No.

JAPAN INTERNATIONAL COOPERATION AGENCY

MINISTRY OF ECONOMY AND BUDGET PLANNNING
ASTANA CITY GOVERNMENT
CAPITAL DEVELOPMENT CORPORATION

THE DETAILED DESIGN STUDY OF THE WATER SUPPLY AND SEWERAGE SYSTEM FOR ASTANA CITY IN THE REPUBLIC OF KAZAKHSTAN

ASTANA WATER SUPPLY AND SEWERAGE ROJECT

(DRAFT) TENDER DOCUMENTS

VOLUME 2-A

PARTICULAR SPECIFICATIONS

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NJS CONSULTANTS CO., LTD.
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THE ASTANA WATER SUPPLY AND SEWERAGE PROJECT

BIDDING DOCUMENTS FOR CONTRACT CP-1:

CONSTRUCTION OF WATER SUPPLY AND SEWERAGE FACILITIES

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SECTION P1.1 SCOPE OF WORK

P1.1.1 LOCATION OF WORK

The project area covers built-up area in the Astana city and water intake site at the Vyacheslavsky reservoir in the Republic of Kazakhstan.

P1.1.2 WORK TO BE DONE

This Contract, CP-1 Construction of Water Supply and Sewerage Facilities, includes 1) the construction of the water intake facility, the water treatment facility, the construction and replacement of the water distribution facility, the procurement and installation of water meters; 2) the construction and rehabilitation of the sewage treatment facility, the sludge treatment facility, and the rehabilitation and replacement of the sewers; and 3) the procurement of operation and maintenance equipment.

The extent of the above work shall cover site survey, design and supply for temporary works, permanent installation of the equipment and materials, performance test, transportation, insurance, and all other things required in and for the project implementation in due conformity with the contract documents.

During the course of construction work, constructed and/or rehabilitated facilities of sewage treatment plant shown in the Drawing will be partially taken over by the O&M staff of ASA. This arrangement is described in the Conditions of Contract to rehabilitate concerned facilities without decrease of the rated capacity during construction work. The Contractor shall provide all associated and necessary work and equipment to accomplish the rehabilitation work without any additional cost.

P1.1.3 INTENT OF CONTRACT DOCUMENTS

Referred to the Standard Specifications.

P1.1.4 PRECEDENCE OF CONTRACT DOCUMENTS

Referred to the Standard Specifications.

P1.1.5 INTERCHANGEABILITY OF STANDARDS

Referred to the Standard Specifications.

P1.1.6 MINIMUM STANDARD

Referred to the Standard Specifications.

P1.1.7 WORKMANSHIP

Referred to the Standard Specifications.

P1.1.8 REQUIREMENTS OF AGENCIES

The Contractor shall, in compliance with the relevant laws and regulations in the Republic of Kazakhstan, take all necessary procedures and applications to the authorities concerned for the facilities and equipment to be procured and installed for the Project.

P1.1.9 SPECIFICATIONS

Referred to the Standard Specifications.

P1.1.10 LOCAL CONDITIONS

The Astana city is located at the southern region of the steppes of central Asia. The general features of topography in the city are characterized by gentle slopes from the east to the west with the highest elevation of 370m at the east and the lowest of 345 m at the west.

Kazakhstan is situated in the center of Eurasia and the large distance from oceans and openness of land influences the climate of the city. The area of the Project lies in a typical continental zone. It is characterized by large fluctuation of temperature and small amount of precipitation. The features of several climatic parameters from the year 1990 to 1999 are as follows:

Monthly average temperature from June to August:	20 °C
Monthly average temperature from December to February:	below - 10 °C
Annual precipitation including snowfall:	227 to 407 mm
Annual average humidity:	67%
Annual average wind speed:	3.6 m/sec

The above information is only for reference. Thus, the Contractor shall satisfy himself as to the accuracy of the information provided.

The Contractor shall pay particular attention to the frost resistance of the facilities and equipment to be designed, procured and installed for the Project, in order to maintain them correctly and in good condition.

P1.1.11 LANGUAGE

The Contractor shall comply with the following requirements, unless otherwise specified.

The following documents shall be written in two (2) languages of English and Russian:

(1) Shop drawings and its supported documents.

(2) Technical literatures

(3) As-built drawings

The Contractor shall submit to the Engineer the standards including SNiP and GOST, and regulations written in English.

The following shall be in Russian language:

(1) Nameplates and tags of equipment

(2) Operation and maintenance manual

(3) Products and structures as the permanent works

P1.1.12 PROGRAMME

Pursuant to its obligations under the conditions of the Contract, the Contractor shall submit to the Engineer a programme for the execution of the works.

The programme shall, as a minimum, consist of procurement and construction schedule, planning of temporary works, and planning of labor, materials and equipment.

The schedule control shall be the responsibility of the Contractor. The approved programme will be used to verify the progress of the works and assess the works amount completed for progress payments for the works.

The programme shall be presented in an arrow diagram showing the critical path to ensure completion of the works within the time for completion.

The rehabilitation work for the sewage treatment plant shall be executed without interference to the existing treatment capacity and its operation. To accomplish the said requirement, the Contractor shall examine condition, operation, and maintenance of the existing facilities and submit a program for the rehabilitation work shown in the Drawings to the Engineer for approval. The program shall comprise a sequence of the rehabilitation work, definitive plan of preparatory and/or temporary work, schedule for delivery and installation of equipment, procedure of testing and commissioning of the facilities, and other work and equipment deemed to be necessary for completion of the work. None of rehabilitation work shall be commenced by the Contractor before approval of the program by the Engineer.

P1.1.13 HEALTH AND SAFETY

1. GENERAL

In addition to the requirements as set forth in the conditions of Contract, the Contractor shall at all times maintain a safe system of working and shall comply with all laws, regulations and working rules relating to safety, security, health and welfare of all persons who may be affected by his work.

The Contractor shall submit to the Engineer his comprehensive proposals relating to the safety, health and welfare of all his personnel on the site.

The Contractor shall be responsible for the implementation of safety related site procedures which shall include but not be limited to:

Safety
Working in hazardous areas
Permit to work
Fire and smoking regulations
First aid
Warning signs
Trenching scaffolding and other construction structures
Safety barriers
Protective clothing and equipment
Safety training
Safety meetings and inspections
Health and welfare

The proposals shall be appropriate for all grades of labor and personnel who will work on or visit the site on behalf of the Employer, Engineer or Contractor.

The Engineer shall have the power to stop any activity or work in any area where there is a breach of the published site safety rules such that health or life is put at risk.

The Contractor shall, in addition, comply with the safety policy of the Employer, copies of which are available on request from the Engineer.

2. FIRST AID AND LIFE-SAVING APPARATUS

The Contractor shall provide on the site such life-saving apparatus as may be appropriate and an adequate and easily accessible first aid outfits. In addition, an adequate number of persons permanently on the site shall be instructed in their use, and the persons so designated shall be made known to all employees by the posting of their names and designations in a prominent position on site.

3. ELECTRICAL SAFETY

(1) The Contractor shall be responsible for the electrical safety of all plant supplied and installed. While, any equipment is being installed or tested, the Contractor shall ensure that all necessary precautions are taken to safeguard personnel working on site. If necessary, this shall include fencing off areas which are considered to pose a risk, and erecting warning notices.

(2) The Contractor shall be responsible for ensuring that the electrical installation is carried out by suitably trained competent personnel and that the work is carried out in a safe manner.

(3) The Contractor shall be responsible for the operation on the site of a permit to work system during the period of electrical equipment installation and testing. This system shall regulate the installation, the energizing and the use of electrical plant installed and the method of work adopted.

4. WARNING AND SAFETY SIGNS

Statutory safety signs in accordance with ISO 3864 shall be adequately provided throughout the site, both indoors and outdoors. These safety signs shall cover mandatory, prohibition, warning, emergency, fire fighting and general notices. All signs shall be positioned around the site at highly visible points. Provision of signs, and the positions of signs shall be subject to the Engineer's approval. Special attention shall be given to areas designated hazardous.

5. HAZARDOUS MATERIAL IDENTIFICATION

(1) There may be hazardous materials supplied as part of the works. The Contractor shall be alert to potentially hazardous materials even though the materials may be located outside the construction area or in an area not normally accessible to the Contractor or his employees. Neither the requirements of this clause nor an act or failure to act by the Employer or the Engineer shall relieve the Contractor of responsibility and liability for the safety of Engineer, Employer, Contractor, or subcontractor personnel and property.

(2) Hazardous materials may include, but are not necessarily limited to, petroleum and associated by-products, paints, thinners and other such construction materials together with those chemicals used in the operation of the facilities to be constructed.

(3) The Contractor shall ensure that all containers of substances belonging to the Contractor and his subcontractors that are on-site or in storage are properly labeled as to the contents and the potential hazard if any. The Contractor shall submit a material safety data sheet for all hazardous material brought to the project site at least five days before delivery.

6. GUIDELINES TO SAFETY IN SEWERS AND SANITARY STRUCTURES

(1) The Contractor must inform his work force of the:

a. hazards of inflammatory or otherwise noxious volatile liquids being discharged into sewers. Some of these may produce vapors which can cause irritation to the eyes, nose or skin. Should the presence of such liquids be suspected, suitable precautionary measures shall be taken.

b. danger of bacterial infection while working in a sewage contaminated environment and shall impress upon them the importance of personal hygiene.

(2) Precautions to be taken include, but not by way of limitation, the provision for each person

working in sewage works of:

a. safety helmet,

b. safety boots with no ferrous studded soles,

c. safety belt,

d. gloves,

e. overalls.

(3) In addition to the above items, each group shall have with them at each entry point to a confined space of the following:

a. a lifting harness,

b. Four (4 No. 15 meter life lines with spring shackle one end, eye at other),

c. ladder,

d. lifting frame complete with ropes and shackles for hand operation,

e. powerful hand lamp, with flameproof switch,

f. ventilation blowers together with portable generator and flexible trunking,

g. positive pressure respiratory face masks with associated portable compressor and air hoses,

h. gas detectors (suitable for H_2S),

i. radio activity detectors,

j. an atmosphere monitoring device capable of monitoring oxygen levels and levels of toxic and flammable gas,

k. washing facilities with disinfectants and toiletries,

l. communication facilities.

(4) The Contractor shall provide safety barriers to be erected around all unattended open manholes and cover them with suitable temporary steel sheets. Whenever the Contractor's workforce leaves the site of the works all manhole covers shall be replaced.

P1.1.14 PROTECTION OF THE ENVIRONMENT

1. GENERAL

The Contractor shall, in compliance with the relevant environmental laws and regulations in the Republic of Kazakhstan, take all necessary environmental protective measures to mitigate negative impacts during the construction period.

2. ENVIRONMENTAL PROTECTION PLAN

The Contractor shall prepare an environmental protection plan how the works shall comply with the

laws and regulations and how to meet the particular requirements of this specification of the Contract.

In addition to the particular requirements of the specification on the environmental protection, the following environmental protective measures may include:

(1) Traffic and public facilities

(2) Culture property

(3) Water rights and rights of common

(4) Public health condition

(5) Waste

(6) Hazards (Risk)

(7) Soil erosion

(8) Groundwater

(9) Hydrological situation

(10) Fauna and Flora

(11) Landscape

(12) Air pollution

(13) Water pollution

(14) Soil contamination

(15) Noise and vibration

(16) Land subsidence

(17) Offensive odor

The plan shall be submitted to the Employer, the Engineer and the authorities concerned at the same time of the submission of the programme as specified in section P1.1.12.

3. PARTICULAR REQUIREMENTS ON ENVIRONMENTAL PROTECTION

The following countermeasures to cope with the negative impacts which are based on the results of the environmental impact assessment (EIA) for the Project, shall be taken by the Contractor:

(1) Air pollution

In the Astana city, at present, total suspended particulate matter (TSP) in the air has exceeded the Kazakhstan standard of 0.5 mg/m3. During the construction period of the water treatment facilities, water distribution pipelines and sewers, the operation of construction machinery and earthwork may generate dust. The following countermeasures are to be conducted by the Contractor to mitigate the negative impact:

a. Covering stored materials with plastic or other materials

b. Spraying exposed areas with water

c. Minimizing traffic over freshly exposed surfaces, etc.

(2) Water pollution

The maximum value of raw water turbidity was recorded lower than 30 mg/l in the period of 1989 to 2002. The Contractor shall therefore keep the raw water turbidity at the existing intake not over 30 mg/l. The following countermeasures are to be taken by the Contractor to mitigate the negative impact:

a. The Contractor shall carefully select excavation method to minimize water contamination during construction.

b. A turbid water protection fence shall be installed in the water around construction site to prevent existing intake from turbid water.

c. The Contractor shall monitor turbidity in the water between existing intake tower and the turbid water prevention fence (two to three points in location, two to three times per month in frequency).

(3) Noise

During the construction of the water treatment facilities, the noise levels at the nearest hospital (Mental Asylum) are estimated to be 52 dB(A) to 69 dB(A), which has exceed the Kazakhstan noise standard on hospital area with 50 dB(A). The following countermeasures are to be taken by the Contractor to mitigate the impact:

a. The Contractor shall prepare a detailed plan for noise control, especially piling work, before construction starting.

b. Before construction starting, the Contractor shall notify the construction plan of water treatment facilities to Mental Asylum and to hear their opinions and requirements on noise control.

c. Construction schedule and methods shall be arranged reasonable in order to properly disperse equipment and vehicles at the construction sites.

d. The use of construction machinery and equipment may be prohibited during 23:00 to 07:00.

e. During the construction period, the noise levels shall be monitored at least once a month in daytime at the borderline of the water treatment plant and Mental Asylum.

During the construction period of water distribution pipelines and sewers, the noise levels at selected points of residential areas and schools are estimated to be 54 dB(A) to 87 dB(A), which has exceed the Kazakhstan noise standards with 60 dB(A).

The following countermeasures are to be taken by the Contractor to mitigate the impact:

a. The Contractor shall prepare a detailed plan for noise control before construction starting.

b. Before construction starting, the Contractor shall inform the residents, hospitals and schools through newspaper or poster for understanding with short-term disturbances.

c. Construction schedule and methods shall be arranged reasonable in order to properly disperse equipment and vehicles at the construction sites.

d. Dump trucks and other heavy vehicles shall be operated at reasonably low speed so as to prevent unnecessary noise and vibration along the routes. Construction workers shall be educated to pay attention on noise and traffic control.

e. The use of construction machinery and equipment may be prohibited during 23:00 to 07:00.

f. Special attention should be paid on following sections:

   i) Line 1 of sewer construction

   ii) Line 11 of sewer construction

   iii) Trade-economic College section of water distribution pipeline route along the street of КЕННСАРЫ

   where construction sites are very close to residential areas and schools, and noise levels at these areas are estimated to be over Kazakhstan noise standards with 20 dB (A) or more.

(4) Public traffic interference

The EIA survey results show that the traffic flow at main road, where some sections of water distribution pipelines and sewers are planed to cross, are more than 1,000 vehicles/hr. Therefore, the following countermeasures are to be taken by the Contractor to mitigate public traffic interference during the installation of the water distribution pipelines and sewers:

a. The Contractor shall notify the citizens of the construction plan of proposed sewers and water distribution pipelines by media (such as TV, newspapers and posters etc.).

b. The Contractor shall carefully examine the construction plan for the sections of crossing roads, especially main road, and make an effort to finish constructions within the shortest period (such as within one or two days).

c. The Contractor shall prepare a detailed plan for the traffic control during construction period. For instance, necessary personnel shall be arranged for the traffic control during construction.

d. The construction of the sewers or water distribution pipelines for crossing main road shall be carried out on Saturday and/or Sunday when the traffic volume usually is lower than that of working day.

e. The excavation and installation works may be carried out by half span of the road width.

P1.1.15 QUALITY CONTROL

Pursuant to its obligations under the conditions of the Contract, the Contractor shall be responsible for implementing quality control and quality assurance procedures.

The Contractor shall submit to the Engineer a quality control plan on the basis of a Contractor's quality management system certified by ISO for the control of the quality for the workmanship,

construction and materials.

A representative of the Contractor shall designate a full-time quality control manager in the whole period of the Contract. The quality control manager shall organize a team of the quality management.

The quality control plan shall include, but not limited to, the following to cover all construction works including all subcontracts for construction and procurement, unless otherwise specified:

(1) Manufacturing

(2) Shipment

(3) Freight

(4) Fabrication

(5) Inland transportation

(6) Loading and unloading

(7) Documentation and reporting

(8) Installation

(9) Testing and inspection

P1.1.16 SHOP DRAWINGS

1. GENERAL PROCEDURE

The Contractor shall submit, unless otherwise directed by the Engineer, three (3) copies of shop drawings for all permanent and temporary works or design variations, sufficiently in advance to enable the Engineer to examine and correct them.

The Contractor shall also submit design calculation sheets together with the drawings as may reasonably be required by the Engineer.

The Contractor shall not commence work on items covered by shop drawings before the Engineer's approval. The Engineer shall notify the Contractor in writing with respect to his approval or disapproval for shop drawings after receipt thereof from the Contractor. When the Engineer deems it necessary to make corrections to the submitted shop drawings, the Contractor shall submit revised ones for approval by the Engineer without delay.

2. RESPONSIBILITY

Notwithstanding any approval by the Engineer of the Contractor's shop drawings, calculations or specifications, the Contractor shall remain wholly responsible for errors made therein.

3. AS-BUILT DRAWING

Upon completion of the work or if required by the Engineer upon completion of any part of the work, the Contractor shall furnish the Engineer with three (3) copies of final "as-built" drawings.

4. SIZE OF DRAWINGS

All drawings to be submitted by the Contractor shall be of A3 size, except as otherwise approved by the Engineer, and shall conform to a clear system of identification and nomenclature to be agreed upon the Engineer.

SECTION P1.2 CONTROL OF WORK

P1.2.1 CONTRACTOR'S EQUIPMENT

Referred to the Standard Specifications.

P1.2.2 LOCATIONS OF WORK

Referred to the Standard Specifications.

P1.2.3 OPEN EXCAVATIONS

Referred to the Standard Specifications.

P1.2.4 TEST PITS

Referred to the Standard Specifications.

P1.2.5 PROTECTION OF EXISTING STRUCTURES AND UTILITIES

Referred to the Standard Specifications.

P1.2.6 OBSTRUCTION OF UTILITY SERVICES

Referred to the Standard Specifications.

P1.2.7 OPERATION OF UTILITY SERVICES

Referred to the Standard Specifications.

P1.2.8 MAINTENANCE OF FLOW

Referred to the Standard Specifications.

P1.2.9 PROVISIONS FOR TRAFFIC AND DETOURS

Referred to the Standard Specifications.

P1.2.10 CLEAN-UP WORK TO BE DONE

Referred to the Standard Specifications.

P1.2.11 PRIVATE LANDS

Referred to the Standard Specifications.

P1.2.12 FLOTATION

Referred to the Standard Specifications.

P1.2.13 INCONVENIENCE AND RIGHT OF ACCESS

Referred to the Standard Specifications.

P1.2.14 PREVENTIVE MEASURES

Referred to the Standard Specifications.

P1.2.15 EXCESS FILL MATERIALS

Referred to the Standard Specifications.

P1.2.16 PUMPING AND DRAINAGE

Referred to the Standard Specifications.

P1.2.17 OVERHEAD CONSTRUCTION

Referred to the Standard Specifications.

P1.2.18 SURVEY BEFORE CONSTRUCTION

The Contractor shall undertake a topographic survey of the entire project site. The survey shall include establishment of a traverse line and levels covering the whole area of the Project. The Contractor shall establish survey control points on the traverse line. Some of the control points shall be constructed in concrete blocks which will be used for the bench marks for the construction work of the Project.

P1.2.19 PROGRESS PHOTOGRAPHS

The Contractor shall compile a photographic record of execution of the work by taking color photographs at every stage of the construction work as directed by the Engineer.

The Engineer will advise the Contractor on the specified timing and location of photographs based on the progress schedule submitted by the Contractor. To show the original conditions, photographs shall

be taken of the entire site and adjacent boundary areas before construction starts.

From then on photographic work shall be taken of the excavations, foundations, reinforcing steel layout immediately prior to the concrete placement and at all other times and locations requested by the Engineer.

Before the works are taken over, final photographic records for completion of the works shall be prepared.

Each record to be submitted shall be properly arranged in an album of a type and size approved by the Engineer. Each print of photograph shall be a standard service size and a glossy finish.

Also beside each photographic print, an additional label as required above shall be attached.

SECTION P1.3 CONTROL OF MATERIALS

Referred to the Standard Specifications.

SECTION P1.4 TEMPORARY FACILITIES

1.4.1 TEMPORARY OFFICE

Referred to the Standard Specifications.

1.4.2 TEMPORARY TELEPHONE

Referred to the Standard Specifications.

1.4.3 TEMPORARY WORKSHOP AND DWELLINGS FOR EMPLOYEE'S FAMILIES

Referred to the Standard Specifications.

1.4.4 SANITARY ARRANGEMENTS

Referred to the Standard Specifications.

1.4.5 FIRST AID

Referred to the Standard Specifications.

1.4.6 ENGINEER'S OFFICE

The Contractor shall complete the installation and furnishing of offices for the exclusive use of the Engineer in compliance with the following requirements:

(1) The Engineer’s offices shall be located near the site of the work and shall be located in an area acceptable to the Engineer and in proximately to those of the Contractor.

(2) The Contractor shall provide for the use of the Engineer, one main site office at near the Nasosno-filtrovalnaya stantsiya water treatment plant or on the premises of the plant, and two (2) field offices comprising one at the Vyacheslavsky intake site and another at the sewage treatment plant.

(3) Within 60 calendar days after the date of issue of the notice to commence, the Contractor shall have completed the installation and furnishing of the Engineer's main site office, provided it conforms to the requirements specified.

(4) All office equipment and furnishings shall be for the exclusive use of the Engineer. At completion, the equipment and furnishings of the main site office and the field offices shall be handed over to ASTANA CITY GOVERNMENT (AKIMAT) and will become the property of AKIMAT thereafter. Immediately prior to handing over to AKIMAT all defects in equipment and furnishings shall be made good and shall be in a serviceable condition to the satisfaction of the Engineer. The Contractor shall provide all required toner cartridges and consumables for the equipment provided.

(5) The Contractor shall provide the Engineer with field offices, not later than 60 calendar days after the date of issue of the notice to commence at each specific area. The offices shall be maintained by the Contractor until the completion of the specific area work.

(6) Windows of the all offices shall be mosquito proofed and shall have blinds. The accommodation of the all offices shall have provisions foe air conditioning / heating such as to maintain an ambient temperature of between 20 to 25 ºC.

(7) The Contractor shall provide janitorial services to maintain a good working environment and security service at each office. Water and electricity supply including receptacles on all walls shall be provided. The Contractor shall provide all wiring, receptacles and fixtures in accordance with relevant codes and regulations. The offices, in general, shall comply with local building ordinances and be provided with all necessary fire extinguishers and approved first-aid kits.

(8) The Engineer's main site office shall be made up as follows:

Room	**Approximate Area (m^2)**
Resident Engineer's room	30
Engineer's rooms	2 rooms each 80
Reception area	15
Staff rooms	2 rooms each 30
Conference room	80
Storage room	25
Equipment room (Photocopy machine etc.)	25

Kitchen	10
Wash room	10
Toilet (Water closet)	3 toilets

(9) The Engineer's field office at the sewage treatment plant shall be made up as follows:

Room	**Approximate Area (m^2)**
Engineer's rooms	2 rooms each 40
Reception area	15
Staff rooms	2 rooms each 20
Conference room	40
Storage room	25
Equipment room (Photocopy machine etc.)	25
Kitchen	10
Wash room	10
Toilet (Water closet)	2 toilets

(10) The Engineer's field office the Vyacheslavsky intake site shall be made up as follows:

Room	**Approximate Area (m^2)**
Engineer's rooms	20
Conference room	30
Storage room	15
Kitchen	10
Wash room	10
Toilet (Water closet)	1 toilet

(11) The kitchen shall contain a sink, 700-liter refrigerator, one microwave oven, electric kettle, lockable cupboard (approx. 1.9 x 0.7 x 0.9 m high) with Formica top.

(12) A covered parking area shall be constructed and maintained for at least seven motor vehicles for the Engineer's use at the Engineer's main site office.

(13) At the Engineer's offices, new furniture and equipment as shown below shall be provided to meet the approval of the Engineer.

The Engineer's main site office

Item	**Quantity**
Steel desk 1.6 m x 0.9 m with six lockable drawers	1
Steel desk 1.5 m x 0.75 m with six lockable drawers	29
Table 1.5 m x 0.75 m	2
Conference table 1.8 m x 3.6 m x 2 with 40 chairs	1
Swivel medium back executive chair	29
Chairs	6

Item	Quantity
Steel Cupboard 1.8 m x 0.9 m x 0.45 m	4
Four (4)-drawer steel filing cabinet	12
Steel book shelf 1.8 m x 1.2 m	8
Magnetic white board 1.0 m x 1.5 m	2
Three (3) telephone lines (with 5 extensions)	1 set

The Engineer's field office at the sewage treatment plant

Item	Quantity
Steel desk 1.5 m x 0.75 m with six lockable drawers	19
Table 1.5 m x 0.75 m	2
Conference table 1.8 m x 3.6 m x 1 with 20 chairs	1
Swivel medium back executive chair	19
Chairs	5
Steel Cupboard 1.8 m x 0.9 m x 0.45 m	3
Four (4)-drawer steel filing cabinet	9
Steel book shelf 1.8 m x 1.2 m	6
Magnetic white board 1.0 m x 1.5 m	1
Two (2) telephone lines (with 4 extensions)	1 set

The Engineer's field office at the Vyacheslavsky intake site

Item	Quantity
Steel desk 1.5 m x 0.75 m with six lockable drawers	3
Table 1.5 m x 0.75 m	1
Swivel medium back executive chair	19
Chairs	3
Steel Cupboard 1.8 m x 0.9 m x 0.45 m	1
Four (4)-drawer steel filing cabinet	2
Steel book shelf 1.8 m x 1.2 m	2
Magnetic white board 1.0 m x 1.5 m	1
One (1) telephone line	1 set

(14) The Contractor shall install in the Engineer's main site office three (3) telephone lines with 6 extensions in the name of Employer and provide an e-mail system for the Engineer's use and maintain it in good working order and pay for all monthly charges, excluding long distance charges. In addition, the Contractor shall supply the Engineer with four (4) mobile telephones and maintain them and pay for all monthly charges, including long distance charges until they revert four (4) mobile telephones to the Contractor on completion of the Project.

(15) The Contractor shall provide, as required by the Engineer, safety helmets, safety boots, rubber boots, gloves, torches and the like for the use of the Engineer and his staff and for visitors to the site.

SECTION P1.5 SPECIAL PROVISIONS

1.5.1 WATER

Referred to the Standard Specifications.

1.5.2 ELECTRICITY

Referred to the Standard Specifications.

1.5.3 WORK IN PUBLIC WAYS

Referred to the Standard Specifications.

1.5.4 PRESSURE AND LEAKAGE TESTS

1. GENERAL

This section is applied for non-destructive testing of welded joint and pressure/leakage testing after installation of pipelines, including water mains, valves, pipe jacking and other crossings, and all other appurtenances.

All field-welded joints of steel pipes shall be subjected to non-destructive testing. The testing shall be undertaken by the independent inspection company certified by the authorities concerned and accepted by the Engineer. The Contractor shall submit the information on the proposed inspection company including its experience for the Engineer's approval.

The Contractor shall provide all labor, equipment and materials for testing such as the non-destructive tests of field-welded joints, hydrostatic pressure tests and leakage tests. Metering devices required for the pressure and leakage tests shall be furnished by the Contractor.

Water for the testing shall be provided by the Contractor.

All testing shall be conducted in the presence of the Engineer or his representative unless otherwise approved by the Engineer.

The Contractor shall appoint a qualified chief supervisor who is responsible for supervising field welding and testing procedures. At the end of each month, the Contractor shall prepare and submit to the Engineer a monthly report covering the results of tests of field-welded joints. The report shall contain analysis of the tests, films, photographic records and etc.; be signed by the chief supervisor; and be submitted to the Engineer in three (3) copies.

2. NON-DESTRUCTIVE TEST OF FIELD-WELD SEAMS

(1) Radiographic Testing

For steel pipes of diameters 900 mm and larger, all field-welded joints shall be subjected to the radiographic testing.

The test of butt-weld seams shall be carried out in accordance with JIS Z 3104: "Method of Radiographic Test and Classification of Radiographs for Steel Welds", or other standards acceptable to the Engineer. At each joint of underground pipeline for testing, two spots where longitudinal shop-seam (or spiral shop-seam) and field-girth seam are intersecting shall be tested.

Results of the radiographic test are classified in the said standard as follows:

Class	1	2	3
Grade	1 to 4	1 to 4	no grade

Acceptable class and grade shall be Class 1, Grades 1 to 3 and Class 2, Grades 1 to 3 only. If the test results show other classes and grades than the above, the Contractor shall reweld and retest at his own expense until results are obtained that are acceptable to the Engineer.

(2) Dye-Penetrate Testing

For steel pipes of diameters 800 mm and smaller, all field-welded joints shall be subjected to the dye-penetrate testing.

a. Visual Inspection

The route run and the second run shall be subjected to the visual inspection.

Lining of the following defects shall cause rejection of the weld and the Contractor shall re-weld and re-test at his own expense.

i) Any pit on the beads surface;

ii) Any undercut of 1 mm depth or deeper;

iii) Any undercut of more than 0.5 mm and less than 1.0 mm in depth and longer the wall thickness;

iv) Any overlap;

v) Any excess reinforcement of weld;

Wall thickness (mm)	Maximum Reinforcement (mm)
12.7 or less	3.2
More than 12.7	4.8

vi) Any throat and/or leg shorter than specified;

vii) Uneven beads; and

viii) Any arc strike.

b. Dye-Penetration Test

The dye-penetrant shall be applied to the final run of the weld. The application procedure shall be in conformity with the manufacturer's recommendations.

Any crack and/or pin holes shall be repaired and re-tested.

3. HYDROSTATIC PRESSURE TEST

All tests shall be conducted on the pipeline in sections after the trench is backfilled, but before pavement restoration unless otherwise instructed by the Engineer. Joints shall be exposed during the tests wherever possible.

All pipelines shall be thoroughly flushed out with water prior to testing.

The pipeline shall be prepared for testing by closing all valves, placing substantial stops and bulkheads at openings, and opening air valve assemblies, along the pipeline. For air release at high points where no air valves are installed, the Contractor shall install corporation cocks as directed by the Engineer.

Pipe ends of the test span shall be protected against water pressure of 0.98 MPa in a manner approved by the Engineer, if no such permanent structure such as a valve chamber is available.

The pipeline shall be slowly filled with water of approved quality, allowing all air pockets to be released. After the pipe is completely filled, the pipeline should be allowed to stand for 24-hours under slight pressure. Any apparent defects in the pipeline at this stage shall be immediately rectified by the Contractor.

Cement-mortar-lined pipes to be tested should be filled with water and allowed to stand for at least 24 hours to permit maximum absorption of water by the lining.

The hydrostatic pressure shall be raised to the test pressure. The test pressure shall not be less than 1.25 times the working pressure. The duration of the pressure test shall be for a period of two (2) hours. Any defective pipe, fitting, joint, or valve shall be removed and replaced and the test shall be repeated until satisfactory to the Engineer.

Should any test of pipe laid disclose a leakage greater than that specified in the formula below, the Contractor shall locate and repair or replace the defective materials or joint, to the satisfaction of the Engineer. The test shall be repeated until any leakage falls within the specified allowance.

$$Q = \frac{L * D * \sqrt{P}}{71,526}$$

Where,

Q: allowable leakage in liters/hour

L: length of pipe tested, in meters

D: inside diameter of the pipe, in millimeter

P: average test pressure during the test, in bar

4. FLASHING OF PIPES

The Contractor shall clean all the laid pipe by flushing with potable water. The flushing shall be made by blowing off from the drainage branch, starting from the upstream and gradually proceeding downstream.

The Contractor shall locate and repair immediately when any leaks are found during flushing, even though the above test results were approved by the Engineer.

1.5.5 DISINFECTION

Before being placed into service, and before certification of completion by the Engineer, all new water mains, or extensions and connections to existing systems, or the valved section of such extension, shall be disinfected with chlorine in accordance with the following procedure, or as directed by the Engineer.

(1) Disinfection shall be accomplished by filling the pipeline with water containing at least 10 mg/liter available chlorine.

(2) After 24 hours, the residual chlorine shall be checked and if found to be more than 5 mg/liter, it will be considered that the disinfection has been satisfactorily attained.

(3) However, if the residual chlorine shows the value less than 5 mg/liter, more chlorine shall be added, followed by an additional contact period of 24 hours.

Disinfection shall be the responsibility of the Contractor including measurement of chlorine residuals. Water and chemicals to be used for disinfection shall be supplied by the Contractor. The works shall include temporary piping or tapping as required for sampling to do the tests under the direction of the Engineer. Disinfection shall be done after completion and acceptance of the specified leakage and pressure tests.

1.5.6 PROJECT SIGNBOARD

The Contractor shall erect the project signboards at three (3) locations as directed by the Engineer not later than 28 calendar days after the date of signing of the Contract.

The Contractor shall submit designs for the Engineer's consent with the following minimum requirements:

(1) Face plate size not less than a 2.5 m by 2.0 m

(2) Double post support with concrete foundations

(3) Names and logos of the Employer, funding agency, the Engineer and the Contractor, and anticipated completion date

The Contractor shall keep all signboards clean, repair them if damaged and repaint them as necessary to maintain a neat appearance throughout the construction period.

The Contractor shall remove all signboards on completion of the defect liability period.

DIVISION P2 SITE WORKS

SECTION P2.1 SITE PREPARATION AND MISCELLANEOUS WORK

Referred to the Standard Specifications.

SECTION P2.2 EXCAVATION, DEWATERING, BACKFILL, FILL AND GRADING

P2.2.14 DISPOSAL OF EXCAVATED MATERIAL

Any surplus of excavated materials shall be used for common fill or embankment fill on the premises of the existing sewage treatment plant.

SECTION P2.3 INSTALLATION OF UNDERGROUND PIPING AND FITTINGS

Referred to the Standard Specifications.

SECTION P2.4 LANDSCAPING

Referred to the Standard Specifications.

SECTION P2.5 PAVING

Referred to the Standard Specifications.

SECTION 2.6 FENCING

Referred to the Standard Specifications.

SECTION P2.7 PILING

P2.7.1 GENERAL

The Contractor shall supply all labor, materials, equipment and incidentals necessary to furnish and install piles as shown on the drawings and specified herein.

The piles shall be reinforced pre-cast concrete piles.

The following standards are referred to:

SNiP 2.02.03-85: Pile foundations

SNiP 3.02.01-87: Earthwork structure, base and foundations

GOST 5686-94: Soils. Methods of field testing with piles

Other applicable SNiP/GOST and internationally accepted standards

P2.7.2 SHOP DRAWINGS

The Contractor shall submit shop drawings showing the proposed details of the piles including pile length, cross-sectional dimensions, pile top and tip details, reinforcing bars, and lifting inserts or devices.

Prior to the commencement of the pile driving work, the Contractor shall also submit a pile-driving schedule indicating the sequence of the work for the Engineer's approval.

The Contractor shall not initiate production of pile casting operations until shop drawings have been reviewed and approved by the Engineer.

P2.7.3 LINES AND GRADES

The Contractor shall engage an engineer qualified and experienced in this type of work, who shall establish lines and grades. The Contractor shall be responsible for the correct locations of piles.

Piles shall be located and staked out by the Contractor and the Contractor shall maintain all location stakes and shall establish all elevations required including the elevation of the top of the pile prior to cutting off any length of pile. All location and survey stakes shall be checked on a regular basis to ensure that pile-driving operations do not cause movement of the stakes. Each pile is to be identified by a number, on a shop drawing.

Within one week after the completion of driving of all piles, the Contractor shall provide the Engineer with a certified plan showing the as-driven location and elevation of the top of piles prior to cutting off all piles driven within the structures.

P2.7.4 INSPECTION

Inspection of pile driving operations will be provided by the Engineer at any time. No piles shall be driven without notice to the Engineer.

Approval shall not relieve the Contractor of his responsibilities for performing the work in accordance with these specifications and contract drawings.

P2.7.5 MATERIALS

All precast concrete piles furnished under these specifications shall be new, undamaged members which have not been previously rejected for any reason and shall be manufactured especially for this project. Members which are damaged or which do not meet the requirements of these specifications shall be rejected.

Piles shall in all cases be stored and handled in accordance with the recommendations of the pile manufacturer. Particular care shall be taken to avoid dropping or severe jarring while in a horizontal position. If for any reason the pile is damaged or the reinforcement is exposed, its use shall not be allowed.

Concrete piles shall be so proportioned, cast, cured, handled and driven as to resist without cracking the stresses induced by handling and driving as well as by the design loads as shown on the drawings or as specified. The piles shall have a uniform cross section for the length which is embedded in the bearing soil.

Piles shall be so designed with enough reinforcement that the piles can withstand the bending moments caused by the lateral load as specified herein or as shown on the drawings.

Each pile shall be stamped or marked with the date of its manufacture, identification of dimensions and identification of manufacturer. Lifting hooks or points shall be plainly marked on each pile.

The top of the pile must be perpendicular to the longitudinal axis of the pile, and the ends of any prestressing or reinforcing steel shall be cut flush with the top of the pile to prevent direct impact on the steel during driving.

Pile top ends shall be plane surfaces which shall be perpendicular to the long axis of the pile within a tolerance of 10 mm per meter. Pile tips shall be tapered and include a cast iron or steel made cone

shaped shoe.

Concrete and reinforcement shall conform to Division 3 of the Particular Specifications titled "Concrete".

Concrete piles shall be of such quality that the finished piles can be handled and driven to the required bearing without cracking or other damage which would impair their strength or durability.

Concrete for precast concrete piles shall be cast in smooth and mortar tight forms so supported as to prevent deformation or settlement during concrete placement or curing. The piles after being cast shall be cured by water or such other methods of curing as may be approved by the Engineer. Curing shall be continued until specimens of the concrete from which the piles were cast attain a specified compressive strength. Piles shall not be driven until completion of the specified curing.

The piles shall present true, smooth, even surfaces, free from honeycombing or voids and shall be sufficiently straight. Defects in any pile may be accepted if repaired to the approval of the Engineer.

P2.7.6 PILE DRIVING

1) STANDARD

Piles shall be accurately located and driven vertically or on slope surface established by the line as indicated on the drawings. No greater variation from the vertical line than 10 mm per meter of length will be permitted. Piles driven with greater variation and those seriously damaged in driving shall be removed or cut off and replaced with new piles as directed by the Engineer. Should any pile be heaved by the subsequent driving of adjacent piles it shall be re-driven at the expense of the Contractor.

The Contractor's engineer who is designated as stipulated in Section P2.7.3 shall specify the tip elevation to which the pile shall be driven at each location to develop the bearing value required as determined by the formula in Subsection 3 of this Section and the results of exploratory pile driving.

Excavation required in the areas through which the piles are to be driven shall be made before any pile is driven, except as approved by the Engineer.

Pre-augering, pre-drilling or pre-jetting at pile locations shall not be allowed, except as approved by the Engineer.

Driving of all piles shall be continuous without intermission until the pile has been driven to its final elevation. The tops of piles shall be cut off true and level at the elevations as indicated on the drawings. All portions battered, split, warped, damaged or imperfect in any way shall be removed or repaired to the satisfaction of the Engineer.

2) DRIVING EQUIPMENT

The driving method shall be such as not to impair the strength of the pile and shall meet the approval of the Engineer. The Contractor shall submit a written statement describing the proposed equipment and shall obtain from the Engineer's approval of the same before driving any pile.

Driving caps or rings and or followers shall be capable of protecting the head of the pile and of providing a uniform distribution of hammer energy to the pile head.

Followers may be used to drive the tops of piles to cutoff grade which are below the level of the ground surface at the time of driving. The maximum length of such followers shall be 3.0m, unless specific approval for longer follower length has been obtained from the Engineer. Followers shall consist of a cylindrical steel mandrel or wide flange section with cap plates at each end welded perpendicular to the axis of the follower.

The Contractor shall employ such cushioning devices as required to protect the pile from damage

during driving.

Adequate weight of the ram shall be selected to meet the size of piles and length of driving together with the drop height which is the subject to the approval of the Engineer.

3) BEARING VALUE

Piles shall be driven to the penetration and bearing value specified herein as a minimum. The bearing value shall be determined from the applicable formula in the following schedule:

i. For piles driven with a drop hammer $P = \frac{WH}{5S + 0.1}$

ii. For piles driven with a single acting steam or air hammer $P = \frac{WH}{5S + 0.1}$

iii. For piles driven with a double acting steam or air hammer $P = \frac{F}{5S + 0.1}$

Where, P: Safe bearing load developed by the pile in tons
W: Weight of hammer in tons
H: Length of stroke or height of free fall of hammer in meters
S: Penetration of the pile into the ground per blow in meters taken as the average over the 10 blows immediately before the measurement Penetration measurement shall be started upon observing an appreciable rebound of the hammer
F: Energy of hammer per blow, in ton-meters (F=2WH: in case of diesel hammer)

4) PILE HEAVE

Immediately after a concrete pile is driven, the Contractor shall establish a reference point of the pile and its elevation on the pile. After all piles within the foundation of a structure have been driven, the Contractor shall measure again the elevation of the reference points on each of the piles driven, and determine the uplift of each pile caused by the driving of other piles.

