

II – Design – Build Requirements

Part 2 – Material and Equipment

General and Specific Requirements for Mechanical Works

TABLE OF CONTENT

2.4.	MATERIAL AND EQUIPMENT	5
2.4.1.	General.....	5
2.4.1.1.	Suitability of Design and Equipment	6
2.4.1.2.	Environmental Conditions of the Site	6
2.4.1.3.	Work Program for Mechanical Equipment and Machinery	7
2.4.1.4.	Coordination.....	7
2.4.1.5.	On-Site Manufacturing	8
2.4.1.6.	Storage of Materials and Equipment	8
2.4.1.7.	Installation Works	8
2.4.1.8.	Standards.....	8
2.4.1.9.	Mechanical Equipment & Manufacture	8
2.4.1.10.	Machinery Protectors and Labelling	9
2.4.1.11.	Lubrication.....	9
2.4.1.12.	Inspection and Acceptance Procedures	9
2.4.1.13.	Maintenance Works	11
2.4.2.	General Specifications for Mechanical Works.....	11
2.4.2.1.	Pipe Works	11
2.4.2.2.	Steel Pipe Works	13
2.4.2.3.	Supports.....	18
2.4.2.4.	Expansion Pieces (Expansion Loop).....	20
2.4.2.5.	Penetrations	20
2.4.2.6.	Noise reduction.....	20
2.4.2.7.	Thermal Insulation	20
2.4.2.8.	Steel Structures	21
2.4.2.9.	Protection Against Corrosion	22
2.4.2.10.	Welding.....	22
2.4.2.11.	Joints.....	28
2.4.2.12.	Bolts	29
2.4.2.13.	Conveyors.....	30
2.4.2.14.	Dismantling Joint.....	31
2.4.2.15.	Compensators.....	32
2.4.2.16.	Pumps	32
2.4.2.17.	Valves.....	40
2.4.2.18.	Check valves.....	44
2.4.2.19.	Penstocks	45
2.4.2.20.	Actuators	46
2.4.2.21.	Tanks (Pressure Vessels).....	51

2.4.2.22.	Heat Exchangers	51
2.4.2.23.	Fans	52
2.4.2.24.	Air Compressors	52
2.4.2.25.	Lifting Equipment	53
2.4.2.26.	Polymer Preparation and Feeding System	56
2.4.2.27.	Electromagnetic Flowmeter	58
2.4.2.28.	Fire Extinguishing Systems.....	61
2.4.3.	Specific Specifications of Mechanical Works	61
2.4.3.1.	Sludge Acceptance/Storage Unit.....	61
2.4.3.2.	Sludge Pre-drying Unit.....	61
2.4.3.3.	Condenser	62
2.4.3.4.	Fluidized Bed Incinerator (FBI) Unit with heat recovery system	63
2.4.3.5.	Energy Recovery Unit with Steam Turbine	66
2.4.3.6.	Flue Gas Emission Control Unit	69
2.4.3.7.	Odour Control Unit	79
2.4.3.8.	Ash Collection and Storage Unit.....	88

2.4. MATERIAL AND EQUIPMENT

2.4.1. General

The equipment and productions defined in general terms in this Specification shall be manufactured and/or installed with the appropriate method with the approval of the Employer's Representative.

The equipment shall be supplied from abroad and/or Employer's Country shall be submitted to the Employer's Representative in advance, for approval. All materials and equipment supplied within the scope of design-build works shall be of first-class quality and shall comply with Turkish Standards (TSE) and/or international standards (ISO and/or equivalent certifications). The Contractor shall submit the relevant certificates and technical documentation to the Employer's Representative for approval before supplying.

If the Contractor proposes any equipment is not specified in this section in their technical bid, the Contractor shall demonstrate the documentation and specifications that the equipment proposed for this project is equal to or better than the quality requirements specified in this section.

The Contractor shall keep the quality of work and manufacturing from the beginning to the end of the works. Materials such as molds, mold locks, etc., which are worn over time, shall be replaced with new ones without any Employer's Representative's request or warning. Low-quality manufacturing shall be dismantled by the Employer's Representative and no additional cost shall be paid to the Contractor for this reason.

The Contractor is obliged to take all kinds of safety, communication, traffic, and other measures for the safety of the personnel (including employees and the environment) during the design-build works and operation periods.

The Contractor shall obtain approval from the Employer's Representative for each stage of design-build works.

If any technical issues such as deficiencies, design-build works and other works that require technical necessity are not specified in the Employer's Requirements section, they shall be carried out in accordance with the methodology to be approved by the Employer's Representative. In case of any discrepancy between technical specifications and the Contractor's designs, the Contractor shall take the Employer's Representative's consideration on these issues.

The contractor has to carry out the installation/manufacturing in accordance with the assembly and disassembly instructions of the manufacturer regarding the materials and equipment to be used. The Contractor shall be strictly adhered to the manufacturers' recommendations concerning installation.

A sufficient number of staff and equipment shall be used during the works in order to carry out the mechanical works specified in this section.

The Contractor shall organize the laboratory and its facilities or submit an accredited laboratory for approval by the Employer's Representative to execute the analyses/tests of the materials of the mechanical works in accordance with the relevant Regulations. All expenses related to tests and analyses shall be covered by the Contractor. Laboratories shall have the capacity to take samples and conduct analyses in the time and number defined by the Employer's Representative.

Even if the Employer's Representative has approved, it is the Contractor's responsibility to change and remediate the parts that is not be manufactured in accordance with the designs. Employer's

Representative's approval shall not be a reason not to remediate the malfunctions and deficiencies of the mechanical works.

All piping, valves and components shall be resistant to maximum pressure (including shock pressure) during the commissioning and operation periods.

During the installation of the distribution, suction, and pneumatic pipe networks, a flange adapter should be used for easy disassembly and flexible joints should be used between the structures and pipes.

The pipes that shall be installed through the walls, the Contractor shall use a welded sealing ring (Collar Pipe) approved by the Employer's Representative to ensure the tightness of the wall penetrations. The sealing ring to be used shall be supplied from the pipe manufacturer in accordance with the pressure class of the pipe.

Flanged disassembles and fittings shall be provided and fitted to pipes to allow flanges, valves and equipment to be easily removed without the need to remove long pipe segments.

The Contractor shall be responsible for ensuring that the inner and outer surfaces of all pipes are completely clean during the pre-installation, installation, and before the operation. Cleaning also includes removing all dirt, rust, grout, flaking and slag from welds made on-site.

All small inner diameter pipes shall be cleaned by pressing compressed air before being connected to instruments and other equipment.

2.4.1.1. Suitability of Design and Equipment

During the selection and/or design and/or installation of equipment, the following special attention shall be taken:

- Operational safety and easy maintenance
- Recognized and reliable components
- Ability to withstand the operation conditions
- Uncontaminated from pesticides, dust, and moisture
- Measures to keep corrosion at the minimum level
- Availability of spare parts in Employer's Country
- Availability of the maintenance service in the Employer's Country
- To keep the noise at the minimum level

2.4.1.2. Environmental Conditions of the Site

All equipment shall have suitable values for the ambient temperatures, relative humidity and altitude of the construction site in Antalya.

All kinds of materials and equipment required for work shall be transported to the construction site and protected from adverse weather and environmental conditions.

During the design period, the Contractor shall take into account the conditions that can be encountered for each mechanical work during its operation. The equipment to be installed in the open area shall be designed to be protected from direct sunlight.

Equipment that shall be in contact with the sludge, waste heat, high-temperature area, etc. should be effectively protected against any kind of corrosive effects, moisture, and water.

There shall be drainage holes at the bottom of the location of the equipment where there is a risk of condensation.

In addition, the design of the equipment shall be executed to prevent the entering of insects and small reptiles.

2.4.1.3. Work Program for Mechanical Equipment and Machinery

The work program of the supply and the installation of the equipment shall be executed according to below-mentioned steps:

Manufacturing Step:

The design and manufacture of all equipment to be supplied under the Contract are subject to manufacturer tests and inspection.

Transportation Step:

The transportation of equipment from the manufacturer's facility to the Contractor's warehouse/storage area at the construction site shall cover the expenses, such as all transportation, loading, handling, and customs charges.

Installation Step:

It covers the transportation of materials and equipment from the warehouse/storage area to the implementation site and the execution of installation works.

Pre-Commissioning Test Step:

Functional tests shall be applied for all mechanical equipment and machinery under the supervision of Employer's Representative during the pre-commissioning as defined in the Employer's Requirements V – Commissioning and Testing.

Commissioning Test and Tests on Completion Steps:

All installed mechanical equipment and machinery shall be adjusted and tested in accordance with the operating conditions and steady-state conditions as defined in Employer's Requirements V – Commissioning and Testing.

During the Commissioning Period, the Contractor shall prepare/revise the operational and maintenance manuals of the equipment in accordance with the manufacturer's instructions and the results of the pre-commissioning tests.

2.4.1.4. Coordination

The Contractor has responsible to ensure the supply of the equipment in accordance with the Building/Electrical Works specifications.

The Contractor shall also be responsible for all subcontractors and suppliers of equipment and materials.

2.4.1.5. On-Site Manufacturing

The Contractor is responsible of supplying of equipment that needs to be manufactured at the construction site. The installation area can be used as an intermediate warehouse for equipment provided that the contractor assumes all own risk.

In addition, the Contractor is obliged to take the necessary security measures for the site.

2.4.1.6. Storage of Materials and Equipment

The Contractor shall inform the Employer's Representative about the delivery and expected arrival dates of the machines and equipment.

All equipment shall be stored in accordance with the conditions specified by the manufacturer. In the event that equipment and/or machinery is required to be stored at the installation site, the Contractor shall implement one of the following:

- Proper packaging of equipment and materials that need to be stored in open areas to prevent deterioration,
- or
- Providing an approved warehouse that meets the following minimum requirements:
 - For electro-mechanical equipment:
 - A covered, ventilated and protected from entering of the insects and small reptiles.
 - For pipes, valves, steel materials, etc.:
 - Covered with the resist material on proper ground.

2.4.1.7. Installation Works

The Contractor shall take the necessary measures for the handling of the equipment and materials provided and shall be responsible for any damages. The Contractor shall provide all instruments, measuring instruments, meters, temporary requirements, necessary labor to execute the mechanical and electrical works and install them in working condition.

During the installation of mechanical equipment in accordance with the Employer's Requirements, an authorized representative from the manufacturer and service company shall approve the installation and sign the related documents together with the Contractor. The signed copy of the installation conformity certificate shall be submitted to the Employer's Representative.

2.4.1.8. Standards

The standards to be applied within the scope of the Employer's Requirements are defined in this section and Article 1.4 of Part 1 – General Information of the Employer's Requirements.

2.4.1.9. Mechanical Equipment & Manufacture

The Contractor shall give the guarantees for all mechanical equipment, against faulty or improper design, installation, materials and workmanship, as well as leaks, cracks or other failures. The materials shall be suitable for the operating conditions.

All equipment shall be designed, manufactured, and installed in accordance with accepted and approved methodology applied in previous experiences and workshop practices for a long life and

minimum maintenance. Individual parts shall be manufactured in standard sizes for easy installation of the spare parts.

It is the Contractor's responsibility to ensure the compatibility of the system components in terms of dimensions, capacities and operating conditions, and efficiency.

2.4.1.10. Machinery Protectors and Labelling

Machinery shall have enclosures to prevent injury to persons and shall comply with international and local safety regulations.

Suitable enclosures shall be provided and installed throughout the installation to cover all drive mechanisms. All rotating and reciprocating parts, driver belts, etc., shall be covered in such a way as the Employer's Representative deems appropriate and to ensure the complete safety of both maintenance and operation personnel. However, they shall also be detachable in order to access the equipment, while all such enclosures are suitable and durable.

The Contractor shall issue, procure and install warning labels for all machines operated under automatic control.

All introductory information and warning labels shall be in English and Turkish.

The enclosures of the machines shall be made of stainless steel wire mesh or other corrosion-resistant material. The housing of the parts that need to be inspected shall be secured in place by bolts and studs in guided holes. Self-groove screws shall not be used.

Machinery, equipment, valves and pipes shall be mounted in such a way that labels with P&I codes written on them are made of materials suitable for environmental conditions and corrosion.

2.4.1.11. Lubrication

Equipment shall be lubricated by appropriate lubrication systems that require maintenance no more often than once a week during continuous operation. Lubrication systems shall not require operation during the start-up or shutdown of the system and shall not waste oil.

Lubrication installations shall be convenient and accessible. Oil drains and filler holes shall be easily accessible from the normal work area or platform. The oil drains should be positioned in such a way that the waste oils can be discharged into the containers without moving the equipment from its normal position.

The lubricants recommended by the equipment manufacturers shall be supplied in quantities sufficient to cover the consumption for the filling of all lubrication chambers and for testing, commissioning and operation of the equipment prior to acceptance by the Employer's Representative.

Beyond that, a list of recommended oils and their equivalents shall be included in the instructions for use and protection. The proposed oils shall be available in Türkiye. Lubricants sufficient to operate the facility during the entire operation period shall be provided. Amounts shall be determined based on working 24 hours a day.

2.4.1.12. Inspection and Acceptance Procedures

Commissioning of the equipment shall be made after the equipment has been installed properly at site and delivered in working condition. Commissioning procedures shall be executed as defined in Commissioning and Testing Part of the Employer's Requirements.

The Contractor shall assemble all equipment and equipment and deliver them to the Employer's Representative in working condition. After the installation, the certificate of conformity for the installation prepared and approved by the manufacturer's authorized service shall be submitted to the Employer's Representative. No additional amount of material fee shall be paid for the installation.

If the Employer's Representative wishes, it may inspect the production site, request and supervise testing according to the production standards mentioned in the document, and the Contractor cannot make any objection in this regard.

The contractor shall provide all facilities to the Employer's Representative for inspection and testing during the manufacture and installation of mechanical equipment and works. In addition, the Contractor shall fulfill all obligations and necessary conditions related to the manufacture, installation, assembly and domestic and/or international inspections and tests of its mechanical facility and equipment before, during and after the end of the assembly, and all costs shall be borne by the Contractor. Special attention shall be paid to the systematic installation in an orderly and adequate manner.

Provided that the manufacturer is in the factory where the production is made, it shall notify the Employer's Representative before starting the acceptance tests, and it shall be ensured that they are carried out under the supervision of the Acceptance Commission which will be composed by the Employer's Representative. However, if necessary, the Acceptance Commission may have the inspections carried out through an international independent audit institution or under the supervision of the Employer's Representative, and all costs of these inspections shall be borne by the Contractor.

In the event that the factory test stand is not deemed sufficient by the commission, the tests shall be carried out in another accredited Institution that the commission deems appropriate, provided that the costs of the factory acceptance tests are covered by the Contractor.

Factory tests shall be carried out by the test control committee formed by the Employer's Representative, and all expenses related to these tests (including on-site tests for equipment produced abroad) such as transportation, accommodation, communication, etc. shall be covered by the Contractor.

All pipes shall be pressure tested and cleaned before being transferred to the Employer. The water tightness of all structures shall be tested with clean water for a minimum of 24 hours as specified. The contractor is responsible for carrying out all kinds of cleaning arising from the activities during the construction. Mechanical equipment installation works shall not be started until the construction works are completed. The outer surfaces of the mechanical equipment shall be kept covered in order not to be affected by all kinds of construction activities (mortar, plaster, dust, etc.), and the original packaging shall not be opened. In case of damage to the electro-mechanical equipment due to construction activities, all responsibility shall belong to the Contractor, and the Contractor is obliged to provide the new equipment in good condition if necessary. After the cleaning and maintenance of all internal pipelines, sludge, water, heat lines within the WTE facility, the Commissioning Certificate shall be approved by the Employer's Representative.

The Contractor shall also ensure that all mechanical and electrical installations have been inspected and tested, are ready for use and in working order, and can be effectively maintained. All identification signs on electromechanical equipment shall be firmly fixed in place. As defined in the Employer's Requirements, during the commissioning period, an "Installation Conformity

Certificate" issued by the manufacturer or Authorized Service of all electro-mechanical equipment is shall be submitted to the Employer's Representative.

During installation of the electro-mechanical equipment such as pumps, instruments, conveyors, heat exchangers, actuators, nozzles, generators, filters, penstocks etc., the authorized service of each equipment or the manufacturer company itself is required to provide supervision services and prepare the conformity report at the end of the assembly and submit it to the Employer's Representative. The warranty documents of the equipment shall be submitted to the Employer's Representative.

2.4.1.13. Maintenance Works

The Contractor shall carry out the installation and commissioning of the Hurma WTE Facility, including all relevant equipment, within the design-build period.

The Contractor shall be responsible for all defects observed in materials and workmanship during the commissioning period and for the elimination of these defects. It shall keep all kinds of spare parts of the equipment available at the facility in a way that shall not allow the operation activities to be disrupted under any circumstances (the warranty process of the equipment shall start from the pre commissioning period of the facility).

2.4.2. General Specifications for Mechanical Works

2.4.2.1. Pipe Works

The Contractor shall be responsible for the design, supply, quality control and installation of all piping and fittings, associated supports and accessories of the Hurma WTE Facility. These items shall comply with a standard issued upon written approval of the Employer Representative or the strictest requirements of the current version of the Pressure Equipment Directive EN 13480 Metallic Industrial Pipes.

The piping design shall be subject to a HAZID/HAZOP study. This study shall require input from the system designer of the Contractor.

The Contractor shall plan these studies and include any recommended changes if they are compatible with the system design.

If requested by the Employer's Representative, detailed piping design calculations for each pipeline shall be provided by the Contractor. The Contractor shall submit, without limitation, the identification numbers, materials of construction, nominal internal diameter, thickness, class, fluid, process conditions, design standard, test and approval certificate requirements for each pipeline. It shall also provide a piping list containing all other information that shall prove that the equipment is suitable for its intended use.

Each pipeline shall be designed, wherever possible, to maximize energy efficiency and to minimize the effects of abrasion, corrosion, noise, vibration and pressure drop under transient conditions such as surges, compressible flow, reverse flow and thermal expansion under maximum operating conditions. All water pipes shall have a minimum corrosion allowance of 3 mm in addition to the calculated wall thickness. No covers <25 mm NB shall be accepted unless otherwise agreed in writing by the Employer/Employer's Representative.

All pipes shall be seamless according to approved standards. All fittings and elements shall be arranged to allow maintenance and replacement of permanent access roads and platforms. Each pipe section shall be cleaned by air or water after installation and dirt and waste shall be removed.

Any piping or service line that shall carry biogas/natural gas shall be completely dried with dehumidifying equipment, if necessary, before being put into operation. Each pipe section shall be the maximum length applicable on-site manufacturing to minimize the number of joints. Flanged joints in accordance with DIN standards shall be used throughout the entire facility.

All piping shall be equipped with double shut-off valves placed at appropriate points and in appropriate numbers for ventilation, drainage, regular maintenance or cleaning. Double shut-off valves shall be equipped with discharge points between them. Where necessary, these double shut-off valves shall be remotely operated. This practice should be given more attention in hot water lines. All piping shall be equipped with valves and drains at the lowest and highest points, respectively.

When the piping feeds a tank or is fed from such a tank, there is no need for vents. In all cases, valves shall be used in drain lines. Plugged drain points shall not be accepted. Pipes carrying similar fluids shall be grouped and directed to appropriate drain points, drain tanks or similar discharge points. The Contractor shall propose requirements for valve and drain management, particularly those relating to pressure, temperature, discharge vessels, valve points, valve collection points, recovery vessels, funnel overflow pipes, etc. All valves and drains shall be safely directed to the vent point or suitably designed expansion chamber as seen in the operation.

Thermostatic steam traps shall be located at the lowest point in the steam pipework and at the condensate drain. Steam traps shall be installed at a distance not more than 50 m. An automatic standard condensate drain shall be provided. All condensates shall be directed to a collection container. The Contractor shall provide a detailed program of cleaning procedures for each pipeline. The Employer's Representative reserves the right to make changes to these procedures as deemed necessary to obtain satisfactory results.

Reinforced (set-on) connections should be widely used for piping connections. In systems where steam is transmitted, the use of branded branch connections such as weld ends, threaded places and sockets is not allowed. Branch connections in such systems shall be formed by giving a profile to the branch pipe dimensions and preparing the necessary weld. In systems transmitting steam (including steam drain lines), the use of socket welds is not allowed at any temperature and pressure value. Socket welds may be used to a limited extent in pipelines with a nominal inner diameter of 50 mm or less. Compression fittings for pipelines shall not be allowed.

A. Protection of piping connected to the turbine generator against induced currents

All piping in the vicinity of heavy current connections shall be positioned and/or insulated in such a way as to minimize the induction of currents in the piping. This generally includes all piping in any partitioned or insulated area near busbar connections and generator end connections.

Where piping exists in a partitioned area, it shall be sectioned, and the two sections shall be isolated from each other. In addition, if there is a piping loop within the area, these shall also be sectioned and insulated to prevent current from circulating in any of the pipes.

Piping shall be earthed at only one point within the partitioned area (preferably where it connects to the machine enclosure).

Piping outside the partitioned area shall be properly connected and earthed. If any section of piping cannot be separated for any reason, then all sections shall be earthed.

It should be borne in mind that insulated joints shall be visible along the insulation when they need to be cleaned periodically. Depending on where they are located, it may be necessary to place warnings to prevent short-circuiting of insulated joints (using ladders or other means).

B. Temperature and flow measurement and sampling points

Where necessary, pockets serving permanent remote-controlled instruments shall be provided.

Sampling points shall preferably be fitted to the side or top of the pipework, not at the bottom, for the attachment of the apparatus and shall be easily accessible.

Sampling equipment shall include a fixed cooler where necessary to reduce the sample temperature to 25°C or below.

C. Threaded and flexible joints

Threaded pipework shall not be used for liquid fuel lines or steam applications.

Where the fluid conditions, temperature and pressure limitations are in accordance with the design regulations, threaded pipework under 50 mm (2 fingers) nominal diameter may be joined with threaded (BS tapered) couplings provided that movable joints are not used.

The Contractor shall, where appropriate, provide flexible joints on all pipework.

D. Corrosion protection

All piping carrying corrosive fluids shall be suitably protected against corrosion. Protective coatings to be applied after pressure testing shall surround the face of all flanges and cover all termination and branch pipes.

Piping to be coated shall be prepared in accordance with the coating material manufacturer's instructions.

2.4.2.2. Steel Pipe Works

All pipes and fittings covered by this Project must be of first quality, circular and uniform thickness, free from flaking, stratification or other defects, and must be designed to comply with operating pressures and temperatures.

Steel pipes with a nominal diameter less than or equal to 200 mm shall be of the hot-drawn seamless steel pipe type according to DIN 2448/DIN 1629 (or internationally acceptable standards) and all pipe installations shall be made in the form of pipe laying in accordance with this requirement.

Pipes larger than 200 mm and up to 350 mm nominal diameter shall be ERW, larger diameter pipes shall use spiral welded steel pipe.

Pipework shall be carried out in such a way as to facilitate the removal and removal of important parts of pumps or equipment, e.g. by installing dismantling joints where appropriate.

