SPECIFICATION

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SPECIFICATIONS FOR SUPPLY AND INSTALLATION OF GAS CHLORINATORS, CHEMICAL DOSING EQUIPMENT, CHEMICAL HOISTS, LABORATORY EQUIPMENT AND ACCESSORIES

1. GENERAL

1.1 WORK INVOLVED

Total quality assurance system for manufacturing process of chlorinators, booster pumps, chemical equipment, hoisting equipment, laboratory equipment and all other accessories to be supplied and installed under the scope of this bid shall comply with ISO 9002:2008 or "equivalent"

The contractor shall be responsible for installation of the units supplied by him in accordance with the specifications and drawings approved by the Board.

The supplying and fixing of all items such as brackets, supports, clamps, clips, plugs, bolts, screws etc. shall be carried out by the contractor. Details shall be submitted for approval by the Engineer before fixing.

The painting of all equipment, brackets, supports, etc; shall be done by the contractor. The contractor shall also carry out all Civil, Electrical and Mechanical works, adjustments and tests and provide his own tools and testing equipment for this purpose.

When completed all equipment shall be suitable in every respect for the service intended. The contractor shall supply all the material and do all work which may be reasonably implied as being incidental to this work.

1.2 ENVIRONMENTAL CONDITIONS

The equipment to be provided under this contract shall be suitable for installation and operation at site conditions and environmental conditions given in **Clauses 1&2 in Appendix 3**.

Relative humidity is expected to range between 80 and 100 percent. Atmosphere is dusty.

1.3 INFORMATION TO BE PROVIDED AT THE COMMISSIONING

The contractor shall provide the following in three copies at least **14 days** before handing over of the equipment.

1. Certified copies of all performance tests of pumps, motors, Chlorinators, lifting equipments etc.
2. Manufacturer's Certification that all dosing units, stirrers, motor control equipment are fully in conformance with the specification.
3. Operation and Maintenance manuals of Pumps and Motors.
4. Control wiring diagrams for Electrical Panels. (Including Automatic Controls).
5. Spare Parts Manuals and all other literature pertaining to the items supplied.

1.4 INSTALLATION TESTING AND COMMSSIONING

1.4.1 INSTALLATION

The contractor shall provide the all equipment with necessary accessories and factory-trained personnel to supervise installation and initial operation of all components. The Gas chlorinators, Lime and Alum/Poly aluminium chloride dosing units, Laboratory Equipments, Lifting equipment and other accessories shall be connected and installed at the locations shown in the drawings in Appendix 02 and in accordance with the manufacturer's recommendations. Contractor shall certify that the equipment is installed in a manner to ensure proper operation.

1.4.2 TESTING AND COMMISSIONING OF EQUIPMENT

After the completion of installation of Gas chlorinators, Lime and Alum/Poly aluminium chloride dosing units, Laboratory Equipments, Lifting equipment and other accessories shall be field tested to ensure compliance with the performance requirements as specified.

When all installation work is satisfactorily completed the Contractor shall inform the Engineer in writing that the Gas chlorinators, Lime and Alum/Poly aluminium chloride dosing units, Laboratory Equipments, Lifting equipment and other accessories are ready for handing over and then Engineer shall fix a date for taking over.

After the satisfactory completion of all tests, the Contractor shall operate the equipments and accessories for 7 days, and during this period, instruct, train any person nominated by the Engineer regarding the operation and maintenance of the equipment.

At the taking over, all equipment shall be tested for a period of 7 days to determine that the equipments are in satisfactory of all conditions.

If the Engineer is not satisfied with the performance of equipment or their installation he may refuse to take over until necessary improvements are effected. Any time necessary for this additional works will be considered as contractor's delay.

1.4.3 APPLICABLE REGULATIONS

All installation work shall be carried out in accordance with relevant international standards and codes of practice.

1.4.4 CERTIFICATION

Manufacturer shall supply test certificates demonstrating compliance with the performance specified herein.

1.4.5 WARRANTY

The supplier shall warrant to the Purchaser that the Goods and Services Supplied under the contract will comply strictly with the Contract and shall be first class in every case and shall be free from defects. The supplier further warrants to the Purchaser that all materials, equipment and supplies furnished by the supplier for the purpose of the goods will be new, merchantable of the most suitable grade, and fit for their intended purposes. The supplier shall warrant that the services to be carried out under this contract will conform to generally accepted professional standards and engineering principals.

This warrant shall remain valid for the period mentioned in **Clause 3 in Appendix 3** after the final acceptance, any part of the equipment which fails or does not give satisfactory performance during this period of warranty, shall be replaced within the number of days as mentioned in the **Clause 4 in Appendix 3** from the date of Contractor has been notified to do so.

All expenses involved in this connection shall be borne by the contractor who should take this into consideration when bidding.

1.4.6 MAINTENANCE PERIOD

Maintenance of the all equipments and accessories supplied in this contract to be carried out by the contractor jointly with NWS&DB staff for the period mentioned in the **Clause 5 in Appendix 3**. Contractor shall submit the maintenance schedule with the offer.

1.5 CALIBRATION OF INSTRUMENT & METERS

All instruments & meters shall be calibrated in the Metric Units as follows:

(i) Pressure shall be indicated in metric water column.
(ii) Flow shall be indicated in cubic meters/hour.
(iii) Quantities shall be indicated in cubic meters.
(iv) Water level shall be indicated in meters.
(v) Current shall be indicated in Amperes.
(vi) Voltage shall be indicated in Volts.
(vii) Chlorine dosage rate shall be indicated in Kilograms per hour

1.6 MOTORS AND LT EQUIPMENT

1.6.1 MOTORS

Motor capacities less than 0.75 kW motors shall be **Continuous single phase**, Squirrel Cage, Induction type designed for **230V, 50 Hz**. Design of the motors shall be such that they can operate within **± 6%** of the nominal voltage continuously without damage.

Motor capacities above 0.75 kW motors shall be **Continuous three phase**, Squirrel Cage, Induction type designed for **400V, 50 Hz**. Design of the motors shall be such that they can operate within **± 6%** of the nominal voltage continuously without damage.

Synchronous speed shall be 3000 rpm or 1500 rpm. Each Motor shall be provided with a lifting eyebolt and shall have a service factor.

1.6.2 INSULATION

Motors shall be of **class F** insulation of NEMA standards but the operating temperature rise shall be restricted to that of **class B**

1.6.3 PROTECTION OF ENCLOSURE

Motor enclosures shall be protected to **IP68** for submersible pump motor and dry installed motor enclosures shall be protected to **IP55.**
Motors installed in areas exposed to dust (ex. dust o alum/Poly aluminium chloride /lime) shall be protected to **IP64**. Protection for power & control panel shall be **IP55** and especially for panels installed at dusty environment (Lime/Alum/Poly aluminium chloride dusts) shall have protection of **IP64**.

1.6.4 CONTROLS - INDICATORS AND ALARMS

1. Push Buttons for Start/Stop/Reset
2. Indicator lamps to indicate following,
    - Motor Running

- Motor Stopped (Manual)
- Motor Tripped (Overload/Thermal Tripped)

1.6.5 ELECTRICAL SWITCHGEAR TO BE PROVIDED FOR MOTOR STARTERS

- **Stirrers**

The supplier shall provide and install following electrical switchgear necessary for DOL (<3kW or above star-delta) starters wired for manual start and stop and automatic stop function of the stirrers when the solution level in the tank is low.

a) One suitable 3 phase MCCB with adequate breaking capacity to serve as the feeder for the starters
b) Contactor wired for DOL (<3kW) starting / Contactor wired for Star Delta (>3kW) starting
c) One three phase adjustable thermal over load
d) Surge protection device of 25kA
e) Indicator lamps to indicate the following

*	Stirrer Running	-	Red
*	Stirrer Stop	-	Green
*	Stirrer Tripped	-	Amber
*	Solution level low	-	Blue

f) Control relays, transducers, cables etc. necessary for realizing above shall be provided.

