TECHNICAL SPECIFICATIONS
FOR
DESIGN, ENGINEERING, SUPPLY, ERECTION, TESTING & COMMISSIONING
OF
5 MLD DRINKING WATER TREATMENT PLANT & 200KL CLEAR WATER RESERVOIR
ON TURNKEY BASIS

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(April, 2012)

NATIONAL INSTITUTE OF TECHNOLOGY,
ROURKELA
769008

GENERAL DATA

1.0	LOCATION :-	
1.1	Address	: National Institute of Technology, Rourkela PO: Rourkela, Dist: Sundergarh, State : Odisha PIN Code : 769 008
1.2	Telephone	: 0661-2462751 / 2462315 Direct
	Fax	: 0661-2472926 / 2462999 Fax
2.0	TRANSPORTATION :-	
2.1	Road Connectivity	: Connected by NH-23 and State Highway
2.2	Nearest Railway Station	: Rourkela, S.E.Railway
2.3	Nearest Airports	: Ranchi, 148 KM by Rail : Kolkata, 415 KM by Rail : Bhubaneswar, 462 KM by Rail & 325 KM by Road
3.0	AMBIENT CONDITIONS :-	
3.1	Max. Dry Bulb Temp.	: 48 ^{O}C
3.2	Min. Dry Bulb Temp.	: 4 ^{O}C
3.3	Design Wet Bulb Temp.	: 27.5 ^{O}C
3.4	Max. Relative Humidity	: 87%
3.5	Min. Relative Humidity	: 27%
3.6	Annual Average Rainfall	: 1200 mm
3.7	Heaviest Rainfall in 24 Hrs	: 18 mm
4.0	WIND :-	
4.1	Max. Wind Velocity	: 161 KM/Hr
4.2	Wind Direction	: Pre-dominantly from South to North
5.0	SEISMIC DATA :-	: Rourkela is located in a Zone which is subject to liable danger from Earthquake strokes
6.0	POWER SUPPLY :-	: 415 V, 3 Phase, 4 Wire, Un-Earthed, 50 Hz, AC Supply (Purchased Power Supply)

SCOPE OF WORK

1.0 General :

1.1 The scope of work for the Tenderer shall include design, engineering, detailed calculations, detailed drawings, supply of all materials, equipments, auxiliaries, fabrication, construction, erection, painting, supervision, testing & commissioning including all civil, structural, mechanical, electrical, piping, instrumentation, utility works of 5.0 MLD Capacity Water Treatment Plant alongwith 200 KL Underground Clear Water Reservoir and One-year Operation & Maintenance for Supply of Drinking Water to National Institute of Technology, Rourkela on **'Turnkey Basis'** in conformity with the technical specifications & other details as enumerated further.

1.2 The scope of work shall also include soil investigation, site clearing, site levelling, earth filling & soling, bailing water, temporary approach road, temporary power supply & lighting etc. as required for the construction purpose and dismantling & cleaning of all temporary constructions after completion of scheme.

1.3 Location:

Site	: National Institute of Technology, Rourkela (NITR)
Town	: Rourkela, Odisha
Road Connected to	: National Highway-23
Railway Station	: Rourkela, SERly.

1.4 Drinking Water Treatment Plant of 5.0 MLD capacity complete with with following Units, facililities & ancillary structures at NIT, Rourkela –

a) Cascade Aerator
b) Flash Mixer Unit (Hydraulic Type)
c) Flow Measuring Flume / Device
d) Primary Clarifier – 1 unit @ 5.0 MLD (Million Litres/Day)
e) Clariflocculator – 1 unit @ 5.0 MLD
f) Filter House with Constant Rate Rapid Gravity Filter Beds of 5.0 MLD, with Backwash Pump Sets & Sump, Air Blowers etc.
g) Overhead Backwash Water Storage Tank
h) Clear Water Reservoir (Underground) – 1 unit @ 200 KL (Kilo Litres)
i) Testing Laboratory with Lab. Instruments
j) Entrance Lobby, Control Room, Toilet
k) Chemical House with Storage & Chemical Solution Preparation Tanks for Alum, PAC, Lime & Bleaching Powder alongwith Electrical Agitators & Dosing Devices, Metering Pumps, Piping & Valves, Pre & Post Chlorination System etc.
l) Chlorine House with Chlorinator & Pre & Post Chlorine Dosing Facility
m) Required Sump, Channels, Underground Drainage, Break-pits, Man-holes

n) Required Inter-connection of Raw Water Header at Cascade Aerator & Clear Water Header at Clear Water Reservoirs, Piping, Valves, Sluice Gates and Chemical Dosing Piping etc.

o) Internal Roads, Walkways & Pavements

p) Sludge & Waste Water Disposal facility

q) Sludge Drying Pond

r) Miscellaneous items like Stairs-case, Ladders, Hand Railings & Safety Chains, Flow Sheet Board, Sign Boards, Fire Extinguishers etc.

s) All electrics, OH Electric Monorail & Hoists, MCC Panels, DOL Starters, MCBs, MOCBs, DBs, Indication Lamps, Voltage & Ampere Meters, Power Cables & Control Cables, Conduits, Lamps & Illumination, Exhaust Fans & Ceiling Fans, Earthing & Earthing Pits etc.

t) One Year Operation & Maintenance of Water Treatment Plant

However, periphery boundary wall around WTP and supply of raw water from River Koel to proposed site of Water Treatment Plant are not included here in the scope of work and same shall be executed by another agency.

The above scope of work is not exhaustive but gives only an idea about the type of work involved. Any other items / work which have not been specifically mentioned but required for completeness & soundness of the system shall also be covered within the scope of work of the Tenderer.

These Specifications shall be read in conjunction with the 'Invitation of Tender', 'General Conditions of Contract' and other documents issued which shall also form a part of the contract. Wherever, the clauses stipulated in the GCC are in contradiction to those stated herein, the clauses mentioned in these Specification shall be treated as valid for the purpose of this work.

2.0. Treatment Objectives:

The quality of treated water from the plant shall be consistently maintained conforming to the requirements of the latest editions of the relevant Indian Standard of BIS and the Manual on Water Supply and Treatment by the CPHEEO, Government of India.

3.0 Site Plan :

The contour map & general layout of proposed site plan of Water Treatment Plant is given at Annexure:IV.

4.0 Soil Investigation Report:

For structural design purposes, SBC at required depths and different locations below ground level at respective places for all units of the Water Treatment Plant as well as 200 KL capacity Clear Water Reservoir shall be found out by the contractor through an approved agency / laboratory conforming to relevant IS code. The soil test shall include bore log, SPT, UDS test, Tri-axial test, Vane shear test, core sample test, plate load test depending upon requirement of the structure. Before detailed engineering & design, the

contractor shall submit detailed soil test report to the Engineer-in-Charge of NITR for approval of SBC to be adopted for structural design. Accordingly, the contractor has to design the structures. The maximum ground water table for design of WTP & ancillary structures shall be taken as 1.0 M below virgin ground level in worst rainy season condition. In case further data would be necessary before or after submission of tender / during execution of the work, the tenderer / contractor shall collect the same of his own & at his cost.

Ignorance of any data shall not relieve the Contractor of his obligation to complete & commission the work as per the provisions of the Tender.

While designing of the structures, it shall be ensured that the weight of the structure including foundation, water, over burden earth on foundation / slab / raft etc. as applicable shall be with in the permissible limit of SBC allowed by Department.

5.0 **Battery Limits :**

i) **Raw Water Inlet Side:** Thirty (30) Metres from inlet of Cascade Aerator, Contractor shall construct a RCC Valve Pit with an Isolation Valve & Enlarger and extend the raw water pipe to inlet of Cascade Aerator.

ii) **Drinking Water Outlet Side:** Upto & Including New Clear Water Underground Reservoir including Interconnecting Existing 3 nos. & 1 no. new Clear Water Underground Reservoirs.

iii) **Sludge & Waste Water Side :** Upto Interconnecting Existing Storm Water Drainage System

iv) **Power Supply Side:** Tenderer to make all arrangements to draw Power Supply safely by tapping from Employer's nearby Electric Sub-station by providing necessary feeder, equipments & accessories. The Contractor shall make all his arrangements to lay power cable underground from this point.

v) **Internal Roads :** All internal roads within Water Treatment Plant premises and inter-connecting nearby Main Road of NITR.

6.0 **Raw Water Quality:**

Physical & Chemical analysis of raw water samples of **River Koel** is enclosed at Annexure:II. In case further analysis of raw water would be necessary before or after submission of tender, the Tenderer shall collect samples of water and carryout such analysis at his own cost in approved laboratories. Ignorance of raw water quality parameters shall not relieve the contractor of his obligation to meet the Water Quality Standards. The turbidity of raw water widely fluctuates and often exceeds beyond 6000 NTU during monsoon period.

7.0 **Site Visit:**

The Tenderer before submission of his tender shall inspect the site at his own cost in consultation with Engineer In-charge of work and shall satisfy himself with regard to the nature and extent of the work involved, the actual site conditions, existing facilities etc. and shall collect any other information

which may be required before submitting the tender. Any claim afterwards by the Tenderer shall not be entertained on account of the ignorance of the site conditions.

8.0 **Format Language and Units:**

The language of all documents shall be in English. Units of measurement in the documents, on the drawings, and the submissions shall be in S.I / Metric Units.

9.0 **Detailed Designs & Drawings of Works, their Submission and Approval:**

9.1 Since this is a **'Turnkey Contract'**, the contractor is supposed to have the best of the expertise available in the field of water treatment plant design. The contractor shall be entirely responsible for the detailed design of **5.0 MLD** Drinking Water Treatment Plant with ancillary structures, Underground Clear Water Reservoir of 200 KL storage capacity at National Institute of Technology, Rourkela (NITR) including civil, process, structural, mechanical and electrical designs for the duties specified and to achieve the water quality standards specified earlier. The design submission and approval formalities are described below.

9.2 **Design Submission Guidelines:**

All designs shall be submitted in the form of booklets in complete shape along with relevant drawings & in a presentable manner neatly type written/ computer printed on **A4** size bond paper.

1) All design calculations / findings shall be supported with illustrative drawings in the form of plans, sections etc. as applicable which shall form a part of the design booklet.

2) All references made in the design shall be indicated in "Reference Chapter" of the design booklet. On demand, the contractor shall furnish reference materials to the Engineer I/c to facilitate checking of the designs.

3) All drawings shall be with black lines on white tracing paper in metric scale in size **560mm X 810** mm & shall be titled, cross referenced & fully explanatory with the contractor's name, date, seal & signature on it. Additionally each drawing shall contain the title at the bottom right hand corner. Alternatively, the contractor may submit computer aided drawings drawn in different colours conforming to other specifications as described above.

4) In case of computer aided designs, the firm shall also additionally submit the floppy containing the software & the design to the Department to facilitate checking of the designs. The contractor shall also furnish the design calculations through manual methods if demanded by Employer.

9.3 **Design Basis:**

All designs shall be based on the best modern practices enumerated in the Standard Text Books / Reference Books & Handbooks by authors of International & National repute. Reference books like the Manual on Water Supply & Treatment by CPHEEO, Government of India, latest relevant Indian Standards of BIS, Codes of Practices & Specifications, norms fixed by State Pollution Control Board, Indian Electricity Rules shall also be followed wherever required. Controller of Explosive Rules & Regulations, Govt. of India shall be followed for designing Chlorinator Room, Chlorinator & Tonner. In case of any contradiction, the decision of the Engineer In-charge, NITR shall be final.

For computer aided design, the contractor shall use only widely accepted standard software of International/ National repute.

Thumb rule designs based on the contractor's own experience/ sub-standard books & literature/ sub-standard softwares shall be out rightly rejected.

9.4 **Submission & Approval of Detailed Designs & Drawings:**

i) The Contractor shall submit to the Employer two sets of process & hydraulics designs, drawings & layout drawings alongwith rainwater drainage and sludge & wastewater drainage scheme in a manner as described in the preceding paragraphs within **21 days** of issue of letter of intent.

ii) These designs and drawings shall be checked by the Competent Authority of the Employer. After checking, these designs shall be preliminarily approved by the Employer after incorporating the corrections/ modifications/ observations etc. as may be required and one set of preliminarily approved designs & drawings shall be communicated to the contractor for re-submission of **5 (five) sets** of detailed corrected designs & **10 (ten) sets** of detailed corrected drawings to Employer within 10(ten) days of preliminary approval by Employer. The time span between the receipt of the design & drawings by Employer & the date of preliminary approval shall not normally exceed **30 days** time.

iii) The final approval of the designs & drawings shall be communicated to the contractor within **15 days** time from the date of receipt of the final designs & drawings if all the corrections/ modifications/ observations as indicated during preliminary approval are duly incorporated.

iv) To expedite the design submission & approval process, the contractor shall submit the complete structural designs & drawings of all the components with General Arrangement, Electrical, Process & Instrumentations and Mechanical designs & drawings based on the preliminarily approved process, hydraulic & layout designs & drawings

within **15** (fifteen) days of communication of the preliminary approval. Submission of designs & drawings in piece meal shall not be accepted.

v) Same procedure shall be followed as described in Sl. 2 & 3 for approval of these designs & drawings.

vi) The work shall start after final approval of all the designs & drawings.

9.5 **Equipment Drawings:**

Prior to the delivery of any item of plant or equipment for the erection of treatment plant, the contractor shall, in triplicate, submit to the Department office for approval, accurately detailed mechanical and electrical drawings relating thereto together with spare parts, tests, references, drawings etc. for the plant. The make of all equipment shall have to be approved by Engineer In-charge, NITR.

9.6 **Obligation to Provide Documentation:**

The contractor shall, as an integral part of the contract, supply detailed documentation and working drawings of the process and the equipment to be supplied by him within the specified periods and assist in checking the design calculations, other information or data relating to problems arising from the design of all components or supply of the process or the mechanical or electrical equipment.

The contractor shall supply all the documentation and drawings asked for or implied in this section or elsewhere in the specification.

Approval of designs, drawings, calculations, or equipment supplied by the contractor shall not relieve the contractor from any of his contractual responsibilities or obligations, if any rectification or replacement is felt necessary at a later stage.

10.0 **Quality of Material and Workmanship:**

10.1 All the materials supplied by the contractor shall be best of their respective kinds and shall comply with latest revisions of BIS / Water Supply & Public Health regulations stipulated by Govt. of India & Govt. of Odisha, State Pollution Control & Prevention Board, Indian Electricity Rules, Controller of Explosives and other statutory requirements of Govt. of India and Govt. of Odisha.

10.2 The Contractor shall be responsible for the design of the entire system and quality of materials and workmanship. The Contractor shall guarantee the satisfactory functioning & performance of entire Water Treatment Plant. If any modification/ replacement is necessitated during trial-run and guarantee period, the same shall be carried out immediately free of cost.

11.0 **Construction & Erection Facilities:**

Water, power and open space for storage of materials and fabrication at site shall be provided to the Contractor free of cost. Their proper utilisation, Safety, watch & ward shall be the responsibility of the contractor & no extra payment shall be made on account of this. NITR will be responsible for supply of water for testing, trial running & commissioning of the water treatment plant.

12.0 **Inspection & Testing:**

For all materials, the Contractor shall furnish Manufacturer's test certificates with each consignment. Testing and inspection shall be carried out as per relevant Indian standards of BIS / International Standards in presence of Engineer-in-Charge/Representative of NITR, Contractor / Manufacturer. The Contractor shall detail out the codes and standards in accordance with which the testing shall be carried out.

Inspection by the Engineer-in-charge/Representative of NITR shall not relieve the Contractor of his liability for rectifying the defects / replacement which may subsequently appear or be detected during testing and commissioning or subsequent operation. After rectification of the defects or replacement, the equipments shall be re-tested to the satisfaction of the NITR.

All equipments, labour, tools & tackles, instruments and other facilities for testing shall be provided by the contractor. He shall also maintain records of all the tests and furnish copies of the same to the Engineer In-charge.

Whenever untested materials are used, written permission from the Engineer-in-Charge shall be obtained. Manufacturer's test certificates shall be furnished by the contractor for such equipments and materials used.

The Employer, NITR reserves the right to test any material at any of the reputed laboratories if necessity arises & the cost of such test(s) shall be borne by the Contractor & rejected materials shall have to be replaced by the Contractor by approved material at his cost.

13.0 **Completion Schedule:**

The time is the essence of this contract. The entire job is to be completed within a time frame of **12 (twelve) months** from the date of issue of work order. The Tenderer shall submit a Bar Chart indicating starting and completion dates of each activity such as submission of designs & drawings, site mobilisation, procurement of materials and equipments, transportation, execution, assembly/ erection, testing, trial running and commissioning without which the tender shall be liable for rejection.

On approval, the Bar Chart shall form a part of the contract. The successful tenderer shall submit PERT Net work based on above Bar Chart for

monitoring of the project as per relevant clause of "Conditions of Contract/Special Condition of Contract".

14.0 **Tendering:**

Ordinarily, modifications of technical specifications during execution of the work shall not be permitted excepting in cases where such a modification is warranted due to technical requirements.

14.1 **Tender Drawings:**

The tender drawings submitted by the contractor/firm in their offer are subjected to change during detailed design if so required from technical considerations without extra financial implications.

14.2 **Schedule of Tender for Submission:**

The Tenderer shall submit the following details in addition to other documents along with the 'General & Techno-commercial Bid' of his tender document without which his 'tender' shall not be considered further for appraisal.

i) Technical write-up on the facility/scheme offered.

ii) General Arrangement Drawings, proposed general layout Drawings, sectional elevation drawings with dimensions, flow diagram, hydraulic diagram, electrical circuit diagram, P&I diagram, site drainage and wastewater disposal scheme etc.

iii) Perspective drawings of the proposed plant showing all the units to give a general idea as to how the plant offered by them would look like architecturally.

iv) Detailed specifications with codes/standards of all the materials/ Equipments / construction work etc, with makes & their source of supply and testing codes including manufacturer's catalogue.

v) Battery Limits / Exclusions, if any.

vi) Delivery period with Bar Chart for the complete scheme.

vii) Equipments, tools & tackles (with their capacities) proposed to be mobilised to the site.

vii) Personnel & staff proposed to be deployed at site.

ix) Past experience of the Tenderer with respect to eligibility criteria. A list of similar jobs designed & executed by the tenderer with their capacity, year of commencement & installation, value of work and full addresses of their client.

x) Brief details of the tenderer, technical personnel/ executive Employed with the tenderer, their qualifications & experience, Organization chart.

xi) Enclosed 'Questionnaire' at Annexure duly filled in by the tenderer.

TECHNICAL SPECIFICATIONS

The Water Treatment Plant shall be designed conforming to state-of-the-art technology & practice to produce and maintain output water quality hygienically safe and palatable in an economical manner. The output quality of water shall conform to physical and chemical standards stipulated in the manual on Water Supply and Treatment (latest edition) published by Central Public Health & Environmental Engineering Organisation and relevant Indian Standards of BIS. The entire Treatment Plant shall be designed to work on gravity flow principle without need of any additional pumping. The treatment plant shall be designed based on conventional type water treatment plant. Basic design guide lines given below are indicative only and however, in order to achieve designed parameters for drinking water, Tenderer, if feels necessary, may assume better data with technical justification. Similarly, RCC Primary Clarifier, Clariflocculator, Filter House, Chemical House, Clear Water Underground Reservoir shall be designed based on the latest concepts & principles enumerated in the standards conforming to latest BIS Code. The treatment capacity of Water Treatment Plant shall be **5.0 Million Litres per Day (MLD)** on continuous operation basis.

