN25; F. Mechanical sealing; G. Bearings on the pump shaft without cooling with service water.

Medium	PN-C-04601:1985 "Water for energy purposes. Water quality requirements and tests for water boilers and closed district heating circuits"
Nominal capacity	Q = 540 m ³ /h
Methodology for determining the nominal efficiency	Assumptions: <ul style="list-style-type: none"> • charging the heat accumulator with half of the rated power, i.e. 75 MW • value of the water flow to be charged at the level of 1400 t/h; • temperature of hot water from units 110°C and temperature at the DH water return from the city 67°C.
Pump head	H = 24 mH ₂ O (0.23 MPa)
Nominal rotational speed	1 500 rpm
Motor rated power	45 kW
Efficiency for Q _{nom}	82% acc. to PN-EN 9906 class 2B
Vibration	acc. to ISO 10816-7:2009E cat. II
Noise	acc. to PN-EN 12639:2002
Medium operating temperature	Max. 75°C
Maximum suction pressure	8 bar (0.8 MPa)
Electric motor supply voltage	400 V AC / 690 V AC
Control	Yes / Inverter

4.4.3.4. Cold mixing pump (CMP)

The cold mixing pump (CMP) controls DH water temperature at the inlet of the DH system (supply).

Table 4.4.3.4.1 Parameters of the cold mixing pump

Model:	Cold mixing pump for controlling the temperature of the DH water at the inlet to the heating network (supply)
Quantity	2 pieces of the 300-700 size, nozzles Dt/Ds = 300/400
Configuration	2 x 1100 m ³ /h; The cold mixing pumps (CMP), located within the accumulator area, should ensure the mixing flow to approx. 2500 m ³ /h. More intense mixing will require the use of a DH pump for the gas unit or the other heating power units at EC-4. /h, In parametrically necessary situations, an additional flow can be provided by the mixing pump ~500 m ³ /h. Such an approach is justified because it minimises the number of necessary mixing pumps, and therefore investment costs. The suction of cold mixing pumps (CMP) should be located in front of the accumulator cold water (CP) pump. In this way, the range of required control of the mixing pumps is reduced and the operation of the mixing pumps becomes independent (in the parameter-related sense) of the accumulator operating cycle.

Type and design	The pumps must meet the following parameter, material and pressure conditions: A. 300–700 double-flow centrifugal pump; B. pumps should be steel, horizontal, two-flow; centrifugal pump with longitudinally divided spiral body, centrifugal two-flow impeller with accessories: pressure gauge on discharge side (1 piece) and suction (1 piece) with pressure taps (2 pieces) and fasteners – “local measurement”, thermometric nozzles, pressure nozzles;
	C. geometric (common, horizontal) axis of the pump and the motor; D. the design must enable disassembly of the impeller without the need to unscrew the pump nozzles from the pipeline and without the need to move the motor away; E. material: pump body and gland (cast steel), impeller (cast steel). Cast iron body and rotor are not allowed; F. pump connection nozzles: PN25; G. mechanical sealing, Omega type flexible coupling, pump installed together with its motor on a common frame; H. bearings on the pump shaft without cooling with service water.
Medium	PN-C-04601:1985 “Water for energy purposes. Water quality requirements and tests for water boilers and closed district heating circuits”
Nominal capacity	1100 m ³ /h
Nominal pump head	H = 130 mH ₂ O (1.27 MPa)
Nominal rotational speed	1 500 rpm
Motor rated power	560 kW
Maximum capacity	1400 m ³ /h
Efficiency for Q _{nom}	82% acc. to PN-EN 9906 class 1B
Pump vibration	acc. to PN-ISO 10816-7:2009E cat. I (> 200 kW)
Noise	acc. to PN-EN 12639:2002
Medium operating temperature	Max. 75°C
Maximum suction pressure	4 bar (0.4 MPa)
Nominal rotational speed (approx.)	1 500 rpm
Motor rated power	560 kW

Electric motor supply voltage	400 V AC / 690 V AC
Control	Yes / Inverter
Protection against hydraulic overload of pumps	<p>Yes / by equipping the valves on the discharge side with a control drive with continuous control, together with an appropriate pressure differential controller. For extremely high flows and at the same time low availability, the required mixing area slightly “escapes” from the control area of the pump system (control-critical area). Operation of the pumps in this area, possible for electrical reasons (power, current), may be unfavourable from the hydraulic point of view and lead to overloading the machines due to flow. The pumps would then operate in an area outside the Qmax line, which may result in the occurrence of dynamically transient states (vibration). The phenomena may be additionally aggravated by the greater sensitivity of pumps to cavitation hazard (please note that the NPSH curve changes parabolically as Q increases).</p> <p>For this reason, to protect the capable of operating in this area, it is suggested to install a differential pressure-controlled butterfly valve on the pump discharge side (individually on each pump), which will prevent the pump from leaving the control area.*</p>
General requirements	<p>A. energy curves of the pumps should be in accordance with the curves presented in the document, after verification at the final design stage, and accepted by the Employer – the complete pump motor-inverter combination should enable operation with the parameters resulting from these curves also at $f > 50$ Hz;</p> <p>B. Each pump must undergo a parametric acceptance test with full energy performance witnessed by the user's representative at the pump manufacturer's factory testing station – according to EN ISO 9906, class 1B;</p> <p>C. Additional testing of pump-motor-inverter combinations is required (at the user's site) and to determine the actual control characteristics for the development of precise control algorithms and the determination of the actual control limits;</p> <p>D. The pumps must be brand new, as confirmed by material and casting certificates – date of manufacture no earlier than the date of contract for the main project process; must have with complete technical documentation to adapt the pumps to the essential requirements of the applicable EU regulations and directives (Machinery Directive 2006/42/EC); must have an Operating Manual and the EC Declaration of Conformity issued; must be CE marked.</p>

4.4.3.5. Return pressure stabilising pump

Table 4.4.3.5.1 Parameters of return pressure stabilising pumps

Model:	Heat accumulator return pressure stabilising pump
Quantity	2 pieces

Configuration	<p>2 x 60 m³/h</p> <p>The return discharge pump(s) shall be a unit envisaged for the discharge of excess water from the DHN return pipeline into the Heat Accumulator. As a result of changing the DH parameters and possible overheating of the network, there is an increase in the water volume in the system, which is manifested by an increase in the return pressure. The pump should be controlled based on the set pressure value, with the condition that it is not exceeded, i.e. if pressure exceeds the set value, the pump is switched on and water is pumped from the return pipe to the Heat Accumulator, using its maximum retention capacity (the pump should be connected to the maximum water level sensor in the Heat Accumulator). Ultimately, the system shall be equipped with a valve that controls the return pressure using accumulator resources, which enables the implementation of a process that is the opposite of pumps, i.e. making up water in the DH network when the water volume in the network and the pressure in the return pipelines decrease. The retention of the accumulator shall not ensure the make-up of the system water volume losses resulting from normal operating losses – this process will be carried outside the accumulator in a separate part of the EC-4 plant.</p>
Type and design	<p>A. Multi-stage impeller pump, the vertical “in-line” pump design is allowed, mounted directly on the pipeline, on a light foundation with a centrifugal impeller with accessories, pressure gauge on discharge side (1 piece) and suction (1 piece) with pressure taps (2 pieces) and fasteners – “local measurement”, thermometric nozzles, pressure nozzles;</p> <p>B. Geometric (common, vertical) axis of the pump and the motor;</p> <p>C. The design must enable disassembly of the rotating unit without the need to unscrew the pump nozzles from the pipeline;</p> <p>D. Material: pump body and gland (cast steel or cast iron), impellers (Cr-Ni steel);</p> <p>E. Pump connection nozzles: PN25;</p> <p>F. Mechanical sealing.</p>
Medium	PN-C-04601:1985 “Water for energy purposes. Water quality requirements and tests for water boilers and closed district heating circuits”
Nominal capacity	Q = 60 m ³ /h
Pump head	H = 63 mH ₂ O (0.62 MPa)
Nominal rotational speed	n = 3000 rpm
Motor rated power	15 kW
Efficiency for Q _{nom}	75% acc. to PN-EN 9906 class 2B
Vibration	acc. to ISO 10816-7:2009E cat. II
Noise	acc. to PN-EN 12639:2002
Medium operating temperature	Max. 75°C
Maximum suction pressure	4 bar (0.4 MPa)

Electric motor supply voltage	400 V AC / 690 V AC
Control	Yes / Inverter

4.4.4. Equipment of the steam cushion system

In the new pumping station building, in addition to the hot water pumps and cold water mixing pumps in its south-eastern part, it is planned to install equipment for the steam cushion system for the heat accumulator, i.e. circulation pumps and steam generators for the steam cushion system necessary for the proper operation of the accumulator. The electric steam generator shall serve as the primary and backup steam generator for the steam cushion system. Supply water for the generator shall be sourced from the buffer layer located directly under the water surface in the accumulator tank. Depending on the season and the set parameters of the hot water, the water shall have a temperature of approx. 95 to 98°C in winter, approx. 85°C in spring and autumn, and approx. 75°C in summer. In the generator, it shall be superheated to a temperature exceeding 100°C. This water shall be injected through the nozzle into the space of the steam cushion above the water surface in the tank and shall generate the so-called steam fall, i.e. steam and water in the saturation state.

Water circulation through the 2 x 100% circulation pump system in the steam cushion system is necessary due to the need to avoid contact of superheated (process) steam with the water surface in the Heat Accumulator tank and to keep the breather valve filled. The control of steam pressure under the tank roof shall be carried out by the electric steam generator. If the circulation pump(s) of the steam cushion system is/are not working, or there is no flow through the circulation pumps 3 x 50% (common for two steam generators), then the electric steam generator must not be operated either. The buffer layer, at the first start-up of the accumulator, is also generated based on the steam generator by generating the so-called steam fall over the water surface in the accumulator tank. After such a process, the cushion shall be durable and may be subject only to temporary disturbance, i.e. several hours of disturbance, especially at strong water flows charging or discharging the battery or strong changes in the water level in the tank related to the stabilisation of the water volume in the system (pressure control on the network water return pipelines or emergency network make-up).

Remark: It is essential that the operating range of the steam cushion system (in the area of repositioning the suction pipeline with the floater) should be adjusted to the WHAL operating functions anticipated by the project owner and, in particular, enable water to be collected for the steam cushion production process also in the emergency mode when DH water is made up from the WHAL, assuming that the accumulator is not being charged and the level in the tank drops below the normal level adopted for the upper diffuser. Operating range of the diffuser, assuming a tank diameter of 25.5 m, is estimated by the Employer at approx. 3 m (value to be converted during the technical design phase) – see Table 4.4.4.1. below.

Table 4.4.4.1 Moving levels of nozzles (to be clarified at the design stage)

in normal operating conditions of the accumulator due to the change in the volume of water in the tank resulting from the change in the amount of cold and hot water:	approx. 1 m
in extreme operating conditions of the accumulator when there is a need to make up the district heating network in the event of a decrease in the temperature of the medium in the network	approx. 2 m
maximum daily water changes in the tank due to leakage of the district heating network and increased make-up need (the Employer provides this initial estimation based on the assumptions in Appendix 16 to this document)	approx. 3 m

4.4.4.1. Steam cushion system

Table 4.4.4.1.1 Steam cushion system parameters

Model:	Electric steam generator in the steam cushion system
Quantity	2 pieces
Configuration	2 x 100%
Type and design	Horizontal
Medium	PN-C-04601:1985 "Water for energy purposes. Water quality requirements and tests for water boilers and closed district heating circuits"
Nominal pressure	16 bar (1.6 MPa)
Inlet temperature	approx. 75°C to 99°C
Outlet temperature	approx. 120°C to 150°C

4.4.4.2. Steam cushion circulation pumps

Table 4.4.4.2.1 Parameters of steam cushion circulation pumps

Model:	Steam cushion circulation pump
Quantity	3 pieces / 2 steam generators
Configuration	3 x 50%
Type and design	Impeller, centrifugal, horizontal pump with accessories, thermometric nozzles, manometric nozzles.
Medium	PN-C-04601:1985 "Water for energy purposes. Water quality requirements and tests for water boilers and closed district heating circuits"
Capacity	approx. 12 m ³ /h – 20 m ³ /h (the Contractor shall be responsible for the verification of the parameter depending on the requirements of the Employer, the technological solution and the design of the heat accumulator). The accumulator function consisting in stabilising the pressure in the return water pipelines from the DH network and the function of emergency make-up of the DH network in the event of a leak in the system should be included.
Medium operating temperature	73°C to 100°C
Electric motor supply voltage	400 V AC

4.4.5. Emergency overflow pipeline of the Heat Accumulator

In accordance with the requirements, the Heat Accumulator shall be equipped with an emergency (hot) overflow pipeline. The pipe through the water U-bend, which prevents steam from escaping from the steam cushion, shall drain hot water into the sewage system when the maximum permissible water level in the tank is exceeded, and in the case of a cooled medium, through a cooling pit, after reaching a temperature below 350°C, it shall be possible to drain the water into the sanitary and industrial wastewater system. It is necessary to enable operating services to control the discharge of water through the U-bend in order to eliminate DH water losses during the operation of the Heat Accumulator (monitoring of hot water losses). In the Heat Accumulator, which will be operated with a (slightly ~5%) changing liquid level, it is assumed that the liquid level in the tank will change by about 2 m due to the change in volume of the DH water in the system together with the change in volume of hot water in relation to cold water during charging and discharging, the need to collect an additional water flow from the return pressure stabilising pumps if the pressure exceeds the permissible values or an additional water flow to the system if return pressure is too low (to be confirmed at the design stage). Greater level fluctuations are not allowed if the tank operates in the heat accumulation function with the charging function. It is allowed to lower the water level in the tank from the maximum level to about 3 m and to provide a water reserve in the emergency DH network make-up mode, but in this case the tank can only work as a buffer for making up DH water without the possibility of heat accumulation and without the charging process taking place. The control system for the Heat Accumulator (maintaining the maximum permissible level in the tank) shall be configured in such a manner that the emergency overflow through the U-bend is only activated in the event of a fault in the above-mentioned system.

4.4.6. Water drain pipeline of the Heat Accumulator (for service purposes)

In accordance with the requirements, the accumulator shall be equipped with a service drain (drainage) of the tank in the lower part. The drainage pipeline shall be suitable to discharge the cooled water volume from the accumulator into the sewage system in a safe and controlled manner. The drainage pipeline shall be equipped with a double cut-off, ensuring full tightness during the tank operation and a controlled drainage process during the tank drainage process. It is not envisaged to use the drain during normal operation of the Heat Accumulator. It is necessary to enable operating services to control the absence of water leaks through the drain valves in order to eliminate DH water losses during accumulator operation (valve leakage monitoring). The functioning of the bottom and top orifices shall not require periodic inspections or maintenance, and the water in the tank shall not be drained, except in the event of an emergency or general overhauls as specified by the supplier. In order to reduce the amount of water discharged into the sewage system, one of the pressure stabilising pumps on the DH water return line shall be connected to an additional system of reverse pipes with shut-off and return valving to enable the tank to be drained for maintenance without water loss and to pump water back into the (district heating system) when the tank is drained through return pipes of the district heating network. This function will reduce the amount of water lost in such a situation to the necessary minimum. The pump should be equipped with a dry-running protection system.

4.4.7. Hot and cold water pipelines of the Heat Accumulator

Hot water pipelines supply and discharge DH water from and to the Heat Accumulator through the Heat Accumulator pumping station to the connection points prepared by the Employer that will design and connect the above-mentioned pipelines to the EC-4 DH system. The temperature of hot water should be kept relatively constant (in winter) at approx. 98°C, in spring and autumn at approx. 85°C, and in summer at approx. 75°C.

The movable upper orifice built into the accumulator, through which hot water will be supplied to and discharged from the storage tank in a laminar manner, shall always be located at a fixed depth in relation to the water surface in the accumulator tank. With the use of a floater connected to the upper orifice of the accumulator, this position will remain fixed even when the water surface in the tank drops or rises by the assumed 2 metres. This solution with a floater is necessary for the steam cushion system used to determine the position of the suction pipeline that collects water for the steam generator to produce a so-called buffer layer of hot water with a temperature of approximately 99°C and with a thickness 'H', which insulates the steam cushion from the DH water stored in the DH water tank.

The cold water pipeline supplies and drains the DH water to and from the Heat Accumulator via the Heat Accumulator pumping station to the connection point prepared by the Employer that will design and construct the connection of the pipelines to the EC-4 DH system. The temperature of cold water in the accumulator is the temperature (resulting) of return water from the district heating network.

In order to reduce the amount of water discharged into the sewerage system and the loss of thermal energy contained in this water in a situation where excessive pressure (~> 2.5 bar) is recorded in the return network, 2 pumps for stabilising the return water pressure shall be connected to the cold water pipeline, which will inject excess water into the accumulator tank. This function will reduce the amount of water and energy in the DH water lost in the network system to the necessary minimum.

4.4.8. Cold circulation pipeline of the Heat Accumulator

The circulation pipeline connects the cold side of the accumulator (return from the DHN network) and the hot side (accumulator supply from EC-4) and shall be equipped with a mixing pump. The mixing system shall maintain the maximum water temperature at the inlet to the Heat Accumulator at a constant level, regardless of the temperature value of water coming out of the power units to the network supplying the city and charging the accumulator, in the event of exceeding the 98°C threshold (in winter conditions). The mixing system together with the mixing pump shall operate in the event that the temperature range of DH water on the supply of the Heat Accumulator fluctuates between 99°C and 110°C in order to maintain the maximum temperature of water supply to the accumulator up to 98°C. The mixing pump shall also be used to provide additional support for the cold mixing system to enable precise control of the cold mixing water flow in order to maintain the temperature on the supply side of the district heating network. If this is the case, the additional cold water flow from the mixing pump shall be routed to the suction of the hot water pumps and further after mixing with the remaining flow

from the cold mixing pumps to the district heating network. In addition, the Employer envisages the function of water discharge from the accumulator charging pipeline for the above-mentioned pipeline. The discharge shall be carried out towards the return pipelines of the DH network. To this end, it is envisaged to make a bypass of the mixing pump on its discharge side and to connect the bypass pipeline to the cold water pipeline, which will discharge cooled water towards the return pipelines of the district heating network. This pipeline shall be equipped with cut-off and control valving (both types of valving shall be equipped with at least position indicators indicating full closing and opening). This system can also be used as an element of maintaining the pipeline temperature above the freezing zone – in the event of a longer lack of accumulator operation during periods of significant frost. The Employer envisages the pipeline to be approximately DN80 (to be confirmed by the Contractor during the implementation of the project).

4.4.9. Cold mixing pipeline

The cold mixing pipeline along the section from the return pipelines that is shared with the DN 800 cold water pipeline, downstream of DN 800 branching, connects the cold side of the accumulator (return from the DHN network) and the hot side of the exit from the Heat Accumulator to the district heating network and shall be connected to the suction side of cold mixing pumps.

The cold mixing system in the heat accumulator pumping station shall maintain the temperature of water supplied from the accumulator in the direction of exit from the EC-4 at a level similar to that required in accordance with the control table, in the event that the required temperature to the city is below 98°C in the winter season, 85°C in the transitional season and 75°C in the summer season.

The system of cold mixing pumps shall operate in the event that the range of required DH water temperatures on the supply side of the district heating network is lower than the temperature of hot water in the accumulator and fluctuates (between 97°C in winter conditions and 66°C in summer conditions). In this case, the process of mixing with return water carried out by cold mixing pumps shall be necessary in order to achieve the desired parameters of DH water at the exit to the city (in accordance with the control table).

The mixing pump shall also be used for the same purpose, which shall provide additional support for the cold mixing system to enable precise control of the cold mixing water flow in order to maintain the temperature on the supply side of the district heating network. If this is the case, the additional cold water flow from the mixing pump shall be routed to the suction of the hot water pumps.

The temperature of hot water entering and leaving the heat accumulator tank shall be maintained at a relatively constant level, e.g. about 98°C (in winter), and below this temperature, e.g. at a constant level of 85°C (during the transitional period) and at a constant level, e.g. about 75°C (in summer).

4.4.10. Pipelines for the Heat Accumulator – requirements

Steel pipelines shall be constructed in accordance with the requirements of the PED and harmonised standards (PN-EN 13480).

Steel pipelines shall be made of attested steel, at least P235GH steel or its equivalent.

Fixings of steel pipelines shall be provided as spring and tie rod suspensions and as supports: fixed, sliding, sliding, with friction and with limited freedom of movement on springs or without, depending on: medium parameters, displacements and design possibilities at fixing points.

All pipelines and elements installed on them (valving, measurements, fixings, etc.) must be marked and named according to the KKS book (C2GL-VLD-00xxx00-PMT-PRO-0020) – **Appendix 15.4** to this document. In addition, permanent marking (identification colour codes, permissible parameters, medium flow direction) shall be provided on all pipelines in accordance with the standards for marking pipelines.

The design pressure of PS 18 barg and the design temperature $t_{max} = 150^{\circ}\text{C}$ should be assumed.

When making calculations for the pipelines, the settlement of the Heat Accumulator tank shall be taken into account.

The above should be adopted in the analysis of stresses during compensation calculations, when selecting the material and wall thickness of pipelines, fittings, bends and tees.

The design and arrangement of piping systems shall take into account:

- A. the shortest possible routes while maintaining the permissible stresses resulting from the compensation and the parameters of the medium;
- B. the permissible forces and torques on the nozzles of the equipment reserved by the suppliers;
- C. access to equipment for repair and maintenance purposes, ensuring the required vertical and horizontal clearances for personnel (in accordance with health and safety regulations) and vehicles, adapted to the dimensions of the dismantled equipment;
- D. pipeline slopes;
- E. accessibility of valving;
- F. accessibility of I&C equipment;
- G. maintaining the necessary space for insulation works.

Technical requirements for pipelines to the Heat Accumulator:

- A. steel pipes with seam or seamless made of P235GH steel (wall thickness and selection of materials will be confirmed by calculation in the documentation – PN-EN 13480);
- B. Bends – fittings, P235GH steel, type B according to PN-EN 10253-2;
- C. reducers, P235GH steel, type B according to PN-EN 10253-2;
- D. tees, steel P235GH, type B according to PN-EN 10253-2, or nozzles on the pipe confirmed by calculation in the documentation;
- E. basket bottoms, P235GH steel, according to PN-EN 10253-2;
- F. neck flanges, PN25, P280GH steel;

- G. gaskets for flange connections: high-quality, temperature range + 150°C at a pressure of 40 bar, gasket thickness for flange connections up to and including DN 400 – 2 mm, above DN 400 – thickness 3 mm;
- H. thermal insulation with a density of at least 80 kg/m³ ensuring that the temperature on the shell surface (galvanised sheet) is below 50°C;
- I. corrosion coatings (C4) – hot pipelines: heat-resistant silicone primer on zinc powder; surface paint 2 x silicone enamel (painting system to be verified by the Employer at the design stage);
- J. corrosion coatings (C4) – cold pipelines and structures: phthalic and minimum primer (60%); topcoat paint 2 x silicone enamel (painting system to be verified by the Employer at the design stage);
- K. tests to be carried out in accordance with PN-EN 13480-5 as for cat. III, (for welds on pipelines to diffusers in cold and hot space – 100% NDT welds).

4.4.11. Valving

Supplied valving shall comply with applicable standards, regulations and the PED Directive and shall bear the CE marking.

The use of flanged valving shall be envisaged on steel process lines with DH water with diameters above DN 125.

Shut-off and control valves shall be provided with electric drives; the drives shall be unified in terms of suppliers.

It is allowed to use valves with manual drive for service cut-offs and on drains and vents (poppet -type), in normal open or closed operation, with diameters smaller or equal to DN125.

All drainage and venting pipelines shall have double cut-offs.

Valving above DN125 shall be equipped with position indicators.

It is required to unify the supply and select suppliers with proven references in the Polish energy sector.

Access to the shut-off valving must be provided from the ground level or from the working platform.

The first cut-offs on the side of the accumulator tank shall be provided as welded.

4.4.11.1. General requirements for valving

- A. General requirements for all components:
 - a. ambient conditions:
 - temperature: 5 to 80°C;
 - humidity: up to 95%;
 - in the case of outdoor installation, the valving and their drives must be resistant to climatic conditions typical of Poland.
 - b. working medium:

- DH water;
 - operating temperature $t_r = \text{max. } 125^\circ\text{C}$;
 - design temperature $T_S = 150^\circ\text{C}$;
 - operating pressure $p_r = \text{max. } 1.6 \text{ MPa}$;
 - design pressure $P_S = 1.8 \text{ MPa}$;
- c. in terms of strength, valving and equipment shall be selected for the medium temperature of $T_S = 150^\circ\text{C}$ and pressure of $P_S = 1.8 \text{ MPa}$. The conditions for both parameters must be met simultaneously. Valving class PN 25;
 - d. design of the valving must allow efficient opening of the closing unit at the maximum pressure difference that may occur across the valving. unless a different pressure difference value is specified in the contract, the maximum pressure difference is $\Delta p_{\text{max}} = p_r = 1.6 \text{ MPa}$;
 - e. the shut-off valving should ensure the possibility of two-way operation – at the maximum pressure difference, it should provide complete tightness of the cut-off in both directions;
 - f. connection type:
 - welded, preparation of welded connections in accordance with PN-ISO 6761;
 - flanged (the flange shall constitute a uniform part with the valving);
 - g. flange dimensions according to PN-EN 1092-1+A1;
 - h. material: grey cast iron body is not allowed;
 - i. length of the flanged valving installation according to PN-EN 558;
 - j. all materials used in valving components that affect tightness must be corrosion-resistant;
 - k. only materials with quality certificates (attestations) confirming the compliance of their properties with the requirements of the relevant standards and design documentation may be allowed to be used in the manufacture of valving subject to the pressure of the working medium;
 - l. all materials intended for pressure-loaded parts must have acceptance certificates 3.1 according to PN-EN 10204;
 - m. valving shall be resistant to operating stresses caused by mechanical loads (pressure, internal and external stresses, erosion, cavitation) and non-mechanical stresses (temperature, corrosion), which reduce safety, reliability, service life and cause wear and tear of materials;
 - n. valving shall be resistant to cavitation and erosion;
 - o. valving must not have elements requiring periodic maintenance, i.e. elements for lubrication or sealing, available only after its disassembly from the pipeline;
 - p. damage to valving or its drive must not cause sudden closure or opening of the shut-off component;
 - q. valving must be designed in such a manner that the drive can be repaired or replaced without being removed from the pipeline;
 - r. $DN \geq 200$ valving must be equipped with mounting brackets or other elements enabling the fastening of slings for vertical and horizontal transport;
 - s. the permissible noise level, as defined in the PN-B-02151-2 standard, must not exceed 62 dB;
 - t. the connections for the installation of drives and gearboxes must comply with PN-EN ISO 5210 and PN-EN ISO 5211;
 - u. for valving drives with electrical power supply:

- minimum protection rating according to PN-EN 60529: IP 67;
 - minimum protection class: 2;
- v. in accordance with PN-EN 19, the following markings must be permanently and legibly affixed to each piece of valving or rating plate:
- nominal diameter DN;
 - nominal pressure PN;
 - body material;
 - manufacturer's name or trademark;
 - arrow indicating the preferred direction of flow (in the case of butterfly valves);
 - year of manufacture;
 - type of valving;
- w. arrow indicating the preferred direction of flow (in the case of butterfly valves);
- P10 (housing strength);
 - P11 (housing tightness);
 - P12 (tightness of the closure) – required tightness class A (no leakage);
- x. valving must be subjected by the manufacturer to statistical tests to confirm that it meets the requirements of the P-20 test (strength of the closing component) according to PN-EN 12266-2;
- y. valving manufacturers should have a quality management system in place (e.g. in accordance with ISO 9001);
- B. requirements for ball cocks (shut-off cocks):
- a. material:
- body of ball cocks: with connections for welding – low-carbon non-alloy steel with a minimum yield strength of $Re_{min} = 235$ MPa (e.g. P235GH), fine-grained non-alloy steel, e.g. P355N, boiler steel, flanged steel: steel, cast steel, ductile cast iron;
 - ball (closing component) – stainless steel;
 - drive spindle – stainless steel;
 - ball sealing: PTFE + C;
 - stem sealing: EPDM, Viton, PTFE+C;
- b. drive:
- $DN \leq 125$ – manual lever (the price of the lever is included in the price of the cock);
 - $DN > 125$ – manual drive with mechanical gearbox (the price of the gearbox is included in the price of the cock);
 - electric drive – according to the needs specified in the contract;
- c. valving should have a rotation limiter ensuring correct positions in the states of full opening or closing of the valving;
- d. direction of the valve lever should be in accordance with the valve opening status (along the pipeline – open position; perpendicular to the pipeline – closed position);
- e. in the case of mechanical drives, there must be an indicator of the valve opening status in the drive;
- f. height of the guide bushing of the ball drive spindle should ensure the possibility of installing thermal insulation;
- g. it is recommended to make ball cocks in the non-removable version, however – if the contract allows it, they can be made in the demountable version;

- h. DN \geq 65 ball cocks must be equipped with an elastic sealing system ensuring constant pressure of the seal against the ball;
- i. the maximum opening torques of ball cocks (with manual lever) are shown below (Table 4.4.11.1.1):

Table 4.4.11.1.1 Maximum opening moments of ball cocks

DN	M_o , Nm
15	15
20	18
25	23
32	29
40	45
50	55
65	75
80	110
100	170
125	300

C. requirements for poppet valving (cut-off valving)

a. material:

- body of poppet valving with connections for welding:
 - low-carbon non-alloy steel with a minimum yield strength of $Re_{min} = 235$ MPa (e.g. P235GH), fine-grained non-alloy steel, e.g. P355N, boiler steel, flanged steel: steel, cast steel, ductile cast iron;
 - stem sealing: EPDM, Viton, PTFE+C;

b. drive: DN \leq 80 – manual lever (the price of the lever is included in the price of the cock);

c. marking of valving with an arrow indicating the direction of installation, in accordance with the direction of medium flow;

d. in the case of mechanical drives, there must be an indicator of the valve opening status (so-called rotation arrow) on the drive;

D. technical requirements for butterfly valves:

a. cast steel body, PN25 flange connections;

b. metal-to-metal sealing;

c. frictionless closure of the disk against the socket – triple eccentricity of the closure;

d. stellite or bolted body seat;

e. 100% tightness at 25 bar, bi-directional according to EN 12266-1 table A.5, class A, confirmed by a type 3.1 certificate;

f. steel-graphite resilient lamella sealing ring (1.4462 steel) or all-steel;

g. design of the butterfly valves shall compensate for thermal expansion between the disc and the body;

h. elastic metal spiral gasket under the sealing ring;

i. one-piece stem made of high alloy steel ASTM A479 UNS S41000, two sliding bearings and a thrust bearing, transmission of torque from the stem to the disc through the keyway;

j. drive position indicator integrated with the stem;

k. stainless steel rating plate permanently attached to the body flange;

l. selection of drives (SIL level) for the main shut-off butterfly valves of the accumulator tank depending on the results of the HAZOP analysis. The Employer

realises the need to install fast-acting drives for the effective shut-off of water flow to the accumulator in the event of an emergency turbine shutdown for one of the heating power units that charges the tank with hot water (possibility of a sudden drop in the temperature of the water supplying the accumulator).

E. technical requirements for drives:

- a. in closing component control systems, fixed-speed electric actuators with electronic positioners shall be used.
- b. in automatic control systems (ACS), intelligent actuators shall be used;
- c. the electric actuators shall meet the following requirements:
 - tightness class IP 68 according to EN 60529;
 - idle heater;
 - supply of the transducer by a fully separated internal power supply unit (4-20 mA signal);
 - remote control with 24 V DC signals for ON-OFF valving;
 - remote control with 4-20 mA signals for control valving;
 - supply 3 x 400 V AC / 50 Hz;
 - manual drive that must not be made of plastic. The knob shall be disconnected automatically in electric control. The handwheel should be mounted on the side of the drive.
- d. drive with motor thermal protection, phase decay, torque overload in the open and close direction; in addition, overcurrent, short-circuit protection;
- e. testing the sequence of phases and their automatic correction;
- f. electric drive with the possibility of programmable configuration of its parameters by means of buttons placed on its housing without the need to use additional devices and tools;
- g. separation of feedback and control signals from one another and mains voltage;
- h. sending signals: BGE, limit positions of valving, exceeded torque, operational readiness, drive failure;
- i. drive operation in any position;
- j. horizontal orientation of the local control panel regardless of the method of mounting the drive on the valving;
- k. drives on shut-off valving equipped with an integral contactor control system for shut-off valving and a thyristor control system for control valving installed in the drive controller;
- l. drive equipped with a round multi-pin plug-socket electrical connection;
- m. drives shall be selected according to the standard "Industrial valves – Actuators – Part 2: Electric actuators for industrial valves – Basic requirements – EN 15714-2:2010-02;
- n. controller housing independent of the drive housing – the possibility of suspending the controller from the drive after delivery if vibration occurs, operator access is difficult or temperature is high;
- o. drive torque and closing time to be selected in accordance with the design assumptions or guidelines of the manufacturer of the valving on which the drive will be mounted;
- p. drives of shut-off valving on the first cut-off from the side of the Heat Accumulator must ensure closure within no more than 60 s.

4.4.12.Measurement nozzles

The material, shape and dimensions of the measuring nozzles shall be properly selected and sized depending according to the type of equipment installed.

The location of the nozzles for local measurements shall take into account the access to the measuring instrument.

Elements of the pipelines equipped with measuring nozzles shall be protected against damage during transport, storage and installation.

Pressure measuring nozzles shall be terminated with a shut-off valve.

The Employer requires that the measuring nozzles for temperatures should be made as welded thermowells in order to replace sensors in the tank and on pipelines without the need to discharge the medium.

4.4.13.Additional technical requirements

- A. All equipment, valving and pumps must be provided with instructions in the Polish language.
- B. The Contractor shall ensure the supply of materials and components used in the supplied system, meeting all operating conditions of the system and complying with the requirements of standardisation.
- C. Materials for seals and gaskets shall cause no corrosion, contain no asbestos.
- D. All elements intended for installation and their dimensions shall be selected in such a manner that corrosion and erosion phenomena do not adversely affect the service life and performance of the system as a whole throughout its life.
- E. Along the pipelines, nozzles and drainage pipes shall be provided for periodic drainage and venting to allow safe emptying and filling of the system.
- F. The pipelines shall be made in such a manner as to prevent freezing of the medium in the pipelines.
- G. Clean installation conditions must be maintained. The welding method shall minimise the likelihood of introducing welding contaminants and contaminants resulting from the processing of ends prepared for welding into the pipeline.
- H. Once installed, the pipelines shall be flushed internally and cleaned externally. The pressure and/or tightness test of the pipeline shall be carried out after flushing and cleaning, but before the final treatment of the external surface of the pipeline (painting, insulation) and within the scope of the pressure test required by the documentation, i.e. along the section between the valving items.
- I. The Contractor shall carry out tests and inspections in accordance with PN-EN 14015. In addition, at the request of the Employer, the scope of tests in the indicated places may be extended.
- J. The materials of the pipelines and their dimensions shall be selected taking into account corrosion allowance. For diameters below DN350, corrosion allowance min. 1 mm, and above and including min. 3 mm.
- K. The actuators of the valving shall be selected with a sufficient margin taking into account the increase in resistance to manoeuvring in all possible operating conditions.

It shall be possible to open the valve with the actuator at the highest differential pressure that may occur under the operating conditions of the system.