- **Booster Pumps/Chemical Feeding Pumps**

The supplier shall provide and install following electrical switchgear necessary for DOL (<3kW or above star-delta) starters wired for manual start and stop and automatic stop function of the pumps when the water level in the suction side is low.

a) One suitable 3 phase MCCB with adequate breaking capacity to serve as the feeder for the starters
b) Contactor wired for DOL (<3kW) starting / Contactor wired for Star Delta (>3kW) starting
c) One three phase adjustable thermal over load
d) Indicator lamps to indicate the following

*	Pump Running	-	Red
*	Pump Stop	-	Green
*	Pump Tripped	-	Amber
*	Solution level low	-	Blue

e) Control relays, transducers, cables etc. necessary for realizing above shall be provided.

1.6.6 EARTHING TERMINALS

Earthing bar mounted in the lower part of the enclosure shall be marked main earth terminal and shall be completed with screw connections, for earthing conductors. All earths available at site shall be bonded together by proper and standard means.

1.6.7 POWER SUPPLY

The main power shall be taken from High lift pump house main panel/ as directed by the engineer, and Panel board at chemical house shall be supplied with suitably sized MCCB for each motor and other electrical accessories. The panel for chlorinators and chemical equipment and all other connections shall be provided and fixed by the contractor.

All electrical equipment & wiring shall conform to the standards set by the I.E. E., U.K. as well as Sri Lanka regulations and be acceptable to the Ceylon Electricity Board, Sri Lanka.

Equipment shall be rated to operate on 230V single-phase 50 Hz supply – 3 wire including "earth wire" or
Equipment shall be rated to operate on 400V three-phase 50 Hz supply – 4 wire including "earth wire

1.6.8 POWER CABLES

All power cables shall be PVC insulated, with copper conductors. Cable sizes shall be determined in accordance with latest IEC wiring regulations and Engineer's approval shall be sought in this regard.

All under ground cables shall be PVC/SWA/2/4 core with copper conductors.

All power and control cables shall be supplied and installed/laid by the contractor to suit the existing site condition and as instructed by the Engineer.

1.6.9 CABLE INSTALLATION

Method of installation for cables shall be selected in accordance with IEC wiring regulations to suit the specific application. However, the following requirements are to be met.

(a) Cables which are to be run on walls, ceilings or other building structures shall be secured on cable trays, ladders or enclosed in conduits or trunking.

(b) Where building structure incorporates covered trench system cable shall be laid on horizontal trays against the side(s) of the trench.

(c) Every cable shall be permanently identified at each end by cable markers with semi rigid black PVC carrier strip, which shall be fixed axially by means of 2 PVC straps.

(d) All power cables to be run external to the buildings shall be in type 250 PVC pipes so that the cable can be pulled out for inspection and easy replacement. Manhole openings shall be provided every **30m** or after bend and top side of the cable path shall be covered by suitable concrete slabs.

1.6.10 EARTH CONDUCTORS

Earth conductors shall be sized in accordance with IEC regulations. PVC cable insulation shall be green. Cable armoring and screens shall not be used as sole earth protective conductor, and earthing shall be arranged in accordance with BS 7430 of 1991.

1.6.11 ITEMS TO BE EARTHED

The following equipment shall be connected to the main earth terminal by means of earthing conductor with cross sectional area as per requirement of IEE wiring regulations;

a) All motor cases
b) Any other metal object, which may become under faulty conditions.
c) Panel boards
d) Lightening protection system earth
e) All surge protection devices of equipments
f) Any other items

2 SPECIFICATIONS FOR GAS CHLORINATORS AND ACCESSORIES

2.1 SCOPE

The contractor shall supply and install Chlorination equipment, located and installed as specified herein and shown on the drawings given in Appendix 2 and chlorinator lay out arrangement & drawings in Appendix 3. All accessories not specifically mentioned herein that are required to make the system operable shall be furnished and installed by the contractor. The system provided shall meet or exceed chlorine Institute guidelines.

Each chlorinator shall consist chlorinators of type as mentioned in the **Clause 8 in Appendix 3**, measuring glass, ejectors, booster pump with starter, weighing scale, change over unit, chlorine leak detector, chlorine gas resistant exhauster, gas respirator, chlorine test kit with 1,000 numbers DPD (for measuring residual chlorine) tablets and all necessary appurtenances to provide a complete chlorination system. The Contractor shall supply, install, commission and hand over all the equipment to the satisfaction of the Engineer.

2.2 TYPE

Type of the chlorinator & chlorine gas cylinder shall be as mentioned in **Clause 12 in Appendix 3**.

2.3 QUALITY ASSURANCE

The chlorinator manufacturers shall have a test certificate for total quality assurance of the manufacturing process from the relevant authority (BSI, ISO etc.) for the manufacturing facility of chlorinators and accessories.

Total Quality Assurance system shall comply with **ISO 9001, 2008; or BS 5750 Part 2, EN 9002** or an equivalent acceptable to the Engineer.

The certificates valid for current production years shall be produced with the offer.

All chlorinators and accessories to be supplied under this contract shall only be from the approved factory location.

2.4 UNIT RESPONSIBILITY

The Contractor shall cause all equipment specified under this contract to be furnished by the chlorinator manufacturer who shall be responsible for the adequacy and compatibility of all chlorination unit components. Any component of each chlorination unit not provided by the chlorinator manufacturer shall be designed, fabricated tested and installed by factory-authorised representatives experienced in design and manufacturer of such components. This requirement, however, shall not be constructed as relieving the contractor of the overall responsibility for this portion of work.
The chlorination facility shall be the product of an experienced manufacturer and

1. Must demonstrate equal or larger capacity installations using similar equipment installed and operating satisfactorily for at least 5 years.

2. Provide names and phone numbers of contract-referenced installation to verify performance.

2.5 DESIGN REQUIREMENT

The arrangements shown on the drawing is based upon the best information available to the Engineer at the time of design and is not intended to show exact dimensions peculiar to specific equipment unless otherwise shown or specified. Therefore, it may be anticipated that the structural supports, foundations connecting piping and valves shown in part or whole, may have to be changed in order to accommodate the chlorination equipment furnished. No additional payment will be made for such changes. Any such changes shall be submitted to the Engineer for his approval.

The complete chlorination unit shall be designed to operate without overload on any component at any point along the chlorination range specified.

2.6 FACTORY TESTING

The chlorinator units and other accessories shall be tested at manufacturer's works and the contractor shall provide the test results of the equipment prior to the shipment of the equipment.

2.7 SUBMITTALS

The information listed below shall be submitted with the offer to the Engineer for review. The submittals shall include:

1. Technical details, catalogues are submitted with the offer together with detailed specification and data covering performance and materials of construction, parts devices and other accessories.
2. Technical details of respirators.
3. Technical details of Chlorine Test Kits.
4. Proposed panel layout (indicators, meters, switches etc.)
5. Technical details of Exhauster.
6. Printed literature-supporting details given in the questionnaire
7. 14 days before the handing over technical literature on spare parts & maintenance apart from the request made in general specifications should be submitted.

2.8 CHLORINATORS

2.8.1 Chlorinators

These specifications are for the Supply and Installation of Gas Chlorinators and accessories as shown in the drawings in Appendix 02 and as stated in the Bill of Quantities.

Chlorinators shall be suitable for continuous operation and capable of maximum dosing as mentioned in **Clause 13 in Appendix 3** with a minimum meter range as specified in the **Clause 14 in Appendix 3**.

Chlorinators with remote flow meters and change over switch shall be installed as per the drawings.

It shall incorporate a flow meter to indicate the dosing rate, Chlorine gas pressure and operating water pressure gauges, Chlorine gas filter and injector assembly with non-return valves and shall be complete with all connected pipe work (all chlorine solution piping & fittings shall be of suitably sized, 600 type PVC pipes), specials, injection fittings etc., for connecting up to the point of application of Chlorine solution.

