WATCO
WATER CORPORATION OF ODISHA

Bid Identification No. WATCO (W)-15/2026-27, Dt.01.09.2026

AGREEMENT

Construction of Waste Water Treatment Plant at the Confluence point of River Daya & Ganguanala (Phase-II)" on Engineering, Procurement & Construction (EPC) Contract Including Operation & Maintenance for a Period of Five (5) Years

INDICATIVE ESTIMATED COST: Rs.7244.52 LAKH
(Construction Cost: Rs.6468.31 Lakh + O&M Cost: Rs.776.21 Lakh)

BID PROCESSING FEE: Rs.30,000.00 + GST @ 18%

OFFICE OF THE MANAGING DIRECTOR
Ground Floor, Unnati Bhawan,
H.B. Colony, Satyanagar, Bhubaneswar-751007, Odisha, India
Telefax: - +91-674-2391444
e-mail :- watcoodisha@gmail.com / mdwatcoodisha@gmail.com

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SEPTEMBER - 2026

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Part I
Preliminary

ENGINEERING, PROCUREMENT AND CONSTRUCTION AGREEMENT

THIS AGREEMENT[1] is entered into on this the …….. day of ……, 2026.

BETWEEN

[THE General Manager, WATCO Division, Puri and having its office at **Puri**, representative of **the Managing Director, WATCO**, **Bhubaneswar**, **under Government of Odisha** the "**Authority**" which expression shall, unless repugnant to the context or meaning thereof, include its administrators, successors and assigns of One Part;

AND

{----------,}[2] means the selected bidder[3] having its registered office at ……, (hereinafter referred to as the "**Contractor**" which expression shall, unless repugnant to the context or meaning thereof, include its successors and permitted assigns) of the Other Part.

WHEREAS:

(A) The Government of Odisha] had entrusted to the Authority for **"Construction of Waste Water Treatment Plant at the Confluence point of River Daya & Ganguanala (Phase-II)" on Engineering, Procurement & Construction (EPC) Contract Including Operation & Maintenance for a Period of Five (5) Years**[4& 5].

(B) The Authority had resolved to **"Construction of Waste Water Treatment Plant at the Confluence point of River Daya & Ganguanala (Phase-II)" Including Operation & Maintenance for a Period of Five (5) Years** on Engineering, Procurement, Construction ("**EPC**") basis in accordance with the terms and conditions to be set forth in an agreement to be entered into.

(C) The Authority had accordingly invited single stage two-part bidding proposal by its [Request for Proposal vide Tender ID No**. WATCO (W)-15/2026-27, dated 01.09.2026**] (the "**Request for Proposal" or "RFP**") from bidders for EPC of the above referred Sewerage Project and had shortlisted certain bidders including, inter alia, the selected bidder.

(D) The Authority had prescribed the technical and commercial terms and conditions, and invited bids (the "**Request for Proposals**" or "**RFP**") from the bidders pursuant to the RFP for undertaking the Project.

(E) After evaluation of the bids received, the Authority had accepted the bid of the selected bidder and issued its Letter of Acceptance No. …….. dated …….. (hereinafter called the "**LOA**") to the selected bidder for the work **"Construction of Waste Water Treatment Plant at the Confluence point of River Daya & Ganguanala (Phase-II)" on Engineering, Procurement & Construction (EPC) Contract Including Operation & Maintenance for a Period of Five (5) Years** at the contract price specified hereinafter, requiring the selected bidder to inter alia:

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1 Serially numbered footnotes in this Agreement are for guidance of the Authority and should be omitted from the draft Agreement forming part of Bid Documents. Footnotes marked "$" shall be retained in the draft Agreement.

2 All provisions enclosed in curly parenthesis shall be retained in the Bid Documents and shall be modified as required after the selected bidder has been identified.

3 Refers to the single entity or the lead member of the consortium/joint venture, which is the selected bidder under the RFP.

4 All asterisks in this Model Agreement should be substituted by project-specific particulars in the draft Agreement forming part of Bid Documents.

5 All project-specific provisions in this Model EPC Agreement have been enclosed in square parenthesis and may be modified, as necessary, before issuing the draft Agreement forming part of Bid Documents.

(i) deliver to the Authority a legal opinion from the legal counsel of the selected bidder with respect to the authority of the selected bidder to enter into this Agreement and the enforceability of the provisions thereof, within 10 (ten) days of the date of issue of LOA; and

(ii) execute this Agreement within **15 (fifteen) days** of the date of issue of LOA.

(F) The Contractor has fulfilled the requirements specified in Recital (E) above;

NOW THEREFORE in consideration of the foregoing and the respective covenants and agreements set forth in this Agreement, the sufficiency and adequacy of which is hereby acknowledged,the Authority hereby covenants to pay the Contractor, in consideration of the obligations specified herein, the Contract Price or such other sum as may become payable under the provisions of the Agreement at the times and in the manner specified by the Agreement and intending to be legally bound hereby, the Parties agree as follows:

ARTICLE 1

DEFINITIONS AND INTERPRETATION

1.1 Definitions

The words and expressions beginning with capital letters and defined in this Agreement (including those in Article 28) shall, unless the context otherwise requires, have the meaning ascribed thereto herein, and the words and expressions defined in the Schedules and used therein shall have the meaning ascribed thereto in the Schedules.

1.2 Interpretation

1.2.1 In this Agreement, unless the context otherwise requires,

(a) references to any legislation or any provision thereof shall include amendment or re-enactment or consolidation of such legislation or any provision thereof so far as such amendment or re-enactment or consolidation applies or is capable of applying to any transaction entered into hereunder;

(b) references to laws of Odisha/ India or Indian law or regulation having the force of law shall include the laws, acts, ordinances, rules, regulations, bye laws or notifications which have the force of law in the territory of India and as from time to time may be amended, modified, supplemented, extended or re-enacted;

(c) references to a "person" and words denoting a natural person shall be construed as a reference to any individual, firm, company, corporation, society, trust, government, state or agency of a state or any association or partnership (whether or not having separate legal personality) of two or more of the above and shall include successors and assigns;

(d) the table of contents, headings or sub-headings in this Agreement are for convenience of reference only and shall not be used in, and shall not affect, the construction or interpretation of this Agreement;

(e) the words "include" and "including" are to be construed without limitation and shall be deemed to be followed by "without limitation" or "but not limited to" whether or not they are followed by such phrases;

(f) references to "construction" or "building" include, unless the context otherwise requires, survey and investigation, design, developing, engineering, procurement, supply of plant, materials, equipment, labour, delivery, transportation, installation, processing, fabrication, testing, and commissioning of the Sewerage Project, including Operation & Maintenance and removing of defects, if any, and other activities incidental to the construction and "construct" or "build" shall be construed accordingly;

(g) references to "development" include, unless the context otherwise requires, construction, renovation, refurbishing, augmentation, up-gradation and other activities incidental thereto during the Construction Period, and "develop" shall be construed accordingly;

(h) any reference to any period of time shall mean a reference to that according to Indian standard time;

(i) any reference to day shall mean a reference to a calendar day;

(j) references to a "business day" shall be construed as a reference to a day (other than a Sunday) on which banks in [Odisha] are generally open for business;

(k) any reference to month shall mean a reference to a calendar month as perthe Gregorian calendar;

(l) references to any date, period or Project Milestone shall mean and include such date, period or Project Milestone as may be extended pursuant to this Agreement;

(m) any reference to any period commencing "from" a specified day or date and "till" or "until" a specified day or date shall include both such days or dates; provided that if the last day of any period computed under this Agreement is not a business day, then the period shall run until the end of the next business day;

(n) the words importing singular shall include plural and vice versa;

(o) references to any gender shall include the other and the neuter gender;

(p) "lakh" means a hundred thousand (100,000) and "crore" means ten million (10,000,000);

(q) "indebtedness" shall be construed so as to include any obligation (whether incurred as principal or surety) for the payment or repayment of money, whether present or future, actual or contingent;

(r) references to the "winding-up", "dissolution", "insolvency", or "reorganisation" of a company or corporation shall be construed so as to include any equivalent or analogous proceedings under the law of the jurisdiction in which such company or corporation is incorporated or any jurisdiction in which such company or corporation carries on business including the seeking of liquidation, winding-up, reorganisation, dissolution, arrangement, protection or relief of debtors;

(s) save and except as otherwise provided in this Agreement, any reference, at any time, to any agreement, deed, instrument, license or document of any description shall be construed as reference to that agreement, deed, instrument, license or other document as amended, varied, supplemented, modified or suspended at the time of such reference; provided that thisClause shall not operate so as to increase liabilities or obligations of the Authority hereunder or pursuant hereto in any manner whatsoever;

(t) any agreement, consent, approval, authorisation, notice, communication, information or report required under or pursuant to this Agreement from or by any Party or the Authority's Engineer shall be valid and effective only ifit is in writing under the hand of a duly authorised representative of such Party or the Authority's Engineer, as the case may be, in this behalf and not otherwise;

(u) the Schedules and Recitals to this Agreement form an integral part of this Agreement and will be in full force and effect as though they were expressly set out in the body of this Agreement;

(v) references to Recitals, Articles, Clauses, Sub-clauses or Schedules in this Agreement shall, except where the context otherwise requires, mean references to Recitals, Articles, Clauses, Sub-clauses and Schedules of or to this Agreement, and references to a Paragraph shall, subject to any contrary indication, be construed as a reference to a Paragraph of this Agreement or of the Schedule in which such reference appears;

(w) the damages payable by either Party to the other of them, as set forth in this Agreement, whether on per diem basis or otherwise, are mutually agreed genuine pre-estimated loss and damage likely to be suffered and incurred by the Party entitled to receive the same and are not by way of penalty (the "**Damages**"); and

(x) time shall be of the essence in the performance of the Parties' respective obligations. If any time period specified herein is extended for the reasons specified in the Agreement, such extended time shall also be of the essence.

1.2.2 Unless expressly provided otherwise in this Agreement, any Documentation required to be provided or furnished by the Contractor to the Authority shall be provided free of cost and in three copies, and if the Authority is required to return any such Documentation with its comments and/or approval, it shall be entitled to retain two copies thereof.

1.2.3 The rule of construction, if any, that a contract should be interpreted against the parties responsible for the drafting and preparation thereof, shall not apply.

1.2.4 Any word or expression used in this Agreement shall, unless otherwise defined or construed in this Agreement, bear its ordinary English meaning and, for these purposes, the General Clauses Act, 1897 shall not apply.

1.3 Measurements and arithmetic conventions

All measurements and calculations shall be in the metric system and calculations done to 2 (two) decimal places, with the third digit of 5 (five) or above being rounded up and below 5 (five) being rounded down.

1.4 Priority of agreements and errors/discrepancies

1.4.1 This Agreement, and all other agreements and documents forming part of or referred to in this Agreement are to be taken as mutually explanatory and, unless otherwise expressly provided elsewhere in this Agreement, the priority of this Agreement and other documents and agreements forming part hereof or referred to herein shall, in the event of any conflict between them, be in the following order:

(a) this Agreement; and

(b) all other agreements and documents forming part hereof or referred to herein; i.e. this Agreement at (a) above shall prevail over the agreements and documents at (b).

1.4.2 Subject to the provisions of Clause 1.4.1, in case of ambiguities or discrepancies within this Agreement, the following shall apply:

(a) between two or more Clauses of this Agreement, the provisions of a specific Clause relevant to the issue under consideration shall prevail over those in other Clauses;

(b) between the Clauses of this Agreement and the Schedules, the Clauses shall prevail and between Schedules and Annexes, the Schedules shall prevail;

(c) between any two Schedules, the Schedule relevant to the issue shall prevail;

(d) between the written description on the Drawings and the Specifications and Standards, the latter shall prevail;

(e) between the dimension scaled from the Drawing and its specific written dimension, the latter shall prevail; and

(f) between any value written in numerals and that in words, the latter shall prevail.

1.5 Joint and several liability

1.5.1 If the Contractor has formed a Consortium of two or more persons forimplementing the Project:

(a) these persons shall, without prejudice to the provisions of this Agreement, be deemed to be jointly and severally liable to the Authority for the performance of the Agreement; and

(b) the Contractor shall ensure that no change in the composition of the Consortium is effected without the prior consent of the Authority.

1.5.2 Without prejudice to the joint and several liability of all the members of the Consortium, **the Lead Member shall represent all the members** of the Consortium and shall at all times be liable and responsible for discharging the functions and obligations of the Contractor. The Contractor shall ensure that each member of the Consortium shall be bound by any decision, communication, notice, action or inaction of the Lead Member on any matter related to this Agreement and the Authority shall be entitled to rely upon any such action, decision or communication of the Lead Member. **The Authority shall have the right to release payments solely to the Lead Member** and shall not in any manner be responsible or liable for the*inter se* allocation of payments among members of the Consortium.} [$]

[$]This Clause 1.5 may be omitted if the Contractor is not a Consortium. Even if the Contractor is a Consortium, the Authority may, at its discretion, delete this provision.

Part II
Scope of Project

ARTICLE 2

SCOPE OF THE PROJECT

2.1 Scope of the Project

Under this Agreement, the scope of the Project (the "**Scope of the Project**") shall mean and include:

(a) **Construction of Waste Water Treatment Plant at the Confluence point of River Daya & Ganguanala (Phase-II) on Engineering, Procurement & Construction (EPC) Contract Including Operation & Maintenance for a Period of Five (5) Years** set forth in Schedule-A (Project) and as specified in Schedule-B together with provision of Project Facilities as specified in Schedule-C, and in conformity with the Specifications and Standards set forth in Schedule-D;

(b) Operation &maintenance of the Sewerage Project in accordance with the provisions of this Agreement and Inconformity with the requirements set forth in Schedule-E; and

(c) Performance and fulfilment of all other obligations of the Contractor in accordance with the provisions of this Agreement and matters incidental thereto or necessary for the performance of any or all of the obligations of the Contractor under this Agreement.

ARTICLE 3

OBLIGATIONS OF THE CONTRACTOR

3.1 Obligations of the Contractor

3.1.1 Subject to and on the terms and conditions of this Agreement, the Contractor shall undertake the survey, investigation, design, engineering, procurement, construction, operation and maintenance of the Sewerage Project and observe, fulfil, comply with and perform all its obligations set out in this Agreement or arising hereunder.

3.1.2 The Contractor shall comply with all Applicable Laws and Applicable Permits (including renewals as required) in the performance of its obligations under this Agreement.

3.1.3 Subject to the provisions of Clauses 3.1.1 and 3.1.2, the Contractor shall discharge its obligations in accordance with Good Industry Practice and as a reasonable and prudent person.

3.1.4 The Contractor shall remedy any and all loss or damage to the Sewerage Project from the Appointed Date until the end of the Construction Period at the Contractor's cost, save and except to the extent that any such loss or damage shall have arisen from any default or neglect of the Authority.

3.1.5 The Contractor shall remedy any and all loss or damage to the Water Project during the Defects Liability Period at the Contractor's cost to the extent that such loss or damage shall have arisen out of the reasons specified in Clause 17.3.

3.1.6 The Contractor shall remedy any and all loss or damage to the Sewerage Project during the Operation & Maintenance Period at the Contractor's cost, including those stated in Clause 14.1.2, save and except to the extent that any such loss or damage shall have arisen on account of any default or neglect of the Authority or on account of a Force Majeure Event.

3.1.7 The Contractor shall, at its own cost and expense, in addition to and not in derogation of its obligations elsewhere set out in this Agreement:

(a) make, or cause to be made, necessary applications to the relevant Government Instrumentalities with such particulars and details as may be required for obtaining Applicable Permits set forth in Schedule-F and obtain and keep in force and effect such Applicable Permits in conformity with the Applicable Laws;

(b) procure, as required, the appropriate proprietary rights, licenses, agreements and permissions for Materials, methods, processes and systems used or incorporated into the Sewerage Project;

(c) make reasonable efforts to maintain harmony and good industrial relations among the personnel employed by it or its Sub-contractors in connection with the performance of its obligations under this Agreement;

(d) ensure and procure that its Sub-contractors comply with all Applicable Permits and Applicable Laws in the performance by them of any of the Contractor's obligations under this Agreement;

(e) not do or omit to do any act, deed or thing which may in any manner be violative of any of the provisions of this Agreement;

(f) support, cooperate with and facilitate the Authority in the implementation and operation of the Project in accordance with the provisions of this Agreement;

(g) ensure that the Contractor and its Sub-contractors comply with the safety and welfare measures for labour in accordance with the Applicable Laws and Good Industry Practice;

(h) keep, on the Site, a copy of this Agreement, publications named in this

Agreement, the Drawings, Documents relating to the Project, and Change of Scope Orders and other communications given under this Agreement. The Authority's Engineer and its authorised personnel shall have the right of access to all these documents at all reasonable times;

(i) cooperate with other contractors employed by the Authority and personnel of any public authority; and

(j) not interfere unnecessarily or improperly with the convenience of the public, or the access to and use and occupation of all roads and footpaths, irrespective of whether they are public or in the possession of the Authorityor of others.

3.1.8 The Contractor shall undertake all necessary superintendence to plan, arrange, direct, manage, inspect and test the Works.

3.2 Obligations relating to sub-contracts and any other agreements

3.2.1 **The Contractor shall not sub-contract the construction Works of any major structures i.e. units & components of Wastewater Pumping Stations, I.D. Structures & Sewer Network.** The contractor shall not sub-contract any works **excluding major structures as out lined above** in more than 50% (fifty per cent) of the Project and shall carry out Works directly under its own supervision and through its own personnel in at least 50% (fifty per cent) of the Project. Provided, however, that in respect of the Works carried out directly by the Contractor, it may enter into contracts for the supply and installation of Materials, Plant, equipment, road furniture, safety devices and labour, as the case may be, for such Works. For the avoidance of doubt, the Parties agree that the Contractor may sub-divide the aforesaid project of 50% (Fifty per cent) of the Project. The Parties further agreethat all obligations and liabilities under this Agreement for the entire project shallat all times remain with the Contractor. {The Parties also agree that obligation of the Contractor to carry out Works directly in at least 50% (Fifty per cent) of the total Project shall be discharged solely by the Lead Member.} [$]

For Operation & Maintenance purpose, the Contractor can sub-contract any part of Sewerage Project without detrimental to quality of effluent and holistic service of the entire Sewerage System.

3.2.2. In the event any sub-contract for Works, or the aggregate of such sub-contracts with any Sub-contractor, exceeds **5% (five percent)** of the Contract Price, the Contractor shall communicate the name and particulars, including the relevant experience of the sub-contractor, to the Authority prior to entering into any such sub-contract. The Authority shall examine the particulars of the sub-contractor from the national security and public interest perspective and may require the Contractor, no later than 15 (fifteen) business days from the date of receiving the communication from the Contractor, not to proceed with the sub-contract, and the Contractor shall comply therewith.

3.2.3 In the event any sub-contract referred to in Clause 3.2.2 relates to a sub-contractor who has, over the preceding 3 (three) years, not undertaken at least one work of a similar nature with a contract value exceeding 40% (forty per cent) of the value of the sub-contract to be awarded hereunder and received payments in respect thereof for an amount equal to at least such 40% (forty per cent), the Authority may, no later than 15 (fifteen) business days from the date of receiving the communication from the Contractor, require the Contractor not to proceed with such sub-contract, and the Contractor shall comply therewith.

3.2.4 It is expressly agreed that the Contractor shall, at all times, be responsible and

[$] May be deleted if the Contractor is not a Consortium.

liable for all its obligations under this Agreement notwithstanding anything contained in the agreements with its Sub-contractors or any other agreement that may be entered into by the Contractor, and no default under any such agreement shall excuse the Contractor from its obligations or liability hereunder.

3.3 Deleted

3.4 Contractor's personnel

3.4.1 The Contractor shall ensure that the personnel engaged by it or by its Sub- contractors in the performance of its obligations under this Agreement are at all times appropriately qualified, skilled and experienced in their respective functions in conformity with Good Industry Practice.

3.4.2 The Authority's Engineer may, for reasons to be specified in writing, direct the Contractor to remove any member of the Contractor's or Sub-contractor's personnel. Provided that any such direction issued by the Authority's Engineer shall specify the reasons for the removal of such person.

3.4.3 The Contractor shall on receiving such a direction from the Authority's Engineer order for the removal of such person or persons with immediate effect. It shall be the duty of the Contractor to ensure that such persons are evicted from the Site within 10 (ten) days of any such direction being issued in pursuance of Clause 3.4.2. The Contractor shall further ensure that such persons have no further connection with the Works or **Operation &Maintenance** under this Agreement. The Contractor shall then appoint (or cause to be appointed) a replacement.

3.5 Advertisement on Sewerage Project

The Sewerage Project or any part thereof shall not be used in any manner to advertise any commercial product or services.

3.6 Contractor's care of the Works

The Contractor shall bear full risk in and take full responsibility for the care of the Works, and of the Materials, goods and equipment for incorporation therein, from the Appointed Date until the date of Provisional Certificate (with respect to the Works completed prior to the issuance of the Provisional Certificate) and/or Completion Certificate (with respect to the Works referred to in the Punch List), save and except to the extent that any such loss or damage shall have arisen from any default or neglect of the Authority.

3.7 Electricity, water and other services

The Contractor shall be responsible for procuring of all power, water and other services that it may require.

3.8 Unforeseeable difficulties

Except as otherwise stated in the Agreement:

(a) the Contractor accepts complete responsibility for having foreseen all difficulties and costs of successfully completing the Works;

(b) the Contract Price shall not be adjusted to take account of any unforeseen difficulties or costs; and

(c) the Scheduled Completion Date shall not be adjusted to take account of any unforeseen difficulties or costs.

ARTICLE 4

OBLIGATIONS OF THE AUTHORITY

4.1 Obligations of the Authority

4.1.1 The Authority shall, at its own cost and expense, undertake, comply with and perform all its obligations set out in this Agreement or arising hereunder.

4.1.2 The Authority shall be responsible for the correctness of the Scope of the Project, Project Facilities, Specifications and Standards and the criteria for testing of the completed Works.

4.1.3 The Authority shall provide to the Contractor:

(a) upon receiving the Performance Security under Clause 7.1.1, the land/site in accordance with the provisions of Clauses 8.2 and 8.3, within a period of 30 (Thirty) days from the date of this Agreement, on not less than 90% (ninety per cent) of the total land/site requirement for the Sewerage Project;

(b) approval of the general arrangement drawings (the "**GAD**") from appropriate authorities to enable the Contractor to lay the sewer lines across the railway line / roads on the Sewerage Project in accordance with the Specifications and Standards, and subject to the terms and conditions specified in such approval, within a period of 60 (sixty) days from the Appointed Date, and reimbursement of all the costs and expenses paid by the Contractor to the appropriate authorities for and in respect of the crossing of sewer lines; [56]

(c) all environmental clearances as required under Clause 4.3.[7]

4.1.4 Delay in providing the land/site or approval of GAD by appropriate authorities, as the case may be, in accordance with the provisions of Clause 4.1.3 shall entitle the Contractor to Damages in a sum calculated in accordance with the provisions of Clause 8.3 of this Agreement and Time Extension in accordance with the provisions of Clause 10.5 of this Agreement. For the avoidance of doubt, the Parties agree that the Damages for delay in approval of GAD by the appropriate authorities for a particular road / railway crossing shall be deemed to be equal to the Damages payable under the provisions of Clause 8.3 for delay in providing Railway / Road crossing clearance for a length of 500 m for each such road / railway crossing.

4.1.5 Notwithstanding anything to the contrary contained in this Agreement, the Parties expressly agree that the aggregate Damages payable under Clauses 4.1.4, 8.3and 9.2 shall not exceed1% (one per cent) of the Contract Price. For the avoidance of doubt, the Damages payable by the Authority under the aforesaid Clauses shall not be additive if they arise concurrently from more than one cause but relate to the same part of the Sewerage Project.

Both the parties agree that payment of these Damages shall be full and final settlement of all claims of the Contractor and such compensation shall be the sole remedy against delays of the Authority and both parties further agree this as final cure against delays of the Authority.

4.1.6 The Authority agrees to provide support to the Contractor and undertakes to observe, comply with and perform, subject to and in accordance with the provisions of this Agreement and the Applicable Laws, the following:

[6] Clause (b) may be omitted if the Project does not include a major structure.

[7] Clause 4.1.3(c) may be suitably modified in the event that all the environmental clearances for the Sewerage Project have been received or are not required. It should be clearly stated that all the environmental clearances for the Sewerage Project have been received; or such environmental clearances for the Sewerage Project are not required.

(a) upon written request from the Contractor, and subject to the Contractor complying with Applicable Laws, provide reasonable support to the Contractor in procuring Applicable Permits required from any Government Instrumentality for implementation of the Project;

(b) upon written request from the Contractor, provide reasonable assistance to the Contractor in obtaining access to all necessary infrastructure facilities and utilities, including water and electricity at rates and on terms no less favourable than those generally available to commercial customers receiving substantially equivalent services;

(c) procure that no barriers that would have a material adverse effect on the works are erected or placed on or about the Sewerage Project by any Government Instrumentality or persons claiming through or under it, except for reasons of Emergency, national security, law and order or collection of inter-state taxes;

(d) not do or omit to do any act, deed or thing which may in any manner be violative of any of the provisions of this Agreement;

(e) support, cooperate with and facilitate the Contractor in the implementation of the Project in accordance with the provisions of this Agreement; and

(f) Deleted.

4.2 Operation &Maintenance obligations prior to the Appointed Date - Deleted

4.3 Environmental Clearances

The Authority represents and warrants that the environmental clearances required **if any** for construction of the Project shall be procured by the Authority prior to the date of issue of LOA. For the avoidance of doubt, the present status of environmental clearances is specified in Schedule-A.[6]

[6]Clause 4.3 may be suitably modified in the event that all the environmental clearances for the Sewerage Project have been received or are not required. It should be clearly stated that all the environmental clearances for the Sewerage Project have been received; or such environmental clearances for the SewerageProject are not required.

ARTICLE 5

REPRESENTATIONS AND WARRANTIES

5.1 Representations and warranties of the Contractor

The Contractor represents and warrants to the Authority that:

(a) it is duly organised and validly existing under the laws of Odisha/India, and has full power and authority to execute and perform its obligations under this Agreement and to carry out the transactions contemplated hereby;

(b) it has taken all necessary corporate and/or other actions under Applicable Laws to authorise the execution and delivery of this Agreement and to validly exercise its rights and perform its obligations under this Agreement;

(c) this Agreement constitutes its legal, valid and binding obligation, enforceable against it in accordance with the terms hereof, and its obligations under this Agreement will be legally valid, binding and enforceable obligations against it in accordance with the terms hereof;

(d) it is subject to the laws of Odisha/ India, and hereby expressly and irrevocably waives any immunity in any jurisdiction in respect of this Agreement or matters arising there under including any obligation, liability or responsibility hereunder;

(e) the information furnished in the Bid and as updated on or before the date of this Agreement is true and accurate in all respects as on the date of this Agreement;

(f) the execution, delivery and performance of this Agreement will not conflict with, result in the breach of, constitute a default under, or accelerate performance required by any of the terms of its memorandum and articles of association or any Applicable Laws or any covenant, contract, agreement, arrangement, understanding, decree or order to which it is aparty or by which it or any of its properties or assets is bound or affected;

(g) there are no actions, suits, proceedings, or investigations pending or, to its knowledge, threatened against it at law or in equity before any court or before any other judicial, quasi-judicial or other authority, the outcome of which may result in the breach of this Agreement or which individually or in the aggregate may result in any material impairment of its ability to perform any of its obligations under this Agreement;

(h) it has no knowledge of any violation or default with respect to any order, writ, injunction or decree of any court or any legally binding order of any Government Instrumentality which may result in any material adverse effect on its ability to perform its obligations under this Agreement and no fact or circumstance exists which may give rise to such proceedings that would adversely affect the performance of its obligations under this Agreement;

(i) it has complied with Applicable Laws in all material respects and has not been subject to any fines, penalties, injunctive relief or any other civil or criminal liabilities which in the aggregate have or may have a material adverse effect on its ability to perform its obligations under this Agreement;

(j) no representation or warranty by it contained herein or in any other document furnished by it to the Authority or to any Government Instrumentality in relation to Applicable Permits contains or will contain any untrue or misleading statement of material fact or omits or will omit to state a material fact necessary to make such representation or warranty not misleading;

(k) no sums, in cash or kind, have been paid or will be paid, by it or on its behalf, to any person by way of fees, commission or otherwise for securing the contract or entering into this Agreement or for influencing or attempting to influence any officer or employee of the Authority in connection therewith;

(l) all information provided by the {selected bidder/ members of the Consortium} in response to the Request for Proposal is to the best of its knowledge and belief, true and accurate in all material respects; and

(m) nothing contained in this Agreement shall create any contractual relationship or obligation between the Authority and any Sub- contractors, designers, consultants or agents of the Contractor.

5.2 Representations and warranties of the Authority

The Authority represents and warrants to the Contractor that:

(a) it has full power and authority to execute, deliver and perform its obligations under this Agreement and to carry out the transactions contemplated herein and that it has taken all actions necessary to execute this Agreement, exercise its rights and perform its obligations, under this Agreement;

(b) It has taken all necessary actions under the Applicable Laws to authorise the execution, delivery and performance of this Agreement;

(c) It has the financial standing and capacity to perform its obligations under this Agreement;

(d) This Agreement constitutes a legal, valid and binding obligation enforceable against it in accordance with the terms hereof;

(e) it has no knowledge of any violation or default with respect to any order, writ, injunction or any decree of any court or any legally binding order of any Government Instrumentality which may result in any material adverse effect on the Authority's ability to perform its obligations under this Agreement;

(f) It has complied with Applicable Laws in all material respects;

(g) It has good and valid right to the Site and has the power and authority to grant the clearance in respect thereof to the Contractor; and

(h) It has procured land / road and environment clearances such that the Contractor can commence construction forthwith on 90% (ninety per cent) of the total land/site requirement for the Sewerage Project.

5.3 Disclosure

In the event that any occurrence or circumstance comes to the attention of eitherParty that renders any of its aforesaid representations or warranties untrue or incorrect, such Party shall immediately notify the other Party of the same. Such notification shall not have the effect of remedying any breach of the representationor warranty that has been found to be untrue or incorrect nor shall it adversely affect or waive any obligation of either Party under this Agreement.

ARTICLE 6

DISCLAIMER

6.1 Disclaimer

6.1.1 The Contractor acknowledges that prior to the execution of this Agreement, the Contractor has, after a complete and careful examination, made an independent evaluation of the Request for Proposal, Scope of the Project, Specifications and Standards of design, construction and Operation & Maintenance, Site, local conditions, physical qualities of ground, subsoil and geology, suitability and availability of access routes to the Site and all information provided by the Authority or obtained, procured or gathered otherwise, and has determined to its satisfaction the accuracy or otherwise thereof and the nature and extent of difficulties, risks and hazards as are likely to arise or may be faced by it in the course of performance of its obligations hereunder. Save as provided in Clause 4.1.2 and Clause 5.2, the Authority makes no representation whatsoever, express, implicit or otherwise, regarding the accuracy, adequacy, correctness, reliability and/or completeness of any assessment, assumptions, statement or information provided by it and the Contractor confirms that it shall have no claim whatsoever against the Authority in this regard.

6.1.2 The Contractor acknowledges and hereby accepts to have satisfied itself as to the correctness and sufficiency of the Contract Price.

6.1.3 The Contractor acknowledges and hereby accepts the risk of inadequacy, mistake or error in or relating to any of the matters set forth in Clause 6.1.1 above and hereby acknowledges and agrees that the Authority shall not be liable for the same in any manner whatsoever to the Contractor, or any person claiming through or under any of them, and shall not lead to any adjustment of Contract Price or Scheduled Completion Date.

6.1.4 The Parties agree that any mistake or error in or relating to any of the matters set forth in Clause 6.1.1 above shall not vitiate this Agreement, or render it voidable.

6.1.5 In the event that either Party becomes aware of any mistake or error relating to any of the matters set forth in Clause 6.1.1 above, that Party shall immediately notify the other Party, specifying the mistake or error.

6.1.6 Except as otherwise provided in this Agreement, all risks relating to the Project shall be borne by the Contractor; and the Authority shall not be liable in any manner for such risks or the consequences thereof.

Part III

Construction and Operation & maintenance

ARTICLE 7

PERFORMANCE SECURITY

7.1 Performance Security

(i) (A)Within **15(fifteen) days** of receipt of Letter of Acceptance, the selected Bidder shall furnish to the Authority an irrevocable and unconditional guarantee from a Bank in the form set forth in Annex-I of Schedule-G (the "**Performance Security**") for an amount equal to **5% (five percent)** of its Bid Price (for Construction Cost). In case of bids mentioned below, the Selected Bidder, along with the Performance Security, shall also furnish to the Authority an irrevocable and unconditional guarantee from a Bank in the same form given at Annex-I of Schedule-G towards an Additional Performance Security (the "**Additional Performance Security**") for an amount calculated as under:

(a) If the Bid Price offered by the Selected Bidder (for Construction Cost) is lower than 10% but up to 20% of the estimated Project Cost, then the Additional Performance Security shall be calculated @20% of the difference in the (i) Estimated Project Cost (as mentioned in RFP)-10% of the Estimated Project Cost and (ii) the Bid Price offered by the selected Bidder.

(b) If the Bid Price offered by the Selected Bidder (for Construction Cost) is lower than 20% of the Estimated Project Cost, then the Additional Performance Security shall be calculated @ 30% of the difference in the (i) Estimated Project Cost (as mentioned in RFP)-10% of the Estimated Project Cost and (ii) the Bid Price offered by the Selected Bidder.

(c) This Additional Performance Security shall be treated as part of the Performance Security.

(B)The Performance Security shall be valid until 60(sixty) days after the Defects Liability Period. The Additional Performance Security shall be valid until 28 (twenty-eight) days after Project Completion Date.

(ii) The Selected Bidder has the option to provide 50% of the Performance Security and 50% of the Additional Performance Security, if any, within 15(fifteen) days of receipt of Letter of Acceptance, in any case before signing of the Contract Agreement and the remaining Performance Security and Additional Performance Security, if any, shall be submitted within 30 days of signing of this agreement.

(iii) In the event the Selected Bidder fails to provide the remaining Performance Security and Additional Performance Security, if any, as prescribed herein, it may seek extension of time for a further period up to 60 days by paying the Damages upfront along with the request letter seeking the extension. The Damages shall be the sum calculated at the rate of 0.01% (zero point zero one per cent) of the Bid Price offered by the Selected Bidder for each day until the Performance Security and Additional Performance Security, if any, is provided in full as prescribed herein. The damages at full rate as given above shall be applicable even if a part of the Performance Security and the Additional Performance Security is provided.

(iv) For avoidance of any doubt, in case of failure of submission of Performance Security

and Additional Performance Security, if any, within the additional 60 days' time period, the award shall be deemed to be cancelled/ withdrawn and the Bid Security shall be encashed and the proceeds there of appropriated by the Authority. Thereupon all rights, privileges, claims and entitlements of the Contractor under or arising out of the Award shall be deemed to have been waived by, and to have ceased with the concurrence of the Contractor, and the Award shall be deemed to have been withdrawn by the Authority

7.1 Extension of Performance Security and Additional Performance Security

The Contractor may initially provide the Performance Security for a period of 2 (two) years; provided that it shall procure the extension of the validity of the Performance Security, as necessary, at least 2 (two) months prior to the date of expiry thereof. Upon the Contractor providing an extended Performance Security, the previous Performance Security shall be deemed to be released and the Authority shall return the same to the Contractor within a period of 7 (seven)business days from the date of submission of the extended Performance Security.

7.2 Appropriation of Performance Security

(i) Upon occurrence of a Contractor's Default, the Authority shall, without prejudice to its other rights and remedies hereunder or in law, be entitled to encash and appropriate the relevant amounts from the Performance Security as Damages for such Contractor's Default.

(ii) Upon such encashment and appropriation from the Performance Security, the Contractor shall, within 30 (thirty) days thereof, replenish, in case of partial appropriation, to its original level the Performance Security, and in case of appropriation of the entire Performance Security provide a fresh Performance Security, as the case may be, and the Contractor shall, within the time so granted, replenish or furnish fresh Performance Security as aforesaid failing which the Authority shall be entitled to terminate the Agreement in accordance with Article 23. Upon replenishment or furnishing of a fresh Performance Security, as the case maybe, as aforesaid, the Contractor shall be entitled to an additional Cure Period of 30 (thirty) days for remedying the Contractor's Default, and in the event of the Contractor not curing its default within such Cure Period, the Authority shall be entitled to encash and appropriate such Performance Security as Damages, and to terminate this Agreement in accordance with Article 23.

7.3 Release of Performance Security

(i) The Authority shall return the Performance Security to the Contractor within 60 (sixty) days of the expiry of the Maintenance Period or the Defects Liability Period, whichever is later, under this Agreement. Notwithstanding the aforesaid, the Parties agree that the Authority shall not be obliged to release the Performance Security until all Defects identified during the Defects Liability Period have been rectified.

(ii) The Authority shall return the Additional Performance Security to the Contractor within 28 (twenty-eight) days from the date of issue of Completion Certificate under Article 12 of this Agreement.

(iii) The Authority shall be liable to pay interest @ 9% (nine per cent) per annum for any

delay in the return of Performance Security and Additional Performance Security, if any, beyond the period prescribed above for the period of delay.

7.3.1 The selected Bidder shall furnish to the Authority an irrevocable and unconditional guarantee from a Bank in the form set forth in Annex-I of Schedule-G (the "**Performance Security**") for an amount equal to **5% (five percent)** of its Bid Price (for O & M Cost) Prior to commencement of the **O&M period.** The Contractor shall for the performance of its obligations hereunder during the operation & maintenance period, provide to the Authority, on commencement of the **O&M period,** an irrevocable and unconditional guarantee from a Nationalized Bank, counter guaranteed by its branch at Bhubaneswar in the form set forth in Schedule-G (the **"Performance Security for O&M"**) for an amount equal to 10% (ten percent) of the contract price for O&M cost (excluding energy cost). The performance security shall be valid until 60 days after the O&M period of 5 (five) years. The Authority shall return the performance security for O&M within 60 (sixty) days of the expiry of the operation & maintenance period of 5 years. **In case the bid amount for O&M cost is less than the estimated** cost by more than **10%,** the successful bidder will deposit additional performance security to the extent of the differential cost of bid amount and 90% of the estimated cost relating to O&M cost in shape of Bank Guarantee in Schedule-G within 10 working days of singing of agreement and the same shall remain valid until 60 days after the O&M period.

7.4 Retention Money[10]

(i) From every payment for Works due to the Contractor in accordance with the provisions of Clause 19.5, the Authority shall deduct 6% (six per cent) thereof as guarantee money for performance of the obligations of the Contractor during the Construction Period (the "**Retention Money**") subject to the condition that the maximum amount of Retention Money shall not exceed 5% (five per cent) of the Contract Price.

(ii) Upon occurrence of a Contractor's Default, the Authority shall, without prejudice to its other right sand remedies here under or in law, been titled to appropriate the relevant amounts from the Retention Money as Damages for such Contractor's Default.

(iii) Within 15 (fifteen) days of the date of issue of the Completion Certificate, the Authority shall refund the balance of Retention Money remaining with the Authority after adjusting the amounts appropriated under the provisions of Clause 7.5 (ii).

(iv) The Parties agree that in the event of Termination of this Agreement, the Retention Money specified in this Clause 7.5 shall be treated as if they are Performance Security and shall be reckoned as such for the purposes of Termination Payment under Clause 23.6.

[7]The Authority may, in its discretion, omit Clause 7.5 and in lieu thereof increase the Performance Security under Clause 7.1 from 7.5% (seven point five per cent) to 10% (ten percent).

ARTICLE 8

SITES FOR THE PROJECT

8.1 The Site

The site of the Sewerage Project (the "**Site**") shall comprise the site described in Schedule-A in respect of which the land shall be provided by the Authority to the Contractor. The Authority shall be responsible for:

(a) acquiring and providing the site in accordance with the alignment finalised by the Authority, free from all encroachments and encumbrances, and free access thereto for the execution of this Agreement; and

(b) obtaining licenses and permits for environment clearance for the Sewerage Projects if required.

8.2 Procurement of the Site for construction of structures:

8.2.1 The Authority's Representative and the Contractor shall, within 10 (ten) days of issue of LOA inspect the Site and prepare a memorandum containing an inventory of the Site including the vacant and unencumbered land, buildings, structures, road works, trees and any other immovable property on or attached to the Site. Subject to the provisions of Clause 8.2.3, such memorandum shall have appended thereto an appendix (the "**Appendix**") specifying in reasonable detail those parts of the Site to which vacant access and land has not been given to the Contractor. Signing of the memorandum, in two counterparts (each of which shall constitute an original), by the authorised representatives of the Parties shall be deemed to constitute valid evidence of giving the land to the Contractor for discharging its obligations under and in accordance with the provisions of this Agreement and for no other purpose whatsoever.

Whenever the Authority is ready to hand over any part or parts of the Site included in the Appendix, it shall inform the Contractor, by notice, the proposed date and time of such handing over. The Authority Representative and the Contractor shall, on the date so notified, inspect the specified parts of the Site, and prepare a memorandum containing an inventory of the vacant and unencumbered land, buildings, structures, road works, trees and any other immovable property on or attached to the Site so handed over. Signing of the memorandum, in two counterparts (each of which shall constitute an original), by the authorised representatives of the Parties shall be deemed to constitute valid evidence of giving the relevant land to the Contractor.

8.2.2 The Authority shall provide **all land to the Contractor** included in the Appendix by the date specified in **Schedule-A** for those parts of the Site referred to therein, or no later than 90 (ninety) days of the Appointed Date for those parts of the Site which have not been specified in Schedule-A, and in the event of delay for any reason other than Force Majeure or breach of this Agreement by the Contractor, it shall pay to the Contractor, Damages in a sum calculated in accordance with Clause 8.3.

8.2.3 Notwithstanding anything to the contrary contained in this Clause 8.2, the Authority shall specify the parts of the Site, if any, for which land shall be provided to the Contractor on the dates specified in Schedule-A. Such parts shall also be included in the Appendix prepared in pursuance of Clause 8.2.1. For avoidance of doubt, the Parties expressly agree that the Appendix shall in no event contain areas required for the Sewerage Project cumulative area of which exceeds 10% (ten per cent) of the total area of the Sewerage Project.

8.3 Damages for delay in handing over the Site for construction of structures / crossing of sewer line.

8.3.1 In the event any part of the construction Site is not provided by the Authority on or before the date(s) specified in Clause 8.2 for any reason other than Force Majeure or breach of this Agreement by the Contractor, the Authority shall pay Damages to

the Contractor in a sum calculated in accordance with the following formula forand in respect of those parts of the Site which has not been provided:

Amount of Damages shall be paid in a sum calculated at the rate of Rs.5.00 (Rupees Five) per day for every 1000 (One thousand) square meters or part thereof, commencing from the 91st (Ninety first) day of the appointed date and until such site is procured.

In the event that any Damages are due and payable to the Contractor under the provisions of this Clause 8.3.1 for delay in providing the land, the Contractor shall, subject to the provisions of Clause 10.5, be entitled to Time Extension equal to the period for which the Damages have become due and payable under this Clause 8.3.1, save and except that:

(a) if any delays involve time overlaps, the overlaps shall not be additive; and

(b) such Time Extension shall be restricted only to the Works which are affected by the delay in providing the land.

For the avoidance of doubt, the Parties expressly agree that the Damages specified hereunder and the Time Extension specified in Clause 10.5 shall be restricted only to failure of the Authority to provide the land for and in respect of the construction of major structures.

8.3.2 Notwithstanding anything to the contrary contained in this Agreement, the Contractor expressly agrees that Works on all parts of the Site for which land is granted within 90 (ninety) days of the Appointed Date, or with respect to the partsof the Site provided in Schedule-A, no later than the date(s) specified therein, as the case may be, shall be completed before the Scheduled Completion Date and shall not qualify for any Time Extension under the provisions of Clause 8.3.1.

8.3.3 **Notwithstanding anything to the contrary contained in this Agreement, the Authority** may at any time withdraw any Works forming part of this Agreement, subject to such Works not exceeding an aggregate value, such value to be determined in accordance with Schedule-H, equal to 10(ten) percent of the Contract Price.

Provided that if any Works cannot be undertaken within the municipal limits of a town or within any area falling in a reserved forest or wildlife sanctuary, as the case may be, because the requisite clearances or approvals for commencing construction of Works therein have not been given within 240 (two hundred and forty) days of the Appointed date, the affected Works shall be deemed to be withdrawn under the provisions of this Clause 8.3.3 unless the Parties agree to the contrary, and such Works shall not be computed for the purposes of the aforesaid ceiling of 10% (ten per cent) hereunder.

8.3.4 **In the event of withdrawal of Works under Clause 8.3.3**, the Contract Price shall be reduced by an amount equal to 90 (ninety) per cent of the value of the Works withdrawn and the Contractor shall not be entitled to any other compensation or Damages for the withdrawal of Works.

Provided that if any Works are withdrawn after commencement of the Construction of such works, the Authority shall pay to the Contractor 110% (one hundred and ten per cent) of the fair value of the work done, as assessed by the Authority's Engineer:

8.4 Site to be free from Encumbrances

Subject to the provisions of Clause 8.2, the Site shall be made available by the Authority to the Contractor pursuant hereto free from all Encumbrances and occupations and withoutthe Contractor being required to make any payment to the Authority on account of any costs, compensation, expenses and charges for the acquisition and use of such Site for the duration of the Project Completion Schedule. For the avoidance of doubt, it is agreed thatthe existing rights of way, easements, privileges, liberties and appurtenances to the Site shall not be deemed to be Encumbrances. It is further agreed that, unless otherwise specified in this Agreement, the Contractor accepts and undertakes to bear any and all risks arising out of the inadequacy or physical condition of the Site.

8.5 Protection of Site from encroachments

On and after signing the memorandum and/or subsequent memorandum referred to in Clause 8.2.1, and until the issue of the Completion Certificate, the Contractor shall maintain a round-the-clock vigil over the Site and shall ensure and procure that no encroachment thereon takes place. During the Construction Period, the Contractor shall protect the Site from any and all occupations, encroachments or Encumbrances, and shall not place or create nor permit any Sub-contractor or other person claiming through or under the Agreement to place or create any Encumbrance or security threat over all or any part of the Site or the Project Assets, or on any rights of the Contractor therein or under this Agreement, save and except as otherwise expressly set forth in this Agreement. In the event of any encroachment or occupation on any part of the Site, the Contractor shall report such encroachment or occupation forthwith to the Authority and undertake its removal at its own cost and expenses.

8.6 Special/temporary land

The Contractor shall bear all costs and charges for any special or temporary land required by it in connection with access to the Site. The Contractor shall obtain at its cost such facilities on or outside the Site as may be required by it for the purposes of the Sewerage Project and the performance of its obligations under this Agreement.

8.7 Access to the Authority and the Authority's Engineer

8.7.1 The land given to the Contractor hereunder shall always be subject to the right of access of the Authority and the Authority's Engineer and their employees and agents for inspection, viewing and exercise of their rights and performance of their obligations under this Agreement.

8.7.2 The Contractor shall ensure, subject to all relevant safety procedures, that the Authority has un-restricted access to the Site during any emergency situation, as decided by the Authority's Engineer.

8.8 Geological and archaeological finds

It is expressly agreed that mining, geological or archaeological rights do not form part of this Agreement with the Contractor for the Works, and the Contractor hereby acknowledges that it shall not have any mining rights or interest in the underlying minerals, fossils, antiquities, structures or other remnants or things either of particular geological or archaeological interest and that such rights, interest and property on or under the Site shall vest in and belong to the Authority or the concerned Government Instrumentality. The Contractor shall take all reasonable precautions to prevent its workmen or any other person from removing or damaging such interest or property and shall inform the Authority forthwith of the discovery thereof and comply with such instructions as the concerned Government Instrumentality may reasonably give for the removal of such property. For the avoidance of doubt, it is agreed that any reasonable expenses incurred by the Contractor hereunder shall be reimbursed by the Authority. It is also agreed that the Authority shall procure that the instructions hereunder are issued by the concerned Government Instrumentality within a reasonable period.

ARTICLE 9

UTILITIES AND TREES

9.1 Existing utilities and roads

Notwithstanding anything to the contrary contained herein, the Contractor shall ensure that the respective entities owning the existing roads, land, level crossings, structures, or utilities on, under or above the Site are enabled by it to keep them in continuous satisfactory use, if necessary, by providing suitable temporary diversions with the authority of the controlling body of that road, landor utility.

9.2 Shifting of obstructing utilities

The Contractor shall, in accordance with Applicable Laws and with assistance of the Authority, cause shifting of any utility (including electric lines, water pipes and telephone cables) to an appropriate location or alignment, if such utility or obstruction adversely affects the execution of the Works or Operation & Maintenance of the Sewerage Project in accordance with this Agreement. The actual cost of such shifting, as approved and communicated by the entity owning the utility, shall be paid by the Contractor and reimbursed by the Authority to the Contractor on certification by the entity owning such utility that the work has been satisfactorily executed by the Contractor. In the event of any delay in such shifting by the entity owning the utility beyond a period of 180 (one hundred and eighty) days from the date of notice by the Contractor to the entity owning the utility and to the Authority, the Contractor shall be entitled to Damages in a sum calculated in accordance with the formula specified in Clause 8.3.1 for the period of delay, and to Time Extension in accordance with Clause 10.5 for and in respect of the part(s) of the Works affected by such delay; provided that if the delays involve any time overlaps, the overlaps shall not be additive.

9.3 New utilities

9.3.1 The contractor Should give the GPS Location with photograph of before Dismantling and after reinstatement of Municipality Drains of each location where it will be executed.

9.3.2 The contractor Should give the GPS Location with photograph of before Dismantling and after reinstatement of Water pipe line of each location where it will be executed. No patch work will be allowed only complete work should be done.

9.3.3 Deleted.

9.3.4 Deleted.

9.4 Felling of trees

The Authority shall assist the Contractor in obtaining the Applicable Permits for felling of trees to be identified by the Authority for this purpose if and only if such trees cause a Material Adverse Effect on the construction or operation & maintenance of the Sewerage Project. The cost of such felling shall be borne by the Authority and in the event of any delay in felling thereof for reasons beyond the control of the Contractor; it shall be excused for failure to perform any of its obligations hereunder if such failure is a direct consequence of delay in the fellingof trees. The Parties hereto agree that the felled trees shall be deemed to be owned by the Authority and shall be disposed in such manner and subject to such conditions as the Authority may in its sole discretion deem appropriate. For the avoidance of doubt, the Parties agree that if any felling of trees hereunder is in a forest area, the Applicable Permit thereof shall be procured by the Authority within the time specified in the Agreement.

ARTICLE 10

DESIGN AND CONSTRUCTION OF THE SEWERAGE PROJECT

10.1 Obligations prior to commencement of Works

10.1.1 Within 20 (twenty) days of the Appointed Date, the Contractor shall:

(a) appoint its representative, duly authorised to deal with the Authority in respect of all matters under or arising out of or relating to this Agreement;

(b) appoint a design director (the "**Design Director**") who will head the Contractor's design unit and shall be responsible for surveys, investigations, collection of data, and preparation of preliminary and detailed designs;

(c) undertake and perform all such acts, deeds and things as may be necessary or required before commencement of Works under and in accordance with this Agreement, the Applicable Laws and Applicable Permits; and

(d) make its own arrangements for quarrying of materials needed for the Sewerage Project under and in accordance with the Applicable Laws and Applicable Permits.

10.1.2 The Authority shall, within 15 (fifteen) days of the date of this Agreement, appoint an engineer (the "**Authority's Engineer**") to discharge the functions and duties specified in this Agreement, and shall notify to the Contractor the name, addressand the date of appointment of the Authority's Engineer forthwith.

10.1.3 Within 30 (thirty) days of the Appointed Date, the Contractor shall submit to the Authority and the Authority's Engineer a programme (the **"Programme")** for the Works, developed using networking techniques giving the following details:

Part I Contractor's organisation for the Project, the general methods and arrangements for design and construction, environmental management plan, Quality Assurance Plan including design quality plan and safety plan covering safety of users and workers during construction, Contractor's key personnel and equipment.

Part II Programme for completion of all stages of construction given in Schedule-H and Project Milestones of the Works as specified in Project Completion Schedule set forth in Schedule-J. The Programme shall include:

(a) the order in which the Contractor intends to carry out the Works, including the anticipated timing of design and stages of Works;

(b) the periods for reviews under Clause 10.2;

(c) the sequence and timing of inspections and tests specified in this Agreement. The Contractor shall submit a revised programme whenever the previous programme is inconsistent with the actual progress or with the Contractor's obligations.

10.1.4 The Contractor shall compute, on the basis of the Drawings prepared in accordance with Clause 10.2.4, and provide to the Authority's Engineer, the length, area and numbers, as the case may be, in respect of the various items of work specified in Schedule-H and comprising the Scope of the Project. The Parties expressly agree that these details shall form the basis for estimating the interim payments for the Works in accordance with the provisions of Clause 19.3. For the avoidance of doubt, the sum of payments to be computed in respect of all the items of work shall not exceed the Contract Price, as may be adjusted in accordance with the provisions of this Agreement.

10.1.5 The Contractor shall appoint a safety consultant (the "**Safety Consultant**") to carry out safety audit at the design / construction stage of the Sewerage Project in accordance with the Applicable Laws and Good Industry Practice.

10.1.6 The safety audit pursuant to Clause 10.1.5 shall be carried out by the Safety Consultant in respect of all such design details that have a bearing on safety of Users involved in or associated with accidents. The recommendations of the Safety Consultant shall be incorporated in the design of the Sewerage Project and the Contractor shall forward to the Authority's Engineer a certificate to this effect together with the recommendations of the Safety Consultant. In the event that any works required by the Safety Consultant shall fall beyond the scope of Schedule-B, Schedule-C or Schedule-D, the Contractor shall make a report thereon and seek the instructions of the Authority for Change in Scope. For the avoidance of doubt, the Safety Consultant to be engaged by the Contractor shall be independent of the design and implementation team of the Contractor.

10.2 Design and Drawings

10.2.1 Design and Drawings shall be developed in conformity with the Specifications and Standards set forth in Schedule-D. In the event, the Contractor requires any relaxation in design standards due to restricted area in any section, the alternative design criteria for such section shall be provided for review of the Authority's Engineer.

10.2.2 The Contractor shall appoint a proof check consultant (the "**Proof Consultant**") after proposing to the Authority a panel of three names of qualified and experienced firms from whom the Authority may choose one to be the Proof Consultant.

10.2.3 The Proof Consultant shall:

(a) evolve a systems approach with the Design Director so as to minimise the time required for final designs and construction drawings; and

(b) proof check the detailed calculations, drawings and designs, which have been approved by the Design Director.

10.2.4 In respect of the Contractor's obligations with respect to the design and Drawings of the Sewerage Project as set forth in Schedule-I, the following shall apply:

(a) The Contractor shall prepare and submit, with reasonable promptness and in such sequence as is consistent with the Project Completion Schedule, three copies each of the design and Drawings, duly certified by the Proof Consultant, to the Authority's Engineer for review. Provided, however, thatin respect of Major Structures, the Authority's Engineer may require additional drawings for its review in accordance with Good Industry Practice.

(b) by submitting the Drawings for review to the Authority's Engineer, the Contractor shall be deemed to have represented that it has determined and verified that the design and engineering, including field construction criteria related thereto, are in conformity with the Scope of the Project, the Specifications and Standards and the Applicable Laws;

(c) within 15 (fifteen) days of the receipt of the Drawings, the Authority's Engineer shall review the same and convey its observations to the Contractor with particular reference to their conformity or otherwise with the Scope of the Project and the Specifications and Standards. The Contractor shall not be obliged to await the observations of the Authority's Engineer on the Drawings submitted pursuant hereto beyond the said periodof 15 (fifteen) days and may begin or continue Works at its own discretion and risk; Provided, however that in case of a Major Structure, the aforesaid period of 15 (fifteen) days may be extended up to 30 (thirty) days;

(d) if the aforesaid observations of the Authority's Engineer indicate that the

Drawings are not in conformity with the Scope of the Project or the Specifications and Standards, such Drawings shall be revised by the Contractor in conformity with the provisions of this Agreement and resubmitted to the Authority's Engineer for review. The Authority's Engineer shall give its observations, if any, within 10 (ten) days of receipt of the revised Drawings. In the event the Contractor fails to revise and resubmit such Drawings to the Authority's Engineer for review as aforesaid, the Authority's Engineer may withhold the payment for the affected works in accordance with the provisions of Clause 19.5.4. If the Contractor disputes any decision, direction or determination of the Authority's Engineer hereunder, the Dispute shall be resolved in accordance with the Dispute Resolution Procedure;

(e) no review and/or observation of the Authority's Engineer and/or its failureto review and/or convey its observations on any Drawings shall relieve the Contractor of its obligations and liabilities under this Agreement in any manner nor shall the Authority's Engineer or the Authority be liable for the same in any manner; and if errors, omissions, ambiguities, inconsistencies, inadequacies or other Defects are found in the Drawings, they and the construction works shall be corrected at the Contractor's cost, notwithstanding any review under this Article 10;

(f) the Contractor shall be responsible for delays in submitting the Drawing as set forth in Schedule-I caused by reason of delays in surveys and field investigations, and shall not be entitled to seek any relief in that regard from the Authority; and

(g) the Contractor warrants that its designers, including any third parties engaged by it, shall have the required experience and capability in accordance with Good Industry Practice and it shall indemnify the Authority against any damage, expense, liability, loss or claim, which the Authority might incur, sustain or be subject to arising from any breach of the Contractor's design responsibility and/or warranty set out in this Clause.

10.2.5 Any cost or delay in construction arising from review by the Authority's Engineer shall be borne by the Contractor.

10.2.6 Works shall be executed in accordance with the Drawings provided by the Contractor in accordance with the provisions of this Clause 10.2 and the observations of the Authority's Engineer thereon as communicated pursuant to the provisions of Clause 10.2.4 (d). Such Drawings shall not be amended or altered without prior written notice to the Authority's Engineer. If a Party becomes aware of an error or defect of a technical nature in the design or Drawings, that Party shall promptly give notice to the other Party of such error or defect.

10.2.7 Within 90 (ninety) days of the Project Completion Date, the Contractor shall furnish to the Authority and the Authority's Engineer a complete set of as-built Drawings, in 2 (two) hard copies and in micro film form or in such other mediumas may be acceptable to the Authority, reflecting the Sewerage Project as actually designed, engineered and constructed, including an as-built survey illustrating the layout of the Sewerage Project and setback lines, if any, of the buildings and structures forming part of Project Facilities.

10.3 Construction of the Sewerage Project

10.3.1 The Contractor shall construct the Sewerage Project as specified in Schedule-B and Schedule-C, and in conformity with the Specifications and Standards set forth in Schedule-D. The Contractor shall be responsible for the correct positioning of all parts of the Works, and shall rectify any error in the positions, levels, dimensions or alignment of the Works. The [as per the stipulated period of completion) *day from

the Appointed Date shall be the scheduled completion date (the "**Scheduled Completion Date**") and the Contractor agrees and undertakes that the construction shall be completed on or before the Scheduled Completion Date, including any extension thereof.

* Period of completion.

10.3.2 The Contractor shall construct the Sewerage Project in accordance with the Project Completion Schedule set forth in Schedule-J. In the event that the Contractor fails to achieve any Project Milestone or the Scheduled Completion Date within a period of 30 (thirty) days from the date set forth in Schedule-J, unless such failurehas occurred due to Force Majeure or for reasons solely attributable to the Authority, it shall pay Damages to the Authority of a sum calculated at the rate of **0.05% (zero point zero five percent)** of the Contract Price for delay of each day reckoned from the date specified in Schedule –J and until such Project Milestone is achieved or the Works are completed; provided that if the period for any or all Project Milestones or the Scheduled Completion Date is extended in accordance with the provisions of this Agreement, the dates set forth in Schedule-J shall be deemed to be modified accordingly and the provisions of this Agreement shall apply as if Schedule-J has been amended as above; provided further that in the event the Works are completed within or before the Scheduled Completion Date including any Time Extension, applicable for that work or section, the Damages paid under this Clause 10.3.2 shall be refunded by the Authority to the Contractor, but without any interest thereon. For the avoidance of doubt, it is agreed that recovery of Damages under this Clause 10.3.2 shall be without prejudice to the rights of the Authority under this Agreement including the right of Termination thereof. The Parties further agree that Time Extension hereunder shall only be reckoned for and in respect of the affected works as specified in Clause 10.5.2.

10.3.3 The Authority shall notify the Contractor of its decision to impose Damages in pursuance with the provisions of this Clause 10.3. provided that no deduction on account of Damages shall be effected by the Authority without notifying the Contractor of its decision to impose the Damages, and taking into consideration the representation, if any, made by the Contractor within 20 (twenty) days of such notice. The Parties expressly agree that the total amount of Damages under Clause 10.3.2 **shall not exceed 10% (ten percent) of the Contract Price**.

10.4 Deleted.

10.5 Extension of time for completion

10.5.1 Without prejudice to any other provision of this Agreement for and in respect of extension of time, the Contractor shall be entitled to extension of time in the Project Completion Schedule (the **"Time Extension")** to the extent that completion of any Project Milestone is or will be delayed by any of the following, namely:

(a) delay in providing the land and clearances or approval of appropriate authorities, specified in Clause 4.1.4;

(b) Change of Scope (unless an adjustment to the Scheduled Completion Date has been agreed under Article 13);

(c) occurrence of a Force Majeure Event;

(d) any delay, impediment or prevention caused by or attributable to the Authority, the Authority's personnel or the Authority's other contractors on the Site; and

(e) any other cause or delay which entitles the Contractor to Time Extension in accordance with the provisions of this Agreement.

10.5.2 The Contractor shall, no later than 15 (fifteen) business days from the occurrence of

an event or circumstance specified in Clause 10.5.1, inform the Authority's Engineer by notice in writing (in the prescribed format of Government of Odisha), with a copy to the Authority, stating in reasonable detail with supporting particulars, the event or circumstances giving rise to the claim for Time Extension in accordance with the provisions of this Agreement. Provided that the period of 15 (fifteen) business days shall be calculated from the date on which the Contractor became aware, or should have become aware, of the occurrence of such an event or circumstance.

Provided further that notwithstanding anything to the contrary contained in this Agreement, Time Extension shall be due and applicable only for the Works which are affected by the aforesaid events or circumstances and shall not in any manner affect the Project Completion Schedule for and in respect of the Works which arenot affected hereunder.

10.5.3 In the event of the failure of the Contractor to issue to the Authority's Engineer a notice in accordance with the provisions of Clause 10.5.2 within the time specified therein, the Contractor shall not be entitled to any Time Extension and shall forfeit its right for any such claims in future. For the avoidance of doubt, in the event of failure of the Contractor to issue notice as specified in this clause 10.5.3, the Authority shall be discharged from all liability in connection with the claim.

10.5.4 The Authority's Engineer shall, on receipt of the claim in accordance with the provisions of Clause 10.5.2, examine the claim expeditiously within the time frame specified herein. In the event the Authority's Engineer requires any clarifications to examine the claim, the Authority's Engineer shall seek the same within 15 (fifteen) days from the date of receiving the claim. The Contractor shall, on receipt of the communication of the Authority's Engineer requesting for clarification, furnish the same to the Authority's Engineer within 10 (ten) days thereof. The Authority's Engineer shall, within a period of 60 (sixty) days from the date of receipt of such clarifications, forward in writing to the Contractor its determination of Time Extension.

Provided that when determining each extension of time under this Clause 10.5, the Authority's Engineer shall review previous determinations and may increase, but shall not decrease, the total Time Extension.

10.5.5 If the event or circumstance giving rise to the notice has a continuing effect:

(a) a fully detailed claim shall be considered as interim;

(b) the Contractor shall, no later than 10 (ten) days after the close of each month, send further interim claims specifying the accumulated delay, the extension of time claimed, and such further particulars as the Authority's Engineer may reasonably require; and

(c) the Contractor shall send a final claim within 30 (thirty) days after the effect of the event or the circumstance ceases.

Upon receipt of the claim hereunder, the Authority's Engineer shall examine the same in accordance with the provisions of Clause 10.5.4 withina period of 60 (sixty) days of the receipt thereof.

10.6 Incomplete Works

In the event the Contractor fails to complete the Works in accordance with the Project Completion Schedule, including any Time Extension granted under this Agreement, the Contractor shall endeavour to complete the balance work expeditiously and shall pay Damages to the Authority in accordance with the provisions of Clause 10.3.2 for delay of each day until the Works are completed in accordance with the provisions of this Agreement. Recovery of Damages under this Clause shall be without prejudice to the rights of the Authority under this Agreement including the right to termination under Clause 23.1.

10.7 Operation & Maintenance Manual

No later than 60 (sixty) days prior to the Project Completion Date, the Contractor shall, in consultation with the Authority's Engineer, evolve a operation &maintenance manual (the **"Operation &Maintenance Manual"**) for the regular and preventive operation &maintenance of the Sewerage Project in conformity with the Specifications and Standards, safety requirements and Good Industry Practice, and shall provide 5 (five) copies thereof to the Authority's Engineer. The Authority's Engineer shall review the Operation &Maintenance Manual within 15 (fifteen) days of its receipt and communicate its comments to the Contractor for necessary modifications, if any.

