Energy Audit of Water and Wastewater Utilities in 6 towns of Moldova

Construction Works of Selected Water Supply Pipelines and Pumping Stations

TECHNICAL REQUIREMENTS

for
construction works of water supply pipelines and pumping stations
in Balti, Causeni and Orhei

PARTICULAR SPECIFICATIONS

PARTICULAR TECHNICAL SPECIFICATION
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1 SCOPE OF WORKS

1.1 Introduction

The IDA provided financing in the amount of 0.9 mln USD which will be used for investments to raise energy efficiency in 6 (six) water and wastewater utilities of Moldova. The Project is expected to demonstrate and disseminate through energy audits and following investments the potential for increasing energy efficiency in municipal water and wastewater operations.

The program finances energy audits, hydraulic regime optimizations, and the selective rehabilitation of electromechanical equipment (equipment replacement) which are expected to increase energy efficiency in municipal water and wastewater operations in the cities Balti, Cahul, Orhei, Causeni, Floresti and Ungheni. A part of the allocated funds are planned to be invested in the energy conservation measures under this Contract.

In 2011, Tehno Consulting & Design carried out Energy Audits for 6 Project utilities and recommended a number of energy conservation measures to be financed from the IDA (WB) Moldova National Water Supply and Sanitation Project.

This Technical Requirements refer to implementation of the identified energy conservation measures through optimization of existing water pipelines/networks in Causeni, Orhei and Balti.

The objectives of the contract is the design, supply, installation, construction and commissioning of selected energy saving works within the **Water Supply systems in Balti, Causeni and Orhei** , in details:

- Site A - Design and build of booster pumping station and a pressure pipeline of approx. 2 km in Balti;
- Site B - Design and build of two (2) booster pumping stations and selected pipelines of approx. 1.2 km in Causeni;
- Site C - Design and renovate of water pumping station and build a pressure main pipeline of approx. 2 km in Orhei.

The Scope of Works for the Contractor includes the following main tasks:

- Detailed design of selected parts of the water networks.
- Detailed design of PS buildings.
- Detailed design of mechanical equipment installations,
- Detailed design of electrical installations,
- Detailed design of switchboards, PLC and communications,
- Manufacture of materials, equipment,
- Delivery of all materials and equipment to the site,
- Supervision during the dismantling of the existing constructions, pumps and valves,
- Construction works related to the pumps foundations,
- Installation, installation supervision, testing, pre-commissioning and commissioning of all new materials and equipment for pumping stations installations
- Training of Water Utility staff in the operation and maintenance of equipment supplied and installed under this contract

The Contractor shall perform all tasks in accordance with the instructions and specifications described in the Technical Requirements.

All the works are as determined in detail in the present **Particular Specifications**.

The General Specification are intended to indicate the minimum standard of design, workmanship and materials acceptable for this project. The itemised specific requirements are given in the present Particular Specification.