Chlorine supply status shall be indicated by means of a loss-of gas indicator operated by the vacuum regulator.

Each chlorinator shall be fitted with a pressure and vacuum relief and vent connections. Vent lines shall extend to the exterior of the building, with ends turned down and covered with insect screens.

Safety precautions to be taken in connection with the storage and handling of chlorine should be provided in the form of warning notices to be mounted at the appropriate places. Please refer the **Clause 17 in Appendix 3** for safety precautions required.

2.8.2 Water Supply and Solution Mixing

The chlorinator's (Booster pump) water requirements shall be met with the available facilities at site. Contractor should supply, install and fixing of all suction and delivery (up to the point where the chlorine solution is fed) pipe lines, fittings specials, valves etc necessary for the proper chlorination system as shown in the drawings & Appendix and instructed by the engineer.

Chlorine solution is fed / injected in the point as mention in the **Clause 18 in Appendix 3**.

The ejectors shall be designed to mix the solution properly (equally distribute) with water.
No of booster pumps & ejectors shall be decided in such a way to assure 100% spare for each booster pump & ejector in operation.
Also the bidders are requested to provide following data with the offer, they are dimensioned layout showing lengths, Pipe sizes etc related to the ejector and comprehensive calculation sheet based on selection of suitable ejectors.

The contractor shall supply and install 2 Nos. booster-pumping units (one standby) shall be provided for chlorinator sets to generate the pressure required (refer the **Clause 6 in Appendix 3** for necessity of booster pumps). These pumps shall be suitably sized so that the required differential pressure is created to draw off the specified dose of chlorine. Relevant calculations shall be submitted with the offer.

Mode of operation of booster pumps is specified in **Clause 7 in Appendix 3** and sequence of operation with necessary controls & displays of booster pumps shall be as instructed by the engineer.

2.8.3 ACCESSORIES

2.8.3.1 CHLORINE RESISTANT WEIGHING SCALES

Please insert specification for weighing scale as mentioned in **Clause 9 in Appendix 3**

Accuracy shall be better than one percent and maximum measuring range as mentioned in the **Clause 10 in Appendix 3**.

Platform should be space enough to keep …….. (***no of cylinders shall be decided depending on requirement***) numbers of cylinders vertically upward and easy exchange of single cylinder without disturbing the other in case of 68kg and incase of 1000kg cylinders platform should be space enough to keep …….. (***no of cylinders shall be decided depending on requirement***) numbers of cylinders horizontally and easy exchange of single cylinder without disturbing the other. The chlorine cylinders shall be mounted on the platform of the weighing scale. Whole and each and every component of the weighing scale should be suitable to use in chlorine rich environment.

2.8.3.2 AUTOMATIC CHANGE OVER SYSTEM

Please insert specification for type of automatic change over system as mentioned in **Clause 11 in Appendix 3**

The automatic change over system shall be provided to avoid interruption of chlorine feeding, it shall consists of a changeover modular which shall sense the low weigh switch when the 'on line' container/s is/are (depending on need) 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 change over module shall be furnished and shall be packaged for prolonged. This package shall clearly identify the contents and equipment to which it applies. The vacuum and vent pipes should be of plastic tubing.

2.8.3.3 KEYS AND TOOLS

All special spanners, keys and other tools required to dismantle and re-erect all equipment to the satisfaction of the Engineer should be supplied by the bidder in a wooden box.

A list of tools/keys supplied in this contract shall be submitted with the offer separately. Tools and other maintenance equipment provided under this item should not be used for the purpose of erection of the works under the contract.

2.8.3.4 CUPBOARD FOR TOOLS & EQUIPMENT

The cupboard shall be of sheet metal construction using 1.5 mm thick steel sheets and the approximate dimensions of 1500x 1200x 450 (H x W x D) mm. Fabrication shall be done using seam or spot welding and shall be finished with gloss white paint in side the cupboard and exterior shall be finished to cream color.
The cupboard shall be fabricated from electro-galvanized mild sheet steel and cold rolled sections bolted together. All steel parts shall be treated effectively against corrosion after manufacturing. The treatment shall include sand blasting, anti-grease, primer and coating. Paint must be sprayed and kiln-dried.
Doors shall be properly hinged to ensure uniform pressure on right along the rubber beading. The front doors shall be made with transparent glass sections and lockable doors. The rubber beading shall be flat type that provides protection against dust and drops of water. Hinges shall be zinc die-casting or stainless steel. The cupboard shall be partitioned in to 4 sections to accommodate the above supplied tools & safety equipment.

2.8.4 SAFETY EQUIPMENT

2.8.4.1 GAS RESPIRATORS

Two gas respirators of reputed make shall be provided for the safety of operators working in the chlorinator room. Respirators shall be of canister type, complete with gas masks and all necessary accessories. The respirators should be store in labeled protective case and positioned in a readily accessible location close to the chlorinator room. (Bidder shall supply relevant literature pertaining to the Gas Respirators)
Supplier shall also install a water shower for eyewash & body wash as safety equipment.

2.8.4.2 CHLORINE LEAK DETECTOR

a. The chlorine leak system can be supplied and installed where the chlorine cylinders and chlorinators are installed (where the panel and other accessories are installed in separate room). Atmospheric chlorine gas detectors shall be supplied which have a minimum sensitivity as mentioned in the **Clause 20 in Appendix 3**. The units shall be completely self-contained with a die cast aluminium or fibreglass case, for wall mounting. All materials of

construction shall be entirely suitable for operation in an atmosphere as may be encountered in a chlorination room. The unit shall include an air-sampling pump, a rotameter electro-chemical sensing cell and indicating meter with alarm contacts and indicating light. A separate light shall indicate instrument failure. Three sets of independent contacts shall be provided for automatic actuation of alarms, exhausters and fans installed in the chlorine cylinder room.

b. In operation the unit shall pump in a filtered air sample, the rate of which may be set by a control valve. The air sample shall enter the sensing cell and produce a signal proportional to only the concentration of chlorine gas in the air. A sensing meter with adjustable contacts shall measure the generated signal, and actuate the alarm circuit (also provision for auto start of exhauster shall be provided). A one year supply of chemicals shall be included. Sufficient flexible sampling hose shall be provided to obtain the sample approximately 75mm above the floor in the locations shown on the plans.

c. A warning audible alarm signal system shall be provided to indicate the chlorine gas leakage.

2.8.4.3 RESIDUAL CHLORINE TEST KIT

A residual chlorine test kit including all reagents suitable for 1000 tests shall be provided. The bid shall supply relevant literature pertaining to the test kit.

2.8.4.4 EXHAUSTER

The bidder shall provide and install an electric motor driven exhausters of numbers as mentioned in the **Clause 21 in Appendix 3** resistant to corrosion to remove air from the chlorine room. Exhauster system shall be sized to have number of air changer per minute of the entire room as mentioned in **Clause 22 in Appendix 3**. The exhauster should be installed just above the floor level and be able to operate manually from out side of the Chlorinator room and auto operation also to be provided as stated above in para 2.8.4.2.b. Noise level of the exhauster shall not be exceeding 65 at dB at 1m.

2.8.5 BOOSTER PUMPS

2.8.5.1 GENERAL

2 Nos. booster-pumping units (one duty and one standby) shall be provided for each chlorinator sets to generate the pressure required. These pumps shall be suitably sized so that the required differential pressure is created to draw off the specified dose of chlorine. Contractor should provide the calculations and other factors which led to size the suitable booster pumps with the offer.

The contractor shall supply the booster pumps complete with suitably sized suction and delivery piping, valves, solution diffusers and other necessary fittings. Each booster pump shall start and stop as mentioned in **Clause 7 in Appendix 3** and shall be supplied with a push button DOL starter with overload protection. All booster pumps, starters, chlorinators and accessories shall be installed as shown in the relevant drawings.