ARTICLE 11

QUALITY ASSURANCE, MONITORING AND SUPERVISION

11.1 Quality of Materials and workmanship

The Contractor shall ensure that the Construction, Materials and workmanship are in accordance with the requirements specified in this Agreement, Specifications and Standards and Good Industry Practice.

11.2 Quality control system

11.2.1 The Contractor shall establish a quality control mechanism to ensure compliance with the provisions of this Agreement (the **"Quality Assurance Plan"** or **"QAP"**).

11.2.2 The Contractor shall, within 30 (thirty) days of the Appointed Date, submit to the Authority's Engineer its Quality Assurance Plan which shall include the following:

(a) organisation, duties and responsibilities, procedures, inspections and documentation;

(b) quality control mechanism including sampling and testing of Materials, test frequencies, standards, acceptance criteria, testing facilities, reporting, recording and interpretation of test results, approvals, check list for site activities, and proforma for testing and calibration in accordance with the Specifications for Sewerage and Sewage Treatment Works issued by CPHEEO &relevant IS specifications and Good Industry Practice; and internal quality audit system.

c). The Authority's Engineer shall convey its comments to the Contractor within a period of 21 (twenty-one) days of receipt of the QAP stating the modifications, if any, required, and the Contractor shall incorporate those in the QAP to the extent required for conforming with the provisions of this Clause 11.2.

11.2.3 The Contractor shall procure all documents, apparatus and instruments, fuel, consumables, water, electricity, labour, Materials, samples, and qualified personnel as are necessary for examining and testing the Project Assets and workmanship in accordance with the Quality Assurance Plan.

11.2.4 The cost of testing of Construction, Materials and workmanship under this Article 11 shall be borne by the Contractor.

11.3. Methodology

The Contractor shall, at least 15 (fifteen) days prior to the commencement of the construction, submit to the Authority's Engineer for review the methodology proposed to be adopted for executing the Works, giving details of equipment to be deployed, traffic management and measures for ensuring safety. The Authority's Engineer shall complete the review and convey its comments to the Contractor within a period of 10 (ten) days from the date of receipt of the proposed methodology from the Contractor.

11.4. Inspection and technical audit by the Authority

The Authority or any representative authorised by the Authority in this behalf may inspectand review the progress and quality of the construction of Sewerage Project and issue appropriate directions to the Authority's Engineer and the Contractor for taking remedial action in the event the Works are not in accordance with the provisions of this Agreement.

11.5 External technical audit

At any time during construction, the Authority may appoint an external technical auditor to conduct an audit of the quality of the Works. The findings of the audit, to the extent accepted by the Authority, shall be notified to the Contractor and the Authority's Engineer for taking remedial action in accordance with this

Agreement. The Contractor shall provide all assistance as may be required by the auditor in the conduct of its audit hereunder. Notwithstanding anything contained in this Clause 11.5, the external technicalaudit shall not affect any obligations of the Contractor or the Authority's Engineer under this Agreement.

11.6 Inspection of construction records

The Authority shall have the right to inspect the records of the Contractor relating to the Works.

11.7 Monthly progress reports

During the Construction Period, the Contractor shall, no later than 10 (ten) days after the close of each month, furnish to the Authority and the Authority's Engineer a monthly report on progress of the Works and shall promptly give such other relevant information as may be required by the Authority's Engineer.

11.8 Inspection

11.8.1 The Authority's Engineer and its authorized representative shall at all reasonable times:

(a) have full access to all parts of the Site and to all places from which natural Materials are being obtained for use in the Works; and

(b) during production, manufacture and construction at the Site and at the place of production, be entitled to examine, inspect, measure and test the Materials and workmanship, and to check the progress of manufacture of Materials.

11.8.2 The Contractor shall give the Authority's Engineer and its authorized agents access, facilities and safety equipment for carrying out their obligations under this Agreement.

11.8.3 The Authority's Engineer shall submit a monthly inspection report (the "**Inspection Report**") to the Authority and the Contractor bringing out the resultsof inspections and the remedial action taken by the Contractor in respect of Defects or deficiencies. For the avoidance of doubt, such inspection or submission of Inspection Report by the Authority's Engineer shall not relieve or absolve the Contractor of its obligations and liabilities under this Agreement in any manner whatsoever.

11.9 Samples

The Contractor shall submit the following samples of Materials and relevant information to the Authority's Engineer for pre-construction review:

(a) manufacturer's test reports and standard samples of manufactured Materials; and

(b) samples of such other Materials as the Authority's Engineer may require.

11.10 Tests

11.10.1 For determining that the Works conform to the Specifications and Standards, the Authority's Engineer shall require the Contractor to carry out or cause to be carried out tests, at such time and frequency and in such manner as specified in this Agreement, and in accordance with Good Industry Practice for quality assurance. The test checks by the Authority's Engineer shall comprise at least 20 (twenty) percent of the quantity or number of tests prescribed for each category or type of test for quality control by the Contractor.

11.10.2 In the event that results of any tests conducted under this Clause 11.10 establish any Defects or deficiencies in the Works, the Contractor shall carry out remedial measures and furnish a report to the Authority's Engineer in this behalf. The Authority's Engineer shall require the Contractor to carry out or cause to be carried out tests to determine that such remedial measures have brought the Works into compliance with the Specifications and Standards, and the procedure shall be repeated until such Works conform to the Specifications and Standards. For the avoidance of doubt, the cost of such tests and remedial measures in pursuance thereof shall be solely borne by the Contractor.

11.11 Examination of work before covering up

In respect of the work which the Authority's Engineer is entitled to examine, inspect, measure and/or test before it is covered up or put out of view or any part of the work is placed thereon, the Contractor shall give notice to the Authority's Engineer whenever any such work is ready and before it is covered up. The Authority's Engineer shall then either carry out the examination, inspection or testing without unreasonable delay, or promptly give notice to the Contractor that the Authority's Engineer does not require to do so. Provided, however, that if any work is of a continuous nature where it is not possible or prudent to keep it uncovered or incomplete, the Contractor shall notify the schedule of carrying out such work to give sufficient opportunity, not being less than 3 (three) business days' notice, to the Authority's Engineer to conduct its inspection, measurement or test while the work is continuing. Provided further that in the event the Contractor receives no response from the Authority's Engineer within a period of 3 (three) business days from the date on which the Contractor's notice hereunder is delivered to the Authority's Engineer, the Contractor shall be entitled to assume that the Authority's Engineer would not undertake the said inspection.

11.12 Rejection

If, as a result of an examination, inspection, measurement or testing, any Plant, Materials, design or workmanship is found to be defective or otherwise not in accordance with the provisions of this Agreement, the Authority's Engineer shall reject the Plant, Materials, design or workmanship by giving notice to the Contractor, with reasons. The Contractor shall then promptly make good the Defect and ensure that the rejected item complies with the requirements of this Agreement.

If the Authority's Engineer requires the Plant, Materials, design or workmanship to be retested, the tests shall be repeated under the same terms and conditions, as applicable in each case. If the rejection and retesting cause the Authority to incur any additional costs, such cost shall be recoverable by the Authority from the Contractor; and may be deducted by the Authority from any monies due to be paidto the Contractor.

11.13 Remedial work

11.13.1 Notwithstanding any previous test or certification, the Authority's Engineer may instruct the Contractor to:

(a) remove from the Site and replace any Plant or Materials which are not in accordance with the provisions of this Agreement;

(b) remove and re-execute any work which is not in accordance with the provisions of this Agreement and the Specification and Standards; &

(c) execute any work which is urgently required for the safety of the Sewerage Project, whether because of an accident, unforeseeable event or otherwise; provided that in case of any work required on account of a Force Majeure Event, the provisions of Clause 21.6 shall apply.

11.13.2 If the Contractor fails to comply with the instructions issued by the Authority's Engineer under Clause 11.13.1, within the time specified in the Authority's Engineer's notice or as mutually agreed, the Authority's Engineer may advise the Authority to have the work executed by another agency. The cost so incurred by the Authority for undertaking such work shall, without prejudice to the rights of the Authority to recover damages in accordance with the provisions of this Agreement, be recoverable from the Contractor and may be deducted by the Authority from any monies due to be paid to the Contractor.

11.14 Delays during construction

Without prejudice to the provisions of Clause 10.3.2, in the event the Contractordoes not achieve any of the Project Milestones or the Authority's Engineer shall have reasonably determined that the rate of progress of Works is such that Completion of the Sewerage Project is not likely to be achieved by the end of the Scheduled Completion Date, it shall notify the same to the Contractor, and the Contractor shall, within 15 (fifteen) days of such notice, by a communication inform the Authority's Engineer in reasonable detail about the steps it proposes to take to expedite progress and the period within which it shall achieve the Project Completion Date.

11.15 Quality control records and Documents

The Contractor shall hand over to the Authority's Engineer a copy of all its quality control records and documents before the Completion Certificate is issued pursuant to Clause 12.2.

11.16 Video recording

During the Construction Period, the Contractor shall provide to the Authority for every calendar quarter, a video recording, which will be compiled into a 3 (three)- hour compact disc or digital video disc, as the case may be, covering the status and progress of Works in that quarter. The video recording shall be provided to the Authority no later than 15 (fifteen) days after the close of each quarter after the Appointed Date.

11.17 Suspension of unsafe Construction Works

11.17.1 Upon recommendation of the Authority's Engineer to this effect, the Authority may by notice require the Contractor to suspend forthwith the whole or any part of the Works if, in the reasonable opinion of the Authority's Engineer, such work threatens the safety of the Users.

11.17.2 The Contractor shall, pursuant to the notice under Clause 11.17.1, suspend the Works or any part thereof for such time and in such manner as may be specified by the Authority and thereupon carry out remedial measures to secure the safety of suspended works& the Users. The Contractor may by notice require the Authority's Engineer to inspect such remedial measures forthwith and make a report to the Authority recommending whether or not the suspension hereunder may be revoked. Upon receiving the recommendations of the Authority's Engineer, the Authority shall either revoke such suspension or instruct the Contractor to carry out such other and further remedial measures as may be necessary in the reasonable opinion of the Authority, and the procedure set forth in this Clause 11.17 shall be repeated until the suspension hereunder is revoked.

11.17.3 Subject to the provisions of Clause 21.6, all reasonable costs incurred for maintaining and protecting the Works or part thereof during the period of suspension (the "**Preservation Costs**"), shall be borne by the Contractor; provided that if the suspension has occurred as a result of any breach of this Agreement bythe Authority, the Preservation Costs shall be borne by the Authority.

11.17.4 If suspension of Works is for reasons not attributable to the Contractor, the Authority's Engineer shall determine any Time Extension to which the Contractoris reasonably entitled.

ARTICLE 12

COMPLETION CERTIFICATE

12.1 Tests on completion

12.1.1 At least 30 (thirty) days prior to the likely completion of the Sewerage Project, or a Section thereof, the Contractor shall notify the Authority's Engineer of its intent to subject the Sewerage Projector a Section thereof, to Tests. The date and time of each of the Tests shall be determined by the Authority's Engineer in consultation with the Contractor, and notified to the Authority who may designate its representative to witness the Tests. The Contractor shall either conduct the Tests as directed by the Authority's Engineer or provide such assistance as the Authority's Engineer may reasonably require for conducting the Tests. In the event of the Contractor and the Authority's Engineer failing to mutually agree on the dates for conducting the Tests, the Contractor shall fix the dates by giving not less than 10 (ten) days' notice to the Authority's Engineer.

12.1.2 All Tests shall be conducted in accordance with Schedule-K. The Authority's Engineer shall either conduct or observe, monitor and review the Tests conducted by the Contractor, as the case may be, and review the results of the Tests to determine compliance of the Sewerage Projector a Section thereof, with Specifications and Standards and if it is reasonably anticipated or determined by the Authority's Engineer during the course of any Test that the performance of the Sewerage Projector Section or any part thereof, does not meet the Specificationsand Standards, it shall have the right to suspend or delay such Test and require the Contractor to remedy and rectify the Defect or deficiencies. Upon completion of each Test, the Authority's Engineer shall provide to the Contractor and the Authority copies of all Test data including detailed Test results. For the avoidance of doubt, it is expressly agreed that the Authority's Engineer may require the Contractor to carry out or cause to be carried out additional Tests, in accordance with Good Industry Practice, for determining the compliance of the Sewerage Project or Section thereof with the Specifications and Standards.

12.2 Provisional Certificate

12.2.1 Subject to the provisions of Clause 12.2.5, upon completion of all Works forming part of the Sewerage Project, save and except the Works for which Time Extension has been granted under Clause 10.5, the Authority's Engineer shall, at the request of the Contractor, issue a provisional certificate of completion substantially in the form set forth in Schedule-L (the "**Provisional Certificate**") if the Tests for and in respect of the completed Works are successful. The Provisional Certificate shall have appended thereto a list of outstanding items of work (the "**Punch List**") that need to be completed in accordance with the provisions of this Agreement. The Contractor undertakes to complete the minor outstanding items of works in respectof those Sections of the Sewerage Project for which the Provisional Certificate has been issued, within a period of 30 (thirty) days of the date of Provisional Certificate, and those parts of the Works in respect of which Time Extension has been granted, within the extended period thereof. For the avoidance of doubt, the Parties agree that the Punch List shall include all Works for which Time Extension has been granted and shall also include any minor outstanding items of work forming part of the completed Sections if such works do not materially affect the use of the completed Sections for their intended purpose. The Parties further agree that Provisional Certificate shall not be issued if the completed Works cannot be safely and reliably placed in service of the Users thereof.

12.2.2 Upon issue of Provisional Certificate, the provisions of Articles 14 and 17 shall apply to the completed parts of the Sewerage Project and the property and ownership of all such completed Works shall vest in the Authority.

12.2.3 If the Authority's Engineer determines that the Sewerage Projector any completed part thereof does not conform to the provisions of this Agreement and cannot be safely and reliably placed in operation, it shall forthwith make a report in this behalf and send copies thereof to the Authority and the Contractor and withhold issuance of the Provisional Certificate until the Defects or deficiencies are rectified by the Contractor and Tests are successful in accordance with this Article 12.

12.2.4 Notwithstanding anything to the contrary contained in Clause 12.2.3, the Authority may, at any time after receiving a report from the Authority's Engineer under that Clause, direct the Authority's Engineer to issue a Provisional Certificate under Clause 12.2.1 and such direction shall be complied forthwith.

12.2.5 No Provisional Certificate shall be issued under the provisions of this Clause 12.2 until the Contractor has submitted valid claims for payment of at least 80% (eighty per cent) of the amount arrived at after reducing the lump sum price specified in Clause 19.1.1by the amount attributable to works which have been withdrawn under the provisions of Clause 8.3.3. For the avoidance of doubt and by way of illustration, the Parties agree that if the Contract Price specified in Clause 19.1.1 is **Rs.105 cr. (Rs. one hundred and five crore)** and the works withdrawn under Clause 8.3.3 have a value of **Rs.5 cr. (Rs. five crore),** a Provisional Certificate shall not be issued until valid claims for payment of an amount of **Rs.80 cr. (Rs. eighty crore)** have been submitted by the Contractor in accordance with the provisions of this Agreement. It is further agreed that all price adjustments made in pursuance of Clause 19.10 shall not be reckoned for computation of the claims for payments referred to in this Clause 12.2.5.

12.3 Completion of remaining Works

All items in the Punch List shall be completed by the Contractor in accordance with the provisions of this Agreement. For any delay in their completion other than for the reasons solely attributable to the Authority or due to Force Majeure, the Authority shall be entitled to recover Damages from the Contractor in accordance with the provisions of Clause 10.3.2 of this Agreement.

12.4 Completion Certificate

12.4.1 Upon completion of all Works, including the items specified in the Punch List, and the Authority's Engineer determining the Tests to be successful, it shall forthwith issue to the Contractor and the Authority a certificate substantially in the form set forth in Schedule-L (the "**Completion Certificate**").

12.4.2 Upon receiving the Completion Certificate, the Contractor shall remove its equipment, materials, debris and temporary works from the Site within a period of 30 (thirty) days thereof, failing which the Authority may remove or cause to be removed, such equipment, materials, debris and temporary works and recover from the Contractor an amount equal to 120% (one hundred and twenty per cent) of the actual cost of removal incurred by the Authority.

12.4.3 Without prejudice to the obligations of the Contractor specified in Articles 14 and 17, the property and ownership of all the completed Works forming part of the Sewerage Project shall vest in the Authority.

12.5 Rescheduling of Tests

If the Authority's Engineer certifies to the Authority and the Contractor that it is unable to issue the Completion Certificate or Provisional Certificate, as the case may be, because of events or circumstances on account of which the Tests could not be held or had to be suspended, the Contractor shall be entitled to re-schedule the Tests and hold the same as soon as reasonably practicable.

ARTICLE 13

CHANGE OF SCOPE

13.1 Change of Scope

13.1.1 The Authority may, notwithstanding anything to the contrary contained in this Agreement, require the Contractor to make modifications/alterations to the Works ("**Change of Scope**") before the issue of the Completion Certificate either by giving an instruction or by requesting the Contractor to submit a proposal for Change of Scope involving additional cost or reduction in cost. Any such Change of Scope shall be made and valued in accordance with the provisions of this Article 13.

13.1.2 Change of Scope shall mean:

(a) change in specifications of any item of Works;

(b) omission of any work from the Scope of the Project except under Clause 8.3.3; provided that, subject to Clause 13.5, the Authority shall not omit any work under this Clause in order to get it executed by any other authority; and / or

(c) any additional work, Plant, Materials or services which are not included inthe Scope of the Project, including any associated Tests on completion of construction.

13.1.3 If the Contractor determines at any time that a Change of Scope will, if adopted, (i) accelerate completion, (ii) reduce the cost to the Authority of executing, the Sewerage Project, (iii) improve the efficiency or value to the Authority of the completed Sewerage Project, or (iv) otherwise be of benefit to the Authority, it shall prepare a proposal with relevant details at its own cost. The Contractor shall submit such proposal, supported with the relevant details and the amount of reduction in the Contract Price to the Authority to consider such Change of Scope. The Authority shall, within 15 (fifteen) days of receipt of such proposal, either accept such Change of Scope with modifications, if any, and initiate proceedings thereof in accordance with this Article 13 or reject the proposal and inform the Contractor of its decision. For the avoidance of doubt, the Parties agree that the Contractor shall not undertake any Change of Scope without the express consent of the Authority, save and except any Works necessary for meeting any Emergency.

13.2 Procedure for Change of Scope

13.2.1 In the event of the Authority determining that a Change of Scope is necessary, it may direct the Authority's Engineer to issue to the Contractor a notice specifyingin reasonable detail the works and services contemplated there under (the "**Change of Scope Notice**").

13.2.2 Upon receipt of a Change of Scope Notice, the Contractor shall, with due diligence, provide to the Authority and the Authority's Engineer such information as is necessary, together with preliminary documentation in support of:

(a) the impact, if any, which the Change of Scope is likely to have on the Project Completion Schedule if the works or services are required to be carried out during the Construction Period; and

(b) the options for implementing the proposed Change of Scope and the effect, if any, each such option would have on the costs and time thereof, including the following details:

(i) breakd own of the quantities, unit rates and cost for different items of work;

(ii) proposed design for the Change of Scope; and

(iii) proposed modifications, if any, to the Project Completion Schedule of the Sewerage Project.

For the avoidance of doubt, the Parties expressly agree that, subject to the provisions of Clause 13.4.2, the Contract Price shall be increased or decreased, as the case may be, on account of Change of Scope.

13.2.3 The Contractor's quotation of costs for the Change of Scope shall be determined on the following principles:

(a) For works where Schedule of Rates (SOR) for concerned area of State's Public Works / P.H. Department are available shall be applicable for determination of costs. In case of non-availability of current SOR, the available Schedule of Rates shall be applied by updating the same based on WPI.

(b) For works not similar in nature to the Works being executed, the cost ofwork shall be derived on the basis of CPWD analysis of rates Standard Data Book and the applicable schedule of rates for the relevant circle, as published by the State Government, and such rates shall be indexed with reference to the WPI once every year, with the base being the month andyear of the publication of the said schedule of rates; provided, however, that for any item not included in the schedule of rates, the prevailing market rates as determined by the Authority's Engineer shall apply, and for any item in respect of which CPWD analysis of rate does not provide the requisite details, the Authority's Engineer shall determine the rate in accordance with Good Industry Practice.

13.2.4 Upon reaching an agreement, the Authority shall issue an order (the "**Change of Scope Order**") requiring the Contractor to proceed with the performance thereof. In the event that the Parties are unable to agree, the Authority may:

(a) issue a Change of Scope Order requiring the Contractor to proceed with the performance thereof at the rates and conditions approved by the Authority till the matter is resolved in accordance with Article 26; or

(b) proceed in accordance with Clause 13.5.

13.2.5 The provisions of this Agreement, insofar as they relate to Works and Tests, shall apply *mutatis mutandis* to the works undertaken by the Contractor under this Article 13.

13.3 Payment for Change of Scope

Payment for Change of Scope shall be made in accordance with the payment schedule specified in the Change of Scope Order.

13.4 Restrictions on Change of Scope

13.4.1 No Change of Scope shall be executed unless the Authority has issued the Change of Scope Order save and except any Works necessary for meeting any Emergency.

13.4.2 Unless the Parties mutually agree to the contrary, the total value of all Change of Scope Orders **shall not exceed 10 (ten) per cent** of the Contract Price.

13.4.3 Notwithstanding anything to the contrary in this Article 13, no change made necessary because of any default of the Contractor in the performance of its obligations under this Agreement shall be deemed to be Change of Scope, and shall not result in any adjustment of the Contract Price or the Project Completion Schedule.

13.5 Power of the Authority to undertake works

13.5.1 In the event the Parties are unable to agree to the proposed Change of Scope Orders in accordance with Clause 13.2, the Authority may, after giving notice to the Contractor and considering its reply thereto, award such works or services to any person on the basis of open competitive bidding from amongst bidders who are pre-qualified for undertaking the additional work; provided that the Contractor shall have the option of matching the first ranked bid in terms of the selection criteria, subject to payment of 2% (two per cent) of the bid amount to the Authority[$], and thereupon securing the award of such works or services. For the avoidance of doubt, it is agreed that the Contractor shall be entitled to exercise such option only if it has participated in the bidding process and its bid does not exceed the first ranked bid

[$] The Authority shall transfer 75% (seventy five percent) of the amount so received to the first ranked bidder whose bid shall have been matched by the Contractor.

by more than 10% (ten percent) thereof. It is also agreed that the Contractor shall provide assistance and cooperation to the person who undertakes the works or services hereunder, but shall not be responsible for rectification of any Defects and/ or operation &maintenance of works carried out by other agencies.

13.5.2 The works undertaken in accordance with this Clause 13.5 shall conform to the Specifications and Standards and shall be carried out in a manner that minimises the disruption in operation of the Sewerage Project. The provisions of this Agreement, insofar as they relate to Works and Tests, shall apply *mutatis mutandis*to the works carried out under this Clause 13.5.

ARTICLE 14
OPERATION &MAINTENANCE

14.1 Operation &Maintenance obligations of the Contractor

14.1.1 The Contractor shall operate & maintain the infrastructure developed by him under the Sewerage Project for a period of 5 (five) years] commencing from the date of issue of theProvisional Certificate (the "**Operation &Maintenance Period**"). The Energy charges shall be paid by the department directly to the concerned Electrical Authority. The energy consumption shall be assessed by the bidder basing on **energy efficient design** of the electro-mechanical equipment (those are covered under the scope of work) at **Waste Water pumping stations and Manhole pumping stations. etc.** The bidder shall **offer towards** yearly energy consumption considering the rated capacity of electromechanical equipment @ **Rs.7.00/KWH in the online BoQ**. **From the offered price WATCO shall derive the assured energy consumption in the KWH unit during financial bid evaluation**. The energy consumption charges for each month will be directly paid by the department up to the consumption units as assessed by the contractor, beyond which the cost of energy consumption shall be borne by the contractor and the excess amount will be deducted from the bill of the contractor for payment to the Electrical Authority. The price for manpower & materials for the respective years of the O&M period quoted by the bidder shall correspond to the Present Value (PV) which shall be adjusted as per the price adjustment clause mentioned in the contract document (Clause No. 19.12)

For the avoidance of doubt, it is agreed that in the event no Provisional Certificate is issued, the Operation & Maintenance Period shall commence from the date of the Completion Certificate.

Note-1: The detailed calculation towards Operation & Maintenance cost of the project to be executed by the Agency is provided at Annex-III of Schedule-E for reference and guidance only.

14.1.2 During the Operation &Maintenance Period, the Authority shall provide to the Contractoraccess to the Site for Operation &Maintenance in accordance with this Agreement. The obligations of the Contractor hereunder shall include but not limited to the following: -

(a) permitting safe &smooth functioning of Sewerage Project;
(b) undertaking routine maintenance including prompt repairs of Civil, Electrical &Mechanical installations including pipe lines;
(c) undertaking repairs to structures;
(d) informing the Authority of any un authorized use of the Sewerage Project;
(e) informing the Authority of any encroachments on the Sewerage Project; and
(f) operation and maintenance of all collection and conveyance systems necessary forthe efficient operation & maintenance of the Sewerage Project in accordance withthe provisions of this Agreement.

14.1.3 In respect of any Defect or deficiency not specified in Schedule-E, the Contractor shall, atits own cost, undertake repair or rectification in accordance with Good Industry Practice, save and except to the extent that such Defect or deficiency shall have arisen on account ofany default or neglect of the Authority or a Force Majeure Event.

14.1.4 The Contractor shall remove promptly from the Sewerage Project any waste materials (including hazardous materials and waste water), rubbish and other

debris (including without limitation, accident debris) and keep the Sewerage Project in a clean, tidy and orderly condition, and in conformity with the Applicable Laws, Applicable Permits and Good Industry Practice.

14.2 Operation &Maintenance Requirements

The Contractor shall ensure and procure that at all times during the Operation &Maintenance Period, the Sewerage Project conforms to the operation &maintenance requirements set forth in Schedule-E (the "**Operation &Maintenance Requirements**").

14.3 Operation &Maintenance Programme

14.3.1 The Contractor shall prepare a monthly operation &maintenance programme (the **Operation &Maintenance Programme**") in consultation with the Authority and submit the same to the Authority not later than 10 (ten) days prior to the commencement of the month in which the Operation &Maintenance is to be carried out. For this purpose, a joint monthly inspection by the Contractor and the Authority shall be undertaken. The Operation &Maintenance Programme shall contain the following:

(a) The condition of the Civil, Electrical & Mechanical installations including pipeline in the format prescribed by the Authority,
(b) the proposed operation &maintenance works; and
(c) deployment of resources for operation &maintenance works.

14.4 Safety, vehicle breakdowns and accidents

14.4.1 Deleted

14.4.2 Deleted

14.5 Zone closure

14.5.1 The Contractor shall not close any Zone of the Sewerage Project for undertaking operation &maintenance works except with the prior written approval of the Authority. Such approval shall be sought by the Contractor through a written request to be made at least 10(ten) days before the proposed closure of Zone and shall be accompanied by particulars thereof. Within 5 (five) business days of receiving such request, the Authority shall grant permission with such modifications as it may deem necessary.

14.5.2 Upon receiving the permission pursuant to Clause 14.5.1, the Contractor shall be entitled toclose the designated Zone for the period specified therein, and in the event of any delay inre-opening such Zone, the Contractor shall, for every stretch of 250 (two hundred and fifty) metres, or part thereof, pay Damages to the Authority calculated at the rate of 0.1% (zero point one per cent) of the monthly operation &maintenance payment for each day ofdelay until the Zone has been re-opened for Water Supply.

14.6 Reduction of payment for non-performance of Operation &Maintenance obligations

14.6.1 In the event that the Contractor fails to repair or rectify any Defect or deficiency set forth inSchedule-E within the period specified therein, it shall be deemed as failure of performance of Operation &Maintenance obligations by the Contractor and the Authorityshall be entitled to effect reduction in monthly lump sum payment for operation &maintenance in accordance with Clause 19.7 and Schedule-M, without prejudice to the rights of the Authority under this Agreement, including Termination thereof.

14.6.2 If the nature and extent of any Defect justifies more time for its repair or rectification than the time specified in Schedule-E, the Contractor shall be entitled to additional time in conformity with Good Industry Practice. Such additional time shall be determined by the Authority and conveyed to the Contractor.

14.7 Authority's right to take remedial measures

In the event the Contractor does not maintain and/or repair the Sewerage Projector any part thereof in conformity with the Operation &Maintenance Requirements, the Operation &Maintenance Manual or the Operation &Maintenance Programme, as the case may be, and fails to commence remedial works within 15 (fifteen) days of receipt of the Operation&Maintenance Inspection Report under Clause 15.2 or a notice in this behalf from the Authority, the Authority shall, without prejudice to its rights under this Agreement including Termination thereof, be entitled to undertake such remedial measures at the costof the Contractor, and to recover its cost from the Contractor. In addition to recovery of the aforesaid cost, a sum equal to 20% (twenty per cent) of such cost shall be paid by the Contractor to the Authority as Damages.

14.8 Restoration of loss or damage to Sewerage Project

Save and except as otherwise expressly provided in this Agreement, in the event that the Sewerage Project or any part thereof suffers any loss or damage during the Operation &Maintenance from any cause attributable to the Contractor, the Contractor shall, at its cost and expense, rectify and remedy such loss or damage forthwith so that the Sewerage Project conforms to the provisions of this Agreement.

14.9 Overriding powers of the Authority

14.9.1 If in the reasonable opinion of the Authority, the Contractor is in material breach of its obligations under this Agreement and, in particular, the Operation &Maintenance Requirements, and such breach is causing or likely to cause material hardship or danger to the Users and pedestrians, the Authority may, without prejudice to any of its rights under this Agreement including Termination thereof, by notice require the Contractor to take reasonable measures immediately for rectifying or removing such hardship or danger, as the case may be.

14.9.2 In the event that the Contractor, upon notice under Clause 14.9.1, fails to rectify or remove any hardship or danger within a reasonable period, the Authority may exercise overridingpowers under this Clause 14.9.2 and take over the performance of any or all the obligations of the Contractor to the extent deemed necessary by it for rectifying or removing such hardship or danger; provided that the exercise of such overriding powers bythe Authority shall be of no greater scope and of no longer duration than is reasonably required hereunder; provided further that any costs and expenses incurred by the Authority in discharge of its obligations hereunder shall be recovered by the Authority from the Contractor, and the Authority shall be entitled to deduct any such costs and expenses incurred from the payments due to the Contractor under Clause 19.7 for the performance of its Operation &Maintenance obligations.

14.9.3 In the event of a national emergency, civil commotion or any other circumstances specifiedin Clause 21.3, the Authority may take over the performance of any or all the obligations of the Contractor to the extent deemed necessary by it, and exercise such control over the Sewerage Project or give such directions to the Contractor as may be deemed necessary; provided that the exercise of such overriding powers by the Authority shall be of no greater scope and of no longer duration than is

reasonably required in the circumstances which caused the exercise of such overriding power by the Authority. For the avoidance ofdoubt, it is agreed that the consequences of such action shall be dealt in accordance with the provisions of Article 21. It is also agreed that the Contractor shall comply with such instructions as the Authority may issue in pursuance of the provisions of this Clause 14.9.3, and shall provide assistance and cooperation to the Authority, on a best effort basis, for performance of its obligations hereunder.

ARTICLE 15

SUPERVISION AND MONITORING DURING OPERATION &MAINTENANCE

15.1 Inspection by the Contractor

15.1.1 The Authority shall undertake regular inspections to evaluate continuously the compliance with the Operation & Maintenance Requirements.

15.1.2 The Contractor shall carry out a detailed inspection of all structures &Sewerage System in accordance with the guidelines contained in Manual on O&M of Sewerage Systems published by CPHEEO. Report of this inspection together with details of proposed operation & maintenance works as required shall be conveyed to the Authority forthwith. The Contractor shall complete the proposed operation & maintenance works and send a compliance report to the Authority.

15.2 Inspection and payments

15.2.1 The Authority may inspect the Sewerage Project at any time, but at least once in every month, to ensure compliance with the Operation & Maintenance Requirements. It shall make a report of such inspection (**"Operation & Maintenance Inspection Report"**) stating in reasonable detail the Defects or deficiencies, if any, with particular reference to the Operation & Maintenance Requirements, the Operation & Maintenance Manual, and the Operation & Maintenance Programme and send a copy thereof to the Contractor within 10 (ten) days of such inspection.

15.2.2 After the Contractor submits to the Authority the Monthly Operation & Maintenance Statement for the Sewerage Project pursuant to Clause 19.6, the Authority shall carry out an inspection within 10 (ten) days to certify the amount payable to the Contractor. The Authority shall inform the Contractor of its intention to carry out the inspection at least 3 (three) business days in advance of such inspection. The Contractor shall assist the Authority in verifying compliance with the Operation & Maintenance Requirements.

15.2.3 For each case of non-compliance of Operation & Maintenance Requirements as specified in the inspection report of the Authority, the Authority shall calculate the amount of reduction in payment in accordance with the formula specified in Schedule-M.

15.2.4 Any deduction made on account of non-compliance will not be paid subsequently even after establishing the compliance thereof. Such deduction will continue to be made every month until the compliance is procured.

15.3 Tests

For determining that the Sewerage Project conforms to the Operation & Maintenance Requirements, the Authority shall require the Contractor to carry out, or cause to be carried out, tests specified by it in accordance with CPHEEO Manual/ Good Industry Practice and Pollution Control Board norms . The Contractor shall, with due diligence, carry out or cause to be carried out all such tests in accordance with the instructions of theAuthority and furnish the results of such tests forthwith to the Authority.

15.4 Reports of unusual occurrence

The Contractor shall, during the Operation & Maintenance Period, prior to the close of each day, send to the Authority by facsimile or e-mail, a report stating unusual occurrences on the Sewerage Project relating to the safety and security of the Users. A monthly summary of such reports shall also be sent within 3 (three) business days of the closing of month.

ARTICLE 16
TRAFFIC REGULATION

16.1 Traffic regulation by the Contractor

16.1.1 The Contractor shall take all the required measures and make arrangements for the safety of Users during the construction of the Sewerage Project or a Section thereof in accordance with the relevant provisions. It shall provide, erect and maintain all such barricades, signs, markings, flags, and lights as may be required by Good Industry Practice for the safety of the traffic passing through the Section under construction.

16.1.2 All works shall be carried out in a manner creating least interference to traffic passing through the Sewerage Projector a Section thereof. In stretches where construction works are taken up, the Contractor shall ensure that proper passage is provided for the traffic. Where it is not possible or safe to allow traffic on part width of the carriageway, a temporary diversion of proper specifications shall be constructed by the Contractor at its own cost. The Contractor shall take prior approval of the Authority's Engineer for any proposed arrangement for traffic regulation during Construction and Operation & Maintenance, which approval shall not be unreasonably withheld.

ARTICLE 17

DEFECTS LIABILITY

17.1 Defects Liability Period

17.1.1 The Contractor shall be responsible for all the Defects and deficiencies, except usual wear and tear in the Sewerage Projector any Section thereof, till the expiry ofa period of **2 (Two)** years commencing from the date of Provisional Certificate (the "**Defects Liability Period**"). Provided that the Defects Liability Period shall in no case be less than **24 (Twenty-four) months** from the date of Completion Certificate for andin respect of works for which Time Extension was granted. Provided further that in the event no Provisional Certificate is issued, the Defects Liability Period shall commence from the date of the Completion Certificate. For the avoidance of doubt, any repairs or restoration on account of usual wear or tear in the Sewerage Project or any Section thereof shall form a part of the **Operation & Maintenance** obligations of the Contractor as specified in Article 14.

17.1.2 Deleted.

17.2 Remedying Defects

The Contractor shall repair or rectify all Defects and deficiencies observed by the Authority's Engineer during the Defects Liability Period within a period of 15 (fifteen) days from the date of notice issued by the Authority's Engineer in this behalf, or within such reasonable period as may be determined by the Authority's Engineer at the request of the Contractor, in accordance with Good Industry Practice.

17.3 Cost of remedying Defects

For the avoidance of doubt, any repair or rectification undertaken in accordance with the provisions of Clause 17.2, including any additional testing, shall be carried out by the Contractor at its own risk and cost, to the extent that such rectification or repair is attributable to:

(a) the design of the Project;

(b) Plant, Materials or workmanship not being in accordance with thisAgreement and the Specifications and Standards;

(c) improper operation &maintenance during construction of the Sewerage Project by the Contractor; and/ or

(d) failure by the Contractor to comply with any other obligation under this Agreement.

17.4 Contractor's failure to rectify Defects

In the event that the Contractor fails to repair or rectify such Defect or deficiency within the period specified in Clause 17.2, the Authority shall be entitled to get the same repaired, rectified or remedied at the Contractor's cost so as to make the Sewerage Project conform to the Specifications and Standards and the provisions of this Agreement. All costs consequent thereon shall, after due consultation with the Authority and the Contractor, be determined by the Authority's Engineer. The costso determined and an amount equal to twenty percent of the cost as Damages shall be recoverable by the Authority from the Contractor and may be deducted by the Authority from any monies due to the Contractor.

17.5 Contractor to search cause

17.5.1 The Authority's Engineer may instruct the Contractor to examine the cause of any Defect in the Works or part thereof before the expiry of the Defects Liability Period.

17.5.2 In the event any Defect identified under Clause 17.5.1 is attributable to the Contractor, the Contractor shall rectify such Defect within the period specified by the Authority's Engineer, and shall bear the cost of the examination and rectification of such Defect.

17.5.3 In the event such Defect is not attributable to the Contractor, the Authority's Engineer shall, after due consultation with the Authority and the Contractor, determine the costs incurred by the Contractor on such examination and notify the same to the Contractor, with a copy to the Authority, and the Contractor shall be entitled to payment of such costs by the Authority.

17.6. Extension of Defects Liability Period

The Defects Liability Period shall be deemed to be extended till the identified Defects under Clause 17.2 have been remedied.

ARTICLE 18

AUTHORITY'S ENGINEER

18.1 Appointment of the Authority's Engineer

18.1.1 The Authority shall appoint a consulting engineering firm substantially in accordance with the selection criteria set forth in Schedule-N, to be the engineer under this Agreement (the "**Authority's Engineer**").

18.1.2 The appointment of the Authority's Engineer shall be made no later than 15 (fifteen) days from the date of this Agreement. The Authority shall notify the appointment or replacement of the Authority's Engineer to the Contractor.

18.1.3 The staff of the Authority's Engineer shall include suitably qualified engineers and other professionals who are competent to assist the Authority's Engineer to carry out its duties.

18.2 Duties and authority of the Authority's Engineer

18.2.1 The Authority's Engineer shall perform the duties and exercise the authority in accordance with the provisions of this Agreement, and substantially in accordance with the terms of reference ("**Terms of Reference" or "TOR")** set forth in Annex 1of Schedule N, but subject to obtaining prior written approval of the Authority before determining:

(a) any Time Extension;
(b) any additional cost to be paid by the Authority to the Contractor;
(c) the Termination Payment; or
(d) any other matter which is not specified in (a), (b) or (c) above and which creates an obligation or liability on either Party for a sum exceeding Rs.50,00,000 (Rupees fifty lakh).

18.2.2 No decision or communication of the Authority's Engineer shall be effective or valid unless it is accompanied by an attested true copy of the approval of the Authority for and in respect of any matter specified in Clause 18.2.1.

18.2.3 The Authority's Engineer shall submit regular periodic reports, at least once every month, to the Authority in respect of its duties and functions under this Agreement. Such reports shall be submitted by the Authority's Engineer within 10 (ten) days of the beginning of every month. For the avoidance of doubt, the Authority's Engineer shall include in its report, compliance of the recommendations of the Safety Consultant.

18.3 Delegation by the Authority's Engineer

18.3.1 The Authority's Engineer may, by order in writing, delegate any of his duties and responsibilities to suitably qualified and experienced personnel who are accountable to Authority's Engineer, or may revoke any such delegation, under intimation to the Authority and the Contractor. Provided, however, that the Authority's Engineer shall be responsible and liable for all actions and omissions of such personnel.

18.3.2 Any failure of the Authority's Engineer to disapprove any work, Plant or Materials shall not constitute approval, and shall therefore not prejudice the right of the Authority to reject the work, Plant or Materials, which is not in accordance with the provisions of this Agreement and the Specifications and Standards.

18.3.3 Notwithstanding anything stated in Clause 18.3.1 above, the Authority's Engineer shall not delegate the authority to refer any matter for the Authority's prior approval wherever required in accordance with the provisions of Clause 18.2.

18.4 Instructions of the Authority's Engineer

18.4.1 The Authority's Engineer may issue to the Contractor instructions for remedying any Defect. The Contractor shall take such instructions from the Authority's Engineer, or from an assistant to whom appropriate authority has been delegated under Clause 18.3.

18.4.2 The instructions issued by the Authority's Engineer shall be in writing. However, if the Authority's Engineer issues any oral instructions to the Contractor, it shall confirm in writing the oral instructions within 2 (two) working days of issuing them.

18.4.3 In case the Contractor does not receive the confirmation of the oral instruction within the time specified in Clause 18.4.2, the Contractor shall seek the written confirmation of the oral instructions from the Authority's Engineer. The Contractor shall obtain acknowledgement from the Authority's Engineer of the communication seeking written confirmation. In case of failure of the Authority's Engineer or its delegated assistant to reply to the Contractor within 2 (two) days of the receipt of the communication from the Contractor, the Contractor may not carry out the instruction.

18.4.4 In case of any dispute on any of the instructions issued by the delegated assistant, the Contractor may refer the dispute to the Authority's Engineer, who shall then confirm, reverse or vary the instructions within [3 (three)] business days of the dispute being referred.

18.5 Determination by the Authority's Engineer

18.5.1 The Authority's Engineer shall consult with each Party in an endeavour to reach agreement wherever this Agreement provides for the determination of any matter by the Authority's Engineer. If such agreement is not achieved, the Authority's Engineer shall make a fair determination in accordance with this Agreement having due regard to all relevant circumstances. The Authority's Engineer shall give notice to both the Parties of each agreement or determination, with supporting particulars.

18.5.2 Each Party shall give effect to each agreement or determination made by the Authority's Engineer in accordance with the provisions of this Agreement. Provided, however, that if any Party disputes any instruction, decision, direction or determination of the Authority's Engineer, the Dispute shall be resolved in accordance with the Dispute Resolution Procedure.

18.6 Remuneration of the Authority's Engineer

The remuneration, cost and expenses of the Authority's Engineer shall be paid by the Authority.

18.7 Termination of the Authority's Engineer

18.7.1 The Authority may, in its discretion, replace the Authority's Engineer at any time, but only after appointment of another Authority's Engineer in accordance with Clause 18.1.

18.7.2 If the Contractor has reasons to believe that the Authority's Engineer is not discharging its duties and functions in accordance with the provisions of this Agreement, it may make a written representation to the Authority and seek termination of the appointment of the Authority's Engineer. Upon receipt of such representation, the Authority shall hold a tripartite meeting with the Contractor and Authority's Engineer and make best efforts for an amicable resolution of the representation. In the event that the appointment of the Authority's Engineer is terminated hereunder, the Authority shall appoint forthwith another Authority's Engineer in accordance with Clause 18.1.

Part IV
Financial Covenants

ARTICLE 19

PAYMENTS

19.1 Contract Price

19.1.1 The Authority shall make payments to the Contractor for the Works on the basis of the lump sum price accepted by the Authority in consideration of the obligations specified in this Agreement for an amount of Rs. … … … … (Rs. … … … … … … … … …) (the "**Contract Price**"), which shall be subject to adjustments in accordance with the provisions of this Agreement. For the avoidance of doubt, the Parties expressly agree that the Contract Price shall not include the cost of Operation &Maintenance which shall be paid separately in accordance with the provisions of Clause 19.7. The Parties further agree that save and except as provided in this Agreement, the Contract Price shall be valid and effective until issue of Completion Certificate.

19.1.2 (a) **The Contract Price shall be excluding of GST which will be paid as applicable**

(b) The Contract Price includes all duties, taxes, royalty, and fees that may be levied in accordance with the laws and regulations in force as on the Base Date on the Contractor's equipment, Plant, Materials and supplies acquired for the purpose of this Agreement and on the services performed under this Agreement. Nothing in this Agreement shall relieve the Contractor from its responsibility to pay any tax including any tax that may be levied in India on profits made by it in respect of this Agreement. Statutory deduction of taxes as applicable & royalty shall be made from each bill at the time of payment.

(c) The Building & Other Construction Workers Welfare Cess Act 1996: In accordance with the provisions under the said Act 1% (One percent) of the approved agreement value will be deducted from the R/A Bill at the time of making payment to the contractor and such amount shall be remitted in favourof **The Odisha Building & Other Construction Workers Welfare Board.**

19.1.3 The Contract Price shall not be adjusted for any change in costs stated in Clause 19.1.2 above, except as stated in Clauses 19.10 and 19.17.

19.1.4 The Contract Price shall not be adjusted to take account of any unforeseen difficulties or costs, unless otherwise provided for in this Agreement.

19.1.5 Unless otherwise stated in this Agreement, the Contract Price covers all the Contractor's obligations for the Works under this Agreement and all things necessary for the Construction and the remedying of any Defects in the Sewerage Project.

19.1.6 All payments under this Agreement shall be made in Indian Rupees.

19.2 Advance Payment

19.2.1 The Authority shall make an interest-bearing advance payment **@10% per Annum** (the **"Advance Payment"**), equal in amount to 10 (ten) percent of the Contract Price, **for construction work** for mobilization expenses and for acquisition of equipment. The Advance Payment shall be made in four installments. The first installment shall be an amount equal to **2%** (two percent) of the Contract Price **for construction work**, the second installment shall be equal to 3% (three percent) of the Contract Price **for construction work**, the third installment shall be equal to 3% (three percent) of the Contract Price and the fourth installment shall be equal to 2% (two percent) of the Contract Price **for construction work**.

19.2.2 The Contractor may apply to the Authority for the first installment of Advance Payment at any time after the Appointed Date, along with an irrevocable and unconditional guarantee from a Nationalised Bank, counter guaranteed by its branch at Bhubaneswar for an amount equivalent to 110% (one hundred and ten per cent) of such installment, substantially in the form provided at **Annex-III of Schedule-G**, to remain effective till the complete and full repayment thereof. At any time after 30 (thirty) days from the Appointed Date, the Contractor may apply for the second

instalment of the Advance Payment along with an irrevocable and unconditional guarantee from a Nationalized Bank, counter guaranteed by its branch at Bhubaneswar for an amount equivalent to 110% (one hundred and ten per cent) of such instalment, substantially in the form provided at Annex-III of Schedule-G, to remain effective till the complete and full repayment thereof.

19.2.3 At any time, after 60 (sixty) days from the Appointed Date, the Contractor may apply to the Authority for the third instalment of the Advance Payment along withan irrevocable and unconditional guarantee from a Nationalized Bank, counter guaranteed by its branch at Bhubaneswar Bank for an amount equivalent to 110% (one hundred and ten per cent) of such instalment, substantially in the form provided at Annex-III of Schedule-G, to remain effective till the complete and full repayment thereof.

19.2.3.1 At any time, after 90 (Ninety) days from the Appointed Date on verification of acquisition of required materials and equipment by Project Director of concerned Project Management Circle, the Contractor may apply to the Authority for the fourth installment of the Advance Payment along with an irrevocable and unconditional guarantee from a Nationalized Bank, counter guaranteed by its branch at Bhubaneswar for an amount equivalent to 110% (one hundred and ten per cent) of such installment, substantially in the form provided at Annex-III of Schedule-G, to remain effective till the complete and full repayment thereof

19.2.4 The first, second, third and the fourth instalments shall be paid by the Authority to the Contractor within 15 (fifteen) days of the receipt of its respective requests in accordance with the provisions of this Clause 19.2.

19.2.5 Each instalment of Advance Payment shall be repaid by the Contractor to the **Authority no later than 365 (three hundred and sixty-five) days** from the respective date of Advance Payment.

19.2.6 The Contractor shall repay each instalment of the Advance Payment on or before the due date of repayment. In the event of the Contractor's failure to make the repayment on time, the Authority shall be entitled to encash the Bank guarantee for Advance Payment. The Parties expressly agree that for any delay in repayment of the Advance Payment, the Contractor shall pay interest to the Authority for each dayof delay, such interest to be calculated at the rate of **18% (eighteen per cent) per annum.**

19.2.7 If the Advance Payment has not been fully repaid prior to Termination under Clause 21.7 or Article 23, as the case may be, the whole of the balance then outstanding shall immediately become due and payable by the Contractor to the Authority. Without prejudice to the provisions of Clause 19.2.7, in the event of Termination for Contractor Default, the Advance Payment shall be deemed to carry interest at the rate of 10% (ten per cent) per annum from the date of Advance Payment to the dateof recovery by encashment of the Bank Guarantee for the Advance Payment. For the avoidance of doubt, the aforesaid interest shall be payable on each instalment of the Advance Payment, regardless of whether the instalment or any part thereof has been repaid to the Authority prior to Termination.

19.3 Procedure for estimating the payment for the Works

19.3.1 The Authority shall make interim payments to the Contractor as certified by the Authority's Engineer on completion of a stage, in a length, number or areas specified and valued in accordance with the proportion of the Contract Price assigned to each item and its stage in Schedule-H.

19.3.2 The Contractor shall base its claim for interim payment for the stages completed till the end of the month for which the payment is claimed, valued in accordance with Clause 19.3.1, supported with necessary particulars and documents in accordance with this Agreement. Any reduction in the Contract Price arising out of Change of Scope or the works withdrawn under Clause 8.3 shall not affect the amounts payable for the items or stage payments thereof which are not affected by such Change of Scope or withdrawal. For avoidance

of doubt and by way of illustration, the Parties agree that if the amount assigned to Major structures is reduced owing to Change of Scope or withdrawal of work, the reduction in payment shall be restricted to relevant payments for Major structures only and the payment due in respect of all other stage payments shall not be affected in any manner. The Parties further agree that the adjustments arising out of the aforesaid modifications shall be carried out in a manner that the impact of such modifications is restricted to the said Change of Scope or withdrawal, as the case may be, and does not alter the payments due forand in respect of items or stage payments which do not form part of such Change of Scope or withdrawal.

19.4 Stage Payment Statement for Works

The Contractor shall submit a statement (the **"Stage Payment Statement")**, in 3 copies, by the 7th(seventh) day of the month to the Authority's Engineer in the form set forth in Schedule-O, showing the amount calculated in accordance with Clause 14019.3 to which the Contractor considers himself entitled for completed stage(s) of the Works. The Stage Payment Statement shall be accompanied with the progress reports and any other supporting documents. The Contractor shall not submit any claim for payment of incomplete stages of work.

19.5 Stage Payment for Works

19.5.1 Within 10 (ten) days of receipt of the Stage Payment Statement from the Contractor pursuant to Clause 19.4, the Authority's Engineer shall broadly determine the amount due to the Contractor and recommend the release of 90 (ninety) percent of the amount so determined as part payment against the Stage Payment Statement, pending issue of the Interim Payment Certificate by the Authority's Engineer. Within 10 (ten) days of the receipt of recommendation of the Authority's Engineer, the Authority shall make electronic payment directly to the Contractor's bank account.

19.5.2 Within 15 (fifteen) days of the receipt of the Stage Payment Statement referred to in Clause 19.4, the Authority's Engineer shall determine and shall deliver to the Authority and the Contractor an IPC certifying the amount due and payable to the Contractor, after adjusting the payments already released to the Contractor against the said statement. For the avoidance of doubt, the Parties agree that the IPC shall specify all the amounts that have been deducted from the Stage Payment Statement and the reasons there for.

19.5.3 In cases where there is a difference of opinion as to the value of any stage, the Authority's Engineer's view shall prevail and interim payments shall be made to the Contractor on this basis; provided that the foregoing shall be without prejudice to the Contractor's right to raise a Dispute.

19.5.4 The Authority's Engineer may, for reasons to be recorded, withhold from payment:

(a) the estimated value of work or obligation that the Contractor has failed to perform in accordance with this Agreement and the Authority's Engineer had notified the Contractor; and

(b) the estimated cost of rectification of work done being not in accordance with this Agreement.

19.5.5 Payment by the Authority shall not be deemed to indicate the Authority's acceptance, approval, consent or satisfaction with the work done.

19.6 Monthly Operation &Maintenance Statement of the Sewerage Project

19.6.1 The Contractor shall submit to the Authority a monthly operation & maintenance statement ("**Monthly Operation &Maintenance Statement")/claim** in 3 (three) copies bythe 7th (seventh) day of each month in the format set forth in Schedule-O for the Operation& Maintenance of the Sewerage Project during the previous month.

19.6.2 The monthly lump sum amount payable for Operation &Maintenance shall be 1/12th (one- twelfth) of the annual cost of Operation &Maintenance as specified in Clause 14.1.1.

19.7 Payment for Operation &Maintenance of the Sewerage Project

19.7.1 Within 15 (fifteen) days of receipt of the Monthly Operation & Maintenance Statement/claim from the Contractor pursuant to Clause 19.6, the Authority shall verify theContractor's monthly operation & maintenance statement and certify the amount to be paidto the Contractor taking into account:

(a) Compliance with the Operation & Maintenance Requirements; and

(b) reduction for non-compliance with the Operation & Maintenance Requirement in accordance with Clause 19.7.2.

The Authority shall approve or amend the monthly operation & maintenance statement/claim to reflect the amount due to the Contractor in accordance with this Agreement.

19.7.2 Payment for Operation & Maintenance shall be made in fixed monthly amounts in accordance with this Agreement. If the Operation & Maintenance Requirements set forth inSchedule-E are not met, reduction in payments shall be made in accordance with the provisions of Schedule-M. The reductions for non-compliance with the Operation & Maintenance Requirements shall be applied on the basis of monthly inspections by the Authority.

19.7.3 The deduction made on account of non-compliance with the Operation & Maintenance Requirements shall not be subsequently considered for payment after the compliance is achieved by repair or rectification.

19.7.4 The Authority shall pay to the Contractor every month any amount due under this Clause

19.7. The payment shall be made no later than 30 (thirty) days from the date of submissionof the last claim for the relevant month.

19.8 Payment of Damages

19.8.1 The Contractor may claim Damages due and payable to it in accordance with the provisions of this Agreement.

19.8.2 The Authority, within 15 (fifteen) days of the receipt of the claim under Clause 19.8.1, after making adjustments in accordance with the provisions of this Agreement shall pay to the Contractor the amount due within a period of 30 (thirty) days from the date of the submission of the claim under this Clause 19.8. In the event of the failure of the Authority to make payment to the Contractor within the specified time, the Authority shall be liable to pay to the Contractor interest thereon and the provisions of Clause 19.9 shall apply *mutatis mutandis* thereto.

19.9 Time of payment and interest

19.9.1 The Authority shall pay to the Contractor any amount due under any payment certificate issued by the Authority's Engineer in accordance with the provisions of this Article 19, or in accordance with any other clause of this Agreement as follows:

(a) payment shall be made no later than 30 (thirty) days from the date of submission of the Stage Payment Statement by the Contractor to the Authority's Engineer for certification in accordance with the provisions of Clause 19.4 for an IPC; provided that, in the event the IPC is not issued by the Authority's Engineer within the aforesaid period of 30 (thirty) days, the Authority shall pay the amount shown in the Contractor's Stage Payment Statement and any discrepancy therein shall be added to, or deducted from, the next payment certificate issued to the Contractor; and

(b) payment shall be made no later than30 (thirty) days from the date of submission of the Final Payment Certificate for Works along with the discharge submitted to the Authority's Engineer in accordance with the provisions of Clause 19.15 for certification.

19.9.2 In the event of the failure of the Authority to make payment to the Contractor within the time period stated in this Clause 19.9, the Authority shall be liable to pay to the

Contractor interest at the Base Rate plus 2% (two percent), calculated at quarterly rests, on all sums remaining unpaid from the date on which the same should have been paid, calculated in accordance with the provisions of Clause 19.9.1(a) and (b)and till the date of actual payment.

19.10. Price adjustment for the Works

19.10.1 The amounts payable to the Contractor for Works shall be adjusted in accordance with the provisions of this Clause 19.10.

19.10.2 Subject to the provisions of Clause 19.10.3, the amounts payable to the Contractor for Works, shall be adjusted in the IPC issued by the Authority's Engineer for the increase or decrease in the index cost of inputs for the Works, by the addition or subtraction of the amounts determined by the formulae prescribed in Clause 19.10.4.

19.10.3 To the extent that full compensation for any increase or decrease in costs to the Contractor is not covered by the provisions of this or other Clauses in this Agreement, the costs and prices payable under this Agreement shall be deemed to include the amounts required to cover the contingency of such other increase or decrease of costs and prices.

19.10.4 The Contract Price shall be adjusted for increase or decrease in rates and price of labour, cement, steel, Plant, machinery and spares, bitumen, pipes, fuel and lubricants, and other material inputs in accordance with the principles, procedures and formulae specified below: **(as per OM No.15847/W Dt.19.11.2019 of Works Department, Govt. of Odisha)**:

(a) Price adjustment shall be applied on completion of the specified stage of the respective item of work in accordance with Schedule-H;

(b) Adjustment for each item of work/stage shall be made separately.

(c) Deleted

(d) Deleted

(e) Deleted

(f) In case an IPC relates to a month which is within 3 (three) months from the Base Date, no price adjustment shall be applicable.

19.10.5 Contract price shall be adjusted for increase or decrease in rates and price of labour, materials, fuels and lubricants in accordance with the following principles and procedures and as per formula given in following Paras.

(a) The price adjustment shall apply for the work done from the start date given in the contract data up to end of the initial intended completion date or extensions granted by the Engineer and shall not apply to the work carried out beyond the stipulated time for reasons attributable to the contractor.

(b) The price adjustment shall be determined during each month from the formula given in following Paras.

(c) Following expressions and meanings are assigned to the work done during each month:

R= Total value of work done during the month. It would include the amount of secured advance granted, if any, during the month, less the amount of secured advance recovered, if any during the month. It will exclude value for works executed for extra items under variations.

19.10.6 To the extent that full compensation for any rise or fall in costs to the contractor is not covered by the provisions of this or other clauses in the contract, the unit rates and prices included in the contract shall be deemed to include amounts to cover the contingency of such other rise or fall in costs

The formula (e) for adjustment of prices are:

19.10.6 (a)(i): **Adjustment of Other Materials Component**

Price adjustment for increase or decrease in cost of local materials other than cement, steel, bitumen, pipe and POL procured by the contractor shall be paid in accordance with the following formula:

$V_M = 0.85 \times P_m/100 \times R \times (M_1 - M_0)/M_0$

V_M = Increase or decrease in the cost of work during the month under consideration due to changes in rates for local materials other than cement, steel, bitumen and POL.

M_o = The all India wholesale price index (all commodities) on 28 days preceding the date of opening of Bids, as published by the Ministry of Commerce and Industry, Government of India, New Delhi.

M_1 = The all India wholesale price index (all commodities) for the month under consideration as published by the Ministry of Commerce and Industry, Government of India, New Delhi.

P_m = Percentage of local material component (other than cement, steel, bitumen and POL) of the work.

19.10.6 (a)(ii): **Adjustment for Cement Component**

Price adjustment for increase or decrease in the cost of cement procured by the contractor shall be paid in accordance with the following formula:

$V_c = 0.85 \times P_c/100 \times R \times (C_1 - C_0)/C_0$

V_c = Increase or decrease in the cost of work during the month under consideration due to changes in the rates for cement

C_0 = The all India wholesale price index for Ordinary Portland Cement (OPC) on 28 days preceding the date of opening of Bids as published by the Ministry of Commerce and Industry, Government of India, New Delhi.

C_1= The all India wholesale price index for Ordinary Portland Cement (OPC) for the month under consideration as published by the Ministry of Commerce and Industry, Government of India, New Delhi.

P_c = Percentage of Cement Component of the Work.

19.10.6 (a)(iii): **Adjustment for Steel Component**

Price adjustment for increase or decrease in the cost of steel procured by the contractor shall be paid in accordance with the following formula:

$V_s = 0.85 \times P_s/100 \times R \times (S_1 - S_0)/S_0$

V_s = Increase or decrease in the cost of work during the month under consideration due to changes in the rates for steel.

S_0 = The all India wholesale price index for steel (Mild Steel long products) on 28 days preceding the date of opening of Bids as published by the Ministry of Commerce and Industry, Government of India, New Delhi

S_1= The all India wholesale price index for steel (Mild Steel long products) for the month under consideration as published by the Ministry of Commerce and Industry, Government of India, New Delhi.

P_s = Percentage of steel component of the work

Note: For the application of this clause, index of (Mild Steel long products) has been chosen to represent steel group.

19.10.6 (a)(iv): **Adjustment of Bitumen Component**

Price adjustment for increase or decrease in the cost of bitumen shall be paid in accordance with the following formula:

$V_b = 0.85 \times P_b/100 \times R \times (B_1 - B_0)/B_0$

V_b = Increase or decrease in the cost of work during the month under consideration due to changes in the rate for bitumen.

B_0 = The official retail price of bulk bitumen at the IOCL/BPCL depot at nearest center on the day 28 days prior to date of opening of Bids.

B_1 = The official retail price of bulk bitumen at IOCL/BPCL depot at nearest center for the 15th day of the month under consideration.

P_b = Percentage of bitumen component of the work

19.10.6 (a)(v): **Adjustment towards differential cost of Pipes.**

Price adjustment for increase or decrease in the cost of pipe shall be paid in accordance with the following formula:

$V_{pi} = 0.85 \times P_{pi}/100 \times R \times (P_{i1}-P_{i0})/P_{i0}$

V_{pi} = Differential cost of pipe i.e. amount of increase or decrease in rupees to be paid or recovered during the month under consideration.

P_{pi} = Percentage of pipe component of the work

P_{i1} = **All India Whole sale price index of pipe** for the period under consideration as published by the Ministry of Commerce and Industry, Government of India, New Delhi.

P_{i0} = All India Whole sale price index of pipe on 28 days preceding the date of opening of Bids as published by the Ministry of Commerce and Industry, Government of India, New Delhi.

19.10.6 (b): **Adjustment of Labour Component**

Price adjustment for increase or decrease in the cost due to labour shall be paid in accordance with the fallowing formula:

$V_L = 0.85 \times P_l/100 \times R \times (L_1 - L_0)/L_0$

V_L = Increase or decrease in the cost of work during the month under consideration due to changes in rates for local labour.

L_0= The minimum wages for unskilled labour as Notified by Government of Odisha as prevailed on the last stipulated date of receipt of tender including extension, if any.

L_1 = The minimum wages for unskilled labour as Notified by Government of Odisha as prevailed on the last date of the Month previous to the one under consideration.

P_l = Percentage of labour component of the work.

19.10.6 (c) :**Adjustment of POL (fuel and lubricant) Component**

Price adjustment for increase or decrease in cost POL (fuel and lubricant) shall be paid in accordance with the following formula:

$V_f = 0.85 \; x \; P_f/100 \times R \times (F_1 - F_0)/F_0$

V_f = Increase or decrease in the cost of work during the month under consideration due to changes in the rates for fuel and lubricants.

F_0 = The official retail price of High-Speed Diesel (HSD) at the existing consumer pumps of IOCL/ BPCL/ HPCL at nearest center on the day 28 days prior to the date of opening of Bids.

F_1 = The official retail price of HSD at the existing consumer pumps of IOCL/BPCL/ HPCL at nearest center for the 15th day of the month under consideration .

P_f = Percentage of fuel and lubricants component of the work

Note: For the application of this clause, the price of High-Speed Diesel oil has been chosen to represent fuel and lubricants group.

19.10.6 (d): **Adjustment for Plant and Machinery Spares Component**

(vi) Price adjustment for increase or decrease in the cost of plant and machinery spares procured by the Contractor shall be paid in accordance with the following formula:

V_p- $0.85 \times P_p/100 \times R \times (P_1-P_0)/P_0$

V_p- Increase or decrease in the cost of work during the month under consideration due to changes in the rates for plant and machinery spares.

P_0- The all India wholesale price index for manufacture of machinery for mining, quarrying and construction on 28 days preceding the date of opening of Bids as published by the Ministry of Commerce and Industry, Government of India, New Delhi.

P_1- The all India wholesale price index for manufacture of machinery for mining, quarrying and construction for the month under consideration as published by the Ministry of Commerce and Industry, Government of India, New Delhi.

P_p- Percentage of plant and machinery spares component of the work.

Note: For the application of this clause, index of manufacturing of machinery for mining, quarrying and construction has been chosen to represent the Plant and machinery Spares group.

Regarding wholesale price Index (WPI) for appropriate commodity for payment of price adjustment, due to change of base year of WPI from 1993- 94 to 2004-05 & 2011-12, it is observed that, the commodity 'Bars and Rod', 'Cement', 'Heavy machinery and parts' included in the list of WPI 1993-94 series are not mentioned as such in the WPI 2004-05 & 2011-12 series. Therefore, the following items in the WPI 2004-05 & 2011-12 series shall be considered corresponding to items in WPI 1993-94 series:

Sl. No.	Item in WPI 1993-94 series	Item in WPI 2004-05 series	Item in WPI 2011-12 series
1.	Cement	Grey Cement	Ordinary Port land cement
2.	Bars & rods	Rebars	Mild steel long products
3.	Heavy Machinery & parts	Construction Machinery	Manufacture of machinery for mining, quarrying & construction.