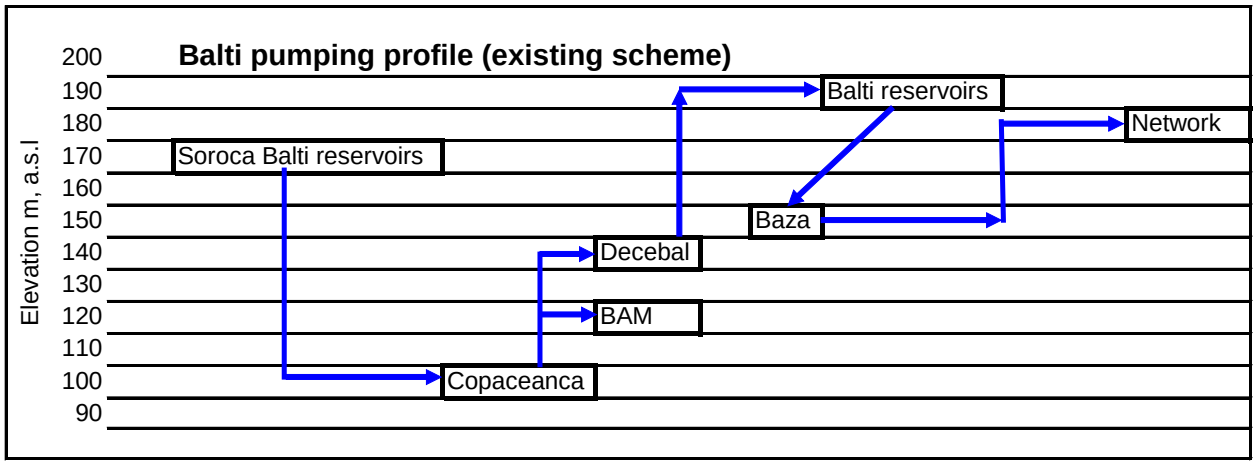
1.2 Scope of Works

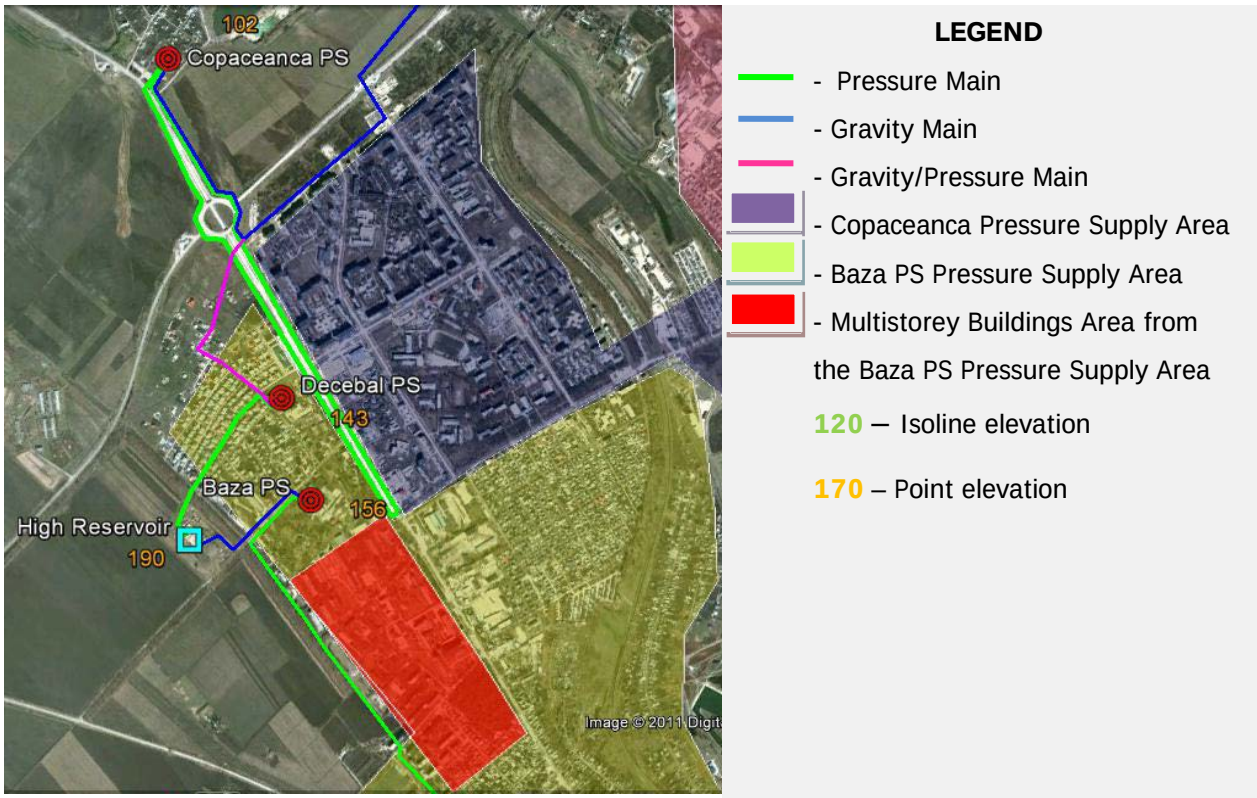
1.2.1 *Site A - Balti*

Currently, Balti Municipality is supplied with water from a surface water regional pipeline (Soroca-Balti). Northern part of Balti is supplied from a separate water main, conveying water from the Soroca-Balti city reservoirs to the Copaceanca PS reservoirs. Copaceanca PS is used to provide water to BAM District (north) of Balti, including reservoir from Decebal PS, and a small area on the left bank of the Raut River.

Decebal PS lifts water to the upper reservoirs at 190 m a.s.l, which feed Baza PS reservoir via gravity. However Baza PS is placed at 156 m a.s.l. and potential energy of 34 m is lost between upper reservoirs and Baza reservoir. Baza PS supplies water to the north/central part of the town. Its supply area is located at 95 – 180 m a.s.l. Design pump head is 50 m. Actual pumping head is kept at 42 m.

Existing situation of supply and distribution of water in Nortern part of Balti is shown in below Figures:





The general scope of project is network optimization through decommissioning of the existing Baza PS and establishment of gravity water supply to the Northern/Central part of Balti from upper reservoirs (190