The inlet and discharge piping of all pumps shall have a disassembly connection for easy removal.

All piping shall be fixed with appropriate support.

In addition, all stainless-steel parts shall have the original manufacturer's document number, which verifies the quality class, origin and date of manufacture. All pipes shall comply with the TS EN 10217-7 standard and there shall be a test certificate in accordance with the TS EN 10204 standard. The certifications shall be part of the Quality Assurance (QA) documents.

All pipes inside the building shall have permanent markings indicating standards and material identification numbers.

Pipe ends shall be insulated with PVC caps during transportation.

Welded steel pipes shall have at least the following wall thicknesses:

DIAMETER	Sum	Dimensions	Wall Thickness
25	33,70	x	2,60
32	42,40	x	2,60
40	48,30	x	2,60
50	60,30	x	2,90
65	76,10	x	2,90
80	88,90	x	3,20
100	114,30	x	3,60
150	168,30	x	4,00
200	219,10	x	6,30
250	273,00	x	5,00
300	323,90	x	5,60
400	406,40	x	6,30
500	508,00	x	6,30
600	609,60	x	7,100
700	711,20	x	7,10
800	912,80	x	8,00
900	914,40	x	10,00

A. Hot Dip Galvanized Coated Steel Pipes

Manufacturers of hot-dip galvanized pipes shall have TS EN 10255 + A1 certificate.

As a production series, it shall be in the TS EN 10255 heavy and medium series class.

Fittings shall be produced as patents and all shall be hot-dip galvanized.

Hot-dip galvanized pipes and patent fittings shall be produced with a socket weld.

Hot-dip galvanized air pipes shall be manufactured as flanged black pipes and then galvanized together with their flanges and no cutting, bending or welding shall be carried out during assembly on site.

These tests shall provide the values specified in the relevant TS, TS EN, DIN norms.

The manufacturer's values specified in these standards shall be tested. The pipes randomly selected by the Employer's Representative from the pipes to be taken from the products ready for shipment shall be tested.

Visual and Dimensional Control:

1. Average Coating Thickness
2. Local Coating Thickness
3. Coating Thickness Measurement
4. Visual Inspection

Mechanical Tests:

1. Peel test
2. Bending Test
3. Flattening Test

Chemical Analysis:

1. Spectral Analysis

Installation:

The installation of the supplied products shall be done by the method recommended by the manufacturer. The method proposed by the manufacturer shall be implemented after the approval of the Employer's Representative. Tightness must be ensured in the pressure tests to be performed after the implementation. If the sealing is not achieved, the pipes shall be removed and reassembled. The valves and suction cups to be placed on the pipes in question shall not be made by welding but shall be made with hot-dip-coated fittings.

B. Stainless Steel Pipes

Stainless steel used anywhere in the Waste to Energy Facility shall be of at least TS EN 10088-1 standard AISI 304 class, unless otherwise stated. The requirements in the special mechanical technical specifications shall be applied for each unit.

Piping installations for water and air environments shall consist of pipes of stainless steel unless otherwise specified. The material shall comply with the conditions set out in this section for stainless steel.

Pipes shall comply with TS EN 10217-7 standard. Pumping outlines and pressure pipes shall be of at least PN 10 quality class.

The materials shall be new and unused, and shall not be repaired for any reason.

Material certificates are required for all stainless steels to be used in the enterprise. Certificates shall comply with EN 10204-3.1 standard. The certifications shall form part of the Quality Assurance (QA) documents.

Stainless steel pipes, welded and longitudinally welded, and industrial type shall comply with TS EN 10217-7 internationally acceptable standards and all installations shall be made in accordance with this requirement.

Pipes shall comply with TS 6814 EN ISO 1127 or ASTM-A312 Welded and Seamless Stainless Steel Pipe Dimensions and Tolerances.

All pipes must have passed non-destructive testing with the Eddy Current test and a 50 bar hydrostatic tightness test. Companies shall provide certificates of hydraulic testing with delivery.

Pipe tolerances are at least according to EN ISO 1127 or ASTM-A312;

Wall thickness: (-/+) 12.5% - 10%

Outer Diameter: (-/+) 0.5 – 1.50%

Weight: $\pm 10\%$

Length: $\pm 50\text{mm}$

Curvature: It shall be 1 mm/m.

Marking shall be made according to TS EN 10255 + A1. Brand, pipe diameter, wall thickness and material quality information shall be on the pipe with laser printing.

The minimum wall thickness of stainless steel pipes according to the diameters shall comply with the SCH10 norm. Stainless Steel Fittings (Elbow, TE, Reducer, cap etc.) shall comply with the following items.

- Fittings shall be made of AISI 304 quality stainless steel material, the socket weld shall be opened.
- Elbows are longitudinally welded and transversely welded; segmented workshop production elbows shall not be accepted.
- Reducers shall comply with DIN 2616 and ASTM A403 standards. The type of reduction shall be Concentric. Marking shall be made according to TS EN 10255 + A1. Reduction properties and tolerances shall be in accordance with production standards. Piecemeal workshop manufacturing shall not be accepted.
- Fitting wall thicknesses shall be in accordance with the SCH 10 norm.
- The inner and outer surfaces of the fittings shall be clean and smooth, and there shall be no defects such as burrs, scale, layers, cracks, rust, tingling, etc.

The welded areas shall be cleaned with stainless steel welding cleaning liquid after burr and slag cleaning.

The minimum wall thickness of stainless steel pipes according to the diameters shall be used in SCH10 and above norm in process wastewater, sludge lines, process lines, air lines, and polyelectrolyte lines.

C. Flanges

All flanges shall be minimum PN 10 class and shall be drilled in accordance with DIN 2501 standard. If the working pressure requires PN25 components, weld neck flanges in accordance with the DIN 2634 standard shall be installed.

D. Pipe Elbows

The elbows shall have the same material class and at least the same wall thickness as the pipes being joined. The application shall be carried out in accordance with DIN 2605. The radius shall be $1.5 \times D$.

E. Disassembling the Parts

Each pipeline shall have a sufficient number of dismantling parts. The dismantling parts shall be made of the same material as the pipe material and shall be capable of axial adjustment of at least ± 25 mm to allow easy removal of pumps, valves, non-return valves, measuring equipment, etc. Grooved rods and nuts passing through the opposing flanges shall secure the removal part to the position determined during installation, so that the system ensures a secure connection of the two adjacent pipes.

F. Conical Parts (Tapers)

The conical parts shall be made of stainless steel. In general, all conical parts shall be of concentric type, similar to the DIN 2616 standard, unless otherwise specified in the projects.

However, the suction inlet conical heads of the pumps shall be of the eccentric type. The installation of the conical head shall be carried out with the flat side on top in dry-type pumps. The length of the conical head shall not be less than $0.5 \times D$ ($D+d$).

G. Secondary Pipes

Where possible, fittings in accordance with the DIN 2618 standard shall be used.

H. Measuring Instruments

Where it is necessary to install measuring instruments from the point of view of Project Management or operation, the necessary union or flange connections shall be provided on the pipelines.

I. Pipe Clamps

All pipe clamps shall be suitable for the material in which they are used and of the material type. Pipe clamps shall consist of snap-through and fixed clamps. The design and installation of the sliding supports shall be carried out in such a way as to guarantee that the pipe can be properly adjusted even if it moves longitudinally. No stress shall be transferred to the supports other than the weight caused by the pipe and the environment inside. The design of the fixed supports shall be carried out in such a way that all forces and moments arising from the operating conditions are safely transferred to the building structure. Necessary supports, brackets, etc. shall be connected to the pipes with reinforced welds.

The design of the supports in terms of axial movement and static and dynamic forces such as water hammer etc. shall be carried out on the basis of the operating and ambient temperatures to which the pipe system in question shall be exposed.

All support and pipe components that shall not be accessible after installation shall be satisfactorily protected against corrosion prior to installation.

J. Assembling Pipes

Pipelines shall be mounted on the level (horizontally), vertically and properly aligned, in accordance with the required slope. For all pipes connected to machines and equipment, the utmost care shall be

taken to ensure that they do not transfer forces and moments to the equipment. Under no circumstances shall the forces and moments arising due to improper adjustment of the piping be transferred to the wall ducts.

K. Pressure Tests of Pipes

The contractor shall conduct pressure tests for all pipes according to the following instructions.

The Contractor shall apply to the Employer's Representative without delay and provide all the necessary equipment for the pressure test and carry out their installation.

In the event that pressure tests are carried out against closed valves, the valve manufacturer's instructions regarding the unilateral maximum pressure that can be applied against the closed valve shall be followed.

Hydraulic pressure tests shall be carried out using potable water.

During pressure tests, 1.5 times the maximum permissible operating pressure is applied and this pressure is maintained throughout the test.

The contractor shall verify on-site that the piping has been completely vented prior to the pressure test.

After the successful and approved pressure test, the piping shall be drained and the test fluid shall be discharged.

In the event that a visual inspection of all welded joints for leaks is not possible, the pipeline shall be tested in accordance with the following rules:

- Pipes are tested with a pressure of 1.5 times the maximum permissible operating pressure.
- It is not allowed to add water during the period of pressure retention,
- All visible attachments, flange inserts and valves shall be inspected.
- After the completion of the air lines and the commissioning of the air fans, foam tests shall be carried out for leakage controls at the welding points of the galvanized steel pipes on the aeration pool.

The acceptance criteria require that there be no detectable leaks.

Upon termination of the pressure tests, the Contractor shall prepare a report and submit a copy to the Employer's Representative. The report shall, at a minimum, include:

- Pressure test procedure,
- Test procedure specification,
- Duration of pressure tests,
- Results and signature of acceptance,
- A description of typical test results, their causes, and corrective actions.

2.4.2.3. Supports

The Contractor shall design all necessary supports and hangers to ensure the complete and proper fabrication of all pipes, accessories and valves. Pipelines shall be supported and their movements

shall be controlled in a manner that shall meet planned and unplanned operating modes. Situations such as load shedding and valve closure due to failure shall be taken into consideration, and special attention shall be paid to dynamic effects resulting from risky operating conditions.

All supports shall be designed in accordance with the EN 13480 Design Regulation if they are suitable for the manufacturing conditions of the pipe to which they are attached. The distance between pipe supports shall be determined to be able to accommodate the acceptable continuous stress and to minimize deflection to prevent drainage accumulation.

Pipes shall be fixed using suitable attachments to prevent damage to pipe supports due to thermal expansion or other expected movements during normal operation of the system.

Spring and fixed hangers shall be selected to accommodate a maximum load change of 25% from cold to hot. All fixed and variable force hangers shall comply with the following:

- Hangers shall provide both the necessary shortening or extension to meet the thermal expansion of the piping system and shall also cover excessive shortening and extension.
- A load adjustment mechanism shall be provided on hangers to ensure that at least $\pm 20\%$ adjustment can be made when needed during load balancing operations in the field.
- The design of fixed-load hangers shall be such that maximum load deviations shall be $\pm 5\%$ of the specified load.
- The springs inside the hangers shall be plastic-coated and thus shall be resistant to corrosion.
- The construction parts of the hanger set located inside the building shall be painted in a standard manner. However, all metallic construction parts remaining outside, except the springs, shall be galvanized.
- A nameplate shall be attached to each side of the support in the hangers, containing at least the following information:
 - Support reference load in kN
 - Hanger type and size
 - Full extension in terms of cold and hot angle positions
- Design extension in millimeters (mm), the hanger movement scale shall be clearly marked with the cold and hot positions. Hangers may be placed at remote points where the movement scale shall be read from a distance. For this reason, the movement scale must be visible from a distance. It shall be clear enough to allow this and must be selected and sized appropriately.

The hanger shall be readable from both sides, or a direct reading scale shall be fitted on each side (if possible). All brackets, frames, tensioners, fixed or rotating supports and hangers required to secure and support the pipes, valves and fittings shall be provided in a fixed and complete manner. Piping, fixing or fittings shall not be supported or suspended from sections of main structural steel unless expressly designed for this purpose. Supports for piping and associated equipment shall be designed to minimize the stress, heat and vibrations transmitted to the connected equipment to the extent permitted by the manufacturer's recommendations or the relevant standard. The Contractor shall provide a suitable number of contraction and expansion members to minimize stresses at fixed points, and these members shall be considered as loops, expansion joints or elbows if necessary.

Piping shall not be supported by any other piping system. In the manufacture of pipe support joints directly connected to high-temperature ($>380\text{ }^{\circ}\text{C}$) piping, suitable alloy steel shall be used. Thus, it shall be ensured that it can meet the design load and conditions. The Contractor shall submit to the Employer's Representative, upon request, the forces, reactions, moments and movements related to the connection points and supports in all important facility assemblies.

2.4.2.4. Expansion Pieces (Expansion Loop)

In piping systems, metallic expansion bellows can be used where it is not appropriate to make an expansion system by bending the pipes. Expansion bellows are not allowed in areas where there is potential for steam or water hammer in the system. Where axial expansion pieces are foreseen, the pipe guides and supports used must be made in a way that prevents the bellows from bending. Suitable connection pieces that shall provide freedom of movement in the transverse plane shall be used in the connecting rods of the transverse expansion pieces. The connecting rods must be sized to meet the applied continuous piping load and the pressure thrust force. The tensile force resulting from negative pressure shall be considered as the most severe design condition for the connecting rods in systems subject to vacuum.

Expansion pieces shall not be used in systems whose main purpose is to compensate for misalignment. All metallic expansion bellows shall be fitted with internal flow liners that shall be fully welded to the transition parts of the bellows along their perimeter. The inner linings (liners) shall have discharge holes that shall not restrict the transverse movements of the bellows. These holes shall allow fluids to flow freely through the system.

The piping system with expansion joints (Viking Johnson couplings, etc.) attached shall be supported on both sides of the connection and shall be resistant enough to prevent the coupling from separating under pressure load.

2.4.2.5. Penetrations

All penetrations in walls, surfaces and roofs shall be suitably designed to eliminate the effects of harsh weather conditions and/or external or internal environments/pollutants such as dust, moisture etc. Buried pipework shall be covered with a covering material (including taping) in accordance with the relevant Turkish or European standards where necessary.

2.4.2.6. Noise reduction

The Contractor shall use all necessary silencers, insulation and enclosure systems to remain below the maximum noise limit specified for 1 m from the source. Noise measurement shall be carried out in accordance with the relevant EN norm.

2.4.2.7. Thermal Insulation

Where necessary, insulation shall be applied to ensure that the surface temperature remains above the dew point conditions. Insulation shall be in accordance with EN/ISO.

Insulation shall be made of pre-formed asbestos-free material that can be easily removed for maintenance purposes.

Insulation shall be made to provide personal protection, maintain heat and prevent condensation as follows:

- i. Provide energy savings;

- ii. Assist in maintaining process temperatures;
- iii. Prevent condensation;
- iv. Protect field personnel against burns;
- v. Protect against frost;
- vi. Provide fire protection;
- vii. Protect equipment from corrosion;
- viii. Provide acoustic insulation.

All surfaces accessible to operating personnel shall be insulated such that the surface temperature does not exceed 60°C.

The section after the combustion chamber, boilers etc. and other equipment with large surface areas shall be insulated to a minimum thickness of 150 mm.

Chemically inert, vapor, water resistant and non-flammable mineral wool insulation boards designed to withstand continuous exposure to operating temperatures shall be used. Only low chloride (< 0.15%) mineral wool shall be used for insulation of stainless steel pipes, vessels and other equipment.

The maximum thermal conductivity of the insulation installed up to 100°C shall be 0.05 W/mK. In special conditions or at high temperatures (e.g. insulation of the combustion chamber, boiler and turbine interior), brick, tile or molded calcium silicate boards may be used as insulation material.

All insulated equipment shall be covered with a protective layer of marine-grade aluminum coating material.

The minimum thickness of the aluminum coating shall be 0.56 mm for the pipework and 1.5 mm for all other installations, thus ensuring the structural integrity of the access. The coating shall not contain weld spatter, indentations and protrusions caused by grinding activities or other defects. In case of such, necessary changes shall be made and the costs shall be borne by the Contractor.

Water ingress shall be prevented from all insulation joints.

The air conditioning piping system shall be insulated using aluminum-coated resin-bonded mineral wool profiles.

2.4.2.8. Steel Structures

Steel structures shall be designed to withstand the static and dynamic forces to which they are exposed. The contractor must specify the most important materials to be used in their technical bid.

Galvanic separation is necessary where the risk of galvanic corrosion persists.

Shall comply with the requirements defined in Employer's Requirements II - Design - Build Requirement Part 3 – Material and Equipment – Building Works, Clause 2.5.8.

A. Steel for Mechanical Components

Structural steel shall be selected in quality in accordance with the TS EN 10025-2 standard and shall be accompanied by a material certificate according to TS EN 10204.

Where the risk of galvanic corrosion persists, galvanic separation is required.

B. Forged Steel

Unless otherwise stated, forged steel parts shall be selected from among those that are not defective in the class in accordance with the TS EN ISO 683 standard, and do not have impact or hammer marks.

Steel must be suitable for hot-dip galvanizing. Rust should be absent.

The Contractor shall provide the selected class numbers for the various components to the Employer's Representative for approval.

C. Cast Iron

All supplied gray cast iron parts must be of the appropriate class of TS EN 1561 standard. All cast iron parts should not contain bubbles, crevices and cracks.

No plugging, filling, welding, or "burning" shall be accepted.

D. Stainless Steel

Stainless steel used anywhere in the Waste to Energy Facility (WTEF) must be of at least TS EN 10088-1 standard AISI 304 class, unless otherwise stated.

However, the Contractor shall determine whether the specified minimum requirements are sufficient for the application in question and, if necessary, select a higher quality.

Material certificates are required for all stainless steels to be used in the enterprise. Certificates shall comply with TS EN 10204 standard. The certifications shall form part of the Quality Assurance (QA) documents.

All stainless steel materials, pipes, flanges, etc. shall be stamped according to their type, grade and pressure class. In addition, all stainless steel material shall be accompanied by the original manufacturer's certificate so that the source and date of manufacture can be verified.

E. Aluminum and Aluminum Alloys

Due to the corrosion-prone environment, the use of aluminum and aluminum alloy requires the approval of the Employer's Representative in each individual case.

The installation immersed in liquid or the installation immersed in liquid for certain periods of time should not be made of aluminum and aluminum alloy.

If alloys are used, it must be of the type with magnesium as the main additive used in marine applications.

2.4.2.9. Protection Against Corrosion

Relevant description has been specified in Employer's Requirements II - Design - Build Requirement Part 3 – Material and Equipment – Building Works, Clause 2.5.8.18.2.

2.4.2.10. Welding

All welders shall have a valid certificate in accordance with TS EN ISO 9606-1 from a qualified and recognized testing institute. The certificate shall indicate proof that the welder has passed the tests with successful results.

All welding of pipe joints shall be carried out in accordance with the Welding Procedure Specifications (WPS) published for each specific type of weld material in accordance with TS EN

ISO 15607, TS EN ISO 15609-1 and TS EN ISO 15614-1. The Welding Procedure Specifications shall be completed or approved by an independent organization approved by the Employer's Representative prior to welding.

All welding works shall be carried out under optimum working conditions; therefore, all welding works shall be carried out in the manufacturer's workshop. Welding on-site shall only be permitted with the prior approval of the Employer's Representative. Modern, efficient equipment and techniques and the latest welding technologies shall be used. All welding shall be carried out by welders who are specialized and experienced in the specific type of welding required. The Contractor is responsible for ensuring that all welding operators are suitably qualified and competent personnel to carry out all required field welding.

Records of welding procedures and welder performance qualification tests for the works to be performed shall be kept by the Contractor for review by the Employer's Representative.

The welding methods and procedures to be applied in the workshops and at the installation site shall be approved by the Employer's Representative before production starts.

A. Welding Procedure Adequacy

The Contractor shall submit a detailed welding procedure in accordance with TS EN ISO 9606-1. The procedure specification shall cover all dimensions and combinations of the materials to be joined and all repair welds. The procedure specification is subject to the approval of the Employer's Representative.

For each procedure specification and prior to the start of production welding, the Contractor shall weld the test joints under assembly site conditions following all details of the approved procedure specification.

Qualification testing shall be carried out on steel having the highest specified minimum efficient strength/maximum carbon equivalent estimated to be covered by the Welding Procedure Specification. All results of the procedure qualification records shall be submitted to the Employer's Representative for approval of the welding procedures.

B. Competence of Welders and Welding Processes

Only specialized welders and welding operators who can provide their competence for pipeline welding shall be accepted by the Employer's Representative. Before any production welding operations are carried out, welding operators shall be subject to qualification selection for the relevant welding procedures in accordance with TS EN ISO 9606-1.

Qualification tests shall be acceptable if they meet the requirements for visual, destructive and radiographic examinations specified in TS EN ISO 9606-1. The tests shall be carried out by an approved laboratory at the Contractor's expense.

performance test certificates shall be prepared and these shall be kept at the installation site during the entire working period.

Welder and welding operator qualification tests can be carried out in conjunction with welding procedure tests. These certificates are only valid for six months after the final welding.

C. Welding of Pipelines

The Contractor shall supervise the assembly site, the welders and their work during the entire working period.

It is the sole responsibility of the Contractor to certify that the welding works and welding inspections meet the specified conditions.

D. Before Welding

The material classes, wall thicknesses and pressure classifications of the parts shall comply with the conditions specified in the applicable drawings and technical specifications.

Each pipe or component shall be visually inspected to ensure that there is no visible damage. The condition of damaged parts shall be decided in consultation with the Employer's Representative.

All welding preparation requirements shall be fully detailed in the approved welding procedure specification and shall be strictly followed.

E. Welding

All welding works shall be carried out by qualified welders and in strict accordance with approved welding procedures.

Welding works shall be suspended by the Contractor when weather conditions, e.g. air humidity, wind blowing sand, high winds, or storms, are likely to impair the quality of the work.

Leakage arcs outside the welding slit are not permitted. If a stray arc occurs outside this area, it shall be brought to the attention of the Employer's Representative who will decide whether such damaged section shall be repaired or cut out and disposed of at the Contractor's expense.

Each pass shall be completed around a full circle before the next pass begins.

The start/end position shall not be the same in subsequent transitions.

Welded joints shall be no less durable than attached parts.

After completion of welding work, the pipe surface shall be cleaned of welding spatters and other residues.

F. Ingredients

The weld filler metal shall be selected to provide a weld metal compatibility as close as possible to the metal properties of the base material. The yield strength of consumables shall not be above the yield strength of the base material, nor above the level in TS EN ISO 2560 standard, nor below the compatibility level.

G. Cleaning Carbon Steel after Welding

The surface must be dry and free from oil, grease, soil and concrete residues. All loose rust and machining scales should be removed by wire brushing immediately before weld inspection. In order to prevent polishing of the steel surface on smooth tubes, brushing should be carried out with mechanically sharp brushes. For this reason, a sufficient number of new brushes should be readily available.

Metals produced with basic filling material should be washed with clean water.