19.10.6 (e): **APPLICATION OF ESCALATION CLAUSE:**

The contractor shall for the purpose of **availing reimbursement/refund of differential cost of steel, bitumen, cement, pipe, POL and wages, keep such books of account and other documents as are necessary to show that the amount of increase claimed or reduction available and shall allow inspection of the same by a duly authorized representative of Government and further, shall at the request of the Engineer-in-Charge**, furnish documents to be verified in such a manner as the Engineer-in-Charge may require any document and information kept. The contractor shall within a reasonable time of 15 days of his becoming aware of any alteration in the price of such material, wages of Labour and/or price of POL give notice thereof to the Engineer-in-Charge stating that the same is given pursuant to this condition along with information relating to there to which he may be in a position to supply.

Percentage Table

Sl. No.	Category of works		% Component (cost wise)		
			Labour (P_l)	P.O.L (P_f)	Steel (P_s)+ Cement(P_c)+ Bitumen (P_b)+ Pipes (P_{pi}) + Plant &Machinery Spare& Component (P_p) + Other Materials*
1.	R&B works (% of component)	Road works	5	5	90
		Bridge works	5	5	90
		Building works	5	5	90
2.	Irrigation works (% of component)	Structural work	5	5	90
		Earth, Canal & Embankment work	5	5	90
3.	P.H. Work	Structural work	5	5	90
		Pipeline work	5	5	Pipe – 70% * Machinery + Other material -20%
		Sewer line	5	5	Pipe – 70% * Machinery + Other material -20%

Note: Further break up may be worked out considering the consumption of Cement. Steel, Bitumen, pipe and Plant & Machinery Spare Component in the concerned works and shall be provided in the bid document in shape of "Schedule of Adjustment Data" as an "Appendix to Bid". (Enclosed herewith).

Appendix to Bid

Schedule of Adjustment Data

[For all works, adjustment factor for Labour and POL shall be considered @ 5% each. Steel, Cement, Pipes, other Materials and Machinery shall contribute to 90% of Price Adjustment and shall be calculated for each work separately during preparation of estimate, shall be approved by the authority during technical sanction as a "Schedule of Adjustment Data" and shall form part of the Bid Document]

Cl. No.6.19 ofF2/P1 Contracts Sl. No.	Index description	Source of index	Base value*	Base Date*	Weightage of Item**
19.10.6 (a)(i)	Other Materials	All India Whole sale price index (all commodities) as published by the Office of the Economic Advisor to the Govt. of India, Ministry of Commerce and industry.			
19.10.6 (a)(ii)	Cement	All India Whole sale price index for Cement (Ordinary Portland Cement) as published by the Office of the Economic Advisor to the Govt. of India, Ministry of Commerce and industry.			
19.10.6 (a)(iii)	Steel	All India Whole sale price index for Steel (Mild Steel-Long Products) as published by the Office of the Economic Advisor to the Govt. of India, Ministry of Commerce and lndustry			
19.10.6 (a)(iv)	Bitumen (VG-30)	Official retail price of bulk bitumen at the nearest IOC/HPCL Depot.			
19.10.6 (a)(v)	Pipes	All India Whole sale price index for the **type of pipe under consideration**, as published by the Office of the Economic Advisor to the Govt. of lndia, Ministry of Commerce and lndustry			
19.10.6 (b)	Labour	Minimum Wage notified by the Labour and Employee's State Insurance Department of Government of Odisha, India.			5%
19.10.6 (c)	POL	Official retail price of HSD at nearest IOCL/ HPCL/ BPCL Consumer Pump Depot.			5%
19.10.6 (d)	Plant and Machinery	All India Whole sale price index for Manufacture of Machinery for Mining, Quarrying and Construction as published by the Office of the Economic Advisor to the Govt. of lndia, Ministry of Commerce and lndustry.			
		Total :			**100%**

**** Values to be filled up at the time of drawl of contract.***

***** Values to be filled up in the bid document.***

19.11 Restrictions on price adjustment

Price adjustment shall be due and payable only in respect of the stages of Works for which the Stage Payment Statement has been submitted by the Contractor no later than 30 (thirty) days from the date of the applicable Project Milestone or the Scheduled Completion Date, as the case may be, including any Time Extension granted there for in accordance with the provisions of this Agreement. For the avoidance of doubt, in the event of submission of any Stage Payment Statement after the period specified herein, price adjustment shall be applicable until the date of the respective Project Milestone or the Scheduled Completion Date, as the case may be.

19.12. Price adjustment on labour for Operation &Maintenance of water supply Project.

The contract price for operation & maintenance shall be adjusted **quarterly** for increase or decrease in rates and prices of labour, materials & spare parts, fuel & lubricants & chemical etc. in accordance with the principles, procedures & formula specified below.

19.12.1: Price Adjustment on labour component

Differential cost of labour due to enhancement of minimum wages by the State Government will be adjusted in accordance with the following formula.

VOL = 0.85xPLx R(L1 – Lo)/Lo

Where,

VOL = Increase in the payment on labour

PL = % of Labour component of the O&M contract price.

Lo = Minimum wages prevailing on the bid due date

L1 = The minimum wages for the first day of relevant quarter under consideration for determining price adjustment.

R = Value of O&M work done**.**

19.12.2: Price adjustment on O&M materials & Spare parts

Price adjustment for O&M materials & Spare parts component of the contract price for O&M shall be made in accordance with Wholesale Price Index (WPI) as per following formula.

VOM = 0.85 PM x R (M1 – M0)/M0

Where,

VOM = Increase or decrease in the cost of O&M materials & Spare parts component during the period under consideration due to changes in the rates for relevant components as stated in 19.12.5.

PM = Materials& spare parts component of the O&M contract price.

M1 = The WPI for materials& Spare parts on the first day of month three months prior to the month to which the IPC relates.

M0 = The wholesale price index as published by the Ministry of Commerce &Industry, Government of India (Hereinafter called as "WPI") for materials & Spare parts for the month of base date.

R = Value of O&M work done.

19.12.3: Price adjustment on Fuel & Lubricants

VOF = 0.85 PF x R(F1 – F0)/F0

VOF = Increase or decrease in the cost of Fuel & Lubricants component during the period under consideration due to changes in the rates for relevant components as stated in 19.12.5

PF is the percentage of fuel & lubricant component for the relevant item as stated in sub-paragraph 19.12.5

FI = The official retail price of HSD at the existing consumer pumps of IOC in the State of [Odisha] on the first day of the month three months prior to the month to which the IPC relates.

FO = The official retail price of highspeed diesel (HSD) oil at the existing consumer pumps of Indian Oil Corporation ("IOC") in the State of [Odisha] on the Base Date.
R = Value of O&M work done.

19.12.4: Price adjustment on Chemicals & chemicals products

VOC = 0.85 PC x R(C1 – C0)/C0

VOC = Increase or decrease in the cost of Chemicals & chemicals products component during the period under consideration due to changes in the rates for relevant components as stated in 19.12.5

PC is the percentage of chemicals, chemical product for the relevant item as stated in sub-paragraph 19.12.5.

C1 = The WPI for chemical & chemical products on the 1st day of month three months prior to the month to which the IPC relates.

CO = The WPI for chemical & chemical products for the month of base date

R = Value of O&M work done.

19.12.5 The following percentages shall govern the price adjustment of the contract price for O&M excluding the cost of energy.

Sl.No	Components	Percentage
01	Labour component (PL)	**60 %**
02	O&M materials & Spare parts (PM)	**29 %**
03	Fuel & Lubricants (PF)	**3 %**
04	Chemicals, chemicals products (PC)	**8 %**
	Total	**100%**

19.13 Final Payment Statement

19.13.1 Within 60 (sixty) days after receiving the Completion Certificate under Clause 12.4, the Contractor shall submit to the Authority's Engineer for consideration six copies of a Final Payment Statement (the "**Final Payment Statement**") for Works, with supporting documents showing in detail, in the form prescribed by the Authority's Engineer:

(a) the summary of Contractor's Stage Payment claims for Works as submitted in accordance with Clause 19.4;
(b) the amounts received from the Authority against each claim; and
(c) any further sums which the Contractor considers due to it from the Authority.

If the Authority's Engineer disagrees with or cannot verify any part of the Final Payment Statement, the Contractor shall submit such further information as the Authority's Engineer may reasonably require. The Authority's Engineer shall deliver to the Authority:

(i) an IPC for those parts of the Final Payment Statement which are not in dispute, along with a list of disputed items which shall then be settled in accordance with the provisions of Article 26; or
(ii) a Final Payment Certificate in accordance with Clause 19.15 if there are no disputed items.

19.13.2 If the Authority's Engineer does not prescribe the form referred to in Clause 19.13.1 within 15 (fifteen) days of the date of issue of the Completion Certificate, the Contractor shall submit the statement in such form as it deems fit.

19.14 Discharge

Upon submission of the Final Payment Statement for Works under Clause 19.13, the Contractor

shall give to the Authority, with a copy to the Authority's Engineer, a written discharge confirming that the total of the Final Payment Statement represents full and final settlement of all monies due to the Contractor in respect of this Agreement for all the Works arising out of this Agreement, except for any monies due to either Party on account of any Defect. Provided that such discharge shall become effective only after the payment due has been made in accordance with the Final Payment Certificate issued pursuant to Clause 19.15.

19.15 Final Payment Certificate

19.15.1 Within 30 (thirty) days after receipt of the Final Payment Statement for Works under Clause 19.13, and the written discharge under Clause 19.14, and there being no disputed items of claim, the Authority's Engineer shall deliver to the Authority, with a copy to the Contractor, a final payment certificate (the "**Final Payment Certificate")** stating the amount which, in the opinion of the Authority's Engineer, is finally due under this Agreement or otherwise. For the avoidance of doubt, before issuing the Final Payment Certificate, the Authority's Engineer shall ascertain from the Authority all amounts previously paid by the Authority and for all sums to which the Authority is entitled, the balance, if any, due from the Authority to the Contractor or from the Contractor to the Authority, as the case may be.

19.15.2 The Authority shall, in accordance with the provisions of Clause 19.9, pay to the Contractor the amount which is stated as being finally due in the **Final Payment Certificate**.

19.16 Final payment statement for Operation &Maintenance of Sewerage Project.

19.16.1 Within 30 (thirty) days after completion of the Operation & Maintenance Period, the Contractor shall submit to the Authority six copies of the final payment statement for Operation & Maintenance of the Sewerage Project, with supporting documents showing the details set forth below in the form prescribed by the Authority:

(a) the total amount claimed in accordance with the monthly statement for Operation & Maintenance of Sewerage Project;

(b) the amount paid in accordance with the **Interim Payment Certificates**/claims; and

(c) any sums which the Contractor considers to be due to it, with supporting documents.

19.16.2 The Authority shall check and approve the final payment within 30 (thirty) days of the receipt of the final payment statement of Operation & Maintenance under Clause 19.16.1, segregating the items of amount payable from the items of amount disallowed. The Authority shall make payment on the basis of the final payment statement within a period of 30 (thirty) days thereafter.

19.16.3 If the Authority does not prescribe the form within 15 (fifteen) days of the date of issue of the Completion Certificate, the Contractor shall submit the statement in such form as it deems fit.

19.17 Change in law

19.17.1 If as a result of Change in Law, the Contractor suffers any additional costs in the execution of the Works or in relation to the performance of its other obligations under this Agreement, the Contractor shall, within 15 (fifteen) days from the date it becomes reasonably aware of such addition in cost, notify the Authority with a copy to the Authority's Engineer of such additional cost due to Change in Law.

19.17.2 If as a result of Change in Law, the Contractor benefits from any reduction in costs for the execution of this Agreement or in accordance with the provisions

of this Agreement, either Party shall, within 15 (fifteen) days from the date it becomes reasonably aware of such reduction in cost, notify the other Party with a copy to the Authority's Engineer of such reduction in cost due to Change in Law.

19.17.3 The Authority's Engineer shall, within15 (fifteen) days from the date of receipt of the notice from the Contractor or the Authority, determine any addition or reduction to the Contract Price, as the case may be, due to the Change in Law.

19.18 Correction of Interim Payment Certificates

The Authority's Engineer may by an Interim Payment Certificate make any correction or modification in any previous Interim Payment Certificate issued by the Authority's Engineer.

19.19 Authority's claims

If the Authority considers itself to be entitled to any payment from the Contractor under any Clause of this Agreement, it shall give notice and particulars to the Contractor 20 (twenty) days before making the recovery from any amount due to the Contractor, and shall take into consideration the representation, if any, made by the Contractor in this behalf, before making such recovery.

19.20 Bonus for early completion

In the event that the Project Completion Date occurs prior to the Scheduled Completion Date, the Contractor shall be entitled to receive a payment of bonus equivalent to **0.03%** (zero point zero three percent) of the Contract Price **for each day** by which the Project Completion Date precedes the Scheduled Completion Date, but subject to a **maximum of 3% (three percent)** of the Contract Price. Provided, however, that the payment of bonus, if any, shall be made only after the issue of the Completion Certificate. For the avoidance of the doubt, the Parties agree that for the purpose of determining the bonus payable hereunder, the Contract Price shall always be deemed to be the amount specified in Clause 19.1.1, and shall exclude any revision thereof for any reason. The Parties also agree that bonus shall be payable only if each work for which Extension of Time has been granted is completed within respective Extended Time.

ARTICLE 20

INSURANCE

The Contractor shall effect and maintain at its own cost the insurances specified in Schedule-P and as per the requirements under the Applicable Laws.

20.1 Insurance for Work

20.1.1 Subject to the provisions of Clause 21.6, the Authority and the Contractor shall, in accordance with its obligations as provided for in this Agreement, be liable to bear the cost of any loss or damage that does not fall within the scope of this Article 20or cannot be recovered from the insurers.

20.1.2 Subject to the exceptions specified in Clause 20.1.4 below, the Contractor shall, save and except as provided for in this Agreement, fully indemnify, hold harmless and defend the Authority from and against any and all losses, damages, costs, charges and/or claims with respect to:

(a) the death of or injury to any person; or

(b) the loss of or damage to any property (other than the Works);

that may arise out of or in consequence of any breach by the Contractor of this Agreement during the execution of the Works or the remedying of any Defectstherein.

20.1.3 Notwithstanding anything stated above in Clause 20.1.3, the Authority shall fully indemnify the Contractor from and against any and all losses, damages, costs, charges, proceedings and/or claims arising out of or with respect to

(a) the use or occupation of land or any part thereof by the Authority;

(b) the right of the Authority to execute the Works, or any part thereof, on, over, under, in or through any land;

(c) the damage to property which is the unavoidable result of the execution and completion of the Works, or the remedying of any Defects therein, in accordance with this Agreement; and

(d) the death of or injury to persons or loss of or damage to property resulting from any act or neglect of the Authority, its agents, servants or other contractors, not being employed by the Contractor.

Provided that, in the event of any injury or damage as a result of the contributory negligence of the Contractor, the Authority shall be liable to indemnify the Contractor from and against any and all losses, damages, costs, charges, proceedings and/or claims to the extent as may be proportionately determined to bethe liability of the Authority, its servants or agents or other contractors not associated with the Contractor in such injury or damage.

20.1.4 Without prejudice to the obligations of the Parties as specified under Clauses 20.1.3 and 20.1.4, the Contractor shall maintain or effect such third- p a r t y insurances as may be required under the Applicable Laws.

20.1.5 The Contractor shall provide to the Authority, within 30 days of the Appointed Date, evidence of professional liability insurance maintained by its Design Director and/or consultants to cover the risk of professional negligence in the design of Works. The professional liability coverage shall be for a sum of not less than [3% (three per cent)] of the Contract Price and shall be maintained until the end of the Defects Liability Period.

20.1.6 Insurance for Construction as well as O & M period shall be in the scope of bidder

20.2 Notice to the Authority

` No later than 15 (fifteen) days after the date of this Agreement, the Contractor shall by notice furnish to the Authority, in reasonable detail, information in respect of the

insurances that it proposes to effect and maintain in accordance with this Article 20. Within 15 (fifteen) days of receipt of such notice, the Authority may require the Contractor to effect and maintain such other insurances as may be necessary pursuant hereto, and in the event of any difference or disagreement relating to any such insurance, the Dispute Resolution Procedure shall apply.

20.3 Evidence of Insurance Cover

20.3.1 All insurances obtained by the Contractor in accordance with this Article 20 shall be maintained with insurers on terms consistent with Good Industry Practice. Within10 (ten) days from the Appointed Date, the Contractor shall furnish to the Authority notarised true copies of the certificate(s) of insurance, copies of insurance policies and premium payment receipts in respect of such insurance, and no such insurance shall be cancelled, modified, or allowed to expire or lapse until the expiration of at least 45 (forty-five) days after notice of such proposed cancellation, modification or non-renewal has been delivered by the Contractor to the Authority. The Contractor shall act in accordance with the directions of the Authority. Provided that the Contractor shall produce to the Authority the insurance policies in force and the receipts for payment of the current premium.

20.3.2 The Contractor shall ensure the adequacy of the insurances at all times in accordance with the provisions of this Agreement.

20.4 Remedy for failure to insure

If the Contractor shall fail to effect and keep in force all insurances for which it is responsible pursuant hereto, the Authority shall have the option to either keep in force any such insurances, and pay such premium and recover the costs thereof from the Contractor, or in the event of computation of a Termination Payment, treat an amount equal to the Insurance Cover as deemed to have been received by the Contractor.

20.5 Waiver of subrogation

All insurance policies in respect of the insurance obtained by the Contractor pursuant to this Article 20 shall include a waiver of any and all rights of subrogation or recovery of the insurers there under against, inter alia, the Authority, and its assigns, successors, undertakings and their subsidiaries, Affiliates, employees, insurers and underwriters, and of any right of the insurers to any set-off or counterclaim or any other deduction, whether by attachment or otherwise, in respect of any liability of any such person insured under any such policy or in any way connected with any loss, liability or obligation covered by such policies of insurance.

20.6 Contractor's waiver

The Contractor hereby further releases, assigns and waives any and all rights of subrogation or recovery against, inter alia, the Authority and its assigns, undertakings and their subsidiaries, Affiliates, employees, successors, insurers and underwriters, which the Contractor may otherwise have or acquire in or from or inany way connected with any loss, liability or obligation covered by policies of insurance maintained or required to be maintained by the Contractor pursuant to this Agreement (other than third party liability insurance policies) or because of deductible clauses in or inadequacy of limits of any such policies of insurance.

20.7 Cross liabilities

Any such insurance maintained or effected in pursuance of **this Article 20** shall include a cross liability clause such that the insurance shall apply to the Contractor and to the Authority as separately insured.

20.8 Accident or injury to workmen

Notwithstanding anything stated in this Agreement, it is hereby expressly agreed between the Parties that the Authority shall not be liable for or in respect of any damages or compensation payable to any workman or other person in the employment of the Contractor or Sub-contractor, save and except as for death or injury resulting from

any act, omission or default of the Authority, its agents or servants. The Contractor shall indemnify and keep indemnified the Authority from and against all such claims, proceedings, damages, costs, charges, and expenses whatsoever in respect of the above save and except for those acts, omissions or defaults for which the Authority shall be liable.

20.9 Insurance against accident to workmen

The Contractor shall effect and maintain during the Agreement such insurances as may be required to insure the Contractor's personnel and any other persons employed by it on the Sewerage Project from and against any liability incurred in pursuance of this Article 20. Provided that for the purposes of this Clause 20.9, the Contractor's personnel/any person employed by the Contractor shall include the Sub-contractor and its personnel. It is further provided that, in respect of any persons employed by any Sub-contractor, the Contractor's obligations to insure as aforesaid under this Clause 20.9 shall be discharged if the Sub-contractor shall have insured against any liability in respect of such persons in such manner that the Authority is indemnified under the policy. The Contractor shall require such Sub- contractor to produce before the Authority, when required, such policy of insurance and the receipt for payment of the current premium within 10 (ten) days of such demand being made by the Authority.

20.10 Application of insurance proceeds

The proceeds from all insurance claims, except for life and injury, shall be applied for any necessary repair, reconstruction, reinstatement, replacement, improvement, delivery or installation of the Sewerage Project and the provisions of this Agreement in respect of construction of works shall apply *mutatis mutandis* to the works undertaken out of the proceeds of insurance.

20.11 Compliance with policy conditions

Each Party hereby expressly agrees to fully indemnify the other Party from and against all losses and claims arising from its failure to comply with conditions imposed by the insurance policies effected in accordance with this Agreement.

Part V
Force Majeure and Termination

ARTICLE 21

FORCE MAJEURE

21.1 Force Majeure

As used in this Agreement, the expression "Force Majeure" or "Force Majeure Event" shall mean occurrence in India of any or all of Non-Political Event, Indirect Political Event and Political Event, as defined in Clauses 21.2, 21.3 and 21.4 respectively, if it affects the performance by the Party claiming the benefit of Force Majeure (the "**Affected Party**") of its obligations under this Agreement and which act or event (i) is beyond the reasonable control of the Affected Party, and (ii) the Affected Party could not have prevented or overcome by exercise of due diligence and following Good Industry Practice, and (iii) has Material Adverse Effect on the Affected Party.

21.2 Non-Political Event

A Non-Political Event shall mean one or more of the following acts or events:

(a) act of God, epidemic, extremely adverse weather conditions, lightning, earthquake, landslide, cyclone, flood, volcanic eruption, chemical or radioactive contamination or ionising radiation, fire or explosion (to the extent of contamination or radiation or fire or explosion originating from a source external to the Site);

(b) strikes or boycotts (other than those involving the Contractor, Sub- contractors or their respective employees/representatives, or attributable to any act or omission of any of them) interrupting supplies and services to the Sewerage Project for a continuous period of 24 (twenty-four) hours and an aggregate period exceeding 30 (thirty) days in an Accounting Year, and not being an Indirect Political Event set forth in Clause 21.3;

(c) any failure or delay of a Sub-contractor but only to the extent caused by another Non-Political Event;

(d) any judgement or order of any court of competent jurisdiction or statutory authority made against the Contractor in any proceedings for reasons other than (i) failure of the Contractor to comply with any Applicable Law or Applicable Permit, or (ii) on account of breach of any Applicable Law or Applicable Permit or of any contract, or (iii) enforcement of this Agreement,or (iv) exercise of any of its rights under this Agreement by the Authority;

(e) the discovery of geological conditions, toxic contamination or archaeological remains on the Site that could not reasonably have been expected to be discovered through a site inspection; or

(f) any event or circumstances of a nature analogous to any of the foregoing.

21.3 Indirect Political Event

An Indirect Political Event shall mean one or more of the following acts or events:

(a) an act of war (whether declared or undeclared), invasion, armed conflict oract of foreign enemy, blockade, embargo, riot, insurrection, terrorist or military action, civil commotion or politically motivated sabotage;

(b) industry-wide or State-wide strikes or industrial action for a continuous period of 24 (twenty-four) hours and exceeding an aggregate period of 30 (thirty) days in an Accounting Year;

(c) any civil commotion, boycott or political agitation which prevents construction of the Sewerage Project by the Contractor for an aggregate period exceeding 30 (thirty) days in an Accounting Year;

(d) any failure or delay of a Sub-contractor to the extent caused by any Indirect Political Event;

(e) any Indirect Political Event that causes a Non-Political Event; or

(f) any event or circumstances of a nature analogous to any of the foregoing.

21.4 Political Event

A Political Event shall mean one or more of the following acts or events by or on account of any Government Instrumentality:

(a) Change in Law, only if consequences thereof cannot be dealt with under and in accordance with the provisions of Clause 19.17;

(b) compulsory acquisition in national interest or expropriation of any Project Assets or rights of the Contractor or of the Sub-Contractors;

(c) unlawful or unauthorised or without jurisdiction revocation of, or refusal to renew or grant without valid cause, any clearance, license, permit, authorisation, no objection certificate, consent, approval or exemption required by the Contractor or any of the Sub-contractors to perform their respective obligations under this Agreement; provided that such delay, modification, denial, refusal or revocation did not result from the Contractor's or any Sub-contractor's inability or failure to comply with any condition relating to grant, maintenance or renewal of such clearance, license, authorisation, no objection certificate, exemption, consent, approval or permit;

(d) any failure or delay of a Sub-contractor but only to the extent caused by another Political Event; or

(e) any event or circumstances of a nature analogous to any of the foregoing.

21.5 Duty to report Force Majeure Event

21.5.1 Upon occurrence of a Force Majeure Event, the Affected Party shall by notice report such occurrence to the other Party forthwith. Any notice pursuant hereto shall include full particulars of:

(a) the nature and extent of each Force Majeure Event which is the subject of any claim for relief under this Article 21 with evidence in support thereof;

(b) the estimated duration and the effect or probable effect which such Force Majeure Event is having or will have on the Affected Party's performance of its obligations under this Agreement;

(c) the measures which the Affected Party is taking or proposes to take for alleviating the impact of such Force Majeure Event; and

(d) any other information relevant to the Affected Party's claim.

21.5.2 The Affected Party shall not be entitled to any relief for or in respect of a Force Majeure Event unless it shall have notified the other Party of the occurrence of the Force Majeure Event as soon as reasonably practicable, and in any event no later than 10 (ten) days after the Affected Party knew, or ought reasonably to have known, of its occurrence, and shall have given particulars of the probable material effect that the Force Majeure Event is likely to have on the performance of its obligations under this Agreement.

21.5.3 For so long as the Affected Party continues to claim to be materially affected by such Force Majeure Event, it shall provide the other Party with regular (and not less than weekly) reports containing information as required by Clause 21.5.1, and such other information as the other Party may reasonably request the Affected Party to provide.

21.6 Effect of Force Majeure Event on the Agreement

21.6.1 Upon the occurrence of any Force Majeure after the Appointed Date, the costs incurred and attributable to such event and directly relating to this Agreement (the "**Force Majeure costs**") shall be allocated and paid as follows:

(a) upon occurrence of a Non-Political Event, the Parties shall bear their respective Force Majeure costs and neither Party shall be required to pay to the other Party any costs thereof;

(b) upon occurrence of an Indirect Political Event, all Force Majeure costs attributable to such Indirect Political Event, and not exceeding the Insurance Cover for such Indirect Political Event, shall be borne by the Contractor, and to the extent Force Majeure costs exceed such Insurance Cover, one half of such excess amount shall be reimbursed by the Authority to the Contractorfor the Force Majeure events; and

(c) upon occurrence of a Political Event, all Force Majeure costs attributable to such Political Event shall be reimbursed by the Authority to the Contractor.

For the avoidance of doubt, Force Majeure costs may include costs directly attributable to the Force Majeure Event, but shall not include debt repayment obligations, if any, of the Contractor.

21.6.2 Save and except as expressly provided in this Article 21, neither Party shall be liable in any manner whatsoever to the other Party in respect of any loss, damage, cost, expense, claims, demands and proceedings relating to or arising out of occurrence or existence of any Force Majeure Event or exercise of any right pursuant hereto.

21.6.3 Upon the occurrence of any Force Majeure Event during the Construction Period, the Project Completion Schedule for and in respect of the affected Works shall be extended on a day for day basis for such period as performance of the Contractor's obligations is affected on account of the Force Majeure Event or its subsisting effects.

21.7 Termination Notice for Force Majeure Event

21.7.1 If a Force Majeure Event subsists for a period of 60 (sixty) days or more within a continuous period of 120 (one hundred and twenty) days, either Party may in its discretion terminate this Agreement by issuing a Termination Notice to the other Party without being liable in any manner whatsoever, save as provided in this Article 21, and upon issue of such Termination Notice, this Agreement shall, notwithstanding anything to the contrary contained herein, stand terminated forthwith; provided that before issuing such Termination Notice, the Party intending to issue the Termination Notice shall inform the other Party of such intention and grant 15 (fifteen) days' time to make a representation, and may after the expiry ofsuch 15 (fifteen) days period, whether or not it is in receipt of such representation, in its sole discretion issue the Termination Notice.

21.8 Termination Payment for Force Majeure Event

21.8.1 In the event of this Agreement being terminated on account of a Non-Political Event, the Termination Payment shall be an amount equal to the sum payable under Clause 23.5.

Provided that in the event Termination occurs during the Operation & MaintenancePeriod, the Authority's Engineer shall only determine the value of Works associated with Operation &Maintenance.

21.8.2 If Termination is on account of an Indirect Political Event, the Termination Payment shall include:

(a) any sums due and payable under Clause 23.5; and

(b) the reasonable cost, as determined by the Authority's Engineer, of the Plant and Materials procured by the Contractor and transferred to the Authority for use in Construction or Operation & Maintenance only if such Plant and Materials are in conformity with the Specifications and Standards;

Provided that in the event Termination occurs during the Operation & Maintenance Period, the Authority's Engineer shall only determine the value of Works associated with Operation & Maintenance.

21.8.3 If Termination is on account of a Political Event, the Authority shall make a Termination Payment to the Contractor in an amount that would be payable under Clause 23.6.2 as if it were an Authority Default.

21.9 Dispute resolution

In the event that the Parties are unable to agree in good faith about the occurrence or existence of a Force Majeure Event, such Dispute shall be finally settled in accordance with the Dispute Resolution Procedure; provided that the burden of proof as to the occurrence or existence of such Force Majeure Event shall be upon the Party claiming relief and/or excuse on account of such Force Majeure Event.

21.10 Excuse from performance of obligations

If the Affected Party is rendered wholly or partially unable to perform its obligations under this Agreement because of a Force Majeure Event, it shall be excused from performance of such of its obligations to the extent it is unable to perform on account of such Force Majeure Event; provided that:

(a) the suspension of performance shall be of no greater scope and of no longer duration than is reasonably required by the Force Majeure Event;

(b) the Affected Party shall make all reasonable efforts to mitigate or limit damage to the other Party arising out of or as a result of the existence or occurrence of such Force Majeure Event and to cure the same with due diligence; and

(c) when the Affected Party is able to resume performance of its obligations under this Agreement, it shall give to the other Party notice to that effect and shall promptly resume performance of its obligations hereunder.

ARTICLE 22

SUSPENSION OF CONTRACTOR'S RIGHTS

22.1 Suspension upon Contractor Default

Upon occurrence of a Contractor Default, the Authority shall be entitled, without prejudice to its other rights and remedies under this Agreement including its rightsof Termination hereunder, to (i) suspend carrying out of the Works or Operation & Maintenance or any part thereof, and (ii) carry out such Works or Operation & Maintenance itself or authorise any other person to exercise or perform the same on its behalf during such suspension (the "**Suspension**"). Suspension hereunder shall be effective forthwith upon issue of notice by the Authority to the Contractor and may extend up to a period not exceeding 90 (ninety) days from the date of issue of such notice.

22.2 Authority to act on behalf of Contractor

During the period of Suspension hereunder, all rights and liabilities vested in the Contractor in accordance with the provisions of this Agreement shall continue to vest therein and all things done or actions taken, including expenditure incurred by the Authority for discharging the obligations of the Contractor under and in accordance with this Agreement shall be deemed to have been done or taken for andon behalf of the Contractor and the Contractor undertakes to indemnify the Authority for all costs incurred during such period. The Contractor hereby licenses and sub-licenses respectively, the Authority or any other person authorised by it under Clause 22.1 to use during Suspension, all Intellectual Property belonging to or licensed to the Contractor with respect to the Sewerage Project and its design, engineering, construction and operation &maintenance, and which is used or created by the Contractor in performing its obligations under the Agreement.

22.3 Revocation of Suspension

22.3.1 In the event that the Authority shall have rectified or removed the cause of Suspension within a period not exceeding 60 (sixty) days from the date of Suspension, it shall revoke the Suspension forthwith and restore all rights of the Contractor under this Agreement. For the avoidance of doubt, the Parties expressly agree that the Authority may, in its discretion, revoke the Suspension at any time, whether or not the cause of Suspension has been rectified or removed hereunder.

22.3.2 Upon the Contractor having cured the Contractor Default within a period not exceeding 60 (sixty) days from the date of Suspension, the Authority shall revoke the Suspension forthwith and restore all rights of the Contractor under this Agreement.

22.4 Termination

22.4.1 At any time during the period of Suspension under this Article 22, the Contractor may by notice require the Authority to revoke the Suspension and issue a Termination Notice. The Authority shall, within 15 (fifteen) days of receipt of such notice, terminate this Agreement under and in accordance with Article 23.

22.4.2 Notwithstanding anything to the contrary contained in this Agreement, in the event that Suspension is not revoked within 90 (ninety) days from the date of Suspension hereunder, the Agreement shall, upon expiry of the aforesaid period, be deemed to have been terminated by mutual agreement of the Parties and all the provisions of this Agreement shall apply, *mutatis mutandis*, to such Termination as if a Termination Notice had been issued by the Authority upon occurrence of a Contractor Default.

ARTICLE 23

TERMINATION

23.1 Termination for Contractor Default

23.1.1 Save as otherwise provided in this Agreement, in the event that any of the defaults specified below shall have occurred, and the Contractor fails to cure the default within the Cure Period set forth below, or where no Cure Period is specified, then within a Cure Period of 60 (sixty) days, the Contractor shall be deemed to be in default of this Agreement (the "**Contractor Default**"), unless the default has occurred solely as a result of any breach of this Agreement by the Authority or dueto Force Majeure. The defaults referred to herein shall include:

(a) the Contractor fails to provide, extendor replenish, as the case may be, the Performance Security in accordance with this Agreement;

(b) subsequent to the replenishment or furnishing of fresh Performance Securityin accordance with Clause 7.3, the Contractor fails to cure, within a Cure Period of 30 (thirty) days, the Contractor Default for which the whole or partof the Performance Security was appropriated;

(c) the Contractor does not achieve the latest outstanding Project Milestone due in accordance with the provisions of Schedule-J, subject to any Time Extension, and continues to be in default for 45 (forty five) days;

(d) the Contractor abandons or manifests intention to abandon the construction or Operation & Maintenance of the Sewerage Project without the prior written consent of the Authority;

(e) the Contractor fails to proceed with the Works in accordance with the provisions of Clause 10.1 or stops Works and/or the operation & maintenance for 30 (thirty) days without reflecting the same in the current programme and such stoppage has not been authorized by the Authority's Engineer;

(f) the Project Completion Date does not occur within the period specified in Schedule-J for the Scheduled Completion Date, or any extension thereof;

(g) failure to complete the Punch List items within the periods stipulated therefore in Clause 12.2.1;

(h) the Contractor fails to rectify any Defect, the non-rectification of which shall have a Material Adverse Effect on the Project, within the time specified in this Agreement or as directed by the Authority's Engineer;

(i) the Contractor subcontracts the Works or any part thereof in violation of this Agreement or assigns any part of the Works without the prior approval of the Authority;

(j) the Contractor creates any Encumbrance in breach of this Agreement;

(k) an execution levied on any of the assets of the Contractor has caused a Material Adverse Effect;

(l) the Contractor is adjudged bankrupt or insolvent, or if a trustee or receiver is appointed for the Contractor or for the whole or material part of its assets that has a material bearing on the Project;

(m) the Contractor has been, or is in the process of being liquidated, dissolved, wound-up, amalgamated or reconstituted in a manner that would cause, in the reasonable opinion of the Authority, a Material Adverse Effect;

(n) a resolution for winding up of the Contractor is passed, or any petition for winding up of the Contractor is admitted by a court of competent jurisdiction and a provisional liquidator or receiver is appointed and such order has not been set aside within 90 (ninety) days of the date thereof or the Contractor is ordered to be wound up by court except for the purpose of amalgamation or

reconstruction; provided that, as part of such amalgamation or reconstruction, the entire property, assets and undertaking of the Contractor are transferred to the amalgamated or reconstructed entity and that the amalgamated or reconstructed entity has unconditionally assumed the obligations of the Contractor under this Agreement; and provided that:

(i) the amalgamated or reconstructed entity has the capability and experience necessary for the performance of its obligations under this Agreement; and

(ii) the amalgamated or reconstructed entity has the financial standing to perform its obligations under this Agreement and has a credit worthiness at least as good as that of the Contractor as at the Appointed Date;

(o) any representation or warranty of the Contractor herein contained which is,as of the date hereof, found to be materially false or the Contractor is at any time hereafter found to be in breach thereof;

(p) the Contractor submits to the Authority any statement, notice or other document, in written or electronic form, which has a material effect on the Authority's rights, obligations or interests and which is false in material particulars;

(q) the Contractor has failed to fulfil any obligation, for which failure Termination has been specified in this Agreement; or

(r) the Contractor commits a default in complying with any other provision of this Agreement if such a default causes a Material Adverse Effect on the Project or on the Authority.

23.1.2 Without prejudice to any other rights or remedies which the Authority may have under this Agreement, upon occurrence of a Contractor Default, the Authority shallbe entitled to terminate this Agreement by issuing a Termination Notice to the Contractor; provided that before issuing the Termination Notice, the Authority shall by a notice inform the Contractor of its intention to issue such Termination Notice and grant 15 (fifteen) days to the Contractor to make a representation, and may after the expiry of such 15 (fifteen) days, whether or not it is in receipt of such representation, issue the Termination Notice.

23.1.3 After termination of this Agreement for Contractor Default, the Authority may complete the Works and/or arrange for any other entities to do so. The Authority and these entities may then use any Materials, Plant and equipment, Contractor's documents and other design documents made by or on behalf of the Contractor.

23.2 Termination for Authority Default

23.2.1 In the event that any of the defaults specified below shall have occurred, and the Authority fails to cure such default within a Cure Period of 90 (ninety) days or such longer period as has been expressly provided in this Agreement, the Authority shall be deemed to be in default of this Agreement (the "**Authority Default**") unless the default has occurred as a result of any breach of this Agreement by the Contractor or due to Force Majeure. The defaults referred to herein shall include:

(a) the Authority commits a material default in complying with any of the provisions of this Agreement and such default has a Material Adverse Effect on the Contractor;

(b) the Authority has failed to make payment of any amount due and payable to the Contractor within the period specified in this Agreement;

(c) the Authority has failed to provide, within a period of 180 (one hundred and eighty) days from the Appointed Date, the environmental clearances required for construction of the Sewerage Project;

(d) the Authority repudiates this Agreement or otherwise takes any action that amounts to or manifests an irrevocable intention not to be bound by this Agreement; or

(e) the Authority's Engineer fails to issue the relevant Interim Payment Certificate within 60 (sixty) days after receiving a statement and supporting documents.

23.2.2 Without prejudice to any other right or remedy which the Contractor may have under this Agreement, upon occurrence of an Authority Default, the Contractor shall be entitled to terminate this Agreement by issuing a Termination Notice to the Authority; provided that before issuing the Termination Notice, the Contractor shall by a notice inform the Authority of its intention to issue the Termination Notice and grant 15 (fifteen) days to the Authority to make a representation, and may after the expiry of such 15 (fifteen) days, whether or not it is in receipt of such representation, issue the Termination Notice.

If on the consideration of the Authority's representation or otherwise, the contractor does not issue the Termination Notice on such 15th day and prefers to continue with the project, it is deemed that the cause of action of the Termination Notice has been condoned by the Contractor. Hence, he forfeits his right to any other remedy on that count.

23.3 Termination for Authority's convenience

Notwithstanding anything stated hereinabove, the Authority may terminate this Agreement for convenience. The termination shall **take effect 30 (thirty) days** from the date of notice hereunder.

23.4 Requirements after Termination

Upon Termination of this Agreement in accordance with the terms of this Article 23, the Contractor shall comply with and conform to the following:

(a) deliver to the Authority all Plant and Materials which shall have become the property of the Authority under this Article 23;

(b) deliver all relevant records, reports, Intellectual Property and other licences pertaining to the Works, Operation & Maintenance other design documents and in case of Termination occurring after the Provisional Certificate has been issued, the "as built" Drawings for the Works;

(c) transfer and/or deliver all Applicable Permits to the extent permissible under Applicable Laws; and

(d) vacate the Site within 15 (fifteen) days.

23.5 Valuation of Unpaid Works

23.5.1 Within a period of 45 (forty-five) days after Termination under Clause 23.1, 23.2 or 23.3, as the case may be, has taken effect, the Authority's Engineer shall proceed in accordance with Clause 18.5 to determine as follows the valuation of unpaid Works (the "**Valuation of Unpaid Works**"):

(a) value of the completed stage of the Works, less payments already made;

(b) reasonable value of the partially completed stages of works as on the date of Termination, only if such works conform with the Specifications and Standards; and

(c) Deleted

and shall adjust from the sum thereof (i) any other amounts payable or recoverable, as the case may be, in accordance with the provisions of this Agreement; and (ii) all taxes due to be deducted at source.

23.5.2 The Valuation of Unpaid Works shall be communicated to the Authority, with a copy to the Contractor, within a period of 30 (thirty) days from the date of Termination.

23.6 Termination Payment

23.6.1 Upon Termination on account of Contractor's Default under Clause 23.1, the Authority shall:

(a) **encash** and appropriate the Performance Security and Retention Money, or in the event the Contractor has failed to replenish or extend the Performance Security, claim the amount stipulated in Clause 7.1.1, as agreed pre- determined compensation to the Authority for any losses, delays and cost of completing the Works and Operation & Maintenance if any;

(b) **encash** and appropriate the bank guarantee, if any, for and in respect of the outstanding Advance Payment and interest thereon; and

(c) pay to the Contractor, by way of Termination Payment, an amount equivalent to the Valuation of Unpaid Works after adjusting any other sums payable or recoverable, as the case may be, in accordance with the provisions of this Agreement.

23.6.2 Upon Termination on account of an Authority Default under Clause 23.2 or for Authority's convenience under Clause 23.3, the Authority shall:

(a) return the Performance Security and Retention Money forthwith;

(b) encash and appropriate the bank guarantee, if any, for and in respect of the outstanding Advance Payment; and

(c) pay to the Contractor, by way of Termination Payment, an amount equal to:

(i) Valuation of Unpaid Works;

(ii) the reasonable cost, as determined by the Authority's Engineer, ofthe Plant and Materials procured by the Contractor and transferred to the Authority for its use, only if such Plant and Materials are in conformity with the Specifications and Standards;

(iii) the reasonable cost of temporary works, as determined by the Authority's Engineer; and

(iv) **10% (ten percent)** of the cost of the Works Operation & Maintenance that are not commencedor not completed,

and shall adjust from the sum thereof(i) any other amounts payable or recoverable, as the case may be, in accordance with the provisions of this Agreement, and (ii) all taxes due to be deducted at source.

23.6.3 Termination Payment shall become due and payable to the Contractor within 30 (thirty) days of a demand being made by the Contractor to the Authority with the necessary particulars, and in the event of any delay, the Authority shall pay interestat the Base Rate plus 2% (two percent), calculated at quarterly rests, on the amountof Termination Payment remaining unpaid; provided that such delay shall not exceed 90 (ninety) days. For the avoidance of doubt, it is expressly agreed that Termination Payment shall constitute full discharge by the Authority of its payment obligations in respect thereof hereunder.

23.6.4 The Contractor expressly agrees that Termination Payment under this Article 23 shall constitute a full and final settlement of all claims of the Contractor on accountof Termination of this Agreement and that it shall not have any further right or claim under any law, treaty, convention, contract or otherwise.

23.7 Other rights and obligations of the Parties

Upon Termination for any reason whatsoever

(a) property and ownership in all Materials, Plant and Works and the Sewerage Project shall, as between the Contractor and the Authority, vest in the Authority in whole; provided that the foregoing shall be without prejudice to Clause 23.6

b) risk of loss or damage to any Materials, Plant or Works and the care and custody thereof shall pass from the Contractor to the Authority; and

(c) the Authority shall be entitled to restrain the Contractor and any person

claiming through or under the Agreement from entering upon the Site or any part of the Project except for taking possession of materials, stores, implements, construction plants and equipment of the Contractor, which have not been vested in the Authority in accordance with the provisions of this Agreement.

23.8 Survival of rights

Notwithstanding anything to the contrary contained in this Agreement any Termination pursuant to the provisions of this Agreement shall be without prejudice to the accrued rights of either Party including its right to claim and recover money damages, insurance proceeds, security deposits, and other rights and remedies, which it may have in law or Agreement. All rights and obligations of either Party under this Agreement, including Termination Payments, shall survive the Termination up to a period of 3 (three) years for giving effect to such rights and obligations.

Part VI
Other Provisions

ARTICLE 24

ASSIGNMENT AND CHARGES

24.1 Restrictions on assignment and charges

This Agreement shall not be assigned by the Contractor to any person, save and except with the prior consent in writing of the Authority, which consent the Authority shall be entitled to decline without assigning any reason.

24.2 Hypothecation of Materials or Plant

Notwithstanding the provisions of Clause 24.1, the Contractor may pledge or hypothecate to its lenders, any Materials or Plant prior to their incorporation in the Works. Further, the Contractor may, by written notice to the Authority, assign its right to receive payments under this Agreement either absolutely or by way of charge, to any person providing financing to the Contractor in connection with the performance of the Contractor's obligations under this Agreement. The Contractor acknowledges that any such assignment by the Contractor shall not relieve the Contractor from any obligations, duty or responsibility under this Agreement.

ARTICLE 25

LIABILITY AND INDEMNITY

25.1 General indemnity

25.1.1 The Contractor will indemnify, defend, save and hold harmless the Authority and its officers, servants, agents, Government Instrumentalities and Government owned and/or controlled entities/enterprises, (the "**Authority Indemnified Persons**") against any and all suits, proceedings, actions, demands and third party claims for any loss, damage, cost and expense of whatever kind and nature, whether arising outof any breach by the Contractor of any of its obligations under this Agreement or from any negligence under the Agreement, including any errors or deficiencies in the design documents, or tort or on any other ground whatsoever, except to the extent that any such suits, proceedings, actions, demands and claims have arisen due to any negligent act or omission, or breach or default of this Agreement on the partof the Authority Indemnified Persons.

25.2 Indemnity by the Contractor

25.2.1 Without limiting the generality of Clause 25.1, the Contractor shall fully indemnify, hold harmless and defend the Authority and the Authority Indemnified Persons from and against any and all loss and/or damages arising out of or with respect to:

(a) failure of the Contractor to comply with Applicable Laws and Applicable Permits;

(b) payment of taxes required to be made by the Contractor in respect of the income or other taxes of the Sub-contractors, suppliers and representatives; or

(c) non-payment of amounts due as a result of Materials or services furnished to the Contractor or any of its Sub-contractors which are payable by the Contractor or any of its Sub-contractors.

25.2.2 Without limiting the generality of the provisions of this Article 25, the Contractor shall fully indemnify, hold harmless and defend the Authority Indemnified Persons from and against any and all suits, proceedings, actions, claims, demands, liabilities and damages which the Authority Indemnified Persons may hereafter suffer, or pay by reason of any demands, claims, suits or proceedings arising out of claims of infringement of any domestic or foreign patent rights, copyrights or other intellectual property, proprietary or confidentiality rights with respect to any materials, information, design or process used by the Contractor or by the Sub- contractors in performing the Contractor's obligations or in any way incorporated in or related to the Project. If in any such suit, action, claim or proceedings, a temporary restraint order or preliminary injunction is granted, the Contractor shall make every reasonable effort, by giving a satisfactory bond or otherwise, to secure the revocation or suspension of the injunction or restraint order. If, in any such suit, action, claim or proceedings, the Sewerage Project, or any part thereof or comprised therein, is held to constitute an infringement and its use is permanently enjoined, the Contractor shall promptly make every reasonable effort to secure for the Authority a licence, at no cost to the Authority, authorising continued use of the infringing work. If the Contractor is unable to secure such licence within a reasonable time, the Contractor shall, at its own expense, and without impairing the Specifications and Standards, either replace the affected work, or part, or process thereof with non- infringing work or part or process, or modify the same so that it becomes non-infringing.

25.3 Notice and contest of claims

In the event that either Party receives a claim or demand from a third party in respect of which it is entitled to the benefit of an indemnity under this Article 25 (the "**Indemnified Party**") it shall notify the other Party (the "**Indemnifying Party**") within 15 (fifteen) days of receipt of the claim or demand and shall not settle or pay the claim without the prior approval of the Indemnifying Party, which approval shall not be unreasonably withheld or delayed. In the event that the Indemnifying Party wishes to contest or dispute the claim or demand, it may conduct the proceedings in the name of the Indemnified Party, subject to the Indemnified Party being secured against any costs involved, to its reasonable satisfaction.

25.4 Defence of claims

25.4.1 The Indemnified Party shall have the right, but not the obligation, to contest, defend and litigate any claim, action, suit or proceeding by any third party alleged or asserted against such Party in respect of, resulting from, related to or arising out ofany matter for which it is entitled to be indemnified hereunder, and reasonable costs and expenses thereof shall be indemnified by the Indemnifying Party. If the Indemnifying Party acknowledges in writing its obligation to indemnify the Indemnified Party in respect of loss to the full extent provided by this Article 25, the Indemnifying Party shall be entitled, at its option, to assume and control the defence of such claim, action, suit or proceeding, liabilities, payments and obligations at its expense and through the counsel of its choice; provided it gives prompt notice of its intention to do so to the Indemnified Party and reimburses the Indemnified Party for the reasonable cost and expenses incurred by the Indemnified Party prior to the assumption by the Indemnifying Party of such defence. The Indemnifying Party shall not be entitled to settle or compromise any claim, demand, action, suit or proceeding without the prior written consent of the Indemnified Party, unless the Indemnifying Party provides such security to the Indemnified Party as shall be reasonably required by the Indemnified Party to secure the loss to be indemnified hereunder to the extent so compromised or settled.

25.4.2 If the Indemnifying Party has exercised its rights under Clause 25.3, the Indemnified Party shall not be entitled to settle or compromise any claim, action, suit or proceeding without the prior written consent of the Indemnifying Party (which consent shall not be unreasonably withheld or delayed).

25.4.3 If the Indemnifying Party exercises its rights under Clause 25.3, the Indemnified Party shall nevertheless have the right to employ its own counsel, and such counsel may participate in such action, but the fees and expenses of such counsel shall be at the expense of the Indemnified Party, when and as incurred, unless:

(a) the employment of counsel by such party has been authorised in writing by the Indemnifying Party; or

(b) the Indemnified Party shall have reasonably concluded that there may be a conflict of interest between the Indemnifying Party and the Indemnified Party in the conduct of the defence of such action; or

(c) the Indemnifying Party shall not, in fact, have employed independent counsel reasonably satisfactory to the Indemnified Party, to assume the defence of such action and shall have been so notified by the Indemnified Party; or

(d) the Indemnified Party shall have reasonably concluded and specifically notified the Indemnifying Party either:

(i) that there may be specific defences available to it which are different from or additional to those available to the Indemnifying Party; or

(ii) that such claim, action, suit or proceeding involves or could have a material adverse effect upon it beyond the scope of this Agreement:

Provided that if Sub-clauses (b), (c) or (d) of this Clause 25.4.3 shall be applicable, the counsel for the Indemnified Party shall have the right to direct the defence ofsuch claim, demand, action, suit or proceeding on behalf of the Indemnified Party, and the reasonable fees and disbursements of such counsel shall constitute legal or other expenses hereunder.

25.5 No consequential claims

Notwithstanding anything to the contrary contained in this Article 25, the indemnities herein provided shall not include any claim or recovery in respect of any cost, expense, loss or damage of an indirect, incidental or consequential nature, including loss of profit, except as expressly provided in this Agreement.

25.6 Survival on Termination

The provisions of this Article 25 shall survive Termination.

ARTICLE 26

DISPUTE RESOLUTION

26.1 Dispute Resolution

26.1.1 Any dispute, difference or controversy of whatever nature howsoever arising under or out of or in relation to this Agreement (including its interpretation) between the Parties, and so notified in writing by either Party to the other Party (the "**Dispute**") shall, in the first instance, be attempted to be resolved amicably in accordance with the conciliation procedure set forth in Clause 26.2.

26.1.2 The Parties agree to use their best efforts for resolving all Disputes arising under or in respect of this Agreement promptly, equitably and in good faith, and further agree to provide each other with reasonable access during normal business hours to all non-privileged records, information and data pertaining to any Dispute.

26.2 Conciliation

In the event of any Dispute between the Parties, either Party may call upon the Authority's Engineer, or such other person as the Parties may mutually agree upon (the "**Conciliator**") to mediate and assist the Parties in arriving at an amicable settlement thereof. Failing mediation by the Conciliator or without the intervention of the Conciliator, either Party may require such Dispute to be referred to the Managing Director, WATCO and the Chairman of the Board of Directors of the Contractor for amicable settlement, and upon such reference, the said persons shall meet no later than 7 (seven) business days from the date of reference to discuss and attempt to amicably resolve the Dispute. If such meeting does not take place within the 7 (seven) business day period or the Dispute is not amicably settled within 15 (fifteen) days of the meeting or the Dispute is not resolved as evidenced by the signing of written terms of settlement within 30 (thirty) days of the notice in writing referred to in Clause 26.1.1 or such longer period as may be mutually agreed by the Parties, either Party may refer the Dispute to arbitration in accordance with the provisions of Clause 26.3.

26.3 Arbitration

26.3.1 Any Dispute which is not resolved amicably by conciliation, as provided in Clause 26.2, shall be finally decided by reference to arbitration by a Board of Arbitrators appointed in accordance with Clause 26.3.2. Such arbitration shall beheld in accordance with the Arbitration and Conciliation Act, 1996 of India. **The venue of such arbitration shall be [Bhubaneswar]**, and the language of arbitration proceedings shall be English.

26.3.2 There shall be a Board of three arbitrators, of whom each Party shall select one, and the third arbitrator shall be appointed by the two arbitrators so selected and in the event of disagreement between the two arbitrators, the appointment shall be made in accordance with the Rules.

26.3.3 The arbitrators shall make a reasoned award (the "**Award**"). Any Award made in any arbitration held pursuant to this Article 26 shall be final and binding on the Parties as from the date it is made, and the Contractor and the Authority agree and undertake to carry out such Award without delay.

26.3.4 The Contractor and the Authority agree that an Award may be enforced against the Contractor and/or the Authority, as the case may be, and their respective assets wherever situated.

26.3.5 This Agreement and the rights and obligations of the Parties shall remain in full force and effect, pending the Award in any arbitration proceedings hereunder.

26.3.6 In the event the Party against whom the Award has been granted challenges the Award for any reason in a court of law, it shall make an interim payment to the

other Party for an amount equal to 75% (seventy-five per cent) of the Award, pending final settlement of the Dispute. The aforesaid amount shall be paid forthwith upon furnishing an irrevocable Bank Guarantee for a sum equal to 120 % (one hundred and twenty per cent) of the aforesaid amount. Upon final settlement of the Dispute, the aforesaid interim payment shall be adjusted and any balance amount due to be paid or returned, as the case may be, shall be paid or returned with interest calculated at the rate of 10% (ten per cent) per annum from the date of interim payment to the date of final settlement of such balance.

26.4 Adjudication by Regulatory Authority, Tribunal or Commission

In the event of constitution of a statutory regulatory authority, tribunal or commission, as the case may be, with powers to adjudicate upon disputes between the Contractor and the Authority, all Disputes arising after such constitution shall, instead of reference to arbitration under Clause 26.3, be adjudicated upon by such regulatory authority, tribunal or commission in accordance with the Applicable Law and all references to Dispute Resolution Procedure shall be construed accordingly. For the avoidance of doubt, the Parties hereto agree that the adjudication hereunder shall not be final and binding until an appeal against such adjudication has been decided by an appellate tribunal or court of competent jurisdiction, as the case maybe, or no such appeal has been preferred within the time specified in the Applicable Law.

ARTICLE 27

MISCELLANEOUS

27.1 Governing law and jurisdiction

This Agreement shall be construed and interpreted in accordance with and governed by the laws of Odisha/ India, and the courts at [Bhubaneswar] shall have exclusive jurisdiction over matters arising out of or relating to this Agreement.

27.2 Waiver of immunity

Each Party unconditionally and irrevocably:

(a) agrees that the execution, delivery and performance by it of this Agreement constitute commercial acts done and performed for commercial purpose;

(b) agrees that, should any proceedings be brought against it or its assets, property or revenues in any jurisdiction in relation to this Agreement or any transaction contemplated by this Agreement, no immunity (whether by reason of sovereignty or otherwise) from such proceedings shall be claimed by or on behalf of the Party with respect to its assets;

(c) waives any right of immunity which it or its assets, property or revenues now has, may acquire in the future or which may be attributed to it in any jurisdiction; and

(d) consents generally in respect of the enforcement of any judgement or award against it in any such proceedings to the giving of any relief or the issue of any process in any jurisdiction in connection with such proceedings (including the making, enforcement or execution against it or in respect ofany assets, property or revenues whatsoever irrespective of their use or intended use of any order or judgement that may be made or given in connection therewith).

27.3 Delayed payments

The Parties hereto agree that payments due from one Party to the other Party under the provisions of this Agreement shall be made within the period set forth therein, and if no such period is specified, within 30 (thirty) days of receiving a demand along with the necessary particulars. In the event of delay beyond such period, the defaulting Party shall pay interest for the period of delay calculated at a rate equal to Base Rate plus 2 (two) percent, calculated at quarterly rests, and recovery thereof shall be without prejudice to the rights of the Parties under this Agreement including Termination thereof.

27.4 Waiver

27.4.1 Waiver, including partial or conditional waiver, by either Party of any default by the other Party in the observance and performance of any provision of or obligations under this Agreement:-

(a) shall not operate or be construed as a waiver of any other or subsequentdefault hereof or of other provisions of or obligations under this Agreement;

(b) shall not be effective unless it is in writing and executed by a duly authorised representative of the Party; and

(c) shall not affect the validity or enforceability of this Agreement in anymanner.

27.4.2 Neither the failure by either Party to insist on any occasion upon the performance of the terms, conditions and provisions of this Agreement or any obligation there under nor time or other indulgence granted by a Party to the other Party shall be treated or deemed as waiver of such breach or acceptance of any variation or the relinquishment of any such right hereunder.

27.5 Liability for review of Documents and Drawings

Except to the extent expressly provided in this Agreement:

(a) no review, comment or approval by the Authority or the Authority's Engineer of any Document or Drawing submitted by the Contractor nor any observation

or inspection of the construction or operation &maintenance of the Sewerage Project nor the failure to review, approve, comment, observe or inspect hereunder shall relieve or absolve the Contractor from its obligations, duties and liabilities under this Agreement, the Applicable Laws and Applicable Permits; and

(b) the Authority shall not be liable to the Contractor by reason of any review, comment, approval, observation or inspection referred to in Sub-clause (a) above.

27.6 Exclusion of implied warranties etc.

This Agreement expressly excludes any warranty, condition or other undertaking implied at law or by custom or otherwise arising out of any other agreement between the Parties or any representation by either Party not contained in a binding legal agreement executed by both Parties.

27.7 Survival

27.7.1 Termination shall:

(a) not relieve the Contractor or the Authority, as the case may be, of any obligations hereunder which expressly or by implication survive Termination hereof; and

(b) except as otherwise provided in any provision of this Agreement expressly limiting the liability of either Party, not relieve either Party of any obligations or liabilities for loss or damage to the other Party arising out of,or caused by, acts or omissions of such Party prior to the effectiveness of such Termination or arising out of such Termination.

27.7.2 All obligations surviving Termination/ final settlements shall only survive for a period of 3 (three) years following the date of such Termination/ final settlements.

27.8 Entire Agreement

This Agreement and the Schedules together constitute a complete and exclusive statement of the terms of the agreement between the Parties on the subject hereof, and no amendment or modification hereto shall be valid and effective unless such modification or amendment is agreed to in writing by the Parties and duly executed by persons especially empowered in this behalf by the respective Parties. All prior written or oral understandings, offers or other communications of every kind pertaining to this Agreement are abrogated and withdrawn. For the avoidance of doubt, the Parties hereto agree that any obligations of the Contractor arising fromthe Request for Proposal or Request for Proposals, as the case may be, shall be deemed to form part of this Agreement and treated as such.

27.9 Severability

If for any reason whatever, any provision of this Agreement is or becomes invalid, illegal or unenforceable or is declared by any court of competent jurisdiction or any other instrumentality to be invalid, illegal or unenforceable, the validity, legality or enforceability of the remaining provisions shall not be affected in any manner, and the Parties will negotiate in good faith with a view to agreeing to one or more provisions which may be substituted for such invalid, unenforceable or illegal provisions, as nearly as is practicable to such invalid, illegal or unenforceable provision. Failure to agree upon any such provisions shall not be subject to the Dispute Resolution Procedure set forth under this Agreement or otherwise.

27.10 No partnership

This Agreement shall not be interpreted or construed to create an association, joint venture or partnership between the Parties, or to impose any partnership obligation or liability upon either Party, and neither Party shall have any right, power or authority to enter into any agreement or undertaking for, or act on behalf of, or to act as or be an agent or representative of, or to otherwise bind, the other Party.

27.11 Third parties

This Agreement is intended solely for the benefit of the Parties, and their respective successors and permitted assigns, and nothing in this Agreement shall be construed to create any duty to, standard of care with reference to, or any liability to, any person not a Party to this Agreement.

27.12 Successors and assigns

This Agreement shall be binding upon, and inure to the benefit of the Parties and their respective successors and permitted assigns.

27.13 Notices

Any notice or other communication to be given by any Party to the other Party under or in connection with the matters contemplated by this Agreement shall be in writing and shall:

(a) in the case of the Contractor, be given by facsimile or e-mail and by letter delivered by hand to the address given and marked for attention of the person set out below or to such other person as the Contractor may from time to time designate by notice to the Authority; provided that notices or other communications to be given to an address within Odisha may, if they are subsequently confirmed by sending a copy thereof by registered acknowledgement due, air mail or by courier, be sent by facsimile or e-mail to the person as the Contractor may from time to time designate by notice to the Authority;

(b) in the case of the Authority, be given by facsimile or e-mail and by letter deliveredby hand and be addressed to the Authority with a copy delivered to the Authority Representative or such other person as the Authority may from time to time designate by notice to the Contractor; provided that if the Contractor does not havean office in [Bhubaneswar], it may send such notice by facsimile or e-mail and by registered acknowledgement due, air mail or by courier; and

(c) any notice or communication by a Party to the other Party, given in accordance herewith, shall be deemed to have been delivered when in the normal course of postit ought to have been delivered and in all other cases, it shall be deemed to have been delivered on the actual date and time of delivery; provided that in the case of facsimile or e-mail, it shall be deemed to have been delivered on the working day following the date of its delivery.

27.14 Language

All notices required to be given by one Party to the other Party and all other communications, Documentation and proceedings which are in any way relevant to this Agreement shall be in writing and in English language.

27.15 Counterparts

This Agreement may be executed in two counterparts, each of which, when executed and delivered, shall constitute an original of this Agreement.

27.16 Confidentiality

The Parties shall treat the details of this Agreement as private and confidential, except to the extent necessary to carry out obligations under it or to comply with Applicable Laws. The Contractor shall not publish, permit to be published, or disclose any particulars of the Works in any trade or technical paper or elsewhere without the previous agreement of the Authority.

27.17 Copyright and Intellectual Property rights

27.17.1 As between the Parties, the Contractor shall retain the copyright and other intellectual property rights in the Contractor's Documents and other design documents made by (or on behalf of) the Contractor. The Contractor shall be deemed (by signing this Agreement) to give to the Authority a non-terminable transferable non-exclusive

royalty-free license to copy, use and communicate the Contractor's Documents, including making and using modifications of them. This license shall:

(a) apply throughout the actual or intended working life (whichever is longer) of the relevant parts of the Works,

(b) entitle any person in proper possession of the relevant part of the Works to copy, use and communicate the Contractor's Documents for the purposes of completing, operating, maintaining, altering, adjusting, repairing and demolishing the Works, and

(c) in the case of Contractor's Documents which are in the form of computer programs and other software, permit their use on any computer on the Site and other places as envisaged by this Agreement, including replacements of any computers supplied by the Contractor:

27.17.2 The Contractor's Documents and other design documents made by (or on behalf of) the Contractor shall not, without the Contractor's consent, be used, copied or communicated to a third party by (or on behalf of) the Authority for purposes other than those permitted under this Clause 27.17.

27.17.3 As between the Parties, the Authority shall retain the copyright and other intellectual property rights in this Agreement and other documents made by (or on behalf of) the Authority. The Contractor may, at its cost, copy, use, and obtain communication of these documents for the purposes of this Agreement. They shall not, without the Authority's consent, be copied, used or communicated to a third party by the Contractor, except as necessary for the purposes of the contract.

27.18 Limitation of Liability

27.18.1 Neither Party shall be liable to the other Party for loss of use of any Works, loss of profit, loss of any contract or for any indirect or consequential loss or damage which may be suffered by the other Party in connection with this Agreement, save and except as provided under Articles 23 and 25.

27.18.2 The total liability of one Party to the other Party under and in accordance with the provisions of this Agreement, save and except as provided in Articles 23 and 25,shall not exceed the Contract Price. For the avoidance of doubt, this Clause shall not limit the liability in any case of fraud, deliberate default or reckless misconduct by the defaulting Party.