- L. Valving with a design solution allowing only one direction of fluid flow shall be provided with a permanent sign (arrow) indicating this fact.
- M. The direction of rotation for valving closing shall be clockwise. Shut-off and control valving shall be provided with opening (closing) indicators, and control valving – with a scale indicating the degree of opening.

4.5. Detailed description of civil engineering and road disciplines

The scope of Construction Works should include all civil structures necessary for the implementation of the investment project in question, used to achieve the technological and functional objectives of the heat accumulation system. The civil structures should meet the requirements resulting from this document and from applicable law, including compliance with the Construction Law Act, so that after the completion of the investment project, the Contractor obtains an occupancy permit and all other approvals and permits required in accordance with applicable law.

At least the following groups of facilities presented in Table 4.5.1 are planned for the heat accumulation system facilities:

Table 4.5.1 Heat accumulation system facilities

07UNE10	Heat accumulator
07UND10	HAS cold DH water pumping station (adaptation of the existing summer-period pumping station)
07UBA10	HAS Electrical Switchgear – Existing (to be adapted)
07UND20	HAS Hot DH Pumping Station HAS – New
07UNY10	Bridge for DH water pipelines from the Accumulator to the HAS Cold and Hot DH Water Pumping Station
07UNY20	Bridge for DH water pipelines from the HAS hot DH water pumping station to the rest of the EC-4 infrastructure
07UNY30	Bridge for DH water pipelines from the HAS cold DH water pumping station to the rest of the EC-4 infrastructure

In addition, the scope of Construction Works includes the construction of in-house access roads, sidewalks, manoeuvring areas, street lighting and the tidying up of green areas in accordance with the Building Permit as in **Appendix 13** (WHAL-PBM-07NDx00-PER-LAY-0002, WHAL-PBM-07NDx00-PER-LAY-0003) to this document. The Contractor shall attach a general layout in the Offer.

4.5.1. Specific parameters for the scope of construction and erection works

Construction and erection works shall include, among others:

- A. completion of demolitions, alterations and adaptations;

- B. completion of earthworks, including soil replacement and subsoil improvement or indirect foundation, including piling – depending on the needs;
- C. construction of foundations and supporting structures for all process facilities of the heat accumulation system;
- D. installation of all systems, process equipment and control systems constituting a complete plant of the heat accumulation system;
- E. construction of roads, yards and sidewalks as well as restoration of greenery in the area of the location of the heat accumulation system;
- F. adaptation of existing pedestrian and circulation routes to newly designed roads, yards and sidewalks;
- G. construction of all external networks constituting the underground infrastructure in the area of the heat accumulation system together with their integration into the existing system of CHP Plant No. 4;
- H. adaptation of existing buildings to joint operation with the heat accumulation system;
- I. connection of all building systems and process systems of the heat accumulation system to the indicated CHP Plant No. 4 process systems.

4.5.2.Planning and architectural requirements

The HAS civil structures shall be suitable for their intended use, meet the specific architectural requirements and correspond to the current quality standards of civil engineering in the power sector. The form, colour and texture of the HAS building façades shall be agreed with the Employer. For this purpose, the colour scheme adopted in the Building Permit (**Appendix 13**) and the requirements for the colour and appearance of the logotype (**Appendix 17** to this document) may be used as a template. Civil structures and their associated systems shall meet the requirements of Polish Construction Law and its implementing regulations, standards in accordance with separately defined fire protection, environmental protection as well as occupational health and safety requirements, and all legal acts in force in Poland that contain requirements relating to civil structures such as: implementing regulations for geological and mining law, technical supervision acts, aviation law, environmental protection law, waste management acts, etc. Furthermore, the HAS facilities at CHP Plant No. 4 shall take into account the requirements arising from the Protection Plan for CHP Plant No. 4, as agreed with the locally competent police chief, with regard to technical safeguards and ensuring appropriate working conditions for the direct physical security of CHP Plant No. 4.

All civil structures must meet the requirements of the Ordinance of the Minister of Infrastructure on the Technical Conditions to be met by buildings and their location, and in particular all partitions and members of facilities must have adequate thermal insulation (according to **Appendix 2** of the aforementioned Ordinance) unless greater thermal insulation is required for process-related reasons. The same applies to acoustic insulation for which requirements shall be defined according to the requirements of technology, Polish law and local conditions. Compliance with acoustic requirements must be confirmed by appropriate analysis and calculations.

There are no permanent workplaces in the HAS facilities unless it results from the requirements of the Contractor's technology.

An appropriate fire scenario should be prepared for the facilities.

Whenever this specification sets stricter requirements than the applicable laws or standards, the requirements of this specification shall apply.

The Contractor shall be obliged to develop the following designs: replacement design, basic design, detailed engineering designs, installation designs as well as workshop and as-built documentation, and to provide design supervision for the aforementioned designs. The cost of the aforementioned documentation and design supervision shall be included in the scope of the Subject of the Contract.

All materials and equipment used shall bear the relevant approvals for use in civil engineering required by Polish law. The Contractor shall be obliged to provide the aforementioned documents and documents confirming that the products used meet the relevant parameters.

4.5.2.1. Heat Accumulator

It should be equipped with the necessary transport equipment to operate the equipment of this facility, such as hoists or cranes, as well as appropriate platforms (maintenance, repair and circulation platforms) with stairs. The platforms should provide access to the measuring equipment on the wall of the Heat Accumulator (temperature), on the roof (levels, pressure), as well as in the pumping stations.

A suitable hoist (or davit) with a lifting capacity appropriate for the heaviest equipment installed on the roof must be mounted on the roof of the Heat Accumulator.

4.5.2.2. Cold DH water pumping station (adaptation of existing summer-period pumping station).

A single-storey building using the room of the former summer-period pumping station. In the building, it is planned to install or leave the equipment specified below:

- A. 3 cold water pumps;
- B. 1 mixing pump;
- C. 2 pressure stabilising pumps;
- D. necessary pipelines with valving;
- E. new ventilation and air conditioning system, in place of the existing one;
- F. the Mounters dehumidifier for seasonal maintenance of the dry cooling tower to be left in its current location;
- G. cabinets of the Heat Accumulator control system in the I&C room;
- H. Frequency converter cabinets for the above pumps.

Detailed parameters of the pumps are provided in 4.3.3 (Equipment of the hot and cold DH water pumping station of the Heat Accumulator).

The installation of the pumping station should be fully ergonomic and meet all the requirements of health and safety regulations (both required by Polish law and internal regulations at Veolia) and should be equipped with:

- A. materials handling equipment (hoists) adapted to the weight of the transported equipment or its parts
- B. proper platforms enabling the operation and servicing of the equivalent located inside
- C. support structures for pipelines
- D. support structures for cable routes
- E. support structures for HVAC systems
- F. supporting structures for other building and process systems in accordance with the requirements of the technology provided by the Contractor
- G. service ducts.

The pumping station should have transport routes enabling the installation of pumps and equipment as well as frames enabling such transport.

It should also have doors with dimensions and in quantities in accordance with the relevant fire protection requirements for evacuation.

Floors with an appropriate oil-resistant load-bearing capacity, with a washable surface with appropriate slopes and a load-bearing capacity adapted to the movement of vehicles (transport and forklift trucks with a load capacity adapted to the equipment to be handled).

Pump foundations should be structurally separated from the building foundation and floor, protected with oil-resistant and corrosion-resistant coatings that are washable and raised about 10 cm above the floor surface.

4.5.2.3. Electrical switchgear (adaptation of the existing switchgear)

According to the documentation of the existing switchgear, it is divided into the following rooms:

- A. transformer room;
- B. electrical switchgear;
- C. I&C room.

These rooms are described in the design documentation of the existing building (**Appendix 12** to this document).

They should be adapted to the Contractor's technology to a standard no worse than the existing one and brought into line with the existing regulations of Polish law and the insurer.

They should meet current fire regulations and electrical room standards (including the number of doors and distances between them), and ensure the fire-safe evacuation of people operating such rooms.

In the transformer room, there should be steel rails installed, suitable for transporting transformers.

In the transformer room, the number and size of door openings, barriers and ventilation systems must also be customised to the new transformer size.

Particular attention should be paid to the acoustic parameters for door and ventilation openings for this room.

The structure under the transformer stations should provide sufficient load-bearing capacity.

The floors of the electrical switchgear and I&C rooms (system cabinets) are raised (underneath is a cable space) and will require adaptation to the new technology and current regulations.

4.5.2.4. Hot DH Water Pumping Station (New)

A single-storey building is planned for the eastern side of the existing former summer-period pumping station and electrical switchgear.

The following will be installed in the building:

- A. 3 hot water pumps with foundations and supporting structure;
- B. 2 cold mixing pumps with foundations and supporting structure;
- C. necessary pipelines with valving with foundations and support structure;
- D. 2 steam generators with appropriate accessories with foundations and supporting structure;
- E. Frequency converter cabinets for the above pumps.

Detailed parameters of the pumps are provided in sections 4.4.3 and 4.4.4. of this document.

The installation of the pumping station should be fully ergonomic and meet all the requirements of health and safety regulations (both required by Polish law and internal standards at Veolia) and should be equipped with:

- A. materials handling equipment (hoists or travelling crane) adapted to the mass of the transported equipment or its parts;
- B. proper platforms enabling the operation and servicing of the devices located inside;
- C. support structures for pipelines;
- D. support structures for cable routes;
- E. support structures for HVAC systems;
- F. supporting structures for other building and process systems in accordance with the requirements of the technology provided by the Contractor;
- G. service ducts.

The pumping station should have transport routes and laydown areas enabling the installation of pumps and equipment as well as frames enabling such transport.

Existing MV and LV cable lines should be protected with conduits or be installed in a cable duct.

The pumping station should also have doors with dimensions and in quantities in accordance with the relevant fire protection requirements for evacuation.

Floors with an appropriate oil-resistant load-bearing capacity, with a washable surface with appropriate slopes and a load-bearing capacity adapted to the movement of vehicles (transport and forklift trucks with a load capacity adapted to the equipment to be handled).

Pump foundations should be structurally separated from the building foundation and floor, and protected with oil-resistant and corrosion and resistant coatings that are washable and raised about 15 cm above the floor surface.

The building shall feature a concrete band around the building.

4.5.3. Fire resistance of civil structures

WHAL civil structures and their components shall ensure that the load-bearing capacity of the entire structure and its components, as well as fire integrity and insulation, are maintained for a period of time resulting from applicable regulations in the event of a fire. Fire resistance shall be determined according to the function of the building or its part separated by fire divisions, its height, fire load, and the fixed fire extinguishing equipment used. In addition, the consequences of destruction of a building structure or its components as a result of a fire should be taken into account.

Fire compartments and fire divisions

- A. The facilities shall be divided into appropriate fire compartments. Fire compartments and their size shall meet the requirements of applicable regulations.
- B. Rooms in buildings such as switchgears, cable spaces, cable ducts, transformer rooms and civil structures shall constitute separate fire compartments.

Fire detection and alarm equipment

- A. The civil structures shall be equipped with fire detection devices ensuring the detection of fire in its initial phase.
- B. The alarm system outside the fire detection equipment shall be provided with fire alarm call points. This system should be compatible and connected to the in-house fire protection system of the CHP plant.

Fire-fighting equipment

- A. The Contractor shall provide a set of fire equipment and systems for external and internal fire extinguishing operations, including: fixed, semi-fixed systems (if required by Polish law) and hand-held fire extinguishing equipment. Fire extinguishing equipment shall be capable of operating autonomously in the absence of power supply.

Smoke extraction ventilation

- A. WHAL facilities and electrical rooms, switchgears, transformer rooms and escape routes in buildings etc. shall be provided with smoke extraction ventilation (**if required by Polish law**).
- B. Smoke extraction ventilation shall be capable of being started automatically and manually, both from the inside of the room undergoing smoke extraction and from the outside.
- C. In order to ensure the proper functioning of smoke extraction ventilation, air supply vents should be used for rooms undergoing smoke extraction, the opening of which shall be synchronised with the operation of the smoke extraction system.

Explosion protection

- A. At the building permit design and basic design stage, the Contractor shall assess the explosion hazard of rooms and determine explosion hazard zones in the degree of detail corresponding to a given design phase;
- B. The Contractor shall provide solutions minimising the possibility of explosion hazard, preventing the formation of an explosive concentration of gases or dusts in the rooms **(if such rooms or zones occur)**;
- C. In areas at risk of explosion, there shall be equipment that will not pose a risk of initiating an explosion as well as materials and finishes eliminating the possibility of electrostatic discharge **(if such areas occur)**.

Fire protection of steel structures of civil structures

- A. Fire protections should be made in accordance with the relevant regulations and design guidelines, respectively for the required fire resistance of individual structural members of buildings. It is required that intumescent paints or non-combustible gypsum boards, e.g. Ridurit or equivalent, should be used to provide fire protection for the steel structure.

4.5.4. Requirements for the structural, civil engineering and road disciplines

4.5.4.1. Common requirements

- A. The durability of all civil structures is assumed to be min. 50 years.
- B. All concrete and reinforced concrete structures shall have a selected environmental exposure class depending on the corrosive environment for the individual components, assuming that the resistance of additional protective coatings is not taken into account.
- C. All above-ground steel structures and those that come into contact with atmospheric air must have appropriate corrosion protection suitable for the environment in which they will be located, but not less than for C4 – corrosive environment (according to PN-EN ISO 12944-2) for a long (H) service life (according to PN-EN 12944-1). The corrosion protection of the Heat Accumulator's steel tank is an exception, which is described in the Heat Accumulator section.
- D. For other steel components, the corrosion protection requirements are the same as for steel structures.
- E. However, all steel structures that are immersed in water or in contact with the ground should be protected according to the corrosive environment in which they will be located. The Contractor shall assume the classification of corrosive environment in accordance with the soil tests, which the Contractor is obliged to carry out, but the selected protections must not offer lower (worse) properties than the protections resulting from the Soil Test Documentation as well as Im1 and Im3 environments (according to the PN-EN ISO 12944-2 standard) for a long durability period (H), as provided by the Employer.
- F. Structures and other building components shall have adequate chemical protection against the environment in which they are located and against chemical substances and process-related effects.
- G. The Employer has (for reference) the geological engineering documentation as well as the documentation of the subsoil surveys.

NOTE: The responsibility for the use of the above-mentioned documentation prepared by the Employer or its updating lies with the Contractor. In case of doubt, the Contractor shall be obliged to carry out its own supplementary geotechnical/geological surveys, as well as to supplement the aforementioned surveys with documents required by Polish law (including geotechnical designs).

- H. The structure of the facilities must meet the requirements of structural safety and be able to bear the process-related and environmental loads specified in the Polish PN-EN standards for this type of facility, in accordance with the technical conditions for buildings and the requirements of other standards stipulated by Polish law.
- I. Civil structures shall be designed and constructed in such a manner that the loads to be applied to them do not cause:
 - a. destruction or damage of all or part of the facility;
 - b. occurrence of excessive deformations or displacements of the facility or its elements that would prevent the proper operation of the facility, equipment installed in it or adversely affect the appearance of the facility;
 - c. occurrence of excessive vibration, which may adversely affect the operation or installed equipment;
 - d. occurrence of damage and losses disproportionate to the cause as a result of the occurrence of emergency situations.
- J. The above-mentioned structural safety conditions shall be deemed fulfilled if the civil structure complies with the requirements of Polish Standards and legal acts relating to the determination of the conditions for the foundation system of the structure, structural design, construction, quality control and acceptance, as well as the best practices in the construction industry. Conducting construction and erection works for a structure should be under the supervision of persons with the required qualifications, based on the work method statement and installation designs.
- K. All steel structures in the civil engineering and system-related part shall have electrical (metallic) continuity and shall be connected to the equipotential bonding system.

4.5.4.2. Civil engineering and structural requirements for HAS Facilities (specific requirements)

Heat Accumulator

For the foundation system of the tank, the construction of a foundation slab is planned. Due to the existence of a non-construction embankment layer that is approx. 3–4 metres thick, it will most likely be necessary to replace or reinforce the soil or to construct an indirect foundation (on large-diameter piles, directional piles, or other solutions to be agreed with the Employer). The selection and responsibility for the selection of the appropriate solution remains with the Contractor. Execution of a safe foundation system supported by appropriate calculations and a detailed engineering design for both reinforcement and replacement of the subsoil and the execution of indirect foundation – within the scope of the Contractor.

It is planned to provide a slab foundation with the following parameters:

- A. foundation slab:
 - a. concrete min. C30/37 (with shrinkage minimising properties);
 - b. reinforcing steel (primary reinforcement) BSt500S (AIIIIN);

- B. external surfaces of the concrete in contact with the ground should be protected with bituminous material;
- C. accumulator tank should be equipped with a flat bottom, shell, roof, spiral stairs and platforms necessary for the proper service of the Heat Accumulator;
- D. these solutions must be designed in accordance with the regulations and technical knowledge;
- E. in order to minimise losses, the tank shall be covered from the outside of the walls and the roof with insulation with a thickness of at least 500 mm and a conductivity of less than 0.045 W/(mK);
- F. type and design: steel tank with sheet metal welded panelling, cylindrical with vertical axis, with roof, fixed bottom, thermally insulated;
- G. bottom ring and bottom panelling on an insulated concrete foundation;
- H. tank shell with hatch and stiffening rings;
- I. roof (roof ring, girders and load-bearing beams as well as panelling sheets, inspection hatch);
- J. corrosion protection: accumulator tank on the inside and outside – sheet metal cleaning:
 - a. mechanical cleaning of welds;
 - b. surface cleaning to obtain the cleanliness required by the standards;
- K. basic materials of the Heat Accumulator (to be confirmed by the Contractor at the detailed engineering design stage and to be approved by the Employer):
 - a. shell and bottom ring sheets, P355NH steel;
 - b. bottom and roof dome sheets, S235JRG2 steel;
 - c. rolled profiles: steel S235JRG2 and S275JR;
 - d. pipes: steel S235JRG2 and P355GH;
 - e. and others referred to in the following standards – to be accepted by the Employer;
- L. structural requirements for the steel tank shell:
 - a. damage consequence class – min. CC2 (acc. to PN-EN 1990 and PN-EN 14015);
 - b. Service category – min. SC1 – acc. to PN-EN-1090-2;
 - c. Production category – min. PC2 – acc. to PN-EN-1090-2;
 - d. Structure execution class – min. EXC2 – acc. to PN-EN-1090-2;
 - e. in addition, the scope of tests must meet the requirements of PN-EN 14015:2010;
 - f. Design durability min. 25 years.

The Employer reserves the right to raise some of the requirements described in PN-EN 1090-2 Appendix A.3 (i.e. items for points 7.4 and 7.6 and 12.4.2.3. and 12.7.3.1) for the structure execution class EC3 structure after prior agreement with the Contractor's designer.

Standards for the design and fabrication of the Heat Accumulator:

- A. PN-EN 1991-4 Eurocode 1: Actions on structures – Part 1-4: Silos and tanks;
- B. PN-EN 1993-1-6 Eurocode 3: Design of steel structures – Part 1-6: Strength and stability of shell structures;
- C. PN-EN 1993-4-2 Eurocode 3: Design of steel structures – Part 4-2: Tanks;

- D. PN-EN 14015:2010 Specification for the design and manufacture of site built, vertical, cylindrical, flat-bottomed, above ground, welded, steel tanks for the storage of liquids at ambient temperature and above;
- E. PN-EN 1090-2 2008 Execution of steel structures and aluminium structures. Part 2: Technical requirements for steel structures;
- F. and the standards referred to in the aforementioned standards in the scopes referred to in the references for application.

Buildings for the foundation system and supply of the pump system

It is expected that the cold water pump systems for the heat accumulator will be located in the existing summer-period pumping station building adapted to the DH water pumping station building. As part of the adaptation of the building, it is planned to demolish the old and make new foundations for 3 cold water pumps, 1 mixing pump and 2 pumps for stabilising the pressure of return from the district heating network, changing the layout of supports for pipelines and changing the location of pipelines outside the building. It is also possible that existing manual handling equipment will be adapted. Due to the limited space in this building, a new pumping station is planned to be constructed, which will accommodate the hot water pumps, cold mix pumps, steam generators and other accumulator systems. In this part, it is planned to locate 2 cold mixing pumps, 3 hot water pumps and automation cabinets for the accumulator system. The new part of the pumping station is planned to be located on the eastern side of the switchgear that currently supplies the summer-period pumping station, and ultimately to supply the complete accumulator system as well as the electrode boiler (general purposes) that is planned for future installation. The new building shall be constructed in a similar manner to the existing summer-period pumping station building.

It is assumed that the building of the existing switchgear is sufficient to supply the new pumping station system serving the Heat Accumulator and only requires adjustments to some of the electrical infrastructure and the ventilation and air conditioning system.

Adaptation of the summer-period pumping station building to the HAS Cold DH Water Pumping Station and the HAS Electrical Switchgear Building

It is envisaged that new pumps will be installed in the existing summer-period pumping station building in accordance with the technology description in another specification section. The following elements shall be provided as part of the adaptation of the existing building:

- A. new foundations for the cold DH water pump, mixing and pressure stabilising pump (old foundations to be demolished);
- B. linear drainage in the area of foundations;
- C. service ducts;
- D. foundations for pipelines;
- E. supports for pipelines in the form of steel frames placed on foundation feet;
- F. replacement of the 0.00 floor slab in part of the hall, along with demolition of existing foundations for equipment;
- G. penetrations in external walls at the points where pipes pass through;
- H. possibly sound insulation of external walls and the gate;
- I. installation of service and maintenance platforms in accordance with the requirements of the delivered technology to be agreed with the Employer;
- J. adaptation of switchgear and transformer rooms in order to install new supply equipment (including new transformer doors, ventilation of transformer rooms, possibly a partition wall between the transformers);

- K. installation of the pump system together with the pipeline infrastructure;
- L. replacement of the existing raised floor with bases for electrical and automation cabinets with adequate fire resistance.

Construction of a new part of the pumping station for the location of other equipment and systems – Hot DH Water Pumping Station

The new building shall be constructed in a similar manner to the existing summer-period pumping station building, i.e.: It is expected that the supporting structure of the pumping station in the transverse direction will consist of rigid frames with joint fixing in the foundation. In the longitudinal direction, the joint system braced in the axes in the edge area. Roof covering of the pumping station building: corrugated sheet metal on purlins, horizontal bracing. Sandwich walls shall be fastened to steel structure members. In the new DH water pumping station building, mainly hot DH water pumps, cold mix pumps and steam generators for the steam cushion with the necessary pumps and pipelines shall be installed. The following members shall be provided as part of the construction works for the above-mentioned building:

- A. new foundations for the hot DH water pump, cold mix pump and other equipment, including steam generators with accompanying infrastructure;
- B. linear drainage in the area of foundations;
- C. service ducts;
- D. foundations for pipelines;
- E. supports for pipelines in the form of steel frames placed on foundation feet;
- F. passages in external walls at the points in places of the foundation system of pipelines;
- G. thermal insulation and soundproofing of external walls as well as gates and entrance doors;
- H. interconnection of switchgear and transformer rooms in order to connect new supply equipment for the above-mentioned infrastructure;
- I. system of pumps for: hot water, circulation pumps for the steam cushion;
- J. foundations of the steam cushion generator and the steam cushion system pump system;
- K. foundations for electrical and I&C cabinets;
- L. installation of service and maintenance platforms in accordance with the requirements of the delivered technology to be agreed with the Employer;
- M. installation of conduits or a cable duct to protect the existing MV and LV cables.

The pumping station shall be equipped with hoists or travelling cranes to service the pumps and other equipment, with a load capacity suitable for the installed equipment. The required load capacity of the travelling crane shall be confirmed by the Contractor at the detailed engineering design stage and presented to the Employer for approval.

Construction of a new bridge for DH water pipelines from the Heat Accumulator to the HAS Pumping Station

The bridge for DH water pipelines as well as electrical and control cables shall connect the Heat Accumulator with cold DH water and hot DH water pumping stations. It is to be made as a steel structure based on reinforced concrete foundations. The height of the pipe bridge shall allow the truck to pass between the Heat Accumulator and the pumping station and switchgear buildings (the dimensions of the road gauge to be maintained are at least 5.4 m). The pipe bridge shall feature an earthing system. Bridge structures shall be designed and constructed in accordance with PN-EN (Eurocodes) standards listed in the current Ordinance of the Minister of Development and Technology on “Technical Conditions to be met by buildings...”.

Construction of members of the new bridge for DH water pipelines from the HAS Pumping Station to the bridge for DH water pipelines to the city

The DH pipeline bridge shall connect the cold and hot water pumping stations with the remaining EC-4 infrastructure (DH water pipelines). It is to be made as a steel structure based on reinforced concrete foundations. The height of the pipe bridge shall allow the truck to pass over the existing and newly designed road and circulation system by the Contractor (the dimensions of the road gauge to be maintained are at least 5.4 m). The pipe bridge shall feature an earthing system. Partial use of the structures of the existing heating pipe bridges (support structures of heat pipelines) is assumed. Bridge structures shall be designed and constructed in accordance with PN-EN (Eurocodes) standards listed in the current Ordinance of the Minister of Development and Technology on "Technical Conditions". Please be advised that the Employer, as part of a separate task, intends to raise the existing pipelines by about 1 metre to obtain an adequate road gauge for the transported elements for the construction of a new gas unit.

4.5.5. Requirements for structural members

Concrete and reinforced concrete structures as well as members shall be made of concrete that meets the requirements of the most recent edition of the PN-EN 206 standard. Concrete samples shall undergo appropriate tests in accordance with the requirements of the above-mentioned standard in a Laboratory independent of the concrete manufacturer.

All structures and members of civil structures shall be made in accordance with the requirements and recommendations of the standards related to and referred to in the relevant PN-EN standards (Eurocode). The concrete production and treatment technology shall comply with the requirements of PN-EN 13670 and be described in detail in the relevant working designs and work method statements, including information on the location of construction and expansion joints, as well as the use of appropriate concrete mixes (special requirements apply to the construction of the Heat Accumulator foundation).

The use of formwork and engineered scaffolding is required.

The Employer reserves the right to the presence of appropriate construction products, including concrete, reinforcement and steel members, during the tests. Particular attention shall be paid to the inspection of welding processes. The execution of welded joints at the construction site should be limited to the necessary minimum and agreed with the Employer.

It is required to use marked bolt sets with at least one washer under the nut.

Differences in the settlement of individual facilities as well as between facilities must meet the requirements of the relevant Polish standards and the requirements of the installed process-related systems and equipment.

Structures, wall cladding and other structural members shall be protected against damage during construction works.

Requirements for structural members:

- A. The foundations of civil structures shall ensure the transfer of loads from the structure to the subsoil while meeting the load-bearing and service limit states. Both direct and

indirect foundations should be considered depending on the actual soil conditions at the foundation site, as determined by subsoil surveys. The number, arrangement and depth of the boreholes depend on the requirements determined by the structure and the geotechnical conditions prevailing in a given place. The verification and possible supplementation of the geotechnical and hydrogeological documentation provided by the Employer shall remain with the Contractor.

- B. Foundation works also include reinforcement or replacement of the subsoil.
- C. The foundations placed in the soil shall be protected against the impact of groundwater with an insulating layer. Parts of the foundations, located above the ground surface or above the floor level in closed rooms, shall be protected against atmospheric factors and media occurring there.
- D. The foundations shall be protected against being washed away, e.g. caused by a failure of pipelines located nearby.
- E. The execution of reinforced concrete foundations shall allow the use of their reinforcement as natural earth electrodes.

Foundations of equipment:

- A. The foundations of equipment shall meet the requirements relating to civil structures, as well as additional requirements resulting from the specificity of the equipment placed on these foundations.
- B. The foundations of equipment generating dynamic loads should absolutely be made of reinforced concrete. The foundations shall be designed and constructed in a manner that prevents the transmission of vibration to adjacent structures.
- C. Surfaces of foundations exposed to oil shall be protected with oil-resistant coatings. In places of potential oil leakage, appropriate trays should be provided to protect against oil spillage into the surrounding area.
- D. The foundations of equipment (heat accumulator and possibly an electrode boiler) shall have benchmarks installed to assess the settlement of foundations. The benchmarks shall be protected against accidental damage during operation. The number and arrangement of benchmarks shall be agreed with the Employer.
- E. The joints of equipment with the foundation shall be detachable in order to enable disassembly of the equipment.

Above-ground structures:

- A. Above-ground structures of civil structures shall be made of steel, reinforced concrete or brick.
- B. Reinforced concrete, as a structural material, shall be used for elements of facilities that must be fire-resistant or are constantly exposed to contact with water or moisture, or where it is justified by structural reasons. Reinforced concrete floor slabs (if any) shall primarily be wet cast. Reinforced concrete prefabricated floor slabs may only be used as roof slabs or to cover installation clearances.
- C. Steel shall be the basic structural material of civil structures. Installation joints of steel structure members shall be bolted. Connectors for steel structures shall have increased corrosion resistance. Wherever a steel structure is exposed to moisture, the lower parts of the steel columns shall be concreted to a level of 0.3 m above the ground or floor level and protected with coatings such as floors.

- D. Steel structures shall be made in such a manner that they do not have places (“pockets”) enabling the accumulation of water, dust and other contaminants.
- E. The Contractor shall use vibration protection elements everywhere and expansion joints where necessary to eliminate the harmful impact of vibration on structures, equipment, civil structures and people.
- F. Steel structures shall be protected against corrosion by painting or hot-dip galvanising. Galvanising should be used primarily on steel structure members exposed to atmospheric factors and on such elements as platform gratings, ribbed or chequered sheets covering platforms, steel structure members made of thin-walled profiles and small elements such as steel structure connectors, etc.
- G. Steel structures including complete corrosion protection shall be delivered to the Construction Site as ready to erect. The individual shipping elements of the steel structure for all HAS structures shall be uniformly marked in a manner that enables their unambiguous identification.
- H. Platform gratings should be made as non-slip in areas where there is a risk of slipping due to snow, ice, grease or moisture. Steps for the above instances must be finished with a non-slip strip.
- I. Additional structures such as service platforms, ladders, support structures, reinforcements of existing structures, etc., shall be delivered as ready for installation and shall have all the necessary fixing elements. Their colours scheme shall be adapted to the colour scheme of the existing structure.
- J. The method of transport, storage at the construction site and installation should protect against damage to the structure itself and corrosion coatings.
- K. Reinforced concrete structures shall ensure that the strength and serviceability conditions are met and shall be characterised by resistance to environmental factors (appropriate exposure classes shall be established).
- L. The basic type of reinforced concrete structure is its monolithic construction made of concrete of minimum class C25/30. Prefabricated units may be used as roof slabs, as well as in cases of secondary members, intended for periodic disassembly, for example, slabs covering ducts, chambers, etc.
- M. Surfaces of members poured using concrete shall be uniform, smooth and without excessive discolouration (this applies in particular to all uncovered concrete surfaces). Reinforced concrete of members exposed to atmospheric factors shall be characterised by high frost resistance, and in the case of members exposed to constant contact with water – water resistance. Concrete surfaces exposed to corrosive chemical agents shall be covered with chemical-resistant coatings. The method of finishing the concrete surface, frost resistance, water resistance and possibly additional protection of the surface by its impregnation or chemical resistant coatings shall be clearly specified in the technical documentation. All permanently exposed edges of reinforced concrete structures shall have 2 x 2 cm bevels.

Underground structures – ducts

- A. Underground structures shall be made of reinforced concrete.
- B. The surfaces of the structure in direct contact with the ground shall feature damp-proofing and, in the event of direct exposure to water, water-proofing with a damage-resistant layer. If exposed to water pressure, the component shall be sufficiently

watertight. Members of the structure exposed to moisture and negative temperatures shall be characterised by high frost resistance. If it is necessary to ensure positive temperatures in the interior of the room, adequate thermal insulation of walls and ceilings should be ensured.

- C. In the case of the foundation system of reinforced concrete structures below the groundwater level, waterproof insulation of the walls and bottom slabs shall be designed and made from the outside to guarantee tightness and provide protection against damage.
- D. The ducts shall be made as reinforced-concrete structures. Cable ducts and pipelines shall have removable prefabricated covers. It is advisable to make it possible to completely uncover a given section of the duct. In addition, the following requirements shall be met:
 - a. covering of the ducts shall protect against the ingress of rainwater;
 - b. in the case of installation ducts, drainage should be used to ensure the removal of any water that seeps inside;
 - c. reinforced concrete ducts shall be expansion jointed and sealed at the expansion joints in accordance with the recommendations of the relevant Polish Standard concerning the design of reinforced concrete structures, both along the length and at the points where the tunnel or duct connects to another civil structure;
 - d. for underground ducts, descent points (not less than one) should be designated, equipped with steel steps attached to the walls to enable convenient descent into their interior. The number of places in which they will be used should be agreed with the Employer.

Building partitions

- A. Building partitions, i.e. ceilings, walls and roofs, shall provide protection against weather conditions, the required thermal and acoustic insulation, and shall constitute fire separation (where required).
- B. Building partitions shall be made of non-combustible materials.
- C. Exterior walls:
 - a. external walls shall primarily be made of smooth sandwich panels with a mineral wool core. Only the lower parts of walls that may be exposed to impact or in the case of low single-storey buildings, when it is functionally or aesthetically required, should be made of brick. External walls with a height of at least 0.50 m shall be made of masonry and finished with a 12 cm layer of clinker bricks.
 - b. Walls for which increased fire resistance will be required shall be made of brick or reinforced concrete.
 - c. Sheet metal used to make façade panels must come from one production batch.
 - d. During the erection period, the curtain wall surfaces on all working levels shall be permanently protected against damage.
 - e. Brick walls (except for clinker brick walls) shall be plastered with cement-lime plaster that meets the requirements for category III.

Internal walls: Internal walls (if any) shall be made of brick, concrete or reinforced concrete. The walls shall provide adequate acoustic insulation and have the required fire resistance if they constitute fire separation.

Ceilings

- A. The ceilings on the process levels may be open-work, made of galvanised 'Mostostal' type platform gratings or equivalent. It is required to provide anti-slip platform gratings for all outdoor platforms and stairs. To fix the platform gratings to the ceiling support structure, it is required to use Hilti-type fasteners or equivalent, i.e. those shot into the support structure.
- B. All service penetrations through ceilings and ceiling edges must be equipped with bushings or flanges installed before the ceilings are concreted. For open-work floors and platforms, all service penetrations through the floor gratings and the gratings around the structural members shall be fitted with sheet metal flanges.
- C. The floors on reinforced concrete ceilings and floors on the ground shall be made of concrete – concrete class min. C25/30 and in the appropriate exposure class. In order to ensure the appropriate floor standard, the subfloors must be perfectly even and sloped appropriately.
- D. Reinforcement must be used for floors in rooms with heavy traffic. The floor surface shall be hardened by screeding with a mixture of hard aggregates, high-performance cements and modifying additives to form a smooth, hard and abrasion-resistant, non-dusting and non-absorbent layer.