H. General Conditions for Welding Inspection

The inspection shall be carried out in accordance with the specifications and the following rules and standards:

- TS EN ISO 4136 Destructive tests on welds of metallic materials - Transverse tensile test
- TS EN 23277 Non-destructive testing of welds - Penetrant inspection of welds - Acceptance levels
- TS EN ISO 17638 Non-destructive testing of welds: Magnetic track testing of welds: Method
- TS EN ISO 23278 Non-destructive testing of welds: Magnetic part testing of welds: Acceptance criteria
- TS EN ISO 17643 Non-destructive testing of welds: Induction current examination with complex planar analysis
- TS EN ISO 11666 Non-destructive testing of welds: Acceptance criteria for ultrasonic examination of welded joints
- TS EN ISO 17640 Non-destructive testing of welds: Ultrasonic examination of welded joints
- TS EN ISO 17635 Non-destructive testing of welds: General rules for metal materials.
- TS EN ISO 10675-1 Non-destructive testing of welds: Acceptance criteria for radiographic examination of welds
- Radiographic examination shall be carried out in accordance with ISO 17636-1 Destructive testing of welds - Radiographic examination - Part 1: Filmed X and gamma-ray techniques.
- Ultrasonic inspection shall be conducted in accordance with ASME Boiler and Pressure Vessel Rules, Section V, Non-Destructive Testing, Article 5, Ultrasonic Inspection Methods for Materials.
- Magnetic particle inspection shall be carried out in accordance with ASME Boiler and Pressure Vessel Rules, Section V, Non-Destructive Inspection, Article 7, Magnetic Particle Inspection.
- Liquid leakage inspection shall be carried out in accordance with TS EN ISO 3452, Non-Destructive Tests, Liquid Leakage Inspection, and General Principles.
- Visual inspection shall be carried out in accordance with ASME Boiler and Pressure Vessel Rules, Section V, Non-Destructive Inspection, Article 9, Visual Inspection.
- Hardness measurement shall be carried out in accordance with ASTM E 110, Standard Test Method for Indentation Hardness for Materials and Manufacture with Portable Hardness Testing Equipment.
- Welding inspections shall be carried out by an independent inspection company appointed by the Contractor. The inspection company shall be approved by the Employer's Representative.

- All non-destructive examinations shall be carried out according to a written procedure. The procedure shall be in accordance with the appropriate method standard and the requirements of this specification. Procedures shall be submitted to the Employer's Representative for approval and shall be selected as the Employer's Representative deems appropriate.

i. Scope of Welding Inspection

All welds shall be 100% visually inspected.

Thirty percent of the resources shall be tested. The following methods may be applied as approved by the Employer's Representative.

- Radiographic
- Ultrasonics
- Penetration

A radiographic method shall be used. However, if this method cannot be applied, one of the other methods deemed appropriate by the Employer's Representative may be used.

Ultrasonic examination can replace radiographic examination when radiographic examination is impractical and can be used as a general backup to radiography in case interpretation/validation problems arise.

Guaranteed welds (welds not subjected to pressure testing) and concealed joint connections shall be 100% inspected using both radiography and ultrasound.

The welds to be tested shall be selected primarily from those that cannot be visually inspected from the back side of the weld. Such welds shall be tested by radiography and ultrasonography. The selection of welds shall be carried out by an accredited independent representative approved by the Employer's Representative.

All repaired or altered welds shall be 100% inspected again using the same methods and the same acceptance criteria as required for the original work.

Hollow welds and branch connection welds which have not been radiographed shall be examined by magnetic particle or penetrating methods to the extent specified for butt welds.

Where spot inspection is required in subsequent sections, welds shall be selected to ensure that each welder's work and each welding procedure is included.

If defects are found in the required spot inspection, the previous and subsequent welds made by the same welder shall also be inspected.

If a defect is found in one of these sources, the previous three and the next three sources shall be examined at the Contractor's expense.

In the event of failure of five or more consecutive welds of a welder, all welds of that particular welder shall be examined at the Contractor's expense.

J. Acceptance Criteria

Acceptance criteria shall be class C in accordance with ISO 5817. Testing shall be conducted by an independent accredited organization approved by the Employer's Representative. A report on the tests shall be provided.

K. Production Tests

The Employer's Representative is authorized to select a large number of seams for destructive testing.

The Contractor is responsible for cutting the seams, bevelling the pipe ends and re-welding the joint. Destructive tests shall be carried out in accordance with the requirements of the relevant general welding specification covering proficiency tests for welding procedures unless otherwise agreed.

If the welding location does not fulfill all the conditions, the Contractor shall bear the costs at his own expense. In this case, the Employer's Representative may insist that additional weld seams be tested and the costs of such tests and re-testing shall be borne by the Contractor, regardless of the results. If this weld seam location does not fulfill the requirements, the control may be extended further at the Contractor's expense.

The decision on such an extension of the inspection work shall be made by the Employer's Representative after consideration of whether the welding works satisfactorily fulfil the conditions.

In the event of personnel changes, while welding works are in progress, the Employer's Representative may request a new weld joint to be destructively tested at the Contractor's expense, as this may affect the quality of the weld joints.

L. Required Documents

The following documents must be provided before the inspection:

- NDE (Non-Destructive Testing) personnel certificates
- NDE (Non-Destructive Examination) procedures
- Report forms
- Request for deviations from established conditions, if any

During the examination:

- Field reports

After the examination:

- Authorized inspection reports with field reports and films attached.

M. Coating of Welding Seams

After successful completion of all inspection procedures, the welds on carbon steels and their surrounding areas shall be carefully cleaned and protected with internal and external coating (paint) as specified in the clauses of this section.

N. Welding Carbon Steel

Acceptable welding processes are:

- Shielded Metal Arc Welding (Stick), SMAW

- Gas Metal Arc Welding (Gas Metal Arc Welding (MIG/MAG), GMAW)
- Flux Cored Arc Welding (FCAW)

The use of welding processes other than those listed above is only permitted with the prior approval of the Employer's Representative. The process may be used as a combination if the same combination and sequence of processes have been found satisfactory by the welding procedure qualification test.

Previously realized productions in the workshops shall be used to the maximum extent possible.

For welding of carbon steel pipes, the practices recommended by AISI rules B31.1 and API standard 5L shall apply. Welded structures shall comply with TS EN ISO 3834.

After the welding of all galvanized pipelines is completed, slag cleaning shall be done and galvanized spray paint shall be applied.

O. Welding of Stainless Steel

AWS D10.4-79 standard shall apply for welding of stainless steel pipes.

The welding method is either tungsten inert gas welding (TIG welding) or metal inert gas welding (MIG welding) for welding operations in the workshop and at the assembly site. Regardless of the method chosen, the inner surface of the weld shall be protected by clean inert gas. The oxygen content of the oxygen/inert gas mixture must not exceed 20 ppm during welding.

To guarantee high-quality welded joints, pipes, and other quality stainless steel components shall be produced in the workshop whenever possible.

For stainless steel welding, the following points must be observed:

- For the pipes to be manufactured, welding shall be performed on the stands (platform) established at a height of at least 90 cm from the ground.
- The welding area shall be completely protected from wind and dust.
- Only butt welding of pipes is permitted during construction work,
- Where butt welding is used, penetration shall be completed with a root run if necessary,
- Support rings shall not be used.
- Surface defects that reduce corrosion resistance or cause surface discoloration shall not be accepted,
- After welding, the weld shall be carefully pickled and passivated,
- The welds shall be thoroughly washed in clean water after pickling and passivation.

2.4.2.11. Joints

In general, pipe joints shall be cleaned prior to assembly, ensuring that all surfaces are free from dirt, oil, and dust. Before the joint is made, the pipe shall be properly supported, bedded, and aligned to avoid stress or misalignment during installation.

Joint rings shall be lubricated with the material recommended by the manufacturer and correctly positioned.

For steel flange joints in wastewater and water pipelines, steel-reinforced gaskets shall be used.

For air pipeline flange joints, cylinder head gaskets shall be applied.

The quality of all gaskets shall comply with DIN 3754.

Gasket thicknesses:

3 mm up to DN200

4 mm up to DN500

DN500 and above 5 mm

High-pressure service seals shall be used where necessary.

The pressure and temperature shall comply with DIN 3754 (or internationally acceptable standards).

2.4.2.12. Bolts

All bolts, rods, studs, nuts and washers used in all flanged connections shall be made of stainless steel of at least A2 (or internationally acceptable standards) in accordance with DIN 17007 and BS EN ISO 3506.

The bolts shall have an additional length of at least 3 mm and a maximum of 12 mm after the nut for drilled or buried bolts, as well as flanged inserts.

All necessary bolts, nuts, washers and clamping plates shall be supplied with attachments. Bolts and nuts shall be made of high tensile strength steel, with metric threads and hexagonal heads.

All bolts, screws, nuts and plinths must correspond to the material to be tightened with the bolt. This also applies to chemical dowels.

Bolts, washers, nuts to be used for galvanized steel painted steel parts must be hot-dip galvanized. In order to prevent damage to the paint, the bolts used to tighten (fasten) the painted steel shall always be used with washers.

Bolts, washers and nuts to be used for stainless steel parts such as flanges shall be of stainless steel of the same grade or higher.

Molybdenum-sulphide or similar substance should be applied to the teeth and washers to prevent abrasions (galling), stress hardening, crack and contact corrosion.

A. Chemical Anchors

Chemical dowels shall be used in the assembly of all equipment and pedestals to be used in wet areas.

Fixing bolts of the appropriate length shall be provided to fix the machine to the pedestal as a whole and be fixed in place

Chemical anchors shall be supplied with a quality suitable for the conditions in which they are constantly exposed to the effect of water.

Alternatively, an injection technique can be applied.

During the application, the inside of the holes drilled for chemical dowels should be cleaned mechanically with a brush and with compressed air or vacuum apparatus, and free particles and dust should be cleaned. It should not be applied to wet and frozen surfaces. Ground moisture and adherence should be checked before application.

Fixing mechanical equipment to concrete structures can be carried out with dowels placed during pouring or by drilling holes with a drill. No dowels should come into contact with the reinforcement bars inside the concrete structure. The dowels to be used in the installation of stainless steel equipment must be made of stainless steel of equivalent quality.

2.4.2.13. Conveyors

A. Screw Conveyors

The conveyor must be of a robust design and have a high fill level with a central shaft. The gutter bed shall be made of 1000 green upollen material, with a wall thickness of at least 10 mm. The wall thickness of the gutter sheet shall be at least 4 mm.

Auger conveyor (Auger, groove, covers, grate, fasteners) shall be made of AISI 304 quality stainless steel material. Screw conveyors shall be of shaftless auger conveyor type.

The screw pitch, screw diameter, screw blade thickness, and motor power of the auger conveyor shall be calculated based on the flow rate. Following the contract award, the screw pitch, conveyor diameter, blade thicknesses, motor power, calculations, and related drawings shall be submitted by the awarded company to the Employer's Representative. Production shall commence only after receiving approval from the Employer's Representative.

Screw conveyors shall be made of wear-resistant stainless material and protected and coated with suitable coating material, without shaft. Together with the body and auger of the conveyor, it shall be made of AISI 304 quality stainless steel material.

The design of the feeding container (hopper) should be carried out according to local requirements. In order to be a hygienically acceptable system, the chute of the screw conveyor should be covered. The caps shall be bolted and the wall thickness of the cover sheet shall be 2 mm. The carrier legs to be used for the conveyors shall be made of NPU 80 x 4 mm U profile. Carrier legs shall be made of AISI 304 quality stainless steel material. The discharge pipe of the conveyor filtrate water shall be connected to the channel and shall be made of stainless steel material.

For compact conveyors, bevel helical gear reducer drive group shall be used. The reducers shall work on the drive direction pull side.

To protect the shaft bearing, the sluice plate must be placed inside the auger collection channel. The material must be stainless steel. (AISI 304)

The operation of the conveyor shall be fully automated, and the waste materials shall travel on a stainless steel closed chute (chute) of sufficient length to allow them to be discharged into a container.

There shall be a protective device (torque wrench/switch) against snagging (including alarm).

Electrical Equipment

All controls, timing devices, etc., required for manual and automatic control of gratings and conveyors shall be incorporated into a stainless steel control cabinet.

The cabinet shall cover all necessary connection devices, fuses, protection switches, main switches and push buttons. Voltage-free contacts shall be provided for the transmission of operating and fault signals. The cabin shall be equipped with anti-condensation heaters.

The electrical equipment of the grills shall be compatible with the following characteristics:

- The automatic control shall be as follows for the two principal grids running separately under time control:
 - In case of clogging of the grids, before the automatic cycle is activated, the control contacts that enable the grids to be selected for automatic operation shall start the operation of the work grids. The activated grids shall operate at least in the time set in the time setters.
 - The electrical system shall be fully supplied and equipped, connected, tested and commissioned, including all documentation and switchgear and all cables between electricity consumers. All signals related to monitoring the functions of the facility must be brought to the terminal strips without potential. All electrical components must be of high quality. All connections and accessories that need to be made to the SCADA system for control and monitoring purposes are within the scope of this work.

2.4.2.14. Dismantling Joint

Dismantling joints shall be used on all valves in the inlet and pressure pipes of pumps, air lines, and electromagnetic flow meters and where necessary to ensure easy disassembly of pipes.

Scope: Rigid type, double flange, full-length stud, ductile iron, materials shall have EN TSE certificate, in the specified dimensions and quantities, shall be suitable for raw wastewater flow.

Long Part: According to TS 526 EN 1563 / A1 standards; ductile iron shall be made of EN JS 1020 (GGG 40) quality material.

Short Part: According to TS 526 EN 1563 / A1 standards; ductile iron shall be made of EN JS 1020 (GGG 40) quality material.

Intermediate Flange: According to TS 526 EN 1563 / A1 standards; ductile iron shall be made of EN JS 1020 (GGG 40) quality material.

Sealing Gasket: It shall be EPDM or NBR.

Fasteners: Stud and nut made of minimum A2 quality stainless steel shall be used.

Operating Pressure: It shall be in the pressure class compatible with the line to be used specified in the projects.

Operating Temperature Range: +4, ..., +60°C range

Mobility: The mobility shall be ± 50 mm in the horizontal plane.

Flange Dimensions: Flange dimensions shall be in accordance with EN 1092-2 standards DIN 2501 – the pressure class of the line in which it is used.

Marking: It shall be legible and embossed from casting, and shall include information about the manufacturer, TS standard, body material, pressure class and nominal size.

Test: According to EN 12266-1 standard, it shall be RATE-A class (zero tightness).

Paint: It shall be epoxy oven paint by immersion method according to DIN 3476 or DIN 30677-1 standards.

Packaging: The products shall be individually packed in plastic bags and stacked on standard wooden pallets and delivered in this way.

2.4.2.15. Compensators

It shall be installed on all pipes at the air fans outlet. Compensators shall be capable of balancing heat expansion, incompatibilities of the assembly, vibrations and settling of the machines.

Compensators shall have metal bellows, fixed flanges and limit rods.

Flange material: ST37

Bellows material: min. AISI 304

Limit tie rod: ST37

The flanges to be used shall comply with TS EN 1092-1 Standard.

It shall be RATE-A class (Zero Sealing) in accordance with TS 10880 and EN 12266-1 Standards.

2.4.2.16. Pumps

The pumps supplied shall be capable of meeting the specified performance requirements.

The pumps shall be easy to maintain and repair and shall provide safe and continuous operation.

The pumps shall be quiet and vibration-free.

Unless otherwise specified, the casings shall be manufactured from the best quality ductile iron/cast iron and shall be capable of withstanding all pressures that may occur due to normal operating pressure fluctuations.

The pumps shall be mounted on cast iron base plates (bases) or concrete pedestals. The pumps shall be correctly aligned/positioned. Holes shall be provided in the base plates or pedestals for foundation bolts.

The pump shafts and elements shall be suitably designed to ensure that the impeller is firmly supported and also to ensure that it rotates without shaking, vibration or excessive deflection at all operating speeds and under all operating conditions.

Approved guards shall be fitted on all moving parts.

Where pumps operate in parallel, individual and parallel operating curves shall be provided.

In the single and multiple parallel operating performance curves of the pumps, the NPSH requirement shall never exceed 8 m. Unless otherwise stated, electric motors shall be 400 volt three-phase, 50 Hz and in the IE3 efficiency class.

For the installation of pumps in accordance with this Contract, an authorized representative from the manufacturer and service company shall approve the installation process and provide it duly signed by the Contractor. This signed installation conformity certificate shall be delivered to the Employer's representative.

Gauge connections shall be provided with a shut-off valve for testing and isolating purposes. In addition, each pump shall have an air release valve and a drain valve shall be installed where necessary. All strainers shall be regularly checked for contamination levels and cleaned during commissioning and testing. Drainage facilities shall be provided on pump casings or adjacent piping to drain fluid from the system before maintenance.

- It shall also be ensured that the fluid to be discharged is directed to a suitable drain point.
- Pressure relief valves shall be installed on pumps where necessary

Pumps shall be manufactured by companies with ISO 9001:2008 quality system certificates.

Pumps supplied from abroad shall be ISO-certified and in accordance with international norms.

Before the pumps are delivered to the site, all pumps shall be tested according to EN ISO 9906-2012 GRADE 2U, and the documents shall be submitted to the Employer's Representative. The pumps shall have a witnessed factory test.

A. Centrifuge Pumps

Pumps shall be designed to be suitable for wastewater, sewage, and sludge and shall be able to be operated for long periods.

The peripheral speed of the impeller blades shall not exceed 25 m/s at the specified capacity. The critical speed of the pumps shall not be less than 150% of the maximum nominal speed. The closing height shall be as low as possible, preferably around 160% of the operating height.

The net positive suction head (NPSH) for the pumps during pumping, either alone or in any specified combination, shall provide the NPSH. The calculations shall be submitted to the Employer's Representative after the tender. Deviations in the NPSH of the pumps shall be corrected at the Contractor's responsibility and expense.

The rotating parts of the pumps shall be statically balanced during manufacturing and dynamically balanced after assembly.

The hand hole shall be bolted onto the impeller to facilitate inspection and cleaning of blockages, and the internal parts shall be shaped to fit the internal contour of the casing and to minimize adverse effects on the flow.

Renewable internal 'wear plates' shall be fitted or the casing shall be adjusted to accommodate replaceable suction and seal plates.

Impellers shall be manufactured from GG25 or better quality cast iron or stainless steel, smooth, well-polished, statically and dynamically balanced and free of air holes and defects.

All pump bearings shall be supplied in SI unit dimensions, where appropriate, according to DIN standards.

Each length of the transmission shafts, complete with couplings, shall be dynamically balanced.

The weight of the transmission shafts shall be carried by the thrust bearing on the motor.

Submersible Pumps

The NPSH requirement shall never exceed 8 m in the single and multiple parallel operating performance curves of the pumps.

Pumps shall be shown with pump curves that they can operate smoothly up to 30% above and below the given discharge head.

Pumps shall be easy to maintain and repair and shall provide safe and continuous operation.

Pumps shall be submersible, suitable for use in wastewater, and shall have a rail system and discharge connections that shall guide them to be lifted without disassembling any bolted connection. There shall be double guides for each wet-type pump. Pump guide pipes and supports shall be made of AISI 304 stainless steel. The pump shall not be placed on the base in any way, and the pump shall pass to the elbowed fixed discharge inlet with its own weight and shall be locked.

The runner pipe wall thickness shall be in accordance with the minimum SCH40 norm. The runner pipe shall be made of SS316L stainless steel material. The pump chain shall be a GR80 load-carrying chain. an original catching apparatus shall be provided for wet-type pumps.

The pump shall constitute a compact unit with an electric motor and shall be suitable for operation underwater. The motor shaft shall also constitute the shaft of the pump and no bearing shall be used for the pump other than the motor's own bearing housings. The shaft material shall be AISI 316 stainless steel or higher. Stainless steel sheaths shall not be considered equivalent to stainless steel shafts.

The motor and pump shall constitute a complete integrated unit that can operate uninterruptedly underwater. The motor and pump shall be designed and assembled by the same manufacturer.

The main components of the pump shall be manufactured from grey cast iron (ASTM A-48) Class 35B, BS 1452 quality 260 or DIN 1691 GG25, the surfaces shall be smooth and without holes. All exposed nuts, bolts, gaskets, washers, etc. shall be made of AISI Type 316 stainless steel. All metal surfaces, other than stainless steel or brass, exposed to external factors during pumping shall be resistant to corrosion.

The sealing of the main components of the pump shall be ensured by the complete contact of the machined surfaces. Critical parts that interlock and require complete sealing shall also be properly machined and connected with Nitrile or Viton O-rings.

Motors shall be sized so that they can be adequately cooled by the pumped material or the surrounding area (pumps over 10 kW shall have cooling jackets).

The seal between the pump and the motor shall be provided by a mechanical seal system operating in an oil chamber. The lower seal material shall be SIC-SIC or Tungsten carbide. The upper seal material shall be SIC-CARBON, CARBON/SERAMICS or Tungsten Carbide. The seal housing design shall be shown in the pump technical brochure.

B. Submersible Pumps

Pumps shall be produced by companies with ISO 9001:2008 quality system certificates.

Pumps to be procured from abroad shall be ISO-certified and comply with international norms.

Before the pumps are delivered to the site, all pumps shall be tested according to EN ISO 9906-2012 GRADE 2U and the documentation shall be submitted to the Employer's Representative. The pumps shall have a factory test with witnesses.

In the single and multiple parallel operation performance curves of the pumps, the NPSH requirement shall never exceed 8 m.

Pumps shall be indicated by pump curves that they can operate smoothly above and below 30% of the given head of the head.

The pumps shall be easy to maintain and repair and shall ensure safe and continuous operation.

The pumps shall be submersible type, suitable for use in wastewater, and shall have discharge connections with a rail system that shall guide the removal without dismantling any bolted connections. There shall be a double guide for each wet-type pump. Pump guide pipes and bearings shall be made of AISI 304 stainless steel. The pump shall not be placed on the base under any circumstances, and the pump shall be sealed and locked by its own weight into the cantilevered fixed

discharge inlet. The pump can be easily removed for maintenance and servicing, and there shall be no need to enter the wastewater pit for this purpose. The skid and coupling system shall be supplied with the pump. The wall thickness of the slide pipe shall be in accordance with the minimum SCH40 norm. The skid tube shall be made of SS316L stainless steel material. The pump chain shall be a GR80 load-carrying chain. For wet-type pumps, the original capture apparatus shall be provided.

The pump shall constitute a compact unit with an electric motor and shall be convenient to work underwater. The motor shaft shall also form the shaft of the pump and no separate bearing shall be used for the pump other than the engine's own bearing housings. The shaft material shall be AISI 316 stainless steel or above. Stainless steel cases; It shall not be considered equivalent to stainless steel shafts.

The motor and pump shall form a completely integrated unit that can operate seamlessly underwater. The motor and pump shall be designed and installed by the same manufacturer.

The head shall be calculated by including the losses in pipes and fittings and this calculation shall be given to the Employer's Representative. The pumping head shall be calculated and verified by the Contractor.

The contractor shall provide the system curves of the pumps against various static pressures to the Employer's Representative. If the pumps are running in parallel, the curves shall be given for a single operation and parallel combinations.