ARTICLE 28

DEFINITIONS

28.1 Definitions

In this Agreement, the following words and expressions shall, unless repugnant to the context or meaning thereof, have the meaning hereinafter respectively assigned to them:

"**Accounting Year**" means the financial year commencing from the first day of April of any calendar year and ending on the thirty-first day of March of the next calendar year;

"**Advance Payment**" shall have the meaning set forth in Clause 19.2;

"**Affected Party**" shall have the meaning set forth in Clause 21.1;

"**Affiliate**" means, in relation to either Party {and/or Members}, a person who controls, is controlled by, or is under the common control with such Party {or Member} (as used in this definition, the expression "control" means, with respect toa person which is a company or corporation, the ownership, directly or indirectly, of more than 50% (fifty per cent) of the voting shares of such person, and with respectto a person which is not a company or corporation, the power to direct the management and policies of such person, whether by operation of law or by contractor otherwise);

"Agreement" means this Agreement, its Recitals, the Schedules hereto and any amendments thereto made in accordance with the provisions contained in this Agreement;

"Applicable Laws" means all laws, brought into force and effect by GOI or the State Government including rules, regulations and notifications made there under, and judgements, decrees, injunctions, writs and orders of any court of record, applicable to this Agreement and the exercise, performance and discharge of the respective rights and obligations of the Parties hereunder, as may be in force and effect during the subsistence of this Agreement;

"Applicable Permits" means all clearances, licenses, permits, authorisations, no objection certificates, consents, approvals and exemptions required to be obtained or maintained under Applicable Laws in connection with the construction, operation and maintenance of the Sewerage Projects during the subsistence of this Agreement;

"**Appointed Date**" means that date which is later of the 15th day of the date of this Agreement, the date on which the Contractor has delivered the Performance Security in accordance with the provisions of Article 7 and the date on which the Authority has provided the land / site on no less than 90% (Ninety per cent) of the required **area of major structures of the** of ***the Project***;

"Arbitration Act" means the Arbitration and Conciliation Act, 1996 and shall include modifications to or any re-enactment thereof, as in force from time to time;

"Authority" shall have the meaning attributed thereto in the array of Parties hereinabove as set forth in the Recitals;

"Authority's Default" shall have the meaning set forth in Clause 23.2;

"Authority's Engineer" shall have the meaning set forth in Clause 18.1;

"Authority's Representative" means such person or persons as may be authorised in writing by the Authority to act on its behalf under this Agreement and shall include any person or persons having authority to exercise any rights or perform and fulfil any obligations of the Authority under this Agreement;

"Bank" means a Nationalised Bank in India;

"Base Rate" means the floor rate of interest announced by the State Bank of India for all its lending operations;

"Base Date" means the last date of that calendar month, which date precedes the Bid Due Date by at least28 (twenty-eight) days;

"Bid" means the documents in their entirety comprised in the bid submitted by the [selected bidder/Consortium] in response to the Request for Proposals in accordance with the provisions thereof;

"**Bid Security**" means the bid security provided by the Contractor to the Authorityin accordance with the Request for Proposal, and which is to remain in force until substituted by the Performance Security;

"Change in Law" means the occurrence of any of the following after the Base Date:

(a) the enactment of any new Indian law;

(b) the repeal, modification or re-enactment of any existing Indian law;

(c) the commencement of any Indian law which has not entered into effect until the Base Date;

(d) a change in the interpretation or application of any Indian law by a judgement of a court of record which has become final, conclusive and binding, as compared to such interpretation or application by a court of record prior to the Base Date; or

(e) any change in the rates of any of the Taxes or royalties that have a direct effect on the Project;

"Change of Scope" shall have the meaning set forth in Article 13;

"Change of Scope Notice" shall have the meaning set forth in Clause 13.2.1;

"Change of Scope Order" shall have the meaning set forth in Clause 13.2.4;

"Completion Certificate" shall have the meaning set forth in Clause 12.4;

{"Consortium "means the consortium of entities which have formed a joint venture for implementation of this Project;}[$]

"Construction" shall have the meaning set forth in Clause 1.2.1 (f);

"Construction Period" means the period commencing from the Appointed Date and ending on the date of the Completion Certificate;

"Contract Price" means the amount specified in Clause 19.1.1;

"Contractor" shall have the meaning attributed thereto in the array of Parties hereinabove as set forth in the Recitals;

"Contractor Default" shall have the meaning set forth in Clause 23.1;

"Cure Period" means the period specified in this Agreement for curing any breach or default of any provision of this Agreement by the Party responsible for such breach or default and shall:

(a) commence from the date on which a notice is delivered by one Party to the other Party asking the latter to cure the breach or default specified in such notice;

(b) not relieve any Party from liability to pay Damages or compensation under the provisions of this Agreement; and

(c) not in any way be extended by any period of Suspension under this Agreement; provided that if the cure of any breach by the Contractor requires any reasonable action by the Contractor that must be approved by the Authority or the Authority's Engineer hereunder, the applicable Cure Period shall be extended by the period taken by the Authority or the Authority's Engineer to accord their approval;

"CPHEEO" means Central Public Health & Environmental Engineering Organisation, MoUD, Govt. of India.

[$]This definition may be omitted if the Contractor is not a Consortium.

"Damages" shall have the meaning set forth in paragraph (w) of Clause 1.2.1;
"Defect" means any defect or deficiency in Construction of the Works or any part thereof, which does not conform with the Specifications and Standards, and in the case of Operation &Maintenance, means any defect or deficiency which is specified in Schedule-E;
"Defects Liability Period" shall have the meaning set forth in Clause 17.1;
"Dispute" shall have the meaning set forth in Clause 26.1.1;
"Dispute Resolution Procedure" means the procedure for resolution of Disputes set forth in Article 26;
"Drawings" means all of the drawings, calculations and documents pertaining to the Sewerage Project as set forth in Schedule-I, and shall include 'as built' drawings of the Sewerage Project;
"Document" or "Documentation" means documentation in printed or written form, or in tapes, discs, drawings, computer programmes, writings, reports, photographs, films, cassettes, or expressed in any other written, electronic, audio or visual form;
"Emergency" means a condition or situation that is likely to endanger the safety or security of the individuals on or about the Sewerage Project, including Users thereof, or which poses an immediate threat of material damage to any of the Project Assets;
"Encumbrances" means, in relation to the Sewerage Project, any encumbrances such as mortgage, charge, pledge, lien, hypothecation, security interest, assignment, privilege or priority of any kind having the effect of security or other such obligations, and shall include any designation of loss payees or beneficiaries or any similar arrangement under any insurance policy pertaining to the Sewerage Project, where applicable herein but excluding utilities referred to in Clause 9.1;
"EPC" means engineering, procurement and construction;
"Final Payment Certificate "shall have the meaning set forth in Clause 19.15.1;
"**Final Payment Statement** "shall have the meaning set forth in Clause 19.13.1;
"Force Majeure" or "Force Majeure Event" shall have the meaning ascribed to it in Clause 21.1;
"GAD" or "General Arrangement Drawings" shall have the meaning set forth in Clause 4.1.3 (b);
"GOI" or "Government" means the Government of India or the Government of Odisha, as the case may be;
"Good Industry Practice" means the practices, methods, techniques, designs, standards, skills, diligence, efficiency, reliability and prudence which are generally and reasonably expected from a reasonably skilled and experienced contractor engaged in the same type of undertaking as envisaged under this Agreement and which would be expected to result in the performance of its obligations by the Contractor in accordance with this Agreement, Applicable Laws and Applicable Permits in reliable, safe, economical and efficient manner;
"Government Instrumentality" means any department, division or sub-division of the Government or the State Government and includes any commission, board, authority, agency or municipal and other local authority or statutory body including panchayat under the control of the Government or the State Government, as the case may be, and having jurisdiction over all or any part of the Sewerage Projector the performance of all or any of the services or obligations of the Contractor under or pursuant to this Agreement;
"Indemnified Party" means the Party entitled to the benefit of an indemnity pursuant to Article 25;

"Indemnifying Party" means the Party obligated to indemnify the other Party pursuant to Article 25;

"Indirect Political Event" shall have the meaning set forth in Clause 21.3;

"Insurance Cover" means the aggregate of the maximum sums insured under the insurances taken out by the Contractor pursuant to Article 20, and includes all insurances required to be taken out by the Contractor under Clauses 20.1 and 20.9 but not actually taken, and when used in the context of any act or event, it shall mean the aggregate of the maximum sums insured and payable or deemed to be insured and payable in relation to such act or event;

"Intellectual Property" means all patents, trademarks, service marks, logos, get-up, trade names, internet domain names, rights in designs, blue prints, programmes and manuals, drawings, copyright (including rights in computer software), database rights, semi-conductor, topography rights, utility models, rights in know-how and other intellectual property rights, in each case whether registered or unregistered and including applications for registration, and all rights or forms of protection having equivalent or similar effect anywhere in the world;

"**Interim Payment Certificate**" or "**IPC**" the interim payment certificate issued by the Authority's Engineer for payment to the Contractor in respect of Contractor's claims for payment raised in accordance with the provisions of this Agreement;

{"Lead Member" shall, in the case of a consortium, mean the member of such consortium who shall have the authority to bind the contractor and each member of the Consortium; and shall be deemed to be the Contractor for the purposes of this Agreement;}[$]

"LOA" or "Letter of Acceptance" means the letter of acceptance referred to in Recital (E);

"Operation &Maintenance" means the operation &maintenance of the Sewerage Project as set forth in Article 14 for the period specified therein;

"**Operation & Maintenance Inspection Report**" shall have the meaning set forth in Clause 15.2.1;

"Operation &Maintenance Manual" shall have the meaning ascribed to it in Clause 10.7;

"Operation &Maintenance Programme" shall have the meaning set forth in Clause 14.3;

"Operation & Maintenance Period" shall have the meaning set forth in Clause 14.1.1;

"Operation &Maintenance Requirements" shall have the meaning set forth in Clause 14.2;

"Major structures" means different units & components of Sewage Treatment Plant and Sewage Pumping Stations.

"**Manual**" shall mean the Manual on sewerage and sewage treatment published by CPHEEO, MoUD, GoI;

"Material Adverse Effect" means a material adverse effect of any act or event on the ability of either Party to perform any of its obligations under and in accordance with the provisions of this Agreement and which act or event causes a material financial burden or loss to either Party;

"Materials" are all the supplies used by the Contractor for incorporation in the Works or for the Operation & Maintenance of the Sewerage Project;

"Monthly Operation &Maintenance Statement shall have the meaning set forth in Clause 19.6.1;

"**MoUD**" means the Ministry of Urban Development, GoI;

$This definition may be omitted if the Contractor is not a Consortium.

"**Non-Political Event**" shall have the meaning set forth in Clause 21.2;
"Parties" means the parties to this Agreement collectively and "Party" shall mean any of the parties to this Agreement individually;
"Performance Security" shall have the meaning set forth in Clause 7.1;
"Plant" means the apparatus and machinery intended to form or forming part of the Works;
"Political Event" shall have the meaning set forth in Clause 21.4;
"Programme" shall have the meaning set forth in Clause 10.1.3;
"Project" means the construction and operation &maintenance of the Sewerage Project in accordance with the provisions of this Agreement, and includes all works, services and equipment relating to or in respect of the Scope of the Project;
"Project Assets" means all physical and other assets relating to (a) tangible assets such as civil works, electrical works, mechanical works and equipments, electrical systems, communication systems, rest areas and administrative offices, laboratory facilities; and (b) Project Facilities situated on the Site; etc.
"Project Completion Date" means the date on which the Provisional Certificate is issued and, in the event, no Provisional Certificate is issued, the date on which the Completion Certificate is issued;
"Project Completion Schedule" means the progressive Project Milestones set forth in Schedule-J for completion of the Sewerage Project on or before the Scheduled Completion Date;
"Project Facilities" means all the amenities and facilities situated on the Site, as described in Schedule-C;
"**Sewerage Project**" means the proposed Sewerage Project to be executed as mentioned at Annex –I of schedule –A in accordance with this Agreement;
"Project Milestone" means the project milestone set forth in Schedule-J;
"Proof Consultant" shall have the meaning set forth in Clause 10.2.2;
"Provisional Certificate" shall have the meaning set forth in Clause 12.2;
"Punch List" shall have the meaning set forth in Clause 12.2.1;
"Quality Assurance Plan" or **"QAP"** shall have the meaning set forth in Clause 11.2**;**
"Re.", "Rs." or "Rupees" or "Indian Rupees" means the lawful currency of the Republic of India;
"**Request for Proposals**" *or* "**RFP**" shall have the meaning set forth in Recital 'D';
"Retention Money" shall have the meaning set forth in Clause 7.5.1;
"Land / Site" means the constructive possession of the Site free from encroachments and encumbrances, together with all way leaves, easements, unrestricted access and other rights of way, howsoever described, necessary for construction and operation &maintenance of the Sewerage Project in accordance with this Agreement;
"**Safety Consultant**" shall have the meaning set forth in Clause 10.1.5;
"Scheduled Completion Date" shall be the date set forth in Clause 10.3.1;
"Scope of the Project" shall have the meaning set forth in Clause 2.1;
"Section" means a part of the ***Sewerage Project***;
"Site" shall have the meaning set forth in Clause 8.1;
"Specifications and Standards" means the specifications and standards relating to the quality, quantity, capacity and other requirements for the Sewerage Project, as set forth in Schedule-D, and any modifications thereof, or additions thereto, as included in the design and engineering for the Sewerage Project submitted by the Contractor to, and expressly approved by, the Authority;
"**Stage Payment Statement**" shall have the meaning set forth in Clause 19.4;
"**Structures**" means all civil, electrical and mechanical installations, as the case maybe;
"Sub-contractor" means any person or persons to whom a part of the Works or the

Operation &Maintenance has been subcontracted by the Contractor and the permitted legal successors in title to such person, but not an assignee to such person;
"Suspension" shall have the meaning set forth in Article 22;
"Taxes" means any Indian taxes including **GST**, customs duties, value added tax, sales tax, local taxes, cess and any impost or surcharge of like nature (whether Central, State or local) on the goods, Materials, equipment and services incorporated inand forming part of the ***Sewerage Project*** charged, levied or imposed by any Government Instrumentality, but excluding any interest, penalties and other sums in relation thereto imposed on any account whatsoever. For the avoidance of doubt, Taxesshall not include taxes on corporate income;
"Termination" means the expiry or termination of this Agreement;
"Termination Notice" means the communication issued in accordance with this Agreement by one Party to the other Party terminating this Agreement;
"Termination Payment" means the amount payable by either Party to the other upon Termination in accordance with Article 23;
"Terms of Reference" or "TOR" shall have the meaning set forth in Clause 18.2.1;
"Tests" means the tests set forth in Schedule-K to determine the completion of Works in accordance with the provisions of this Agreement;
"Time Extension" shall have the meaning set forth in Clause 10.5.1;
"User" means a person or entity who uses or intends to use the sewerage system for discharge of wastewater.
"**Valuation of Unpaid works**" shall have the meaning set forth in Clause 23.5.1;
"Works" means all works including survey and investigation, design, engineering, procurement, construction, Plant, Materials, operation &maintenance, temporary works and other things necessary to complete the Sewerage Project in accordance with this Agreement; and
"WPI" means the wholesale price index for various commodities as published by the Ministry of Commerce and Industry, GOI and shall include any index which substitutes the WPI, and any reference to WPI shall, unless the context otherwise requires, be construed as a reference to the WPI published for the period ending with the preceding month.

IN WITNESS WHEREOF THE PARTIES HAVE EXECUTED AND DELIVERED THIS AGREEMENT AS OF THE DAY, MONTH AND YEAR FIRST ABOVE WRITTEN.

SIGNED, SEALED ANDDELIVERED
For and on behalf of
[MANAGING DIRECTOR, WATCO] by:

(Signature)

(Name)
(Designation)

In the presence of: 1.

2.

SIGNED, SEALED ANDDELIVERED
For and on behalf of
THE CONTRACTOR by:

(Signature)

(Name)
(Designation)

{COUNTERSIGNED and accepted by:
Name and particulars of other members of the Consortium}

SCHEDULES

Schedule A & B for "Construction of Waste Water Treatment Plant at the Confluence point of River Daya & Ganguanala (Phase-II)" on Engineering, Procurement & Construction (EPC) Contract Including Operation & Maintenance for a Period of Five (5) Years.

SCHEDULE - A

(See Clauses 2.1 and 8.1)

SITE OF THE PROJECT

1 The Site

1.1 Site of the Project **Construction of Waste Water Treatment Plant at the Confluence point of River Daya & Ganguanala (Phase-II)**.

1.2 The dates of handing over the site to the Contractor are specified in Annex-II of this Schedule-A.

1.3 An inventory of the Site including the land, buildings, structures, road works, trees and any other immovable property on, or attached to the Site shall be prepared jointly by the Authority's Engineer or his Representative and the Contractor; and such inventory shall form part of the memorandum referred to in Clause 8.2.1 of this Agreement.

1.4 The alignment plans of the sewerage project are specified in Annexure-III.

1.5 The status of the environment clearances (obtained or awaited) is given in Annex IV.

Annexure - I

(Schedule-A)

Site

[Note: Through suitable drawings and description in words, the land, buildings, structures and road works comprising the Site shall be specified briefly but precisely in this Annex-I.]

1. The Site

The Site of the work "**Construction of Waste Water Treatment Plant at the Confluence point of River Daya & Ganguanala (Phase-II)" on Engineering, Procurement & Construction (EPC) Contract Including Operation & Maintenance for a Period of Five (5) Years**, comprises of construction of 17.13 Km of RCC Gravity Sewer Network, 7.67 Km of Rising Main, 623 nos of Manholes, 5 numbers of sewage pumping stations, 5 nos Sub-stations along with transformer 100KVA to 350 KVA, DG sets, construction of 11 nos Interception & Diversion works, including preparation of detail design and drawings, supply of labour, materials, equipment, fabrication, erection, construction, testing, commissioning, guaranteeing the performance of the proposed sewerage system.

The details of locations of STP and SPSs are given below.

1.1 Interception & Diversion Structures

Sl. No.	I & D Strurcture	Location/ Chainage	Cluster No	Status	Remark
1.	Drain-1	300m	Cluster-I	Available	Existing Drain / Govt. Land
2.	Drain-2 & 3	2900m		Available	Existing Drain / Govt. Land
3.	Drain-4	5100m	Cluster-II	Available	Existing Drain / Govt. Land
4,	Drain-4A	8000m		Available	Existing Drain / Govt. Land
5.	Drain-10	10400m		Available	Existing Drain / Govt. Land
6	Drain-5	12050m		Available	Existing Drain / Govt. Land
7	Drain-6	14000m	Cluster-III	Available	Existing Drain / Govt. Land
8	Drain-7	18700m		Available	Existing Drain / Govt. Land
9	Drain-8, 8a & 9	23700m	Cluster-IV	Available	Existing Drain / Govt. Land
10	Drain-9A	25100m		Available	Existing Drain / Govt. Land
11	Drain-11	28000m		Available	Existing Drain / Govt. Land

1.2 Sewage Pumping Stations (SPS) sites

Sl. No.	Pumping Station Name	Location	Cluster No	Status	Remark
1.	SPS-1A for STP at Rokat	Bhubaneswar	Cluster-I	Available	Govt. Land
2.	SPS-1B for STP at Rokat	Bhubaneswar		Available	Govt. Land
3.	SPS-2 for STP at Meherpali	Bhubaneswar	Cluster-II	Available	Govt. Land

4,	SPS-3 for STP at Basuaghai	Bhubaneswar	Cluster-III	Available	Govt. Land
5.	SPS-4 for 60MLD STP at Confluence	Bhubaneswar	Cluster-IV	Available	Govt. Land

- For further details about land please contact the **General Manager, WATCO Division-II, Bhubaneswar, (M) 70088 29309 and the Manager, WATCO Sub Division Bhubaneswar, (M) 7978487105.**

1.3 Gravity Sewer network & Rising Mains

The gravity sewer network along with manholes and the rising mains originating from the sewage pumping stations shall be laid along the road beside Gangua nalla.

Annexure - II

(Schedule-A)

Dates for providing different construction site

The tentative dates on which the Authority will provide site to the Contractor are stated below:

Sl. No	Sites For SPS	Details of location	Date of providing the site*
1	2	3	4
1	SPS-1A	STP at Rokat, Bhubaneswar	Within 90 Days
2	SPS-1B	STP at Rokat, Bhubaneswar	Within 90 Days
3	SPS-2	STP at Meherpali, Bhubaneswar	Within 90 Days
4	SPS-3	STP at Basuaghai, Bhubaneswar	Within 90 Days
5	SPS-4	60 MLD STP at Confluence River Daya & Gangua Nalla, Bhubaneswar	Within 90 Days

Sl.	I & D Sturcture	Location/ Chainage	Cluster No	Date of providing the site*
1.	Drain-1	300m	Cluster-I	Within 90 Days
2.	Drain-2 & 3	2900m		Within 90 Days
3.	Drain-4	5100m	Cluster-II	Within 90 Days
4.	Drain-4A	8000m		Within 90 Days
5.	Drain-10	10400m		Within 90 Days
6.	Drain-5	12050m		Within 90 Days
7.	Drain-6	14000m	Cluster-III	Within 90 Days
8.	Drain-7	18700m		Within 90 Days
9.	Drain-8, 8a & 9	23700m	Cluster-IV	Within 90 Days
10.	Drain-9A	25100m		Within 90 Days
11.	Drain-11	28000m		Within 90 Days

* The dates specified herein shall in no case be beyond 180 (One hundred and eighty) days after the Appointed Date.

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Annexure - III

(Schedule-A)

Alignment Plans

The proposed Layout Plan of Underground Sewerage Project includes includes SPS , Pipe network and I&D structures having following maps and as given in Schedule -A.

(i) Key Map showing Cluster-I to IV – shall be provided in Schedule-A

(ii) Proposed sewer network – shall be provided in Schedule-A

(iii) Location of Sewage Pumping Stations, I&D Structures & Rising Mains. – shall be provided in Schedule-A

(iv) Other relevant drawings

Annex - IV

(Schedule-A)

Environment Clearances

Requirement of any Environment clearance is being assessed.

SCHEDULE - B

(See Clause 2.1)

Development of the Waste Water Project

1 Development of the Sewerage Project

Development of the Sewerage Project shall include Topographic survey, Geo-Technical Investigation, Design, Detailed Engineering, and Construction of the Sewerage Project as described in this Schedule-B and in Schedule-C.

2 Specifications and Standards

The Sewerage Project shall be designed and constructed in conformity with the Specifications and Standards specified in Annex-I of Schedule-D.

Annex - I

(Schedule-B)

Description of the Project

1. General Features of the Project

The intent of this Section is to specify the work items to be covered on **'EPC Contract Basis'** in conformity with the technical specifications as enumerated in the subsequent clauses for the work **"Construction of Waste Water Treatment Plant at the Confluence point of River Daya & Ganguanala (Phase-II)" on Engineering, Procurement & Construction (EPC) Contract Including Operation & Maintenance for a Period of Five (5) Years.**

2. Project Background

Bhubaneswar, the capital of Odisha, has experienced unprecedented urban growth over the past few decades, leading to increasing pressure on its urban infrastructure systems, particularly in water supply, sanitation, and waste management. In line with the larger vision of sustainable urban development, Water Corporation of Odisha (WATCO) has undertaken a critical initiative to address the problem of untreated sewage entering natural water bodies. Among the identified intervention areas, the confluence points of Gangua Nallah and River Daya has emerged as a hotspot of concern due to its role as a major carrier of untreated sewage from large parts of Bhubaneswar city. Gangua Nallah, a historically significant drainage channel, now functions as an informal sewage conduit, affecting the ecological health of River Daya and its downstream environments. Recognizing this issue,

In phase-I, Work Order has been issued for construction of 60 MLD capacity STP at the confluence point of river Daya and Gangua nalla. Now, in Phase-II tender, it has been proposed for construction 11 Nos I&D structures to divert a portion of waste water from branch drains to the nearest existing STPs and ancillary works. This initiative forms part of a broader goal to improve sewerage infrastructure, comply with CPHEEO norms, and protect the hydrological balance of urban streams.

All the hydraulic and process design shall be carried out as per latest CPHEEO manual and relevant IS codes. If there is any ambiguity in design, the design shall be carried out as per direction of Engineer in charge. Similarly, any component if not mentioned in RFP/EPCA document, and same shall require to successful completion of work, same shall be carried out by contractor without claiming any extra cost.

The salient features of the overall proposed system are summarised below:

Indicative Quantities for Gravity Sewer Network and Rising Main:

Sl No	Cluster	Gravity Sewer Network		No. of Manholes	Rising Main	
1	Cluster-I	700mm to 1200mm RCC NP3/NP4	1202 m	43	400mm to 600mm DI-K7	1020 m
2	Cluster-II	700mm to 1000mm RCC NP3/NP4	7138 m	263	800mm DI-K7	180 m
3	Cluster-III	600mm to 700mm RCC NP3/NP4	4517 m	168	450mm DI-K7	280 m
4	Cluster-IV	700mm to 1000mm RCC NP3/NP4	4271 m	149	700mm DI-K7	6190 m

Indicative details of proposed Sewage Pumping Stations:

Sl No	Cluster	SPS	Wet Well Internal Dia.	Wet Well depth	Discharge Point	Flow	Pumps Details
1	Cluster-I	SPS-1A	7.0 m	7.5 m	STP at Rokat	20.07 MLD	H-22m Q=306 Cum/hr 5 Nos, submersible
		SPS-1B	5.0 m	7.5 m	STP at Rokat	8.0 MLD	H-20m Q=122.5 Cum/hr 5 Nos,submersible
2	Cluster-II	SPS-2	9.0 m	7.5 m	STP at Meherpali	35.06 MLD	H-23m Q=540 Cum/hr 5 Nos, submersible
3	Cluster-III	SPS-3	5.5 m	7.5 m	STP at Basuaghai	12.11 MLD	H-20m Q=198 Cum/hr 5 Nos, submersible
4	Cluster-IV	SPS-4	9.0 m	7.5 m	STP at Conflence of river Daya & Ganguanala	32.01 MLD	H-29m Q=486 Cum/hr 5 Nos, submersible

Indicative details of proposed I&D structures

Sl. No.	I & D Structure	Location/ Chainage	Length	Cluster No
1.	Drain-1	300 m	9.10 m	Cluster-I
2.	Drain-2 & 3	2900 m	8.60 m	
3.	Drain-4	5100 m	7.50 m	Cluster-II
4.	Drain- 4A	8000 m	14.00 m	

5.	Drain-10	10400 m	12.00 m	
6.	Drain-5	12050 m	10.00 m	
7.	Drain-6	14000 m	10.40 m	Cluster-III
8.	Drain-7	18700m	10.40 m	
9.	Drain-8, 8A & 9	23700m	14.70 m	Cluster-IV
10.	Drain-9A	25100m	26.20 m	
11.	Drain-11	28000m	26.20 m	

Development of Plot/Area:

- The plots allocated for 5 no's pumping stations are undulated and plots are lower than finished Road level (FRL) hence before construction, contractor need to develop the site by its own by filling or cutting earth so as to maintain the average ground level 0.15m above FRL. There is provision for construction of compound wall of RCC column beam frame with brick work, Bituminous approach road of 4.0m width, Paver block in open area, plinth protection, landscape and garden.

Electro-Mechanical Scope:

- Providing supplying installation and commissioning of all Mechanical pumps and equipment's for 5 no's SPS with 15 working & 10 standby pumps sets of 15HP to 85 HP Capacity including EOT crane of 2 times of maximum weight of unit and necessary mechanical units.

- **External & internal power supply** shall be provided for operation of Pump sets including substation & ancillary electrical work ranging from 100 KVA to 350 KVA, 11/33KV/0.4 KV Transformer) and drawl of required length (approx. 26.80 Km) of LT/HT transmission line from nearest Power Grid of TPCODL.

- **The external Electrification/Power supply work has to be carried out as per the approved estimate and specifications of TPCODL/Energy Department and under the supervision of TPCODL authorities.**

- All pumping stations shall be equipped with PLC and SCADA to operate pump station remotely and data acquisition at central remote location.

SCADA Philosophy for Pumping Stations

- The SCADA philosophy for the sewerage project is designed to ensure centralized, automated, and efficient monitoring and control of 5 no's pumping units from the nearest STPs. Each pump house will be equipped with a local PLC that controls pumps, monitors levels, and manages critical interlocks. These PLCs will communicate with a central SCADA system located in the Central Control Room (CCR) via reliable communication protocols such as Modbus TCP/IP or IEC 60870-5-104 over Ethernet, fibre, or wireless networks. The SCADA system will provide real-time visibility into operational parameters such as pump status, flow rates, sump

levels, and equipment health. Operators will be able to monitor alarms, trends, and reports from a graphical user interface. The system supports auto and manual operation modes, with manual override available locally in case of failure. Redundancy in servers and communication links will ensure high availability. The SCADA will support data logging, remote diagnostics, and user access control to ensure operational security. It will also enable performance reporting and maintenance planning through historical data analysis. Centralized operation from the CCR will improve response times and reduce manual intervention. The system will be scalable, cyber-secure, and designed for remote access through web or mobile applications.

- The pumping station and wet well associated with this project shall be integrated with a centralized monitoring system located at STPs. Communication between the IPS and respective STPs shall be established via GPRS to enable real-time data transmission and remote supervision. Each pumping station shall be equipped with PLC and SCADA systems for automated control, monitoring, and fault diagnostics. Key parameters such as flow, pressure, level, and equipment status shall be continuously monitored. All instrumentation shall be calibrated and interfaced with the SCADA for efficient data logging, alarm generation, and operational safety.

- The Central Control Room (CCR) at the STP shall be equipped with SCADA workstations, HMI displays, communication servers, data loggers, backup power supply (UPS), and adequate storage for historical data. It shall facilitate remote monitoring, trend analysis, report generation, and command execution for the pumping station and STP, ensuring seamless operation and centralized management of the wastewater infrastructure.

3. Broad Scope of Work

Broad Scope of Work is elaborated in the following paragraphs to be read inter-alia with the detailed scope of works enumerated in the schedule-B and technical specification provided in Schedule-D of the DTCN. An indicative plan of the proposed system is attached as Annexure-A.

3.1 **Survey, Investigation, detailed Engineering, design and drawings:** Detailed Survey, Investigation, Soil Testing shall be conducted as per project requirement for approval by WATCO. Being an EPC contract, the contractor shall do the detailed Planning, Engineering, design and drawings in a comprehensive manner for ensuring that the proposed sewerage system is run on automation with PLC-SCADA-Instrumentation and control system. Execution of the Sewerage Project as per the detailed scope of work shall be done strictly in accordance with designs and drawings approved by WATCO.

3.2 The contractor shall, Provide, supply, install / erect / construct, test, trial run & commission various components of sewerage system, designed & approved as per clause 3.1 above adhering to strict quality assurance & quality control as well as stipulated project duration.

3.3 The contractor shall operate and maintain the commissioned sewerage system for a period of **5 years**, ensuring uninterrupted and efficient performance. Upon successful completion of the O&M period, the system shall be handed over to WATCO in fully functional condition.

Note: The above-mentioned Scopes / Quantity written anywhere in the documents are indicative only. All ancillary items required to make the sewerage system technically feasible & functional to be provided by the bidder within the bid amount.

It is intent of the Engineer-in-Charge to construct a sewage treatment facility, using highest standards of construction and supply of material and equipment to enable a sustained reliable system for performance over next 30 years. The responsibility of the contract starts from the interception of sewage at the confluence point through the weir and wet well, pumping through rising main to the STP, and up to the treated sewage disposal outlet into River Daya

4.0 General

4.0.1 The bidder before bidding shall visit the site at his own cost and shall satisfy himself with the nature and extent of the work involved, actual site conditions, and existing facilities. Shall collect any other information which may be required before submitting the tender. Any claim in this regard shall not be entertained.

4.0.2 The scope of work for the Sewerage scheme covers surveys including Topographical survey, Geo-technical survey, untreated sewage testing, design & detailed engineering of all components of the scheme, do the necessary changes as per site condition, develop detail drawing and getting approval from Engineer-in-Charge, supply of equipment and construction materials, testing at manufacturer's works, delivery up to site, erection, execution of works as per the work described under "Scope of Work" clause 16.0 or elsewhere in the tender and as per IS codes, CPHEEO, OPWD specifications and detailed specifications attached hereto, final check-up, painting, testing, commissioning including hydraulic testing of all water retaining structures and pipes with fittings, valves, etc. as per relevant IS codes and relevant specification.

4.0.3 The work shall be carried out according to the design / drawings submitted by bidder and approved by Engineer-in-Charge. For building, facilities, systems, structures, etc., necessary layout and details are furnished with tender document. Any changes, if required, shall be done by the bidder keeping in view the scope, minimum specified requirement, the statutory and functional requirement and providing enough space and access for operation, use and maintenance. The bidder's work shall cover the complete requirement as per tender specification.

4.0.4 The work to be performed under the specification consists of providing all labours, supervision, materials, scaffolding, construction power, fuel, construction water, and construction equipment, testing equipment, tools and plants, supplies, transportation and all incidental items not shown or specified but necessary for successful completion of the work.

4.0.5 The nature of work generally involves site clearance, excavation in all types of soils, foundation preparation, dewatering and its disposal, backfilling, disposal of surplus excavated material, supply of all construction material and supply of all necessary plant machinery and equipment, etc., construction with the materials of specified quality, constructing drains, embedding, encasement of pipes, cleaning the site from all waste and surplus material after completion of work and other ancillary work as per specifications, as per drawings submitted by the contractor and approved by the Engineer-in-Charge.

4.0.6 Any items of work, either supply and / or erection of material / equipment which have not been specifically mentioned in the scope / specifications but are necessary for operation and guaranteed performance of the entire sewerage scheme, and equipment offered shall be deemed to be included within the scope of this specifications and shall be provided by the bidder without any additional cost.

4.0.7 All material / equipment which have been mentioned and have not been specifically mentioned in the scope / specifications but are necessary for operation and guaranteed performance of the entire sewerage scheme shall be any of the make mentioned in Clause 21.iii, (Schedule-D). Contractor shall have to obtain written approval of make of any item from Engineer-in-Charge before supply.

4.0.8 The scope of work also includes shifting of electrical/ telephone/ any other type of cable, electric poles, water, sewer or any other type of pipeline or any other facility. Any arrangement for crossing roads, drains, nallah including bypass arrangement and their restoration to the satisfaction of Engineer-in-Charge after completion of particular work also included in the "Scope of work".

4.1 Services to be Provided by the Contractor

4.1.1 The contractor shall open a fully furnished site office with all necessary facilities having office equipment such as computer, printer, etc. A separate room shall be provided to the Engineer-in-Charge or its representative.

4.1.2 The contractor shall provide **2 nos. of brand-new Air-conditioned diesel running vehicles (minimum 6-seater) preferably of Mahindra make Scorpio / Toyota make Inova** within three months of issue of work order for use by the Authority's personnel for inspection of work. The vehicle should be supplied with insurance papers, RC book, Road tax receipt etc. and equipped with all accessories. The model of the vehicle shall be approved by the Authority before procurement. The contractor shall provide Drivers and necessary POL for regular running of the vehicles (average 3000Km/month) during the project construction and operation & maintenance period. The contractor shall maintain the vehicles to keep the vehicles in good running condition and carry out regular repair & maintenance during the above period. After completion of operation & maintenance period, the contractor shall hand over the vehicles to the Authority in good running condition.

4.1.3 The Contractor will make necessary arrangement for power and water required for construction activity

4.1.4 The Contractor shall make necessary arrangement for all the testing and inspection to be conducted in a manner as specified in the specifications and as per codes.

4.1.5 Transportation of all equipment / raw material / spares from manufacturers work to the project site, inclusive of all intermediate handling and unloading / storage at site and all taxes, etc.

4.1.6 Supply, erection as per manufacturers recommendations / specifications, inspection, testing, start up and running of the equipment during trial run / performance guarantee period at rated capacity and speed.

4.1.7 Deploying qualified and experienced staff for supervision of all erection and commissioning services. The Contractor shall also arrange for rectifying the defects during defect liability period.

4.1.8 During **defect liability period of two years,** the contractor has to replace any equipment, component, etc. for manufacturing defect, malfunctioning and below rated performance. He will make good any structure or part of it if found defective or becomes during functioning.

4.1.9 Application of the final paints and final finishing work shall be done by the Contractor after complete erection and testing, trial run but before handing over to the department.

4.1.10 The contractor shall also arrange technical experts of equipment from proprietary supplier as and when necessary, till the commissioning, trial run and performance guarantee period of the equipment.

4.1.11 Any survey/ leveling/ fixation of bench mark/ reference level required for detailed engineering of the any component of the scheme will be done by survey team deputed by contractor. The survey team will carry out the area survey and leveling of SPS, STP compounds or wherever required as per the instruction of Engineer-in-Charge.

4.1.12 The detailed scope of work has been mentioned in clause no 16.0 of this chapter.

4.1.13 Nothing extra over the quoted price shall be paid to contractor on account of any financial implications of all the conditions and specifications. It will be treated that necessary financial provisions are deemed to have been kept in the quoted price. Any contiguous item or any provision / requirement, if not included in the general specification and scope of work, special specification and detailed specification but necessary to be provided for the completion of the work and for its functional necessity, shall be provided at no extra cost above quoted price. The decision of the Engineer-in-Charge in such cases shall be final and biding on the contractor.

4.1.14 The time is the essence of this contract. The entire work described under "Scope of Work" clause 18.0 or elsewhere in the tender (Design, approval of design & drawings, execution and commissioning) is to be completed within a time frame of **24 (Twenty-four) calendar months from the date of issue of work order**.

5 Tender Drawings

The Tender drawings shall form the part of tender document. The contractor shall submit detail design and drawings of all component of the sewerage scheme for its sufficiency in all respect before taking up the construction work. The contractor can do addition, modification, alteration or detailing in the drawings as per the prevailing conditions and he has to take approval from Engineer-in-Charge. The structural stability throughout its working life lies with the contractor. The work has to be executed as per the construction drawings (latest revision) with additions, alterations and modifications made from time to time as required and approved by the Engineer-in-Charge and also according to any other drawing prepared by contractor progressively during the execution of the contract.

6 Test for Material/Workmanship

All tests required for all brought out materials as desired by the Engineer-in-Charge shall be carried out by the contractor as per relevant IS code and at his own cost in the presence of authorized representative of the Engineer-in-Charge.

7 Specifications

The detailed specifications, IS codes and OPWD specifications are intended for the general description of the works, quality and workmanship. All works are to be carried out according to the specifications. Wherever reference to the standard codes of practice etc. is made, they shall be taken as the latest edition of the same issued within one month before the date of submission of the Tender.

8 Layout and Levels

The layout and levels of all structures etc. shall be made by the contractor at his own cost from the general grid of the plot and bench marks given by the Engineer-in-Charge. Contractor shall provide all help in instruments, materials and men to the Engineer-in-Charge at no extra cost for checking the detailed layout and correctness of the layout and levels. However, the Contractor shall be solely responsible for correctness of layout and levels.

Permanent reference pillars shall be established by the contractor and under no circumstances shall the contractor remove or disturb any permanent/reference pillar/ benchmark without the approval of the Engineer-in-Charge. The contractor shall carefully maintain and protect all benchmarks and reference points and shall mark the layout of all his work by accurate reference to the benchmarks and reference points.

9 Construction Method

The bidder shall submit a pert chart along with this tender showing the time schedule for the overall construction activities along with construction methodology. The construction method and mobilization of resources to be adopted by the contractor shall match with this time schedule and shall be approved by the Engineer-in-Charge. After approval of tender the contractor will submit his detailed schedule of work and methodology statement.

10 Quality Assurance Plan

A Quality Assurance plan giving details of necessary tests to be carried out on various materials for construction of work shall be submitted by the contractor for approval before start of the work. The Contractor shall be responsible for carrying out such tests. The contractor shall test the samples of all materials in presence of authorized representative of the Engineer-in-Charge at the specified frequencies as per relevant IS codes or elsewhere given in the tender document and keep proper record of all tests.

11 Testing of Materials

All arrangement shall be made by the contractor to provide testing requirement as specified in the specifications. For the tests for which, equipment required is not available with the contractor shall provide the same or will arrange the test to be done at a Government approved laboratory. No extra claim is admissible in this regard.

12 Approach Roads

The Contractor where required shall make his own arrangement for approach to the work site (including, burrow and disposal area) and for movement of men, machinery, other equipment etc. required for carrying out the work included under this contract. The contractor will also arrange for any land required for burrowing earth or disposal of any dispensable material.

13 Dealing with Water / Dewatering,

Bailing and pumping out of subsoil water may have to be carried out during execution of work. The contractor's program and methods must be capable of dealing with rainfall / subsoil water. The contractor shall supply, install and operate his own temporary pumping equipment wherever required.

14 Prevention of pollution

14.1 Arrangement shall be made by the contractor to prevent Air Pollution and pollution in any stream, nallah or rivers. Arrangements for sprinkling of water in the construction and burrow area to prevent any dust blowing also shall be done by the contractor. The contractor shall be solely responsible and liable for all damage caused by any pollution that may take place during the execution of the works, and he shall make arrangements as the Engineer-in-Charge may approve, for preventing pollution.

14.2 No separate payment shall be made for the pollution control measures.

15 Safety Measures

In respect of all labour directly or indirectly employed in the work for the performance of the

contractor's part of this agreement, the contractor shall at his own expense arrange for the safety provision as per IS code framed from time to time and shall at his own expense provide for all facilities in connection therewith. In case the contractor fails to make the above arrangement Engineer-in-charge shall be at liberty to make arrangements and provide facilities as aforesaid and recover the cost incurred on his behalf from the contractor.

The contractor shall ensure the safety of men, material, machinery, existing structure and any other facilities. Since the work is to be done on road/lanes/by lanes, all necessary safety arrangements including proper barricading and lighting etc. shall be done by the contractor.

The Contractor shall be absolutely and solely responsible for any accident that may occur during the progress of the work and for injury or damage to the men, material, machinery, existing structure and any other facilities of any description whatsoever which may be caused by or result from the execution of work. The Contractor shall make good any damage due to accident or pay any claim arising out of accident and will indemnify the employer of expenses on account thereof. No separate payment shall be made for safety measures.

16 Equipment & Machinery.

The contractor shall have to use his own earth moving equipments & concreting equipment such as dumpers, poclain Hydraulics, dozers, batching & mixing plant, vibrators etc. and any other machinery required for the entire scope of work including the work of excavation and conveyance of earth from the burrow areas to site and also shall have to use his own compaction machinery to compact the fill material such as vibratory /pneumatic rubber typed rollers, water tankers etc. A list of equipment/machinery to be deployed at site as per the requirement of the project schedule shall be submitted by the contractor within one week of award of work. All the equipment/machinery shall be kept in working condition by the contractor during the tenancy of the contract. Contractor will not move any equipment/machinery without written permission of Engineer-in-charge to any other work which is not under the scope of this work.

17 Storage and Handling of Materials

The protection all material and machinery from dirt, clay, rust, theft or damage at any stage of the project is the responsibility of the contractor and no claim will entertain in this regard.

17.1 Reinforcement

Reinforcement steel shall be stored in a manner that no damage/rusting is caused to the material.

17.2 Cement

The Cement shall be stored as per IS code and in a manner that no damage/setting is caused to the material.

17.3 Coarse and Fine Aggregate

Aggregates shall be stored on brick soling or an equivalent platform so that they do not come in contact with dirt, clay, grass or any other foreign substance at any stage. Aggregates of different sizes shall be kept in separate stacks. Aggregates from different sources shall be stacked separately, if so desired by the Engineer-in-Charge with proper care to prevent intermixing.

17.4 Sand

Sand shall be stored on brick soling or an equivalent platform so that they do not come in contact with dirt, clay, grass or any other foreign substance at any stage.

17.5 Pipes

Pipes shall be stored in stacks as per relevant IS codes.

17.6 Electro-mechanical equipment

A Go-down with roof and brick soling floor of sufficient size is to be constructed by the contractor for storage of equipment to protect from rust, damage, theft, etc. All electro-mechanical equipment shall be stored in the go-down.

17.7 All other material required for construction will be stored properly by the contractor.

18 Detailed scope of work

This project proposes a scientifically engineered wastewater treatment system to intercept, treat, and dispose of untreated domestic sewage currently being discharged into Gangua Nallah, which ultimately drains into the ecologically sensitive River Daya. The core component is the construction of a Sewage Treatment Plant (STP) near the confluence, supported by sewerage interception, conveyance, and treatment infrastructure.

The work under Phase-II, involves Construction of **Interception & Diversion** (I & D) Structures, including **Sewage Pumping Station** with wet well, rising main for conveying untreated sewage to the STP,

a. Interception & Diversion Structures

Construction of Interception & Diversion (I & D) Structures will be executed at following places

Sl.No.	I & D Structure at	Location/ Chainage	Cluster No
1.	Drain-1	300m	Cluster-I
2.	Drain-2 & 3	2900m	
3.	Drain-4	5100m	Cluster-II
4,	Drain-4A	8000m	
5.	Drain-10	10400m	
6	Drain-5	12050m	
7	Drain-6	14000m	Cluster-III
8	Drain-7	18700m	
9	Drain-8, 8a & 9	23700m	Cluster-IV
10	Drain-9A	25100m	
11	Drain-11	28000m	

i) A Vertical lift Sluice Gate is to be provided in the Main Drain to divert the Dry weather waste water Flow to the Inlet Channel of I & D Structure. The size of the Sluice Gate shall be 1000mm x 1000mm. Operation Platform shall be provided to operate the Gate. Vertically Sliding reputed Make Sluice Gate shall be used.

ii) Inlet Channel shall be provided to divert the waste water Flow to a Receiving Chamber of I&D Structure. Inlet Channel size shall be about -2000mm (W) x 4000mm (L). 1000mm Wide RCC Walk way shall be provided around the channel. Necessary SS 304 rails & posts shall be provided for walkways. Inlet Cannel shall be constructed as per the Approved Layout Plan and C/S Drawings. It shall be RCC with M30 Grade Concrete and shall be executed as per IS-456 & IS- 3370.

iii) Mechanical/Manual type Screen Chambers shall be provided for I&D structures. Necessary perforated operating platform shall be provided for manual cleaning of screens by suitable scraping tools. Storage space shall be

provided in the platform area, for screen materials. Suitable steps shall be provided to the platform from the top of the screen chambers. The stainless-steel bar screens shall be inclined with 45 - 60 deg. to the base level. 1000mm Wide RCC Walk way shall be provided around the channel. Necessary SS 304 rails & posts shall be provided for walkways. It shall be RCC with M-30 Grade Concrete and shall be executed as per IS-456 & IS- 3370.

iv) Vertical lift Sluice Gates of required size with platform shall be provided for each Screen Chambers at the entrance. The Civil works shall be carried out by the contractor before installation of the Gates.

v) Grit Chamber of required size with a 300mm thick partition wall shall be provided after screen chambers, to arrest sand, grit etc. It shall be RCC with M-25 Grade Concrete and shall be executed as per IS-456 & IS- 3370.

vi) 1200mm dia. NP3 Concrete Pipe shall be provided as Outlet Pipe which shall be connected to a RCC Manhole of 1500mm dia. for conveyance of Primarily Treated Used Water to the Intercepting Sewer System & final disposal to Wet well of Pumping Station. The contractor shall provide required concrete bedding & cradle for laying of 600mm dia. Concrete pipe as per the CPHEEO Manual guidelines. The pipe shall be laid under Trench Conditions

b. Sewerage Pumping Station

Construction of Sewerage Pumping Station will be executed at following places

Indicative details of proposed Sewage Pumping Stations:

Sl No	Cluster	SPS	Wet Well Internal Dia.	Wet Well depth	Discharge Point	Flow	Pumps Details
1	Cluster-I	SPS-1A	7.0 m	7.5 m	STP at Rokat	20.07 MLD	H-22m Q=306 Cum/hr 5 Nos, submersible
		SPS-1B	5.0 m	7.5 m	STP at Rokat	8.0 MLD	H-20m Q=122.5 Cum/hr 5 Nos, submersible
2	Cluster-II	SPS-2	9.0 m	7.5 m	STP at Meherpali	35.06 MLD	H-23m Q=540 Cum/hr 5 Nos, submersible
3	Cluster-III	SPS-3	5.5 m	7.5 m	STP at Basuaghai	12.11 MLD	H-20m Q=198 Cum/hr 5 Nos, submersible
4	Cluster-IV	SPS-4	9.0 m	7.5 m	STP at Confluence of river Daya & Ganguanala	32.01 MLD	H-29m Q=486 Cum/hr 5 Nos, submersible

The wet well shall be designed with adequate hydraulic capacity, suitable depth and diameter, and all required civil, mechanical, and electrical components. Rising mains shall be provided from the wet well to the STP using HDPE/DI pipes of required diameter and pressure class, complete with valves, specials, thrust blocks, and chambers as per site condition. The pumping station shall be equipped with suitably rated pump sets along with standby arrangement, allied electro-mechanical works, EOT crane, substation, DG set, transformers, LT/HT electrical system, and complete instrumentation with PLC-SCADA for automation and remote monitoring.

Indicative details of power supply to different Sewage Pumping Stations:

Sl No	Cluster	SPS	Discharge Point	Pumps Details	Substation Capacity	Silent DG Sets Capacity
1	Cluster-I	SPS-1A	STP at Rokat	H-22m Q=306 Cum/hr 5 Nos, submersible	11/33 KV 250KVA	415 Voltage/ 180 KVA
		SPS-1B	STP at Rokat	H-20m Q=122.5 Cum/hr 5 Nos, submersible	11/33 KV 100KVA	415 Voltage/ 82.5 KVA
2	Cluster-II	SPS-2	STP at Meherpali	H-23m Q=540 Cum/hr 5 Nos, submersible	11/33 KV 350KVA	415 Voltage/ 320 KVA
3	Cluster-III	SPS-3	STP at Basuaghai	H-20m Q=198 Cum/hr 5 Nos, submersible	11/33 KV 250KVA	415 Voltage/ 160 KVA
4	Cluster-IV	SPS-4	STP at Confluence of river Daya & Ganguanala	H-29m Q=486 Cum/hr 5 Nos, submersible	11/33 KV 350KVA	415 Voltage/ 320 KVA

c. Rising Main Network & Sewerage Network

Indicative Quantities of Gravity Sewer Network and Rising Main:

Sl No	Cluster	Gravity Sewer Network		No. of Manholes	Rising Main	
1	Cluster-I	700mm to 1200mm RCC NP3/NP4	1202 m	43	400mm to 600mm DI-K7	1020 m
2	Cluster-II	700mm to 1000mm RCC NP3/NP4	7138 m	263	800mm DI-K7	180 m
3	Cluster-III	600mm to 700mm RCC NP3/NP4	4517 m	168	450mm DI-K7	280 m
4	Cluster-IV	700mm to 1000mm RCC NP3/NP4	4271 m	149	700mm DI-K7	6190 m

The above-mentioned Scopes / Quantity written anywhere in the documents are indicative only. All ancillary items required to make the project technically feasible & functional to be provided by the bidder within the bid amount.

The work involved under these specifications is mainly related but not limited to the following:

18.1 The work shall be carried out according to the detailed specifications, IS codes and OPWD/CPHEEO/PHEO specifications. The design/drawings shall be submitted by the contractor and approved by Engineer-in-Charge. For building, facilities, systems, structures etc., necessary layout and details are to be developed by the bidder keeping in view the scope, minimum specified requirement, the statutory and functional requirement and providing adequate space and access for operation, use and maintenance. The bidder's work shall cover the complete requirement as per tender specification.

18.2 The Geo-technical investigation at locations of sewage pumping stations, sewage treatment plant (STP) & other RCC structures shall be carried out by the contractor for structural design of civil structures proposed in the compound or as required.

18.3 Preparation of work areas, clearing site, jungle clearance etc. in the entire area including dismantling and removing of any existing above ground and underground structures including existing roads, uprooting of all the trees, debris and vegetation and their disposal, shifting of pipes, cables, electrical poles etc. The dismantled and removed material shall be stacked/ disposed as per direction of Engineer in Charge. The bidders should visit the site prior to submission of bid and make himself conversant with the site conditions to estimate the dismantling/removing work. Shifting of electrical or any other type of cables, electric poles, water, sewer, gas or any other type of pipeline or any other facility, their restoration to the satisfaction of Engineer-in-Charge after completion of work.

i. Repair to damages caused during construction to any existing road, bridge, culvert, water supply line, sewerage line, drain, electricity cable & pole, gas pipeline and telephone line, etc. shall be reinstated as per the original specification and satisfaction of concerned Authority/ Authority's Engineer.

ii. Cutting of road surface for taking of sewer/pipeline at required depth will be done with making good to the damages by mending & restoring to existing condition.

iii. Supplying & Filling in foundation and plinth with sand watered and rammed including cost of sand & labour, T & P all complete.

18.4 Sewer Network:

Excavation of sewer trench

Excavation of sewer trenches shall be done as per the approved drawing. The trenches should not be opened in advance of the laying of the sewer pipe for a distance greater than that required to install the sewer pipe. Backfill in the excavated trenches shall be done immediately after jointing the pipe to prevent movement. Testing of the pipeline shall be done prior to refilling the trench in order to ascertain the leakage at joints. Shoring, sheeting and benching of trench is to be provided to prevent caving during excavation, to protect adjacent structure, property, workers and the public. Sheeting shall be maintained in place until the pipe or structure has been placed and backfilled. Shoring and sheeting shall be removed, as the backfilling is done, in a manner that will not damage the pipe or structure or permit voids in the backfill.

The contractor shall furnish, install and operate all necessary machinery, appliances and equipment to keep the excavations reasonable free from water during construction and shall dewater and dispose of the water so as not to cause injury to public or private property or to cause a nuisance or menace to the public. The control of ground water shall be such that softening of the bottom of excavations or formation of "quick" conditions or "boils" shall be prevented. Dewatering system shall be designed and operated so as to prevent the removal of the natural soils. The trench shall be dewatered until bedding and pipe laying are complete.

Pipe bedding

The contractor shall provide Class-A (a,b,c,d), Class B bedding below the DWC & RCC sewer line as per the CPHEEO manual and as per design requirement.

Pipe laying in water logged area

The contractor need to take care during laying pipeline in water logged area. The special treatment shall be provided for strata improvement; contractor need to design anti floatation blocks considering site ground water level.

Pipe laying and jointing

The contractor shall provide trench excavation, pipe bedding and backfill as per specification. Pipe laying shall begin at the downstream end of a sewer segment and progress upstream, with socket ends upstream. When laying is not in progress, the open end of the pipe shall be kept tightly closed with pipe plug. Pipe shall be lowered into the trench in such a manner as to avoid any physical damage to the pipe. Pipe shall not be dropped or dumped into trenches under any circumstances.

A statement showing tentative length of different diameters of sewers to be laid has been presented in Table 1.1.

Repair of Roads

Repair of road damaged due to excavation of trench is included in the scope of the work and shall be carried out as per MoSRT&H specification and shall be brought to the pre-excavated condition to the satisfaction of the Authority/Authority's Engineer and acceptable to the road owning authority.

Continuity Test /Hydraulic Testing

Continuity of the pipe segments in between two manholes is required to be ensured in the same modality as practiced for non-pressure RCC pipeline. Hydraulic testing of pipes shall be done, if specifically asked for by the client for any specific stretch. The procedure for hydraulic testing shall be similar to that for non-pressure RCC pipes.

Hydraulic testing of pipes shall be done, if specifically asked for by the client for any specific stretch. The procedure for hydraulic testing shall be similar to that for non- pressure RCC pipes.

Sand Filling

After the pipe line is tested successfully, the trenches shall be filled up after receipt of written permission of the Authority's Engineer. For the trenches excavated within the carriage way of roads, the backfill should be done with river sand or selected excavated material as per the direction of Authority's Engineer. For the trenches not within the carriage of roads the back filling shall be done with excavated materials. The filling materials shall be free from boulders, sharp objects and rubbish etc and shall be approved by the Authority's Engineer. The back filled materials should be well watered and consolidated to 90% of maximum density at optimum moisture content. Proper care should be taken to see that rising main level and alignment are not disturbed.

Backfilling Of Trenches

Backfilling of the trenches shall not be commenced till the pipes are tested and till approval for filling of the trenches is given by the Engineer.

Backfilling of the trenches shall be done with sand as approved by the Engineer. The filled-up material shall be well watered and consolidated, taking proper care to see that pipe level and alignment are not disturbed. Particular care shall be taken not to cause unequal loading or damage of any sort to the pipe.

Backfill materials shall be compacted to 90% of maximum density at optimum moisture content as per IS 2720 (Part 8), with approved mechanical compactors in layers having a maximum depth of 150 mm.

Testing Of Sewer Pipe Line

Each section (from manhole to manhole) of the sewer shall be tested for water tightness as per IS 783 before being put into service. The test should be a hydrostatic test performed by filling the pipe line with water and raising the pressure to the selected test pressure as decided by the Engineer in charge which should not be less than the maximum pipe line operating pressure with surge pressure, if any, and should not exceed the hydrostatic proof test pressure and maintaining this for a sufficient period to allow for absorption of water by the pipe material. A graph of quantity of water to maintain the test pressure against time is to be plotted which will show when absorption of water is substantially completed.

Any sewer or part thereof that does not meet the above requirements shall be repaired, or re-laid and tested again.

The Contractor shall be bound to follow the instructions of the Engineer regarding the test procedure, test pressures, lengths of sections for testing etc. The tests shall be carried out only in the presence of the Engineer.

Disposal Of Surplus Excavated Materials

All the excavated materials shall be the property of the Authority. All hard materials, such as hard mortar, rubber etc. not intended for use shall be stacked neatly as specified and as directed by the Authority's Engineer.

Unsuitable and surplus materials not intended for use shall be separated out and disposed of at a predetermined place selected by the Authority's Engineer.

Dewatering

Attention of the Contractor is drawn to the fact that water table may be high at some places, even during the dry season.

Ground and surface water shall be controlled to the extent that excavation and pipe installation can proceed in the specified manner and such that the trench bottom is not disturbed to the detriment of the pipe installation. Trench water shall not be permitted to enter the pipe being installed unless approval is received from the Engineer.

If necessary, pumps and well points, or other suitable (subject to the approval of the Engineer) equipment shall be deployed to keep excavations free of water. Caution shall be exercised to make sure that foundations in proximity to sewer excavations are not adversely affected by the excavation or dewatering process.

Discharge from pumps, well points, or other dewatering equipment shall be located and controlled so that loss, damage, nuisance or injury to the public property is not occurred

Wooden Shoring

Attention of the Contractor is drawn to the fact that most of pipe laying will require the use of shoring equipment which will be compulsory at any time when the excavated depth in trench exceeds 1.20 m, which is as per health and safety regulations. Trenches shall be maintained such that pipe can be installed by not allowing water, silt, gravel or other foreign material into the pipe. Material remaining in the trench bottom on completion of excavation by machine which has been disturbed or softened by workmen or trench water, shall be removed before bedding material is placed.

18.5 Sewage Pumping Stations:

The work relates to Engineering, Procurement, Construction, Testing and Commissioning of Sewage Pumping Station, Wet Well, I&D /Weir Structure. The Sewage Pumping Station will intercept and collect sewage from different location/drain (as given in Table) through the weir/ID Structure and pump the same to the Sewage Treatment Plant through the proposed rising main. The Sewage Treatment Plant will treat the sewage and the treated effluent shall be disposed safely back into River Daya as per prescribed norms.

The scope of work is not exhaustive but gives only an idea about the type of work involved. The works shall have to be executed in accordance with the detailed scope of work, specifications and conditions of the bid document, approved design and drawing.

The scope of work is Topographic survey & Geotechnical investigation at the sewage pumping station and STP area, Design and detailed Engineering, Supply, Erection, Testing and Commissioning of all related Civil, Mechanical, Electrical and Instrumentation works for the Sewage Pumping Station, Rising Main, Weir and 60 MLD STP.

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

Design and Construction of Sewage Pumping Station (SPS), Wet Well, Weir and 60 MLD STP including supply & installation of pumping machineries, Topographical and Geotechnical Survey including Subsoil Investigation for Water Table and Safe Allowable Bearing Capacity. Subsoil Investigation shall be carried out by the Contractor through a reputed and specialized firm approved by the Authority/ Authority's Engineer for confirmation of Geotechnical data. All the pumping sets shall be Submersible sewage pumps with energy efficient motors and conform to relevant IS specifications, and provided with Variable Frequency Drive (VFD).

Site Development including but not limited to cutting of Trees, Plants, Bushes and Shrubs etc. and removing the same from the Site; demolishing existing Structures if any and removing debris; shifting of Pipe Lines, Cables and Poles etc. if required; leveling and grading; arranging Construction Power & Water.

Preparation of Process, Hydraulic, Civil, Mechanical, Structural, Piping, Electrical and Instrumentation Design and Drawings including Construction, Architectural and As-built Drawings.

Construction of Civil Engineering Works for Wet Well, Weir, STP units, Roads & Pathways, Plant Drains and Boundary Walls etc. as detailed in Civil Specifications and reference drawings. Layout shall be made in such a way that all Process Units are interconnected and can be accessed from one Point.

Supply, Erection, Testing & Commissioning of all Pumping sets, Mechanical, Electrical & Instrumentation Equipment as detailed in respective Specifications, including DG sets, sub-station, transformers, MCC rooms and allied equipment.

Obtaining incoming HT Power Supply from State Electricity Authority (OPTCL) from nearby Source to the STP Site (33kV power supply is available). All necessary Deposits and Documents shall be arranged by the Contractor.

PLC/ SCADA based Automation System for SPS, Weir and STP as detailed in Specifications.

Hydraulic testing of the Pumping Station, Rising Main and STP pipelines as per Tender

specifications. Contractor shall arrange water and power for the hydraulic testing.

Trial Run of the constructed and hydraulically tested Pumping Station and STP as per Tender specifications.

Supply of all Spares, Tools & Tackles required during Performance Run and O & M Period. Repairing & reconditioning of all the equipment's in the concluding year of the Operation & Maintenance Period to such a condition that they are in running condition with regular preventive and recommended maintenance.

Providing "on the job" training to the Authority's personnel.

Preparation and submission of As-Built Drawings and Operation & Maintenance Manuals for Mechanical, Electrical & Instrumentation Items.

Any other Items which have not been specifically mentioned in specifications but are necessary for construction of the Plant as per good engineering practice, safety norms and successful operation and guaranteed performance of the entire Plant shall be deemed to be included within Scope of Work and shall be provided by the Contractor without any extra cost to the Authority.

The Sewage Pumping Station layout will have Wet well, Inlet chamber, Screen chamber, Valve chambers, MCC room, DG room and Access Roads. Diesel Generator Set of required capacity shall be provided as standby unit during power failures. Before the wet well, a screen chamber fitted with one mechanical screen as working and one manual bar screen of 20 mm spacing as standby shall be provided. Air vent pipes with exhaust arrangement shall be provided to drive out the odours generated in the wet well. Sulphate resistant cement confirming to IS 12330:1988 shall be used in structures exposed to sewage & sewer gases.

All pumps shall be automatically controlled from level switches in the wet well.

The drawing showing the Layout of Sewage Pumping Station, Weir and STP, General arrangement and structural drawings are to be furnished by the contractor for approval by the Authority/ Authority's Engineer before execution of the work. Before execution of the work the contractor has to make survey of the entire area and familiarize with geotechnical and other aspects for the construction of the Sewage Pumping Station and STP. It is to be noted that the contractor shall prepare and get approval from the Authority/ Authority's Engineer for the construction drawings before ordering the pumps and pipe work. The datum for elevation shall be Mean Sea Level.

The tentative details of pumping stations have been presented in above Table and the details of work to be performed for each pumping is given below.