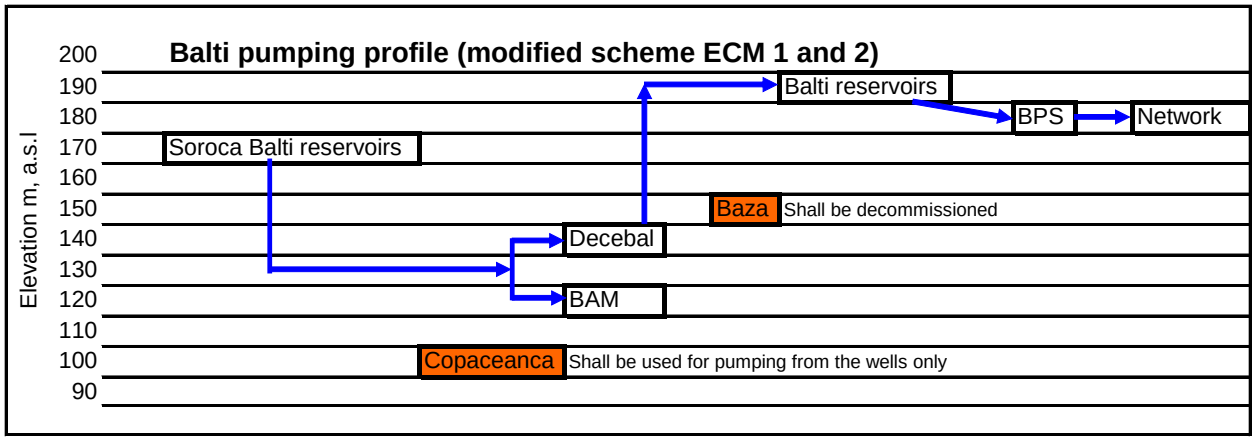
m a.s.l). In order to ensure necessary pressure for 9-story buildings in the upper part of Baza supply area (180 m a.s.l), the project envisages a new BPS to be built. New BPS will serve several multistory buildings along Colesov Street, which are located within elevation range 162 and 180 m a.s.l.

Due to the difficulties with available land for new pumping station and power connection from the grid, it is planned to locate boosting PS at the territory of upper reservoirs.

The scope of works includes:

- Design and build boosting pumping station (including all electromechanical equipment) to lift water to the upper located multi-storey buildings.
- Design and construction of approx. 2 km pipeline from upper reservoirs to the block district to be supplied by new booster PS.

Proposed modifications of water supply scheme are shown in below scheme:



Map of the multi-storey buildings to be supplied from the new BPS:

1.2.2 *Site B - Causeni*

The town of Causeni is provided with water from the underground Main water intake, located in the city Centre, right bank of the Botna River.

Northern service area is geographically divided into two regions – Valul lui Traian (area of private houses located at 25-50 m a.s.l.) and Micro (private houses and 4-5-floor apartment blocks located at 10-25 m a.s.l.). Central area is located at some 10-45 m a.s.l.

Northern part of Causeni is supplied from the main pumping station (PS 2, located at the main water intake) via 3,000 m^3 gravity reservoir. Water is pumped from elevation of 10 m to the reservoir benchmark of 61 m. Most of water consumers of Northern supply area are located at elevations between 12 and 25 m, except the Valul lui Traian area close to reservoir at elevations between 28 and 49 m. In the lowest part of the Micro area pressures are more than 60 m and Apa-Canal staff throttles the valve to the low located districts in order to reduce excessive pressure.

The scope of works includes:

- Design and build of two (2) water mains to create a common central pressure zone through connection of existing northern and central parts of the network;
- Design and build of a new BPS (including all electromechanical equipment) to create a separate pressure service area for Valul lui Traian;
- Design and build of a new BPS (including all electromechanical equipment) to create a separate high-pressure service area for multi-storey buildings in the Micro district of Causeni.

The proposed works are shown in the figure below:

LEGEND

- New combined central pressure network
- New mains to be built to create the combined network
- New separate pressure network in Vadul lui Traian
- New separate pressure network in Micro