Roofs

- A. The roofing of heated steel-framed buildings should primarily consist of coated trapezoidal sheet metal, rigid mineral wool and heat-sealable modified roofing membrane (2 layers – top layer and base layer) or thermally insulated engineered mineral-wool layered roof panels. A vapour barrier must be used. Sheet metal flashings made of galvanised and coated sheet with a minimum thickness of 0.8 mm. It is not allowed to use sandwich roof panels with a polystyrene or polyurethane foam core.
 - a. All roofs shall have a rainwater drainage system connected to the stormwater system. When draining rainwater from the roof into the building, the roof drain should be heated.
 - b. It is necessary to provide main circulation routes to equipment requiring constant maintenance, periodic activities requiring the use of tools or local access to equipment requiring occasional maintenance using reinforced roof slopes, e.g. by means of an additional layer of heat-sealable roofing membranes in a colour contrasting to the roof covering.
 - c. Easy and safe access to the roofs of all facilities shall be provided through exits with a light hatch, with a lighting function or, alternatively, by means of an external ladder permanently attached to the structure of the facility in accordance with the relevant regulations. Safe maintenance and operation works on the roof (e.g. snow removal) should be ensured.
 - d. Roofs shall be protected against falls from height. Wherever required by the technical equipment or for periodic maintenance of the roof or façade during the operating stage, items such as hooks, safety line holders, etc. shall be installed to enable safe work at heights.
 - e. The roof structure must be able to withstand snow loads in accordance with DIN EN 1991-1-4 and loads from the bidder's installed equipment and technology

as well as due to operation in accordance with DIN EN 1991-1, but not less than 0.50 kN/m².

Joinery

- A. Entrance gates used for process rooms shall be sectional, insulated and controlled gates with an electric drive. The gates should be suitable to be manually opened and closed. In addition, there will be a door near the gate to allow access without lifting the gates. The gates shall be made of aluminium profiles. In justified cases, e.g. when fire resistance of the gate is required, steel structure gates may be used in agreement with the Employer.
- B. Window joinery used in the power plant facilities shall be made of aluminium profiles with thermal insulation, powder-coated in the colour indicated by the Employer. Corrosion protection for the C4 corrosive environment for a long service life according to PN-EN ISO 12944. Minimum technical requirements for glazing to be used in accordance with the current provisions of Polish law, but not less than:
 - a. Heat transfer coefficient $U \leq 1.4 \text{ W/m}^2\text{xK}$;
 - b. Sound attenuation coefficient $d \geq 32\text{dB}$ (and meeting the acoustic requirements according to their location in appropriate partitions and buildings).
- C. The door joinery used in external partitions and for technical rooms shall be made of powder-coated aluminium profiles in RAL colour agreed with the Employer. In partitions with thermal protection, they shall be provided with thermal insulation. External doors and in places indicated by the Employer shall be equipped with door closers. The doors located along evacuation routes shall be additionally equipped with panic locks. Corrosion protection for the C4 corrosive environment for a long service life according to PN-EN ISO 12944.
 - a. External doors and external gates leading to rooms where people are expected to be present should be equipped with air locks or air curtains or other means that prevent the exchange of air.

Door joinery should be designed to accommodate Access Control System components – details in section 4.8.10 of this document.

Circulation and transport in civil structures

- A. The circulation routes inside the building shall enable the transportation of process equipment associated with the EC-4 HAS and Electrode Boiler during operation and for maintenance purposes, and shall include all transportation routes, platforms, stairs, ladders, as well as goods and passenger lifts needed for the transportation (optional) for the heat accumulator, evacuation, equipment service and repair purposes, as well as access to measuring points. The design, dimensions and layout of roads, platforms, stairs, ladders and railings shall comply with the requirements of the applicable health and safety and fire regulations.
- B. The stairs where fire resistance is required shall be made of reinforced concrete.
- C. Service platforms and access ways to equipment may be made of reinforced concrete, steel or a combination of both. The service platforms and access ways to outdoor equipment shall have an open-work covering on which snow will not accumulate – panels and steps with anti-slip platform gratings.
- D. Circulation areas shall have a non-slip finish.

- E. The dimensions of the circulation roads, the width of the stairs and landings, the dimensions of the steps, and the shape and dimensions of the railings shall comply with the regulations in force in Poland and shall be adapted to the requirements of internal transport during operation.
- F. Roads in buildings shall be clearly marked as continuous lanes in a highly visible colour (taking into account the colour of the floor) – in accordance with applicable standards.
- G. The interior of the goods and passenger lifts shall be made in accordance with the basic standard (coated sheet metal), i.e. wall panels, doors, ceiling and handrails. Operating panel shall be made according to the basic standard. All shall be made in a manner that enables long-term and failure-free operation. Both the interior of the cars and the equipment of the lifts on each level will be designed in a manner that facilitates cleaning. Floor shall be made of durable, impact-resistant and abrasion-resistant material. The interiors of the lifts shall be illuminated with indirect lighting. In addition, the lifts should be equipped with: car overload signalling, emergency power supply for lowering the lift to the nearest landing and opening the doors in the event of a malfunction, lowering the car to the ground floor, opening the doors and locking them (according to fire protection requirements), intercom with automatic dialling of programmed emergency numbers. Displays showing the position and direction of the cabin should be placed at all levels and in the car. All lifts shall be in accordance with Directive 96/16/EC “Lifts and safety components”.

4.5.6. Corrosion and chemical protection in civil structures

General requirements:

- A. The requirement to use corrosion protection applies to all members of civil structures. The Contractor shall ensure a high standard of the provision of protection and its durability. The type of protection should be based on the type of components to be protected and the existing corrosion risk. The Contractor should present, together with the basic design, the specification of corrosion protection systems, including the following elements:
 - a. description of the member to be protected;
 - b. description of the corrosion hazard;
 - c. protection technology;
 - d. conditions for provision, inspection and acceptance of works;
 - e. colours of corrosion coatings.
- B. The requirements for the protection of steel, concrete and reinforced concrete structures are presented below.
 - a. The Contractor shall control the quality of the coating, including the thickness of the coating and the quality of adhesion according to the PN EN ISO 2409 standard.

Protection of steel members:

- A. corrosion protection of all members made of low-alloy steels shall take into account the environmental conditions and the working environment resulting from the introduced technology;

- B. for external coatings (including those that are insulated and enclosed), the durability of corrosion coatings shall be at least 15 years (required durability of the 'H' paint system according to PN-EN ISO12944) – for atmospheric corrosivity category C4. The external coating of the Heat Accumulator is an exception, where the required paint kit is to be designed and manufactured for a corrosivity environment C3;
- C. preference is given to painting kits in accordance with PN-EN ISO 12944 (mainly epoxy-polyurethane). The system shall be finally agreed with the Employer;
- D. corrosion protection must also take into account the effects of technology (the process-related discipline must determine the corrosiveness of the environment inside the facility), especially the inside of the Heat Accumulator tank;
- E. preparation of the substrate for painting in accordance with the requirements of PN-EN ISO 12944 and the relevant standards mentioned in the aforementioned standard, such as PN-EN-ISO-8501;
- F. design and construction of facilities must enable future maintenance of corrosion protection;
- G. factory-made steel equipment and tanks must have corrosion protection coatings applied prior to installation and undergo a formal acceptance procedure carried out by the Employer;
- H. bolts, nuts and other fasteners shall be galvanised or coated to withstand corrosive environments, min. C4 for a long service life;
- I. all elements shall be protected against corrosion and shall be protected against the influence of external conditions during of transport and storage. Any damage to the corrosion protection coating must be repaired and recorded in writing by the Employer;
- J. the colours of each corrosion protection layer shall differ and be agreed with the Employer;
- K. The condition of the surface preparation prior to painting shall meet the conditions for Sa 2½ according to PN-EN-ISO-85;
- L. the corrosion protection layers shall be made strictly according to the system data sheets provided by the paint manufacturer;
- M. the steel structures of the facilities (except for the Heat Accumulator shell) are to be protected against corrosion in workshop conditions;
- N. for hot-dip galvanised components, it shall be made in accordance with the requirements of the PN-EN ISO-1461 standard;
- O. thickness of the zinc layer must fulfil the requirements of EN ISO 14713:1999 for environment C4 and a long service life of at least 15 years;
- P. minimum zinc thickness of galvanised components shall be 70 µm.

Reinforced-concrete members

- A. Surfaces of concrete and reinforced concrete structural components exposed to corrosive factors shall have appropriate corrosion protection:
 - a. surfaces in direct contact with the ground – by applying bituminous coatings;
 - b. external surfaces (foundations, columns, etc.) up to 30 cm above ground level – with waterproof coatings;
 - c. surfaces exposed to oil – to be protected by oil-resistant coatings;
 - d. surfaces exposed to permanent moisture – by appropriate surface finishing or waterproof coatings;

- e. surfaces exposed to chemical attack – by applying a chemical-resistant coating specific to the corrosive agent;
 - f. surfaces exposed to abrasion – by applying a suitable finish or abrasion-resistant coating.
- B. Furthermore, reinforced concrete and concrete members shall be designed and manufactured in the appropriate exposure class in accordance with PN-EN 206.
- a. Coatings that come into contact with atmospheric air shall have a durability of at least 20 years, while other coatings shall have a durability equal to the service life of EC-4 HAS facilities and the Electrode Boiler.
 - b. Concrete and reinforced concrete elements directly exposed to atmospheric conditions shall have an appropriate exposure class and a degree of frost resistance not lower than F75 according to PN-B-06265.

4.5.7. Insulation in civil structures

Waterproofing and damp-proofing

- A. Civil structures shall be designed and constructed in a manner that prevents penetration into their interior of:
- a. water from precipitation;
 - b. groundwater and surface water;
 - c. water vapour;

which may pose a risk to health and hygiene during use, as well as have a negative impact on the structure of the facility and the equipment installed in the facility. Particular attention shall be paid to the underground parts of the facilities that may be located below the groundwater level. All surfaces located below the groundwater level should have reliable heavy waterproof insulation to ensure no leakage. The configuration of the buildings and the surrounding area shall ensure that stormwater drains freely.

For roofs with roofing membranes and waterproofing, heat-sealable bitumen sheets or other coatings shall be used.

- A. In the case of external vertical insulation in direct contact with the ground, the insulation surface shall be protected against mechanical damage.
- B. Roofing and system enclosures, both sheet metal and as well as roofing membrane laid on a thermal insulation layer, should be made in a manner that ensures adequate ventilation to avoid the accumulation of water vapour under the roofing, condensation of water vapour on structural and system components or in thermal insulation, and ensures the removal of any condensed water vapour from under the roofing.

Thermal insulation

- A. Thermal insulation applies to all external partitions of EC-4 HAS civil structures, and those structural members for which there will be significant temperature differences during their operation in relation to the environment, and where heat exchange with the environment can cause significant losses. The thermal insulation performance of the partitions shall comply with the construction regulations in force in Poland. Thermal insulation shall be provided in such a manner and with non-combustible materials as to ensure that the fire and performance requirements for the specific location are met.

- B. All insulation materials used shall have the technical approvals and certificates required by Polish law. The Employer prefers mineral wool insulation.
- C. Insulation of the tank shell made of mineral wool with a thickness of **minimum 500 mm** on the entire surface should be made in accordance with PN-B-02421:2000.
- D. The density of the insulating material of the tank shell shall be min. 35 kg/m³, for which the coefficient of thermal conductivity at 50°C is less than 0.045 W/mK. Panelling of galvanised trapezoidal sheets with weather-resistant protective coating.
- E. The insulation density of the tank roof (mineral wool and mineral wool panels) shall be min. 100 kg/m³, while for mineral wool panels – min. 150 kg/m³. Outer layer: e.g. PVC fabric (maintaining full tightness in the event of process-related discharges or precipitation).

Soundproofing

- A. The acoustic insulation used shall be made of non-combustible materials and shall have the required acoustic insulation and sound absorption capacity adapted to the levels and frequencies of the sounds generated, as well as durability. Guards constituting the enclosures of equipment shall be easy to disassemble. Moreover, for equipment located outside, they shall be weatherproof.
- B. The selection of appropriate insulation shall be based on the design works and, in the process of commissioning the WHAL facilities, appropriate acoustic measurements shall be carried out by the Contractor to check the correctness of the selection of the design solutions used.
- C. Information on the type and location of the sound insulation shall be included in the basic design.

4.5.8. Road discipline (external circulation – roads and sidewalks)

The HAS EC-4 facilities are to be equipped with an external circulation system including roads and sidewalks.

The road design should be adapted to the Traffic Category that is able to transfer loads from the transported technology, but not lower than KR4.

It should also comply with fire regulations in terms of fire routes and access by rescue teams, if necessary.

General requirements

- A. Road and yards shall be marked in accordance with the traffic organisation design in the EC-4 HAS area approved by the Employer.
- B. The lighting of roads and yards shall be positioned at a height that does not cause glare experienced by drivers.
- C. Road and railway sections, as well as areas where contamination can occur, e.g. oil spills, should be equipped with surfaces that are resistant to these types of contamination and a separate wastewater system with a contaminant trap, e.g. an oil separator. All the separated wastewater systems will be incorporated into the in-house combined stormwater and industrial wastewater system. All separators shall be equipped with filling signalling systems, with the signal being displayed at a location agreed with the Employer.

Roads

- A. The designed internal roads for the EC-4 HAS shall be connected to the EC-4 internal road system in a manner that ensures efficient traffic on the premises in accordance with fire safety regulations.
- B. The roads shall enable the delivery of process equipment, materials and consumables.
- C. The roads shall be adapted to the maximum loads that may occur during the operation of the EC-4 HAS. They shall meet the following requirements:
 - a. concrete or asphalt surface;
 - b. edges made of concrete curbs;
 - c. The road structure shall be adapted to the loads and traffic intensity of EC-4 HAS vehicles, as well as erection equipment and fire service vehicles, but not less than for traffic intensity category KR4.
 - d. road surface shall be constructed of road layers designed on the basis of:
 - e. Catalogue of Typical Flexible and Semi-rigid Pavement Structures
 - i. or Catalogue of Typical Rigid Pavement Structures;
 - ii. or individually designed pavements (supported by calculations).
- D. Roads shall be made of materials listed in the aforementioned catalogues and standards related to the aforementioned catalogues, resistant to weather conditions and increased exposure to corrosive environments.
 - a. stormwater from roads shall be discharged into the wastewater system;
 - b. roads shall be made using specialised equipment adapted to their width.
- E. Basic parameters of roads:
 - a. road width of 4.0 m for one-way traffic and 6.0 m for two-way traffic, with roadsides;
 - b. design speed – 20 km/h;
 - c. transverse slopes of the pavement – 2%;
 - d. minimum longitudinal slopes – 0.5%;
 - e. roadside width – 1.00 m;
 - f. minimum radii of rounding bends – 3.00 m;
 - g. height of the road gauge – 4.50 m or more depending on the process-related needs.
- F. Pavements should be made along the roads at least on one side (minimum scope in accordance with the Building Permit **Appendix 13** to this document).
- G. The radii of the road bends shall enable the passage of vehicles delivering elements related to the construction and operation of the EC-4 HAS facilities.
- H. At the intersection of roads and railway tracks, level crossings with crossing plates must be provided. The crossings shall be appropriately marked and equipped with signalling to warn of train traffic.
- I. Structures or equipment that are exposed to damage by vehicles travelling at the EC-4 site, and whose damage could affect the operation of EC-4, must be protected (for example, with protective barriers or structural reinforcement).
- J. The cable routes under the roads shall be constructed as monolithic ducts or concrete culvert blocks.
- K. The roads shall be equipped with, among other things:
 - a. stormwater system;

- b. vertical road signs, i.e. signs mounted 2.2 m above ground level, and horizontal signs in accordance with the Road Traffic Act and agreed with the Employer;
- c. roads that will not be properly fenced off or have sidewalks – also in horizontal signs clearly marked with horizontal signs in accordance with the provisions of the Road Traffic Act of 20 June 1997, as amended, and agreed with the Employer.

Parking and manoeuvring yards

- A. Parking and manoeuvring yards shall provide sufficient space for the manoeuvring, unloading and loading of vehicles involved in:
 - a. normal work of the EC-4 HAS;
 - b. traffic related to maintenance works;
 - c. temporary storage of elements related to maintenance;
 - d. provision of back-up facilities for maintenance teams;
 - e. fire-fighting and rescue operations.
- B. Other requirements for parking and manoeuvring yards as for roads.

Sidewalks

- A. Sidewalks on the premises of the HAS EC-4 shall ensure access to service points for systems and equipment as well as any places of permanently or temporarily occupied by people.
- B. All roads shall have at least one sidewalk.
- C. The width of sidewalks by the roadway shall be at least 1.50 m, and the remaining one minimum 1.0 m.
- D. Transverse sidewalks shall have 2% slopes and longitudinal slopes of up to 6%;
- E. The surface of the sidewalks shall be made of 8 cm thick concrete blocks, the colour and shape of which shall be agreed with the Employer, resistant to occasional heavy goods vehicle traffic with a maximum load of 100 kN/m². The sidewalk edges shall be limited by 8 x 25 cm concrete curbs.
- F. Crossings over the sidewalks shall be of adequate width, limited by concrete kerbs, lowered to a level of 3 cm above the edge of the road, with a cross-section of 15 x 20 cm. They shall be made of 8 cm thick concrete blocks, of a colour and shape agreed with the Employer.

4.6. SCOPE OF THE SYSTEM-RELATED DISCIPLINE

The requirements are described in the sections below.

4.6.1.SYSTEM-RELATED REQUIREMENTS FOR FACILITIES

4.6.1.1. DH water pumping station building for cold and hot water.

The building shall be fitted with the following systems:

- A. stormwater system
- B. industrial wastewater system (process drains)

- C. ventilation
- D. emergency electrical heating and heaters along ventilation ducts (**if there is supply ventilation**)
- E. earthing and lightning protection – as described in the electrical part and the telecommunications part
- F. lighting and service sockets – as described in the electrical part and the telecommunications part
- G. communication and telecommunications – in accordance with the description of the field part of the I&C part.
- H. with ABC powder extinguishers
- I. smoke extraction – **if required by law**
- J. water for industrial purposes (for the DH water pumping station)

For the cold DH water pumping station, the existing system shall be adapted and extended to the needs of the new technology.

4.6.1.2. Electric switchgear building

The building shall be fitted with the following systems:

- A. stormwater system
- B. ventilation
- C. emergency electrical heating and heaters along ventilation ducts(**if there is supply ventilation**)
- D. earthing and lightning protection – as described in the electrical part and the telecommunications part
- E. lighting and service sockets – as described in the electrical part and the telecommunications part
- F. communication and telecommunications – in accordance with the description of the field part of the I&C part.
- G. with ABC powder extinguishers
- H. smoke extraction – **if required by law**
- I. air-conditioning system of the room with system cabinets (I&C)

For the cold DH water pumping station, the existing system shall be adapted and extended or replaced to the needs of the new technology.

4.6.1.3. Roads and yards

Road and yards shall be equipped with a drainage system connected to the existing wastewater system in accordance with applicable regulations and equipped with appropriate pre-treatment systems (if necessary) and earthing systems.

4.6.1.4. Pipe bridges

In the vicinity of pipe bridges (places intended for draining pipelines), there should be industrial wastewater connections (including cooling pits).

4.6.1.5. Heat Accumulator.

The Heat Accumulator shall be fitted with the following systems:

- A. stormwater system;
- B. industrial wastewater system (process drains).

4.6.2.REQUIREMENTS FOR INDIVIDUAL SYSTEMS

4.6.2.1. Wastewater systems

- A. The HAS system shall consist of the following systems:
 - a. stormwater system;
 - b. industrial/stormwater system.
- B. The Contractor shall provide complete systems inside buildings and route them the outside of the building;
- C. The stormwater drainage system in each building shall drain rainwater from the roofs into the external stormwater or stormwater/industrial wastewater network.
- D. The sanitary system shall discharge sanitary wastewater from all sanitary appliances located in sanitary rooms into the external sanitary sewage network.
- E. The industrial wastewater system shall discharge wastewater from washing, leaks from technical equipment, etc. from individual buildings into the external stormwater and industrial wastewater system.
- F. The Contractor shall provide a uniform system of pipelines and valving throughout the scope of supply. The Employer allows the use of only full-value materials in the first grade. The quality of materials shall be documented by appropriate attestations, quality certificates and approvals.
- G. The type and design of the wastewater pipelines shall be adapted to the conveyed medium.
- H. Pipelines shall have external corrosion protection appropriate to the extent of exposure to corrosion.
- I. Pipelines shall be labelled to indicate the type of medium (sanitary, stormwater, industrial).
- J. Sewerage systems shall be protected against freezing.
- K. If the wastewater downpipes are installed inside the building, roof inlets will be heated.
- L. It is not allowed to drain stormwater from roofs to the ground or to soakaway pits.
- M. The vertical and horizontal sewage pipes shall be equipped with inspection chambers that enable easy cleaning in places that are easily accessible.
- N. It is not allowed to route sewage systems through electrical rooms.
- O. The wastewater system, which may be contaminated by petroleum products, shall be equipped with separators with filling level indicators to send signals to a location agreed with the Employer.
- P. Industrial wastewater containing aggressive substances shall be routed to a wastewater treatment plant equipped with appropriate neutralisation tanks.
- Q. The design of the wastewater system shall prevent environmental contamination in the event of failure, including contamination by petroleum substances.

- R. The expected service life of the system shall be no less than the expected service life of the HAS facility.
- S. It is preferable that valving comes from one manufacturer, divided into utilities. In the absence of a given product in the manufacturer's assortment, it is allowed to use other valving that meets the technical requirements and of not inferior standard;
- T. Valving shall be equipped with opening and closing indicators.

4.6.2.2. Water systems

- A. The Contractor shall provide complete systems inside buildings and route them the outside of the building.
- B. Water systems for industrial purposes in the hot water pumping station building should be supplied from an external potable water network with the use of appropriate backflow preventer valve, supplying potable water to the technical sink.
- C. The Contractor shall provide a uniform system of pipelines and valving throughout the scope of supply. The Employer allows the use of only full-value materials in the first grade. The quality of materials shall be documented by appropriate attestations, quality certificates and approvals.
- D. It is required that valving come from one manufacturer divided into utilities. In the absence of a given product in the manufacturer's assortment, it is allowed to use other valving of not inferior standard.
- E. Valving shall be equipped with opening and closing indicators.
- F. Water systems shall meet the following requirements:
 - a. The type and design of the pipelines and valving shall be adapted to the conveyed medium.
 - b. Pipelines and valving shall have external corrosion protection appropriate to the extent of exposure to corrosion.
 - c. Pipelines shall be labelled to indicate the type of medium (cold water, hot water, washing water) and the direction of flow.
 - d. Cold water pipelines and tanks that are exposed to condensation shall be fitted with thermal insulation.
 - e. Water systems shall be protected against freezing;
 - f. Pipelines shall be routed in a manner allowing for their easy replacement;
 - g. It is not allowed to route water systems through electrical rooms;
 - h. It is not allowed to weld galvanised components.
 - i. The required service life of the system shall be equivalent to the service life of the HAS system.
 - j. The required service life of faucet valves shall be no less than 15 years.

4.6.2.3. Ventilation systems

- A. The HAS facilities shall be equipped with mechanical or gravity ventilation having the required efficiency.

- B. Gravity or mechanical ventilation shall be used in buildings. Ventilation shall be capable of maintaining a temperature not higher than 40°C at the highest summer temperatures. Air intakes shall be equipped with heaters to prevent local cooling in ventilated rooms.
- C. Overpressure shall be provided in all electrical rooms.
- D. In addition, the ventilation systems shall meet the following requirements:
 - a. Ducts shall be made of non-flammable and corrosion resistant materials;
 - b. The interior finish of the ducts shall be durable and easy to clean;
 - c. Ductwork steel components shall be galvanised.
 - d. The ducts shall have inspection openings for cleaning;
 - e. The design of the air intake shall limit the possibility of pollutants entering the system;
 - f. The system shall be equipped with signalling to inform that the air filters are full;
 - g. The air speed in the ducts and their design and shape shall be designed in a manner that minimises excessive noise generation by the air-conditioning system.
 - h. The ducts shall be equipped with silencers limiting the spread of noise in the event of exceeding the standards in accordance with Polish law and local requirements;
 - i. The ducts shall be made of non-combustible materials with fire resistance in accordance with the relevant fire regulations;
 - j. The ducts shall have fire dampers closed automatically in the event of a fire at the points of passage through the building partitions of the fire separation;
 - k. Air ducts passing through heated rooms shall be acoustically and thermally insulated.

4.6.2.4. Air-conditioning system

- A. Rooms where a constant temperature and humidity level is required shall be equipped with air-conditioning systems. This mainly applies to I&C system cabinet rooms in electrical switchgear buildings. It shall be adapted from an existing air-conditioning system.
- B. The air-conditioning system shall have at least two independent air-conditioning circuits.
- C. Rooms that require air conditioning but cannot be connected to the central air-conditioning system for technical reasons shall have local air-conditioning systems.
- D. In rooms with advanced process equipment such as server rooms, I&C cabinets, UPS rooms, etc., a 100% spare capacity of equipment should be provided.
- E. The air ducts shall be thermally insulated.
- F. In rooms with air-conditioning systems, supply air humidification shall be provided.
- G. The air-conditioning units shall be able to be controlled and communicated with from a higher-level system.
- H. The remaining air conditioning requirements are in accordance with the requirements for the ventilation system provided above.

4.6.2.5. Heating systems

- A. Unless otherwise specified, the rooms shall be equipped with emergency heating. Room shall be equipped with electric heating.
- B. Space heating of the HAS facilities, if no specific requirements are defined, shall enable the maintenance of the set room temperatures in accordance with the requirements of the applicable regulations, but not less than + 5°C.
- C. When the EC-4 units and the HAS system are shut down for the winter, the rooms shall be heated to exceed the freezing point to ensure the safety of the equipment and to enable repair works and start-up.
- D. Requirements for the design and construction of central heating systems in civil structures.
 - a. In process facilities (except for adapted facilities), it is planned to use heating and ventilation units with electric heaters or high-parameter water heaters (if the Contractor finds it necessary), supplied directly from the in-house DH network. Electrical equipment should be integrated into a single control and power supply system. The possibility of controlling and communicating from a higher-level system should be envisaged. In emergency situations, when the room temperature decreases below the set temperature, the devices should switch on automatically.
 - b. Rooms accommodating electrical equipment (electrical switchgears, control rooms, server rooms, etc.) should be equipped with electric convection heaters with thermostats.

4.7. SCOPE OF THE ELECTRICAL SECTION

4.7.1. General information

The system for heat accumulation and the auxiliaries of the planned electrode boiler shall be supplied from the existing switchgears of CHP Plant No. 4: switchgear PO1 – bay 14 and PR2 – bay 12 located in the electrical aisle of the main building.

Operating parameters of PO1 and PR2 switchgears:

A. Rated voltage	6.3 kV
B. Number of phases	3
C. Rated frequency	50 Hz
D. Short-circuit power on switchgear busbars	220 MVA
E. Short-circuit current I_{k3}''	20.2kA
F. Rated short-circuit current of the switchgear	31.5 kA

The existing transformers TWW1 and TWW2 are supplied from the above-mentioned bays via underground YAKYftly 3x120mm² 3.6/6kV cable lines and cable routes in the main building.

Figure 4.7.1.1 shows the power supply diagram of the existing systems with the range requiring replacement for the Heat Accumulator power supply system.

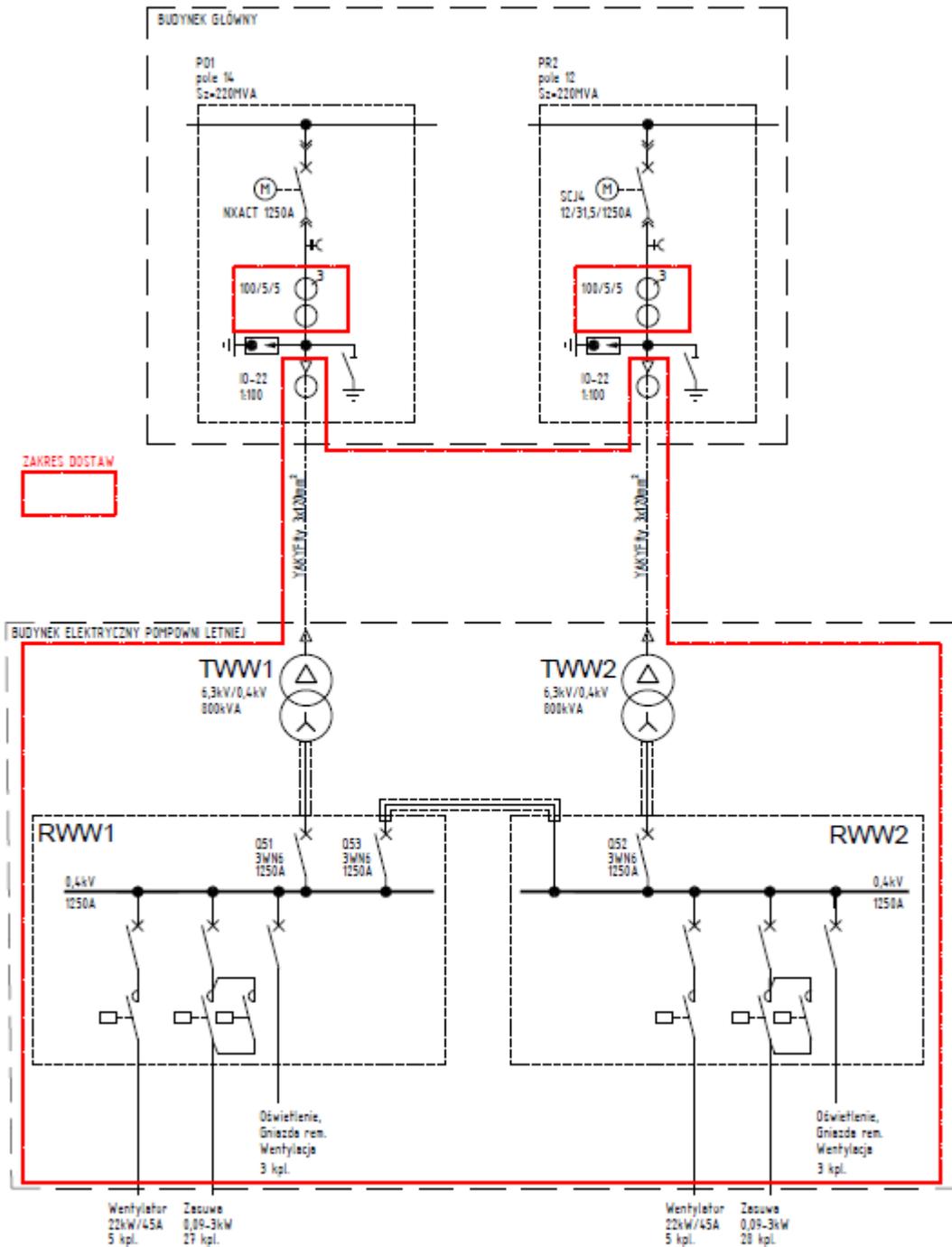


Fig.

4.7.1.1 Power supply diagram of the existing system

It is assumed that the entire system will be supplied from existing 6kV bays via the planned 6.3 kV/LV transformers and main LV switchgears. It is possible to use a low voltage of 690 V, with an additional 690 V/400 V transformer to supply 400 V and 230 V consumers.

Four outgoing feeders (two in each section) with a 400 A circuit breaker must be provided in the main switchgear for the redundant power supply of the auxiliary systems of the planned

electrode boiler or other systems. The power required for these systems, approx. 200 kW, should be taken into account in the power balance.

The 3-phase power and control cabling of the existing summer cooling tower equipment must be disconnected from switchgears RWW1 and RWW2 and secured against removal. Once the new switchgear has been provided, the cables shall be connected to the dedicated bays. Before connecting, the condition of the cables and their insulation shall be checked. If any damage is found, the cables shall be replaced with new ones. After connecting the cables, commissioning work must be carried out to restore the full functionality of the summer cooling tower.

4.7.2. Equipment of the existing 6 kV bays

For existing bays of the 6kV switchgear – PO1 bay 14 and PR2 bay 12, the existing equipment shall be retained, except for adaptation to the new operating current values. Therefore, the Contractor shall define the basic scope of the bay conversion in the basic design. At a minimum, the scope of adaptation should include:

- A. current transformers;
- B. ammeter scales;
- C. adaptation to the introduction of temperature protection of 6.3 kV/LV transformers
- D. adaptation to emergency shutdown with a button on the front panel of the LV switchgear powered from a given transformer;
- E. protection settings.

Parameters of the replaced equipment shall be agreed with the Employer at the detailed engineering design stage.

4.7.3.6 kV power supply and control cables

The Contractor shall be responsible for laying new power supply cables between the bays of the 6 kV switchgear and the designed 6 kV/LV transformers in the electrical building of the Heat Accumulator.

MV cables must be matched to the expected load and short-circuit conditions.

Cable routing:

- A. in the section from the 6kV switchgear bays to the wall of the main building: in the existing cable routes in the cable room (after dismantling the existing MV cables to the summer-period pumping station building);
- B. from the wall of the main building to the manhole at the eastern edge of the biomass road: in the planned cable block (the cable block is expected to be built in Q2 2025);
- C. from the cable manhole to the wall of the building of the hot water pumping station of the Heat Accumulator – in the ground, under roads and sidewalks and at the intersection of other networks in a conduit;
- D. in the hot water pumping station building; in conduits or cable ducts under the floor;
- E. in electrical rooms: under the raised floor.

Along the 6 kV cables, control and signalling cables should be laid for the required connections with the 6 kV bay instrumentation.

4.7.4.MV/LV transformers

The selection of transformers shall be made by the Contractor. The MV/LV distribution transformer shall be as follows:

- A. three-phase two-winding transformer;
- B. dry-type transformers in resin insulation are preferred;
- C. indoor design, (min. ambient temperature: +5°C, max. ambient temperature:
 - a. + 40°C, max. humidity: 95%, altitude up to 1000m above sea level).

Table 4.7.4.1 Technical data:

rated voltage on the HV side:	-	6.3 kV
rated voltage on the LV side:	-	400 V or 690 V
rated power:	-	to be determined by the Contractor
rated voltage ratio;	-	(MV \pm 2 x 2.5%) / LV V/V,
voltage control:	-	no load,
rated frequency:	-	50 Hz,
short-circuit voltage:	-	6%,
vector group:	-	Dyn5,
cooling:	-	natural,
design:	-	indoor,
material of windings:	-	AL/AL,Cu/Cu,
ambient temperature:	-	+5°C to +40°C,
maximum humidity:	-	95%
protection rating:	-	IP00
protection:	-	Thermal protection in windings, two-stage type
insulation class (heat resistance):	-	F
maximum load and no-load losses	-	AkAo-10%

The transformers shall be of the same type, identically constructed and interchangeable.

Operating conditions

Transformers shall be suitable for continuous operation. The transformer shall withstand short-term overloads resulting from motor start-up. HV and LV windings shall be made of copper or aluminium, the cross-sections of which shall be sized so that voltage drops do not exceed 10% of rated voltage when starting the motors from the switchgear.

Voltage conditions

The transformers shall be suitable for continuous operation at a supply voltage 10% higher than the rated voltage for a given position of the taps at rated power and at 140% of the rated voltage for 5 seconds.

Voltage control

The winding of the HV side shall be equipped with 5 taps, enabling the voltage ratio to be adjusted within $\pm 2 \times 2.5\%$ when de-energised.

Short circuit withstand capability

The transformers shall be able to withstand the mechanical and thermal effects of phase and ground faults, taking into account the following values on the HV side:

- A. 1-sec. thermal short circuit substitute current: - to be determined by the Contractor in the design documentation
- B. surge short-circuit current: - to be determined by the Contractor in the design documentation
- C. short circuit clearance time: - 1 sec.
- D. cooling - AN

Insulation

Insulation shall be made of epoxy resin in temperature class F.