If an uplift of 1.5 cm or more has occurred for any pile, then corrective measures shall be made by the Contractor at no additional cost to the Employer. Such additional measures may include but not be limited to the following:

The Contractor shall re-drive the pile to its original elevation and deeper, if necessary, to the original final driving resistance. After re-driving each pile the Contractor shall re-check the elevation of the reference points on all piles and shall re-drive any other uplifted piles to the original final driving resistance.

5) PILE INSTALLATION RECORDS

The Contractor shall maintain a full record of every pile driven. This record shall include the following:

- pile type
- pile number
- original ground level related to datum
- nominal diameter or dimensions

- date of driven
- depth from ground level to toe of pile
- depth or height from ground level to cut-off level of pile
- depth or height from ground level to top of the concrete
- weight and drops of hammers
- details of any obstructions observed

Unusual phenomena shall be noted, especially if they indicate possible damage to the pile.

All records shall be accurately kept in duplicate as the work proceeds and one copy shall be handed to the Engineer at the completion of each day's work.

In addition the Contractor shall prepare an "As-built" plan showing the location of all piles as installed at the design cut-off grade. The plan shall be prepared on a reproducible paper. The original plus four (4) copies shall be provided to the Engineer.

The plan shall also indicate the design pile location at cutoff grade. The dimension indicating the offset from the design location shall be tabulated for each pile. The tabulation shall be shown on the as-built drawing.

P2.7.7 TESTING

1) STANDARD

The Contractor shall carry out driving tests on piles driven at the sites.

A pile to be tested shall be located in places proposed by the Contractor for the approval of the Engineer.

Working piles shall not be installed until the test pile has been driven and tested and the results have been reviewed and approved by the Engineer.

Test piles shall be of the same size and materials as the working piles and shall be driven with the same equipment and in the same manner as the working piles as specified herein.

The satisfactorily driven test pile may be used as working pile subject to the Engineer's approval.

2) PROCEDURE

Driving equipment for the testing pile shall be the same as to be used for working pile driving.

During the testing the following shall be measured and recorded:

- Dimensions, shape and make of piles
- Number of blows per 50 cm or 100 cm
- Penetration at final stage and rebound
- Driving time (duration)
- Deviation from the line
- Fall height of hammer
- Weight of hammer

- Specification of driving equipment
- Any extraordinary matters observed during the testing such as changes of soil conditions, unusual noise / vibration and behavior of pile.

The test result shall be analyzed to determine the allowable bearing load to be derived from the formulas shown in Section P2.7.6 Subsection 3 "Bearing Value."

Test result shall be reported to the Engineer both in the form of tabulated values of load, time and penetration, also in form of graphs of load and penetration against time and of penetration against load.

The Contractor shall provide, set up and remove all testing equipment such as load transfer beams, reference systems, pile caps, jacking equipment, measuring equipment and the like needed to carry out the test.

Before beginning any pile test, the Contractor shall submit to the Engineer his proposals for testing procedure.

The Contractor's supervisor conducting and observing the pile testing shall be a qualified engineer experienced in this type of work.

DIVISION P3 CONCRETE

SECTION P3.1 CONCRETE

P3.1.1 SCOPE OF WORK

The work consists of furnishing all labor and materials for concrete, and mixing, placing, curing, repairing, finishing, testing and all other works incidental to the construction of concrete as shown on the drawings.

P3.1.2 GENERAL PROVISIONS

The following standards and their subsequent amendments, whether listed or not, are the minimum accepted standards. They will be referred to hereafter by basic designation only and will form part of these specifications to the extent indicated by reference hereto. This will be the basis for evaluation of any other standard submitted or referred for approval:

SNiP 2.03.01-84: Concrete and reinforced concrete structures

GOST 22266-94: Sulfate resisting cement

GOST 23464-79: Cements, Classification

GOST 25192-82: Concrete, Classification and general technical requirement

GOST 26633-91: Heavy weight and small grained concrete, Technical condition

JIS A1101: Method of Slump Test for Concrete

JIS A1102: Method of Test for Sieve Analysis of Aggregates

JIS A1103: Method of Test for Amount of Material Finer than Standard Sieve 0.088 mm in Aggregate

JIS A1104: Method of Test for Unit Weight of Aggregate

JIS A1105: Method of Test for Organic Impurities in Sand

JIS A1108: Method of Test for Compressive Strength of Concrete

JIS A1109: Method of Test for Specific Gravity and Water Absorption of Fine Aggregate

JIS A1118: Method of Test for Air Content of Fresh Concrete by Volume

JIS A1132: Method of Marking and Curing Concrete Test Pieces

JIS R5202: Chemical Analysis of Portland Cement

JIS R5210: Standard for Portland Cement

Other applicable SNiP/GOST and internationally accepted standards

P3.1.3 SUBMITTALS

1. SAMPLES

Samples of concrete for testing are to be taken from concrete immediately after it has been deposited in the works. If this is impracticable, samples are to be taken from concrete as it is being delivered at the point of deposit. Care is to be taken to obtain representative samples. All the concrete for each sample is to be taken from one place.

Samples are to be taken for a series of 6 specimens per every fifty (50) cubic meters of concrete at a time. The location of the concrete from which the samples are taken and the date are to be noted by mark on the specimen. Each is to be given a reference number, and each individual sample is to be denoted by suffixes "a", "b", "c", "d" to that number. Each sample is to be slightly remixed before molding.

2. TEST SPECIMENS AND METHOD OF TESTING

The test specimens are to be cylinders, cast in metal molds, having the liner faces accurately machined so that opposite sides are plane and parallel. Each mould is to have a metal base plate having a smooth machined surface. The interior surfaces of the mould and base plate are to be slightly oiled before being filled.

The Contractor shall transport the test specimens to an authorized laboratory for testing. The Contractor shall pay costs of said transportation and testing of the samples.

P3.1.4 QUALITY

The Contractor shall furnish labor, materials, equipment and incidentals necessary to produce and place concrete with such quality as required for members or structures.

The compressive strength test shall be carried out by the Contractor at seven (7) days and 28 days.

The ultimate compressive strength of test specimens for each class of concrete is to be not less than the followings.

Concrete class	Strength after	
	7 days	28 days
B30 (Reinforced)	As recorded	38.5 MPa
B15 (Non-reinforced)		19.3 MPa

The quality or class of concrete to be applied for each member or structure shall be in accordance with the following:

CLASS OF CONCRETE

1. Class of Concrete	B30	B15
2. Structures/members applied	Reinforced	Non-reinforced
3. Design strength (MPa)	17	8.5
4. Mix proportioning strength (MPa)	38.5	19.3
5. Minimum Cement Content (kg/m3)	300	
6. Maximum Water/Cement Ratio (%)	Less than 50	
7. Maximum size of aggregate (mm)	25	25
8. Air Content (%)	4.5 $\pm$1.5%	4.5 $\pm$1.5%
9. Standard Slump (cm)	10.0 $\pm$ 2.5	8.0 $\pm$ 2.5

P3.1.5 ACCEPTANCE TEST

Refer to the Standard Specifications.

P3.1.6 MATERIALS

1. CEMENT

The cement to be used throughout the work shall be the best quality sulfate resisting Portland cement and shall conform in every respect with all the conditions contained in the applicable publications herein, and any modification thereof made before the commencement of or during the continuance of the Contract.

Cement is to be delivered in the undamaged original branded backing direct from the manufacturers, and is to be stored in a weather-proof shed, the floor of which must be raised at least 50 cm from the ground. A sufficient supply is to be kept in store to ensure a continuous supply to the works. Cement is not to be stored at the site for more than three (3) months without the Engineer's consent.

If required, manufacturer's test sheets are to be supplied with each consignment certifying that the cement delivered to the site has been tested and found to comply with the requirements mentioned above. Such test sheets are to be passed to the Engineer for approval as they arrive and are to be retained by him at the site until the completion of the works.

2. AGGREGATE

Materials used as aggregates shall be obtained from a source known to produce aggregates satisfactory for concrete and shall be strong, hard, durable, and chemically inert of limited porosity and free from all impurities that may cause corrosion of the reinforcement or may impair the strength or durability of the concrete.

Aggregates shall be tested in accordance with the requirements as instructed by the Engineer.

From the results of these test, the Contractor will decide the proportions of coarse to fine aggregates that are to be used for each mix thereafter throughout the progress of the work or until there is some change in the aggregates.

The object of these is to obtain the strongest and densest concrete, with due regard to workability from the materials available.

i) Fine Aggregate

Fine aggregate shall be natural sand or sand derived by crushing stone and shall be perfectly clean, free from coagulated lumps, igneous, organic and other impurities. Sand derived from stone unsuitable for coarse aggregate shall not be used as fine aggregate.

ii) Coarse Aggregate

Coarse aggregate shall be crushed granite, or natural gravel approved by the Engineer, and only clean, hard, sound stone, free from earthy or friable matter. It shall be cubical rather than flaky in shape.

iii) Storage of Materials

Each class of aggregate is to be stored separately and the Contractor is to provide means of ensuring that they are stored on a suitable hard clean surface to prevent contamination from the ground.

iv) Proportions of Coarse and Fine Aggregate

The nominal ratio of the volume of fine aggregate shall be decided by compression test of concrete

specimen.

At the beginning of the work and where there is any change in the coarse or fine aggregates or in their source of supply, the Contractor is to have a series of test on specimens made, as specified in Section P3.1.3 "Test Specimens and Method of Testing", representative of and marked as to the aggregates and their grading and mix of concrete. Such specimens are to be tested by a laboratory under identical conditions, except for small variations in the relative proportions of the coarse and fine aggregates up and down from the best proportions derived from the sieve analysis. The specimens are to be tested at 7 days and 28 days.

3. WATER

Water shall be clean, fresh and free from organic matter in solution or suspension in such amounts that it may not impair the strength or durability of the concrete. Water shall be obtained from a public supply where possible and shall be taken from any other source only if approved by the Engineer. No dirty water from excavation shall be used. Only water of good quality shall be used for washing out, shuttering, curing concrete and similar purposes.

4. ADMIXTURE

The Contractor may use concrete admixture as approved by the Engineer. The agents shall be of uniform consistency and quality within each container.

The Engineer reserves the right at any time to sample and test the concrete admixture used on the job by the Contractor. In no event shall any of the said agents be used for the work under this Contract without the approval of the Engineer.

P3.1.7 MEASURING MATERIALS

The coarse and fine aggregates are to be weighed or accurately measured to the Engineer's satisfaction. In no event they are to be measured by the shovel or barrow. Cement is to be measured by bag. The size if mixer is to be such that it will take a batch of materials appropriate to one or more complete bags.

P3.1.8 MIXING

1. SITE MIXING

The site mixing of concrete shall be done in a power driven batch mixer of approved type which will ensure the thorough mixing of all materials. The volume of the mixed materials per batch shall not exceed the manufacturer's rated capacity of the mixer.

On commencing work with a clean mixer, the first batch shall contain only half the normal quantity of coarse aggregate to compensate for the adhesion of the other materials to the drum.

The moisture contents of the aggregates shall be determined before the commencement of each day's concreting and at such intervals during each day as may be necessary. The Contractor shall make due allowance for the water contained in the aggregates when determining the quantity of water to be added to each mix, and shall adjust the amount of water added to each mix to maintain constant the approved free water/cement ration of the mixed concrete.

P3.1.9 TRANSPORTING

Refer to the Standard Specifications.

P3.1.10 FIELD TESTS

Refer to the Standard Specifications.

P3.1.11 INSPECTION AND CONTROL

Refer to the Standard Specifications.

P3.1.12 CONCRETE APPEARANCE

Refer to the Standard Specifications.

P3.1.13 FORMS

Shuttering shall be of wood, plywood, metal and/or other approved material.

The inside faces of shuttering shall be treated with such material as to prevent adhesion of the concrete and all such material shall be kept clear of the reinforcement and other items to be embedded.

Shuttering shall be so constructed and placed that resulting concrete will be of the shape, lines dimensions, and to the elevations indicated on the drawings.

Shuttering being reused shall be thoroughly repaired and cleaned before re-assembly.

When shuttering has been built and has been prepared ready for concreting, it will be inspected by the Engineer and no concrete shall be placed until the shuttering has been approved by him.

P3.1.14 PLACING AND COMPACTING

1. PLACING CONCRETE

After being mixed, the concrete is to be conveyed to its position in the works as quickly as possible, thoroughly rammed into place around the reinforcement, properly spaced with suitable steel tools against the formwork to ensure a good surface and dense concrete free from honey-combing, and well-tamped to bring any surface water to the surface and to prevent air pockets. The formwork should be tapped to release air bubble that may be clinging to it.

Concrete is to be placed before it has taken its initial set and in any event not more than 30 minutes after being mixed.

The method of conveying the concrete from the mixed to its place in the works is subject to the Engineers' approval. No method will be allowed which encourages segregation of the coarse and fine particles. To this end, the Contractor shall consult the Engineer on the maximum height from which the Contractor intends to drop the concrete.

2. VIBRATING CONCRETE

All concrete shall be vibrated during casting by immerse vibrators. The vibrators must be capable of producing vibrations at the rate of not less than 5,000 cycles per minute. The Contractor shall take every care to avoid contact between the vibrators and the reinforcement, and to avoid segregation of the aggregates through over-vibration.

The vibrators shall be inserted vertically into the concrete at point about 50 cm apart and gradually withdrawn when air bubbles no longer come to the surface.

Mallets shall be applied to the outside of the formwork where vibrators cannot be applied. If, hand hammers are applied to the outside of the formwork, great care must be exercised to avoid damage and distortion to the formwork and consequent malformation of the reinforced concrete member.

P3.1.15 CURING AND PROTECTION

Concrete placed in the works is to be kept continuously moist by watering and protected by sacking kept damp or by other approved means for at least 7 days after being placed.

P3.1.16 PLACING CONCRETE IN HOT WEATHER

Refer to the Standard Specifications.

P3.1.17 REMOVAL OF FORMS

Refer to the Standard Specifications.

P3.1.18 FAILURE TO MEET REQUIREMENTS

Refer to the Standard Specifications.

P3.1.19 PATCHING AND REPAIRS

Refer to the Standard Specifications.

P3.1.20 CONSTRUCTION AND EXPANSION JOINTS

Wherever the placing of concrete is interrupted, the concrete must on no account be allowed to tail off to a feather edge, but is to be stopped and thoroughly consolidated against a properly constructed stop and so shaped as to form an efficient construction joint which is generally to be at right angles to the main reinforcement. The position and design of such construction joints are to be subject to the Engineer's approval.

Before further concrete is placed the surfaces of all joints are to be well hacked, brushed clean, washed with clean water, and coated with a thin layer of 1:1 sand: cement mortar. It is advisable that the roughing of the concrete shall be carried out immediately i.e. when the concrete is green and not left until it is set hard.

P3.1.21 FIELD CONTROL

Refer to the Standard Specifications.

P3.1.22 SLEEVES, PIPES, AND OTHER ITEMS

Refer to the Standard Specifications.

P3.1.23 EQUIPMENT BASES

Refer to the Standard Specifications.

P3.1.24 NON-SHRINK GROUT

Refer to the Standard Specifications.

P3.1.25 INSTALLATION SCHEDULE

Refer to the Standard Specifications.

P3.1.26 GENERAL STRUCTURAL NOTES

Refer to the Standard Specifications.

P3.1.27 COLD WEATHER PROTECTION

When the ambient temperature is below five (5) degrees C or when so directed, the Contractor shall provide secure weather protection in and around the facilities. The protection should be provided

being concreted to prevent infiltration by wind.

The Contractor shall distribute unit heaters throughout the concrete to maintain the ambient temperatures in the range between 10 to 21 degrees C.

When mean daily temperatures are expected to fall below five (5) degrees C, heat the concrete mix to a maximum temperature of 38 degrees C in the mixer, and a maximum of 32 degrees C leaving the mixer.

Care shall be taken as specified in the following:

a. Consideration should be made to heating the concrete mix

b. Aggregates must be free of surface ice

c. Mixing time of concrete be increased by 25%

d. Ensure no contact with frozen surfaces

e. Use of anti-freezing admixtures (subject to approval of the Engineer)

f. Large diameter reinforcing bars (more than 24mm diameter) to be pre-heated to ensure no freezing

g. Increasing strength of specified concrete mix

h. Avoid occurrence of temperature gradients within concrete sections that can be detrimental to concrete

SECTION P3.2 CONCRETE REINFORCEMENT

P3.2.1 SCOPE OF WORK

Refer to the Standard Specifications.

P3.2.2 SHOP DRAWINGS

Refer to the Standard Specifications.

P3.2.3 MATERIALS

Unless otherwise specified or required, the design, materials, workmanship and erection shall conform to the requirements of the following standards as approved by the Engineer.

SNiP 2.03.01-84:Concrete and reinforced concrete structures

GOST 5781-82: Hot rolled steel for reinforcement of reinforced concrete structures

JIS G3112: Steel bars for concrete reinforcement

ACI 315: Manual of standard practice for detailing reinforced concrete

Other applicable SNiP/GOST and internationally accepted standards

Classification and design reinforcement resistance to tension of reinforcing steel bars shall comply with the requirements of SNiP 2.03.01-84 and other related GOST standards or internationally accepted standards as follows:

Plain bars: Class A-I, 225 MPa

Deformed bars: Class A-III, 365 MPa

BAR SIZE

No.	Area (cm2)	Weight (Kg/m)	Type
P6	0.283	0.222	Plain
P8	0.503	0.395	Plain
D-10	0.785	0.617	Deformed
D-12	1.131	0.888	Deformed
D-14	1.540	1.210	Deformed
D-16	2.010	1.580	Deformed
D-18	2.540	2.000	Deformed
D-20	3.140	2.470	Deformed
D-22	3.800	2.980	Deformed
D-25	4.910	3.850	Deformed
D-28	6.160	4.830	Deformed
D-32	8.040	6.310	Deformed

P3.2.4 FABRICATION

Refer to the Standard Specifications.

P3.2.5 HANDLING MATERIALS

Refer to the Standard Specifications.

P3.2.6 INSTALLATION

6. CONCRETE COVER

The following concrete cover dimensions are the minimum and to be applied for the design section of members unless otherwise specified:

Member	Net concrete cover (cm)
Bottom reinforcing bars for base slabs or foundations	7.0
All surfaces in contact with water or soil	5.0
Beams and columns of which surfaces do not contact water or soil	4.0
Underside of slabs over water in conduit	4.0
Other surfaces exposed to air	2.5

P3.2.7 STRAIGHTENING STEEL

Refer to the Standard Specifications.

P3.2.8 GENERAL STRUCTURAL NOTES

Refer to the Standard Specifications.

SECTION P3.3 - CONCRETE FINISHES

P3.3.1 SCOPE OF WORK

Refer to the Standard Specifications.

P3.3.2 WORK SPECIFIED ELSEWHERE

Refer to the Standard Specifications.

P3.3.3 GENERAL

Refer to the Standard Specifications.

P3.3.4 TYPES OF FINISHES FOR CAST-IN-PLACE CONCRETE

1. GENERAL

Corrosion protection shall be applied, unless otherwise directed by the Engineer, inside the tank of sewage treatment plant and intermediate pump station as specified in the following.

2. SPECIFICATION

a. Coating Material

Tar Epoxy Resin Coating

b. Quantity

0.2kg/m^2 x 2 times

c. Thickness

More than 0.2mm for 2 times coating

d. Application Method

After curing surface, Roller finishing shall be done.

3. PLACE OF CORROSION PROTECTION COATING

Corrosion protection must be done for the following tank/facility both newly construction and rehabilitation. Coating shall be done the side of top slab facing to the water surface, bottom and wall inside the tank.

No.	Tank/Facility	Slab	Wall	Bottom
Sewage Treatment Plant				
S01	Inflow Tank	Done	Done	Done
S01	MH-12 Manhole	Done	Done	Done
S02	Temporary Influent Pump Station	Done	Top to 50cm below low water level	Not Necessary
S02	Influent Pump Station (Inlet Channel)	Done	Top to 50cm below low water level	Not Necessary
S02	Influent Pump Station (Pump Well)	Done	Top to 50cm below low water level	Not Necessary
S03	Grit Chamber	Done	Top to 50cm below water level	Not Necessary
S04	P/ST Distribution Tank	Done	Top to 50cm below water level	Not Necessary
S05	Primary Sedimentation Tank	-	Top to 50cm below water level	Not Necessary
S06	Scum Pit	Done	Done	Done
S09	S/ST Distribution Tank	Not Necessary		
S10	Secondary Sedimentation Tank	Not Necessary		
S11	Sludge Pit	Done	Done	Done
S12	MH-13 Manhole	Not Necessary		
S12	Temporary Discharge Pump Station	Not Necessary		
S12	Discharge Pump Station	Not Necessary		
S21	Gravity Thickener	-	Top to 50cm below water level	Not Necessary
S23	Digester	Done	Done	Done
S24	Sludge Treatment Building			
S24	Sludge Holding Tank	Done	Done	Done
S24	Thickened Sludge Holding Tank	Done	Done	Done
S24	Waste Water Tank	Done	Done	Done
S24	Digested Sludge Holding Tank	Done	Done	Done
Intermediate Pump Station				
S64	PS No.28	Done	Top to 50cm below low water level	Not Necessary
S64	PS No.34	Done	Top to 50cm below low water level	Not Necessary
S64	PS No.37	Done	Top to 50cm below low water level	Not Necessary
S64	PS NoIH	Done	Top to 50cm below low water level	Not Necessary

P3.3.5 MORTAR PLASTERING

Refer to the Standard Specifications.

P3.3.6 OTHER SURFACES

Refer to the Standard Specifications.

P3.3.7 CLEANING

Refer to the Standard Specifications.

P3.3.8 SULFATE RESISTING FINISHES

Sulfate resisting finishes shall be applied, unless otherwise directed by the Engineer, on all concrete surfaces in contact with the ground or where at risk to sulfate attack, as specified in the following.

1. WORKING MAT

Acid-resistant crushed stone or granular material with the layer of asphalt mortar, BTM bitumen water proof membranes or hydro isolation layer form polymer sheet with 1.5 mm thickness.

2. EXTERNAL WALL

Three (3) layers of cold asphalt insulation or mastic “Hamat” with a total thickness of 12 mm or BTM bitumen water proof membranes.

3. PRECAST WALL AND INSIDE RC CHANNEL FOR SEWAGE

Polymer mortar on two (2) layers of methyl methacrylate.

SECTION P3.4 - CONCRETE JOINTS

P3.4.1 SCOPE OF WORK

Refer to the Standard Specifications.

P3.4.2 GENERAL REQUIREMENTS

Refer to the Standard Specifications.

P3.4.3 MATERIALS

Refer to the Standard Specifications.

P3.4.4 INSTALLATION

Refer to the Standard Specifications.

P3.4.5 CONSTRUCTION JOINTS

The Contractor shall submit the schedule and sequence for concrete placing together with locations and treatment methods of construction joints prior to the commencement of the work for the approval of the Engineer. The construction joints shall generally be provided horizontally. Vertical joints shall be avoided as far as practicable.

When the construction joints are provided for water retaining structures or tanks, the interior surfaces of the joints shall be caulked and sealed for the entire length using sealant as specified in the Standard Specifications, Section 3.4, Division 3 titled Concrete Joints. Similarly, the exterior surfaces of joints buried underground shall be sealed. For sealing of the construction joints, the chamfer along the joints may be provided as shown on the drawings, or boundary between old and new concrete may be chipped with 20 x 20 mm after removal of forms.

When vertical joints are required and approved to be provided, water stops may be allowed to be installed between the old and new concrete instead of the sealing described above. The materials of water stop shall be the same quality as specified or approved by the Engineer with the minimum size of 150 mm width.

SECTION P3.5 - PRECAST CONCRETE

Refer to the Standard Specifications.

DIVISION P4 MASONRY

SECTION 4.1 MASONRY WORKS

4.1.1 SCOPE OF WORKS

a. Design of Masonry Structure:

The design shall be submitted to the Engineer for approval.

The Engineer's approval does not release the Contractor of his responsibility to provide a design and the construction detail drawings, which shall be complied with the specification. The Contractor shall be responsible for all data and information provided

The design of masonry structure shall conform to the codes and standards, which shall be equivalent to the ACI code and other applicable standards approved by the Engineer.

The design shall allow for the support of all loads, which are likely to affect the structure. Particular care shall be given to wind loads on masonry walls, which shall be not less than 42 kg/m^2. Loads for which the structure is designed shall be indicated on the drawings.

Compressive strength at 28 days:

Over gross sectional area:

(1) For bearing walls

60 kg/cm^2 average of 12 blocks

50 kg/cm^2 minimum for any one block.

(2) For non-bearing walls

30 kg/cm^2 average of 12 blocks

25 kg/cm^2 minimum for any one block.

Tensile Stress: Not permitted

Shear Stress: 25 kg/cm^2

The maximum unsupported height or width of bearing wall shall not be more than 20 times the nominal thickness of the wall. The minimum nominal wall thickness shall be 12 cm.

For non-bearing walls, the maximum unsupported height shall not be more than 36 times the nominal thickness of the wall. The minimum nominal thickness of the wall shall be 6 cm.

Where a wall is laterally supported at the top and bottom. Its effective height is the actual height of the wall. If there is no lateral support on the top, its effective height is twice the height of the wall above the bottom lateral support.

Tensile stress in bearing walls and shear stress in walls used as shear walls be taken over by reinforcements which shall in either direction be not less than 0.07% of the cross sectional of the wall. The sum of horizontal and vertical reinforcement shall be minimum 0.2%.

The Contractor shall furnish all labor, materials, equipment and incidentals required to complete all masonry work as indicated on the drawings and as specified herein.

4.1.2 WORK SPECIFIED ELSEWHERE

Refer to the Standard Specifications.

4.1.3 MASONRY UNITS (MATERIALS)

The size of masonry units shall be in accordance with the details noted and/or as herein specified or on the shown drawings.

1. BRICKS

1.1 Conventional Underburned Brick

a. General: Provide in accordance with approved specifications and codes. For manufacturing of masonry units, the present codes and standards are applied to bricks and blocks and stones produced by semidry pressing or plastic forming, and made from materials such as clay and silica sedimentary rocks.

b. Basic Parameter of Masonry Units: Masonry units shall be solid, hollow or cellular. Basic parameter of masonry units are mentioned in Clause 3 of GOST 530-95. Type and sizes of masonry units are as classified in Table 1 in the GOST 530-95. Masonry units shall be produced as per the types and sizes as shown the table or equivalent standards as approved by the Engineer. Types and sizes of masonry units with hollows are shown in Appendix A in the GOST 530-95.

c. Maximum deviation from nominal sizes in mm should not exceed to the figures as mentioned in clause 3.2 in the GOST 530-95 or other applicable standard approved by the Engineer.

d. The Contractor shall submit certification and test report as to various materials and method used in the manufacture of masonry units. .

e. Inspection and Testing

Approval tests shall be conducted as per the following categories:

Exterior (presence of exterior defects)

Dimensions and correct form (shape)

Weight of items

Durability limit against pressure

Durability limit when masonry units are bent

Periodical tests shall be conducted at every fortnight, monthly, quarter and yearly as proposed by the Contractor and as approved by the Engineer.

f. Marking

The masonry materials shall be marked on each pack. Each cargo pack shall have a transportation marking in accordance with GOST 14192 or as directed and approved by the Engineer.

g. Storage

Masonry materials shall be stored in plastic bags on a base in accordance with GOST 18343 or as approved by the Engineer. Masonry materials shall be stored with classes and types in single storied line. It is allowed to put packages into 2 stories.

It is allowed to store masonry materials on flat area (ground) with solid cover.

4.1.4 MIXING AND PLACING

Refer to the Standard Specifications.

4.1.5 EXPANSION AND CONTROL JOINTS

Refer to the Standard Specifications.

4.1.6 REINFORCING AND ANCHORS

Refer to the Standard Specifications.

4.1.7 SAMPLES-SAMPLE WALLS

Refer to the Standard Specifications.

4.1.8 INSTALLATION

Refer to the Standard Specifications.

4.1.9 LINTELS, TIES AND MISCELLANEOUS ITEMS

Refer to the Standard Specifications.

4.1.10 GROUTING

Refer to the Standard Specifications.

4.1.11 CLEANING

Refer to the Standard Specifications.

DIVISION P5 METALS

Referred to the Standard Specifications.

DIVISION P6 CARPENTRY

Referred to the Standard Specifications.

DIVISION P7 MOISTURE PROTECTION

Referred to the Standard Specifications.

DIVISION P8 DOORS, WINDOWS, GLASS AND FLOATING FLOOR/ACCESS FLOORING

Referred to the Standard Specifications.

DIVISION P9 FINISHES

Referred to the Standard Specifications.

DIVISION P10 SPECIALITIES

SECTION P10.1 INSULATION

P10.1.1 SCOPE OF WORK

The Contractor shall furnish all labor, materials, equipment and incidentals for insulation of building as indicated on the drawings and/or as specified herein.

P10.1.2 SUBMITTALS

a. Product Data

Submit manufacturer's descriptive data, catalogue and installation instructions. Data shall include written acceptance by the roof manufacturer of the insulation provided and minimum thickness of insulation.

b. Shop Drawings

Show a complete description of the procedures for the installation of each phase of the system indicating the type of materials, thicknesses, identity codes, sequence of laying insulation, location of ridges and valleys, special methods for cutting and fitting of insulation, and special precautions. The drawings shall be based on field measurements.

c. Test Reports: Certified copies from an approved testing laboratory and in accordance with ASTM E 84.

d. Manufacturer's Instructions

Roof insulation, including field of roof and perimeter attachment requirements.

e. Sample duplicate sets of cut sections or panels of each type of material shall be required for approval

P10.1.3 DELIVERY, STORAGE AND HANDLING

1. DELIVERY

a. Deliver materials to site in manufacturer's unopened and undamaged standard commercial containers.

b. Deliver materials in sufficient quantity to allow continuity of the work on site.

2. STORAGE AND HANDLING

a. Store and handle materials in a manner to protect from damage, exposure to open flame or other ignition sources, and from wetting, condensation or moisture absorption. Store in an enclosed building or trailer that provides a dry, adequately ventilated environment.

b. Store felt rolls on ends for the 24 hours immediately before application of felts.

c. Replace damaged material with new material.

3. ENVIRONMENTAL CONDITIONS

Ambient Conditions

a. Not Permitted:

(1) Starting work when rain is imminent.

(2) Installing work during rain or immediately thereafter.

b. Conduct bonding or other tests for moisture or other substrate conditions per assembly manufacturer's instructions and as and when necessary to assure proper adhesion.

c. Do not apply spray-applied thermal insulation when the ambient temperature of the substrate materials and surrounding air is below 5 degree C.

P10.1.4 MATERIALS

1. INSULATION TYPES

Type 1: Board insulation

a. Glass fiberboard shall conform to SNiP, GOST or equal approved.

(1) Insulation shall be thermal insulation and sound insulation.

(2) Insulation shall be moisture resistant and dimensionally stable.

(3) Insulation shall be incombustible and water proof.

(4) Where exposed shall be faced fabric finish.

Thickness shall be not less than 50 mm as shown on the drawings and specific density shall not be less than 100 Kg/m^3.

TYPE 2: Foam insulation

a. Polyethylene thermal conductivity: 0.029 kcal/mh^oC. Devisity: 0.025 gr/cm^2

b. Insulation shall be waterproof and incombustible.

c. Laminated Insulating shall be 4 mm thick, color selected by the Engineer.

d. The insulation shall be suitable for temperature requirement.

TYPE 3: Spray-applied thermal insulation

a. Mineral fiber mixed with binder and adhesive. Spray-applied thermal insulation shall not erode, flake or dust when subjected to air velocity of at least 5m/sec. for 24 hours. Use sealer if required to prevent erosion, klaking and dusting.

b. Sealer for spray-applied thermal insulation shall be the standard product of the insulation manufacturer.

P10.1.5 INSTALLATION

1. INSTALLATION REQUIREMENTS

a. Board insulation

(1) Under metal roof; install suspension system as shown on the drawings. Install boards with all edges tightly butting and closely fitted to under side of decking.

(2) On concrete flat roofs install board in accordance with manufacturer's published specifications and to the Engineer's approval.

(3) Install in strict accordance with manufacturer's published specifications and to the approval of the Engineer.

b. Foam insulation

(1) Installation of spray polyethylene foam on corrugated metal.

(2) The insulation shall be waterproof, watertight and without joints

c. Spray-applied thermal insulation

(1) Mix and apply insulation in strict accordance with manufacturer's recommendations.

(2) Apply over the substrate, building up to the required thickness with as many oases or stages as necessary to produce a monolithic blanket of uniform density and texture. Tamp after application to provide a dense, medium smooth surface.

(3) Apply sealer to sprayed-on surfaces in accordance with the manufacturer's directions.

2. FINISHES

a. Exposed surfaces of spray-on insulation shall be free from scratches, dents, and unnecessary depressions or over build-up, gaps or joints not required, or other defects and damage

b. Other types of insulation shall rigidly secured in place and free from sagging, warping; gaps or poorly fitted joints, dents or breaks in surfaces, or other defects and damage.

SECTION P10.2 METAL ROOF

P10.2.1 SCOPE OF WORK

The Contractor shall furnish all labor, materials, equipment and incidentals for metal roof as indicated on the drawings and/or as specified herein.

P10.2.2 SUBMITTALS

a. Product Data

Submit manufacturer's descriptive data, catalogue, installation instructions, etc.

b. Shop Drawings

Show a complete description of typical and special conditions including flashings, materials and thickness, dimensions, fixing lines, anchoring methods, sealant locations, sealant tape locations, fastener layout, sizes, and spacing, terminations, penetrations, attachments, and provisions for thermal movement.

c. Test Reports: Certified copies from an approved testing laboratory.

d. Manufacturer's Instructions

e. Samples

P10.2.3 DELIVERY, STORAGE AND HANDLING

a. Carefully deliver, store, and handle panels and other manufactured products.

b. Stack materials stored on site on platforms or pallets and cover with weather tight covering.

c. Do not use plastic, which may cause sweating, or condensation.

d. Store panels so that water which may have accumulated during transit or storage, drains off.

e. Do not store panels in contact with materials that might cause staining.

f. Inspect panels upon arrival at site; if wet, remove moisture, and restack and protect panels until used.

P10.2.4 MATERIALS

1. ROOF MATERIAL

1.1 CORRUGATED METAL ROOFING

a. Roof panels shall be steel and shall have a factory color finish meeting the specified requirements with roll-form foam heat insulating 4 mm thickness.

b. Sheet shall be not less than 0.8mm thickness and weight not less than 5.34 kg per square meter.

c. The ridge cap shall not have exposed fasteners except where recommended by the metal roofing system manufacturer.

d. System for securing the roof covering to structural framing members shall be exposed, penetrating fastener type.

e. Panels from coil stock shall be curb formed without warping, waviness or ripples that are not part of the panel profile and shall be free of damage to the finish coating system.

(1) Shape

Standard corrugated type having 30 mm depth as shown on the drawing.

(2) Factory Color Finish

i) Provide factory applied, baked coating to the exterior and interior of metal roof accessories.

ii) Provide exterior finish topcoat of polyester paint with not less than 0.014 mm dry film thickness.

iii) Provide exterior primer epoxy with not less than 0.004 mm dry film thickness.

iv) Interior finish shall not less than 0.007 mm dry film thick backer coat

v) Provide exterior and interior coating meeting the test requirements specified.

vi) Tests shall have been performed on the same factory finish and thickness provided.

1.2 METAL ROOF TILE

a. Roof panels shall have a factory color finish meeting the specified requirements.

b. Sheet for panels shall be not less than 1.56 mm thickness and weight not less than 6 kilograms per square meter.

c. Panels from coil stock shall be formed without warping, waviness or ripples that are not part of the panel profile and shall be free of damage to the finish coating system.

(1) Shape

One sheet consist of three leaves

(2) Factory Color Finish

i) Provide factory applied, baked coating to the exterior and interior of metal roof and metal accessories.

ii) Provide exterior finish topcoat shall be third coat;

- first: Acrylic Base Coat
- second: Stone clips coat
- third: Acrylic Over glaze,

iii) Provide exterior primer epoxy primer and zinc coating.

iv) Interior finish shall consist of the same coating the exterior coating (epoxy & zinc) and seal coat.

v) Provide exterior and interior coating meeting the test requirements specified.

vi) Tests shall have been performed on the same factory finish and thickness provided.

2. ACCESSORIES

a. Provide sheet metal flashings, trim moldings, closure strips, caps, and other preformed metal

panel accessories, of same material and finish as panels, except accessories that are concealed after installation, and are aluminum or zinc-coated steel may be provided unfinished.

b. Provide metal thickness not less than that of panels.

c. Provide molded closure strips of closed-cell or solid-cell synthetic rubber, neoprene, or polyvinyl chloride premolded to match configurations of preformed metal panels.

3. FASTENERS

a. Provide fasteners for attaching panels to structural supports and to adjoining panels as approved and in accordance with printed manufacturer's recommendations.

b. Provide fastening system to withstand design loads indicated. Fasteners shall be zinc cast-head for steel.

c. Fasteners except those having integral hexagonal washer heads and those having aluminum drive caps, shall have composite metal and neoprene washers.

(1) Screws

Not less than 6 mm diameter self-tapping type or self-drilling and self-tapping type.

(2) Stud Welding

Provide shouldered type studs with minimum shank diameter of 4.76 mm and with cap or nut for holding preformed metal panels against shoulder.

(3) Power-Actuated Fasteners

Provide type to be fastened with power-actuated tools and with shank diameter of adequate size to support loads imposed. Provide 13 mm minimum shank length for fastening panels to steel and 25 mm for fastening panels to concrete.

(4) Blind Rivets

Stainless steel with nominal 5 mm diameter shank or aluminum with nominal 5 mm diameter shank. Provide thread-stem-type rivets for other than fastening of trim. Close rivets with hollow stems.

(5) Bolts

Joint-Sealing Material

Compressible adhesive-cohesive butyl polyisobutylene rubber tape.

d. Metal Roofing

(1) Stripe

i) Cut-width of steel stripe shall have the upper side pre-finished and underside with banded insulation.

ii) Factory metal and processed shall be supplied in coils of suitable sizes.

(2) Field-formed pattern shall be the manufacturer's standard shape and size.

(3) Strip width shall be as required for pattern and details.

(4) Strip Lengths

i) As required to form panels in single length units only from ridge to eave or eave to

eave.

ii) Intermediate cross-joints shall not be permitted.

e. Insulation

Board insulation as specified in Section P10.1 Insulation.

f. Field-Forming Equipment

(1) Supply all rollers and other equipment necessary for onsite forming of roof.

(2) Roller sets shall be suitable and specifically designed for panel patterns of styles required.

g. Finishing Accessories:

(1) Eave closers shall be provided for all bearings between exterior and interior of structures with continuous sealing material around all sides of each unit to form airtight seal.

(2) Eave decoration shall be provided for all panel ends where exposed to view from adjacent ground level.

(3) Other Items

i) Ridge coverings.

ii) Ridge end closures with waterproofing materials.

iii) Gable flashing.

iv) Flashing for wall intersection above rooflines.

P10.2.5 INSTALLATION

a. In accordance with manufacturer's approved installation instructions, and approved drawings, except as specified otherwise.

b. Install panels in full and firm contact with each other at side and end laps. Where panels are cut in field or where factory-applied coating is damaged and necessary repairs have been made with material of same type and color as finish coating, obtain approval of the Engineer before installation.

c. Correct defects in materials. Remove defective materials which cannot be corrected, and provide non-defective materials. Provide molded closure strips where indicated and whenever panels terminate with open ends after installation

1. INSTALLATION REQUIREMENTS

a. Roofing

(1) Layouts shall be uniform, symmetrical and meeting completed appearance as specified.

(2) Each panel shall be securely attached using not less than one fastener assembly per flute per bearing.

(3) Adjacent panels shall be securely interconnected at joints using fasteners uniformly spaced in between fasteners at bearings and spaced as shown or approved.

b. Bolt Assemblies

(1) Install with hex head end self drilling or water had type I for roofing.

(2) Each exterior head or nut shall be set over washer unit and tightened sufficient to effect positive watertight connection without unnecessary over-compression of resilient washer.

(3) All metal portions exposed at exterior shall be hand painted to match panel color and be carefully applied for complete coverage of unit without excessive paint on adjacent panel areas.