1.2.3 *Site C - Orhei*

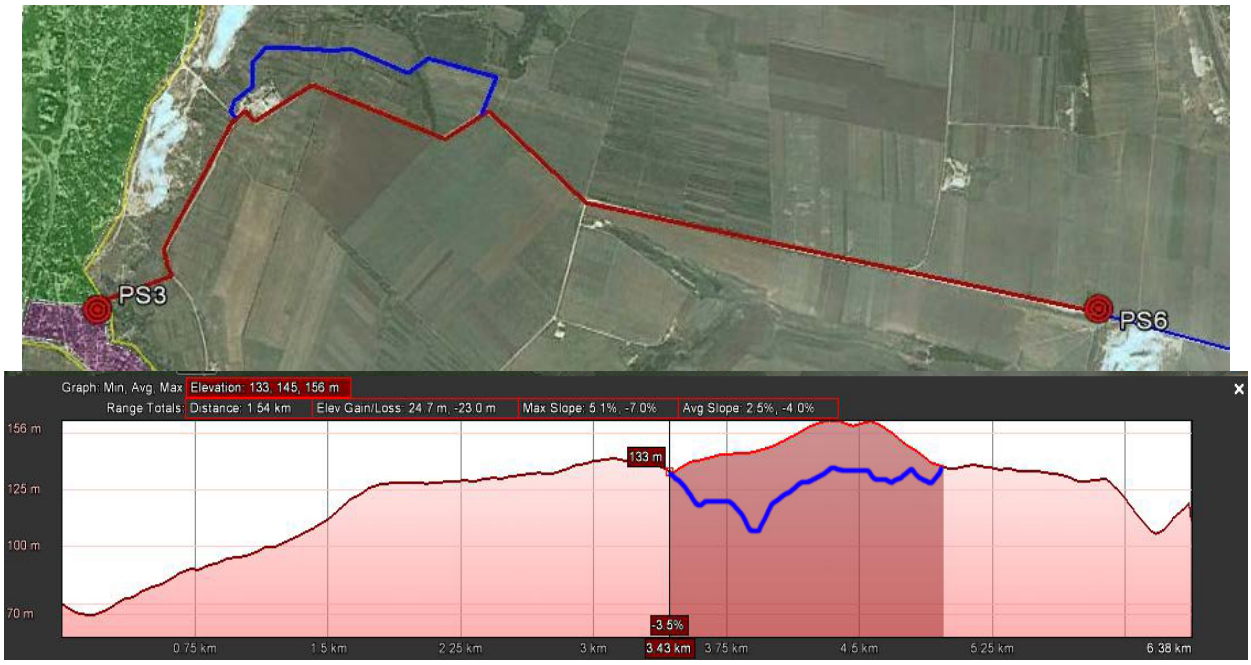
The main water source of Orhei water supply is Jeloboc Intake. From Jeloboc Intake at 37 m a.s.l., the abstracted water is pumped by two pumping stations (PS5 and PS6) into a 2,000 m^3 reservoir from PS3, at an elevation of 118 m a.s.l. However, the PS6 pressure main's highest point reaches 155 m a.s.l. and thereafter water is led to a considerably lower point at the PS3, thereby PS6 (located at 76 m a.s.l.) generates high energy costs for pumping.

A hill between PS6 and PS3 is planned to be by-passed, thereby reducing the highest network point from 155 m to 134 m a.s.l.

The scope of works includes:

- Design and build of a new segment of water main to reduce the pump head from the PS6;
- Design and renovate the existing PS6 (including all electromechanical equipment) to reduce the energy consumption and comply with reduced pipeline heads.

The proposed segment to be changed is shown in the Figure below.



LEGEND

- The proposed new pipeline segment to be built
- Existing pressure main

1.3 Site information

1.3.1 *Limits of the sites*

For the purpose of carrying out the Works the Contractor shall limit his installations and operations to the defined working areas described in this Specifications. The Contractor shall be responsible for complying with byelaws of related Prefectures, and obtain all necessary permits and licences.

1.3.2 *Access to sites*

The project sites are located within or close to the towns of:

- Site A – North-Western part of Balti,
- Site B – Central/Northern part of Causeni,
- Site C – Some 5 km East of Orhei.

1.3.3 *Seismic activity*

The current and official documents concerning seismic design parameters of Moldova are included in the Decree #25 dated 23 December 2009 of the Ministry of Construction and Regional Development "Approval of the Seismic Regions in the Republic of Moldova at scale 1:400,000".
The Seismic Regionalization Map shows that all Project sites are included in the “7-degree seismic zone” (degree of the building resistance - 2nd class).

1.3.4 *Temperature*

The temperature regime is temperate continental climate, characterised by hot summers and cold winters. Table 1.1 shows the average monthly temperatures for the project area sites.

Table 1.1-Montly average temperatures

City	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	**Year**
Căuşeni	-2.7	-1.6	3.5	11.2	17.5	20.6	23.1	23.0	17.8	11.3	3.6	-1.5	**10.5**

The minimum registered temperature during winter is -16°C.

1.3.5 *Rainfall*

Average monthly rainfall for the project area sites are indicated in Table 1.2.

Table 1.2-Montly average rainfall

City	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	**Year**
Căuşeni	34	35	29	37	50	70	66	44	44	26	37	38	**510**

2 DETAILED DESIGN REQUIREMENTS

2.1 General Conditions

Prior to initiation of construction works, the Contractor shall prepare the detailed design for all parts covered by the Contract. All design works shall be done in accordance with the **General Technical Specification.** The detailed design shall be based on the Energy Audit recommendations. All necessary adjustments and deviations are subject to Engineer's approval.

The Energy Audit Study and all relevant calculations/drawings will be made available to the Contractor.

2.2 Design standard requirements and loads

Standard requirements

- MNC C.02.02—2004:	Industrial buildings.
- MNC E-03-02—2001:	Fire safety of buildings and structures;
- SNIP 2.01.07-85:	Pressures and impacts.
- SNIP ||--7--81*:	Construction in seismic areas.
- MNC F.03.02 – 2005:	Designing buildings with stone walls.
- SNIP		-23-81*:	Steel work.
- SNIP 2.04.02-84:	External water supply networks and facilities.
- SNIP 3.05.05-84:	Technological equipment and technologic pipelines

Loads

- wind speed pressure:	0.3 KPa (30 kg/m2)
- snow load:	0.5 KPa (50 кg/m2)
- estimated minimum outside air temperature:	-16° C
- degree of fire resistance of buildings	II

It is a basic requirement of the Contract that all works, materials and articles should be performed, manufactured, tested and supplied in accordance with recognised and approved Moldavian national standards and laws.