Design solutions

The transformers shall be placed in a separate room, ensuring a protection rating of at least IP20 and arc fault resistance in accordance with PN-E-05163 for class A2. It must be possible to work safely at one of the transformers while the other is in operation, by using partitions or enclosures. The HV terminals shall be suitable for the connection of power cables. The HV side terminals shall be designed to enable the transformer to be connected to the low-voltage switchgear and to the supply feeder by means of a busbar.

Natural air cooling of the transformer and the chamber shall be applied. In the chamber, a suitable ventilation system must be selected to maintain proper cooling of the transformers. The transformers shall be equipped with lifting lugs.

Spare parts

Transformers shall be supplied with at least the following spare parts:

- A. set of thermometric sensors of all types.

The transformer shall meet the requirements of COMMISSION REGULATION (EU) No. 548/2014 of 21 May 2014 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to small, medium and large power transformers, as amended.

Along with the supply of the transformer, the Contractor shall conduct and deliver reports from full, complete product tests in accordance with the requirements of the PN-EN 60076-11 standard. In addition, the Contractor shall provide an extract from the type test report (for the supplied transformer series) containing the results of the basic and optional tests (if performed) according to the requirements of PN-EN 60076-11.

FAT

During FAT, the following parameters of transformers shall be checked, in particular:

- A. no-load losses and total losses;
- B. transformer rated voltage ratio;
- C. short-circuit voltage.

SAT

After the transformers have been installed, SAT shall be carried out to the extent previously agreed with the Employer, including at least the following tests:

- A. measuring winding insulation resistance;
- B. checking the vector group;
- C. checking the calibration of temperature sensors.

Compliance with standards: Dry transformers according to PN-EN 60076-11 or IEC 60076-11.

4.7.5.LV/LV transformers

If the main equipment is supplied with 690 V, 690/400 V transformers shall be used.

The requirements for these transformers are the same as for MV/LV transformers.

4.7.6.Main LV switchgear

Design solutions

The LV switchgears and distribution boards to be supplied by the Contractor shall be:

- A. indoor design, stationary;
- B. freestanding or wall-mounted;
- C. two-part in a metal casing;
- D. multi-cabinet with withdrawable modules;
- E. with a separate cable compartment, busbar compartment and functional units;
- F. with resistance to electric arc – arc-protected;
- G. single-system;
- H. a reliable three-phase 400 V switchgear shall be provided for the supply of sensitive consumers (vital valving in the system).

Basic technical parameters of the switchgear:

- A. insulation rated voltage: - 1000 V AC;
- B. rated switching voltage: - 400 V AC or 690 V AC;
- C. rated frequency: - 50 Hz;
- D. rated current of the busbars
20% constant overload - to be determined by the Contractor +
- E. busbar system: - L1, L2, L3, PE, N;
- F. ambient temperature: - +5°C to +40°C;
- G. protection rating
withdrawn, - IP40, IP20 when the module is
or the door is open
- H. cooling: - natural;
- I. Form of fencing - 4b (2b for MCB plug-in solutions
for line bays)
- J. rated voltage of auxiliary circuits - 230 V AC or 220 V DC
- K. busbar material: - copper

Short circuit withstand capability

The switchgears shall be able to withstand the mechanical and thermal effects of phase and earth faults, taking into account the following values:

- A. 1-sec. thermal short circuit substitute current: - to be determined by the Contractor in the design documentation
- B. surge short-circuit current: - to be determined by the Contractor in the design documentation
- C. short circuit clearance time: - 1 sec.

The basic technical data of the switchgear units with regard to rated voltage, operating voltage and short-circuit withstand strength, as presented above, also apply to all equipment of the main circuits of the switchgear.

The main switchgear shall be equipped with:

- A. segments (cabinets) of primary, backup, coupler and cut-off power supply with electrical interlock against parallel operation of power supply sections;
- B. consumer segments (cabinets).

The power supply segments shall not have separate connection compartments.

The power supply segments from the transformers shall be adapted to the upper connection – busbar connection.

The consumer segments shall be equipped with compartments for busbars, cable connection and functional units.

The functional unit compartment shall be equipped with:

- A. withdrawable parts – to supply power to motor consumers;
- B. disconnecting plug-in parts – to supply power to line consumers;
- C. fixed part – to supply power to small consumer that require no control.

The distribution boards shall be equipped with two power supplies (main and backup, from different sections of the main switchgear) with a mechanical interlock to prevent the power supplies from operating in parallel.

The segments supplying the distribution boards shall be adapted to the bottom cable connection.

Each withdrawable part shall be equipped with multi-pole connectors for connecting primary and secondary circuits to the terminal block, located in the cable compartment. The part shall have three operating positions:

- A. "OPERATION";
- B. "TEST";
- C. "WITHDRAWN".

The cables shall be arranged downwards. The busbar compartment shall be located horizontally in the upper part of the cabinet. In each switchgear segment, a ring circuit compartment must be provided in the upper part of the cabinet.

Moreover, it is required to:

- A. equip the switchgear with earthing and short-circuiting parts with a mechanical interlock to prevent unauthorised operation;
- B. envisage group protection for segments with small consumers;

- C. the switchgear should contain a minimum of 20% (not less than one) fully equipped outgoing cassettes of all types and sizes;
- D. leave at least 20% spare capacity of the bay for further expansion, not less than space for two segments;
- E. envisage remote control of the circuit breaker in the "TEST" position;
- F. provide complete wiring of the auxiliary circuit instrumentation to the terminal strip;
- G. adapt the auxiliary circuits to the adopted control and visualisation system in the microprocessor system;
- H. envisage the possibility of extending the switchgear by adding more consumer cabinets.

The design of the switchgear shall ensure the safety of the operator regarding the thermal and dynamic effects of the arc short circuit, according to category B.

Switchgears shall be installed in (a) separate electrical room(s).

Feeders of motors shall be equipped with:

- A. protection device (fuse load switch or breaker for the motor);
- B. contactor;
- C. thermal relay (conventional for motors up to 15 kW and microprocessor-based for larger motors – Micom P211 is preferred);
- D. current transformer in L2 phase (for motors with rated power of 15 kW and above);
- E. ammeter with overcurrent scale (for motors with rated power of 15kW and above);
- F. auxiliary circuits instrumentation.

Feeders of motors controlled by the inverter shall be equipped with:

- A. fuse switch or disconnecter with ultra-fast inserts (according to the inverter supplier's guidelines);
- B. current transformer in L2 phase (for motors with rated power of 15 kW and above);
- C. ammeter with overcurrent scale (for motors with rated power of 15 kW and above).

Feeders of bidirectional motors shall be equipped with:

- A. protection device (fuse load switch or breaker for the motor);
- B. two contactors;
- C. thermal relay;
- D. auxiliary circuits instrumentation.

Bays which feed line consumers shall be equipped with:

- A. fuse load switch (so called "narrow-profile");
- B. current transformer in L2 phase;
- C. ammeter.

Feeders of small consumers that require no control shall be equipped with:

- A. protection device (fuse load switch or breaker).

Feeders and coupler bays shall be adapted to remote control and signalling in the microprocessor system.

Feeders and coupler bays of the main switchgear must be equipped with automatic switching and load shedding.

Contactors shall be adapted to remote control and signalling in the microprocessor system.

The busbars of the switchgears and the connections within the instrumentation of the main bays shall be made of highly conductive copper. The busbars, supporting and fastening elements shall be dimensioned and made to withstand the dynamic and thermal effects of short-circuit currents.

Distribution cabinets shall be completely assembled and equipped with protection, control and measuring instrumentation. Terminal strips installed in the low-voltage compartment shall be labelled and the cables shall be provided with tags attached at both ends of the wire. The strips shall include 20% spare space. The wiring shall be made of class 5 flexible copper cables with PVC insulation for a voltage not lower than 750 V and a cross-section of 1.5 mm²; however, the current transformer circuits shall be made of a cable with a cross-section of not less than 2.5 mm².

Switchgear equipment

Power circuit breakers: Withdrawable circuit breakers, 3-pole, equipped with:

- A. overload protection;
- B. short-circuit protective device: fast and selective;
- C. earth fault protection;
- D. indicator of operation of the aforementioned function;
- E. increase tripping mechanism;
- F. undervoltage tripping mechanism;
- G. anti-pumping device;
- H. motor drive;
- I. position indicator and operations counter;
- J. position interlock of circuit breaker cassette;
- K. circuit breaker trip signal contact ("TRIP");
- L. auxiliary contacts.

Technical data:

- A. insulation rated voltage: - 1000 V;
- B. rated switching voltage: - 400 V or 690 V;
- C. rated frequency: - 50 Hz;
- D. rated continuous current: - to be determined by the Contractor
- E. 1-sec. rated short-time withstand current: - to be determined by the Contractor
- F. rated peak withstand current: - to be determined by the Contractor
- G. rated breaking current: - to be determined by the Contractor
- H. ambient temperature: - +5°C to ÷ +40°C;
- I. protection rating - IP40;
- J. auxiliary voltage of control circuits: - 220 V DC;
- K. auxiliary contacts: - 4z+4r;

Motor circuit breakers and moulded case circuit breakers

3-pole circuit breakers equipped with:

- A. overload protection;
- B. short-circuit protective device;
- C. partial-phase protective device;
- D. position indicator;
- E. auxiliary contacts.

Technical data:

- A. insulation rated voltage: - 1000 V;
- B. rated switching voltage: - 400 V, 690 V
- C. rated frequency: - 50 Hz;
- D. rated continuous current: - 0.55 to 200 A;
- E. 1-sec. rated short-time withstand current:
 - a. - to be determined by the Contractor
 - b. rated peak withstand current: - to be determined by the Contractor
- F. rated breaking current: - to be determined by the Contractor
- G. ambient temperature: - +5°C to ÷ +40°C;
- H. protection rating: - IP40;
- I. control voltage: - 230 V AC;
- J. auxiliary contacts: - 2z+2r.

Fuse load-break switches

- A. 3-pole;
- B. position 0-1
- C. designed for operation with power fuse-links of the following types: gG, aM, gR;
- D. with optical indicator of fuse operation;
- E. with auxiliary contacts.

Technical data:

- A. insulation rated voltage: - 1000 V;
- B. rated switching voltage: - 400 V, 690 V
- C. rated frequency: - 50 Hz;
- D. rated continuous current: - to be determined by the Contractor
- E. rated peak withstand current: - to be determined by the Contractor
- F. ambient temperature: - +5°C to ÷ +40°C;
- G. protection rating - IP40;

Contactors

- A. designed for direct switching on of motors with normal and heavy start-up;
- B. vacuum or air type.

Technical data:

- A. insulation rated voltage: - 1000 V;
- B. rated switching voltage: - 400 V, 690 V

- C. rated frequency: 50 Hz;
- D. rated continuous current: - to be determined by the Contractor
- E. category of duty: - AC3, AC4
- F. auxiliary voltage: - 230 V, 50 Hz;
- G. minimum number of operations: - 10⁶;
- H. ambient temperature: - +5°C to ÷ +40°C;
- I. auxiliary contacts: - 4z+4r.

Thermal relays

- A. adapted for operation with the selected contactors.

Technical data:

- A. insulation rated voltage: - 1000 V;
- B. rated operating voltage: - 400 V, 690 V
- C. rated frequency: - 50 Hz;
- D. setting current: - to be determined by the Contractor
- E. ambient temperature: - +5°C to ÷ +40°C;
- F. auxiliary contacts: - 1z+1r.

Microprocessor motor protection

Technical data:

Protection functions:

- A. immediate overcurrent protection
- B. thermal part – thermal model
- C. load asymmetry protection
- D. voltage dip
- E. partial phase operation
- F. excessive motor temperature (interaction with PTC sensors)
- G. earth-fault
- H. rated auxiliary voltage of the relay: - 230 V AC, 220 V DC
- I. current measurement in the frequency range - 10 to 1000 Hz;
- J. rated primary side current of the relay: - 5 to 50 A by direct connection;
expanded by instrument transformers x/5A
- K. Switch-off time range at 6xIB - 1 to 40 s
- L. communication with the protected facility - programmable output relays
- M. other relay functions - measurement of phase currents

Due to the unification of solutions, MiCOM P211 relays should be used.

Current transformers

- A. in enclosures made of flame-retardant materials.

Technical data:

- A. insulation rated voltage: - 1 000 V;
- B. rated operating voltage: - 400 V, 690 V;
- C. rated frequency: - 50 Hz;
- D. rated primary side current: - to be determined by the Contractor

- E. rated secondary current: - 5 A;
- F. accuracy class: - 1;
- G. rated power: - 2.5 to 20 VA;
- H. safety factor - FS5;
- I. 1-sec. rated short-time withstand current:
 - a. - to be determined by the Contractor;
 - b. rated peak withstand current: - to be determined by the Contractor;
- J. ambient temperature: - +5°C to +40°C;

ATS automation – applies to the main LV switchgear

ATS and SSC of switchgears shall be based on an automatic switching of power supply in a system with an open or hidden back-up capability in a microprocessor technology.

The automated device shall perform the following basic functions:

- A. slow automatic transfer switch (ATS);
- B. slow scheduled supply change-over (SSC).

The type of switching operations performed depends on the voltage conditions and the selection of individual cycles performed in the regulator setting mode. If the uninterruptible synchronous switching operations are unsuccessful, the switching operation will be terminated in a slow cycle.

The automated device should enable the recording of events relevant to the operation of the automated device and the entire power switching system as well as the residual voltage control element of the motors.

If necessary, voltage transformers to match the voltage level of the switchgear to the needs of the automated device shall be used.

Earthing

Switchgears shall be suitable for installation of portable earthing devices on busbars in feeders upstream of circuit breakers and on the supply side.

Tools

Together with the switchgear, a set of tools necessary for proper installation and operation shall be provided. At a minimum, the toolkit will include:

- A. trolley lift for handling withdrawable parts;
- B. holders for replacing fuse-links of power fuses.

The Contractor shall supply a rack for the toolkit with each switchgear.

For the necessary DC circuits in the main switchgear, a DC power supply unit with a minimum of 1 hour of operation shall be provided

OH&S equipment

The Contractor shall equip the LV switchgear rooms with an OH&S equipment cabinet, which shall contain:

- A. portable earthing devices with short-circuit parameters adapted to the expected 3-phase short-circuit current on the switchgear power supply side and its duration;
- B. earthing parts for individual types of withdrawable parts with a rack;
- C. information plates;
- D. dielectric rubber gloves;
- E. dielectric rubber footwear;
- F. voltage indicators;
- G. colourless protective goggles;
- H. first aid cabinet with supplies;
- I. portable fencing;
- J. instructions for providing on-the-spot first aid in the event of an electric shock.

The number of sets of equipment should be selected in such a manner as to enable safe work at least on n-2 switchgears installed in the room, but not less than 1.

Nameplates and switchgear markings

Switchgears shall be equipped with nameplates with technical data and with switchgear identification plates and each of its cabinets, which shall be placed on each switchgear cabinet. All outgoing feeders shall be numbered so that they can be unambiguously identified – KKS designation and the process name of the device. An up-to-date, legible single line diagram of the switchgear shall be placed in the switchgear room.

Descriptions in the Polish language should be made on engraved plates – black inscriptions against white background.

Spare parts

The set of spare parts provided by the Contractor shall at least include the following elements:

- A. one fully equipped cassette (withdrawable part) of each type;
- B. motor drive of the circuit breaker;
- C. two switching and breaking coils of each type;
- D. set of circuit breaker auxiliary contacts;
- E. two protection relays;
- F. four auxiliary relays;
- G. one set of buttons, position indicator lamps.

Along with the supply of switchgears, the Contractor shall carry out and provide full (complete) routine test certificates (for each switchgear supplied) in accordance with the requirements of PN-EN 62271-200: 2022-02. In addition, the Contractor shall provide an extract from the type test certificate (for the supplied series of switchgear types) containing the results of basic and optional tests (if performed) according to the requirements of PN-EN 62271-200: 2022-02. Guidelines for testing under conditions of arc discharge due to internal short circuit (or IEC 61641). Full type tests must include complete switchgear equipment. After prior agreement with the Employer, partial type testing of the switchgear shall be allowed due to the use of different instrumentation than that used for the full type tests. In addition, as part of the routine tests, current transformers shall be tested to confirm the accuracy class required in each circuit.

FAT During FAT, the following checks shall be carried out:

- A. input control of all switchgear components;

- B. in-process tests, including corrosion coatings;
- C. functional tests of measurements and the safety system;
- D. mechanical and electrical interlock tests.

SAT:

- A. checking the level of insulation of the main circuits with power-line frequency;
- B. resistance measurement of main and auxiliary circuits;
- C. functional tests of all switchgear components, including drives and mechanical interlocks of withdrawable modules;
- D. confirmation of interchangeability of withdrawable modules;
- E. electric shock protection test.

Compliance of the design and equipment of the switchgears with the following standards (or later) is required:

- A. PN-IEC 61439 Parts 1– to 4;
- B. PN-EN 05163:2002;
- C. PN-EN 60947-1:2006;
- D. PN-EN 60947-4-1:2001;
- E. PN-EN 60947-3:2009;
- F. PN-EN 60044-1:2000;
- G. PN-EN 60934:2004.

4.7.7. Guaranteed DC and AC power supply system

For the purposes of power supply and control, the Contractor shall provide dedicated DC and AC guaranteed power supply systems.

Supply voltage, the number of phases and the output current of the rectifiers used in the guaranteed power supply systems must be selected so as to provide supply of all DC consumers ensuring that the batteries are charged within the required time.

The guaranteed AC power supply systems shall be equipped with automatic and manual by-pass systems.

Batteries in power supply systems in VRLA technology, with a service life of min. 10 years. In the guaranteed DC power supply systems, an earthing detection system shall be implemented.

4.7.8. Valving power cabinets, lighting and socket switchgears

The power cabinets for valving as well as switchgears for lighting and service socket shall be made as free-standing cabinets based on Rittal VX25 cabinets or similar.

The switchgears should be supplied from both sides, from different sections of the main switchgear.

Each switchgear shall be equipped with a main switch (I-0-II switch) with a rotary handle on the switchgear front panel, an ammeter and voltmeter (on the front panel) and a 3P busbar system.

Basic technical parameters of switchgears:

- A. insulation rated voltage: - 1000 V AC;
- B. rated switching voltage: - 400 V AC;
- C. rated frequency: - 50 Hz;
- D. rated current of the busbars - to be determined by the Contractor
- E. busbar system: - L1, L2, L3, PE, N;
- F. ambient temperature: - +5°C to +40°C;
- G. protection rating - IP40;
- H. cooling: - natural;
- I. rated voltage of necessary auxiliary circuits – 230 V AC

Requirements for electrical instrumentation as for the main switchgear.

4.7.9. Local control units

The drives of the heat accumulator system should be capable of remote control (microprocessor system) and local control (local control boxes located at the drives). The selection of the control location may be implemented as follows:

- A. via a remote / local switch installed in the local control box;
- B. via a microprocessor system, issuing a local control permit signal.

Drives equipped with speed control devices, instead of local control units, should have emergency shutdown boxes.

Local control boxes and emergency shutdown boxes should be selected taking into account the environmental conditions at the facility: temperature, humidity, dust level, etc.

4.7.10. Electrical systems

Primary, emergency and obstruction lighting systems

All electrical system shall be provided by the Contractor in accordance with PN-HD 60364-4-41:2017 and Technical Conditions to be met by buildings and their locations of 12 April 2002. – Journal of Laws 02.75.690, as amended.

The lightning system should ensure free and safe movement of the personnel throughout the entire facility. Lighting and power socket systems shall be designed and constructed in accordance with the latest and proven technology in accordance with the latest industry standards.

The Contractor shall guarantee that all parts will be resistant to electrical, mechanical and other influences that may occur during operation.

The following lighting systems shall be designed, delivered and constructed in process facilities:

- A. primary lightning system;
- B. emergency lighting system – back-up and evacuation;
- C. obstruction lighting system.

Lighting fixtures with LED sources, selected for environmental conditions.

Primary lightning illumination intensity according to PN-EN 12464-1:2022-01, PN-EN 12464-2:2014-05.

Emergency lighting must meet the requirements and parameters provided in PN-EN 1838:2013-11 and PN-EN 50172:2005.

Emergency lighting supply from the central battery. Emergency lighting fixtures with approval – CNBOP certificate.

Emergency evacuation lightning should be on at least 1 hour after the primary lightning goes off. For powering the circuits of the emergency lightning, cables that should ensure continuous power supply in the event of a fire for not less than 90 minutes shall be used.

Emergency and escape light fixtures should be distinguished by marking them with a painted yellow strip with a width of 2 cm located in such a place so as to minimise the reduction of the luminous flux of the fixture.

Above the exit of rooms and along the evacuation routes, there shall be evacuation light fixtures – illuminated signs with appropriate pictographs.

In the case of facilities with a height of 45 m or higher, obstacle lighting designed in accordance with the Ordinance of the Minister of Infrastructure of 12 January 2021 on aviation obstacles, obstacle-limiting surfaces and dangerous devices (Journal of Laws of 2021, item 264) should be provided on the roof of the facility.

Emergency and obstacle lighting shall be supplied from a 220 V DC, guaranteed 230 V AC, and primarily from 230 V AC switchgear (lighting switchgear).

Primary lighting shall be supplied from lighting switchgears located in buildings. Power supply for lighting switchgears from two sections of the main LV switchgear, with a manual switch.

Control of the primary lightning shall be carried out by means of:

- A. buttons installed on the front panels of switchgears for general areas;
- B. buttons located at the entrance of technical rooms;
- C. installation connectors at the entrances to sanitary rooms.

Control of the emergency and escape routes lightning shall be provided from the switchgear only (daylight working system).

All connectors and buttons in the facility shall be installed at a height of 1.2 above the floor. The installation should be provided as surface-mounted, with the exception of sanitary, electrical and I&C rooms.

In the case of a surface-mounted installation, the main lines of the lighting systems and 1-ph sockets should be laid in metal trays and individual cables in steel pipes.

External lighting system

In the area of the system provided by the Contractor, the Contractor shall implement the external lighting system to complement the existing system.

The system should be provided using fixtures with energy-saving LED light sources mounted on steel, galvanised, single-arm poles or on pipe extension arms to pipe bridges and buildings. Power cables should be routed in the ground at a depth of 0.7 m and under sidewalks at a depth of 0.5 m. The external lighting system should be powered from the existing external lighting circuit in the area of the construction site. Under the roads, cables should be routed in steel pipe culverts.

Working earthing should be provided on each lighting pole and distribution box (for fixtures attached to facilities).

The average illumination intensity should be provided for roads and yards, min. 10 lx.

Illumination intensity shall comply with the provisions of PN-EN 12464-2:2014-05.

Non-process 3-phase power system (230 V and 400 V)

All system shall be provided by the Contractor in accordance with PN-HD 60364-4-41:2007 (multi-sheet system) and Technical Conditions to be met by buildings and their locations of 12 April 2002 – Journal of Laws 02.75.690, as amended.

Heating and ventilation systems

Copper cable and wires shall be used to supply control cabinets of air handling units, heating-ventilation devices, electric heaters and duct-type extract fans. The Contractor shall determine the control of the heating and ventilation equipment in such a manner as to ensure that the temperature requirements are met in all rooms located in the process buildings. Supply of ventilation and heating equipment from a dedicated switchgear, supplied on both sides from different sections of the main switchgear, with a manual switch.

3-phase 230 V and 400 V socket system

The plug-in socket system shall be used for powering equipment and repair tools which are not associated with the technology. Single-phase plug-in sockets with earthing shall be used to supply power to cleaning equipment, minor repair equipment and more.

Service socket sets shall be arranged in such a manner that it is not required to use extension cords or power cables longer than 25 m.

The sets shall be equipped with the following types of sockets:

- A. 3f + N +PE, 400 V – 63 A;
- B. 3f + N +PE, 400 V – 32 A;
- C. 1f + N +PE, 230 V – 16 A, min. 2 pcs.;

with complete overcurrent and residual current safety devices.

Three-phase socket sets shall be equipped with disconnectors enabling the plug to be inserted and pulled out in the voltage-free state.

Wires and cables for the 3-phase system shall be routed in trays, laid as far as possible on cable structures. In the case of routes routed vertically, appropriate trays should be used to secure wires and cables.

4.7.11. Lightning protection and earthing system

The Contractor shall carry out a lightning hazard risk analysis and, on its basis, shall provide a lightning protection system of heat accumulator facilities, in accordance with PN-EN 62305 - 1, -2, - 3, -4.

As an external lightning protection device, steel structures of buildings shall be used. An equipotential bonding ring should be arranged around the buildings (creation of an equipotential zone around the building to eliminate touch voltage) made of galvanised steel FeZn 40x5 mm and connected to the down conductors (reinforcement of load-bearing columns) by means of test connectors located in the corners of the building. The ring earth electrode should be connected to the earthing network of the site at least at two points.

Earthing systems and earthing conductors shall be installed in accordance with PN-HD 60364-5-54:2007.

Each steel support column of the building shall be connected (by welding at a height of +750 mm from the base of the column) with a 40x5 mm galvanised steel strap and a natural earth electrode, i.e. a strap extending from the foundation into the inner part of the building. The earthing system should be constructed on the basis of the main earthing busbar installed on the lowest floor of the building. The following shall be connected to the earthing busbar:

- A. ring earth electrode of the building;
- B. conductive housings;
- C. main routes of cable ducts;
- D. distribution terminals of the PEN conductor to PE and N;
- E. common terminals of class B, C surge arresters;
- F. pipelines entering and exiting buildings (the Contractor shall provide a metallic connection of pipeline elements);
- G. other elements of supporting metal structures.

The cross-sections of the conductors of the lightning protection system and the combined earthing system shall be selected by the Contractor.

Earthing systems and earthing conductors shall be installed in accordance with PN-HD 60364-5-54:2011.

The neutral points of the 6.3/0.4 kV transformers should be connected directly to the earth electrode.

4.7.12. Telecommunications systems

The DH water pumping station building and the process building shall be equipped with administrative and dispatching communications via VoIP. The phones shall be located in the I&C rooms, electrical rooms and process rooms of the heat accumulator system buildings. The facility should be connected to in the existing telecommunications system.

The contractor shall install indoor cabling and telecommunications ducting and connect it to the existing EC-4 infrastructure at terminal points (telecommunications manholes).

In accordance with **Appendix 8** to this document, the Contractor shall design, supply and construct a backbone network for the purposes of the Employer's systems.

The switchgear room and the pumping station room shall be equipped with a fire alarm system. The fire alarm system control panel shall be located in the EC-4 main control room. The fire alarm system control panel must have the technical capabilities to be connected via a communication link or by wire to the master system managing fire control panels.

4.7.13.Cable management

The cable system (electric power, signal and I&C cables) shall comply with: PN-IEC/HD 60364, PN-EN 45510-2-9, N-SEP-E-004. The Employer allows cables to be routed over pipe bridges.

The Contractor shall use or envisage the following elements for the cable routes:

- A. cable ducts;
- B. suspended sheet metal cable troughs;
- C. open routes (cable ladders);
- D. cable shafts.

The designed cable routes shall be equipped with:

- A. braces;
- B. ladders;
- C. metal sheet ducts;
- D. penetrations through walls and floor ceilings;
- E. sealing of penetrations;
- F. other prefabricated accessories for fixing ladders and cables;
- G. covers in external areas.

All the items mentioned above shall be prefabricated, made of hot-dip galvanised steel. Galvanised items shall not be welded. The elements of cable routes used shall be system-based and shall be selected in accordance with the system manufacturer's guidelines.

The main cable routes shall contain a minimum of 20% spare. The adjacent braces shall not be distanced from each other by more than 2 m.

Vertical separation between 3-phase power cable shelves shall be not less than 250 mm and, for control cables, not less than 150 mm providing access to the shelves. Horizontal distances of power cables shall not be less than the diameter of the larger cable. Control cables shall be arranged side by side.

Various cables classes shall be routed along different cable shelves and cable ladders, in the following sequence, from the top:

- A. E90 cables;
- B. HV 3-phase power cables;
- C. LV 3-phase power cables;
- D. control cables.

All cables shall be clearly marked with tags attached to the cable at the beginning and at the end and at the route change points.

Fire protection

Cable fire protection shall be carried out in accordance with the standard adopted at the Facility. The system shall have passive and active protection of cable routes such as:

- A. fire separations in cable tunnels and ducts;
- B. fire separations in vertical service shafts;
- C. sealing of cable penetrations through walls and ceilings;
- D. application of non-flammable coatings.

Cable selection

The Contractor shall select power cables taking into account the following factors:

- A. load;
- B. short circuit withstand strength;
- C. voltage drop, including when starting up motors;
- D. mechanical strength;
- E. temperature conditions;
- F. method of arrangement.

The control cables shall be selected taking into account the following factors:

- A. continuous and peak load current;
- B. voltage drop;
- C. possibility of induction in the cable due to environmental conditions;
- D. mechanical strength.

Low voltage 3-phase cables ≤ 1000 V

The cables shall be of copper conductors, class 1 to 16 mm², class 2 above 16 mm². The minimum cross-section area of copper conductors of power cables shall be 2.5 mm². Shielded cables specially designed for this purpose should be used to power the motors from the inverter systems.

Low voltage 3-phase cables ≥ 1000 V

Three-phase power cables with copper or aluminium conductors with insulation selected for the level of working voltage, with shielding as the shielding conductor.

Control cables

The control cables having the cross-section area greater than 1.5 mm² shall be of multi-conductor type. Cables for special purposes, e.g. computer connections, shall have paired conductors, shielded pairs and an external shielding. For general-purpose control cables the minimum conductor cross-section area shall not be lower than 1.5 mm² and for current transformer circuits not lower than 2.5 mm². The control cables shall contain at least 20% spare conductors for later use.

Cable insulation

The cables used shall have PVC or XLPE insulation and an outer sheath with increased resistance to flame spread, complying with the requirements of PN-EN 60332-3-24 (Cat. C), taking into account the guidelines of PN-EN 50575. The cables shall meet the CPR requirements.

Cable and wire tags

All cables and wires shall be clearly marked with tags attached to them. The tags shall be attached at their beginning, end and at the route change points and on both sides of the penetrations. The Contractor shall present a sample cable tag with mounting for the Employer's approval, including the proposed cable and wire labelling system. The above requirements also apply to tags on wires in internal connections of all switchgears and field cabinets.

Cable accessories

The Contractor shall provide complete necessary accessories for the correct termination of power and control cables. Cable connections using splicing kits are not allowed.

4.7.14. Electric shock prevention

Direct contact protection of electrical equipment (basic protection measure) shall use appropriate working insulation (guards). Alternatively, the equipment can be located out of the contact range. The direct contact protection (additional protection) shall be ensured by means of:

- A. in MV kV network arranged as IT — connecting accessible conductive parts with the earthing system in a manner that meets the requirements specified for protective earthing;
- B. in 230/400 V network; 690 V network arranged in TN configuration, in accordance with standard PN-HD 60364-4-41, by quick switching off if safe voltage is exceeded (automatic circuit-breakers, thermal fuses).

4.7.15. Drive rotational speed control systems

Environmental operating conditions

It is required that the drive speed control system, including frequency converters, is designed and adapted to continuous operation in indoor conditions as follows:

- A. min. ambient temperature: +5°C;
- B. max. ambient temperature: + 40°C;
- C. max. humidity: 95%;
- D. altitude above sea level up to 1000 m.

It shall therefore operate reliably in the absence of air conditioning of rooms.

Normal operating conditions of frequency converters in with air conditioning in operation:

- A. normal operating temperature + 20°C
- B. permissible ambient temperature range +10°C to +25°C;
- C. maximum relative humidity up to 70%.

Required minimum protection rating of enclosures: IP54.

Frequency converters shall be suitable for operation with a higher-level microprocessor system.

It is required that the speed control range of the motors should be compatible with the load curves of the consumers.

Required control, vector-based or DTC: overload current min. 110% I_n .

Requirements for equipment, at least:

- A. equipment with an AC/DC line reactor;
- B. RFI input filter for the second environment, class C3 according to EN 61800-3;
- C. drive for pump and fan applications ($M = f(n^2)$), overload capacity min. 110% $\times I_n$ for 57 s in a cycle of 300 s and 150% $\times I_n$ for 3 s;
- D. automatic energy optimisation function;
- E. Integrated safety function – STO (safe torque switch-off) in the converter, meeting the requirements of SIL 2 or PL d category;
- F. automatic function for adjustment to the connected motor – with the pump unit stopped and coupled;
- G. text LCD control panel, digital communication ports, password lock – in the Polish language;
- H. LCD display for measurement values (min. 3 programmable values, e.g. current, revolutions, power);
- I. display of 4-20 mA indications in process units (e.g. flow, pressure, temperature);
- J. the following protections as a minimum: under- and overvoltage, directional protection against the effects of ground faults in a circuit powered by a converter ensuring normal operation of the converter in the event of an earth fault in the network supplying the converter, supply voltage phase control, output voltage phase control, current overshoot, protection against drive overheating, motor overload protection, motor stall protection, motor underload protection, protection against short-circuiting of auxiliary voltages, motor and drive temperature monitoring;
- K. design of the converter shall ensure normal operation of the converter in the event of an earth fault in the power supply network;
- L. equipped with the following functions: automatic restart after voltage decay, on-the-fly start-up (converter connection with the rotating motor), kinetic buffering (maintaining motor operation with short line voltage drop or decay), drive braking option, minimum 96% efficiency;
- M. frequency converters suitable for cogeneration with pumps in the PAT system must enable energy return to the network (regenerative drive in continuous electricity generation or braking mode). It is planned to install only one pump operating in the PAT system. For other cold water pumps, it is necessary to envisage the supply of converters enabling expansion with a regenerative operating module.

Technical requirements

Technical requirements for converters:

- A. Rated voltage: 400 V or 690 V
- B. Voltage applied to the motor 0–100% of the supply voltage
- C. Efficiency > 96%
- D. Higher harmonic emission level for 0–100 Hz power supply networks
- E. Overvoltage immunity category III acc. to EN 61800-5-1
- F. Power factor at the converter input -1 (adjustable from 0.8 inductive to 0.8 capacitive)
- G. Inverter current overload capacity: 110% I_n for 60 s in a cycle of 300 s, 150% $\times I_n$ for 10s in a cycle of 300 s, both in motor and regenerative operation

Compliance with standards

- A. PN-EN IEC 61800-2:2021-11;
- B. PN-EN IEC 61800-3:2019-02;
- C. PN-EN IEC 61800-5-1:2024-03;
- D. PN-EN IEC 61800-5-2:2017-07.

Tests and inspections of frequency converters:

- 1. Type and product tests - type and product tests of frequency converters shall be carried out in accordance with the requirements of the relevant standards. Type and routine test reports shall be provided along with the Delivery.
- 2. FAT shall be carried out in accordance with a programme agreed with the Employer.
- 3. SAT shall be carried out in accordance with a programme agreed with the Employer.

Frequency converters shall meet the requirements of law and the TNC in terms of harmonic emissions into the power supply and off-take network. Permissible current distortion levels are included, among others, in the PN-EN 61000-3-12 standard and in the Ordinance of the Minister of Climate and Environment of 22 March 2023 on detailed conditions for the operation of the power system, Journal of Laws of 2023, item 819. The Contractor shall provide: inverter current curve in the function of motor rotational speed and system efficiency curve (inverter – motor) in the function of motor rotational speed, specifying the following technical parameters:

- A. rated continuous power;
- B. rated continuous current;
- C. maximum 1-second current;
- D. heat loss at rated load;
- E. air flow at rated values;
- F. THDI as per the above-mentioned requirements;
- G. THDU shall be in accordance with IEEE 519-1992, respecting system.