10.0 **Water Treatment Plant Layout & Hydraulics :**

10.1 Due consideration should be given to the following factors while deciding for positions of various plant units. A site plan is enclosed for planning the layout of the Water Treatment Plant, Roads & Drainage system etc. considering the following aspects.

i) Geometry of the available land.
ii) Topography
iii) Soil and foundation conditions.
iv) Safety to Operating Personnel
v) Plant hydraulic: preferably with straight flow paths between units to minimize head loss & provide symmetry for flow splits.
vi) Site drainage.
vii) Accessibility to Operating Personal.
viii) Reliability & economy in operation.
ix) Transportation access.
x) Aesthetics.
xi) Statutory & Govt. Regulations.

11.0 **DESIGN PARAMETERS :**

11.1 The Water Treatment Plant shall be designed based on state-of-the-art technology and practice to produce and maintain output water quality hygienically safe and palatable in an economic manner. The treatment plant shall be designed based on conventional type water treatment plant with Clarifier & Clariflocculator of RCC construction. The output quality of water shall conform to physical and chemical standards stipulated in relevant IS:10500 of BIS and the manual of Water Supply & Treatment (latest revision) published by CPH&EEO.

The entire process of Water Treatment Plant shall be designed to work on **Gravity Flow** principle without need of any pumping from the Cascade Aerator to all the four Clear Water Underground Reservoirs (3 existing & 1 new). Similarly, it shall be designed for **Gravity Flow** of sludge & waste water from all the Units to Sludge Drying Pond and then to existing Storm Water Drain. Pumps shall be used only for lifting wash water from sump to overhead wash water tank.

Basic design guidelines given below are indicative only and however, in order to achieve designed parameters of drinking water, the Tenderer if feels necessary, may assume better design data of his own.

11.2 **Cascade Aerator:**

Number of Units	:	1 (one)
Type of Construction	:	Elevated Circular RCC construction
Number of Steps	:	5 nos. finished with Glazed Tiles
Space Required	:	0.04 m^2/ m^3/hr.
Capacity of Basin	:	To accommodate a flow of 5 MLD raw water upto 50% (fifty percent) Overloading with Inspection Platform & MS Ladder & Hand railing.
Free Board	:	500 mm (minimum)
Requirement of Raw Water Head at Battery Limit	:	Tenderer to Design & Specify
Battery Limit	:	30 M Inlet Pipe from the center of Cascade fitted with Isolation Valve & all fittings & Valve Pit
Launder Design Capacity	:	50% (fifty percent) Overloading.
Core Pipe	:	RCC NP_2 pipe or MS of 6mm thick minimum.
Channel Flow Velocity	:	to 0.6 M/S

11.3 **Raw Water Channel & Flow Measurement:**

Type of Construction	:	RCC construction, Channel connecting Cascade Aerator, Primary Clarifier & Clariflocculator with Raw Water Distribution Ports, Isolation / Sluice Gates for each unit, Primary Clarifier By-pass Arrangement & Operating Platform
Free Board	:	300 mm (minimum)
Capacity of Unit	:	To accommodate a flow of 5 MLD process water with 50% (fifty percent) overload & with catwalk along length of channel with MS /GI hand railing.
Flow Measurement	:	Parshall flume with mechanical flow

		meter suitable for measurement of flow within a Range of 0.5 MLD to 8.00 MLD. Necessary straight length of the raw water channel upstream and downstream of the Flow Measuring device and access to the channel shall be provided.
Channel Flow velocity	:	0.6 M/S

11.4 **Rapid Mixing Unit (Flash Mixer):**

Type	:	Mechanical-Turbine / Propeller type. The shaft & propeller shall be of Stainless Steel.
Number of Units	:	1 (one)
Type of Construction & Shape	:	RCC Construction, Circular shape with Distribution Ports & Isolation/Sluice gates, Operating Platform
Capacity	:	To accommodate a flow of 5.0 MLD
Detention time	:	60 sec
Mean Velocity Gradient.	:	400/sec. approximate.
Velocity of Flow	:	0.9 m/sec
Drive	:	Motor with suitable Gear Box
Shaft Speed of Propeller	:	Less than 100 RPM.
Free Board	:	300 mm (minimum)
Tangential Velocity at Tip of Blade	:	More than 3.0 M/s
Tank Height to Dia. Ratio	:	1.5 : 1 to 3 : 1
Impeller Dia. to Tank Dia.	:	0.2 : 1 to 0.4 : 1

Motor with suitable reduction gear box shall be provided for each tank. They shall be placed on suitable RCC/Steel supporting arrangement on top of the tank.

Vertical strip of baffles, projecting $^{1}/_{10}^{th}$ to $^{1}/_{12}^{th}$ of the tank width, shall be provided at minimum 4 places from the wall of tank to reduce vortex. Walking platform of 800mm wide shall be provided all round the Flash Mixer at top of the wall with 1200mm height G.I/M.S. Hand railing. Suitable supporting arrangement shall be made at top of wall level for placement of mechanical/electrical mixing devices. Motor, reduction gear, cabling, mixing arrangement, etc. shall be provided in complete shape as required for smooth functioning of the units.

11.5 **Primary Clarifier :**

The Primary Clarifier shall be suitable for clarification of **5.0 MLD** input raw water of turbidity of 2000 NTU to 200 NTU in non-monsoon period and

occasional turbidity of 6000 NTU to 8000 NTU experienced during monsoon and flash floods. The Clarifier shall be designed for 25% overloading capacity and Inlet & Outlet control arrangements shall be designed for 100% overloading capacity. The power supply cable and conduits for drive mechanism shall be taken underground in a separate conduit below the Clarifier.

The rotating scrapper bridge shall be of fabricated steel structure with walk-way of 1200 mm width, access ladder, safety hand-railing of 1.2M height etc. suitable for approaching centre while scrapper is in motion. The wheels of the service / scraper rotating bridge shall move on circular mild steel rail of appropriate size & design properly mounted on wall.

Raw water By-pass arrangement shall also be provided to by-pass the Primary Clarifier from the process stream and to divert raw water directly from Flash Mixer to the Clariflocculator during lean period.

No. of Clarifier	:	1 (one)
Capacity	:	5.0 MLD
Detention period	:	3 Hours
Inlet Water Turbidly	:	200 NTU to 8000 NTU
Outlet Water Turbidity	:	200 NTU Max.
Type of Construction	:	RCC Structure, Circular in Shape with Centre Feed & Peripheral Effluent Collection, Bottom Hopper Sludge Removal arrangement, Peripheral Walkway of 800mm wide with MS Safety Hand-railing of 1200mm height.
Side Water Depth	:	3.0 Metre (maximum)
Free Board	:	300 mm
Outlet Effluent Structure	:	RCC Effluent launder with "V" Notches / Sub-merge Orifice
Surface Loading	:	30-40 m^3/m^2/day.
Weir loading	:	300 m^3/day/m (Max.) designed to take 50% overload.
Scraper & Scraper Rotating Bridge	:	Fabricated Steel Structure with 1200mm Wide Walkway & Checkered Plate, Both side Safety Hand-railing of 1200mm Height, Rotating on MS Rail fixed on Periphery RCC Wall
Scraper Drive Mechanism	:	Electric Traction Drive Mechanism, Peripheral / End Driven with Motor & suitable Gearbox, AC, 415/240 V, 3 Phase supply, Continuous Rating
Scraper Bridge Tip Velocity	:	0.3 Metre/min. (maximum), One Revolution in 30 to 40 minutes
Inlet Water Pipe	:	C.I Class-B pipe with Velocity 0.6 m/sec.

Sludge Removal Pipe	:	200 mm C.I Class-B embedded in concrete below the tank portion. Control Valve shall be provided in the Sludge removal pipe at suitable location.
Sludge Removal Arrangement	:	Continuous De-sludging arrangement with manual Telescopic Sludge Discharge Pipe for sludge disposal by gravity / hydrostatic pressure
Sludge Pit	:	Circular Sludge pit of 600mm dia. & 500mm depth around the central shaft of Clarifier shall be provided with sludge removal arrangement. The foundation of Central Shaft shall start from minimum 1 M below invert level of sludge pit.
Slope of Bottom Floor	:	Not flatter than 1 in 12

11.6 **Clariflocculator:**

The Clariflocculator shall be suitable for treatment & clarification of **5.0 MLD** river raw water of turbidity ranging from 200 NTU to 2000 NTU (or clarified water when Primary Clarifier is in operation during monsoon). The Clariflocculator shall be circular in shape and combination of Flocculator at centre & peripheral Clarifier. Both shall be of RCC structure.

The Flocculator shall be electrically operated type consisting of revolving paddles. The Clarifier shall be designed with suitable scrapper arrangement with electric traction driven mechanism.

The rotating scrapper bridge shall be of fabricated steel structure with walk way of 1200 mm width, access ladder, safety hand-railing of 1200 mm height etc. suitable for approach to centre of the Flocculator while scrapper is in motion. The wheel of the rotating foot bridge shall move on circular mild steel rail of appropriate size & design properly mounted on wall. The Clarifier shall be designed for 25% overloading capacity and Inlet & Outlet control arrangements shall be designed for 100% overloading capacity. The power supply cable and conduits for drive mechanism shall be taken underground in a separate conduit below the Clarifier.

No. of Flocculator	:	1 (one)
Capacity	:	5.0 MLD
Detention Period	:	Flocculator Portion: 30 min. Clarifier Portion: 2.5 Hours
Inlet Water Turbidity	:	200 NTU to 2000 NTU
Outlet Water Turbidity	:	20 NTU (Maximum)
Type of Construction	:	RCC Structure, Circular in Shape, Comprising Chambers for Flocculator & Clarifier, Centre Feed & Peripheral Effluent Collection, Bottom Hopper Sludge Removal arrangement, Peripheral Walkway of 800mm wide with MS

		Safety Hand-railing of 1200mm height.
Side Water Depth	:	3.0 Metre (maximum)
Free Board	:	300 mm
Slope of Bottom Floor	:	Not flatter than 1 in 12
Type of Mixing in Flocculator	:	Mechanical Paddles type Vertical shaft with Stainless Steel shaft and paddles of 8mm thickness minimum with required nut & bolts.
Outlet Structure	:	RCC Effluent launder with "V" Notches / Sub-merge Orifice
Inlet Water Arrangement	:	C.I. Class-B pipe with Velocity 0.6 m/sec from Bottom of Flash Mixture to bottom of central shaft duly laid below the floor slab of the Clariflocculator with required concrete cushion.
Flocculator Paddles Drive	:	Motor & suitable Gearbox, AC, 415/240 V, 3-Phase supply
Scraper Drive Mechanism	:	Electric Traction Drive Mechanism, Peripheral / End Driven with Motor & suitable Gearbox, AC, 415/240 V, 3 Phase supply, Continuous Rating
Scraper & Scraper Rotating Bridge	:	Fabricated Steel Structure with 1200mm Wide Walkway & Checkered Plate, Both side Safety Hand-railing of 1200mm Height, Rotating on Periphery RCC Wall
Scraper Bridge Tip Velocity	:	0.3 Metre/min. (maximum), One Revolution in 30 to 40 minutes
Velocity Gradient	:	10 to 75/s (preferred average 40 sec^{-1}).
Velocity of Flow	:	0.40 to 0.80 m/sec. (preferred 0.6 m/sec.)
Total Area of Paddle	:	15 to 25% of cross-sectional area of Tank.
Peripheral Velocity of Blades	:	0.30 m/sec to 0.40 m/sec
Sludge removal Pipe	:	200 mm CI Class-B embedded in concrete below the tank portion. Control Valve shall be provided in the Sludge removal pipe at suitable location. Limit of contract upto the nearest drainage manhole.
De-sludging Arrangement	:	Continuous De-sludging arrangement with manual Telescopic sludge discharge pipe for sludge disposal by gravity / hydrostatic pressure
Sludge Pit	:	Circular Sludge pit of 600mm wide & 500mm depth around the central shaft of Clariflocculator shall be provided with sludge removal arrangement. The foundation of Central Shaft shall start from 1m below invert level of sludge pit.

Distance between Paddle tips	:	1.0 Metre
No. of Driving Units	:	Two (2) for Paddles & One(1) for Rotating Bridge
RPM of Mixing Paddles	:	3 to 4 RPM

The Channel carrying clarified water from each Clariflocculator shall lead to a Break Pit from where it shall run through a common channel upto Filter House.

Motor and reduction gearbox arrangements for mixing devices of Flocculator, rotating foot way bridge/ scrappers, under ground power cabling, current collector, central bearing on central shaft, scrapper driving system , scrappers for de-sludging, telescopic sludge discharge system, fabricated steel foot way bridge with hand rail and floor MS Checkered plate of 3 mm thick minimum, driving rail on top of wall etc., and all other related items required for completion and smooth functioning of Clariflocculator shall be provided based on required design.

11.7 **Filter House:**

The total filtration capacity of Filter House shall be **5.0 MLD** of clarified water input.

The Filter House shall comprise of **2 (two) twin-bed Rapid Sand Gravity Filters of Constant Rate Filtration type.**

Each Filter Bed shall be designed in twin compartments. The Filter Beds shall be designed for a rate of filtration of 80 LPM/Sq.M and shall be designed for 25% overloading capacity. The inlet & the outlet control arrangements shall be designed for 200% hydraulic capacity.

The layout of Filter House shall be so designed that pipe gallery, valves, appurtenance walkway etc. shall be provided at centre with twin filter beds on either side.

The Filter House shall be so designed that it shall also house the followings facilities of total 50 Sq.M. floor area with RCC roof on front Entrance side.

Entrance Lobby : 10 sq.M
Control Room : 15 sq.M
Testing Laboratory : 15 sq.M
Toilet : 10 sq.M.

The Filter House shall also have an Annex Building with RCC roof of 30 Sq.M floor area (approx) to house the Pump & Motor sets for filling Backwash Water Tank, Suction Sump for Wash Water Pumps, Air Blowers, OH Monorail & Electric Hoist, MCC & Control Panels etc.

Double-bit type rate controller shall be provided for constant rate filtration. Suitable handling system, manual operated shall be provided for erection and maintenance of pipe gallery.

The filter unit channels and gutters shall be of RCC structure. The filter media shall be so selected that same are available easily and economically for future replacement. The piping and pipe gallery shall be C.I pipe, Class:LA, IS:1536 with neoprene joint and G.I pipes, IS:1239 (Part:I).

Facility for back-wash of filter beds shall be suitably designed and C.I Siphons shall be provided for draining out the spent & stagnant water from the filter beds during back-wash.

The Filter House shall be constructed with RCC roof on RCC framed structure with Brick masonry filler walls to house the filter beds & operation gallery etc. The roof height shall be 4.2 M measured from top of filter bed wall.

The filter operating floor should be designed for safety and maximum convenience to the operating personnel including ease of maintenance & provision of facilities to place & replace filtering materials, for accommodating the hand wheels for manual operation of valves etc. The provisions made for operating floor shall be clearly shown in the offer along with proper justification. There shall be adequate access from the operating floor to the pipe gallery. The width of the operating platform shall not be less than 2.00 metres.

The pipe gallery should offer adequate space for convenience of inspection and for removal of faulty equipment. It should be possible to remove any individual valve or any fitting/appurtenance with disassembly of minimum piping. Ample points of access should be provided for ease in handling of heavy pieces of equipment. The designer should use his ingenuity to develop an arrangement of piping that satisfies all functional requirements & ensures easy of maintenance & operation. The width of the pipe gallery shall not be less than 3.50 Metres. All cares must be exercised to obtain water tight joints & connections. Some leakage of water which may be expected in the pipe gallery shall have to be disposed of by providing conceal floor drains with MS grated openings/screens with Sump & Dewatering Pump sets (one working & one stand-by) of required capacity with all piping, valves, automatic level control on/off switch and mechanical & electrical accessories to discharge the collected drainage. Dewatering Sump Pumps shall be operated automatically by means of level control on/off switch.

Walkways of 900 mm wide shall be a provided around the filter beds & wherever necessary for easy access & operation & maintenance.

Appurtenances such as Rate of Flow Meters, Venturi Meters & Gauges, Loss of Head, Flow Rate Controllers, Sand Expansion Gauges & Indicators, Backwash Water Controller & Indicator, Water Sampling Devices etc. shall be provided for each filter bed unit in complete sets. One Total Rate of Flow Meter with Integrator showing daily filtration quantity shall also be provided at the outlet channel of Filter House.

General Design Criteria:

Filter House	:	Framed Structure fully covered with RCC Roof
Total Filtration Capacity	:	5.0 MLD (input)
Number of Filtration Units	:	2(two) x Twin Bed Filter Units ie, Total 4(four) Filter Beds, each of 1.25 MLD Capacity
Type of Filter Beds	:	Conventional Rapid Gravity Sand Filters of Constant Rate filtration type.
Filter Bed Size Ratio	:	1.25 to 1.33 for each bed.
Filter Media	:	Filter Sand over Graded Gravel.
Rate of Filtration	:	80 LPM / M^2
Effective size of Sand	:	0.45 to 0.70 mm
Uniformity Co-efficient of Sand	:	>1.3 and < 1.7
Depth of Sand	:	750 mm filter sand, conforming to IS: 8419 Part-I : 1977
Depth of Standing Water	:	1.0M to 2.0M
Free Board	:	500 mm above water level.
Filter Gravel size	:	40 to 60 mm at bottom to 2 to 5 mm at top conforming to IS: 8419 (part-I) 1977.
Depth of Filter Gravel	:	500 mm (Minimum)
No. of Filter Beds to be Back-washed at a time	:	One Twin-bed to be washed at a time
Overhead Wash Water Tank, Capacity	:	RCC, 180 Cubic Metres Storage, with Feeding & Overflow Pipes
Suction Sump for Wash Water Pumps	:	RCC, UG Sump, Minimum Storage Capacity: 30minutes of WW Pumping Capacity
Type of Wash Water Pumps	:	Vertical Turbine, Wet Pit Type, One Working & One Standby Capacity: 120 M^3 / Hr (Each)
Type of Air Blowers	:	Twin Lobe Type Roots Blower, One Working & One Standby

Inlet and Outlet Control Arrangements:

The inlet and outlet control arrangements of Filters shall be designed for **200 (two hundred) percent** hydraulic capacity.

Filter Feed:

The inlet flow to the filters shall be evenly distributed along the length of the filter battery through reinforced concrete settled water common influent channel with a suitable arrangement of piping and weir to enable the incoming flow to be automatically divided between the total number of filters and to allow for common constant rate of filtration through all the filter beds. The feed channels shall be appropriately dimensioned to keep turbulence and velocities within the required limits which shall not in any case exceed 0.60 Metre / sec. The channels and associated chamber floor shall be given slope towards the drains and drainage valves and shall be fitted with steps or step irons for internal access.

Filter Media and Charging:

Before providing filter media and filter bottom, the contractor must provide three sets of samples each containing 10 kg of filter sand and graded gravels for examination and keeping them at site for visual verification of actual verification of quality through random sampling. The filter media and gravel should be brought to site in clean containers at least two months before the same are laid in the filter box. The Contractor shall prepare the grain size distribution curve by taking representative samples from the stock filter sand to show that the d_{10} and Uniformity co-efficient values conform to the Technical Specification. Following installation and satisfactory testing of all the filter floors, when the Engineer-in-charge is satisfied that the installations are complete; the contractor will be given written permission to commence filling the filters.

The filter media shall be carefully placed and not charged by dropping dumping, machine handling or any other method which in the opinion of the Engineer-in-charge will be detrimental to the floor media, nozzles, drains, laterals etc.

Following the initial charging, the filters shall be washed by the contractor. Filter beds, designed for expansion during cleaning, shall be skimmed prior to disinfection and the commissioning of the works.

Filter Bottom and Under-drainage System :

The under drainage system shall be carefully designed to collect the filtered water and to distribute the wash water in such a fashion that all portions of the bed should perform nearly the same amount of work and when washed, receive nearly the same amount of cleaning. Since the rate of backwash is several times higher than the rate of filtration, the former shall be the governing factor in the hydraulic design of the under-drainage system.