A. CIVIL ITEMS	
1	Allied structures at the sewage pumping stations shall be raw sewage sump with minimum dia and depth as mentioned in table given in clause 18.4 above for each location, pump house of minimum area and height as mentioned in above table for each location, inlet chamber / manhole to receive incoming sewer with by-pass arrangement, with by-pass arrangement, approach road (concrete) of 4.5 m width is required, and balance plot area to be covered with paver blocks plantation. Each plot of pumping station shall be filled up 0.15m above finish Road Level.
a	PLC-SCADA cum Substation Electrical panel room, Operator room, toilet with minimum area of 200 Sqm, along with Shed for DG set

b	Provision of internal roads having 4.0 M width of C.C / Paver Block with side drain.
c	Boundary wall of required length with height up to 2 meter above adjoining road level with 2 Nos of M.S. Gates. The FGL of the sewage pumping station site shall be 0.15 mtr above the adjoining road level.
d	Road yard lighting arrangement with energy efficient illumination.
B	**MECHANICAL**
1	Installation of submersible sewage pumps as per the duty discharge & head and as per the numbers mentioned for each location in the table given in clause 18.4 above complete with installations of required capacity of EOT crane
2	Supplying, fitting & fixing of Motor operated Sluice Valves with actuator of required size with approved make & quality with matching flanges, nuts, bolts & gaskets with proper alignment & support complete in all respect with all labour & material, T&P as per specification & direction of Engineer-In-Charge.
3	Supplying, fitting &fixing of Non-Return Valves multiport with damper kit of approved make & quality with matching flanges, nuts, bolts &gaskets with proper alignment &support complete in all respect with all labour &material, T&P as per specification &direction of Engineer-In-Charge.
4	Supply & erection of spring-loaded relief valve for controlling water hammer with Globe type Surge Anticipating Valve all-inclusive as per requirement
5	Supply, fitting and fixing of EOT crane of adequate capacity
C.	**ELECTRICALS**
1	Supply & laying of LT/HT transmission line from nearest available grid through underground cable (1W+1S) with necessary RCC inspection chamber to the sewage pumping stations of a length as per requirement
2	Supply & erection of substation with indoor VCB (incomer) & outgoing indoor VCB at Panel Room.
3	Supply & Installation of protection device (VCB/ACB)
4	Supply & erection of control panel with VFD
5	Supply & erection of cabling arrangement
6	Energy Efficiency System
7	Earthing system as per IS/IEC-62305 & NBC-2016 & IEC-62561
8	Provision for inspection charges @6% of total cost
9	Procurement and installation of 1 Nos. of Silent DG sets of adequate capacity including with NGR, NIS, AMF panel & Synchronized panel with precision AC & DG house with panel room including 3000 ltr. Capacity SS 316 grade diesel container with automatic loading of diesel to DG set with fire proof pump & necessary tubbing.
	However, the external Electrification/Power Supply work has to be carried out as per the sanctioned estimate and specifications of TPCODL and under the supervision of TPCODL authorities.
D.	**INSTRUMENTATION**
1	Sluice valve, MoV, Pressure gauge dial type fitted and fixed with Snuber Cock, Pressure transmitter etc.
2	Full Bore Type Electro-Magnetic Flow Meters
3	Instrumentation panel, interlock arrangement and PLC-SCADA system.

18.6 Sewage Pumping Mains

a. Detailed engineering of sewage pumping mains as given in table in clause 18.4 above, water hammer / surge protection system including allied works, thrust blocks, etc. as per CPHEEO manual.

b. Excavation of trenches in all kind of soils, including shoring and shuttering, wherever required, as per the approved alignment up to the depth to maintain minimum one meter earth cover over crown of the pipe for laying of pipes and fittings, including proper stacking of excavated soil/material, backfilling and disposal of surplus material.

c. Supply, laying & jointing of sewage pumping main pipes as given in table in clause 18.4 above and conforming to relevant IS codes and as shown in relevant drawings and detailed specifications.

d. The pipes shall be DI- K7 confirming to IS: 8329:2000(Latest edition) with its inside cement mortar lining using sulphate resistance cement and outside coated with Zinc, and suitable for Socket and Spigot joints using rubber gaskets. The Rubber gaskets shall be of EPDM rubber and confirm to IS 5382 with latest amendment and should have ISI mark on it. Ductile iron fittings (Tee, tail piece, bend etc.) shall be conforming to IS 9523:2000 with latest amendment as per site requirement & as per instruction of Authority's Engineer. This shall be applicable to all MPS/IPS.

e. deleted

18.6.1 Works to Perform:

a. Supply, laying, testing and commissioning of the pumping mains, including pipe manifolds
b. Supply & Installation of NR Valves, Sluice/Gate valve, Air Cushion Valve and M.S. Special as per requirement.
c. Cutting & Re-doing of Various Road after laying of Pipe line etc. all complete. Cost of Certification for road & sewage pumping stations.
d. Supply & laying of ISI marked Ductile Iron fittings (Tee, tail piece, bend etc.) of required sizes conforming to IS: 9523 with latest amendment.
e. Supply & erection of ISI marked double flanged Cast Iron / Ductile Iron sluice valve with mechanical seal, scour valves, double acting kinetic air valves as per IS specification and Zero velocity valve confirming to relevant IS specification as per site requirement & as per instruction of Engineer-in-Charge.
f. Construction of thrust blocks of required size as per approved drawing at all bends and other necessary locations in the pipeline as per field requirement.
g. Construction of valve chambers as per approved drawing for all types of valves as per site requirement & as per instruction of Engineer-in-Charge.
h. Backfilling of the excavated trenches with selected excavated earth. Backfilling shall be done in layers of 150mm thickness and shall be watered and compacted as per detailed specifications.
i. Making all arrangements for laying of pipes and its stability for Railway Crossing, Canal Crossing, NH Crossing, PWD Road Crossing and small culverts/ nallah / drain / road / any other facility and their restoration with minimum disruption including making any by-pass arrangement and dismantling of all above arrangement after completion and testing of work. At every crossing over, the pipeline will be supported through a suitable steel structure as per direction of Engineer-in-Charge.
j. Repair to damages caused during construction to any existing road, bridge, culvert, water supply line, sewerage line, drain, electricity cable & pole, gas pipeline and telephone line, etc. shall be reinstated as per the original specification and satisfaction of concerned authorities / Engineer-in-Charge.

k. Cutting of road surface for taking of pipeline at required depth will be done with making good to the damages by mending & repair to existing condition.
l. Testing and commissioning of sewage pumping mains as per relevant IS code and to ensure minimum terminal head of 3.0m.

Interconnecting Piping and Valves:

All interconnecting Piping, Gates, Valves, Specials and other appurtenances, auxiliaries and accessories required as per Process Design and Scope of Work. In case of Rising Mains, thrust blocks shall be provided wherever required. In case of buried Pipes, warning tapes shall be provided of the appropriate colours. The material of construction for major interconnecting Piping shall be as follows:

Piping: Guide Line for Velocity

Sl. No.	Service	Design Velocity m/s	Limitations
1.	Gravity Lines for Sewage & Water	0.6 – 1.2 Designed as pipe line flowing full.	Min. Velocity shall not be less than 0.6 m/sec. Max. Velocity up to 1.2 m/sec is allowable at Peak Flow.
2.	Pressure Lines for Sewage &Water	0.6 – 2.5	Min. Velocity shall not be less than 0.6 m/sec. Max. Velocity up to 2.5 m/sec is allowable at Peak Flow.
3.	Air (Pressurized Lines)	18 – 22	Max. Velocity shall not be morethan 25 m/sec in any section.
4.	Scum & Sludge Lines	0.6 – 1.5	Irrespective of flow, Diameter shall not be less than 150 mm for Gravity Lines.
5.	Chemical Feed Lines	0.6 – 1.5	Irrespective of flow, Diameter shallnot less than 20 mm.

Notwithstanding the above, the Tenderer shall submit a Pipe Line Schedule withTag No., Flow, Size& Type, Material of Construction etc. with detailed P & ID for approval of the Authority Engineer prior to any further engineering or procurement/fabrication and installation.

Generally, the Material of Construction shall be selected based on the following guide lines. The Tenderer can make suitable selection depending on Service, Typeof Flow (i.e. Gravity or Pressurized) and Diameter of Pipe.

Piping: Guide Lines for MOC

Sl. No.	Service	Type of Flow	MOC
1.	Waste Water / Sludge	Gravity	RCC NP-3 Class
2.	Waste Water / Sludge	Pressurized	CI / DI K-9
3.	Service Water	Gravity/ Pressurized	GI “C” Class

4.	Air Lines: Headers, Vertical Down-comers	Pressurized	Above Water: MS Sand/ Shot Blasted, Epoxy Painted Under Water: SS 304
5a	Air Grid Piping: Aeration Zone	Pressurized	UPVC Schedule 40
5b	Air Grid Piping: SelectorZone	Pressurized	SS 304
6.	Chemicals	Gravity/ Pressurized	SS 304 except Chlorine &$FeCl_3$
7.	Chlorine & $FeCl_3$	Gravity/ Pressurized	Schedule 40 UPVC

Valve: Guide Line

Sl. No.	Service	Type	MOC	End Connection
A	Sewage/ Sludge			
1.	Gravity/ Pressurized	Knife Gate	CI Body & SS 304 Gate & SS 410 Spindle	Flanged
2.	Delivery of Pump	Swing Check	CS Body & SS 304 Internals	Wafer
3.	Suction & Delivery of Pump	Knife Gate	CI Body & SS 304 Gate & SS 410 Spindle	Flanged
B	Service Water			
1.	Gravity/ Pressurized	Ball	CS Body & SS 304 Internals	Flanged
2.	Delivery of Pump	Swing Check	CS Body & SS 304 Internals	Wafer
3.	Suction & Delivery of Pump	Butterfly	CI Body & SS 304 Internals	Flanged
C	Air			
1.	Pressurized	Ball	CS Body & SS 304 Internals	Flanged
2.	Delivery ofBlower	Swing Check	CS Body & SS 304 Internals	Wafer
3.	Suction & Delivery of Blower	Butterfly	CI Body & SS 304 Internals	Flanged
D	Chemicals			
1a	Gravity/ Pressurized	Ball	As per Chemical Compatibility Chart	Flanged

Sl. No.	Service	Type	MOC	End Connection
1b	Gravity/ Pressurized	Diaphragm	As per Chemical Compatibility Chart	Flanged
1c	Gravity/ Pressurized	Plug	As per Chemical Compatibility Chart	Flanged

Notwithstanding the above, the Tenderer shall submit a Valve Schedule with Tag No., Flow, Size, Type, Materials of Construction, End Connections etc. with detailed P & ID for approval of the Authority Engineer prior to any further engineering or procurement/fabrication and installation.

The standardization of sewers by increasing the size, if done by the contractor, for convenience of construction, the same shall be done at his own cost provided the hydraulic characteristics of flow remains unchanged. The changes in size of pipes shall be got approved by the Authority/ Authority's Engineer.

It is entirely the responsibility of the contractor to select appropriate micro tunneling system for the installation of the sewer. The soil strata in the project area up to a depth of 2.0 m are predominantly hard or gravelly soils and beyond 2.0 m are disintegrated rock. It is therefore important to select appropriate Micro tunneling system which has capability to handle unconfined compressive strength (UCS) up to10 MPa as well as water charged clay strata Slurry Pressure Balance Shield tunneling system with appropriate cutter head with cone crusher to excavate the rock and crush the excavated rock in to small piecesso that they can be transported through the slurry pipeline system, may be considered as one of the suitable method for this.

18.7 CCTV Equipment:

The CCTV equipment shall include auto crawling type video cameras, a video monitor cable, power sources, and all equipment necessary to perform a CCTV inspection. The cameras shall have Pan-and-Tilt capabilities, and shall have a minimum of 360 x 270-degree rotation and illumination sensitivity shall be three lux or less and provide a minimum of 460 lines of resolution. The focal distance shall be adjustable through a range from 25 mm (1 inch) to infinity. During CCTV inspection, lighting intensity shall be adjusted to minimize glare. Lighting and picture quality shall be adjusted to provide a clear, in focus picture of the entire periphery of the pipeline for all conditions encountered. Camera systems shall be able to navigate around minor objects, roots, and debris. The system used to movethe camera through the pipe shall not obstruct the camera's view or interfere with proper documentation of the sewer conditions. The camera cable shall be retracted to remove slack and to ensure an accurate footage reading. The distance shall be measured between the exit of the start manhole and the entrance of the finish manhole for a true measurement of the length of the pipe segment, as required. It shall be recorded in standard units and the video display readout shall display units to one-tenth of a foot. The cable footage-counter shall be accurate to plus or minus2 feet per 1,000 feet. The camera lens shall be kept clear of condensation and debris during the CCTV inspection. All observations and defects shall be documented in a database and shall include digital video recording and digital photographs. Each video clip and photograph provided shall correspond to inspection data in the database, and each set of inspection data listed in the database shall be properly linked to the appropriate video clip and photos. All observations shall be selected from a standard table of descriptions incorporated in the inspection reporting

software, as required. Video files shall have a minimum resolution of 352 x 240 pixels and an interlaced frame rate at a minimum of 24 frames per second. Audio reporting will be avoided to prevent inconsistent operator subjectivity. Video inspection will not exceed a traverse rate of 30 feet per minute. The Contractor shall pause the digital recording at any time there is a delayin the inspection and restart the digital video recording in the same digital file. The pause shall in no way affect, freeze, or interrupt the replay of the video and shallnot close the video file during the inspection. Each pipe segment (manhole to manhole) shall be identified with an initial text screen and completed in accordance with CCTV inspection form header Instructions. This data must completely match the data entered in the database header information. The initial text screen shall appear no more than 15 seconds at the beginning of the video footage, and shall appear before the 360 degree pan of the starting manhole. During the CCTV inspection, the video shall show the following text at all times: During the CCTV inspection, the camera shall stop at all defects and significant observations to ensure a clear and focused view of the pipe condition and shall rotate the camera head at the defect to allow for adequate evaluation at a later time. All defects and significant observations shall include a text overlay of the recorded observation. The video recording shall include on-screen observation text for every observation recorded in the database.

18.8 Danger Flags, Battery operated lanterns etc. CHANGE OF SCOPE

The length of Pipe lines and capacity of different structures of Civil, Mechanical and electrical installations specified herein above shall be treated as an approximate assessment. The actual lengths and capacity as required on the basisof detailed investigations shall be determined by the Contractor in accordance with the Specifications and Standards. Any variations in the lengths specified in this Schedule-B shall not constitute a Change of Scope, save and except any variationsin the length arising out of a Change of Scope expressly undertaken in accordance with the provisions of Article 13.

19 Operation & Maintenance:

On issue of provisional completion certificate, the Operation & Maintenance of the project are to be undertaken by the Executing Agency for a period of 5 (Five) years with supply of manpower, chemicals, consumables & other repair & maintenance works including spare parts, if any. *It should be noted by the contractor that construction of compound wall with MS Gate of Sewage Pumping stations (SPS) and STP has been constructed separately by WATCO, but should be maintained by the contractor which is included in the scope of Operation & Maintenance*. The energy charges shall be paid by the Department directly to the concerned electrical authority. Any defects/ discrepancies noticed in civil, mechanical and electrical works has to be attended promptly. It is to be ensured that the quality of treated sewage has to be maintained by the Executing Agencyas per CPCB standards for safe disposal to river or stream. Daily test of sewage samples is to be carried out by the Executing Agency. The entire project needs to be operated up to 24 Hours per day.

20 Works to be performed for Operation & Maintenance:

20.1 Sewerage System:

After successful completion & commissioning of the gravity/pumping sewers and accepted by Employer, Operation & Maintenance (O&M) will commence for a period" of **five (5) years (60 Calendar Months).**

In an engineering sense, operation refers to hourly and daily operation of the components of a system. This is a routine work. For trouble free operation of the system it should be maintained properly. In a Sewerage system, maintenance helps to protect the capital investment and ensures an effective and economical expenditure in operating and maintaining the facilities. It also helps to build upand maintain cordial relations with the public, whose understanding and support are essential for the success of the facility.

The contractor should have sufficient experience in the design and construction of the system to enable him to perform his task efficiently with an understanding and appreciation of the problems that may arise during maintenance. One has not only to be a technical man but has also to deal with human relations in order to be successful in his work.

Operation & Maintenance offices with dedicated communication facility (including internet, telephone and cell-phone to the key staff) shall be established in **Bhubaneswar** area by the contractor.

The maintenance of sewer system can be classified into 2 categories.

20.1.1 Preventive or Routine maintenance

20.1.2 Emergency maintenance.

Preventive maintenance is to be carried out to prevent any break down of the system and to avoid emergency operations to deal with clogged sewer lines or over flowing man holes or backing up of sewage into a house or structural failure of the system. Preventive maintenance is more economical and provides for reliability in operation of sewer facilities.

In spite of well-organized regular preventive maintenance, sometimes emergency situations occur due to obstruction in sewers because of entry of solid matters through the manholes due to vandalism, excessive silt accumulation in sewer line, all damages leading to the breakdown of the system. This needs emergency attention to bring the system into order.

19.1.1 Strategy for Good Operation & Maintenance

The minimum requirement for good operation & maintenance are depicted below.

a) Preparation of a plan for operation & maintenance

b) Providing required personnel to operate and maintain the system

c) Providing capacity building program for O&M personnel

d) Availability of spares, tools & plant for ensuring maintenance

e) Preparation of GIS base map of the system

f) Maintaining MIS records on the system including history of equipment, cost and life etc.

g) Establishing a sound financial system

19.1.2 Preparation of Plan

A “Comprehensive Sewerage System Management Plan” shall be prepared by the contractor and approved by the Engineer/ Employer. It will provide for safe & reliable

performance of the sewers and enable the sewers to function properly.

Briefly the plan shall contain what actions are required, when the actions are to be taken, who is to take these actions, how these actions are to be achieved, and why the actions are required.

Check lists are to be prepared for use by the supervising or inspecting officers to ensure that the actions indicated in the operation & maintenance plans are carried out properly and promptly.

The management plan should include at least the following:

i. <u>Sewerage System Drawings, maps & data base</u>

- ✧ Prepare and get approved from Employer detailed as-built drawings (in AutoCAD) of the entire sewerage system under contractor's scope (including the sewage collection and transportation system showing all gravity line segments, manholes, pumping facilities, pressure pipes, valves and relevant appurtenances).
- ✧ Convert as-built drawings to GIS platform (including acquisition, processing of latest satellite imagery in Quick-Bird at 0.6 M resolutionand GIS software).
- ✧ Attach sewerage system data attributes (should at-least include hydraulic, geographic, life and cost data).
- ✧ Develop centralized facility for data base preparation, conversion, maintenance including data analysis and output facility as necessary for Operation, Maintenance and record keeping purpose.
- ✧ Develop facility for updating and maintenance of the data in the Centralized system.

ii. <u>Operation and Maintenance Equipment</u>

- ✧ Procure mechanical equipment necessary for Operation and Maintenance (O & M) of sewerage facilities. (A typical list of Equipment necessary for sewer maintenance work is given in Schedule-B, Section-16.9).
- ✧ Employ suitably skilled operators to operate the equipment.
- ✧ Procurement of all necessary safety equipments & gear. This is as per the detailed list in the "Health and Safety Manual" to be prepared by Contractor. A typical list of Safety Equipment required during operation & maintenance of Sewer system is given in below.

1. Safety helmet
2. Rubber gloves and boots
3. Canister type Gas mask
4. Explosion proof portable light
5. Non sparking tools
6. Oxygen breathing apparatus
7. Safety belt
8. Portable Air blower
9. Oxygen deficiency Indicator
10. Hydrogen sulfide Indicator
11. Carbon Monoxide detector
12. Chlorine detector
13. Fire Extinguisher
14. First Aid & Lifesaving kit
15. Warning signals.

- ✧ Make effective use of the equipments for the O & M of the sewerage system.

- ✧ Operate and maintain the equipment in workable state throughout the O & M period including supply of all spare parts.
- ✧ At the end of O & M period hand over the equipment in working state to the Authority.

iii. Maintain data base for procurement, operation, maintenance, repairs, and replacements of the equipment including routine updating of the central data base.

iv. Planning for Sewer Maintenance

The maintenance of a sewer system consists of inspection of the system, cleaning of sewers including flushing wherever necessary and repair & construction of damages.

Inspection of a sewer system can be done by (i) direct and (ii) indirect methods.

Direct Inspection is carried out manually by crawling or walking through the sewer line. Direct inspection can be carried out in sewers above 500mm diameter, where a man can crawl through, and above 900mm diameter, a mancan walk through.

Indirect inspection is carried out by sending a camera through the sewer for taking photographs or a closed-circuit television equipment (CCTV) to send pictures which can be seen on TV screen or recorded in a video tape. The CCTV inspection can be used for sewer lines as small as 100mm.

An experienced maintenance engineer will be able to identify critical sewers which require to be inspected in the first phase. If proper watch is kept during the sewer cleaning operation it will be possible to observe damages to manholes due to deterioration in the joints and collapse of bricks and /or removal of bricks and soil by the sewer cleaning machines regularly from the same area. These may be the early warning signs of an impending disaster. Settlement of road surfaces, pollution of water by the sewage, high chlorine contents of the sub soil water are other signs indicating leaking joints or cracks in the sewer. History of previous collapses of sewer lines will also indicate the priority areas for sewer inspection.

A list of such critical areas should be drawn up and a program of sewer inspection chalked out. Other areas singled out for sewer inspection would bethe heavily built up and congested areas where a sewer failure would have very severe repercussions

For Operation & Maintenance purpose the whole sewer system should be marked on plan and divided in to several maintenance sections and areas, which are to be placed under different maintenance gangs.

There shall be separate gangs for cleaning operation and construction repair works. While the cleaning of manholes and sewer pipes etc will be done by cleaning gang, the repair of damages will be taken up by repair and construction gang.

The inspection and cleaning gang will consist of one mate and 4-6 sweepers whereas the repair & construction gang will consist of a mason, one helper anda sweeper. The works of the above gangs will have to be supervised by a supervisor.

The area under each gang will depend on the size of the sewer, depth to whichit is laid, the number and spacing of manholes, condition of sewers, size and length of rising mains and number of valves etc.

v. Works of Sewer Maintenance Gang

- ✧ Check manhole condition for deposition of silt, flow, new connections if any, damaged walls or steps, damage or missing of manhole covers, clogged vertical pipes in drop man holes. It is preferable that the repairgang comes out on the work when the sewer cleaning or maintenance gang is working so that brickbats, debris, mortar etc. which fall

in the manholes are removed then and there, as these materials cause a major blockage if the same is allowed to flow into the sewer line.

- ✧ Check the sewer lines in between two successive manholes for silting and flow conditions and remove the deposited silt.
- ✧ Check for any harm full and extraneous matter entering in to the sewer line so that further investigation for the cause and location can be determined.
- ✧ Check the Air release valves and Blow off valves in rising or force mains.
- ✧ Flushing regularly the lateral sewers at the head of the sewer once in a day during non peak hours.

vi. O & M Staffing

- ✧ The contractor should deploy staff experienced in the O & M works of sewerage systems
- ✧ The schedule of the O & M staff should be as stated in Annexure - III (Schedule - E).

vii. O & M Procedures

- ✧ The contractor should prepare and implement procedures/protocolsdocument for O & M of the sewerage network.
- ✧ The procedure document should include material specifications, procedure & protocols for routine O & M.
- ✧ The procedure document should include detailed material specifications,procedures and protocols for repair (both major & minor) works.
- ✧ The document should include list of material & technology vendors.
- ✧ The document should explain in details actual O & M procedures usableby operators and unskilled staff.
- ✧ The document should include safety procedures in details including “TODO” and “DO NOT DO” activities.
- ✧ The document should include in details procedures for equipment and material handling.
- ✧ The document should include detailed procedures for safe manhole opening, safety checks and manhole entry. The document should also include sample form for manhole entry permission.
- ✧ The document should include procedures in details for manhole cleaning.
- ✧ The document should include procedures for regular flushing at the headof the lateral sewers and periodical flushing of branch/ main/ Trunk sewers.
- ✧ The document should include procedures for structural safety and stability status check for manholes.
- ✧ The document should include procedures in details for checking & assessing sewer blockages. The document should include in details procedure for sewer cleaning.
- ✧ The document should include in details procedure for checking andassessing structural safety and stability of sewer lines
- ✧ The document should include in detailed procedures for checking andassessing safety and structural stability of sewerage system appurtenances.
- ✧ The document should include the detailed schedules for periodic O & Mactivities.

viii. Maintenance of Operation and Management Records

- ✧ Routine daily O & M maintenance records including staff employed, equipment status and usage, material usage
- ✧ Routine daily O & M records including complaint received, attention status, problem resolve status.
- ✧ Minor repairs records including problem identification source, repair status, problem resolve status. A weekly update to central data base should be made.
- ✧ Major repairs records including identification source, status record of repair/ replacement proposal, status record of approval, status record of repair/ replacement, problem resolve status. The central database should be updated weekly.
- ✧ Record of budgetary provisions for minor & major repairs/replacements, monthly review & updates of the budget and expenditures.

ix. Emergency Action Plan

Emergency maintenance becomes necessary for removal of obstructions in sewers caused by excessive silt accumulation or damage leading to the breakdown of the system with flow much lower than the normal.

For emergency repairs the contractor has to prepare an Emergency Action Plan which is to be approved by the Engineer.

The Emergency Action Plan aims to set up and implement procedures to respond to the emergency situations like failed network, leakages likely to affect water system in the city, pump station failure, major repair shut downs. The document should aim to and include followings;

- ✧ Procedure for incident notification to various agencies and response route& time.
- ✧ Procedure for assessment of emergency situation and assigning theresources.
- ✧ Alternative operation procedures during emergency.
- ✧ Procedure to reinstate original operation procedures post emergency.
- ✧ Notification to different authorities about end of emergency.

The sewer gang to be engaged for this type of work should consist of specially trained men who are aware of the hazards and capable of coping with situations calling for prompt action.

The supervision in this case should be entrusted to a responsible person well versed in the use of the special equipment like CCTV, and High velocity jetting machines for cleaning, and suction pumps or gully emptiers.

For locating the exact location of blockages, it is necessary to commence observation from the overflowing man holes down the line until the first man hole with little or no overflow is reached. The section between the man holeand the one immediately upstream is the one which is blocked and requires tobe tackled.

In the case of simple blockages, the split bamboo rods can be effectively usedfor cleaning the blockage whereas for major blockages High Velocity Jetting machine will be required.

For solidified deposits causing the blockage, rodding machine with auger head may be useful.

x. Health & Safety Manual

A detailed “Health and Safety” manual for the operation and maintenance staff should

be prepared. This should include H&S procedures in anticipation of every possible event likely to happen during O & M of the sewerage system.

xi. O & M Manual

"Operating and Maintenance Manual" should be prepared and implemented with the approval of Employer. The Operating and Maintenance Manual shall contain all necessary data to enable the works to be properly operated and maintained, including, but not limited to, the following:

1. Table of Contents
2. Description of the sewerage system and components
3. Layout drawings / P&IDs / cable drawings
4. Operating schedule with equipment / instrumentation data and instruction
5. Maintenance schedule with equipment / instrumentation data andinstruction
6. Routine maintenance schedule
7. Schedules of equipment
8. Instrumentation commissioning data
9. Test certificates of equipment and instruments
10. List of vendors for equipment and instruments
11. List of spares required for day-to-day operation and maintenance
12. Index
13. Safety rules, "Dos" and "Don'ts"
14. Record requirements
15. Manufacturers O & M documents for equipment and instruments
16. Manufacturer's guarantee documents for equipment and instruments
17. Safety measures and Precautions to be taken in operation andmaintenance
    The precautions and safety measures to be taken during operation &maintenance of a sewer system is briefly described at following paragraphs

xii. Traffic control and safety measures Precautions to be taken during Operation& Maintenance of Sewer network

Personnel engaged in operation and maintenance of sewerage systems areexposed to different types of occupational hazards like physical injuries, injuries caused by chemicals and radioactive wastes, infection caused by pathogenic organisms in sewage, and dangers inherent with explosives or noxious vapour and oxygen deficiency.

The health and safety of personnel can be safeguarded to a great extent by taking the likely hazards in to consideration, at the time of design of the system. In spite of care taken in the design, hazards are still possible and these can be reduced by use of safety equipments and precautions appropriate for each hazard condition.

Traffic Control:

a) Place easily readable and clear warning signs well ahead of work area.
b) Fence off adequate space around the man hole for placing equipmentsand deposition of silt removal.
c) Place barricades or signs to channelize the traffic, if possible.
d) Vehicles can be parked between the traffic and the work area.
e) Place flag man at both ends of the road for controlling flow of traffic from each direction and to avoid traffic jam if the road is narrow and only one lane of traffic is possible.

Manhole Safety:

a) Ventilate the sewer line by opening two or three manholes on both sides where work is to be carried out. This is more important when adequate blowers for ventilating the

sewers are not available. The manholes should be opened at least one hour before start of the operation. The opened manholes should be properly fenced to prevent any person especially children accidentally falling in to the sewer. Dummy covers with BRC welded fabric can be used.

b) Where it is desirable to use blowers, operate these for at least 30 minutes before start and during cleaning operations to ventilate the lowest working levels.

c) Use safety harness and life line before entering the sewer lines. Two helpers at the top should be provided for each person. The person standing at the top must send signals at every four minutes interval to the person in the man hole to ensure safety.

d) Test for hazardous gases before entry of a person in to the sewer line and also in between if the operations are for a longer time.

e) Test manhole rungs/steps for structural safety before using.

f) Ensure that when portable ladders are used, they are properly seated orfixed.

g) Ensure that no material or tools are located near the edge which can fallin to the manhole and injure the workman.

h) Lower all tools and materials for use by the workmen inside themanhole, in a bucket.

i) Use lighting equipments which must be explosion proof and fire proof.

j) Use gas masks when men have to enter in to the sewer line.

k) Precautions for Infection:

The personnel working in sewerage maintenance system are prone to infectionsand hence the following precautions are to be taken.

a) Emergency first aid treatment kits be provided to take care of all minorinjuries like cut and burns.

b) A Physician's services should be available for emergencies. Workers should be educated about the hazards of water borne disease such as typhoid, and cholera etc. through sewage and tetanus through cuts and wounds. Preventive inoculations should be given particularly to workers.

c) The importance of personal hygiene should be emphasized and workers should be instructed to keep fingernails short and well-trimmed, wash hands with soap and hot water before taking food and keep fingers outof nose, mouth ,and eyes, because the hands carry most infections.

d) Use of rubber gloves should be issued to so that sewage or sludge does not come in direct contact with the hands.

Workers should be provided with a complete change of work clothes to be worn during working hours. Gum boots should also be provided to workers.

19.1.3 Payment Schedule

The contractor should prepare a Payment Schedule and get it approved by the Authority.

This should clearly specify the payments made towards consumable materials, spares for machineries and payments made towards labour etc. and should include:

- ✧ Payment schedule for Routine Inspection & Maintenance
- ✧ Schedule of payments for non-routine (emergency) maintenance and repairs.

20.2 Intermediate Pumping Stations & Sewage Treatment Plant:

a) Scope of Work:

The Contractor shall operate and maintain the Sewage Treatment Plant (the Plant),

pumping stations and all allied works under the Contractor's contract, for a base period of 5 (five) years, with the option to extend for two (2) consecutive or one (1) year periods at the Authority's discretion. For the Operations and Maintenance period the salient features of works are:

1. Sewage Treatment Plant (Plant) and Sewage Pumping Stations including all the civil units, mechanical and electrical equipment as per the Contractor's proposal, to ensure that all the output guarantees are met.
2. General facilities and utility services including all other components of workdone under the Contractor's project.
3. Programmable Logic Controller (PLC) and SCADA based automation system.
4. Any other services required for efficient and smooth running of the scheme.
5. All buildings and staff quarters.

The Contractor shall also dispose of sludge, screenings, grit and any other material,as per specifications and to the satisfaction of the Engineer and Employer. It is noted that all costs during the Operation and Maintenance (O&M) period, excluding the cost of power is to be borne by the Contractor. Within the Contractor's quoted cost, the Contractor is to ensure that the following guarantees are maintained during the operation and maintenance period. Each is explained in further detail later in this specification section:

1. Quality of treated effluent.
2. Consumption of chemicals.
3. Electrical switchgear and standby generators. Automation, remote monitoring and control.
4. On the job training for Employer staff as per specifications.

At the end of 4th year of the O&M period, assessments of the condition of the plant will be done by Employer or by an independent body and based on that assessment the Contractor shall, at no extra cost to the Authority repair and recondition all the mechanical equipment in the concluding year of the O&M contract to a conditionso that they are in running condition with regular preventive and recommended maintenance as per manufacturer's instructions or as per CPHEEO manual. The Contractor's scope shall include supply of all necessary spares that may be required to operate for another 5 years after the initial period. The list of critical spares shall be drawn up at the end of the 6th year depending upon the maintenance record of equipment in the ultimate year of the contract and the spares shall be supplied in the concluding year of the contract.

b) Output and Operations Guarantees

The Contractor is fully responsible for treating all the sewage received at the inlet chamber. The performance of the Contractor shall be treated as unsatisfactory if Contractor fails to treat the complete sewage or does not maintain the guarantees listed in the Contractor's clause excepting in force majeure condition or fails to fulfil other conditions of the contract.

c) Treated Effluent Quality

The Contractor shall operate the Sewage Treatment Plant in such a way that at all times the treated effluent quality attains the following parameters (as per CPCB Guideline and the Guideline prescribed by MoHUA):

S. No.	Parameters	UoM	Values
1.	pH		6.5 to 9.0

S. No.	Parameters	UoM	Values
2.	Biochemical Oxygen Demand (BOD_5)	mg/l	≤ 10
3.	Chemical Oxygen Demand (COD)	mg/l	≤ 50
4.	Total Suspended Solids (TSS)	mg/l	≤ 10
5.	Ammoniacal Nitrogen (NH_4-N)	mg/l	≤ 5
6.	Total Nitrogen (TN)	mg/l	≤ 10
7.	Total Phosphorous (TP)	mg/l	≤ 1
8.	Fecal Coliform	MPN/100 ml	≤ 100

d) Treated Sludge Disposal

The Contractor shall operate the Plant such that the sludge produced is of a spreadable consistency and the volume of sludge produced after necessary process, is minimum. The sludge generated from the Plant shall be disposed by the Contractor outside the plant under a specific plan to be drawn up.

e) Chemical Requirements

The chemicals consumed to operate the Plant and other facilities under the Contractor's contract shall not exceed the guaranteed chemical consumption as specified by the Contractor in the bid. Extra consumption, if any, shall be in the Contractor's account and Contractor shall undertake suitable modifications worksto ensure that the chemical consumption remains within the limits specified in the Contractor's offer. Tests and Sampling During O&M Period

The sampling and testing shall be carried out daily and at least at the points given below. The Contractor's schedule for tests and sampling shall also be maintained during the O&M period:

1. Inlet works (flow, BOD, pH, suspended solids, temperature, COD, and oil &grease)
2. Outlet of the SBR basin (BOD, pH, suspended solids, COD and oil & grease)
3. Primary sludge (volatile suspended solids, total solids and specific gravity)
4. Secondary sludge (volatile suspended solids, total solids and specific gravity)
5. Various parameters to be tested by online monitoring system at specified locations

f) Staffing

The work and monitoring of the treatment process and pumping stations shall be conducted on a 24 hour per day, continuous basis, without interruption. The Contractor shall give or provide all necessary supervision during the O&M period and as long thereafter as the Engineer may consider necessary. Such supervision shall be given by a competent person having adequate knowledge of the operationand maintenance duties to be carried out including the methods and techniques required, the hazards likely to be encountered and methods of preventing accidents as may be required for the satisfactory working of the entire Plant and pumping stations.

Details of personnel to be employed by the Contractor: The number and details of personnel (minimum) to be employed by the Contractor shall be given as stated below. In addition, the Contractor will provide adequate number of qualified and experienced skilled staff, laboratory staff and unskilled personnel during the O&M

period of the Sewer Networks, Plant and pumping stations, as and when required.

Minimum indicative Staff and Qualifications Requirements during O&M Period

Sr. No.	Designation	Qualifications	Experience in Years	Minimum No. required
1.	General Manager	Post Graduate in Civil, Public Health or Environmental Engineering with specialization in sewage collection and treatment and having experience in Sewerage and Sewage Pumping Stations Testing, Commissioning, Operation & Maintenance, Liaison with Government, Pollution Control Authorities	10	0
2.	Senior Manager	Graduate/ Post Graduate in Civil, Public Health or Environmental Engineering with specialization in sewage collection and treatment and having experience in Sewerage and Sewage Pumping Stations Testing, Commissioning, Operation & Maintenance, Liaison with Government, Pollution Control Authorities.	8	1
3.	Manager	Graduate in Civil/ Public Health/ Environmental, Electrical, Mechanical Engineering with specialization in sewage collection and treatment.	5	1
4.	Junior Manager	Diploma in Civil/ Electrical/ Mechanical, with specialization in sewage collection and treatment.	5	2
5.	Chemist	Graduate/ Post Graduate in Environmental Science/ Chemistry having experience in SEWAGE laboratory (sampling & analysis), operation and maintenance.	3	0
6.	Computer Operator	PGDCA with knowledge in MS Office with typing speed of minimum 40 words/ minute.	3	1
7.	Office Assistant	Bachelor degree in any faculty with computer knowledge	3	1
8.	Laboratory Assistant	Graduate in Environmental Science/ Chemistry having experience in SEWAGE laboratory (sampling & analysis), operation and maintenance.	1	0
9.	ITI qualified Plumber	ITI Certification in Fitter/ Plumber Trade with experience in Sewerage/ Water Supply work.	3	1
10.	ITI qualified Electrician	ITI Certification in Electrician Trade with experience in STP/ WTP/ Pumping Stations	3	1
11.	Jetting Machine operator	8th Pass with HMV driving license	2	0
12.	Winch Machine operator	8th Pass	1	0
13.	Tanker Driver	8th Pass with HMV driving license	2	0
14.	LightVehicle Driver	8th Pass with LMV driving license	2	2
15.	Messenger	10th Pass	-	1
16.	Semi-skilled labour	Experience in Sewerage or Water supply works	2	8
17.	Unskilled	-	-	2

Sr. No.	Designation	Qualifications	Experience in Years	Minimum No. required
	labour			
18.	Watchman/ Security	8th Pass	-	8
				24

Note:

a. The above requirement is indicative minimum only. The Contractor will arrange extra work force, as and when required, so as to smoothly run the operation and maintenance including preventive maintenance, repairs etc. and general cleanliness of the installations. The above staff strength is exclusive of leave reserve required for different category ofstaff. The Contractor shall ensure availability of the personnel given in the above tablefor all seven days in a week.

b. The Contractor shall make appropriate arrangements for maintenance of items like road work, buildings, arboriculture, patrolling and maintenance of civil structures, vehicle operations and other activities defined to fulfill its obligations under O&M Contract.

No labour below the age of 18 years shall be employed.

Staff credentials and experience shall be provided to the Engineer for approval in advance of placement or replacement for the duration of the Contract. Not more than one of the Contractor's key staff (noted in table above) shall be absent fromthe project site at any given time. In case, it is necessary for more than one of the key personnel to be absent at a given time, the Contactor shall provide replacement of equivalent or better qualification and experience for prior approval by Engineer.

Engineer is authorized for direct removal of any or all staff employed during the O&M period of the Plant and pumping stations if in the sole opinion of the Engineer it becomes necessary. The Contractor shall comply with such directions and post a suitable substitute(s).

g) Safety / Security

The Contractor shall take all safety precautions under various acts and rules under central and state government. Contractor shall be responsible for safety of staff and the consequences thereof. The Contractor shall deploy round the clock security personnel at plant entrance and in the compound for the safety of the plant and premises during the O&M period. The Contractor shall be completely responsible for the safety of the plant, equipment and personnel.

The care of the whole of the permanent works shall remain with the Contractor who shall be responsible for all accidents or damages from whatever cause arising and chargeable for anything that may be stolen, removed, destroyed or damaged to whomsoever belonging and also for making good all defects and damages to the said works or to any property adjoining to any cause whatever, whether such damage or defects were occasioned by the negligence of the Contractor or not or completion whereof or whether payment may wholly or partially have been made or the works approved as supposed to have been properly done and no certificate of approval of any works by any officers or members of the Authority shall affect or prejudice the right of the Authority against the Contractor or be considered or held as at all conclusive as to the sufficiency of any work materials.

Adequate safety precautions against fire, flooding, lightening, electrical shocks, accident due to moving/ non-moving heavy/ light equipment shall be strictly observed by the Contractor at the Contractor's own cost. Suitable safety measures like gumboots, gloves, safety belts, ladders, safety lamps, gas masks, Oxygen apparatus, insulated tools, alarm etc. shall be provided by the Contractor except those provided by the Department. Necessary medical first aid kit shall be made available all time. In presence of observance of above safety precautions, the Contractor shall be responsible for any unforeseen loss of the equipment or persons dealing with it. Special care shall be taken by the Contractor while carrying out the work in sewage gas zone. Any incidence of loss of human life or accident will be totally Contractor's responsibility. The Contractor shall ensure that the staff employed takes all necessary precautions while carrying out the work either in shift duties or any general shift as per Indian Electricity Rules /Factory Act /CPHEEO Manual or, manufacturer's special instruction for safety /gas handling. The staff shall use: gas masks, oxygen breathing apparatus, gum boots, safety belts, safety lamps and hand gloves during execution of the work as required per the task.

During night hours after 7.00 P.M, the main gate shall be locked. However, shift duty staff shall be alerted and open the gate during surprise checking by Employer staff or any other Government authorities or the Contractor's nominee without any wait after checking their proof of identification. Only bona-fide persons shall be allowed on the Plant and pumping station premises. Smoking, consumption of alcohol and other illegal substances are strictly prohibited within the Plant and pumping station sites.

The staff engaged shall wear common uniform with name plate indicating name and designation during duty hours.

h) Reporting

The Contractor will prepare daily and monthly reports (in format provided) of pumping, treatment and project performance and submit to the Engineer and will assist the department in preparing the necessary documents for their purpose and record as proforma given from time to time. The reports shall contain the following:

1. Raw sewage quantity and quality: as per the on–line monitoring;
2. Effluent quality: as per the on–line monitoring;
3. A description of maintenance work carried out in the reporting period;
4. A report on major failures, if any, their causes and remedial actions taken;
5. Sludge quality and quantity (daily basis) in the reporting period;
6. Power and chemicals consumed in the reporting period;
7. An inventory of the chemicals and spare parts available at the end of the reporting period;
8. O&M staff deployed by the Contractor during the reporting period;
9. Major repairs work, if any;
11. Contractor is required to maintain separate register/ computerized records at allsites of following information:

a. Pumping register;
b. Quantity of sewage treatment and performance register;
c. Working hours register;
d. Maintenance register;
e. Staff attendance register;
f. Equipment breakdown, repair record and extent of repair;
g. Maintenance record of individual machines;
h. Gas engine operating register. Site Order Book

i) Operation

In case, the motor or any other equipment is burnt or damaged due to negligence of the Contractor or due to faulty operation, it shall be the sole responsibility of the Contractor to rewind/ replace/ repair it as per standards of the equipment free of cost. In case of any fault in operation, maintenance and performance of the Plant, Contractor or the Contractor's staff at duty will immediately report to the Engineer about it.

The Contractor shall run the Plant at the proper voltage. Contractor shall record all power failures and voltage levels in daily log sheet. Contractor will bring into the notice of power supply agency as well as control room and Departmental Engineer about all power failures and related breakdowns. Contractor will also get the electricity restored immediately. Any dispute with the workmen shall be Contractor's responsibility as per Labour Laws/Govt. Rules and Regulations. In no way the department shall be responsible for the disputes between them.

The Contractor shall follow the rules and regulations as per Factory Act as applicable. The Contractor shall arrange all necessary required tools tackles and instruments in advance for proper operation and maintenance of the entire plant.

The Contractor shall operate and maintain all electrical, control, instrumentation, SCADA and mechanical equipment as per the instructions of the respective equipment manufacturer. Contractor shall further maintain and operate the plant, as per CPHEEO manual to the treated effluent results as per approved norms specified in the Contractor's document elsewhere along with the Technical Bid. The Contractor shall be free to follow manufacturers' manual in the Contractor's regard. However, in case of any doubt, the department shall refer to best of the above standards and the Contractor shall be bound to carry out the works accordingly.

The floating material/scum not pumped to the anaerobic digesters shall be collectedin bins and disposed in open pits away from the Plant and machinery. It should be dried and disposed off regularly at a location outside the plant and approved by statutory authority. During rainy seasons, it should be buried after mixing with lime.

The grit shall be collected in trailers, trucks or tractor and the same should be disposed off at appropriate place away from the plant on Contractor's own. Suitable site for that purpose shall be identified by the Contractor. Regarding costof sludge manure, the Contractor will be required to follow Employer practice and rules.

The Contractor shall know all Central /State Government/Semi- Government/local Bodies' rules & regulations to the Contractor's contract without any excuse. Gas coming out of sewage is hazardous containing methane, CO, CO_2 and H_2S etc.

Therefore, necessary precaution and measures shall be taken in regard to human life and installations.

Gas emissions shall be as per the norms as modified by the appropriate rules or regulatory governmental agencies from time to time.

No structure of any kind shall be allowed to be constructed /altered within the plant premises without the permission of Employer. Nothing is to be paid by Employer for any addition if allowed. In case of damages to the buildings/machines and shortcoming to the machines, the same has to be made good as per original shape/good running condition by the Contractor. The decision of Engineer in the Contractor's regard shall be final and binding.

j) Maintenance

Every part of the works and all materials to be used therein shall be subjected to such tests from time to time during the O & M period as the Engineer may direct and the whole of such tests shall in all cases be made at the Contractor's sole expense.

The work shall be carried out and completed under the exclusive control, direction and supervision and to the satisfaction of the Engineer. The Engineer shall likewise have full power to reject or condemn any work or material that Contractor may deem unsuitable. In case of any work or material being rejected by the Engineer, the Contractor shall immediately remove and replace the same to the satisfaction of the Engineer who shall have full powers to get the same removed and replaced and deduct the expenditure incurred in the process form any amount due or that may become due to the Contractor.

The Contractor shall use only the original and genuine spares of the original equipment as per recommendations given in the maintenance booklet of the manufacturers/ as per directions of the Engineer. Adequate stock of such spares is to be maintained by the Contractor. Test certificate of manufacturer is required for bearing along with supplies. Test certificate of all major equipment will be submitted from the manufacturer.

If any material brought upon the site of works or to the places where any operations have been or are being carried out in connection with or for the purpose of the works, be in the judgment of the Engineer of any inferior or improper description be used in the works, the said materials or workmanship shall where be required by the said officer be removed or amended by the Contractor forthwith or within such period for every breach by the Contractor in the Contractor's clause. The Engineer is hereby authorized to remove or cause to be removed the materials and workmanship objected to or any part thereof and replace the same with such materials and workmanship as shall be satisfactory. The Contractor shall reimburse Employer for all costs and expenses incurred thereby or to which the Authority may be put or be liable in connection therewith the amount thereof to be certifiedby the Engineer whose certificate shall be final.

The Contractor shall be responsible of civil maintenance of buildings and roads, while washing and painting every two years and watering of lawn/ plants withinthe plant premises according to the O&M manual.

The Contractor shall also be responsible to maintain cleanliness in and around the plant including machineries, disposal of floating removed from the Bar Screens/ primary sedimentations, etc. Grit and other unwanted material.

All the steel structures and machines installed in open areas shall be painted after every monsoon period after cleaning the surface as per CPWD manual.

However, all the machines, equipment as well as steel structures inside all buildings shall be painted once every twelve calendar months after proper cleaning of the surface as per CPWD manual except HT panel and transformers which shall be painted after three years. Wall painting of the building and painting of doors and shutters etc. shall be done at least once in every two years.

Surface drains shall be cleaned every year before start of monsoon.

All leakages shall be attended promptly to avoid any nuisance etc. Materials causing Choking of all the effluent flumes and pipes should be removed at once. All the valves/ gates which are not used regularly should be operated at least once a week and made sure that they are properly lubricated/ greased.

All safety valves shall be checked daily and ensured that they are working properly. In case of any fault the same should be checked daily and ensured that they are working properly. In case of any fault the same should be attended immediately without any wait. The maintenance of the plant shall be as per maintenance manuals of the manufacturer for all equipment. The Contractor shall keep all the safety devices in working order.

The Contractor shall make sure that no unwanted material should float/ grow in and around different units. In case it is found, the same shall be removed/ cleaned immediately. The Contractor shall also be responsible for cleaning/ sweeping the plant building, inside and outside roads, footpath etc.

Launders, weirs etc. shall be maintained clean round the clock. During preventive/ breakdown maintenance, the Contractor has to visit the unit/ units as and when needed. The pumping units or other machineries required, if any, shall have to be arranged by the Contractor at the Contractor's own costs for completing the work.In case of battery-operated auto system panels and also system alarm etc., batteries are required to be maintained and replaced as and when needed by the Contractor.

The Contractor shall ensure that proper fire extinguishers are used to cover any kind of fire during any mishaps within the total boundary area including plant machineries. The expiry period of refills of various fire extinguishers should be etched and maintained during the period of contract.

The Contractor shall maintain all toilets in running condition for proper use by the staff. The Contractor shall make minor repairs of all civil structures, including replacement of sanitary items, glass panes etc. as and when needed.

The Contractor shall provide all consumable items in the site office for Employer for the 5 years O&M period.

The Contractor shall maintain the PLC system in working condition for the 5 years O&M period.

The Contractor shall not remove/ shift any equipment/ machinery, even temporarily, without written permission of the Engineer.

Though the Contractor has to operate and maintain all the equipment/ machineries, lighting (plant area, boundary walls, gate lightening etc.) but the machine or the equipment under warranty should not be dismantled without prior permission ofthe Engineer. The list of such equipment (under warranty), if any, will be given

by the Contractor.

POL (Petrol/ Diesel Oil & Lubricant) shall be arranged by the Contractor as and when needed as per manufacturer's recommendations for periodic maintenance of entire plant. The Department will not provide such items.

The Contractor shall have to carry out periodical testing of the installations/ equipment as per CPWD/ OPWD specifications, relevant manuals, relevant IS standards and Indian Electricity Rules as amended up to date and shall have to maintain complete record in the maintenance register. The Contractor has to provide necessary protection system wherever necessary including alarms and fire extinguishers.

Employer will be at liberty to post its staff for surveillance/ inspection at the plant along with access to all units, control room and records, log books, MIS (Management Information System) data etc. round the clock as required. The log books and other records shall be properly maintained and any cutting should be attested by the staff from authorized Employer and all other government Agencies viz. OPCB etc. for further action/ improvements / rectifications. The staff in each shift shall mark their attendance on the log sheet individually.

The Plant and equipment covered under the above contract shall be totally maintained by the Contractor including any 'Trouble Shooting' to ensure smooth and trouble-free operation. In case of major repairs due to normal wear and tear/ break down, the Contractor shall inform the Engineer immediately and necessary measures for its repair shall be taken simultaneously. Breakdown and all repairs of any kind are to be attended by the Contractor. Any unit/ equipment being irreparable in the opinion of the Engineer will be replaced by the Contractor at no cost of Employer during the O&M period, the machinery/ media to be replaced from time to time as per manufacturer's recommendations.

All relays, pressure vessels, process instruments (measuring and controlling devices), power metering and HT equipment shall be calibrated and tested at least once a year and the report shall be submitted to the Engineer.

The Department reserves the right to carry out any work including capital works in the plants and pumping stations for improvement of the efficient parameters including coliform reduction. The Contractor shall not obstruct, hinder nor object to any such work/ works by Employer or its authorized agencies.

The Contractor shall provide the Contractor's telephone nos., contract address etc.to the Authority as well as the contact information of person in shift duty to contact him during emergency/ odd hours.

The Contractor will be responsible to carry day to day as well as periodic maintenance, necessary to ensure smooth and efficient performance/ running of all mechanical and electrical equipment and instruments installed at the Plant and pumping stations.

The Contractor shall also be responsible for maintenance/ replacement of street light poles and site lighting.

All the Plant building land sewage treated/ untreated/ gas /sludge etc. shall remain the property of Employer.

k) Typical items in SEWAGE, TPS / IPS & their checks

The purpose of maintenance is shown below.

-Pump up sewage to Sewage Treatment Plant etc.

Maintenance and management of facilities are divided into operation surveillancework and preservation work.

-Operation surveillance work is the surveillance of apparatus operation, apparatusoperation at the time of usual, a pumping mode at the time of a heavy rain, and correspondence at the time of a power failure.

-Preservation work is inspection check, a periodic check, apparatus maintenance,repair of failure apparatus, cleaning, etc.

The item of the main preservation work is shown below.

Name of Facility	**Daily**	**Periodic**	
	Point to be checked	**Frequency**	**Point to be checked**
Motorised Gates	-Check Smooth-Operation	Weekly	-Check Greases up & Oils
	-Check safety equipment		-Smoothness of operation
	-Check Smooth-Operation	Monthly	-Check opening and closing time
	-Check safety equipment		
Wet wells, Channels and Chambers	-Removal of floating matter -Check of a water level	As needed basis	-Cleaning of a sediment -Check H_2S gas concentration
Coarse screens	-Check Smooth-Operation	Monthly	-Adjustment of take-up for Drive chain
	-Check of the difference of the water level before and behind a screen		-Check Screen shape -Check Operation ofa wiper
	-Remove floating un-removable matter on screens		-Adjustment of space between rakes and a screen
	-Clean-up drop garbage -Clean-up Top of Screen -Check abnormal noise		-Check of the lubricating oil level of reduction gears
	-Check safety equipment		-Check Rake-speed
	-Check manual cleaning equipment Correctness		-Check emergency stop system
Screening Conveyor	-Check Smooth Operation abnormal noise	Weekly	-Grease up & Oils
	-Meandering of a belt		
	-Check scraper performance		
	-Check rollers-performance		
	-Cleaning of Conveyor		
	-Check safety equipment`	Monthly	-Check Damage to a belt -Check Slack of a belt & adjustment of take-up -Check of an emergency shutdown

Name of Facility	Daily	Periodic	
	Point to be checked	Frequency	Point to be checked
			system -Check Belt-speed
Submersible Pumps	-Check Smooth-Operation -Check discharge rate, pressure, abnormal noise, Vibration -Checkup minimum submergence in wet well -Check safety equipment -Position of valve	Monthly	-Check pump damage -Check the pump lifting
		Every 6 Months	-Check wear on pump impeller -Check Oil level and grease up -Check bearings
		Every 1~3 Year	-Check pump performance & wearon pump impeller
Monorail Motorized Hoist	-Check Smooth-Operation -Check all lifting equipment includingwire and hook -Check lifting and traveling performance -Check safety equipment	Monthly	-Check End-stop system
		As needed basis	-Check traveling speed -Check hoist rails, structure & support -Check deflection of girder
Valves	-Check water leakage	As needed basis	-Check seal -Check damage

l) Operation and Maintenance practices (Mechanical)

The item of the main preservation work is shown below.

Name of Facility	Daily	Periodic	
	Point to be checked	Frequency	Point to be checked
1.HEAD WORKS/ MEDIUM / FINE SCREEN INLET CHANNELS			
Medium / Fine Screen	-Check Smooth-Operation -Check of the difference of the water level before and behind a screen -Remove un-removable floating matter on screens -Clean-up Top of Screen -Check abnormal noise -Check safety equipment -Check manual cleaning equipment Correctness	Monthly	-Check Screen-shape -Operation of a wiper -Adjustment of space between rakes and ascreen -Check of the lubricating oil level ofreduction gears -Check emergencystop system
Screenings Conveyor	-Check Smooth-Operation -Abnormal noise -Meandering of a belt -Check Smooth-Operation -Check scraper performance	Weekly	-Check Grease up &Oils -Check emergencystop system

Name of Facility	Daily	Periodic	
	Point to be checked	Frequency	Point to be checked
	-Check rollers-performance -Cleaning of Conveyor -Check safety equipment		
Screenings Conveyor	-Check Smooth-Operation -Abnormal noise -Meandering of a belt -Check Smooth-Operation -Check scraper performance -Check rollers-performance -Cleaning of Conveyor -Check safety equipment	Monthly	-Check Damage to abelt -Check Slack of a belt & adjustment of take-up -Check Belt-speed
2.HEAD WORKS / GRIT BASINS			
Grit Collectors	-Abnormal noise -Check Smooth-Operation -Check safety equipment	Weekly	-Check grease up &Oil level of reduction gears -Remove scum&cleaning -Check emergency stop system
Grit Collectors	-Abnormal noise -Check Smooth-Operation -Check safety equipment	Every 6 Months	-Check of shaft rotation speed
Grit Collectors	-Abnormal noise -Check Smooth-Operation -Check safety equipment	Yearly	-Dry basins for checking of damage, space between rake and bottom floor, peripheral velocity, repair, painting & cleaning
Air Diffusers Assembly	-Check mixing condition in the zone -Check air flow rate & pressure	Every 6 Months	- Check the diffuser lifting equipment for performance andsmoothness - Check diffusers Assembly
		As needed basis	- Check the air flow rate and size of air bubble -Check diffuser performance -Chemical cleaning for diffusers -Remove deposited material between diffuser and basin floor
Inclined Grit Removal Equipment	-Check Smooth-Operation -Check discharge rate, abnormal noise -Check liquid leakage -Check safety equipment	Weekly	- Check grease up & Oil level of reduction gear box - Remove scum &cleaning - Clean up with water
		Monthly	- Check emergencystop system
		Every 6 Months	-Check of shaft speed -Check space betweenrake and bottom

Name of Facility	Daily	Periodic	
	Point to be checked	Frequency	Point to be checked
Grit Conveyor	-Check Smooth-Operation -Abnormal noise -Meandering of a belt -Check Smooth-Operation -Check scraper performance -Check rollers-performance -Cleaning of Conveyor -Check safety equipment	Weekly	- Check grease up &Oils - Check emergencystop system
		Monthly	- Check damage to a belt - Check Slack of a belt & adjustment of take-up - Check Belt-speed
3 SBR			
Air Diffusers Assembly	-Check mixing condition in the zone -Check air flow rate & pressure	Every 6 Months	- Check the diffuser lifting equipment for performance andsmoothness - Check diffusers Assembly
		As needed basis	- Check the air flow rate and size of air bubble -Check diffuser performance -Chemical cleaning for diffusers -Remove deposited material between diffuser and basin floor
Decanter	As per manufacturer's guidelines		As per manufacturer's guidelines
4. SLUDGE PUMP STATION			
Primary Sludge Pumps	-Check Smooth-Operation	Weekly	- Check grease up & Oil level of reduction gear box
	-Check discharge rate, pressure, abnormal noise, heat and vibration -Check sludge leakage -Check pump speed & rotation direction -Check safety equipment	Every 6 Months	- Check pump damage - Check wear of pump impeller - Check of pump speed-Clean up with water
		Every 1~3 Year	- Check pump performance
5. SCUM PIT			
Primary Scum Pumps	-Check Smooth-Operation -Check discharge rate, pressure, abnormal noise -Check safety equipment	Monthly	- Check pump damage - Check the pump lifting equipment for performance andsmoothness - Clean up with water
		Every 6 Months	- Check wear onpump impeller - Pump speed & rotation direction
		Every 1~3 Year	- Check pump performance
6. PROCESS AIR BLOWER BUILDING			
Air blowers	Check smooth operation	Weekly	- Check grease up & Oil level of reduction gear box

Name of Facility	Daily	Periodic	
	Point to be checked	Frequency	Point to be checked
	Check discharge rate, pressure, abnormal noise, heat and vibration Check blower speed & rotation direction Check coupling connection Check cooling system Check air leakage Check safety equipment		- Check safety equipment - Check Air filter - Check drain
		Every 1~3 year	- Check Blower performance
		As needed basis	-Check blower system -Check Silencers
EOT Crane	-Check Smooth-Operation -Check all lifting equipment Including wire and hook	Monthly	-Check end-stopsystem - Check travelingspeed
	-Check lifting and travelling performance - Check abnormal noise and vibration - Check safety equipment	As needed basis	- Check rails, structure & support - Check any damage
7. CHEMICAL BUILDING			
Monorail Motorized Hoist	-Check Smooth-Operation -Check all lifting equipment including wire and hook -Check lifting and traveling performance -Check safety equipment	Monthly	- Check End-stopsystem
		As needed basis	- Check travelingspeed - Check hoist rails, structure & support
8. CHLORINE CONTACT TANK INLET CHANNEL			
Motored Chlorine Injectors (In-line)	-Check Smooth-Operation -Check motor running -Check Chorine residual in chlorine contact tank -Check abnormal noise & vibration -Check chlorine gas leakage by ammonia liquor -Check Gas pressure gauge, vacuum gauge, gas flow meter -Check safety equipment	Weekly	-Check damage of chlorine gas supplyline -Check back flow prevention valve -Check leakage of chlorine solution
		Yearly	-Check the injector maintenance lifting equipment for performance -Check in-line injector performance and smoothness
9. CHLORINE BUILDING			
Chlorinators	- Check solution leakage and/or chlorine gas - Check Gas pressure gauge, gas flow meter - Check dosing rate/amount - Check chlorine gas rate valves, check valves&	Weekly	- Check total System

Name of Facility	Daily	Periodic	
	Point to be checked	Frequency	Point to be checked
	pipe line -Check safety equipment		
Chorine Cylinders (Ton)	- Check chlorine gas / solution leakage - Check no gas leakage, and no wet or keep dray in the room -Check room temperature & humidity -Check Gas header, pipe line& gasket -Check safety equipment	Weekly	- Check Condition of the cylinder-material and safety valve -Check storage way -Classification ofcylinder as new orempty, and check the stock -Cleaning
Cylinder Scales	-Cleaning weight area	Weekly	-Check measuringerror
Cylinder Lifting Equipment& Hoist	-Check Smooth-Operation -Check lifting equipment -Check lifting and travelling performance -Check safety equipment	Monthly	-Check End-stopsystem
		As needed basis	-Check travelingspeed -Check hoist rails, structure & support
Safety Equipment	-Check performance of chlorine gas detectors and sensors, Ventilation system -Check sequence of Auto / manual mode -Check safety equipment	Weekly	-Cleaning gas detector& sensors -Clean up the areainstalled detectors -Check safety shower performance
		Monthly	-Try-on oxygen mask,other safety appurtenances -Check Gas LeakageRepair Kits
Neutralization Equipment (Emergency Chlorine Scrubber)	-Check NaOH solution leakage from the tank / equipment /pipe/ valves -Check solution level -Check performance of splays, pumps -Check performance of exhaust blower -Check safety equipment	Weekly	-Check pH of NaOH solution
10. PLANT WATER PUMP STATION			
Submersible Pumps	-Check Smooth-Operation -Check discharge rate, pressure, abnormal noise -Check safety equipment	Monthly	-Check pump damage -Check the pump lifting equipment for performance and smoothness -Clean up with water
		Every 6 Months	-Check wear on pump impeller -Pump speed & rotation direction
		Every 1~3 Year	-Check pump performance
Monorail Motorized Hoist	-Check Smooth-Operation -Check all lifting	Monthly	-Check End-stopsystem
		As needed	-Check travelingspeed -Check hoist rails,

Name of Facility	Daily	Periodic	
	Point to be checked	**Frequency**	**Point to be checked**
	equipment includingwire and hook -Check lifting and travelling performance -Check safety equipment	basis	structure & support
11. CENTRIFUGE BUILDING			
Centrifuge Feed Pumps	-Check Smooth-Operation -Check discharge rate, pressure, abnormal noise, bearing temperature & vibration -Check feeding rate to meet speed of dewatering equipment -Check sludge leakage -Check safety equipment	Weekly	-Check grease up &Oil level of reduction gear box -Check safety equipment -Clean-up with water
		As needed basis	-Check pump performance
Dewatering Centrifuges	-Check Smooth-Operation -Check pressure, abnormal noise, bearing temperature & vibration	Monthly	-Check quality of oilin reduction gear box -Check all safety equipment -Clean-up drain pipeof separate liquid
	-Check feeding sludge concentration and ratio of Polymer dosing -Check cake moisture and G-value -Check SS in drain -Check emergency stop system -Check no liquids leakage from casing, loose bolts/ Nuts/ tighten -Check grease up & Oil level of reduction gear box -Check safety equipment	Every 1~3 Year	-Check dewatering centrifuge performance
		As needed basis	-Check dewatering centrifuge system -Check space betweenscrew and casing
Conveyer (Sludge Cake)	-Check Smooth-Operation -Abnormal noise -Meandering of a belt -Check Smooth-	Weekly	-Check grease up &Oils -Check emergencystop system

Name of Facility	Daily	Periodic	
	Point to be checked	**Frequency**	**Point to be checked**
	Operation -Check scraper performance -Check rollers-performance -Cleaning of Conveyor -Check safety equipment	Monthly	-Check damage to abelt -Check Slack of a belt & adjustment of take-up -Check Belt-speed
Cake Hopper	-Check Smooth-Operation -Check abnormal noise& vibration -Check gate operation on opening and closing	Weekly	-Check grease up &Oils -Check gate performance
		As needed basis	-Check cake hopperassembly
Powder Polymer Storage Hopper	-Check Smooth-Operation -Check abnormal noise & vibration -Check no polymer bridge	Weekly	-Check grease up &Oils -Cleaning dust off
	-Check safety equipment -Check Smooth-Operation -Check abnormal noise & vibration -Check no polymer bridge -Check safety equipment	As needed basis	-Check powder polymer storagehopper assembly
Auto Feeder	-Check Smooth-Operation -Check abnormal noise &vibration -Check feeding rate -Clean-up feeder	Weekly	-Check feeding accuracy -Clean up feeder
Auto Feeder	-Check Smooth-Operation -Check abnormal noise & vibration -Check feeding rate -Clean-up feeder	As needed basis	Check the feeder performance

Name of Facility	Daily	Periodic	
	Point to be checked	Frequency	Point to be checked
Polymer Batch Tanks	-Check corrosion condition -Check leakage -Check drain & Over flow pipe	Weekly	-Remove deposition substance -Clean up tank &touch-up painting
Polymer Mixers	-Check Smooth-Operation -Check abnormal noise & vibration -Check mixing time -Check safety equipment	Weekly	-Clean up mixer
Polymer Mixers	-Check Smooth-Operation -Check abnormal noise & vibration -Check mixing time -Check safety equipment	Monthly	-Check mixing speed -Check shaft and coupling connection
Polymer Feeding Pumps	-Check Smooth-Operation	Monthly	-Check accuracy offlow rate -Clean up with water
	-Check discharge rate, pressure, abnormal noise and vibration	Every 1~3 Year	-Check pump performance
Motorized Monorail Hoist	-Check Smooth-Operation -Check all lifting equipment includingwire and hook -Check lifting and traveling performance -Check safety equipment	Monthly	-Check End-stopsystem
Motorized Monorail Hoist	-Check Smooth-Operation -Check all lifting equipment including wire and hook -Check lifting and traveling performance -Check safety equipment	As needed basis	-Check traveling speed -Check hoist rails, structure & support
12. BELT FILTER PRESS (IF PROVIDED)			

Name of Facility	Daily	Periodic	
	Point to be checked	Frequency	Point to be checked
Belts, nozzles, gear box, wash station, drainage section, rollers, tension assembly, drive train, hydraulic power unit	-Clean belts by running belt drive and wash system without sludge or polymer for a minimum period of 45 minutes -Clean spray nozzles on wash box -Check fluid level in hydraulic unit and fill as required -Lubricate bearings	Weekly	- Inspect wear items specifically chicanes, scrpper blades, gravity drainage grid, dwatering belt, rubber seals on the sludge restrainer – and wash station. Replace as required. Follow lubrication requirements on motor nameplates. - Inspect frame and and roller coatings for wear - Inspect belt guides and wiper bars
		Monthly	- Clean belt with a soap and bleach mixture - Inspect belt seam wires for break and replace if broken.
		Every 6 - months	- Clean hydraulic filterscreen - Check il level in driveunit gear box - Inspect polymer mixer / injection assembly andclean if required. - Replace belt seamwires
		1~3 year	-Change the oil in thedrive unit gear box. If the drive unit gearbox is used in a high humidity,or corrosive environment, the lubricate has to be changed more frequently. -Drain, flush and grease the gearcase.

m) Operation & Maintenance practices (Electrical)

i. Typical items in Electrical Facility & their checks

Name of equipment	Daily	Periodic	
	Description	Frequency	Description
Transformer	Verification of KVA, V, A, abnormal sound, current protection, oil temperature	Every 6 Months	- Verification of general performance, - Verification of oil levels, silica gel in breather, OLTC, OTI, WTI, Buchholz relay, CTs etc, testing of oil, verification of earth connections, IR measurement.