Frequency converters shall meet the requirements of PN-EN 60146-2 and the requirements of standards and normative acts regarding electromagnetic compatibility.

4.7.16. Requirements for electric motors

The following requirements for electric motors shall be regarded as additional to the applicable standards. The Contractor shall ensure high quality and availability of motors. The motors shall be selected according to the external surrounding conditions and to the environmental operating conditions. The motors shall be sized to min. 15% higher than the power for the design nominal operating point. Starting the motor must not cause the max. 10% voltage drop on switchgear busbars and power cable. Motor service life shall be minimum 20 years. The motor shall sustain at least 5,000 starts without any damage under the following conditions:

- A. voltage across motor terminals during start-up shall range from 0.9 U_n to 1.0 U_n ;
- B. shaft load (braking torque and moment of inertia) shall be such that the rise of adiabatic temperature in the stator winding during every start-up within 60% of the permissible rise for a given insulation class shall not be exceeded.

The motors shall be suitable for self-starting at a voltage reduced to 0.75 rated voltage after a power failure of 3 seconds without exceeding the permissible temperature rises in the hot state in the stator windings. The permissible starting frequency shall result from the requirements of the process system, but shall not be less than two consecutive starts from the cold state and

one from the hot state within an hour. The motor shall be adapted to overloads resulting from the nature of operation of the driven device, without exceeding the permissible temperature for a given insulation class. Torque overloading at rated voltage should not be less than twice the rated torque.

Requirements for MV electric motors

It is not envisaged to install MV motors.

Requirements for LV electric motors:

- A. type: three-phase induction motors with a cage rotor;
- B. 400 V, 50 Hz or 690 V, 50 Hz;
- C. temperature increase class B;
- D. insulation class F;
- E. protection rating of the enclosure IP 54 or higher;
- F. direct start-up or individual inverter;
- G. PTC temperature sensors in windings (in each phase) – motors exceeding 150 kW;
- H. noise level < 80 dB;
- I. motors interacting with inverters with a power above 100 kW should be equipped with a minimum of one bearing with an insulated raceway and reinforced front insulation of the stator windings due to the overvoltages generated in the converter systems. Insulating spacers should be used in the couplings to prevent the flow of shaft currents.
- J. When selecting motors that interact with inverters, depending on the extent of speed control and the conditions of heat dissipation from the motor, the possibility of factory equipping the motor with an additional cooling fan operating at a capacity independent of the speed of the motor shaft should be taken into account.
- K. The motors shall meet the minimum requirements of class IE3 in accordance with IEC 60034-30-1 Rotating electrical machines – Part 30-1: Efficiency classes of line operated AC motors (IE-code), 2014.

Compliance with standards:

- A. PN-EN 60034;
- B. PN-EN 60034-1;
- C. PN-EN 60034-2;
- D. PN-EN 60034-2-3;
- E. PN-EN 60034-5;
- F. PN-EN 60034-30-1;
- G. PN-E-06722;
- H. PN-EN ISO 1680.

4.8. SCOPE OF THE I&C AND IT DISCIPLINE

4.8.1. General information

The scope of I&C works shall include the design, delivery, installation and start-up of a complete DCS with control and measurement equipment (remote and local) as well as control

systems with controllers and cabling. The controllers designed and commissioned by the Contractor shall be capable of being integrated into the existing DCS.

The Employer allows two control system solutions for the Heat Accumulator:

- A. Control system based on the Valmet DNA platform as an island with its own central unit, integrated into the existing EC-4 DCS network via a communication link, with the possibility of local control (e.g. operator panel), with the possibility of full remote control from the heating or power unit control room and local control with a local HMI operator panel.
- B. Control system based on a platform from a renowned supplier of control systems for the energy industry, connected to the existing EC-4 DCS system via a communication link (Ethernet TCP/IP protocol), with full remote control from the heating or power unit control room and local control from the local HMI operator panel. If this solution is selected, the control system must be open and its engineering service must not be limited to the manufacturer's service.

This system must meet the cybersecurity requirements applicable in the Veolia Group in Poland – details in section 4.8.10 of this document.

It is required that the system should provide the AVEVA PI system with operational data from the HAS via the interface existing at Veolia Energia Łódź S.A.

The Employer prefers the Valmet solution.

The communication link between the existing DCS and the accumulator control system shall be provided by the Employer using a single-mode optical fibre. The Contractor shall provide the communication equipment for this solution.

For all new measurements and I&C equipment, KKS codes shall be applied in accordance with the standard applied at Veolia Energia Łódź S.A.

4.8.2. System-related part

The Heat Accumulator shall perform all tasks related to monitoring and controlling the main process equipment and auxiliary systems. In addition, the aim is to optimise and increase the economic efficiency of the Heat Accumulator, taking into account:

- DH water systems;
- steam cushion preparation systems;
- electrical systems.

The use of local control systems in the “Black box” design shall be limited to the absolute minimum.

Local control systems in the ‘black box’ design are only permitted under the condition that the Contractor provides all software licences and the source code of the software (editable version of the implemented algorithm) is delivered to the Employer to enable future programming changes and service work. The source code should include appropriate comments and required descriptions to facilitate its analysis for possible future needs.

In addition, the task of the automation system is to optimise and increase the economic efficiency of the Heat Accumulator.

The automation system shall provide:

- Running process systems with a constant or variable load within the range from the technical minimum to 100% of the available capacity;
- Conducting start-ups and shutdowns of the Heat Accumulator;
- Running the Heat Accumulator in the event of disturbances on the heating network side with control of discharges from or to the network;
- Controlling individual drives in automatic and manual mode;
- Interlocks and protection devices of individual drives (implemented at the control level);
- Process interlocks;
- Interaction with power units and, in the future, with an electrode boiler.

In order to achieve the set objectives, the system architecture shall be hierarchical and based on the following control levels:

- Heat Accumulator management level (control, optimisation, operation supervision);
- Level of drives and I&C equipment.

If a control system other than that of Valmet is selected, only controllers/hardware platforms that are generally available for purchase at the time of the design and for which the manufacturer has not announced plans to discontinue production are permitted for the development of automation systems.

System configuration

The DCS shall enable full on-line configuration of the software. The on-line hardware configuration shall minimally support the addition of new modules mounted in standby stands to the configuration. In addition to the above on-line configurations, the DCS shall have the functionality of forcing signals.

In order to ensure internal reliability, the DCS shall have self-diagnostics, minimally in the range of processor unit cards, I/O cards, memory, communication ports.

The availability of the system shall be ensured by the use of a redundant and/or fault-tolerant configuration for critical components.

Minimally redundant components shall be used for:

- system power supply units;
- processing unit cards;
- networks between I/O cards and processing unit cards;
- networks between processing unit cards.

Processor unit cards shall operate in hot standby mode with no impact switching in the event of failure.

Modifications to the application software must not entail a restart of the process station (on-line modification).

I/O cards shall be installed in a configuration allowing their replacement during system operation (hot swap). The use of hot-swap functionality shall not involve modifications to cabling or disconnection of other system components.

In the event of damage to individual components, the system shall be able to operate correctly.

The operator, through HMI mechanisms, shall be informed about the current status and fault of system components.

In order to extend the functionality or upgrade during the operation of the facility, the DCS shall have spare capacity. The use of I/O spare capacity shall not involve the purchase of additional hardware, software and/or licenses or the performance of additional assembly activities.

As of the date of Provisional Acceptance, spare capacity shall be guaranteed as follows:

- I/O cards with necessary accessories and licenses – 10%;
- free card stands/racks – 15%;
- processor unit idle time – min. 20%.

It is required to provide free space in cable trays according to spare capacity in I/O cabinets. Communication spare capacity for new DCS subunits and field devices shall be determined at the detailed engineering design stage.

At the stage of Offer submission, the Contractor shall prepare the preliminary architecture of the Heat Accumulator DCS (in conjunction with the DCS of the CHP Plant), which shall be an appendix to the Offer, which constitutes an appendix to the Contract.

The Employer does not require the supply of operator stations – in order to operate the Heat Accumulator, the Employer envisages the use of existing operator stations in the EC-4 main control room.

4.8.3. Automatic control systems

The automation system shall implement all automatic control systems required for the Heat Accumulator over the entire range of load changes.

The automation system shall enable switching operating modes of the Heat Accumulator.

Automatic control systems should have self-diagnostic systems resulting in shutdown from automatic operation and adopting a safe level in the event of failure or malfunction.

All tests involving automatic control systems should be performed in automatic operation mode to obtain the system response to disturbances.

The process system of the Heat Accumulator, depending on the operating mode, should be equipped with the following automatic control systems:

4.8.3.1. Heat Accumulator charging

A diagram of the Heat Accumulator charging system is shown in Fig. 4.8.3.1.1. In the process of charging the Heat Accumulator, the control butterfly valves RVG1, RVZ1, RVZ2 take part in controlling the amount of hot water flow from the network to the accumulator. In fact, each of the butterfly valves is a control subunit consisting of several devices selected to ensure a correct change in the water flow over a wide range. During this time, one of the three cold

water pumps – by the motor and the converter equipped with an electrical energy return system – transmits power to the network.

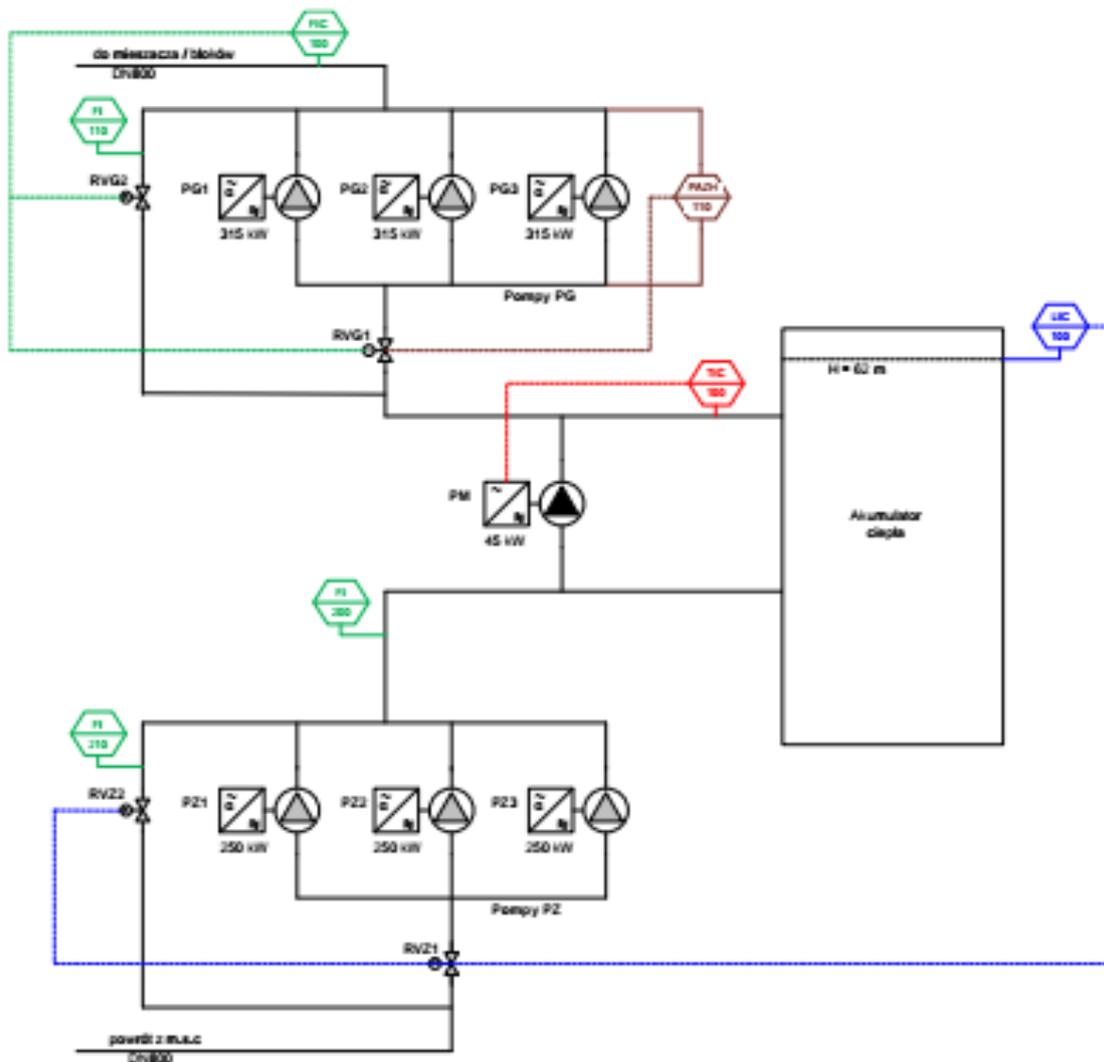


Fig. 4.8.3.1.1 Diagram of the accumulator charging system

The value controlled in the hot water flow control system for the flow to the Heat Accumulator (FIC 100) shall be the signal from the flow meter mounted on the hot water pipeline from the mixer. The actuators of the system are control butterfly valves for hot water RVG2. The system controls the amount of water flowing into the Heat Accumulator with RVG2 butterfly valves from 0 to 100%. The controller maintains the value of water flow to the Heat Accumulator set by the operator. At the output from the Heat Accumulator, the flow of water to the network is controlled as follows: the RVZ1 valves control the flow of water through the PAT pump, and the RVZ2 valves control the flow of water through the bypass, which results in the set total flow. The controller in this area controls the opening of the valves RVZ1 and RVZ2 in such a manner as to obtain optimal energy return to the network from the PAT pump.

The controller is also designed to maintain the water level in the Heat Accumulator by controlling the valves on both the hot and cold water side.

The controller should be provided in such a manner that it is possible to add PAT control to subsequent pumps in the future.

4.8.3.2. Water level in the Heat Accumulator

The LIC 100 Heat Accumulator water level control system is designed to maintain the water level in the Heat Accumulator in terms of safe operation of the charging diffuser during the charging process of the Heat Accumulator with hot water. It shall be operated jointly with the automatic control system for hot water flow to the Heat Accumulator and uses only RVZ1 and RVZ2 control butterfly valves. In order to maintain the desired water level in the Heat Accumulator during the filling, it is necessary to empty it simultaneously. The controller opens the RVZ1 butterfly valve to maintain the set and safe water level in the Accumulator. The RVZ2 butterfly valve shall be closed. The stream of water from the Heat Accumulator shall flow through PZ1-PZ3 cold water pumps generating electricity to the network. When the controller opens the RVZ1 butterfly valve completely and the water level in the accumulator is constantly increasing, the RVZ2 butterfly valve shall be activated to lower the water level in the Heat Accumulator to the set level. If the water level falls below the set point, the controller shall close the RVZ2 butterfly valve completely and further control with ensured using the RVZ1 butterfly valve. As in the previous system, the stream of water flowing from the Heat Accumulator through cold water pumps generates electricity in the motors – transmitted to the network by inverters with energy return systems to the network. The amount of energy produced by the motors of PZ1-PZ3 pumps is the resultant quantity.

In emergency situations, e.g. making up water in the DH network, it is possible to operate the Heat Accumulator at a level set within the safe operating range of the diffuser.

4.8.3.3. Water temperature control in the Heat Accumulator

This system is an independent control system operating during the transfer of a hot water stream to the heat accumulator. Its task is to maintain the temperature of water entering the Heat Accumulator at a set level. The TIC control system 100 maintains a set value of the inlet temperature to the accumulator by controlling the rotational speed of the mixing pump. This pump shall collect water at a lower temperature from the accumulator by mixing it with the currently injected stream into the accumulator so as to ensure a value set by the operator. It is extremely important to design the hydraulic system in such a manner to ensure proper mixing of both water streams in the inlet pipeline to the accumulator and place the temperature sensor of the control system there.

4.8.3.4. Heat Accumulator discharging

When discharging the Heat Accumulator and introducing a stream of hot water from the Heat Accumulator into the DHN network, PG1-PG3 hot water pumps and PZ1-PZ3 cold water pumps shall be in operation. The butterfly valves shall not be involved in this process (the RVG1 and RVZ1 butterfly valves are open and the RVG2 and RVZ2 b valves are closed).

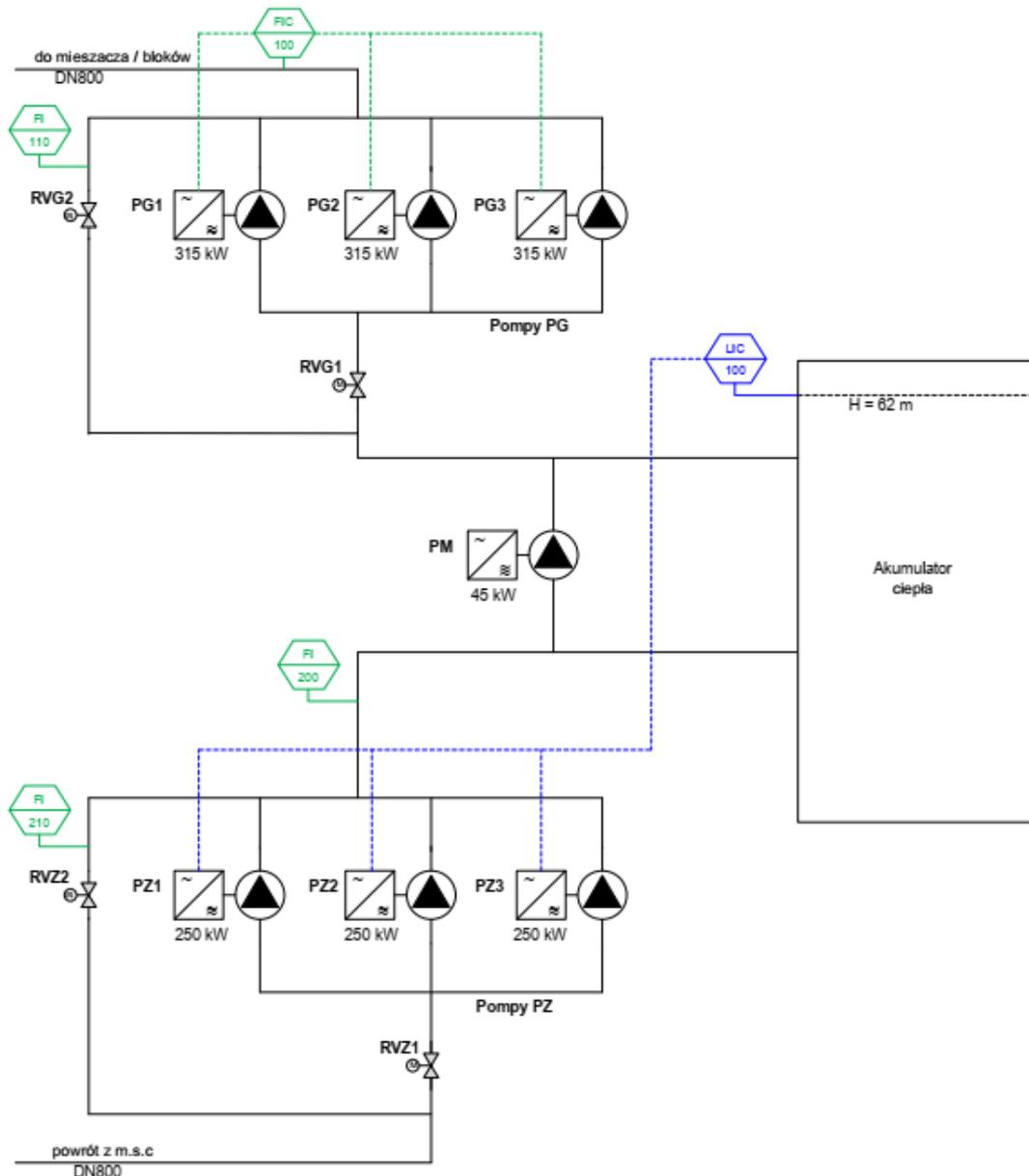


Fig.

4.8.3.4.1 Diagram of the accumulator discharging system

The FIC 100 hot water flow automatic control system maintains a constant flow to the DHN network set by the operator. PG1-PG3 hot water pump converters shall be the final actuating system. The generated offset signal from the controller shall be sent to the inputs of the operating frequency converters, changing the speed of the pumps continuously and steplessly depending on the value of the hot water flow reading. The switched on converter-pump units should operate synchronously and be driven by the same control signal. The controller uses the selection and setting of suitable parameters to determine operational behaviour of the pumps.

The number of PG1-PG3 pumps that are actually in operation depends on current operational and service conditions. The operator decides to switch each pump on and off.

4.8.3.5. Maintaining water level in the accumulator when discharging

The purpose of the LIC 100 automatic control system is to maintain the water level in the accumulator in terms of safe operation of the diffuser when the Heat Accumulator is being discharged. The level depends on the operation-related situation and the method of operation at a given moment. The level value is measured by means of a transducer in the Heat Accumulator tank. The final controlling element – cold water pump converters PZ1-PZ3. The controller from the DCS controls the operation of all pumps operating continuously, commanding them with the same control signal. PZ1-PZ3 pump units in operation must operate at the same rotational speed. The number of pumps in operation is decided by the operator, switching them on depending on current operational conditions. The PZ1-PZ3 cold water pumps must be equipped with signalling and interlocking when suction pressure is too low, which will protect the equipment against cavitation.

4.8.3.6. Automatic discharge of return pressure

This system is an independent system. Its operation ensures that the pressure on the return side from the DHN network is reduced in the event of a sudden increase. The measuring signal comes from a pressure transducer mounted in the return pipeline from the DHN network. In the event of an increase in pressure, the control system with the use of PR1 and PR2 pumps shall route the water stream from the return pipeline to the Heat Accumulator. At the first stage, it shall switch on the PR1 pump and attempt to maintain the pressure setpoint. If the pump is fully actuated and the pressure in the return pipeline continues to rise, it shall activate the PR2 pump. Both operating pumps shall be driven by the same control signal – they shall rotate at the same rotational speed. In the event of a drop in pressure, the controller shall switch off the PR2 pump and continue the control process with the PR1 pump.

If the return water pressure is discharged at the maximum level in the Heat Accumulator tank, it shall be blocked by the LAZH 100 limiter mounted in the accumulator. Further operation of the control system shall be possible after the water level in the Heat Accumulator has decreased. Further pressure reduction in the event of reaching the maximum level in the accumulator should be initiated by operating personnel and carried out in accordance with the applicable procedure for the remaining heating power units.

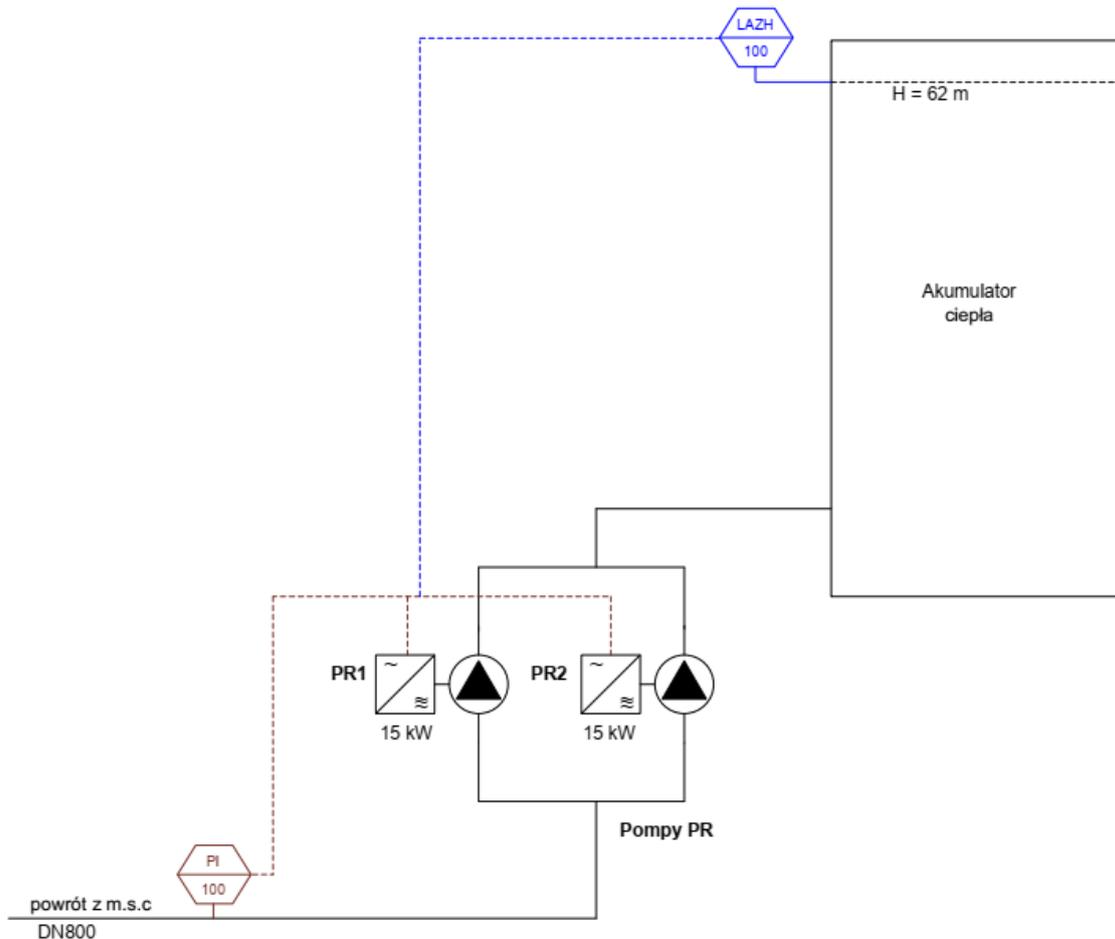


Fig. 4.8.3.6.1 Diagram of the accumulator discharging system

The above automatic control system shall be integrated into the controller, which shall also be able to be connected to the DCS system.

4.8.3.7. Algorithms for emergency or abnormal situations in network systems

For emergency states and for exceptional states of the district heating network, not related to the nominal operating state, the Employer requires the following algorithms to be included in the Heat Accumulator DCS:

- Network supply without making up water in the Heat Accumulator, e.g. if the network becomes unsealed – process-related description in section 4.2.2.
- Increase in supply temperature for a short period of time due to an emergency condition related to generating units – process-related description in section 4.2.2.
- Cold water supply by mixing water pumps at the suction of hot water pumps – process-related description in section 4.2.2.
- Emergency signalling by a sensor installed in the overflow and drain pit – process-related description in section 4.3.1.
- Pumping when emptying the Heat Accumulator – process-related description in section 4.5.4. Pressure stabilising pumps shall be equipped with dry-running sensors for this operating mode.

- Maintaining the water level in the Heat Accumulator above the overflow – water loss through the overflow is a highly emergency condition.

All algorithms must be prepared in accordance with the guidelines for the Contractor's Documentation, section 8.3., to this document.

4.8.4. Field part

The heat accumulator systems should be equipped with a set of necessary measuring instruments, both remote (sensors, transducers, transmitters, local controllers) and local (manometers, thermometers).

The scope of the field part shall include complete measurement circuits from the nozzle to the control system.

Measuring nozzles, first shut-off valves, nozzles of temperature sensors, measuring orifices and control valves are to be provided by supplier of process equipment and pipelines. Installation of the above elements shall be carried out by the contractor of process equipment installation under the supervision of the I&C contractor.

The instrumentation shall be selected taking into account the operating factor, process device parameters, installation conditions, environmental conditions, required accuracy, service availability and operating availability, taking into account the specific requirements and recommendations of the instrumentation manufacturer.

Materials, design and dimensions of the valving as well as impulse tubes between the process system – process and the transducer should be selected so that:

- A. They guarantee the measurement of full maximum process parameters in accordance with ISO, IEC, EN guidelines;
- B. they take into account metrological requirements (only acid-resistant materials will be used for chemical measurements);
- C. they take into account ambient conditions (e.g. temperature, aggressive fumes, etc.).

The supplied instrumentation shall be a product of companies of established reputation on the industrial instrumentation market, types that have proven themselves at power facilities in recent years under similar operating conditions as the instrumentation will operate.

All measurement nozzles, transmitters and actuators shall be accessible from maintenance platforms or, where appropriate, portable maintenance platforms approved for use in the power industry. In addition, field lighting shall be adapted.

The temperature measurements on the heat accumulator shall be installed in the thermometer pockets so that when the Heat Accumulator is filled, the sensor can be replaced.

Temperature sensors shall be installed along the staircase of the Heat Accumulator in dedicated insulated chambers (service access from the staircase; chambers cut out in the insulation of the Heat Accumulator and thermally insulated).

Only certified components and materials of proven quality and origin shall be used.

Measuring ranges of the measuring instrumentation shall be selected so that normal operating values occur at approximately 75% of the maximum measuring range.

All measuring instruments shall be checked before being installed on the equipment of the Subject of the Contract.

All instruments and transmitters for measuring temperature, pressure and differential pressure (including flow and level transmitters) shall have a specific metrological status:

- A. obtained by checking the instrument or transmitter at the Construction Site using validated measuring instruments;
- B. documented in the form of a record of checking the instrument before installing it on the equipment of the Subject of the Contract, drawn up by the I&C supplier.
in accordance with the procedures which are elements of the supplier QA programme and the programme of inspections and tests.

The instrumentation shall be delivered complete with the installation accessories such as:

- A. pressure gauge valves for pressure measurements with vents;
(manometric taps should not be used)
- B. three-way (five-way) blocks for differential pressure and flow measurements;
- C. panels of preparation and sampling for physical-chemical measurements;
- D. clamps adapted for mounting transmitters on field pipe stands;
- E. all equipment must be checked before installation and have calibration certificates;

The components of the measuring systems shall be equipped with such fastenings and such shut-off valving as to enable safe disassembly and replacement of the Heat Accumulator system during operation.

The required field voltage standard for electronic sensors (inductive, capacitive, vibration, etc.) is 24 V DC.

The power supply for such measuring sensors shall be 24 V DC.

If necessary, signal separators with full galvanic separation (input, output, power supply) with an insulation voltage of not less than 1.5 kV shall be used.

Climatic requirements and protection ratings of measurement instrumentation enclosures

- A. The equipment located in the rooms shall be suitable for operation under the following ambient conditions:
 - a. outdoor temperature 5°C to 40°C
 - b. relative humidity 5% to 95% (non-condensing)
 - c. protection rating IP54
- B. The equipment located outside the buildings shall be suitable for operation under the following ambient conditions:
 - a. outdoor temperature -30°C to +50°C
 - b. relative humidity 5% to 95% (condensing)
 - c. protection rating IP65

Alternatively, it is allowed to use enclosures with heating elements. The automation equipment must be vibration-proof.

4.8.4.1. Units of measurement

Full unification of units of measurement is required. In the case of units not specified below, units of measurement shall be used in accordance with the International System of Units (SI). At the basic design engineering stage, the Contractor shall present the Employer with a list of units used in the design for approval.

The basic units of measurement used during the implementation of the Contract shall be:

- A. Pressure: Pa, (and derivative units) (g) or (a);
- B. Temperature: °C;
- C. Flow (liquid): t/h, l/h
- D. Flow (gas): Nm³/h
- E. Level: %, m, mm;
- F. Pressure differential: Pa, kPa.

General requirements

The supplied instrumentation shall be brand new. The Contractor shall maintain the unification of equipment and components within the system.

All instruments and measuring equipment shall be checked before being installed in accordance with the suppliers' quality assurance plans and shall have calibration or check certificates.

The requirements below do not apply to the instrumentation from the package delivery of the so-called "Black Boxes". In the case of package deliveries, the Employer allows, after prior agreement, the standard solutions of the manufacturers as part of the package supplier.

Preference shall be given to instrumentation from suppliers whose components are installed and used at EC-4.

- Pressure and differential pressure measurements. The following transmitters are used: Aplisens, Emerson, E+H;
- Temperature measurements are carried out with sensors from: Termoaparatura, Limatherm, Aplisens;
- Temperature measurements use transmitters from Aplisens Emerson, E+H;
- Control actuators. Equipment manufactured by the following companies are used: INTEC, AUMA, SIPOS;
- Cut-off actuators. Equipment manufactured by the following companies are used: AUMA, INTEC;
- Pneumatic positioners. Equipment manufactured by the following companies are used: SIEMENS, Aplisens, ABB.

The Employer requires that the control and measurement equipment comes from well-known global suppliers with a service centre in Poland or in the European Union. The Employer's consent is required in case of deviations.

For the purposes of guarantee measurements, additional measuring nozzles shall be prepared. For pressure and differential pressure measurements, the signals from the nozzles shall be supplied to the instrument stands and shall be terminated with plugged block valves.

All transmitters and local indicators shall be provided with permanent service access in accordance with PN-EN-ISO 14122. It is not envisaged to use portable mobile access platforms. In justified cases, the Employer shall allow servicing from portable maintenance platforms approved for use in the power industry.

Temperature sensors must be installed in such places and in such a manner that they can be replaced during operation (does not apply to sensors for temperature measurements of bearings and drive windings).

For other systems, where such requirements cannot be met due to process requirements or access restrictions, this shall be discussed and agreed with the Employer at the detailed engineering design stage.

The Contractor shall use continuous measurements. The use of binary process parameter relays shall be agreed with the Employer.

It is not allowed to use measuring devices containing isotopic sources.

All instruments installed in places protected from direct weather conditions shall be adapted, to a minimum, to operation in climatic conditions prevailing on the System.

All instruments installed outdoors shall be adapted, to a minimum, to operation in the climatic conditions prevailing in the facility and shall additionally be protected against direct UV radiation if required – this applies only to devices installed outdoors.

Instruments supplied in bulk that do not meet the requirements of class C1 and/or D1 shall be installed in suitably adapted protective cabinets.

Transmitter instrumentation enclosures shall have a protection rating of IP65 (according to PN-EN 60529) as appropriate to the place of installation.

The cables shall be equipped with spare capacity enabling operational duties (e.g. calibration) of the sensor without disconnecting the circuit.

The indicating and display elements shall be oriented so that the presented values can be correctly read when standing facing the instrument of the device in the place intended for its operation.

If the transmitter is damaged, the output signal levels shall be in accordance with Namur NE 43. or IEC 60947-5-6.

The transmitter shall be equipped with diagnostic functions in accordance with Namur NE 107 or IEC 60947-5-6.

All transmitters shall have a 4–20 mA output as standard and shall support the HART protocol.

All pressure and differential pressure transmitters shall have measuring chamber vents.

Transmitters shall be grouped and mounted on measuring stands. In justified cases, local installation on the pipeline is possible.

Measurements shall be carried out using thermocouples of class 1 according to PN-EN 60584-1.

All measuring instruments shall have the KKS code of the device (process-related designation) uploaded.

The minimum accuracy of the entire measuring circuit depends on the type of application (exact data in points for specific measurements):

A. Performance monitoring and calculations:

- a. Level: $\pm 0.5\%$
- b. Flow: $\pm 1\%$
- c. Temperature: $\pm 0.5\%$
- d. Pressure: $\pm 0.5\%$

B. Control circuits:

- a. Level: $\pm 1\%$
- b. Flow: $\pm 3\%$
- c. Temperature: $\pm 2\%$
- d. Pressure: $\pm 1\%$

C. Monitoring of values:

- a. Level: $\pm 5\%$
- b. Flow: $\pm 5\%$
- c. Temperature: $\pm 3\%$
- d. Pressure: $\pm 2\%$

For vibration measurements of pump units, the Employer does not require the delivery of a separate vibration monitoring system. Signals from these measurement systems should be connected to the DCS in which alarm and safety thresholds will be implemented, to be used in equipment protection logics.