In cases where Moldavian standards are recognized as in contrast or less stringent then the EN directives, the European standards and requirements shall be applied.

3 STRUCTURAL WORKS, PIPEWORKS AND ELECTRO-MECHANICAL SPECIFICATIONS

3.1 General

The materials, equipment, workmanship and installation of the Civil and Pipe works included in the Contract shall fully comply with requirements described in the **General Technical Specification.**

The Electromechanical Works shall comply with the following specific requirements included in the present **Particular Specification** according to the requirements described in the General Technical Specification.

The following specification specifies the design, supply, delivery, installation, testing, commissioning and proof of performance testing of:

- water supply pipe works for 3 Project sites;
- four new pumping stations (2 in Causeni, 1 in Balti and 1 in Orhei) with 4 groups of electromechanical centrifugal pumps to be built in the 3 project sites;
- valves and fittings in accordance with the approved Detailed Design.

The electromechanical equipment to be installed shall be in accordance with this Specification and the approved Detailed Design, and shall be suitable for its total function and affordability.

All the devices to be installed and electrical works to be performed should be verified by the Contractor taking into consideration the existing pipes. **The Contractor shall be responsible for the final efficiency of the system built.**

3.2 Structural Works - Water Pumping Stations civil works

All the structural works must be in accordance with the General Technical Specifications. The civil works to be implemented for construction of the new water pumping station buildings in Causeni and Balti, and the exact scope of works shall de defined and approved in the Detailed Design.
The major works are expected to be, but not limited to:

Structural works

- construction of the foundation for the new building;
- construction of the reinforcement concrete pillars and beams;
- construction of the external walls;
- construction of a unique reinforced concrete belt at the top of the walls of both existing and new building, to improve the seismic resistance of the building;
- construction of the new insulated roof.
- construction of foundations for new pumps to be installed.

Finishing works

- construction of the internal partition walls;
- first plaster layer and insulation of the walls by polystyrene plates;
- plastering and painting, internal and external walls;
- installation of the new doors and windows.

All new PS buildings shall be adequately supplied with necessary sanitary facilities.

3.3 EXTERNAL PIPE WORKS

3.3.1 *Pipeline*

The pipelines must be manufactured according to the General Technical Specification requirement. The tentative pipelines parameters are briefly described and quantified in the following tables 2.1 and 2.2:

Table 2.1: Water Supply Pipes

	Length (m)								
	Nominal Diameter (mm)								
	25	**32**	**40**	**50**	**90**	**160**	**200**	**225**	**355**
Site A: Balti									
HDPE, PE80, SDR 13.6 PN10						2,000			
Site B: Causeni									
HDPE, PE80, SDR 13.6 PN10								1,150	
Site C: Orhei									
HDPE, PE80, SDR 13.6 PN10								340	1,620

The pipe lengths of the pipelines shall be adjusted and approved during Detailed Design. Change of pipeline diameters during the detailed design is subject to the Engineer's approval.

Pipes shall be welded or coupled, according the following:

- pipe diameter >90 mm shall be coupled by butt welding according UNI 1052;
- pipe diameter <90 mm shall be combined with compression couplers.

All the fittings shall in HDPE if not otherwise specified elsewhere.

3.3.2 *Network Fittings*

The fittings must be manufactured according to the General Technical Specification requirement. The types and quantities of fittings shall be set in the approved Detailed Design.

3.3.3 *Network Pre-cast control chamber*

The control chambers should be in pre-cast concrete (concrete class: C32/40), with cast iron manhole covers. The precast concrete manhole should be manufactured in accordance to the harmonized European standard SR EN 1917 "Concrete manholes and inspections chambers, unreinforced, steel fibre and reinforced".

The bottom and the walls of the chambers, should be coated by a two component epoxy paint.

The steps should be made from galvanized steel.

The types and quantities of chambers shall be set in the approved Detailed Design.

3.3.4 *Network Valves*

The valves must be manufactured according to the General Technical Specification requirement. The types and quantities of fittings shall be set in the approved Detailed Design.

3.4 ELECTROMECHANICAL PUMPS

3.4.1 *General*

Detailed Survey

Before any ordering, works and installation the Contractor is obliged to perform the detailed design, including detailed survey, the scope of which shall be to verify the existing work condition and dimensions for the new electromechanical installation.

Nameplates

All wording on nameplates, labels and taps shall be in Romanian or Russian language.