The main components of the pump shall be made of gray cast iron. (ASTM A-48) Class 35B, BS 1452 grade 260 or DIN 1691 GG25, surfaces shall be smooth and free of holes. All exposed nuts, bolts, gaskets, washers, etc., shall be AISI Type 316 stainless steel. All metal surfaces, except stainless steel or brass, which are exposed to external factors during pumping, shall be resistant to corrosion.

The sealing of the main components of the pump shall be ensured by the exact contact of the treated surfaces with each other. Critically important parts that are interlocking and require a complete seal shall also be properly machined and connected with Nitrile or Viton O-rings.

On the pumps, the direction of rotation shall be indicated in the casting embossed or by mounting a metal plate.

Motors shall be sized so that they can be adequately cooled by the substance being pumped or the area around it (pumps above 10 kW shall have a cooling jacket).

The cooling jacket shall wrap around the stator housing and dissipate heat regardless of the type of installation. The cooling jacket of the pumps shall be of closed circuit type, and the wastewater pumped by the pump shall not be used as a coolant in the cooling jacket channels. The coolant must be different from the pressed liquid (oil or glycol-water mixture) and must be circulated in a closed circuit. The first filling of the coolant shall have been done and tested in the factory environment.

The coolant shall be circulated in the water jacket with the help of a specially designed fan located in the mechanical seal. Clogging shall be prevented by making channels for cooling purposes in appropriate sizes.

Said cooling system shall allow the pump to operate uninterrupted at an ambient temperature of up to 40°C.

The sealing between the pump and the motor shall be ensured by a mechanical seal system operating in an oil chamber. The bottom seal material shall be SIC-SIC or Tungsten carbide. The top packing material shall be SIC-CARBON, CARBON/SERAMICS or Tungsten Carbide. The seal housing design shall be shown in the pump technical brochure.

The pump shall be equipped with an oil reservoir to ensure sealing in the shaft. There shall be an oil drain device to control the oil. It shall be in a place where the oil plug can be intervened from the outside.

The pumps shall be of a non-clogging type and suitable for wastewater use. The impeller shall have unobstructed flow paths and shall be single-channel to ensure operation without clogging and fiber. The type of propeller shall be submitted to the approval of the Employer's Representative.

The pump design shall be such that even in the event of an inversion of the impeller, it shall not allow any part of the pump to loosen or dislodge. There shall be no hydraulic balance holes. The impeller shall be fixed to the high-strength steel shaft and positively compressed, static and dynamic balance test and adjustments shall be made.

The pump housing shall be of cast iron. The pump housing and all parts that come into contact with the liquid shall be compatible with the liquid they come into contact with. The sealing between the volute part of the pump and the suction port shall be ensured by wear rings. These wear rings shall be made of brass or rubber-coated steel and shall be fixed. The wear rings shall be easily replaceable.

The pump shall be able to work for a long time without cleaning and maintenance. Special precautions shall be taken to prevent corrosion of moving parts that may be caused by sand particles.

C. Dry-mounted pumps

In addition to the submersible pump specifications defined above;

- The cooling jacket of the pumps shall be of the closed circuit type and the wastewater pumped by the pump shall not be used as a coolant in the cooling jacket channels. The coolant must be different from the liquid pumped (oil or glycol-water mixture) and must be circulated in a closed circuit. The first filling of the coolant shall be done in the factory environment and tested.
- Stainless steel mounting bases shall be manufactured and installed in dimensions approved by the manufacturer for dry-type pumps. Technical drawings of the mounting bases shall be submitted to the Employer's Representative for approval before manufacturing.

D. Positive Displacement (Mono Type) Pump

Polymer dosing pumps shall be positive displacement pumps and shall mainly cover the following:

- Horizontal dry-placed pump
- General base plate for motor and pump
- Three-phase motor, comply with IE3 standards
- Positive displacement type, variable speed motor controllable by frequency converter
- Temperature sensor element for stator protection with pressure switch as protection against overpressures
- Temperature sensor element for stator protection with suction switch as protection against low pressures

The pump body shall be ductile iron, the stator shall be NBR rubber, and the rotor shall be chrome-nickel stainless steel.

The pumps shall be delivered ready for operation with control panels and frequency converters. The pumps shall be started with a frequency converter and shall allow operation at the desired poly supply flows.

Poly solution can be given to the static mixer inlet when desired, and directly to the decanter inlet when desired, from the bypass and guidance line. All elements used in this regard shall be made of AISI 304 L stainless steel material. At the poly preparation unit low-level alarm, the poly preparation pump and the sludge feeding pump shall automatically shut down.

Polydosing mono pumps shall be placed on the suction and discharge lines with the specified amount of deaeration valve, cleaning valve, and manometer suitable for line pressure.

E. Chemical Dosing Pumps

- Dosing pumps shall be of the stroke length adjustable, positive displacement, motor-driven diaphragm type.
- Pump sensitivity shall be better than +/-4%.
- Stroke number shall be a minimum of 120 str/min at 50 Hz.
- Pumps shall be manually controlled.
- Dosing pump flow control shall be made by adjusting the stroke length. The stroke length can be adjusted on the pump body and shall be adjustable in the range of at least 30-100%. The dosage amount shall also be adjustable at low dosage levels.
- Pumps shall have an on/off switch and shall be suitable for low-level input and alarm output connection.
- The suction height of the pump shall not be less than 2 mSS at 100%.
- There shall be an input for the level sensor on the pump as an option. The pump shall have a system that can automatically stop when the substance in the tank it is suctioning is finished.
- Electric motor shall be overload protected.
- The pump's electric motor must be 220-240 V powered, and the motor must be at least IP55 in protection class.
- All parts of the pumps that come into contact with the chemical to be dosed must be made of material resistant to this chemical and must never react with this chemical.
- The diaphragm material shall be coated with PTFE as standard.
- Pump o-rings shall be made of chemically resistant Viton or EPDM and materials of this quality.
- Valve springs must be Hastelloy C4.
- There shall be two check valves on the suction and discharge of the dosing pump. Check valves and diaphragms must be easily replaceable.

Chemical Storage Tanks

The chemical storage tank shall contain the following:

- Level control/indicator
- Supply pipe with coupling and flood pipe
- Pump suction outlets from the tank bottom

- Drainage with flange and isolation valve
- Hoists

The tanks shall be made of high-density polyethylene material and shall be vertical type and shall have the ability to be easily processed and welded.

Chemical tanks shall be manufactured from a single cast part. (It shall be monoblock.)

The wall thickness that should be according to the volumes of the chemical tanks to be supplied is given below.

- The wall thickness of tanks with a volume of 1,000-3,000 liters is at least 14 mm,
- The wall thickness of tanks with a volume of 5,000-10,000 liters is at least 18 mm,

The tanks located on the outside shall have a UV-resistant coating. The color of the tanks should be according to the ISO standard for the processing of chemical substances.

The contractor shall be responsible for any damage to the chemical tanks during cracking, leakage, transportation and waiting at the storage site.

Stainless steel platforms, stairs and railings shall be built around it for access to chemical tanks.

The entire installation shall be resistant to the environment. For safety reasons, an eyewash shower must be installed and connected to the drinking service water line. Safety equipment must be available, and the equipment and installation must comply with the relevant international safety standards.

F. Pump Electric Motors

Electric motors shall be capable of ensuring that the pumps to be coupled to these motors operate safely and continuously under operating conditions.

Electric motors shall be manufactured as squirrel cages, high efficiency in accordance with IE3 standards (motors below 3 kW shall be IE2 efficiency), 400V, 50Hz, and specially protected insulated and asynchronous motors suitable for staying in water. Stator windings and cable heads shall be insulated with moisture-resistant class H (IEC 85) and the stator shall be coated with varnish in accordance with class H. Thus, the engine temperature shall be allowed to rise up to 185°C.

The motor shall be ball-bearing, and the weight of the motor shall be borne by the bottom bearing inside the motor housing.

The engine shall provide uninterrupted pumping of the material at a temperature of 40°C and shall be capable of making an average of 15 start-stops per hour. The motor and cable shall be able to work continuously underwater, and continuous sealing shall be ensured. The protection class shall be IP68 (20 m). It shall be designed in such a way that there is no need to use silicone, etc., during the repair.

The rated power of the pump shall be sufficient to withstand overload along the pump performance curve.

The motor shall be able to operate without vibration and its rotor shall be statically and dynamically balanced. The rotor shall be tuned for dynamic equilibrium and tested with approved methods.

The electric motor of the pumps shall be manufactured with IP 68 protection and H class (motors under 3 kW shall be considered as F class insulated). The engine manufacturer must certify that the

engine is manufactured in class H, and the companies shall submit this document at the acceptance stage of the goods. The motors shall have a thermistor for the control of the winding temperature and a moisture leakage sensor for the control of water leaks. Necessary relays shall be placed in the control panels for thermistors and water leakage notifications. When the water leak alarm sounds, the pump shall automatically shut off.

The cables shall be constructed of twisted, flexible copper wire and shall be completely covered by flexible twisted insulation suitable for underwater use.

The power cable shall have the capacity to carry all the engine power under outdoor temperatures and acting fluid conditions. The supply cables of all underwater equipment shall have original cable socks, and cable hangers made of stainless steel material and shall be connected to the accessible point outside the chamber.

The design of the cable entry seals shall be such that they are waterproofed (with rubber wedges). The cable connection, on the other hand, should be designed to facilitate the replacement of the cable when necessary. The cable entry box and the motor shall be separated from each other by a terminal, thus providing the necessary insulation and preventing the entry of foreign matter from outside. Sealing with materials such as epoxy, silicone, etc. shall not be accepted.

G. Factory Inspection and Acceptance

Testing Block

The factory test stand shall be capable of performing the tests specified in Turkish Standards. Tests and experiences of imported pumps; It can be done at the factory test stand of the manufacturer, or if the Employer's Representative deems it appropriate; It can also be done at the test stand of the contractor or at the test stand of another organization.

The measuring instruments to be used in the tests shall be calibrated once a year by the authorized institutions and the documents shall be submitted if requested.

In the event that the factory test stand is not deemed sufficient by the commission, the tests shall be carried out in another accredited Institution that the commission deems appropriate, provided that the costs of the factory acceptance tests are covered by the Contractor.

Test documents of the tests and experience tests of the pumps shall be submitted to the Employer's Representative.

Physical Inspection and Material Testing

A visual physical inspection of the bodies of the pumps is performed. If the Commission deems it necessary, it may request a chemical analysis of the material to be carried out at the factory or an accredited institution it deems appropriate, if possible. In this case, the laboratory costs shall be borne by the Contractor.

Efficiency Test

Performance and efficiency tests of submersible pumps shall be carried out according to the ISO9906-2012 GRADE 2U standard.

Tests and experiences of submersible pumps shall be carried out under operating conditions (in wastewater).

Labeling

For the pump;

There shall be a metal label on the pumps indicating their technical specifications. The information that should be on the coin label is given below.

- Pump serial number
- Operating voltage
- Pump power (kW)
- Max current drawn
- Head Hmax
- Delivery head Hmin
- Pump outlet diameter DN
- $\cos Q$
- Date of manufacture
- Pump speed 1/min

2.4.2.17. Valves

All valves must be of a quality that shall withstand maximum pressure, including shock pressure, and shall not disrupt service. But all valves, whichever is bigger; It shall be tested for resistance to working pressure of 1.5 times the working pressure of the pipeline.

The valves shall be capable of withstanding the same test pressures as the pipeline on which they operate. Spring washers and locking jaws shall be placed on all nuts and studs exposed to vibration.

Where necessary, stainless steel socket head extension shafts, operating mechanisms, spacers, anchor fasteners, and stainless steel table shaft seat consoles shall be provided. Extension shafts and cantilevers shall be anchored, and all fasteners shall be stainless steel.

Galvanized steel or stainless steel support bases shall be made according to the location, conditions and type of pipe in which DN 400 and above valves are used.

A. Elastomer Seated Gate Valves

The handwheels shall be well-walled and of a diameter that one person can operate the valve. The opening and closing directions shall be shown as casting on the handwheel. The closing direction shall be clockwise.

Scope: Flat type, elastomer seat, flanged, ductile iron, F4 (isomorphic) dimensions, materials are TSE certified according to TS EN 1171 in EN standards, in specified dimensions and quantities, fixed shaft, shall be suitable for raw wastewater flow.

Body: According to TS 526 EN 1563 / A1 standards; ductile iron shall be made of EN JS 1020 (GGG 40) quality material.

Cover: According to TS 526 EN 1563 / A1 standards; ductile iron shall be made of EN JS 1020 (GGG 40) quality material.

Shaft: It shall be made of AISI 410 or 420 quality stainless steel material, threaded by rubbing method, and O-ring channels polished.

Slider: According to TS 526 EN 1563 / A1 standards; ductile iron is made of EN JS 1020 (GGG 40) quality material and its surface shall be coated with Shore A EPDM rubber material using the vulcanization method.

Bolt Nut: It shall be made of brass (CuZn36Pb2As) with high corrosion resistance, MS 58 quality bronze alloy, or equivalent material.

Cover Bolts: A2 quality stainless steel, Allen head bolt in DIN 912 standards, insulated with cover gasket and wax, embedded in the cover seat, shall be used.

Fasteners: Bolts made of minimum A2 quality stainless steel shall be used.

Flywheel: According to TS 526 EN 1563 / A1 standards; ductile iron, EN JS 1020 (GGG 40) or cast iron, EN JL 1040 (GG 25) quality material. Flywheel shall be provided for each valve by the supplier.

Working (Rated) Pressure: It shall comply with the minimum PN10 pressure class. The valve shall be able to operate easily even under maximum pressure, without the need for a By-Pass and actuator.

Operating Temperature Range: +4, ..., +60°C range

Valve Dimensions: Front-to-face dimensions shall comply with TS EN 558-1 Series-14 straight-type F4 gate valve standards.

Flange Dimensions: Flange dimensions shall be in accordance with DIN 2501 – PN10 pressure class in EN 1092-2 standards.

Marking: It shall be legible and embossed from casting, and shall include information about the manufacturer, TS standard, body material, pressure class, and nominal size.

Paint: It shall be epoxy oven paint by immersion method according to DIN 3476 or DIN 30677-1 standards.

Test: According to EN 12266-1 standard, it shall be RATE-A class (zero tightness).

Packaging: The products shall be individually packed in plastic bags and stacked on standard wooden pallets and delivered in this way.

B. Metal Seated Gate Valves

The handwheels shall be well-walled and of a diameter that one person can operate the valve. The opening and closing directions shall be shown as casting on the handwheel. The closing direction shall be clockwise.

Scope: Flat type, metal seat, flanged, ductile iron, F4 (isomorphic) dimensions, materials are TSE certified according to TS EN 1171 in EN standards, in specified dimensions and quantities, fixed shaft, shall be suitable for raw wastewater flow.

Body: According to TS 526 EN 1563 / A1 standards; ductile iron shall be made of EN JS 1020 (GGG 40) quality material.

Cover: According to TS 526 EN 1563 / A1 standards; ductile iron shall be made of EN JS 1020 (GGG 40) quality material.

Shaft: It shall be made of AISI 410 or 420 quality stainless steel material, threaded by rubbing method, and O-ring channels polished.

Slider: According to TS 526 EN 1563 / A1 standards; ductile iron shall be made of EN JS 1020 (GGG 40) quality material.

Bolt Nut: It shall be made of brass (CuZn36Pb2As) with high corrosion resistance, MS 58 quality bronze alloy, or equivalent material.

Cover Bolts: A2 quality stainless steel, Allen head bolt in DIN 912 standards, insulated with cover gasket and wax, embedded in the cover seat, shall be used.

Fasteners: Bolts made of minimum A2 quality stainless steel shall be used.

Flywheel: According to TS 526 EN 1563 / A1 standards; ductile iron, EN JS 1020 (GGG 40) or cast iron, EN JL 1040 (GG 25) quality material. Flywheel shall be provided for each valve by the supplier.

Working (Rated) Pressure: It shall comply with the minimum PN10 pressure class. The valve shall be able to operate easily even under maximum pressure, without the need for a By-Pass and actuator.

Operating Temperature Range: +4, ..., +60°C range

Valve Dimensions: Front-to-face dimensions shall comply with TS EN 558-1 Series-14 straight-type F4 gate valve standards.

Flange Dimensions: Flange dimensions shall be in accordance with DIN 2501 – PN10 pressure class in EN 1092-2 standards.

Marking: It shall be legible and embossed from casting, and shall include information about the manufacturer, TS standard, body material, pressure class, and nominal size.

Paint: It shall be epoxy oven paint by immersion method according to DIN 3476 or DIN 30677-1 standards.

Test: According to EN 12266-1 standard, it shall be RATE-A class (zero tightness).

Packaging: The products shall be individually packed in plastic bags and stacked on standard wooden pallets and delivered in this way.

C. Knife Valve

Knife gate valves shall have one hundred dimensions in accordance with the EN 558 standard.

The bodies shall be made of ductile iron GGG 40 material. Gasket materials shall be suitable for use with wastewater.

A knife valve with a wafer-type connection shall be used. A lug-type connected valve shall be used at the end of the line.

Working Pressure: shall comply with at least the PN4 pressure class.

Operating Temperature: -10°C-+100°C

Bolt – Bolt Nut: It shall be Stainless Steel.

O-ring: EPDM

Blade: SS304

Flange Dimensions: It shall comply with DIN 1092 – PN2501 pressure class in TS EN 10-10 standards.

Test: According to TS EN 12266-1 standard, it shall be RATE-A class (zero tightness).

These shall be of the internal screw non-rising shaft type. It shall turn off clockwise.

Valve shafts/stems shall be made of 316L stainless steel and machined on the bench throughout. Trapezoidal or rectangular threads shall be drawn on the shafts and the threads shall work in a red bronze nut.

All valves shall be equipped with impellers (with hand flywheels) or extension shaft sockets.

The extension shaft installation shall include all necessary consoles, intermediate supports, etc., and the necessary supplies shall be made for adequate lubrication.

The impellers (hand flywheels) shall be well-walled and of such a diameter as to allow two people to operate the valve. The opening and closing directions shall be shown as casting on the handwheel.

D. Butterfly Valves

Butterfly valves shall be of the type used for air/water according to DIN 3202. It shall be of flanged type in accordance with DIN 2501 (or internationally acceptable standards), DIN 2631 and DIN 2632 (or internationally acceptable standards) according to the line pressure and position shown in the projects.

The fuselage (with slot) shall be cast GGG 40 ductile iron. Unless otherwise stated, the body site shall be EPDM.

Manually controlled valves shall be suitable to be opened and closed by one person.

The flaps shall be supplied with renewable two-way elastic seals. Hinges and internal fasteners shall be made of stainless steel.

Marking: It shall be legible and embossed from casting, and shall include the manufacturer, TS standard, body material, pressure class and rated size, and arrow sign indicating the direction of flow.

Paint: It shall be epoxy oven paint by immersion method according to DIN 3476 or DIN 30677-1 standards.

Test: According to EN 12266-1 standard, it shall be RATE-A class (zero tightness).

Packaging: The products shall be individually packed in plastic bags and stacked on standard wooden pallets and delivered in this way.

E. Ball Valve

Ball valves shall be produced in accordance with the current TSE and DIN norms with full passage flanged from both sides. The valve sphere shall be manufactured in one piece of solid material with the strength to provide full sealing in both directions under pressure and to meet the static and dynamic loads to which it shall be exposed during operation.

Material Properties:

Housing: GGG 40 or GGG 50 ductile iron up to PN 40 atu operating pressure (DIN 1693)

- At operating pressures of PN 40 atu and above, GS-C25 quality steel casting shall be made.

Disc: AISI 304 or equivalent stainless steel

Disc bearing: PTEF - Teflon

Shaft: AISI 304 or equivalent stainless steel

Shaft bearing and bushings: Bronze, delrin, EPDM oring + Polyamide

Gasket: EPDM

Bolts and nuts used in the valve: Stainless steel

Connecting bolts and nuts: Stainless steel

Valve handle: St 37 shall be steel.

2.4.2.18. Check valves

All check valves shall be suitable for operation in the horizontal plane unless otherwise specified.

Carrier stands shall be manufactured under valves larger than 200 mm in diameter. Check valves to be used in air fans installations; Wafer Type Swing Check Valve shall be used between flanges, without springs, with TSE or CE certificates in EN standards, and in appropriate dimensions.

Wafer-type swing check valve shall be used on the foam pump line to be used in the sedimentation pool. The body shall be cast iron GGG40 ductile iron, the flap shall be made of AISI 304 quality stainless steel.

A. Swing Check Valve

Scope: Flat Type, flanged, ductile iron, dimensions and materials shall be TSEK certified in EN standards, in the specified dimensions and quantities, in accordance with the raw wastewater flow.

Body: According to TS 526 EN 1563 / A1 standards; ductile iron shall be made of EN JS 1020 (GGG 40) quality material.

Cover: According to TS 526 EN 1563 / A1 standards; ductile iron shall be made of EN JS 1020 (GGG 40) quality material.

Flap: According to TS 526 EN 1563 / A1 standards; Ductile iron shall be made of EN JS 1020 (GGG 40) quality material and its surface shall be coated with Shore A EPDM rubber material using vulcanization method.

Body Fit: It shall be made of corrosion-resistant MS 58 quality bronze alloy tin or equivalent material.

Shaft: It shall be AISI 410 or 420 or 304 grade stainless steel.

Cover Bolts: In DIN 931 or 933 standards, hexagonal head bolts made of A2 quality stainless steel shall be used.

Other Fasteners: Minimum A2 quality stainless steel bolts shall be used.

Gasket Between Cover and Body: It shall be EPDM or NBR.

Body-Body Site Connection Type: Any of the connection methods shall be used with a screw (threaded connection), tight fit in the press or plastering method.

Operating (Rated) Pressure: It shall be in PN10 pressure class.

Operating Temperature Range: +4 to +60°C

Check Valve Dimensions: Front-to-fore dimensions shall comply with TS EN 558-1 Series-48 straight-type swing check valve standards.

Flange Dimensions: Flange dimensions shall be in accordance with EN 1092-2 standards DIN 2501 – the pressure class of the pipe in which it is used.

Marking: It shall be legible and embossed from casting, and shall include the manufacturer, TS standard, body material, pressure class and rated size, and arrow sign indicating the direction of flow.

Paint: It shall be epoxy oven paint by immersion method according to DIN 3476 or DIN 30677-1 standards.

Test: According to EN 12266-1 standard, it shall be RATE-A class (zero tightness).

Packaging: The products shall be individually packed in plastic bags and stacked on standard wooden pallets and delivered in this way.

They shall have flexible slots and be equipped with heavy-duty external arms suitable for backwashing. If necessary, the levers shall be adjusted to help close with additional load. Check valves shall have an intervention cover.

All check valves shall be suitable for operation in the horizontal plane unless otherwise specified. There shall be covers to ensure convenient transportation and cleaning.

Valves larger than 200 mm in diameter shall have carrier feet.