4.8.4.2. Pressure measurements

Required standards and certificates for pressure measurements:

- European Pressure Equipment Directive (PED) or certificate of approval for use in the power industry / Production certificate in accordance with the international ISO 9001 standard;
- Certificates of construction materials: according to PN-EN 60953-1.

Technical requirements for pressure measurements:

- Process connection M20x1.5;
- Output signal: 4...20 mA + HART;

- Accuracy class: $\pm 0.075\%$ of the span of the measuring range (for less critical applications, $\pm 0.5\%$ is allowed – to be determined at the design stage);
- Total measurement error (impact of temperature $\pm 28^\circ\text{C}$ and static pressure of 6.9 MPa): not more than $\pm 0.15\%$ of the calibrated range (for less critical applications, $\pm 0.5\%$ is allowed – to be determined at the design stage);
- Transmitter range: not worse than 100-1;
- Power supply: 12...45 V DC;
- Digital communication: no;
- Stability: 0.125% of the measuring range for 10 years;
- Dynamics (response time): not worse than 125 ms;
- Enclosure IP rating: IP67;
- Additional equipment: surge protection in accordance with IEEE standard 587, category B and IEEE standard 472;
- Operating requirements: ambient temperature: -25°C to $+80^\circ\text{C}$, relative humidity: 100%;
- Overload capacity: min. 125% of the measuring range;
- Installation on an integrated valve block;
- Calibration and testing for overloads together with the block.

Technical requirements for pressure switches

- Process connection M20x1.5;
- Accuracy class: not worse than $\pm 1.5\%$ of the setting range;
- Adjustable hysteresis;
- Operating temperature: -30°C to $+80^\circ\text{C}$;
- Vibration resistance: yes.

4.8.4.3. Temperature measurements

Technical requirements for temperature measurements

- A Temperature measurements in the range of 0...300°C shall be based on Pt100 Ohm/0°C resistive sensors, while temperature measurements in the range above 300°C shall be based on NiCr-NiAl thermocouples. Exceptions are allowed for metal temperature measurements of bearings.
- B Replacement of temperature sensors must be possible during operation (this does not apply to metal sensors of bearings mounted inside bearing pedestals).
- C Water temperature sensors shall be placed along the entire height of the Heat Accumulator (from level 0 to the maximum position of the upper diffuser).
- D The distance between the water temperature sensors in the Heat Accumulator shall not exceed 1 m.
- E Resistive sensors and thermoelectric sensors shall only be mounted in a thermowell.

Resistive sensors

Resistive sensors shall meet the following requirements:

- Standard: DIN 43760 or IEC 751
- Material certificates: sensor jackets – PN-EN 61152
- Thermometric resistor: Pt100 Ohm/0°C, three-four-wire connections

- Accuracy class: A
- Sensor in the immersible part: without outer jacket
- Measurement head: IP65 tightness
- Operating requirements:
 - permissible operating temperature of the head: +100°C
 - vibration: up to 5 g

Thermocouple sensors for installation in the pipeline

The sensors for installation in the pipelines shall meet the following requirements:

- Standard: DIN 43710 or IEC 584
- Material certificates: sensor jackets – PN-EN 61152
- NiCr-NiAl thermoelectric sensor, isolated joint
- Accuracy class: 1
- Outer jacket material: steel
- Sensor in the immersible part: without outer jacket
- Measurement head IP65 tightness

Temperature transmitters

Transducers shall meet the following requirements:

- ISO certificate or certificate of approval for use in the power industry
- Surge protection: according to EC 801-4, 801-5
- Interaction with measurement sensors: resistive: Pt100 Ohm/0°C, 100 Ohm/0°C
thermocouple type: B, E, J, K, N, R, S, T
- Output signal: 4...20 mA + HART;
- Accuracy class: ±0.10% of the span of the measuring range;
- Accuracy: <±0.20% of the span of the measuring range
(for less critical applications, ±0.5% is allowed – selection at the design stage);
- Power supply: 12..45VDC;
- Stability: ±0.10% for 12 months;
- Galvanic isolation between input and output – for analogue converters;
- Resistance to electromagnetic interference;
- Automatic compensation of cold ends;
- Digital communication: no
- Possibility of programmed parameterisation and calibration using a communicator, notebook or from an engineering station;
- Operating requirements: ambient temperature -40 to +75°C

4.8.4.4. Flow measurements

For low-conductivity water flow measurements, it is recommended to use ultrasonic flow meters.

Flowmeters must have the functionality of recognising the flow direction and the ability to measure in both directions.

The Employer requires that the supplied flowmeters should be calibrated with a calibration certificate in a given scope of operation.

Ultrasonic flowmeters

Applicable standards: PN-M-42370 Measurement of fluid flow in pipes.

The flowmeter shall include:

- flow sensor;
- measurement transmitter.

Requirements for flow sensors:

- number of paths: min. 2;
- enclosure: IP68;
- installation of non-invasive or replaceable sensors at a filled pipeline

Requirements for measurement transmitters:

- Material certificates: DIN 50.049-3.1 B standard;
- Output signals: 4...20 mA + HART;
- Accuracy: $< \pm 1\%$ of the real measured value;
- Repeatability: $< \pm 0.25\%$ of the range;
- Power supply: 230VAC;
- Digital communication: Yes: Profibus, Profinet, Modbus
- Enclosure IP rating: IP67;
- Operating requirements: ambient temperature: -20°C to $+55^{\circ}\text{C}$;

4.8.4.5. Level measurements

Level measurements using radar probes are preferred.

Radar method of level measurement

Requirements for transmitters:

- A. Certificate of approval for use in the power industry;
- B. Production certificate in accordance with the international ISO 9001 standard;
- C. Certificates of construction materials: according to EN 10204 3.1B;
- D. Measuring element: radar probe
- E. Output signal: 4...20 mA + HART;
- F. Accuracy: $\pm 0.10\%$ of the span of the measuring range;
- G. Power supply: 12...45 V DC;
- H. Digital communication: no
- I. Enclosure IP rating: IP67;
- J. Operating requirements: ambient temperature: -40 to $+80^{\circ}\text{C}$;
- K. process parameters: -150 to $+400^{\circ}\text{C}$ / 135 bar;
- L. relative humidity: 99%.

Hydrostatic method of level measurement

Requirements for level measurement devices:

- A. European Pressure Equipment Directive (PED) or certificate of approval for use in the power industry;
- B. Production certificate in accordance with the international ISO 9001 standard;

- C. Certificates of construction materials: according to EN 10204 3.1B;
- D. Measurement element: piezoresistive sensor with separating membrane;
- E. Output signal: 4...20 mA + HART;
- F. Accuracy class: $\pm 0.10\%$ of the span of the measuring range;
- G. Total measurement error (impact of temperature $\pm 28^{\circ}\text{C}$ and static pressure 6.9 MPa): not more than $\pm 0.15\%$ of the calibrated range;
- H. Transmitter range: not worse than 100-1;
- I. Power supply: 12...45VDC;
- J. Digital communication: no
- K. Stability: 0.125% of the measuring range for 5 years;
- L. Dynamics (response time): not worse than 250 ms;
- M. Enclosure IP rating: IP65;
- N. Additional equipment: surge protection in accordance with IEEE Standard 587, category B and IEEE Standard 472;
- O. Operating requirements:
 - o ambient temperature: -40 to $+85^{\circ}\text{C}$
 - o relative humidity: 100%.

4.8.4.6. Conductivity analysers

- A. Output signal: 4...20 mA + HART;
- B. Accuracy: $\pm 1\%$ of the span of the measuring range;
- C. Repeatability: $\pm 0.25\%$ of the span of the measuring range;
- D. Temperature compensation: automatic

4.8.5. Measurements of pumping units

For the designed sizes of pumps and motors, it is necessary to equip the pumping units with diagnostic measurements, which will enable the correct operation of the systems. This shall provide the necessary information to assess the current state of the monitored equipment, reduce and even eliminate the risk of emergencies. This shall allow the inspection and maintenance time to be determined.

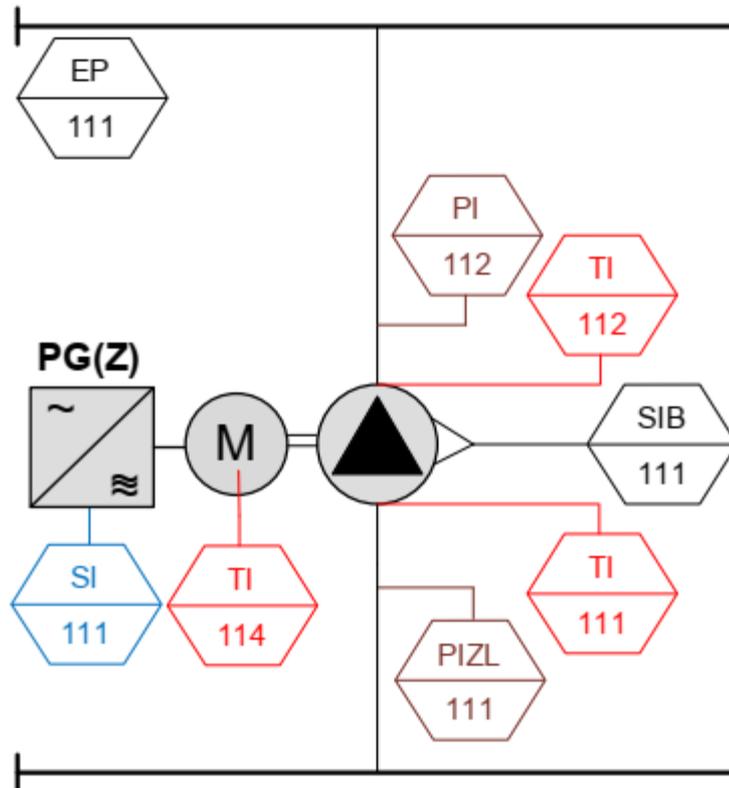


Fig. 4.8.5

Measurements of pumping units

Diagnostics consists of the following measurements:

- A. pressure at the suction and discharge of the pump (in addition, the signal of the minimum pressure at the suction of the cold water pump serves as a permit for the operation of the equipment and provides protection against cavitation of the pump);
- B. pump bearing temperatures;
- C. motor winding temperatures;
- D. level of vibration in two axes of the pump;
- E. motor speed (measurement at the converter necessary to determine the current operating point of the pump);
- F. electricity consumed by the system (meter mounted in the LV switchgear);

4.8.6. Actuators and positioning components

In closing component control systems, fixed-speed electric actuators with electric positioners (for shut-off valving) shall be used.

In automatic control systems, smart actuators shall be used (variable speed actuators are allowed for control valving).

Closing components with pneumatic actuators and electro-pneumatic positioners are also allowed.

Electric actuators should meet the following requirements:

- A. precise electrical braking or a motor with a brake;
- B. protection rating IP68;

- C. possibility of supplying the transmitter with a fully separated internal power supply unit (4–20 mA signal);
- D. remote three-state control: 24 V DC voltage for cut-off valving, 4–20 mA signal for control valving;
- E. manual drive disconnected automatically upon electric control
- F. thermal, phase failure, short-circuit, and motor overloading protection;
- G. phase coincidence testing and automatic correction;
- H. tuning the actuator to limit positions;
- I. separation of control and return signals and from grid voltage;
- J. signal sending: BGE, limit positions of valving, operational readiness, drive failure;
- K. all drive settings should be carried out without the need to open its enclosure: using local control buttons or remotely;
- L. operating position – any
- M. for linear actuators, connection – yoke (casting acc. to ISO 5210) with a connecting member.

Closing components with pneumatic drives operating in the control systems shall be:

- A. equipped with electrical-pneumatic positioners with 4–20 mA signals;
- B. powered on the electrical side by two wires;
- C. the enclosure of the positioner should have at least IP65 rating;
- D. in accordance with PN-92/E-08106.

The Employer requires that on the main cuts-offs connecting the Heat Accumulator with the DH network, the Contractor should use drives with the shortest possible transition time due to the possibility of situations requiring emergency shutdown of the Heat Accumulator from the network. The exact override time shall be agreed at the detailed engineering design stage.

4.8.7.I&C field cabinets and boxes

- A. All types of field (junction) boxes, cabinets and instrument cabinets shall have a protection class of IP65 (in special cases IP67) and appropriate resistance to ambient conditions (temperature, risk of mechanical shocks, environment, etc.).
- B. For of systems where there is a particular risk of corrosion (e.g. chemical dosing systems, chemical measurements), the cabinets and boxes shall be made of stainless materials (acid-resistant steel, ABS plastic) and be properly protected.
- C. The dimensions of the measurement cabinets must be selected in such a manner as to ensure unobstructed access to the equipment and terminal blocks. To be made of ABS plastic or metal.

The cabinets should have locks with a key with the code 333.

- A. Where necessary (internal enclosed spaces in I&C equipment such as cabinets, actuator housings), electrical heating with a thermostat shall be installed to prevent condensation.
- B. Terminal blocks in cabinets and boxes shall be made using single-level spring-loaded connection terminals from reputable manufacturers to guarantee a proper 5 mm wide connection.

As a rule, one cable should be connected to one terminal. Factory-made bridges connecting terminals with the same potential. The rule of thumb is to group terminals with the same potential (power cables) and separate them from the signal cable terminals.

- A. Racks for instruments should be made of corrosion-resistant structural steel with protective roofs.
- B. The racks, field boxes and measuring equipment should have engraved descriptive plates with the KKS symbol and a brief word-based description of the measuring point.
- C. Tags with the full source and destination addresses must be used on all cables, both between the equipment in racks and boxes and on external cables and connections to the equipment. The descriptions on the tags must be printed (not handwritten).

4.8.8.Cable penetrations through wall and ceilings

- A. All cables and cable penetrations through ceilings and walls of rooms (cable bends, switchgears, cable rooms, etc.) shall be properly protected and made in accordance with fire protection in this scope applied at the Employer's premises.
- B. Protection of penetrations shall be applied for the existing cables the bundles of which are damaged during dismantling works and for new cables.
- C. The protection measures shall be made in accordance with the technical approval of the Building Research Institute for the applied set of products for sealing of service penetrations, gaps and expansion joints;
- D. The materials shall have necessary conformity certificates and technical approvals of the Building Research Institute for fire resistance class EI 60 – for the entire space divider – combined out of mineral wool with the use of fireproof paints and fillers.
- E. Implemented protection measures shall be provided with information plates (acc. to the manufacturer template).
- F. Persons to apply fire protection with the above agents shall hold certificates confirming completed training in the subject scope.

4.8.9.I&C cables and wires

- A. I&C measurement cables and wires (analogue and binary signals) and control cables must be shielded with a conductor cross-section of at least 0.5 mm²; For cable lengths exceeding 200 m, the voltage drop must be calculated and cables with the calculated conductor cross-section must be selected.
- B. Cable routes for measuring, control and signalling cables should be routed in cable trays, separated from the routes of 3-phase and power cables;
- C. Cable routes to individual or several measuring sensors (transmitters) should be made with rigid self-supporting cable trays (resistant to mechanical damage);
- D. No cable conduit pipes shall be applied;
- E. If protective sleeves are to be used for corrugated conduits, they shall be fitted with suitable connectors, glands, sensor and transmitter connections;
- F. Special-purpose cables (for digital networks, Ethernet, fibre-optic cables) shall be adequately protected – separated route and the raceway, corrugated conduit, etc.;
- G. For the fibre-optic cables, a protection pipe shall be used, or alternatively, a reinforced fibre-optic cable shall be used;
- H. Reserve cable boxes shall be applied at both ends of the fibre-optic cable;
- I. The fibre-optic cables shall be marked so that they can be identified; the markings shall be at a distance of every 15-20 m as well as before and after every penetration;

- J. For multi-core cables, it is not allowed to connect different voltage levels in one cable, e.g. 230 V AC with 24 V DC. It is allowed to combine analogue and binary signals in one cable.

4.8.10. Requirements for the IT, CCTV and cybersecurity disciplines

The Contractor's scope shall include a set of telecommunications systems described below. The scope of works includes: preparation of project documentation, delivery, installation and commissioning, as well as all works related to ensuring the proper operation of the systems.

The Contractor shall install an IT network for the Heat Accumulator with the possibility of connecting it to the existing network by the Employer, install the necessary cabling (twisted pair, optical fibres), supply cabinets, necessary network equipment (including switches), supply power to the cabinets, and supply UPSs. The scope of design, supply and works for the Contractor is included in **Appendix 8** to this specification – WHAL-VLD-07UND10-TEL-SLD-0001.

The Designer/Contractor shall carry out an on-site inspection of the facility, design the IT network, and present the design to the Employer for approval. The Contractor shall provide a diagram (drawing) of the designed IT network.

All equipment (such as servers, switches, workstations) and software (such as operating systems, databases, antivirus software) provided by the Contractor must be in accordance with the document "Guidelines of the VCUW IT Department for, among others, physical servers, arrays, network equipment and computer networks, stations and software", which is **Appendix No. 17** to the ToR Part III.

The system must meet the "Information security requirements for process systems" constituting **Appendix no. 11** (document no. 28) to the ToR Part III.

Cable routes

The Contractor shall install cable routes that will enable the construction of the necessary fibre-optic infrastructure for the purposes of telecommunications for the entire facility and ensure the protection of telecommunications cabling between facilities.

In the case of road crossings or green areas, the Contractor shall protect the cable routes against damage by using appropriate technical solutions.

The capacity of the cable routes shall be adapted to the amount of cabling with a 100% surplus in case the cabling system needs to be expanded.

The Employer allows telecommunications cables and I&C cables to be routed along the same routes. However, it requires the use of separate cable penetrations for these cables. It is also required to maintain a proper distance between the telecommunications cables and the I&C cables.

The Employer allows telecommunications and power cables to be routed in one cable duct provided that separate ducts are used and a proper distance between the ducts is maintained.

Fibre-optic network

For the Heat Accumulator, the Contractor shall design and construct a fibre-optic network in a basic star configuration with the central point in the server room. The Contractor shall design and provide, in coordination with the Employer, telecommunications cabinets in which the fibre-optic cabling will be terminated. For the distribution points mentioned, the Contractor shall also provide, design and install the necessary 230 V AC UPS power cabling and supply circuit protection in the electrical switchgear for the telecommunications systems that are beyond the Contractor's scope.

The fibre-optic network shall be installed along cable routes, and the cabling termination points shall be located in key buildings of the pumping station and I&C rooms.

The IT network must be provided in accordance with the guidelines contained in the document "Guidelines of the VCUW IT Department for, among others, physical servers, arrays, network equipment and computer networks, stations and software", which is **Appendix No. 17** to the ToR Part III.

Fibre-optic cables

Fibre-optic cables with loose tube – single-mode G.652D 12J, 24J, 48J technology shall be used in the form of underground cables. Insulation of LSZH – flame-retardant cables with aramid fibre core. The cables must have rodent protection in the form of a fibreglass braid.

The supply and system of fibre-optic cabling is part of the Contractor's scope of works.

Access control system

'Access Control System' (ACS) must be installed on the premises of the Heat Accumulator. It shall supervise and manage access to individual rooms in buildings.

The Contractors' scope of works shall include the supply of doors equipped with electromechanical locks with a contact to indicate when the door is opened/closed, as well as the installation of the lock system cables and their routing in junction boxes above the doors. The design, system and commissioning of the access control system using the above elements is part of the Employer's scope of works. The Employer will integrate the newly-built system with the existing system installed in the EC-4 buildings, both in terms of hardware and software.

The Employer will include the following Gas Unit facilities in the Access Control System:

- A. Entrances/access ways to buildings/rooms from the outside;
- B. entrances to the process rooms;
- C. entrances to switchgears;
- D. entrance to the server room and other rooms of the telecommunications cabinets.

The complete list of facilities shall be agreed at the basic design stage.

The following requirements are set for the door joinery to be supplied by the Contractor:

- A. door frame should be factory-fitted with the necessary hardware for the installation of a reversible electric strike (including the option of monitoring);
- B. for one-way passage, the door should fulfil the anti-panic function, i.e. knob-handle system.
- C. for the double-sided passage, the following system applies: knob-knob;

- D. lock in doors installed in process facilities with one-sided control should not allow the door to be permanently bolted with a master key; the key cylinder should only allow the position of the lock trigger to be changed;
- E. option to lock and unlock with a key (with a cylinder lock) the lock will make it possible to bolt doors not covered by the electronic access control system, e.g. fenced-off workstations/rooms, staircases, etc.;
- F. properties: thermal insulation, smoke tightness and fire resistance in accordance with industry requirements;
- G. doors shall be equipped with door closers.

A detailed list of door joinery with the assumed control system shall be specified in detail at the detailed engineering design stage, agreed with the Employer.

Components of the SKD system equipment (except for components installed in doors, gates, etc.) shall be provided by the Employer and may be installed at any stage of the project implementation in agreement with the Contractor.

CCTV

In the newly built facilities of the Subject of the Contract, CCTV shall be provided. The design, implementation of installation and delivery of the equipment shall be the responsibility of the Employer. CCTV elements shall be installed on new facilities and infrastructure within the scope of the Contractor's works. The Contractor's tasks shall include enabling the installation to be carried out on the agreed elements of the infrastructure the Contractor provides, after agreeing with it the appropriate points for the installation of cameras and cabling by the Employer. It is necessary to agree, among others, the number and location of external lighting poles. All lighting poles shall be prepared for installation of CCTV cameras.

Process monitoring (CCTV IP) shall cover key elements of the process system (e.g. pumps) as well as other equipment that is essential in terms of conducting the production process (scope of the Employer). The systems and works carried out by the Employer shall not limit the warranty conditions to the elements of infrastructure provided by the Contractor.

5. REQUIREMENTS FOR THE SUPPLY OF SPARE PARTS AND WEAR PARTS

5.1. General requirements for Spare Parts and Wear Parts

- A. The Contractor shall prepare and present to the Employer, in accordance with Appendix No. 8 to Part III of the ToR, a list of spare parts (Spare Parts and Wear Parts) and submit it to the Employer for approval **3 months before the planned date of commencement of the Test Run**. The Contractor shall ensure the supply of Spare Parts and Wear Parts to the Employer for the Warranty Period, the so-called 'Technical Warranty' (i.e. a period of 24 months from the date of Provisional Acceptance) immediately prior to the start of the Trial Run.

- B. During the Warranty Period, the so-called 'Technical Warranty', the Contractor shall be entitled to use the Spare Parts in its possession or, depending on the Employer's decision, to use the Spare Parts at the Employer's disposal for a fee and to replenish the used stock within the time limit specified by the Employer. The lack of Spare Parts at the Employer's disposal does not release the Contractor from the obligation to meet the Guaranteed Availability Levels.
- C. The Contractor shall provide the Employer in accordance with §14 point 2 of the ToR Part III (within 2 months before the end of the shortest Warranty Period) with a list of Spare Parts and Wear Parts necessary to ensure safe, reliable, efficient and cost-effective operation of the Equipment once the Warranty Period ends and the experience from the operation of the System has been gained. The list shall be developed in accordance with **Appendix 8** to the ToR Part III. The Employer, at their sole option, shall decide to purchase or not any of the Spare Parts or any of the Wear Parts after the Warranty Period, the so-called 'Technical Warranty' (24 months).
- D. If the Contractor decides to discontinue the production of Spare Parts and Wear Parts, it shall be obliged to notify the Employer of this fact in due time in such a manner as to enable the Employer to stock up on the necessary Spare Parts and Wear Parts in advance or to indicate another manufacturer of these parts to the Employer. If no other manufacturer is specified, the Contractor shall be obliged to hand over the documentation for the Spare Parts and Wear Parts to the Employer, which the Employer can use for maintenance purposes.

5.2. Spare parts, wear parts and consumables for the Warranty Period of – the so-called “Technical Warranty” (24 months)

- A. In addition to Spare and Wear Parts, the Contractor shall also provide consumables within the scope of the Remuneration during the Warranty Period, the so-called 'Technical Warranty' (24 months) and deliver them to the Employer within the period specified in section 5.1. A above.
- B. Consumables mean materials used to maintain the technical infrastructure of the Subject of the Contract (e.g. oils, greases, filters, seals).
- C. Spare Parts, Wear Parts and consumables shall be in the possession of the Employer, and the Contractor shall replenish stock in case of shortages on a regular basis in order to maintain the stock level of Spare Parts, Wear Parts and consumables at a safe level.
- D. Shortages of Spare Parts, Wear Parts and consumables shall not release the Contractor from the obligation to meet the Guarantee Levels of Technical Parameters, including availability.

6. SPECIALISED MAINTENANCE EQUIPMENT AND TOOLS

6.1. Requirements for the Supply of specialised maintenance equipment and tools as well as non-standard control and measurement equipment

As part of the Subject of the Contract, i.e. as part of the Remuneration for the operation, tuning and repairs of all equipment and systems in the scope of the Subject of the Contract, the Contractor shall provide, within 7 Days before Provisional Acceptance, a set of special tools and specialised equipment as well as non-standard control and measurement equipment, the use of which will result from the needs of the equipment used.

The Contractor shall be responsible for the quantity, type and suitability of specialised maintenance equipment and tools as well as non-standard control and measurement equipment. Deficiencies in the area of specialised maintenance equipment and tools as well as non-standard control and measurement equipment must not result in the extension of interruptions in the operation of the System during the Warranty Period.

The specialised maintenance equipment and tools as well as non-standard control and measurement equipment shall be the property of the Employer, but with its consent, they can be used by the Contractor to repair the System during the Warranty Period.

Within 3 Days before the end of the Warranty Period, all specialised maintenance equipment and tools used by the Contractor as well as non-standard control and measurement equipment must be returned to the Employer in an undamaged condition or, in the event of damage by the Contractor, they shall be replaced with new ones as part of the Remuneration.

6.2. List of specialised and maintenance tools as well as non-standard control and measurement equipment

The Contractor shall present the Employer with preliminary lists of specialised maintenance equipment and tools as well as non-standard control and measurement equipment three months before the planned start date of the Trial Run.

In addition, the Contractor shall provide the Employer with a list of equipment service cards describing the necessary maintenance to be performed by unauthorised/non-factory service centres (which will not void the warranty) within 3 months before the planned start date of the Trial Run.

7. CONSTRUCTION SITE

7.1. ARRANGEMENT OF THE CONSTRUCTION SITE

7.1.1. Preparation and handover of the Construction Site

As part of the Subject of the Contract, the Contractor shall carry out the preliminary preparation of the Construction Site in terms of the necessary demolition, dismantling of facilities and other inactive members of civil structures in the ground located at the Construction Site, and shall remove or alter the existing systems for wastewater, sanitary sewage, district heating and power cables.

The Contractor shall construct temporary roads (if required) and properly secure the Construction Site for the duration of the Contract.

The yards and site back-up facilities shall be handed over to the Contractor by the Employer as part of a formal procedure. The handover record for yards and site back-up facilities must include all areas that require special attention, i.e. underground and above-ground supply lines (ducts, cable routes, water supply/sewage networks, etc.).

7.1.2. Site Development Plan

The Site Development Plan shall be developed by the Contractor.

The Site Development Plan shall be adapted to the above-mentioned studies, and shall also take into account, among others:

- A. Conditioning of the existing Construction Site and site back-up facilities;
- B. The conditions resulting from the Detailed Milestone Schedule and from the implementation schedules of contractors performing individual works at the adjacent construction sites (i.e. ERF, Gas Unit, and HeatUP);
- C. Scheduled arrangements from working meetings with contractors performing these individual works at adjacent construction sites (i.e. ERF, Gas Unit, and HeatUP)
- D. Conditions resulting from the technology of implementation of individual Works and stages as well as from the equipment used.
- E. Conditions resulting from the approved Health and Safety Plan for the construction.
- F. Conditions resulting from restrictions in the context of other construction works carried out at EC-4 at a similar time (implementation of the ERF and the Gas Unit).
- G. Relevant legal regulations.
- H. Other arrangements with the Employer.

The following shall be marked in the Site Development Plan:

- A. hazardous zones, i.e. those places at the Construction Site that pose a risk to human health and life;
- B. all storage, assembly, joining and laydown yards;
- C. areas and zones for operations with lifting equipment and construction cranes;
- D. locations of enclosed welfare, office, sanitary, logistics and storage facilities;
- E. fencing of the Construction Site with gates, entrances and access ways;
- F. emergency assembly points and first aid points;
- G. fire protection equipment locations;

- H. main circulation routes;
- I. utility connection points for energy, water, sewage (utility connection points shall be agreed with the Contractor at the stage of preparation of the Construction Site for handover);
 - a. The Employer will provide electricity up to the boundary of the Construction Site.
- J. other according to individual needs.

Detailed site development plans divided into zones separately for each Subcontractor, taking into account the above-mentioned provisions and the selection of equipment and organisation of the Works, shall be developed by the Contractor.

7.1.3. Concept for the organisation of construction and erection works during the performance of the Subject of the Contract, taking into account the location conditions

At the design stage, the Contractor shall prepare the so-called “**Work Method Statement**”, which shall include, among others:

- A. Detailed Milestone Schedule; and
- B. Site Development Plan. This plan shall be updated on an ongoing basis by the Contractor in accordance with the progress of the Works.

Before detailed work method statements are drawn up in the form of the Work Method Statement, the key technological, organisational and scheduling conditions must be determined and guidelines drawn up for the implementation of all major facilities to be constructed as part of the Subject of the Contract and types of construction and erection works.

The plans should be coordinated on an ongoing basis with the Employer and the contractors carrying out construction in the neighbouring plots of land – ERF, Gas Unit and HeatUP! (retrofit of unit 2) – **Appendix 4 to this document**.

7.1.4. Arrangement of the site back-up facilities

The handover of the Construction Site from the Employer to the Contractor shall not take place before a legally binding building permit has been obtained in accordance with the requirements of the Construction Act.

The Construction Site shall be made accessible on the date of commencement of works, which shall be specified in **Appendix 2** to Part III of the ToR. The Contractor's back-up facilities shall be located in the area indicated by the Employer.

The Contractor shall be obliged to install a temporary fence separating the Construction Site from the active facilities of the CHP Plant and other construction sites in such a manner as to guarantee internal circulation within the CHP Plant with access to other process facilities and adjacent construction sites.

The Construction Site should be properly fenced and signposted in accordance with applicable regulations.

The fence should be made of steel mesh or metal elements with a height of 1.80 m, securely mounted.

On the site intended for site back-up facilities, areas shall be allocated for site back-up facilities including:

- A. Storage, operational and assembly (pre-assembly) yards in the immediate vicinity of the job site, within the direct reach of the construction and erection equipment. These yards shall be used for the temporary storage, assembly and preparation of construction elements. The yards shall be within the working range of the erection equipment and shall be designated in the work method statements prepared by the Contractor.
- B. Places for welfare and technical back-up facilities and storage, with locations for electricity and water connections and wastewater connections.

The Contractor shall be obliged to prepare the Construction Site and site back-up facilities for the entire project covered by the Contract, including the preparation of a Work Method Statement and the Health and Safety Plan.

The Contractor undertakes to carry out the Works in such a manner that they do not cause disruptions in the operation of the active facilities and equipment of the CHP Plant.

The Employer absolutely requires cooperation and ongoing arrangements in the organisation of construction and planned transports to the EC-4 site with contractors conducting parallel works during the construction of the ERF and Gas Unit, HeatUP! for Unit 2, and CHP Plant personnel services – **Appendix 4** to this document, and the Contractor undertakes to provide the aforementioned cooperation and ongoing arrangements.

7.1.5. Arrangement of access roads, yards and storage areas

The Construction Site is the property of the Employer. The Construction Site shall also include access roads to the point where they connect to the public road. The indicated access roads shall require constant maintenance to ensure the use of these roads by other users.

The ongoing maintenance of access/transport roads shall consist of repairing the surface damaged during the transport of materials to the construction site. The roads should be cleared of mud and dust. The organisation of access possibilities to any area beyond the boundaries of the Construction Site, if such access is required by the Contractor, shall be the sole responsibility of the Contractor.

Pedestrian crossings should be set out in safe locations. The width of a pedestrian walkway should be at least 0.75 m, but 1.2 m is recommended. Passages over or next to pits should be equipped with railings with a protective handrail at a height of 1.10 m, a kerb board at a height of 0.15 m and filling of the space between the handrail and the board in a manner that protects employees from falling from a height.

Access roads should have a hardened surface and be signposted in accordance with the regulations on public road traffic.

The layout of access roads and the Construction Site should be based on the routes of permanent roads that will be used once construction is complete. For construction purposes, these can be extended with access and temporary roads which, together with the network of (permanent) target roads, will create a proper circulation system for the construction site.

For the purpose of transport to the Construction Site, the Contractor shall agree (designate) an acceptable access route with the Employer. It is also possible to use railway sidings, to the extent agreed with the Employer.

After completion of the Works, the Contractor shall be obliged to clean and repair the roads used during construction.

7.1.6. Availability of utilities for the period of construction

The Contractor shall determine its needs for utilities at the stage of preparing the Work Method Statement. The connection and distribution of utilities shall lie with the Contractor. The Employer shall not charge the Contractor with the costs of utilities collected from or through the Employer. Preliminary assumptions that the Contractor shall be obliged to adopt for the Offer:

- A. **Water** – the Employer indicated the connection point (AP-W1), which is located at the boundary of the Construction Site, **Appendix 10** to the ToR Part II.
- B. **Sanitary sewage** – the Employer indicated the nearest well (AP-K1) **Appendix 10** to the ToR Part II to which the above-mentioned sewage can be discharged. As part of the Offer, the Contractor shall prepare the layout of a wastewater manhole located in the area of the site back-up facilities and equip it with (a) pump(s) together with the pipelines necessary to discharge wastewater into the Employer's sewage system. The Contractor shall use the existing DH water bridge to route the pipelines across the biomass road (the location of the Construction Site and site back-up facilities excludes the possibility of draining the wastewater by gravity through the existing wastewater system). Alternatively, the Employer will allow the solution involving the installation of portable 'TOI TOI' toilets.
- C. **Electricity** – the Employer shall supply power from the connection point to the construction site boundary (AP-E1) – **Appendix 10** to the ToR Part II.

7.1.7. Required levelling works

As part of the preliminary works, the Contractor shall pile up and then use the topsoil generated from the excavations on the Construction Site (the Employer proposes to use the A8 laydown area in **Appendix 10** of the ToR Part II for temporary storage of the soil). The Contractor shall remove any remaining excavated material from the area of the CHP Plant and handle or dispose of it at its own expense.

7.1.8. Technical supervision during the Works

During all stages of the construction, the Contractor shall provide the necessary technical supervision in accordance with the Contract. This applies in particular to positions and

functions that require possession of the relevant professional licences required by Polish law (especially the Construction Law and the Energy Law). The requirements are described in other parts of the ToR.

7.1.9.OH&S and fire protection during construction

The Contractor, Subcontractors and Further Subcontractors are required to comply with the applicable regulations, standards, instructions and other normative acts at all stages of the works (design, construction of equipment, operation, transport and storage of equipment, construction works, installation works, tests and the trial run) regarding occupational health and safety.

In accordance with the requirements of the Contract and applicable regulations (including the Construction Law), the Contractor shall be obliged to present the Employer with the following documents before commencing the implementation works:

- A. Plan of site back-up facilities;
- B. Health and Safety Plan.

The Contractor shall familiarise its employees, Subcontractors and Further Subcontractors with the occupational health and safety regulations and laws, as well as with the local regulations, instructions and internal regulations applicable at the Employer's site.

The Contractor shall be obliged to develop and agree with the Employer the rules and procedures for the conduct of the Contractor's employees, Subcontractors and Further Subcontractors during the performance of the Subject of the Contract.