1.1 ROOF PANELS

(1) Corrugated Metal Roofing

i) Apply roofing panels with longitudinal configurations in the direction of the roof slope as shown on the drawing.

ii) Provide roofing panels in longest lengths obtainable, with end laps occurring only at purlins and structural members with no transverse joints except at junction of ventilators, curbs, skylights, chimneys, and similar openings.

iii) Lay side laps away from prevailing wind, and seal side and end laps with joint-sealing material.

iv) Flash seal roof at ridge, eaves, rakes, and at projections through roof. Provide closure strips, flashing, and sealing material to achieve complete weather tightness. Minimum end laps shall be 200, 300 mm, shall occur only over purlins and structural members, and shall be aligned in a staggered pattern with adjoining panels.

v) Side laps shall be standard overlap rib based on manufacturer's standard.

(2) Metal Roof Tile

i) Apply roofing panels with longitudinal configurations in the direction of the roof slope.

ii) Provide roofing panels in longest lengths obtainable, with end laps occurring only at purlins and structural members with no transverse joints except at junction of ventilators, curbs, skylights, chimneys, and similar openings.

iii) Lay side laps away from prevailing wind, and seal side and end laps with joint-sealing material.

iv) Flash seal roof at ridge, eaves, rakes, and at projections through roof. Provide closure strips, flashing, and sealing material to achieve complete weather tightness. Shall occur only over purlins and structural members, and shall be aligned in a staggered pattern with adjoining panels.

v) Side laps shall be standard overlap or interlocking rib based on manufacturer's standard.

1.2 INSTALLATION ACCESSORIES

a. Provide all items necessary for complete and well-secured installation throughout as required for panel patterns and support conditions.

b. Manufacturer's standard items shall be needed where appropriate and custom fabricated as and where required.

c. Roof connectors shall be continuous or unit type as required for panel support and connection for welding to steel structures.

d. Intermediate connectors shall have unit clips or like devices as and where necessary for the

particular installation methods.

e. Connector Bolts

(1) For securing metal panels to roof connectors one assembly shall be used bearing at each pattern high point.

(2) Assembly shall incorporate manufacturer's standard headed bolt, nut, washer and washer plate.

(3) Bolts, nuts, washer plate fabricated from galvanized highly corrosion-resistant alloy shall be used as approved by the Engineer.

(4) Bolt shank shall be threaded the full length and length shall be sufficient to provide full grip of nut threads when installed and secured in place.

(5) Washer units shall be spin-free type consisting of neoprene washer adhered to washer plate.

f. Fastener Bolts

(1) For interconnecting adjacent panels at side joints at intermediate locations between roof connectors.

(2) Assembly shall be as for connector bolts.

g. Sealant

(1) Type shall be silicon metal or comparable standard of manufacturer designed for waterproofing joints where under permanent compression.

(2) Width to joint conditioners with which used and supplied in paper-backed form in coils.

(3) For running side joints between adjacent panels where of lap type.

h. Other sealing materials

(1) For sealing joints other than as specified for lapped compression joints.

(2) Manufacturer's standard resilient strips, pre-formed tapes or fluid-applied sealants shall be used as appropriate for conditions and uses as approved.

1.3 FLASHINGS

a. Provide flashings, related closures, and accessories provided with preformed metal panels where indicated to provide watertight installation.

b. Install flashing, related closure, and accessories not indicated in accordance with panel manufacturer's printed instructions and details or approved shop drawings.

c. Installation shall allow for expansion and contraction of flashing.

1.4 FASTENER INSTALLATION

a. Provide fastener spacing in accordance with manufacturer's recommendations to withstand design loads indicated.

b. Install fasteners in valleys or crowns in accordance with manufacturer's recommendations.

c. Install fasteners in straight lines within tolerance of 13 mm in length of bay.

d. Drive exposed, penetrating-type fasteners normal to surface and to uniform depth to seat washers

with gaskets.

e. Drive so as not to damage factory-applied coating.

f. Provide thermal space blocks at each fastener to provide thermal barrier and to eliminate condensation.

g. Exercise extreme care when drilling pilot hole for fastenings to keep drills perpendicular and centered in valleys or crowns, as applicable.

h. After drilling, remove metal filings and burrs from holes prior to installing fasteners and washers.

i. Torque used when applying fasteners shall not exceed that recommended by manufacturer.

j. Remove panels damaged by over-torque fastenings, and provide new panels.

k. Remove metal shavings and fillings from roofs upon completion to prevent rusting and discoloration of panels.

1.5 STANDING SEAM AND BATTEN ROOFING

a. Provide roofing in full lengths from eaves to ridge where possible.

b. Where transverse joints are required, all sheets shall be the same length, except as required to complete a run or to maintain a pattern.

c. Locate the transverse joints of each panel half way between the joints in adjacent panels.

d. Align the joints of alternate sheets horizontally to produce a uniform pattern.

e. Fasten the sheets to the substrate with clips concealed in the seams or battens, and secure the seams as recommended by the roofing manufacturer.

f. Flash and seal the roof at the ridge, eaves, rakes, projections through the roof, and elsewhere as necessary to produce a weather tight installation.

2. PROTECTION OF APPLIED ROOFING

a. Not permit storing, walking, wheeling, and trucking directly on applied roofing materials.

b. Provide temporary walkways, runways, and platforms of smooth clean boards or planks as necessary to avoid damage to the applied roofing materials, and to distribute weight to conform to indicated live load limits of roof construction.

3. CLEANING

a. Clean exposed sheet metal work at completion of installation.

b. Remove metal shavings, filings, nails, bolts, and wires from roofs.

c. Remove grease and oil films, excess sealants, handling marks, contamination from steel wool, fittings and drilling debris and scrub the work clean.

d. Exposed metal surfaces shall be free of dents, creases, waves, scratch marks, solder or weld marks, and damage to the finish coating.

4. FINISHES

a. Installation shall be free from unnecessary cuts, holes or blank plates.

b. Installation shall be watertight throughout and free from leaks or entry of water into or through interior or concealed spaces of structure.

c. Each panel shall be tightly and rigidly secured in place and free from movement, squeaks or rattles.

d. Corrugations of roofing panels shall be parallel throughout each roof area and square and normal to ridge and eave lines.

e. Each line of fasteners shall be set square and normal to flutes of respective metal panels with each line in straight alignment.

5. LIGHTNING PROTECTION

Allow for fixings and penetrations for the lightning protection system, to be in positions agreed with the Engineer. All metal parts of the systems are to be bonded to ensure electrical continuity. Conducting tapes where used shall have a minimum cross sectional area.

SECTION P10.3 POLYCARBONATE SHEET ROOFING

a. Polycarbonate sheets shall be structured double sheets 16 mm in thickness to "Polygal CX" as manufactured by Polygal Company, approved by the Engineer

b. Depth of engagement in the framing rebates shall be according to the manufacturer's recommendation for the relevant sheet size, but in no case less than 12 mm.

c. Panels shall be supported in galvanized steel frames as specified in the drawings or polycarbonate sheets guaranteed and tested by the producer.

d. The joints and terminal for installation shall be of polycarbonate.

e. Sealing shall be by a combination of soft neoprene rubber strip sized for individual location together with an approved silicone sealing compound.

SECTION P10.4 SEALED INSULATING GLASS

a. Insulating glass shall be Class A pre-assembled units of dual or triple-seal construction consisting of two or three layers of glass separated by steel spacer with desiccant and dehydrated space conforming to ASTM E 773 and ASTM E 774.

c. Spacer shall be roll-formed, with bent or tightly welded or keyed and sealed joints, to completely seal the spacer periphery to eliminate moisture and hydrocarbon vapor transmission into airspace through corners.

d. Primary seal shall be compressed polyisobutylene. Secondary seal shall be silicone.

e. The insulating glass wilts shall be free of parallax or optical distortions.

f. The manufacturers identifying label shall be permanently affixed to both exterior surfaces of the glass units.

g. The insulating glass units shall consist of two or three glass panels separated by an air space 12 mm thick and shall conform to ASTMC 1036.

DIVISION P11 PROCUREMENT FOR O/M EQUIPMENT

1. SCOPE OF WORK

The Contractor shall procure the following machines, vehicles and equipment as specified herein:

a. Heavy machines and vehicles

b. Equipment for the workshop for maintenance and repair of pump equipment, valves and others

c. Entire monitoring system for local pump stations

2. SHOP DRAWINGS AND INSTRUCTIONS

Submit for approval complete shop drawings and descriptive literature showing details of fabrication of all equipment procured under this section. The shop drawings and instructions shall be written in two (2) languages of English and Russian.

3. SHIPPING AND DELIVERY

The Contractor shall prepare all equipment for shipment in such a manner as to protect equipment from damage in transit, and during a prolonged storage period in cold climate.

Particular care shall be taken in the packing of electrical equipment. It shall be packed separately in sealed polyethylene or similar bags taking precaution to exclude moisture.

All cases and crates shall have their contents indelibly stenciled on the outside.

Each shipment of equipment shall be delivered to the designated Government storage area under the responsibility of the Contractor.

4. CHECK AND TEST

Before taking over the equipment procured under this section, all equipment procured shall be checked and tested by the Contractor in the presence of the Employer and the Engineer. The Contractor shall furnish the labor and materials required for checking and testing for:

a. Items of equipment

b. Number of equipment

c. Functioning of equipment

If any defects are found out under checking and testing, the Contractor shall be required to replace them with new ones at his own expense. Any repairing for equipment will not be permitted.

5. INSTRUCTION

Before taking over the equipment furnished under this section, the Contractor shall be required to execute at least for one (1) week of proper instruction on equipment procured to the personnel concerned.

6. SUPPLY AND CHECK LIST

The Contractor shall furnish six (6) sets of supply and check lists of equipment. Each item shall be properly booked on hard papers and they shall be filed with A4 size hard files having four (4) inclined

D-rings with double lock system.

SECTION P11.1 HEAVY MACHINES AND VEHICLES

P11.1.1 BUCKET LOADER (OM-1)

Equipment	: Bucket Loader, 2 m3 capacity
Manufacturer	: Chelyabinsk Equipment Plant, Chelyabinsk, Russia
Type	: Wheel B-138 C
Quantity	: 1 unit
Engine power, nominal, kWt (HP)	: 198 (270)
Nominal carrying capacity, t	: 2
Nominal bucket capacity, m3	: 2.2
Engine:	
Mark/type	: ЯМЗ-236М2
Engine power, nominal, kWt (HP)	: 132 (180)
Operating speed, revolutions per minute	: 1700
Start	: By starter
Transmission	: Hydro static all wheel drive. Front axle –driven, rear axle – driven,

P11.1.2 EXCAVATOR/BACKHOE

1) TYPE A (OM-2)

Equipment	: Excavator/backhoe
Manufacturer	: Tisovets, Russia
Type	: UDS –114 A
Quantity	: 2 units
Maximum transport speed	: 70 km/h
Engine of upper rotation part	: Z 8701
Powered	: 85 kWt at 2200 rev/min
Horizontal crane boom length	: 10.5
Depth of excavation with transposed arm	: 6.60/9.30

Resultant excavation force from clamping	: 85 kH
Lifting capacity in hinge point of fast-clamp	
Pushed-in telescope	: 6 500 kg
Pushed out telescope	: 2 400 kg
Excavation output	: 108 m3/hour
Weight	: 21 800 kg

2) TYPE B (OM-3)

Equipment	: Komatsu Excavator/backhoe
Manufacturer	: Komatsu
Type	: PW 100-3
Quantity	: 3 units
Base	: Wheel-base excavator
Engine Type	: Diesel
Power (HP)	: 108
Weight	: 11 080
Maximum boom length	: 7.2 m

P11.1.3 FROZEN GROUND EXCAVATOR/CHAIN SAW

1) TYPE A (OM-4)

Equipment	: Frozen ground excavator/chain saw
Manufacturer	: Kopei Machine-Building Plant, Chelyabinsk, Russia
Type	: BGM 1, BGM 2
Tractor base	: MTZ 80 base
Quantity	: 2 units
Length of cutter saw	: 1.6 m
Cutter saw speed	: 0.89 m/sec
Range of regulating tractor speed with engaged speed-reducer	: From 1.89 to 0 km/h
Width of cutting trench	: 140/270 mm

2) TYPE B (OM-5)

Equipment	: Frozen ground excavator/chain saw
Manufacturer	: Kopei Machine-Building Plant, Chelyabinsk, Russia
Type	: BGM 1, BGM 2
Tractor base	: T 170 base
Quantity	: 1 unit
Length of cutter saw	: 2.0 m
Cutter saw speed	: 2.12 m/sec
Range of regulating tractor speed with engaged speed-reducer	: From 0.26 to 0 km/h
Width of cutting trench	: not more than 2000 mm
Width of cutting trench	: not more than 2000 mm
Cutter weight	: 2400 kg

P11.1.4 HYDRAULIC HAMMER FOR FROZEN GROUND (OM-6)

Equipment	: Frozen ground excavator/chain saw
Manufacturer	: Caterpillar
Type	: Backhoe base/Oil pressure, H 100/ H 100 s
Quantity	: 1 unit
Working weight	: 820/830 kg
Impact frequency	: 430-1300 bpm
Hammer operating pressure	: 14 500 kPa
Carrier relief pressure	: 21 000 kPa
Acceptable oil flow	: 60 – 120 l/min
Maximum back pressure	: 2000 kPa
Carrier weight class	: 8-14 t

P11.1.5 MOBILE STEAM GENERATING PLANT (OM-7)

Equipment	: Mobile steam generating plant
Chassis	: URAL 5557
Quantity	: 2 units
Model	: ППУА 1600/100
Steam generation	: 1600 ±10% kg/hour
Steam temperature	: 1640 C

Steam pressure	: 0.60 MPa
Fuel consumption	: 35 kg/hour
Tank capacity	: 5.2 m3
Initial steam generation time	: 20 minutes
Weight, full	: 18 200 kg
Weight, without water and fuel	: 12 490 kg
Fuel for steam generating plant	: Diesel
Drive type for all mechanisms	: from engine
Steam generator control	: from drivers' cabin

P11.1.6 DUMP TRUCK (OM-8)

Equipment	: Dump truck
Manufacturer	: JS "Nefaz", Russia
Type	: KamAZ type (6x4)
Quantity	: 5 units
Carrying capacity	: 13 000 kg
Equipped weight	: 9050 kg
Full weight	: 22 200 kg
Engine	: KamAZ type, diesel, 162 kWt (220 HP)
Maximum speed	: 90 km/h
Fuel consumption at 60 km/h	: 28l / 100 km
Body capacity	: 6.6 m3
Body lifting /dropping time	: 19/18 sec
Turnover angle	: 60 degrees
Dimensions	: 6680 x 2500 x 2 710

P11.1.7 SERVICE EMERGENCY TRUCK (OM-9)

Equipment	: Service truck
Manufacturer	: Kletinsky Machine-Building Plant, Russia
Type	: GAZ – 3307, MAVR
Quantity	: 5 units
Setup time	: 5 min.

Set capacity, kWt	: 15
Voltage	: 380/20
Dimensions	: 6580 x 2410 x 3000
Seat places	: 7
Wagon dimensions	: 4.1 x 2.5 x 2.1 m
Wagon sections	: 2 (one working and one heated for staff)
Installed equipment	: electric welding equipment, gas welding equipment, water pump, workbench, set of bench tools

P11.1.8 TRUCK CRANE

1) TYPE A (OM-10)

Equipment	: Truck crane
Manufacturer	: JSC "AutoCrane", Russia
Chassis	: KAMaZ
Type	: KC – 35 714 K
Quantity	: 1 unit
Boom length	: 25 m
Lifting capacity	: 16 t
Gearing type	: hydraulic
Boom	: telescopic, three –section, extended by the hydraulic cylinder and tackle block

2) TYPE B (OM-11)

Equipment	: Truck crane
Manufacturer	: JSC "AutoCrane", Russia
Chassis	: MAZ 5337
Type	: KC – 35 77
Quantity	: 2 units
Boom length	: 14 m
Lifting capacity	: 14 t
Gearing type	: hydraulic
Boom	: telescopic, double –section, extended by the hydraulic cylinder and tackle block

P11.1.9 TRAILER

1) TYPE A (OM-12)

Equipment	: Trailer
Manufacturer	: Uralautopricep, Russia
Type	: ЧМЗАП –93853.013
Quantity	: 1
Weight of transporting load	: 26 200 kg
Trailer equipped weight	: 6500 kg
Trailer total weight	: 32 700 kg
Internal platform dimensions	: length 7040 mm, width 2500 mm
Tires	: 10.00R20, pressure 0.64 MPa
Suspension	: spring, balance type
Working brake system	: chock, drum type, pneumatic,
Parking brake system	: manual drive
Electrical equipment	: 24 V
Prime mover	: МАЗ – 64229
Life time before capital repair	: 250 000
Warranty haulage	: 30 000 (36 months)
Maintenance is admitted with Prime mover	: КрАЗ-258Б1
Operating temperature	: - 45 C0 to + 50 C0

2) TYPE B (OM-13)

Equipment	: Trailer
Manufacturer	: Uralautopricep, Russia
Type	: ЧМЗАП –93853.013
Quantity	: 1
Weight of transporting load	: 39400
Trailer equipped weight	: 8600 kg
Trailer total weight	: 48000 kg
Internal platform dimensions	: length 7480 mm, width 3150 mm
Tires	: 1025 x 420-457 pressure 0,64 MPa
Suspension	: non-spring, balance type
Working brake system	: chock, drum type, pneumatic,

Parking brake system	: manual drive
Speed limit	: 50 km/h
Electrical equipment	: 24 V
Prime mover	: МАЗ – 64229
Life time before capital repair	: 100 000
Warranty haulage	: 20 000 (36 months)
Maintenance is admitted with Prime mover	: КрАЗ-258Б1
Operating temperature	: - 50 C0 to + 45C0

P11.1.10 CHANNEL WASHING MACHINE

1) TYPE A (OM-14)

Equipment	: Channel washing machine
Manufacturer	: Arsamas Utility Machinery Plant, Russia
Type	: KO 514
Chassis base	: Kamaz truck base 43253
Quantity	: 2 units
Tank capacity	: 5.75 m3
Water pump capacity	: 10 m3/h
Working water pressure	: 16 MPa
Diameter of washed pipes	: 150 – 1000 mm
Dimensions	: 7500 x 2500 x 3500
Full vehicle weight	: 15200 kg
Engine type	: turbo diesel, 176/240 hp
Maximum speed	: 90 km/h

2) TYPE B (OM-15)

Equipment	: Channel washing machine
Manufacturer	: Arsamas Utility Machinery Plant, Russia
Type	: KO 514
Chassis base	: ZIL truck base 433362
Quantity	: 2 units
Tank capacity	: 4.9 m3

Water pump capacity	: 10 m3/h
Working water pressure	: 16 MPa
Diameter of washed pipes	: 150 – 1000 mm
Dimensions	: 7100 x 2500 x 2850
Full vehicle weight	: 11000 kg
Engine type	: petrol type
Operating temperature	: 0…….60 C

3) TYPE C (OM-16)

Equipment	: Channel washing machine
Manufacturer	: Arsamas Utility Machinery Plant, Russia
Type	: KO 560
Chassis base	: Kamaz truck base 53229
Quantity	: 2 units
Sludge Tank capacity	: 6 m3
Clean water tank capacity	: 5 m3
Depth of cleaned wells	: 6 m
Vacuum pump capacity	: 720 m3/h
Water pump capacity	: 10 m3/h
Working water pressure	: 15 MPa
Maximum discharge in tank	: 0.09 MPa
Dimensions	: 8250 x 2500 x 3250
Full vehicle weight	: 24000 kg
Engine type	: diesel, 260 hp

P11.1.11 SEWER WASHING MACHINE (OM-17)

Equipment	: Sewer washing machine
Manufacturer	: Dorcomtechnica, Russia
Type	: DKT 260
Quantity	: 1 unit
Chassis base	: ZIL 53016
Tank capacity	: 5.6 m3
Water pump capacity	: 12.5 m3/h

Working water pressure : 16 MPa

Diameter of washed pipes : 0.15 –0.8 m

P11.1.12 VACUUM VEHICLE (OM-18)

Equipment : Vacuum vehicle

Manufacturer : Arsamas, Nizhny Novgorod , Russia

Type : KO 503 B,

Base Chassis : GAZ 3307

Quantity : 10 units

Tank capacity, m3 : 3.75

Cleaned pool depth, m : 3.5

Vacuum pump productivity : 240 m3/ hour

Maximum discharge in tank : 0.08 MPa

Dimensions : 7000 x 2200 x 2600 mm

P11.1.13 FLUSHER VEHICLE (OM-19)

Equipment : Flusher vehicle

Manufacturer : Arsamas, Nizhny Novgorod , Russia

Type : KO 829-1,

Base Chassis : ZIL 5301

Quantity : 2 units

Tank capacity : 2.5 m3

Working water pressure : 0.4-0.7 MPa

Width of working zone : not less than 3 meters

Accessories : high pressure pump, hoses and nozzles

P11.1.14 OFF-ROAD PATROL VEHICLE

1) TYPE A (OM-20)

Equipment : Off-road vehicle

Manufacturer : Toyota, Japan

Type : Land Cruiser 100 GX SW 4 WD

Quantity : 1 unit

Engine : 4.7 l, 8 cylinder, 235 hp

Equipment	: 5 gear mechanical gearbox, ABS, servo, fabric seats, regulated wheel, electric glass and mirrors, stereo-cassette player with AM/FM/SW radio, 4 speakers, 2 front airbags, 2 heaters, air-conditioner, central lock with remote control, immobilizer, electric hatch, rear glass heating, footboard, digital clock with thermometer, mudguards, electric winch, additional fuel tank for 50 l, 2 spare tires, tires 275/70/16
Warranty	: 2 years of unlimited km.

2) TYPE B (OM-21)

Equipment	: Off-road vehicle
Manufacturer	: Toyota, Japan
Type	: HiLux
Model	: Pickup, Double Cab 4 WD
Quantity	: 3 units
Engine	: 2.8 diesel
Equipment	: 5 gear mechanical gearbox, ABS, servo, fabric seats, regulated wheel, electric glass and mirrors, stereo-cassette player with AM/FM/SW radio, 4 speakers, 2 front airbags, 2 heaters, air-conditioner, central lock with remote control, immobilizer, electric hatch, footboard, digital clock with thermometer, mudguards, electric winch, 2 spare tires,
Warranty	: 2 years of unlimited km.

3) TYPE C (OM-22)

Equipment	: Minibus vehicle
Manufacturer	: Toyota, Japan
Type	: HiAce
Model	: Minibus 4WD
Quantity	: 1 unit
Number of seats	: 12
Engine	: 2.9
Equipment	:5 gear mechanical gearbox, ABS, servo, fabric seats, regulated wheel, electric glass and mirrors, stereo-cassette player with AM/FM/SW radio, 4 speakers, heater, air-conditioner, central lock with remote control, immobilizer, spare tire,
Warranty	: 2 years of unlimited km.

P11.1.15 PIPE LAYER (OM-23)

Equipment	: Pipe Layer
Manufacturer	: "Ural – CM", Chelabinskaya Oblast, Miass city.
Type	: TP 12.04.01
Quantity	: 1 unit
Base tractor	: T-170 M1B.01
Engine power	: 132/180
Lifting capacity, nominal	: 12.5 t
Maximum hook lifting height	: 5.4 m
Hook drop depth at min. load overhang	: 2.5 m
Moving speed	: forward 1.75-7.06 km/h, backwards 2.49-8.41 km/h
Weight	: 52.3 t
Fuel tank	: 300 l
Winch	: double drum, reverse with multi-disk friction engagement muffs and hydraulic control
Lifting and lowering hook speed	: 1 gear 1.6-3.3 m/min, 2 gear 6.2-13 m/min, 3 gear 16.4 –34 m/min
Load and boom cables	
Diameter	: 19.5 or 20 mm
Length of load cable	: 49 m
Counterbalance	
Type	: non-dropout
Load	: 4 units
Weight of one load	: 820 kg
Weight of counterbalance	: 3500 kg
Hydraulic system	: 116.5 l

P11.1.16 EARTH BORING MACHINE (OM-24)

Equipment	: Earth Boring Machine
Manufacturer	: ZAO Proftechnica, Ekaterenburg
Type	: BM 317
Quantity	: 1 unit
Base Chassis	: GAZ –330B

Chassis Type	: 4 x 4
Boring Depth	: 3 m
Bore Diameter	: 0.36/0.5 m

P11.1.17 COMPRESSOR (OM-25)

Equipment	: Compressor
Manufacturer	: "Compressor Equipment Plant", Verchnaya Pizhma
Type	: PKCD –1.75
Quantity	: 2 units
Diesel Engine	: D 120
Productivity	: 1.75 m3/min
Pressure	: 7 Atm
Dimensions	: 3000 x 1880 x 2160
Power, kWt	: 11.2
Weight	: 1280 kg

P11.1.18 WELDING TRANSFORMER (OM-26)

Equipment	: Welding transformer
Manufacturer	: "Iskra Equipment Plant", Sverdlovsky region, city Pervouralsk
Type	: TDM 401
Quantity	: 5 units
Supply Voltage	: 380
Value of nominal welding current	: 46 A
Range of regulated welding current	: 80 – 400
Duration of load	: 40%
Dimensions	: 520 x 440 x 620
Weight	: 96 kg

P11.1.19 DIESEL GENERATOR

Equipment	: Diesel generator
Manufacturer	: Distributor "Avangard Energo M", Moscow
Type	: ADS type, mobile

Quantity :

Model ADC 8 –230 РЯ : 2 units

Up to 2.2 kWt (OM-27)

Model ADC 10 – Т400 РЯ : 2 units

Up to 4.5 kWt (OM-28)

Model ADC 135-Т400ЖН : 1 unit

Up to 13 kWt (OM-29)

Model AD 100C T 400 PM 2 : 1 unit

Up to 100 kWt (OM-30)

P11.1.20 SUBMERGED PUMP

Equipment : Submerged pump

Manufacturer : Hydroenergosnab, Russia

Type : submersible model GNOM

Quantity :

GNOM 25*20 (OM-31) : 2 units

25m3/hour, head 20m, 4kWt

GNOM 53*10 (OM-32) : 3 units

53m3/hour, head 10m, 4kWt

GNOM 40*25 (OM-33) : 3 units

40m3/hour, head 25m, 5,5kWt

GNOM 100*25 (OM-34) : 2 units

100 m3/hour, head 25m, 11 kWt

P11.1.21 PUMP+GENERATOR

1) Pump (OM-35)

Equipment : Pump

Manufacturer : Flygt International, Sweden

Type : NP 3201.180 (444)

Quantity : 2 units

Capacity : 175 m^3/h

Head : 19.5 m

Power	: 30 kW
Energy density	: 0.075 kW·hr/m^3

2) Generator (OM-36)

Equipment	: Generator
Manufacturer	: Perkins
Model	: T4.236
Type	: four-cycle, four-cylinder, cooling type
Quantity	: 2 units
Output capacity, KVA/kW	: 63.7/50.96
Rated voltage, V	: 230/400
Rated frequency, Hz	: 50
Fuel tank volume, l	: 120
Fuel consumption, l/hr	
at 100% load	: 17
at 50% load	: 8.9
Dimensions, LxBxH	: 200x70x160
Dry weight, kg	: 1079

P11.1.22 PIPE DETECTING EQUIPMENT (OM-37)

Equipment	: Pipe detecting equipment
Manufacturer	: Seba KMT, Germany
Type	: Ultra-sonic FM 9860 XT
Quantity	: 2 units
Frequency active	: 9, 82, 82 kHz
Frequency passive	: 50/60 kHz, 14-22 kHz
Accuracy of depth measurement	: +/-5% + 5 cm
Maximum measurement depth	: 6 m
Power supply	: 6 AA batteries (1.5 V)
Operating time (without backlighting)	► 30 hours
Battery control	: continuous
Dimensions	: 68.6 x 17.8 x 22,.9 cm

Weight	: 2.2 kg
Generator Model 9860	
Frequency	: 9, 82, 82 kHz
Output	: 3 Wt
Power supply	: 10 batteries (IEC R20)
Options	: NiCd Batteries
Operating time (without backlighting)	► 70 hours, NiCd Batteries - ► 30 hours
Battery control	: at ON position
Dimensions	: 36.2 x 23.5 x 13.3 cm
Weight	: 4 kg incl. Batteries
Temperature range	: - 20 C to + 50 C
Generator/receiver	

P 11.1.23 WATER LEAKAGE DETECTOR (OM-38)

Equipment	: Water Leakage Detector
Manufacturer	: Seba Spectrum, Moscow
Type	: Microcorp 6 DKL 1506,
Quantity	: 2 units
Display	: 280 x 64 points, liquid –crystal type
Data input	: external keyboard
Power supply	: Lead batteries 12V
Interface	: RS 232 for printer or PC, video adapter for external monitor
Frequency range	: 0…50 C
Dimensions	: 150 x 330 x 230 mm
Weight	: 2.6 kg
Amplifier - Transmitter	
Frequency	: UVH 433 MHz /434 MHz
Transmitting power	500 mWt
Indication	Charge status, signal level, filer
Power supply	Lead-helium battery
Temperature range	: 0…50 C

P11.1.24 LABORATORY FOR PIPE TELEINSPECTION (OM-39)

Equipment	: Laboratory for pipe teleinspection
Manufacturer	: Seba Spectrum, Moscow
Type	: Van type
Quantity	: 1 unit
Equipment	: TRITON System
Inspection of channels	: 90-1200 mm
Self-moving trolley with color rotated video camera	: 1 unit
Main and auxiliary lightning system	: 1 unit
Video camera lifting mechanism	: to be provided
Cable winch with 250 m of cable , electric driven and external control panel	: 1 unit
Control panel with monitor and video recorder	: 1 unit
Digital system of registering on the basis of the industrial computer	: to be provided

P11.1.25 POTABLE FLOW METER (OM-40)

Equipment	:Potable flow meter
Manufacturer	: Seba Spectrum, Moscow
Type	: UDM 100
Quantity	: 8 units
Nominal internal diameter	: DN 25 …..DN 1000
Option	: DN 50 …..DN 3000
Flow speed	: 0.1…..20 m/s
Range of measured flow	: 5……100000 l/min
Error	: 3% from +/- 0,03 m/sec
Average time value	: 0……65530 s
LCD display with backlight	: 2 x 16 points
Socket	: RS 232 (V24)
Memory capacity	: for 3000 measured values

Power supply	: nickel – cadmium accumulator, 5 Ah
Time of continuos operation	: 15 hours
Weight	: 3.5 kg
Dimensions	: 220 x 100 x 180 mm
Protection class	: IP 54
Maintenance temperature	: 0…..+50 C
Accessories	: software for PC, connection cable for PC, printer, extension for sensors, strap for sensors, sensors for high temperatures.

P11.1.26 FLOW METER FOR CANALS (OM-41)

Equipment	: Flow meter for canals
Manufacturer	: Seba Spectrum, Moscow
Model	: VZLET RCL
Type	: Ultra sonic flow meter
Quantity	: 2 units
Specification	: D=300-800 mm

P11.1.27 MOBILE ELECTRIC LABORATORY (OM-42)

Equipment	: Mobile Laboratory
Manufacturer	: Seba Spectrum, Moscow
Type	: Truck base, ETL – 35
Quantity	: 1 unit
Testing equipment	: BPA 703
Burning equipment	: control block VT 5000-703
	: high voltage transformer HTR 55
	: high voltage converter HGL 70
	: measurement and charging unit HEM 70
Cable route detecting equipment	: installation Ferrolux FL 8-3-Q
Equipment for remote methods of damage detection	: KABELLUX 2000E system
	LSG 3E unit
Equipment for topographical methods of damage detection	: Generator FLS 500-4
	Receiver FLE –90

	Generator SWG 1000
	Receiver SWE 90
Specification of equipment	: search of cable line routes and definition of the depth position, selection of one cable out of the majority, preventive testing of electrical equipment and cable lines, definition of cable lines damage spots by remote methods, definition of cable lines damage spots by topographical methods, definition of cable casing damage spots, definition of ground in non-ground installations, multi-stage safety system for servicing staff.

P11.1.28 WATER METER TEST BENCH (OM-43)

Equipment	: Water meter test bench
Manufacturer	: OKB Gidrodinamika, Kirov city, Russia
Type	: UPCZH 400/400V
Quantity	: 1 unit
Flow range	: 0.03 – 400 m3/hour
Types of testing meters	: 15 mm to 400 mm
Specification	: three sample meters, three weights, two working benches – mechanical and pneumatic squeezing of meters. Amount of simultaneous tested meters – 8. Methods of testing – volumetrical and weight. Accuracy : weight – 0.08; sample meters – 0.25
Control system	Automatic (built in controller and computer).

P11.1.29 PASSENGER BUS (OM-44)

Equipment	: Passenger Bus
Manufacturer	: PAZ factory, Russia
Type	: PAZ 3205
Quantity	: 2 units
Wheel arrangement	: 4 x 2
Body	: all – metal with one double passenger door, one driver door and emergency door
Number of passengers	: sitting places – 28, nominal –36, limit – 55
Weight, kg	: equipped – 4720, full – 7705, front axis - 2890, rear axis – 4815.
Dimensions	: length – 7000, width – 2520, height – 2 960
Ventilation	: 3 hatches, passenger window leaves
Fuel tank	: 105 l

Brake system	: working – drum type with individual hydro-drive and pneumatic hydro booster; parking – drum type with manual mechanical drive, independent from working system.
Engine	: Petrol Type
Gearbox	: 5 gears

P11.1.30 CRANE TOWER TRUCK (OM-45)

Equipment	: Crane tower truck
Manufacturer	: ZAO "Proftechnica", Moscow
Type	: AGP 22.04
Chassis base	: ZIL - 433362
Quantity	: 1 unit
Tower length	: up to 22 meters
Working temperature	: -40 +40C
Lifting capacity	: 300 kg
Maximum transport speed	: 50 km/h
Time of top lifting	: 95 sec
Maximum rotation speed	: 0.5 rpm
Degree of rotation	: 360
Control	: remote and from cradle
Dimensions	: 8000 x 2500 x 3900

P11.1.31 MAINTENANCE AND REPAIR CENTER (OM-46)

Equipment	: Maintenance and repair center
Manufacturer	: ZAO "Uralavto", Chelabinskaya Oblast, city Miass
Repair Center shall include the following	: Car lifts: 1 for cars - P 1018 (3t capacity) , 1.5kWt (2 motors
	and 1 for trucks - PP 16 (16 t capacity), synchro
	Rolling jack (6-40 t capacity) 2 units
	Press (40t) – 1 unit.
	Truck tire mounting and repair equipment.
	Air compressor PCKD 5.25
	Set of forging equipment
	Test benches for controlling fuel consumption for petrol

carburator engines.

Quantity : 1 unit

P11.1.32 HORIZONTAL BORING MACHINE (OM-47)

Equipment	: Horizontal Boring Machine (Horizontal Directional Drill)
Manufacturer	: Robbins HDD
Type/model	: 4515 TMSC
Quantity	: 1 unit
Regulated rotation speed	: 130 rev/per min
Torque	: 7 050 Hm
Engine	: diesel type, John Deere
Engine power	: 157 hp
Fuel tank	: 151 l
Hydraulic tank	: 246 l
Track	: Rubberized Steel type
Jack rod loader	: for digging 128 m
Weight	: 6 576 kg
Drilling liquor pump	: 265 l/min
Anchoring system	: 4 anchors
Accessories	: Drill mounted crane – 1 unit
	Drill mounted mud pump – 1 unit
	Mud handling/recycling system – 1 unit
	Drill stem – 1 unit, Locating – 1 unit
	Down hole tooling – 1 unit

P11.1.33 TRENCHLESS PIPE LAYER (OM-48)

Equipment	: Trenchless Pipe Layer (Rod Pusher)
Manufacturer	: Ditch Witch
Type/model	: P80
Quantity	: 1 unit
Thrust/pullback	: 36800 kg at 172 bar
Bore length	: 152 m with directional control
Dimensions - Trench box	: 2750 mm x 920 mm x 1220 mm

Back Brace	: 1800 - 2500 mm x 430 mm x 450 mm
T-bar	: Cylinder 200 mm diameter, 145 mm x 300 mm
Bore diameter, max.	: 325 mm

P11.1.34 GROUND WATER REDUCTION SYSTEM (OM-49)

Equipment	: Ground water reduction system
Type	: well-point
Quantity	: 2 units
Specification	: vacuum pump system 1 + well point 25+pipes +jet pump system

P11.1.35 POLYETHYLENE PIPE WELDER

1) TYPE A (OM-50)

Equipment	: Polyethylene pipe welder
Manufacturer	: "Remdetal", Armenia
Type	: OB 2418 U2
Quantity	: 1 unit
Welding diameter	: D 63-110 mm

2) TYPE B (OM-51)

Equipment	: Polyethylene pipe welder
Manufacturer	: "Gazoapparat", Saratov
Type	: UMST-09-00-OOM
Quantity	: 1 unit
Welding diameter	: D 90 - 225 mm

P11.1.36 VACUUM PUMP (OM-52)

Equipment	: Vacuum pump
Manufacturer	: "Gidrospetsstroi"
Type	: LIU-6BM
Quantity	: 2 units
Maximum pumping height	: 7.35
Sewer rated length	: 100m
Weight	: 6750 kg

SECTION P 11.2 EQUIPMENT FOR THE WORKSHOP FOR MAINTENANCE AND REPAIR OF PUMP EQUIPMENT, VALVES AND OTHERS

P11.2 WORKSHOP EQUIPMENT

Manufacturer : Promresources Tel. Fax.: (34145) 5 –04 – 99, 6 – 00- 41

№		Description	Model / Type	Quantity
1	OM-61	Vertical turning lathe	M 1532	1
2	OM-62	Horizontal milling Lathe	6T82Г	1
3	OM-63	Vertical milling Lathe	6T13	1
4	OM-64	Hydraulic Press	П6330	1
5	OM-65	Vertical drilling Lathe	2 C 132	3
6	OM-66	Tool grinding desk Machine	ЗЛ 631	5
7	OM-67	Screw – cutting Lathe	16 ВТП 20П.02	4
8	OM-68	Screw – cutting Lathe	1M63H	3
9	OM-69	Slotting Machine	M 7402	2
10	OM-70	Jig saw	M 8725	2
11	OM-71	Guillotine Crank Shears	НГ -13	2

SECTION P11.3 ENTIRE MONITORING SYSTEM FOR LOCAL PUMP STATIONS

The entire monitoring system for local pump stations shall be establish to monitor mainly emergency alarms at ASA office. A high priority matter in the system is the monitoring for 17 intermediate pump stations which are rehabilitated in this project. The maximum number of local station which should be monitored is 120 stations. Detail of the system shall be determined by a discussion with ASA to match with existing system.

The system shall be composed of a master station at ASA headquarters, local stations at pumping stations and radio system as a communication medium as shown bellow.

Master station

1-1	OM-81	UHF desktop repeater	Vertex VXR-7000	2 sets
1-2	OM-82	Radio modem	CD-711	2 sets
1-3	OM-83	Data concentrator	K-501	1 set
1-4	OM-84	Trunk controller	ST-853	2 sets
1-5	OM-85	Electrical cabinet	CRN	1 set
1-6	OM-86	UPS	220 V	1 set
1-7	OM-87	Computer	Pentium 4, 21’ monitor, Software	2 sets
1-8	OM-88	Notebook computer	Pentium 4	1 set
1-9	OM-89	Omni directional antenna		1 set
1-10	OM-90	Cable, mounting and other material		1 lot
1-11	OM-91	Assembling, primary setting-up and test		1 lot

Local station (The quantities shall be for each station) total : 120 stations (Max)

2-1	OM-92	UHF desktop repeater	Vertex VXR-7000	1 set
2-2	OM-93	Radio modem	CD-711	1 set
2-3	OM-94	Control unit		1 set
2-4	OM-95	UPS	220 V	1 set
2-5	OM-96	Antenna		1 set
2-6	OM-97	Cable, mounting and other material		1 lot
2-7	OM-98	Assembling, primary setting-up and test		1 lot

SECTION P11.4 LIST OF NECESSARY EQUIPMENT REQUIRED FOR ELECTRICAL SURVEY LABORATORY

1.	OM-101	Megahmmeter Ф-4102/1	2 set
2.	OM-102	Ohmmeter Щ – 306/1	2 set
3.	OM-103	Frequency counter Ч3-63	1 set
4.	OM-104	Workplace for Protection Engineer of radio equipment APM- 4150	2 set
5.	OM-105	Workplace for regulator of radio equipment APM 4250	2 set
6.	OM-106	Table lamp ATP-6030	4 set
7.	OM-107	Equipment for oscillography C 1 – 120	2 set
8.	OM-108	Voltmeter B7-35	2 set
9.	OM-109	Generator AHP –1001	2 set
10.	OM-110	Power source ATH – 1031	2 set
11.	OM-111	Multimeter AM – 645	5 set
12.	OM-112	Equipment for current strength determination M –266 Г	5 set
13.	OM-113	Zero wire measurement device TES 1700	5 set
14.	OM-114	Earthmeter Ф 4130	2 set
15.	OM-115	Megohmmeter ЭСО-202/2Г	2 set
16.	OM-116	Measurement device ZCR-9063	2 set
17.	OM-117	Reflectometer P-13	2 set
18.	OM-118	DC bridge P –333	2 set

DIVISION P12 FURNISHINGS

SECTION P12.1 – INSTRUMENTS FOR LABORATORY AT WATER TREAMENT PLANT

P12.1.1 GENERAL

1. SCOPE OF WORK

The Contractor shall furnish the following instruments for laboratory to be furnished at the water treatment plant:

a. Laboratory equipment

b. Glassware and others

c. Chemicals and reagents

2. SHOP DRAWINGS AND INSTRUCTIONS

Submit for approval complete shop drawings and descriptive literature showing details of fabrication of all material and equipment furnished under this section. The shop drawings and instructions shall be written in two (2) languages of English and Russian.