11 Kv Switch board and Switch gears	Verification of kVA, kW, kWh, V, A, PF, Hz, healthiness of protections, indications, alarms, abnormal sound, burning smell.	Every 6 Months	- Verification of condition of breakers, switches, relays, protective devices, earthing, wiring and connections.
PCC/ MCCs/ MLDB	Verification of V, A, healthiness of protections, lamps, abnormal sound, burning smell	Every 6 Months	- Verification of condition of breakers, switches, push buttons, relays, protective devices, earthing, wiring and connections
Variable Frequency Drives	- Verification of Input & output voltage, current, frequency. - Verification of Indications, alarm & protections.	Every 6 Months	- Verification of condition of breakers, switches, pushbuttons, relays, protective devices, earthing, wiring and connections. - Verification of working of converter, inverter, DC Link. - Verification of Harmonic Distortion.
Lighting panels	Verification of lamps, abnormal sound, burning smell.	Every 6 Months	- Verification of condition of breakers, switches, earthing, wiring and connections.
Meters reading	Verification of V, Am, overload protection	Every 6 Months	- Verification of over load protection indication, switch on/Off, accuracy, damage

Diesel Generator Set	- Verification of Engine oil level, Engine oil leakage, air & oil filters, cooling fans, fuel level, water level etc. - Verification of battery voltage, charging & self-start. - Verification of abnormal sound, vibrations etc. - Verification of Voltage, current, frequency, RPM, Indications, Alarms & Protections. - Verification of Oil leakage, fuel leakage. - Verification of Interconnecting Cable, earthing, loose connections etc .	Every 250 hours/ 6 Months	- Verification of Conditions of filters. - Verification of Condition of cooling fan. - Verification of Condition of battery & charger. - Verification of self-start system - Verification of condition of engine, alternator & accessories, doors ofacoustic enclosure, exhaust system etc. - Verification of conditions of Breakers, Switches, Push Buttons, Relays etc. - Verification of Auto / Manual operation, all interlocks, synchronising . - Verification of Indications, Alarms & Protections. - Verification of Condition of Inter connecting Cables, Connection & earthing including Neutral Earthing of AC Generator.
Cable system	Verification of short circuit, burning smell, loose connections, local heating	Every 6 Months	- Verification of voltage drop, damage, insulation resistance
Lighting Fixtures	Verification of working of lamps & ballasts.	Every 6 Months	- Verification of illumination level - Verification of condition of lamps & ballasts. - Cleaning of lighting fixtures. - Verification of wiring.
Switch board	Verification of operation of switches, sockets.	Every 6 Months	- Verification of condition of switches, sockets & fan regulators. - Verification of wiring.
Switch Socket	Verification of operation of Switch	Every 6 Months	- Verification of condition of Switch &
Ceiling Fan	Verification of operation of Fan.	Every 6 Months	- Verification of condition of ceiling fan. - Verification of condition of bearing, abnormal sound/ noise.
Power sockets	Verification of operation of MCB, Plug & Socket.	Every 6 Months	- Verification of condition of MCB, Socket & Wiring.

General	- Inspection of General appearance of various Electrical equipment/ items. - Verification of Cable System for Short circuit, smell, damage etc.	Every 6 Months	- Verification of condition of cables, wires& connections. - Verification of Insulation resistance of individual equipment, cables and total system. - Verification of Condition of Earth Connections.

ii. Electrical System Operation Practices

All the electrical equipments shall be handled and operated by a trained and authorized person only. All the equipment shall be checked for its proper earthing and loose connections prior to start the equipment. Naked wire, loose connections and faulty connections shall be repaired immediately prior to start for operation.

Electrical sockets and switch shall not be touched by bare or wet hands. If there is any live wire found naked or on wet ground, main switch shall be turned off first then the wire shall be repaired or moved.

For any electrical works proper insulated tools shall be used. Do not try to use tools made for other purpose; it may be hazardous.

n) Operation & Maintenance practices (Instrumentation, Control & Automation)

i. General maintenance

A comprehensive maintenance program is critical to attaining long-term reliable performance of SCADA Systems / ICA systems. Periodic device calibration, preventive maintenance, and testing allow potential problems to be identified before they can cause mission failure. Prompt corrective maintenance assures reliability by minimizing downtime of redundant components.

The EPC or Turnkey contractor has to enter in to AMC contracts with system / equipment suppliers of ICA, as necessary. It is mandatory to enter into an agreement for a period of 5 years operation & maintenance contract with the instrumentation, PLC and SCADA system supplier and wireless communication supplier or the authorized system integrator, whosoever has executed the work for this project.

ii. Preventive maintenance

The SCADA system should be part of the overall preventive maintenance (PM)program for the facility.

Table below provides a list of recommended maintenance activities and frequencies for ICA systems and their components.

Preventive maintenance schedules for ICA components and subsystems should be

coordinated with those for the mechanical/ electrical systems they serve to minimize overall scheduled down time.

Activity	Frequency
Pneumatic Systems/Components/Instruments	
Check Regulators and Filters	Monthly
Inspect Tubing and Piping	Monthly
Actuate Pressure Switches	3 months
Calibrate Switches and Sensors	Yearly
Calibrate Pressure Gauges	Yearly
Calibrate Level Transmitters	Yearly
Calibrate Flow transmitters	Yearly
Calibrate Pressure Transmitters	Yearly
Calibrate Thermometers	Yearly
Calibrate Analytical Instruments/Online Instruments (pH, ORP, Turbidity, etc..)	6 Months
Change Sampling solution of Analytical Instruments	As required
Electronic Systems	
Lamp Test/Verify Indicators	Monthly
Inspect Enclosures for Dirt, Water, Heat	Monthly
Run PLC Diagnostics	3 Months
Calibrate Sensors and Transmitters	Yearly
Calibrate Meters	Yearly
PLC Communication Modules	Monthly
PLC Batteries	Yearly
Test Automatic control Sequences	Monthly
Verify Alarms	Weekly
Software Maintenance and Patching	3months
Anti-virus Definition Updates	Monthly
Inspect Wire, Cable and Connections	Monthly
Inter site Communication Network	Weekly
Dead Bus Relays	3 Months
UPS setting with SCADA	Weekly
PLC Redundant Power back up	Monthly
SCADA Redundancy	Monthly
Network Redundancy	Weekly
PLC Hot-Standby	Monthly
Historian Package (Capacity)	Monthly
Data Archiving	Monthly

a. Many components of SCADA systems, such as dead-bus relays, are not required to function under normal system operating modes. For this reason, the system should be tested periodically under actual

or

simulated contingency conditions. These tests should approach as closely aspossible the actual off-normal conditions in which the system must operate. For

example, SCADA for Dual Redundant system should be tested by interrupting the utility source as far upstream of the normal service as possible.

b. Periodic system testing procedures can duplicate or be derived from the functional performance testing procedures.

c. The SCADA software maintenance should include timely updates of any new versions from the supplier and testing to verify proper installation on the SCADA computer. In addition, software antivirus updates should be maintained. This should be performed any time after the computer is connected to the Internet or the antivirus patch should be downloaded as and when the updates are available. Normal operation requires that the SCADA computer not be connected to the Internet.

Faulty Instruments, sensors, transmitters, communication modules, computer hardware should be replaced with new components. Repair of the items would not be accepted.

iii. Concurrent maintenance

Concurrent maintenance is defined as testing, troubleshooting, repair or replacement of a component or subsystem while redundant component(s) or subsystem(s) are serving the load. The ability to perform concurrent maintenance is critical to attaining the specified reliability/ availability criteria for facilities and must be designed into the SCADA system. Where SCADA components are associated with equipment that has redundancy and therefore are not themselves redundant, their maintenance should be scheduled to occur during maintenance of the associated equipment. SCADA components and controllers that are redundant must be capable of being taken out of service, repaired or replaced and tested without interfering with the operation of the redundant component.

iv. Reliability centered maintenance

Reliability-centered Maintenance (RCM) is an approach for developing an effective and efficient maintenance program based on the reliability characteristics of the constituent parts and subsystems, economics, and safety. RCM provides a logical, structured framework for determining the optimum mix of applicable and effective maintenance activities needed to sustain the operational reliability of systems and equipment while ensuring their safe and economical operation and support.

A significant by-product of the application of SCADA systems to the control of facilities is the large amount of operational data made available through the trending and data storage features of the SCADA. This operational data can be used for automated performance monitoring of mechanical and electrical systems that can support a RCM approach.

v. Operations and maintenance documentation

The contractor should perform an O&M analysis to determine the O&M data required to support maintenance of the SCADA system. This analysis should be coordinated with BWSSB to determine maintenance parameters and O&M data that are available. Typical O&M data requirements include the following items:

a. System documentation as defined in FDS, FAT & SAT documents
b. Minimum spare parts list.
c. Recommended spare parts list.
d. Recommended onsite test equipment.

e. Recommended O&M training.
f. Recommended O&M to be performed by contractor

vi. Spare parts stocking

An adequate on-site stock of spare parts is essential to obtaining high availability of ICA systems. All spare parts used for the equipment in the maintenance of the system must be from the manufacturer of the equipment or, if the equipment itself has been made with parts from other manufacturers, the parts must be of the same make as used in the equipment supplied and installed.

All spare parts shall be packed for long storage under the climatic conditions prevailing at the Site. Each spare part shall be labelled on the outside of its packing with its description, number and purpose and, if more than one spare is packed in a single case, a general description of the case contents shall be shown on the outside and a packing list enclosed.

Minimum recommended stocking levels include the following. These quantities may need to be increased for components which are used in large numbers in the facility:

(1) Manufacturer's recommended spare parts list.

(2) One each of all line replaceable boards or modules.

(3) Six each power and control fuses used in the system.

(4) Tools required to terminate coaxial on fibre optic cables.

Automation:

(1) Laptop computer loaded with software required to access controllers.

(2) Licenses for all software installed on the system.

(3) Permission to modify program code.

(4) Spare cables for connecting computer to controllers.

(5) PLC CPU, Power supply module, 1 DI, DO, AI, AO modules, Communication module, protocol converter etc.

(6) PLC batteries, fuses, etc.

vii. Utilities & Consumables

The contractor has to provide consumables for printers e.g.: Ink cartridges (colour & B/W), A4, A3, A1 size of paper, dot-matrix print paper for a period of 7 years.

Downtime of the above system should not exceed more than 2 hours.

viii. Technical support

The Contractor should specify functional areas of the operating system and/or equipment where a technical representative will be furnished by the manufacturer for training, test, checkout, validation, or pre-operational exercises.

Ongoing O&M of SCADA system software may require technical support from the system vendor or from agency technical personnel not located at the facility. Commercial SCADA software typically has provisions for remote modem access that permit this type of support from the vendor's location or an agency central engineering group.

Such remote access provisions represent a vulnerability to "hacking" and must be used with great caution. They should be monitored when in use and physically disconnected when not in use.

Password protection policies for all SCADA systems, including PLC's, shall be in compliance with Established policies and to be agreed with the Authority's representative.

These policies require that the default password that came from the control supplier be changed when placed into operation at the facility.

o) Release of Bio-Gas

The Contractor shall conduct their activities in the Plant and pumping stations in such manner that Bio-Gas will not be released or leak at the site or elsewhere. The Contractor shall bear the cost of correcting any adverse consequences resulting from any such release, leakage or spillage and shall make / file reports with respectto enquire under the conditions of contract for operation and maintenance and applicable law. In case release /flaring of bio-gas is required, necessary arrangement shall be provided for flaring the gas as per the norms as prescribed by PCB / competent regulatory authority.

p) Release of Hazardous Substances or Hazardous Wastes

The Contractor, after first notifying the Authority, shall be responsible for fulfilling all requirements associated with any release of any substance or waste into the environment (from the facility to the site) as required by the Applicable law or by any Legal Entitlement including but not limit to the notification or reporting of release of Hazardous Waste. The Contractor shall prepare memorandum evidenceon such notification or reporting and provide copies thereof to the Authority along with any documents provided to the relevant regulatory agency regarding such release. The Contractor shall store and dispose of plant residuals (bio-solids) offsite in accordance with the rules and regulations in effect at the time the SEWAGEis commissioned, technically under latest norms as declared by Central / Orissa Pollution Control Board and get the certificate of residual disposal from the authority, submit to the Authority in each time.

q) Technical Audit

The Engineer has the right to conduct a technical audit of the Plant and pumping stations and to perform any analysis or inspection it deems necessary. Before any such inspection the Authority shall give a prior written notice of three days to the conductor of the audit. The Contractor shall at the Contractor's own cost and expenses provide all assistance the Authority requires to complete these audits and inspections. Such audits may cover all or any of the obligators, including without limitations:

1. Verifications of the system / capacity for normal wear and tear during the O&M period.
2. Verifications of the performance standards and useful life of the individual assets of the Plant and pumping stations for normal wear and tear during the O&M period.
3. Verifications of the capacity of the Plant and pumping stations to meet Output standards.
4. Measurement of various parameters of power generated.

r) Plant and Pumping Stations Visits

At any point of time or at the end of each twelve-month period or at the initiative of the Authority, a visit shall be organized so that both parties can check the conditionof the installations of the Plant and pumping stations. A report shall be drawn up to record the opinions of both parties. The Authority reserves the right to call the equipment manufacturers or specialized technicians for these visits. All expenses are to be borne by the Contractor for the purpose.

s) Operations and Maintenance Manual

The Contractor shall provide six copies of draft O&M Manual to Employer at the time of the commissioning of the project and on approval of draft, 10 copies of the final O&M Manual shall be supplied by the Contractor. The O&M manual shall include detailed operation and maintenance instructions, procedures and policies required. The Contractor shall provide a complete O&M manual for the Plant and pumping stations to achieve full compliance with the operational guarantees. The O&M Manual shall also include the instructions required to provide the necessary maintenance and repair for the Plant and pumping stations for full compliance with the maintenance specifications.

Without limiting the generality of the foregoing, the O&M Manual shall include descriptions, procedures and shall comply with the requirements, set forth in the provisions of the Bid Documents. Four (4) copies of the draft O&M Manual shall be submitted for review. The draft O&M manual shall be subject to the review and approval of Employer who shall have all rights to make any changes and revisions to the O&M Manual as it may deem appropriate. The Contractor shall revise such draft O&M Manual prior to the commencement of the O&M period.

During the Defects Notification / Liability Period (D N/L P), the Contractor shall revise the draft O&M Manual to reflect any updates, changes or revisions, it deems appropriate, inter alia based on its experience and necessity to reflect any modifications or adjustments to the plant. Without limiting the above, the Contractor shall annually review, revise, update and modify the draft O&M Manual fully as may be necessary or appropriate. Any revision to the draft O&M Manual shall be subject to the review and approval of Employer. Employer shall have the right to require revisions to the O&M Manual as it may deem appropriate. The Contractor shall prepare and submit to Employer, for its review and approval, 30 days prior to the proposed date of "Taking Over", a revised draft O&M Manual which reflects all changes, revision and modifications. The Contractor shall prepare the O&M Manual, as approved by the Authority, prior to the date of taking over operation and maintenance of the Plant and pumping stations.

During the term of the Contractor's agreement, the Contractor shall promptly notify Employer of any revisions, additions or modifications which the Contractor,in the Contractor's professional opinion, believes should be made to the O&M Manual, whether as a result of additional experience in operating and maintainingthe Plant and pumping stations, or changes in influent quality or volume changes or modifications to any equipment, part component or structure incorporated in the Plant and pumping stations: Such notification shall set forth the reason for the proposed revision. Any proposed revision shall be subject to the approval of the Authority or Engineer. In addition, during the term of the Contractor's Agreement,

Employer shall have the right to require relevant changes, revisions, or additions to the O&M Manual, as it shall deem appropriate to ensure full compliance with O&M standards.

The Contractor shall submit 10 copies of the Final O&M Manual.

t) Issue of Completion Certificate for Operation and Maintenance

The Authority shall issue a Completion Certificate for "Operation and Maintenance" after successful completion of O&M by Contractor to the satisfaction of the Authority.

- **The scope includes cost for energy charges, man power, Maintenance & Repair, chemical charges and all supervision, inspection charges etc. including all incidental fees/ charges as per the estimate of concerned electrical authority is to be deposited by the bidder excluding security deposit charges which will be borne by the department.**

- **The external Electrification work has to be carried out as per the approved estimate and specifications of TPCODL and under the supervision of TPCODL authorities.**

17. CHANGE OF SCOPE

The length of Pipe lines and capacity of different structures of Civil, Mechanical and electrical installations specified hereinabove shall be treated as an approximate assessment. The actual lengths and capacity as required on the basis of detailed investigations shall be determined by the Contractor in accordance with the Specifications and Standards. Any variations in the lengths specified in this Schedule-B shall not constitute a Change of Scope, save and except any variations in the length arising out of a Change of Scope expressly undertaken in accordance with the provisions of Article 13.

18. Operation & Maintenance:

On issue of provisional completion certificate, the Operation & Maintenance of the project are to be under taken by the Executing Agency for a period of **5 (Five) years** with supply of manpower, chemicals, consumables & other repair & maintenance works including spare parts, if any. The energy charges shall be paid by the Department directly to the concerned electrical authority. Any defects/discrepancies noticed in civil, mechanical and electrical works has to be attended promptly. It is to be ensured consistently that the sewage is efficiently collected through the property connections and safely conveyed through gravity sewer network to the corresponding sewage pumping stations where from it is efficiently pumped to the proposed STP where the raw sewage shall be treated to consistently produce the treated sewage of desired quality. Daily test of the treated sewage samples is to be carried out by the Executing Agency. It should be ensured that the quality of treated sewage must satisfy the permissible limit as per clause 18.6.3.3. The entire project needs to be operated up to **24 Hours per day**.

19. Works to be performed for Operation & Maintenance:

19.1 Waste water collection

i) Monitoring of smooth flow from the property connections into the gravity network shall be assessed.

ii) Blockages if any has to be removed to maintain the smooth flow.

19.2 Raw sewage conveyance (gravity & pumping)

The conveyance would include gravity sewers as well as sewage pumping mains from sewage pumping station to the sewage treatment plant.

A) All pipes

i) Sufficient stock of spare pipes and specials and jointing materials should be maintained for replacement of damaged ones.

ii) Performance of Sluice valves, air valves, expansion joints, etc. shall be monitored regularly.

iii) Regular Leak detection surveys should be undertaken particularly for bursting of pipes and leaky joints.

iv) A detailed record of break downs and leaks observed and repaired should be maintained section-wise so that more vulnerable lengths could be identified and special measures to repair / replace them could be undertaking.

v) A regular schedule of inspection and attendance to all valves including air and scour valves should be drawn up and the same followed scrupulously. Specials attention should be given to air valves.

vi) Regular inspection of manholes to check and remove blockages

B) Pumping main laid above ground

i. Pipes should be painted at least once in five years to prevent corrosion.

ii. Appurtenances such as sluice valves, air valves, expansion joints, roller should be checked, cleaned at least twice a year and worn-out parts replaced. The cleaning and lubrication of rollers should also be done twice a year, preferably pre and post monsoon.

iii. Expansion joints should be inspected every month.

iv. The catch drains provided for the portion of water mains laid in cutting should be cleaned before on set of monsoon so that no water accumulates in the cutting portion, resulting in uplift pressure on pipes.

19.3. Keeping adequate Spares

i) Inspect test facilities

19.3.2 Stilling chamber, screen channel, grit chamber, chlorine contact tank

i) Periodical painting with weather proof paint.

ii) Annual Overhauling and repainting a month or two prior to monsoon.

iii) Free of blockage of sludge lines

iv) Periodical cleaning of channels

v) Keeping adequate spare parts for mechanical, electrical & instrumentation components

19.3.4 Sequential Batch Reactor Basin

i) Daily Check for cycle of operation.

ii) Free of blockage of sludge lines

iii) Check and monitor performance of blower

iv) Check and monitor performance of decanter & diffusors

vi) Keeping adequate spare parts for mechanical, electrical & instrumentation components

v) Status of functioning of Instrumentation, Valves, Blowers, gauges etc.

vi) Check for corrosion of all underwater equipment

19.3.5 All sumps & pump houses, centrifuge shed & centrifuge

i) Daily Check for cycle of operation.

ii) Free of blockage of sludge lines

iii) Check and monitor performance of pumps

iv) Check for leakages in pipes and pipe appurtenances

v) Keeping adequate spare parts for mechanical, electrical & instrumentation components

vi) Status of functioning of Instrumentation, Valves, gauges etc.

vii) Check for corrosion of all underwater equipment

19.3.6 MAINTENANCE AND REPAIRS OF ELECTRICAL EQUIPMENT

i) CONSUMABLES

Adequate stock of lubricating oil and transformer oil should be maintained.

ii) REPLACEMENT SPARES

To avoid downtime, stock of fast-moving spares and of spares likely to be damaged by short circuit should be maintained. A set of recommended spares for two years of trouble-free operation should be kept.

19.3.7 TOOLS AND TEST EQUIPMENTS

Tools such as crimping tools, soldering, brazing and usual electrical tools should be available.

19.3.8 PREVENTIVE MAINTENANCE

As preventive maintenance, a schedule for the maintenance of the equipment shall be followed. The schedule covers recommendations for checks and remedial actions, to be observed at different periodicities such as daily, monthly, quarterly, semi-annually, annually and bi-annually.

19.3.8.1 DAILY

(i) For Motors

(a) Check bearing temperatures

(b) Check for any undue noise or vibration

(ii) For panel, circuit-breaker, starter;

(a) Check the phase-indicating lamps

(b) Note readings for voltage, current, frequency etc

(c) Note energy meter readings

(iii) For transformer substation

(a) Note voltage and current readings

19.3.8.2 Monthly

(i) For motor: nothing special other than the daily checks

(ii) For panel, circuit-breaker, starter

(a) Examine contacts of relay and circuit breaker. Clean, if necessary.

(b) Check setting of cover-current relay, no volt coil and tripping mechanism and oil in the dashpot relay.

(iii) **For transformer substation**

(a) Check the level of the transformer oil

(b) Check that the operation of the GOD is okay.

(c) Check contacts of GOD and of over-current (OC) relay

(d) Check temperatures of the oil and windings

(e) Clean radiators to be free of dust and scales

(f) Pour 3 to 4 buckets of water in each earth-pit

19.3.8.3 Quarterly

(i) <u>For motor:</u>

(a) Blow away dust and clean any splashing of oil or grease

(b) Check wear of slip ring and bushes, smoothen contact-faces or replace, if necessary. Check spring-tension. Check bush-setting for proper contact on the slip-ring.

(c) Check cable connections and terminals and insulation of the cable near the lugs, clean all contacts, if insulation is damaged by overheating investigate and rectify. All contacts should be fully tight.

(ii) <u>For panel, circuit-breaker, starter, etc.</u>

(a) Check fixed and moving contacts of the circuit breakers/ switches. Check and smoothen contacts with fine glass-paper or file.

(b) Check condition and quantity of oil / liquid in circuit-breaker, auto-transformer starter and rotor-controller.

(iii) For transformer substation:

(a) Check condition of the H.T.bushing.

(b) Check the condition of the dehydrating breather and replace the silica-gel charge, if necessary. Reactivate old charge for reuse.

19.3.8.4 Semi-Annual

(i) For motor

(a) Check condition of oil or grease and replace if necessary. While greasing avoids excessive greasing.

(b) Test insulation by megger.

(ii) For panel, etc

Check for corrosion and take remedial measures. Check by megger the insulation-resistance of switches, bus-bar, starter-terminals, auto-transformer, etc for phase-to-earth and phase-to-phase, resistance.

(iii) For transformer substation,

(a) Check dia-electric strength and acid-test of transformer oil and filter, if necessary.

(b) Test insulation by megger

(c) Check continuity for proper earth connections.

19.3.8.5 Annual

(i) For motors

(a) Examine bearings for flaws, clean and replace if necessary

(b) Check end-play of bearings and reset by lock nuts, wherever provided.

(ii) For panel, etc

(a) All indicating meters should be calibrated

(iii) For transformer substation

(a) Check resistance of earth pit/earth electrode

19.3.8.6 Bi-Annual

(i) For motor: Same as Annual

(ii) For panel, etc. Same as Annual

(iii) For transformer substation

(a) Complete examination including internal connections, core and windings.

19.4 TROUBLE SHOOTING FOR ELECTRICAL EQUIPMENT

Trouble-shooting comprises detecting the trouble, diagnosing the cause and taking remedial action. Detection of the trouble is prompted by noticing the symptoms. The trouble shooting details are hence outlined hereunder for various symptoms.

19.4.1 MOTOR GETS OVERHEATED

(i) Check whether voltage is too high or too low. Change tapping of transformer, if HT supply is availed. Otherwise approach Power supply authorities for correction of the supply voltage.

(ii) Check whether air ventilation passage of motor is blocked. Clean the passage.

(iii) Check whether the motor bearings are properly lubricated or damaged. Replace the damaged bearings and provide proper lubrication.

(iv) Check whether the cable terminals at the motor are loose. Tighten the terminals.

19.4.2 MOTOR GETS OVER LOADED: (DRAWING MORE THAN THE RATED CURRENT AT THE RATED VOLTAGE)

i) Check any excessive rubbing in the pump or any clogging of the impeller passages.

ii) Check whether characteristics of pump (i.e. the related driven equipment) are of the overloading type.

iii) Check for any vortices in the sump

iv) Check that there is no short-circuiting or single-phasing.
v) Check whether any foreign matter has entered the air-gap, causing obstruction to the smooth running of the motor.

19.4.3 STARTER / BREAKER TRIPS

(i) Check whether the relay is set properly. Correct, the setting, if necessary
(ii) Tripping can also occur, if motor is drawing more than the rated current, for which details are mentioned above.
(iii) Oil in dashpot may be either inadequate or of flow viscosity
(iv) Check that there are no loose connections
(v) Check whether the time setting of star delta or auto transformer starter is proper.

19.4.4 VIBRATION IN MOTOR

(i) Check for structural rigidity of supporting frame and foundation
(ii) Check alignment of pump and motor
(iii) Check that the nuts on foundation bolts are tight
(iv) Check if rotor has an imbalance
(v) Check the resonance from supporting structure or foundation or from critical speed of rotor or from vibration of adjoining equipment.

19.4.5 CABLES GET OVER-HEATED

(i) Check whether the cable is undersized. Change the cable or provide another cable in parallel.
(ii) Check for loose termination or joint. Fasten the termination and make proper joint
(iii) Check whether only a few strands of the cable are inserted in the lug. Insert all strand using a new lug, if necessary.

19.5 Pumps:

Pumps should be operated only within the recommended range on the H-Q characteristics of the pump.
The maintenance schedule should enlist items to be attended daily, semi annually, annually as follows:

19.5.1 Daily Checks:

A log book should be maintained to record covering the following items; such as;
a. Timing of pump running
b. Observe for leakages through stuffing box
c. Bearing temperature
d. Any undue noise or vibration
e. Readings of pressure, voltage and current

19.5.2 Half Yearly checks

i) Free movement of the gland of stuffing box
ii) Cleaning and oiling of gland bolts
iii) Inspection of the gland packing and repacking, if necessary.
iv) Alignment of pump and drive
v) Cleaning of oil/grease lubricated bearings and replenishing fresh oil and grease.

19.5.3 Annual Checks:

a. Clean and examine all bearings for flows
b. Examine shaft sleeves for wear or scour
c. Check clearance at wearing ring

d. Check impeller hubs and vane tips for pitting or erosion
e. Calibration of all instruments and flow meters
f. Check performance of pump Q, H, KW and efficiency
g. Check for availability of required tools
h. Check for availability of lubricants and other consumables such as gland packing, bolts etc.
i. Check for repair facilities such as pullers, clamps, machinery, welding set, grinder, blower, drilling machine etc.
j. Records to be kept on the operations.
k. Stock of fast-moving recommended spares for two years of trouble-free operation shall be kept.

19.6 Sumps and basin

i) Check for proper operation of valves, functioning of Water level indicators, lighting arrestor, functioning /cleaning of ventilators; to guard against mosquito breeding and bird dropping.
ii) Check for corrosion of Manhole covers; inter connecting pipes, ladder and railings and replace, if required.
iii) Cleaning of sumps shall be under taken at least once in a year.
iv) Roofing shall be periodically checked to ensure no leakages are there.
v) Check for any structural damages/leakages through the structure of sumps and interconnecting pipes, valves etc. Structural damages and leakage should be promptly repaired.
vi) Check for the availability of consumables, spares and tools
vii) General cleanliness in around the reservoirs should be maintained.

19.7 Additional checks to be carried out in the gravity sewer network:

i) Check for oozing of manholes in gravity sewer and leaking of pipe & valves in pumping mains etc. shall be made at regular intervals.
ii) Adequate spares for valves and pipes and jointing materials shall be kept.
iii) A regular programme of leak detection of all pumping amins and gravity sewers shall be made at least once in three years. Leaks and damages detected shall be promptly required.
iv) Recording of number of property connections given
v) Status of bulk metering at pumping stations - number of meters out of order, quantity of inflows and outflows shall be made.
vi) Identification and disconnection of unauthorised property connections if any shall be made.
vii) Identification and disconnection of storm water connection if any shall be made.

19.8 Control of quality of treated sewage:

The physical, chemical and bacteriological tests of sewage samples need to be carried out at frequent intervals as per direction of Engineer-in-charge at stilling chamber and at chlorine contact tank.

19.9 Odour control:

It shall be made as per CPHEEO Manual.

SCHEDULE - C

(See Clause 2.1)

PROJECT FACILITIES

DELETED

SCHEDULE - D

(See Clause 2.1)

SPECIFICATIONS AND STANDARDS

1 Construction

The Contractor shall comply with the Specifications and Standards set forth in Annex-I of this Schedule-D for construction of the Sewerage Project.

2 Design Standards

The Sewerage Project shall conform to design requirements set out in the following documents:

a). CPHEEO manual on Sewerage & Sewage Treatment, and b) relevant I.S. Specification

3 Specifications and Standards for construction

All Materials, works and construction operations shall conform to the relevant I.S. Specifications and Standards of CPHEEO manual on Sewerage& Sewage Treatment published by MoUD, GoI. Where the specification for a work is not given, Good Industry Practice shall be adopted to the satisfaction of the Authority/ Authority's Engineer.

Annex - I

(Schedule-D)

Specifications and Standards for construction

3.0 SPECIFICATIONS FOR MATERIALS AND WORKMANSHIP

3.1 Reinforced Cement Concrete (RCC) pipes

The Concrete pipes to be used for the work shall be centrifugally cast (spun) non-pressurepipes and should confirm to IS 458:2003 and should have ISI mark on the body of the pipe. The class of pipes shall be NP3 for all diameter gravity sewer (except for pipes to belaid in trenchless method). For gravity sewer of 600 mm dia. and above will be provided with HDPE lining.

The pipes should have spigot & socket ends suitable for push on rubber gasket jointing. The concrete used for the pipe should confirm to IS 456:2000, and should content minimum 350kg of cement/ cubic meter and minimum compressive strength of 20N / mm^2.

The cement shall be Sulphate resisting Portland cement and confirm to IS: 12330.The use of

pozzolana as an admixture shall not be permitted.

The Aggregates used for manufacturing of concrete pipes shall confirm to IS: 383. The maximum size of aggregates should not exceed one third of the thickness of the pipe or 20mm, whichever is smaller.

Reinforcement used for manufacture of the reinforced concrete pipes shall be Mild Steel Grade-I or medium steel bars confirming to IS: 432 (part-I), or hard drawn steel wire confirming to IS:432 (part-II).

The ends of the concrete pipes shall be suitable for roll on rubber ring joints.
Rubber rings used for pipe jointing shall be elastomeric material & confirm to IS:5382.The pipe joints shall be capable of withstanding the same pressure as the pipe.
The pipe of diameters of 600mm and above should be provided with internal HDPE lining. The lining shall be embedded firmly in to the inner concrete surface of the pipe atthe time of manufacturing as an integral part. Thickness of lining shall not be less than 2.5mm...

3.2 Ductile Iron Pipes & fittings

The pipes to be used will be suitable for push on Rubber Gasket Joints. The class of pipeto be used shall be of class K-9 and confirm to IS 8329. The fittings shall be all socketed suitable for rubber ring joints or flanged and of class K-12 and shall confirm to IS:9523

The outer surface of the pipes and fittings shall be zinc coated with bitumen coating overit and the inside surface of the pipes and fittings are to be lined with cement mortar as per IS:11906 and the cement used for mortar lining should sulphate resisting cement confirming to IS: 12330. Pozzolana as an admixture should not be used.

The inside lining and outside coating of pipes are to be done in the factory by the pipe manufacturer.

The pipes shall be supplied in standard length of 4.00, 5.00, 5.50- and 6.00-meters length with suitably rounded or chamfered. The pipes should have spigot and socket ends, and fittings shall be socketed or flanged depending on site requirement. Spigot and Socket Joints shall have sockets which are

integral with the pipe and incorporate an elastomeric rubber ring gasket. The gaskets shall confirm to the IS 5382. The gaskets should also be supplied by the manufacturer of the pipes. They should preferably be manufactured by the manufacturer of the pipes. In case they are not, it will be the responsibility of the manufacturer of the pipes to have them manufactured from a suitable manufacturer under its own supervision and have it tested at his/sub contractor'spremises as per the contract. The pipe manufacturer will however be responsible for the compatibility and quality of the products.

The flanged joints shall confirm to the Clause 6.2 of IS 8329 for PN 10 flanges. The pipe supply will also include one rubber gasket for each flange. Flanged Joints shall comply with dimensions and drilling details in IS: 8329 for PN10 flange.

Ductile iron pipes and fittings shall have inside surface lined with cement mortar with a seal coat of bituminous material on it, and outer surface Zinc coated with a coat of bitumen painting over it,. all in accordance with the following Specifications.

3.2.1 Zinc coating

Zinc coating shall comply with ISO 8179 and shall be applied as a spray coating. Themass of sprayed metal shall not be less than 130 g/m2 as described in Clause 5.2 of ISO 8179.

3.2.2 Bitumen coating:

The pipes shall be coated with bitumen as per appendix C of IS 8329. It shall be of either coal tar or asphaltic base with a minimum thickness of 0.1 mm. The finished coating shall be continuous, smooth, neither brittle when cold nor stickywhen hot, and strongly adherent to the fittings.

3.2.3 Polyethylene sleeving

Where polyethylene sleeving is specified to be applied in addition to bitumen coatingit shall comply with ISO 8180.

3.2.4 Epoxy painting:

Unless otherwise specified, pipes and fittings above ground level shall be epoxy painted. All exposed pipes and fittings shall be painted externally with zinc rich epoxyprimer and epoxy paint. Both shop and site application is to be done by airless spray equipment. Paints of reputed make and approved by Engineer shall be used.

Each lot of primer and paint used by Contractor shall be accompanied by certified copies of the test results on hardness, impact resistance and resistance to corrosion carried out by manufacturers in accordance with relevant Indian or International standards.

Surface preparation shall be in accordance with manufacturer's instructions, but as a minimum the pipes shall be abrasive blast cleaned to BS: 7079 Grade Sa 2.5 or equivalent to achieve surface roughness profile of 40 – 50 microns.

The pipes will be subjected to following tests for acceptance:

- Visual and dimensional check as per Clause 13 and 15 of IS 8329
- Mechanical Test as per Clause 10 of IS 8329
- Hydrostatic Test as per Clause 11 of IS 8329
- The test reports for the rubber gaskets shall be as per acceptance tests of theIS 5832 and will be in accordance to Clause 3.8 of IS8329

The sampling shall be as per the provisions of the IS 8329 and IS 9523. All pipes shall be

marked as per Clause 18 of IS 8329 and show as below:

- Manufacturer name/ stamp
- Nominal diameter
- Class reference
- A white ring line showing length of insertion at spigot end

The following types of DI fittings shall be manufactured and tested in accordance withIS: 9523

- flanged socket
- flanged spigot
- double socket bends (90^0, 45^0, 22 $1/2^0$, 11 $1/4^0$)
- double socket branch flanged tee
- all socket tee
- double socket taper
- Restraint Joints

All the fittings shall be of class K-12.

All the DI fittings shall be supplied with one rubber ring for each socket. The rubber ring shall conform to IS: 5382. Flanged fittings shall be supplied with one rubber gasket per flange and the required number of nuts and bolts. The fittings should also be supplied and preferably manufactured by the manufacturer of the pipes. In case they are not, it will be the responsibility of the manufacturer of the pipes to have them manufactured from a suitable manufacturer under its own supervision and have it tested at his/sub contractor's premises as per the contract. The pipe manufacturer willhowever be responsible for the compatibility and quality of the products.

The lubricant for ductile iron pipes and specials shall have the followingcharacteristics:

- must have a paste like consistency and be ready for use
- has to adhere to wet and dry surfaces of DI pipes and rubber rings
- to be applied in hot and cold weather; ambient temperature 0 – 50 °C, temperature of exposed pipes up to 70 °C
- must be non-toxic
- must be water soluble
- must not have an objectionable odor
- has to inhibit bacterial growth
- must not be harmful to the skin
- must have a service life not less than 2 years

The acceptance tests shall be conducted in line with the provisions of IS 9523.

All the DI fittings shall be properly packed with jute cloth. Rubber rings shall be packed in polyethylene bags. Rubber rings in PE bags and nuts, bolts etc. shall be supplied in separate jute bags

3.3 Specification for rubber gaskets for pipe joints

The Rubber gaskets to be used for jointing Socket spigot pipes should be round to roll on suitably during jointing and should be of elastomeric material and should confirmto IS:5382.

3.4 Specification for HDPE / UPVC S/S Pipes for House Sewers

The pipes for House sewers shall be 110mm dia. High Density Poly ethylene (HDPE) pipes / UPVC S/S .The Pipes should confirm to IS:14333 / IS:-783-1985 (Latest edition). The pressure rating for pipes shall be

minimum 0.4 Mpa and minimum wall thickness of pipes shall be 5mm

3.5 Specification for HDPE/ DWC / SN-8 Pipes for Sewer Network & Property connections

Scope

This specification covers the requirements for manufacturing, supplying, transportation, handling, stacking, installation, jointing, and testing of Class SN 8 Structured Double Wall (Non-Smooth External Annular Corrugated wall & Smooth Internal wall) Polyethylene Piping System for non-pressure underground Sewerage & Drainage Applications herein after called the DWC PE Piping System.

Applicable Codes

The manufacturing, testing at factory, supplying, transportation, handling, stacking, installation, jointing, and testing at sites shall comply with all currently applicable statutes, manuals, regulation, standards & codes. In particular, in addition to all relevant National Standards, following international standards with latest revisions shall be referred. If requirements of these specifications are at variance with any other standards, this particular document shall govern the proceedings.

I) EN 13476-1

Plastics piping Systems for non-pressure underground drainage and sewerage Structured-wall piping systems of Polyethylene (PE) Part 1: General requirements and performance characteristics.

II) EN 13476-3

Plastics piping Systems for non-pressure underground drainage and sewerage Structured-wall piping systems of Polyethylene (PE) Part 3: Specifications for pipes and fittings with smooth internal and profiled external surface and the system, Type B Other International Codes / Standards (EN/ ISO) which are integral part of above two standards as normative references form a significant portion of this specification document.

Manufacturing

The **DWC PE Piping** System of stiffness class designation SN 8 shall confirm to the European Union standards as mentioned above and shall be configured as per the indicative Cross-sectional Drawing annexed herewith. Each pipe shall be coupler (on- line or off-line) and spigot type along with rubber sealing ring (as designated under above international specifications)

Transportation

The arrangement of loading the pipes in a telescopic manner is advised, i.e. smaller diameters inserted into the next higher sizes of pipes. While loading the pipes onto the truck, care should be taken that the coupler- end should be arranged alternatively in the corresponding layers so as to avoid the damage to the coupling/ socket ends.

Handling

Following Recommendations shall be followed while handling the pipes: Adherence to National Safety requirements Pipes to be smoothly lowered to the ground Pipes should not be dragged against the ground to avoid the damages to the Coupler/pipes.800mm and larger diameter pipes are carried with Slings at two points spaced approximately at 3 Meters apart For smaller diameters (400mm 800mm) one lift point shall be sufficient & can be handled either manually or mechanically Do not use a loading Boom or Fork Lift directly on or inside pipe.

Pipe Storage at Site

Stockpiling shall be done temporarily on a Flat Clear Area as per Fig. 1 & 2.For avoiding collapse of Stacks, use Wooden Posts or Blocks Stacking shall not be higher than 2.5 Meters While stacking, alternate the socket/coupler ends at each row of stacked pipes as per Fig. 2.Lowering, Laying & jointing of Pipes The width of a Sewer Trench depends on the soil condition, type of side protection needed and the working space required at the bottom of Trench for smooth installations. Increase in width over required minimum would unduly increase the load on pipe and cost of road restoration. Considering all above factors, the Minimum Trench Width is specified as per Table below :-Indicative Minimum Trench Widths.

Pipe Diameter (mm)	Trench Width (M)
75-170	0.6
250	0.7
400	0.9
600	1.2
800	1.3
1000	1.8

In actual practice the trench width can be as narrow as possible but adequate to allow the workmen to execute the job satisfactorily. The pipe segment between two manholes shall be laid approximately in straight line without any vertical undulations. However, on the strength of its flexibility, the DWC PE Piping system can be laid in very smooth curve if found necessary. The piping system shall rest on the carefully prepared bedding portion of the Backfill Envelope (ref fig. III, Annexure I) and at appropriate jointing locations the trenches shall be excavated deeper to accommodate the bulges of coupler-spigot joints. However, special care shall be ensured as mentioned below:-

Excavation of trenches shall be carried out in accordance with the drawing & specifications and as directed by the field engineer as well. The piping system shall be laid and jointed in true to gradient with the help of sight rails and boning rods as detailed in CPHEEO, MoUD, GoI Manual on Sewerage and sewerage treatment. The levels need be checked with calibrated modern Levelling Instrument. Specific care shall be taken to prevent entry of sand / mud /slush/ any other foreign material etc into the system during the installation operation. The structural property of the system suggests that a minimum cover of 300 mm adequate even for maximum quantum of superimposed (live) load. In case of wider trenches than required (above table), the permission of the competent authority shall be necessary.

The bedding area (ref. fig. III) is an essential portion of Back fill Envelope and shall be constructed with proper bedding material as computed in accordance with appropriate international code of practice for structural bedding design mentioned in the list of normative references under EN 13476.The bedding shall be laid to specified thickness and gradient with proper manual compaction of the aggregate.

The moulded on-line coupler (or separate coupler integrated to the pipe in case of lower sizes) will have a suitable internal surface for push-fitting the said end over the spigot end of the next pipe. On first valley of the corrugation of said spigot end (destined to receive the pushed coupler) the sealing rubber ring of standard (EN 13476) quality shall be placed so that the

coupler end of the pipe smoothly but tightly slides over the sealing ring for making an absolute watertight joint. Similar system is also used for fabricated accessories or moulded fittings required such as Tee, Bends, Elbows, Reducer end caps for the purpose of installation of the system related to drainage/sewerage.

Jointing

For quality connections following steps are to be ensured, failing which the performance aspects are to be severely compromised: -

The non-coupler (socket) end needs to be thoroughly cleared and shall be free from any foreign material Clean and lubricate the coupler end of the pipe, if required Lubricate the exposed Gasket in the same manner, if required. Keep the non- coupler end free from dirt, backfill material, and foreign matter so that the joint integrity is not compromised. Push the coupler into non-coupler and align properly. Always push coupler end into non-coupler end. For smaller diameter pipes simple manual insertion shall be sufficient. It should be ensured that the coup -coupler end to ensure installation and tight joining seal. Therefore prior to insertion always place

homing mark on appropriate corrugation of non-coupler end. Construction of backfill envelope and final backfilling of the trenches DWC PE Piping System with well compacted Backfill Envelope along with the bottom and sides of trench (native soil) work together to support soil overburden and superimposed (traffic) loads. The carefully constructed Backfill Envelop has three distinct but non-isolated stages (Ref. enclosed C/S Drawing III, Annexure I).The construction need to be done stage by stage as per the sequence stated below:

- Bedding portion
- Up to Haunch level
- Remaining portion

The material for backfill envelop shall be in accordance with the structural design of flexible buried conduit as per relevant international codes mentioned in the list of Standards as normative references of EN 13476 /1 & 3. It can be the same material that were removed in the course of excavation or it can be fine sand/course sand/gravel / moral /other form of course / fine aggregates depending on the effected Design Load [Overburden + Superimposed (Live) load]. However, in no circumstances, the flexible pipe should not be embedded in cement concrete (un- reinforced or reinforced) which invariably induces undesired rigidity in the system. The remaining portion of backfilling which do not contribute to the structural integrity of the system may be the materials that were removed in the course of excavation or any other foreign material as may be required to suit the particular site condition. These materials shall consist of at least clean earth and shall be free from large clod or stone above 75 mm, ashes, refuse and other injurious materials. After completion of lying of pipes, etc, first the Backfill Envelope shall be constructed as per design around the pipe. Voids must be eliminated by knifing under and around pipe or by some other indigenous tools. The compaction, by hand rammers or compactors with necessary watering to a possible maximum level of proctor density shall be ensured. Backfilling shall start only after ensuring the water tightness test of

joints for the concerned sewer segments. However, partial filling may be done keeping the joints open. Precautions shall be taken against floatation (if at all necessary) as per the specified methodology and the minimum required cover For indicative.

Continuity Test /Hydraulic Testing

Continuity of the pipe segments in between two manholes is required to be ensured in the same modality as practiced for non-pressure RCC pipeline. Hydraulic testing of pipes shall be done, if specifically asked for by the client for any specific stretch. The procedure for hydraulic testing shall be similar to that for non-pressure RCC pipes.

Hydraulic testing of pipes shall be done, if specifically asked for by the client for any specific stretch. The procedure for hydraulic testing shall be similar to that for non- pressure RCC pipes.

3.6 Specifications of RCPC / SFRC Man Hole covers & frames

Circular RCPC / SFRC Man hole cover & frames shall be of grade EHD-35 and HD-20 as per site requirement and should comply with IS: 12592-2002. They should be ISI marked as per IS: 12592-2002

The material should satisfy the load requirement of relevant IS code.

Fibers or polymer should be added as per relevant IS code.

The material should be inscribed with Employer's logo in casting as approved by the Engineer.

Hooks shall be embedded in the cover.

3.7. Specifications for plastic encapsulated footsteps for man holes and sewer connecting chamber.

The Footsteps for Man Hole chamber and Sewer Connection Chamber shall be plastic encapsulated confirming to IS: 10910. The step shall be tested at a load of 225 kg as per IS: 5455.

3.8. Specifications for cement

Cement used for the all the works except road construction shall be Sulfate resisting Portland Cement confirming to IS-12330-1988 unless otherwise specified. Each bag should bear IS certification mark and should content 50kg cement net. Any bag found torn or damaged or having contents less than 50 kg or sewed manually shall not be accepted and will have to be removed from site. Cement factory should have its own clinker making arrangement as per relevant IS Code. The minimum grade of cement used for the works shall be 43. Cement manufactured in mini cement plants shall notbe accepted.

3.8.1. Ordinary and high strength Ordinary Portland Cement:

This should comply with the requirements of IS: 269-1976 "Specification for Ordinary and Low-Heat Portland Cement (Third Revision)", or of IS: 8112 -1976 "Specification

for High Strength Ordinary Portland Cement." Ordinary Portland cement and High Strength Ordinary Portland Cement are most widely used for concrete pavements.

3.8.2. Rapid hardening Portland Cement:

This should comply with the requirement of IS: 8041E-l976 "Emergency Specification for Rapid Hardening Portland Cement." In general, this cement would be used only where time is a critical factor and the road is required to be opened to traffic at an earlier date than would be possible if Ordinary Portland Cement or High Strength Ordinary Portland Cement is used.

3.8.3. Portland Blastfurnace Slag Cement:

This should comply with the requirement of IS: 455-1967 "Specification for Portland Blast furnace Slag Cement (Second Revision).

3.8.4. Portland Pozzolana Cement:

This should comply with the requirements of IS: 1489-1976 "Specification for Portland Pozzolana Cement (Second Revision)".

3.8.5. Sulphate Resisting Portland Cement:

This should comply with the requirements of IS: 12330-1988 "Specification for Sulphate Resisting Portland Cement.

Cement to be used for construction of Water retaining structures and structures coming in contact with water including Manhole chambers, Inspection Chambers. RCC sewer pipes and lining of DI pipes shall be Sulphate Resisting Cement.

3.9. Aggregates

General:

Aggregates should comply with IS: 383-1970 "Specification for Coarse and Fine Aggregates from Natural Sources for Concrete (Second Revision)" with special reference to the additional requirements stipulated for use in road works excepting in the case of Los Angeles Abrasion Test limit. The Los Angeles Abrasion Test limits shall be not more than 35 per cent and 50 per cent for concrete wearing course and sub-base course respectively. In addition, the limits of deleterious material shall not exceed the requirements set out in IS: 515-1959 '" Specification for Natural and Manufactured Aggregates for Use in Mass Concrete." Weathered rock should not be used. In order to make good concrete, it is important to avoid crushed aggregate of poor shape. Very angular, flaky, elongated or splintery aggregates give a harsh mix of low workability. Maximum size of aggregate should not exceed 1/4th of the pavement slab thickness, in case of pavements having reinforcement, maximum size of aggregate should also not exceed 1/4th of minimum clear spacing between reinforcing bars.

3.9.1. Coarse Aggregates

Quality of Course aggregate

Crushing value	**Permissible value**	**Method of Test**
a. All concrete works except wearing surface	Maximum 45%	IS:2386 part IV
b. For wearing surface	30%	-do-
Impact Value	**Permissible Limit**	**Method of Test**

a. All concrete works except wearing surface	Maximum 45%	IS:2386 part IV
b. For wearing surface	Maximum 30%	-do-
Abrasion Value	**Permissible Limit**	**Method of Test**
a. All concrete works other than wearing surface	Maximum 50%	-do-
b. For wearing surface	Maximum 30%	-do-
Deleterious Materials		
Maximum Percentage shall be 5		
Alkali Aggregate Reaction		
It is harmful for the concrete. The test shall be conducted and use of pozzolanic cement or pozzolanic admixtures shall be studied.		

Grading:

Continuously graded coarse aggregate should be furnished in at least two separate sizes with separation at 20 mm I.S. sieve when combined material graded from 40 to 4.75 mm is specified, and at 25 mm I.S. sieve when combined material graded from 50 to 4.75 mm is specified

Gradation of coarse aggregate of nominal size.

I.S. Sieve Size (mm)	Percentage passing for graded aggregates of nominal size			
	40 mm	**20 mm**	**16 mm**	**12.5 mm**
80	100	-	-	-
40	95-100	100	-	-
20	30-70	95-100	100	100
16	-	-	90-100	-
12.5	-	-	-	90-100
10	10-35	25-55	30-70	40-85
4.75	0-5	0-10	0-10	0-10
2.36	-	-	-	-

3.9.2. Fine Aggregate:

Fine aggregate shall preferably be natural sand. Crushed stone sand may also be used satisfactorily in concrete. The fine aggregate shall conform to IS: 383-1970 except that in Grading Zone IV, the permissible percentage passing limits on 300 and 150- micron sieves shall be 15-55 per cent and 0-20 per cent respectively instead of 15-50 per cent and 0-15 per cent as stipulated in IS Specification. Crushed sand is usually more angular in shape than naturally occurring sand, and for this reason it may tend to make the mix a little more harsh. In some cases, it may prove advantageous to use a mixture of naturally occurring sand and crushed stone sand if the former is not obtained in adequate supply or where its grading is poor. Bulking due to presence of moisture in the fine aggregate should be accounted for when volumetric batching is employed.

IS Sieve Destination	Percentage Passing For			
	Grading Zone – I	Grading Zone – II	Grading Zone – III	Grading Zone - IV
10 mm	100	100	100	100
4.75 mm	90-100	90-100	90-100	95-100

2.36 mm	60-95	75-100	85-100	95-100
1.18 mm.	30-70	55-90	75-100	90-100
600 microns	15-34	35-59	60-79	80-100
300 microns	5-20	8-30	12-40	15-50
150 microns	0-10	0-10	0-10	0-15

N.B. Maximum bulkage shall be limited to 20 %

3.10. Water

Water used in mixing or curing of concrete shall be clean and free from injurious amounts of oil, salt, acid, vegetable matter or other substances harmful to the finished concrete. It shall meet the requirements stipulated in clause 4.3. of IS: 456-1978 "Code of Practice for Plain and Reinforced Concrete (Second Revision)". Potable waters are generally considered satisfactory for mixing or curing.

Permissible limits of solids shall be as per IS:3025 as given below

Organic- 200mg/l
Chloride- 200mg/l
Inorganic- 300mg/l
Sulphate- 400mg/l
Suspended matter-200mg/l

3.11. Specifications for cement mortar

Mortar for brick work shall be prepared as per IS: 2250. The cement used for mortar shall be sulfate resistant cement confirmed to IS: 12230

3.12. Specifications for bricks for brick work

Bricks used for construction of Man hole chambers and other works shall confirm to relevant IS Standard IS: 1077.

Specifications for admixtures for concrete

Accelerating, retarding, water-reducing and air entraining admixtures shall conform to IS: 9103 and integral water proofing admixtures to IS: 2645.These are to be used after obtaining clearance of the Engineer only wherever required.

3.13. Specifications for steel

ISI marked, high yield strength deformed (HYSD) steel bars (CTD bars) or TMT plant rolled bars of grade FE-415 or Fe-500 as per IS: 1786/1985 with up-to-date amendments should be used in the work.

3.14. Specifications for valves

Generally, pressure designation shall not be less than PN 1.0. Valves shall have integral flanges drilled as specified in relevant latest IS specifications. Rubber used in valves shall be Ethylene Propylene Diene Monomer (EPDM) rubber or Styrene Butadiene Rubber (SBR). It shall comply with the requirements of Appendix B of **BS: 5155** or of relevant IS specification, be suitable for making a long-term flexible seal, and be resistant to anything causing deterioration of the flexible seal. Metal seated Valves shall be used for sewage application.

3.15.1 Butterfly Valves

The valves to be used on the rising main for isolating the flow for repair during break down of pipe line or scouring of pipeline etc shall be Butterfly valves. The Butterfly valves shall be of reputed make and should confirm to IS: 13095. The valves of sizes up to 300mm diameter will be hand operated with hand lever and sizes above 300mm dia. should have spur gear arrangement. Unless otherwise specified, butterfly valves shall have valve body and disc of close-grained Ductile Iron, complying with IS 13095.

3.15.2. Air Valves

Air Valves will be fitted on the rising main to release air from the pipeline during pump operation and allow entry of air in to the pipe to protect the pipe from negative surge due to sudden pump closer for power failure during pumping. The Air valves shall be kinetic air valves complying with IS 14845 and should have isolation valve. The Air valves shall be tampering proof

3.15.3. Sluice valves

The Sluice valves to be used for blow off/draining out the Rising mains shall be of Ductile Iron body and the gates & spindles shall be of bronze or stainless steel. The valves shall be of class PN.1.0 & above and shall confirm to IS: 14846.

3.15. Reinforcement steel

Steel for reinforcement shall be high yield strength deformed bars having corrosion resistant characteristics. The steel shall be Re-bars of grade Fe 415 and above and shall have mechanical properties as per IS1786. (Latest edition). (Approved Make of State PWD)

BIS certification

For ISI marked materials, the Contractor shall submit attested photocopies of the license granted by BIS Authority to the manufacturer from whom the material is procured by the Contractor.

4. SPECIFICATION OF CONSTRUCTION WORKS

4.1. Earthwork, plain cement concrete, reinforced cement concrete, brick masonryand plastering

All works pertaining to earthwork, plain cement concrete, reinforced cement concrete, brick masonry and plastering shall be carried out in strict accordance with Odisha Public Works Department (OPWD) specifications, specification of Odisha, P.H. Engineering Organization, relevant IS Codes, Manual of Sewerage and Sewage Treatment, Manual of Water Supply and Treatment Published by Central Public Health & Environmental Engineering Organization (CPHEEO), and all of latest editions and specifications contained in the bidding document and also those based on best engineering practices. In case of any doubt/ clarification, the decision of the Engineer shall be final.

4.2. REINFORCED CEMENT CONCRETE (RCC) SEWER LAYING

The diameters and types of pipes shall be as described in the Drawings. All the materials shall be as per relevant Indian Standards. The work includes supply of all types of pipes at the site of work, road cutting and remaking, excavation of trenchesin all types of

soil, lowering of pipes into the trenches, pipe bedding as specified, aligning to line and grade, jointing, testing and back filling of trenches The Odisha PWD specifications and PHD specifications and IS Codes shall be followed for pipe laying. All sewer pipes shall be laid to proper gradient as per approved drawings.

For laying and jointing of pipes the following codes of practices shall be followed unless otherwise stated.

IS783 : Code of practice for laying concrete pipes
IS 4111: Code of practice for ancillary structures in sewerage system-manholes etc (Part I to IV)

4.2.1 Transportation of pipes

The transportation of pipes to the site of works shall be done in such a way that pipes are not damaged while handling. Light pipes and pipes of smaller diameter may be handled manually. Heavy pipes shall be loaded and unloaded using proper mechanical equipment to the satisfaction of the Engineer. The pipes shall be protected against impact, shocks etc. and shall not be allowed to fall freely on to the ground, into the trench or onto hard surfaces.

Transportation of pipes and stacking at construction sites shall be done in a way to minimize inconvenience to the traffic. Lowering of the pipes into the trenches shall be done carefully so that the pipes are not damaged and that the trenches and bedding are not disturbed or damaged. Larger diameter pipes should be lowered to trench by means of chain pulley blocks or cranes of adequate capacity using properly designed stings and spreader beams or specially designed lifting beams. Alternative methods to be suggested by Contractor shall be approved by the Engineer.

4.2.2. Trench excavation

Before excavating the trench, the alignment of pipe line shall be approved by the Engineer.

Trench excavation style/type shall vary depending on the depth of sewer installation, diameter of sewer to be installed and local conditions. Trenches should be dug to grade as specified and shown in the bid documents.

Trench shall be of sufficient width to provide a free working space on each side of the pipe. The free working space shall not be less than 150 mm on either side.
If the sides of the trench are not vertical, the toe of the side slopes shall end at top of the pipe, and a vertically side trench shall be dug from this point down to the sub- grade.

In case of any conflict IS 783 should be referred to and advice of the Engineer in charge should be taken in to consideration.

Attention of the Contractor is drawn to the fact that most of pipe laying will require the use of shoring equipment which will be compulsory at any time when the excavated depth in trench exceeds 1.20 m, which is as per health and safety regulations. Trenches shall be maintained such that pipe can be installed by not allowing water, silt, gravel or other foreign material into the pipe. Material remaining in the trench bottom on completion of excavation by machine which has been disturbed or softened by workmen or trench water, shall be removed before bedding material is placed.

4.2.3 Dewatering

Attention of the Contractor is drawn to the fact that water table may be high at some places, even during the dry season.

Ground and surface water shall be controlled to the extent that excavation and pipe installation can proceed in the specified manner and such that the trench bottom is not disturbed to the detriment of the pipe installation. Trench water shall not be permittedto enter the pipe being installed unless approval is received from the Engineer.

If necessary, pumps and well points, or other suitable (subject to the approval of the Engineer) equipment shall be deployed to keep excavations free of water. Caution shall be exercised to make sure that foundations in proximity to sewer excavations are not adversely affected by the excavation or dewatering process.

Discharge from pumps, well points, or other dewatering equipment shall be located and controlled so that loss, damage, nuisance or injury to the public property is not occurred.

Transfer of levels to trench bottom
Permanent and temporary bench marks shall be established by the Contractor at convenient and frequent intervals along the alignment. Sewer lines and levels obtained by survey shall be fixed in the trench. The survey methods shall be approved by the Engineer.

4.2.4 Sewer pipe bedding

The trench bottom shall be firm and capable of supporting the pipe to be installed over a bedding layer made of granular material or concrete as per design requirement Bedding of sewer pipes shall be done as per detailed design, drawings /&specifications approved by the Authority's Engineer.

This granular material shall be compacted to 90% of maximum laboratory dry density at optimum moisture content as per IS 2720 (Part 8), with approved mechanical compactors in layers having a maximum depth of 300 mm to provide a thoroughly consolidated pipe base.
The grade of concrete for concrete bedding shall not be less than M-20 and cement to be used shall be Sulphate Resisting Cement

In case of any conflict reference should be made to IS 783 and CPHEEO manual on sewerage & sewage treatment and the decision of Engineer in charge will be final.

No construction of any kind or laying of pipes on the excavated bottom shallcommence until the natural bottom of the trench has been inspected by the Engineer.
The bedding must fully cradle the pipe above the excavated trench floor and this shall extend to accommodate the larger diameters of the socket ends of pipes. Under no circumstances shall a section of pipe be allowed to see-saw or rest on a high point on the excavated floor of a trench before back-filling commences.
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All pipelines shall be kept clean and free of dirt, rubbish and entry by small animals.

4.1.6. Laying, jointing and anchoring
Unless otherwise specified the laying &jointing of pipes shall be as per IS:783

4.1.6.1 Inspection and cleaning of sewer pipes

Prior to installation of sewer pipes in the trench it shall be checked for cracks and damage. The pipes shall also be cleaned and made free from dirt, soil and other foreign materials.

4.1.6.2 Laying

Pipes should be lowered into the trench with the help of tackle suitable for the weight of the pipe such as well-designed shear slings with chain pulley blocks or mobile crane. While lifting, the position of sling should be checked when the pipe is just clear of the ground to ensure proper balance. Laying of pipes shall preferably proceed upgrade of a slope as it is easier to force spigot into socket. When laying not in progress, the open end of the pipe line should be fitted with temporary end closure. Precautions should be taken to prevent floating of pipes due to buoyancy during construction and afterwards, where needed.

If required the Contractor shall have all pipes thoroughly cleaned by approved methods or plugged to prevent debris entering the reticulation

4.1.7. Jointing

The sections of the pipe should be jointed together in such a manner that there shall be as little unevenness as possible from pipe to pipe. The rubber ring of circular cross section is to be held in the groove formed on the socket end of pipe. Then the spigotend should be pushed well home into the socket of the previously laid pipe by means of uniformly applied pressure with the aid of a jack or similar appliance. The rubber ring confirming to IS: 5382 shall be used. The rubber rings shall be lubricated before making the joint with an approved lubricant or soft soap water.

The basic requirements of are:

a) Cleanliness of all parts, particularly joint surface.
b) Correct location of components.
c) Centralization of spigot within socket.
d) Any lubricant used should be approved as to composition and method ofapplication.

After jointing it shall be ensured that the extra jointing materials are removed. It shall also be ensured that no foreign material enters the pipes after they are laid by covering the pipe ends to the satisfaction of the Engineer.

4.1.8. Anchoring of pipes on gradient

Where the gradient is steeper than 1:6 suitable transverse anchor blocks should be provided as recommended in IS 783. The spacing of anchor block should be as shown in Table.