Before starting construction and erection works in individual process subunits connected to the CHP plant, training should be provided on conducting works in accordance with the process and organisational description and detailed schedule, with particular attention paid to health and safety hazards.

As part of ensuring an adequate level of fire protection during construction works, the Contractor is required to present an action plan and solutions agreed with the local fire protection inspector before organising site back-up facilities and carrying out the works.

This plan should include, but not be limited to:

- A. required equipment in the form of fixed fire protection means and hand-held extinguishing means;
- B. plan for the deployment of these means for the period of construction;
- C. arrangements with local fire brigades on an action plan in the event of a fire hazard;
- D. plan for the provision of appropriate (temporary for the construction period) access and evacuation roads.

7.1.10.Construction Site clearance

When performing the Subject of the Contact, the Contractor shall be responsible for keeping the Construction Site clean and tidy. The Contractor shall keep the Construction Site free of unnecessary obstacles and shall remove all hazards on an ongoing and regular basis. If the

Contractor fails to fulfil these obligations, the Employer reserves the right to fulfil these obligations and charge the Contractor for the costs incurred. The Contractor shall leave the Construction Site in a tidy, clean and safe condition.

After the investment project has been completed, the Contractor shall be obliged to remove:

- A. fencing and dismantle Construction Site back-up facilities in terms of buildings, systems, networks and equipment;
- B. all equipment used during the performance of the Contract;
- C. temporary roads, paved yards, sidewalks and lighting of the Construction Site;
- D. all other rubbish and waste.

If the Contractor fails to comply with the above requirements, the Employer may commission cleaning works to an independent entity and charge the Contractor for the costs incurred.

All waste generated as a result of the Contract shall be disposed of by the Contractor. The waste generated by the Contractor shall be transported away from the Construction Site and disposed of in accordance with the applicable regulations within the Subject of the Contract. The elements from the demolition and dismantling works indicated by the Employer as usable must be transported by the Contractor to the warehouse on the EC-4 premises indicated by the Employer.

7.2. OH&S AND FIRE PROTECTION REQUIREMENTS AND REGULATIONS APPLIED BY THE EMPLOYER

The Employer's health and safety as well as fire regulations and provision are set out in **Appendix 11** to the ToR Part III.

7.3. OH&S REQUIREMENTS AND REGULATIONS

The Contractor, Subcontractors and Further Subcontractors are required to comply with the applicable laws and the Employer's internal instructions and regulations at all stages of the works (design, construction of equipment, operation, transport and storage of equipment, construction works, installation works, tests and the trial run) concerning occupational health and safety. Instructions and internal regulations are available at the Employer's.

Key health and safety regulations and requirements are summarised below:

- A. Act of 26 June 1974 – provisions introducing the Labour Code (Journal of Laws No. 24, item 142, as amended);
- B. Act of 26 June 1974 – Labour Code (consolidated text, Journal of Laws of 2023, item 1465, as amended);
- C. Ordinance of the Minister of Labour and Social Policy of 26 September 1997 on general occupational health and safety regulations. (consolidated text, Journal of Laws of 2003, item 1650, as amended);
- D. Ordinance of the Minister of Infrastructure of 6 February 2003 on occupational health and safety during construction works (Journal of Laws, No. 47, item 401, as amended);
- E. Ordinance of the Minister of Infrastructure of 23 June 2003 on information concerning safety and health protection and the health and safety plan (Journal of Laws No. 120, item 1126, as amended);

- F. Ordinance of the Council of Ministers of 18 June 1968 on occupational health and safety when using ionising radiation (Journal of Laws No. 20, item 122, as amended);
- G. Ordinance of the Minister of Economy of 27 April 2000 on occupational health and safety during welding works (Journal of Laws No. 40, item 470, as amended);
- H. Ordinance of the Minister of Economy of 20 September 2001 on occupational health and safety during operation of machines and other technical equipment for earthworks, construction works and road works (Journal of Laws of 2018, item 583, as amended);
- I. Ordinance of the Ministers of Communications and the Administration of Land Management and Environmental Protection of 10 February 1977 on occupational health and safety during road and bridge works (Journal of Laws No. 7, item 30, as amended);
- J. Ordinance of the Minister of Labour and Social Policy of 14 March 2000 on occupational health and safety during manual transport works and other works related to physical effort (Journal of Laws of 2018, item 1139, as amended);
- K. Ordinance of the Minister of Energy of 28 August 2019 on occupational health and safety at power equipment and systems (Journal of Laws of 2021, item 1210, as amended);
- L. Instructions and internal regulations in the area of occupational health and safety applied by the Employer are included in **Appendix 11** to the ToR Part III.

7.4. OH&S REQUIREMENTS DURING CONSTRUCTION

The Contractor shall issue detailed orders regarding compliance with health and safety at the Construction Site. These regulations should be consistent with the regulations and instructions in force on the Employer's premises – **Appendix 11** to the ToR Part III.

The Contractor shall develop regulations governing the rules and procedures for the conduct of construction workers during the performance of the Subject of the Contract. These rules shall take into account the principles of cooperation between the Employer and the Contractor.

In addition, the Contractor shall:

- A. provide OH&S and fire protection measures and prepare guidelines as to the location and type of general OH&S and fire protection points;
- B. fence and signpost Construction Site with appropriate information boards and OH&S and fire safety instructions;
- C. check the implementation of recommendations issued by OH&S committees;
- D. carry out inspections on an ongoing basis in terms of compliance with OH&S regulations and the application of appropriate safeguards;
- E. prepare construction site OH&S safety reports;
- F. keep statistics of accidents at work;
- G. appoint an OH&S service employee at the construction site with at least the professional licence of an OH&S inspector – in accordance with the regulation, notify the Employer's OH&S service of an accident at the construction site, keep OH&S training books;
- H. enforce the obligation of employees to use personal protective equipment during work;

- I. maintain order in the areas of works, on platforms, crossings, access and evacuation roads;
- J. keep records of periodic exam sheets;
- K. Keep records of OH&S training sheets;
- L. keep information sheets of electrical equipment in accordance with the requirements;
- M. secure the boundaries of the work areas with visible barriers and information boards on hazards;
- N. protect working platforms with barriers, bumper rails, etc.;
- O. perform acceptance of scaffolding and working platforms with an entry in the Works Log;
- P. perform acceptance of the transport and lifting structure, lifting equipment and cranes by the Office of Technical Inspection;
- Q. protect cylinders with industrial gases against mechanical damage and thermal effects;
- R. secure and supervise workplaces during and after welding works;
- S. secure and supervise workplaces during works with poisonous and harmful factors for humans and the environment – Instructions to be followed.

When **working at height**, it is absolutely necessary to observe the use of individual protection measures (safety harnesses) by employees. When carrying out **works at different heights**, it is essential to work on both sides and use additional protection in the form of platforms, protective partitions, etc. For **transport and lifting works**, certified ropes and slings with a working load limit marking must be used.

Employees hired by Subcontractors and Further Subcontractors shall be equipped in working clothes, helmets and working footwear in accordance with health and safety regulations and with a clear indication of the name of the Contractor, Subcontractor or Further Subcontractor.

7.5. FIRE PROTECTION REQUIREMENTS AND REGULATIONS

To be followed by the Contractor and Subcontractors at the design stage and when providing equipment and systems of the Power Unit:

- A. Act of 24 August 1991 on fire protection (consolidated text, Journal of Laws of 2024, item 275, as amended);
- B. Ordinance of the Ministry of Infrastructure of 12 April 2002 on technical conditions to be met by buildings and their location (consolidated text, Journal of Laws of 2022, item 1225, as amended);
- C. Ordinance of the Minister of Internal Affairs and Administration of 7 June 2010 on fire protection of buildings of other facilities and areas (Journal of Laws no. 2023, item 822, as amended);
- D. Ordinance of the Minister of Internal Affairs and Administration of 24 July 2009 on fire water supply and fire roads (Journal of Laws of 2009, No. 124, item 1030, as amended);
- E. Ordinance of the Minister of Internal Affairs and Administration of 16 July 2009 amending the Ordinance on the approval of the building design in terms of fire protection (Journal of Laws of 2009 No. 119, item 998, as amended).

In the detailed engineering designs, the Contractor shall present a detailed description of the fire protection systems and protections of the facilities, the operation of the fire alarm system, provided fire protection equipment and a description of the technical solutions that will be applied due to the aforementioned hazards.

7.6. RULES OF COMPLIANCE WITH ENVIRONMENTAL PROTECTION REGULATIONS

The Employer requires that the performance of the Works, including Construction Work and installation works, comply with the applicable environmental regulations, especially with regard to noise protection, the discharge of wastewater into the sewage system and waste management, and dust prevention.

- A. The Contractor shall carry out all Works in a manner that does not violate applicable environmental protection regulations and shall make every effort to minimise negative impacts on the environment.
- B. The Contractor shall be obliged to maintain cleanliness and order on the Construction Site and as part of the implemented Subject of the Contract, as well as at the laydown yards and temporary storage areas;
- C. The Contractor shall inform the Employer about the type, quantities and conditions of the disposal of the waste generated as a result of the performance of the Works;
- D. The waste produced in the course of the Works shall be disposed of by the Contractor, taking into account section 7.1.10 above.
- E. Pursuant to the Waste Act of 14 December 2012 (Journal of Laws of 2013, item 1587, as amended). The Contractor shall be the producer and holder of waste generated in the course of the Works and shall be obliged to handle such waste in accordance with applicable regulations;
- F. The Contractor shall undertake to selectively store the waste generated in places designated and agreed with the representatives and to dispose of the waste generated in accordance with the conditions set out in the decision held and these specifications;
- G. The Contractor shall not discharge any pollutants, in particular liquid and solid chemicals and industrial wastewater, which arise during the performance of the Works into the in-house wastewater system;
- H. The Contractor shall protect soil and ground surface;
- I. The Contractor shall undertake to store the materials used in the works covered by this Contract temporarily in places agreed with the Employer and in an environmentally friendly manner;
- J. Laydown areas shall be signposted (including the name of the Contractor's company and the type of waste) and permanently protected by the Contractor, and shall be protected from the weather;
- K. The Contractor shall agree with the Employer the use of equipment causing excessive noise or emitting harmful radiation;
- L. The Contractor shall make the Construction Site available at the Employer's request for the purpose of internal inspections by the Employer's supervisor of the works or environmental specialists;

- M. If the Contractor causes an environmental hazard as a result of the Works, the Contractor shall be obliged to report this fact immediately in accordance with the Employer's applicable procedures;
- N. After completion of the Works, the Employer shall be provided with summary information (by the Contractor) on the type, quantities and conditions for the disposal of all waste produced within 14 Days prior to Provisional Acceptance.
- O. The Employer shall only accept the works and sign the Provisional Acceptance of the system once the above information has been submitted.

8. REQUIREMENTS FOR THE PROJECT IMPLEMENTATION PROCESS

8.1. REGULATIONS, ORDINANCES AND STANDARDS

8.1.1. STANDARDS – GENERAL REQUIREMENTS

It is required that the Contractor, in the process of implementing the Subject of the Contract, use the standards indicated in the General Description of the Subject of the Contract. The use and use of standards other than those indicated below should always be agreed with the Employer before applying them.

It is required that the Contractor, in the process of implementing the investment project, use only the standards contained in the Public Information Bulletin of the Polish Committee for Standardization and on its website, i.e. acts explicitly approved for use in construction in the Republic of Poland.

In particular, the following rules shall apply:

- A. standards with an obligatory status are in force – referred to by the provisions of Polish law;
- B. standards referred to in the ToR to be used shall apply;
- C. it is required to use PN-EN, PN ISO, PN-EN ISO standards, in particular standards harmonised with directives or ISO, EN, EN ISO standards if they do not yet have Polish equivalents – except for the situations listed below;
- D. it is allowed to use Polish standards that have not yet been replaced by European / international standards;
- E. it is allowed to use DIN, ASME, ANSI, BS standards in justified situations, in particular when there are no relevant European / international standards;

In general, current editions of standards are valid during their application unless specific editions are referred to for justified reasons.

When selecting standards, the requirements of the New Approach Directives relating to the possibility and conditions for the use of standards other than harmonised standards with these directives must be taken into account.

For example, the PED 2014/68/EU sets out specific requirements for the use of standards other than harmonised standards – in Annex III (scope of documentation) and in Annex I (Chapter 4: “Materials”).

All technical equipment subject to acceptance must be agreed by the Contractor with the Polish Office of Technical (UDT) Inspection or another relevant office.

8.1.2. REGULATIONS AND STANDARDS – CIVIL ENGINEERING DISCIPLINE

Regulations, in particular:

- A. Act of 7 July 1994 – Construction Law
- B. Ordinance of the Minister of Infrastructure of 12 April 2002 on technical conditions to be met by buildings and their location

- C. Ordinance of the Minister of Interior and Administration of 21 April 2006 on fire protection of buildings, other facilities and areas
- D. Ordinance of the Minister of Labour and Social Policy of 26 September 1997 on general occupational health and safety regulations
- E. Ordinance of the Minister of Infrastructure of 6 February 2003 on occupational health and safety during construction works.
- F. Act of 27 March 2003 on spatial planning and development.

Table 9.11.1.1 Standards for the civil engineering discipline

PN-B-06050:1999	Geotechnics. Earthworks. General requirements
PN-EN 1997-1:2008	Eurocode 7: Geotechnical design – Part 1: General rules
PN-83/B-02482	<u>Building foundations – Load bearing capacity of piles and pile foundations</u>
PN-B-03264:2002	Concrete, reinforced concrete and prestressed structures. Static calculations and design
PN-EN 1992-1-1:2008	Eurocode 2 – Design of concrete structures – Part 1-1: General rules and rules for buildings
PN-EN 206-1:2003	Concrete – Part 1: Specification, performance, production and conformity
PN-90/B-03200	Steel structures Static calculations and design
PN-EN 1993-1-12:2008	Eurocode 3 – Design of steel structures – Part 1-12:
PN-EN 14015	Specification for the design and manufacture of site built, vertical, cylindrical, flat-bottomed, above ground, welded, steel tanks for the storage of liquids at ambient temperature and above
PN-B-06200:2002	Steel building structures. Execution and acceptance conditions. Basic requirements
PN-EN 1090-1:2010	Execution of steel structures and aluminium structures – Part 1: Requirements for conformity assessment of structural components
PN-EN 10025-1:2007	Hot rolled products of structural steels –Part 1: General technical delivery conditions
PN-B-03002:2007	Masonry structures. Design and calculations
PN-EN 1996-1-1:2010	Eurocode 6 – Design of masonry structures – Part 1-1: General rules for reinforced and unreinforced masonry structures
PN-68/B-10020	Brickwork. Acceptance requirements and tests
PN-EN ISO 14122-1 2005	Safety of machinery. Permanent means of access to machinery. Part 1: Choice of fixed means and general requirements of access (Parts 1 to 4)
PN-90/B-03000	Building designs. Static calculations
PN-EN 1990:2004	Eurocode – Basis of structural design

PN-82/B-02001	Loads on civil structures. Fixed loads
PN-82/B-02003	Loads on civil structures. Process-related variable loads. Basic process-related and installation loads
PN-82/B-02004	Loads on civil structures. Process-related variable loads. Vehicle loads
PN-86/B-02005	Loads on civil structures. Loads with overhead cranes, winches and hoists
PN-80/B-02010/Az1:2006	Loads in static calculations. Snow load
PN-B-02011:1977/Az1:2009	Loads in static calculations. Wind load
PN-88/B-02014	Loads on civil structures. Soil load
PN-B-02013:1987	Loads on civil structures – Variable environmental loads – Icing loads
PN-EN 1991-1-1:2004	Eurocode 1: Actions on structures – Part 1-1: General actions – Densities, self-weight, imposed loads for buildings
PN-EN 1991-1-2:2006	Eurocode 1: Actions on structures – Part 1-2: General actions – Actions on structures exposed to fire
PN-EN 1991-1-3:2005	Eurocode 1 – Actions on structures - Part 1-3: General actions – Snow loads
PN-EN 1991-1-4:2008	Eurocode 1: Actions on structures – Part 1-4: General actions – Wind actions
PN-EN 1991-1-5:2005	Eurocode 1: Actions on structures – Part 1-5: General actions – Thermal actions
PN-EN 1991-1-6:2007	Eurocode 1: Actions on structures – Part 1-6: General actions – Actions during execution
PN-EN 1991-1-7:2008	Eurocode 1 – Actions on structures - Part 1-7: General actions – Accidental actions
PN-EN 1991-2:2007	Eurocode 1: Actions on structures – Part 2: Traffic loads on bridges
PN-EN 1991-3:2009	Eurocode 1 – Actions on structures – Part 3: Actions induced by cranes and machinery
PN-EN 1991-4:2008	Eurocode 1 – Actions on structures – Part 4: Silos and tanks
PN-80/B-03040	Foundation and machine support structures. Calculations and design.
PN-ISO 10816-1:1998	Mechanical vibration – Evaluation of machine vibration by measurements on non-rotating parts – Part 1: General guidelines
PN-EN 1090-2:2009	Execution of steel structures and aluminium structures – Part 2: Technical requirements for steel structures

Polish Standards for design introducing European standards for the design of structures – Eurocodes, approved and published in Polish, may be used for the design of structures if they cover all the necessary aspects related to the design of that structure (they constitute a complete set of standards enabling design). The design of every type of structure requires the application of PN-EN 1990 and PN-EN 1991.

The standards, an up-to-date list of which can be found in the Public Information Bulletin (Biuletyn Informacji Publicznej, BIP) of the Polish Committee for Standardization (PKN) and on the PKN website (www.pkn.pl), are catalogued by topic in the appropriate areas, groups and subgroups according to the International Classification for Standards (ICS).

The most commonly used standards related to construction and implementation are classified as:

- A. in area No. 91 – “Construction and Construction Materials”;
- B. in area No. 13 – “Environment. Health protection. Safety”.

8.1.3. STANDARDS FOR THE ELECTRICAL DISCIPLINE

Table 9.1.2.1 Standards for the electrical discipline

PN-EN 60529:2003	Degrees of protection provided by enclosures
PN-EN 60038:2012	Standard voltages
PN-EN 12464-1:2022-01	Light and lighting. Lighting of work places. Part 1: Indoor work places
PN-HD 60364-4:2007	Electrical systems in civil structures. Protection for safety. Selection of protection measures depending on external influences. Selection of electric shock protection measures depending on external influences.
PN-HD 60364-1:2010	Electrical systems in civil structures. Scope, subject matter and basic requirements.
PN-HD 60364-4-41:2017-09	Electrical systems in civil structures. Protection for safety. Electric shock prevention.
PN-HD 60364-4-42:2011	Electrical systems in civil structures. Protection for safety. Protection against the effects of thermal impact.
PN-HD 60364-4-43:2011	Electrical systems in civil structures. Protection for safety. Overcurrent protection.
PN-HD 60364-4-442:2012	Electrical systems in civil structures. Protection for safety. Surge protection. Protection of low-voltage system against transient surges and damage at earth fault in high-voltage networks.
PN-HD 60364-4-443:2016	Protection for safety – Protection against voltage and electromagnetic disturbances – Protection against transient atmospheric or switching surges.
PN-HD 60364-4-444:2012	Protection for safety – Protection against voltage and electromagnetic disturbances.
PN-HD 60364-5-51:2011	Electrical systems in civil structures. Selection and installation of electrical equipment. General provisions
PN-HD 60364-5-54:2011	Electrical systems in civil structures. Selection and installation of electrical equipment. Earthing and protective conductors
PN-HD 60364-5-56:2019-01	Electrical systems in civil structures. Selection and installation of electrical equipment. Safety systems

PN-HD 60364-7-704:2018-08	Electrical systems in civil structures. Requirements for special systems or locations. System at the construction and demolition site.
PN-EN 60909-0:2016	Short-circuit currents in three-phase a.c. systems. Part 0: Calculation of currents
PN-EN 55015:2019-11	Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment
PN-EN 60073:2003	Basic and safety principles for man-machine interface, marking and identification. Coding principles for indication devices and actuators
PN-EN 60034-5:2021-019	Rotating electrical machines Part 5: Degrees of protection provided by the integral design of rotating electrical machines
PN-EN 60664-1:2021-02	Insulation coordination for equipment within low-voltage supply systems Part 1: Principles, requirements and tests
PN-EN 62305-1:2011	Protection against lightning. General principles
PN-EN 62305-2:2012	Protection against lightning – Part 2: Risk management
PN-EN 62305-3:2011	Protection against lightning – Part 3: Physical damage to structures and life hazard
PN-EN 62305-4:2011	Protection against lightning – Part 4: Electrical and electronic systems within structures
N-SEP-E-004	Power and signalling cable lines. Design and construction.
PN-EN 45510-2-9:2009	Guide for procurement of power station equipment – Part 2-9: Electrical equipment – Cabling systems

All materials used must have current technical approvals of the Building Research Institute and certificates of the Institute of Hygiene.

The Contractor shall present the Employer with a list of materials and appropriate approvals and certificates for approval.

8.1.4.REGULATIONS AND STANDARDS – I&C DISCIPLINE

The Contractor should take into account the use of standards commonly used in the Polish energy sector. It is also important to remember to apply the rules of good engineering practice.

The Contractor shall perform all Works included in the scope of the Subject of the Contract related to installation, functional and process tests in accordance with the applicable regulations for the operation of equipment and health and safety rules in force on the Employer's premises on the day of installation and Start-up, which shall be handed over to the Contractor together with the handover of the Construction Site and updated on an ongoing basis.

Table 9.1.3.1 Standards for the I&C discipline

No	Standard	Description
1	PN-EN ISO 5167-1:2005	Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full Part 1: General principles and requirements
2	PN-EN ISO 5167-2:2005	Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full Part 2: Orifice plates
3	PN-EN ISO 5167-3:2005	Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full Part 3: Nozzles and Venturi nozzles
4	PN-EN ISO 5167-4:2005	Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full Part 4: Venturi tubes
5	PN-EN 60534-1:2005 (U)	Industrial-process control valve. Part 1: Control valve terminology and general considerations
6	PN-EN 60534-2-1:2001	Industrial-process control valve. Part 2-1: Flow capacity – Sizing equations for fluid flow under installed conditions
7	PN-EN 60534-2-3:2001	Industrial-process control valve. Part 2-3: Flow capacity – Test procedures
8	PN-EN 60534-2-5:2004 (U)	Industrial-process control valve. Part 2-5: Flow capacity – Sizing equations for fluid flow through multistage control valves with interstage recovery
9	PN-EN 60534-3-1:2004 (U)	Industrial-process control valve. Part 3-1: Dimensions – Face-to-face dimensions for flanged, two-way, globe-type, straight pattern and centre-to-face dimensions for flanged, two-way, globe-type, angle pattern control valves
10	PN-EN 60534-3-2:2002 (U)	Industrial-process control valve. Part 3-2: Dimensions – Face-to-face dimensions for rotary control valves except butterfly valves
11	PN-EN 60534-3-3:2001	Industrial-process control valve. Part 3-3: Dimensions – End-to-end dimensions for butt-weld, two-way, globe-type, straight pattern control valves
12	PN-IEC 60534-4:2001	Industrial-process control valve. Part 4: Inspection and routine testing
13	PN-EN 60534-5:2004 (U)	Industrial-process control valve. Part 5: Marking
14	PN-EN 60534-6-1:2001	Industrial-process control valve. Part 6-1: Mounting details for attachment of positioners to control valves. Positioner mounting on linear actuators
15	PN-EN 60534-6-2:2002 (U)	Industrial-process control valve. Part 6-2: Mounting details for attachment of positioners to control valves. Positioner mounting on rotary actuators
16	PN-EN 60534-8-1:2003	Industrial-process control valve. Part 8-1: Noise considerations. Laboratory measurement of noise generated by aerodynamic flow through control valves
17	PN-EN 60534-8-2:2003 (U)	Industrial-process control valve. Part 8-2: Noise considerations. Laboratory measurement of noise generated by hydrodynamic flow through control valves

No	Standard	Description
18	PN-EN 60534-8-3:2002 (U)	Industrial-process control valve. Part 8-3: Noise considerations. Laboratory measurement of noise generated by aerodynamic flow through control valves
19	PN-EN 60534-8-4:2002 (U)	Industrial-process control valve. Part 8-4: Noise considerations. Prediction of noise generated by hydrodynamic flow
20	PN-EN 61152:2002	Dimensions of metal-sheathed thermometer elements
21	PN-M-42376:2001	Measurement of fluid flow by means of pressure differential devices. Application guide ISO 5167-1:1991
22	PN-M-42377:200	Measurement of fluid flow by means of pressure differential devices. Guidelines for selection of nozzles and orifices not covered by ISO 5167-1
23	PN-M-42378:2001	Measurement of fluid flow by means of pressure differential devices. Guidance on the impact of deviations from the requirements and conditions of use given in ISO 5167-1
24	PN-EN 50112:2002	Measurement, control, regulation. Electrical temperature sensors. Metal protecting tubes for TC assemblies
25	PN-EN 50113:2002	Measurement, control, regulation. Electrical temperature sensors. Isolating tubes for thermocouples
26	PN-EN 60751+A2:1997	Industrial platinum resistance thermometers and platinum temperature sensors
27	PN-EN 61508-1:2004	Functional safety of electrical/electronic/programmable electronic safety-related systems. Part 1: General requirements
28	PN-EN 61508-2:2005	Functional safety of electrical/electronic/programmable electronic safety-related systems. Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems
29	PN-EN 61508-3:2004	Functional safety of electrical/electronic/programmable electronic safety-related systems. Part 3: Software requirements
30	PN-EN 61508-4:2004	Functional safety of electrical/electronic/programmable electronic safety-related systems. Part 4: Definitions and abbreviations
31	PN-EN 61508-5:2005	Functional safety of electrical/electronic/programmable electronic safety-related systems. Part 5: Examples of methods for the determination of safety integrity levels
32	PN-EN 61508-6:2003 (U)	Functional safety of electrical/electronic/programmable electronic safety-related systems. Part 6: Guidelines on the application of IEC 61508-2 and IEC 61508-3
33	PN-EN 61508-7:2003 (U)	Functional safety of electrical/electronic/programmable electronic safety-related systems. Part 7: Overview of techniques and measures

No	Standard	Description
34	PN-EN 55016-1-2:2005	Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-2: Radio disturbance and immunity measuring apparatus
35	PN-EN 60529:2003	Degrees of protection provided by enclosures (IP Code)
36	PN-EN 61518:2004	Mating dimensions between differential pressure (type) measuring instruments and flanged-on shut-off devices up to 413 bar (41.3 MPa)
37	PN-EN 61326:2006	Electrical equipment for measurement, control and laboratory use – EMC requirements
38	PN-EN 50014:2004	Electrical apparatus for potentially explosive atmospheres – General requirements
39	PN-EN 50020:2005	Electrical apparatus for potentially explosive atmospheres – Intrinsic safety 'i'
40	PN-EN 50303:2004/ Ap1:2005	Group I, Category M1 equipment intended to remain functional in atmospheres endangered by firedamp and/or coal dust
41	PN-EN 1127:2001	Explosive atmospheres – Explosion prevention and protection
42	PN-76/E-05125	Power and signalling cable lines. Design and construction.
43	BN-84/8984-10	Factory wired telecommunications networks. Indoor systems. General requirements
44	PN-EN 50173-1	Information technology. Generic cabling systems. Part 1: General requirements
45	PN-EN 50174-1	Information technology. Cabling installation. Part 1: Installation specification and quality assurance
46	PN-EN 50174-2	Information technology. Cabling installation. Part 2: Installation planning and practices inside buildings
47	PN-EN 50310	Information technology. Telecommunications bonding networks for buildings and other structures
48	PN-EN 60051	Direct acting indicating analogue electrical measuring instruments and their accessories
49	PN-EN 60654	Industrial-process measurement and control equipment
50	PN-EN 60584-1: 1997	Thermocouples – Part 1: EMF specifications
51	PN-EN 60584-2: 1997	Thermocouples – Part 2: Tolerances
52	PN-EN 60439	Low-voltage switchgear and controlgear assemblies.
53	PN-EN 60947	Low-voltage switchgear and controlgear
54	PN-EN 60950-1	Information technology equipment – Safety
55	PN-EN 61000-4-4: 2005	Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test
56	PN-EN 61000-6-3: 2007	Electromagnetic compatibility (EMC) – Part 6-3: Generic standards – Emission standard for equipment in residential environments
57	PN-EN 61000-6-2: 2005	Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity standard for industrial environments

No	Standard	Description
58	PN-EN 10204: 2006	Metallic products – Types of inspection documents
59	PN-M-42370: 1998	Measurement of fluid volume in pipes – Ultrasonic flowmeters
60	PN-EN 60730-1: 2002	Automatic electrical controls – Part 1: General requirements
61	PN-EN 60730-2-6: 2006	Automatic electrical controls – Part 2-6: Particular requirements for automatic electrical pressure sensing controls including mechanical requirements
62	PN-M-42011	Automation and instrumentation – Electrical actuators – General requirements and tests
63	DIN 43760	Industrial Platinum Resistance Thermometer Sensors
64	IEC 751	Industrial Platinum Resistance Thermometer Sensors
65	DIN 43710	Electrical temperature measuring instruments, electromotive forces and materials of thermocouples
66	IEEE Standard 587 category B	Surge withstand capability
67	IEEE Standard 472	Surge withstand capability
68	IEC 60332-3	Tests on electric cables under fire conditions
69	PN-89/M-42007.01	Automation and industrial measurements – Indications on diagrams – Basic graphic symbols and general provisions
70	PN-89/M-42007.03	Automation and instrumentation – Markings in diagrams – Graphical symbols in circuit diagrams
71	PN-89/M-42007.04	Automation and instrumentation – Indications on diagrams – Complementary graphic symbols

8.1.5. OTHER REGULATIONS

With regard to the performance of the Subject of the Contract and Provisional Acceptance, the Employer requires the Contractor to proceed in accordance with, among others, the following legal acts:

- A. Spatial Planning and Development Act along with implementing provisions;
- B. Construction Law Act along with implementing provisions;
- C. Environmental Protection Law Act along with implementing provisions;
- D. Waste Act along with implementing provisions;
- E. Water Law Act along with implementing provisions;
- F. Nature Protection Act along with implementing provisions;
- G. Construction Products Act along with implementing provisions;
- H. Ordinance of the Minister of the Environment of 9 September 2002, Dz.U.165/2002, item 1359.

- I. Ordinance of the Minister of Economy of 21 December 2005 on essential requirements for pressure equipment and units of pressure equipment (introduces the PED Pressure Equipment Directive into Polish law).
- J. EU Pressure Equipment Directive No. 2014/68/EU (PED).
- K. Together with the Directive, this Specification refers, as applicable to this Project, to Polish standards (PN), introducing European standards (EN) harmonised with this Directive, and in particular the standards listed below.
- L. Act of 13 April 2016 on compliance assessment and market supervision systems (Journal of Laws of 2022, item 1854).
- M. Act of 21 December 2000 on technical inspection (Journal of Laws of 2024, item 1194).
- N. Ordinance of the Council of Ministers of 16 July 2002 on types of technical equipment subject to technical inspection (Journal of Laws No. 120, item 1021), as amended by the Regulation of the Council of Ministers of 7 December 2012 (Journal of Laws of 2012, item 1468).
- O. Ordinance of the Minister of Economy of 28 December 2001 on technical conditions of technical inspection applicable to lifting jacks (Journal of Laws No. 4, item 43 as amended).
- P. Ordinance of the Minister of Labour and Social Policy of 26 September 1997 on general occupational health and safety regulations (Journal of Laws of 2003, item 169.1650, consolidated text, as amended).
- Q. Ordinance of the Minister of Economy of 28 August 2019 on occupational health and safety at power equipment and systems (Journal of Laws 2021, item 1210).
- R. Ordinance of the Minister of Economy of 21 August 2007 on essential requirements for electronic equipment (introduces the LVD – Low Voltage Directive into Polish law).
- S. Ordinance of the Minister of Economy of 20 December 2005 on essential requirements for machines and safety members (introduces the Machinery Directive into Polish law) (Journal of Laws No. 259, item 2170).
- T. Machinery Directive 2006/42/EC.
- U. Ordinance of the Minister of Economy of 18 September 2001 on technical conditions of technical inspection applicable to non-pressure and low-pressure tanks for the storage of flammable liquids (Journal of Laws of 2001, item 113.1211).
- V. Ordinance of the Minister of Economy of 16 April 2002 on technical conditions of technical inspection of non-pressure and low-pressure tanks intended for the storage of poisonous and caustic materials (Journal of Laws of 2002, item 63.572).

In addition to the provisions indicated above, the Contractor shall be obliged to perform the Subject of the Contract in accordance with the Legal Requirements as defined in the Contract.

8.2. DETAILED MILESTONE SCHEDULE

The Contractor shall be obliged to prepare and present to the Employer a Detailed Material Schedule.

With regard to the Detailed Milestone Schedule, the Employer requires that the Contractor should:

- A. implement the division of the Contract Subject performance period into stages, including presenting the Milestones indicated in the Milestone Schedule and marking them with an asterisk;
 - B. mark all key stages of implementation, including Milestones, in a legible and clearer manner than other parts/elements of the Detailed Milestone Schedule;
 - C. implement deadlines for obtaining legally valid official decisions;
 - D. implement the deadlines resulting from the Employer's requirements;
 - E. implement the deadlines resulting from the Contractor's obligations;
 - F. implement the deadlines for the Supply of equipment and the dates and places of FAT of equipment and materials in accordance with the scope of Supply;
 - G. implement deadlines for demolition works, dismantling works, relocations and exclusions from the functioning of the existing EC-4 process, which will include the EC-4 shutdowns necessary to implement the arrangements if necessary;
 - H. take into account the time for reviewing the documents by both the Employer and the Contractor, in accordance with the requirements of the Contract;
 - I. identify the critical path and mark it in colour;
 - J. prepare a list of tasks on the critical path, showing activities with zero total time margin;
 - K. implement other important deadlines, including those for which contractual penalties are charged if they are exceeded;
 - L. include and clearly mark unproductive periods such as holidays.
 - M. The Contractor shall provide the Employer with a schedule taking into account the dates and places of factory trials and tests of equipment and materials in accordance with the scope of supply.
 - N. Detailed Milestone Schedule covering the Works, also included in section 8.3.8 F.
- In addition, the Employer requires the Contractor to provide the Employer with original files in .mpp format or equivalent.

Demolition activities

All activities related to demolition, dismantling, relocation of the existing infrastructure, which have an impact on maintaining the continuity of EC-4 operation, shall require separate arrangement with the Employer. Also, the shut-down of existing equipment, process systems at EC-4, shall require separate arrangements with the Employer.

Detailed Milestone Schedule in accordance with the state of facts

Notwithstanding the provisions of Clause 6 of the Contract and other provisions of this document, the Contractor shall submit the Detailed Milestone Schedule to the Employer immediately prior to the Provisional Acceptance. This schedule shall constitute a comprehensive list, indicating the 'actual start date' and 'actual end date' of all activities undertaken by the Contractor during the course of the performance of the Subject of the Contract. In particular, the Contractor shall ensure that this schedule meticulously records all delays and time extensions in relation to the Detailed Milestone Schedule, according to the facts.