2.4.2.19. Penstocks

All penstocks be waterproof when closed in the face of certain load conditions. All penstocks in accordance with DIN 17007 (or internationally acceptable standards) All penstocks shall be AISI 304L grade stainless steel. Where necessary, operating devices, shaft bodies, columns, housing, handwheels, guide clamps, etc., shall be provided and placed in the appropriate position. Sliding doors with a body wider than 2 meters shall have double shafts.

The wall thickness of the sheet and profile materials used in the manufacture of penstocks shall be at least 6 mm.

On the shafts, machined, there shall be solid, trapezoidal or square section teeth. Miller shall be stainless steel according to DIN 17440, AISI 304 grade material according to DIN 17007 (or internationally acceptable standards). The shafts of the sliding doors with rising shafts shall be made to move in a transparent polycarbonate housing.

The required extension shafts shall be of the same quality. All materials fastening the screws shall be stainless steel, AISI 304 grade material according to DIN 17007 (or internationally acceptable standards).

Each penstock shall have a handwheel of the appropriate diameter for the work to be performed and shall have a gear device where necessary to ensure operation by a single person. There shall be casting markings on the handwheels indicating the clockwise closing direction.

Operating assemblies (shaft bodies) shall be supplied in stainless steel.

All retaining bolts (anchor bolts), mounting bolts and nuts shall be of appropriate cross-section to withstand the force caused by the operation of the cover. The quantity and dimensions of the retaining

bolts shall be as recommended by the manufacturer. All anchor bolts shall be AISI 304 quality stainless steel in accordance with DIN 267 or TS EN ISO 3506.

Necessary repairs and insulation works shall be carried out within the scope of the work with grout mortar on the frame edges of the sliding doors.

2.4.2.20. Actuators

This specification covers actuators such as valves, gate covers, etc. belonging to motorized (actuator) equipment to be used in the facility.

Together with the integrated motor control unit, electric actuators with on/off and proportional operation type shall work with the traditional control method via two-wire control

A. Electric Power Supply

The following values and ratios are given:

Product	Characteristic	Deviations in continuous operation
Electric motors	380 V – A.C. 50 Hz 3 faz	$\pm 10 \% / \pm 2 \text{ Hz}$
Anti-condensation heaters	It shall be specified.	

Electric motors shall be equipped with high-torque, low-inertia, one-way squirrel cage electric motors.

B. Design and Production Conditions

Actuators shall be designed to ensure that the valves operate correctly and proportionally at 1% intervals from 0%-100%.

Short-term work (S2 – 15 minutes)

Intermittent work; Depending on the actuator diameter and output speed, up to a minimum of 50 runs per hour proportionally.

Actuators must be suitable for operation in any mounting position.

Actuators shall be designed to operate without the need for an external valve panel. All kinds of contactors, relays (Open - DI, Close - DI, Stop - DI, Open - DO, Closed - DO, Fault or error - DO, valve position 4-20 mA analog output) and locking mechanisms that allow the actuators to operate without an external valve panel shall be available in the actuator. The actuator shall output all contact outputs by means of a terminal box.

The actuators shall be controlled by conventional contact outputs. In no case shall there be a need for an external valve control board.

On the terminal box, there shall be all the contacts, controls, 4-20 mA output (position feedback), relay outputs, as well as a 24 VDC terminal in case of external supply. The connection diagram of this junction box shall be submitted to the Employer's Representative after the tender. All connections shall be shown in the diagram legibly and clearly defined.

Actuators should be designed for easy maintenance and repair. Actuator settings should be made via buttons on the motor control unit or by download-upload methods (non intrusive) without the need

for special tools or tools (such as cordless adjustment tools). Actuator settings should be able to be made via Windows-based software running on the laptop. All kinds of programs, cables, adapters, sockets, etc. related to this subject shall be provided by the contractor.

Torque and sensing units must be available to guarantee high-temperature operation. All material used must be suitable for operation in the specified environmental conditions. All kinds of precautions should be taken against corrosion and electrochemical effects that may occur between different metals.

The electrical connections of the actuator must be of the multi-pin socket connection type, so that they can be easily disassembled for maintenance and repair.

The actuator housing must be aluminium alloy and the aluminium surfaces must be corrosion protected.

Actuators must be designed to enter the limit position, torque or any other parameter without opening any part of the actuator (non intrusive).

In order to reduce the number of spare parts required, covers, sockets, etc. should be interchangeable between different diameters.

Actuators must be protected against environmental conditions, all moving joints must be insulated with a radial seal or O-ring.

Actuators must be self-locking. The locking mechanism must also remain in the active position when the actuator is in the hand position.

The actuators shall be IP 68 protected (72 hours at a minimum water depth of 6 meters), and the cable glands required for the required cable connections shall be available on IP 68. The diameter of these records shall be designed to pull a maximum of 200 m of cable, there shall be one cable gland for the energy cable and one for the signal cables. The records shall all be stainless steel manufactured by the actuator manufacturer.

C. Electric Motors

Motors must be specifically designed for valve-actuator operation that requires high starting torque, low jamming torque and low torque.

Motors must be of a fully enclosed type (TENV) without ventilation. The motor housing and covers must be made of salt-resistant aluminium.

Motor insulation must comply with a minimum IEC 85 Class F (155H°C) – H (180°C) norm.

Motors must be protected by thermal contact embedded in the motor windings. Motor connections must be of plug socket type.

Motors must be completely sealed from the oil-filled gear section of the actuator, allowing the motor to be changed without losing any oil, regardless of the mounting position.

Actuator motors must provide full torque when electrified. All motors must have a high starting torque to fully perform the initial movement of the valve.

Each motor must have a label indicating power consumption in accordance with IEC 34.1.

With a speed sensor connected to the motor, torque data shall be memorized and can be controlled at least 50 times per hour.

D. Sizing

Actuators must be selected to provide the torque value that shall guarantee safe operation.

The actuator output torque rating must be valid for the rated voltage 90%.

In order for the electrical equipment to be selected correctly, the current rating at the maximum torque must be specified by the actuator manufacturer. The actuator must be able to close and open under maximum differential pressure within the time specified in the valve specifications.

E. Limit and Torque Measurement

Torque adjustment: between 40% and 100% of the maximum torque value.

F. Local Control

The pushbutton selector switch should consist of LCD display and contactors, the plug should be electrically connected to the actuator via a socket-type connector.

All control, connection, power signal communication, even if experienced personnel are experienced, should be done with different plug connectors or socket type connections in order to prevent errors that may occur during assembly and disassembly.

The operator faceplate must have the following:

- OPEN – STOP – CLOSE buttons.
- Backlit LCD display showing valve position and actuator status.
- Lockable selector switch with LOCAL – OFF – REMOTE functions.
- There shall be LEDs related to the valve position.

G. Motor Control

The engine control unit must have the following functions:

- Reversing contactors (with mechanical and electrical interlocking)
- Microprocessor-based programmable control logic circuit in CMOS SMD technique
- The termination resistors required for bus termination must be located on the communication card and can be selected via switches.
- There must be an electronic timer on the engine control unit. The ON and OFF time, as well as the stepwise start and end times, must be independently programmable for both directions.

H. Indicators

The gauge on the actuator shall show diagnostics, warnings and alarms. In addition, setup and configuration information shall be shown. This information shall be in Turkish.

- OPEN/CLOSE valve position (in percentage)
- It works in the direction of On and Off.
- The timer function has been activated (if specified)
- Nominal value reached (if specified)

- Continuous condition of the valve
- The actuators were operated in the hand position.
- Actuator torque feedback
- Fault notifications
- Phase failure
- Thermal throw
- Excessive torque in the ON direction
- Excessive torque in the OFF direction

I. Anti-Condensation Heater

A heater suitable for continuous operation must be installed inside the actuator to prevent condensation.

J. Protection

The protection class of the actuator, including the motor, must be IP 68 (minimum 72 hours at a water depth of 6 meters) in accordance with EN 60529. It shall work between -10 ... + 70.

K. Hand Wheel

Actuators must be equipped with a hand wheel for manual operation. Clockwise rotation should lead to a clockwise movement in the output shaft. On the front of the handwheel, there should be an arrow pointing in the direction of closed and the inscription OFF.

The handwheel should be of a sufficient diameter to move the output driver with ease.

The business with the hand wheel needs manual separation. In the hand position, the hand wheel should turn the ball screw. There should be automatic locking in the hand position. In the hand position, the motor must be disengaged. The handwheel should automatically disengage when the electric motor is energized. The handwheel must have an external mechanical locking system.

L. Ball Bearings & Gears

Bearings should be frictionless and self-lubricating type. Maintenance and repair should not be required between general checks of the bearings.

Power gears must be made of steel hardened by heat treatments. Worm gears must be made of metal (bronze, etc.) that shall prevent blocking.

The actuator gearbox must be filled with a sufficient amount of oil. Oil changes should not be required between general checks.

M. Tags

There must be two nameplates made of stainless steel, one on the motor cover showing all motor data and one on the actuator box showing all actuator data. Special information such as the valve label number should also be present on the plates.

The labels must be securely fastened to the motor and actuator so that they cannot be removed during transport, assembly, operation or maintenance.

N. Paint and Rust Prevention

Protection against rust must comply with the requirements for salt spray according to DIN 50021.

Actuator paint should be done in such a way that it does not rust under the specified environmental conditions.

All screws or bolts on the outside must be made of stainless steel material.

Surface cleaning of external parts that need to be disassembled during installation or maintenance should be done by electrolytic dip coating or metallic surface protection method.

- Primer: 2 layers of epoxy resin-micaceous iron oxide mixture
- Paint: 2 layers of polyurethane micaceous iron oxide
- Colour: Silver grey (similar to DB 701, RAL 9007)
- Layer thickness: At least 250 µm (micron)

O. Factory Testing & Inspection

Every actuator shall be tested in the factory. Inspections shall be carried out in accordance with IEC standards. (The manufacturer shall give these tests to the Employer's Representative after the tender.)

These tests shall be carried out at the actuator manufacturer's factory under the supervision of the Employer's Representative. There shall be no additional charge for witnessed tests when needed. In addition, it shall be coupled with the valve and tested again at the valve manufacturer's facilities. If both companies are separate, both companies shall be responsible for valve actuator compatibility.

A final inspection report must be provided for each actuator with the following information:

- Actuator general information
- Nominal current
- No-load current
- Initial actuation current
- Power Factor at peak torque
- Output speed
- Torque wrench adjustment
- Limit switch setting (turn/ travel)
- High voltage test
- Function test (including all options)
- Visual inspection
- Operating manuals and all documentation shall be provided in printed and digital form.

P. Warranty

All hardware shall be covered by a 2-year warranty. All seals, electric motors and electronic boards that can be used under a 2-year warranty shall be supplied with actuators.

Motorized sliding doors shall open and close using electric actuators. The actuator shall be a double-acting or reversing motor with fully enclosed micro-limit switches. Thus, in all cases, the actuator shall be protected. All motorized sliding doors supplied shall be complete with all necessary wiring (cable harnesses) and electrical control panels.

2.4.2.21. Tanks (Pressure Vessels)

All pressure vessels shall be designed, manufactured and tested in accordance with the EU Pressure Vessels Directive or ASME.

All atmospheric and pressure vessels shall be provided with the necessary pipework, instruments, drains, sight glasses, manholes, valves, safety valves, access ladders and connections for platforms to ensure operational safety and ease of maintenance. Where possible, spare connections shall be provided on pressure vessels.

Unless otherwise agreed in writing by the Employer's Representative, the instrumentation shall be capable of being removed whilst the vessel is in service.

Valves shall be impermeable to dust, sediment and vermin.

Pressure vessels shall be designed to operate efficiently and safely under all applicable process conditions, and shall be capable of operating under full vacuum where even a small vacuum is expected.

Structural steel supported vessels shall be designed to accommodate thermal expansion resulting from the cascading effect on the associated equipment connected to them.

Each tank shall be fitted with a nameplate which will bear the following information:

- Name and address of the manufacturer;
- Year of manufacture;
- Vessel identification number (e.g. V001 in accordance with the classification system);
- Description of the vessel (e.g. steam drum);
- Materials of construction (e.g. 316 Stainless Steel);
- Pressure equipment approval certificate directive CE marking; Volumetric capacity;
- Design pressure and temperature;
- Test pressure.

2.4.2.22. Heat Exchangers

Heat exchangers shall be of the tube type unless otherwise agreed in writing with the Employer's representative. They shall have sufficient space to enable them to maintain their design operating temperatures under all operating conditions and to transfer the calculated amount of heat. Aluminum shall not be used in the construction of the heat exchanger. When fluctuations in the temperature and pressure of the fluid, i.e. changes in ambient temperatures and water network pressure cannot be reasonably controlled, full allowance shall be made for these.

Heat exchangers shall be designed to continue their heat transfer duties even if the pipes are blocked by up to 10%.

In case of possible contamination of the heat transfer surface, additional heat transfer surface shall be provided to enable the calculated heat amount to be transferred.

In the facility, it shall be ensured that the automatic shutdown of the heat exchanger that has been operating until that moment while the spare heat exchanger is being started shall not affect the operation of the facility as a whole. The design shall not allow both heat exchangers to be disabled unintentionally at the same time.

In cases where it is necessary for the safe operation of the facility, automatic switching from the faulty heat exchangers to the spare exchanger without any loss in fluid flow shall be provided. This requirement shall be valid for all types of heat exchangers. The application and method to be used in this regard shall be agreed upon with the Employer's representative.

Construction materials shall be selected from the most suitable materials that can resist rust and corrosion of working fluids. Cast iron shall not be accepted as a suitable construction material.

The heat exchanger shall be inspected and cleaned on site without detailed disassembly. It shall be possible to disassemble the tube bundles on site without affecting other equipment in the area. Any necessary tools or lifting equipment shall be provided for their disassembly.

Valves and drains shall be provided on each heat exchanger to enable the heat exchanger to be drained for inspection and maintenance purposes and to remove gases. The drain shall discharge into a suitable drainage system or other approved collection system.

Discharge valves shall be provided where necessary.

Where applicable, wastewater shall be drained upwards from the heat exchangers and the design shall be such that contamination of the heat transfer surfaces and water reservoir is minimized.

2.4.2.23. Fans

All fans shall be directly driven by an electric motor unless otherwise approved in writing by the employer's representative.

The aerodynamic efficiency of the fans shall be high and the rotors shall exhibit stable operating characteristics without stopping. The rotors shall be correctly balanced to ensure noise and vibration free operation.

Variable flow shall be provided by using an automatic actuator throttle damper (where necessary).

All fans shall be fitted with a suitable grille on the upstream side of the impeller to prevent damage. In addition, guards shall be provided around all rotating parts to protect personnel.

All fans shall be easily accessible so that both maintenance and replacement operations can be easily carried out.

There shall be a suitable measuring point upstream and downstream of the fan impeller to determine the pressure difference across the fan.

Adjacent ductwork and all fan enclosures shall be reinforced as necessary to prevent mechanical or flow induced vibrations.

2.4.2.24. Air Compressors

To ensure the effective removal of fly ash, soot, and similar pollutants generated during system operation from equipment, ducts, and piping, and thereby enhance the performance, efficiency, and

operational lifespan of the equipment, soot blowers, jet pulse systems, or other similar pneumatic cleaning systems shall be integrated into the facility.

In order to provide these pneumatic systems with a continuous, reliable, and adequately pressurized air supply, the Contractor shall be responsible for the supply, installation, piping, connection works, and commissioning of air compressors in suitable quantities, capacities, and locations in accordance with the system design.

The air compressors and associated equipment to be supplied shall be properly sized to meet the system requirements, suitable for automatic operation, and compliant with relevant national and international standards. Furthermore, the layout shall be planned to allow easy access for maintenance and operational convenience.

All air compressors shall be directly driven by electric motors and shall be mounted in a manner that is vibration-proof.

Compressors shall be provided with all necessary local controls, instrumentation and alarms mounted in the cabin. The following alarms shall be monitored from the control room with the controls and instrumentation as a minimum:

- Compressor error (including dryer error)
- Air tank pressure low

A silencer and filter with disposable dryers shall be installed on the air intake of each compressor. The filter shall be capable of removing moisture and particles up to 10 microns in size.

2.4.2.25. Lifting Equipment

A. General

- All materials, installations and equipment to be used in the manufacture of cranes shall be in accordance with DIN and TSE standards.
- Crane equipment; It shall be designed to reduce noise and vibration transmission (anti-oscillation system) as much as possible.
- On both sides of the crane, there shall be an inscription indicating the lifting capacity (t) and crane span (m) in a size that is easily legible throughout the crane line.
- It is the responsibility of the contractor to supply and install all kinds of devices, materials, equipment that may be required to ensure the commissioning and operation of the cranes, and all kinds of measuring instruments, hand tools, etc. that can be used during assembly. The contractor shall provide all kinds of construction machinery and equipment to be used in construction, manufacturing and assembly works.
- The contractor shall deliver the technical materials and diagrams describing the theory and operation of the cranes it undertakes to provide to the Employer's Representative in Turkish.
- The materials to be used in the systems to be installed shall comply with the relevant articles of the Occupational Health and Safety Regulation of the Ministry of Labor and Social Security.

- The crane shall be tested according to the relevant standards before being handed over to the Employer. Checks shall be made by the Chamber of Mechanical Engineers and work and assembly conformity certificates shall be delivered to the Employer's Representative.

B. Overhead Crane and Monorail Crane

It shall have a lifting system with a double speed inverter.

Main Hook Lifting Speed	: 0.2-4 m/min (380 V AC INVERTER)
Car Walking Speed	: 5-15 m/min (380 V AC INVERTER)
Bridge Walking Speed	: 5-20 m/min (380 V AC INVERTER)
Lifting Motor	: 1 x 380 V, 50 Hz Induction motor
Lifting Brake	: Electromagnetic Disc Brake
Rope Wrapping Shape	: Guided system
Rope Hardware (Hemp Core)	: 4/1 or 4/2 or 2/1 shall be selected according to the approval of the Employer's Representative.
Car Execution Brake	: Electromechanical Disc Brake
Car Executive Reducer	: 1 x Single Input Shaft, Single Output Shaft
Hook Type	: DIN 15401 (Single mouth, safety latch, forged steel)
Car Execution Drive System	: Pinion Driven
Walking Wheels	: It shall be made of cast steel or forged steel, bearing and in accordance with DIN norm.
Rope Drum	: It is manufactured by steel drawn pipe or centrifugal casting and shall be grooved in accordance with the diameter of the rope.

When the hook is at the lowest level, there shall be 4 winding ropes on the drum.

There shall be a round switch and a magnetic switch that counts the drum turn in the hook up and down motion.

Against unbalanced loading, the lifting group car wheels shall be articulated.

There shall be an audible and led light warning system.

The bridge and cat shall have rubber stop wedges.

Bridge deflection rate : 1/1000 (DIN 15018)

The painting method shall be 1 layer of 25μ primer, 1 layer of 60μ and 1 layer of 40μ industrial epoxy painted after surface cleaning (min. SA 2.5 sandblasting).

There shall be a wired controller. The length of the control cable shall be suitable for the point where the personnel shall control from the ground.

The monorail controls to be supplied for biophosphorus shall be waterproof. There shall be a motor housing on the crane motor to prevent water from passing it.

C. Electrical & Electronic Equipment

- All motors in the system shall be 380 V, 3 phase, 50 Hz squirrel cage short circuit rotor asynchronous motor and all motors shall be thermally protected. The lifting and walking motors in the crane shall be controlled by means of motor drivers. Drivers; It shall have the feature of soft start, soft stop and speed adjustment to prevent shaking, hook swing and other negativities.
- The cables required for the transmission of electrical energy to the carriage shall be transported by an appropriately sized energy chain transport channel. Power transmission cables shall have insulation that is resistant to machine oil, water, and dirt and debris that may occur in the environment.
- There shall be an anti-overspeed and speed-limiting safety system for all movements in the system.
- The movements of the carriage and the lifting group shall be limited by the last switches.
- There shall be an overload switch on the crane. This switch shall disable the crane by disconnecting the control circuit when more than the rated load is desired to be lifted.
- The cables used in the moving parts of the crane shall be rubber-insulated, flexible cable.
- Test Loads; Static load shall be tested with 40% more than the crane capacity, and dynamic load shall be tested with 20% more than the crane capacity.
- During the operation of the crane, at idle and rated load, seizure, shaking, shaking should not be felt, and abnormal sounds should not be heard due to friction, etc.
- The overload switch shall be tested by loading more than the rated load. In addition, the energy shall be cut off at various heights and a brake inspection shall be carried out with this load.

D. Delivery

All of the calculations, technical drawings and projects of the crane, physical and chemical test reports of the materials of the wheels, reducer body and rope guide, project, circuit diagram, operating instructions, maintenance instructions of the electrical system and technical documents such as diagrams, pictures, plans, etc., list of materials for the parts that need to be changed periodically, supply address and pictures, diagrams of these materials, technical documents such as plans shall be submitted to the Employer's Representative.

The crane can be moved in all directions and speeds by controlling it from the ground with the buttons on the main control panel with mobile movable type buttons that go and go at the level of the hoe or hoist.

Single or double girder crane bridges shall be of the bottom flanged type and shall be constructed of universal girders or high-quality steel box girders. These beams shall be manufactured in a single piece of welded joints with the rolled steel profile at the ends and the carrier ends, forming a rigid structure that shall withstand all loads.

Crane rails shall be securely welded to the upper flanges of double girder crane bridges.

The crane rails shall be seated on the concrete cantilevers shown in the fabrication projects. It shall allow the rails to expand.

The carrier wheel assemblies at the ends shall have a derailment and protective brake device that prevents the wheels from falling lower than 10 mm.

The wheels of transverse and longitudinal movement shall be of forged or cast steel, with double flanges. The edges of the wheels shall have the same diameter and shall be rounded so that they fit on the rails. The wheels shall be with roller bearings.

The gear mechanism shall work in the oil, fully closed with the reducer box. Wheel gears can be lubricated with grease.

The motors shall be capable of working continuously for 1 hour at full capacity and shall be IP 54 Class protected.

Checks shall be made by the Chamber of Mechanical Engineers and work and assembly conformity certificates shall be delivered to the Employer's Representative.

E. Jib Crane

The jib crane shall be made of hot-dip galvanized steel and automated and/or manual type. However, the locking windlass shall be stainless steel. Stainless steel load rope with a thickness of at least 8 mm shall be used as a rope in jib cranes.

2.4.2.26. Polymer Preparation and Feeding System

The polymer preparation system shall include, but is not limited to:

- One stainless steel hopper bottom stock/hold/mixing tank.
- Variable speed, heated eccentric (eccentric) dry poly dosing pump with auger impeller
- Drying nozzle and dispensing unit to prevent caking to mix the polymer with water.
- High-speed polyelectrolyte dissolving chamber
- Low-speed polyelectrolyte maturation section
- Poly dosing pumps suction section (There shall also be a mixer in this section.)
- There shall be stainless steel ladder and platform with railing for polymer loading.
- All other components required for a complete polymer preparation system shall be supplied.

The three-chamber polyelectrolyte preparation tank shall be made of AISI 304 quality stainless steel material.