3. SHIPPING

The Contractor shall prepare all materials and equipment for shipment in such a manner as to protect laboratory equipment including glassware, chemicals and others from damage in transit, and during a prolonged storage period in cold climate.

Special care of packing method and material for glassware and chemicals including hazardous chemicals shall be taken. Each package of glassware and hazardous chemicals shall be provided with adequate self-adhesive label in lettering "FRAGILE with symbol mark" and "DANGER with symbol mark" respectively.

Particular care shall be taken in the packing of electrical equipment. It shall be packed separately in sealed polyethylene or similar bags taking precaution to exclude moisture.

All glassware, chemicals and other fragile items shall be separately and adequately packaged with stuffing material. Some packages shall be crated.

All cases and crates shall have their contents indelibly stenciled on the outside.

4. INSTALLATION

All of the equipment required to be installed in a proper location of the laboratory shall be installed by the Contractor.

Water supply piping and drain piping for sink table and sampling sink shall be completed as shown on the drawings and as directed by the Engineer.

The Contractor shall have final responsibility for all equipment furnished under this Contract.

5. CHECK AND TEST

Before taking over the laboratory equipment furnished under this section, the Engineer may order checking and testing of all equipment furnished. The Contractor shall furnish the labor and materials

required for checking and testing for:

a. Items of equipment, glassware and chemicals

b. Number of equipment and glassware

c. Volume of chemicals

d. Functioning of equipment

If any defects in the fabrication of equipment and damaged glassware and hardware will be found out under checking and testing, the Contractor shall be required to replace them with new ones at his own expense. Any repairing for equipment will not be permitted.

6. INSTRUCTION

Before taking over the laboratory equipment furnished under this section, the Contractor shall be required to execute at least for one (1) week of proper instruction on equipment operation and maintenance to the laboratory personnel.

7. SUPPLY AND CHECK LIST

The Contractor shall furnish six (6) sets of supply and check lists of equipment, glassware and chemicals. Each item shall be properly booked on hard papers and they shall be filed with A4 size hard files having four (4) inclined D-rings with double lock system.

P12.1.2 LABORATORY EQUIPMENT

All laboratory equipment specified hereinafter shall be shop fabricated, wired and tested, and power source for the laboratory equipment shall be AC220 V, 50 Hz.

For equipment, all essential and desirable accessories for an installation and operation shall be furnished.

Laboratory equipment furnished under this section is summarized in the following table:

ITEM		QUANTITY
1.	Dry oven	:2
2.	Instruments dryer	:2
3.	Drying sterilizing box	:5
4.1	Autoclave-1	:1
4.2	Autoclave-2	:2
5.1	Washing machine	:1
5.2	Washing accessory	:1
6.	Ultrasonic pipette washer	:1
7.	Ultrasonic washer	:1
8.1	Incubator-1	:1
8.2	Incubator-2	:5

9.	Muffle furnace	:1
10.1	Water bath-1	:1
10.2	Water bath-2	:1
11.	Electric stove	:3
12.	Hot plate	:2
13.	Magnetic stirrer with hot plate	:1
14.	Magnetic mixer	:5
15.1	Shaker-1	:1
15.2	Skaker-2	:1
16.	Analytical balance	:2
17.	Spectrophotometer	:2
18.	Turbidity tester	:1
19.	Transparency tester	:10
20.	Water collector	:1
21.	Water collector with vessel	:1
22.	pH meter	:3
23.	Electro-conductivity meter	:1
24.1	Centrifuge-1	:1
24.2	Centrifuge-2	:1
25.	Microscope	:3
26.	Refrigerator for laboratory-1	:4
27.	Refrigerator for laboratory-2	:2
28.	Rotary evaporator	:1
29.	Residual chlorine meter	:1
30.	Water purification apparatus	:1
31.1	Vacuum pump-1	:1
31.2	Vacuum pump-2	:1
32.	Thermometer	:2
33.	Timer	:2
34.	Thermometer & humidity meter	:1
35.	Liquid analyzer	:1
36.	Gas chromatograph	:1

37.	Atomic absorption spectrometer	:1
38.	Apparatus for bacteriological cultivation and colony calculation	:1
39.	Apparatus of colony calculation	:1
40.	Jar tester	:2
41.	Exhaust hood	:3
42.	Laboratory table-1	:1
43.	Laboratory table-2	:1
44.	Laboratory table-3	:3
45.	Laboratory table-4	:14
46.	Laboratory table-5	:3
47.	Laboratory table-6	:1
48.	Work bench-1	:3
49.	Work bench-2	:3
50.	Table corner	:4
51.	Sink-1	:1
52.	Sink-2	:3
53.	Sink-3	:3
54.	Storage cabinet-1	:7
55.	Storage cabinet-2	:3
56.	Balance table	:2
57.	Van lack case	:1
58.	Laboratory cabinet	:1
59.	Steel shelf-1	:5
60.	Steel shelf-2	:4
61.	Chair-1	:20
62.	Chair-2	:20
63.	Furniture	:1

1. DRY OVEN

Type: Natural convection, auto temperature control dry oven

Number: Two (2) units

Temperature range: 40 to 260 degrees C

Internal capacity: 99 liters

Temperature control accuracy: ±1 degrees C (at 260 degrees C)

Temperature distribution accuracy: ±10 degrees C (at 260 degrees C)

Heat-up time: Approx. 75 min. (reaching max. temperature)

Heater capacity: 1.3 kW

Temperature setting method: Digital setting

Model: DS400, Yamato Scientific Co., Ltd. or equivalent

2. INSTRUMENTS DRYER

Type: Natural convention, vertical type of drying oven with a timer

Number: Two (2) units

Operating temperature range: Room temperature + 5 to 60 degrees C

Internal capacity: 445 liters

Heater capacity: 1.34 kW

Model: DG82, Yamato Scientific Co., Ltd. or equivalent

3. DRYING STERILIZING BOX

Type: Natural convection, auto temperature control drying sterilizing box

Number: Five (5) units

Internal capacity: 99 liters

Operating temperature range: +5 to 260 degrees C

Temperature control accuracy: 2 degrees C (at 260 degrees C)

Temperature distribution accuracy: 20 degrees C (at 260 degrees C)

Heat-up time: Approx. 75 min. (reaching max. temperature)

Heater capacity: 1.2 kW

Temperature setting method: Digital setting

Model: SG400, Yamato Scientific Co., Ltd. or equivalent

4.1 AUTOCLAVE - 1

Type: High pressure steam sterilization/drying, automatic pressure and temperature control

Number: One (1) unit

Operating temperature range: 105 to 128 degrees C. (for sterilizing)

Maximum operating pressure: 0.18 MPa

Effective volume: 20 liters

Heater capacity: 1.3 kW

Model: SM200, Yamato Scientific Co., Ltd. or equivalent

4.2 AUTOCLAVE - 2

Type: High pressure steam sterilization/drying, automatic pressure and temperature control

Number: Two (2) units

Temperature range: 105 to 128 degrees C. (for sterilizing)

Pressure: 0.2 MPa

Effective volume: 47 liters

Model: SM510, Yamato Scientific Co., Ltd. or equivalent

5.1 WASHING MACHINE

Type: Automatic washer of desk-top type

Washing method: Bi-directional, upper and lower, pressurized water-jet, revolving jet nozzle (interchangeable with jet-rack)

Number: One (l) unit

Effective volume: 100 liters

Heater capacity: 1 kW

Model: AW47, Yamato Scientific Co., Ltd. or equivalent

5.2 WASHING ACESSORY

Washing accessory: Jet-rack (100 ml measuring flask: up to 36 pieces)

Test tube rack (18.5 mm test tube: up to 450 pieces)

Model: For the use of AW47

6. ULTRASONIC PIPETTE WASHER

Type: Compact and functional washer capable of both ultrasonic and detergent washing

Number: One (l) unit

Dimension of rack: Internal diameter: 128 mm; height: 540 mm

Pipette accommodation: Measuring pipette (up to 500 mm available)

1 ml pipettes: up to 264 pieces

5 ml pipettes: up to 216 pieces

10 ml pipettes: up to 136 pieces

Model: AW31, Yamato Scientific Co., Ltd. or equivalent

7. ULTRASONIC WASHER

Number: One (l) unit

Volume of washing tank: 20 liters

Ultrasonic wave: 320 W

Timer: 0 to 60 min

Model: 8510J-MT, Yamato Scientific Co., Ltd. or equivalent

8.1 INCUBATOR - 1

Type: Forced ventilate convection, full automatic temperature control

Number: One (1) unit

Operating temperature range: 0 to 60 degrees C.

Temperature control accuracy: ±0.5 degrees C (at 37 degrees C)

Temperature distribution accuracy: ±1 degrees C (at 37 degrees C)

Effective volume: 27 liters

Model: IJ201, Yamato Scientific Co., Ltd. or equivalent

8.2 INCUBATOR - 2

Type: Natural convection through air jacket, full automatic temperature control

Number: Five (5) units

Operating temperature range: 0 to 80 degrees C.

Temperature control accuracy: ±0.2 degrees C

Temperature distribution accuracy: ±1 degrees C (at 37 degrees C)

Heat-up time: Approx. 70 min. (reaching 60 degrees C)

Effective volume: 159 liters

Model: IS600, Yamato Scientific Co., Ltd. or equivalent

9. MUFFLE FURNACE

Type: Compact electrically controlled laboratory furnace with control box?

Number: One (1) unit

Operating temperature range: 100 to 1,150 degrees C

Temperature control accuracy: ±2 degrees C (at 850 degrees C)

Internal capacity: 7.5 liters

Heater capacity: 2 kW

Temperature setting: Digital setting display

Model: FO310, Yamato Scientific Co., Ltd. or equivalent

10.1 WATER BATH - 1

Type: 1 hole, automatic temperature control

Number: One (1) unit

Temperature range: Room temperature + 5 to 95 degrees C

Temperature control accuracy: ±2 degrees C (at 60 degrees C)

Internal capacity: Approx. 3.7 liters

Heater capacity: 0.5 kW

Model: BM100, Yamato Scientific Co., Ltd. or equivalent

10.2 WATER BATH - 2

Type: 1 hole, automatic temperature control

Number: One (1) unit

Temperature range: Room temperature + 5 to 95 degrees C

Temperature control accuracy: ±1 degrees C (at 60 degrees C)

Internal capacity: 7 liters

Heater capacity: 1 kW

Model: BM400, Yamato Scientific Co., Ltd. or equivalent

11. ELECTRIC STOVE

Number: Three (3) units

Usage: Cooking

Number of heater: 4

12. HOT PLATE

Type: Electrically controlled hot plate

Number: Two (2) units

Operating temperature: +5 to 80 degrees C

Temperature control accuracy: ±0.5 degrees C (at 40 degrees C)

Top plate dimension: 450 × 300 mm

Heater capacity: 160 W

Model: HM300, Yamato Scientific Co., Ltd. or equivalent

13. MAGNETIC STIRRER WITH HOT PLATE

Type: Flat top plate, stirring speed control with stir bar

Number: One (1) unit

Stirring speed range: 0 to 1,500 rpm

Top plate dimension: 150 × 150 mm

Mixing capacity: Max. 3 liters

Stirring plate: aluminum plate with fluororesin coated

Heater capacity: 450 W

Model: MH302, Yamato Scientific Co., Ltd. or equivalent

14. MAGNETIC MIXER

Type: Ultra-low height type

Number: Five (5) units

Stirring speed range: 80 to 1,500 rpm

Stirring flat top plate dimension: 164 × 145 mm

Mixing capacity: Max. 2 liters

Stirring plate: stainless steel with ceramic coated

Model: MD200, Yamato Scientific Co., Ltd. or equivalent

15.1 SHAKER - 1

Number: One (1) unit

Shaking method: Rotary/reciprocating shakings (manual switchover)

Shaking number: 20 to 200 rpm

Dimension: Not less than 400 × 400 mm

Accessory: Shaking plate for spitz tube, with stopper for tube

Model: MK200D, Yamato Scientific Co., Ltd. or equivalent

15.2 SHAKER - 2

Type: B type

Number: One (1) unit

Shaking method: Rotary/reciprocating shakings (manual switchover)

Shaking number: 20 to 200 rpm

Dimension: Not less than 400 × 400 mm

Accessory: Shaking plate for Erlenmeyer flask

Model: MK200D, Yamato Scientific Co., Ltd. or equivalent

16. ANALYTICAL BALANCE

Number: Two (2) units

Max. Weighing capacity: 210 g

Readability: 0.1 mg

Model: AG285, Yamato Scientific Co., Ltd. or equivalent

17. SPECTROPHOTOMETER

Number: Two (2) units

Wavelength range: 315 to 990 nm

Transmittance: 0.1 to 100%

Band-pass: 3 nm

Accuracy: less than 0.5% (when measuring transmittance)

Model: КФК-3, АОЭКРОС or equivalent

18. TURBIDITY TESTER

Number: One (1) Unit

Method: Turbidimetric method

Ranges: 0.5, 1, 2, 3, 5, 10, 15 degree

Model: WA-PT-4T or equivalent

19. TRANSPARENCY TESTER

Type: Visual observation transparency tester with plastic stand

Number: Ten (10) units

Scale height: 1,000 mm

20. WATER COLLECTOR

Usage: Water sampling at any depth

Number: One (1) unit

Capacity of sampling bottle: 1 liter

Accessory: Metal fittings for opening and closing the cover of sampling bottle, with chain

21. WATER COLLECTOR WITH VESSEL

Usage: Water sampling at any depth for bacteria test

Number: One (1) unit

Capacity of sampling bottle: 1 liter

Accessory: Metal fittings for opening and closing the cover of sampling bottle, sterilized storage vessel, chain

22. PH METER

Type: Desk-top pH meter with LCD (liquid crystal display) and automatic temperature compensation

Number: Three (3) units

Measuring item: pH and ORP (oxidation-reduction potential)

Measuring range: 0 to 14 pH, 0 to ±1999.9 mV

Sensitivity: 0.0l pH, 0.1 mV

Accuracy: ±0.0l pH, ±0.l mV

Calibration method: 3 points automatic calibration

Power supply: Battery

Model: F-22 Yamato Scientific Co., Ltd. or equivalent

23. ELECTRO-CONDUCTIVITY METER

Type: Desk-top type with digital display

Number: One (1) unit

Measuring range: 0 to 200 ms/cm

Accuracy: ±0.05%

Power supply: Battery

Model: DS-12 Yamato Scientific Co., Ltd. or equivalent

24.1 CENTRIFUGE - 1

Number: One (1) unit

Max. number of revolution: 5,000 rpm

Max. centrifugal force: 4,620 × g

Capacity of treatment: 1,000 ml

Model: H-103N or equivalent

24.2 CENTRIFUGE - 2

Number: One (1) unit

Capacity: 50 ml tube × 8 cells

Max. number of revolution: 5,000 rpm

Max. centrifugal force: 4,640 × g

Model: 5200 (rotor: ST-480) or equivalent

25. MICROSCOPE

Type: High powered binocular microscope with built-in illumination system and mechanical stage

Number: Three (3) units

Magnification: 100 to 1,500 times

Objective lens: l0, 40 and l00 (immersion) times

Ocular lens: 10 and 15 times

Model: KMB-1500 or equivalent

26. REFRIGERATOR FOR LABORATORY - 1

Type: Digital temperature indication, with glass window

Number: Four (4) units

Capacity: 400 liters

Temperature range: 1 box: +2 to +14 degrees C

1 box: -30 degrees C

Model: MPR-411F Yamato Scientific Co., Ltd. or equivalent

27. REFRIGERATOR FOR LABORATORY - 2

Type: Digital temperature indication, with transparency window

Number: Two (2) units

Capacity: 350 liters

Temperature range: +2 to +14 degrees C

Model: BMS-350F3, Yamato Scientific Co., Ltd. or equivalent

28. ROTARY EVAPORATOR

Number: One (1) unit

Rotation number control range: 20 to 180 rpm

Rotation number control method: Variable speed type

Operating temperature range: 5 to 95 degrees C

Temperature setting/display method: Analog setting

Capacity of water bath: Approx. 7 liters

Capacity of distillation flask and receiving flask: 1 liter

Accessory: Standard glass set (cooling tube for C-type, rotary joint, sample feed tube, distillation flask, receiving flask, condenser connector etc.)

Water bath

Stand (arm-jack)

Others

Model: RE200C-WJ, Yamato Scientific Co., Ltd. or equivalent

29. RESIDUAL CLORINE METER

Type: Portable

Number: One (1) unit

Measuring range: 0.00 to 2.50 ppm (free chlorine concentration)

Sensitivity: 0.01 mg/l

Accuracy: ±0.03 ppm (or ±3% of indicated value)

Power supply: Battery

Accessory: Test reagents (300 times) and glass vessel for sampling (4 sets with caps)

Model: HI93701 or equivalent

30. WATER PURIFICATION APPARATUS

Type: Ion exchange and distillation

Number: One (1) unit

Produced pure water: Deionized water, distilled water

Producing capacity of distilled water: Approx. 1.8 liters/hour

Producing capacity of deionized water: Approx. 1 liter/min

Model: WG202, Yamato Scientific Co., Ltd. or equivalent

31.1 VACUUM PUMP - 1

Number: One (1) unit

Pumping speed: 10 l/min

Degree of vacuum: 0.8 kPa

Model: N810.3FT.18 or equivalent

31.2 VACUUM PUMP - 2

Number: One (1) unit

Pumping speed: 20 l/min

Degree of vacuum: 0.8 kPa

Model: N820.3FT.18 or equivalent

32. THERMOMETER

Type: Digital thermometer

Number: Two (2) units

Measuring temperature range: - 50 to + 150 degrees C

Power supply: Battery

Model: CT-220 or equivalent

33. TIMER

Type: Digital type

Number: Two (2) units

Max. input time: 10 hours

Min. input time: 1 second

Power supply: Battery

Model: 899 or equivalent

34. THERMOMETER AND HUMIDITY METER

Type: Weather forecasting function by catching the variation of atmospheric pressure

Number: One (1) unit

Measuring temperature range: -30 to +50 degrees C

Measuring humidity range: 0 to 100 %

Power supply: Battery

Model: BW-5208 or equivalent

35. LIQUID ANALYZER

Method: Luminescent and photometrical

Number: One (l) unit

Work range of spectrum: 200 to 650 nm

Used type of cuvette: K10, K20, K40

Model: 02-3M, ЛЮМЭКС-ЦЕНТРУМ or equivalent

36. GAS CHROMATOGRAPH

Number: One (l) unit

Detectors: Flame Ionization Detector (FID), Electron Capture Detector (ECD) and Flame Thermionic Detector (FTD)

Detector range: Plasma-ionizing (PID): 5×10^{-12} g/sec (hexadecane)

Electronic capture (ECD): 5×10^{-14} g/sec (lindane)

Heat conduction (HCD): 5×10^{-8} g/sm^3 (hexadecane)

Range of thermostat temperature: 50 to 399 degrees C

Volume of thermostat: 22.5 liters

Speed of temperature programming: 0.1 to 40 degrees C/min (from 50 to 220 degrees C)

0.1 to 20 degrees C/min (from 200 to 399 degrees C)

Temperature instability: 0.5 degree

Gas flow: 10 to 100 sm^3/min

Inlet pressure of gas: 0.35 to 0.60 MPa

Max. power consumption: 1,500 W

Model: Г а л с-311, ЛЮМЭКС-ЦЕНТРУМ or equivalent

37. ATOMIC ABSORPTION SPECTROMETER

Type: Automatic test (drying of sample, pyrolysis, atomization and cleaning of cuvette), with electrothermal atomization and Zeeman correction

Spectral range: 190 to 550 nm

Spectral resolution: 2 nm

Argon consumption: 0.6 l/min

Time of analysis: 60 to 120 seconds

Power consumption: 500 W (midium)

In impulse of atomization: 8 kW

Model: МГА-915, ЛЮМЭКС-ЦЕНТРУМ or equivalent

38. APPARATUS FOR BACTERIOLOGICAL CULTIVATION AND COLONY CALCULATION

Number: One (1)

standard set: including sterile nutrient medium, vacuum filtration system, steel forceps, metering syringe, 50 of casing syringe filter/Minisart, CAN , apparatus of colony calculation, filter 10,000 and others

Manufacturer: sartorius

39. APPARATUS OF COLONY CALCULATION

Type: With dector sets and incubator, for 5 types of bacillus (coliform bacillus, general bacteria, staphylococcus, Vibrio and salmonella)

Number: One (1) unit

40. JAR TESTER

Type: 6 paddles, variable speed

Number: Two (2) units

Speed rang: 10 to 300 rpm

41. EXHAUST HOOD

Type: With fan

Number: Three (3) units

Dimension: W1,500 × L750 × H2,350 mm

Model: RFS-150, Yamato Scientific Co., Ltd. or equivalent

42. LABORATORY TABLE-1

Type: Central type table with sink

Number: One (1) unit

Dimension: W1,500 × L3,600 × H800 mm

Accessory: shelf for reagents

Model: PCE-365R, Yamato Scientific Co., Ltd. or equivalent

43. LABORATORY TABLE-2

Type: Central type table with sink

Number: One (1) unit

Dimension: W1,500 × L2,400 × H800 mm

Accessory: shelf for reagents, drawer unit and cart unit

Model: PCE2-245R, Yamato Scientific Co., Ltd. or equivalent

44. LABORATORY TABLE-3

Type: Side type table

Number: Three (3) units

Dimension: W1,800 × L750 × H800 mm

Accessory: shelf for reagents

Model: TFK7-187R, Yamato Scientific Co., Ltd. or equivalent

45. LABORATORY TABLE-4

Type: Side type table

Number: Fourteen (14) units

Dimension: W1,800 × L750 × H800 mm

Model: TFR-187R, Yamato Scientific Co., Ltd. or equivalent

46. LABORATORY TABLE-5

Type: Side type table

Number: Three (3) units

Dimension: W1,200 × L750 × H800 mm

Model: TFR-127R, Yamato Scientific Co., Ltd. or equivalent

47. LABORATORY TABLE-6

Type: Side type table

Number: One (1) unit

Dimension: W900 × L750 × H800 mm

Model: TFR-97R, Yamato Scientific Co., Ltd. or equivalent

48. WORK BENCH-1

Number: Three (3) units

Dimension: W1,800 × L750 × H800 mm

Model: TWB-187R, Yamato Scientific Co., Ltd. or equivalent

49. WORK BENCH-2

Number: Three (3) units

Dimension: W1,500 × L750 × H800 mm

Model: TWB-157R, Yamato Scientific Co., Ltd. or equivalent

50. TABLE CORNER

Number: Four (4) units

Dimension: W950 × L950 × H800 mm

Model: TFP-37R, Yamato Scientific Co., Ltd. or equivalent

51. SINK-1

Type: Side type, partly sink

Number: One (1) unit

Overall dimension: W1,200 × L750 × H800 mm

Dimension of sink: W730 × L495 × D200 mm

Model: TSD-127, Yamato Scientific Co., Ltd. or equivalent

52. SINK-2

Type: Side type, full sink

Number: Three (3) units

Overall dimension: W1,200 × L750 × H800 mm

Dimension of sink: W1,130 × L560 × D200 mm

Model: TSE-127, Yamato Scientific Co., Ltd. or equivalent

53. SINK-3

Type: Side type, full sink

Number: Three (3) units

Overall dimension: W600 × L750 × H800 mm

Dimension of sink: W530 × L560 × D200 mm

Model: TSE-67, Yamato Scientific Co., Ltd. or equivalent

54. STORAGE CABINET-1

Type: Two stages

Number: Seven (7) units

Overall dimension: W1,760 × L400 × H1,800 mm

Model: MC-125G (upper shelf) and MC-125 (lower shelf) , Yamato Scientific Co., Ltd. or equivalent

55. STORAGE CABINET-2

Type: Two stages

Number: Three (3) units

Overall dimension: W880 × L400 × H1,800 mm

Model: MC-124G (upper shelf) and MC-124 (lower shelf) , Yamato Scientific Co., Ltd. or equivalent

56. BALANCE TABLE

Number: Two (2) units

Dimension: W900 × L 600 × H750 mm

Model: TBA-96, Yamato Scientific Co., Ltd. or equivalent

57. VAN LACK CASE

Number: One (1) unit

Overall dimension: W844 × L320 × H1,790 mm

Number of shelf board: 11

Number of drawer: 72 (6 drawers/stage × 12 stages)

Model: 611M-72S, Yamato Scientific Co., Ltd. or equivalent

58. LABORATORY CABINET

Number: One (1) unit

Overall dimension: W485 × L620 × H1,800 mm

Capacity: 1,000 ml bottle: 72 bottles (3 stages)

500 ml bottle: 90 bottles (3 stages)

250 ml bottle: 144 bottles (4 stages)

100 ml bottle: 480 bottles (4 stages)

25 ml bottle: 900 bottles (5 stages)

20 ml bottle: 1,080 bottles (5 stages)

Model: SLK-23, Yamato Scientific Co., Ltd. or equivalent

59. STEEL SHELF-1

Type: NMR-180C-18

Number: Five (5) units

Dimension: W1,800 × L 600 × H1,802 mm

Model: NMR-180C-18, Yamato Scientific Co., Ltd. or equivalent

60. STEEL SHELF-2

Type: NMR-120C-18

Number: Four (4) units

Dimension: W1,200 × L 600 × H1,802 mm

Model: NMR-120C-18, Yamato Scientific Co., Ltd. or equivalent

61. CHAIR-1

Type: LW-4 (height adjustable, rotatable chair with seat back) , Yamato Scientific Co., Ltd. or equivalent

Number: Twenty (20) units

62. CHAIR-2

Type: LW-2 (height adjustable, rotatable chair) , Yamato Scientific Co., Ltd. or equivalent

Number: Twenty (20) units

63. FURNITURE

63.1 TABLES (WOODEN MADE)

1) For chief of laboratory: one (1) writing table and one (1) computer table
2) For engineers: four (4) writing tables
3) For shift: one (1) writing table

63.2 CHAIRS

1) For chief of laboratory: one (1)
2) For engineers: four (4)
3) For day shift: seven (7)
4) For night shift: three (3)

63.3 WORDROBES (WOODEN MADE)

1) For chief of laboratory: one (1) wardrobe and one (1) bookcase
2) For engineers and day shifts: one (1) wardrobe with racks and shelves for 20 persons
3) For night shift: four (4) wardrobe with racks and shelves for eight (8) persons

P12.1.3 GLASSWARE AND OTHERS

Glassware and others furnished under this section are summarized in the following table:

1.1 For Chemical Department

ITEM		QUANTITY	UNIT
1.	Flasks for BOD	:10	nos.
2.	Ditches for photo calorimeters	:50	nos.
3.1	Forceps-Metal	:4	nos.
3.2	Forceps-Plastic	:4	nos.
4.1	Wire brushes for test tube	:2	nos.
4.2	Wire brushes for glasses	:2	nos.
4.3	Wire brushes for flasks	:2	nos.
5.	Desiccators (D14cm × H12cm)	:2	nos.
6.1	Electrode for pH meter	:4	nos.
6.2	Sandglass timer-5 min.	:1	nos.
6.3	Sandglass timer-3 min.	:1	nos.
6.4	Sandglass timer-2 min.	:2	nos.
6.5	Sandglass timer-1 min.	:1	nos.
7.	Measuring flasks	:3	nos.
8.1	Measuring flasks-2,000 ml (glass, transparent)	:4	nos.
8.2	Measuring flasks-1,000 ml (glass, transparent)	:10	nos.
8.3	Measuring flasks-500 ml (glass, transparent)	:5	nos.
8.4	Measuring flasks-250 ml (glass, transparent)	:5	nos.
8.5	Measuring flasks-200 ml (glass, transparent)	:5	nos.
8.6	Measuring flasks-100 ml (glass, transparent)	:50	nos.
8.7	Measuring flasks-50 ml (glass, transparent)	:50	nos.
8.8	Measuring flasks-25 ml (glass, transparent)	:20	nos.
9.1	Measuring glasses-1,000 ml	:30	nos.
9.2	Measuring glasses-500 ml	:10	nos.
9.3	Measuring glasses-250 ml	:10	nos.
9.4	Measuring glasses-150 ml	:50	nos.
9.5	Measuring glasses-100 ml	:100	nos.

9.6	Measuring lasses-50 ml	:50	nos.
10.1	Measuring test-tubes-25 ml（transparent）	:50	nos.
10.2	Measuring test-tubes-15 ml（transparent）	:50	nos.
10.3	Measuring test-tubes-10 ml（transparent）	:50	nos.
11.1	Measuring cylinders-1,000 ml（transparent）	:5	nos.
11.2	Measuring cylinders-500 ml (glass)	:5	nos.
11.3	Measuring cylinders-250 ml (glass)	:5	nos.
11.4	Measuring cylinders-100 ml (glass)	:20	nos.
11.5	Measuring cylinders-50 ml (glass)	:10	nos.
12.1	Conical funnel-D5 mm	:20	nos.
12.2	Conical funnel-D8 mm	:30	nos.
12.3	Conical funnel-D10 mm	:20	nos.
12.4	Conical funnel-D12 mm	:30	nos.
13.1	Conical flasks (flat-bottom) -2,000 ml	:5	nos.
13.2	Conical flasks (flat-bottom) -1,000 ml.	:5	nos.
13.3	Conical flasks (flat-bottom) -500 ml	:20	nos.
13.4	Conical flasks (flat-bottom) –250 ml	:25	nos.
14.1	Conical flat-bottom flask – 1,000 ml	:5	nos.
14.2	Conical flat-bottom flask – 500 ml	:50	nos.
14.3	Conical flat-bottom flask – 250 ml	:200	nos.
14.4	Conical flat-bottom flask – 100ml	:200	nos.
15.1	Burettes – 100 ml（transparent）	:10	nos.
15.2	Burettes – 20 ml（transparent）	:10	nos.
15.3	Burettes – 2 ml（transparent）	:10	nos.
16.1	Mor pipette – 100 ml（whole pipette）	:10	nos.
16.2	Mor pipette – 50 ml （whole pipette）	:10	nos.
16.3	Mor pipette – 25 ml （whole pipette）	:20	nos.
16.4	Mor pipette – 20 ml （whole pipette）	:20	nos.
16.5	Mor pipette – 15 ml （whole pipette）	:20	nos.
16.6	Mor pipette – 10 ml （whole pipette）	:20	nos.
16.7	Mor pipette – 5 ml （whole pipette）	:20	nos.
16.8	Mor pipette – 1 ml （whole pipette）	:20	nos.

17.1	Graded pipette – 10 ml（Measuring pipette）	:50	nos.
17.2	Graded pipette – 5 ml （Measuring pipette）	:50	nos.
17.3	Graded pipette – 2 ml （Measuring pipette）	:50	nos.
17.4	Graded pipette – 1 ml （Measuring pipette）	:50	nos.
18.1	Porcelain glasses – 1,000 ml	:5	nos.
18.2	Porcelain glasses – 500 ml	:3	nos.
19.1	Porcelain cups – 1,000 ml	:2	nos.
19.2	Porcelain cups – 500 ml	:2	nos.
20.1	Thermal resistance cups for evaporation – 100 ml	:20	nos.
20.2	Thermal resistance cups for evaporation – 50 ml	:10	nos.
20.3	Thermal resistance cups for evaporation – 25 ml	:30	nos.
20.4	Thermal resistance cups for evaporation – 10 ml	:10	nos.
21.1	Glass flasks for storage of acids reaction – 1,000 ml	:10	nos.
21.2	Glass flasks for storage of acids reaction – 500 ml	:10	nos.
21.3	Glass flasks for storage of acids reaction – 250 ml	:30	nos.
21.4	Glass flasks for storage of acids reaction – 100 ml	:30	nos.
21.5	Glass flasks for storage of acids reaction – 50 ml	:20	nos.
22.1	Plastic flask –500 ml	:50	nos.
22.2	Plastic flask – 250 ml	:10	nos.
22.3	Plastic flask – 100 ml	:20	nos.
22.4	Plastic flask – 50 ml	:10	nos.
22.5	Plastic flask – 30 ml	:10	nos.

1.2 For Bacteriological Department

ITEM		QUANTITY	UNIT
1.	Petri dishes	:5,000	nos.
2.	Non graded flasks (thermal resistance) - 250 ml	:500	nos.
3.	Pipettes-5 ml	:100	nos.
4.	Pipettes-1 ml	:50	nos.
5.	Flasks for samples with rubber corks - 500 ml	:1,000	nos.
6.	Non graded test tubes - 15 ml	:2,000	nos.
7.	Spirit burner	:10	nos.
8.	Cover glasses for miscracoping	:1,000	nos.

9.	Object plate	:500	nos.
10.	Measuring thermal resistance glasses - 500 ml	:50	nos.
11.	Conic flat botformed retorts - 2 liter	:20	nos.
12.1	Funnels – D5 mm	:50	nos.
12.2	Funnels – D8 mm.	:100	nos.
13.	Ceramic glasses – 100 ml	:10	nos.
14.	Sterilizer for membrane filters	:5	nos.
15.	Platinum bail with a handle – 8 to 10 mm	:5	nos.
16.	Stands (supports) for retorts	:10	nos.
17.	Stands for burettes	:5	nos.
18.	Enamel saucepang for medium preparation – 2 liters	:3	nos.
19.	Enamel saucepang for medium preparation – 5 liters	:3	nos.
20.	Enamel buchests with lids – 10 liter	:4	nos.
21.	Basins for dish washing	:10	nos.
22.	Basins for distilled water – 10 liter	:4	nos.
23.	Magnifying glass	:2	nos.
24.	Rubber gloves	:50	nos.
25.	Rubber corks for sample flasks – 0.5 liter	:1,000	nos.
26.	Cotton wool	:30	kg
27.	Gauze	:100	m
28.	Bandages	:1,000	units
29.	Filter paper - white	:20	sets
30.	Pencils for glasses	:5	nos.
31.	Thermometers – up to 80	:5	nos.
32.	Thermometers – up to 65	:5	nos.
33.	Metal forceps	:20	nos.
34.	Droppers – 50 ml	:20	nos.

P12.1.4 CHEMICALS AND REAGENTS

Chemicals and reagents furnished under this section are summarized in the following table:

ITEM		QUANTITY	UNIT
1	Persulfuric acid of ammonium (persulfate)	1	kg
2	Ammonium sulfuric (sulfate)	1	kg
3	Molybdenic acid of ammonium (geptamolybdate of ammonium)	0.3	kg
4	Sal ammonia	0.5	kg
5	Aluminium sulfuric (sulfate)	1	kg
6	Barium chloride	1	kg
7	Beryllium sulfuric (sulfate)	0.5	kg
8	Benzoic acid	10	gr
9	Glycerin	0.5	l
10	Natrium hyposulphite	2	kg
11	Hydrazine sulfuric (sulfate)	0.1	kg
12	Hydroxylamine muriatic (hydroxlyamine hydrochloride)	0.1	kg
13	Gryss reagent	1	l
14	Dithizone (1,5-diphenyltiocarbazone)	50	gr
15	Diethylparaphenylendiamine sulfate	0.5	kg
16	Three-chloride 6-aqueous iron (III-chloride iron)	0.1	kg
17	Ferrous (iron) sulfate 7-aqueous	0.2	kg
18	Potassium dichromic (Potassium dichromate)	4	kg
19	Potassium chromic (Potassium Chromate)	0.3	kg
20	Potassium bromide (for pharmacopeia)	0.2	kg
21	Potassium chloride	0.2	kg
22	Potassium persulfuric (potassium persulfate)	50	gr
23	Potassium sulfate	50	gr
24	Potassium hydrate	0.2	kg
25	Potassium- sodium tartrate (potassium-sodium D-tartrate)	2	kg
26	Potassium ferrocyanide (yellow blood salt)	0.5	kg
27	Potassium ferrocyanide (red blood salt)	0.5	kg
28	Potassium nitrate	0.3	kg

29	Potassium iodide	10	kg
30	Monobasic potassium phosphate	20	kg
31	Potassium thiocyanate	0.1	kg
32	Cobalt sulfate 7- aqueous (cobalt II-sulfate)	1	kg
33	Calcium chloride	1	kg
34	Calcium chloride waterless for exiccator	0.2	kg
35	Starh (amylodextrine)	0.5	kg
36	Calcium carbonic	0.2	kg
37	Potash alum	0.2	kg
38	Potash Iron-ammonim 12- aqueous	0.1	kg
39	Sodium lauryl sulfate	0.1	kg
40	Magnesium chloride 6-aqueous	0.1	kg
41	Magnesium sulfate 7-aqueous	0.4	kg
42	Magnesium chloride 4-aqueous	0.4	kg
43	Magnesium sulfate 5-aqueous	0.1	kg
44	Copper sulfate 5-aqueous	0.1	kg
45	Natrium acetate	5	kg
46	Natrium phosphorus 2- substituted	25	kg
47	Natrium fluoride	0.1	kg
48	Sodium nitrite	0.1	kg
49	Sodium hydrate	3	kg
50	Sodium sulfate waterless	0.1	kg
51	Sodium N,N-diethyldithyocarbomate	0.1	kg
52	Sodium citric acid 3- substituted	3	kg
53	Sodium carbonate	0.1	kg
54	Sodium carbonate acid	0.1	kg
55	Sodium tetraborate	1	kg
56	Salicylic acid of sodium	0.5	kg
57	Sodium chromicum 4- aqueous	0.3	kg
58	Nessler reagent	2	l
59	Tin doublechloride 2-aqueous (tin oxide)	0.5	kg
60	Tin iron	0.1	kg

61	Ammonium iron II-sulfuric (sulfate)	0.4	kg
62	2-nitro-2-arsonobenzol-1,4-diazoamynoazobenzol-4"-sulfo-acid monosodium salt		0.05 kg
63	Selenium	0.02	kg
64	Selenium gel treated	1	kg
65	Lead nitrate	0.1	kg
66	Lead acetate	0.1	kg
67	Mercury nitrate II	0.1	kg
68	Trilon B(complexone of IIIdinitrate salt of athylendiamintetraacetic acid	1	kg
69	Zinc metallic	2	kg
70	Zinc nitrate	0.1	kg
71	Zinc acetate	0.1	kg
72	Citric acid	1	kg
73	Boric acid	0.5	kg
74	Ascorbic acid	0.5	kg
75	Sulfosalicylic acid	1	kg
76	Sulfonul acid	1	kg
77	Urotropine	0.05	kg
IN AMPOULS			
78	Sulfuric acid	5	ampoul
79	Hydrochloric acid 0,1 H	30	ampoul
80	Tri Z lon "B"	10	ampoul
81	Oxalic acid 0,1 H	20	ampoul
82	Potassium manganese acid 0,1 H	20	ampoul
83	Standard solution for pH-test (pH-3.68; 6.,86; 9.18)	5	ampoul per each sol.
84	Magnesium sulfate 7-aqeous	10	ampoul
INDICATORS			
85	Aluminon	50	g
86	Methyl- orange	2	g
87	Phenolphthalein	5	g
88	Phenol red water soluble	5	g
89	Chromic dark blue	10	g
90	Methyl- blue	1	g

91	Silver nitrate	50	g
92	Azure-eosine by Romanovsky	5	g
93	Murexide	5	g
94	Tropeolin "OO"	2	g
95	Erychrome black	2	g
96	Morin	5	g
97	Benzoic acid	20	g
98	2,3-Diaminonaphthalin (DAN)	5	g
99	Sulfuric acid	40	kg
100	Hydrochloric acid	10	kg
101	Carbon 4-chlorous	20	kg
102	Chloroform	20	kg
103	Ammonium	20	kg
104	Ethylenglycol	10	kg
105	Hexane	1	liter
106	Isoamyl alcohol	1	liter
107	Nitric acid	10	kg
108	Acetic acid ice	20	kg
109	Acetic acid	20	kg
110	Ortophosphorous acid	5	kg
111	Chloric acid	5	kg
BACTERIOLOICAL TEST			
112	Nutrient medium for enterobacterias, dry (ENDO medium)	25	kg
113	Membrane filters No 7,8,10	25	m2
114	Nutrient medium for sterile control, dry (thioglycolic nutrient medium)	5	kg
115	Nutrient agar for bacteria cultivation, dry	25	kg
116	Nutrient medium for identification of enterobacter, dry (Nutrient Gyss with lactose)	3	kg
117	Nutrient medium for identification of enterobacter, dry (Nutrient Gyss with glucose)	3	kg
118	Beef-extract broth	15	liter
119	Nutrient medium for separation and defferentiation of enterobacters,		

	dry (Coda nutrient)	3	m
120	Immersion oil for microscope test	100	ml
121	Alcohol	200	liter
122	Natrium sulfuric acid	10	kg
123	P-glucose	1	kg
124	Tracing papers	50	kg
125	White filter paper	50	kg
126	Gauze	50	m
127	Filter papers standard with D-5 and D-10	50 p- 50 p	
128	a- naphthylamine	1	kg
129	N,N-dimerhyl-p-phenylenediamine	1	kg
130	Fuchsin, basic for microbiological	1	kg
131	Fuchsin, basic for dry nutrient medium	1	kg
132	2,3,5- triphenyltetrazole chloride	1	kg
133	Natrium carbonic acid	1	kg
134	Benzoic acid	1	kg
135	Crystal violet	0,5	kg
136	Crystal Iodine	0,5	kg
137	Cotton wool	20	kg
138	Rozole acid	1	kg
139	Bandage (5,10,20 cm)	100	units

DIVISION P12 FURNISHINGS

SECTION P12.2 – INSTRUMENTS FOR LABORATORY AT SEWAGE TREAMENT PLANT

P12.2.1 GENERAL

1. SCOPE OF WORK

The Contractor shall furnish the following instruments for laboratory to be furnished at the water treatment plant:

a. Laboratory equipment

b. Glassware and others

c. Chemicals and reagents

2. SHOP DRAWINGS AND INSTRUCTIONS

Submit for approval complete shop drawings and descriptive literature showing details of fabrication of all material and equipment furnished under this section. The shop drawings and instructions shall be written in two (2) languages of English and Russian.