The under drainage system shall consist of central manifold of Concrete/Cast Iron with perforated laterals. The laterals shall be of un-plasticized PVC

conforming to relevant IS Code. All other accessories of under drainage system shall conform to relevant IS Code and shall be provided in complete shape required for smooth functioning.

The Contractor may follow the guidelines given in Manual on Water Supply & Treatment by CPHEEO, Govt. of India or any standard text book by authors of National & International repute / Codes of Practice **(IS/BS/DIN)** for design of manifold with perforated lateral under-drainage system. But the outcome of the design findings in any case shall have to be checked for uniformity of distribution of wash water in the laterals of the under-drainage through established hydraulic design without which the design shall not be accepted.

Filter Backwash:

An air wash causing loosening of filter media for 5 minutes shall be followed by a water wash of 15 minutes which can provide an expansion of filter bed to about 130-150% of it's undisturbed original volume at operating temperature. The rates shall be as under:

Air : **0.80** m^3/m^2/min at 0.35 kg/cm^2 pressure.
Water : **0.60** m^3/m^2/min.

Air washing shall be done by airflow from Roots / Twin-lobe Air Blower of required capacity through adequately designed piping & valves system. Two Air Blower units (one working + one standby) shall be complete with inlet filter, silencer and squirrel-cage induction motor. The units shall be provided with Reflux Valves, Isolation Valves, Safety Valves, all gauges, electrical, mechanical, electronic accessories with total instrumentation, control panel etc. required for smooth functioning of the system.

Water washing shall be done by gravity flow from Overhead Wash Water Tank. Storage capacity of Overhead Wash Water shall of 180 Cubic Metres (min.) and shall be suitably located over the Filter House. The height of the backwash tank shall be decided from consideration of backwash head requirement. The backwash head shall have to be precisely calculated by considering the static head requirement at the inlet to the filter plus the dynamic head loss occurring in the piping & specials, valves, inlet & entry losses, control equipments & appurtenances, under drainage system, gravel media, head required for fluidization of filter bed etc. There shall be a separate floor slab for back wash tank above the roof of the filter house. The back wash tank may spread covering full area covered by the filters and operation gallery or only area covered by the filters as per design requirement. Thumb rule provision from manual on water supply & treatment or any other text book shall not be accepted. The back wash tank shall be completed with all piping and valve arrangement, auxiliaries required for its completeness.

The wash water piping and air piping for proper back washing should be adequately designed and the Contractor shall substantiate through calculations and graphs that the provisions made by him is adequate Flanged

C.I/D.I pipes of appropriate class conforming to relevant IS shall be used. The connection pipe from Filter House to 4 (four) nos. 200 KL (three existing and one proposed) Clear Water Reservoirs & Piping for filter house and operation gallery shall be of **C.I. Flanged Class-B Pipe**.
The filter house shall be complete with all related electrical items, internal electrification, piping & valve arrangements for water & air wash, internal electrifications & all other related piping & instrumentation.

The wash water trough should be constructed not more than 2 Metre apart and the same should be capable of discharging the waste water freely into the gullet. The bottom surface of the trough should be 5 cm above the expanded bed level while back washing. In total Filter House alongwith Entrance Lobby, Control Room, Testing Laboratory, Toilet and Annex building shall be completed to the relevant civil, electrical, mechanical, instrumentation, piping and valve arrangements, Internal & External electrification required for completeness and smooth functioning of the Unit and annex building with required pumps, motors, blowers water & air wash system.

Filter Piping and Valves:
Typical range of velocities to be used for design is given below. The contractor should avoid taking the maximum extreme value unless under specific conditions when commercial diameters of pipes are not available.

Conduit	Velocity m/s
Influent	0.6 to 1.83
Effluent	0.91 to 1.83
Wash Water from OH Tank	2.0 to 3.0
Drain from Filters	2.4 to 3.6

Over Head Backwash Water Tank:
The overhead back wash water tank of **180 m^3** storage capacity shall be located over the filter house with sufficient staging height as per clause relevant. The backwash water tank shall serve following purposes:

- for back washing of one twin filter bed at a time.
- for chemical solution tanks for mixing at the desired rate.
- for the laboratory for all tests likely to be conducted.
- for the toilets for flushing and bathing purposes.
- for chlorination.

The backwash tank shall be filled up with filtered water using wash water pumps from filtered water sump of required capacity. The backwash tank shall be complete with all pipings (inlet, outlet, overflow, scour etc.) & valves required for meeting the above purposes, water level indicator etc. all complete. Minimum depth of water in back wash water tank shall be **2.0 Metre**. Over flow pipeline shall be connected to surface water drainage channel and scour line shall be connected to the underground plant

waste drainage line. Piping shall be of CI D/F class-B & valves PN_1. The sizes shall be as per design requirement.

The wash water sump shall be located suitably at ground level in the Annex building of Filter House. The wash water filling Pumps shall be Vertical Turbine, Wet Pit type Pumps mounted suitably on wash water sump floor. There shall be two(2) wash water Pumps, one(1) working & another standby.

The wash water pumps shall be of adequate capacity for filling the wash water tank in **One & half (1.5) hour** time & with 100% standby (wash water pump & motor).

All other scopes required for completion of the unit and for smooth functioning in all respect automatically covers under contract without any extra payment.

Clear Water Under Ground Reservoir:

- Construction **:** Undergournd, RCC Construction, Circular in Shape & Flat Roof
- Storage Capacity **:** 200 KL
- No. of Units **:** One (1)
- Overall Dimensions & RL **:** To match with Existing CWRs

One new Clear Water Underground Reservoir of 200 KL storage capacity alongwith common header for the existing three (3) Clear Water UG Reservoirs shall be constructed by the Contractor under this Contract.
Filtered water from the Filter House will be collected in these four Clear Water Under Ground Reservoirs (One new & Three existing). The Clear Water Reservoir shall be complete with all required piping & valves on the inlet & outlet side, overflow and scour and interconnection pipes.
The scope includes :

- Overall dimensions & RL shall be similar to the existing three (3) Clear Water Underground Reservoirs for equal-distribution.
- Design, construction, testing and commissioning of 200 KL Circular, Flat roof Under Ground Reservoir with inlet, overflow and outlet piping and valves of required dia. as per design.
- Mechanical type (Float Type) Water Level Indicators of Krohne / MEI make shall be provided to each proposed & existing Clear Water Reservoir (total 4 nos.)
- Manholes, two nos., stainless steel Access ladders etc, shall be provided as per detailed specification.
- Ventilators, two nos. with Canopy & stainless steel Mosquito Net shall be provided.
- Interconnection of the UGRs. with all required piping & valves.
- The Contractor shall provide a masonry drain with outfall structure etc. for disposal of overflow water by gravity to the drainage system.
- RCC grade shall be M-25 for all components.

Chemical House:

General

The Chemical House shall be a separate independent two storied building constructed with RCC roof on RCC framed structure with Brick masonry walls. There shall be RCC stairs of 1.0 M wide suitably located for access to the First Floor. The covered area of each floor shall not be less than 40 Sq.Metre..

Ferric Alum, Poly Aluminum Chloride & Lime shall be used for water treatment purpose. Whereas, Bleaching Powder shall be used for Pre & Post Chlorination purpose as an alternative to or non-availability of Liquid Chlorine. Depending on the availability Ferric Alum or PAC or both shall be used for treatment purpose.

The ground floor of Chemical House shall comprise of separate Storage Bins for storage of Ferric Alum, PAC, Lime & Bleaching Powder and a wide Service Corridor for transportation, unloading & stacking of chemicals. Storage capacity of each Storage Bin shall be designed to hold atleast three(3) months stock of above chemicals.

The upper floor of Chemical House shall be suitably designed for housing the Chemical Handling Facility, Chemical Solution Preparation & Dosing, Metering / Dosing Pumps, Piping etc. for all the above chemicals for the water treatment purpose. It shall also house the MCC room, control panels of mixing devices of chemical tanks, dosing pumps & other electrical facilities & the operator's furniture. Two Overhead Monorail & Electric Hoist shall be provided below the ceiling of upper floor for lifting & handling of chemicals from ground floor storage bins to upper floor solution tanks. Exhaust Fans shall be provided in upper floor for proper ventilation.

Facilities to Handle the Following Chemicals for Coagulation & Flocculation and Pre & Post Disinfection :

Alum	:	Aluminium Sulphate (Ferric).
Lime	:	Calcium Oxide / Calcium Hydroxide
PAC	:	Poly Aluminum Chloride
BP	:	Bleaching Powder

Handling of Raw Chemicals:

The Contractor shall provide two (2) electrically operated Traveling Hoist of One Tonne lifting capacity with Monorail arrangement for lifting chemicals upto the Solution Tanks on Upper Floor. One Weighing Machine of 1 Tonne capacity shall be provided.

Stock Tanks:

There shall be minimum 2nos. of tanks for each chemical. The capacity of each tank shall be designed to feed atleast 12 hours dosing requirement. There shall be level indicators for each tank of chemical resistance material.

Dosing will be done through gravity and the height & location of solution tanks are to be placed accordingly. All the piping, fittings, valves, mixing arrangements shall be of chemical resistant materials. Provision for making solution & dosing of Bleaching Powder for Pre and Post Chlorination purpose shall be made with Tanks & all piping etc..

Stock Mixers:

Each solution tank shall be provided with mixing devices. Each mixer shall be mounted on an overhead concrete accessible slab and fitted with a Motor with a Reduction Gear Box and stainless steel shaft and stainless steel turbines. The shaft speed shall not exceed **30 rpm**. The chemical & mixing arrangement shall be provided with relevant internal & external electrification, mechanical items, piping & valve arrangement in complete shape required for completeness & smooth functioning of the system. The chemical house at ground floor & upper floor shall be complete with all related mechanical, electrical & instrumentation, piping & valve arrangements items required for smooth functioning.

Chlorine Store & Chlorinator Arrangement:

Chlorinator facility shall be provided for pre & post chlorination / disinfection purpose. The maximum & average chlorine doses shall be 3 mg/L & 2 mg/L respectively.

There shall be two numbers of vacuum feed type wall mounted gas chlorinators (one working & one standby) of capacity 0-5.0 kg/hr/each with booster pumps, automatic switch over system, all required chemical resistance piping & valves & all electronic, electrical & mechanical accessories & total instrumentation. The gas chlorinators shall be of **PENNWALT/ METITO / SIEMEN** Make. All accessories shall be of **PENNWALT/ METITO** make if manufactured otherwise of any reputed make to be approved by Department.

Chlorinator Room & Chlorine Store :

The Chlorinators shall be housed in the Chlorinator Room of **10 m^2** floor area. The chlorine store including the chlorinator room shall be of (10+30) **40m^2** floor areas & shall be separately & independently located close to the filter house for storage of **2 nos**. of chlorine tonners & two nos. of gas chlorinators. The layout & design of Chlorinator Room & Store shall be made in accordance with Controller of Explosives Rules & Regulations. One emergency underground water sump with ramp shall be provided for sub-mergence of chlorine cylinder in case of leakage. The chlorine tonners shall be kept at **1.5 Metre c/c** apart & shall move on trunions. The loading and unloading of tonners shall be made to and from the truck respectively in the loading bay inside the storage area. Monorail system shall be provided inside the chlorine storage room so that loading & unloading of chlorine cylinder can be done inside the room. Height of the roof above plinth level shall be minimum **5.0** Metre or as per requirement which ever is more.

The contractor shall supply at his cost **two (2) numbers** of full chlorine tonners with necessary certificates of Controller of Explosives, Govt. of India. Each tonner shall have a normal capacity of **1.0 tonne liquid chlorine** available above one bar pressure. These shall be of standard Indian manufacturer without fusible plugs. Each drum shall be fitted with ringed or removable protective valve cap. The drums shall be painted yellow with back concave ends and shall have the words 'liquid chlorine' with the gross and net weight stenciled on the side in Kg. The tonner size, its length and diameter along with the weight of liquid chlorine, which it can contain, shall be clearly mentioned.

Provision shall be made for manually operated hoist of 3 tonne capacity running on monorail system for handling of chlorine cylinders. The gantry shall have an operational design capacity of at least 3 tons and shall be provided with safety type of hook, a drum lifting beam etc. The drum lifting beam shall have a central lifting eye, rotating swivel and hinged steel hooks designed to accurately and safely hold the ends. The contractor shall arrange the layout, the store ceiling height and the elevation of the gantry arrangements to permit any drum to be lifted from any cradle for transfer to any location of the loading vehicle. All drum positions shall be served by the monorail gantry and the clearance shall be such as to enable the drums to be loaded in a standard vehicle with at least 700 mm clearance between the drum in transit and the top of any drums already in position on the vehicle.

Chlorine Gas Detector:

i. Two numbers of chlorine gas detector with alarm facility of reputed make to be approved by Employer shall be provided. One will be in the chlorinator room & the other chlorine store.
ii. Two numbers of self-contained breathing apparatus, with a full-face piece and a cylinder of air or oxygen carried on the body or with a canister that produces oxygen chemically, shall be provided.
iii. One no. of Emergency kit of approved make to handle leakage shall be provided.
iv. One number of first aid kit shall be provided.
v. One number of Steel Almirah of approved make and design suitable for storage of accessories shall be provided.

Ventilation Requirements:

The contractor shall provide forced ventilation system in the chlorine store & chlorinator room conforming to the Govt. of India safety rules, provisions of National Safety Council, IS:4379-1967, other relevant IS codes of practices and Manuals Governing the storage & use of chlorine gas. The forced ventilation system shall be capable to vent even traces of leaked chlorine gas to the atmosphere. The ventilation system shall be manually controlled from external switches outside the rooms at each doorway. Any damage to personnel, property etc. due to mis-handling/ inadequacies in handling facilities shall be the total responsibility of the contractor. The tenderer shall

clearly outline/specify in their offer about the facilities provided by them for storage and handling of chlorine gas and chlorinators.

The chlorine store & related units shall be complete with all related mechanical, electrical & instrumentation, piping & valve arrangements for smooth functioning of system.

Control Room and Testing Laboratory:

Control Room and Testing Laboratory of about 30 Sq.M floor area shall be housed within the Filter House.

The floor area of Control Room shall be 15 Sq.M. One Office Table & four Chairs, One Steel Almirah, One Ceiling Fan shall be provided in the Control Room.

The floor area of the testing laboratory shall be 15 Sq.M. The furniture shall include - (1) Sink base unit (2) Drawer base units (3) Drawer base unit for 6 paddle stirrer (4) Shelf box unit for general work space (5) Refrigerator (6) Office desk with file space (7) Chair. The sink shall be of size 30 inch x 18 inch x 10 inch and in addition a water tap of CP material shall be provided.

The laboratory furniture shall be of plywood construction resistance to acid & water of highest quality material and workmanship. The size of the plywood shall be of 12mm thickness for doors, drawers etc. and not less than 19mm for table tops fixed on wooden construction of adequate thickness. The contractor shall provide handles, locking systems and all other fixtures. The firm shall furnish catalogues from several reputed laboratory manufactures with detailed specification for the laboratory furniture.

The laboratory shall be furnished with equipments & glass wares as listed below, for testing of the following parameters - (i) Optimum doses of coagulant (ii) Turbidity (iii) pH (iv) Residual chlorine (v) Alkalinity (vi) Iron and (vii) Hardness. The **pH meter and turbidity** measuring instruments shall also be of portable type. All type of chemicals required for conducting routine tests during trial run of the WTP, shall be provided by the firm at his cost.

List of Laboratory Equipments & Glass Wares:

1.	pH Meter (0 – 14)	2nos.

2.	Nephlo Turbidity Meter (0 – 8000 NTU)	2nos.
3.	Test Kit to measure Residual Chlorine (0–10 PPM)	2nos.
4.	Jar Jest Apparatus	2nos.
5.	Borosil Make Measuring Cylinder 1000ML	2nos.
6.	Borosil Make Measuring Cylinder 500ML	2nos.
7.	Borosil Make Flask 1000ML	4nos.
8.	Borosil Make Conical Flask 500ML	6nos.
9.	Borosil Make Conical Flask 250ML	4nos.
10.	Borosil Make Beaker 500ML	6nos.
11.	Borosil Make Beaker 250ML	8nos.
12.	Borosil Make Beaker 100ML	8nos.
13.	Borosil Make Burette 100ML.	4nos.
14.	Borosil Make Pipette (50ml, 20ml, 10ml, 5ml, 2ml, 1ml)	2nos. each.
15.	Borosil Make Test Tube (Standard size) - 20ml	12nos.
16.	Burette Stand	4nos.

Toilet :

The Toilet shall be of **4.0 M x 2.5 M** size with one urinal (bowl type) with push button flushing system of C.P. material, one Indian type W.C (23 inch composite type) with low level flushing system, one C.P. tap at low level, one Wash Basin (22 inch X 18 inch) with CP tap and all piping and fittings and fixtures, one mirror of 22 inch X 18 inch size fixed to the wall. The IWC, urinals, wash basin, all fittings and fixtures shall conform to relevant ISS and shall be of reputed make to be approved by the Employer. The Contractor shall provide the manufacturer's Catalogues for selection and approval thereof of all the sanitary fittings and fixtures. The wastewater from the toilets/lavatory shall be connected to the septic tank through PVC/stoneware pipes of appropriate design and as per requirement. The **Entrance Lobby** shall be finished with the Mirror Polished Granite type of Flooring.

Underground Drainage & Waste Disposal System & On-site Sanitation at Treatment Plant Site:

The contractor shall provide open drainage system with masonry drain carrying rain water/ roof top drainage/ surface run-off for its disposal. The drain is to be designed accordingly. Minimum size of the drain shall be 0.4mtr depth x 0.4mtr width. The wall of the open drains shall be of 1st class brick of 375/250mm thick jointed in 1:6 CM and plastered in 1:3 CM with cement punning. The wall shall be constructed over a base of 100mm CC of M15 grade with the same flooring and 100 mm projection on both sides. The flooring shall be with cement concrete (1:1.5:3) with neat punning. Graded weep holes shall be provided at suitable intervals along the drain. The contractor shall provide RCC slabs of required thickness over the open drain wherever necessary. Any concealed drainage works as required shall have to be constructed by the contractor.

The contractor shall provide close conduit under drainage system with RCC NP2 spigot/socket hume pipe of designed dia with manhole duly spaced not exceeding 15 M etc. for carrying the processed water from Chemical House, Primary Clarifier, Clariflocculators, Filter House, Testing Laboratory & Septic Tank system etc. Both the surface drainage system and under drainage system shall meet at a suitable location at the **Master Man Hole** from where it shall be connected to the nearest existing drain to the proposed WTP site by close conduit system with required numbers of Manhole and outfall structure to allow gravity discharge under all conditions. The close conduit under drainage system is to be designed accordingly. Final disposal point shall be as will be shown by the Engineer-in-charge of work based on actual field requirement.

Sludge Drying Pond & Sludge Disposal System :

One Sludge Drying Pond shall be constructed by the Contractor under his scope of work at a suitable location near proposed site of Water Treatment Plant considering the topography of site for gravity flow principle. All the Sludge & Waste water generated & discharged from the Water Treatment Plant shall be collected by gravity flow into these Sludge Drying Pond and clear decant water shall be discharged over a Weir into existing storm water drain.

The Sludge Drying Pond shall be shallow & rectangular in shape and constructed suitably with earthen dykes on three sides and RCC dyke with central weir on discharge side. The earthen dyke height of Sludge Drying Pond shall not be more than 1.5 Metre and shall be designed to hold sludge of volume of atleast three (3) months generation. On regular operation, as and when required, dry sludge shall be removed manually for disposal.

The inner & outer surface of earthen dykes shall be soled with boulders. The Sludge Drying Pond shall be complete with inlet & outlet channels, Sluice Gates / Sluice Valves as required for isolation and easy operation purpose.