Materials

All materials and equipment shall be new and shall be essentially standard products of manufacturers regularly engaged in the production of the type of equipment specified herein.

Operation and maintenance manuals

The Contractor shall submit Equipment manufacturers operating and maintenance manual digitally and in paper.
Three (3) complete sets of installation, operation, and maintenance instructions shall be provided for all equipment and electrical components. The manuals shall be prepared specifically for the installation to which they pertain and shall include all available installation manuals, operation manuals, maintenance manuals, catalogue, cuts, drawings, wiring diagrams, equipment and parts lists, list of spare parts provided, warranties, product descriptions, etc.

Shop drawings
The Contractor shall submit the set of the following prior to ordering equipment and materials or initiating construction:

- shop and erection drawings and data regarding pumps, motors, characteristics, and performance. The data shall include guaranteed performance curves, based on actual shop tests of duplicate pumping units, which show that the units meet the specified requirements for head, capacity, efficiency, and input power. For pumping units of the same size and type, only curves for a single unit need be provided.
- drawings describing the equipment and showing all important details of construction and dimensions so that prior to ordering equipment and materials or initiating construction the final assembly drawings of all parts to be ordered shall guarantee all assembly and disassemble works.

Technical documentation
The manufacturer shall supply up to a maximum of three (3) sets of Submittal Drawings and Technical documentation.
The Standard Submittal will consist of:

- Pump Curve
- Complete technical data showing materials of construction, moments of inertia, weight, type and length of cable.
- Complete motor data including input KW, full load amps, locked rotor amps, motor efficiency, power factory, and moment of inertia.
- Dimensional prints
- Control data (if supplied by pump manufacturer)
- Gate valves and detailed drawing.
- Details on accessories being supplied
- Installation Guides
- Technical Manuals
- Parts List
- Check Valves and non-return valves or one-way valves.

As-Built Drawings
The Record Drawings shall consist of the Contract Drawings revised per as-built conditions and the approved Shop Drawings. As-built revisions to the Contract Drawings shall be professionally drafted.

3.4.2 *Technical Specification*

Description

Site A: Balti.
The systems shall consist of booster set of of 2 (two) vertical multistage centrifugal pumps.

Fluid	potable water, 0°C to 40°C
Pressure class	PN 10
Flow	60 m3/h
Head	25 m
Efficiency in designed point	> 60% (motor + pump)

Speed	< 2910 rpm
Casing	Cast iron GG 25
Impeller	Stainless steel
Pump/motor coupling	Flexible spacer coupling
Motor nominal power	reserve 10% from pump power
Voltage	400 V
Frequency	50 Hz
Enclosure class	IP 55

All stationary cast iron parts shall be dip-painted and spray painted with water based, ether –epoxy no lead painting. Thickness of the dry coating shall be at least 35 μm. Pumps shall be mounted with ball or roller bearings adequately sized and properly grease lubricated for life and suitable for 25 000 hours of trouble free operation.

Spare parts

The following mandatory spare parts shall be supplied for the specified quantity of pumps:

- two sets of impellers
- two sets of neck rings
- two bearings
- two spacer couplings
- two sets of pump casing gaskets

Pump set shall be equipped with **frequency converter** to maintain the minimum required pressure in the system at various water demands during the day and night. The frequency converter shall comply with General Specifications.

Site B: Causeni BPS1 (Micro)

The systems shall consist of booster set of of 3 (three) vertical multistage centrifugal pumps.

Fluid	potable water, 0°C to 40°C
Pressure class	PN 10
Flow	36 m3/h
Head	20 m
Efficiency in designed point	> 60% (motor + pump)
Speed	< 2910 rpm
Casing	Stainless steel
Impeller	Stainless steel
Pump/motor coupling	Flexible spacer coupling
Motor nominal power	reserve 10% from pump power
Voltage	400 V
Frequency	50 Hz
Enclosure class	IP 55

All stationary cast iron parts shall be dip-painted and spray painted with water based, ether –epoxy no lead painting. Thickness of the dry coating shall be at least 35 μm. Pumps shall be mounted with ball or roller bearings adequately sized and properly grease lubricated for life and suitable for 25 000 hours of trouble free operation.

Spare parts

The following mandatory spare parts shall be supplied for the specified quantity of pumps:

- two sets of impellers
- two sets of neck rings
- two bearings
- two spacer couplings
- two sets of pump casing gaskets

Pump set shall be equipped with **frequency converter** to maintain the minimum required pressure in the system at various water demands during the day and night. The frequency converter shall comply with General Specifications.

Site B: Causeni BPS2 (Valul lui Traian)

The systems shall consist of booster set of 2 (two) vertical multistage centrifugal pumps.