3. SHIPPING

The Contractor shall prepare all materials and equipment for shipment in such a manner as to protect laboratory equipment including glassware, chemicals and others from damage in transit, and during a prolonged storage period in cold climate.

Special care of packing method and material for glassware and chemicals including hazardous chemicals shall be taken. Each package of glassware and hazardous chemicals shall be provided with adequate self-adhesive label in lettering "FRAGILE with symbol mark" and "DANGER with symbol mark" respectively.

Particular care shall be taken in the packing of electrical equipment. It shall be packed separately in sealed polyethylene or similar bags taking precaution to exclude moisture.

All glassware, chemicals and other fragile items shall be separately and adequately packaged with stuffing material. Some packages shall be crated.

All cases and crates shall have their contents indelibly stenciled on the outside.

4. INSTALLATION

All of the equipment required to be installed in a proper location of the laboratory shall be installed by the Contractor.

Water supply piping and drain piping for sink table and sampling sink shall be completed as shown on the drawings and as directed by the Engineer.

The Contractor shall have final responsibility for all equipment furnished under this Contract.

5. CHECK AND TEST

Before taking over the laboratory equipment furnished under this section, the Engineer may order checking and testing of all equipment furnished. The Contractor shall furnish the labor and materials

required for checking and testing for:

a. Items of equipment, glassware and chemicals

b. Number of equipment and glassware

c. Volume of chemicals

d. Functioning of equipment

If any defects in the fabrication of equipment and damaged glassware and hardware will be found out under checking and testing, the Contractor shall be required to replace them with new ones at his own expense. Any repairing for equipment will not be permitted.

6. INSTRUCTION

Before taking over the laboratory equipment furnished under this section, the Contractor shall be required to execute at least for one (1) week of proper instruction on equipment operation and maintenance to the laboratory personnel.

7. SUPPLY AND CHECK LIST

The Contractor shall furnish six (6) sets of supply and check lists of equipment, glassware and chemicals. Each item shall be properly booked on hard papers and they shall be filed with A4 size hard files having four (4) inclined D-rings with double lock system.

P12.2.2 LABORATORY EQUIPMENT

All laboratory equipment specified hereinafter shall be shop fabricated, wired and tested, and power source for the laboratory equipment shall be AC220 V, 50 Hz.

For equipment, all essential and desirable accessories for an installation and operation shall be furnished.

Laboratory equipment furnished under this section is summarized in the following table:

ITEM		QUANTITY
1.	Dry oven	:3
2.	Autoclave	:1
3.	Incubator	:1
4.	Muffle furnace	:1
5.	Water bath	:2
6.	Water purification apparatus	:1
7.	Microscope	:1
8.	Liquid analyzer	:1
9.1	Dish-washing machine	:1
9.2	Washing accessory	:1
10.	Instruments dryer	:1

11. Drying carts	:2
12.1 pH meter-on desk	:1
12.2 pH meter-portable	:2
13. Mercury analyzer	:1
14. Apparatus for bacteriological cultivation and colony calculation	:1
15. Analytical balance	:2
16. Technical balance	:1
17.1 Magnetic stirrer-two liters	:2
17.2 Magnetic stirrer-five liters	:2
18. Spectrophotometer	:2
19. BOD tester	:1
20. COD-tester	:1
21. DO meter	:3
22. Bottle heater	:2
23. Electric range	:4
24.1 Extractors-1	:1
24.2 Extractors-2	:1
24.3 Extractors-3	:1
25. Rotary evaporator	:1
26. Personal computer	:2
27. Refrigerator	:3
28. Electric stove	:1
29. Apparatus for Kjeldahl nitrogen determination	:1
30. Residual chlorine meter	:3
31. GOST samples of contents of water solutions-30 items	:1
32. Centrifuge	:1
33. Exhaust hood	:3
34. Laboratory table 1-central	:3
35. Laboratory table 2-side	:3
36. Laboratory table 3-side	:4
37. Laboratory table 4-side	:6
38. Work bench	:2

39.	Table corner	:6
40.	Sink-1	:2
41.	Sink-2	:1
42.	Storage cabinet-1	:3
43.	Storage cabinet-2	:4
44.	Van lack case	:1
45.	Laboratory cabinet	:1
46.	Steel shelf-1	:2
47.	Steel shelf-2	:1
48.	Balance table	:3
49.	Water purification apparatus	:1
50.	Transparency tester	:7
51.	Chair-1	:10
52.	Chair-2	:10
53.	Furniture	:1

1. DRY OVEN

Type: Natural convection, auto temperature control dry oven

Number: Three (3) units

Internal capacity: 162 liters

Operating temperature range: 40 to 260 degrees C

Temperature control accuracy: ±1 degrees C (at 260 degrees C)

Temperature distribution accuracy: ±10 degrees C (at 260 degrees C)

Heat-up time: Approx. 75 min. (reaching max. temperature)

Heater capacity: 1.42 kW

Temperature setting method: Digital setting

Model: DS600, Yamato Scientific Co., Ltd. or equivalent

2. AUTOCLAVE

Type: High pressure steam sterilization/drying, automatic pressure and temperature control

Number: One (1) unit

Operating temperature range: 105 to 128 degrees C.

Maximum operating pressure: 0.2 MPa

Effective volume 32 liters

Heater capacity: 1.7 kW

Model: SM300, Yamato Scientific Co., Ltd. or equivalent

3. INCUBATORS

Type: Natural convection through air jacket, full automatic temperature control

Number: One (1) unit

Operating temperature range: 0 to 60 degrees C.

Temperature control accuracy: ±0.5 degrees C (at 37 degrees C)

Temperature distribution accuracy: ±1 degrees C (at 37 degrees C)

Effective volume: Approx. 43 liters

Model: IJ300, Yamato Scientific Co., Ltd. or equivalent

4. MUFFLE FURNACE

Type: Compact electrically controlled laboratory furnace with control box?

Number: One (1) unit

Operating temperature range: 100 to 1,150 degrees C

Temperature control accuracy: ±2 degrees C (at 850 degrees C)

Internal capacity: At least 17.5 liters

Heater capacity: 3 kW

Temperature setting: Digital setting display

Model: FO610, Yamato Scientific Co., Ltd. or equivalent

5. WATER BATH

Type: 4 holes

Number: Two (2) units, automatic temperature control

Temperature range: Room temperature + 5 degrees C to boiling temperature (water)

Temperature control accuracy: ±3 degrees C (at 70 degrees C)

Internal capacity: Approx. 9 liters

Heater capacity: 1.4 kW

Model: BS400, Yamato Scientific Co., Ltd. or equivalent

6. WATER PURIFICATION APPARATUS

Number: One (1) unit

Producing capacity of distilled water: 25 ± 2.5 liters/hour

Heater capacity: Approx. 18 kW

Model: ДЭ-25, АОЗКРОС or equivalent

7. MICROSCOPE

Type: High powered binocular microscope with built-in illumination system and mechanical stage

Number: One (l) unit

Magnification: 100 to 1,500 times

Objective lens: l0, 40 and l00 (immersion) times

Ocular lens: 10 and 15 times

Model: KMB-1500 or equivalent

8. LIQUID ANALYZER

Method: Luminescent and photometrical

Number: One (l) unit

Wavelength range: 200 to 650 nm

Used type of cuvette: K10, K20, K40

Others: With krio-1 and krio-2

Model: 02-3M, ЛЮМЭКС-ЦЕНТРУМ or equivalent

9. DISH-WASHING MACHINE

Type: Semi-automatic washer of desk-top type

Washing method: Bi-directional, upper and lower, pressurized water-jet, revolving jet nozzle (interchangeable with jet-rack)

Number: One (l) unit

Effective volume: 100 liters

Heater capacity: 1 kW

Washing accessory: For the use of AW47, including:

Jet-rack (100 ml measuring flask: up to 36 pieces)

Test tube rack (18.5 mm test tube: up to 450 pieces)

Model: AW47, Yamato Scientific Co., Ltd. or equivalent

10. INSTRUMENTS DRYER

Type: Natural convention, vertical type of drying oven with a timer

Number: One (l) unit

Operating temperature range: Room temperature + 5 to 60 degrees C

Internal capacity: 445 liters

Heater capacity: 1.34 kW

Model: DG82, Yamato Scientific Co., Ltd. or equivalent

11. DRYING CARTS

Type: Basket type with curtain (flexible vinyl sheet)

Number: Two (2) units

Outside dimension: W820 × L540× H900 mm

Basket supporter: Three (3) stages

Model: NDC-80B, Yamato Scientific Co., Ltd. or equivalent

12. PH METER

12.1 DESK-TOP PH METER

Type: Desk-top pH meter with LCD (liquid crystal display) and automatic temperature compensation

Number: One (1) unit

Measuring item: pH and ORP (oxidation-reduction potential)

Measuring range: 0 to 14 pH, 0 to ±1999.9 mV

Sensitivity: 0.0l pH, 0.1 mV

Accuracy: ±0.0l pH, ±0.l mV

Calibration method: 3 points automatic calibration

Power supply: Battery

Model: F-22, Yamato Scientific Co., Ltd. or equivalent

12.2 PORTABLE PH METER

Type: Portable pH meter with LCD (liquid crystal display)

Number: Two (2) units

Measuring item: pH and ORP (oxidation-reduction potential)

Measuring range: 0 to 14 pH, -1,600 to +1,600 mV

Sensitivity: 0.0l pH, 1 mV

Accuracy: ±0.0l pH, ±l mV

Temperature compensation: Automatic

Calibration method: 3 points automatic calibration

Power supply: Battery

Model: D-22, Yamato Scientific Co., Ltd. or equivalent

13. MERCURY ANALYZER

Type: РА 915^{+} + РП-91+ РП-91С, ЛЮМЭКС-ЦЕНТРУМ (for measuring mercury contents in water and solid)

Number: One (1) unit

Measuring range: 0.05 to 2,000 μ g/l (water)

5 to 10,000 μ g/l (solid)

Accessory: Necessary appurtenances

14. APPARATUS FOR BACTERIOLOGICAL CULTIVATION AND COLONY CALCULATION

Number: One (1)

Standard set: including sterile nutrient medium, vacuum filtration system, steel forceps, metering syringe, 50 of casing syringe filter/Minisart, CAN, apparatus of colony calculation, filter 10,000 and others)

Manufacturer: sartorius

15. ANALYTICAL BALANCE

Type: Electronic top loading balance with a digital display

Number: Two (2) units

Max. weighing capacity: 101 g

Sensitivity: 0.1 mg

Model: AG104, Yamato Scientific Co., Ltd. or equivalent

16. TECHNICAL BALANCE

Type: Electronic top loading balance

Number: One (1) unit

Max. weighing capacity: 1,010 g

Sensitivity: 0.001 g

Model: PG1003-S, Yamato Scientific Co., Ltd. or equivalent

17. MAGNETIC STIRRER

17.1 MAGNETIC STIRRER

Type: Ultra-low height type

Number: Two (2) units

Stirring speed range: 80 to 1,500 rpm

Stirring flat top plate dimension: 164 × 145 mm

Mixing capacity: Max. 2 liters

Stirring plat: stainless steel with ceramic coated

Model: MD200, Yamato Scientific Co., Ltd. or equivalent

17.2 MAGNETIC STIRRER

Type: Ultra-low height type

Number: Two (2) units

Stirring speed range: 70 to 1,300 rpm

Stirring flat top plate dimension: 191 × 177 mm

Mixing capacity: Max. 5 liters

Stirring plat: stainless steel with ceramic coated

Model: MD500, Yamato Scientific Co., Ltd. or equivalent

18. SPECTROPHOTOMETER

Number: Two (2) units

Wavelength range: 315 to 990 nm

Transmittance: 0.1 to 100%

Bandpass: 3 nm

Accuracy: less than 0.5% (when measuring transmittance)

Model: КФК-3, АОЭКРОС or equivalent

19. BOD-TESTER

Type: Portable digital meter

Number: One (1) unit

Range: 0 to 20 mg/l

Accuracy: ±0,5 mg/l (0 to 10 mg/l), ±1 mg/l (10 to 20 mg/l)

Model: AQUA-OXY, АЛИТА

20. COD-TESTER

Type: Automatic micro processor

Number: One (1) unit

Range: 30 to 1,500 mg/l

Model: АВТОМАТИЗИРОВАННЫЙ МИРОПРОЦЕССОРНЫЙ ХПК-МЕТР, АЛИТА

21. DO METER

Type: Desk-top DO meter

Number: Three (3) units

Measuring range: 0 to 60 mg/l

Accuracy: ±0.1%

Operating temperature range: -5 to 50 degrees C

Compensation function: Automatic atmospheric pressure and salinity compensation

Accessory: BOD test electrode

Model: 5000 or equivalent

22. BOTTLE HEATER

Number: Two (2) units

Capacity: 500 ml

Max. temperature: 400 degrees C

Heater capacity: 0.4 kW

Dimension: W300 (with handles) × L290 × H110 mm

Weight: 2.3 kg

Model: ПЭ-4010, АОЭКРОС or equivalent

23. ELECTRIC RANGE

Number: Four (4) units

Operating temperature range: 40 to 370 degrees C

Accuracy: ±3 degrees C (up to 93 degrees C); ±1.1 degrees C (93 to 370degrees C)

Plate dimension: 160 × 160 mm

Heater capacity: 0.75 kW

Model: HPA-1914B or equivalent

24. EXTRACTORS

Number: ПЭ-8000, АОЭКРОС One (1) unit

ПЭ-8010, АОЭКРОС One (1) unit

ПЭ-8010, АОЭКРОС One (1) unit

Capacity for water sample: 0.25 to 5.0 liters

Stirring speed range: 200 to 3,500 rpm

Accuracy: ±20 rpm

Heater capacity: 0.1 kW

Dimension: W390× L420× H980 mm

Weight: 10.1 kg

25. ROTARY EVAPORATOR

Number: One (1) unit

Rotation number control range: 20 to 180 rpm

Rotation number control method: Variable speed type

Operating temperature range: 5 to 95 degrees C

Temperature setting/display method: Analog setting

Capacity of water bath: Approx. 7 liters

Capacity of distillation flask and receiving flask: 1 liter

Accessory: Standard glass set (cooling tube for C-type, rotary joint, sample feed tube, distillation flask, receiving flask, condenser connector etc.)

Water bath

Stand (arm-jack)

Others

Model: RE200C-WJ, Yamato Scientific Co., Ltd. or equivalent

26. PERSONAL COMPUTER

Type: Desk-top type personal computer with CD-RW and laser type printer (A4 + A3)

Number: Two (2) units

Usage: Reporting

Hard disk: Not less that 80 GB

CPU: Latest Intel Pentium Processor

Display: Not less than 17 inch, LCD

OS: Windows 2000

27. REFRIGERATOR

Number: Three (3) units

Capacity: Not less than 300 liters

28. ELECTRIC STORVE

Number: One (1) unit

Usage: Cooking

Number of heater: 4

29. APPARATUS FOR KJELDAHL NITROGEN DETERMINATION

Type: Auto type, digesting system complete with lift motor

Number: One (1) unit

For 100 ml tube

30. RESIDUAL CHLORINE METER

Type: Portable

Number: Three (3) units

Measuring range: 0.00 to 2.50 ppm (free chlorine concentration)

Sensitivity: 0.01 mg/l

Accuracy: ±0.03 ppm (or ±3% of indicated value)

Power supply: Battery

Model: HI93701 or equivalent

31. GOST SAMPLES OF CONTENTS OF WATER SOLUTIONS (30 ITEMS)

Standard reagents for titration, standard pH solution, GOST samples and others

Number: One (1) set

32. CENTRIFUGE

Type: Manual control desk-top type

Number: One (1) unit

Capacity: 15 ml tube × 8 cells

Max. number of revolution: 4,000 rpm

Max. centrifugal force: 2,000 × g

Model: H-11NA or equivalent

33. EXHAUST HOOD

Number: Three (3) units

Dimension: W1,500 × L750 × H2,350 mm

Materials of working plane: Ceramics

Model: RFS-150S-Y, Yamato Scientific Co., Ltd. or equivalent

34. LABORATORY TABLE

Type: Central type table with sink

Number: Three (3) units

Dimension: W2,400 × L1,500 × H800 mm

Accessory: shelf for reagents, drawer unit and cart unit

Model: PCE3-245R, Yamato Scientific Co., Ltd. or equivalent

35. LABORATORY TABLE

Type: Side type table

Number: Three (3) units

Dimension: W1,800 × L750 × H800 mm

Accessory: shelf for reagents

Model: TFK7-187R, Yamato Scientific Co., Ltd. or equivalent

36. LABORATORY TABLE

Type: Side type table

Number: Four (4) units

Dimension: W1,800 × L750 × H800 mm

Model: TFR-187R, Yamato Scientific Co., Ltd. or equivalent

37. LABORATORY TABLE

Type: Side type table

Number: Six (6) units

Dimension: W1,200 × L750 × H800 mm

Model: TFR-127R, Yamato Scientific Co., Ltd. or equivalent

38. WORK BRENCH

Number: Two (2) units

Dimension: W1,500 × L750 × H800 mm

Model: TWA-157R, Yamato Scientific Co., Ltd. or equivalent

39. TABLE CONOR

Number: Six (6) units

Dimension: W950 × L950 × H800 mm

Model: TFR-37R, Yamato Scientific Co., Ltd. or equivalent

40. SINK

Type: Side type

Number: Two (2) units

Overall dimension: W1,500 × L750 × H800 mm

Dimension of sink: W1,430 × L560 × D200 mm

Model: TSE-157, Yamato Scientific Co., Ltd. or equivalent

41. SINK

Type: Side type

Number: One (1) unit

Overall dimension: W1,200 × L750 × H800 mm

Dimension of sink: W730 × L495 × D200 mm

Model: TSD-127, Yamato Scientific Co., Ltd. or equivalent

42. STORAGE CABINET

Type: Two stages

Number: Three (3) units

Overall dimension: W1,760 × L400 × H1,800 mm

Model: MC-125G (upper shelf) and MC-125 (lower shelf), Yamato Scientific Co., Ltd. or equivalent

43. STORAGE CABINET

Type: Two stages

Number: Four (4) units

Overall dimension: W880 × L400 × H1,800 mm

Model: MC-124G (upper shelf) and MC-124 (lower shelf), Yamato Scientific Co., Ltd. or equivalent

44. VAN LACK CASE

Number: One (1) unit

Overall dimension: W844 × L320 × H1,790 mm

Number of shelf board: 11

Number of drawer: 72 (6 drawers/stage × 12 stages)

Model: 611M-72S, Yamato Scientific Co., Ltd. or equivalent

45. LABORATORY CABIN ET

Number: One (1) unit

Overall dimension: W485 × L620 × H1,800 mm

Capacity: 1,000 ml bottle: 72 bottles (3 stages)

500 ml bottle: 90 bottles (3 stages)

250 ml bottle: 144 bottles (4 stages)

100 ml bottle: 480 bottles (4 stages)

25 ml bottle: 900 bottles (5 stages)

20 ml bottle: 1,080 bottles (5 stages)

Model: SLK-23, Yamato Scientific Co., Ltd. or equivalent

46. STEEL SHELF

Number: Two (2) units

Dimension: W1,800 × L 600 × H2,402 mm

Materials: Steel stainless

Model: NMR-180C-24 or equivalent

47. STEEL SHELF

Number: One (1) unit

Dimension: W1,200 × L 600 × H2,402 mm

Materials: Steel stainless

Model: NMR-120C-24, Yamato Scientific Co., Ltd. or equivalent

48. BALANCE TABLE

Type: Balance table with vibration isolator

Number: Three (3) units

Dimension of table: W900 × L 750 × H800 mm

Dimension of vibration isolator: W600 × L 550 × H53 mm

Materials of vibration isolator: Vibro-isolating rubber and cast iron with 36 mm of thickness

Model: PFA-97R (table) and UBL-6 (vibration isolator), Yamato Scientific Co., Ltd. or equivalent

49. WATER PURIFICATION APPARATUS

Type: Ion exchange and distillation

Number: One (1) unit

Produced pure water: Deionized water, distilled water

Producing capacity of distilled water: Approx. 1.8 liters/hour

Producing capacity of deionized water: Approx. 1 liter/min

Model: WG202, Yamato Scientific Co., Ltd. or equivalent

50. TRANSPARENCY TESTER

Type: Visual observation transparency tester with plastic stand

Number: Seven (7) units

Scale height: 500 mm

51. CHAIR-1

Type: LW-4 (height adjustable, rotatable chair with seat back), Yamato Scientific Co., Ltd. or equivalent

Number: Ten (10) units

52. CHAIR-2

Type: LW-2 (height adjustable, rotatable chair), Yamato Scientific Co., Ltd. or equivalent

Number: Ten (10) units

53. FURNITURE

53.1 TABLES (WOODEN MADE)

1) For chief of laboratory: one (1) writing table and one (1) computer table

2) For engineers: three (3) writing tables

53.2 CHAIRS

1) For chief of laboratory: one (1)

2) For engineers: three (3)

3) For day shift: four (4)

4) For night shift: four (4)

53.3 WORDROBES (WOODEN MADE)

1) For chief of laboratory: one (1) wardrobe and one (1) bookcase

2) For engineers and day shifts: one (1) wardrobe with racks and shelves for 13 persons

3) For night shift: two (2) wardrobe with racks and shelves for four (4) persons

P12.2.3 GLASSWARE AND OTHERS

Glassware and others furnished under this section are summarized in the following table:

ITEM	QUANTITY
1. Phenol detector (glass)	:1
2. Phenol distillation equipment	:1
3. COD detectors (glass)	:10
4. Set of ion-selective electrodes	:1
5. Liquid measuring unit	:10
6. Water bath	:1
7. Desiccators	:2
8. Gutters for photo-calorimeter	:1
9. Division funnels (1,000 ml x 2, 250 ml x 8)	:10
10. Cover glass for micro-units	:4
11. Pipettes	:200
(Measuring pipette: 1 ml x 10, 2 ml x 20, 5 ml x 50, 10 ml x 50, 25 ml x 20)	
(Whole pipette: 1 ml x 10, 5 ml x 20, 10 ml x 20)	
12. Cylinders (25 ml x 10, 50 ml x 10, 100 ml x 50,	
250 ml x 25 for measuring transparency, 500 ml x 5) (glass)	:100
13. Measuring Flasks (50 ml x 25, 100 ml x 25, 200 ml x 10)	:60
14. Glasses (50 ml x 30, 100 ml x 30, 500 ml x 20, 1,000 ml x 20)	:100
15. BOD detectors	:100
16. Porcelain bowls	:40
17. Ash value detectors	:20
18. Flat-bottomed conical flasks	:150
19. Overalls	:24
20. Towel	:24
21. Bandages	:100
22. Gauze	:30
23. Surgeon gloves	:24
24. Scalpel	:5
25. Scissors	:3

26. Scissors for crucible :4

P12.2.4 CHEMICALS AND REAGENTS

Chemicals and reagents furnished under this section are summarized in the following table:

ITEM	QUANTITY	UNIT
1. Detergent:	24	pack
2. Soap:	12	dozen
3. Soda:	50	kg
4. Journals:	20	set
5. Pens:	50	nos.
6. Membrane filters:	3	m2
7. Parchment:	25	kg
8. Filter paper red:	50	pack
9. Filter paper blue:	100	pack
10. Standard titer for pH detecting:	4	box
11. Potassium bichromate:	2	box
12. Mor salt (standard-titer ferrous and ammonia oxide, double sulfate; $FeSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O$):	2	box
13. Trilon B:	2	no.
14. Sodium thiosulfate:	3	no.
15. Nitric acid:	1	no.
16. Endo nutrient medium:	0.5	kg
17. Feeding agar:	0.5	kg
18. Glucose:	0.5	kg
19. Chloric tripheniltetrasolium:	0.2	kg
20. Alpha-naphthol	0.2	kg
21. Dimethul-p-phenylenediamine:	0.2	kg
22. Natrium nitrate:	2	kg
23. Ammonia:	25	liter
24. Natrium hydroxide:	10	kg
25. Potassium hydroxide:	10	kg
26. Potassium Iodide	6	kg
27. Potassium permanganate:	1	no.

28. Dissolved starch:	1	kg
29. Sulfuric acid:	40	kg
30. Hydrochloric acid:	30	kg
31. Manganese sulfate:	10	kg
32. Chloride manganese:	10	kg
33. Silver sulfate:	0.2	kg
34. Diphenyl carbazon ($C_{13}H_{12}N_4O$):	0.1	kg
35. Mercury nitrate:	0.2	kg
36. Ammonia molybdate:	0.5	kg
37. Nessler reactive:	1	liter
38. Acetic acid:	5	liter
39. Natrium Salicylate:	0.01	kg
40. Sulfo salicylic acid:	1	kg
41. Tartaric acid:	1	kg
42. Citric acid:	0.5	kg
43. Sulfarsazenium (4-Nitro-2-arsonic benzo 1, 4'-diazo amino azobenzene 4"-sulfonic acids, mononatrium salt 5-Nitro-2-[3-/(n-sulfophenylazo)-phenyl 1-1-triazeno]-benzolarson acid mononatrium salt):	0.01	kg
44. Diphenyl-carbazide ($C_{13}H_{14}N_4O$):	0.05	kg
45. Ammonia persulfate:	0.3	kg
46. Methylene blue:	0.01	kg
47. Copper sulfate:	1	kg
48. Chloroform:	10	kg
49. Tetrachloride carbon:	25	liter
50. Medical ether:	5	liter
51. Ethylene glycol:	2	liter
52. Plumbum nitrate:	0.1	kg

DIVISION P13 SPECIAL CONSTRUCTION

SECTION P13.1 CAISSON WORK OF INTAKE TOWER

P13.1.1 GENERAL

The Contractor shall provide all labor, material, equipment and all other things necessary for the caisson work as shown on the drawings and specified herein.

The intake tower shall be of the reinforced concrete structure to be constructed by open caisson method.

The Contractor shall, prior to commencement of construction, provide a construction planning for the execution of the caisson work including structural design, environmental protection plan, site preparation, shuttering and reinforcement, concreting and sinking, quality control, etc. for approval.

The Contractor shall pay a special attention to displacement and inclination of the structure at the time of sinking of the caisson, and shall provide necessary measures to cope with that matter immediately.

The Contractor shall, at the time, construct a caisson in keeping a required accuracy.

P13.1.2 OPEN CAISSON

a. The Contractor shall submit shop drawing of cutting edge for the Engineer's approval. The cutting edge shall be shop-fabricated to meet the requirement of accuracy. The installation of cutting edge by the Contractor shall be done as accurately as possible to avoid the differential sinking.

b. The Contractor shall place concrete continuously as a lot to be a watertight structure and airtight structure if necessary.

c. In case the Contractor applies explosives for excavation and sinking of the open caisson work, the Contractor shall report to and get an approval for it from the authorities concerned.

d. For the execution of acceleration of sinking of the open caisson, the work shall be so executed that the Contractor shall excavate the all area uniformly and symmetrically from the center part of the area, and shall monitor using theodolite and rectify as not to be the displacement, inclination and rotation of the structure. The Contractor shall, to avoid rapid sinking, monitor the construction speed or the sinking by measuring scale in the length from the cutting edge to be marked on the external wall.

e. For the acceleration of sinking of the open caisson, no excessive excavation by the Contractor shall be done below the cutting edge. In case a difficulty for sinking takes place, the Contractor shall verify the cause of this and report it the measures to cope with this to the Engineer.

f. For the excavation at the designated sinking, the work shall be so executed that the Contractor shall carefully excavate the area from the cutting edge peripheral part towards the central part of the area to avoid the excessive excavation.

g. When the open caisson reaches to the designated depth shown on the drawing, the Contractor shall verify the bearing capacity of the natural ground, and submit the data to the Engineer.

h. The concreting under water for plugging concrete shall be placed by tremie or concrete pump

unless otherwise directed upon confirmation of stability of water elevation.

i. After placing plugging concrete, the Contractor shall not discharge water inside open caisson.

DIVISION P13 SPECIAL CONSTRUCTION

SECTION P13.2 PIPE JACKING

P13.2.1 GENERAL

Pipe materials for pipe jacking work shall be ductile iron pipes or steel pipes.

The Contractor shall furnish all labor, materials, tools and equipment and other incidentals necessary to execute the pipe jacking as shown on the drawings and/or specified herein.

Prior to the construction work, the Contractor shall investigate existing subsurface structures and utilities located in and around the construction site so as not to damage those facilities during all stages of construction.

The Contractor shall obtain written approval from the authorities concerned before the pipe jacking work.

Before, during and after the jacking operation, the Contractor shall make a continuous measurement and record of the level of the existing ground and road surface, When lowering of the levels is observed, the Contractor shall immediately discontinue the jacking operation and such shall be promptly notified to the Engineer.

Any damage to road surface pavement, subsurface structures, equipment and other utilities which are caused by the pipe jacking work shall be repaired and/or renewed by the Contractor at his expense to the satisfaction of the Engineer and the authorities concerned.

The Contractor shall at his expense check all the measurements shown on the drawings by surveying the site of the work by himself.

P13.2.2 SOIL INVESTIGATION

In checking the soil properties of the site, the Contractor shall undertake boring tests including the penetration test in the bored holes, consolidation and other necessary tests of soil samples obtained from the said boring in order to know such soil properties as bearing capacity, sheeting strength, permeability, void ratio and natural water content.

P13.2.3 SHOP DRAWINGS, CALCULATIONS AND OTHER RELATED DATA

The Contractor shall, based on the results of the said checking and testing, calculate the necessary jacking force. The Contractor shall then prepare all necessary shop drawings, calculations and other related data for pipe jacking work including the following based on the estimated jacking force and other requirements as shown on the drawings or specified herein.

a. Time schedule showing the sequence of work items and the time necessary for each item of the work.

b. List(s) showing the power source and its capacity, machines, tools and equipment, materials and labor, all of which the Contractor proposes for the execution of the pipe jacking work.

All said shop drawings, calculations and other related data shall be submitted to the Engineer for his approval prior to the execution of the work.

P13.2.4 EARTH COVERING DEPTH OF JACKING PIPE

The earth covering depth of the jacking pipe shall be not less than four (4) m from the ground surface.

P13.2.5 JACKING PIT

The jacking pit shall be so constructed as to provide enough space for workmen in lowering, jacking and jointing of the pipe safely and efficiently in the pit. Requirements foe safety provisions and maintenance to public and traffic shall be strictly fulfilled by the Contractor.

Each jacking pit at the bottom shall be provided with dewatering sumps and pumps to maintain the pit dry throughout the jacking operation. Each jacking pit shall also have suitable equipment for unloading of pipe and jacking equipment and for removal of excavated soil.

1. SHEETING AND BRACING

Prior to the excavation of the jacking pit, steel sheet piles shall be driven along the outline of the pit as shown on the drawings and as specified herein.

The sheet piles shall be driven along the exterior surface of the bracing, which shall be set prior to the sheet driving, using the bracing as a guide for driving to prevent the sheet from twisting or slanting during driving.

All sheet piles shall be driven into the ground up to a depth not less than eight (8) m.

Size and dimensions of the bracing steel shall be so designed as to sufficiently support the sheet piles driven outside them.

Framing of the bracing steel shall be made true to dimensions as shown by welding or bolting, and the frame shall, after sheet piles are driven, be tightened to the same. However, such frames shall not be welded to the sheet piles.

2. FOUNDATION AND BACKUP CONCRETE

The bottom surface of the jacking pit after excavation shall be finished level and the foundation gravel shall be provided in a layer of 15 cm thick on entire bottom surface of the pit.

A concrete working floor of 15 cm thick shall then be provided in the said foundation gravel and a pit for dewatering and pipe jointing with dimensions as shown on the drawings shall also be provided.

Backup concrete, which shall withstand against the required jacking force without any movement or damage so as to make all the said force efficiently act on pipe jacking, shall be placed as shown on the drawings.

Prior to placing the backup concrete, the Contractor shall, based on the required jacking force, calculate necessary reinforcement for the concrete so as to prevent the same from the damage or cracking and shall submit to the Engineer the results of calculation including arrangement of the necessary reinforcing bars.

P13.2.6 ARRIVING PIT

The arriving pit with sheeting and bracing shall be constructed by the Contractor so as to confirm arriving of the jacking pipe in the required position and elevation and to joint the pipe with that for

ordinary pipelines as shown on the drawings after the leading pipe has been removed from the pipe.

The time for construction of the arriving pit shall be carefully chosen based on the schedule and sequence of the work, and the period of using the pit shall be minimized.

P13.2.7 JACKING OF PIPES

1. PREPARATION

After setting the leading pipe at the required position and elevation, a portion of sheet piles at the frontal wall of the jacking pit shall be burnt off or otherwise cut off for passing the pipe through the opening. The size of the opening shall be about 20 cm larger than the outside diameter of the jacking pipe.

After jacking of the first pipe, open space between the pipe and sheet piles shall be filled with sand bags or similar materials as approved by the Engineer to prevent the earth entering the jacking pit.

2. INSTALLATION OF LEADING PIPE AND CAP

The leading pipe shall, in order to reduce the soil friction, be attached to the spigot end of the first jacking pipe. The cap shall be attached to the leading pipe in order to transmit the thrusting force thoroughly and evenly to the entire surface of the end of jacking pipe.

3. JACKING

Unless otherwise directed by the Engineer, jacking of pipe shall be done continuously until its completion so as to avoid increased friction between the pipe and soil. However, in case the jacking force exceeds the estimated value for a certain cause, the Contractor shall immediately suspend the jacking. In case more than two jacks are used, care shall be taken to start up all the jacks at the same time.

4. JOINTING OF JACKING PIPE

After the jacking pipe has been driven to a certain length, the pipe shall be joined with the succeeding pipe in the jacking pit. Jointing work shall be done in accordance with the manufacturer’s instructions in a manner satisfactory to the Engineer.

5. SURVEY

During the execution of the work, the Contractor shall undertake leveling, transit and other necessary surveys for jacking pipes exactly to the alignment and at the elevations required.

6. CASING OF PIPELINE

In case that jacking pipes are used as casing of main pipeline, all space between jacking pipes and inserted main pipeline shall be filled with non-shrink grouting by means of concrete pump.

P13.2.8 TESTING OF JOINTS

As soon as practicable after the required length of the pipeline has been driven, the Contractor shall carry out hydrostatic test in accordance with the requirements as specified in the specifications. If leakage takes place or any other defect is found in the test, the Contractor shall at his expense make all the necessary repairs and/or renewals to the satisfaction of the Engineer.

In the testing, the Contractor shall take the precautionary measures to protect all staff of the Employer, the Engineer and the Contractor, and third party from physical injury.

DIVISION P14 SPECIAL SYSTEMS

SECTION P14.1 OPERATION AND MAINTENANCE MANUAL

P14.1.1 GENERAL

1. SCOPE OF WORK

The Contractor shall furnish at least twenty (20) sets of operation and maintenance manuals for the water treatment and sewage treatment plants and pump stations which will be specified hereinafter.

2. GENERAL ARRANGEMENTS

Operating and maintenance manuals for the plants shall include but not be limited to the following:

a. Operation Manual

b. Technical Instructions for Mechanical and Electrical Systems

c. Maintenance Manual and Record System

d. Video Visual Instruction System

e. As-built Drawings

f. Field Test Records

3. DOCUMENTATION ARRANGEMENTS

All operating and maintenance manuals furnished under this section shall be arranged properly in accordance with the following:

a. All information shall be both in English and Russian languages. All dimensions and units shall be in metric system and International System of Units (SI) system. Operation manual shall be in both English and Russian languages.

b. All manuals shall be in the International A4.

c. All manuals shall be bound in A4 size hard plastic files having four (4) inclined D-rings with double lock system.

   Spine of the file shall be provided with the following colored indexes:

   - Mechanical: Blue

   - Electrical: Red

   - Others: White

   Colored indexes shall be provided with lettering.

d. The format, arrangement, index etc., shall be submitted to the Engineer for approval before final binding and printing.

e. Twenty (20) sets of indexes including a comprehensive index for each volume and overall index volume shall be furnished and each set shall be bound in a hard plastic file specified above.

f. All manuals shall be submitted with two (2) sets of CD-R ISO formatted.

g. The Contractor shall furnish self-standing steel cabinets for storing two (2) full sets of all operating and maintenance manuals furnished under this section. The steel cabinets shall be painted and furnished with full sized glass front, and a master key plus three (3) spare keys.

P14.1.2 OPERATION MANUAL

The operation manual written for use by the plants' operator shall contain but not be limited to the following:

a. Process description for complete water and sewage treatment plants and pump stations

b. List of plant alarms, giving possible causes for alarm initiation, and sequence of remedial actions to be taken

c. Procedures for setting up chemical feed rates on dosing equipment, methods for calculating dosage rate and feed pump stroke and speed settings from specified doses giving worked examples with cross references to pump calibration curves, where applicable

d. Calibration of metering and dosing equipment

e. Step by step account of plant start-up and shut-down procedures

f. Instructions for normal plants and pump stations operations

g. Instructions on monitoring of plant performance and sample log sheets for each plant item, to be filled by operators on a routine basis

h. Safety precautions to be taken in plant operation, in the handling of hazardous chemicals, action to be taken on chlorine liquid or gas leaks, and chemical spillages, including first aid instructions

i. Basic maintenance procedures such as flushing of pumps, and chemical delivery lines, cleaning of tanks after use and washing down of spillages

j. "Do's" and "Don'ts" in plant operations. Operators' attention shall be drawn to all operations considered to be dangerous to operators or likely to cause damage to the plant

k. Trouble-shooting chart containing symptoms, probable causes, and remedies that should be included

l. A3 size copies of all drawings, folded to A4 size referred to in the operation manual

Operation manual shall be simple and written in either non-technical or semi-technical language. Wherever possible, the operation manual shall be presented in a tabulated and easy to understand form.