The contractor shall submit the necessary drainage layout plan for disposal of rain water & waste water as well showing the position of manholes, invert levels etc. along with the layout & hydraulic profile plan for approval by Employer.

Internal Roads & Walkways :

Road:
There shall be internal roads for access of vehicles to different units as shall be required during operation & maintenance of the plant. The road shall be of 3.5 Metre wide with 1.0 Metre. berm on both sides. The financial offer shall include for a 100 Metre road length irrespective of the actual requirement. However the firm shall clearly show the actual road length provided in the tender layout drawing. The road shall be constructed as per detailed specifications**.**

Walkways:
The Concrete Walkway of 1 Metre wide length as required for smooth accessibility to different units from road shall be provided connecting different units of the WTP.

Beautification of WTP campus by Arboriculture & Horticulture:
The scope includes plantation of 30 saplings of different types of attractive **Croten** plants (including Palm type), 20 varieties of rose sapling and 10 varieties different sapling like Bougainvillea, Hibiscus (Mandar) and other perennial flowering plants in a properly designed landscaping system. The plant shall be nourished properly so that at the time of commissioning of Water Treatment Plant, the decorative plants would be full growth. Necessary care shall be taken for growth of plants by providing Organic Manure, timely watering etc. Minimum 2nos. tap points shall be provided for watering of plants with 60m. of flexible pipe of 20mm diameter.

Miscellaneous items like Brass nameplate, Flow sheet Boards, Glow Sign Boards etc:

i) The name of the plant shall be embossed in 45 cm x 45 cm dimensioned polished brass letters (each letter size) duly fixed on the wall/ projected beyond the wall at appropriate height as per aesthetic requirement.

ii) The contractor shall provide a fluorescent glow Board with all fittings etc. of appropriate size showing the **treatment flow sheet** and allied structures in attractive colours and fix it on MS angle columns at appropriate height and location. The contractor shall also provide one number of wall mounted boards with flow sheets in attractive colours for mounting on the wall of the Manager's room.

iii) The contractor shall provide a fluorescent Glow Sign Board captioned "Water Works" with all fittings etc. of appropriate size

in attractive colours and fix it at appropriate height at the entrance gate.

Process Sampling Points:

The contractor shall provide sampling points generously throughout the works to permit proper and adequate monitoring of the treatment process, chemical solutions, chemical dosing and the works performance. Hand samples shall be made available from at least the following points:

1. Incoming Raw Water
2. Primary Clarifier Outlet Water
3. Coagulated Water
4. Flocculated Water
5. Clariflocculators Outlet
6. Filtered Water from each Filter Bed
7. Filtered Water prior to Chlorination.
8. Filtered water immediately after Chlorination.
9. Final treated water before supply to CWR
10. Alum, PAC, Lime & Bleaching Powder solution tanks.

Hand sampling shall (as appropriate) be by piped supply to conveniently positioned taps. The contractor shall ensure that the arrangements permit ready access to all the required sample points and hand holds are appropriately provided for the sampling throughout the work. Sample pipe work shall be in non-corrosive materials and each sample arranged to enable a 1 ltr. sample to be taken within 5 seconds. Sample taps shall be of Brass and generally about 1 metre above floor or access level and be dentified by an adjacent wall mounted notice 30 mm x 150 mm (block lettering on a white background)

Detailed design and drawings, their submission and approval:

All design shall be submitted in the form of booklet in complete shape along with relevant drawing and in a presentable manner nearly typewritten/ computer printed in A4 size bond paper.

All design calculation/ findings shall be supported with illustrative drawings in form of plan section etc as applicable which shall form a part of design book let.

All reference made in the design shall be indicated in reference chapter of the design booklet on demand of contractor shall furnish reference materials to the department to facilitate checking of design.

All drawings shall be with black line on tracing paper in metric scale in size 560 mm x 810 mm and shall be title cross reference and fully explanatory with the contractors name date seal and signature on it. Additional each drawing shall contain the title at the bottom of the right hand corner.

Alternatively the contractor may submit computer aided drawings drawn in different colours confirming to other specifications as described above.

In case of computer aided design the firm shall also additionally submit the soft copy containing the software and the design to the department to facilitate the checking of the design, contractor shall also furnish the design calculation through manual method if demanded by the department.

Design Basic :

All design shall be based on the best modern practices enumerated in the standard text book/ reference books and hand books by author of international and national repute reference books like the Manual on Water Supply and Treatment by CEPHEEO, Govt. of India, latest Indian Standard code of practice and specification norm fixed by Pollution Control Board, Controller of Explosives and State/ Central Electricity Authority/ European union British/AWWA standard shall also be followed whenever required. In case of any contradiction the decision of the competent authority of the department shall be final.

Authority /European unit British/AWWA standard shall also be followed whenever required. In case of any contradiction the decision of the competent authority of the department shall be final.

For computer aided design the contractor shall use only widely accepted standard software of international/ national repute.

Thumb rule design based on the contractor's own experience / substandard books and literature/ substandard software shall be out rightly rejected.

General Conditions:

1. Cement shall not be less than OPC:43 grade of reputed manufactures conforming to relevant IS Code. (Refer approved Brand list)

2. Reinforcement to conform Fe-415 and relevant IS Code (Refer approved Brand list)

3. As & when required, the steel/cement & other building materials will be tested by Department at the cost of Contractor to ensure proper quality as per IS specification.

4. Testing of water tightness shall be conducted as per relevant IS Codes.

5. Machine mix shall be used in concerted work for all structure. Design mix of concerted will be preferred. Vibrator of appropriate type shall be used for compaction of concerted.

6. All the structures are to be designed as permanent type and shall have aesthetic elevation.

7. Form work shall be of steel plates and frame, sound seasoned timber or any approved materials as decided by Engineer-in-charge to be used for the centring and shuttering of the structures.

8. Painting of all steel structures to be done as per approved quality of enamel paint over a coat of primer.

9. All electrical work / earthings including wiring of filter house, chemical house, chlorine chamber with store, control room & laboratory etc., to be done as per relevant IS specification and Indian Electrical Rules. Single phase wiring shall be done for lighting purpose & three phase wiring shall be done for running pump motors, air blowers and other units of water treatment plant wherever necessary.

10. All the valves are to conform relevant IS specification and of reputed and approved make.

11. The surplus earth and debris should be lifted after completion of work and proper levelling of site as directed by Engineer-in-charge without any extra claim.

12. All the work including supply of materials to be executed as per relevant IS specification and direction of Engineer-in-charge.

13. Foundation of all structure including supply of materials shall be designed depending on ground water table / subsoil condition. In no case the depth of foundation below virgin soil shall be less than 1 metre at respective places.

14. All equipments, accessories, auxiliaries, piping, electrics, instruments, installations, construction, buildings etc. including all mechanical, electrical & civil engineering works covered under the scope of work of contractor shall be subjected to inspection & testing by the Employer for its material, quality, workmanship and the performance. The contractor shall arrange and carryout all such inspection, testing, trial run etc. and demonstrate in presence of the Engineer-in-charge.

15. The cost of such inspection, testing, trial run, demonstration etc. shall be borne buy the contractor. All responsibility of such inspection, testing, trial run, demonstration etc. and any damage/loss that may cause directly or indirectly shall exclusively rest with the Contractor.

16. Such inspection, testing, trial run, demonstration etc. shall, however, not relieve the Contractor of their liability for replacing / rectifying any

defects, which may subsequently appear or be detected during erection and guarantee period.

17. All equipments, sub-assembly and components, auxiliaries and accessories shall be tested at manufacturer's work in accordance with relevant Indian Standards/International Standards. The contractor shall furnish all test certificates etc. related to the quality of all the materials to the Employer along with the delivery of the materials at site without which no payment shall be released. However, such test certificates, quality assurance certificate shall not relieve the contractor of it's obligation to replace forth with any instrument/materials found defective during tests at works / trial running period/guarantee period.

18. Testing for performance of equipments shall be carried out and be checked with the approved parameters and performance characteristic curves for the purpose of acceptance.

Civil Works:

a) **General**:

All the building and structures shall be of permanent type. The Treatment Plant buildings shall have good aesthetic and imposing elevation and architecture with the grounds attractively landscaped and well maintained. **The tenderer shall, therefore, enclose details of the elevation of the buildings along with their offer.** Reinforced cement concrete fins, decorative "**Arch type**" windows, boxes, pebble dash/ rough cast plaster, grills etc. may be proposed to elevate the look.

Sufficient consideration shall be given for the design of the buildings for **aesthetic look.** Ordinary configurations without aesthetic shall not be accepted.

Foundations for all the buildings and structures of Treatment Plant Complex shall be designed depending on Ground water table, sub-soil condition and bearing capacity of soil. In no case the depth of foundation below the virgin soil shall be less than **1.0 Metre.**

Provision of pressure relief valves/earthen overburden for countering full or part of uplift pressure shall not be allowed.

b) **Constructional Features:**

i) **Cascade Aerator, Flume and Channels:**

The construction shall be of **RCC M-25** grade. Cascade Aerator and all Channels shall be cladded with white ceramic tiles of approved Brand.

ii) **Rapid Mixing Unit, Primary Clarifier and Clariflocculator:**

The Rapid Mixing Unit (Flash Mixer), Primary Clarifier, Clariflocculators, Filter House Complex shall be of RCC M-25 grade. Internal surfaces of Rapid Mixing Unit shall be cladded with **acid & alkali resistant** tiles. MS/GI hand railing of 1200mm height around walkway of 800 width over wall of Primary Clarifier, Clariflocculator, Raw Water Channel & Rapid Mixing Unit.

iii) **Filter House:**

The filter house building complex with front lobby entrance, the Annex shall be constructed as a **RCC M-25 Grade** framed structure with brick masonry filler walls above filter bed wall. All water-retaining components like filter box, all channels, weir box, inlet box etc. shall be of **R.C.C M-25 Grade.** Floor of the Operating Platform, Walk way, Supernatant Inspection Chamber of the filter house shall be cladded with **Vitreous tile** of approved Brand & appropriate colour. The filter house annex building and operating gallery shall be provided with all related mechanical, instrumentation, piping and valves control arrangements etc. required for completeness of plant & for smooth working. The filter house building complex will have RCC roof on top & above which there will be backwash tank having floor slab & roof slab.

Filter house interior shall be well ventilated and well lit by provision of sufficient numbers of doors, windows, ventilators and exhaust fans. The flooring of filter house & annex building in general shall be of **Virtified Ceramic Tile** flooring excepting for the operating platform. The exposed column of the filter house near operating platform shall be cladded with **Granite** tiles. All tile flooring shall be of minimum 20mm thick & best quality to be approved by the Engineer-in-charge. Stair shall be cladded with **Marble**.

Necessary access ladders for the filter units, hand railings around filters and railings in operation floor shall be provided. The handrails in the Operating Platform & Walk Way shall be of Stainless Steel.

iv) **Overhead Backwash Water Tank:**

The overhead back wash water tank of **180 m^3** capacity shall be over the filter house with sufficient staging height as per clause relevant having walkway at floor slab level, access ladder from GL to roof & roof to tank floor. The overhead backwash water tank shall have appropriate staging height as per hydraulic design. All components over head backwash water tank shall be of **RCC M-25 Grade**. The shape of the tank shall give an architecturally imposing monumental view and ordinary configuration shall not be accepted.

There shall be RCC access ladder with hand-railing of 1200mm height & 800mm wide combined with supplementary MS ladder with hand railings & landings for access to the roof of backwash tank. Similarly

MS ladder shall be provided for access into the tank. Inlet & outlet pipe shall be as per pump motor & backwash requirement of filters. Overflow & washout line shall be 150mm dia each of CI. D/F Class 'B' pipes. Each pipeline shall be provided with required puddle collars, expansion joint, duck foot bend, CI/DF valves etc., as required for completeness. Inlet pipe and outlet pipe shall be class-B CI D/F & the sizes shall be as per hydraulic design.

One lightening arrester shall be provided on the roof of the tank with earthing as per **IS-2309**. The arrester shall be suitably earthed with an aluminum tape conductor as per IS specification. Two nos. of C.I lockable hinge type manhole covers of minimum **600 mm dia** with frame shall be provided on the roof of the tank. Mechanical type water level indicator shall be provided. All other related items required for completeness of the backwash taken for smooth functioning shall be provided.

v) 200 KL Capacity Clear Water Under Ground Reservoir:

(a) The Clear Water Reservoir shall be constructed underground, circular in shape with flat roof having column beam supporting arrangement similar to existing Underground Reservoirs.

(b) It shall be constructed with RCC M-25 grade.

(c) The bottom level or invert level, internal diameter & height of top of ring beam & overall dimensions shall be designed as per existing Reservoirs in order to maintain same water level.

(d) A Common Header for distributing & filling Filtered Water into all the four Clear Water Reservoirs shall be laid.

(e) The capacity of the reservoir shall be the volume of the water stored between the invert level of overflow pipe and the dead storage level. Due allowance shall be made for plastering inside surface of the wall and floor while calculating the net capacity of reservoir.

(f) Free board shall be designed as per existing CW Reservoirs.

(g) The dead storage level of 100mm to be provided for the reservoir.

(h) The design shall be based on accepted norms and methods of design and provisions contained in latest version of IS-456, IS-3370, IS-875 and IS-1893.

(i) SS ladder shall be provided inside the tank for access into the tank.

(j) 2nos. of C.I. lockable hinge type Man Hole covers of minimum 600mm diameter with frame shall be provided on the roof of the tank.

(k) The UGRs shall be completed with all piping, valves & interconnection.

(l) No overburden on roof top of any kind (earthen, masonry, or in any other form) / Pressure Relief Valves at base slab to counter

a part or full uplift pressure due to presence of GWT shall be allowed.

(m) Inlet & outlet shall be as per design & field requirement, over flow & washout pipeline shall be of 300mm dia and 150mm dia CI/DF class-B pipeline respectively with limit of contract of 10.0M length for each pipe line minimum.

(n) Minimum depth of foundation shall be 1.00 m measured from lowest virgin GL of CWR area.

(o) All other civil specifications have been appended in detailed specification of reservoirs.

(p) Inside surface cement plaster with CM (1:3) 20 mm thick with neat cement punning.

(q) Ventilators, two nos., with Canopy & stainless steel Mosquito Net shall be provided in the Roof.

vi) **Chemical House:**

The chemical house building shall be of **M 20 grade RCC** framed structure with brick masonry filler walls. The solution tanks and channels shall be of RCC M-**25 grade** and provided with acid/ alkali resistant tiles.

Chemical house shall be well ventilated and well lit by provision of sufficient numbers of doors, windows, ventilators and exhaust fans.

Floor for storage of lime, alum & bleaching powder shall be made of **acid /alkali** resistant **tiles/stone** floorings as per direction of Engineer-in-Charge. The floor & wall of the Chemical House up to **2.0mtr** height from the floor level shall be made **acid/alkali** resistance by providing appropriate type of tiles. Other portion of interior walls i.e. above **2.0 meter** height and the ceiling of the chemical house shall be provided with acid/alkali resistant epoxy paint of two (2) coats of approved colour over one (1) coat of primer.

The ground floor ceiling height of Chemical House for chemical storage shall not be less than **4.0 M** from finished floor level.

The floor of MCC room, stairs and other utility spaces shall be of KOTA STONE floorings. All other items including electrical shall be standard PWD/Electrical specification unless other mentioned specifically elsewhere.

vii) **Control Room & Testing Laboratory:**

Shall be RCC M-20 grade framed structure with brick filler walls. Sufficient doors & windows shall be provided in the building.

Floorings of the Control Room & Testing Laboratory shall be of Vitrified Ceramic Tile of approved make & approved colour. The walls of the

Toilet shall be provided with white glazed tiles up to **2.0 M** height from the finished floor level. Entrance lobby shall be finished with good quality vitrified ceramic tile Flooring. Portico shall be of C.C. Chequrred Tile flooring. All other items including electrical shall be standard PWD/Electrical specification unless otherwise mentioned specifically elsewhere.

viii) **General for all Buildings & Structures:**

a) All chemical solution Tanks, Cascade Aerator, Rapid Mixing Unit, Primary Clarifier, Clariflocculators, Filtration Units, Backwash Water Sump & Overhead Water Tank and all the Channels & Launders carrying raw, clarified, coagulated, settled or filtered waters shall be of M25 grade and shall be designed as water retaining tanks and as uncracked section without considering any age factor. All water retaining structures shall be tested for water tightness before installing the equipment, media etc. All channels & launders of the Water Treatment Plant shall be cladded with white glazed ceramic tile of approved make. Required type of foundation as required with respect to actual soil condition & soil parameters, SBC bore log, position of maximum subsoil water table in worst rainy season condition or as specified in tender schedule shall be provided for the units of Water Treatment Plant & Clear Water Reservoir, as per actual design requirements satisfying the requirements of books of reputed authors & IS codes maintaining safety.

b) Portland Cement shall be not less than **OPC / PSC of 43** Grade of approved brand.

c) Minimum free board (FB) of 150mm shall be provided for channels unless specified separately and FB of 300mm minimum shall have to be provided for all other water retaining structures except the Filter Boxes in which case it shall be 500 mm.

d) All channels, launders, conduits etc. shall be designed for 100% overload capacity.

e) No age factor shall be allowed in the design of the structures.

f) The plinth level of all the buildings shall be **0.75 M** above the general ground formation level unless otherwise specified.

g) The room height of Filter House from the top of Filter Bed walls shall be **4.20 M** (minimum). The room height of Chemical House shall be minimum **4.0 M**. The room height (between finished floor level and ceiling) of the Control Room and Testing Laboratory building shall be not less than **3.6 M.**

h) R.C.C. : M 25 grade for all water retaining structures (UGR, Back Wash tank and all units of Water Treatment Plant)

i) Plain cement concrete of grade **M_{10}** of thickness not less than **100** mm shall be provided below the RCC floor slab and the footings and foundation unless otherwise specified specifically.

j) The minimum thickness of the RCC structural members shall be as follows:

1) Wall of the reservoir/ water retaining structures :

Up to 4 m water depth	185 mm
Up to 5 m water depth	200 mm
Up to 6 m water depth	215 mm

2) Floor slab of the reservoirs etc. : 200 mm
3) Shaft staging Wall of load bearing shaft in case of elevated / over head reservoir : 150 mm
4) Roof slab, if designed as shell : 100 mm
5) Roof slab design on flat slab principle : 125 mm
6) Normal RCC plain/flat roof : 125 mm

k) Minimum depth of foundation RCC UGR : 1.0 M

m) Grade of RCC for all components of all water retaining structures : M25

o) Shape of RCC UGR : Circular with flat roof having column beam supporting arrangement.

q) Minimum Free board : RCC UGR – 500mm (flat roof)

r) There shall be RCC / MS access ladder of 1200mm height & 800mm wide combined with supplementary MS ladder with hand railings & landings for access to the roof of Overhead Wash Water Tank. Similarly MS ladder shall be provided for access into the tank. Inlet & outlet pipe shall be as per pump motor & field requirement. Overflow pipe dia shall be more than inlet dia. 200mm dia wash out pipe. Each pipeline shall be provided with required puddle collars, expansion joint, duck foot bend, DI/DF valves, valve chambers etc., as required for completeness.

s) One lightening arrester shall be provided on the roof of the Overhead Wash Water Tank with earthing as per **IS-2309**. The arrester shall be suitably earthed with an aluminum tape conductor as per IS specification. Two nos. of C.I lockable hinge type manhole covers of minimum **600 mm dia** with frame shall be provided on the roof of the tank. Mechanical type water level indicators shall be provided. All

other related items required for completeness of the backwash taken for smooth functioning shall be provided.

t) In case of Overhead Tank of shaft staging there shall be an entrance door at plinth level and ventilators at suitable locations. The plinth shall be provided with suitable flooring over a base course.