Gradient	Spacing of Anchor blocks (in M)
1:2 or steeper	5
1:3 or 1:4	10
1:5 or 1:6	15

4.1.9 Backfilling of trenches

Backfilling of the trenches shall not be commenced till the pipes are tested and till approval for filling of the trenches is given by the Engineer.

Backfilling of the trenches shall be done with sand or approved back fill material free from boulders, sharp objects, and rubbish, as approved by the Engineer. The filled up material shall be well watered and consolidated, taking proper care to see that pipe level and alignment are not disturbed. Particular care shall be taken not to cause unequal loading or damage of any sort to the pipe.

Backfill materials shall be compacted to 90% of maximum density at optimum moisture content as per IS 2720 (Part 8), with approved mechanical compactors in layers having a maximum depth of 150 mm.

4.1.12. Testing of sewer pipe line

Each section (from manhole to manhole) of the sewer shall be tested for water tightness as per IS 783 before being put into service. The test should be a hydrostatic test performed by filling the pipe line with water and raising the pressure to the selected test pressure as decided by the Engineer in charge which should not be less than the maximum pipe line operating pressure with surge pressure, if any, and should not exceed the hydrostatic proof test pressure and maintaining this for a sufficient period to allow for absorption of water by the pipe material. A graph of quantity of water to maintain the test pressure against time is to be plotted which will show when absorption of water is substantially completed.

Any sewer or part thereof that does not meet the above requirements shall be repaired, or re-laid and tested again.

The Contractor shall be bound to follow the instructions of the Engineer regarding the test procedure, test pressures, lengths of sections for testing etc. The tests shall be carried out only in the presence of the Engineer.

4.2. CONSTRUCTION OF MAN HOLE CHAMBERS

The Manhole Chambers shall be circular in shape and their sizes for different sewer depths shall be as per CPHEEO Manual on Sewerage and Sewage Treatment. However the diameter of Manhole chambers are also to be chosen considering the size of sewer pipes to be connected toit.

The Manhole chambers of 900mm dia. shall be of brick walls with RCC base slab and cover slab; and the Manhole chambers of diameters 1200mm and above shall be precast RCC structures with eccentric cone top.

Where installation of Precast Manhole chambers will not be possible and incase of non-availability of Precast Manholes, construction of Manhole chambers shall be done at site. For cast in place Manhole chambers, the Manhole chambers of 1200mm and 1500mm dia. shall be composite structures and concentric cone type. The top 1.5m shall be brick structure and the structure below 1.5m shall be RCC with minimum grade concrete of M-25. The Man hole chambers of 1800 dia. and above shall be eccentric cone type RCC structures. The top 1.5m shall be eccentric cone, and below this the chamber shall be cylindrical. The grade of concrete shall not less than M-25.

The Precast Manhole chambers shall be eccentric cone type . The top 1.2m or 1.5m shall be eccentric cone and the portion below this shall be cylindrical type. The minimum grade of concrete shall be M-35

4.2.1. Excavation for Manhole

Before excavating, the setting out of the man hole shall be approved by the Engineer.The excavation style/type shall vary depending on the depth of man hole, diameter of sewer to be installed and local conditions. Excavation should be dug to grade as specified in the approved drawing and as directed by the authority's Engineer.

Excavation shall be of sufficient width to provide a free working space on each sideof the manhole. The free working space shall not be less than 150mm around in caseof precast structure or 600 mm all round in case of cast in place structure, so as to allow for formworks to be placed and removed.

In case of any conflict IS 4111 shall be referred to and in case of any dispute advice of Authority's Engineer shall be final.
Excavation shall be maintained such that precast units can be installed without allowing water, silt, gravel or other foreign material into the manhole. The same applies for cast in place manholes.

Material remaining in the excavation bottom on completion of machine excavating which has been disturbed or softened by workmen or trench water, shall be removed before benching and channeling in man hole is carried out.

In any case, attention of the Contractor is drawn to the following:

a) High water table levels may be encountered at few places of the project area, even during dry season.
b) The use of shoring &shuttering material will be compulsory any time the excavated depth in collapsible strata exceeds1.2m as per health and safety regulations.

4.2.2. Dewatering

During construction of man holes, sewer connection chamber etc. Ground and surface water shall be controlled to the extent that excavation and pipe installation etc. can proceed in the specified manner and such that the trench bottom is not disturbed to the detriment of the pipe installation. Trench water shall not be permitted to enter the units being installed unless approval is received from the Engineer.

If necessary, pumps and well points, or other suitable (subject to the approval of the Engineer) equipment shall be deployed to keep excavations free of water. Caution shall be exercised to make sure that foundations in proximity to trench excavations are not adversely affected by the excavation or dewatering process.

Discharge from pumps, well points, or other dewatering equipment shall be located and controlled so that loss, damage, nuisance or injury to the public property is not occurred.

Care should be taken to discharge the drainage water in to suitable outlets as not to cause damage to the works, crops or any other property. Due to any negligence on the part of the Contractor, if any sever damage is caused, it shall be the sole responsibilityof the Contractor to repair / restore to the original conditions at his own cost or the contractor has to compensate the of repair for the damage.Approval of the Engineer, however will not relief the Contractor of the responsibility for the adequacy of dewatering and

protection arrangements and for the quality & safety of the works.

At the discretion of Contractor to adopt cement grouting or any other approved methods may be used to prevent or reduce seepage and to protect the excavated area, for which no extra payment will be made.

4.2.3. Construction of Brick Masonry Manhole Chambers

Manhole Cambers of 900mm dia. shall be Brick masonry chambers. The walls of the chamber shall be brick masonry, The base shall be RCC cast over 75mm thick PCC of proportion 1:3: 6 (1 Cement: 3 Sand: 6 Coarse Aggregates) placed on leveled excavated trench.

4.2.3.1 Brick Masonry work

Brick masonry shall be provided for walls of Manhole Chambers of 900 mm dia

4.2.3.1.1 Bricks for brick work

Bricks to be used for brick work in construction of Manhole Chambers shall be sound , hard, homogeneous in texture, of regular shape and size, and shall have sharp and square and parallel faces. The bricks shall be free from pores, chips, flaws or lumps of any kind. The bricks shall give a clear ringing sound when struck and shall have a minimum crushing strength of 75 kg/sqcm.
The size of bricks shall be 25cmX12cmX8cm unless otherwise specified, but increase in length up to 1.3 mm in each direction shall be permitted. Only full size bricks shall be used for the work. If required by theAuthority's Engineer brick samples shall be tested as per IS: 3495 by the Contractor and the cost of such tests shall be borne by the Contractor. Bricks rejected by the Authority's Engineer shall be removed from site within 24 hours.

4.2.3.1.2. Cement Mortar

Brick work for Manhole Chamber shall be with Cement Mortar (1:5) unless otherwise specified, and the mortar shall be prepared as per IS:2250.

The Cement used for mortar shall be sulfate resistant cement confirmed to IS: 12230.

The sand shall be free from clay, shale, loam, alkali and organic matters, and shall be sound, clear and durable particles and shall confirm to IS: 1542. Sand shall be approved by the Engineer before use.

For preparing cement mortar, the ingredients shall first be mixed thoroughly in dry conditions. Water shall then be added and mixing continued to give a uniform mix of required consistency. Cement mortar shall be used within 25 minutes of mixing. Mortar left unused in the specified period shall be rejected.

The Contractor shall arrange for tests on mortar samples if so, required by the Engineer.

4.2.3.2 Construction of Brick Masonry work

All bricks shall be thoroughly soaked in clean water for at least one hour immediately before being laid. Brick work 250 mm thick and over shall be laid in English Bond unless otherwise specified. 125 mm thick brick work shall be laid with stretchers. For laying bricks, a layer of mortar shall be spread over the full width of suitable lengthof the lower course. Each brick shall be pressed into the mortar and shoveled into final position so as to embed the brick fully in mortar. Bricks shall be laid with frogs uppermost.

All brickwork shall be plumb and square unless otherwise shown on drawing and true to dimensions shown. Vertical joints in alternate courses shall come directly one over the other and be in line. Horizontal courses shall be leveled. The thickness of brick courses shall be kept uniform. For walls of thickness greater than 230 mm both faces shall be kept in vertical planes unless otherwise specified. All interconnected brickwork shall be carried out at nearly one level (so that there is uniform distribution of pressure on the supporting structure) and no portion of the work shall be left more than one course lower than the adjacent work. . Workmanship shall confirm to IS: 2212.

Brick shall be so laid that all joints are well filled with mortar. The thickness of joints shall not be less than 6 mm and not more than 10mm. The face joints shall be raked to a minimum depth of 12 mm by raking tools daily during the progress of work when the mortar is still green, so as to provide a proper key for the plastering to be done. . The face of brickwork shall be cleaned daily and all mortar droppings removed. The surface of each course shall be thoroughly cleaned of all dirt before another course is laid on top. If mortar in the lower courses has begun to set, the joints shall be rakedout to a depth of 12mm before another course is laid.

4.2.3.3. Cement Plaster

Both faces of brick masonry walls of Manhole Chamber will be plastered with CM (1:3) and the inside face should be rendered smooth by applying 1mm thick cement punning.

All joints in masonry brick work shall be raked to a depth of 12 mm with hooked tool made for the purpose when the mortar is still green and in any case within 48 hours ofits laying. The surface to be rendered shall be washed with fresh clean water free from all dirt, loose material, grease etc. and thoroughly wetted for 6 hours before plastering work is commenced. Concrete surfaces to be rendered will however be kept dry. The wall should not be too wet but only damp at the time of plastering. The damping shall be uniform to get uniform bond between the plaster and the wall.

Cement shall be mixed thoroughly in dry condition and then just enough water added to maintain a workable consistency. The quality of water, sand and cement shall be as per relevant Indian standard Specification. The mortar thus mixed shall be used immediately and in no case shall the mortar be allowed to remain for more than 25 minutes after mixing with water.Curing of plaster shall be started as soon as the applied plaster has hardened enoughso as not to be damaged. Curing shall be done by continuously applying water in a fine spray and shall be carried out for at least 7 days unless otherwise specified

4.2.3.4Pipe Entering or Leaving Manhole Chamber

Whenever a pipe enters or leaves a Manhole Chamber, bricks on edge must be cut to a proper form and laid around the upper end of the pipe so as to form an arch. All around

the pipes, there shall be a joint of cement mortar (1:2) 13 mm thick between it and the bricks.

4.2.4. Pre-Concrete Manhole Chambers:

The Pre-Cast Manhole Chambers shall be shall be constructed in RCC M-35 Grade and confirm to ASTM C-478 and shall be in portable sections. The minimum wall thickness of cylindrical portion and that of conical section shall be 125mm and the base thickness shall not be less than 150mm. Below the base slab a layer of plain concrete in CC (1:3:6) shall be provided the thickness of which shall not be less than 75mm.The Joints between two sections shall be with rubber ring joints and gaps shall be sealed with non- shrink grout of CC (!:1:2) and finished smooth.

4.2.4.1 Transportation of Precast Manhole Units

The transportation of precast man hole units to the work site shall be done in such a way that units are not damaged while handling. They shall be loaded and unloaded using proper mechanical equipment to the satisfaction of the Engineer. The units shall be protected against impact, shocks etc. and shall not be allowed to fall freely on to the ground, into the trench or onto hard surfaces.

Transportation of units and stacking at construction sites shall be done in a way to minimize inconvenience to the traffic. Lowering of the units into the trenches shall be done carefully so that the units are not damaged and he trenches and bedding are not disturbed or damaged.

Larger units should be lowered to trench by means of chain pulley blocks or cranes of adequate capacity using properly designed slings and spreader beams or specially designed lifting beams. Alternative methods shall be deployed after obtaining approval of the Engineer.

Approval of the Engineer, however will not relief the Contractor of the responsibility for the adequacy of dewatering and protection arrangements and for the quality & safety of the works.

At the discretion of Contractor to adopt cement grouting or any other approved methods may be used to prevent or reduce seepage and to protect the excavated area, for which no extra payment will be made.

4.2.4.2. Laying and jointing Pre-cast Manholes

4.2.4.2.1 Inspection and cleaning of pre-cast units for manholes

Prior to the installation of precast manhole units those shall be checked for cracks an damage. The units shall also be cleaned and made free from dirt, soil and other foreign materials.

4.2.4.2.2. Laying of precast units of manholes

The trench bottom shall be firm and capable of supporting the manhole to be installed with benching and channeling it as shown on relevant drawings attached to the bid document. Precast units should be lowered into the excavated trench bottom with the help of tackle suitable for the weight of the unit, such as well-designed shear slings with chain pulley blocks or mobile crane, or any other method approved by the Engineer. While lifting, the position of sling should be checked when the unit is just clear of the ground to ensure proper balance.

4.2.4.2.3 Jointing of Precast Units for Man Holes

The sections of the pre cast Man hole units should be jointed together in such a manner that there shall be as little unevenness as possible from unit to unit. The rubber ring of circular cross section is to be held in the groove formed on the female end of unit. Then the male end should be pushed well home in to the female end of the previously laid unit by means of uniformly applied pressure. The rubber joint confirming to IS: 5382 shall be used. The rubber joints shall be lubricated before making the joint with an approved lubricant or soft soap water.

The basic requirements are:

a) Cleanliness of all parts, particularly joint surface.
b) Correct location of components.
c) Centralization of male end within female end.

Any lubricant used should be approved as to composition and method of application.

After jointing it shall be ensured that the extra jointing materials are removed. It shall also be ensured that no foreign material enters the units after they are installed by covering the unit ends to the full satisfaction of the Engineer.

4.2.5. Cast in Place RCC and Composite Manhole chambers

At some places where installation of Pre-cast Manhole chambers will not be possible, the Contractor shall construct Manhole chambers at site. The Manhole Chambers may be fully RCC or Composite structures ie partly brick and partly concrete. The Manhole chambers of 1200mm dia. and 1500mm dia. shall be composite structures with top 1.5m as concentric conetype brick structures and rest part of the chamber RCC and cylindrical. The Manhole chambers of 1800mm and above shall be complete RCC structures. The top 1,5m shall be eccentric cone and rest part below this shall be cylindrical. The minimum grade of concrete shall be M-25.The thickness of wall of cylindrical portion as well as conical portion shall not be less than 150mm, and the thickness of base slab shall not be less than 150mm. Below the base slab a plain concrete layer CC(1;3:6) shall be provided the thickness of which shall not be less than 75mm.The outer and inner surface of concrete walls shall be plastered with 6mm thick cement mortar in CM (1;3) and finished smooth.

4.2.6. Wooden Shoring

Attention of the Contractor is drawn to the fact that most of Manholes laying will require the use of shoring equipment which will be compulsory at any time when the excavated depth in trench exceeds 1.20 m, which is as per health and safety regulations. Trenches shall be maintained such that manholes can be Cast or installed by not allowing water, silt, gravel or other foreign material into the pipe. Material remaining in the trench bottom on completion of excavation by machine which has been disturbed or softened by **workmen or trench water, shall be removed before bedding material is placed.**

4.2.7. Drop pipe for Drop Man holes.

The drop pipe used in Drop Man holes shall be cement mortar lined Ductile Iron (DI) flanged pipe of class K-7, and the fitting for connection of drop pipe shall be DI class PN. 1.0. For drop pipes up to 200mm dia, the drop may be provided inside the man hole but for drops more than 200mm, the drop shall be outside.

5. Concrete Work for Manhole chambers and other structures

5.1Hot weather requirements

Concreting during hot weather shall be carried out as per IS: 7861 (Part I). Adequate provisions shall be made to lower concrete temperatures which shall not exceed 40°C at the time of placement of fresh concrete. Where directed by the Engineer, the Contractor shall spray non-wax-based curing compound on unformed concrete surfaces

5.2 Materials

5.2.1 Storing of Materials

All materials shall be stored in a manner so as to prevent its deterioration and contamination which would preclude its use in the works.

Requirements of IS: 4082 shall be complied with.

Each size of course and fine aggregates shall be stacked separately and shall be protected from leaves and contamination with foreign material. The stacks shall be on hard, clean, free draining bases, draining away from the concrete mixing area.

The Contractor shall make his own arrangements for storing water at site in tanks to prevent contamination.

5.2.2 Cement

The Contractor shall procure Sulfate resistant Cement only confirming to IS:12330, as required in the work, only from reputed manufacturer holding license to use BIS certification mark for their product, whose name, shall be in the vendor list approved by the Authority.

Supply of cement shall be taken either in silos or in 50kg bags bearing manufacturer's name period of manufacturing and BIS marking.

Cement must be fresh and unharmed by exposure to moisture.

Cement which has been stored too long or has been hard shall not be used. The cement in which only a few small lumps soft and easily crushable by the finger have formed may be used with care after screening out all the lumps and subject to satisfied in test for strength.

Cement used for reinforced concrete work shall be tested periodically to see that it is up to specification as regards quality and strength and has not deteriorated.

Samples of cement arranged by the Contractor shall be taken by Engineer and tested in accordance with provisions of relevant BIS codes.

Cost of such tests shall be borne by the Contractor.

In case test results indicate that the cement arranged by Contractor does not conform to be relevant BIS codes the same stand rejected and shall be removed from the site by the Contractor at his own cost within one week time of written order from the Engineer.

The cement shall be packed as tightly as possible to prevent moisture getting in to cement.

Cement brought at site and cement remaining unused after completion of work shall not be removed from site without written permission of the Engineer.

5..2.3. Aggregates (general)

Regarding quality and size of aggregate the Indian standard code of practice for Plain and Reinforced concrete for general building construction (IS: 456) shall be followed.

Aggregates shall consist of naturally occurring stones (crushed or uncrushed), gravel and sand. They shall be chemically inert, strong, hard, clean, durable against weathering, of limited porosity, free from clay film dust/silt/ organic impurities/deleterious materials and conform to IS: 383. Aggregates such as slag,

crushed over burnt bricks, bloated clay ash, sintered fly ash and tiles shall not be used.

Granite, trap, quartzite and rocks of similar characteristics are suitable for breaking into coarse aggregate.

Aggregates shall be washed and screened before use where necessary or if directed by the Engineer. Aggregates shall be free from soft or friable pieces generally associated with surface rock.

Aggregates containing reactive materials shall be used only after tests conclusively prove that there will be no adverse effect on strength, durability and finish, including long term effects, on the concrete.

The fineness modulus of sand shall neither be less than 2.2 nor more than 3.2.

The maximum size of coarse aggregate shall be as stated on the drawings but in no case greater than 1/4 of the minimum thickness of the member.

Samples of aggregates arranged by the Contractor shall be taken by the Engineer and tested in accordance with provisions of relevant IS Code. Cost of such tests shall be borne by the Contractor.

5.2.4. Water

Water used for both mixing and curing shall conform to IS: 456. Potable waters are generally satisfactory. Water containing any excess of acid, alkali, sugar or salt shall not be used. The pH value of water shall not be less than 6.

Permissible limits of solids shall be as per IS:3025 as given below

Organic-	200mg/l
Chloride-	200mg/l
In organic-	300mg/l
Sulphate-	400mg/l
Suspended matter-	200mg/l

5.2.5.5. Reinforcement steel

Steel for reinforcement shall be high yield strength deformed bars having corrosion resistant characteristics. The steel shall be Re-bars of grade Fe 415 and above and shall have mechanical properties as per IS1786.

The steel reinforcement, structural steel can be purchased from authorized dealers of the approved manufacturers. The Contractor shall have to obtain and furnish test certificates to the Engineer in respect of all supplies of steel brought by him to the site of work.

Samples shall also be taken and tested by the Engineer as per the provisions in this regard in relevant IS codes. Cost of such test shall be borne by the Contractor. In case the test results indicate that the steel arranged by the Contractor does not conform to IS codes, the same shall stand rejected and shall be removed from the site of work by the Contractor at his cost within a week's time after written orders from the Engineer.

The steel reinforcement, structural steel shall be stored by the Contractor at site of work in such a way as to prevent distortion and corrosion.

Bars of different sizes and lengths shall be stored separately.

For checking nominal mass, tensile strength, bond test, re-bond test etc. specimen of sufficient length shall be cut from each size of the bar at random at a frequency to be determined with the Engineer.

Steel brought to site and steel remaining unused shall not be removed from site without the written permission of the Engineer.

5.4.2.6. Admixtures:

Accelerating, retarding, water-reducing and air entraining admixtures shall conform to IS: 9103. Admixtures may be used in concrete as per manufacturer's instructions only with the approval of the Engineer. An admixture's suitability and effectiveness shall be verified by trial mixes with the other materials used in the works. If two or more admixtures are to be used simultaneously in the same concrete mix, their interaction shall be checked and trial mixes done to ensure their compatibility. There should also be no increase in risk of corrosion of the reinforcement or other embedment.

Calcium chloride shall not be used for accelerating set of the cement for any concrete containing reinforcement or embedded steel parts. When calcium chloride is permitted such as in mass concrete works, it shall be dissolved in water and added to the mixing water by an amount not exceeding 1.5 percent of the weight of the cement in each batch of concrete. The designed concrete mix shall be corrected accordingly.

5.4.3.1. Samples and Tests

All materials used for the works shall be tested before use, and the cost of such tests shall be borne by the contractor. Manufacturer's test certificate shall be furnished for each batch of cement and when directed by the Engineer, samples shall also be tested by the Contractor in a laboratory approved by the Engineer. Sampling and testing shall be as per IS: 2386 under the supervision of the Engineer. Water to be used shall be tested to comply with requirements of IS: 456. The Contractor shall have to make all arrangements at his own cost for water fit for construction purposes and also water for drinking purposes.

The Contractor shall furnish manufacturer's test certificates and technical literature for any admixture proposed for use. If directed, the admixture shall be tested at an approved laboratory.

All the testing charges including sampling, conveyance, packaging etc. shall be borne by the Contractor. For routine quality control tests (e.g. cube tests, sieve analysis etc.) Contractor shall establish a well-equipped laboratory at site or deal with a laboratory, subject to prior approval of the Engineer.

All tests required as per specification/IS codes and as directed by Engineer shall haveto be done by Contractor in the presence of Engineer.

5.4.3.2. Optional Tests

If the Engineer feels that the materials i.e. cement, sand, coarse aggregates, reinforcement and water are not in accordance with the specified requirements or if specified concrete strengths are not obtained, he may order tests to be carried out on these materials in laboratory, to be approved by the Engineer, as per relevant IS Codes.

In the event of any work being suspected of faulty material or workmanship requiring its removal or if the works cubes do not give the stipulated strengths, the Engineer reserves the right to order the Contractor to take out cores and conduct tests on them

or do sclerometer (rebound hammer) testing of structure, etc. The Engineer also reserves the right to ask the Contractor to dismantle and re-do such unacceptable work, at Contractor's cost.

5.5 Concrete work

5.5.1 General

Concrete grade shall be as designated on drawings and BOQ attached to the bid document. In concrete grade M15, M20 etc. the number represents the specified characteristic compressive strength of 150mm cube at 28 days, expressed in N/sq. mm as per IS: 456. Cement to be used for water retaining structures ie STP units, Manhole chambers Inspection chambers and RCC sewer pipes etc shall be Sulphate resisting cement confirming to IS:12330 (Latest edition).

5.5.2 Design mix concrete

Mix Design & Testing: For Design Mix Concrete, the mix shall be designed to provide the grade of concrete having the required workability and characteristic strength not less than appropriate values given in IS: 456. The design mix shall be in addition to such that it is cohesive and does not segregate and should result in a dense and durable concrete and also capable of giving the finish as specified. The Contractor shall exercise great care while designing the concrete mix and executing the works to achieve the desired result.

It will be the Contractor's sole responsibility to adopt appropriate nominal mix proportions to yield the specified strength. The minimum cement content for Design Mix Concrete shall be as per Appendix-A of IS: 456 or as given below, whichever is higher.

Grade of Concrete	Minimum Cement Content in Kg/cum of Concrete (for 20mm downgraded aggregates)
M15	260
M20	300
M25	315
M30	320
M35	340
M40	360

The Contractor shall submit details of the source of all material and the proposed quantities of each ingredient per cubic meter of fully compacted concrete. The Contractor shall then make trial mixes for each class of concrete using the same Contractor's Equipment and the same materials as are proposed for the Permanent Works. He shall furnish to the Engineer at least 30 days before concreting operations,a statement of proportions proposed to be used for the various concrete mixes and the strength results obtained. The strength requirements of the concrete mixes ascertained on 150 mm cubes as per IS: 516 shall comply with the requirements of IS: 456.

7days & 28 days Compressive strength of Different Grade of Concrete:

Grade of Concrete	Minimum Compressive Strength N/sq.mm at 7 days	Specified Characteristic Compressive Strength N/sq.mm at 28 days

M 15	10.0	15.0
M 20	13.5	20.0
M 25	17.0	25.0
M 30	20.0	30.0
M 35	23.5	35.0
M 40	27.0	40.0

The Contractor shall give 24 hours' notice of such trials to enable the Engineer to attend. For each trial mix, three separate and consecutive batches of concrete shall be made by the Contractor and the specimens shall be tested at 7 days and 28 days (9 specimens at 7 days and 9 specimens at 28 days). For 7 days test the acceptance criteria shall be 70% of the corresponding target mean strength.

The Contractor shall not commence concreting in the permanent works until details of trial mixes and test results for each class of concrete have been submitted to and approved by the Engineer.

Unless otherwise specified, only medium graded fine aggregate shall be used.

A trial mix design will be approved by the Engineer with respect to strength if the average compressive strength of the nine specimens each at 7 days and 28 days is more than the specified target mean strength appropriate to the grade of concrete.

The Contractor shall not alter the approved mix proportions nor the approved source of supply of any of the ingredients without having previously obtained the approval of the Engineer.

During production, the Engineer may require trial mixes to be made before a substantial change is made in the materials or in the proportions of the materials to be used.

A range of slumps which shall generally be used for various types of construction unless otherwise instructed by the Engineer is given below:

Range of Concrete Slump for Different Structure/Member:

Structure/Member	Slump in millimeters	
	Maximum	Minimum
Reinforced foundation walls and footings	75	40
Slabs, Beams and reinforced walls	100	40

5.5.3 Batching & Mixing of Concrete

It is expected that batching plants of suitable capacity shall be used. However, the Contractor shall submit monthly programme of concrete works for the approval of the

Engineer. Proportions of aggregates and cement, as determined by the concrete mix design, shall be preferably by weight. These proportions shall be maintained during subsequent concrete batching by means of weigh batchers capable of controlling the

weights within one percent of the desired value.

Based on the adopted nominal mixes, aggregates may be measured by volume. However, cement shall be by weight only

Amount of water added shall be such as to produce dense concrete of required consistency, specified strength and satisfactory workability and shall be so adjusted to account for moisture content in the aggregates. Water- cement ratio specified for use by the Engineer shall be maintained. Each time the work stops, the mixer shall be cleaned out, and while recommencing, the first batch shall have 10% additional cement to allow for sticking in the drum.

Arrangement should be made by the Contractor to have the cubes tested in an approved laboratory or in field with prior consent of the Engineer. Sampling and testing of strength and workability of concrete shall be as per IS: 1199, IS: 516 andIS: 456.

5.6 Formwork

Formwork shall be all inclusive and shall consist of but not be limited to shoring's, bracings, sides of footings, walls, beams and columns, bottom of slabs etc. including ties, anchors, hangers, inserts, false work, wedges etc.

The design and engineering of the formwork as well as its construction shall be the responsibility of the Contractor. However, if so desired by the Engineer, the drawings and calculations for the design of the formwork shall be submitted to the Engineer for approval. Formwork shall be designed to fulfill the following requirements:

1. Sufficiently rigid and tight to prevent loss of grout or mortar from the concrete at all stages and appropriate to the methods of placing and compacting.
2. Made of suitable materials.
3. Capable of providing concrete of the correct shape and surface finish within the specified tolerance limits.
4. Capable of withstanding without deflection the worst combination of self-weight, reinforcement and concrete weight, all loads and dynamic effects arising from construction and compacting activities, wind and weather forces.
5. Capable of easily striking without shock, disturbance or damage to the concrete.
6. Capable of accommodating design temporary openings where necessary for these purposes and to facilitate the preparation of construction joints.

The formwork shall be made of steel joints between formwork and formwork and between formwork and structures shall be sufficiently tight to prevent loss of slurry from concrete, using seals if necessary.

The faces of formwork coming in contact with concrete shall be cleaned and two coats of approved mould oil applied before fixing reinforcement. All rubbish, particularly chippings, shavings, sawdust, wire pieces dust etc. shall be removed from the interior of the forms before the concrete is placed. Where directed, cleaning of forms shall be done by blasting with a jet of compressed air.

Forms intended for reuse shall be treated with care. Forms that have deteriorated shall not be used. Before reuse, all forms shall be thoroughly scraped, cleaned, holes suitably plugged, joints repaired. The Contractor shall equip himself with enough shuttering to

allow for wastage so as to complete the job in time.

Permanent formwork shall be checked for its durability and compatibility with adjoining concrete before it is used in the structure. It shall be properly anchored tothe concrete.

Wire ties passing through beams and walls shall not be allowed. In their place bolts passing through sleeves shall be used. Formwork spacers left insitu shall not impair the desired appearance or durability of the structure by causing spalling, rust staining or allowing the passage of moisture.

All corners and angles exposed in the finished structure shall have chamfers or filletsof 20 mm x 20 mm size, unless otherwise stated on the drawings or elsewhere.

Forms for substructure may be omitted when, in the opinion of the Engineer, the open excavation is firm enough (in hard non-porous soils) to act as a form. Such excavations shall be larger, as approved by the Engineer, than that required as per drawing to compensate for irregularities in excavation.

The Contractor shall provide adequate props carried down to a firm bearing without overloading any of the structures.

The shuttering for beams and slabs shall be so erected that the side shuttering of beams can be removed without disturbing the bottom shuttering. If the shuttering fora wall is erected for the full height of the wall, one side shall be built up in sections as placing of concrete proceeds or windows left for placing concrete from the side to limit the drop of concrete to 1.0m or as approved by the Engineer. The Contractor shall temporarily and securely fix items to be cast (embedments/inserts) in a manner that will not hinder the striking of forms or permit loss of grout.

Formwork showing excessive distortion, during any stage of construction, shall be repositioned and strengthened. Placed concrete affected by faulty formwork, shall be entirely removed and formwork corrected prior to placement of new concrete.

Before concrete is actually placed in position, the inside of the formwork shall be cleaned and mould oil applied, inserts and reinforcement shall be correctly positioned and securely held, necessary openings, pockets, etc. provided.

All arrangements-formwork, equipment and proposed procedure, shall be approved by the Engineer.

5.6.1 Formwork Striking Time

The striking time for formwork shall be determined based on the following requirements:

1. Development of adequate concrete strength;
2. Permissible deflection at time of striking form work;
3. Curing procedure employed - its efficiency and effectiveness;
4. Subsequent surface treatment to be done;
5. Prevention of thermal cracking at re-entrant angles;
6. Ambient temperatures; and

Aggressiveness of the environment (unless immediate adequate steps are taken to prevent damage to the concrete).

Under normal circumstances (generally where temperatures are above 20°C) forms may be struck after expiry of the time period given in IS: 456 unless approved otherwise by the Engineer. For Portland Pozzolana / slag cement the stripping time shall be suitably modified as approved by the Engineer. It is the Contractor's responsibility to ensure that

forms are not struck until the concrete has developed sufficient strength to support itself, does not undergo excessive deformation and resist surface damage and any stresses arising during the construction period.

5.6.2 Finish

The formwork for concrete works shall be such as to give the Surface Finish Type F1 as specified below. The Contractor shall make good any unavoidable defects as approved consistent with the type of concrete and finish specified; defects due to bad workmanship (e.g. damaged or misaligned forms, defective or poorly compacted concrete) will not be accepted. The Contractor shall construct the formwork using the correct materials and to meet the requirements of the design and drawing to produce finished concrete to required dimensions, plumbs, planes and finishes as per standard specification.

Surface Finish Type F1

The main requirement is that of dense, well compacted concrete. No treatment is required except repair of defective areas, filling all form tie holes and cleaning up of loose or adhering debris.

5.7. Reinforcement workmanship

Reinforcing bars supplied bent or in coils shall be straightened cold without damage.

Local warming may be permitted if steel is kept below 100o C. All bars shall be accurately bent gradually and according to the sizes and shapes shown on the drawings/ schedules to be prepared by the Contractor. Re-bending or straightening incorrectly bent bars shall not be done without the approval of the Engineer. Reinforcement shall be accurately fixed and maintained firmly in the correct position by the use of blocks, spacers, chairs, binding wire etc. to prevent displacement during placing and compaction of concrete. The tied in place reinforcement shall be approved by the Engineer prior to concrete placement. Spacers shall be of such materials and designs as will be durable, not lead to corrosion of the reinforcement and not cause spelling of the concrete cover. Binding wire shall be 16 gauge soft annealed wire. Ends of the binding wire shall be bent away from the concrete surface and in no case encroach into the concrete cover.

5.8. Tolerances

Variation from plumb, from specified batter or from curved surfaces of all structures:

1. In 2.5 m: 10 mm
2. In 5 m: 15 mm
3. In 10 m or more: 25 mm
4. In buried construction: Twice the above amounts

Variation from level or grade indicated on drawings in slab, beams, soffits, horizontal grooves and visible arises:

1. In 2.5 m: 5 mm
2. In 7.5 m or more:10 mm
3. In buried construction: Twice the above amounts

Variation in cross-sectional dimensions of columns, beams, buttresses, piers and similar members:

1. Minus: 5 mm
2. Plus: 10 mm

Variation in the thickness of slabs, walls, arch sections and similar members:

1. Minus: 5 mm
2. Plus: 10 mm

Footing for columns, piers, walls, buttresses and similar members:

1. Variation of dimension in plan:
2. Minus: 10 mm
3. Plus: 50 mm
4. Misplacement or eccentricity: 2% footing width in the direction of misplacement but not more than 50 mm
5. Reduction in thickness: 5% of specified thickness subject to a maximum of 50 mm.

Tolerance in fixing anchor bolts or embedded parts such as plastic steps shall be as follows:

1. Anchor bolts without sleeves: 1.5 mm in plan
2. Anchor bolts with sleeves: 5.0 mm in elevation for bolts up to and including 28 mm dia. 5 mm in all directions - for bolts 32 mm dia. and above: 3 mm in all directions
3. Embedded parts: 5 mm in all directions

5.9. Transporting, Placing and Compacting Concrete

Concrete shall be transported from the mixing plant to the formwork with minimum time lapse by methods that shall maintain the required workability and will prevent segregation, loss of any ingredients or ingress of foreign matter or water.

In all cases concrete shall be deposited as nearly as practicable directly in its final position. To avoid segregation, concrete shall not be re handled or caused to flow. For locations where direct placement is not possible and in narrow forms the Contractor shall provide suitable drops through "Elephant Trunks". Concrete shall not be dropped from a height of more than 1.0m.

Concrete shall not be placed in flowing water. Under water, concrete shall be placed in position by tremies or by pipeline from the mixer and shall never be allowed to fall freely through the water.

While placing concrete the Contractor shall proceed as specified below and also ensure the following:

1. Continuously between construction joints and pre- determined abutments without disturbance to forms or reinforcement.
2. Without disturbance to pipes, ducts, fixings and the like to be cast in; ensure that such items are securely fixed. Ensure that concrete cannot enter open ends of pipes and conduits etc.
3. Without dropping in a manner that could cause segregation or shock.
4. In deep pours, only when the concrete and formwork is designed for this purpose, and by using suitable chutes or pipes.
5. Refraining from placing if the workability is such that full compaction cannot be achieved.

6. Without disturbing the unsupported sides of excavations; prevent contamination of concrete with earth. Provide sheeting if necessary. In supported excavations, withdraw the linings progressively as concrete is placed.

7. If placed directly onto hardcore or any other porous material, dampen the surfaceto reduce loss of water from the concrete.

8. Ensure that there is no damage or displacement to sheet membranes.

9. Record the time and location of placing structural concrete.

Concrete shall normally be compacted in its final position within thirty minutes of leaving the mixer. Concrete shall be compacted during placing with approved vibrating equipment without causing segregation until it forms a solid mass free from voids thoroughly worked around reinforcement and embedded fixtures and into all corners of the formwork. Immersion vibrators for compaction of concrete shall be electrically operated and vibrator needles shall be of 60/40 mm size only. Immersion vibrators shall be inserted vertically at points not more than 450 mm apart and withdrawn slowly till air bubbles cease to come to the surface, leaving no voids. When placing concrete in layers advancing horizontally, care shall be taken to ensure adequate vibration, blending and melding of the concrete between successive layers. Vibrators shall not be allowed to come in contact with reinforcement, formwork and finished surfaces after start of initial set.

Concrete may be conveyed and placed by mechanically operated equipment after getting the complete procedure approved by the Engineer. The slump shall be held to the minimum necessary for conveying concrete by this method. When concrete is to be pumped, the concrete mix shall be specially designed to suit pumping. Care shall be taken to avoid stoppages in work once pumping has started.

Each placement of concrete in multiple lift work shall be allowed to set for at least 24 hours after the final set of concrete before the start of subsequent placement. Placing shall stop when concrete reaches the top of the opening in walls or bottom surface of slab, in slab and beam construction, and it shall be resumed before concrete takes initial set but not until it has had time to settle as approved by the Engineer. Concrete shall be protected against damage until final acceptance.

5.10. Curing

Curing and protection shall start immediately after the compaction of the concrete to protect it from:

1. Premature drying out, particularly by solar radiation and wind;
2. Leaching out by rain and flowing water;
3. High internal thermal gradients;
4. Vibration and impact which may disrupt the concrete and interfere with its bond to the reinforcement.

The finished concrete shall be protected from direct exposure to the sun for the first three days after being laid. On the day the concrete is laid generally no watering canbe done but moist condition has to be maintained and water shall be lightly sprinkled on the surface as soon as it is hard enough to stand this. On the next day it shall be more freely sprinkled with water and kept thoroughly wet by being covered with gunny bags or other

suitable materials and kept constantly wet. It shall be inundated and kept under water for at least 7 days. Surfaces where ponding is impracticable shall be covered with very wet gunny bags. Curing with water will be continued till the concrete is at least 10 days old. Shocks to the concrete by throwing material over it or excessive walking shall be avoided for at least seven days. During the curing period it shall be particularly seen that all exposed surfaces are kept thoroughly moist and not allowed to dry out. Verticals or inclined surfaces from which side forms have been removed and also soffits from which centerings have been removed shall receive special attention in this respect by sprinkling with water or keeping covered with wet gunny bags as may be most suitable.

All concrete, unless approved otherwise by the Engineer, shall be cured by use of continuous sprays or ponded water or continuously saturated coverings of sacking, canvas, hessian or other absorbent material for the period of complete hydration with a minimum of 7 days. The quality of curing water shall be the same as that used for mixing.

Where a curing membrane is approved to be used by the Engineer, the same shall be of a non-wax base and shall not impair the concrete finish in any manner. The curing compound to be used shall be approved by the Enghineer before use and shall be applied with spraying equipment capable of a smooth, even textured coat. Curing may also be done by covering the surface with an impermeable material such as polyethylene, which shall be well sealed and fastened.

5.11. Construction joints

Construction joints will be as shown on the drawing or as approved by the Engineer. Concrete shall be placed without interruption until completion of work between construction joints. If stopping of concreting becomes unavoidable anywhere, a properly formed construction joint shall be made with the approval of the Engineer.

Any excess water and laitance shall be removed from surface of joints after the concrete is deposited and before it has set. When resuming work on the hardened concrete surface of the joint it shall be thoroughly cleared and roughened and all lattices removed. The surface shall be swept clean with wire brushes thoroughly wetted and treated with a thin layer of cement mortar consisting of equal volume of sand and cement and fresh concreting will start.

As soon as the exposed concrete has sufficiently hardened, the surface of the joint shall be water jetted or brushed with a stiff brush to expose the larger aggregate without being disturbed. Alternatively, if the preparation is not satisfactory, or proper joint preparation is not possible due to inclement weather, the Contractor shall thoroughly remove the laitance of hardened concrete by mechanical chipping after seven days of concrete work at his own cost. Before placing fresh concrete against a construction joint all loose material shall be removed and the surface sluiced with water until it is perfectly clean, thereafter all ponded water should be removed.

When concreting is to be resumed on a surface which has not fully hardened, all laitance shall be removed by wire brushing, the surface wetted, free water removed and a coat of cement slurry applied. On this, a layer of concrete not exceeding 150 mm thickness shall be placed and well rammed against the old work. Thereafter work shall proceed in the normal way.

5.12. Concreting records

A written record of the concrete works shall be made each day by the Contractor and kept available for inspection by the Engineer. The diary shall contain notes and records of:

1. The names of the Contractor's engineer who are responsible for the different phases of the concrete work and also the names of their assistants.
2. The temperatures of air, water, cement, aggregate, together with the air humidity and type of weather.
3. Deliveries to the Site of concrete materials (quantity, brand of concrete, materials etc).
4. Inspections carried out, tests performed, etc. and their results.
5. Times of commencement and completion of different parts of the concrete works and times of erection and striking of.

5.13. Inspection

All materials, workmanship and finished construction shall be subject to continuous inspection and approval of Engineer. Materials rejected by Engineer shall be expressly removed from site and shall be replaced by Contractor immediately. Additional cost involved will be borne by the Contractor.

5.14. Clean-up

Upon the completion of concrete work, all forms, equipment, construction tools, protective coverings and any debris, scraps of wood, etc. resulting from the work shall be removed and the premises left clean.

5.15. Acceptance by the Engineer

The Engineer's decision as to the acceptability or otherwise of any concrete work shall be final and binding on the Contractor.

For work not accepted, the Engineer may review and decide whether remedial measures are feasible so as to render the work acceptable. The Engineer shall in that case direct the Contractor to undertake and execute the remedial measures. These shall be expeditiously and effectively implemented by the Contractor. Nothing extrashall become payable to the Contractor by the Authority for executing the remedial measures.

5.16. Repair and Replacement of Unsatisfactory Concrete

Immediately after the shuttering is removed, all the defective areas such as honey-combed surfaces, rough patches, and holes left by form bolts etc. shall be inspected by the Engineer who may permit patching of the defective areas or reject the concrete work.

All through holes for shuttering shall be filled for full depth and neatly plugged flush with surface.

Rejected concrete shall be removed and replaced by the Contractor at no additional cost to the Authority.

For patching of defective areas all loose materials shall be removed and the surface shall be prepared as approved by the Engineer. This work is to be done by Contractorat his own cost.

Bonding between hardened and fresh concrete shall be done either by placing cement mortar or by applying epoxy. The decision of the Engineer as to the method of repairs to be adopted shall be final and binding on the Contractor. The surface shall be saturated

with water for 24 hours before patching is done with 1:5 cement sand mortar. The use of epoxy for bonding fresh concrete shall be carried out as approvedby the Engineer. The cost involved will be borne by Contractor.

5.17. Benching and Channeling in Man Holes Chambers

The benching and channeling for the manholes shall be constructed in cement concrete of CC (1:2:4). Both sides of the channel shall be taken up to the level of the crown of the outgoing sewer. They shall be benched up in concrete and rendered plastering in cement mortar (1:3) of 20 mm thickness and 1mm thick neat cement punning and provided with a slope of 1 in 10 towards the channel.

No construction of any kind or laying of precast units on the excavation bottom shall commence until the natural bottom of the trench has been inspected by the Authority's Engineer.

5.18. Backfilling of excavation for manhole

Backfilling of the excavation shall not be commenced till the manhole is tested for water tightness and approval for filling of the excavation is given by the Authority's Engineer. Backfilling of the excavation shall be done with sand or approved back fill material free from boulders, sharp objects, and rubbish. The filled-up material shall be well watered and consolidated, taking proper care to see that precast unit's level and alignment are not disturbed. Particular care shall be taken not to cause unequal loading or damage of any sort to the precast units.

Backfill materials shall be compacted to 90% of maximum density at optimum moisture content as per IS 2720 (Part 8), with approved mechanical compactors in layers having a maximum depth of 150 mm.

5.19. Manhole fittings

Once placed or constructed, the manhole will be fitted with the following, as per relevant drawings and specifications given in clause 3.2. and clause 0 above.:

- RCPC / SFRC Cover and frame fitted with hooks.
- Foot steps

5.20. RCPC/SFRC Man Hole Cover and Frames

For heavy traffic roads manhole cover &frame shall be of Extra Heavy Duty (EHD- 35) and for other roads shall be Heavy Duty (HD-20) confirming to IS: 12592. Cement for the work shall be Sulphate resisting cement confirming to IS:12330 (Latest edition).

The cover should be inscribed with Employers logo in casting as approved by the Engineer.

5.21. Foot Steps

Plastic encapsulated foot steps

Safety footsteps as per IS 10910 shall be provided.

They shall consist of minimum 6 mm thick plastic encapsulated 12mm dia. steel bar confirming to IS 1786 having minimum cross section as 23 mm x 25 mm, and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs.

They will have 2mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to withstand the bend test and chemical resistance test as per specifications and

having manufacturer's permanent identification mark to be visible even after fixing in the cavity around the footsteps in the walls which shall be grouted with cement concrete (1:1:2)

5.22. Drop pipe for Drop Man holes.

The drop pipe used in Drop Man holes shall be cement mortar lined Ductile Iron (DI) flanged pipe of class K-7, and the fitting for connection of drop pipe shall be DI class PN. 1.0. For drop pipes up to 200mm dia, the drop may be provided inside the man hole but for drops more than 200mm, the drop shall be outside.

6. CONNECTION BETWEEN INSPECTION CHAMBERS AND MANHOLE CHAMBERS

The only works included under this contract relating to house connections are the laying of 100 mm RCC pipes from Manhole Chambers to property boundary as per drawings approved by the Authority's Engineer. "

Construction of Inspection Chamber and connection of house sewer with Inspection chamber will be the responsibility of the property owner and is not included in the Scope of Work under this Contract.

6.1 PROVISION FOR HOUSE SEWER / PROPERTY CONNECTION

HOUSE CONNECTION

House connection sewers shall be 135 mm & 170mm dia DWC pipe. The pipe shall meet the requirements of IS:14333 / IS:783-1985 (Latest edition) and should preferably bear ISI mark. The sewers shall be laid as per IS (Latest edition). The house sewers shall have a minimum slope of 1:60. A coarse sand bedding of minimum 150mm thick shall be provided below the pipes. House connection sewers shall be connected to the nearest Manhole chambers of street sewers. Independent house sewer shall be provided to each house hold and shall terminate at the property line. The end of House sewer at the property line shall be plugged which will be connected by the house owner to an inspection chamber constructed by him. Particular attention shall be given to the depth of the termination point and its location in relation to street sewer.

Sewer Construction

All sewers shall be laid with straight alignments between manholes. The contractor shall set Temporary Bench Marks (TBMs) with respect to the Survey of India Bench Marks (GTS Bench Marks). The personnel of contractor shall constantly check line and grade of the pipe.

Cement for sewer and chambers

Sulphate resisting cement confirming to IS 12330:1988 shall be used in manufacture of sewers and construction of manhole chambers, and units of Sewage Treatment plant.

Excavation of sewer trench

Excavation of sewer trenches shall be done as per the approved drawing. The trenches should not be opened in advance of the laying of the sewer pipe for a distance greater than that required to install the sewer pipe. Backfill in the excavated trenches shall be done immediately after jointing the pipe to prevent movement. Testing of the pipeline shall be done prior to refilling the trench in order to ascertain the leakage at joints. Shoring, sheeting and benching of trench is to be provided to prevent caving during excavation, to protect adjacent structure, property, workers and the public. Sheeting shall be maintained in place until the pipe or structure has been placed and backfilled. Shoring and sheeting shall be removed, as the backfilling is done, in a manner that will not damage

the pipe or structure or permit voids in the backfill.

The contractor shall furnish, install and operate all necessary machinery, appliances and equipment to keep the excavations reasonable free from water during construction and shall dewater and dispose of the water so as not to cause injury to public or private property or to cause a nuisance or menace to the public. The control of ground water shall be such that softening of the bottom of excavations or formation of "quick" conditions or "boils" shall be prevented. Dewatering system shall be designed and operated so as to prevent the removal of the natural soils. The trench shall be dewatered until bedding and pipe laying are complete.

Sand Bedding

The contractor shall provide Class-A (a,b,c,d), Class B bedding below the RCC sewer line as per the CPHEEO manual and as per design requirement.

Pipe laying and jointing

The contractor shall provide trench excavation, pipe bedding and backfill as per specification. Pipe laying shall begin at the downstream end of a sewer segment and progress upstream, with socket ends upstream. When laying is not in progress, the open end of the pipe shall be kept tightly closed with pipe plug. Pipe shall be lowered into the trench in such a manner as to avoid any physical damage to the pipe. Pipe shall not be dropped or dumped into trenches under any circumstances.

A statement showing tentative length of different diameters of sewers to be laid has been presented in Table 1.1.

Repair of Roads

Repair of road damaged due to excavation of trench is included in the scope of the work and shall be carried out as per MoSRT&H specification and shall be brought to the pre-excavated condition to the satisfaction of the Authority/Authority's Engineer and acceptable to the road owning authority. .

INSPECTION CHEMBER

The only works included under this contract relating to house connections are the laying of 135mm & 170mm dia DWC SN-8 pipes from Manhole Chambers to property boundary as per drawings approved by the Authority's Engineer. "Construction of Inspection Chamber and connection of house sewer with Inspection chamber will be the responsibility of the property owner and is not included in the Scope of Work under this Contract.

7. RISING MAINS

The pipeline proposed to convey sewage flow from a Sewage Pump Station to the Sewage Treatment Plants (STP) or to another Pump Station or Manhole are named as Rising Mains and designed for pressure flow.

7.1. Pipe material for Rising main

The pipes and fittings for all the Rising Mains shall be of Ductile Iron, and class of pipe shall be pipe K-9 unless otherwise specified. The pipes shall confirm to IS: 8329 and fittings should confirm to IS:9523 the ends of pipe shall be spigot and socket (i.e. one end will be with socket and the other end with spigot) suitable for roll on rubber ring joints. The fittings may be socketed or flanged depending on the site requirement. The socketed fittings shall be suitable for rubber ring joints. The inner surface of the pipes & fittings will be lined with cement mortar lining with a seal coatof bituminous material on it, and outer surface shall be zinc coated with a coat of bitumen painting over it. Two IPS of TP-4 have HDPE PE100 PN10 rising main.

The Rubber gaskets (Rubber rings) shall be elastomeric and made of EPDM / SBR material and confirm to IS:5382 &IS:12820.

The cement mortar to be used for lining of inner surface of pipes and fittings shouldbe of Sulphate Resisting Port land Cement confirming to IS: 12330.and the cement mortar lining shall confirm to IS:11906.

The Zinc coating on the outer surface of pipes & fittings shall be applied as spray coating the mass of spread metal being not less than 130gram per sqm. and should confirm to ISO:8179

The Bitumen painting over the Zinc coating shall be cold applied and shall be 75micron thick and comply the requirements of BS3416 Type-II, suitable for tropical climates.

The outer surface of pipes shall be given two more coats of enamel paint of dark grey or any other shade approved by the Authority's in order to distinguish it from other service pipes (eg. Potable water) in the field.

7.2. Laying and jointing of pipes

7.2.1. Transportation of pipes to site

Pipes are to be carried to site through trucks loaded in such a way that they are secured and that no movement should take place on the vehicle during transit, and pipes are not damaged while handling.

When using mechanical handling equipments, it is necessary to employ sufficient personnel to carry out the operation efficiently with safety. The pipes should be lifted smoothly without any jerking motion and pipe movement should be controlled by use of guide ropes in order to prevent damage caused by pipes bumping together or against surrounding objects.

7.2.2. Stacking of Pipes

Pipes being taken to a stock ground for storage and held pending further distribution should be arranged in to a stack. The first layer of pipe should be laid on a firm foundation consisting of solid timbers set level on the ground. Subsequent layers should be placed according to the method of stacking adopted by method of square or any other method of stacking. Care should be taken so that the pipes do not rest on their sockets.

7.2.3. Inspection of the pipes

Pipes are to be inspected on site to see if any damage to the pipe, inside lining or outside coating has occurred during transportation and handling. Damages if any shall be made good up to the satisfaction of the Authority's Engineer before laying.

A copy of the certificate and factory test reports from the recognised bodies preferably DGS&D should be obtained from the manufacturer or supplier and to be shown to the Authority's if he so desires.

If desired by the Authority's Engineer, inspection to factory to witness the testing of pipes shall be arranged by the contractor at his own cost.

7..2.4. Site Preparation

Preliminary work required to be done before the laying of pipe includes, fixing the alignment of rising main, pegging out, clearing and disposal of all shrubs, grasses, large and small bushes, hedges, fences, gates, portions of old masonry, boulders and debris from the route. The alignment fixed in the field is to be got approved by the Authority's Engineer.

7.2.5. Excavation and Preparation of trench

The excavation of trench may be carried out manually or mechanical means
The width of the trench at bottom between the faces of sheeting shall be such to provide not less than 200mm clearance on either side of the pipe except when rock excavation is involved. Trenches shall be of such extra width, when required, as will permit the convenient placing of timber supports, strutting and planking, and handling of specials.

Special considerations should be given to the depth of the trench. The depth should provide a minimum cover of 1100mm when laid alongside or across the roads. For cross country laying the cover above the crown of the pipe may be 900mm. It may be necessary to increase the depth of excavation to cross surface drains.

When crossing the National High ways, State High ways and Rail way tracks and River embankments the guide line of respective authorities for minimum cover depths will govern the excavation.

All surface materials, which in the opinion of the Authority's are suitable for reuse in restoring the surface, shall be kept separate from the general excavated material .as directed by the Authority's Engineer.

The bed of the trench shall be levelled perfectly to facilitate setting of the entire body of the pipe along with the socket. Excess excavation beyond the required depth shall be filled with sand, watered & well compacted.

Care should be taken to avoid spoil banks causing an accumulation of water
All other excavated materials shall be stacked in such a manner that it will not endanger the work men and it will avoid obstructing foot paths, roads and drive ways. Utility controls shall be left on obstructed.

7.2.6. Dewatering

Attention of the Contractor is drawn to the fact that water table may be high at few places of the Project area even during the dry season.

Ground and surface water shall be controlled to the extent that excavation and rising main installation can proceed in the specified manner and such that the trench bottomis not disturbed to the detriment of the rising main installation. Trench water shall not be permitted to enter the rising main being installed.

The necessary pumps and well points, or other suitable (subject to the approval of the Engineer) equipment shall be employed to keep excavations free of water. Caution shall be exercised to make sure that foundation in proximity to rising mains excavations are

not adversely affected by the excavation or dewatering process. Discharge from pumps, well points, or other dewatering equipment shall be located and controlled so that loss, damage, nuisance or injury to the public does not result.

7.2.7. Laying of Pipes

Pipes shall be lowered in to the trench with tackle suitable for the weight of the pipe. For smaller size up to 250mm nominal bore, the pipe may be lowered by the use of ropes but for heavier pipes, either a well-designed set of shear legs or mobile cranes should be used. All construction debris should be cleared from the inside of the pipe either before or after a joint is made. When laying is not in progress, a temporary end plug should be securely fitted to the open end of the pipeline. When laid in high water table locations care should be taken to prevent floatation of the pipes by holding down the pipe by either partial refilling of the trenches or by temporary strutting wherever needed.

On gradients of 1:15 or steeper precaution should be taken to ensure that the spigot of the pipe being laid does not move in to or out of the socket of the laid pipe during the jointing operation.

7.2.8. Joints and Jointing

The Jointing should be done as per the recommendation in clause.6.3 of IS12288
The Jointing of pipes should be flexible push on rubber ring joints. The Rubber gasket (Rubber ring) should be elastomeric and should be of EPDM / SBR rubber and the quality should confirm to IS: 5382& IS: 12820

Before jointing, the inside of sockets and outside of spigots should be cleaned and wire brushed for a distance of 150 to 225mm. The rubber gaskets should be wiped clean and inspected for damage. When lifting gear is used to place the pipe in the trench, it should also be used to assist in centralising the spigot in the socket.

7.2.9. Pipe Supports and Thrust Blocks

When pipes are laid above ground, the pipes are to be laid on saddles or rocker supports as specified by the Authority's Engineer. Each pipe shall be supported with a support positioned behind the socket of the pipe. The pipe should be fixed to the supports such that the axial movement due to expansion or contraction is taken up at individual joints on the pipe line.

Thrust blocks are to be provided at each bend, tees and taper to resist the thrusts developed by the internal pressure due to the fluid flowing through the pipes. Pipe supports, Anchor Blocks and Thrust blocks are shown on the drawings.

7.3. Valves and Valve chambers

7.3.1. Butterfly Valves

Isolation valve may be provided in long rising mains at required places to isolate and drain sections of pipe to facilitate repair work if desired by the Engineer. Butterfly valves confirming to IS: 13095 should be used for this purpose. The valve should be enclosed in a suitable valve chamber constructed in RCC of Grade M25.

7.3.2. Blow off / Drain out valves

For draining out a section of pipe during repair work blow-off arrangement will be used as shown on the drawings to drain out the flow to drains / nallahs. At this point a Tee with a branch having flanged end should be fitted with the main pipeline. The diameter of the

branch of the Tee may be half or two third of the main pipe as per direction of the Engineer. The flanged end of the Tee shall be fitted with sluice valve confirming to IS:14846 Whenever needed the sluice valve will be opened to drain out the required quantity of flow and then closed.

7.3.3. Air Release Valve

Air release valves shall be provided as shown on the drawings to allow release of air from the pipeline during pump operation and allow atmospheric air to enter in to the pipe during stoppage of pumping which will protect the pipe from surge pressure. Good quality Kinetic Air valves with Isolation valve confirming to IS 14845 or equivalent shall be used. The size of the Air valve should not be less than $1/8^{th}$ of the nominal bore of the Rising mains

7.3.4. Valve Chambers

Valves installed on the Rising Mains should be protected by enclosing them inside suitable size valve chambers constructed with RCC M25 heavy provided with heavy duty RCPC/ SFRC manhole cover as shown in the drawings.

7.4 Hydraulic testing of Pipe line

After the pipeline is laid and jointed, testing shall be done for

a. Mechanical soundness and leak tightness of pipes and fittings
b. Leak tightness of joints, and
c. Soundness of any construction work in particular that of thrust blocks & anchorages

The hydraulic testing is to be carried out as per IS1228

The completed pipeline shall be tested first in sections and then for the whole length of rising main.

When the joints are left uncovered until after testing, sufficient material should be backfilled over the centre of each pipe to prevent movement under the test pressure.
Each section should be properly sealed off preferably with special stop ends secured by adequate temporary anchors.

The test pressure should be measured at the lowest point of the section under the test,or alternately an allowance should be made for the static head between the lowest point and the point of measurement. If the test is not satisfactory, the fault should be found out and rectified immediately as per the direction of Authority's Engineer. After all the sections have been jointed together on completion of section testing, a test on the complete pipe line should be carried out.

7.5. Transition manholes

When a Rising main delivers sewage to a manhole, the manhole receiving the flow will be a Transition Manhole. The invert of the out- going pipe should be kept 25mm above the crown of the incoming Rising Main in order to facilitate flow full in the Rising Main.

7.6 Connection of Rising Main with Sewage Pump Station, Sewage Treatment Plant and Man holes.

The Rising mains will be laid from a Sewage Pumping station to a Sewage Treatment Plant, another pumping station or to a Transition man hole (Ridge Man hole).

The starting point of the Rising main shall be the end flange of the common delivery pipe of the pumping system left outside the pump house structure. The end point ofthe Rising main at a Sewage treatment plant will be the Socket end/Flanged end ofthe inlet pipe embedded in Inlet chamber of STP. When a Rising main will end at another pumping station it will be connected to the Socket/ Flanged end of the inlet pipe embedded in the wall of the wet well, and when the Rising main will end at a Man Hole (Transition Man hole) in case of Lift station or a Man hole pump station, the Rising main shall end at the inner face of the Man hole and its crown shall be keptat 25mm blow the invert of the outgoing sewer.

The connection to Inlet chamber of STP, Wet well of Pumping Station or to Transition Man hole is within the scope of the contract and is the responsibility of the contractor unless otherwise specified.

7.7. Back Filing of Trenches

After the pipe line is tested successfully, the trenches shall be filled up after receipt of written permission of the Authority's Engineer. For the trenches excavated within the carriage way of roads, the backfill should be done with river sand or selected excavated material as per the direction of Authority's Engineer. For the trenches not within the carriage of roads the back filling shall be done with excavated materials. The filling materials shall be free from boulders, sharp objects and rubbish etc and shall be approved by the Authority's Engineer. The back filled materials should be well watered and consolidated to 90% of maximum density at optimum moisture content. Proper care should be taken to see that rising main level and alignment are not disturbed

7.8 Disposal of surplus excavated materials

All the excavated materials shall be the property of the Authority. All hard materials, such as hard mortar, rubber etc. not intended for use shall be stacked neatly as specified and as directed by the Authority's Engineer.

Unsuitable and surplus materials not intended for use shall be separated out and disposed of at a predetermined place selected by the Authority's Engineer.

7.9 Thrust Blocks and Anchor Blocks

Thrust blocks and anchor blocks shall be provided as per the design and drawing provided by the Engineer-in-charge.

8.0 LAYING SEWER PIPES USING TRENCHLESS TECHNOLOGY

The use of trenchless technology will be necessary in the following cases:

- Road Crossings/Along the roads
- Railway Crossings
- Canal /Drain crossings

8.1 Specification

These specifications are intended for general description of quality and workmanship of materials and, finished work. They are not intended to cover minute details. The work shall be executed in accordance with best modern practices and using special techniques.

The Contractor shall read this Specification in conjunction with the relevant standard specification of the Odisha Public Works Department, Odisha Public Health Engineering Organization, and Central Public Works Department of the Government of India, and also the relevant Indian Standard Specifications.

8.2 Contractor's obligations

The clauses in this section are meant to provide general guidelines and compliance requirements to the Contractor. It does not however relieve the Contractor from taking all other steps and precautions as deemed necessary to complete the installation of the sewers successfully within the specified contract period.

Micro tunneling and pipe jacking method is considered as a suitable trenchless method (no-dig or minimum digging) in this project to install the certain stretches of sewers along narrow and congested roads, footpaths and across railways, national highways, drains and canals etc without causing construction nuisances to public and interruptions to motor traffic wherever the sewer runs along or crosses the roads.

The Contractor's responsibility shall be deemed to be for installing the sewers included in the scope of work successfully within the specified contract period, regardless of the methods considered or implied in the specification as a suitable trenchless method.

Furthermore, the consideration of micro231tunneling and pipe jacking as a suitable method of installing the sewer in the Specification shall not relieve the Contractor in any way from his prima facie obligation and responsibility under the contract to successfully install the sewers without causing public nuisance and interruptions to traffic.

8.3 Scope of Work

The Scope of trenchless work includes about 392.5m of 200mm dia. street gravity sewers roads, drains / canal crossings. The standardization of sewers by increasing the size, if done by the contractor, for convenience of construction, the same shall be done at his own cost, the changes in size of pipes shall be got approved by the Authority's Engineer.

It is entirely the responsibility of the contractor to select appropriate micro tunneling system for the installation of the sewer.
Slurry Pressure Balance Shield tunneling system with appropriate cutter head with cone crusher to excavate the rock and crush the excavated rock in to small pieces sothat they can be transported through the slurry pipeline system, may be considered as one of the suitable methods for this.

8.4 Terminology and General Description

Definitions:

For the purpose of this contract document, the technical terms pertaining to micro tunneling and pipe jacking works and their functional details are defined below. The definitions herein are meant only as guidelines. If other (or new) definitions or technical terms are used by the Contractor in his submittals, they shall be clearly defined by him.

Micro tunneling:

Micro tunneling is a process of accurately excavating, non-man entry and man entry tunnels, using laser guided, remote controlled and computer assisted shields of diameters

as small as 250mm for installing underground pipelines. The micro tunneling process permits accurate monitoring and adjustment of alignment and level (either manually or automatically) as the tunnel excavation proceeds.

Pipes& Pipe jacking:

The pipes for jacking system shall be precast jacking quality RCC pipes confirming to DIN EN14457or AS 1342 or or BS 5911 or the acceptable standards and shall meet the requirements of IS 458:2003 and IS: 3597:1998. The pipes should have strength not less than strength of class NP4. The clear cover of concrete over steel reinforcement on the wet side shall not be less than 40mm.The cement should be Sulphate Resisting Cement confirming to IS:12330 (Latest edition).

A load factor (for maximum jacking force) of not less than load factor2.5shall be considered in the calculation to determine the strength of pipes. The outside and inside dia of the pipe shall be such that they match the dimensions of tunneling equipment or vice versa.

All jacking pipes shall be fitted with stainless steel fixed collars. The collars shall be made of wieldable structural stainless-steel confirming to BS4360. The jointing rubber rings shall be of the Cornelius rubber ring type or similar type and shall be capable of accommodating 2-degree deflection at each joint, Jointing rings shall meet the requirements of IS:5382 or BS2494(Latest edition)

Pipe jacking is a process of lining a tunnel bore formed by a shield or other means by pushing specially designed jacking pipes (reinforced concrete or other pipes) into the tunnel bore, from a shaft (known as jacking shaft) to another shaft (known as receiving shaft).