P14.1.3 TECHNICAL INSTRUCTIONS FOR MECHANICAL AND ELECTRICAL SYSTEM

Technical instructions for the mechanical and electrical system shall include but not be limited to the following:

a. A detailed process description for treatment plants and pump stations

   Descriptions shall be supported by detailed process and instrumentation drawings.

b. A detailed description of mechanical plant items which shall include

   - detailed description of each system

- duty of individual equipment
- function of equipment
- full specification of equipment
- manufacturer and type reference

c. A detailed description of all instrumentation which shall include

- plant instrumentation system
- instruments provided
- operating principles for all monitoring, indication and control equipment
- function of instruments
- location of instruments and indicators
- full specification of each instrument
- manufacturer and type reference

Descriptions shall be supported by detailed process and instrumentation drawings.

d. A detailed description of all control systems which shall include

- methods of control for start-up and shut-down
- list of alarms, method of initiation and remedial action to be taken
- plant trips and interlocks

e. A detailed description of the electrical plant which shall include

(i) description of switchgear and panels

- full specifications, manufacturer, type, voltage ratings
- general list of circuits including currents and power ratings

(ii) circuits

- circuit heading
- list of components including manufacturer's type reference
- sub-paragraphs for each circuit giving description of control including control mode and starting condition, and alarm features with cross reference to plant control description, especially methods of control for start-up and shut-down

f. A detailed description of plant start-up and shut-down procedures, which shall include

- all pre-operational checks and tests on the mechanical and electrical plant
- an account of plant start-up and shut-down listing valve to valve operating procedures

The description shall be supported by system operation and instrumentation drawings.

g. A detailed description of day to day plants and pump stations operation procedures shall include instructions

h. A detailed description of process optimization procedures, related to water quality and plant throughput

i. A detailed description of safety procedures to be followed

- in the handling of hazardous chemicals which shall include action to be taken in the event of a leakage or spillage

- in the operation of mechanical and electrical plant

- first aid instructions

The Contractor shall seek the advice of competent authorities such as the chemical supplier's safety officer and medical personnel when preparing safety instructions.

j. A detailed description of plant operation under emergency conditions which shall include

(i) sequence of events giving action required to make plant safe, and corrective action to safeguard plant from damage in event of

- failure of any major plant item

- failure of any control system

- power failure

(ii) sequence of events to be followed on restoration of power which shall include a list of plant items which will re-start automatically and items which require manual re-setting before starting

(iii) manual operation of plant under emergency conditions

(iv) operation of plant under any other foreseeable emergency condition

The descriptions shall be supported by drawings using logic diagrams showing the sequence of operations, checks and remedial operations to be taken under emergency conditions.

k. Technical specification sheets for all major plant items; in the case of pumps, blowers, fans, etc, characteristics curves shall also be included.

l. A3 size copies of all drawings, folded up in A4 size referred to in the technical instructions for mechanical and electrical system

P14.1.4 MAINTENANCE MANUAL AND RECORD SYSTEM

1. GENERAL

Maintenance manual and record system shall include but not be limited to the following:

a. Maintenance Manual

b. Maintenance Record System

c. Manufacturer's Instructions

d. Other Requirements

2. MAINTENANCE MANUAL

a. Checking, testing and replacement procedures to be carried out on all mechanical and electrical plant items on a daily, weekly and monthly basis or at longer intervals to ensure trouble-free

operations; this information shall be presented in a tabulated form with hard and thick paper and bound in hard plastic files

b. Fault location and remedy charts to facilitate tracing the cause of malfunctions or breakdown and correcting faults

c. A complete list of recommended lubricants and lubrication charts for individual plant items; the charts shall include at least three trade names of the products, which are available in the Astana city.

d. A spare schedule which shall consist of a complete list of itemized spare for all electrical and mechanical plant items with ordering references and part numbers

e. A complete manufacturers and suppliers list which shall include address, telephone numbers and e-mail addresses of manufacturers, suppliers and local agents; the list shall be tabulated in alphabetical order giving the name of manufacturer and supplier

f. A complete list of manufacturers instructions for operation and maintenance of all bought-out equipment; the list shall be tabulated in alphabetical order giving the name of the manufacturer, supplier identification of the plant item giving the model number and the literature provided including instruction leaflets and drawing numbers

3. MAINTENANCE RECORD SYSTEM

Maintenance record system, one (1), four (4) card maintenance record system shall be furnished. This four (4) card system shall include all electrical and mechanical equipment furnished under this Contract.

The system shall consist of a four (4) card set for each item of equipment to be maintained and a file for card storage and display.

Sufficient four-card sets shall be furnished to provide one set for each item to be maintained plus 20% extra stock.

The format of each card shall be to the approval of the Engineer. Each card shall be of hard and thick paper approved by the Engineer and this maintenance record system shall be bound in hard plastic files specified.

The cards shall include the following information:

3.1 Card 1 Equipment Data

a. The name of item of equipment

b. The name and address of the manufacturer

c. The name and address of the supplier

d. The name and address of the local agent

e. An identification number

f. Record of spare parts held in stock with provision for additional spare parts

g. Provision for recording maintenance performed, together with the data and cost

h. Preventive maintenance schedule with colored tabs for monitoring completion of each maintenance item

i. Any other pertinent data required by the Engineer

3.2 Card 2 Master Maintenance Data

a. Record of all scheduled maintenance procedure outline including frequency and type of lubricant to be used for each item of equipment

b. A reference to the bound instruction manual where the full description of the maintenance operation may be found

c. List of special equipment that may be required that would not be carried at the plant e.g. mobile crane

d. Any other details requested by the Engineer

3.3 Card 3 Preventive Maintenance Record

Provision for recording all past maintenance data.

3.4 Card 4 Drive Assemblies Record Card

Record of all motor, gear reducers or drivers, and control data for each motor.

P14.1.5 VIDEO VISUAL INSTRUCTION SYSTEM

1. GENERAL

The Contractor shall furnish two (2) sets of video visual instruction systems with two (2) sets of visual display units with video replay units.

The video visual instruction system shall be used to instruct proper operation and maintenance of the plant to the operators using video visual display system and to keep record of proper operation and maintenance.

The Contractor shall be required to take and arrange pictures of operation and maintenance instructions with a video camera during the start-up and test run period of the plant construction.

Final arrangements of the videotapes shall be approved by the Engineer. Each volume of videotape shall be provided with appropriate narration in English and Russian.

Each videotape shall be provided with an appropriate title showing items of content at the beginning of the tape. The spine of the cassette shall be provided with an index and lettering.

The Contractor shall furnish two (2) sets of steel cabinets, appropriately sized for storing videocassette tapes, with one cabinet for each set of system.

The Contractor shall furnish two (2) sets of list of videocassettes and the lists shall be bound in hard plastic files specified.

All videotapes furnished under this section shall become the property of the Employer.

This video visual instruction system shall include

a. Construction record

b. Instruction for plant operation

c. Maintenance instruction

d. Safety instruction

e. Others

2. CONSTRUCTION RECORD

Construction record shall include manufacturing, shop testing, shipping, transporting, erection, checking, start-up and testing of all equipment and systems furnished under this Contract.

3. INSTRUCTION FOR PLANT OPERATION

Instruction for plant operation shall include all facilities, equipment such as pumps, valves, chemical dosing system, sludge handling system, and control/monitoring system

4. MAINTENANCE INSTRUCTION

Maintenance instruction shall include but not be limited to the following:

4.1 Mechanical Plant

a. Checking and testing procedure of all mechanical equipment

b. Lubricants checking and replacement

c. Packing and other spare parts checking and replacement

d. Sludge scraper daily and periodical maintenance procedure

e. Chemical feeders and pumps daily and periodical maintenance procedure

f. Chemical feeders and pumps disassembly and assembly procedure

g. Chlorinator daily and periodical maintenance procedure

h. All drive units including reduction gears with motor daily and periodical maintenance procedure

i. All other special maintenance procedures of mechanical equipment

4.2 Electrical Plant

a. Circuit breaker maintenance procedure including switchgear draw outing and inserting, replacement vacuum bulbs and others

b. Power transformer maintenance procedure including tap changing and others

c. Battery cells maintenance procedure including measurement of temperature and specific gravity of electrolyte, water supply and others

d. Motor maintenance procedure including replacement bearing and others

e. Withstand voltage test procedures for all panels and equipment

f. Megger test procedure for all panels, equipment and cables

g. Grounding resistance measurement procedure

h. Power transformer insulation oil measurement procedure

i. Testing procedure for all protection relays

4.3 Instrumentation

a. Replacing procedure of paper, pen and toner for all types of recorders

b. Analyzer maintenance procedure including inspection, disassembly, zero point correction using reagent, dissolving reagent, cleaning of electrodes and others

c. Program input and correction procedure for PLC and SCADA system

d. Transmitter zero-point correction procedure

5. SAFETY INSTRUCTION

Safety instruction shall include but not be limited to the following:

a. Handling hazardous chemical

b. Action to be taken on liquid chlorine and chlorine gas leaks

c. Action to be taken on chemical spillages

d. First aid instructions

6. VISUAL DISPLAY UNIT WITH VIDEO REPLAY UNIT

The Contractor shall furnish two (2) sets of visual display units with video player unit.

Each unit shall be the latest model, and visual display unit and video player unit shall be supplied from the same manufacturer.

Video system shall be the VHS system and videocassette tape shall be VHS cassette. The visual display unit shall be a standard color TV set and size shall be at least 20 inches.

Video player unit shall be the standard, solid state, compact type, having but not limited to the following functions:

a. HQ and EX 4 tape heads

b. High quality replay system with ANR circuit and twin filter

c. High quality and easy recording system

d. Five (5) steps slow motion

e. Double speed replay

f. Tape counter

g. Others

P14.1.6 FIELD TEST RECORDS

The Contractor shall prepare and submit field test records which shall be approved by the Engineer.

Field test records shall include field performance test records and other test records for mechanical and electrical equipment, executed by the Contractor during start-up and test-run of the plant.

DIVISION P15 MECHANICAL WORKS

P15.1 WATER SUPPLY FACILITIES

P15.1.1 Intake Pump Station (W11)

a. General

Intake Facility shall be capable of supplying water of 210,000 m^3/day from Vycheslavsky Reservoir and shall consist of the following major facilities, namely,

- Intake Pump Station
- Surge Control House

The mechanical components of Intake Pump Station shall consist of the following equipment. Equipment shall be designed using the following conditions and in accordance with the specification set forth hereinafter in this Section.

b. Equipment List of Intake Pump Station

W11-MM- 01	Inflow Screen	W11 HS 01 to 03	: 3 units
W11-MM - 02	Inflow Valve	W11 MV 01 to 03	: 3 units
W11-MM - 03	Suction Valve A	W11 MV 11 to 61	: 6 units
W11-MM - 04	Suction Valve B	W11 MV 71 to 81	: 2 units
W11-MM - 05	Raw Water Pump	W11 RP 11 to 61	: 6 units
W11-MM - 06	Discharge Valve A	W11 MV 12 to 62	: 6 units
W11-MM - 07	Discharge Valve B	W11 MV 72 to 82	: 6 units
W11-MM - 08	Isolation Valve	W11 MV 04 to 05	: 2 units
W11-MM - 09	Overhead Hoist A	W11 MH 01 to 02	: 2 units
W11-MM - 10	Overhead Hoist B	W11 MH 03	: 1 units
W11-MM - 11	Sump Drain Pump	W11 DP 01 to 02	: 2 units
W11-MM - 12	Piping		: 1 lot
W11-MM - 13	Steel Works		: 1 lot
W11-MM - 14	Other Necessary Works		: 1 lot

c. Design Condition

Flow Rate

- Daily minimum : 150,000 m^3/day
- Daily maximum : 210,000 m^3/day

1. Inflow Screen (W11 HS 01/02/03)

a. General

Inflow Screens shall be installed at the inlet mouths of the Pump Station and shall be capable of preventing floating matters entering the station.

b. Specification

Type	: Bar Screen
Quantity	: 3 units
Dimension	: 2,200 mm W x 2,200 mm H
Bar	: 75 mm x 6 mm Thickness
Clearance between bars	: 50 mm
Materials (Screens, Guide Rails)	: Stainless Steel Type 304

c. Fabrication

i) The screen shall be constructed with steel flats. The steel flats, with spacers inserted to separate them at equal intervals, shall be tightened and assembled together by means of through-bolts, which have nuts at both ends.

ii) The screen shall be mounted in the guide rails. The guide rails shall be fixed by means of anchor bolts at both ends to the wall of Pump Station.

iii) A stop log shall be provided for each inflow screen to prevent any floating matters entering to the intake piping during maintenance the screens. The stop logs shall be made of aluminum plate for easy handling and shall be properly fabricated to protect against hydraulic pressure and to secure water tightness.

d. Accessories

Guide rails	: 3 sets
Portable chain hoist 0.5 ton x 20 m	: 1unit
Anchor bolt	: 3 sets
Plastic mesh net (opening 30mm x 30mm)	: 3 sets
(dimension : 2,200 mm W x 2,200 mm H)	

2. Inflow Valve (W11 MV 01/02/03)

a. General

Inflow Valve shall be installed on the intake pipe in the Pump Station and shall be capable of separating the incoming raw water.

b. Specification **(Refer to Standard Specification – Section 15.3)**

Type	: Motor Driven Metal-Seated Butterfly Valve
Quantity	: 3 units
Dimension	: 1,500 mm dia.

Design water depth	: 15.7 m
Motor output	: 3.7 kW
Special Materials : Body Seat	: Stainless Steel Type 304
Disc Seat	: Monel, Aluminum Bronze or Stainless Steel

3. Suction Valve A (W11 MV 11/21/31/41/51/61)

a. General

Inflow Valve shall be installed on the intake pipe in the Pump Station and shall be capable of separating the incoming raw water.

b. Specification **(Refer to Standard Specification – Section 15.3)**

Type	: Motor Driven Butterfly Valve
Quantity	: 8 units
Dimension	: 500 mm dia.
Design water depth	: 15.7 m
Motor output	: 0.75 kW

4. Raw Water Pump (W11 RP 11/21/31/41/51/61)

a. General

Raw Water Pumps shall be installed in the Intake Pump Station and shall be capable of pumping raw water to the distribution chamber in the Water Treatment Plant through raw water transmission pipelines.

b. Specification **(Refer to Standard Specification – Section 15.4)**

Type	: Split casing, vertical centrifugal pumps
Quantity	: 6 units (4 duty, 2 standby)
Rated capacity	: 36.5 m^3/min
Rated head	: 35.0 m TDH
Speed	: Approx. 1000 rpm
Efficiency	: not less than 88 percent at duty point
	: not less than 85 percent at water level of + 402 m amsl
NPSHA (minimum)	: approx. +1.8 m
Max. noise level for pump	: 85 dB(A) at 1.0 m
Driving method	: through shafting from motor at ground level

Motor output	: 280 kW
Installation	: indoor
Motor encl. protection	: IP 44
Wet well water levels	: HWL +404.400 m amsl
	: Median WL + 402.000 m amsl
	: LWL +391.000 m amsl
Pump room floor level	: +387.200 m amsl
TWL at discharge	: +363.400 m amsl
Motor room floor level	: +404.400 m amsl
Transmission main	: 1000 mm and 1400 mm diameter, approx. 51 km long (refer to attached Technical Schedule)

c. Space is left in the station for seventh and eighth pumps which will be provided for future stages. The connection pipework and valving for the seventh and eighth pumps will be provided in this stage and blanked off.

d. The intermediate bearing units shall be supplied by the pump manufacturer and the pump manufacturer shall have the experience of furnishing units of the same configuration. At the time of shop test, pumps may be operated directly coupled with motor without the intermediate power transmission facilities.

e. The pump manufacturer shall substantiate quoted efficiency with at least one owner's certificate and corresponding test record of specific speed similar to the specified pump with suction diameter of not less than 500 mm.

f. The Contractor shall provide the supporting steelwork for the pump motors. The steelwork shall be removable for direct access to the lower levels. The entire access hole in the ground floor slab shall be provided with sectionalised, removable covers of checker plate steelwork and necessary supports designed for the equipment supplied.

g. The pump manufacturer shall substantiate manufacturing and supplying of pumps and motors with the following conditions satisfactorily completed outside of home country during the last 5 years.

   i) Vertical centrifugal pump of similar capacity and head with floating shaft and intermediate bearing unit.

   ii) Vertical centrifugal pump with quoted pump efficiency at same or lower speed and capacity than specified.

h. The pump manufacturer shall carry out surge analysis on the raw water transmission pipelines on the basis of data of rotating element, characteristic of reflux valve and the raw water transmission pipelines to ensure no damages caused due to the surge. If any protection methods are required for the surge, the methods shall be proposed by the pump manufacturer for the Engineer's approval along with report of surge analysis included with the tender. The pump manufacturer shall have experience of surge analysis of similar discharge capacity of the pump and approximately 25 km of transmission pipelines.

i. Spare Parts

Complete set of pump rotor assembly : 1 set

Complete set of bearings for pump	: 6 sets
Complete set of bearings for motor	: 6 sets
Complete set of weir rings	: 6 sets
Complete set of all packing/gaskets	: 6 sets
Shaft Sleeves	: 6 sets

5. Discharge Valve A (W11 MV 12/22/32/42/52/62)

a. General

Discharge Valve shall be installed on the discharge pipe of the Raw Water Pump and shall be capable of separating the pumping raw water.

b. Specification **(Refer to Standard Specification – Section 15.3)**

Type	: Motor Driven Butterfly Valve
Quantity	: 6 units
Dimension	: 500 mm dia.
Design water depth	: 50 m
Motor output	: 0.75 kW

6. Isolation Valve (W11 MV 04/05)

a. General

Isolation Valve shall be installed on the raw water transmission pipe in the Pump Station and shall be capable of separating the pumping raw water.

b. Specification **(Refer to Standard Specification – Section 15.3)**

Type	: Motor Driven Butterfly Valve
Quantity	: 2 units
Dimension	: 1400 mm dia.
Design water depth	: 50 m
Motor output	: 2.2 kW

7. Overhead Hoist (W11 MH 01/02/03)

a. General

Overhead Hoists shall be installed at the top of the Pump Room and Motor Room, and shall be used for the installation, assembly, maintenance and checking of the pump system.

b. Specification **(Refer to Standard Specification – Section 15.6)**

Type	: Motorized Overhead Wire Hoist with Trolley
Quantity	: 3 units

Rated load : 5 tonne

Main Hoist speed : Approx. 2m/min

Traveling speed : Approx. 10m/min

Lifting height: W11 MH 01/02 : 25m

W11 MH 03 : 7m

Hoist motor output : 13kW

Traveling motor output : 1.5kW

8. Sump Drain Pump (W11 DP 01/02)

a. General

Sump Drain Pump shall be installed at the Bottom of the Pump Room and shall be used to drain water accumulated in the sump.

b. Specification **(Refer to Standard Specification – Section 15.5)**

Type : Submersible Drain Pump

Quantity : 2 units (1 duty, 1 standby)

Discharge flow : 0.3 m^3/min

Total head : 25m

Motor output : 5.5kW

9. Piping (Refer to Section 15.2)

The piping work shall include the piping systems as shown in the following table. The sizes and materials shall be based on the value as shown on the contract drawings, and all piping systems shall be comply with the requirements of Section 15.2.

The piping shall include all necessary pipes, support, valves, expansion joints, insulation and necessary appurtenances and shall be designed, furnished, installed, tested and adjusted by the Contractor.

No	Piping Name	Scope of Works	
		From	To
1	Raw water transfer piping	Inflow screen	Raw water transmission pipe
2	Drainage discharge piping	Sump drainage pump	Outside of station
3	Other necessary piping	-	-

10. Steel Works (Refer to Division 5)

This steel works shall include all necessary steel works for the operation and maintenance of

the plant such as covers, manholes, stages, walkways, handrails, steps, ladders, etc. even if not shown on the drawings and shall be designed, furnished, installed and adjusted by the Contractor.

P15.1.2 Surge Control House (W12)

a. General

The following equipment specifications in the Surge Control House are tentatively provided based on the surge analysis during the detailed design stage for reference.

The pump manufacturer shall carry out surge analysis on the raw water transmission pipelines and the protection methods shall be proposed for the Engineer's approval along with the report of the surge analysis. Both the company carrying out the surge analysis and the software used for the computer transient analysis shall have a proven record in surge analysis. The mechanical components of Surge Control House shall consist of the following minimum equipment which was tentatively prepared for the purpose of bidding. Equipment shall be designed using the result of the surge analysis by the pump manufacturer. The Bidder's price shall include for all necessary equipment required to provide a complete surge protection system, whether listed below or not.

b. Equipment List of Surge Control House

W12-MM - 01	Surge Tank	W12 ST 01 to 02	: 2 units
W12-MM - 02	Air Compressor	W12 AC 01 to 02	: 2 units
W12-MM - 03	Air Tank	W12 AT 01	: 1 unit
W12-MM - 04	Flow Control Valve	W12 MV 11	: 1 unit
W12-MM - 05	Isolation Valve	W12 HV 11	: 1 unit
W12-MM - 06	Piping		: 1 lot
W12-MM - 07	Steel Works		: 1 lot
W12-MM - 08	Other Necessary Works		: 1 lot

c. Design Condition

Flow Rate

- Daily minimum : 150,000 m^3/day
- Daily maximum : 210,000 m^3/day

Surge Analysis

- Raw water transmission pipeline : refer to Technical Schedule
- Existing and proposed surge tanks : refer to Technical Schedule

1. Surge Tank (W12 ST 01/02)

a. General

Surge Tanks shall be installed in the Surge Control House and shall be capable of preventing any damages caused due to the surge in the raw water transmission pipelines.

b. Specification

Type	: Hydropneumatic Surge Vessels (with compressors)
Quantity	: 2 units
Effective Capacity	: 75 m^3
Maximum Pressure	: 0.6 MPa
Dimension	: Approx. 3.5 m dia. x 9.0 m L
Materials	: Structural Steel JIS G 3106 SS400 or equivalent
Accessory	: Isolation/drain valves
	: Pressure relief valve
	: Level meter/ switch
	: Pressure meter/switch
	: Anchor bolts

c. Fabrication

i) Hydropneumatic Atmospheric Surge Vessel shall include the following features:

- facility for draining the vessel. If possible, this shall be using the pressure pipeline
- manway access if the vessel is large enough to accommodate this, or inspection hatch for cleaning out the vessel
- pressure gauge with isolating cock to measure the maximum and minimum pressures
- liquid level gauges
- air pipework
- air compressor assembly
- automatic air volume control system

ii) Tubular glass, liquid-level gauges with 20 mm tube outside diameter shall be provided. The minimum viewing length shall be 600 mm per gauge. Sufficient gauges shall be provided to view the entire operating range of water levels in the pressure vessel. Threaded 20 mm connections shall be provided. Isolation valves with ball checks shall be provided to prevent loss of liquid upon gauge breakage. Valves shall be of an offset pattern with integral bonnet. Valve bodies shall be bronze. A drain cock shall be provided on the lower valve. Valves shall have pressure ratings of 1.5 times the maximum surge pressure anticipated, or NP 16, whichever is greater

iii) Safety relief valves shall be capable of passing air and water. Valves shall have a bottom inlet and side outlet. The inlet shall incorporate a calibrated spring set to allow the valve to open at the vessel design pressure.

iv) Air piping shall be galvanised steel pipe of a minimum of 25 mm diameter. A brass ball valve shall be provided as a block valve at the pressure vessel. Brass check valves shall be provided in the air line. All shall have pressure ratings of 1.5 times the maximum surge pressure anticipated, or NP 16, whichever is greater

v) The automatic air volume control system, in conjunction with pressure vessel-mounted sensor probes and the air compressor unit, shall control the air/water ratio in the hydropneumatic pressure vessel and maintain the air/water ratio within a range compatible with the surge control system design and established system static and maximum operating pressures.

vi) Contacts shall be provided for remote indication of excessive high or low water level in the vessel. Capacitance type level probes with a probe well plumbed to the side of the hydropneumatic vessel shall be provided. A control panel with all necessary controls, relays and time delay circuits to actuate the air add/vent solenoid valves, and signal a high or low tank water level shall be provided.

vii) Solenoid valves of sizes 5 mm through 40 mm for air service shall have forged bronze bodies with Teflon seats. Internal plunger, core tube, plunger spring, and cage assembly shall be stainless steel. Solenoid enclosures shall be IP 68. Valve actuators shall be 220 V a.c. Seals shall be Teflon. Valves shall have a maximum operating pressure and a maximum differential pressure of 16 bar. Solenoid valves shall be energised to open.

viii) Proper heating system for the surge control system shall be provided by the Contractor for protecting the system from phenomena caused by low temperature such as freezing.

2. Air Compressor (W12 AC 01/02)

a. General

Air compressors shall be installed in the Surge Control House and shall be capable of supplying necessary volume and pressure of air for preventing any damage caused due to the surge in the raw water transmission pipelines.

b. Specification **(Refer to Standard Specification – Section 15.3)**

Type	: Air-cooled reciprocating oil-free type
Quantity	: 2 units (1 duty, 1 standby)
Rated Discharge	: 405 N l/min (at 1.0 atm)
Maximum Pressure	: 0.93 MPa
Operation	: Pressure control system
Motor output	: 3.7 kW
Accessory (for each unit)	: Air tank 130 l
	: Silencer
	: Pressure gauge
	: Air transformer

: Air filter

: Air Dryer

Accessory (for total system) : Air tank 230 l (Tag No. W12 AT 01)

3. Flow Control Valve (W12 MV 11)

a. General

Flow Control Valve shall be installed in the Surge Control House and shall be capable of controlling flow from the Intake Pump Station to the Water Treatment Plant.

b. Specification **(Refer to Standard Specification – Section 15.3)**

Type	: Motor Driven Toothed Butterfly Valve		
Quantity	: 1 unit		
Dimension	: 1100 mm dia.		
Maximum pressure	: 0.98 MPa		
Motor output	: 2.2 kW		
Special Materials :	Disc	:	Stainless Steel Casting

c. Fabrication

i) The disc of the valve shall be a tooth shaped vane disc to control a wider flow range.

ii) The valve shall also be capable of being shut off tightly.

d. The valve manufacturer shall carry out cavitation analysis on the flow control valve within the operation flow range to ensure no damage caused due to the cavitation and the result shall be prepared by the valve manufacturer for the Engineer's approval.

e. The valve manufacturer shall substantiate manufacturing and supplying of valves with the similar conditions satisfactorily completed outside of home country during last 5 years.

4. Piping (Refer to Section 15.2)

The piping work shall include the piping systems as shown in the following table. The sizes and materials shall be based on the value as shown on the contract drawings, and all piping systems shall be comply with the requirements of Section 15.2.

The piping shall include all necessary pipes, support, valves, expansion joints, insulation and necessary appurtenances and shall be designed, furnished, installed, tested and adjusted by the Contractor.

No	Piping Name	Scope of Works	
		From	To
1	Raw water transfer piping	Raw water transmission pipe	Raw water transmission pipe
2	Compressed air piping	Air compressors	Air chambers
3	Other necessary piping	-	-

5. Steel Works (Refer to Division 5)

This steel works shall include all necessary steel works for the operation and maintenance of the plant such as covers, manholes, stages, walkways, handrails, steps, ladders, etc. even if not shown on the drawings and shall be designed, furnished, installed and adjusted by the Contractor.

P15.1.3 Distribution Chamber (W31)

a. General

Water Treatment Plant shall be capable of producing potable water of 100,000 m^3/day and shall consist of the following major facilities, namely,

- Distribution Chamber
- Receiving Well
- Flocculation/Sedimentation Basins
- Rapid Sand Filter
- Distribution Pump Station
- Wash Drain Basin
- Sludge Thickener
- Sludge Drying Bed
- Sludge Cake Yards
- Discharge Pool
- Chemical Room

The mechanical components of Distribution Chamber shall consist of the following equipment. Equipment shall be designed using the following conditions and in accordance with the specification set forth hereinafter in this Section.

b. Equipment List of Distribution Chamber

W31-MM - 01	Inflow Control Valve	W31 MV 11 to 21	: 2 units
W31-MM - 02	Distribution Weir	W31 MG 11 to 31	: 3 units
W31-MM - 03	Outflow Isolation Valve	W31 HV 11	: 1 unit
W31-MM - 04	Piping		: 1 lot
W31-MM - 05	Steel Works		: 1 lot
W31-MM - 06	Other Necessary Works		: 1 lot

c. Design Condition

Flow Rate (for Distribution Chamber)

- Daily minimum (from the reservoir) : 150,000 m^3/day
- Daily maximum (from the reservoir) : 210,000 m^3/day
- Daily maximum (from Washing Drain Basin) : 10,200 m^3/day

  (Washwater recovery pump: 22.0 m^3/min)

1. Inflow Control Valve (W31 MV 11/22)

a. General

Inflow Control Valve shall be installed at the inflow pipe of the Distribution Chamber and shall be capable of controlling flow from the Intake Pump Station to the Water Treatment Plant.

b. Specification **(Refer to Standard Specification – Section 15.3)**

Type		: Motor Driven Toothed Butterfly Valve
Quantity		: 2 units (1 duty, 1 standby)
Dimension		: 1000 mm dia.
Maximum pressure		: 0.98 MPa
Motor output		: 2.2 kW
Materials :	Disc	: Stainless Steel Casting

c. Fabrication

i) The disc of the valve shall be a tooth shaped vane disc to control a wider flow range.

ii) The valve shall also be capable of being shut off tightly.

d. The valve manufacturer shall carry out cavitation analysis on the flow control valve within the operation flow range to ensure no damage is caused due to the cavitation and the result shall be prepared by the valve manufacturer for the engineer's approval.

e. The valve manufacturer shall substantiate manufacturing and supplying of valves with the similar conditions satisfactorily completed outside of home country during last 5 years.

2. Distribution Weir (W31 MG 11/21/31)

a. General

Distribution Weir shall be installed at the overflow weir in the Distribution Chamber and shall be capable of controlling flow from the Distribution Chamber to the new and existing receiving wells.

b. Specification **(Refer to Standard Specification – Section 15.3)**

Type		: Motor Driven Overflow Weir
Quantity		: 3 units
Dimension		: 3000 mm W x 500 mm Stroke
Floorstand		: Two floorstands with single drive unit
Motor output		: 1.5 kW
Installation level :	Weir	: Lowest overflow level +363.050 m amsl
	Floorstand	: Floor level + 364.350 m amsl
Materials :	Frame	: Stainless Steel Type 304

Slide : Stainless Steel Type 304

Seating Surface: Phosphor Bronze Plate

c. Fabrication

i) Frames shall be fabricated in one piece and shall be furnished with a proper numbers of rollers for smooth operation and water tightness.

ii) Slides shall be fabricated in one piece with strengthening ribs, where required, and reinforced section to receive the seating faces.

iii) Seating faces shall be secured firmly in frame and slide faces.

3. Piping (Refer to Section 15.2)

The piping work shall include the piping systems as shown in the following table. The sizes and materials shall be based on the value as shown on the contract drawings, and all piping systems shall be comply with the requirements of Section 15.2.

The piping shall include all necessary pipes, support, valves, expansion joints, insulation and necessary appurtenances and shall be designed, furnished, installed, tested and adjusted by the Contractor.

No	Piping Name	Scope of Works	
		From	To
1	Raw water transfer piping	Raw water transmission pipe from Intake Pump Station	Raw water transmission pipe to Receiving Well
2	Wash drain recovery piping	Wash drain recovery pipe	Distribution Chamber
3	Activated Carbon Dosing piping	Chemical Room	Distribution Chamber
4	Sampling water piping	Raw water transmission pipe	Sampling pipe to Laboratory
5	Other necessary piping	-	-

4. Steel Works (Refer to Division 5)

This steel works shall include all necessary steel works for the maintenance of the plant such as covers, manholes, stages, walkways, handrails, steps, ladders, etc. even if not shown on the drawings and shall be designed, furnished, installed and adjusted by the Contractor.

P15.1.4 Receiving Well (W32)

a. General

The mechanical components of Receiving Well shall consist of the following equipment. Equipment shall be designed using the following conditions and in accordance with the specification set forth hereinafter in this Section.

b. Equipment List of Receiving Well

W32-MM - 01 Inflow Valve	W32 MV 11/21	: 2 units
W32-MM - 02 Inflow Gate	W32 MG 11/21	: 2 units
W32-MM - 03 Coagulant Distribution Tank	W32 CT 01	: 1 unit
W32-MM - 04 Flocculant Distribution Tank	W32 CT 02	: 1 unit
W32-MM - 05 Piping		: 1 lot
W32-MM - 06 Steel Works		: 1 lot
W32-MM - 07 Other Necessary Works		: 1 lot

c. Design Condition

Flow Rate (raw water and wash drain recovery water)

- Daily maximum (from Distribution Chamber) : 105,000 m^3/day

1. Inflow Valve (W32 MV 11/21)

a. General

Inflow Valve shall be installed at the inflow pipe of the Receiving Well and shall be capable of isolating between both sides of the valve.

b. Specification **(Refer to Standard Specification – Section 15.3)**

Type	: Motor Driven Butterfly Valve
Quantity	: 2 units
Dimension	: 1,100 mm diameter
Pressure	: 0.49 Mpa

2. Inflow Gate (W32 MG 11/21)

a. General

Inflow Gate shall be installed in the Receiving Well and shall be capable of isolating between both sides of the gate.

b. Specification **(Refer to Standard Specification – Section 15.3)**

Type	: Motor Driven Sluice Gate
Quantity	: 2 units
Dimension	: 1000 mm W x 1000 mm H
Motor output	: 0.75 kW
Installation level : Gate	: Gate Center level +357.700 m amsl
Floorstand	: Floor level + 364.400 m amsl

c. Accessories

Portable electrical gate/valve actuator operators : 3 sets

Item	Seiwa model and part number	Quantity
Drive body	UDP-2	1
Attachment	AM-R40 ig=1:40	1
Flexible shaft	F-18A	2
Stay pipe with adjuster	Stand type including an adjuster	1
Seiwa handler dedicated handle	AM- Ø600	1
Dedicated tools	T-320	1
Spare part (clutch board)	UDPN-20122	2

3. Coagulant Distribution Tank (W32 CT 01)

a. General

Coagulant Distribution Tank shall be installed at the Receiving Well and shall be capable of evenly distributing coagulant to two wells.

b. Specification

Type	: Rectangular Tank
Quantity	: 1 unit
Dimension	: Approx. 1000 mm W x 1200 mm L x 300 mm H
Material	: Stainless steel Type 316

4. Flocculant Distribution Tank (W32 CT 02)

a. General

Flocculant Distribution Tank shall be installed at the Receiving Well and shall be capable of evenly distributing flocculant to two wells.

b. Specification

Type	: Rectangular Tank
Quantity	: 1 unit
Dimension	: Approx. 1000 mm W x 1200 mm L x 300 mm H
Material	: Stainless steel Type 316

5. Piping (Refer to Section 15.2)

The piping work shall include the piping systems as shown in the following table. The sizes and materials shall be based on the value as shown on the contract drawings, and all piping systems shall be comply with the requirements of Section 15.2.

The piping shall include all necessary pipes, support, valves, expansion joints, insulation and necessary appurtenances and shall be designed, furnished, installed, tested and adjusted by the Contractor.

No	Piping Name	Scope of Works	
		From	To
1	Raw water transfer piping	Distribution Chamber	Receiving Well
2	Drain piping	Receiving Well	Drain Pit
3	Coagulant dosing piping	Chemical Room	Receiving Well
4	Pre-chlorination piping	Chemical Room	Receiving Well
5	Flocculant dosing piping	Chemical Room	Receiving Well
6	Other necessary piping	-	-

6. Steel Works (Refer to Division 5)

This steel works shall include all necessary steel works for the maintenance of the plant such as covers, manholes, stages, walkways, handrails, steps, ladders, etc. even if not shown on the drawings and shall be designed, furnished, installed and adjusted by the Contractor.

P15.1.5 Flocculation/Sedimentation Basins (W33)

a. General

The mechanical components of Flocculation and Sedimentation Basins shall consist of the following equipment. Equipment shall be designed using the following conditions and in accordance with the specification set forth hereinafter in this Section.

b. Equipment List of Flocculation and Sedimentation Basins

W33-MM - 01 Inflow Gate	W33 MG 11 to 61	: 6 units
W33-MM - 02 Sludge Collector	W33 SC 11 to 61	: 6 units
W33-MM - 03 De-sludge Valve	W33 MV 11 to 64	: 24 units
W33-MM - 04 Air Compressor	W33 AC 01 to 02	: 2 units
W33-MM - 05 Air Tank	W33 AT 01	: 1 unit
W33-MM - 06 Sump Drainage Pump	W33 DP 01 to 04	: 4 units
W33-MM - 07 Sampling Pump	W33 MP 01	: 1 unit
W33-MM - 08 Piping		: 1 lot
W33-MM - 09 Steel Works		: 1 lot
W33-MM - 10 Other Necessary Works		: 1 lot

c. Design Condition

Flow Rate (raw water and wash drain recovery water)

- Daily maximum (from Receiving Well) : 105,000 m^3/day

1. Inflow Gate (W33 MG 11/21/31/41/51/61)

a. General

Inflow Gate shall be installed at inflow channel of Flocculation Basin and shall be capable of isolating between both sides of the gate.

b. Specification **(Refer to Standard Specification – Section 15.3)**

Type	: Motor Driven Sluice Gate
Quantity	: 6 units
Dimension	: 600 mm W x 600 mm H
Motor output	: 0.4 kW
Installation level : Gate	: Gate Center level +357.600 m amsl
Floorstand	: Floor level + 362.200 m amsl

2. Sludge Collector (W33 SC 11/21/31/41/51/61)

a. General

Sludge Collector shall be installed in the Sedimentation Basin, and shall be capable of removing accumulated sludge, as a result of the pre-treatment of raw river water, from the floor of the sedimentation basins to the sludge hoppers.

b. Specification

Type		: Reciprocating Scraper
Quantity		: 6 units
Tank dimension		: approx. 8.4 m wide, 40 m long, 4.4 to 5.3 m depth.
Speed :	Scraping	: 0.2 m/min
	Return	: 0.6 m/min
Motor output		: 1.5 kW
Materials :	Scraper frame	: Stainless Steel Type 304
	Scraper	: Stainless Steel Type 304
	Lever arm system	: Stainless Steel Type 304
	End wall support frame	: Stainless Steel Type 304
	Low-friction strip	: High Density Polythene

c. Fabrication

i) The sludge collector shall be used to collect and remove the sludge that settles and accumulates at the bottom of the sedimentation basins. The scraper consists of a series of wedge shaped sections fixed together to form a continuous unit so that they function as a moving floor over the bottom of the tank.

ii) The direction of movement of the collector is such that when the scraper sections

move forwards, towards the sludge hopper, they transport the sludge with them. During the return movement the wedge shape of the scraper slides under the blanket of sludge, so that the top layer flows over them.

iii) The scrapers movement is induced by a system of levers attached to the drive mechanism located at one end of the tank above water level.

iv) The scraper blades travel over low-friction strips laid on the tank floor.

v) The scraper sections shall be wedge shaped with a concave face for movement of the sludge to the sludge hopper. The shape of the inclined slope, on the return movement side, shall be such as to cause minimum disturbance to the sludge.

vi) Sufficient lengths of low-friction strips shall be fixed longitudinally to the floor of the tank to provide minimum frictional resistance to the motion of the scraper blades and to reduce the wear on the steel sections. The strips shall be firmly fixed to the floor of the tanks with stainless steel bolts. The strips shall be supplied in the longest lengths possible to minimise the number of joints in the strips perpendicular to the scraper movement.

vii) The reciprocating movement for the scrapers is achieved by a system of levers transferring the motive power from the electric motor located at one end of the tank on the slab of the sedimentation basin above water level, down the end wall and then horizontally to the scrapers.

viii) When the power is turned on, the mechanism starts scraping. As the lever arm from the motor rotates and the scraper reaches the limit of forward travel, the motor control changes the speed of the motor to achieve the faster return motion of the scraper. On return to the start position the speed control again adjusts the speed of the motor to provide the slower forward motion.

ix) The motor shall be directly coupled to the lever arm and with variable speed control. The equipment shall be fixed onto a common floor panel. The drive unit shall perform cyclic operation through the various control selection switches once it is turned on.

x) For safety, the driving gear shall be provided with torque limiter device to protect the machine and motor from overload, etc.

xi) This equipment shall be delivered after completion of manufacturing and after it has passed all the tests and inspections carried out. For the delivery, the equipment shall be packaged carefully so that the equipment is not deformed or damaged during normal transportation. Stainless steel material shall be used for all the bolts and nuts for fixing the equipment and anchors. Painting shall be carried out on all surfaces other than stainless steel.

d. The Contractor shall furnish and install the specified sludge collector (reciprocating scraper type) complete with motors and appurtenances as shown on the drawings and as specified herein.

e. The complete system shall be provided by a single supplier, having unit responsibility for the equipment and shall be the product of an experienced manufacturer and:

i) must demonstrate equal or larger capacity installations using similar equipment and equipment installed and successfully operating for at least 5 years;

ii) provide names and phone numbers of contacts at referenced installations to verify performance;

iii) demonstrate to satisfaction of the Engineer that the equipment to be provided is equal to that specified.

f. All special tools required for normal operation and maintenance shall be furnished with the equipment. In addition, spare parts shall be furnished with the equipment as follows:

scraper blades	:	four for each unit
lever arm system	:	one set
end wall support framework	:	one set
drive unit	:	one set
(motor, reduction gears etc.)		
lubricating oil	:	2 cans

3. De-sludge Valve (W33 PV 11 to 64)

a. General

De-sludge Valve shall be installed near the sludge hoppers of the Sedimentation Tank and shall be capable of removing accumulated sludge from the hoppers.

b. General Specification **(Refer to Particular Specification – Section 15.3)**

Type	: Pneumatic Driven Eccentric Valve
Quantity	: 24 units
Dimension	: 150 mm diameter
Pressure	: 0.98 Mpa

c. Fabrication

i) Pneumatic valve operator shall be single operation (spring return) type with manual handle.

ii) A limit switch for each valve shall be provided to monitor the full-close position of the valve.

iii) Eccentric valves shall be of the non-lubricated type with rubber resilient faced disc.

iv) The valve bodies shall be cast iron or ductile cast iron and shall be fitted with corrosion resistant seat.

d. Accessories

Solenoid valves (for air) : 24 sets

Solenoid valves box (for four solenoid valves) : 6 sets

f. All special tools required for normal operation and maintenance shall be furnished with the equipment. In addition, spare parts shall be furnished with the equipment as follows:

De-sludge valves (for spare) 150 mm dia. : 4 sets

Solenoid valves (for air) : 12 sets

4. Air Compressor (W33 AC 01/02)

a. General

Air compressors shall be installed in the Flocculation Basin and shall be capable of providing the necessary volume and pressure to operate pneumatic valve for accumulated sludge removal from the Sedimentation Tank.

b. Specification **(Refer to Particular Specification – Section 15.7)**

Type	: Air-cooled reciprocating oil-free type
Quantity	: 2 units (1 duty, 1 standby)
Rated Discharge	: 165 N l/min (at 1.0 atm)
Maximum Pressure	: 0.93 MPa
Operation	: Automatic pressure switch system
Motor output	: 1.5 kW

c. Accessories (for each unit)

Air tank (70 l)	: 1 set
Silencer	: 1 set
Pressure gauge	: 1 set
Air transformer	: 1 set
Air filter	: 1 set
Air Dryer	: 1 set

d. Accessory (for each unit)

Air tank (Tag No. W33 AT 01, 150 l)	: 1 set

5. Sump Drain Pump (W33 DP 01/02/03/04)

a. General

Sump Drain Pump shall be installed at the Sedimentation Tank and shall be used to drain water accumulated in the sump.

b. General Specification **(Refer to Particular Specification – Section 15.5)**

Type	: Submersible Drain Pump
Quantity	: 4 units (2 duties, 2 standby)
Discharge flow	: 0.3 m^3/min
Total head	: 15m
Motor output	: 1.5 kW

6. Sampling Pump (W33 MP 01/02)

a. General

Sampling Pump shall be installed at the Rapid Sand Filter and shall be used to pump sample water to Laboratory.

b. General Specification **(Refer to Particular Specification – Section 15.5)**

Type	: Self-priming Volute Pump
Quantity	: 2 units (1 duty, 1 standby)
Discharge flow	: 0.3 m^3/min
Total head	: 15m
Motor output	: 1.5 kW

7. Piping (Refer to Section 15.2)

The piping work shall include the piping systems as shown in the following table. The sizes and materials shall be based on the value as shown on the contract drawings, and all piping systems shall be comply with the requirements of Section 15.2.