Fluid	potable water, 0°C to 40°C
Pressure class	PN 10
Flow	7 m3/h
Head	26 m
Efficiency in designed point	> 60% (motor + pump)
Speed	< 2910 rpm
Casing	Stainless steel
Impeller	Stainless steel
Pump/motor coupling	Flexible spacer coupling
Motor nominal power	reserve 10% from pump power
Voltage	400 V
Frequency	50 Hz
Enclosure class	IP 55

All stationary cast iron parts shall be dip-painted and spray painted with water based, ether –epoxy no lead painting. Thickness of the dry coating shall be at least 35 μm. Pumps shall be mounted with ball or roller bearings adequately sized and properly grease lubricated for life and suitable for 25 000 hours of trouble free operation.

Spare parts

The following mandatory spare parts shall be supplied for the specified quantity of pumps:

- two sets of impellers
- two sets of neck rings
- two bearings
- two spacer couplings
- two sets of pump casing gaskets

Pump set shall be equipped with **frequency converter** to maintain the minimum required pressure in the system at various water demands during the day and night. The frequency converter shall comply with General Specifications.

Site C: Orhei PS6

The systems shall consist of 2 (two) horizontal single stage centrifugal pumps.

Fluid	potable water, 0°C to 40°C

Pressure class	PN 10
Flow	110 m3/h
Head	80 m
Efficiency in designed point	> 60% (motor + pump)
Speed	< 2910 rpm
Casing	Stainless steel
Impeller	Stainless steel
Pump/motor coupling	Flexible spacer coupling
Motor nominal power	reserve 10% from pump power
Voltage	400 V
Frequency	50 Hz
Enclosure class	IP 55

All stationary cast iron parts shall be dip-painted and spray painted with water based, ether –epoxy no lead painting. Thickness of the dry coating shall be at least 35 μm. Pumps shall be mounted with ball or roller bearings adequately sized and properly grease lubricated for life and suitable for 25 000 hours of trouble free operation.

Spare parts

The following mandatory spare parts shall be supplied for the specified quantity of pumps:

- two sets of impellers
- two sets of neck rings
- two bearings
- two spacer couplings
- two sets of pump casing gaskets

3.4.3 *Program Logic Control*

During normal operation all pumps shall be controlled automatically by the PLC system installed in the Switchboard.

It shall be possible to switch each pump (with on/off) individually between local mode (control from the Switchboard) and automatic mode (control from the PLC). The choice between local and automatic mode shall be carried out locally at the switchboard respectively at the frequency converter. The choice of mode for a pump shall be communicated to the PLC by a binary signal (the signal contact shall be closed when the pump is in automatic mode). Local is mode only to be used for testing purposes.

Each pump motor (both on/off controlled motors) shall be monitored by a binary signal, normally closed contact, to the PLC. The signal shall be activated by a hardware error in the motor.

If automatic mode has been chosen for a motor, and if the above-mentioned fault signal is not active, then the motor shall be automatically controlled from the PLC. Manual control of a motor from the operation panel is not required.

If one or more motors becomes unavailable for the automatic control, because of a fault or because of switching into local mode, then the automatic control shall continue to function in a suitable way for the other motors that remain available for automatic control.

The booster pumping stations pumps shall be able to operate in a fully automatic mode and in fully or partly manual mode.

It shall be possible to control the automatically controllable components (the components that can be controlled by a program, for example a pump or a sectioning valve at the three levels A, B and C:

The software in the PLCs that takes care of the process control and monitoring shall preferably be based on the IEC 1131-3 standard. Graphic programming should be possible.

The PLC programs shall to the largest possible extent be composed of standardised modules that can be individually tested and documented.

The variables that correspond to the standardised components (for example sectioning valves) shall be organised in standardised structures that correspond with the standardised program modules that carry out the functions for the individual components. These program modules shall be compatible with the corresponding functionalities of a future SCADA system (for example symbols for display and commands, alarm presentation, and data logging). The same applies to the data structures for the standardised control functions (for example analogue regulation).

3.5 INTERNAL PIPE WORKS

The Contractor shall design and include all necessary internal pipes, valves and fittings within the new PS. All proposed internal pipelines shall be in accordance with Specifications.

3.5.1 *PS Check Valve*

Resilient seated swing check valve with lever and weight shall comply with the following specifications:

- Body, bonnet and hinge of GGG-50
- Pressure rating PN 16
- Disc fully vulcanised with EPDM rubber.
- Flanges to BS EN 1092-2: 1997, face to face to BS 5153.
- Full bore. Disc and hinge assembled on a stainless steel shaft fitted in the bonnet.
- Bonnet gasket of EPDM in groove between body and bonnet.
- Epoxy coating to DIN 30677 - internally and externally.