The polyelectrolyte preparation unit shall have PLC layout, including water supply and proportioning system, level control for each eye, fully automatic, automatic control panel with the possibility of preparing polyelectrolyte solution at the desired concentration. The unit shall be programmed to automatically make the desired dry poly dosage at the set poly concentration according to the water flow rate entering the poly reservoir instantly. Instant data received from the unit (inlet water flow, poly concentration, poly pump information, etc.) can be read on the digital screen on the control panel. The dry poly dosage structure shall be designed in such a way as not to allow agglomeration of poly within the unit. There shall be resistance and vibration motor in the dry poly dosing chamber

and the dosing screw to prevent the polynin from solidifying. The capacity of the dry poly dosing pump shall be at least 5,000 lt/h.

For the water inlet flow rate, both a mechanical water meter and an electromagnetic flow meter shall be installed on the line. The water pressure in the line shall be measured by a pressure transmitter to be mounted on the line. The dry poly dosing pump shall have a frequency converter and the frequency value shall automatically vary according to the instantaneous water flow entering the poly tank and the set poly concentration value. Dry poly dosing shall be done continuously as long as there is water inlet into the tank.

The supply and signal cables on the poly preparation unit shall be passed through the cable trays and there shall be no exposed cables.

The poly preparation unit shall be made entirely of AISI 304 quality stainless steel material, including tank body, observation covers, feet, mixer mixers, all fittings, local control panel, relief valves and piping, ladder and platform structure. For cleaning operations of poly preparation units, there shall be chamber covers and sight covers of sufficient width. There shall be stainless steel spherical type bottom discharge valves for each section of the poly preparation unit. The stainless steel flood line taken from the upper level of the first chamber of the unit shall be connected to the filtrate water drain. The relief valves shall be connected to each other by the collector, and this collector shall also be connected to the poly dosing pumps suction line and the filtrate water drain. The poly preparation unit shall be located at a height above the suction level of the poly solution dosing pumps.

There shall be an ultrasonic level meter that instantly measures the solution level in the poly tank, and the water inlet and poly dosage at the overflow level shall be closed automatically. At the lower level alarm, the poly dosing pump shall automatically shut off and the decanter shall automatically switch to flushing mode.

The mixers shall be 1 direct-coupled fast mixer and two slow mixers (there shall be a mixer in the last compartment of the three-chamber poly preparation tank to prevent poly clumping). The material of the mixer, fan and shaft shall be made of AISI 304 quality stainless steel material. The dry dosing unit shall be made of AISI 304 quality stainless steel. For the cleaning of the poly preparation units, there shall be chamber covers of sufficient width.

The polymer preparation unit shall be a stand-alone unit and can be controlled automatically from SCADA with a local at least 7 inch control panel. The inlet water flow rate of the poly preparation unit shall be measured with the flow meter to be mounted on the water line, and the water pressure shall be measured with the pressure transmitter to be mounted on the line. For the water inlet flow rate, both a mechanical water meter and an electromagnetic flow meter shall be installed on the line. Instantaneous water flow, instantaneous water pressure and dry poly dosing pump frequency information entering the poly preparation unit, mixer mixers are working and fault information and tank level information can be controlled and controlled via the local control panel and SCADA automation system. It shall work fully automatically according to the poly concentration set through the poly preparation unit or SCADA. The dry poly dosing pump shall have a frequency converter and the frequency value shall automatically vary according to the instantaneous water flow entering the poly tank and the set poly concentration value. Dry poly dosing shall be done continuously as long as there is water inlet into the tank. All of these processes can be controlled and controlled through the SCADA automation system.

All necessary flow control valves, suction screen on the polymer pumps, level switch on the polymer tank and pressure switch on the outlets of the dosing pumps (connected to the automatic control system). All connecting pipes for the equipment listed in this clause shall be included.

Polyelectrolyte dosing pumps shall be made with mono pumps. The dosing pump shall be controlled by the frequency converter.

There shall be electro-magnetic flow meters on the polymer dosing lines.

The pump shall be adjustable by frequency converter. Compression Pump body shall be ductile iron, stator shall be NBR rubber, rotor shall be chrome nickel stainless steel.

Pumps shall be delivered ready for operation with control panels and frequency converters. The pumps shall be started with a frequency converter and shall allow operation at the desired poly supply flows.

A deaeration valve, cleaning valve and pressure gauge shall be installed on the poly dosing pumps pipeline.

Within the scope of this work, the supply and installation of these equipment, the necessary piping and valveing for the connections in the sludge dewatering building, all kinds of supports, anchors, supports, connection and fixing elements, tests, electrical and automation connections shall be made. All elements to be used shall be AISI 304 quality stainless steel material.

Poly solution can be given to the static mixer inlet when desired, and directly to the decanter inlet when desired, from the bypass and guidance line. All elements used in this regard shall be made of AISI 304 quality stainless steel material.

Polymer suction and discharge lines shall be AISI 304 quality stainless steel pipes. Gate valve shall be installed on the suction and discharge line of each poly dosing pump.

2.4.2.27. Electromagnetic Flowmeter

The electromagnetic flowmeters to be used shall be used to measure the wastewater flow values and shall work with the Faraday measurement principle.

The electromagnetic flowmeters to be used shall have an empty pipe detection electrode, reference electrode and 2 measuring electrodes as standard. In order for the measurement to be precise and reliable, the flow meter must be able to equalize the potential of the fluid and the sensor. The electromagnetic flowmeter shall have the ability to detect empty pipes. In addition, the electromagnetic flowmeter installed in the field shall be provided with grounding rings in both directions in order to protect it from in-line electrical noises and cathodic protection that shall adversely affect the measurement.

According to the preference of the Employer's Representative, the body and flange parts of the flow meters can be supplied as a single piece (integrated) with the transmitter or as a separate type transmitter.

There shall be no moving and protruding parts in the electromagnetic flowmeter that shall disrupt the flow rate and cause pressure loss.

Flowmeters shall be able to measure with an accuracy of 5xDN at the inlet and a maximum of 3xDN at the outlet with an accuracy of 0.5% ± as standard.

The flowmeter should be capable of allowing the user to select the key points for low flow cut-off.

In compact (integrated) type flow meters, the protection class of the sensor and transmitter shall be IP 66/67. For the discrete type, the sensor protection class shall be IP68 and the protection class of the transmitter unit shall be IP 66/67. This is how it shall be delivered from the factory.

The discrete type flowmeter shall be suitable for 3m (≤ 10 ft) operation permanently under ground or corrosive water. It shall comply with EN ISO 12944 Im2 and Im3 class in order not to be affected by corrosive atmospheric conditions.

The excitation currents of the coils shall be pulsed.

The housing part of the transmitter unit of the flow meter shall be made of aluminum or polycarbonate material, and the inner coating of the flow meter shall be made of polyurethane, hard rubber, or any of the teflon materials. The inner coating of the flowmeters to be purchased shall be made of material that shall not be affected by the fluid passing through the flowmeter and shall not be exposed to any deformation due to the particles inside. This is necessary for the longevity and precise measurement of the flow meter.

The electrodes shall be made of stainless steel 316L, Hastelloy C or tantalum material.

Converter / Transmitter units shall be of full electronic type with microprocessor and shall have a built-in sensor calibration memory.

The transmitter unit shall be menued in Turkish or English.

Flow meters shall be able to measure bidirectional flow in liquids with a minimum conductivity of 5 $\mu\text{S/cm}$. The sensors of the flowmeters shall be able to measure bidirectionally without the need for additional adjustment. The device shall be able to measure conductivity as standard.

Upon request, the device must be available in accordance with one of the following communication protocols: HART, Profibus DP, Modbus RS485 or Ethernet/IP.

Upon the request of the Employer's Representative, electronic cards that can be integrated with the existing transmitter, provide instantaneous flow value 4-20mA, total flow value over pulse/frequency, and have contact output can be supplied as spare materials. With the replacement of the relevant spare parts, the device communication shall be transformed into Hart protocol.

The supply of electromagnetic flowmeters shall be both 100-220 VAC and 24 VDC.

Flowmeters can be supplied with a signal cable from 10 meters to 200 meters (cable between tube and converter / transmitter) at the request of the Employer/Employer's Representative. Cable quantities shall be indicated in the unit price table.

The flow meter should show the instantaneous flow and total flow value on the screen and should be able to transfer it to the output when desired. The flowmeter shall have 4 in-line digital displays, both instantaneous flow and total flow values can be seen on the screen at the same time. Thanks to the touch keypad, the menu can be accessed and programmed without opening the transmitter cover. If requested, it shall be available with WLAN feature.

The flow meter measurement accuracy shall be at least 0.5%. If requested, it shall be available with an accuracy of $0.2\pm\%$. Each flowmeter shall be calibrated at least 2 points in an accredited calibration center in accordance with the international ISO 17025 standard and delivered with a calibration certificate.

The repeatability of the device shall be a maximum of $\pm 0.1\%$ for flow.

The flowmeter shall be able to measure at speeds up to 0.05–10 m/s.

The body and flange parts of compact (integrated) type flowmeters are in DIN standards; It shall be manufactured as a single piece (integrated) together with the flow meter. The flange parts of the flowmeters shall be made of carbon steel or stainless steel material. Flowmeters shall have a pressure protection class of at least PN10. Flanges are epoxy coated painted against corrosion in all pressure classes and shall be delivered from the factory as such. For a discrete flowmeter, the corrosion protection of the sensors shall comply with the EN ISO 12944 C5-M/lm1 standard.

Electromagnetic flow meters shall be able to detect that there is no water in the pipe (empty pipe detector).

The material in contact with the process medium shall be capable of withstanding the corrosion and erosion properties of the measured fluid.

The bodies of electromagnetic flowmeters shall be able to operate smoothly at an ambient temperature of -10 °C to +60 °C. When the temperature of the fluid passing through the electromagnetic flowmeters is between 0 °C and +50 °C, the flowmeter shall work smoothly.

The self-verification feature of the device shall be found and it shall be able to generate an electronic verification report.

It should have the ability to self-diagnose and display error messages on the screen in accordance with Namur NE 107 standards. The device shall display error messages and shall be able to transmit these messages as alarms.

In order to prevent data loss, serial number, calibration information, device configuration and status history can be stored online and offline in the device.

The supplier of the equipment must have an authorized technical service provider in Türkiye, be capable of providing technical support for spare parts and fault diagnosis, and hold a TSE 13201 Service Competency Certificate.

A. Pitot Type Flow Meter

A probe-type flowmeter shall be used for gas flow measurement.

The device shall measure flow using a Pitot tube based on the differential pressure within the tube.

The device shall feature an optional low-flow cut-off function, which, when activated, shall suppress small flow rates that may cause large fluctuations in the measured value.

The transmitter of the flowmeter shall have a compact design and be available in both indicator-equipped and non-indicator versions. If required, it shall be offered with Bluetooth functionality.

The sensor may be supplied with either an integrated 3-valve manifold or an integrated 5-valve manifold, depending on the request.

The device shall be available in single or dual housing configurations. The housing material shall be aluminum or 316L stainless steel.

The device shall measure differential pressure, with a measurement range from a minimum of 10 mbar up to a maximum of 40 bar. The sensor diaphragm shall be made of metal, and constructed from 316L, Alloy C276, Tantalum, or Monel.

The ambient temperature range shall be:

- With indicator: down to -20 °C
- Without indicator: from -40 °C up to +85 °C

Devices with integrated manifolds shall be capable of operating under process conditions up to 110 °C.

The device shall support the HART communication protocol and shall have a 4–20 mA HART output.

Process connections shall comply with NPT standards, and be made of either 316L stainless steel or Alloy C276.

2.4.2.28. Fire Extinguishing Systems

Fire extinguishers shall be provided in all control rooms, laboratories, offices, workshops, and other areas where the risk of fire exists.

Depending on the type of potential fire, extinguishers shall be of the following types:

- Water Type
- Dry Chemical Powder Type
- BCF (Halon) Type

Generally, water-type fire extinguishers shall be used in Class A fire zones and shall have a capacity of 9 liters.

Dry chemical powder and Halon-type extinguishers shall be used in electrical, chemical, and petroleum-related fires, and shall contain a minimum of 5 kg of extinguishing agent.

All fire extinguishers shall be color-coded, clearly marked with their type and the class of fire they are suitable for, and shall comply with the relevant sections of TS, DIN, or BS standards.

The number and location of fire extinguishers shall be determined in accordance with local requirements and in coordination with the Employer's Representative.

A sprinkler system shall be installed in all buildings where there is a risk of fire. The designs of the sprinkler system must prepare according to Employer's Requirements I – General Information Clause 1.4. Technical Standards and Applicable Regulations and shall be submitted to the Employer's Representative for review and approval.

2.4.3. Specific Specifications of Mechanical Works

The materials of the Hurma WTE Facility shall comply with the latest Turkish, European and International standards and shall have, as a minimum, the following requirements:

2.4.3.1. Sludge Acceptance/Storage Unit

Silos shall be manufactured from ST37 (S235JR) material. The wall thickness of the silo shall be at least 12 mm.

2.4.3.2. Sludge Pre-drying Unit

Manufacturing and testing of steel pipes and hot air pipes shall be executed in accordance with the EN 13480 "Section 4 Manufacturing and Installation" and EN 13480 "Section 5 Testing Procedures".

- i. All Materials of the sludge drying unit that contact the steam should be AISI 316 SS.

- ii. Electrical motors should comply with the DIN EN 60034 / IEC 60034.
- iii. Insulation of the electrical equipment's motors should have F-class insulation.
- iv. The maximum temperature of the environment should be 50 °C.

2.4.3.3. Condenser

- Steam supply for the energy of the drying system
- Steam condensers made of AISI 316 stainless steel,
- Heat transfer pipes and ducts made of AISI.316 stainless steel,
- Heat exchangers made of heat resistant steel,
- An integrated air intake system to minimize PM (dust) leakage and emission/odour from the equipment,
- Explosion ventilation system and explosion prevention systems that comply with VDI and other guide systems referenced herein (The oxygen level in the dryer shall not exceed 7% during operation),
- Complete instrumentation and control package with all control panels, PLC, MCC and I/O connection points for remote control required for a complete system, insulation of the dryer to minimize heat losses and protect the operating personnel (Insulation material shall be at least 1 mm thick)
- AISI 316 stainless steel sheathing.
- Access facilities include platforms, side roads, stairs, handrails and ladders,
- The completed facility shall include machine guards and all necessary work and worker safety measures and procedures (all necessary permanent equipment required by American, European or local health and safety regulations.)
- Electrical system components, motors, motor control centers, electrical power panels - Waste heat obtained from the dryer shall be utilized.
- The Contractor shall provide a complete instrumentation and control system for the sludge drying system. This system shall include all materials and documentation required for the installation, testing and operation of a complete and operational instrumentation and control system as defined. The system shall include all measurement units, control devices, local control panels, signal converters, transmitters, motor control centers, digital software and hardware, work stations and communication network to provide the specified functions.
- The Contractor shall reduce the emission/odour and PM (dust) values to the permissible limit values in the relevant legal legislation by providing a suitable design and ventilation, as required by this specification.
- Storage spare parts (main bearings, bearings, reducer, motor, main equipment components) shall be provided for the necessary equipment in the drying facility.

2.4.3.4. Fluidized Bed Incinerator (FBI) Unit with heat recovery system

A. Bedding materials:

The bedding material shall consist of dry silica with a moisture content below 1%. Sand shall be used that does not contain chloride, sodium, or potassium components. The sand shall not melt or show a tendency to melt at 985°C. The sand grains shall not be rounded, and the bulk density of the sand shall be approximately 1600 kg/m³ (minimum 1450 kg/m³).

Materials for FBI furnace manufacturing and construction:

Reinforced Concrete	Construction Materials	TS EN 1998-5 TS 500 TS 648 TS EN 771-1 TS 2510 BS 8007 EN 1992-3 TS 825
Steel	Plates	P295GH or equivalent EN10028-2
Steel	Structural elements	P295GH or equivalent EN10028-2
Steel	Pipe	ST 45, EN 10025 S235JRG2 ST 37-2, EN10025 S235JR DIN1629 ASTM A53 Grade B
Steel	Flanges	Flat face plate flange material ST 37-2 DIN1629 ASTM A 36 EN10025 S235JR
Steel	Tension strips	Terebration ASTM A36 ST 37-2 DIN 1629 In accordance with ANSI/ASME B16.5 Class 150 690 kN/mm ² hot worked steel

Stainless steel	Sheet and steel	According to need Type 304, 310, 316L or 330 EN1.4301 EN1.4841 EN1.4404
Stainless steel	High temperature pipe assembly and auxiliary devices	According to need A-167 Type 304, 316, 316L EN1.4301 EN1.4841 EN1.4404 330 or 625
Stainless steel	Low temperature hair and plate	ASTM A-167 Type 304, 316, 316L EN1.4301 EN1.4841, EN1.4404
Refractory		Refractory properties are given under the subheading of refractory and coolant.
Coating	The interior of the furnace, the hot air chamber, and the flue gas exiting the furnace and directed to the heat exchanger. Non-insulated high-temperature surfaces of the thermal oxidation system.	Coating systems shall be approved by the Employer/Employer's Representative. Shall be constructed as recommended by the furnace designer and manufacturer to keep corrosion to a minimum.

FBI furnace structure:

FBI furnace steel body

FBI furnace body shall be manufactured from carbon steel in accordance with P295GH or equivalent EN 10028-2 standards, and the metal thickness of the hot air chamber, conical bed, and other parts shall be a minimum of 14 mm.

Inner surface

Inner surface, FBI furnace body, including FBI furnace flue gas channel, from the refractory belt to the roof curves, not behind the roof curves, shall be coated with sodium silicate and ceramic fiber paper.

Steel body

Before shipment, the inside and outside of the steel body shall be sandblasted and primed in accordance with BS4232/SSPC-10 (Near White) standard.

Nozzles

Nozzles and their welded flanges, sealing rings and snap-on type rings made of 316 SS stainless steel shall be used unless otherwise specified. Door frames, doors, burner casing, preheat air inlet casing, flue gas outlet casing, sealing rings, support rings and structural members shall be manufactured from St37-2/EN10025 S235JR/DIN1629/A36 carbon steel.

Furnace refractory lining

The refractory thicknesses specified in this specification are minimum values and actual values shall be increased (if necessary) to provide the maximum cold face surface temperature listed in the design requirements

Refractory belt

The castable type refractory belt supporting the fluidized bed shall be a self-supporting belt and shall consist of high temperature alumina. The specifications for acceptable refractory materials shall be as follows:

Pyrometric cone equivalent

(BS EN 993-12-13/BS 1902-5-2/ASTM C24) : 33–34 (1740–1760°C)

Hot load test

(BS EN ISO 1893/ASTM C16) : % 0.5 – 3.5

Deformation at 1450°C

Reheat (Permanent Linear Change,

(ASTM C113) : 0 – 1.3% shrinkage at 1600°C

Apparent porosity

(DIN EN 993-1/ASTM C20) : 11 – 18%

Specific gravity

(DIN EN 993-1/ASTM C20) : 2080 – 2245 kg/m³

Modulus of rupture

(BS7933-4/BS EN 754-2/ASTM C133) : 70 – 99 kg/cm²

Cold compression resistance

(BS7933-4/BS EN 754-2/ASTM C133) : 245 – 315 kg/cm²

Tuyeres (hot air blowing nozzles) shall be firmly placed inside the refractory belt using refractory cement.

Tuyeres shall be designed in such a way that no sand is transferred to the hot air chamber during the processes when the incinerator is operating and not operating, when the incinerator is activated and closed.

Refractory Material Properties

The nominal strength of all refractories shall be determined in accordance with BS EN 993-12-13/BS 1902-5-2/ASTM C24: "Standard Test Method for Refractory Material Pyrometer Cone Equivalent."

The conditions regarding the refractory shall be as defined in BS 3446:1962/ASTM C71.

Insulation materials shall be applied as specified below. The materials shall comply with the latest edition of one of the ASTM, EN, BS, DIN, or ISO standards listed in table below.

Insulation materials and properties:

Material	Feature
Fire-resistant clay and high alumina, especially refractory brick.	BS-EN1094-1/ASTM C27, resistant to very heavy loads
Fire-resistant brick for insulation	PD IEC/TR 61946/ ASTM C155, Group 20
BS EN ISO 10081/ASTM C401; C401; Class C Normal or Class N	
Pourable refractory material	Isolating feature
Mortar	BS ISO 13765/BS ISO 10059/ BS EN 993-1/BS EN 1902-4/ ASTM C198
Loose fill insulation	Metallic wool
Ceramic fiber insulation	Necessary thickness calculated by the contractor

2.4.3.5. Energy Recovery Unit with Steam Turbine

A. Hot Air Heat Exchanger Material Specifications

The construction materials and the heat exchanger metal shall have minimum properties and thicknesses as specified in table below.

Properties of Materials and Heat Exchanger:

Material	Features
Body	St37-2/EN10025 S235JR/DIN1629/A36 carbon steel with a thickness of 7.6 mm
Plenums	St37-2/EN10025 S235JR/DIN1629/A36 carbon steel 8 mm thickness
Tubular expansion elements	Alloy 625 – Bellows
Alloy 800 HT Welding tips	
Main expansion elements	Alloy 625 – Bellows
Tubes	Alloy 20
Upper tube sheet (hot)	Alloy 800 HT, minimum 50 mm
Lower tube sheet (cold)	Alloy 625
Separation curtains and support irons	Tip 304L stainless steel, 30 mm

Refractive thickness	It shall be calculated by the contractor.
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B. Waste Heat Boiler

The waste heat generated by the Fluidized Bed Incinerators (FBI) shall be recovered in order to improve overall energy efficiency and utilized through dedicated waste heat steam boilers. Each waste heat boiler shall be designed to operate safely and reliably across the full load range up to its maximum steam generation capacity. The load change response of the boiler shall be compatible with the dynamic characteristics of the associated fluidized bed furnace.

Each waste heat steam boiler system shall include, as a minimum, the following main components:

- Superheaters
- Steam drum
- Ash collection system
- Thermal insulation and boiler cladding
- Safety valves
- Blowdown valves
- Control panels
- Instrumentation and control devices

The superheaters integrated with the waste heat boiler shall be designed to generate steam at a minimum temperature of 400 °C, and this steam shall be supplied to the designated turbine at adequate pressure and flow rate to ensure stable and continuous operation.

A complete steam soot blowing system shall be installed, through which all soot deposits formed on the heat transfer surfaces of the entire heating unit shall be effectively and continuously removed.

The materials to be used in the manufacturing of the Waste Heat Boiler shall comply with the standards given in the table below.