The piping shall include all necessary pipes, support, valves, expansion joints, insulation and necessary appurtenances and shall be designed, furnished, installed, tested and adjusted by the Contractor.

No	Piping Name	Scope of Works	
		From	To
1	Sludge piping	Sedimentation Tank	Sludge Thickener/Drain Piping
2	Compressed air piping	Air compressors	De-sludge valves
3	Drain piping	Sump Drain Pit	Drain Piping
4	Other necessary piping	-	-

8. Steel Works (Refer to Division 5)

This steel works shall include all necessary steel works for the maintenance of the plant such as covers, manholes, stages, walkways, handrails, steps, ladders, etc. even if not shown on the drawings and shall be designed, furnished, installed and adjusted by the Contractor.

P15.1.6 Rapid Sand Filter (W34)

a. General

Rapid sand filter shall be gravity type filter consisting of sand, gravel, underdrain system, inlet siphon, wash siphon, surface wash piping and ancillaries . Backwashing shall be done in one filter at a time, and simultaneous washing of two or more filter shall be prevented. Frequency of washing shall be once a day for each filter.

The mechanical components of the Rapid Sand Filter shall consist of the following equipment. Equipment shall be designed using the following conditions and in accordance with the specification set forth hereinafter in this Section.

b. Equipment List of Rapid Sand Filters

W34-MM - 01	Inflow Siphon	W34 SI 011 to 121	: 12 units
W34-MM - 02	Wash Siphon	W34 SI 012 to 122	: 12 units
W34-MM - 03	Surface Wash Valve	W34 MV 011 to 121	: 12 units
W34-MM - 04	Surface Wash Piping	W34 SW 011 to 121	: 12 units
W34-MM - 05	Effluent Isolation Gate	W34 HG 011 to 122	: 24 units
W34-MM - 06	Drain Valve A	W34 HV 011 to 122	: 24 units
W34-MM - 07	Flat Bottom Valve	W34 HV 053 to 123	: 4 units
W34-MM - 08	Flow Control Valve	W34 HV 15 to 16	: 2 units
W34-MM - 09	Drain Valve B	W34 HV 01 to 02	: 2 units
W34-MM - 10	Drain Valve C	W34 HV 03 to 04	: 2 units
W34-MM - 11	Effluent Weir	W34 HG 01 to 10	: 10 units
W34-MM - 12	Overhead Hoist	W34 MH 01 to 02	: 2 units
W34-MM - 13	Vacuum Pump	W34 VP 01 to 04	: 2 units
W34-MM - 14	Vacuum Tank	W34 VT 01	: 1 unit
W34-MM - 15	Air Compressor	W34 AC 01	: 2 units
W34-MM - 16	Air Tank	W34 AT 01	: 1 unit
W34-MM - 17	Sampling Pump	W34 MP 01	: 1 unit
W34-MM - 18	Filter Underdrain System		: 877 m^2
W34-MM - 19	Filter Gravel		: 285 m^3
W34-MM - 20	Filter Sand		: 737 m^3
W34-MM - 21	Piping		: 1 lot

W34-MM - 22 Steel Works : 1 lot

W34-MM - 23 Other Necessary Works : 1 lot

c. Design Condition

Flow Rate (settled water)

- Daily maximum (from Sedimentation Basin) : 105,000 m^3/day

Type : Gravity rapid sand filter with single media

Rising level and self-back washing type

Number : 12 units

Dimension : 12.6 mL x 5.8 mW (Approx. 73 m^2)

Filtration rate : All in filtration 120 m/day

Ten filters in filtration (one in washing and one in maintenance)

144 m/day

Washing rate : Surface washing 0.15 m^3/m^2/min x 5 minutes

Backwashing 0.6 m^3/m^2/min x 7 minutes

1. Inflow Siphon (W34 SI 011/021/031/041/051/061/071/081/091/101/111/121)

a. General

Inflow Siphon shall be installed at the inflow channel of the Rapid Sand Filter and shall be capable of supplying and stopping water to the filter.

b. Specification

Type	: Rectangular shaped
Quantity	: 12 units
Dimension	: 650 mm W x 300 mm H
Material	: Mild steel (JIS G3101 SS400 or equivalent)

c. Fabrication

i) The siphon shall be of proper strength and shall not vibrate with water stream. It shall be provided with mounting ribs to fix the siphon securely. 50 mm flanged piping shall be installed at the top for connecting to vacuum piping.

ii) The outer and interior surfaces of the siphon shall be painted with three coats of epoxy resin painting of total thickness of not less than 250 micron.

d. Accessories

Pneumatic diaphragm valve (for exhausting air) 50 mm dia.	: 12 sets
Pneumatic diaphragm valve (for intaking air) 40 mm dia.	: 12 sets
Anchor bolts (stainless steel type 304)	: 12 sets
Weir plates(stainless steel type 304)	: 12 sets
(1.5 m W x 0.25m H x 9 mm thick)	
Inlet pipe (500 mm dia.)	: 12 sets

e. Spare parts

Pneumatic diaphragm valve (for exhausting air) 50 mm dia.	: 12 sets
Pneumatic diaphragm valve (for intaking air) 40 mm dia.	: 12 sets
O-ring for piston and diaphragm	: 100 percent

2. Wash Siphon (W34 SI 012/022/032/042/052/062/072/082/092/102/112/122)

a. General

Wash Siphon shall be installed at the wash drain channel of the Rapid Sand Filter and shall be capable of discharging and stopping wash water to the wash drain channel.

b. Specification

Type	: Rectangular shaped
Quantity	: 12 units

Dimension : 1000 mm W x 750 mm H

Material : Mild steel (JIS G3101 SS400 or equivalent)

c. Fabrication

i) The siphon shall be of proper strength and shall not vibrate with water stream. It shall be provided with mounting ribs to fix the siphon securely. 80 mm flanged piping shall be installed at the top for connecting to vacuum piping.

ii) The outer and interior surfaces of the siphon shall be painted with three coats of epoxy resin painting of total thickness of not less than 250 micron.

d. Accessories

Pneumatic diaphragm valve (for exhausting air) 80 mm dia. : 12 sets

Pneumatic diaphragm valve (for intaking air) 80 mm dia. : 12 sets

Anchor bolts (stainless steel type 304) : 12 sets

e. Spare parts

Pneumatic diaphragm valve (for exhausting air) 80 mm dia. : 12 sets

Pneumatic diaphragm valve (for intaking air) 80 mm dia. : 12 sets

O-ring for piston and diaphragm : 100 percent

3. Surface Wash Valve (W34 PV 011/021/031/041/051/061/071/081/091/101/111/121)

a. General

Surface Wash Valve shall be installed at the pipegallery of the Rapid Sand Filter, and shall be capable of supplying surface wash water for the filter washing.

b. General Specification **(Refer to Particular Specification – Section 15.3)**

Type : Pneumatic Driven Butterfly Valve

Quantity : 12 units

Dimension : 300 mm diameter

Pressure : 0.98 Mpa

c. Fabrication

i) Pneumatic valve operator shall be double action type with manual handle.

ii) Two limit switches for each valve shall be provided to monitor the full-close and the full-open position of the valve.

d. Accessories

Solenoid valve (for air) : 12 sets

e. Spare parts

Surface wash valve (for spare) 300 mm dia. : 2 sets

Solenoid valve (for air) : 12 sets

4. Surface Wash Piping (W34 SW 011/021/031/041/051/061/071/081/091/101/111/121)

a. General

Surface Wash Piping shall be installed above the filter sand of the Rapid Sand Filter and shall be capable of washing accumulated sludge from the filter sand.

b. General Specification

Type	: Fixed Grit Piping with Nozzles
Quantity	: 12 units
Surface wash flow	: Approx. 11 m^3/min/unit
Number of nozzle	: Approx. 200 pieces/unit
Materials :Piping	: Steel piping with epoxy coating
Nozzle	: Bronze Casting

c. Accessories

Pipe Support (mild steel with epoxy coating)	: 12 sets
Sleeve Joint	: 12 sets
Anchor bolts (stainless steel type 304)	: 12 sets

5. Effluent Isolation Gate (W34 HG 011/012/021/022/031/032/041/042/051/052/061/062/071/072/ 081/082/091/092/101/102/111/112/121/122)

a. General

Effluent Isolation Gate shall be installed at the effluent channel of the Rapid Sand Filter and shall be capable of isolating between both sides of the gate.

b. Specification **(Refer to Standard Specification – Section 15.3)**

Type	: Manual Sluice Gate
Quantity	: 24 units
Dimension	: 600 mm W x 600 mm H
Installation level : Gate	: Gate Center level +355.100 m amsl
Floorstand	: Floor level + 358.500 m amsl

6. Drain Valve A (W34 HV 011/012/021/022/031/032/041/042/051/052/061/062/071/072/081/082/ 091/092/101/102/111/112/121/122)

a. General

Drain Valve shall be installed at the effluent channel of the Rapid Sand Filter and shall be capable of isolating between both sides of the valve.

b. Specification **(Refer to Standard Specification – Section 15.3)**

Type		: Manual Sluice Valve with Floorstand
Quantity		: 24 units
Dimension		: 100 mm dia.
Pressure		: 0.49 Mpa
Installation level :	Valve	: Valve Center level +354.660 m amsl
	Floorstand	: Floor level + 358.500 m amsl

7. Flat Bottom Valve (W34 HV 053/063/113/123)

a. General

Drain Valve shall be installed at the influent channel of the Rapid Sand Filter and shall be capable of isolating between both sides of the valve.

b. Specification **(Refer to Standard Specification – Section 15.3)**

Type		: Manual Flat Bottom Valve
Quantity		: 4 units
Dimension		: 200 mm dia.
Pressure		: 0.98 Mpa
Installation level :	Valve	: Valve Center level +358.500 m amsl
	Opetation	: Floor level + 361.400 m amsl

8. Flow Control Valve (W34 HV 15/16)

a. General

Flow Control Valve shall be installed on the surface washing pipelines of the Rapid Sand Filter and shall be capable of regulating surface wash flow and pressure for adequate surface washing of filters.

b. Specification **(Refer to Standard Specification – Section 15.3)**

Type		: Manual Variable Orifice Valve
Quantity		: 2 units
Dimension		: 350 mm dia.
Pressure		: 0.98 Mpa
Installation level :	Valve	: Valve Center level +357.200 m amsl
	Operation	: Floor level + 358.500 m amsl

c. Fabrication

i) Variable orifice valve shall be designed and fabricated to minimize cavitations for controlling flow and pressure.

ii) The valve shall consist of two discs with many holes and flow shall be controlled by sliding one of the disc and varying openings of valve. The valve shall be operated by manually by handle.

iii) The body of the valve shall be made of ductile cast iron, and disc and stem shall be made of stainless steel type 304.

9. Drain Valve B (W34 HV 01/02)

a. General

Drain Valve shall be installed at the effluent channel of the Rapid Sand Filter and shall be capable of isolating between both sides of the valve.

b. Specification **(Refer to Standard Specification – Section 15.3)**

Type	: Manual Sluice Valve with Floorstand
Quantity	: 2 units
Dimension	: 100 mm dia.
Pressure	: 0.98 Mpa
Installation level : Valve	: Gate Center level +354.660 m amsl
Floorstand	: Floor level + 358.500 m amsl

10. Drain Valve C (W34 HV 03/04)

a. General

Drain Valve shall be installed at the effluent channel of the Rapid Sand Filter and shall be capable of isolating between both sides of the valve.

b. Specification **(Refer to Standard Specification – Section 15.3)**

Type	: Manual Sluice Valve with Floorstand
Quantity	: 2 units
Dimension	: 150 mm dia.
Pressure	: 0.49 Mpa
Installation level : Valve	: Gate Center level +354.460 m amsl
Floorstand	: Floor level + 358.500 m amsl

11. Effluent Weir (W34 HG 01/02/03/04/05/06/07/08/09/10)

a. General

Effluent Weir shall be installed at the overflow weir in the Rapid Sand Filter and shall be capable of controlling flow from the filtered water effluent channel to the Clorination Mixing Basin.

b. Specification **(Refer to Standard Specification – Section 15.3)**

Type	: Manual Overflow Weir

Quantity		: 10 units
Dimension		: 1500 mm W x 600 mm Stroke
Floorstand		: Two floorstands with single drive unit
Installation level :	Weir	:.Lowest overflow level +357.700 m amsl
	Floorstand	: Floor level + 358.600 m amsl
Materials :	Frame	: Stainless Steel Type 304
	Slide	: Stainless Steel Type 304
	Seating Surface	: Phosphor Bronze Plate

12. Overhead Hoist (W34 MH 01/02)

a. General

Overhead Hoists shall be installed at the top of the Rapid Sand Filter, and shall be used for the installation, assembly, maintenance and checking of the Rapid Sand Filter.

b. Specification **(Refer to Standard Specification – Section 15.6)**

Type	: Motorized Overhead Wire Hoist with Trolley
Quantity	: 2 units
Rated load	: 3 Ton
Main Hoist speed	: 2m/min
Traveling speed	: 10m/min
Lifting height:	: Approx. 5m
Hoist motor output	: 9 kW
Traveling motor output	: 0.75 kW

13. Vacuum Pump (W34 VP 01/02)

a. General

Vacuum Pumps shall be installed in the Rapid Sand Filter building and shall be capable of providing vacuum for operation of Inflow/Wash Siphons of filters.

b. Specification **(Refer to Standard Specification – Section 15.7)**

Type	: Liquid sealed rotary vacuum pump
Quantity	: 2 units (1 duty, 1 standby)
Displacement capacity	: 4.5 m^3/min
Maximum vacuum	: - 93 kPa
Motor output	: 7.5 kW

c. Accessories

Seal water tank with necessary apparatuses : 2 sets

Separator tank (capacity of approx. 130 L) : 2 sets

Special tools : 1 set

d. Spare parts

Rotor and shaft : 2 sets

Port cylinder : 2 sets

Complete set of bearings for pump and motor : 2 sets

14. Vacuum Tank (W34 VT 01)

a. General

Vacuum Tank shall be installed in the Rapid Sand Filter building and shall be capable of providing vacuum condition for operation of Inflow/Wash Siphons of filters.

b. Specification **(Refer to Standard Specification – Section 15.7)**

Type : Vertical cylindrical type

Quantity : 1 unit

Dimension : Approx. 1,600 mm dia. x 2,700 mm H

Maximum vacuum : -93 kPa

Materials : Mild Steel SS400, JIS G 3101

c. Fabrication

i) The inside of the tank shall be divided into two chambers, upper and lower chambers.

ii) The upper chamber shall be low vacuum for Inflow Siphon, while the lower one shall be high vacuum for Wash Siphon.

d. Accessories

Water level electrode (5 poles, stainless steel electrodes) : 1 set

Vacuum gauge with alarm contact for high vacuum chamber : 1 set

Direct reading water level gauge (acrylic resin, 40 mm dia.) : 1 set

Pneumatic operated valve (normally closed, 80 mm dia.) : 1 set

15. Air Compressor (W34 AC 01/02)

a. General

Air compressors shall be installed in the Rapid Sand Filter and shall be capable of providing the necessary volume and pressure to operate pneumatic valve for the operation of the filter.

b. Specification **(Refer to Particular Specification – Section 15.7)**

Type : Air-cooled reciprocating oil-free type

Quantity : 2 units (1 duty, 1 standby)

Rated Discharge : 240 N l/min (at 1.0 atm)

Maximum Pressure : 0.93 MPa

Operation : Pressure-control system

Motor output : 2.2 kW

c. Accessory (for each unit)

Air tank (80 l) : 1 set

Silencer : 1 set

Pressure gauge : 1 set

Air transformer : 1 set

Air filter : 1 set

Air dryer : 1 set

d. Accessory (for each unit)

Air tank (Tag No. W34 AT 01, 500 l) : 1 set

16. Sampling Pump (W34 MP 01/02)

a. General

Sampling Pump shall be installed at the Rapid Sand Filter and shall be used to pump sample water to the Laboratory.

b. General Specification **(Refer to Particular Specification – Section 15.5)**

Type : Self-priming Volute Pump

Quantity : 2 units (1 duty, 1 standby)

Discharge flow : 0.3 m^3/min

Total head : 15m

Motor output : 1.5 kW

17. Filter Underdrain System

a. General

Filter Underdrain System shall be installed at the bottom of the Rapid Sand Filter and shall be capable of supporting filter gravel and filter sand, as well as flowing filtered water and backwash water.

b. General Specification **(Refer to Drawing W34-M-06 showing typical installation)**

Type : Pre-cast concrete blocks

Quantity : 877 m^2

c. Fabrication

i) The Contractor shall submit to the Engineer the detailed description of the fabrication including the fabrication sequence, forms, aggregate, concrete mix, concrete depositing, curing and stockpiling for approval of the Engineer prior to the work.

ii) The nozzles of PVC pipe shall be embedded with adequate anchoring as required at the time of concrete casting. The nozzles shall be accurately located and fixed as indicated on the Drawings and shall not be moved during concrete placing.

iii) The formed plate shall be of stainless steel (SS 304) and fabricated accurately as shown on the Drawings.

d. Installation

i) Installation of the underdrain system shall commence after all concrete works, including waterproofing, have been completed and upon approval of the Engineer.

ii) Pre-cast sections of the underdrain blocks damaged during transportation and handling shall be replaced by the Contractor at his expense. All blocks shall be subject to inspection by the Engineer before installation. Only lifting eyes shall be used for transporting, handling and installing.

iii) Due care shall be taken during installation to prevent damage to the waterproofing of the filter.

iv) Protection of the waterproofing for the filter shall be taken in a manner approved by the Engineer. The Contractor shall submit the detailed schedule and sequence of the installation work, including the methods of waterproofing protection for approval of the Engineer prior to the work.

v) The underdrain blocks shall be installed true to the line and level as shown on the Drawings and there shall be continuously smooth surfaces between the blocks.

vi) After the blocks are installed on the filter concrete base, the voids shall be filled with mortar, and all joints between the blocks shall be caulked with epoxy mortar as shown on the Drawings. The surplus mortar shall be struck off level and in a neat line with the blocks. The mortar shall be 1 part cement and 1.5 parts sand, mixed with water to the consistency of thick cream. The epoxy mortar shall be the same material as applied for waterproofing of the filter and the blocks.

vii) After all underdrain blocks are installed, every void between the walls of the filter and the blocks or plates shall be grouted or caulked.

viii) All installations shall be thoroughly cleaned during and after installation work, and damage to the waterproofing of the filter and blocks shall be avoided. Under no circumstances shall any materials for the works be removed from the work area and any spots and stains of mortar and other damage shall be cleaned during the progress and after the work without damaging waterproofing.

ix) After all underdrain system installation works are completed, all surface areas shall be covered to protect from the loads, shocks, dirt and any other harmful effects which may affect the system. The protection works shall be undertaken in a manner satisfactory to the Engineer. The protection shall be removed right before the installation work of the filter media and after approval of the Engineer.

18. Filter Gravel

a. General

Filter Gravel shall be installed at the bottom of the Rapid Sand Filter, and shall be capable of supporting filter sand and flowing filtered water and backwash water.

b. General Specification **(Refer to Drawing W34-M-06 showing typical installation)**

Type	: Natural gravel	
Quantity	: Total 285 m^3 (duty 263 m^3 and spare 22 m^3)	
Diameter/installation thickness	: Diameter (mm)	Thickness (mm)
	2.0 – 5.0	100
	5.0 – 9.0	50
	9.0 – 16.0	50
	16.0 – 25.0	100

c. Installation

i) Filter gravel shall be natural gravel as approved by the Engineer, and shall consist of coarse aggregate in which a high proportion of the particles are rounded and tend toward a generally spherical and equidimensional shape. It shall possess sufficient strength and hardness to resist degradation during handling and use, and shall be clean and substantially free from deleterious materials, clayey, organic and other impurities.

ii) The gravel shall have a saturated-surface-dry specific gravity of not less than 2.5.

iii) No gravel produced by crushing shall be used, and flat or elongated gravel shall be avoided.

iv) Acid solubility shall not exceed 5 percent for sizes smaller than 3.0 mm and 15 percent for sizes larger than 3.0 mm.

d. Sampling

i) A representative sample of each size and type of filter media shall be submitted to the Engineer for his approval together with attached test results before shipment. The testing of filter media shall be done at an independent laboratory approved by the Engineer in accordance with the requirements described herein. The samples shall be submitted in clean and dust-proof containers or bags, plainly marked with the identity and address of the supplier, and identity of the contents as to size or grade. After approval, shipment shall be of a quality equal to the sample. Shipment to the job site shall be in bags unless approved otherwise.

ii) Upon arrival of the shipment to the site, representative samples shall be collected using a core sampler. The representative samples from each bag shall be combined to produce the field sample. The samples for each size of gravel and sand shall be provided from those to be installed in each filter unit unless approved otherwise. The sample shall be marked with date and receiving point, and provided for testing in the presence of the Engineer or his representative. The extraction rate of sampling shall be 5 percent.

iii) The minimum size of field samples for each filter unit by types and sizes of filter media shall be as requirement of the Engineer.

e. Testing

i) The Contractor shall test the field samples for each filter unit at an independent laboratory acceptable to the Engineer in accordance with the provisions in JWWA A 103 as modified and supplemented herein.

ii) The specific gravity of the filter sand and gravel shall be determined in accordance

with JIS A 1109 and JIS A 1110 respectively or other internationally accepted methods approved by the Engineer. The test result shall be reported as saturated - surface - dry specific gravity.

iii) Particle sizes shall be determined by screening through standard sieves calibrated in accordance with JIS Z 8801, and they shall be defined in terms of the smallest sieve opening through which it passes. Duration of shaking by machine sieving shall be not less than five minutes followed by manual sieving for 1 minute, and when sieving is carried out by manpower only, it shall be for a minimum of 10 minutes. The minimum number of sieve analyses for each sample shall be two for filter gravel and three for filter sand. The cumulative percentage in weight passing each sieve shall be calculated and plotted on log-probability paper. A smooth curve shall be drawn through the points plotted. Effective size of sand is defined as the 10 percent size in weight, and uniformity coefficient is defined as the 60 percent size divided by the 10 percent size. The maximum and minimum sizes of particles shall be defined in terms of the sieve size in which they are retained.

iv) The acid solubility test shall be performed by immersing a known weight of material in hydrochloric acid until the acid soluble materials are dissolved and then the weight loss of the material will be determined. The details of testing shall be in accordance with JWWA A 103 and under the direction of the Engineer. Duplicate tests shall be made on each size of material and the average percentage shall be reported.

v) Other tests such as thermal decrement of sand, and wearing rate of sand shall be done in accordance with JWWA A 103 as required by the Engineer.

f. Rejection

i) If the filter media does not meet the applicable requirements specified in this specification, they shall be removed from the site at the Contractor's expense. As an alternative to removing the rejected materials, the Contractor may process the materials at the site when approved and under the direction of the Engineer. The materials after re-processing shall be tested at the same laboratory as previously approved. All expenses for processing and testing shall be borne by the Contractor.

19. Filter sand

a. General

Filter Sand shall be installed at the bottom of Rapid Sand Filter, and shall be capable of catching particulate matter in settled water.

b. General Specification **(Refer to Drawing W34-M-06 showing typical installation)**

Type	: Natural sand
Quantity	: Total 737 m^3 (duty 614 m^3 and spare 123 m^3)
Diameter (mm)	: 0.6 mm
Installation thickness	: 700 mm

c. Material

i) Filter sand shall be natural and consist of hard, durable and dense grains of predominantly siliceous materials. The sand shall be free from clayey, organic and other impurities. Acid solubility of sand shall not exceed 3.5 percent, the thermal decrement shall be less than 0.75 percent and the wearing rate shall be within 3 percent.

ii) The saturated-surface-dry specific gravity of sand shall be in the range of 2.55-2.65.

iii) The effective size shall be 0.6 mm and the uniformity coefficient shall be 1.4.

iv) The range of size of sand particles shall be within 0.3-2.0 mm, and the allowable percentage of undersize and oversize particles shall be less than 1 percent by weight.

d. Installation

i) Each filter shall be cleaned thoroughly throughout all the installation work before any filter media is placed. Each size and type of filter media shall be stored separately and shall be kept separated throughout the work. Special care shall be taken to avoid damage to the filter underdrain system as well as the water proofing of the filter. Before any filter media is placed, the top elevation of each layer shall be marked by a continuous level line on the inside of the filter.

ii) Filter sand shall be placed to the elevation shown on the Drawings, and the finished elevation shall be measured after all necessary backwashing and surface scraping have been performed.

iii) Special care shall be taken in transporting and placing the sand to avoid the possibility of contamination and to prevent the sand from becoming dirty. Any filter sand that becomes dirty and contaminated shall be removed and be replaced with clean and proper sand as specified above and approved by the Engineer.

iv) To provide for initial expansion of the sand bed due to segregation of the particle sizes, the top surface before washing shall be approximately 10 percent of the bed thickness below the finished elevation.

v) After all filter media has been placed, wash water shall be slowly admitted through the underdrain system until the entire bed is flooded, and then the wash rate shall be increased gradually during the initial wash to remove air from the bed. To obtain and control the proper initial backwash, the backwash at the initial stage shall be witnessed by the Engineer.

vi) After initial washing, the top surface of the filter sand shall have an elevation equal to the finished elevation plus the thickness of sand to be removed by scraping.

vii) The filter shall be washed until obtaining the Engineer's approval. During each interval of backwashing, a layer of fine sand shall be removed from the filter surface by scraping. The depth of scraping shall be based on sampling under the direction of the Engineer.

viii) The washing shall be coordinated with other plant operation to ensure a continuous washing operation is available without any interference.

ix) Finally, the sand bed shall have the finished surface elevation as indicated on the Drawings.

e. Sampling/Testing/Rejection

i) The above Item d, e and f of Filter Gravel shall be referred to.

20. Piping (Refer to Section 15.2)

The piping work shall include the piping systems as shown in the following table. The sizes and materials shall be based on the value as shown on the contract drawings, and all piping systems shall be comply with the requirements of Section 15.2.

The piping shall include all necessary pipes, support, valves, expansion joints, insulation and necessary appurtenances and shall be designed, furnished, installed, tested and adjusted by the Contractor.

No	Piping Name	Scope of Works	
		From	To
1	Filtered water piping	Rapid sand filter	Clear water reservoir
2	Surface wash water piping	Distribution pump station	Surface wash piping
3	Vacuum piping	Vacuum pumps	Siphons
4	Compressed air piping	Air compressors	Pneumatic valves
5	Drain piping	Underdrain system	Drain channel
6	Post-chlorine piping	Chemical room	Chlorination channel
7	Sampling	Rapid sand filter	Laboratory
8	Other necessary piping	-	-

21. Steel Works (Refer to Division 5)

This steel works shall include all necessary steel works for the maintenance of the plant such as covers, manholes, stages, walkways, handrails, steps, ladders, etc. even if not shown on the drawings and shall be designed, furnished, installed and adjusted by the Contractor.

P15.1.7 Distribution Pump Station (W35)

a. General

The mechanical components of the Distribution Pump Station shall consist of the following equipment. Equipment shall be designed using the following conditions and in accordance with the specification set forth hereinafter in this Section.

b. Equipment List of Distribution Pump Station

W35-MM - 01	Distribution Pump Nos. 4	W35 WP 11 to 21	: 2 units
W35-MM - 02	Suction Valve Nos. 4	W35 MV 11 to 21	: 2 units
W35-MM - 03	Delivery Valve Nos. 4	W35 MV 12 to 22	: 2 units
W35-MM - 04	Distribution Pump Nos. 7	W35 WP 11 to 21	: 2 units
W35-MM - 05	Suction Valve Nos. 7	W35 MV 11 to 21	: 2 units
W35-MM - 06	Delivery Valve Nos. 7	W35 MV 12 to 22	: 2 units
W35-MM - 07	Distribution Pump No. 8	W35 WP 31	: 1 unit
W35-MM - 08	Suction Valve No. 8	W35 MV 31	: 1 unit
W35-MM - 09	Delivery Valve No. 8	W35 MV 32	: 1 unit
W35-MM - 10	Motorized Bridge Crane	W35 MC 01	: 1 unit
W35-MM - 11	Pressure Reduce Valve	W35 HV 01	: 2 units
W35-MM - 12	Sump Drain Pump	W35 DP 01 to 02	: 2 units
W35-MM - 13	Piping		: 1 lot
W35-MM - 14	Steel Works		: 1 lot
W35-MM - 15	Removal Works		: 1 lot
W35-MM - 16	Other Necessary Works		: 1 lot

c. Design Condition

Flow Rate (clear water from Clear Water Reservoir)

- Daily maximum (from Clear Water Reservoir) : 200,000 m^3/day
- Hourly maximum (from Clear Water Reservoir) : Approx. 280,000 m^3/day

(including the existing pumps)

1. Distribution Pump Nos. 4 and 7 (W35 WP 11/21)

a. General

Distribution Pump shall be installed in the Distribution Pump Station and shall be capable of supplying clear water to the drinking water distribution network of the City of Astana.

b. Specification **(Refer to Standard Specification – Section 15.4)**

Type	: Split casing, horizontal centrifugal pumps
Quantity	: 2 units
Rated capacity	: 66.67 m^3/min
Rated head	: 55.0 m TDH
Speed	: Approx. 1000 rpm
Efficiency	: not less than 86 percent at duty point
NPSHA (minimum)	: approx. +2 m
Max. noise level for pump	: 85 dB(A) at 1.0 m
Driving method	: direct coupling from motor
Motor output	: 800 kW
Installation	: indoor
Motor encl. protection	: IP 44
Wet well water levels	: HWL +357.000 m amsl
	: LWL +352.000 m amsl
Pump room floor level	: +349.000 m amsl

c. Pumps shall be connected to the existing suction and delivery pipes as per drawings. The Contractor shall carefully survey the existing pipes and plan pump installation and piping accordingly.

d. A variable speed motor for No. 4 Distribution Pump shall be provided for a stable pressure to the distribution network.

e. The pump manufacturer shall substantiate quoted efficiency with at least one owner's certificate and corresponding test record of specific speed similar to the specified pump with suction diameter of not less than 500 mm.

f. The pump manufacturer shall substantiate manufacturing and supplying of pumps and motors with the following conditions satisfactorily completed outside of home country during last 5 years.

i) Horizontal centrifugal pumps of similar capacity and head with quoted pump efficiency at same or lower speed and capacity than specified.

ii) Horizontal centrifugal pump with invert type variable speed motor of similar motor output with quoted pump.

g. Spare Parts

Complete set of pump rotor assembly	: 1 set
Complete set of bearings for pump	: 2 sets
Complete set of bearings for motor	: 2 sets
Complete set of wear rings	: 2sets
Complete set of all packing/gaskets	: 2 sets
Shaft Sleeves	: 2 sets

2. Distribution Pump No. 8 (W35 WP 31)

a. General

Distribution Pump shall be installed in the Distribution Pump Station and shall be capable of supplying clear water to the drinking water distribution network of the City of Astana.

b. Specification **(Refer to Standard Specification – Section 15.4)**

Type	: Split casing, horizontal centrifugal pumps
Quantity	: 2 units
Rated capacity	: 41.67 m^3/min
Rated head	: 55.0 m TDH
Speed	: Approx. 1000 rpm
Efficiency	: not less than 84 percent at duty point
NPSHA (minimum)	: approx. +1 m
Max. noise level for pump	: 85 dB(A) at 1.0 m
Driving method	: direct coupling from motor
Motor output	: 520 kW
Installation	: indoor
Motor encl. protection	: IP 44
Wet well water levels	: HWL +357.000 m amsl
	: LWL +352.000 m amsl
Pump room floor level	: +349.000 m amsl

c. Pumps shall be connected to the existing suction and delivery pipes as per drawings. The Contractor shall be carefully survey the existing pipes and plan pump installation and piping accordingly.

d. Spare Parts

Complete set of pump rotor assembly	: 1 set
Complete set of bearings for pump	: 1 set
Complete set of bearings for motor	: 1set

Complete set of weir rings : 1 set

Complete set of all packing/gaskets : 1 set

Shaft Sleeves : 1 set

3. Suction Valve Nos. 4, 7 and 8 (W35 MV 11/21/31)

a. General

Suction Valve shall be installed on the suction pipe of the Distribution Pump in the Pump Station and shall be capable of separating the incoming clear water.

b. Specification **(Refer to Standard Specification – Section 15.3)**

Type : Motor Driven Butterfly Valve

Quantity : 2 units

Dimension : 800 mm dia.

Pressure : 0.98 MPa

Motor output : 0.4 kW

4. Delivery Valve Nos. 4, 7 and 8 (W35 MV 12/22/32)

a. General

Delivery Valve shall be installed on the delivery pipe of the Distribution Pump in the Pump Station and shall be capable of stopping the clear water.

b. Specification **(Refer to Standard Specification – Section 15.3)**

Type : Motor Driven Butterfly Valve

Quantity 700 mm dia. : 2 units (W35 MV 12/22)

600 mm dia. : 1 unit (W35 MV -32)

Pressure : 0.98 MPa

Motor output : 0.4 kW

5. Double Beam Motorized Bridge Crane (W11 MH 01)

a. General

Double beam motorized bridge crane shall be installed at the top of the Distribution Pump Station and shall be used for the installation, assembly and maintenance of the Pump system.

b. Specification **(Refer to Standard Specification – Section 15.6)**

Type : Double beam motorized bridge crane

Quantity : 1 unit

Rated load : 5 tonne

Hoist speed : 2 m/min

Traveling speed	: 10 m/min
Traversing speed	: 10 m/min
Lifting height	: Approx. 8 m
Hoist motor output	: 13kW
Traveling motor output	: 1.5kW
Traveling motor output	: 1.5kW
Span	: Approx. 12 m

c. Cranes shall be installed on the existing crane rails in the Distribution Pump Station. The Contractor shall carefully survey the existing station and crane rails, and shall plan the crane installation and cabling accordingly. The Contractor shall repair or replace the rails, if necessary.

6. Sump Drain Pump (W35 DP 01/02)

a. General

Sump Drain Pump shall be installed at the Bottom of the Distribution Pump Station and shall be used to drain water accumulated in the sump.

b. Specification **(Refer to Standard Specification – Section 15.5)**

Type	: Submersible Drain Pump
Quantity	: 2 units (1 duty, 1 standby)
Discharge flow	: 0.5 m^3/min
Total head	: 12 m
Motor output	: 2.2 kW

7. Pressure Reducing Valve (W35 HV 08)

a. General

Pressure Reducing Valve shall be installed on the plant water supply pipelines blanching from the Distribution Main near the Rapid Sand Filter and shall be capable of regulating pressure for adequate for the usage.

b. Specification **(Refer to Standard Specification – Section 15.3)**

Type	: Hydraulically Operated Automatic Pressure Control Valve	
Quantity	: 1 unit	
Dimension	: 450 mm dia.	
Pressure	Primary	: Approx. 0.54 MPa
	Secondary	: Approx. 0.4 MPa

c. Fabrication

i) Pressure reducing valve shall be piston type. It consists of body, Cover, piston,

cylinder, indicator, pilot valve etc.

ii) The body and cover shall be made of ductile cast iron, piston and cylinder shall be stainless steel type 304 or bronze.

d. Spare Parts

Pilot valve assembly	: 3 sets
Strainer	: 3 sets
Other consumables	: 300 percent

8. Piping (Refer to Section 15.2)

The piping work shall include the piping systems as shown in the following table. The sizes and materials shall be based on the value as shown on the contract drawings, and all piping systems shall be comply with the requirements of Section 15.2.

The piping shall include all necessary pipes, support, valves, expansion joints, insulation and necessary appurtenances and shall be designed, furnished, installed, tested and adjusted by the Contractor.

No	Piping Name	Scope of Works	
		From	To
1	Clear water piping	Clear water reservoir	Distribution pump station
2	Surface wash water piping	Distribution pump station	Surface wash piping
3	Drain piping	Sump pit	Drainage piping
4	Sampling	Distribution pump station	Laboratory
5	Other necessary piping	-	-

9. Steel Works (Refer to Division 5)

This steel works shall include all necessary steel works for the maintenance of the plant suchas covers, manholes, stages, walkways, handrails, steps, ladders, etc. even if not shown on the drawings and shall be designed, furnished, installed and adjusted by the Contractor.

10. Removal Works (Refer to Section 15)

This removal works shall include all necessary removal works for the following equipment, piping materials, steel works and accessories, etc. All removed equipment, materials etc. shall be transported to the area within the water treatment plant designated by the Engineer.

No.	Equipment
1	Distribution Pump No. 4
2	Distribution Pump No. 7
4	Distribution Pump No. 8
4	Sump Drainage Pumps
5	Other related piping materials/steel works

P15.1.8 Washing Drain Basin (W36)

a. General

The mechanical components of the Wash Drain Basin shall consist of the following equipment. Equipment shall be designed using the following conditions and in accordance with the specification set forth hereinafter in this Section.

b. Equipment List of Washing Drain Basins

W36-MM - 01 Inlet Valve	W36 HV 11 to 21	: 2 units
W36-MM - 02 Float Suction Unit	W36 FS 11 to 21	: 2 units
W36-MM - 03 Backwash Recovery Pump	W36 BP 11 to 31	: 3 units
W36-MM - 04 Sludge Pump	W35 SP 11 to 21	: 2 units
W36-MM - 05 Sump Drain Pump	W35 DP 01 to 02	: 2 units
W36-MM - 06 Piping		: 1 lot
W36-MM - 07 Steel Works		: 1 lot
W36-MM - 08 Other Necessary Works		: 1 lot

c. Design Condition

Flow Rate (backwash water from Rapid Sand Filter)

- During filter washing (for 10 minutes) : Approx. 800 m^3

1. Inlet Valve (W36 HV 11/21)

a. General

Inlet Valve shall be installed on the inlet pipe to the Wash Drain Basin and shall be capable of stopping the incoming wash drain water.

b. Specification **(Refer to Standard Specification – Section 15.3)**

Type	: Manual Butterfly Valve
Quantity	: 2 units
Dimension	: 1000 mm dia.
Pressure	: 0.98 MPa

2. Float Suction Unit (W36 FS 11/21)

a. General

Float Suction Unit shall be installed on the inlet pipe to the Backwash Recovery Pump in the Wash Drain Basin and shall be capable of intaking from the surface of stored wash drain water in the basin.

b. Specification

Type	: Float Type
Quantity	: 2 units
Dimension	: 500 mm dia.
Water levels	: HWL +352.500 m amsl
	: LWL +349.500 m amsl
Pipe center level	: +348.800 m amsl

c. Fabrication

i) A float type surface water collection device shall be provided at each Wash Drain Basin.

ii) The device consists of a float, a collection pipe, flexible joints, a discharge valve, etc.

iii) The device shall be able to collect surface water by opening of a delivery valve.

iv) The device shall collect the surface water of the Wash Drain Basin with water level ranges indicated in the above Specification.

v) The device shall be made of stainless steel 304 type.

vi) The float shall be supported by stainless steel rope to prevent damage when the water level of the tank will be below LWL.