3.5.2 *Gate Valve*

Resilient seated gate valve shall comply with following specifications:

- Body and bonnet of ductile iron GGG-50 to DIN 1693
- Flanges and drilling to ISO 7005-2, PN 16
- Short face to face to DIN 3202 part 1, F4.
- Wedge of ductile iron with fixed wedge nut, fully vulcanized with EPDM rubber
- Stem of stainless steel DIN X 20 cr 13
- Stem sealing consists of a EPDM rubber manchette, 4 O-rings in a nylon bearing and a wiper ring.
- Bonnet gasket EPDM rubber
- Indicator nut and housing of dezincification resistant brass
- Valve coating of electro-statically applied epoxy resin to DIN 30677 internally and externally

3.5.3 *Expansion Joints*

Each pump shall be equipped with two expansion joints on suction and pressure side respectively to axial, lateral and angular movements. Expansion joints shall be flanged and made of rubber or stainless steel for pressure class PN 16

3.5.4 *Internal Pipe works*

Under this item the Contractor shall evaluate and include in his tender all costs related to the manufacturing of equipment ready for installation, and welding pipes and pipe components for necessary pipe work for pumps installation in this particular pumping station. Tender Price shall include pipes, flanges, bolts, nuts, washers, gaskets, supports and whatever additional material necessary for proper installation of the above equipment and fittings on site.

3.5.5 *Flange Adaptors/Couplings*

Flange adapters should correspond to the range for pipe size and materials:

- The adapters and couplings should cover ranges of the outside diameters of the specified pipes,
- Epoxy coating DIN 30677 - internally and externally.

3.5.6 *Pressure Sensors and gauges (manometers)*

Pressure monitoring shall be suitable for the medium and specified pressure range by a transducer. Each transducer shall be ranged to provide adequate sensitivity over the working range and be capable of sustaining a 400% overpressure without damage. They shall be of rugged and waterproof design to IP 57 with a stainless steel enclosure having an isolation diaphragm, suitable for either free wire suspension in the medium or provided with an internal pipe connection.

Pressure gauges body shall be made of stainless steel and scale of each manometer to be installed on the pressure pipe shall correspond to measurement range closest to the maximum pumping head.

A transmitter shall be provided either integrally with the transducer or separately mounted as specified, suitable for operation from the mains or specified battery supply (not greater than 24V) and conversion of the signals received from the transducer to a 4-20 mA signal proportional to the specified range. The transmitter shall have provision for range and zero adjustment.

Technical data:

Type of sensor	ceramic
Measuring range:	pressure pipe: 0...10 bar suction pipe –1...1,5 bar
Ambient temperature for probe:	-30 ° C +50 ° C
Ambient temperature for converter	+5 ° C +50 ° C
Fluid temperature	0 ° C +50 ° C
Material of measuring cell:	SS 1.4571
Protection class:	IP 57
Accuracy:	0.5%
Power supply:	12/24 (≤24VDC) for probe
Output signal:	4-20 mA

Installation:

Pressure sensors and manometers shall be supplied and installed with socket, isolating valve and tee including test valve. Valves are to be ball type.

Installation set to be provided with each pressure sensor shall include all equipment for necessary power supply (220 V) and indicator of the measurement results. Indicator shall be installed in the Switchboard.

The sensor shall be supplied and installed as a rigid assembly comprising a stainless steel tube, a tube holder (both as used for control electrodes) and the transducer) with the cable passing through the tube. The transducer shall be a close fit located completely within the tube at the lower end. The assembly shall be fixed at not less than two places to the sump wall and installed with the bottom of the tube just clear of the sump invent.

For all installations the cable between the transducer and the controller/transmitter shall be a continuous length and kept as short as is reasonably possible. This cable shall be run in conduit and installed well clear of all AC mains and power cables.

All fixings. brackets, etc as required for the complete installation shall be provided.

3.5.7 *Ball valves DN15*

Ball valve DN 15 shall correspond to the following technical specifications:

- Body made from dezincification resistant brass CZ 132 or BS 2872
- Ball shall be full bore, chromed zinc stable brass
- Handle made of steel, covered with plastic
- Working pressure PN16
- Temperature 0...100°C
- Coupling – internal thread ½".

3.6 ELECTRICAL WORKS

All electrical works shall be in compliance with the General Specifications. The scope of supply for the electrical installations shall include detailed design of the communication system and PLC for monitoring, delivery of all needed equipment, materials and electrical installation works performance.

The Contractor shall evaluate the accessibility and reliability of power supply and if necessary design and build of a new **Transformer Station**.

The scope of supply is minimum and as follows:

- Detailed design of complete power supply and electrical system
- Design, manufacturing and delivery of Low Voltage Switchboard, including soft starters and frequency converters
- Selection and delivery of all necessary cables (power and instrumentation)
- Delivery of necessary measurement equipment and supervision of installations.
- Delivery of necessary tools for installation and spare parts
- Installation or installation supervision
- Testing
- Running in
- Training
- Preparation of operation and maintenance manuals

Within the contract sum, the Contractor shall design, supervise performance of installation works and deliver all supplies necessary for the complete finishing of the work in the pumping stations.

All notifications, approvals, tests, completion declarations, etc., and payments in this connection shall be included in the tender.