u) Manual water level indicator with measuring gauge, floats with related items shall be provided for all water retaining structures.

v) RCC manhole covers of 600mm dia minimum of two numbers shall be provided in each water retaining structures.

w) All water retaining structures shall be designed based on latest IS:456, 3370, 1893, 875, IRC-6, 78 etc. & all other relevant IS codes and books of good repute of national & international standards.

x) R.C.C works of all water retaining structures shall be finished perfectly smooth and no plastering shall be allowed, except in the inside surface of walls and floors which shall be rendered with 20 mm thick cement plaster in (1:3) ratio with neat cement punning.

y) The water reservoirs shall be provided with suitable ventilating arrangement at the roof. The opening of the ventilator be protected with mosquito proof wire net made of copper wire mesh

z) All Iron works shall be painted with two coats of approved anticorrosive synthetic enamel paint over a coat of primer. All wood works shall be painted with two coats of approved paint over a coat of primer.

aa) All External surfaces shall be painted with two coats of Weather proof acrylic emulsion paint of approved make and approved colour over a coat of primer. The Engineer I/c shall approve the computerized colour code prior to application of paint.

ab) The specification of **building works** shall be as below:

i) Brick work:

Bricks should conform to IS 1077. First class KB Bricks in cement mortar (1:4) in foundation and plinth. All non-load bearing outer walls shall be minimum 250 mm thick & inside partition walls shall be minimum 125 mm thick. First class KB bricks in cement mortar (1:6) in superstructure. The thickness of plaster shall not be more than 20 mm size for outside face & 15 mm in the inside face.

ii) Plastering :

All brick works with 16 mm thick cement mortar in 1:6 & all RCC exposed surfaces & roof ceilings except for the Water retaining structures shall be with 12mm thick cement mortar in 1:4 unless specifically mentioned.

iii) PCC :
Minimum 100mm thick **M-10** under RCC foundation and flooring.

iv) Painting / Colouring over Plastering:
All External surfaces shall be painted with two coats of Weather proof acrylic emulsion paint of approved make and approved colour over a coat of primer. All internal surfaces of all the buildings/Room shall be given with two coats of distemper paint over a coat of primer. Ceiling of all round of building shall be painted with two coats of white distemper over a coat of primer.

v) Flooring :
Level of flooring shall be 0.75m above the virgin soil at respective structures. There shall be sand filling between the virgin soil & the floor. Different types of floorings to be adopted for different units as has been discussed under the respective structures in preceding paragraphs. AS flooring (cement concrete flooring) shall be of 25mm thick of 1:2:4 CC with punning over 100 mm CC 1:3:6 base in case of ground floors/directly on roof in case of first floor. The KOTA STONE flooring shall be of minimum 20mm thick. The dado in all types of flooring shall be of 0.3mtr height.

ac) The Contractor shall provide necessary Sun Shades/Chajja etc. wherever necessary.

ad) The contractor shall provide ramp with gentle scope to the buildings wherever required.

ae) Plinth protection for a width of 1.00 m around all the buildings shall be provided. It shall be C.C. checkered floor over 100 mm PCC.

af) All roofs shall be provided with screed concrete with approved water proofing compound with required grading for drainage. There shall be drainage pipes of 110 mm PVC pipes with all fixtures and specials extending up to the surface drain for disposal of rainwater. The number of pipes shall be as per the roof drainage plan to be approved by the Department. A DPC coarse in 1:2:4 concrete shall be provided at plinth level for a thickness of 40mm for all buildings.

ag) There shall be parapet walls of 250 mm brick masonry up to 600 mm height above the roof of all buildings.

ah) Expansion joints shall be provided in exposed pipelines as per standard practice & in conformity with relevant IS Specification.

ai) Machine mix shall be used in concrete works of the structures. Design mix concrete shall be preferred to the nominal mix. Vibrator of appropriate type shall be used for compaction of the concrete.

i) The Contractor shall give at his own cost concrete cubes to the Engineer I/c made from samples of fresh concrete taken as per **IS: 1199** cured for 7 days and 25 days for testing by the Employer at the cost of the Contractor. Besides, the contractor shall also carry out such tests as required by the Employer at regular intervals at his own cost.

ii) The sample shall be taken from the concrete prepared for use in the following component of the structure:
1) Foundation.
2) Each lift of supporting structure
3) Floor beam
4) Floor
5) Each lift of the wall
6) Roof slab.
7) Any other portion of the structure as required by the Engineer-in-charge.

In the event of not meeting the desired strength, the Contractor shall dismantle the defective parts of the construction and make good the same at his own cost. All the building materials including steel rods shall be tested in recognized testing laboratory to be selected by Department at the cost of the Contractor. Any material found defective/not to specification shall be replaced forth with by the contractor without any extra financial implication.

The testing for water tightness of the structures shall be conducted as per **IS: 3370** and the results shall have to satisfy the relevant provisions of the above code.
All reinforcement shall be checked and recorded prior to concreting by the Engineer-in-charge or his representative and the contractor shall countersign this. Entire concreting work shall be done in the presence of an officer deputed by the Engineer l/c, The Contractor shall, therefore, give notice of at least two days to the Engineer I/c or his representative so that the works can be checked by him or his authorised representative.

i) The form work shall be of steel plates of steel frame, sound and seasoned timber or of any approved materials, having sufficient strength to hold the concrete and withstand ramming and vibrations. If

timber shuttering is used it shall be constructed in such a way that none of the concrete grout leaks away and shall be such as to leave a clean smooth surface not requiring further plastering. The surface of all forms in contact with concrete shall be clean, rigid, tight and smooth. Before a piece of work on formwork is concreted, the formwork shall be cleaned of all mortar, shavings, concrete from previous work and all other dirt. It shall then be covered with thin coat of mould oil approved by the purchaser.

ii) The joints in the form work shall be arranged in a regular pattern.

iii) Shuttering shall be provided to concrete faces where the slope exceeds 1: 2½.

iv) The stripping time of all form work shall be in accordance with recommendations contained in **IS:456**.

ak) **Concrete face work:**

- The exposed faces of concrete shall be true to line, have smooth surface and without roughness occurring between successive sections of shuttering. In removal of forms, minor uneven surface defects shall be picked out to such a depth, refilled and properly replaced with such class concrete as necessary. All pin holes shall be plugged.
- The surface of non shuttered faces of concrete shall be finished with a wooden float to give a finish equal to that of the rubbed down shuttered faces. The top faces of slabs not intended to be surfaced shall be leveled and floated to a smooth finish.

al) **Embedment and Anchorages**:

All the embedment and anchorages shall be provided by the contractor and shall be rigidly fastened. Anchor bolts and other anchorages or inserts shall be set to template and /or firmly secured in position.

am) **Grouting** :

Nominal minimum strength of grouting concrete shall be 40 N/mm^2 or such other values as may be shown on the approved drawings. The nominal maximum size of aggregate for grouting concrete shall be 10 mm.

In case 'Dry' concrete or mortar is used, slump shall not exceed 6 mm.

If 'Wet' expanding concrete or mortar is used, slump shall be at least **125 mm** or more but not exceeding 225 mm. An expanding grouting admixture shall be of approved type and in accordance with the manufacturer's instruction.

an) **Doors/Window/Ventilators/Grills :**

1. There shall be adequate nos. of doors & windows in all the buildings/structures.
2. The area of openings shall not be less than 25% of floor area.
3. All windows shall be with aluminium frame & 5 mm thick reinforced glass panels provided with all related aluminium hardware fittings. The shutters shall be of sliding type in two folds.
4. All doors except for those specified separately shall be with aluminium frame & 12mm thick pre laminated plywood panels provided with all related aluminium hardware fittings.
5. There shall be adequate nos. of ventilators of size 750mm x 300 mm fitted with decorative RCC Jally.
6. There shall be a **3 M** wide **2.4 M** height MS shutter of standard thickness with all hardware fittings suitably located to facilitate conveyance of chemical bags in to the storage area. There shall be an normal outside door for general thoroughfare.
7. There shall be MS grills of member thickness not less than 5 mm of decorative designs fitted to all the windows of the Control Room & Testing Laboratory, Chemical Storage area for safety. Similarly the Grill Gate to be fixed to the boundary wall shall be approved design and of 2.0m. height.
8. The panels of all external doors, toilets, filter house shall be of waterproof pre-laminated plywood shutter of minimum 12 mm thickness. For chemical house, the panels should be of chemical resistant materials.
9. The specifications of Aluminum frames for doors & windows shall be as per relevant ISS & suitable from aesthetic point of view to be approved by Department.
10. All other materials used in doors & windows shall conform to relevant ISS & to be approved by Department.
11. The fixing of doors & windows shall conform to relevant ISS.

x) **Steel & Structural Fabrication:**

i) **Method and Material for construction:**

Steel structures shall generally be of welded construction. Structural steel shall conform to IS:226 or IS:2062 as required from design considerations. In welded construction plates up-to and including 20 mm thickness and rolled section shall be of grade St.42 conforming to IS:226. Plates above 20 mm thickness, where welding is employed shall be of steel grade St.42 conforming to IS:2062. Electrodes, bolts, nuts, washers etc. shall conform to relevant Indian Standards.

Only tested materials shall be used and all test certificates are to be submitted by the Contractor, unless permission of the Purchaser is granted for use of untested materials for specifically mentioned structures.

ii) **Fabrication:**

The fabrication of structures shall be carried out as per relevant India Standards and also according to latest practices. Steel structures shall be fabricated to suit transport requirement and minimum site work.
All steel structural works shall be subjected to inspection by the purchaser before erection and painting.
All permissible tolerance in workmanship shall be as per IS:7215.

iii) **Erection:**
The erection shall be carried out as per relevant Indian Standards. The minimum tolerance for alignment and level of the steel work shall be + 3 mm on any part of the structure. The structure shall not be out of plumb by more than 10 mm. These tolerances shall apply to all parts of the structure.

iv) **Painting:**
- ❖ All the steel works shall be painted.
- ❖ Members coming in direct contact with concrete shall not be painted.
- ❖ Painting operation and paint schedules shall be as per IS:1477 (part-II).
- ❖ All steel structural other than in chemical house shall receive one coat of red oxide zinc chromate primer conforming to IS:2239 after fabrication and one coat of the same primer after erection. Steel structures in chemical house shall receive acid / alkali resistant epoxy based primer.
- ❖ Priming coat shall be followed by two coats of painting by approved quality colour shade paints. Steel structure in chemical house shall be painted with acid/alkali resistant epoxy-based paint.
- ❖ Before starting actual painting operation, the members to be painted shall be thoroughly cleaned of all dirt, grease, rust, scales etc.

xi) **Road Work:**

i) The road shall be concrete with nominal reinforcement and of **3.5 M** wide with **1.0 M** berm on both the sides and constructed with the following specification.

ii) The sub-base shall consist of 0.225m sand moorum and then base of **150 mm** thick **hard granite** formation achieved by spreading hard granite metal of size from 63 mm to 40mm & 50mm to 20mm in two layers of **100 mm** thickness (loose) /each layer and compacted to **75 mm** each layer with **moorum** and sand in equal proportion for filling the interstices duly watered and consolidated by power driven Road Roller. Necessary camber shall be provided while spreading the materials with adequate drainage work as per actual field condition.
The ground shall be prepared by cutting and filling up of earth to make it up for the desired level and slope and consolidated.

xii) Walkway work:

i) The walkway shall be paved with Chequered tile and of 1 Metre wide and constructed with the following specification.

ii) The base shall consist of 150mm thick sand layer & above 100mm thick PCC layer, paved with Chequrred tile of approved design uniformly jointed by 1:4 mixed cement mortar.

xiii) Sludge Drying Pond :

The Sludge Drying Pond shall be shallow & rectangular in shape and constructed suitably with earthen dykes on three sides and RCC dyke with central weir on discharge side. The earthen dyke height of Sludge Drying Pond shall not be more than 1.5 Metre and shall be designed to hold sludge of volume of atleast three (3) months peak generation. On regular operation, as and when required, dry sludge shall be removed manually for disposal.

The inner & outer surface of earthen dykes shall be soled with boulders. The Sludge Drying Pond shall be complete with inlet & outlet channels, Sluice Gates / Sluice Valves as required for isolation and easy operation purpose.

xiv) Disposal of Surplus Earth & Debris after construction:

The surplus left over earth and debris after completion of erection work and leveling the site shall be transported, dumped, levelled in areas as directed by the Engineer I/c without any extra claim.

9.6. **Piping & Valves:**

C.I. Piping :	
Specifications for C.I. pipe	IS : 1536-1989 Class-A flanged and Tested.
Specifications for C.I. fittings	IS:1538-1976 (part-1 to 24) tested.
Type of joint	Flange Joint.
Code of practice for laying	IS : 3114
Test pressure	1.5 times the working pressure subject to minimum 1.0 kg/cm^2 for 24 hrs.
MS Piping :	
Specifications for MS pipe	IS: 5504-1969 for Spirally Welded Pipes, IS 3589-1991 : Seamless or electrically welded steel pipes

Wall Thickness	Not less than 8 mm
In-lining & out coating	As given in IS: 10221-1982/IS 5822-1986 as applicable
Laying	IS :5822- 1986
Flange thickness	As per relevant ISS
PVC pipes & fittings	For internal water supply/sewerage : Relevant ISS.
DI pipes & fitting & their laying	As per IS 8329 /1977, IS 9523/ 1980&IS 12288 /1987
Pump Delivery Sluice Valves & Scour Valves.	Double flanged Sluice Valves, Rising Spindle, Rating: PN 1.0 (10 kg/cm^2) or as per requirement whichever is more, Conforming IS:780, IS:2906, Body: C.I., Spindle: SS, AISI–410
Non-return valves	Double flanged Swing Check type, Rating: PN 1.0 (10 kg/cm^2) or as per requirement whichever is more. Conforming IS: 5312, Body: C.I., Disc: C.I., Spindle: SS, AISI –410.
Throttle Valve/ Control Valve	Butterfly Valves (Rating:10kg/cm^2) suitable rating BS: 5155, AWWA : C-504, Body : C.I. Disc: C.I., Spindle :SS AISI-410.
Specification for Pipe	IS:1239 (part-I) G.I. Screw/Socket end tested (Heavy)
Specification for Fittings	IS:1239 (Part-II), GI, Screw end tested.
Valves, Stop Cocks, Bib Cocks	IS:778, Gun Metal Construction, Screwed ends.
Pillar Cocks / Taps	IS 1795 - 1982 Chromium Plated.
Chemical Piping	
Specification & material for chemical dosing pipe.	IS : 4985 -2000 UPVC.
Specification & material for chemical scour/ drain pipe	IS : 3006 chemically resistant stoneware
Valves	Teflon, Double flanged Diaphragm type.
Regulating throttle valve	S.S. Slim seal type butterfly valves.

9.7. **Technical Requirement:**

All the valves shall confirm to relevant **BIS/BS/AWWA** and bear such embossed certification mark.

Valves, wherever required, shall be provided with extended spindle (AISI-410 material) and head stock so that hand wheels can be provided at 1.2 m level for manual operation.

All valves for water supply & air applications shall be CI (IS:210, FG:220) body with 13% Chrome-steel (AISI-410) spindle and seat & seat ring made of gun metal. All valves for chemical & corrosive application shall be Teflon body & internals.

The valves shall be double flanged body with 'raised-face' flanges and drilling to conform IS: 1538.

RCC Valve chambers/CI surface box as required shall be provided for the valves with CI lockable manhole of standard size.

Suitable anchor blocks shall be provided at bends and other locations where unbalanced forces may develop under normal operation, during power failures, during reverse flow or during testing of pipe line that tend to cause movements in the pipe line.

Valves of size NB 300 and above shall be installed with a dismantling joint or short-piece in the pipe line to facilitate easy replacement.

On completion of erection, trial-run and testing all the pipelines, valves and fittings shall be cleaned thoroughly and painted with two (2) coats of enamel paint over by one (1) coat of primer. The colour code shall conform to Department's norms for identification of raw water/ clear water/ spent water/ wash water/ air etc. The flow direction shall also be stenciled on the pipe lines.

The scope of work for the tender includes entire piping work & valves of all types as per actual requirement at site for the completeness of the project. Any variation in piping work & valves shall be borne by the contractor and shall not be entertained for extra payment.

9.8. **Instrumentations:**

a) (i) The scope of work for the contractor shall include the following instrumentations. The Contractor shall also suggest and include in his scope of work the additional & Standard Instrumentation required for smooth & effective operation of the 'system' and for protection of equipments. The instruments shall be suitable for indication in **'MKS'** unit and the respective dials shall be calibrated & printed accordingly.

(ii) The Instrumentation shall be of latest technology and best of their kind used in Water Works. The contractor shall furnish **2-3 makes** with copies of catalogues along with his tender documents that he intends to supply under this scope of work and same shall form a part of contract.

Location	Instruments
Flash Mixer	Parshall Flume (rate of raw water in-flow to Treatment plant.
Filter House	Loss of Head Indicator (Dial type) for each Filter Bed
	Rate of Flow Indicator (Dial type) for each Filter Bed

	Total Rate of Out Flow from the Filter House With Integrator
OH Wash Water Tank	Water Level Indicator of Mechanical type
Clear Water Reservoirs	- Do- 4 nos. for the All Four Reservoirs
Testing Laboratory	Turbidity Meter (electronic) 0 - 8000 NTU
	pH Meter (Electronic) Range 0-14
	D.O Meter (Electronic)
	Jar Test Apparatus
Filter House MCC	Voltage Meter & Ampere Meter Indication Lamps, Hooter
Wash Water Pumps	Pressure Gauges
	Ampere Meters
Air Blowers	Pressure Gauges
	Ampere Meters
Chemical House MCC	Ampere Meters
Chemical House	Weighing Machine

c) Pressure gauges shall be `**Dial'** type with min. 100 mm dia. Dial. The range for the pressure gauges shall be two times the normal working pressure of the pipe line. The pressure gauge shall be mounted in vertical position with a three-way cock. It shall have the scales in metric system.
All other Instrumentations mentioned elsewhere in this Tender Document shall have to be provided in addition to the above. Besides, any instrumentation which is not indicated above but shall be required for completeness of a system shall have to be provided by the contractor without any extra claim.

9.9. **Material Handling, Fire Protection, Ventilation & other miscellaneous facilities:**

1. The scope of work for the contractor shall include the following material handling facilities, fire protection, ventilation and other miscellaneous facilities.

2. **Material Handling Facility:**

Location	Facility
Chemical House	Two (2) no. Electrically Operated Traveling Hoist of one (1) Tonne capacity with Bucket of 500kg Capacity for handling chemicals from storage to the solution tanks. Complete with Monorail & Operating & Lifting Chain

For Replacement of Valves & Spare handling.	One (1) no. of Portal Frame with wheels and One Tonne Capacity Chain Pulley Block for miscellaneous purpose.
Miscellaneous	One number of framed Aluminium foldable ladder with table top & wheels.

3.a) **Fire protection facility**:

Location	Facility
Filter House	Portable Carbon-dioxide type Fire Extinguisher - one no.
Chemical House	Portable Carbon-dioxide type Fire Extinguisher - one no.
Treatment & Filtration complex premises.	Fire Bucket - Four (4) nos. with stand.

b) Portable Carbon-dioxide Fire Extinguishers shall be 6.8 kg type conforming to **IS:2878-1976**. The Fire Buckets shall be galvanized mild steel conforming to **IS:2546-1974**. The installation of fire protection equipments shall conform to **IS:2190-1979**.

4. **Ventilation***:*

i) Adequate numbers of suitable exhaust fans shall be provided in Filter House, Chemical House, and Testing Laboratory for proper ventilation.

ii) The exhaust fans shall be heavy duty continuous rating, industrial type, ring mounted of not less than 450 mm dia size and shall be suitable for 230V, 50 Hz. single-phase, AC power supply. The exhaust fans shall be complete with frame, pads, louver/ birds screen etc.

iii) The exhaust fans installed in Chemical House shall be painted with anti-corrosive paint suitable for corrosive atmosphere.