Materials and Standards

Material	Standard
Connection, piping, and support	In accordance with the relevant Turkish and European Standards.
Piping for control air collecting pipes and control and instrument air lines.	In accordance with the relevant Turkish and European Standards.
Instrument lines within the enclosures	ASME A213 Type 316 H alloy steel piping DIN 17456/58 EN 10216-5, BS3606
Special connection parts	ASME A234 or ASTM A217 carbon and alloy steel pipe fittings DIN 1.5415, 1.7335, 1.7380, 1.7362, 1.4903 DIN EN 10213
Bolts and washers – structural steel	ASTM A325 high-strength bolts

	DIN 933
Thermal leveler	Inconel A4-10d Equivalent to BS, EN or DIN
Connection points for air and flue gas circuit instruments	ASTM A 132 Type 304 stainless steel Equivalent to BS, EN, or DIN
Material for aluminum water pipe	ANSI C80.5 and UL 6 Equivalent to BS, EN, or DIN
Metal pipe fittings	ANSI C80.4 and UL 514B BS, EN or DIN equivalent
PVC-covered flexible waterproof hose	UL 360, BS, EN or DIN equivalent
Metal outlet boxes	UL 514A Equivalent to BS, EN, or DIN
Non-metallic outlet boxes and covers	UL 514C Equivalent to BS, EN or DIN

C. Steam Turbine and Generator System

The system shall be designed to operate safely under all loads up to the maximum steam quantity anticipated at initial startup.

The design and materials supplied under this specification shall meet all requirements specified in NFPA 70 or its equivalents in BS, EN, ISO, or TSE standards.

The materials to be used in this package and the standards they must comply with are provided in table below.

Material/Component and Standards

Material	Standard
Connection, piping, and support	In accordance with the relevant Turkish and European Standards.
Piping for control air collection pipes and control and instrument air lines.	In accordance with the relevant Turkish and European Standards.
Instrument lines within the enclosures	ASME A213 Type 316 H alloy steel piping DIN 17456/58 EN 10216-5 BS3606
Special connection parts	ASME A234 or ASTM A217 carbon and alloy steel pipe fittings DIN 1.5415, 1.7335, 1.7380, 1.7362, 1.4903 DIN EN 10213

Special connection parts	ASTM A325 high-strength bolts DIN 933
Thermal leveler	Inconel A4-10d TS, BS, EN, or DIN equivalent
Connection points for air and flue gas circuit instruments	ASTM A 132 Type 304 stainless steel Equivalent to TS, BS, EN, or DIN
Material for aluminum water pipe	ANSI C80.5 and UL 6 TS, BS, EN or DIN equivalent
Metal pipe fittings	ANSI C80.4 and UL 514B TS, BS, EN or DIN equivalent
PVC lid liquid-proof flexible water hose	UL 360 Equivalent to TS, BS, EN, or DIN
Metal outlet boxes	UL 514A Equivalent to TS, BS, EN or DIN
Non-metallic outlet boxes and covers	UL 514C Equivalent to TS, BS, EN or DIN

2.4.3.6. Flue Gas Emission Control Unit

Emission treatment units shall be designed in consideration of sustainable operation management. The flue gas system in which the emissions formed after incineration are released to the atmosphere after treatment shall be included in the Hurma Waste to Energy Facility. Emission treatment units shall be designed to operate in series as dry type and/or if necessary, wet type. (i.e. multicyclone, chemical dosing units and reactors, electrostatic filter, bag filter unit (mandatory))

If a wet type treatment system is proposed in addition to the dry type treatment, the impact of the wet treatment system on the overall thermal efficiency and the adequacy of the dry type treatment system shall be assessed during the technical evaluation. In case of wet type treatment systems being found inefficient or not acceptable in terms of performance, they may be rejected based on the evaluation results, and only the dry type treatment system shall be considered in the assessment of compliance with the Employer's Requirements.

There shall be an ash collection tank (with separation plates) at the bottom for the dust captured in the cyclone, sampling nozzles at the inlet and outlet, pressure and temperature indicators, and ventilation plates. Since the exhaust air temperature passing through the cyclone is high, appropriate insulation shall be manufactured. Before the bag filter, lime or bicarbonate dosages or any other chemical dosages recommended by the Contractor in the design shall be made for the removal of acidic gases such as SO₂, H₂S, HF, and HCl. However, if measured in the flue gas, active carbon or a chemical recommended by the Contractor shall be used for the removal of organic matter (PAH, dioxin-furans, etc.) or possible heavy metals. Sufficient retention/contact times of these chemicals must be achieved before the bag filter, and reactors can also be designed. Bag filters shall have sampling nozzles at the inlet and outlet, pressure and temperature indicators, and ventilation plates.

Additionally, when the FBI combustion furnace operates at high temperatures, urea/ammonia can be injected into the FBI furnace to remove NOx. However, if the NOx level is still above the standard even with this injection, a separate DeNOx system should be installed. Since the exhaust gas temperature passing through the filters is high, appropriate insulation shall be manufactured. If the previous dry type systems could not meet the flue gas discharge regulations, wet type flue gas treatment units (chemical washing through the packed bed, for example lime or NaOH or a different chemical recommended by the contractor) can be included in the system. The contractor should specify the methods to be applied to condense the water vapor in the flue gas outlet so that it does not create a bad visual.

The emission treatment system shall be designed to be connected to a single flue (stack) in two lines. For each of the chemicals to be used in the emission treatment system, at least 2-day dosing units with all necessary equipment shall be supplied and installed.

A continuous measurement and monitoring system shall be established for the emission and pollutant parameters emitted to the air from the stack outlet as a result of the incineration of sludge. This system shall be in compliance with the European Directive 2010/75/EU and the “Regulation on the Incineration of Wastes” (Official Gazette dated 06/10/2010; No 27721; available for instance at the following website: <https://www.resmigazete.gov.tr/eskiler/2017/04/20170407-1.htm>).

The treated combustion gases drawn from the waste gas treatment system with air blowers shall be released to the atmosphere through the stack in a way that they shall not fall below 140°C. The stack height shall be designed at least 40 m and in accordance with the conditions specified in the regulations. A suitable process shall be added for the condensation of treated flue gas under normal operating conditions. In addition, the heat of the flue gas shall be recovered to the WTE Facility by establishing energy recycling.

Multi Cyclone

The waste gas inlet to each cyclone shall be tangential. The cleaned gas outlet shall be from the top of the cyclone. The dust captured in the cyclone shall be collected from the bottom of the cyclone. There shall be an ash collection tank with a maintenance cover under the cyclone group. The flow rate coming to each cyclone should be homogeneous and equal. The flue gas flow rates should be directed in multiple cyclones with flow control valves.

Especially the cyclone inlet area should be made of wear-resistant material.

Cyclones shall operate under negative pressure. Hardened, wear-resistant materials should be used in the manufacture of cyclones. The material should be resistant to rust and acid corrosion. In addition, since the flue gas coming to the cyclones shall be around 160°C, the cyclones should not be deformed at this temperature and there should be no leaks in their connections. The gaskets of the multi-cyclone unit should be leak-proof and easy to maintain.

Accessories required for multi-cyclone:

- Sampling nozzle (inlet-outlet)
- Differential pressure gauge
- Temperature gauge
- Aeration plates

- Separation plates (in ash collection tank)

There should be systems to prevent dew formation in the ash storage under the multiple cyclones. Since the waste gas coming to the cyclones shall be around 160°C, proper insulation is required to protect personnel, prevent heat loss, and prevent moisture condensation.

Ashes collected under the multiple cyclone unit should be transported to the ash storage silo with a pneumatic system.

A. Reactors

The reactor shall be used to add chemicals to the waste gas after the multi-cyclone unit in order to remove pollutants in the flue gas and to provide sufficient reaction times. The flue gas should enter the reactor from the bottom and exit from the top. The residence time of the flue gas in this unit should be at least 10 seconds. The chemicals and the waste gas must be fully mixed. There should be no dust or consumables settling inside the reactor. The reactor should be made of corrosion-resistant stainless steel. In addition, since the ambient temperature shall be around 170°C, the reactor should not deform at this temperature and there should be no leaks in the connections. Depending on the temperature of the reactor, proper insulation is required to protect personnel, prevent heat loss and prevent moisture condensation. In addition, since the reactor unit shall operate under negative pressure, there should be no deformation.

B. Bag Filters

The bag filter unit (BFU) shall be a jet pulse type. Cleaning one section of the filter should not prevent the operation of the other filters. The BFU shall operate under negative pressure. Therefore, the body of the construction where the filters are located shall be manufactured from stainless steel of a thickness that shall not allow any deformation or flexing.

A cylindrical bag filter design should be used. Each filter should be supported by an internal cage. A sufficient number of stainless steel wires (at least 304 quality) should be used in the filter cage manufacturing. The cleaning tool should be made of at least 304 quality stainless material. BFU shall prevent the entry of dust and gas.

There should be maintenance covers and compressed air blowing parts on the BFU body, and a ladder should be placed to exit this section. There should be a dust collection tank with a maintenance cover under the filter. All surfaces in the system should be designed to prevent dust accumulation.

The filter bag material to be used in the BFU shall be resistant to a gas temperature of at least 160°C. In this context, the filter material to be used shall be Teflon (PTFE) or double-layer glass fiber reinforced Teflon (PTFE). In order to prevent dew formation for the BFU to operate healthily, the exhaust gas temperature at the filter inlet must be at least 150°C. Necessary precautions shall be taken so that the highest gas temperature at the filter inlet does not exceed 170°C. There shall be a system that includes a temperature sensor to prevent gas flow from damaging the bag filters at high temperatures.

Pulse-type valves that control the compressed air used to clean the bags in jet pulse-type filters shall be provided. The diaphragm should be a single-piece TPE-TPU type springless diaphragm, and the operating range should be between -30°C and +250°C. The maximum pressure loss that may occur when the diaphragm ruptures should not exceed 2 bar. The valves should be in accordance with the TS EN 13445 standard.

Blow pipes shall be made of stainless steel material and shall be designed for easy attachment to allow quick replacement of the filter bag.

In order to prevent condensation inside the filter, a sufficient number of heaters with adequate power shall be installed on the BFU body and the ash tank. When the system is shut down or when a temperature difference occurs, the system shall automatically stabilize the internal temperature of the filter at the desired level. Thermal insulation shall be applied to the entire filter body, including the bunker and top covers.

The flue gas shall be directed to the groups within the BFU with flow control valves. The flow rate to each filter shall be homogeneous and equal.

The calculated number of bag filters should be divided into at least 3 groups and positioned as separate structures. These groups should be connected in parallel, and the flue gas inlet of each group should be independent from the other. In this way, in case of failure or maintenance, the other bag filter group should be able to continue operating.

Accessories required for the bag filter unit:

- Sampling nozzle (Inlet-outlet)
- Differential pressure indicator
- Temperature indicator
- Ventilation plates
- Separation plates (In ash tank)

At the BFU outlet, the emission limit values given in the Turkish regulations and European Union Directives shall be provided. A system shall be established that shall continuously measure and report SO₂ and particulate matter for the flue gas at the BFU outlet. These results could be monitored in the SCADA system.

C. Chemical Dosing and Storage Tanks

Chemical dosing and storage units shall be constructed for lime bicarbonate, activated carbon, sodium hydroxide, urea, ammonia, and any additional chemicals proposed by the Contractor depending on the design.

The chemical storage tank shall contain the following:

- Level control / indicator
- Supply pipe with coupling and flood pipe
- Pump suction outlets from the tank bottom
- Drainage with flange and isolation valve
- Hoists

The tanks shall be made of high-density polyethylene material and shall be vertical type and shall have the ability to be easily processed and welded.

Chemical tanks shall be manufactured from a single cast part. (It shall be monoblock.)

The wall thickness that should be according to the volumes of the chemical tanks to be supplied is given below.

- The wall thickness of tanks with a volume of 1,000-3,000 liters is at least 14 mm,
- The wall thickness of tanks with a volume of 5,000-10,000 liters is at least 18 mm,

The tanks located on the outside shall have a UV-resistant coating. The color of the tanks should be according to the ISO standard for the processing of chemical substances.

The contractor shall be responsible for any damage to the chemical tanks during cracking, leakage, transportation and waiting at the storage site.

Stainless steel platforms, stairs and railings shall be built around it for access to chemical tanks.

The entire installation shall be resistant to the environment. For safety reasons, an eyewash shower must be installed connected to the drinking service water line. Safety equipment must be available, and the equipment and installation must comply with the relevant international safety standard.

D. Flue Gas Outlet (Stack)

A common emission discharge stack shall be designed and manufactured for both lines. The stack design shall be resistant to wind, snow and seismic loads. The Contractor shall submit the stack height, strength, static etc., calculations to the Employer's Representative.

The contractor's proposed material for the internal design of the emission stack shall ensure corrosion resistance. The selected material shall be resistant to temperatures of at least 250 °C. The stack shall be insulated to prevent heat loss and minimize potential adverse effects on personnel.

A cathodic protection system shall be installed if the stack is constructed from steel to protect the steel structure against corrosion.

A lightning protection system compliant with relevant standards shall be supplied and installed on the stack.

A Continuous Emissions Monitoring System (CEMS) shall be installed on the emission discharge stack. In addition to this system, the stack shall be manufactured with at least two sampling ports, which shall be sealed with a blunt flange or cap.

In accordance with the Continuous Emission Monitoring Systems (CEMS) Communiqué, a dedicated monitoring cabin shall be constructed, fully complying with all criteria stipulated in the legislation of the Ministry of Environment, Urbanization and Climate Change. The measurement parameters specified in this Communiqué shall also be transferred to the Hurma WTE automation system, and their monitoring and control shall be ensured.

For stack design calculations, a wind speed at least twice the average wind speed recorded in Antalya Province shall be considered.

Based on the height of the stack, an aircraft warning system shall be installed at the top.

A system shall be installed at the stack gas outlet section to prevent rainwater ingress, and necessary equipment shall be provided to drain condensed water and rainwater from inside the stack.

E. Economizer/Pre-heater

In order to recover waste heat from the flue gas, an economizer or air pre-heater system of suitable capacity shall be installed to utilize this heat for preheating the combustion air supplied to the Fluidized Bed Incinerators (FBI).

F. Air Blowers

Air blowers shall be of multi-stage rotation fan type, complete with motors, control equipment and accessories.

- A spare forced draft air blower shall be made for both facilities.
- When sizing the air blower, it shall be taken into consideration that it is sufficient to draw the required amount of exhaust gas and provide the required pressure increase.
- Each air blower motor shall have a spare tank.
- The air blowers shall be positioned inside the incinerator process building.
- The air blower body shall be of welded construction from Type 316L stainless steel plates. The joints shall be of the flanged gasket type.
- The air blower shall be of the single width, single inlet type and the electric motor shall be variable frequency driven by means of a flexible coupling.
- The air blower inlet and outlet openings shall be of Type 316L stainless steel flanges designed to be airtight with bolted gasket construction.
- The rotor shaft shall be of Type 316L stainless steel.
- The rotating parts shall be machined with precision and shall have the best possible rotational balance.
- The weight and distribution of the unit shall be such that resonance is not possible at normal operating speeds.
- In all cases, the unfiltered vibration velocity measured at any point of the machine, including the motor, shall remain below the maximum vibration values declared by the manufacturer.
- The units shall be tested on site to prove that their vibrations do not exceed the maximum permissible limit.
- A pressure gauge and a temperature gauge shall be provided on the inlet and outlet sides of each air blower. The indicators shall be pre-piped and shall be visible without removing the casing or insulation.
- Workshop primer shall be applied to fans, motors, ferrous metal surfaces, accessories, etc. All gears, machined surfaces, bearing surfaces, and other surfaces that should not be painted shall be coated with grease and other anti-corrosive coatings.
- Insulation materials shall be of a type and thickness that will maintain the anticipated cold surface temperatures when exposed to maximum continuous operating temperatures. Unless otherwise specified, all insulation materials shall be covered with aluminum insulation liners.

- Unless otherwise specified, all hot surfaces of flue gas stack and all equipment shall be thermally insulated. Thus, they shall meet the anticipated cold surface temperatures.

Motors

Motors shall be of appropriate size to continuously drive the fan at any point on the fan operating curve without exceeding the power specified on the technical data label.

Motors shall be completely closed fan cooled with Class F insulation.

Motors shall be suitable for operation with a 50 Hz power supply.

Motors shall have a service factor of 1.15 and shall comply with the latest edition of at least one of the following standards: ANSI, BS, EN, DIN, ISO, NEMA, ABMA, IEC, IEEE.

Locked rotor current shall comply with NEMA/IEC standards.

Each fan motor shall have a storage reserve.

Control panel

- A non-resettable timer shall be provided for each fan.
- A local control panel shall be provided for each fan.
- Panel construction shall be IEC/NEMA 4X.
- A power feeder shall be installed in the control panel.
- The control panel shall include a main disconnect, transformer(s) and circuit breaker load center for all panel power requirements.
- Contacts shall be provided for remote control status and alarm indication.

Motor Tests:

Each motor shall be subjected to routine testing at the manufacturer's plant.

Fan Tests, Workshop Tests:

For fans, it will be tested according to the Power test code in one of the ASME PTC 11 or equivalent BS, EN, ISO, TSE standards. For compressors and exhaust devices, it will be subjected to the power test in one of the PTC 10 or equivalent BS, EN, ISO, TSE standards.

G. Other Components

A single common emission discharge stack shall be constructed for the two lines detailed in this section of the specification.

Separate ash storage silos shall be constructed for each line.

For each line described in this section, two parallel Emission Control Lines shall be supplied, installed, and constructed. Each line shall consist of:

- A multi-cyclone unit
- A bag filter unit
- A urea/ammonia dosing unit
- An activated carbon dosing system
- A lime/bicarbonate dosing system

- A lime/NaOH dosing system
- An ash transfer system
- And consumables storage areas

This configuration shall be taken into account during the automation, instrumentation, and system configuration phases.

Ash transfer system

The necessary pneumatic transfer system shall be established to separate and collect the ash that shall be formed in the sludge incineration plant from materials such as sand and slag from the multi-cyclones and bag filter unit and store it.

The ash collection and transfer system shall be designed in a way that prevents ash and dust spread into the environment. The contractor shall specify the technical details regarding this system in their technical bid. An ash cooling system shall be installed.

Ash storage silos

For the storage of ash coming out of multiple cyclones, min. 2 ash storage silos shall be provided for each line. For ash to be taken from the bag filter outlet, min. 2 ash storage silos shall be provided for each line.

Each storage silos shall be equipped with the necessary ventilation and filters to ensure the safe operation of the system during unloading and operation. There shall be no dust escape to the outside environment.

Silos shall be equipped with continuous level indication devices, High- and Low-level detectors and alarms to prevent overfilling and over-discharging. Sufficient capacity above the High alarm shall be provided to receive the full load. The Contractor shall provide audible and visual alarms in the storage silo and at the Facility Control and Command Center. There shall be Silo Level indicators at the Facility Control and Command Center.

The ventilation filters shall capture particles fine enough to ensure that the system complies with the license. The ventilation filters shall be sized to allow for the entire air flow from the discharge and any discharge operations. The filter shall be weatherproof, waterproof and easily replaceable within its minimum lifespan. Each filter should be equipped with an automatic cleaning system.

Each silo shall have a pressure relief system to prevent over pressurization in the event of filter blockage. Ladders, hand ladders and inspection platforms shall be provided to safely access the top of each silo and items requiring maintenance on it. Fences shall be installed all around the top of each silo. Manholes shall be provided to enable inspection and maintenance inside the silo. In case more than one silo is provided, the silos shall be connected to each other via a walkway at the roof level. Ladders shall be angled to the vertical and shall not be perpendicular to the horizontal plane.

Silos shall be designed and constructed to be able to be discharged into silo bus tankers and to be suitable for a bagging system for use in emergency situations.

Emission control consumable storage silos

The injection rates of all consumables to be used in emission control shall be automatically controlled and continuously monitored by emission monitoring equipment according to values that can be set in the Facility Control and Command Center. All consumable storage silos shall be equipped with

continuous level indication devices, High- and Low-level detectors and alarms to prevent overfilling and over-discharging. Sufficient capacity above the High alarm shall be provided to receive the full load. The Contractor shall provide audible alarms in the storage silo and the Facility Control and Command Center. There shall be Silo Level indicators in the Facility Control and Command Center. These Silo Level indicators shall be in the Facility Observation and Monitoring Center.

All consumables to be used in emission control (Urea/Ammonia, Lime/Bicarbonate, Active carbon, Lime/NaOH) shall have a specific acceptance, storage, transfer and injection (dosing) system for this process. For each system, a minimum of 7 days of additive/consumable storage capacity shall be provided based on guaranteed additive consumption for normal operating conditions.

The consumable tanks and pump skids shall be equipped with sets to absorb leaks, and all materials shall be corrosion resistant. Local push-button releases shall be provided for emergency deactivation. Installation shall be provided to enable the system to be flushed with water prior to inspection or maintenance. The system design should take into account the risk of odour and environmental pollution due to leakage. The tank areas shall be equipped with all necessary control, safety, measurement and emergency equipment (e.g. showers, eyewash etc.) as well as means for evacuating vehicles arriving for delivery.

Lime/bicarbonate storage systems shall be capable of discharging at least 30 tons of the additive at a time (on the truck minimum).

Lime could be delivered to the site in silo bus tankers, while activated carbon additive can be delivered to the site in bulk tankers or big bags. The dimensions and turning circles of the vehicles used for delivery shall be taken into account to ensure appropriate access for unloading.

The tanker discharge point shall be as close as possible to the storage tank and the discharge area shall allow the tanker to be tilted to discharge its contents. Additives shall be transferred directly from the tankers to the storage silos. If rubber or plastic pipes are used, a spare set of pipes shall be provided for each additive.

Each storage silo shall be equipped with the necessary ventilation and filters to ensure the safe operation of the system during unloading and operation. Each system shall be capable of unloading a single vehicle arriving for delivery at the same time while the additive feeding system is operating normally.

The ventilation filters shall capture particles fine enough to ensure that the system complies with current applicable regulations. The ventilation filters shall be sized to allow for the entire air flow from the discharge and any discharge operations. The filter shall be weatherproof, waterproof and easily replaceable within its minimum lifespan. Each filter should be equipped with an automatic cleaning system.

Each silo shall have a pressure relief system to prevent over pressurization in the event of filter blockage. Ladders, hand ladders and inspection platforms shall be provided to safely access the top of each silo and items requiring maintenance on it. Fences shall be installed all around the top of each silo. Manholes shall be provided to enable inspection and maintenance inside the silo. In case more than one silo is provided, the silos shall be connected to each other via a walkway at the roof level. Ladders shall be angled to the vertical and shall not be perpendicular to the horizontal plane.

Each silo should be equipped with a positive discharge system designed to prevent bridging and clogging and shall allow the desired additive mass flow under all operating conditions. The positive

discharge system may be created from fluidization pads, while other discharge aids should be considered and provided as necessary. The feeding funnel angles within the silo shall be selected based on the results of funnel index tests conducted on the materials. A dust-proof separation device shall be provided in each silo to allow upstream and downstream equipment to be removed without loss of additive. Each additive transfer system shall accurately measure the flow rate of additive entering the Emission Control System.

Silos shall be equipped with surface heating and mixing systems if deemed necessary or requested by the Employer.

2.4.3.7. Odour Control Unit

In order to reduce the emission gases and bad odours that spread from the facilities to the environment, disturb people and threaten the health of the workers, air circulation shall be made from sources that emit gas and bad odour in the facility, and the gases and odours received shall be purified by advanced biological and chemical gas treatment method. In the first stage, the waste gas shall be removed with the advanced Biological Odour Removal System, and in the second stage, the remaining pollution, if any, shall be removed with the Chemical Odour Removal system. The facility where both systems are used at the same time, covering all relevant components, shall be called "Odour Removal System".