Mode of operation of booster pumps is specified in **Clause 7 in Appendix 3** and sequence of operation with necessary controls & displays of booster pumps shall be as instructed by the engineer.

2.8.5.2 PUMP TYPE

Booster pump shall be an inline centrifugal type pumps. All pumps, motors and accessories to be supplied under this contract shall only be from the approved factory location and it shall be suitable for chlorine rich environment.

2.8.5.3 CONSTRUCTION MATERIALS

Shaft	-	Stainless steel conforming to BS 970 Grade 431S29
Impeller	-	Stainless steel conforming to BS 970 Grade 431S29
Casing	-	Cast Iron conforming to BS 1452: Grade 220/ Stainless steel conforming to BS 970 Grade 431S29
Shaft sleeves	-	Stainless steel conforming to BS 970 Grade 431S29
Gland Bush	-	Stainless steel conforming to BS 970 Grade 431S29

2.8.5.4 ELECTRIC MOTORS AND LT EQUIPMENT

All motors shall be of Energy Efficient Continuous three/single phase Squirrel Cage induction type suitable for direct-on-line/star-delta starting, with starting current not exceeding 6 times full load current unless specifically detailed in the relevant sections as an alternative arrangement.

Design of the motors shall be such that they can operate within + 6% of the nominal voltage continuously without damage. Synchronous speed shall be 3000/1500 rpm.

All motors shall be suitable for operation at 400 Volts 3 phase or 240 Volts single phase and 50 Hz supply and shall comply with following general standards and norms:

- IEC 34-1, 34-5, 34-6 and 34-8.

Non-submerged motors shall be designed for running conditions as mentioned in **Clauses 1&2 in Appendix 3**

All motors shall be suitable for operation in the site climatic conditions.

Motors shall be of class F insulation of NEMA standards but the operating temperature rise shall be restricted to that of class B

Motor bearings shall be of high-precision manufacture, antifriction type designed for a continuous (24 hrs/day) duty life of 70,000 hours.

Motor enclosures shall be protected to IP55**.**

The motors shall be coupled to the pump through a semi flexible coupling.

Motors shall be continuous duty type (duty designation - S1) with minimum 6 starts per hour and the ratings of the Motors shall be at least 10% more than the power required by the pump at the specified duty point.

2.8.5.4.1 Starter and control panel for each booster pump

Following features shall be accommodated in the starter and control panel.

1. Indicator lamps to power supply
2. Indicator lamps to indicate following,
   - Pump Running
   - Pump Stopped (Manual)
   - Pump Tripped (Overload/Thermal Tripped)
3. Duty selector and mode selector switch for pumps as
   - P1/P2
   - Mode of operation as mentioned in **Clause 7 in Appendix 3**
4. Push Buttons for pumps
   - Start
   - Stop
   - Reset
5. Any other control system as instructed by the engineer

2.8.5.5 SPARES

2.8.5.5.1 SPARES FOR CHLORINATORS

The following List of Spares for the Chlorinator shall be supplied with the offer separately.

1.	O' Rings	02 Set
2.	Gaskets	02 Set
3.	Springs	02 Sets
4.	Throat (Ejector)	01 No.
5.	Tailway (Ejector)	01 No.
6.	Diaphragms	06 Nos.
7.	Regulating Cartridge Assembly	02 Nos.
8.	Diaphragm body	06 Nos.
9.	Flow Meter Tubes	02 Nos.
10.	Vacuum Gauges	01 No.
11.	Specific spares for type of chlorinator selected	

2.8.5.5.2 SPARES FOR BOOSTER PUMPS

Following spares shall be provided for booster pumps for each site.

1	Impeller	01 Set.
2	Shaft sleeves	02 Sets
3	Pump bearings	02 Sets
4	Impeller neck rings	01 Set
5	Lantern rings	01 Set
6	Couplings bushes	01 Set
7	Mechanical Seal	02 Sets
8	All gaskets, seals and packing	02 Sets
9	Stuffing box gland with nuts & bolts.	01 Set

An itemized price list should be attached with the offer.

3 SPECIFICATION FOR LIME AND ALUM/POLY ALUMINUM CHLORIDE DOSING PACKAGES

3.1 SCOPE OF WORK

Each Dosing packages shall consist of a packaged type lime, alum/poly aluminum chloride dosing systems and all necessary appurtenances to provide complete dosing system.
The contractor shall require that the pumping units specified herein are supplied by a single manufacture. The contractor shall supply install, test, commission and hand over the package dosing systems which consists of dosing pumps, necessary pipes, valves, fittings, specials, incoming, starter & control panels, necessary cables, solution mixing tanks with necessary accessories, stirrer with motor and reduction gear box arrangement, supporting arrangements of stirrer motor, tanks pumps etc (which are not mentioned here but necessary for the dosing system also to be included) to the satisfaction of the Engineer.

3.2 CHEMICAL DOSING PACKAGES

These specifications are for the supply and installation of Lime and Alum/Poly aluminum chloride Dosing Packages with accessories, pipe works, valves, fittings, stirrer with motor and reduction gear box arrangement tanks, supports and electrical work at place as mentioned in **Clause 21 in Appendix 3**.

The dosing rate and feeding points of alum/poly aluminum chloride & lime dosing system is mentioned in **Clauses 24, 25, 26 & 27 in Appendix 3**.

The materials of construction of the respective package shall be totally chemically resistant to the liquid being dosed at ambient temperature range as mentioned in **Clause 2 in Appendix 3**.
The chemical dosing system shall be properly sized to feed the given dosage to the feeding point mention in **Clauses 24 & 26 in Appendix 3.** All PVC pipes shall be properly guided suitable bracket/pipe trench, supports arrangement from chemical tanks to each feeding point.

3.3 LIME DOSING PACKAGE

1. Solution Tanks as mentioned in **Clause 28 in Appendix 3** complete with electric Mixer with motor and reduction gear box, Empty Signal sensor, solution pipe work to the feeding points with isolating valves, Drain and over flow valves, water fill valves, level gauges and flushing system.
2. Number of dosing pumps shall be as mentioned in **Clause 33 in Appendix 3**
3. A system/process shall be provided to remove sand and impurities available in lime solution to protect dosing pumps and systems from damages caused by sand and impurities.
4. All piping and necessary accessories from suction to feeding points shall be provided. Pipes shall be as mentioned in **Clause 34 in Appendix 3** and arrangement for flushing the pipes shall be provided. The pipes shall be capable of adjustable constant flow rate of forced flow-feeding system of Lime solution to the feeding points. The piping arrangement shall be designed up to chemical feeding point as mentioned in the drawings and directed by the engineer.
5. Dosing system shall be complete with the following accessories Pressure Relief Valves, Pulsation dampers with vent valves and drain valves, pressure gauges, flow meters, Pressure retention valves, and Automatic flushing system whenever the pumps come to rest, piping and Textile - Fiber Transparent Plastic hosing of approximate length 10 m for solution being pumped.

3.4 ALUM DOSING PACKAGE/POLY ALUMINIUM CHLORIDE DOSING PACKAGE

1. Solution Tanks as mentioned in **Clause 30 in Appendix 3** complete with electric Mixer with motor and reduction gear box, Empty Signal sensor, solution pipe work to the feeding points with isolating valves, Drain and over flow valves, water fill valves, level gauges and flushing system.
2. Only for Poly aluminium chloride dosing package, a dust collector/scrubber shall be provided to extract the dust comes from Poly aluminium chloride powder when emptying the bags in to the solution mixing tanks.
3. Number of dosing pumps shall be as mentioned in **Clause 32 in Appendix 3**
4. All piping and necessary accessories from suction to feeding points shall be provided. Pipes shall be as mentioned in **Clause 35 in Appendix 3** and arrangement for flushing the pipes shall be provided. The pipes shall be capable of adjustable constant flow rate of forced flow-feeding system of Alum/Poly aluminium chloride solution to the feeding points. The piping arrangement shall be designed up to chemical feeding point as mentioned in the drawings and directed by the engineer.
5. Dosing system shall be complete with the following accessories Pressure Relief Valves, Pulsation dampers with vent valves and drain valves, pressure gauges, flow meters, Pressure retention valves, and Automatic flushing system whenever the pumps come to rest, piping and Textile - Fiber Transparent Plastic hosing of approximate length 10 m for solution being pumped.