9.10. **ELECTRICALS :**

1. **Scope of Work :**

The scope of work of the contractor shall include complete electrics & power feeder, cable work between the Sub-station and main LT Distribution Board (main LTDB), outlets to all the equipments, illumination, ventilation, plug-sockets etc.

2. **Technical Specifications:**

(a) **Medium Voltage A.C. Motors:**

i) All A.C Medium voltage squirrel cage induction motors shall be designed, manufactured and tested in accordance with the requirements. All AC induction motors shall fully conform **to IS:325-1978.**

ii) The TEFC induction motors shall be designed for the maximum ambient temperature of 55^0C. The relative humidity (RH) can be upto the maximum of 100%. But the maximum ambient temperature and 100% relative humidity both may not occur simultaneously.

iii) The Motors shall be designed for an over load capacity of 115% of rated capacity for frequent operations.

iv) The insulation class of motors shall be B/F and degree of protection to be provided by the enclosure shall be IP 55 in accordance with IS:325 & IS:4691. Degree of protection provided by enclosure for rotating electrical machinery.

v) The motor body shall have two separate earthing terminals for earthing in compliance with Indian Electricity Rules.

(b) **Motor Control Centre (MCC):**

1) Separate motor control centers (MCC) - one in Filter House control room for filling wash water overhead tank, back-wash water pumps & air-blowers, one in Chemical House control room for chemical dosing pumps, agitators and another for operating Clarifier & Clariflocculator shall be provided.

2) The motor control centre (MCC) shall be designed, manufactured and tested in accordance with the requirements. The control of individual motors shall be suitably designed. It shall have load break isolator, fuses, electromagnetic contactor and thermal over load relays etc.

3) The MCC shall be sheet steel enclosed, floor mounted, free standing type and fully draw out type. The thickness of sheet steel used shall be 2.0 mm minimum.

4) The degree of protection provided by the enclosure shall be IP-52 as per IS:2147. Durable gaskets shall be provided for all doors and covers. The MCC shall be able to withstand a rated symmetrical fault level of 40KA for 1 second.

5) The main horizontal and vertical bus-bars shall be designed and supported to withstand the thermal and dynamic stresses corresponding to the above fault level.

6) The out going functional units shall be designed such that the components and wiring can withstand the stresses arising out of a bolted short circuit at the out going terminals till such time that the short circuit protective devices (SCPD) clears the fault. The protection shall be type 'C' of Clause No.2.1 of **IS:8544(Part-I**) 1971.

7) The short circuit protection shall be graded that a fault occurring in any out going branch circuit is cleared by the SCPD

in the faulted branch without affecting the other outgoing branch circuits.

8) MCC shall be assembled by suitable combination of panels arranged side by side and shall be easily extensible on either side.

9) MCC shall be front wired.

10) The MCC shall have uniform height and preferably uniform depth also, through out its entire length.

11) The cable entry shall be from bottom only, detachable ground plates of minimum 2.5 mm thick shall be provided.

12) The control transformer shall be housed in a non draw out module in one of a separate bottom compartment.

13) The MCC shall be provided with indicating instruments along with selector switches.

14) The MCC shall be provided with **'DANGER'** name plates in accordance with IS:2551-1963 and IS:8923-1978.

15) The bus-bars shall be of electrical grade aluminium and shall be so selected that the total operating temperature does not exceed 85^{o} C. The control bus shall be of suitable rating.

16) Clearances between phase buses shall not be less than 25 mm.

17) Power connections shall be done by single core 1100V grade PVC insulated copper cables and control wiring by 1100 V grade PVC wires with minimum 2.5 mm^2 copper conductor.

18) All power and control terminals shall be properly separated and suitably identified.

19) All sheet steel work shall under go a process of degreasing, pickling in acid, cold rinsing and phosphetising and then sprayed with a corrosive resistant primer followed by stove enameling, two coats of final painting shall be given with the opeline green finish as per shade 275 of IS:5.

20) Continuous earth bus shall be provided for the full length of the MCC running at the bottom with an earthing terminal at each end.

21) Mode of motor starting shall be as follows:

a) Direct-On-Line system upto 10kW Motor rating,

b) Star/Delta system for above 10kW & below 40kW Sq.Cage Motor,

c) Slip-ring or VVVF Direct for 40kW & above to limit current

Protection safety measures shall be taken to comply with statutory regulations ad the design shall generally confirm to IS:8623 (Part-I) 1977.

(c) **Control Board :**

i) The Control Board shall be of sheet steel clad, floor mounting type, free standing design. The thickness of sheet steel shall be 2.00 mm minimum. The enclosure shall be dust and vermin proof with rubber gasketing conforming to IS:8623. The bottom of the control Board shall have removable cover plate to facilitate drilling of holes for cable entry as required during installation.

ii) The Control Board shall be provided with push buttons, selector switches, indicating lamps, indicating instruments. The control board shall also be provided with audio visual annunciation facilities. The measuring instruments for indicating voltage and currents shall be provided. The emergency push buttons with mushroom head for all pumps shall be provided for any emergency off operation. This shall be non key type with mushroom head snapped push button with latch and twist release. A standard colour code shall be used.

iii) The control board shall be properly earthed.

iv) The control board shall be wired with a minimum of 1.5 sqmm. PVC insulated copper cables. All outgoing connections shall be brought out to terminal blocks. All terminals shall be covered with ferrules having engraved numbers.

v) Protection safety measures shall be taken to comply with statutory regulation and the design shall generally conform to IS:8623 (Part-I) 1977.

(d) **Cables :**

i) The multi core 1.1 KV grade power and control cables shall be included under the scope of supplying, lying and terminating of power/ control cables.

ii) **Power Cables** : The 1.1 KV grade power cables shall be XLPE insulated, PVC sheathed armoured, aluminium conductor. The minimum size of each core power cable shall be 6 sqmm. The power cables shall conform to IS:1554 (Part-I) 1964.

iii) **Control cables** : The multi core 1.1 KV grade control cables shall be PVC insulated, PVC sheathed armoured, copper conductor. The minimum size of each core shall be 2.5 sqmm. The control cables shall conform to IS:1554 (Part-I) 1964.

(e) **Cable Laying :**

i) All the precautions, customaries in modern code of practices shall be observed with while laying of cables. Latest ISS, code of practices shall be followed for laying of cables. The underground cables for 1.1 KV grade for power/control shall be laid at a depth of 800/1000 mm and after laying of cables the excavated earth trenches shall be back filled with sand & brick protection from three sides (both sides & top) and back filled with soil.

ii) When cables cross existing cables, water main and sewers the, cables shall be laid at least 300 mm below existing cable or water mains. Where the cables have to cross deep drains, the crossing shall be covered by fixing protective RCC pipe across the drain.

iii) All 1.1 KV grade power and control cables run on cable trays/racks shall be laid touching each other but shall be in one layer only.

iv) Cables of different voltages shall generally be laid on separate trays, where this is not possible; cables may be installed on the same trays with suitable barriers. At least 20 percent space on each tray shall be kept reserved for future installation.

v) Cables laid on vertical tray shall be clamped to the rangs at regular intervals using PVC cable strips, also cables entering or leaving cable trays shall be adequately supported or protected.

vi) Cable trays shall be provided with sheet steel covers.

vii) In the main plant buildings, sub-stations, control room etc. power and control cables shall be generally be taken on cable trays laid in tunnels, concrete trenches, cable cellars/ basements or along building structure, walls ceilings etc. Cables routed from tunnels/ trenches, the cables shall be taken to embedded/ exposed rigid steel conduits or flexible conduit unless directly terminated to the equipment located above the tunnel/ basement/ trenches.

viii) Cable for lighting installation shall generally be run on buildings, structures, ceilings, walls etc. provided in concealed PVC conduits conforming to relevant ISS.

ix) The RCC pipe protection for cables shall be provided for crossing the roads.

x) All cable entry openings for the equipments shall be sealed and made vermin proof.

(f) **Cable Trays/Racks :**

i) The cable trays/ racks shall be designed, fabricated, supplied and installed suitably. The racks shall be fabricated ladder type made of MS angles and flats/rods. These shall be properly painted. The racks shall be of standard width of 300 mm or 600 mm suitable wherever required & shall be flush with walls etc. i.e. conceal type.

ii) The vertical and horizontal supports for the cable racks shall be fabricated steel sections/rods. The spacing of cable trays supports shall be to suit the loading of the racks but shall not exceed 1500 mm vertical spacing between the two racks & not less than 300 mm.

iii) All 1.1 KV grade power and control cables run on racks shall be laid touching each other but shall be in one layer only.

iv) Cables of different voltages shall generally be laid on separate trays, where this is not possible; cables may be laid on the same racks with suitable barriers. At least 20% space on each rack shall be kept reserved for future installation. All LT cable and control cables laid on trays/racks should have identification tags at every 5 meters of length.

v) All cable trays shall be protected by sheet steel covers duly bolted/screwed.

(g) **Earthing & Earth Pit :**

Earthing & Earth Pit for all installations as per **IS:3043 –1966** shall be included in the scope. The earthings shall include all the motor control, center control post, cable racks, and illumination and ventilation installations. The earth electrodes shall be 3000 mm long and 50mm dia. perforated GI pipes in accordance with the code of practice for earthing IS: 3043. The size of G.I. strips to be used for earthings for different equipments shall be suitably selected and shall be subjected to the approval of the Employer and shall meet the stipulation of the Indian Electricity Rules and Regulations to the satisfaction of State Government Electricity Inspector.

(h) **Illumination and Ventilation:**

i) The Scope for illumination & ventilation covers the complete lighting system both interior & exterior lighting of all the units of the treatment plant, road & yard lighting along with ventilation for chemical house, filter house, testing laboratory all complete. The contractor shall provide the **Energy efficient illumination with auto ON & OFF system (Light Sensitive Sensor) for total WTP Complex, Pump House, B.W.T. area, yard & ground lighting**.

The scope of supply shall include but not be limited to the following: -

a) Light fittings complete with accessories for all buildings interior & exterior lighting and yard lighting including road lighting facilities.

b) Main lighting distribution board along with sub distribution boards to be suitably located.

c) 10 Amps. and 20 Amps., 240 V switch socket outlets

d) Ceiling fans for all manned rooms.

e) Exhaust fans as required.

ii) **Requirements of lighting fixtures/lamps***:*

a) Illumination level in different area shall be as per recommended level of illumination for industrial area/special area conforming to IS codes/ Electrical Engineering Hand Books. The illumination level for particular areas, illumination for interior/exterior luminaries and their minimum mounting heights above floor area shall be based on recommended electrical engineering hand books/ Indian Standards Code of Practice & Specification.

b) Inside the Filter House, Chemical House etc., indoor type high bay fluorescent luminaries shall be designed for water vapours protection. Illumination intensity shall be suitably designed as per recommended illumination lux, nos. of fixtures and wattage of fluorescent lights selected.

c) Out side area near Cascade Aerator, Rapid Mixing unit, Primary Clarifier, Clariflocculator, Chemical House, Filter House, etc. out door flood light type with metal halide lamps of 150 watt similar to M/NVC-52 model of Phillips shall be provided. The luminaries shall be designed for the protection of high humidity. The lux of lighting system shall be designed as per recommended illumination lux.

a) Inside of office, toilet & laboratory building shall be provided with fluorescent luminaries similar to TCS 31/218 Phillips make with fluorescent lamps. Number of luminaries shall be suitably designed as per recommended illumination lux.

b) Yard area and roads shall be provided with street light luminaries with HPSV lamps. The no. of fixtures shall be decided based on recommended illumination lux.

(i) **Lighting Fixtures (Indoor luminaries):**

A) Fluorescent lighting fixtures for interior illumination of all structures except office & laboratory building :

Fluorescent lighting fixtures shall have the following main features:

a) Vitreous enameled reflector, CRCA sheet steel channel.

b) Copper wound polyester filled low loss ballast.

c) Two pins neon starter

d) Capacitor for power factor improvement.

e) Two nos. fluorescent troposphere tube light in each fixture.

B) **Fluorescent fixtures for office & laboratory building:**

i) Housing made of CRCA sheet steel stove enameled white inside & brown or white outside. The ends of the luminaries are provided with a decorative finish click fix lamp holders.

ii) All other accessories such as copper wound polyester filled ballast, starters, starter holders, power factor improvement capacitors are mounted on a gear tray. All accessories are pre-wired upto the terminal block.

iii) A specially designed aluminium reflector system for obtaining a high optical efficiency & a widespread bat wing type of light distribution. This reflector is fixed to the housing by a clip on mechanism & can be hinged to the housing during maintenance.

C) **Street Lighting fixtures**:

(make shall be of Philips/ Bajaj/ Crompton greaves)

The street lighting fittings with HPSV lamps shall have the following features :

a) End mounting cantilever type moisture proof fixture.

b) Consisting of single piece die cast aluminium housing made out of LM6, an easily removal gear tray for easy maintenance & a clear acrylic cover, capacitor etc. all complete fitting. The dimensions of housing are 690 x 400 x 225mm with IP65 protection like SRP-51 model with SON-T-150W lamp of Philips make.

c) Street lighting fixtures for road lighting shall be provided with 150 W HPSV integrated type fittings on steel tubular poles of 6m height (from finished ground level) and 1.5m out reach. The spacing between poles shall be suitably designed.

D) **MCB lighting distribution Boards:**

The lighting distribution boards shall have the following features:

a) The lighting distribution board shall be sheet steel enclosed wall/column mounting type. The thickness of sheet steel used shall be **2.0 mm** minimum.

b) The degree of protection shall be IP-42.

c) The power supply shall be 415/230V, 3-phase, 4-wire, 50 Hz. AC neutral solidly earthed system. All components of LDB shall be capable to withstand a symmetrical short circuit level of 28 MVA (40 KA) for 1 sec.

d) The lighting distribution board shall be provided with miniature circuit breaker (MCB) of 10kA rating for outgoing circuits. The bus bars shall be of EC grade aluminium alloy equivalent to E:63401-WP (E-91E) conforming to IS:5082-1969.

e) 415V, TPN combination fuse switch shall be provided for the lighting distribution board. The ratings shall suitably be designed as per load requirements.

f) The MCB distribution board shall be properly grounded.

(j) **10/20A Socket Outlet:**

The socket outlets shall have the following features :

i) Die cast metal housing with porcelain/mol amine body for heavy body operation.

iii) Interlocked plug pin with die cast metal body and silvered pins.

iv) 110V, 3 pins (phase, neutral and earth) 10/20 Amps. rating.

v) 230V, 3 pins, (phase, neutral & earth 10/20 Amps.

vi) Self closing shutter on sockets.

(k) **Point Wiring:**

i) The type of wiring shall be done as per requirement at different locations.

i) Neutral conductor for each sub circuit shall be taken separately and terminated in a junction box. Terminal block from where neutral conductor for each point shall be taken separately.

ii) Junction Boxes for the point wiring shall be of malleable casting with threaded conduit entry and fixed terminal slip.

iii) All wirings shall be in PVC conduit & of conceal type with junction boxes, switch board flush with wall.

(l) **Ventilation:**

- The office building shall be suitably ventilated as per required norms. There shall be ceiling fans of 48 inch blade size as given below.

  1) Filter House Operator's Room : 1no.

  2) Testing Laboratory : 2 nos.

- Heavy duty Exhaust Fans with louver/ shutters shall be provided wherever required. The fans shall be painted for anti-corrosion/ acidic effect.

(m) **Earthing & Earth Pit :**

Complete earthing of all the electrical installations as per **IS: 3043-1966** shall be included. The earthing shall include MCC, Cable Racks, all the equipments for illumination/ventilations including lighting main distribution board and sub distribution board. All light fittings and exhaust fans shall also be properly earthed.

The sizes of G.I. strips used for earthing equipments shall be suitably designed.

(n) **Technical Requirements**:

i) All electrical items shall conform to the Indian Electricity Rules, statutory regulations of Government of India and Government of Orissa as regards safety, earthing and other provisions specified therein for the installation and operation of electrical equipments.

ii) The equipment offered shall be so designed as to allow for safe and adequate access to all wearing parts to facilitate maintenance, Inspection and repair/replacement with minimum loss of time.

iii) The Contractor shall clearly indicate in the tender, the type, make and other technical particulars of various components and equipments.

iv) Wherever necessary the Employer reserves the right of selecting the make of the item in the interest of standardisation and the contractor shall agree to supply items of that particular make if so required.

v) The general arrangement drawing of the system offered shall be submitted along with the tenders including the regulation block diagram.

iv) The contractor shall submit a list of recommended spares for one year operation.

o) The agency has to submit Bar Chart / PERT analysis along with the tender.

p) **Disposal of Surplus Earth & Debris after construction:**

The surplus left over earth and debris after completion of erection work and levelling the site shall be transported and dumped in areas as directed by the Department's Engineer without any extra claim.

9.11. **GAS CHLORINATOR**

The gas chlorinator should comprise of direct cylinder mounted vacuum regulator complete with control unit having flow meter and V-notch control and injector suitable for mounting on piping, complete with piping, vacuum tubing & diffuser for smooth operation or gas chlorinator system. The chlorinator should confirm to chlorine institute inc., USA recommendations.

i)

Chlorinator Capacity	:	2 Kg/hr.
Operating range	:	20:1 (Manual)
Accuracy	:	$\pm$ 4% of indicated flow

ii) **Vacuum Regulating Valve**

a) It shall be spring loaded, diaphragm type and shall be designed for directed mounting of chlorine cylinder.

b) The unit shall include a selector knob and icons to indicate the chlorine gas container status (empty container, filled container, container in use).

c) An off position shall be provided to isolate the Diaphragm and integral components from atmospheric air when the operator changes, containers.

d) It shall contain integral pressure relief and shall also include as secondary check to prevent gas under pressure from venting in to the atmosphere.

e) The check valve shall close in the event of leakage past the primary valve.

f) It should in built gas filter and should be supplied with drip leg assembly and heater for vacuum regulator the mounted on toner.

g) It should reduce directly cylinder pressure in to vacuum in single.

iii) **Control Unit**

a) It should have arrangement for mounting on the wall for easy of operation and monitoring. However, if desired it shall be able to get mounted locally to vacuum regulator itself.

b) Control Unit shall have V-notch design for best précis control of gas flow and it should be a standard design of the manufacture.

c) The Rota-meter of control unit shall indicated gas flow in kg/Hr and for better control the Rota meter tube should have graduation length of at least 75mm for 0-4 Kgs. Graduations.

iv) **Injector**

a) The injector shall be capable of producing sufficient vacuum (650mm of mercury) for withdrawal of 2 Kg./ Hr. of chlorine gas.

b) It shall have built in double check valve to prevent water from back flooding.

c) The injector shall have integral mounting both vertically or horizontally to suit plant layout conditions.

d) The injector shall be capable of mounting both vertically and horizontally to suit plant layout conditions.

e) Injector should be able to withstand pressure of 20kg/cm^2 at 38^oC.

The vacuum and vent tubing shall be of polyethylene. The complete system operates under vacuum. The chlorine withdrawal through vacuum regulator shall get automatically shut off when injection water stops.

The tenderer should be manufacture/authorised dealer and submit certificate in support of their past experience in supply and commissioning minimum 10 nos. of chlorine system which should have been successful working with PHD/RWS&S/OWS&SB for minimum three years in Orissa.