8.3. REQUIREMENTS FOR THE CONTRACTOR'S DOCUMENTATION

8.3.1. Scope of the Contractor's Documentation

The Contractor shall prepare and provide the Contractor's Documentation necessary to carry out the Works, including but not limited to:

- A. Inventory and expert opinions for design purposes;
- B. The Contractor shall submit a replacement building design and other documents necessary to obtain a legally valid replacement building permit and occupancy permit for the Investment Project (if applicable). The Employer shall be released from any liability for the correctness or completeness of the building permit design, replacement design, replacement building permit, or other Contractor's Documentation.
- C. Detailed engineering designs in the disciplines: civil engineering (including architectural, structural, sanitary, water supply and sewage, ventilation, heating, air conditioning, fire protection, process-related, electrical and I&C systems).
- D. As-built design documentation.

The Contractor shall prepare and provide all other documentation necessary to carry out the Works, including but not limited to:

- A. As-built Documentation of the civil structure;
- B. Data on limitations of supply;
- C. Procurement and manufacturing documentation (including quality control documentation);
- D. Project implementation plan;
- E. Provisional acceptance procedure;
- F. Operating documentation of the equipment;
- G. Training documentation;
- H. Legal documentation (including licence and permit documentation).

8.3.2. General requirements for the Contractor's Documentation

- A. The Contractor's Documentation provided to the Employer as part of the performance of the Subject of the Contract shall be the property of the Employer, and the Employer shall be entitled to dispose of it in accordance with the provisions of §33 of the Contract. It shall meet the following essential requirements:
- B. The Contractor's Documentation shall be in Polish.
- C. Drawings and diagrams shall comply with the standards and codes adopted in the territory of the Republic of Poland, including in the scope of symbols, markings, scales, etc., as well as the applicable Polish law;
- D. All equipment and systems shall be designed in such a manner that their operation, maintenance and other works can be carried out in accordance with the Ordinance of the Minister of Energy of 28 August 2019 on occupational health and safety at power equipment (Journal of Laws of 2021, item 1210, as amended).
- E. The Contractor shall use the SI system of units of measurement and mass in all documents, descriptions and calculations.

- F. The use of terminology, text descriptions and symbols in the Contractor's Documentation shall be consistent.
- G. In the Contractor's Documentation, the KKS system used at Veolia Energia Łódź S.A. shall be applied to for the marking of facilities, systems and equipment.
- H. The Contractor shall present a summary list of the Contractor's Documentation, specifying the structure and division rules.
- I. The provided Contractor's Documentation shall include at least one copy with original signatures and stamps of design engineers and legally required approvals from fire protection, ergonomics, occupational safety and health experts, etc.
- J. The Contractor shall submit a declaration of completeness of the Contractor's Documentation at each design stage.
- K. Detailed calculations shall be available for review of the Contractor's Documentation at the Employer's request, while the same shall be presented in the Contractor's Documentation in the form of results.
- L. It is advisable that the Contractor's Documentation for the electrical and I&C disciplines be carried out by one entity. In case this is not possible, it is essential to ensure that there is full consistency from the signal source to the digital system input.
- M. The entire Contractor's Documentation shall be prepared and submitted to the Employer in 3 paper copies, and copies of the documentation shall be delivered to the Employer in electronic form via dedicated platforms in one of the following standards:
 - a. descriptions, text documents: Word 2010 or higher;
 - b. drawings, diagrams: both in *.dwg and *.pdf;
 - c. tables, graphs: Excel 2010 or higher.

In case the Contract or the Description of the Subject of the Contract indicates different requirements for individual parts of the Contractor's Documentation in relation to those indicated above, the Contractor shall be obliged to comply with them.
- N. Each volume of the Contractor's Documentation submitted to the Employer shall include a completed list of documents and drawings.
- O. The Contractor's Documentation list shall be provided regardless of whether the documentation is submitted in paper or electronic form.
- P. The Contractor shall describe each item in the Contractor's Documentation volume in the "Procedure for submission, exchange, approval and update of documentation".

8.3.3.Scope of the Employer's system for documentation management – AODocs

- A. For the purposes of managing the Contractor's Documentation and all other documentation (including correspondence) during the performance of the Subject of the Contract, from the date of entry into force of the Contract until the 60th calendar day after the expiry of the Warranty Period (unless the Parties agree otherwise, which does not require an amendment to the Contract in the form of an annex), the Employer shall provide the Contractor with the AODocs electronic platform, in accordance with **Appendix 15a** to the ToR Part II. The Employer will not allow any other official method of transferring and managing the Contractor's Documentation and any other documentation. Other platforms, databases, Contractor's Documentation databases used by the Contractor or Subcontractors are considered to be a working version or

temporary, and activities with their use are not considered to be binding on the Parties and in accordance with contractual requirements.

- B. The procedures for the AODocs electronic platform indicate the following Contractor's Documentation management areas:
- a) Numbering system of the Contractor's Documentation and any other documentation;
 - b) Management of issuing, checking and approving the Design Documentation;
 - c) Management of the schedule for issuing the Contractor's Documentation and any other documentation;
 - d) Tracking of the path of issuing, checking and approving the Contractor's Documentation;
 - e) Correspondence management.
- C. The Employer shall grant the Contractor a licence for the AODocs platform to a limited extent and adapted to the Contractor's area of responsibility:
- a) Use of the coding procedures of the Contractor's Documentation, ready-made design blanks and correspondence blanks;
 - b) Uploading of the Contractor's Documentation to the platform;
 - c) Review of the Contractor's Documentation on the platform to the extent specified by the Employer;
 - d) Conducting of official correspondence during the performance of the Subject of the Contract.
- D. Each document, in accordance with the Contractor's standard numbering system for Contractor's Documentation, shall have a unique number based on the AODocs document coding procedure PROJECT DOCUMENT IDENTIFICATION PROCEDURE, document No.: WHAL-VLD-00xxx00-PMT-PRO-0001. This number shall constitute the official document number and shall be used in references between other documents, in the content of other documents (if the Contractor refers to it). It is not acceptable to use numbers from other documents of the Contractor in the content of the Contractor's Documentation, which are assigned according to a numbering system not related to the Subject of the Contract. It is not acceptable to use an internal number (of the supplier or manufacturer of the device) in other of the Contractor's Documentation (e.g. process descriptions); only the official document number for the Contract is permitted.
- E. The Contractor shall develop the KKS Code Book for the WHAL Project on the basis of the code book in force at Veolia Energia Łódź S.A. KKS Code Book, document No.: C2GL-VLD-00xxx00-PMT-PRO-0020 (**Appendix 15** to the ToR Part II).
- F. The Contractor's Documentation shall be based on the KKS Code Book developed by the Contractor. All KKS code lists (comprehensive lists of codes of equipment, measurements, signals from the gas unit, cable and wire, etc.) shall also be provided in an editable Excel spreadsheet format.
- G. The Employer shall train the Contractor as part of the Contract in the use of AODocs software to manage the Contractor's Documentation and any other documentation prepared during the performance of the Subject of the Contract. The training will be carried out in Łódź, at the construction site of the Heat Accumulator, on the date designated by the Employer, taking into account the date of signing the Contract and the Milestone Schedule. The training shall be carried out for a selected group of the Contractor's employees (initially approx. 10–20 people).

- H. A more detailed description of the AODocs platform can be found in **Appendix No. 15a** (WHAL-VLD-00xxx00-PMT-NOT-0001).

8.3.4. Requirements for inventory and expert opinions for design purposes

- A. The Contractor shall make an inventory of civil structures necessary to carry out the project properly. The Contractor shall also prepare the necessary expert opinions, measurements and analyses, and make their results available to the Employer.
- B. The requirements for the replacement building design and other documents necessary to obtain a replacement building permit for the Subject of the Contract and its occupancy permit:
- C. The content of the documents must enable building permits to be obtained and comply with the requirements of:
 - a. Construction Law of 7 July 1994 as amended (Journal of Laws of 2024, item 725);
 - b. other legal acts associated with the Construction Law.
 - c. The Building Permit Design must be prepared in accordance with the requirements contained in the Ordinance of the Minister of Development of 11 September 2020 on the detailed scope and form of the building permit design, as amended. The design shall be approved by experts in OH&S (qualification group 2.3), ergonomics, and fire protection (Journal of Laws of 2022, item 1679, as amended).

8.3.5. Requirements for detailed engineering designs

- A. All detailed engineering designs of the civil engineering and system-related disciplines shall be drawn up and checked (verified) by persons with construction professional licenses for design without restrictions in the relevant specialisations; the design engineer and the reviewer must not be the same person;
 - B. All detailed engineering designs shall be prepared, in particular, in accordance with the requirements set out in the Ordinance of the Minister of Development and Technology 1 of 20 December 2021 on the detailed scope and form of design documentation, technical specifications for the performance and acceptance of construction works and the functional-utility programme (Journal of Laws 2021, item 2454), as well as in accordance with the following rules:
 - C. Every volume and package of detailed engineering designs shall contain a general part, including:
 - a. list of relevant documentation (associated);
 - b. confirmation of conformity of the solutions with the Building Permit Design;
 - c. confirmation of conformity with the binding regulations and standards;
 - d. approvals and verification of the documentation of detailed engineering designs in the scope of OH&S, ergonomics and fire protection regulations;
 - e. interdisciplinary coordination;
- and moreover:
- a. in the process-related scope:

- detailed description of systems, valving and equipment along with their parameters;
 - process flow diagrams of systems;
 - assembly drawings of systems, equipment, pipelines and structures, etc.;
 - detailed drawings of atypical (unitary) elements of systems and structures;
 - specifications of elements of systems, valving, auxiliary equipment, instrumentation, insulation and protection measures;
 - detailed technical conditions for fabrication, installation, and acceptance of corrosion protection measures.
- b. in the scope of civil engineering:
- detailed description of civil engineering structures constituting the subject of documentation.
 - list of assumptions from the process discipline and other system-related disciplines, which were input data for the implementation of a given design of the civil engineering discipline (including arrangement (general layout) drawings, construction assumptions, load plans, etc.);
 - specification of corrosion, water and moisture protection, chemical resistance, fire protection;
 - static calculations of the main structural members and dynamic calculations, where required;
 - complete drawing documentation complying with standards and applicable regulations, including both assembly and workshop drawings of structures, formwork drawings and reinforcement drawings of reinforced concrete structures, as well as drawings of non-standard structural components;
 - complete lists and specifications of materials and structural members;
 - operational loads of process levels;
 - locations of foundations, structures, etc.;
 - detailed technical conditions for fabrication, installation, acceptance.
- c. in the system-related scope:
- detailed description of systems, equipment, and valving constituting the subject of the documentation together with their parameters;
 - functional diagrams of systems with principles of operation described;
 - detailed drawings of equipment, pipelines, support structures of atypical system components together with assembly drawings, if required;
 - specification of components of systems, equipment, devices, structures, corrosion and fire protection measures;
 - detailed description of the principle of operation of such automation for systems in which it exists, with references the I&C part;
 - detailed technical conditions for manufacturing, installation, and acceptance of systems as well as their corrosion and fire protection measures.
- d. in the electrical scope:
- detailed description of the equipment in electrical systems constituting the subject of the documentation (including the lighting system);

- detailed design calculations;
 - complete drawing documentation including single line diagrams, circuit diagrams, assembly diagrams of equipment, instrumentation, terminal blocks as well as cable connections, system plans, layout drawings, etc.;
 - specification of ancillary materials;
 - power supply and earthing diagrams;
 - cable books;
 - complete lists and specifications of equipment, instrumentation, materials, and system components.
- e. in the scope of I&C:
- detailed description of the automation system, including configuration and arrangement of system components, changes in the existing measuring system, control systems, and the automatic control systems;
 - description of automatic and manual control systems;
 - P&I diagrams with marked measuring points, control systems and automatic control systems (the so-called “bubble diagrams”);
 - full specification of system equipment and modules;
 - diagrams of individual measuring circuits on separate pages, with all data provided;
 - diagrams relating to signals associated with control circuits – one page (or two subsequent pages) shall include all signals referring to a given control circuit, it shall not be allowed to trace coverage of control system modules. The diagrams shall be made with proper addressing as regards the electrical documentation;
 - in the electrical documentation, the diagram relating to a given control circuit shall include the entire control circuit, from power supply terminal at the switchgear to the input modules, control system outputs (inclusive) and proper addressing at switching elements;
 - control (sequential), regulation, interlock and safety algorithms in the full range of operation. The following variants of documentation are possible: PFUP (Process Functional Plans), block type, descriptive with interlocks;
 - diagrams of instrumentation location in the field;
 - drawings illustrating the arrangement of instrumentation in prefabricated elements;
 - assembly diagrams of prefabricated elements (layouts of connections between cabinets);
 - cable lists;
 - cable books;
 - specification of ancillary materials;
 - power supply and earthing diagrams;
 - documentation of specialised system software (in particular, for digital links and network connections) and diagnostic software;
 - assembly diagrams and specifications of I&C power supply;
 - detailed technical conditions for fabrication, installation, acceptance;

- graphics and control logics shall be approved by the Employer at the design stage;
 - engineering software (tools and sources) should be provided as part of the project for both the hardware (controllers) and the visualisation system so that the Employer can make ongoing changes or make it available free of charge to entities performing system upgrades in the future for purposes related to this upgrade;
 - reports on functional tests of interlocks, protective devices, and process signalling of the equipment, as corrected after the changes and replacement of measuring circuits.
- f. in the scope of telecommunications systems, fire protection and monitoring:
- detailed description of the systems, including their configurations and arrangement of system components;
 - full specification of circuits implemented in such systems;
 - schematic diagrams;
 - software algorithms;
 - drawings illustrating instrumentation arrangement;
 - installation diagrams of prefabricated elements (connections between cabinets);
 - cable books;
 - specification of ancillary materials;
 - power supply and earthing diagrams;
 - software documentation;
 - Installation diagrams and specifications of the power supply system;
- The replacement building design, the systems themselves and their installation must meet the requirements of current standards for fire protection systems and monitoring systems and have corresponding certificates in accordance with current standards.

8.3.6. Requirements for the As-Built Design Documentation

The Design Documentation with corrections and changes made during installation, enabling safe operation of the Works by the Employer's operational personnel during and immediately after the Trial Run, shall be submitted to the Employer's personnel services 10 Days before the start of the Trial Run. It shall be corrected on an ongoing basis by the Contractor to reflect the changes made during the Trial Run. **At least 10 days before the notification of the Subject of the Contract for obtaining the occupancy permit**, it shall be replaced by the As-Built Documentation prepared on its basis and submitted to the Employer for approval.

8.3.6.1. Requirements for to the I&C As-Built Documentation

In the scope of I&C, the As-Built Documentation must be supplemented with:

- A. reports from factory tests of supplied equipment as well as control and measurement instrumentation;
- B. warranty cards;

- C. material attestations (for nozzles, metering orifices, impulse tubes etc.);
- D. inspection reports for I&C (prior to installation);
- E. setpoint sheets with parameters of programmable transmitters, etc.;
- F. inspection reports for the measuring circuits and command circuits at the facility after connecting the instrumentation to the control system;
- G. inspection reports for the equipment supplied by subcontractors with setpoint sheets of parameters for local controllers;
- H. reports on the start-up of the control system and all connections to the industrial computer network;
- I. reports on functional tests of interlocks, protective devices and process signalling equipment carried out by the Contractor in the presence of the Employer, with threshold values specified;
- J. inspection reports on the operation of manual/automatic control system circuits;
- K. acceptance testing reports on automatic control systems;
- L. source codes of the software of controllers and the visualisation system (in electronic format).

8.3.6.2. Requirements for the As-Built Documentation of a civil structure

- A. The as-built documentation of the civil structure shall be prepared in accordance with Art. 57 of the Act of 7 July 1994 – Construction Laws (Journal of Laws of 2024, item 725, as amended) and shall include:
 - B. Construction Logbook;
 - C. reports on tests and inspections as required by the Construction Law;
 - D. as-built geodetic survey;
 - E. approved architectural and building design with changes made during construction – constituting an integral part of the building permit held by the project owner;
 - F. declaration issued by the Site Manager confirming that the Construction Works have been carried out in accordance with the replacement building design and the conditions of the building permit and the technical building regulations, and that the Construction Site has been restored to its proper condition and order.

8.3.7. Requirements for the procurement and manufacturing documentation (including quality control documentation)

The procurement and manufacturing documentation shall include all documents confirming the quality of performance as well as operating safety of the systems and equipment. These shall include, for instance:

- A. Quality control certificates.
- B. Material attestations and certificates.
- C. Technical approvals.
- D. Certificates of conformity with essential requirements set forth by relevant directives, ordinances of competent ministers, technical standards, etc.
- E. The procurement and manufacturing documentation shall be submitted before first start-up attempts of the entire System or any of its parts.

8.3.8. Implementation Plan

The Implementation Plan shall contain:

- A. Site Development Plan with the minimum scope including:
 - a. specification of the Construction Site area, site fencing together with information and warning inscriptions, laydown yards, transport roads, location of cranes etc.;
 - b. specification of the area and location of personnel amenities;
 - c. plan for the systems to provide the construction site with electricity, telephone and water supply/sewage, including a list of the required utilities;
 - d. interdisciplinary description of organisation of erection, taking into account its process-related sequence, working shifts, dimensions of the elements to be erected etc., as well as the work safety rules at work with power equipment;
 - e. main technical data of the equipment to be used in the course of project implementation.
- B. Organisation chart demonstrating the organisation to be established by the Contractor for the purpose of implementing the Contract. The organisation chart shall include names and professional experience of the senior expert staff and the Contractor's Representative. The Contractor shall notify the Employer's Representative of any review or amendment of the organisation chart.
- C. Schedule of the technical design, list of the key technical documents, the deadlines for their preparation and submission, taking into account the Employer's commenting procedure.
- D. Itemised and scheduled list of the permit and consent procedures including the identification of effective legal procedures/actions and indicating the competent public authorities, the running time (time) of the permit and consent procedure, planned submission dates of application documents for individual permits.
- E. Detailed Milestone Schedule including the Works divided into activities included in:
 - f. Engineering Design (including the application for Permits...)
 - g. Procurement (including purchasing, manufacturing, shipping, transport, etc.)
 - h. Construction (including civil engineering works, installation, Provisional Acceptance, Tests, etc.).to be developed using the critical path method (CPM), predecessor/successor networking techniques, showing early start of Works, float, late start of Works, early finish and late finish of Works for all phases of activities included in the Works, and the dates of the Milestones. The uniform computer software used to develop the Detailed Milestone Schedule shall be Microsoft Project (or other planning software agreed with the Employer as long as the Contractor provides the Employer with the appropriate software at no additional cost). The Detailed Milestone Schedule shall include the progress of each activity expressed in percentage, together with the planned and actual commencement and completion deadlines.
- F. Hand-over Schedule relating to the Construction Site and any part of the Construction Site.
- G. Break-down list of the interfaces with the Works and the erection activities together with main elements of such activities;

- H. Preliminary Provisional Acceptance and Testing Programme.
- I. Conditions to be provided by the Employer: services, technologies and other assembly connections, energy supplies, external systems necessary for Provisional Acceptance, etc..
- J. Preliminary list of relevant checks and tests to be carried out during the complete procedure.
- K. Code system (specified by the Employer) in technical documents.
- L. List of completeness of Milestones to be used for the purpose of partial discipline acceptance procedures.
- M. Procedure to be applied when submitting, replacing, approving and updating documentation.
- N. Quality assurance plan including:
 - i. description of the applied quality assurance system (procedures);
 - j. specification of licenses held in the scope of design, manufacturing and Construction Works;
 - k. description of the manner of coordination for all Works as part of the implementation of the Subject of the Contract from the design stage to the completion of construction.
- O. Health and Safety Plan that complies with the requirements of the Ordinance of the Minister of Infrastructure of 23 June 2003 (Journal of Laws of 2003, item 120, as amended).
- P. Main items of the manufacturing and shipment programme, indicating the planned Subcontractor, as well as itemised and scheduled list of the inspection procedures to be performed jointly by the Employer and the Contractor (factory inspections, hand-over/take-over procedure).
- Q. Principles of cooperation between the Employer and the Contractor, to be applied at the Construction Site, including:
 - l. manner of notifying of progress of Works, occurred obstacles in respect of deadlines and quality as well as methods of eliminating them (weekly coordination meetings and monthly written reports to be issued by the Contractor);
 - m. manner of documenting events occurred at the construction site (Construction Log, minutes from meetings, memos, etc.);
 - n. principles of issuing written orders;
 - o. personal-goods traffic rules (applying for passes).
- R. The Implementation Plan shall be approved by experts in OH&S and fire protection.
- S. The Implementation Plan shall be delivered to the Employer not later than twenty-one **(21) Days after the Effective Date of the Contract.**

8.3.9. Operating documentation of the equipment

This documentation shall include (in addition to the separately described As-Built Documentation) all documents necessary for the proper operation of equipment and systems, in particular:

- A. Operation and Maintenance Documentation (O&MD), in 3 copies, from the manufacturer of every piece of the equipment in the Polish language, including

equipment description, its technical parameters, description of control panels, recommended maintenance tasks to be carried out during operation and inspection intervals, a list of wear and spare parts (with the replacement frequency specified), and consumables;

- B. The Operation and Maintenance Manual for the entire system and other instructions of systems or equipment comprising process-related entirety. The manual and instructions shall include:
 - a. Description of utilities.
 - b. Consumption of consumables.
 - c. Description of process subunits.
 - d. Preparation of the system to be started up – the scope of inspections and preparation of the equipment for operation;
 - e. Start-up procedure – procedures to be carried out by the operating personnel during start-up;
 - f. Operating the equipment and the system during normal operation – ensuring proper operation of the system;
 - g. Planned shut-down of the System;
 - h. Emergency shutdown of the System;
 - i. System operation interruptions;
 - j. Periodic inspection, cleaning and maintenance, and inspection measurements;
 - k. OH&S and fire protection guidelines;
- C. The instructions shall be approved by the Employer within 10 Days.
- D. The instructions must be supplied to the Employer and approved **before the start of the Commissioning**, with the provision that minor changes to the O&M Manual are allowed at further stages of the Works.

8.3.10. Training documentation

- A. The Contractor shall prepare training materials for the Employer's equipment operators, presenting the System and how to handle it separately for each discipline.
- B. The Contractor shall prepare training materials on overhaul and maintenance for the employees of the maintenance department separately for each discipline. In the training materials, the Contractor shall define the maintenance programmes, i.e. indicate the types of maintenance activities to be carried out (maintenance / diagnostics / preventive maintenance), taking into account the scope and frequency.
- C. Participation in the training shall be confirmed by the Employer's employees by signing the attendance list.

8.3.11. Requirements for legal documentation

- A. With regard to the equipment of the System and structures that require legal approval by institutions established for that purpose (such as, for example, the Office of Technical Inspection), the Contractor shall prepare documentation required under relevant regulations, submit it to appropriate institutions and, once the documentation has been approved, to the Employer.

- B. If the subject of supply and implementation to be performed by the Contractor includes equipment or a system constituting know-how, a licence, or a patent, § 33 of the ToR, Part III (of the Contract) shall apply.
- C. The Employer shall receive suitable documentation including full data and information that allows proper operation, licences for software used, as well as documents confirming the right to use them.
- D. Such legal documentation, including necessary approvals and tests, shall be submitted before first start-up of the entire system or any of its parts.

8.3.12. Progress Report

Each monthly report on the progress of the Works until the Date of Provisional Acceptance shall include:

- A. Description of the main activities carried out in the past month, the main works to be commenced in the coming month and the main works that were not carried out but should have been carried out and related events in the period covered by the report (charts and detailed descriptions of the progress of the Works, including each stage of design, Contractor's Documentation, procurement, production, Deliveries to the Construction Site, construction, installation, Guarantee Measurements, Commissioning and trial operation).
- B. Description of the status of progress as related to the original Detailed Milestone Schedule. Estimate dates for achievement of Milestones. Presentation of a summary of Milestones and the percentage completion included in the report period, and the cumulative versus planned value.
- C. Comparison of actual and planned progress of critical tasks, with a detailed description of those activities currently delayed against the Detailed Milestone Schedule, which have the likelihood of affecting the Detailed Milestone Schedule or which may jeopardise the Milestone, and the required corrective action or measures being (or to be) adopted to overcome such aspects and the individuals who would be responsible for such action.
- D. With regard to the production of each main component of the System and materials – the name of the manufacturer, the location of production, the status of production expressed as a percentage and the actual or expected dates: start of production, inspections performed by the Contractor, tests.
- E. Statement concerning unanticipated difficulties which can affect the progress of the Works, such as latent conditions, serious job accidents, labour difficulties, quantity overruns, material shortages, and similar events, shipments, and arrivals at the Site.
- F. Monthly updates of the critical path (CPM) of the Detailed Schedule and in electronic form.
- G. Status of the technical design, which shall include a list of technical documents submitted against the Detailed Milestone Schedule.
- H. Status of procurement and manufacturing, including factory inspection, which should include a list of Equipment status against the Detailed Milestone Schedule.
- I. Status of shipping and Deliveries, which should include a list of Equipment status against the Detailed Milestone Schedule, to be delivered in the current quarter, their location and country of origin.

- J. Status of discrepancies and status of relevant corrective actions, as well as the list of changes referred to in § 30 of the Contract.
- K. Risk status.
- L. Environmental, health and safety issues.
- M. Safety statistics, including details of any hazardous events and activities related to environmental and public relations aspects.
- N. Status of Permits, which should include a list of Permit status against the Detailed Milestone Schedule.
- O. Quality inspection report, which shall include a list of test results status against the Detailed Milestone Schedule.
- P. Site manpower report.
- Q. Photographs showing the state of production and progress at the Construction Site.
- R. Other items, according to the Contractor's knowledge, that should be communicated to the Employer to enable project management in accordance with the Employer's Standards.
- S. At the request of the Employer, the number of people working at the Construction Site and their areas of expertise, in accordance with the GDPR, if there is a legitimate reason for the Employer to request such information, such as delays, safety issues or other significant circumstances affecting the Contractor's performance of its contractual obligations.

8.4. REQUIREMENTS FOR TEST, START-UP, TRIAL RUN AND TUNING RUN

[IN ACCORDANCE WITH APPENDIX NO. 1 TO THE CONTRACT (PART III TOR)]

8.5. REQUIREMENTS FOR PROVISIONAL ACCEPTANCE

[IN ACCORDANCE WITH APPENDIX NO. 1 TO THE CONTRACT (PART III TOR)]

8.6. REQUIREMENTS FOR THE PROCEDURE FOR MEASUREMENTS OF THE GUARANTEED TECHNICAL PARAMETERS

[IN ACCORDANCE WITH APPENDIX NO. 1 TO THE CONTRACT (PART III TOR)]

8.7. REQUIREMENTS FOR THE FINAL ACCEPTANCE PROCEDURE

[IN ACCORDANCE WITH APPENDIX NO. 1 TO THE CONTRACT (PART III TOR)]

8.8. TRAINING FOR THE EMPLOYER'S PERSONNEL

The training shall ensure that the Employer's personnel or the personnel designated by the Employer are prepared, both practically and theoretically, for the operation of all equipment, systems and facilities included in the scope of the Subject of the Contract, provided that the

Employer submits employees with appropriate qualifications for training, i.e. with appropriate professional licences for operation and supervision in power engineering. In addition, the Contractor shall provide appropriate training on fire protection and OH&S.

Trained personnel of the Employer shall be able to:

- A. To operate the System safely and economically, including all auxiliary equipment included in the Scope of the Contract and the Employer's management systems in interaction with/associated with the System, without the Contractor's support, in all operational situations.
- B. Provide regular operation in the correct manner.
- C. Make repairs, carry out ongoing repairs, using specialised tools provided by the Contractor.
- D. Plan and prepare maintenance orders.
- E. Use the provided software.

The training shall include a theoretical and practical parts and should be divided into management and executive personnel, operators and on-call engineers, operating staff and maintenance service.

The training shall include the personnel indicated by the Employer.

8.8.1. Training materials and provision of training

- A. The programme and dates of the training per every job position shall be agreed on by the Employer and the Contractor. Training for each position shall take place on at least two different dates, and for shift employees on different dates, adapted to the organisation of the Employer's work and taking into account the shifts in the work of the trained personnel.
- B. The Contractor, at least 3 months before the start of the first stage of training, shall present the proposed training program including detailed topics, proposed numbers of participants in individual groups and the duration of training on the Employer's premises.
- C. The training shall be conducted in the Polish language.
- D. Prior to the commencement of the training, at the latest 30 days before each stage of the training, the Contractor shall prepare and provide the Employer with a set of training materials and additionally one copy for each participant of the training. The training materials shall be drawn up in the Polish language.
- E. The training materials shall be based on drawings and instructions, which shall be presented in the operation and maintenance manual of the System.
- F. The training materials shall be the property of the Employer and may be used by the Employer to train personnel during internal courses.
- G. Theoretical training (for supervisory and operational personnel, on-duty electric power and automation engineers) and simulation and diagnostics training (for the system engineer) shall be conducted prior to the system start-up (the Employer does not require the provision of a simulation and/or training station).
- H. Practical and operational training (for supervisory and operational personnel, on-duty electric power and automation engineers, for the system engineer) shall take place

successively during the Trial Run, the tuning run and the optimisation run and shall be carried out until Provisional Acceptance.

- I. At the end of the training, the Contractor shall issue certificates to the participants confirming their participation in the training and acquisition of the skills to work independently in the positions.

8.8.2. Training site

- A. Basic theoretical training shall be conducted on the Employer's premises.
- B. As part of the practical training, the training participants shall take part in tests and commissioning of the system.

8.8.3. Training programme

- A. The training programme shall be implemented within the deadlines resulting from the Detailed Milestone Schedule.
- B. The training programme for each course shall include:
 - a. purpose of the training;
 - b. number of trained persons;
 - c. training site;
 - d. training duration;
 - e. scope of training;
 - f. summary of the training documentation used.
- C. The training of management and executive personnel shall take place on 2 dates and shall include:
 - a. general overview of the main process systems and their operational characteristics;
 - b. design criteria for the selection of components for individual systems, adopted design spare capacity, justification of adopted solutions;
 - c. experience from the operation of existing process systems identical or comparable to those specified in the Contract; recorded failures and disruptions, methods of eliminating them, and conclusions for the Employer.
- D. The training of supervisory and operating personnel shall cover the start-up and shutdown of equipment in normal operation, safe operation of equipment, and shutdown of equipment in emergency mode. It shall be held on 6 dates and shall include the following parts:
 - a. training shall be provided taking into account the individual process areas
 - b. general overview of the main process systems and their operational characteristics;
 - c. system operating principles, in particular during transition states such as start-up, shutdown, load changes and in disruptive states such as main equipment failures;
 - d. existing system spare capacity and critical values of operating parameters.
- E. The training for on-duty electrical and automation engineers, as well as specialists, shall cover electrical equipment and I&C, shall be held on 6 dates and shall include the following parts:
 - a. process;

- b. electrical;
 - c. I&C.
- F. The training of system engineers shall take place on 1 date and shall include:
- a. programming;
 - b. diagnostics;
 - c. maintenance;
 - d. troubleshooting;
 - e. checking interlocks and protection devices;
- among others, in the operator system, digital security systems, PLCs, communication systems and diagnostic systems.
- G. The training of asset management specialists shall take place on 2 dates and shall concern:
- a. temporary repairs, replacement of spare parts, maintenance and overhaul of devices and equipment relevant to ensuring high operational reliability;
 - b. annual overhauls – routine and minor;
 - c. planning and ordering major overhauls;
 - d. heating and ventilation systems, fire protection systems, etc.

II. INFORMATIVE PART

1. Documentation confirming that the construction project complies with the requirements resulting from separate regulations

The Contractor shall obtain on its own all necessary documents confirming that the construction project complies with the requirements of separate regulations.

Documents in the Employer's possession that the Contractor shall duly take into account and apply when performing the Subject of the Contract:

- A. Decision discontinuing the proceedings regarding the issue of the decision on environmental conditions DEK-OŚR-I.6220.130.2023 of 4 January 2024.
- B. Decision on zoning conditions DPRG-UA-IX.6730.154.2024 of 21 June 2024.

Documents in the Employer's possession that may be used by the Contractor to assess whether and to what extent and how the Contractor will use these documents for the implementation of the Subject of the Contract:

- A. Building design No. WHAL-PBM-07NDx00-PER-TED-0001 prepared by PROBUDMIX Biuro Projektów Inżynierskich Spółka z o.o. of 6 December 2024.
- B. Building Permit Decision No. DPRG-UA-III.159.2025.

2. Employer's declaration confirming its right to use the real property for construction purposes

All Works covered by the Subject of the Contract will be carried out within the plot owned by the Employer.

The declaration on the right to use the real property for construction purposes will be submitted to the Contractor at the stage of developing the Design Documentation.

3. Basic legal regulations and standards associated with design engineering and performance the Subject of the Contract

Basic legal regulations:

- A. Act of 7 July 1994 – Construction Law (Journal of Laws No. 89 item 414), as amended.
- B. Act of 12 September 2002 on standardisation (Journal of Laws No. 169, item 1386), as amended.
- C. Act of 16 April 2004 on construction products (Journal of Laws No. 92, poz.881), as amended.
- D. Act of 17 May 1989 – Geodetic and Cartographic Law (Journal of Laws No. 30, item 163), as amended.
- E. Act of 21 December 2000 on technical inspection (Journal of Laws No. 122, item 1321), as amended.
- F. Act of 24 August 1991 on fire protection (Journal of Laws No. 81, item 351), as amended.

- G. The Act of 26 June 1974 – Labour Code (Journal of Laws No. 24, item 141), as amended.
- H. Waste Act of 14 December 2012 (Journal of Laws with 2013, item 21), as amended.
- I. Act of 27 April 2001 – Environmental Law (Journal of Laws No. 62, item 627, as amended).
- J. Act of 30 August 2002 on the conformity assessment system (Journal of Laws No. 166, item 1360), as amended, and implementing acts.
- K. Ordinance of the Minister of Spatial Management and Construction on technical conditions to be met by buildings and their location of 12 April 2002 (Journal of Laws No. 75, item 690), as amended.
- L. Ordinance of the Minister of Spatial Development and Construction of 21 February 1995 on the type and the scope of surveying and cartographic documents and survey activities in force in the civil the construction industry (Journal of Laws No. 25, item 133).
- M. Ordinance of the Minister of Infrastructure and Development of 11 September 2014 on independent technical functions in the construction industry (Journal of Laws of 2024, item 1278).
- N. Regulation of the Minister of Economy of 20 September 2001 on occupational health and safety during operation of machines and other technical equipment for earthworks, construction works and road works (Journal of Laws No. 118, item 1263).
- O. Ordinance of the Minister of Infrastructure of 23 June 2003 on information concerning safety and health protection and the health and safety plan (Journal Laws No. 120, item 1126).
- P. Ordinance of the Minister of Infrastructure of 26 June 2002 on the construction, erection and demolition log, information board and announcement containing data on occupational safety and health protection (Journal of Laws No. 108, item 953)
- Q. Ordinance of the Minister of Infrastructure of 6 February 2003 on occupational health and safety during construction works (Journal of Laws No. 47, item 401).
- R. Ordinance of the Minister of Labour and Social Policy of 6 September 1997 on general occupational health and safety regulations (Journal of Laws No. 129, item 844, as amended).
- S. Ordinance of the Minister of Labour and Social Policy of 6 June 2014 on the highest permissible concentrations and intensity values of factors that are harmful to health in the working environment (Journal of Laws of 28 April 2023, item 817)
- T. Ordinance of the Minister of Development of 11 September 2020 on the detailed scope and form of the building permit design (Journal of Laws of 2020, item 1609)
- U. Ordinance of the Minister of Interior and Administration of 7 June 2010 on fire protection of buildings, other facilities and areas (Journal of Laws of 2023, item 822).