3.5 SOLUTION TANKS

Solution tanks for mixing of Alum/Poly aluminium chloride and Lime powder shall be as mentioned in **Clause 28 & 30 in Appendix 3** and should be resistance to solution handled & the environmental conditions and strong enough.
The solution tanks supplied and installed in this contract should be of new, with no defects and can be used for the purpose intended for minimum of years as mentioned in Appendix. Contractor should warrant the items supplied in this contract as specified above. It shall be provided easy accesses to put the chemical into the tank without any inconvenient. When supplying circular tanks consider the space available at site where these tanks are to be installed. The capacity of each solution tank shall be as mentioned in **Clause 28 & 30 in Appendix 3**. The solution tanks (if necessary) can have suitable coating conform to the international food quality standards.
The contractor shall supply and install number of Solution mixing tanks as mentioned in **Clause 28 & 30 in Appendix 3** with isolating valves, Drain and over flow valves, water fill valves, level gauges and flushing system etc.
(Refer the Detail drawings in Appendix 02&06).

3.6 ELECTRIC STIRRER

Each solution tank shall be fitted with Electric stirrer with adequate supports, geared to generous capacity and speed, and arranged so that no bearings are in contact with the solution being agitated. The Stirrers should be suitable for a supply Voltage of 230 V 50 Hz single phase or 400 V
50 Hz Three phase. The propeller/blades and shaft shall be made out of stainless steel and conform to the international food quality standards and fully resistant to the liquid being agitated.
Contactor shall supply and install one stirrer to each solution tank with all brackets and supporting arrangements etc.

Rotation speed (Revolution per minute) of the Stirrer shall be manually adjustable by micrometer or by any other means.
Motors used to drive stirrers can be single phase 230V±5% or three phase 400V±5%, 50Hz.
Speed reduction gear box shall be supplied and installed for the stirrers if requirement arises.

3.7 SOLUTION FEEDING PUMPS

Pumps shall be positive displacement diaphragm type chemical dosing pumps suitable for feeding Lime and Alum/Poly aluminium chloride solutions complete with squirrel cage induction motors, motor control center and other accessories to suit the requirements given in specifications.

3.8 OPERATING CONDITIONS AND CONSTRUCTION FEATURES

Dosing pumps shall be suitable for pumping metered amount of the dosing solution with specific gravity 1.05, at a maximum temperature of 40 °C.

The Alum/ Poly aluminium chloride & Lime feeding pumps shall be suitable to feed the capacity given in **Clause 25 & 27 in Appendix 3**, the pump head shall be decided by the contractor to satisfy the requirement (contractor shall submit calculation which leads to select the suitable feeding pumps with the offer). If the pump parameter such as Capacity is not met as indicated by the bidder, it shall be corrected without any additional costs as directed by the engineer.

Dosage shall be manually adjustable by micrometer adjustment from 0% to 100% of the pump capacity while the pump is in operation. Accuracy of the pumps shall be within 2 %.

The dosing pumps shall have diaphragm dosing heads and special valves suitable for handling abrasive media. Diaphragms shall be of Teflon or Polytetrafluoro ethylene (PTFE) coated and shall be immune from degradation by air or oil.

An alarm signal shall automatically come on in case of a diaphragm leakage. Automatic cut off shall be provided to stop the pumps when liquid level in the solution tanks drops below a predetermined level and when there is less flow in the solution feeding points.

The suction line of each pump shall be as short as possible from the solution tank to the pump.

As the dosing takes place into an open channel, a pressure retention valve shall be fitted at the feeding points.

An automatic flushing system shall be fitted in the suction lines between the tank and the pump for flushing the line with water when the pumps are stopped.

The suction lines of the pumps shall be permanently connected to solution tanks and to a clear water line with quarter turn valves for flow control to have provision for cleaning the pipe lines after use.

Materials of construction of parts in contact with the pumped liquid shall be of corrosion proof and chemical resistant.

Textile - fiber transparent Plastic hosing capable of withstanding the working pressures and direct exposure to Sun light shall be used as dosing lines.

Individual isolating valves shall be fitted to suction and discharge section of all pumping units to make it possible to isolate a pump for repair or maintenance while the other pump is working.

Pressure relief valves shall be fitted to both pumps to protect the pumps and pipe works.

Pulsation damper shall be included to provide smooth operations of the system.
The pumps shall be capable of continuous operations and capable of a minimum number of starts per hour as mentioned in **Clause 32 & 33 in Appendix 3**.
The bearings shall be adequately sized and greased sufficiently for at least 25,000 hours continuous smooth and vibration free operation.

Dosing system shall be complete with Pressure Relief Valves, Pulsation dampers with vent and drain valves, pressure gauges, flow meters, Pressure retention valves, Automatic flushing system whenever the pumps come to rest, PVC piping and Textile - Fiber Transparent Plastic hosing and all other accessories necessary for complete system.
Motors used to drive pumps can be single phase 230V±10% or three phase 400V±10%, 50Hz and as mentioned above.

Construction Materials

Head	- Poly Propylene (PP)
Valves	- Ethylene Propylene Diene Monomer (EPDM)
Diaphragm	- Poly tetrafluoro ethylene (PTFE)
Resonating diaphragm	- Poly tetrafluoro ethylene (PTFE)
O-rings	- Ethylene Propylene Diene Monomer (EPDM)
Assembly screws	- Resistive for the liquid handling and the environment

3.9 STARTER AND CONTROL PANEL FOR DOSING PUMPS

Following features shall be accommodated in the starter and control panel.

1. Indicator lamps to power supply
2. Indicator lamps to indicate following,
    - Pump Running
    - Pump Stopped (Manual)
    - Pump Tripped (Overload/Thermal Tripped)
3. Duty selector switch for selection of pumps as
    - P1/P2 etc
4. Push Buttons for pumps
    - Start
    - Stop
    - Reset
5. Audio visual display for diaphragm leakage
6. Display for low solution at solution tank
7. Display for less water flow at relevant feeding points (same as in the booster pump panel)

3.10 STARTER AND CONTROL PANEL FOR STIRRERS

1. Indicator lamps to power supply
2. Indicator lamps to indicate following,
    - Stirrer Running
    - Stirrer Stopped (Manual)
    - Stirrer Tripped (Overload/Thermal Tripped)
3. Duty selector switch for selection of stirrers as
    - S1/S2 etc
4. Push Buttons for stirrers
    - Start
    - Stop
    - Reset

3.11 TECHNICAL LITERATURE

3.12 The following shall be provided with the offer,

a. A schematic diagram of the proposed layout of Tanks, pipes specials & arrangement of pipe work
b. Printed literature supporting all details given in the questionnaire
c. A set of pump curves indicating efficiency input power and Head (Total Pumping Head) as a function of discharge.
d. Sectional drawing of the pump and agitator and gear box indicating all components and materials.

3.13 The following in three copies, shall be provided by the contractor at least 14 days before handing over,

a. Start up procedure, operation and maintenance manual
b. Illustrated spare parts manual l

3.14 SPARES

3.14.1 Spares for each Dosing Package

Following spare parts shall be supplied for each dosing package separately with the offer.

1. Diaphragm - 02 No
2. Suction valve - 02 No
3. Back pressure valve - 02 No
4. Pressure relief valve - 02 No
5. Motor bearings - 02 Set
6. Stuffing box gland with nuts & bolts - 02 Set
7. Indicator lamp covers - 02 Set
8. Indicator lamps - 02 Set
9. Fuses - 02 Set
10. Thermal overload - 02 Set of each
11. An additional stirrer complete with motor and gear box - 01 No

An itemized priced list of spares shall also be submitted with the offer.