The firm should have local facility of after sail service and supply of spares as and when required.

v) Materials of Construction :-

i) Vacuum Regulators

a)	Body	:	PVC/Bronze
b)	Spindle	:	Bronze
c)	Seat	:	PTFE

	d)	Inlet valve	:	Halar & Tungsten
	e)	Gasket	:	Lead
	f)	Chlorine Gas Filter	:	Felt
	g)	Diaphragm	:	Fluoro Elastomer/Hypalon
	h)	Spring	:	Haste Alloy C(Exposed to CIZ)
	i)	Gasket	:	Hypalon
ii)	Control Unit			
	a)	Body	:	PVC
	b)	Tube	:	Boro Silicate Glass
	c)	Float	:	4Kg Glass
	d)	Gasket	:	Fluoro Elastomer
	e)	V-notch	:	Self lubricated PVC
	f)	Seat	:	PTFE
iii)	Injector			
	a)	Body	:	PVC
	b)	Diaphragm	:	PTFE
	c)	Nozzle	:	Rigid PVC
	d)	Throat	:	Rigid PVC
	e)	'O' ring	:	Fluoro Elastomer
	f)	Nut & Bolts	:	Monel

INSPECTION, TESTING, TRIAL-RUN, GUARANTEE, GUARANTEE TEST & ACCEPTANCE

1.0 **General:**

1.1 All equipments, accessories, auxiliaries, piping, electrics, instruments, installations, construction, buildings etc. including all mechanical, electrical & civil engineering works covered under the scope of work of Contractor shall be subjected to inspection & testing by the Employer-NITR for its material, quality, workmanship and the performance. The Contractor shall arrange and carry-out all such inspections, testing, trial-run etc. and demonstrate in presence of the Engineer In-charge of the Employer.

1.2 The cost of such inspection, testing, trial-run, demonstration etc. shall be borne by the contractor. All responsibility of such inspection, testing, trial-run, demonstration etc. and any damage/loss that may cause directly or indirectly shall exclusively rest with the contractor.

1.3 Such inspection, testing, trial-run, demonstration etc. shall, however, not relieve the Contractor of their liability for replacing/ rectifying any defects which may subsequently appear or be detected during erection and guarantee period.

1.4 Copies of certificates for materials test, hardness, balancing test along with other routine shop's quality assurance tests shall be furnished by the Contractor/Manufacturer/Sub-contractor prior to carrying out of the inspection and testing.

2.0 **Tests at Works:**

2.1 All equipments, sub-assembly and components, auxiliaries and accessories shall be tested at manufacturer's works / sub-contractor's premises in accordance with relevant Indian Standards/International Standards and Engineer In-charge's norms.

2.2 The Contractor shall extend all testing facilities for carrying out such testing. If certain testing facilities are not available with the Contractor, the Contractor shall arrange to carry-out such tests at recognised and approved testing laboratory / authority.

2.3 The Contractor shall furnish all test certificates etc. related to the quality of all the materials along with the delivery of the materials at site without which no payment shall be released. However, such test certificates, quality assurance certificates shall not relieve the contractor of it's obligation to replace forth with any instrument/materials found defective during tests at works/trial running period/guarantee period.

2.4 Testing for performance of equipments shall be carried out and be checked with the approved parameters and performance characteristic curves for the purpose of acceptance.

3.0 **Tests at Site:**

3.1 On completion of erection, all equipments, accessories, auxiliaries, piping, electrics, controls, instruments etc. covered under the scope of work of the contractor shall be tested to demonstrate their smooth operation and proper functioning. All instruments, gauges, interlocks etc. shall be checked for calibration and for proper functioning during the test. All testing requirements specified elsewhere in this technical specifications and mentioned in relevant Indian standard / International Standards shall be carried out by the Contractor. All defective items or any defects observed during the test shall be replaced and/ or rectified by the Contractor and test shall be repeated.

3.2 All the water retaining structures shall be tested for **water tightness** as per relevant IS code of practice before starting of Trial run.

3.3 The Contractor shall also carry out at site, any tests, which may be required by the State/Central Government, State Pollution Control & Prevention, Controller of Explosive and/or any other Statutory Body.

4.0 **Trial Run & Hydraulic Testing:**

4.1 On completion of erection and testing at site the Tenderer shall carry out trial-run & hydraulic testing of all individual items one after another. The

duration of trial run & hydraulic testing for individual items shall be not less than 24 hours in continuous operation. On satisfactory performance of individual items, trial-run & hydraulic testing of composite units, one after another and then of complete 'Installation' shall be carried out. The duration of each 'trial-run' for each composite unit shall not be less than 48 (forty eight) hours continuous operation, and the duration of trial run for complete 'Installation' shall not be less than ninety six (96) hours continuous operation. All defective items or any defect is observed during trial run shall be replaced and/or rectified by the Tenderer.

4.2 The detailed schedule of trial-run and procedure shall be furnished by the Contractor for approval of Engineer In-charge. Proper record shall be maintained by the Contractor for all such testing and trial-run.

5.0 **Performance Guarantee Test:**

5.1 On satisfactory completion of trial-run, the complete 'Installation' shall be tested for demonstration of guaranteed performance. The duration for such **'Performance Guarantee Test' shall not be less than continuous twenty day (480 hours).**

5.2 The performance guarantee test by the Contractor shall demonstrate satisfactory operation of all individual items, equipments, controls, instruments, electrics, auxiliaries & accessories, piping, rapid mixing unit, Clariflocculator, filter beds etc. covered under the scope of work of the Contractor and the following major guaranteed parameters:

a) Discharge Capacity & Turbidity of clarified water from the Primary Clarifier.
b) Discharge Capacity & Turbidity of clarified water from the Clariflocculators.
c) Discharge Capacity & Turbidity of Filtered Water from each Filter Bed & Filter House.
d) Discharge Capacity & Turbidity of composite Water Treatment Plant at Filter House outlet
e) Guaranteed Water Quality Parameters of final out put water form the Treatment Plant after disinfection

The discharge capacity of treatment and filtration plant units shall be determined by adjusting the inflow rate and maintaining the quality of outflow water within the guaranteed norm and shall be an average of values recorded over a period of 8 (eight) hours.

All consumables required for the trial run, performance guarantee test etc. shall be the arranged by the Contractor at his own cost & responsibility. However, Employer shall be responsible for the power consumption & supply of raw water during the above tests & trial run.

6.0 **Performance Guarantee :**

6.1 The Contractor shall guarantee the parameters, the rated capacity, energy consumption, time duration, water quality etc. for the individual items and for the complete installation.

6.2 A penalty at a rate of two (2) percent of the contractual price of the concerned unit/equipment shall be imposed on the Contractor for every one (1) percent or part thereof shortfall in the rated capacity subject to a ceiling of five (5) percent maximum. In case the shortfall is beyond five (5) percent of the rated capacity, the concerned equipment/ facility/installation shall be rejected at Contractors cost and risk. No extra payment shall be permissible and be claimed by the Contractor for any excess (+) tolerance in rated capacity.

6.3 Any variance in tolerance beyond the permissible limit in **'quality' of drinking water** specified in relevant Indian Standard, IS:10500 and in Manual on Water Supply & Treatment published by Government of India, shall not be accepted and such installation be summarily rejected. The Contractor shall collect the water samples from different units as per requirement as per sampling methods given in Manual on Water Supply and Treatment by CPHEEO, Govt. of India / Standard Methods for examination of water and wastewater, for water quality testing and test the **physical, chemical and bacteriological parameters** in any of the reputed laboratories approved by the Employer at Contractor's cost and furnish the test report in support of the guaranteed water quality parameters. However, Employer reserves the right to assess the water quality parameters independently through any reputed laboratory of its choice to check quality parameters at the cost of the contractor.

7.0 **Guarantee:**

The Contractor shall guarantee the design, materials, quality, workmanship and the satisfactory performance of all the equipments, accessories, auxiliaries, piping, electrical instruments, installations, constructions, buildings, facilities, infrastructure etc. under his scope of work for a period of **12 (twelve) months** from the date of commissioning. Any defects noticed during the guarantee period shall be replaced / rectified immediately without any extra cost to the Department.

8.0 **O & M Manual:**

8.1 The contractor shall deliver to the Engineer-in-charge duplicate copies of draft operational and maintenance manuals for the plant after setting necessary standards basing on the tests conducted. The Manual shall fully and clearly set out the contractor's own recommendations, and instructions for the satisfactory operation and maintenance of the plant or equipment. The manual shall also accompany drawings showing the electrical wiring, handling and erection instructions. Draft manual shall, during the testing and commissioning of the works, be carefully checked by the contractor and

updated and modified to ensure that it is fully descriptive and applicable to the final process plant as installed and as found to behave under operational conditions.

8.2 The contractor shall also conduct Jar test for finding out optimum doses of Ferric Alum for different turbidity range ranging between 10-2000 NTU and varying **pH** conditions. The turbidity ranges can be simulated by adding bentonite clay or any other artificial /natural colloidal material. The contractor shall develop workable graphical output of the experimental data with recommendations as to select particular doses of coagulant depending on pH and raw water turbidity conditions. The findings shall be included in the manual.

8.3 Besides, the contractor shall also do Jar tests in the similar fashion as above with addition of **poly-electrolyte** (brand to be indicated and chemical should be certified for use in drinking water works) to find out the optimum doses of coagulants and produce the output of the experiment in form of Graphs which shall form a part of the Manual. The contractor shall include his recommendation as to how the use of poly-electrolyte can allow over loading of the plant and to what extent, the savings in coagulant consumption, improvement of clarified water quality etc.

The above laboratory experiments shall be conducted in presence of the Employer's representative/Engineer-in-Charge. All chemicals, consumables etc as required for such tests shall be at contractor's cost.

8.4 The **Manual** shall also highlight handling of **emergency situations during chlorine leaks**, electric short circuiting, personnel safety and hygiene. Apart from the above, it shall enumerate procedures for analysis of pH, alkalinity, turbidity, Iron, and residual chlorine.

8.5 The various aspects of the manual shall be discussed under highlighted captioned heading. There shall be a table of contents as usual. The draft manual shall be in English and may include manufacturer's standard literature, but the contractor shall fully supplement the literature by his own descriptive text explanations and drawings. After satisfactory trial run & performance guarantee test the draft manual shall be approved by the Engineer I/c and one copy shall be communicated to the contractor.

8.6 Five copies of the approved manual for the plant shall be submitted to the Engineer-in-charge prior to the commencement of the maintenance period. They shall be securely bound in A_4 sized loose leaf binders, clearly titled, indexed and cross referenced. The final Manuals shall incorporate instructions, recommendations, and advice for the operation of the entire process covering the full range of raw water conditions. If during the maintenance period, the Engineer-in-charge finds that the manual requires modification or enlargement as a result of subsequent operational and

maintenance experience in the works, the contractor shall provide approved modifications for each manual.

8.7 The manual shall also include a check list for the mechanical and electrical plant procedures for their smooth operation and maintenance broadly as follows:

Calibration, adjustment, checking and lubrication of each component.
Attention at weekly, monthly or other regular intervals to ensure reliable trouble free operation.
Complete overhaul, dismantling, reassembling and re-commissioning of various components.
Identification and selection of suitable lubricants of various, Indian Manufacturer's suitable equivalents.
Fault findings.
Maintenance of protective coatings.
Monitoring of water quality throughout the works including sampling techniques, laboratory and reporting procedure.

The work shall not be considered as complete unless this requirement has been met.

8.8 **Operating Log Sheets:**
Record Books of operating log sheets shall be handed over by the contractor to the Engineer-in-charge in an approved form before the completion of the trial run period.

8.9 **Completion Drawings:**
A set of approved process, hydraulic, structural, mechanical, electrical, equipment as-built drawings & design calculations sheets based on actual execution shall be handed over by the Contractor to the Engineer In-charge before completion of trial run and performance guarantee test. The record drawings shall be on best quality on polyester tracing papers.

8.10 **Penalty for non submission of O&M manual, completion drawings:**
A penalty @ **0.3 % of 10 %** meant for **"inspection, testing, trial-run, performance guarantee test, training, operation & maintenance manual, completion drawings"** per day shall be imposed for each day of non submission of the manual & completion drawings beyond 7 days of date of completion of successful performance guarantee test upto a maximum ceiling of 2% of the 10% meant for the aforesaid item, after which 1% of ISD shall also be forfeited.

9.0 **Acceptance:**
On completion of construction & erection work, the Contractor shall clear all the left over surplus earth, bricks, boulders, debris, scrap, temporary structures etc. from the construction site and present the entire premises in a neat and tidy manner. All units, equipments, tanks, reservoirs, pipelines etc.

shall be cleaned thoroughly and disinfection shall be done. **On completion of finishing work, colour wash & painting work, the contractor shall provide name plates on the main units and shall stencil in bold letters the equipment code nos. & direction of flow on all the units, equipments, pipelines, valves etc.** The code nos. scheme shall be worked out in consultation with the Engineer In-charge.

9.1 Preliminary Acceptance :

On completion of successful testing, trial-run, satisfactory performance guarantee test, training, submission of O&M Manual, Operating log sheets and completion drawings, the 'Installation' shall be put into regular operation. Thereof, on completion of three(3) months of satisfactory operation & performance the Installation shall be "preliminarily accepted" by the Employer.

9.2 Final Acceptance:

On completion of six (6) months of satisfactory operation & performance, the **'Installation'** shall be "finally accepted" by the Employer.

LIST OF APPROVED MAKE OF ELECTRICAL ITEMS

SN	MATERIAL DESCRIPTION	MAKE OF MATERIALS
1	Non-Metallic conduit & accessories	Berlia /Uniflow /Sudhakar
2	Switch, socket, Holder, Ceiling Rose etc.	Anchor /Cona
3	PVC Insulated wires	Finolex/ KDK/ Rajanigandha/ Anchor/ NICCO/ L&T / Havells
4	Bakelite sheets	Hylam /Formica
5	PVC Insulated cables (ISI Mark only)	NICCO/ Finolex/ Crystal/ Fort Gloster/ Poly Cab
6	Cable lugs	Dowells/ Ismal/ Clipon
7	Cable joining Kits	M.Seal
8	Switchgears viz., Isolator Switches, SFU, Starter, change over switch, HRC fuse holder etc.	Siemens /L&T
9	MCB RCCB & Associated Distribution Board	HPL/ Havells/ Standard /Indo Asian
10	MCCB	Seimens/ L&T/ ABB/ Legrand
11	Instrument viz colmeter etc	AE/IMP/ Meco/ Cosmo
12	Selector Switch	Kaycee/ Saltzer
13	Timer /Time switch	L&T/ Hanger/ Legrand
14	Energy Meter	GEC/ Capital Jaipur
15	LT Distribution Board(Fabricated)	ESS/ Technocrat/ Utkal
16	Kit Kats	BPC/ Anchor
17	HRC Fuses	Siemens/ L&T

18	CTs & PTs	AE/ Kappa/ Eastern Switchgear
19	Metal Clad plug Socket	Crompton/ Havells
20	Fluorescent Fixtures	Philips/ Crompton/ Bajaj/ PAC
21	HPSV/HPMV/LPSV Luminaries & PL/SL Lamp Luminaries /Metal Hamide	Philips/ Crompton / Bajaj
22	Incandescent lamp Luminaries	Philips/ Crompton/ Bajaj
23	Lamps (HPSV/HPMV/LPSV/Fluorescent. Incandescent	Philips/ Bajaj/ Crompton/ Sylvania
24	Ceiling Fans	Crompton / Usha / Bajaj / Orient
25	Exhaust Fan	Calcutta / Almonard / Crompton /GEC
26	Call Bell & Buzzers	Anchor/ Cona/ Rider
27	Electronic Regulator & Dimmer	Anchor/ Cona/ Rider
28	Adhesive & Insulating Tapes	Streel grip
29	G.I Pipes	TATA/ Jindal/ Prakash
30	Transformer	Alfa/ OTPL/ OEU/ Bright
31	A.B Switch	S&S/ Motison/ Orissa Electrum /Sigma
32	H.G Fuse	S&S/ Motison/ Orissa Electrum /Sigma
33	Lightening Arrestor	Oblum/ WS/ IGE

Make of Electrical & Mechanical Equipment:

The following makes shall only be allowed unless specifically mentioned elsewhere in this Tender Document.

(a) **Pumps:** Kirloskar/ Mather & Platt / Voltas / Greaves

(b) **Motors**: Kirloskar/ Siemens/ CGL/ Alsthom GEC

(c) **Sluice Valves**: Kirloskar/ Fouress / IVC / Calsens

(d) **Butterfly Valves**: Audco/KSB/Fouress/Kirloskar/IVC /Calsens

(e) **Air Valves**: IVI or IVC/ FOURESS/ Calsens

(f) **Liquid level indicators**: Krohne/MEI

(g) **Cable:** NICCO/Finolex/Havells/CCI

(h) **Laboratory Instruments**: Polymetron/ Zellweger Analytic/ Hach make

(i) **Laboratory glass wares :** Borosil

(j) **Weighing Machine**: Avery

(k) **Flowmeter:** Batilboi / Rota instrumentation / Reliable

(l) **Parshel flume**: Reliable

(m) **Blowers:** K-International/ Swam/ Everest

(n) **MS pipes**: ERW pipes from SAIL / TATA / Jindal

(o) **CI pipes**: KIW/ Electrosteel/ IISCo/ Kesoram

(p) **DI pipes**: Electrosteel / Jindal

(q) **GI pipes and fittings**: TATA / Jindal

(r) **Sanitary wares:** Parry / Nycer / Hindustan

(s) **Sanitary fitting:** Jaguar/ ESSESS

(t) **All furniture :** Godrej

(u) **All Luminaries :** Phillips / Bajaj / Crompton

(v) **Ceiling & Exhaust Fans**: Usha / Bajaj / Orient / Crompton

(w) **Paints & Distemper**: Johnsons Nicholsons / Asian Paint / Berger Paints

(x) **All locks and locking arrangements, hydraulic door closures**: Godrej.