3. Backwash Recovery Pump (W36 BP 11/21)

a. General

Backwash Recovery Pump shall be installed in the Wash Drain Basin and shall be capable of returning wash drain water to the Distribution Chamber.

b. Specification **(Refer to Standard Specification – Section 15.5)**

Type	: End-suction, horizontal slurry pump
Quantity	: 3 units (2 duty, 1 standby)
Rated capacity	: 11.0 m^3/min
Rated head	: 17.0 m TDH
Speed	: Approx. 1500 rpm
Efficiency	: not less than 65 percent at duty point
NPSHA (minimum)	: approx. +0.5 m
Max. noise level for pump	: 85 dB(A) at 1.0 m
Driving method	: direct coupling from motor
Motor output	: 55 kW
Installation	: indoor
Motor encl. protection	: IP 44
Wet well water levels	: HWL +352.500 m amsl
	: LWL +349.500 m amsl
Pump room floor level	: +347.500 m amsl
TWL at discharge	: +363.400 m amsl
Transmission main	: 600 mm diameter, approx. 500 m to Distribution Chamber

c. Fabrication

i) Impeller shall be non-clog, screw type and sufficient for slurry, and shall be made of stainless steel casting type 304.

d. The pump manufacturer shall substantiate quoted efficiency with at least one owner's certificate and corresponding test record of specific speed similar to the specified pump with suction diameter of not less than 250 mm.

e. The pump manufacturer shall substantiate manufacturing and supplying of pumps and motors with the following conditions satisfactorily completed outside of home country during last 5 years.

i) Horizontal centrifugal slurry pumps of similar capacity and head with quoted pump efficiency at same or lower speed and capacity than specified.

4. Sludge Pump (W36 SP 11/21)

a. General

Sludge Pump shall be installed in the Wash Drain Basin and shall be capable of removing accumulated sludge in Wash Drain Basin.

b. Specification **(Refer to Standard Specification – Section 15.5)**

Type : End-suction, horizontal sludge pump

Quantity	: 2 units (1 duty, 1 standby)
Rated capacity	: 2.2 m^3/min
Rated head	: 7.0 m TDH
Speed	: Approx. 1500 rpm
Efficiency	: not less than 60 percent at duty point
NPSHA (minimum)	: approx. +0.5 m
Max. noise level for pump	: 85 dB(A) at 1.0 m
Driving method	: direct coupling from motor
Motor output	: 5.5kW
Installation	: indoor
Motor encl. protection	: IP 44
Wet well water levels	: HWL +352.500 m amsl
	: LWL +349.500 m amsl
Pump room floor level	: +347.500 m amsl
TWL at discharge	: +353.000 m amsl
Transmission main	: 200 mm diameter, approx. 50 m to Sludge Thickener

c. Fabrication

i) Impeller shall be non-clog, screw type and sufficient for slurry, and shall be made of stainless steel casting.

5. Sump Drain Pump (W36 DP 01/02)

a. General

Sump Drain Pump shall be installed at the Bottom of the Distribution Pump Station and shall be used to drain water accumulated in the sump.

b. Specification **(Refer to Standard Specification – Section 15.5)**

Type	: Submersible Drain Pump
Quantity	: 2 units (1 duty, 1 standby)
Discharge flow	: 0.5 m^3/min
Total head	: 12 m
Motor output	: 2.2 kW

6. Piping (Refer to Section 15.2)

The piping work shall include the piping systems as shown in the following table. The sizes and materials shall be based on the value as shown on the contract drawings, and all piping

systems shall be comply with the requirements of Section 15.2.

The piping shall include all necessary pipes, support, valves, expansion joints, insulation and necessary appurtenances and shall be designed, furnished, installed, tested and adjusted by the Contractor.

No	Piping Name	Scope of Works	
		From	To
1	Wash drain water piping	Rapid sand filter	Wash drain basin
2	Recovery water piping	Wash drain basin	Distribution chamber
3	Sludge piping	Wash drain basin	Sludge thickener
4	Seal water piping	Plant water piping	Sludge pumps
5	Drain piping	Sump pit	Drainage piping
6	Other necessary piping	-	-

7. Steel Works (Refer to Division 5)

This steel works shall include all necessary steel works for the maintenance of the plant suchas covers, manholes, stages, walkways, handrails, steps, ladders, etc. even if not shown on the drawings and shall be designed, furnished, installed and adjusted by the Contractor.

P15.1.9 Sludge Thickener (W37)

a. General

The mechanical components of the Sludge Thickener shall consist of the following equipment. Equipment shall be designed using the following conditions and in accordance with the specification set forth hereinafter in this Section.

b. Equipment List of Sludge Thickeners

W37-MM - 01	Sludge Thickener	W37 ST 11 to 21	: 2 units
W37-MM - 02	Sludge Pump	W37 SP 11 to 21	: 2 units
W37-MM - 03	Sump Drain Pump	W37 DP 01 to 02	: 2 units
W37-MM - 04	Piping		: 1 lot
W37-MM - 05	Steel Works		: 1 lot
W37-MM - 06	Other Necessary Works		: 1 lot

c. Design Condition

Flow Rate (sludge from Sedimentation Basin and Wash Drain Basin)

- De-sludging from Sedimentation Basin : Approx. 1,600 m^3/day
- De-sludging from Wash Drain Basin : Approx. 2,040 m^3/day

1. Sludge Thickener (W37 ST 11/21)

a. General

Sludge Thickener shall be installed in the Sludge Thickener Basin and shall be capable of storing and thickening sludge from the Sedimentation and Wash Drain Basins and also capable of discharge supernatant to the Discharge Pool.

b. Specification

Type	: Central driven circular gravity picket fence sludge thickener
Quantity	: 2 units
Dimension	: 18.0 m dia. x 3.8 to 4.8 m D
Water level	: +354.500 m amsl
Bridge install level	: +354.800 m amsl

c. Fabrication

i) Gravity sludge thickener shall consist of central-drive unit, access bridge and walkway, sludge collector arms with pickets, influent well, and all necessary accessories.

ii) Support bridge shall be made of structural steel conforming JIS G 3101 SS400. Walkway shall be a minimum 1 m wide and shall include a platform at the drive unit which provides 1 m clear access on one sides of the drive unit. Structural members shall be sufficient to support and resist all lateral loads, the walkway and the operating platform at peak torque condition. Deflection of the access bridge under maximum load shall not exceed 1/360 of span. Handrailing shall be provided on both sides of the bridge and around operating platform. Walkway surface shall be checker plate

iii) Drive shall be capable of meeting the torque requirements specified. Main bearing designed for total rotating mechanism load with a minimum life of 20 years (175,000 hours) continuous operation. Gears and bearings shall be oil bath lubricated. Housings shall be provided with oil level sight gauges, oil fill and valved drain connections and valved condensate drain connections from the low points of the oil reservoir. The main gear bearing shall be a radial-thrust type ball bearing with renewable strip liner races or full contour raceway. Drive assembly shall be assembled in the manufacturer's shop and tested to ensure the drive is running properly and to calibrate the drive control. A complete test report shall be provided to the Engineer verifying that the drive meets the quality assurance requirements.

iv) Torque monitoring and overload devices shall be incorporated into each drive assembly, each enclosed in a weatherproof enclosure provided with access panels for field adjustments and maintenance, Overload Protection System consisting of two microswitches, one to close an alarm circuit at alarm torque and one to cut off the motor when the load reaches shutoff torque as specified herein Additional protection shall be provided above the shutoff torque by shear pins of corrosion resistant material.

v) Influent well shall efficiently distribute flow entering the tank and shall be fabricated from minimum 6 mm thick steel plate, supported from the torque tube or access bridge.

vi) Sludge collector arms shall be constructed of 6 mm minimum thick carbon steel members. Mechanism shall include two sludge removal arms with raking blades, and vertical pickets and adjustable spring brass squeegees. The blades shall be spaced to

completely rake the entire tank bottom twice per revolution.

d. Tools (for each unit)

All special tools required for normal operation and maintenance : 1 set

e. Spare Parts (for each unit)

Sight glasses or oil gauges	: 1 set
Rubber squeegees	: 2 sets
Gaskets	: 2 sets
Oils and lubricants	: Sufficient for three changes of all

2. Sludge Pump (W37 SP 11/21)

a. General

Sludge Pump shall be installed in the pump room of the Sludge Thickener and shall be capable of removing accumulated sludge in the Sludge Thickener.

b. Specification **(Refer to Standard Specification – Section 15.5)**

Type	: End-suction, horizontal sludge pump
Quantity	: 2 units (1 duty, 1 standby)
Rated capacity	: 1.3 m^3/min
Rated head	: 6.0 m TDH
Speed	: Approx. 1500 rpm
Efficiency	: not less than 55 percent at duty point
NPSHA (normal)	: approx. +5.5 m
Max. noise level for pump	: 85 dB(A) at 1.0 m
Driving method	: direct coupling from motor
Motor output	: 3.7 kW
Installation	: indoor
Motor encl. protection	: IP 44
Wet well water levels	: HWL +353.500 m amsl
	: LWL +350.500 m amsl
Pump room floor level	: +348.500 m amsl
TWL at discharge	: +363.400 m amsl
Transmission main	: 200 mm diameter, approx. 50 m to Sludge Thickener

c. Fabrication

i) Impeller shall be non-clog, screw type and sufficient for slurry, and shall be made of

stainless steel casting type 304.

3. Sump Drain Pump (W36 DP 01/02)

a. General

Sump Drain Pump shall be installed at the bottom of the Distribution Pump Station and shall be used to drain water accumulated in the sump.

b. Specification **(Refer to Standard Specification – Section 15.5)**

Type	: Submersible Drain Pump
Quantity	: 2 units (1 duty, 1 standby)
Discharge flow	: 0.5 m^3/min
Total head	: 12 m
Motor output	: 2.2 kW

4. Piping (Refer to Section 15.2)

The piping work shall include the piping systems as shown in the following table. The sizes and materials shall be based on the value as shown on the contract drawings, and all piping systems shall be comply with the requirements of Section 15.2.

The piping shall include all necessary pipes, support, valves, expansion joints, insulation and necessary appurtenances and shall be designed, furnished, installed, tested and adjusted by the Contractor.

No	Piping Name	Scope of Works	
		From	To
1	Washing drain sludge piping	Washing drain basin	Sludge thickener
2	Settled sludge piping	Sedimentation basin	Sludge thickener
3	Sludge piping	Sludge thickener	Sludge drying bed
4	Supernatant piping	Sludge thickener	Discharge pool
5	Seal water piping	Plant water piping	Sludge pumps
6	Drain piping	Sump pit	Drainage piping
7	Other necessary piping	-	-

5. Steel Works (Refer to Division 5)

This steel works shall include all necessary steel works for the maintenance of the plant such as covers, manholes, stages, walkways, handrails, steps, ladders, etc. even if not shown on the drawings and shall be designed, furnished, installed and adjusted by the Contractor.

P15.1.10 Sludge Drying Bed (W38)

a. General

The mechanical components of the Sludge Drying Bed shall consist of the following equipment. Equipment shall be designed using the following conditions and in accordance with the specification set forth hereinafter in this Section.

b. Equipment List of Sludge Drying Bed

W38-MM - 01	Inlet Valve	W38 HV 11 to 62	: 12 units
W38-MM - 02	Outlet Valve	W38 HV 13 to 64	: 12 units
W38-MM - 03	Piping		: 1 lot
W38-MM - 04	Steel Works		: 1 lot
W38-MM - 05	Other Necessary Works		: 1 lot

C. Design Condition

Flow Rate (thickened sludge from Sludge Thickening Tank)

- Thickened sludge : Approx. 450 m^3/day

1. Inlet Valve (W38 HV 11/12/21/22/31/32/41/42/51/52/61/62)

a. General

Inlet Valve shall be installed on the inlet pipe to the Sludge Drying Bed and shall be capable of stopping the incoming thickened sludge.

b. Specification **(Refer to Standard Specification – Section 15.3)**

Type		: Manual sluice valve with floorstand
Quantity		: 12 units
Dimension		: 200 mm dia.
Pressure		: 0.49 MPa
Installation level :	Valve center	: + 351.200 m amsl
	Floorstand	: + 352.300 m amsl

2. Outlet Valve (W38 HV 13/14/23/24/33/34/43/44/53/54/63/64)

a. General

Outlet Valve shall be installed on the outlet pipe from the Sludge Drying Bed and shall be capable of stopping the discharging drain water.

b. Specification **(Refer to Standard Specification – Section 15.3)**

Type		: Manual sluice valve with floorstand
Quantity		: 12 units
Dimension		: 200 mm dia.
Pressure		: 0.49 MPa
Installation level :	Valve center	: + 350.150 m amsl
	Floorstand	: + 352.500 m amsl

3. Piping (Refer to Section 15.2)

The piping work shall include the piping systems as shown in the following table. The sizes and materials shall be based on the value as shown on the contract drawings, and all piping systems shall be comply with the requirements of Section 15.2.

The piping shall include all necessary pipes, support, valves, expansion joints, insulation and necessary appurtenances and shall be designed, furnished, installed, tested and adjusted by the Contractor.

No	Piping Name	Scope of Works	
		From	To
1	Sludge piping	Sludge thickener	Sludge drying bed
2	Drain piping	Sludge drying bed	Discharge pool
3	Other necessary piping	-	-

4. Steel Works (Refer to Division 5)

This steel works shall include all necessary steel works for the maintenance of the plant such as covers, manholes, stages, walkways, handrails, steps, ladders, etc. even if not shown on the drawings and shall be designed, furnished, installed and adjusted by the Contractor.

P15.1.11 Discharge Pool (W40)

a. General

The mechanical components of the Discharge Pool shall consist of the following equipment. Equipment shall be designed using the following conditions and in accordance with the specification set forth hereinafter in this Section.

b. Equipment List of Discharge Pool

W40-MM - 01 Inlet Valve – A (Thickener)	W40 HV 11 to 21	: 2 units
W40-MM - 02 Inlet Valve – B (Drying Bed)	W40 HV 12 to 22	: 2 units
W40-MM - 03 Wastewater Discharge Pump	W40 WP 11 to 21	: 2 units
W40-MM - 04 Sump Drain Pump	W40 DP 01 to 02	: 2 units
W40-MM - 05 Piping		: 1 lot
W40-MM - 06 Steel Works		: 1 lot
W40-MM - 07 Other Necessary Works		: 1 lot

c. Design Condition

Flow Rate (supernatant from sludge thickener and sludge drying bed)

- Sludge Thickener : Approx. 3,190 m^3/day
- Sludge Drying Bed : Approx. 450 m^3/day

1. Inlet Valve - A (W40 HV 11/21)

a. General

Inlet Valve shall be installed on the inlet pipe to the Discharge Poor and shall be capable of stopping the incoming wastewater from the Sludge Thickener.

b. Specification **(Refer to Standard Specification – Section 15.3)**

Type	: Manual Sluice Valve with Floorstand
Quantity	: 2 units
Dimension	: 250 mm dia.
Pressure	: 0.49 MPa
Floorstand level	: + 352.600 m amsl
Valve center level	: + 350.400 m amsl

2. Inlet Valve - B (W40 HV 12/22)

a. General

Inlet Valve shall be installed on the inlet pipe to the Discharge Pool and shall be capable of stopping the incoming wastewater from the Sludge Drying Bed.

b. Specification **(Refer to Standard Specification – Section 15.3)**

Type	: Manual Sluice Valve with Floorstand
Quantity	: 2 units
Dimension	: 200 mm dia.
Pressure	: 0.49 MPa
Floorstand level	: + 352.600 m amsl
Valve center level	: + 349.800 m amsl

3. Wastewater Discharge Pump (W40 WP 11/21)

a. General

Wastewater Discharge Pump shall be installed in the Discharge Pool and shall be capable of draining wastewater generated from the water treatment and sludge disposal in the plant.

b. Specification **(Refer to Standard Specification – Section 15.5)**

Type	: End-suction, horizontal slurry pump
Quantity	: 2 units (1 duty, 1 standby)
Rated capacity	: 1.3 m^3/min
Rated head	: 8.0 m TDH
Speed	: Approx. 1500 rpm

Efficiency	: not less than 55 percent at duty point
NPSHA (minimum)	: approx. +1 m
Max. noise level for pump	: 85 dB(A) at 1.0 m
Driving method	: direct coupling from motor
Motor output	: 3.7 kW
Installation	: indoor
Motor encl. protection	: IP 44
Wet well water levels	: HWL +350.500 m amsl
	: LWL +347.500 m amsl
Pump room floor level	: +346.000 m amsl
TWL at discharge	: +352.000 m amsl
Transmission main	: 200 mm diameter, approx. 25 m to drainage manhole

c. Fabrication

i) Impeller shall be non-clog, screw type and sufficient for slurry, and shall be made of stainless steel casting type 304.

4. Sump Drain Pump (W40 DP 01/02)

a. General

Sump Drain Pump shall be installed at the Bottom of the Distribution Pump Station and shall be used to drain water accumulated in the sump.

b. Specification **(Refer to Standard Specification – Section 15.5)**

Type	: Submersible Drain Pump
Quantity	: 2 units (1 duty, 1 standby)
Discharge flow	: 0.5 m^3/min
Total head	: 12 m
Motor output	: 2.2 kW

5. Piping (Refer to Section 15.2)

The piping work shall include the piping systems as shown in the following table. The sizes and materials shall be based on the value as shown on the contract drawings, and all piping systems shall be comply with the requirements of Section 15.2.

The piping shall include all necessary pipes, support, valves, expansion joints, insulation and necessary appurtenances and shall be designed, furnished, installed, tested and adjusted by the Contractor.

No	Piping Name	Scope of Works	
		From	To
1	Supernatant piping	Sludge thickener	Discharge pool
2	Supernatant piping	Sludge drying bed	Discharge pool
3	Wastewater discharge piping	Discharge pool	Sewer manhole
4	Seal water piping	Plant water piping	Sludge pumps
5	Drain piping	Sump pit	Drainage piping
6	Other necessary piping	-	-

6. Steel Works (Refer to Division 5)

This steel works shall include all necessary steel works for the maintenance of the plant such as covers, manholes, stages, walkways, handrails, steps, ladders, etc. even if not shown on the drawings and shall be designed, furnished, installed and adjusted by the Contractor.

P15.1.12 Chemical Room (W45)

a. General

The mechanical components of the Chemical Room shall consist of the following equipment. Equipment shall be designed using the following conditions and in accordance with the specification set forth hereinafter in this Section.

b. Equipment List of the Chemical Room

(Coagulant Dosing System - Alum)			
W45-MM - 01	Coagulant Transfer Pump	W45 CP 11 to 21	: 2 units
W45-MM - 02	Coagulant Pump	W45 CP 31 to 41	: 2 units
W45-MM - 03	Flow Control Valve	W45 MV 31	: 1 unit
(Flocculant Dosing System - Polymer)			
W45-MM - 04	Flocculant Tank	W45 CT 01	: 1 unit
W45-MM - 05	Flocculant Tank Mixer	W45 CM 01	: 1 unit
W45-MM - 06	Flocculant Pump	W45 CP 51 to 61	: 2 units
(Activated Carbon Dosing System)			
W45-MM - 07	Activated Carbon Blower	W45 AB 11 to 21	: 2 units
W45-MM - 08	Activated Carbon Pump	W45 CP 71 to 81	: 2 units
W45-MM - 09	Chemical Hoist	W45 MH 01	: 1 unit
W45-MM - 10	Dust Extraction Fan	W45 EF 11	: 1 unit
W45-MM - 11	Dust Extraction Tank	W45 GW 11	: 1 unit
(Chlorination System - Polymer)			
W45-MM - 12	Weighing Scale	W45 WD 01	: 1 unit
W45-MM - 13	Evaporator	W45 EV 11 to 21	: 2 units
W45-MM -M -14	Chlorinator - Pre	W45 CL 11 to 21	: 2 units
W45-MM - 15	Chlorinator - Post	W45 CL 31 to 41	: 2 units
W45-MM - 16	Chlorine Hoist	W45 MH 02	: 1 unit
W45-MM - 17	Exhaust Fan	W45 EF 01 to 02	: 2 units
(All Chemical Dosing Facilities)			
W45-MM - 18	Piping		: 1 lot
W45-MM - 19	Steel Works		: 1 lot
W45-MM - 20	Other Necessary Works		: 1 lot

c. Design Condition

Flow Rate (raw water and wash drain recovery water)

- Daily maximum (raw water) : 105,000 m^3/day
- Hourly maximum (wash drain recovery water – random operation): 1,320 m^3/day

Dosing Rate (Coagulant : 10 % of $Al_2(SO_4)_3$)

- Maximum : 30 mg/l
- Average : 7.5 mg/l
- Minimum : 1.0 mg/l

Dosing Rate (Flocculant : 0.5 % of Polymer)

- Maximum : 0.100 mg/l
- Average : 0.050 mg/l
- Minimum : 0.025 mg/l

Dosing Rate (Activated Carbon Powder : 3%)

- Maximum : 30 mg/l
- Average : 20 mg/l
- Minimum : 10 mg/l

Dosing Rate (Chlorine Gas)

	Pre	Post
- Maximum	: 5.0 mg/l	1.5 mg/l
- Average	: 3.0 mg/l	1.0 mg/l
- Minimum	: 1.5 mg/l	0.5 mg/l

1. Coagulant Transfer Pump (W45 CP 11/21)

a. General

Coagulant Transfer Pump shall be installed at the existing Chemical Room and shall be capable of supplying dissolved alum to the Alum Tank in the new Chemical Room.

b. Specification

Type	: Vertical-split type rubber-lined horizontal centrifugal pump	
Quantity	: 2 units (1 duty, 1 standby)	
Rated capacity	: 200 l/min	
Rated head	: 15 m TDH	
Speed	: 2900 rpm	
Driving method	: V-belt driven	
Motor output	: 5.5 kW	
Materials	: casing	: cast iron
	: casing liner	: natural rubber
	: impellor	: natural rubber
	: shaft	: carbon steel
Pump room floor level	: Approx. + 352.000 m amsl (existing Chemical Room)	
TWL at discharge	: + 359.900 m amsl	
Transmission pipe	: 80 mm PVC lining steel pipe, approx. 150 m long	

c. Tools (for each unit)

All special tools required for normal operation and maintenance : 1 set

d. Spare Parts (for each unit)

Impeller	: 1 set
Pump casing liner	: 1 set
Gaskets	: 2 sets
Shaft sleeve	: 2 sets

2. Coagulant Pump (W45 CP 31/41)

a. General

Coagulant Pump shall be installed at the new Chemical Room and shall be capable of supplying dissolved alum to the Flow Control Valve in the new Chemical Room.

b. Specification

Type	: Vertical-split type rubber-lined horizontal centrifugal pump	
Quantity	: 2 units (1 duty, 1 standby)	
Rated capacity	: 25 l/min	
Rated head	: 10 m TDH	
Speed	: 2900 rpm	
Driving method	: V-belt driven	
Motor output	: 2.2 kW	
Materials	: casing	: cast iron
	: casing liner	: natural rubber
	: impellor	: natural rubber
	: shaft	: carbon steel
Pump room floor level	: + 356.400 m amsl (new Chemical Room)	
TWL at discharge	: + 363.400 m amsl (Receiving Well)	
Transmission pipe	: 50 mm PVC lining steel pipe, approx. 20 m long	

c. Tools (for each unit)

All special tools required for normal operation and maintenance : 1 set

d. Spare Parts (for each unit)

Impeller	: 1 set
Pump casing liner	: 1 set
Gaskets	: 2 sets
Shaft sleeve	: 2 sets

3. Flow Control Valve (W45 MV 11)

a. General

Flow Control Valve shall be installed on the alum dosing pipe in the Chemical Building and shall be capable of adjusting the rate of alum dosing.

b. Specification **(Refer to Standard Specification – Section 15.3)**

Type	: Motorized Needle Valve	
Quantity	: 1 unit	
Dimension	: 50 mm dia.	
Pressure	: 0.49 MPa	
Materials	: body	: stainless steel casting

: vane : stainless steel casting

c. Spare Parts

Flow control valve (complete set) : 2 sets

4. Flocculant Tank (W45 CT 01)

a. General

Flocculant Tank shall be installed in the Chemical Building and shall be capable of dissolving and storing flocculant.

b. Specification

Type	: Cylindrical tank
Quantity	: 1 unit
Effective capacity	: 2.0 m^3
Dimension	: 1.5 m dia. x 1.2 m
Pressure	: 0.49 MPa
Materials	: FRP (fiber glass reinforced plastic)

c. Accessories

Flocculane Tank Mixer (W45 CM 01) : 1 set

5. Flocculant Pump (W45 CP 51/61)

a. General

Flocculant Pump shall be installed at the new Chemical Room and shall be capable of supplying dissolved flocculant to the Receiving Well.

b. Specification

Type	: Magnetic seal less chemical centrifugal pump	
Quantity	: 2 units (1 duty, 1 standby)	
Rated capacity	: 1.5 l/min	
Rated head	: 10 m TDH	
Speed	: 2900 rpm	
Driving method	: magnetic driven	
Motor output	: 2.2 kW	
Materials	: casing	: Polypropylene
	: impellor	: Polypropylene
	: shaft	: ceramic
Pump room floor level	: + 356.400 m amsl (new Chemical Room)	

TWL at discharge : + 363.400 m amsl (Receiving Well)

Transmission pipe : 50 mm PVC lining steel pipe, approx. 20 m long

c. Tools (for each unit)

All special tools required for normal operation and maintenance : 1 set

d. Spare Parts (for each unit)

Impeller : 1 set

Pump casing liner : 1 set

Gaskets : 2 sets

Shaft sleeve : 2 sets

6. Activated Carbon Blower (W45 AB 11/21)

a. General

Activated Carbon Blower shall be installed at the new Chemical Room and shall be capable of supplying air to theActivated Carbon Tank.

b. Specification

Type : Rotary, positive displacement type

Quantity : 2 units (1 duty, 1 standby)

Rated capacity : 3.6 Nm^3/min

Rated pressure : 0.35 MPa

Speed : Approx. 1200 rpm

Driving method : V-belt driven

Motor output : 5.5 kW

Blower room floor level : + 359.900 m amsl (new Chemical Room)

c. Fabrication

i) The impeller shall be close grain ductile iron with internal ribbing. Impellers shall be machined on all exterior surfaces for operation at close clearances and shall be securely fastened to alloy steel-machined shafts.

ii) The impeller case shall be strongly ribbed to eliminate distortion when operating at rated pressure, and shall have an elliptical inlet port and multiported discharge area to achieve maximum attenuation of air borne noise.

iii) Gears shall be manufactured with alloy steel and be accurately finished on all surfaces. They shall be securely attached to shafts by means of wedge rings permitting easy re-timing of the unit.

iv) The shaft centres shall be maintained by at least four heavy-duty anti-friction bearings. Bearings shall have a life of 20,000 hours and be located in bearing cartridges of the flanged type for easy field removal.

v) Gears shall be enclosed in an oil tight housing and shall be lubricated by a splash

oiling system from a reservoir in the gear housing. Gear and bearings shall be splash lubricated by the same reservoir. Drive and bearings shall be splash lubricated by a splash oil system from the reservoir in the drive end cover plate.

vi) Air vents shall be located between the seals and the impeller chamber to relieve the air pressure on the seals.

vii) The blower shall be supplied with an intake silencer. The intake silencer shall be of the combination acoustical- reaction type with acoustical material located in the transition area adjacent to the blower intake. The silencer shell shall be constructed of fabricated steel with double wall thickness, and shall have multiple chambers for attenuation of both high and low frequency noise. Silencers shall have inlets with mounting brackets supplied to mount silencers vertically.

viii) The blower shall be supplied with a discharge silencer. The discharge silencer shall be of the combination acoustical-reaction type with the acoustical material located in the transition area connected directly to the blower discharge flange. The silencer shell shall be fabricated with double wall thickness, and shall have multiple chambers for attenuation of both high and low frequency noise.

ix) Each blower shall be supplied with one intake filter. The filter housing shall be fabricated from heavy gauge sheet steel, welded and caulked to provide a weatherproof housing. The filter elements shall be of the panel type and shall have a pleated paper media, held in place by a metal holding frame.

x) Each blower shall be supplied with a pressure relief, check and isolation butterfly valve located on the discharge piping. The pressure relief and check valves shall be provided by the blower manufacturer and sized for the operating conditions.

xi) The air flow meter shall be sized and provided by the blower manufacturer. The unit shall be of durable construction and proven design and be compatible with the operation of the system as shown on the Drawings and described in the Particular Specifications.

xii) Each blower shall contain one inlet air pressure gauge, one discharge air pressure gauge, and one discharge air temperature gauge. The pressure gauges shall be calibrated in kPa absolute and be of the compound type. The gauges shall have circular dials, minimum 100 mm diameter with black figures on white background. Pressure gauges shall be furnished with pulsation damper. Temperature gauges shall be manufactured with standard temperature bulb.

c. Tools (for each unit)

All special tools required for normal operation and maintenance : 1 set

d. Spare Parts (for each unit)

all bearings for the blowers and motors : 1 set

"O" rings, gaskets and seals for the blowers and motors : 1 set

Spare inlet air filters : 2 sets

7. Activated Carbon Pump (W45 CP 71/81)

a. General

Activated Carbon Pump shall be installed at the new Chemical Room and shall be capable of supplying activated carbon solution to the Receiving Well.

b. Specification

Type	: Vertical-split type rubber-lined horizontal centrifugal pump	
Quantity	: 2 units (1 duty, 1 standby)	
Rated capacity	: 80 l/min	
Rated head	: 10 m TDH	
Speed	: 2900 rpm	
Driving method	: V-belt driven	
Motor output	: 2.2 kW	
Materials	: casing	: cast iron
	: casing liner	: natural rubber
	: impellor	: natural rubber
	: shaft	: carbon steel
Pump room floor level	: + 356.400 m amsl (new Chemical Room)	
TWL at discharge	: + 363.400 m amsl (Receiving Well)	
Transmission pipe	: 50 mm PVC lining steel pipe, approx. 20 m long	

c. Tools (for each unit)

All special tools required for normal operation and maintenance : 1 set

d. Spare Parts (for each unit)

Impeller	: 1 set
Pump casing liner	: 1 set
Gaskets	: 2 sets
Shaft sleeve	: 2 sets

8. Motorized Wire Hoist (W45 MH 01)

a. General

Overhead Hoists shall be installed at the Chemical Room, and shall be used for handling chemicals for storage.

b. Specification **(Refer to Standard Specification – Section 15.6)**

Type	: Motorized Overhead Wire Hoist with Trolley
Quantity	: 1 unit
Rated load	: 2 tonne
Main Hoist speed	: 2m/min

Traveling speed	: 10m/min
Lifting height:	: Approx. 7m
Hoist motor output	: 1.8kW
Traveling motor output	: 0.4kW

9. Dust Exhaust Fan (W45 EF 11)

a. General

Dust Extraction Fan shall be installed at the new Chemical Room and shall be capable of handling air with activated carbon powder during feeding the powder to the Activated Carbon Tank.

b. Specification

Type	: Turbo fan
Quantity	: 2 units (1 duty, 1 standby)
Rated capacity	: 10 m^3/min
Rated head	: 50 mmAq
Materials – body	: PVC
Motor output	: 0.75 kW

10. Dust Exhaust Tank (W45 GW 11)

a. General

Dust Extraction Tank shall be installed at the new Chemical Room and shall be capable of washing air with activated carbon powder during feeding the powder to Activated Carbon Tank.

b. Specification

Type	: Rectangular washing tank
Quantity	: 2 units (1 duty, 1 standby)
Rated capacity	: 10 m^3/min
Rated head	: 50 mmAq
Materials – tank body	: PVC

11. Weighing Scale (W45 WD 01)

a. General

Weighing Scale shall be installed at the new Chemical Room and shall be capable of measuring the weight of chlorine cylinders.

b. Specification

Type	: hydraulic load cell type with one dial at the scale for two, 1 tonne chlorine cylinders

Quantity : 1 unit

Rated capacity : Approx. 4 tonne

12. Evaporator (W45 WD 01)

a. General

Evaporator shall be installed at the new Chemical Room and shall be capable of gasifying the liquid chlorine from chlorine cylinders.

b. Specification

Type : electrically heated

Quantity : 2 units (1 duty, 1 standby)

Rated capacity : Min. 80 kg/hour

c. Fabrication

i) The evaporator shall be of the electrically heated type with a thermostatically controlled water chamber. The evaporator shall automatically vaporize and superheat liquid chlorine at a rate controlled by the using system and shall have a capacity of more than rated capacity of chlorine gasAdditional superheat shall be furnished by the pressure reducing regulator at the evaporator outlet.

ii) The vaporizing chamber shall be constructed of Schedule 80 welded steel pipe having a minimum wall thickness of 12 mm with forged steel fittings and shall be designed, constructed and tested to conform to the lethal substances section of the ASME code, Section VIII, for unfired pressure vessels. The chamber shall be provided with a "U" stamp to meet unfired pressure vessel requirements. The chamber shall also be supplied with an "L" Certification which includes the additional stamps: "W-L" welding meets lethal gas requirements; "S-L" fabricated using seamless pipe; "HJT" whole vessel has been post-weld heat treated and "RT-1" complete chamber satisfies the full radiography requirements (100 percent) of all welded joints for lethal substances. The vaporizing chamber shall be hydrostatically tested at 2352 kPa. The water jacket shall be composed of stainless steel with a minimum wall thickness of 6 mm. The water heater shall be of the electric immersion type 15 kW maximum capacity. The electric heater shall be mounted in the lower portion of the water jacket to insure proper heat distribution. A magnetic contactor shall be required for operating the heater and shall be furnished.

iii) The evaporator shall be equipped with a front panel mounted control thermostat, water level gauge, gas pressure and temperature gauges. A front panel mounted low temperature switch shall also be provided to cause the closing of the gas pressure reducing and shut off valve in the event of low water temperature. The thermostat and switch shall have calibrated gauges for ease of adjustment. A gas pressure relief valve complete with a safety head/rupture disc and pressure switch with diaphragm protector shall be provided for venting.

iv) The evaporator shall be housed in a color impregnated, corrosion resistant, cabinet which shall be removable from the front. This shall permit multiple evaporators to be mounted 25 mm apart in order to minimize floor space requirements. The unit shall be supplied with adequate insulation for the water chamber in order to conserve energy.

13. Chlorinator (W45 CL 11/21 and W45 CL 31/41)

a. General

Chlorinator shall be installed at the new Chemical Room and shall be capable of controlling the chlorine gas for chlorination.

b. Specification

Type : Automatic control, solution feed vacuum type

Quantity : 2 units (1 duty, 1 standby) each for pre and post

Rated capacity W45 CL 11/21 (pre-chlorinators) : Max. 25 kg/hour

W45 CL 31/41 (post-chlorinators) : Max. 10 kg/hour

Feed range : 6.6 to 20.8 kg/hour (pre-chlorinators)

: 2.2 to 6.6 kg/hour (post–chlorinators)

Accuracy : within +/- 2 percent of full scale

c. Fabrication

i) Chlorinators shall be of the floor-mounted, free standing, and of the manual or automatically-controlled type. Units shall be configured to automatically control the feed rate of chlorine to the vacuum powered system using continuously monitored parameters of flow as input data; or a combined signal from system magnetic flow meters; or at a manually adjusted fixed feed rate, as specified. All chlorinators shall be designed and constructed to ensure maximum safety for operating personnel. All dispensers shall consist of a positive acting chlorine gas shutoff valve, remote mounted vacuum regulator, pressure relief valve, independent vacuum breaker, electric motor-actuated control valve, and a differential pressure regulator to ensure reproducible accuracy.

ii) The electric motor operated valve actuator on automatic chlorinators shall accept a 4-20 mA DC flow and or other signal. An integral signal conditioner shall automatically position the control valve to provide the required chlorine feed rate. The electric valve positioner shall utilize a heavy-duty motor. The positioner components shall be housed in a NEMA 4X, fiberglass-reinforced-plastic enclosure and factory-installed in the chlorinator module. Provide non-adhesive wire markers or, plastic sleeves at both ends of conductors in the control panel. The unit shall be provided with front panel-mounted off-on switch, manual-auto selector, and increase-decrease switches for local manual feed rate control. In the event of local power failure, gas flow shall be manually adjustable.

iii) A separate control shall be provided to adjust feed rate such that full-scale output may be obtained with half-scale inputs and half-scale output with full-scale inputs. Chlorinator accuracy shall be plus or minus 4 percent of indicated flow rate over a 20:1 range.

iv) A rotameter shall be provided on the cabinet face to indicate chlorine gas flow. The chlorinator shall be furnished with a gauge for indication of ejector vacuum. The rotameter and vacuum gauge shall be graduated in metric units. A loss of vacuum alarm switch shall be provided with dry contacts for actuating remote alarm devices.

v) The chlorinator shall be constructed entirely of materials resistant to the corrosive attack of chlorine gas. The unit shall be floor-mounted with operating components, except the injector and the vacuum regulator, housed within a polyester-impregnated fiberglass cabinet.

vi) Accessory equipment for each vacuum regulator shall include one chlorine strainer, one chlorine heater, one set of extra gaskets, and twelve lead gaskets,one bottle of

chlorine testing ammonia, one tube of thread lubricant, three sets of special tools or wrenches, and one vent screen . Each chlorinator shall be equipped with one set of extra gaskets, lubricants, strainers, O-rings, filters, and spare parts normally supplied. Parts shall be stocked in a 22-gauge, minimum, steel enclosure with locking handle.

vii) Each chlorinator shall be provided with a remotely mounted ejector to generate the vacuum required for chlorinator operation and for mixing the metered chlorine gas with the solution water in preparation for piping it to the diffusers at the points of application. The chlorine ejectors shall have built-in back flow preventers. The chlorine ejectors shall be sized for chlorine delivery equal to the maximum capacity of the associated chlorinator, and shall be furnished with PVC "Y" type strainers.

viii) The vacuum regulators shall be wall mounted and shall close automatically if the operating vacuum fails. The vacuum regulator shall be provided with an integral liquid trap and inlet heater to reduce the likelihood of liquid reaching the regulator. The heater shall operate from 240/415 VAC, 50 Hz electric power. A pressure check-pressure relief valve shall be furnished with each vacuum regulator. The vacuum regulator-pressure check units shall be constructed of metal and plastic materials. They shall be designed to withstand full supply pressure. They shall have built-in filters to minimize the effect of contaminants in the gas, and they shall be capable of a flow rate rangeability of 20:1.

ix) The automatic changeover system shall provide liquid chlorine under pressure without interruption from the tonne containers. It shall consist of a changeover module which shall sense from the low weigh switch when the "on-line" container is empty and automatically switch the system over to the "standby" container. Indication of which container is "on-line" and which is "standby", shall be provided. One spare changeover module shall be furnished and shall be packaged for prolonged storage. This package shall clearly identify the contents and equipment to which it applies. The automatic change over system shall be furnished with all required motorized valves, expansion chambers, graphic display panel, external malfunction sensors for gas, fire, and smoke and which will automatically close all line valves on detection of hazardous conditions.

c. Accessories

Chlorine leak detector	: 2 sets

d. Tools (for each unit)

All special tools required for normal operation and maintenance	: 1 set

e. Spare Parts

Gas masks and cabinets	: 10 sets
Cylinder emergency kit	: 5 sets
Emergency shower and eye wash	: 2 sets

14. Motorized Wire Hoist (W45 MH 01)

a. General

Overhead Hoists shall be installed at the Chemical Room, and shall be used for handling chlorine cylinders.

b. Specification **(Refer to Standard Specification – Section 15.6)**

Type	: Motorized Overhead Wire Hoist with Trolley

Quantity	: 1 unit
Rated load	: 2 tonne
Main Hoist speed	: 2m/min
Traveling speed	: 10m/min
Lifting height:	: Approx. 3m
Hoist motor output	: 1.8kW
Traveling motor output	: 0.4kW

15. Piping (Refer to Section 15.2)

The piping work shall include the piping systems as shown in the following table. The sizes and materials shall be based on the value as shown on the contract drawings, and all piping systems shall be comply with the requirements of Section 15.2.

The piping shall include all necessary pipes, support, valves, expansion joints, insulation and necessary appurtenances and shall be designed, furnished, installed, tested and adjusted by the Contractor.

No	Piping Name	Scope of Works	
		From	To
1	Coagulant transfer piping	Chemical room (existing)	Chemical room (new)
2	Coagulant dosing piping	Chemical room	Receiving well
3	Flocculant dosing piping	Chemical room	Receiving well
4	Act'd carbon dosing piping	Chemical room	Receiving well
5	Pre-chlorine dosing piping	Chemical room	Receiving well
6	Post-chlorine dosing piping	Chemical room	Rapid sand filter
7	Plant water piping	Discharge pool	Chemical room
8	Mixing air piping	Air blower	Act'd carbon tank
9	Dust extraction piping	Act'd carbon tank	Outside of chemical room
10	Drain piping	Chemical room	Drainage piping
11	Other necessary piping	-	-

16. Steel Works (Refer to Division 5)

This steel works shall include all necessary steel works for the maintenance of the plant such as covers, manholes, stages, walkways, handrails, steps, ladders, etc. even if not shown on the drawings and shall be designed, furnished, installed and adjusted by the Contractor.