3.15 TESTING AT MANUFACTURER'S WORKS

The pumping units shall be tested at manufacturer's works prior to shipment and the contractor shall supply the test results of the pumping sets along with the shipping documents. These results shall include curves of head, input power and overall efficiency plotted against discharge.

4 SPECIFICATIONS FOR HOISTING EQUIPMENT AND ACCESSORIES

4.1 GENERAL REQUIREMENTS

The contractor shall be responsible for the design, supply and installation of the complete overhead gantry crane /monorail hoists as mentioned in **Clause 37, 39 & 40 in Appendix 3**. Contractor shall guarantee the complete lifting equipment shall be operated without any harmful torsion or other stress during lifting up, lifting down, transverse and travelling at the rated load. The lifting equipment shall meet the requirements and conditions shown in the drawings but not limited to that. The mode of operation of the lifting equipment shall be as mentioned in **Clause 38 in Appendix 3**. Correct the paragraph with in bracket ***(single girder crane with electrically operated hoist and manual transverse movement. The total overhead monorail hoist and accessories shall be constructed to operate safely, accurately, adequately, durably and easy for maintenance. Before fabrication of the overhead monorail hoist and accessories, the contractor should determine its major dimensions with careful investigation in the chemical house and shall be submitted for the approval of engineer)***.
Design, supply, installation, commission and handing over should be according to the relevant BS or International standards. All members of the crane shall have minimum safety factor of 5.0 based on the ultimate load.

4.2 SPECIFICATIONS

The orientation, clearances, operating levels, spans, travel, access and limiting dimensions shall be in accordance with the specification and the Drawings. Refer Drawing Nos W892/12/01, 02, 03 & 05 in Appendix 02,

Where any of the common parts below are incorporated in hoists, cranes, or lifting equipment they shall conform to the following specifications.

Lifting hooks shall comply with BS 2903, incorporate a safety catch and shall be capable of swiveling through 360 deg.

Top suspension hooks shall comply with BS 2903.

Load chains shall be grade 80 alloy steel chain to BS 3114 and shall be contained in suitably sized chain buckets fitted to the hoist assembly.

Hand chains shall be grade 30 mild steel chains to BS 590 and have lengths as shown on the drawings.

Bearings shall be ball or cylindrical roller type to BS 292.

Wire rope lings shall comply with BS 1290.

Shackles shall comply with BS 3032.

Eyebolts shall comply with BS 4278.

Rating plates, Cranes, hoists, lifting equipment runway beams shall be provided with suitable plates giving safe working loads. Wording in English

Rails may be the flat bottom type supplied complete with holding down bolts or square section welded to the beams.

The lifting capacity of cranes shall be sufficient for the heaviest single item in the chemical room (Chlorine cylinder), but in any case the lifting capacity shall not be less than 1.5 tones.

4.3 SCOPE

The contractor shall refer the relevant drawings before starting any works related to the overhead monorail hoist.
Under this contract, following all should be designed, supplied, installed, commissioned and handed over to the satisfaction of the engineer.

- Cross beams on the cobles of concrete columns
- Monorail fixing on the cross beams
- Overhead monorail hoist
- All other required accessories and components which are not mention here but necessary for proper and smooth operation of the Overhead monorail hoist.

4.4 TESTING ON MANUFACTURERS PREMISES:

All hoists, cranes and lifting equipment shall be tested at the place of manufacture in accordance with BS 3243; deflections shall be in accordance with BS 466 and 2573. Please submit test reports on delivery of equipments.

4.5 TESTS ON COMPLETION:

After installation of cranes shall be retested. The Contractor shall provide all loads and other materials and equipment for the tests. The traveling cranes and hoist shall be subject to safe working load running tests.

4.6 SAFETY

The lifting cage shall be properly designed with suitable safety cables, self-lock etc. After installation the equipment shall be retested.

4.7 LIFTING ARRANGEMENT AND ACCESSORIES FOR CHEMICAL

4.7.1 CHEMICAL LIFTING

The plant has been designed to receive supplying of chemicals by road transport to chemical stores at chemical house ground floor.
The lifting arrangement (lift for goods) is to be designed to take chemical bags from ground floor to upper floor through the slab opening of size of 1750mm x 1750mm. Then it shall be carried by a hand operated trolley and emptied in to relevant mixing chamber directly. Refer the Drawings in Appendix 02. All tanks shall be provided with suitable arrangement to put the chemicals in to the tanks having time saving and minimum wastage.

4.7.2 LIFTING BUCKET

The lifting bucket shall be used to lift alum/Poly aluminium chloride or lime filled bags to the upper floor. This bucket shall be made out of steel and shall be painted with suitable paints which are resistive to chemicals handled.

4.7.3 HOIST OPERATION

Two-dimensional (2-D) Movement shall be driven by electric motor and manually. The lift shall be electrically driven motor operated and longitudinal (transverse) movement can be done manually. A hanging type control unit shall be provided with the hoist to control the lifting arrangement from upper floor. The necessary clamps and accessories should be offered to satisfy the requirement of the 500 kg capacity hoist. In case 1000 kg chlorine gas cylinders are used in the treatment plant then a 1.5 tons hoist shall be provided with above mentioned facility to handle the chlorine cylinders.

4.8 ACCESSORIES

4.8.1 CHEMICAL CARRIAGE TROLLEY

Two numbers of two wheel hand operated trolleys shall be supplied to carry the alum and lime bags (sketch of chemical carriage trolley is given in Appendix 06), each shall be sufficient to load maximum of 250 kgs and having easy loading and unloading facility.
These trolleys shall be made out of steel and properly galvanized or protected by any other means against corrosion, erosion and durable. Dimensions of the hand operated trolley can be according to the space available in the ground and upper floor of the chemical house and size of the goods (chemical bags) to be carried. Please refer the relevant drawings. Contractor should provide all sketches, specifications of trolleys with the offer.

4.8.2 CHLORINE CYLINDER CARRIAGE TROLLEY

One number of two wheel hand operated trolley shall be supplied to carry chlorine cylinders (sketch of chlorine cylinder carrying trolley is given in Appendix 07), trolley shall be sufficient to carry two numbers of 68kgs chlorine cylinders at a time and having easy loading and unloading facility.
The trolley shall be made out of steel and properly galvanized or protected by any other means against corrosion, erosion, shall suitable for chlorine rich environment and durable. Dimensions of the hand operated trolley can be according to suit the space available in the chlorinator house Contractor should provide all sketches, specifications of trolleys with the offer.

5 SPECIFICATIONS FOR WATER SAMPLING COLLECTION SYSTEM

5.1 GENERAL REQUIREMENTS

Samples of water at various stagers in the treatment plant process are required for monitoring water quality. The locations of the sample abstraction points are listed in the **Clause 36 in Appendix 3**together with the instruments and sample taps they serve. The contractor shall provide for making all sample abstraction points and installing and fixing all necessary valves & pipe work,

The capacity size and length of pipe work shall be according to the needs of the monitoring units supplied so as to cause the minimum delay from sampling point to delivery point. The velocity of flow within pipes feeding sample taps or monitoring equipment shall be adequate to prevent silting within the pipes and significant distortion of the quality of the sample at the delivery point.

The sampling points shall be designed and sited to take representative samples. Wherever possible they shall remain immersed, not close to walls or the invert of channels and delivery line shall be ended at common stainless steel washbasin in the laboratory.

Sampling pumps, panels, cables and accessories shall be supply and installed for collecting water samples as mentioned in **Clause 36 in Appendix**. Pump operating switches shall be ended up at sample collecting point (closer to wash basin) in the laboratory (refer the relevant drawings).

Contactor should supply, install, commission and handing over of the total sample collecting (from point of abstraction to the sample collecting points) system to the satisfaction of the engineer.