The Odour Removal System shall be able to clean the flue air flow containing H₂S and NH₃ in the amount specified in the design criteria at least at the following removal rates;

- Minimum average 99.5% H₂S removal between the inlet and outlet of the Odour Removal System or average H₂S < 0.25 ppm at the outlet
- Minimum average 99.5% NH₃ removal between the inlet and outlet of the Odour Removal System or an average NH₃ < 0.25 ppm at the outlet
- Minimum average 98% Odour Removal between the entrance and exit of the Odour Removal System and / or maximum 500 KB/m³ at the exit (EN 13725 standard)

The manufacturer must have provided at least ten odour removals and systems using the same biomedica and process, and the Inspection Organization shall be able to see the equipment on site if it wishes.

Whether the performance criteria are met or not, H₂S and NH₃ concentrations shall be checked with odalog type mobile measuring devices or on-line measuring devices for a minimum of 1 week from the system input and output. These measurements shall be carried out in the time periods and number to be determined by the Employer's Representative, and the contractor is responsible for any problems that may occur in this regard. In the same period, one accredited odour measurement shall be made at the system entrance, advanced biological output and odour disposal system output; All these analyzes are included in the unit price of the odour system.

The components and instruments to be used in the system shall be of top quality. Biomedica or system components that are not of Far Eastern origin or have been used for many years without problems, field application shall not be accepted.

Advanced Biological Odour Removal System

The essence of the Biological Process; It is based on the oxidation and degradation of H₂S and other pollutants in biomedica (specially structured, bacterial culture adhering to the material) environment.

The mechanism of action of the odour removal system is based on the biological reduction of odour-forming pollutants. The exhaust air, which is simply closed in the facility or withdrawn from the already closed sections, containing H_2S , NH_3 , odorous volatile organic compounds (VOC), is presented to the system in the gas phase and reduced to harmless compounds such as water, carbon dioxide and biomass by bacteria. All degradation processes occur through biological reactions.

Main process elements; The shutdown of the selected units shall consist of suction pipes, suction fans, ventilation fans, advanced biological gas treatment unit, control instruments, Local / Remote control and PLC panels.

The advanced Biological Gas Treatment system shall be modular. When necessary, the capacity can be easily increased and it should be portable.

Advanced Biological Odour control system; It should include a carrier tank (bioreactor) with irrigation system and media, medium dosing system, water dosing and control system, and electricity - PLC control panel.

The tank of the biological system is vertical and cylindrical made of GRP with a minimum nine-year warranty, and all gas contact surfaces shall be resistant to all gases that may come from the facility, the outer surfaces of the tanks shall be covered with UV-resistant topcoat and gelcoat in the color to be determined by the Employer's Representative.

Biomedia shall be guaranteed for a minimum of nine years.

System; Free replacement, commissioning, bacterial revaccination and repair shall be guaranteed by the contractor, the odour removal system manufacturer and the manufacturer of the biomedia during the media warranty period.

Biomedia; It should be designed to allow vertical (perpendicular to the ground) and even gas passage at each point. It shall consist of at least two different types of materials sequentially in the same horizontal (perpendicular to the air flow direction) section; media made of one type of material in the same horizontal section or media containing sponge, mesh foam, foam, polyurethane, polyurethane foam (PUR) and the like, even if they are two different types, shall not be accepted.

The system manufacturer is obliged to prove that the same biomedia required in this specification is a full-scale, unchanged public installation manufactured at least nine years ago. The biomedia and system, which is not clear whether it shall meet the conditions in the specification at the facility, shall not be tested in the field.

In order to ensure the vitality and activities of the biomass, the medium can be dosed into the irrigation water when necessary. Apart from this, no chemical consumables shall be used.

The system shall have a media system and dosing pumps with the capacity to allow sufficient amount of media dosing.

Enough PE (polyethylene) storage to store the one-month medium requirement of the system shall be supplied with the system and connected to the system.

The supply of media is the responsibility of the contractor. The documentation to be delivered to the Employer's Representative at the end of the work shall include the type, quantity and usage characteristics of the medium used in the system.

Systems with random filling materials shall not be accepted. Organic, inorganic (including shell, peat, etc.) or carbon-impregnated media and synthetic/plastic media that are piecemeal to provide a cylindrical form (cut or come out of a mold in small pieces) shall not be used within the system.

There shall be no recirculation pump in the system. Irrigation water shall be supplied to the system intermittently (maximum irrigation time 5 min/hour), the water shall pass through the media once, and this effluent shall be drained from the nearest point to the pumping center or treatment plant.

Water shall not be recirculated within the system at any stage of the commissioning process, including operation or bacterial inoculation.

The biomedial media must be fully structured, so the tank shall be manufactured as a solid, cylindrical block with an inner diameter. For example, if the inner diameter of the tank is 3 meters, the outer diameter of the media shall also be in the form of 3 meters of cylindrical blocks (or cylindrical blocks with a minimum height of 1 meter). These cylindrical blocks must be able to be inserted and removed into the tank as a single piece to cover the tank diameter. Segmented, angled, wavy, tubes, cubic, rectangular, honeycomb (hexagonal, rectangular, etc., channeled) media in horizontal/vertical section according to the ground shall not be accepted, even if such media are combined into pieces and cut (or in some way) into cylindrical blocks in pieces.

Biomedial media must maintain its static, physical, and functional structure during the warranty period, otherwise, the contractor is obliged to replace the media free of charge.

In biomedial media, the processing time of the gas shall be a minimum of eighteen seconds, but if the manufacturer proves that at least ten systems provide odour performance, and that the media of at least one system has not changed for at least nine years, the gas processing time can be selected for a minimum of ten seconds according to the manufacturer's data.

The system shall have its own touch screen PLC panel with VFD control, where alarms and operating statuses can be seen, and system parameters can be adjusted. System equipment shall have separate switches that can be operated manually from the panel (including drive adjustment).

Water and PLC/electrical panel shall be in a separate and air-conditioned structure for the purpose of protecting sunlight, high temperature, rain, etc.

The pressure loss in the biosystem shall be a maximum of 1000 Pa.

There shall be an online pH sensor in the system.

The biomedial media and tank contact surfaces shall be resistant to low-pH process water and emissions from the suction line.

Drainage shall be made from natural flooding in the system.

A mechanical differential pressure manometer shall be placed in the system.

All system equipment 1. It shall be designed and manufactured according to the degree earthquake zone and 120 km/h wind speed.

All pumps shall be covered with suitable material so that they are not affected by the sun and rain.

The equipment, cables, electrical materials to be used shall be TSE or CE certified.

Considering the interruption of the water supply in the facility, a clean water tank and clean water pump shall be provided to meet the minimum 2 (two) days of water need. All kinds of manufacturing

and labor related to the discharge of the system effluent to the place to be indicated by the Employer's Representative in the relevant location shall be carried out by the contractor without requesting an additional price, including the price.

The biological odour removal system shall be controlled by PLC. Software, hardware, electricity, cabling works and all kinds of materials, labor, and other expenses related to this are within the scope of work.

The manufacturer of an advanced biological odour removal system or Odour Removal Unit must have at least five years of experience in the manufacture of advanced biological systems. This issue shall be proven with documents such as industrial registry, invoice, etc.

There shall be a minimum of 10" colored touchscreen operator panel on the panel.

All installation pipes shall be constructed using a minimum of PN10 class PVC pipes.

The purpose of purchasing the relevant systems is to use them for many years without any problems and to operate them easily, in addition to the technical explanation of the media and the process, a special know-how; It requires manufacturing knowledge and experience. In order not to waste public resources, the contractor must have at least one self-manufactured system in which the same media and process described in this specification are used in our country, and at least one biomedica has not changed for the biomedica warranty period required in this specification, and at least ten in total. If the contractor does not meet these criteria, he is obliged to work with an appropriate subcontractor or manufacturer.

The biomedica shall be designed to allow equal gas passage at all points. Biomedica shall be manufactured, structured and multi-layered from two types of different materials, except for polyurethane foam and its derivatives, by forming one-piece monolithic cylindrical block(s) with the inner diameter of the tank, sequentially for air, water passage and placement of microorganisms.

The minimum data required to appear on the PLC screen for the biological odour removal system are as follows;

- Vacuuming fans frequencies, operation, stop and malfunction conditions,
- Discharge water temperature and pH value,
- Operation, stop and malfunction conditions of all pumps (irrigation and medium),

Advanced Biological odour removal system alone; It shall be able to clean the waste air flow containing 0 – 100 ppm H₂S at the operating flow rate and NH₃ at a maximum of half of the H₂S density instantaneously, at least at the following removal rates;

- Minimum average 99% H₂S removal between the inlet and outlet of the biological odour removal system or average H₂S < 0.5 ppm at the outlet
- A minimum average of 99% NH₃ removal between the inlet and outlet of the biological odour removal system or an average NH₃ < 0.5 ppm at the outlet
- Minimum average 95% Odour Removal between the inlet and outlet of the biological odour removal system or maximum 1,000 KB/m³ at the outlet (EN 13725 standard)

a. Chemical Odour Removal System

When the system is required, it shall be bypassed or valved in such a way that it can use only advanced biological + chemical treatment when necessary.

The tanks are made of GRP with a minimum of ten years warranty, all gas and chemical contact surfaces shall be made of vinylester resistant to all gases that may come from the facility, and the outer surfaces of the tanks shall be covered with UV resistant topcoat in the color to be determined by the Employer's Representative.

There shall be transparent inspection and maintenance covers on the body, and water discharge and natural flood at the bottom.

Chemical dosing tanks shall be manufactured from HDPE or GRP.

There shall be pH, ORP, level indicator, level switch and similar accessories suitable for each stage.

The essence of the process; flue gas containing H₂S, NH₃ and similar odour-forming pollutants or pollutants harmful to human health shall be removed by washing the recirculated gas scrubbing solutions in two different stages. The gas shall be washed with three chemicals: acidic, basic and oxidative. Eventually, the resulting gas shall be released into the atmosphere. The chemical washing system shall be in the desired number of towers, vertical type, basic and acidic double stage.

The dosing tanks in the system should be large enough to store enough chemicals for 1 month according to a minimum H₂S input of 5 ppm.

At each treatment stage, the pressure loss within the system shall be a maximum of 1000 Pa.

The minimum processing time shall be 3 s for raschig-like or flat filling materials, and the minimum processing time shall be 1.5 s for solar type, prismatic, structural or protruding special type filling materials. The calculation shall be presented to the Employer's Representative, but no fill shall be selected under 1.5 seconds, even if it is lower in the calculation. The Employer's Representative may reject the types of fillings that he has had problems with in the past in the business.

All dosing and washing pumps in the system shall be redundant.

There shall be a sailor's ladder for the exit to the tank.

A mechanical differential pressure manometer shall be placed in the system.

All pumps shall be covered with suitable material so that they are not affected by the sun and rain.

All installation pipes shall be made using minimum PN16 class PVC and PPRC pipes in the required lines according to chemical resistance.

Considering the weather conditions and freezing, piping and storage tanks shall be manufactured.

The minimum data required to appear on the PLC screen for the chemical odour removal system are as follows;

- Vacuuming fan frequency, operation, stop and fault conditions,
- Chemical odour removal system open/closed positions of actuated valves on all liquid lines,
- Chemical odour removal system pH and ORP data,
- Operation, stop and malfunction conditions of all pumps,

Chemical odour removal system; In the flue gas cleaning capacity, it shall be able to clean the flue gas stream containing 0 – 50 ppm H₂S at least at the following removal rates;

- Minimum 98% H₂S removal between the inlet and outlet of the chemical deodorization system or H₂S < 0.5 ppm at the outlet
- Minimum 98% NH₃ removal between the inlet and outlet of the chemical deodorization system or NH₃ < 0.5 ppm at the outlet
- Minimum 90% Odour Removal between the inlet and outlet of the chemical odour removal system and/or maximum 1,000 KB/m³ at the outlet (EN 13725 standard)

b. Odour Removal Units and Equipment

Within the relevant facility, units with H₂S, NH₃, VOC and other gas outlets shall be covered if necessary and completely isolated from the external environment. The materials to be used in this context are explained in detail below.

c. Gas Collection Pipes

Within the scope of the work, the necessary piping for the connection of the main flue air suction line from the existing odour removal system to the new odour removal system to be constructed, as well as the internal piping (in-system) of the new odour removal system, shall be completed. All such works are included in the unit price of the odour removal system.

The Contractor shall submit the complete piping layout to be applied in all relevant spaces, along with the corresponding ventilation calculations (including computer-aided fan pressure loss simulations), to the Employer's Representative. Piping works shall be carried out in accordance with the technical specifications and the application project approved by the Employer's Representative.

Within the scope of the work, exhaust air suction piping connecting the volumes with 10 mm GRP closures to the existing odour removal system shall also be constructed and is included in the unit price of the odour removal system.

In addition, minor modifications to existing GRP pipelines shall be performed by the Contractor as part of the scope and are included in the unit price.

In the suction pipes, the air velocity shall be between 3–12 m/s. As far as practicable, a velocity range of 8–10 m/s shall be targeted. The velocities specified in the application project shall be verified using a mobile air velocity meter on the main pipelines.

Measurement points shall be installed at the facility's inlet and outlet to enable mobile H₂S and NH₃ measurements.

Gas collection pipes shall be made of GRP (Glass Fiber Reinforced Plastic) material. For exceptionally small diameters or in specific segments under GRP enclosures, PVC-U / PP / PE pipes may be used with the approval of the Employer's Representative.

Pipes and fittings shall be manufactured to a minimum pressure rating of PN 4. The inner surfaces shall be smooth to minimize pressure loss. Piping routes shall not obstruct the operation of the facility or internal transportation.

The outer surface of the pipes and fittings shall be finished with paraffin and an ultraviolet-resistant isophthalic topcoat, in a color approved by the Employer's Representative.

All materials used for pipes and fittings shall be resistant to chemicals, gases, and corrosion typically found in wastewater treatment environments.

The internal surfaces in contact with gas shall be coated with a chemical corrosion barrier produced using isophthalic resin.

Polluted air shall be conveyed through these pipes and fittings to the odour removal systems.

On long pipeline sections, flanged connections shall be made at intervals not exceeding 12 meters.

Manual air regulation dampers or adjustable open/close mechanisms shall be installed on secondary branches stemming from the main lines to enable flow regulation or shut-off as needed. Connections with fixed closure systems shall be flanged and designed to allow disassembly when required.

Depending on the installation location, pipes shall be either flanged or sealed on site using the hand-tilting technique.

All metal fasteners and accessories used in the piping system shall be of 316L (A4) stainless steel grade.

GRP structural profiles shall be used for the construction of pipe supports. These profiles shall be connected with A4-grade stainless steel fasteners. Exceptionally, in locations where GRP profiles may compromise the building's integrity or aesthetics, or where technical constraints exist, alternative support structures may be used with the knowledge and approval of the Employer's Representative, based on the nature and layout of the specific area.

Flow measurement points compatible with mobile measurement devices shall be provided at pipeline junctions and at the fan inlets and outlets.

Condensate collection points shall be installed wherever necessary.

d. Air Regulating Flaps

All air regulating flaps shall be manufactured from GRP (Glass Fiber Reinforced Plastic) material and rated for a minimum pressure class of PN 4. If necessary, flap shafts and internal components may be manufactured from alternative materials that are resistant to the gases they may come into contact with.

At the main suction points of each section, manual air regulating flaps or adjustable open/close mechanisms shall be installed and designed to be lockable in order to control the suction flow rate.

Air regulating flaps shall be of a quality and type suitable for continuous operation, capable of withstanding frequent opening and closing cycles without performance degradation.

e. Gas Vacuuming (Suction) Fans

The polluted air drawn by the air suction fans shall be transferred to the odour removal unit through suction ductwork. The positioning of the fans—either upstream or downstream of the deodorization system—shall be determined based on the supplier's process design and shall be subject to the approval of the Employer's Representative.

The fan capacity shall be selected in accordance with the capacities of the flue gas fan and the associated piping system. System losses shall be calculated based on the piping layout and ventilation design, including computer-aided fan pressure loss simulations for all relevant spaces. In addition to

the calculated pressure loss, each fan shall be capable of operating with a minimum additional pressure reserve of 500 Pa.

The number and capacity of the air suction fans shall also be determined based on the flue gas fan and ducting requirements. While the number of primary fans may be modified with the approval of the Employer's Representative, the system shall be designed to include at least one standby fan.

Compensators and vibration-damping dampers shall be installed on both the inlet and outlet piping connections of each fan to minimize vibrations.

Fan flow rate and pressure class calculations, including all related ventilation and piping calculations, shall be submitted to the Employer's Representative for approval. These calculations shall consider:

- Friction and dynamic losses in the piping network
- Load losses from the odour removal systems
- Internal fan losses

Fan production shall only proceed following the Employer's Representative's approval of these calculations.

All surfaces of the fans in contact with flue gas shall be constructed of 316L stainless steel.

Each fan shall be equipped with a frequency converter (VFD) for speed control.

Fans shall be housed in galvanized sheet metal enclosures with thermal insulation.

Each fan motor shall be equipped with a thermostat to prevent overheating.

Fans shall be installed on rubber vibration isolation wedges.

During the construction of the Odour Treatment System, GRP sheet panels or equivalent sealing systems shall be used as enclosure material in the units where odour absorption will take place.

f. Fixed Closing Systems

- The Contractor shall submit the closure design project and required calculations to the Employer's Representative. Closures shall be implemented in accordance with the technical specification and the application project approved by the Employer's Representative.
- Fixed closure systems shall be manufactured from GRP (Glass Fiber Reinforced Plastic) and produced using the open-mold method with monoblock molds.
- The walking surfaces of fixed closures shall be finished with a non-slip, patterned isophthalic gelcoat containing UV protection, in a color selected by the Employer's Representative. Different colors may be chosen for each facility to match the surrounding environment and facility design.
- An isophthalic topcoat shall be used on closure surfaces that will be exposed to wastewater.
- Fixed closure designs may incorporate features that allow wastewater to overflow and return to the channel, depending on their location.

- Where vacuum or fresh air discharge pipes pass through fixed closures, these pipes shall be flanged to allow the removal of caps or lids.
- Fixed closures shall be manufactured as monoblock units, suitable for modular combinations.
- Depending on the application site, GRP sheet panels or sandwich panels of similar thickness may be used as an alternative, with the approval of the Employer's Representative.
- All metal fasteners and accessories used in fixed closures shall be made of 316L (A4) stainless steel.
- Closure systems shall be designed so that no metal fasteners are located beneath the covers, as much as possible. This is to eliminate risks of collapse or failure due to corrosion or deterioration of metal components.
- For areas where GRP closure systems are installed, the relevant articles of the General Technical Specifications for Construction Works shall apply.
- Closure systems shall be designed to minimize personnel contact with wastewater, thereby enhancing occupational health and safety.
- Fixed closure systems shall be installed in the facility as close as possible to the wastewater level, in accordance with the Regulation dated July 19, 2013 – 28712 Official Gazette.
- Fixed closure systems shall be designed to support a minimum load capacity of 150 kg/m².
- The maximum deflection under load shall not exceed L/200.
- Inspection hatches shall be installed in the closure systems if requested by the Employer's Representative. A yellow marking shall be applied around open hatches to provide a visual warning even when the covers are open.
- The minimum mechanical properties of products manufactured by the open-molding method, which shall be used for the production of closure systems, shall comply with the values specified in the following table:

Open Molding Mechanical Properties			
Characteristic	Unit	Test Method	Minimum Value
Glass Ratio	%	Burn-in Test	35
Tensile Strength	Mpa	TS EN ISO 527-4	55
Compressive Strength	Mpa	TS EN ISO 527-4	140

g. Ventilation Systems

Ventilation Fans

Ventilation fans shall be of axial or centrifugal type, as specified in the relevant project documents and data sheets. All fans shall be equipped with anti-reverse current dampers to prevent backflow.

Fans shall be constructed from electrogalvanized steel, and all external surfaces shall be resistant to the degrading effects of ultraviolet (UV) radiation.

Both fans and motors shall be statically and dynamically balanced, and the first critical speed shall be designed to be at least 25% higher than the fan's operating speed, ensuring mechanical stability and reliable performance.

The design of all fan units shall ensure that impellers, motors, and bearings are easily accessible for inspection and maintenance. Unless otherwise specified, fans shall be equipped with electric motors directly coupled to the shaft and shall be weather-protected by suitable enclosures.

All fan bearings shall be of the ball or roller type, and unless otherwise stated, they shall be lubricated and sealed for lifetime operation.

Louvered air intakes shall comply with the requirements defined in the technical specification. In addition, the following design criteria shall be taken into account:

- The dimensions of the roller shutters shall be such that the incoming air velocity does not exceed 0.5 m/s. At this velocity, the shutters shall be capable of capturing at least 85% of debris and dust in the incoming air. Collected debris shall continuously fall outside the building.
- When operating under an intake velocity of 0.5 m/s, the roller shutters shall be designed to ensure a maximum pressure drop of 25 N/m² across the shutter.
- On the downstream side of the shutters, a hinged aluminum frame shall be installed, fitted with heavy-duty stainless steel wire mesh, with a mesh spacing of 12 mm, to prevent the ingress of birds, vermin, and other unwanted elements.
- The types and locations of grilles and protective cages shall be selected to provide even and effective air distribution.
- Dampers installed within all cages shall be airtight when in the closed position, preventing unwanted air exchange.
- The capacity of the fans supplying air to enclosed spaces shall be sufficient to achieve 10 air changes per hour. These fans shall be of the centrifugal type and shall be capable of delivering the rated airflow capacity while compensating for ductwork pressure losses.

2.4.3.8. Ash Collection and Storage Unit

In order to ensure effective collection of ash and dust generated throughout the system, ash conveying ducts and integrated ash hoppers shall be designed and implemented accordingly. The ash collected in these hoppers shall be transferred to the ash collection area and temporarily stored using a suitable collection and conveying system to be proposed by the Contractor.

For cleaning of the ducts and equipment within the system, various automated cleaning technologies such as soot blowers, jet pulse units, and pneumatic systems shall be utilized. These systems shall ensure efficient removal of ash and dust accumulation, thereby maintaining the operational continuity and efficiency of the overall system.

The facility process shall be designed to ensure that ambient dust levels remain below permissible limits.

Buildings shall be designed to operate under slightly negative atmospheric pressure to maintain control over dust dispersion.

Ventilation points shall be primarily located in zones with the highest dust concentration, and the ventilation system shall be designed to minimize dust accumulation on piping, channels, and other horizontal surfaces.

Low-pressure generation and dust control shall be achieved exclusively through mechanical methods, such as bag filters or cyclone separators.

Dust suppression by spraying water or using chemical agents is strictly prohibited.

The building design shall avoid unnecessary protrusions or features where dust may accumulate, as much as reasonably possible.

Cable trays located in areas prone to dust formation shall be installed vertically to reduce the accumulation of dust on their surfaces.

A vacuum dust collection system shall be incorporated into the facility design to ensure effective dust removal.