(x) Other Accessories : The firm shall clearly state the make for approval of Employer

PAYMENT BREAK-UP SCHEDULE

Sl. No.	Description of Units / Items	% age of Lumpsum Quoted Price
1	On Employer's Approval of Layout Plan, Process Design, Hydraulic Design, Structural, Mechanical & Electrical design drawings of all units of 5.00 MLD Water Treatment Plant with ancillary structures and Clear Water Reservoir of 200 KL capacity.	**2.0**
2	On completion of Cascade Aerator & Raw Water Inlet Header, Valve Pit	**2.0**
3	On completion of Raw Water Channel to Rapid Mixing Unit along with Flow Measuring Device & Rapid Mixing Unit (Flash Mixer) alongwith Sluice Gates, Mechanical & Electrical equipments etc.	**2.0**
4	On completion of Primary Clarifier alongwith its Scraper Rotating Bridge, Mechanical & Electrical equipments etc.	**10.0**
5	On completion of Clariflocculator alongwith its Rotating Paddles & Bridge, Mechanical & Electrical equipments etc.	**10.0**
6	On completion of Filter House with Rapid Gravity Filter Beds with Sand & Gravels, RCC Back Wash Tank & Sump, Entrance Lobby, Control Room, Testing Laboratory, Toilet, Annex Building, Pipe Gallery, Valves, Mechanical & Electrical equipments etc.	**15.0**
7	On completion of Supply & Installation Air Blowers & Wash Water Pumps & Motors, Hoist and all Mechanical & Electrical equipments etc.	**5.0**
8	On completion of Chemical House with Chemical Storage & Dosing Units with piping arrangement, OH Electrical Hoists, Mech.& Elect. equipments	**10.0**
9	On completion of Chlorine House with Gas Chlorinator & Chlorine Gas Cylinder Storage, Chlorine Tonners, Mechanical & Electrical equipments	**10.0**
10	On completion of Underground Drainage & Sludge Disposal System	**3.0**
11	On completion of Sludge Drying Pond	**5.0**
12	On completion of Internal Roads, Walkways	**3.0**
13	On completion of 200 KL Clear Water Reservoir alongwith all piping, valves, fittings and inter-connection to existing UGR	**5.0**
14	Internal & External Electrics, Power Supply to WTP	**2.0**
15	On completion of finishing items & beautification of WTP campus by Arboriculture & Horticulture etc. & Miscellaneous items	**1.0**
16	Inspection, Testing, Hydraulic Testing, Trial Run	**2.5**
17	On Completion of Successful Performance Guarantee Test, Training, Submission of O&M Manual, As-built Drawings etc.	**2.5**
18	On Preliminary Acceptance	**5.0**
19	On Final Acceptance	**5.0**
20	**Total:**	**100.0**

Sl. No:	**Sub-Price Break-Up for Individual Item of works Payment Due On Completion of Following Items**	Percentage Break-up Schedule Item
1.	**Approval of Drawings & Design Calculations :**	
	Approval of Layout Plan, Process Design, Hydraulic Design	50
	Approval of Structural, Mechnaical & Electrical Drawings	25
	Approval of Clear Water Reservoir & Ancillary Structures	25
2.	**Cascade Aerator :**	
i.	Casting of foundation & Shaft upto 20% height	20
ii.	Shaft upto 80% height	20
iii.	Aerator Steps and Shaft upto 100% height.	30
	Valve Pit & Laying of Raw Water Inlet Header upto 30 M	20
iv.	Finishing of plastering and fixing glazed tiles.	10
3.	**Raw Water Channel to Rapid Mixing Unit alongwith Flow Measuring Device & Rapid Mixing Unit (Flash Mixer) alongwith Sluice Gates Mechanical Electrical equipments etc. :**	
i.	Raft foundation of rapid mixing unit with foundation for supporting column of raw water channel.	20
ii.	50% wall height of rapid mixing unit and supporting columns of raw water channel.	20
iii.	100% wall height of rapid mixing unit and completion of raw water channel with flow measuring device.	20
iv.	Supplying, erection, installation of Mechanical & Electrical equimpment for rapid mixing unit and parshall flume & Sluice Gates	30
v.	Finishing Work	10
4.	**Primary Clarifier alongwith its Scraper Rotating Bridge, Mechanical & Electrical equipments :**	
i.	Foundation, Bottom Hopper & wall upto 5% height of Clarifier	20
ii.	Wall height upto 50% of Clarifier	10
iii.	Wall height upto 100 % alongwith Launder / Channel etc	20
iv.	Supplying, errection and installation of Scraper Rotating Bridge & Scraper Mechanism, Mechanical and Electrical Items including Motors & Gear-Boxes	40
v.	Finishing Work	10
5.	**Clariflocculator alongwith its Rotating Paddles & Bridge, Mechanical & Electrical equipments etc. :**	
i.	Foundation, Bottom Hopper & wall upto 5% height of Clariflocculator	20
ii.	Wall height upto 50% of Clariflocculator	10
iii.	Wall height upto 100 % alongwith Launder / Channel etc	20
iv.	Supplying, errection and installation of Paddle Mechanism, Scraper Bridge & Mechanism, Mechanical and Electrical Items including Motors & Gear-Boxes	40

6.	**On completion of Filter House with Rapid Gravity Filter Beds with Sand & Gravels, Entrance Lobby, Control Room, Testing Laboratory, Toilet, Annex Building, RCC Back Wash Tank & Sump, Pipe Gallery, Valves, Mechanical & Electrical equipments etc. :**	
i.	Foundation of Filter House, Rapid Gravity Fillters, Internal Channels	10
ii.	Filter House complete with Channels, Operating Floor, Roof slab & completion of all civil structure, windows & Doors/Shutters	15
iii.	Filter box, Syphon system, under drainage piping, wash water & air piping, placing sand & gravel filter media etc.	15
iv.	Entrance Lobby, Control Room, Testing Laboratory, Toilet,	10
v.	Annex Building Complete, RCC Back Wash Tank & Sump, Foundation for Air Blowers, Back Wash Pumps & Motors.	10
vi.	Supplying and installation of all units of Air Blowers & Back Wash Water Pumps and Motors, OH Hoist	15
vii.	Supplying and installation of Pipe gallery, Wash Water Header & all Valves etc.	15
viii.	Finishing work complete with installation of all Mechanical & Electrical work, Exhaust Fans & Ceiling Fans, Laboratory Equipments	10
7.	**On completion of Supply & Installation Air Blowers & Wash Water Pumps & Motors, OH Hoist and Piping, Valves & Electrical equipments & accessories etc. :**	
	Supply & Installation of Air Blowers & Motors – 2 sets	25
	Supply & Installation of Wash Water Pumps & Motors – 2 sets	25
	Supply & Installation of OH Hoist & Beam – 1 set	25
	Piping, Valves & Electrical equipments & accessories etc.	25
8.	**On completion of Chemical House with Chemical Storage & Dosing Units with piping arrangement, OH Electrical Hoists, Mech.& Elect. Equipments :**	
i.	On completion of Chemical House upto plinth level	25
ii.	On completion of Ground Floor with Roof of Chemical House & Storage Bins	25
	On completion of First Floor with Roof of Chemical House & Solution Tanks	25
iii.	On Installation of Dosing Pumps, Piping & Chemical Dosing arrangement	15
iv.	On completion of Plastering, Finishing work, color washing etc.	10
9.	**On completion of Chlorine House with Gas Chlorinator, Chlorine Gas Cylinder Storage, Chlorine Tonners, Mechanical & Electrical equipments :**	
i.	On completion upto plinth level of chemical house, chlorine dosing house withstore	20
ii.	On completion of 50% height of Chemical house chlorine dosing house withstore	10

iii.	On completion of roof slab	15
iv.	Supplying and installation for gas chlorinator with supply of Tonner and dosing unit for alum and lime.	40
v.	Supplying and installation of piping arrangement.	5
vi.	Finishing work Plastering, color washing etc.	10
10.	**On completion of Underground Drainage & Sludge Disposal System :**	
i.	Completion of Construction of underground drainage system	50
ii.	Cosntruction of sewerage system with on-site sanitation.	50
11.	**On completion of Sludge Drying Pond :**	
	Completion of Sludge Drying Pond with Weir	75
	Completion of Sludge Piping to Sludge Drying Pod	25
12.	**On completion of Internal Roads, Walkways :**	
i.	On casting of RCC walk way to all units of Water Treatment Plant.	20
ii.	Earth work in-excavation, filling of moorum and soling stone with compaction for road work.	10
iii.	Concreting with C.C (1:2:4) to road work and finishing work for walk way.	30
iv.	Lighting arrangement along the road & inside area of Treatment Plant.	30
13.	**On completion of 200 KL Clear Water Reservoir alongwith all piping, valves, fittings and inter-connection to existing UGR :**	
i.	Earth work excavation with P.C.C	5
ii.	Casting of raft foundation.	20
iii.	On casting of 50% of wall	15
iv.	On casting of 100 % wall.	20
v.	On casting of ring beam and top slab.	20
vi.	Piping arrangement with valves to UGRs	10
vii.	All finishing work.	10
14.	**Internal & External Electrics, Power Supply to WTP :**	100
15.	**On completion of finishing items & beautification of WTP campus by Arboriculture & Horticulture etc. & Miscellaneous items :**	100
16.	**Inspection, Testing, Hydraulic Testing, Trial Run :**	100
17.	**On Completion of Successful Performance Guarantee Test, Training, Submission of O&M Manual, As-built Drawings etc. :**	100
18.	**On Preliminary Acceptance :**	100
19.	**On Final Acceptance :**	100

ONE YEAR OPERATION & MAINTENANCE

Tenderer shall also quote additional Lumpsum Price for Operation & Maintenance of Water Treatment Plant for a period of One Year after successful commissioning of the Plant. Payment towards Operation & Maintenance shall released on six (6) monthly basis ie., 50% after 6 months period and 50% after 12 months period.

The Lumpsum Price for Operation & Maintenance of Water Treatment Plant for a period of One Year shall include all consumables & materials, tools & tackles, safety appliances, transportation & freight, all man-power (unskilled, skilled & supervisory), all salary & wages, perks, statutary benefits eg. ESI, PF, medical benefits, social security, safety etc.

Tender submitted without quoting separate Lumpsum Price for Operation & Maintenance of Water Treatment Plant for a period of One Year shall be considered as incomplete tender and will be rejected.

Total price including price quoted for Water Treatment Plant, Clear Water Reservoir & One Year Operation & Maintenance shall be considered for evaluation purpose while awarding of Contract.

ANNEXURE : I

TECHNICAL QUESTIONNAIRES ON WATER TREATMENT PLANT

1.0	**General Description**	:-	
	Give brief write-up on Treatment & filtration process offered & enclose flow diagram, GA drawing etc.	-	
	Total capacity (normal) of the Plant	-	MLD
	Process design, Design code, make, patent etc.	-	
	Details of Technical Collaboration, Experience etc.	-	
2.0	**Cascade Arerator**	:-	
	Head Required	-	MWC
	Rate of Flow	-	m^3 / m^2/ hr
	No. of steps	-	
3.0	**Parshall Flume**	:-	
	Nos. & Location	-	
	Type/ construction	-	
	Design rate of flow	-	
	Measuring Range & Indication	-	MLD
	Accuracy	-	
	Head Loss	-	Cm.
4.0	**Rapid Mixing Unit**	:-	
	Type	-	
	No. of Units	-	
	Effective water volume	-	
	Detention time	-	Seconds
	Head Loss	-	Cm.
	Velocity of flow	-	M/Sec
	Water Depth	-	M
5.0	**Primary Clarifier**	:-	
	Type of Construction	-	
	Diameter (Inner) of Clarifier	-	M
	Free Board	-	mm
	Side Water Depth	-	M
	Treatment Capacity (Normal)	-	MLD
	Detention Time (Normal)	-	Hrs.
	Designed Input Turbidity Range	-	NTU
	Designed Output Turbidity Range	-	NTU
	Overloading Capacity & Duration	-	
	Surface loading	-	M^3/m^2/day
	Weir loading rate	-	M^3/m/day
	Additional depth for sludge storage	-	M

	Slope of Bottom Floor	-	%
	Type of Sludge Removal Arrangement	-	
	Dia. of sludge removal pipe	-	M
	Type of Scraper Bridge, Size of Rail & Wheel	-	
	Scarper Speed in RPM & Tip Speed in Metres/M	-	
	Total Head Loss	-	M
	Entrance Velocity	-	M/Sec.
	Spacing of 'V' notch.	-	
6.0	**Clariflocculator :**	:-	
	Type of Construction	-	
	Outer Diameter	-	
	Treatment Capacity (Normal)	-	MLD
	Designed Input Turbidity Range	-	NTU
	Designed Outlet Turbidity Range	-	NTU
	Overloading Capacity & Duration	-	
	Side Water Depth	-	M
	Surface loading	-	
	Weir loading rate	-	
	Additional depth for sludge storage	-	
	Slope of Bottom Floor	-	
	Type of Sludge Removal Arrangement	-	
	Dia. of sludge removal pipe	-	
6.1	**Flocculator Zone :**	:-	
	Detention Time (Normal)	-	
	Diameter (Inner) of Flocculator	-	
	Water Depth	-	
	Velocity gradient	-	Sec.
	Velocity of flow	-	M/Sec.
	Total Area of Paddle	-	
	Speed of Paddle	-	RPM
	Type of Current Collector for Power Supply	-	
6.2	**Clarifier Zone :**	**:-**	
	Detention time (Normal)	-	Hrs.
	Diameter (Inner) of Clarifier	-	
	Side water Depth	-	M
	Free Board	-	mm
	Surface loading	-	$M^3/m^2/day$
	Weir loading rate	-	$M^3/m/day$
	Additional depth for sludge storage	-	M
	Slope of Bottom Floor	-	%
	Settled water turbidity	-	NTU
	Dia. / type of sludge removal pipe	-	M
	Scarper Speed in RPM & Tip Speed in Metres/M	-	
	Type of Scraper Bridge, Size of Rail & Wheel	-	
	Outlet structure	-	
	Entrance Velocity	-	M/Sec.

	Spacing of 'V' notch.	-	
	Distance between Paddle Tip	-	
7.0	**filter house :**	:-	
	Type of Filter Beds	-	
	Design code	-	
	No. of filter beds provided	-	
	Overall dimensions of each filter bed.	-	MxM
	Normal filtration capacity/ each bed	-	M^3/hr
	Total normal filtration capacity of the Filter House	-	M^3/hr
	Overloading capacity/each & duration of overloading.	-	% Hours
	Total overloading capacity of filter House & duration of overloading.	-	M3/hr.
	Designed unit rate of filtration	-	Lpm/m^2
	Details of filter media, no. of layers, size etc.	-	
	Designed input water turbidity range.	-	PPM
	Percentage of reduction in turbidity	-	%
	Guaranteed output water quality.	-	
	Normal frequency of backwash of each filter bed	-	Hours
	Duration of each backwash	-	Min.
	Quantity & rate of flow required for each backwash per filter bed :		
	Water (i) Qty. (ii) Rate	- -	M^3 M^3/hr.
	Air (i) Qty. (ii) Rate	- -	M^3 M^3/hr.
	Head loss -		
a	Clean bed after back wash	-	Cm.
b	Max. before backwash	-	Cm.
	Overall dimension of filter House, walkway, pipe gallery, covered area blower room, control room etc.(enclose GA Drg.)	-	
	Pipe gallery Material	-	
	Type of filter bottom strainer system & material.	-	
	Wash Water System	-	
	Clear Water Sump -	-	
a	Size		
b	Capacity	-	
c	Shape	-	
d	Type of construction	-	
	Overhead Wash Water Tank -		
a	Staging height	-	
b	Size	-	
c	Capacity	-	
d	Location	-	
e	Shape	-	
f	Type of construction	-	

g	Water filling-in arrangement	-	
8.0	**Pumps for filling overhead backwash tank**	:-	
a	Nos. of pumps	-	
b	Type of Pumps	-	
c	Make	-	
d	Capacity/each	-	M^3/Hr
e	Head	-	MWC
f	Efficiency	-	%
g	HP / kW Requirement	-	
h	Materials of construction	-	
i	Coupling	-	
9.0	**Motor**	:-	
a	Rating kW	-	kW
b	Type	-	
c	Power Supply Requirement	-	
d	Efficiency	-	
e	Method of starting	-	
f	Protection	-	
10.0	**Control Panels (Circuit diagram)**	:-	Give details of all Starters used, protections given, & other accessories like voltmeter, energy meter, ammeter, indicating lamps, on/off starters etc.
11.0	Air Compressors :	:-	
a	Capacity & pressure	-	M^3/hr
b	Type and nos.	-	
c	Location	-	
d	No. of compressors offered operating/ standby.	-	
e	Kw requirement & motor Kw offered.	-	
f	Make & type, efficiency, method of starting, phase of supply, control panel details etc. of motors.	-	
g	Size & capacity of air receiver/ tank provided.	-	
12.0	Valves : Type, ISI-certification, materials of construction , make	:-	
a	Sluice valves	-	
b	Butterfly valves	-	
c	Non-return valves	-	
d	Rate controllers	-	
e	Float valves	-	
f	Foot valves	-	
g	Others	-	

13.0	Appurtenances : Type, range, material of construction, make etc.of each type of appurtenances :	:-	
a	Rate of flow controllers	-	
b	Filter Gauges -		
	i) Loss of Head	-	
	ii)Rate of flow	-	
c	Sand expansion Gauges	-	
d	Others	-	
	Any other information	-	
14.0	**Chemical House & Chemical Storage & dosing Facilities.**	:-	
	Solution preparation	-	
	Type of chemicals & coagulants proposed.	-	
	No. of Chemicals solution preparation tanks provided for each chemical.	-	
	Capacity of each tank in volume and duration	-	M^3/Hr.
	Shape & overall dimension of the tank.	-	
	Type of construction & liner materials	-	
	Brief Details of Agitators -		
	i) Type	-	
	ii) Material of construction	-	
	iii) Shaft kw	-	
	iv) Motor Kw rating offered	-	
	v) Drive Arrangement	-	
	vi) Speed	-	
	Dosing system	-	
	Type of Dosing Pumps, Make & Qty..	-	
	Type of dosing system & control method	-	
	Material of construction of dosing pipelines	-	
	Type, materials of construction & make of valves.	-	
	Chemical storage (alum, lime & bleaching)	-	
	Chemical storage space provided for each chemical separately.	-	
	Type of construction of storage building & liner material	-	
	Overall dimensions of storage building.	-	
	Handing facility provided for handling the chemicals both for alum and lime.	-	
	Chlorinator arrangement with chlorine storage.	-	
	Materials for pipe & valves	-	
15.0	**Control Room & Testing Laboratory**	:-	
	Shape, overall dimensions & covered area of each unit.	-	
16.0	**Sludge Drying Pond & Waste Water Drainage**	:-	

	system (encl: GA drawings)		
	Scheme in Brief	-	
	Overall Dimensions of Sludge Drying Pond	-	M x M
	Sludge Holding Capacity	-	Months
	Type of Construction	-	
17.0	**List of Instruments & Gauges, their type :**	:-	
	Location	-	
	Range	-	
	Make : (Enclose drawing, catalogues, technical details etc. of each type).	-	
18.0	**Material Handling Facility**	:-	
	Location	-	
	Type	-	
	Capacity	-	
	Duty	-	
	No. of units	-	
	Make	-	
	Indoor & Outdoor illumination details	-	
	Yard & road lighting details	-	
19.0	**Fire Protection Facility**	:-	
	Location	-	
	Type	-	
	Capacity/size	-	
	No. of units	-	
	Make	-	
20.0	**Ventilation**	:-	
	Location	-	
	Type /Duty	-	
	Capacity/size	-	
	No. of units	-	
	Make	-	
	Enclose catalogue	-	
21.0	**Clear Water Underground Reservoir**	:-	
	Type of Construction	-	
	Overall Dimensions	-	
	Storage Capacity	-	
22.0	**Any other technical details that Tenderer desires to furnish here**	:-	

ANNEXURE : II

ANALYSIS OF RAW WATER SAMPLES OF RIVER KOEL, ROURKELA

Sl No.	Parameters	During Monsoon	During Non-Monsoon
1.	Turbidity, NTU	2000 – 8000	50 - 2000
2.	Temperature, ^0C	27.5	18 - 28.5
3.	Conductivity, M/s	155	175
4	Chloride, mg/L	1.5	2.0
5	Fluoride, mg/L	N.T	N.T
6	Sulphate, mg/L	3.5	1.0
7	Iron, mg/L	1.6	0.5
8	Total Hardness, mg/L as $CaCO_3$	64	82
9	Alkalinity, mg/L as $CaCO_3$	50	90
10	Calcium, mg/L	16.0	14.8
11	Magnesium, mg/L	4.3	5.8
12	Free CO_2	2.0	0.8
13	Dissolved Oxygen	6.8	8.2
14	Total Solids	126 (Varies)	130
	a) Dissolved	95 (Varies)	110
	b) Suspended	560 (Varies)	10
	c) Volatile	20	28

ANNEXURE : III

PRICE SCHEDULE PRO-FORMA

(Tenderer to submit the Price Bid as shown below,
Prices to be indicated clearly both in figures & words, Over-writing not allowed)

Sl.	Item	Lumpsum Price Rs.	Taxes & Duties Rs. & (%)	Total Contract Price including Taxes & Duties Rs.	Exclusion, Details if any
1	Design, Engineering, Supply, Fabrication, Construction, Erection, Painting, Supervision, Testing & Commissioning including all Civil, Structural, Mechanical, Electrical, Piping, Instrumentation, Utility works of 5.0 MLD Capacity Water Treatment Plant alongwith 200 KL Underground Clear Water Reservoir complete work as per scope of work				
2	Operation & Maintenance of Water Treatment Plant for a period of One Year				
3	**Total**				

Tenderer's Signature
& Seal