5.2 SERVICE WATER ARRANGEMENT

Any arrangement necessary to provide service water within treatment plant site shall be done according to the site arrangement and as instructed by the Engineer.

6 SPECIFICATION FOR LABORTERY EQUIPMENT

(Requirement of the laboratory equipment depends on the treatment plant capacity and facilities select suitable equipment & accessory from below given and also alter the relevant BOQ)

6.1. Electronic Balance

Readability	: -	0.01 mg
Capacity	: -	200 g min
Reproducibility	: -	+/-0.1 mg
Response Time	: -	03 Sec, or less
Size of Pan	: -	Stainless Steel or non corrosive metal dia. 75-100 mm
Calibration	: -	Internal Automatic and Manual calibration
Operating Temperature	: -	Ambient - 40^{o}C
Space above the pan	: -	200 mm (min)
Power	: -	AC 230 V, 50 Hz
Standard features	: -	Draught shield, Level indicator, sealed keypad for spill protection
Installation	: -	The balance should be installed at the laboratory of the treatment Plant. After installation the balance should be calibrated by the supplier.
Warranty	: -	02 years (Min)

6.2. NESSLERIZER

For visual colorimetric analysis of dilute solution using a 50/100 ml. of samples with provision for relatable under mentioned color discs and prism viewing head with white light cabinet containing day light correction filter

- Iron disc (0.0 – 1.0 mg/1) Method : - Thioglycolic acid
- Fiuoride disc (0.2 – 1.5 mg /1) Method : - Acid Zirconium alizarin
- Aluminium disc (0.5 – 4.0 µg) Method : - Straight colour match to samples
- Nesslar cylinders, Soda lime glass – capacity 100 ml
- Warranty 02 years (Min)

6.3. CONDUCTIVITY METER

Scale 0-10,000 microsemons/cm
Battery operated or AC 230V, 50HZ
Temperature compensation 0 – 100^{0}C with carrying case and instruction manual
Warranty - 02 years (Min)

6.4. LABORATORY FLOCCULATOR

Six stainless paddles
Digital read out
Variable speed (10 – 300 rpm)
With illuminator, anti glare curtain and dust cover
Power: 230 V, 50 Hz
Warranty 02 years (Min)

6.5. TURBIDITY METER

Range	: -	0-1000 NTU
Resolution	: -	0.01 – 0.1 Unit
Precision	: -	2%
Detector	: -	Silicon Photodiode
Calibration standards	: -	2 minimum
Sample cells	: -	5 minimum
Standardization	: -	Turbid solutions with known turbidity values
Power	: -	DC or AC if DC battery charger should be provided 240V, 50 Hz
Warranty	: -	02 years (Min)

6.6. pH /MV METER WITH COMBINED GLASS ELECTRODE

Range pH	: -	0 –14
mV	: -	+/- 1999
Accuracy pH	: -	+/- 0.01 min.
mV	: -	+/-1 min
Calibration	: -	Manual / Automatic
Calibration standards	: -	pH 4, 7 and 10
Temperature Compensation	: -	Automatic
Power	: -	DC with battery charger 230V, 50 Hz. with operation manual and service manual
Warranty	: -	02 years (Min)

6.7. COMPARATOR FOR RCI

Calibrated colored standards for D.P.D.

02 number of Sample cells

Range 0.1 – 2.0 mg/l

Sample volume : - 10 ml

Day light illumination system for the above comparator

6.8. WATER DISTILLATOR

Water distillator, electrically heated, 220 - 240 VAC with automatic cut out, output 3 -4 litters per hour with stainless steel or borosilicate glass operating parts. Conductivity 1-2 µs/cm with pyrogen free distilled water.02 years minimum warranty.

6. SCHEDULE OF PARTICULARS

QUESTIONNAIRES

1.0 QUESTIONNAIRE FOR CHLORINATORS AND ACCESSORIES

1.1 CHLORINATORS

1. Make and Country of Manufacture: .....
2. Model :.....
3. Type :.....
4. What is the feed range and control possible: .....
5. Is the Feed Range manually adjustable: .....
6. Type of Chlorine flow indicator: .....
7. Accuracy of chlorine flow indicator: .....
8. What is the maximum Operating Water Pressure: .....
9. What is the solution Discharge Pressure: .....
10. The operating temperature range: .....
11. Is a Chlorine Pressure Gauge provided: .....
12. If so, type and size of dial: .....
13. Is an operating water pressure Gauge provided: .....
14. If so, type and size of dial: .....…
15. Chlorinator diaphragm material: .....
16. Seat material: .....
17. Is corrosion resistance material used for the chlorinator: .....
18. Are two check valves provided to prevent ingress of water to chlorinator:..... .....……
19. The type of valves provided: .....
20. Is chlorine supply status indicated on the chlorinator: .....
21. The type of piping and connections used for chlorine supply line from cylinder: .....……
22. The type of piping used for vacuum and vent pipes and connections:.....
23. Type of "Y" strainers provided: .....

24. Does a loss in operating water pressure automatically shut-off the chlorine gas flow?.....

25. The type and make of cabinet: .....……..

26. Type of Diffuser: .....

1.2 BOOSTER PUMPING SETS AND ACCESSORIES

1.2.1 PUMP

1 Make and Country of Manufacture:-

2 Type:-

3 Model:-

4 Stagers:-

5 R.P.M.:-

6 Capacity at duty point m^3/hr: -

1.2.2 MOTORS

1 Make and Country of Manufacture:-

2 Model:-

3 Nr. of Poles :-

4 Voltage :-

5 Class of Insulation :-

6 Rated output in kW :-

7 Current approximate in Amps at rated output :-

8 Speed in R.P.M. at rated output:-

1.2.3 STARTERS

1 Make and Country of Manufacture:-

2 Whether push button operated:-

1.2.4 EXTRACTOR (Exhauster)

1 Make and Country of Manufacture:-

2 Model: -

3 Capacity:-m^3/Hr:-

4 Noise level at 1m (dB): -

5 Size (Diameter mm): -

1.2.5 WEIGHING SCALES

1 Make and Country of Manufacture: -

2 Model: -

3 Type of Operation: -

1.2.6 CHLORINE LEAK DETECTOR

1 Make and Country of Manufacture: -

2 Model: -

3 Type of Operation: -

1.2.7 OTHERS

1. Is chlorine measuring scale provided to measure the weight of chlorine in cylinders?

2. What is the type of safety equipment provided? :-

3. The type and make or Residual Chlorine test kit provided:-

4. Whether available ex-stock in Mahawa: -

5. Otherwise, approximate date of delivery:-

2.0 CHEMICAL CARRYING TROLLEY

1. Make and Country of Manufacture: -
2. Type: -
3. Model: -
4. Capacity: -
5. Material: -
6. No of cylinders, this can carry.
7. Whether it suitable for chlorine rich environment.

3.0 CHLORINE CYLINDER CARRYING TROLLEY

1. Make and Country of Manufacture: -
2. Type: -
3. Model: -
4. Capacity: -
5. Material: -
6. No of cylinders, this can carry.
7. Whether it suitable for chlorine rich environment.

4.0 HOISTING EQUIPMENT FOR CHEMICALS

1. Make and Country of Manufacture: -
2. Type: -
3. Model: -
4. Capacity: -
5. Motor power: -
6. Full load current: -
7. Nominal supply voltage, frequency and number of phase: -
8. Allowable voltage fluctuation: -
9. Details of similar works carried out in the past 3 years :-
10. Details of similar facilities available
    (a). Machinery
    (b). Location of workshop
11. Details of technical staff to be deputed to carry out the installation work: -

5.0 HOISTING EQUIPMENT FOR TONNERS

1. Make and Country of Manufacture: -
2. Type: -
3. Model: -
4. Capacity: -
5. Motor power: -
6. Full load current: -
7. Nominal supply voltage, frequency and number of phase: -
8. Allowable voltage fluctuation: -
9. Details of similar works carried out in the past 3 years :-
10. Details of similar facilities available
    (a). Machinery
    (b). Location of workshop
11. Details of technical staff to be deputed to carry out the installation work: -

6.0 QUESTIONNAIRE FOR ALUM/POLY ALUMINIUM CHLORIDE DOSING PACKAGES

6.1 DIAPHRAGM TYPE ALUM/ POLY ALUMINIUM CHLORIDE DOSING PUMPS

	Pump: -	**Alum/Poly aluminium chloride**
1	Make and Country of Origin :-	
2	Type :-	
3	Model No. :-	
4	Maximum Capacity L/hr :-	
5	Capacity at specified head, Is characteristic curve provided :-	
6	Inlet diameter/outlet diameter mm :-	
7	Pump Casing Material :-	
8	Diaphragm Material :-	
9	Type of Bearings :-	
10	No. of Strokes/Min :-	
11	Make, model and type of the pressure relief valve :-	
12	Make, model and type of the pressure retention valve :-	

	Motor: -	**Alum/Poly aluminium chloride**
1	Make and Country of Origin :-	
2	Model/Type No. :-	
3	Model No :-	
4	Nominal Supply voltage (V) :-	
5	Allowable voltage fluctuation % :-	
6	Synchronous speed (RPM) :-	
7	Full load power factor :-	
8	Insulation Class :-	
9	Enclosure protection class (IP No):-	

6.2 TANK

		Alum/Poly aluminium chloride
1	Country of origin:	
2	Name and Address of the Manufacture:-	
3	Tank capacity:-	
4	Material of construction:-	
5	Material Thickness:-	
6	Coating Material and Thickness:-	
7	Whether coating material is food quality:-	
8	Warranty certificate for the coating:-	
9	Whether it provide suitable provision to put chemical easily:-	
10	Other :-	

6.3 STIRRER

		Alum/Poly aluminium chloride
1	Name and Address of the Manufacture:-	
2	Make: -	
3	Model: -	
4	Type: -	
5	Material of construction of the Impeller and Shaft	
6	Number of blades in the Impeller and diameter of the shaft: -	
7	Rotating Speed: -	
8	Whether speed reduction Gear box provided: -	
9	If yes, Mentioned the Gear ratio: -	
10	Nominal supply voltage frequency and number of phase: -	
11	Allowable voltage fluctuation: -	
12	Full load out put power: -	
13	Full load current: -	
14	Power factor at full load: -	
15	Class of insulation: -	
16	Enclosure protection class (IP No): -	
17	Motor Efficiency: -	

6.4 SCRUBBER/DUST EXTRACTOR FOR POLY ALUMINIUM CHLORIDE

1. Method of extraction
2. Country of origin
3. Model No
4. Made of material

6.5 CONTROL PANEL FOR ALUM/ POLY ALUMINIUM CHLORIDE STIRRER

		Alum/Poly Aluminum Chloride
1	Name and Address of the Manufacture:-	
2	Make: -	
3	Country of Manufacture: -	
4	Make of MCB: -	
5	Rating's of MCB: -	
6	Type of Starter: -	
7	Make of Starter: -	
8	Make of water level switch: -	
9	Type/Operation of water level switch:-	
10	Whether dry running protection is provided:-	
11	Whether all control wires in the starter and LT Panel are lugged and connected:-	
12	Whether all control wires are numbered: -	

6.6 CONTROL PANEL FOR ALUM DOSING PUMP

		Alum/Poly Aluminum Chloride
1	Name and Address of the Manufacture:-	
2	Make: -	
3	Country of Manufacture: -	
4	Make of MCB: -	
5	Rating's of MCB: -	
6	Type of Starter: -	
7	Make of Starter: -	
8	Make of water level switch: -	
9	Type/Operation of water level switch:-	
10	Whether dry running protection is provided:-	
11	Whether all control wires in the starter and LT Panel are lugged and connected:-	
12	Whether all control wires are numbered: -	

7.0 QUESTIONNAIRE FOR LIME DOSING PACKAGES

7.1 DIAPHRAGM TYPE LIME DOSING PUMPS

	Pump: -	**Lime**
1	Make and Country of Origin :-	
2	Type :-	
3	Model No. :-	
4	Maximum Capacity L/hr :-	
5	Capacity at specified head, Is characteristic curve provided :-	
6	Inlet diameter/outlet diameter mm :-	
7	Pump Casing Material :-	
8	Diaphragm Material :-	
9	Type of Bearings :-	
10	No. of Strokes/Min :-	
11	Make, model and type of the pressure relief valve :-	
12	Make, model and type of the pressure retention valve :-	

	Motor: -	**Lime**
1	Make and Country of Origin :-	
2	Model/Type No. :-	
3	Model No :-	
4	Nominal Supply voltage (V) :-	
5	Allowable voltage fluctuation % :-	
6	Synchronous speed (RPM) :-	
7	Full load power factor :-	
8	Insulation Class :-	
9	Enclosure protection class (IP No):-	

7.2 TANK

		Lime
1	Country of origin:	
2	Name and Address of the Manufacture:-	
3	Tank capacity:-	
4	Material of construction:-	
5	Material Thickness:-	
6	Coating Material and Thickness:-	
7	Whether coating material is food quality:-	
8	Warranty certificate for the coating:-	
9	Whether it provide suitable provision to put chemical easily:-	
10	Other :-	

7.3 STIRRER

		Lime
1	Name and Address of the Manufacture:-	
2	Make: -	
3	Model: -	
4	Type: -	
5	Material of construction of the Impeller and Shaft	
6	Number of blades in the Impeller and diameter of the shaft: -	
7	Rotating Speed: -	
8	Whether speed reduction Gear box provided: -	
9	If yes, Mentioned the Gear ratio: -	
10	Nominal supply voltage frequency and number of phase: -	
11	Allowable voltage fluctuation: -	
12	Full load out put power: -	
13	Full load current: -	
14	Power factor at full load: -	
15	Class of insulation: -	
16	Enclosure protection class (IP No): -	
17	Motor Efficiency: -	
18		

7.4 CONTROL PANEL FOR LIME STIRRER

		Lime
1	Name and Address of the Manufacture:-	
2	Make: -	
3	Country of Manufacture: -	
4	Make of MCB: -	
5	Rating's of MCB: -	
6	Type of Starter: -	
7	Make of Starter: -	
8	Make of water level switch: -	
9	Type/Operation of water level switch:-	
10	Whether dry running protection is provided:-	
11	Whether all control wires in the starter and LT Panel are lugged and connected:-	
12	Whether all control wires are numbered: -	

7.5 CONTROL PANEL FOR LIME DOSING PUMP

		Lime
1	Name and Address of the Manufacture:-	
2	Make: -	
3	Country of Manufacture: -	
4	Make of MCB: -	
5	Rating's of MCB: -	
6	Type of Starter: -	
7	Make of Starter: -	
8	Make of water level switch: -	
9	Type/Operation of water level switch:-	
10	Whether dry running protection is provided:-	
11	Whether all control wires in the starter and LT Panel are lugged and connected:-	
12	Whether all control wires are numbered: -	

8.0 CUPBOAR0D

		Description
1	Name and Address of the Manufacture: -	
2	Type of material used: -	
3	Thickness of material used: -	
4	Size of the Cupboard: -	
5	Coating Material and Thickness: -	
6	Weight of the Cupboard: -	
7	Whether resistant to chlorine rich environment: -	

5. **LOCAL AGENT**

1 Name & Address of local agent:

2 Indicate facilities (After sales services, availability of spares, repair & workshop facilities) provided by the local agent

6. **LIST OF NUMBER OF SIMILAR UNITS SOLD DURING PAST 2 YEARS IN SRI LANKA**

7. **LIST THE ESTABLISHMENT USING THE ABOVE UNITS IN SRI LANKA:**

8. **DEVIATIONS:-**

All deviations from specifications shall be listed here if any.