Micro tunneling and Pipe jacking:

It is an art of accurately installing smaller diameter pipelines (usually from 150/200mm to 1000mm diameter but the diameters can go up as high 3000mm), without digging up of ground surface, using a laser guided remote controlled mini shields for tunnel boring and pipe jacking technique for lining the bore with the product pipe.

The process of installing a pipeline by micro tunneling and pipe jacking system comprises five parts: -

(a) Laser guided tunnel boring machine
(b) Automated spoil removal system
(c) Jacking system for pushing the product pipe
(d) Guidance system to guide the tunnel excavation
(e) Remote control system to operate the shield and other paraphernalia equipment.

Laser Guided Tunnel Boring Machine (TBM):

It is mechanized, steerable mini boring machine (or shield) equipped with suitable cutter head in front to excavate smaller diameter tunnels under controlled conditionsin which the tunnel face and ground water pressure are continuously balanced as the shield excavates and moves forward. The operation and steering of the shield are remotely controlled and operated with the aid of laser, CCTV system and computer.

Compact micro tunneling

Compact micro tunneling system uses a compact jacking frame so that it can be fitted inside the manholes or smaller shafts. These are suitable for installing sewers in narrow streets and pathways where no adequate specie is available to construct a conventional jacking or receiving shafts.

Automated spoil removal system

The spoil removal system conveys the excavated material from the tunnel face to the ground surface for disposal. The spoil removal rate and the speed of the shield are fully or semi-automatically controlled in such a way to achieve minimal heave or settlement. There are three systems available for the conveyance of the spoil and they are: - slurry system, augur system, and vacuum system.

Slurry System of spoil removal

In this system, the excavated materials at the tunnel face is continuously mixed with water or bentonite to covert the materials into slurry so that the slurry can be kept under a desired balancing pressure to support the tunnel face. The slurry is pumpedvia pipelines to the ground surface where the excavated materials is separated for disposal and the slurry fluid is pumped back to the tunnel face for further mixing with excavated materials.

Augur System of spoil removal

In this system, the excavated materials at the tunnel face are continuously removedby an encased screw conveyor attachment connected to the rear of the tunnel cutter face. By controlling the speed of the screw augur and the outlet of the conveyor at the spoil discharge point, the excavated soil at the tunnel face can be kept under a desired balancing pressure to support the tunnel face.

Vacuum suction system of spoil removal.

In this system, the excavated material at the tunnel face is removed by vacuum system. The soil excavated by the tunnel cutter is sucked by an air assisted suction process and is transported to the ground surface via a 100mm diameter suction pipeline. The process does not permit any positive pressure at the tunnel face and hence the system is suitable in ground where the tunnel face is self-supported.

8.5. Jacking System.

The jacking system comprise high thrust hydraulic jacks mounted in a jacking frame capable of exerting the required jacking force against a purpose-built thrust wall to push the pipes and the shield forward through the ground. The jacking force is transferred evenly to the jacking pipe through a push ring connected to the pipe.

8.6. Guidance System.

The guidance system comprises a laser beam device or a theodolite with laser beam attachment. The device is installed in the jacking shaft and the beam is set to the desired level, gradient and alignment.

Some machines have photo sensitive cells on the target panel located at the rear of the shield which converts the laser position into digital data. The data are then electronically transmitted to the operator's control panel where digital readout of the location can be made. Some modern shields have built-in capabilities to use the digital data and automatically make necessary steering adjustments to guide the machine to the true alignment and level.

The contractor shall submit complete details of the guidance system he proposes to use and shall incorporate appropriate check points and hold points in the Quality Assurance

Manual that he shall implement in the contract.

The laser torch or theodolite shall be firmly supported in the jacking pit so that it is independent of any movement that may take place during the micro tunneling operation.

8.9. Remote Control System

All micro tunneling systems rely on remote-control capability. The control system monitors and controls the steering of the shield, spoil removal system (slurry or augur or vacuum), jacking system and guidance system. The system operation varies from totally manual to fully automated. The remote-control system is usually housed in portable control cabin.

The control cabin shall be located near to the jacking pit so that the operator can visually monitor the activities in the pit. Where it is not possible to locate the control cabin near to the pit due to space limitations, a CCTV camera system shall be set upin the pit to allow the operator to monitor the activities in the pit. For the manual operating system, the operator's skill is very crucial for a successful completion of the project. The operator shall monitor all the information and continuously feed data into the control panel as necessary. He shall be alert at all time and shall observe the crew's activities and other site activities, evaluate the information and make appropriate operational decisions. The information relayed back to the operator shall be audible, tactile and visual. The TBM shall have facilityto transmit sounds and vibrations from the excavation face to the operators to enable him to make appropriate operational decisions. He shall monitor and keep record of line and grade of the machine, cutter head torque, jacking thrust, RPM, steering pressures, slurry flow rate, pressures of slurry systems and rate of advancement.

In fully automated system, the machine acquires and evaluates the information and selects the operational steps for automatic steering of TBM. The information collected shall be logged in a microprocessor to obtain a printout as necessary.
The contractor shall incorporate check points and hold points for the guidance control system in the Quality Assurance System that he shall implement in the contract.

8.10. Supplementary Systems.

The supplementary system required for micro tunneling and pipe jacking operation shall include Muck disposal system, Pipe lubrication system, Grouting system, Guide rails, and Entrance and Exit ring installations.

Jacking shaft (or Jacking Pit).

Jacking Shaft is an important temporary structure from where jacking operation is performed. The shaft is usually rectangular or circular in shape and built using liner plates, sheet piles, precast concrete segments or timber. The size of the shaft shall be such that it is capable of accommodating the jacking equipment (and also the shield), jacking pipe and other paraphernalia. It is usually constructed at locations where permanent manholes are to be built.

Receiving shaft (Receiving pit).

A purpose-built temporary structure to receive and remove the tunneling shield after its completion of a tunnel drive. The shaft is also rectangular or circular in shape and much smaller than the jacking shaft. The size shall be sufficient enough to accommodate the tunneling shield when it emerges into shaft after completion of a tunnel drive.

Footprint.

The footprint of a tunnel drive shall be taken as the net area occupied by the jacking or receiving shafts. The size of the footprint depends on many factors including the micro tunneling system and the length of jacking pipe used. The footprint requirement shall be an important factor, especially in congested and narrow roads when selecting the micro tunneling system for a project.

The Contractor shall take into consideration of the space constraints and restrictions along the sewer route for location of shafts and he shall ensure that the micro tunneling system selected for use in such sites shall require absolutely minimum space for the footprint.

Thrust wall.

Thrust wall is a temporary concrete or steel structure built within the jacking shaft to transfer the jacking force to the ground during jacking operation. The jacking shafts may often have more than a single thrust wall and each thrust wall shall be perpendicular and square to the pipeline. The thrust walls shall be in good contactwith the soils behind so that wall can transmit the jacking force effectively to the ground.

Often the first thrust wall may have to be demolished fully or partially to construct the second thrust wall.

Entrance Ring.

A steel flange fitted with a rubber seal (a 10mm to 20mm thick circular rubber gasket whose outside diameter is same as that of the steel flange and the inside diameter is smaller than that of the jacking pipe) installed perpendicular to the pipeline at the entrance. The purpose of the rubber seal is to prevent the slurry or ground water from entering into the shaft through the pipe entrance.

Exit Ring.

This is similar to the entrance ring except that the internal diameter of the rubber seal is much smaller than that of the jacking pipe and is installed to prevent the slurry or ground water from escaping the tunneling machine when it emerges at the receiving shaft.

Guide Rails (or Jacking Table).

To facilitate placing of the micro tunneling machine and pipes in the jacking shaft, a set of guide rails are installed in position on the base of the shaft. The guide rail assembly (also known as jacking table) shall be carefully set up in the shaft to correct alignment and gradient so that the pipe when placed on it stays in line withand square to the sewer alignment. The guide rail assembly shall be independent ofthe trust wall so that it is not disturbed due to jacking force exerted onto the thrust wall.

Thrust Pressure Plate.

The thrust pressure plate is usually a 50mm or 100mm thick steel plate installed between the jack assembly and the thrust wall. The pressure plate enables the concentrated jacking load from the jacks to be transmitted evenly to the thrust wall.

Intermediate Jacking Station

For longer distance jacking, intermediate jacking stations, comprising a telescopic type jacking pipe assembly (usually made of steel), are used. A set of inter jacks and push

rings are installed around the inner side of the female pipe of the telescopic pipe assembly. The intermediate jacking pipe assembly shall be installed at appropriate point and jacked-in along with the other jacking pipes.

Cutter Head.

It is usually a disc shaped wheel mounted on the face of the TBM and is driven by hydraulic or electrical motor, located within the machine. The excavation capabilities of a micro tunneling machine depends very much on the type of cutter head used, its speed of rotation and average and peak torque etc.

Different types of cutter head configuration are used in micro tunneling machines to suit the type and nature of the ground through which tunneling is to be carried out.

For example, in soft ground tunneling the cutter head shall have bits arranged in such a way to cleave and guide the soil into a chamber behind the cutter head through the openings provided in the cutter disc.

In the case of rock or hard ground tunneling the cutter head shall be equipped with suitable bits, roller bits or disc cutters for effective transfer of cutting energy to rock. The tunneling machine shall be equipped with a crushing chamber behind the cutter head with powerful crusher to crush the excavated rocks into smaller pieces. Moreover, the machine shall be capable of exerting a large thrust force/torque on to the tunnel face to facilitate excavation of rock. The speed of rotation, torque bit arrangement (and its structural and mechanical characteristic to withstand rock excavation for longer drive) of the cutter head and the thrust force the tunneling machine is capable of exerting on to the rock face are important features to consider when selecting machines for tunneling in rock.

Jacking Ring

Jacking ring or thrust plate is a purpose made structural fitting which shall be installed between the jacking assembly and the jacking pipe to transfer the point loads from the individual jacks into evenly distributed jacking force to the pipes being jacked. The ring shall be fabricated and machined, if necessary, so that it fits exactly onto end the jacking pipe.

8.11. Performance Requirements and Site Restrictions

Design Life.

For the purpose of designing the sewer and the associated structures, the design life shall be 50 years. The materials incorporated in the works and the workmanship shall be of required quality to sustain the specified life span.

Level and Alignment Accuracy

The pipes shall be jacked into place, true to line and level. The maximum tolerance allowable in the displacement of the centerline of the laid pipe from the design centerline is 50mm in the horizontal plane and 25mm in the vertical plane but there shall be no backfill at any point.

There shall be provision to prevent the relative movement between pipes at the joints by the use of steel gaiters or other approved methods during jacking operation. A packing piece of compressible material shall be provided at each joint and shall be securely held before the pipes are lowered into the thrust pit. Details of proposals shall be submitted to the Authority's Engineer for approval.

Limits on ground settlement and upheaval.

The method of micro tunneling adopted by the Contractor shall be such that the initial surface settlement measured directly above the front face of the shield during the tunneling operation does not exceed 15mm and the maximum surface settlement after the tail voids are grouted shall not exceed 25mm for pipes up to 900mm diameter. For pipes of diameters greater than 1000mm, they shall be and 25mm and 50mm respectively. The affected ground and the structures shall be subsequently reinstatedto their original condition at Contractor's cost.

However, for the sections of sewer crossing under roads and railways, the Contractor shall be required to incorporate measures in his tunneling method to arrest the expected settlements so as to safeguard the integrity of the road surfaces and railway lines at all times. The Contractor shall ensure that the traffic flow along the roads and railways are not affected in any way by his work.

Limitation on Footprint

The contractor shall be deemed to have visited the sites and carefully planned and located the shafts at convenient points along the roads so as to minimize the road area to be occupied by the footprint. The contractor shall be deemed to have allowed for such site constraints and measures required, including working in the night and construction of decking over the shafts, if deemed necessary to allow the traffic to flow, in his rates. He shall take the site constraints and restrictions into consideration when selecting the micro tunneling system.

9Road Restoration work:

Roads damaged during trench excavation and construction of structures are need to be repaired and brought to original condition and shall be acceptable to road owning authorities. The road construction work shall be as per MoSRT&H specification of Indian Roads Congress. The different types of roads namely Water Bound Macadum (metalled) roads, Bituminous/Asphalt Road and Concrete Road need to be cut for construction of sewers and need to repaired after sewer construction works are constructed.

The existing road crust details are as below:

Sr No	Road Width (m)	Carriage Way Width(m)	Thickness of Layer	Specification	Remark
1	9m, 12m, 15m & 18M	3.75m 5.50m 7.5m 2x5.5m	0.33	Dismantling and bituminous courses of flexible pavement and disposal of dismantled material and staking the serviceable material with all lifts and lead and other incidental and operational charges etc., as per directions of engineer in charge	Dismantling Layer
2	9m, 12m, 15m & 18M	3.75m 5.50m 7.5m 2x5.5m	0.05	Providing 50 mm thick Bitumen Macadam using crushed stone Grading II materials & 60/70 penetration grade of bitumen as per approved drawing & technical Specification and as per Clause - 504 of MoSRT&H specification for Road & bridge work (latest Revision)	Layer 1
3	9m, 12m, 15m & 18M	3.75m 5.50m 7.5m 2x5.5m	Sqm	providing tack coat on prepared surface with bitumen emulsion as per technical specification and as per Clause - 503 of MoSRT&H specification for Road & bridge work (latest Revision)	Layer 2

Sr No	Road Width (m)	Carriage Way Width(m)	Thickness of Layer	Specification	Remark
4	9m, 12m, 15m & 18M	3.75m 5.50m 7.5m 2x5.5m	0.25	Providing and laying spreading and compacting graded stone aggregate to Wet Mix Macadam specification including premixing the materials with watered at OMC in Mechanical mix plant, carriage of mixed materials by tipper to site, laying in uniform layer with paver in subbase /base course on well-prepared surface and compacting with vibratory roller to achieve the desired density as per clause 406 of MoSRT&H specification for road and bridge work (latest revision)	Layer 3
5	9m, 12m, 15m & 18M	3.75m 5.50m 7.5m 2x5.5m	0.15	Construction of granular sub base by providing closed graded granular sub base Grading -IV materials as per table 400-1 spreading in uniform layers with mortar grader on prepared surface, mixing by in place method with rotator at OMC and compacting with vibratory roller to achieve the desired density complete as per clause 401 of MoSRT&H specification for road & bridge work etc complete.	Layer 4
6	9m, 12m, 15m & 18M	3.75m 5.50m 7.5m 2x5.5m	0.5	SUB-GRADE SOIL Earth work in ordinary soil in embankments, roads, etc. within 50m initial lead and 1.5m initial lift including rough dressing and breaking clods to maximum 5cm to rough dressing and breaking clods to maximum 5cm to 7cm and laying in layers not exceeding 0.3m in depth and as per specification approved by the department along with proper compaction with H.R.R. including hire and running charges of H.R.R. (Measurement to be taken on the finished compacted section of the fill).	Layer 5
7	9m, 12m, 15m & 18M	3.75m 5.50m 7.5m 2x5.5m	1	Providing 600mm thick Sand bedding for pipeline trenches including watering and consolidation by punners etc., complete with an initial lead of 50 metres	Layer 6
8	9m, 12m, 15m & 18M	3.75m 5.50m 7.5m 2x5.5m	1	Dry stone masonry or rough stone dry masonry for guard walls and retaining walls with hard granite stones	Layer 7

The suitable latest power roller or compaction equipment shall be used by the contractor to compact the sewer trench width.

9.1 Repair and Restoration of Water Bound Macadam (WBM) roads:

The repair and restoration work of WBM roads will consist of 2 layers of WBM and each of compacted thickness of 75mm laid on prepared subgrade. Where the trenches are backfilled with excavated earth, the top layer of earth filling should be removed for at least 200mm and filled with moorum and sand mixture in proportion 70:30 and the fill

should be consolidated to 90% of maximum density at OMC. Where back filling is done with sand the subgrade shall be well compacted. On the prepared Sub grade,150mm thick Granular Sub Base (GSB) shall be provided before WBM is laid.

The WBM should be constructed in layers of 75mm thick with stone aggregates of Grade-II material, spreaded properly in uniform thickness and compacted by rolling with 3-wheeled 8-10 Ton rollers in stages to proper grade and camber, applying and brooming requisite type of screening / binding material (moorum) to fill up the interstices of course, watering and compacting to the required density as per Clause 404 MoSRT&H Specification and as per direction of Authority's Engineer.

9.2 Repair and Restoration of Bituminous/ Asphalt Roads:

The repair and restoration of Bituminous roads will consist of 200mm thick Granular SubBase(GSB) ,75mm of Wet Mix Macadam(WMM), 50mm of Bituminous Macadam and top 25mm of Semi-Dense Bituminous Concrete (SDBC)as wearing and profile correction courses.
The Granular Sub-base work shall consist of laying and compacting well graded material on prepared sub-grade with Grade III materials as per Table 401 ofMoSRT&H, laid in two uniform layers of 100mm thick each and spread with motorgrader on prepared surface, mixing by mix-in-place method with rotavator at OMCand compacting with vibratory roller to achieve the required density complete as perClause 401 of MoSRT&H specification. Before laying granular sub-base, the sub-grade shall be compacted and surface finished to receive the GSB.

The WMM will be with graded stone aggregates, spread and compacted including Premixing the material with water at OMC in mechanical mix plant, carriage ofmaterials by tipper to site, laying in uniform layers by paver and compacting withvibratory roller to achieve the desired density as per Clause 406 of MoSRT&Hspecification. Before WMM is laid over the GSB, the GSB surface shall be appliedwith a single coat of low viscosity bituminous emulsion primer complying to IS:8887.Over the priming coat a single layer tack coat of low viscosity bituminous materialmay be applied.
After the WMM is laid and compacted the surface shall be applied with a single coat of primer and a single layer of tack coat after which WMM work will start.

The Bituminous Macadum (BM) shall be50mm thick using coarse aggregates of grading-I premixed with bituminous binder of 60/70 penetration grade bitumen confirming to IS:73in hot mix plant, transported to site, laid over the prepared surface with hydrostatic paver finisher with sensor control to required grade, level and alignment and rolling with vibratory and tandem rollers to achieve the required compaction as per Clause 504. The top surface shall be finished with 25mm Semi Dense Bituminous Concrete (SDBC).

The SDBC shall serve as a wearing and profile correction course and shall be with crushed aggregates of 13mm nominal size premixed with bituminous binder of 60/70 penetration grade bitumen in hot mix plant, transporting the mix to work site, laying with hydrostatic paver finisher with sensor control to the required grade, level and alignment, rolling with smooth wheeled vibratory and tandem rollers to achieve the desired compaction as per Clause 508 of MoSRT&H specification.
A single coat of primer and a tack coat shall be applied to BM surface before the SDBC is placed over it.

10. Design Criteria and specification for RCC Structures (Sewage Pumping Stations & Sewage Treatment Plant).

Concrete structures should be designed as per IS:456 -2000 using limit state method of design. For RCC works the Grade of concrete shall not be less than M30 for water retaining structures and M20 for other structures. Machine mix shall be used in concrete works of the structures. Vibrators of appropriate type shall be used for compaction of the concrete. The contractor shall give at his own cost concrete cubes to the department made from fresh concrete prepared for the work taken as per IS:1199 cured for 7 days and 28 days for testing by the department at any recognized/Govt. testing laboratory, and the testing charges shall be borne by the contractor. Besides the above arrangements, contractor shall also carry out such tests as required by the department at regular intervals at his own cost. Samples shall be taken from the concrete prepared for use in the following components of the structure. The concrete mix design shall be prepared in a Govt. Laboratory recommended by the Authority at the cost of the Contractor and design mix test report shall be submitted to the Authority/ Authority's Engineer for approval before starting the work.

i) Foundation
ii) Each lift of supporting structure (column/shaft)
iii) Supporting beams / Floor beams / Tie beams /Bracings.
iv) Floor
v) Each lift of the wall.
vi) Roof slab.
vii) Any other portion of the structure as desired by the Authority's Engineer.

In the event of deviation from the desired strength, the contractor shall dismantle the defective parts of the construction and make good the same at his own cost and no extra payment will be made by the department for the same.

All pipes, valves & fittings required, shall be of best quality confirming to relevant IS specifications which shall be provided by the contractor at his own cost as per P.H. specification and direction of Authority's Engineer.

The safe bearing capacity of the soil is to be ascertained before preparation of drawing& designs for construction of different components of sewage Pumping Stations and Sewage Treatment Plant.

The contractor shall submit the design & drawing in a phased manner after one monthof issue of LoI and complete the same for the whole project within three months. Two sets of design calculation and drawings should be submitted to the Authority/ Authority's Engineer. The design and drawings shall be scrutinized and preliminary approval will be communicated by the competent authority.

On receipt of preliminary approval, the contractor shall furnish within fifteen days, ten sets of clearly typed design calculations and drawings for final approval and communication to all concerned.

10.1 Soil Investigation Report:

For structural design purposes, Geotechnical investigation shall be conducted and SBC shall be found out at required depths of all important structures by the contractor confirming to relevant IS Code, through the Government approved agencies. 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 structural design of the structures. Before detailed

engineering & design of the structures the contractor shall submit detailed soil test report along with calculation of SBC to the Authority/ Authority's Engineer for approval of SBC to be adopted for structural design. On approval of the SBC the contractor shall design the structure considering the recommended SBC. 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 Agreement. 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 within the permissible limit of S.B.C. allowed by the Authority/ Authority's Engineer.

10.2 Design Criteria and Specification for Water retaining structures

All the RCC Water Retaining structures shall be designed as per IS456-2000 and IS: 3370-2009.The concrete grade for the water retaining members shall be M30. The steel used for reinforcement shall be Corrosion resistance high yield strength deformed bars confirming to IS:1786 (Latest edition)

i. Design shall be based on accepted norms and methods of design and the provision contained in the latest versions of IS: 456, IS:3370, IS:1893, IS:875 and all other relevant codes etc. No age factor shall be allowed in the design of the structure.
ii. Plain cement concrete of grade M-10 thickness, not less than 100 mm shall be provided below the footings/ foundation.
iii. The design calculations and drawing shall be worked out in either metric or in S.I. unit.
iv. The water retaining component/ member including member subject to condensation like Roof Slab of Wet well& Manhole chambers etc shall be designed as water retaining with M-30grade concrete.
At high ground water table areas the foundation of structures shall be designed for full uplift pressure considering the level of Ground water Table at ground level. No pressure reducing device like PRVs etc will be allowed for release of water pressure in the design.
v. The Authority's Engineer or his authorized representative shall have the right to inspect and test the materials collected by the contractor for use in the work. The materials not confirming to relevant specification shall be rejected and the contractor shall have to replace the defective materials immediately.
vi. The Authority/ Authority's Engineer shall have the authority to reject or accept any or all the works and materials and to direct the contractor to stop the work if the work is not taken up to the specification. The Authority Engineer shall also have authority to suspend a part or whole of the above and no claim whatsoever on this account made by the contractor shall be entertained. In case of any dispute, the decision of the Member Secretary, OWSSB, Bhubaneswar shall be final and binding.
vii. All design shall be submitted in the form of booklet in complete shape along with relevant drawing and in a presentable manner neatly typewritten/ computer printed in A4 size bond paper.
viii. All design calculation/ findings shall be supported with illustrative drawings inform of plan section etc as applicable which shall form a part of design book let.
ix. All reference made in the design shall be indicated in reference chapter of the design booklet on demand, the contractor shall furnish reference materials to the department to facilitate checking of design.

x. All drawings shall be with black line on which tracing paper in metric scale in size 560 mm x 810 mm and shall be title cross reference and fully explanatory with the contractor's name date seal and signature on it. 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.

xi. 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.

10.3 Design Basis:

i) 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 Sewerage and Treatment by CPHEEO. Government of India, latest Indian Standard code of practice and specification norm fixed by Pollution Control Board and state/ central Electricity Authority shall also be followed whenever required. In case of any contradiction the decision of the Authority of the department or his representative shall be final.

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

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

iv) Size of pipes, fittings and valves will be as per design requirement for individual components.

11. Civil Works:

a) **General**:

i) 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. Reinforced cement concrete fins, decorative "**Arch type**" windows, boxes, pebble dash/ rough cast plaster, grills etc. may be proposed to elevate the look.

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

iii) 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 mtr**.

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

b) Boundary Wall:

Boundary wall shall be of Brick Masonry in CM (1:4). The brick used for the purpose shall be good quality KB Clay bricks or Fly Ash bricks the compressive strength of which shall not be less than 75kg/cm^2. Both side surfaces of the walls shall be plastered with 16mm thick CM (1:6). **M- 20**grade RCC Column & Plinth Beam structure shall be provided. Top of the wall shall be provided with 40mm thick PCC (1:2:4) layer. Depth of foundation of Boundary wall shall be minimum 1.00 m **R.C.C. Column** for the Gate Opening shall be of 0.38mx0.38m size & 2.0 m high of **M-20** grade structure. The

depth of foundation of the R.C.C. Column with isolated footing shall be minimum1.00m below the ground level. The both side of the compound wall should be painted with two coats of weather coat paint over one coat of primer. Construction joints in boundary wall shall be provided at suitable interval as per the direction of Authority's Engineer.

11.1 General for all Buildings & Structures:

a) All tanks and all channels carrying sewage shall be of M**30** grade and shall be designed as water retaining tanks without considering any age factor. All the water retaining structures shall be tested for water tightness before installing the equipment, media etc. Required type of foundation as required with respect to actual soil condition & soil parameters, SBC, position of maximum subsoil water table in worst rainy season condition shall be provided for the units of SPS and STP, buildings and other structures as per actual design requirements satisfying the requirements of books of reputed authors & IS codes.

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

g) Plain cement concrete of grade **M10** 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) 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.

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

l) 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) shall be used 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) shall be used in superstructure. The thickness of plaster shall not be more than 20 mm for outside face & 15 mm for the inside face.

ii) **Plastering:**

All brick works shall be plastered with 16 mm thick cement mortar in 1:6& all RCC exposed surfaces & roof ceilings except for the Water retaining structures shall be plastered with 12mm thick cement mortar in 1:4(1cement: 3 sand) unless specifically mentioned.

iii) **PCC:**

Minimum 100mm thick **PCC (1:3:6)** shall be provided 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 colour over a coat of primer. All internal surfaces of all the buildings/Rooms shall be given with two coats of distemper paint over a coat of primer. Ceiling of all buildings 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. The flooring shall be of glazed ceramic tile (stain less) flooring. The dadoin all types of flooring shall be of 0.3mtr height.

m) The contractor shall provide necessary sun shades/Chajja etc. wherever necessary.

n) The contractor shall provide ramp with gentle slope to the buildings wherever required.

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

p) All roofs shall be provided with grading plaster of 25 mm thick in 1:4 cement plasters with required grading for drainage. There shall be drainage pipes of 110 mm SWR PVC pipes with all fixtures and specials extending up to the surface drain for disposal of rainwater. The number of pipes shallbe 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.

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

r) Expansion joints shall be provided in exposed pipelines as per standardpractice & in conformity with relevant IS Specification.

i) In the event of any deviation from 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.

ii) All reinforcement shall be checked and recorded prior to concreting bythe Authority's Engineer or his representative and the contractor shall countersign this. Entire concreting work shall be done in the presence of an officer not below the rank of Assistant Engineer, the contractor shall, therefore, give notice of at least two days to the Authority Engineer or his representative so that the works can be checked by himor his authorized representative.

iii) 1. 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 Mobil oil.

2. The joints in the form work shall be arranged in a regular pattern.
3. Shuttering shall be provided to concrete faces where the slope exceeds 1: 2½.
4. The stripping time of all form work shall be in accordance with recommendations contained in **IS:456**.

s) 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.

t) **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.

u) **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 **125mm** or more but not exceeding 225 mm. An expanding grouting admixture shall be of approved type and in accordance with the manufacturer's instruction.

v) 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 aluminum frame & 5 mm thick reinforced glass panels provided with all related aluminum hardware fittings. The shutters shall be of sliding type in two folds.
4. All doors except for those specified separately shall be with aluminum frame & 12mm thick pre laminated plywood panels provided with all related aluminum hardware fittings.
5. There shall be adequate nos. of ventilators of size 750mm x 300 mm fitted with decorative RCC Jally.
6. MS rolling shutters of standard thickness with all hardware fittings shall be provided at suitable locations to facilitate conveyance ofchemicals,

equipments, spareparts etc. There shall be MS grills of member thickness not less than 5 mm of decorative designs fitted to all the windows of the office & laboratory building, 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.

7. The panels of all external doors shall be of waterproof pre- laminated plywood shutter of minimum 12 mm thickness. For chemical house, the panels should be of chemical resistant materials.
8. 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.

12. 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 conformto relevant Indian Standards. Only tested materials shall be used and all test certificates are to be submitted by the Contractor.

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 Authority Engineer.

All permissible tolerance in workmanship shall be as perIS:7215.

iii) Erection:

The erection shall be carried out as per relevant Indian Standards. Theminimum 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.
- ❖ 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.

v) Walkway work:

- The walkway over finished ground level shall be paved with chequered tile and of minimum 1 mtr wide and constructed with the following specification.
- The base shall consist of 150mm thick sand layer & above 100mm thick PCC layer, paved with chequered tile of approved design uniformly jointed by 1:4 mixed cement mortar.

vi) 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 and dumped in areas as directed by the Authority's Engineer without any extra claim.

13. EOT Cranes:

The Cranes shall be electrically operated, bridge type complete with all accessoriesincluding down shop conductor, crane rails and fixtures and shall confirm to IS:3177. The crane should consist of bridge girders on which a wheeled trolley is to run. Thebridge trucks and trolley frames shall be fabricated from structural steel. Accesswalkway with safe hand railing as is required along the full span length of the bridgegirder shall be provided. Steel to be used shall be tested quality confirming to ASTMA36, except that, plates more than 20mm thick shall confirm to BS: 4360.The bridgeshall be designed to carry safely the loads specified in IS:807 and IS:800. All anti-friction bearings for bridge and trolley track wheels, gear boxes and bottom sheaveson hook shall be lubricated manually by hand operated grease pump throughrespective grease nipples.

Wheels and structural frame of the wheel mounting of the end carriage shall be designed so as to ensure that the crane remains square and prevent skewness. Bridge and trolley track wheels shall be of forged steel and shall be double flange type. The crane rails shall be manufactured from wear resistant austenitic manganese steel. Walkways shall be at least 500mm clear inside width with a 6mm thick non-skid steel plate surface. Steel rail stops to prevent rails from creeping and trolley from running off the bridge The hook shall be solid forged, heat-treated alloy or carbon steel for the duty service. They shall have swivels and operate on ball thrust bearings with hardened races. The lifting hooks shall comply with requirements of BS:2903/BS:3017 and shall have a safety latch to prevent rope coming off the hook.

14. SCADA System

14.1 Components

a) Personal computers: To be used by the operator to view the data acquired and allow the operator to control and improve optimization.
b) Programmable Logic Controllers: To control the outputs based on the inputs being monitored in the required sequential steps and it also communicates withthe personal computers.
c) Modems: To transfer data from the Intake, point and Water treatment plant site, to the centralized control station.
d) Remote terminal units (RTU): To allow the central SCADA to communicate with the various instruments at Intake and Water treatment plant to control, acquire and

transfer data from the process equipment at the site, in conjunction with the central SCADA.

14.2 SCADA Software

The standard SCADA software need to be installed in application servers at the plant site, but they should be capable of controlling and monitoring the various instruments. The data acquired from the RTU should be displayed in the SCADA screen and the logs of each site station measurement should be transferable using data export to data base processing software like Oracle, Microsoft Excel, etc. It should also support internet connectivity for data transfer.

14.3 SCADA Security Level

In order to prevent misuse and to restrict access to a site station measurement there should be privileges to the various users of the SCADA. Typically, there are three levels, which are (1) Operator Level, (2) Assistant Executive Engineer Level and (3) Executive Engineer Level.

14.4 RTU Security Level

The RTU communication port should have a configurable access level for its security. The minimum access levels are described in the following sub-section. These access levels are required to control read and write access to that port. Hence, once all the RTU ports are configured with these varying access levels depending on the requirement, then it becomes secure against unauthorized usage. It can be re- configured only after unlocking the RTU common port.

14.5 Minimum Access Levels of Programming and Configuration Interface

The interface shall have the minimum varying levels of user access that can be configured by the system controller. They are:

a) Unlimited Access: This will allow the user to read and write all RTUconfiguration parameters such as local, network and system registers, Hardware input and output registers, event logs and logic programs.
b) Access without configuration: This will allow reading and writing of all RTU configuration parameters except system registers and ladder logic.
c) Access limited to only reading the RTU parameters
d) Access limited to RTU port configuration.

14.6 SCADA User Interface

The SCADA system shall permit the user to access displays via printing device and/or soft key menus with a choice of function keys, cursor, control keys or any key on the keyboard. The system shall support operator access to multiple displays at one time, including split screens where the operator may view more than one process area at a time and permit pop-up displays.

The operator shall be able to have access to context sensitive help at any time during operation of the system. The operator shall be able to access multiple data sources/items with a single tag name.

14.7 Command/Control Functions

The system shall allow the user to control a specific set point or to adjust a set of points depending on the operating limits. Control of individual set points shall be enabled based upon a user's security level.

14.8 Display Capability

The system shall allow the user to view animated graphics for process templates including valves, meters, etc. The system shall support the capability for the operatorto view scanned images and be possible to animate these images.

14.9 Text Description

The system shall support use of true-type scale able fonts that may be scaled according to the desired size of the text. The fonts shall be loaded by the operating system.

Text shall be able to blink based upon any user definable condition occurring in the system such as an alarm on a particular set point.

14.10 Alarm Capabilities

i) Alarm Display Capability

The system shall support alarm display capability on the display. Current alarms shall be available as an alarm summary object and a chronological summary of alarms shall be available.

It shall be possible to inform the operator of an alarm condition via an audible tone, a pop-up display or any combination of animation types on the screen.

Alarm acknowledgement may be performed on all alarms, alarms in a single group, and alarms in a collection of groups in defined in alarm group hierarchy or on a point-by-point basis.

ii) Alarm File Capability

Alarms shall be logged to a file for future viewing or review of alarm history data. The user shall have the capability to review the file for cause and event analysis. The alarms that are logged shall be configurable from a choice of the parameters listed during configuration.

iii) Alarm Printing Capability

a. Alarms shall be allowed to be printed and the format shall be configurable and made up of any of the parameters listed during configuration.

b. Any item or any provision/requirement if not included in this section, but is necessary to be provided for the completion of the project and for its functional necessity, the same shall be provided by the contractor. No extra payment shall be admissible on this account.

14.11 CONTROL & INSTRUMENTATION DETAILS FOR STP

The Control & Instrumentation System for the STP - Master / Intermediate Sewage Pumping Station facilities shall be designed for reliable, safe, and efficient operation with Local and Remote Operation Facility.

PROJECT COMPONENT:

The Major Components of the Control & Instrumentation Scheme are as follow:

1	Mechanical Coarse screen
2	Well / Chamber
3	Submersible PUMPS
4	Electrically Operated CRANE
5	PLC/SCADA PANEL
6	Butterfly/Sluice Valve
7	Knife Gate Valve
8	Dismantling Joint
9	Non-Return Valve
10	Level Transmitters
11	Pressure Transmitters
12	Electromagnetic Flow Meter
13	Sluice Gate's
14	Control Panel / PLC / HMI
15	Alarms and indicators
16	Motor Soft Starters

INSTRUMENTATION & CONTROL SYSTEM

It is proposed to operate the plant though PLC & SCADA. Online monitoring system and compatible automation system will be envisaged to run the plant from local control centers and in auto mode from PLC/SCADA system in Central Control Room within the STP plant.

OVERVIEW OF PLC & SCADA SYSTEMS

A) PLC AT COARSE SCREEN CHANNEL

PLC systems with local HMI at Coarse screen channel will be provided to meet out its local IOs and it will be communicated to Main PLC at STP through GSM/GPRS communication. Instruments for online monitoring and UPS system to meet out the VA rating of entire system will be provided.

B) PLC AT CRITICAL MONITORING POINTS

Supply of micro-PLC systems with local HMI at CMP to meet out its local IOs and it will communicate to Main PLC at STP through GSM/GPRS communication. Instruments for online monitoring.

CONSIDERATION OF DIGITAL INPUT, DIGITAL OUTPUT, ANALOG INPUT &

ANALOG OUTPUT FOR EQUIPMENT & INSTRUMENTS:

(A) For Butterfly/Sluice Valve at Pump House (Motorized Operated Valve) Outlet
DO: Valve OPEN Command, Valve Close Command, Valve Stop Command
DI: Healthy Feedback, Local/Remote Feedback, Open Feedback,
Close Feedback AI: 4-20 mA Analog Signal for Position Transmitter

(B) For Sluice Gate at Pump House (Motorized/Manual Operated Valve) INLET
DO: Valve OPEN Command, Valve Close Command, Valve Stop Command
DI: Healthy Feedback, Local/Remote Feedback, Open Feedback,
Close Feedback AI: 4-20 mA Analog Signal for Position Transmitter

a. For Pump
DO: Start Command, Stop Command
DI: LOCAL/REMOTE Feedback, On Feedback, Off Feedback, Trip Feedback

b. Level Switch – 4 Nos. or 3 Nos.
DI: High Set, Low Set

c. Flow Meter, Pressure Transmitter, Level Transmitter
AI: 4-20 mA Analog Signal

PLC at Well / Chamber
Well Chamber consist of

1. Main Drive motor (4 working + 2 standby or 3 Working + 2 Standby)
2. Electromagnetic Flow Meter
3. Level Transmitter
4. Pressure Guage
In this PLC, mode of operation will be Auto, Remote and Local.

14.12 PUMP/ MOTOR OPERATION:

Objective
To operate four pumps in sequence based on rising water level in a well to meet increasing water lifting demand. As water level drops, pumps will shut down sequentially to protect from dry running and optimize energy usage.

System Overview
4 Nos. Pumps (P-1, P-2, P-3, P-4) or 3 Nos. Pumps (P-1, P-2, P-3,) + 2 Standby installed to extract water from a common well.

Pumps are controlled automatically based on water level transmitters/switches installed in the well.

Each pump will be assigned a specific level setpoint for start and stop operations.

Manual control and automatic control modes shall be provided from the control panel/PLC/HMI.

Water Level-Based Control Logic
Level Sensors:
Multiple level switches or a level transmitter configured to detect:

L1 – Low Low Level

L2 – Low Level
L3 – Medium Level
L4 – High Level
L5 – High High Level

Pump Starting Sequence (as water level increases)

Pump shall not start unless valve position is confirmed closed/open as required and healthy feedback is available from motor and control system

Pump Stopping Sequence (as water level decreases)

Water Level	Condition	Action
L5 → L4	Level ≤ L4	Stop PUMP-4
L4 → L3	Level ≤ L3	Stop PUMP-3
L3 → L2	Level ≤ L2	Stop PUMP-2
L2 → L1	Level ≤ L1	Stop PUMP-1 (All pumps OFF)

Additional Features:

- Manual Override
  Each pump can be manually started/stopped via HMI or local selector switch.
  Interlocks prevent running below minimum safe water level (L1).

- Dry Run Protection
  All pumps will trip if level falls below L1 (Low Low Level).
  Alarm and lockout may be activated until level recovers.

- Timers & Interlocks
  Optional delay timers to prevent short cycling (on/off in short intervals).
  Interlocks with pressure switch or flow sensor to confirm successful pump operation.

- Lead-Lag Rotation
  To balance runtime hours, pump starting sequence can be rotated periodically (e.g., daily) by PLC.

  Alarms & Indications
  - Pump running status
  - Pump fail/trip
  - Low level / High level alarms
  - Dry run alarm (Level < L1)
  - Manual mode active indication

  DATA MONITORING OF THE ANALOG INSTRUMENTS:
  Data of Pressure & Flow transmitter should be monitor on SCADA at STP and will generate alarm on deviation from pre-set points.

  DATA RECORDING OF THE ANALOG INSTRUMENTS:
  Data of Flowmeter, Level & Pressure Transmitter (value v/s date & time log) should be recorded on daily & monthly basis with 15 minutes interval. For flowmeter totalizer, records should be generated on daily basis for analysis of flow. Records of water quality willbe made available on daily basis. Log of 15 days data will also be stored.

ANNUNCIATION, POP-UP, COMMAND AND STATUS WINDOWS:
Minimum Status feedback, operation mode selection and commands for operation of equipment will be designed on Command & Status windows. For full status, operator can open Annunciation Windows through single Click and for malfunctioning, tripping or unhealthy feedback received from equipment or from control panel will automatically comeon Pop-up Windows.

14.13 Detailed Technical specification for an intermediate/main pumping sewage station for Programmable Logic Controller (PLC) and Supervisory Control and Data Acquisition (SCADA) system

1. Overview
This specification defines the requirements for the design, supply, installation, configuration, and testing of the PLC and SCADA systems for an intermediate pumping sewage station (IPSS). The system shall automate and monitor the operation of pumps, valves, sensors, alarms, and related equipment.

2. System Objectives
- Ensure reliable and automatic operation of sewage pumps.
- Provide real-time monitoring, control, and alarming.
- Facilitate remote operation and data logging via SCADA.
- Minimize manual intervention and optimize energy consumption.
- Operations of Pump Station in-line with the Control Philosophy for Efficient System Output.

3. General Requirements

Type	Master & Intermediate Sewage Pumping Stations
Control System:	PLC-based local control
Monitoring System:	SCADA-based remote monitoring
Communication:	Ethernet/Modbus TCP/IP or Fiber Optic / GSM etc. for long-distance.

4. Programmable Logic Controller (PLC):
The auto-control shall be through the PLC provided and programmed for this. The input to PLC will be the station Sewage water level and the control will be through the starters of motor. The auto and manual mode operation shall be provided

4.1 Hardware
- Industrial-grade PLC with at least:
  - CPU with real-time clock
  - I/O modules (Digital and Analog)
  - Communication module
  - Local HMI
- Input Types:
  - Digital: Float switches, door open/close, pump status
  - Analog: Wet well level (ultrasonic/pressure), flow rate
- Output Types:
  - Digital: Pump start/stop, alarm horn, valve actuators

- Analog: VFD control signals (if applicable)

4.2 Software & Programming

- IEC 61131-3 compliant programming languages (Ladder Logic, Structured Text)
- Features:
  - Auto/Manual control modes
  - Duty/Standby pump rotation logic
  - Pump start based on level thresholds
  - Overload/failure detection
  - Logging of operational hours and number of starts
- Integration with SCADA for data exchange via standard protocol (Modbus TCP/IP or OPC UA)

4.3 Redundancy & Safety

- Battery-backed memory or flash storage
- Surge protection
- Optional redundant power supply

5 SCADA System

SCADA based Automation System to monitor reference parameters and each Pump Station shall be designed for automatic operation through Programmable Logic Control (PLC) and Supervisory Control and Data Acquisition (SCADA).

The Pump stations shall have provision for operations in following modes – Automatic – Auto operation through PLC/digital controller. Manual – Operator intervention through SCADA/HMI. Local – Local operation through local control panel located near equipment.

5.1 Architecture

- Central SCADA server with:
  - Historian database
  - Web-based user interface (optional)
  - Alarm and event logging
- Client workstations (Engineering, Operator)
- Remote access capability with secure VPN

5.2 Functional Requirements

- Real-time data acquisition
- Visualization of:
  - Wet well levels
  - Pump status and runtime
  - Valve positions
  - Alarms and event logs
- Control interface:
  - Remote start/stop
  - Alarm acknowledgment
  - Manual override (with security permissions)

5.3 Alarming

- Configurable alarm thresholds for:

- High/low wet well levels
- Pump overload
- Communication failure
- Power failure

- Visual and audible indications
- SMS/email alerts

5.4 Reporting

- Historical data trending
- Daily/weekly/monthly reports:
  - Pump run time
  - Flow data (if available)
  - Alarm log
  - Maintenance schedules

6. Communication & Integration

- Protocols: Modbus TCP/IP, OPC UA, or equivalent
- Ethernet switch with industrial grade
- Fiber optic or wireless option for long-distance stations
- Time synchronization with SNTP/NTP

7. Power & Backup

- UPS for PLC and communication systems
- Backup battery sizing: 2 hours
- Generator auto-start interface

8. Security

- Multi-level user access for SCADA
- Password protection on PLC/HMI
- Secure remote access (firewall + VPN)

9. Testing & Commissioning

- Factory Acceptance Test (FAT)
- Site Acceptance Test (SAT)
- Functional testing with wet well simulation
- Training for operators and maintenance personnel

10. Documentation

- As-built wiring diagrams
- PLC and SCADA programming documentation
- Operation and Maintenance Manual
- Configuration backups

14.14] INSTRUMENTATION DETAILS FOR MPS & IPS

1. Overview

Instrumentation in a MPS & IPS is critical for measuring and monitoring liquid levels, flow rates, pump performance, and system alarms to ensure effective and automatic operation.

All instruments should be suitable for harsh, corrosive, and potentially explosive environments found in sewage applications.

2. Instrumentation List

Instrument	Function	Type / Technology	Output Signal	Remarks
Level Transmitter	Measures sewage level in wet well	Ultrasonic / Hydrostatic (Pressure)	4–20 mA / HART	Redundant level sensors recommended
Flow Meter (Optional)	Measures inflow/outflow sewage flow	Electromagnetic Flow Meter	4–20 mA / Pulse	Used if flow tracking is required
Pump Status Indicator	Indicates pump running, stopped, or fault	Auxiliary contacts from pump starters	Digital (NO/NC contact)	One per pump
Pressure Transmitter	Measures pressure on discharge pipeline	Pressure Transmitter	4–20 mA / HART	Optional – to monitor discharge blockage
UPS Monitoring Contacts	Indicates health and status of UPS system	Dry Contacts	Digital	Alarm for battery failure/low voltage
Power Failure Relay	Detects utility power loss	Voltage Monitoring Relay	Digital	Triggers alarms and generator start signal

3. Signal Types and Standards

Signal Type	Description
Analog (4–20 mA)	Used for continuous process variables (level, flow, pressure, etc.)
Digital (NO/NC)	Used for discrete status (switches, alarms, etc.)
Modbus RTU/TCP	Digital communication for smart instruments
HART Protocol	Optional for smart analog devices

4. Environmental Considerations

Parameter	Specification
Enclosure Rating	Minimum IP54
Material Construction	SS316 / FRP for corrosive resistance
Operating Temperature	-10 °C to +55 °C typical

5. Calibration and Testing

- All instruments shall be calibrated at the factory and rechecked during installation.
- On-site commissioning shall include loop checking, signal testing, and verification with SCADA.
- Certificates of calibration and test reports to be submitted.

6. Integration with PLC/SCADA

- All Analog and Digital signals to be wired to the PLC I/O modules.
- Smart instruments (Modbus/HART) to be integrated via protocol converters or communication modules.
- Alarms, trends, and diagnostic data to be made available on SCADA.

7. Maintenance & Diagnostics

- Devices must support remote diagnostics if smart protocols are used.
- Easily accessible locations for service and cleaning.
- Spare parts: One set per type of instrument recommended.

14.15 TECHNICAL SPECIFICATION: PLC PANEL WITH HMI (COMPATIBLE WITH SOFT STARTERS)

1. General Description

The PLC Panel shall be designed for automated control and monitoring of an intermediate pumping sewage station. It shall house all necessary components including the PLC, HMI, power distribution, annunciator system, and control accessories. The panel must be compatible with soft starters for pump motor control.

2. Construction Requirements

Feature	Specification
Panel Type	Floor-mounted, front-operated, indoor type
Enclosure Material	2.0 mm CRCA (Cold Rolled Close Annealed) Sheet steel
Surface Treatment	Seven-tank process followed by powder coating (RAL 7035 – light gray or equivalent)
Ingress Protection	Minimum IP54 (IP65 optional for harsher environments)
Mounting	Floor standing with lifting hooks, gland plate at bottom
Cable Entry	Bottom entry with removable gland plate
Busbar System	Rated aluminium busbar, properly insulated and color-coded
Internal Wiring	Tinned copper flexible wires with lugs/ferrules; neatly routed in ducts
Panel Earthing	Two external earthing studs with internal earthing bar

3. Electrical Components

Component	Specification
PLC System	Modular type PLC with rack-mounted CPU and I/O modules, compatible with soft starter control logic
Digital Input Modules	2 Modules, each 16-channel, 24 VDC (Total: 32 Digital Inputs)
Digital Output Modules	2 Modules, each 16-channel, 24 VDC / Relay (Total: 32 Digital Outputs)
Analog Input Module	1 Module, 8-channel, 4–20 mA
Analog Output Module	1 Module, 8-channel, 4–20 mA
HMI Screen	Touchscreen HMI (minimum 7” TFT display), Ethernet/RS485 communication, programmable via SCADA interface
Annunciator	8 or 16-window annunciator with LED indication and audible alarm, pushbutton for ACK/Reset/Test
Push Buttons	Heavy-duty industrial type: Start, Stop, Reset, Auto/Manual selector switch

Component	Specification
Indication Lamps	LED type, RYB for power indication, pump status, and fault indicators
Power Supply	24 VDC for PLC and instruments via industrial-grade SMPS
MCBs / Fuses	Modular type MCBs for power/control circuits protection
Wiring Terminals	DIN rail-mounted, with label tags and covers
Soft Starter Compatibility	Provision for interface (start/stop, fault feedback, current monitoring) with soft starters (Dry Contact and Analog interface)

4. Communication & SCADA Integration

Feature	Specification
Communication Protocols	Modbus TCP/IP, Modbus RTU, or as required
SCADA Connectivity	Ethernet port for SCADA/remote monitoring
Remote Access (Optional)	Provision for VPN/modem for remote diagnostics

5. Environmental & Power Specifications

Parameter	Specification
Operating Temperature	0 to 55 °C
Humidity	10% to 95% RH, non-condensing
Supply Voltage	230/400 VAC, 50 Hz ±10%
UPS Backup (Optional)	For PLC & HMI, 30–60 min backup

6. Testing & Documentation

- Panel should undergo insulation resistance test, high-voltage test, functional test of I/O and power circuits
- All test certificates and quality documents to be submitted
- Complete as-built drawings including wiring diagrams, PLC and HMI logic
- Operating manual, configuration backup files, and IO list

7. Compliance & Standards

Category	Standards
Design and Fabrication	IEC 60204, IEC 61439, IS 8623
EMC/EMI Compliance	IEC 61000
Panel Wiring	IS 5082, IS 694
PLC Programming	IEC 61131-3
Markings and Labels	All components and terminals must be clearly tagged and labeled

14.16 TECHNICAL SPECIFICATION: SCADA SYSTEM

1. Overview

The SCADA (Supervisory Control and Data Acquisition) system shall enable centralized

monitoring, control, data logging, and alarm management for the Intermediate Pumping Sewage Station. It shall consist of licensed SCADA software, a server-grade CPU for hosting the application, and an operator interface laptop. The system shall be scalable, secure, and capable of remote communication with the PLC.

2. SCADA Software

Item	Specification
Software Type	SCADA software with hard or soft license
Licensing	OEM-perpetual license with support for minimum 100 I/O points
Features	Real-time monitoring, historical trending, event logging, alarm management, remote access (optional), HMI screens
Protocol Support	Modbus TCP/IP, Modbus RTU, OPC DA/UA
User Interface	Graphical interface with animated objects, mimic diagrams, and configurable dashboards
Data Logging	Local logging in SQL-based database or historian format
Alarm System	Configurable alarms with visual, audible alerts and history logging
Reporting	Daily/weekly/monthly reports with export to Excel or PDF
Security	Multi-level user authentication, role-based access
Backup & restore	Backup utility for project configuration and historical data

3. Server Hardware

Component	Minimum Specification
CPU	Intel Core i5, 3.5 GHz or better
RAM	DDR4, 4 GB (expandable)
Storage	500 GB HDD or higher (SSD preferred)
Operating System	Windows 10/11 Professional 64-bit or Windows Server 2012/2016 (licensed copy)
Ports	Minimum 4 USB ports, 1 HDMI/VGA, Ethernet (10/100/1000 Mbps)
Input Devices	USB Keyboard – 1 No., USB Optical Mouse – 1 No.
Power Supply	Internal 230V AC SMPS with surge protection
Warranty	1-year OEM manufacturer warranty

4. Operator Interface Laptop

Component	Minimum Specification
Display	15.6” HD LED screen
Processor	Intel Core i5 or equivalent
RAM	4 GB DDR4
Storage	500 GB HDD
Operating System	Windows 10/11 Professional
Ports	USB 3.0, HDMI/VGA, LAN Port, Audio
Software	SCADA client interface (view-only or engineering access based on license)
Networking	Wi-Fi, Ethernet
Warranty	1-year manufacturer warranty

5. Communication & Networking

Feature	Specification
Protocol Support	Compatible with field PLC (Modbus TCP/IP / RTU)
Network Interface	10/100/1000 Mbps LAN, optional VPN router for remote access
Switching Hardware	Industrial-grade Ethernet switch (if required)

6. System Integration and Commissioning

- Software installation and license activation
- SCADA tag configuration for all PLC points
- Mimic screen design for pump station overview, alarms, and trends
- Commissioning with PLC communication and live data testing
- Handover of source files, backups, and documentation

7. Documentation and Deliverables

- SCADA system architecture diagram
- Software license certificate
- Configuration backup files
- User and maintenance manual
- As-built mimic screens and I/O list

8. Compliance and Standards

Standard	Compliance
SCADA Software	IEC 62264 / ISA-95
Cybersecurity	IEC 62443 recommendations
Software Development	IEC 61131 for PLC compatibility
Electrical Safety (Hardware)	IEC 60950 / BIS equivalent

14.17 TECHNICAL SPECIFICATION: INDUSTRIAL GSM MODEM

1. General Description

The Industrial GSM Modem shall provide reliable wireless communication over GSM/GPRS/3G/4G networks for industrial automation systems. It shall support SMS messaging, data transmission, and remote diagnostics for integration with PLCs, SCADA systems, and remote-control applications.

2. Functional Requirements

Feature	Specification
Network Support	Quad-band GSM/GPRS (850/900/1800/1900 MHz), optional 3G/4G LTE
SIM Support	1 x Mini/Micro SIM card slot (standard SIM size)
Communication Protocols	SMS (Text and PDU), GPRS, TCP/IP, HTTP, MQTT, optional Modbus RTU over serial

Feature	Specification
Data Transfer	Supports both CSD and GPRS (packet-switched) data modes
PLC/RTU Integration	Serial RS232 and/or RS485 interface for direct connection to PLC or RTU
SCADA Compatibility	Compatible with Modbus TCP/RTU-based SCADA or SMS alert triggering systems

3. Hardware Specifications

Component	Specification
Enclosure	Rugged industrial-grade, IP30/IP40 metal or ABS plastic
Power Supply	9–36 VDC input, with overvoltage and reverse polarity protection
Operating Temperature	-20°C to +70°C (extended range optional)
Humidity	5% to 95% RH, non-condensing
Antenna	External SMA connector with detachable GSM antenna
Status Indicators	LED indicators for Power, Network, Signal, and Data Transmission
Mounting	DIN rail or wall mount options

4. Electrical & Interface

Interface	Specification
Serial Communication	1 x RS232 and/or 1 x RS485 port (configurable baud rate 1200–115200 bps)
USB Port	Optional USB 2.0 port for configuration or power
Digital I/Os	Optional 2–4 Digital Inputs/Outputs for triggering alarms or controlling devices

5. Software and Configuration

Feature	Specification
Configuration Utility	Windows-based software or AT commands via terminal
Firmware Upgrade	Local via USB/serial or remote (FOTA – Firmware Over The Air)
SMS Command Support	Supports custom SMS command sets for I/O control and status requests
Security	SIM PIN protection, IP filtering, user authentication
Diagnostics	Signal strength, network registration status, modem health check

6. Certifications and Standards

Standard	Compliance
EMC Compliance	EN 55022, EN 55024
Safety Standard	EN 60950-1 / IEC 62368-1
Network Certification	CE, RoHS, PTCRB, GCF (as applicable)
Environmental Rating	IP30 or higher (for indoor installation)

7. Deliverables

- Industrial GSM modem unit
- SMA Antenna
- Power cable or adapter (if external power supply required)

- RS232/RS485 communication cable
- Configuration software (on USB or downloadable)
- Operation & Installation Manual
- Warranty Card (minimum 1 year)

8. Optional Features
- 4G LTE fallback to 3G/2G
- Built-in MQTT/HTTP client for IoT integration
- DIN rail-mountable enclosure
- Built-in battery backup (limited runtime)

14.18 TECHNICAL SPECIFICATION: REMOTE TERMINAL UNIT (RTU)

1. General Description

The RTU shall be a rugged, industrial-grade remote terminal unit capable of collecting real-time analog and digital data from pressure and flow sensors, processing the data, and transmitting it continuously (24x7) to a central SCADA/control center. The RTU shall support both wired (RS232/RS485) and wireless (GSM/4G/Ethernet) communication modes, with local logging and alarm handling.

2. Functional Requirements

Feature	Specification
Primary Function	Real-time data acquisition, logging, and remote communication of flow and pressure data
Data Transmission	Continuous (24x7) telemetry over GSM/4G or Ethernet
Control Capability	On-board logic for threshold-based alarms, data validation, and local control if needed
Fail-Safe Operation	Local storage with auto-sync on communication recovery

3. Hardware Specifications

Component	Specification
Processor	32-bit Industrial Microcontroller or Embedded ARM CPU
Memory	Min. 128 MB RAM, 4 GB Flash, expandable SD/USB optional
Analog Inputs (AI)	Min. 4 Channels, 4–20 mA / 0–10 V configurable (for pressure and flow)
Digital Inputs (DI)	Min. 4 Channels (for pump run status, level switches, etc.)
Digital Outputs (DO)	Min. 2 Channels (for alarms or local actuation)
Analog Outputs (AO)	Optional, 2 Channels, 4–20 mA
Communication Ports	RS232, RS485 (Modbus RTU), 1 x Ethernet (Modbus TCP/IP)
Wireless	Built-in GSM/GPRS/3G/4G modem with SIM slot

Component	Specification
Communication	
Antenna	External SMA connector with 3 dBi or better antenna
Enclosure	IP65-rated, weatherproof, polycarbonate/metallic (for outdoor use)
Power Supply	12–24 VDC (±10%), overvoltage and reverse polarity protection
Battery Backup	Optional 1–4 hours via inbuilt Li-Ion or external VRLA battery
LED Indicators	Power, Communication Status, Signal Strength, Alarm Status

4. Software and Configuration

Feature	Specification
Programming Interface	Web-based GUI or Windows-based software
Protocols Supported	Modbus RTU, Modbus TCP/IP, MQTT, HTTP(S), FTP, SNMP
Data Logging	Onboard circular buffer with min. 10,000 logs
Time Synchronization	NTP or GPS-based time sync
Alarm Handling	Configurable thresholds for pressure/flow with SMS/email alerts
Diagnostics	Real-time health monitoring, watchdog timer, signal strength
Firmware Upgrade	Remote (FOTA) or local via USB/Ethernet

5. Communication & Integration

Requirement	Specification
SCADA Compatibility	Must integrate with third-party SCADA over Modbus or MQTT
Data Push Interval	Configurable: every 1 min to 60 min or event-triggered
Mobile Communication	Quad-band GSM/3G/4G LTE with fallback
SIM Management	Dual SIM optional for redundancy
Data Security	Encrypted communication (TLS/SSL) for MQTT/HTTPs

6. Environmental and Mechanical

Parameter	Specification
Operating Temperature	-10°C to +55°C
Storage Temperature	-10°C to +55°C
Humidity	5% to 95%
Protection Class	IP65 or higher

Parameter	Specification
Mounting	DIN rail or pole/wall mount

7. Certifications and Standards

Category	Standards
EMI/EMC	EN 55022, EN 61000
Electrical Safety	IEC 60950 / IEC 62368
Environmental Compliance	RoHS, CE
Protocol Standards	Modbus RTU/TCP, MQTT v3.1, HTTP(S), FTP

8. Deliverables

- RTU unit with antenna and mounting accessories
- Power supply cable and documentation
- Configuration and diagnostic software
- Operation & maintenance manual
- Warranty certificate (minimum 1 year)
- Protocol manual and wiring diagram
- Factory test certificate and inspection report

9. Optional Features

- GPS tracking for mobile units
- Integrated flow totalization and pressure analytics
- Solar power kit for standalone operation
- Edge computing with Python or IEC 61131 logic support
- SCADA-ready dashboard template

14.19 TECHNICAL SPECIFICATION: ULTRASONIC LEVEL INDICATOR / TRANSMITTER

1. General Description

The ultrasonic level transmitter shall be a non-contact type level measurement instrument designed for continuous monitoring of liquid levels in open or closed tanks. It shall be suitable for corrosive, turbulent, or dirty environments such as sewage pumping stations and water treatment plants.

2. Measurement Principle

Feature	Specification
Technology	Ultrasonic, based on Time-of-Flight (ToF) principle
Type	Two-wire or four-wire, non-contact type transmitter

3. Measuring Range & Accuracy

Parameter	Specification
Measuring Range	0.3 to 5 m (standard); extendable to 10 m or more as required
Dead Zone / Blind Area	< 300 mm
Accuracy	±0.25% to ±0.5% of full-scale
Resolution	≤ 3 mm
Response Time	< 1 second (adjustable damping optional)

4. Output & Communication

Feature	Specification
Analog Output	4–20 mA, 2-wire loop-powered or 4-wire
Digital Communication	Optional: HART / RS485 (Modbus RTU)
Relay Outputs	Optional: 2 programmable relay setpoints for level alarms or pump control

5. Electrical & Power Supply

Feature	Specification
Power Supply	18–30 VDC (loop-powered), or 85–265 VAC (with integral power module)
Power Consumption	< 2.5 W
Surge Protection	Built-in or external protection required
Cable Entry	M20 or PG11 cable glands (weatherproof)

6. Display & Programming

Feature	Specification
Local Display	LCD / LED with level, distance, and status indication
Programming Interface	Integrated push-button keypad or external handheld programmer
Remote Configuration	Via HART/RS485 or optional Bluetooth for field calibration

7. Environmental Specifications

Parameter	Specification
Enclosure	IP65 / IP67 / IP68 (as per installation location)
Material (Housing)	ABS / Polycarbonate / Aluminum (corrosion resistant)

Parameter	Specification
Transducer Face	PVDF or PTFE (for chemical/sewage resistance)
Operating Temperature	-10°C to +55°C
Storage Temperature	-10°C to +55°C
Humidity	5–95%
Mounting Type	Top-mounted, threaded or flange (1½" or 2" BSP/NPT)

8. Certifications & Standards

Category	Standard
EMC Compliance	EN 61326-1
Safety Compliance	IEC 61010-1
Ingress Protection	IP65 / IP67 (certified)
Hazardous Area	Optional: ATEX / IECEx for Zone 2 (if required)

9. Typical Applications

- Sewage sump pits
- Water tanks
- Wet wells in IPSS
- Overflow tanks or reservoirs
- Sludge handling systems

10. Deliverables

- Ultrasonic level transmitter with mounting accessories
- Calibration and test certificate
- Instruction manual and wiring diagram
- Warranty card (minimum 1 year)
- Optional: HART communicator or interface cable

11. Optional Features

- Bluetooth wireless configuration
- Built-in datalogger
- Solar power kit for remote installation
- Integration-ready with PLC/SCADA

14.20 TECHNICAL SPECIFICATION: PRESSURE GAUGE WITH PRESSURE TRANSMITTER

1. General Description

The pressure measuring system shall consist of a mechanical pressure gauge for local indication

and an electronic pressure transmitter for remote monitoring and integration with PLC/SCADA systems. The assembly shall be suitable for use in sewage, water, and industrial fluid systems, including harsh and corrosive environments.

2. Pressure Gauge (Analog Dial Type)

Parameter	Specification
Type	Bourdon tube type, dial pressure gauge
Dial Size	100 mm or 150 mm
Pressure Range	0–6 bar / 0–10 bar / 0–16 bar (as required)
Accuracy	±1.0% of full-scale (Class 1.0)
Connection Type	Bottom or back entry, ½" BSP/NPT male
Case Material	Stainless Steel 304 (SS316 optional)
Wetted Parts	SS316 or chemical-resistant alloy
Window	Shatter-proof glass / polycarbonate
Pointer	Micrometer adjustable
Mounting	Direct / Surface / Panel Mount (with bracket)
Protection Class	IP65 / IP66

3. Pressure Transmitter (Electronic Sensor)

Parameter	Specification
Type	Gauge or Absolute Pressure Transmitter
Pressure Range	0–6 bar / 0–10 bar / 0–16 bar (matching gauge)
Output Signal	4–20 mA, 2-wire (standard); Optional: 0–10V, Modbus RTU (RS485)
Accuracy	±0.25% or better of full-scale
Sensor Technology	Piezoresistive / Strain Gauge with stainless steel diaphragm
Power Supply	12–30 VDC
Overpressure Limit	1.5 to 2 times of rated pressure
Process Connection	½" BSP/NPT male
Wetted Material	SS316 or higher-grade alloy
Housing Material	SS316 or Die-cast Aluminum with epoxy coating
Electrical Connection	M12 connector / Cable gland with shielded cable
Ingress Protection	IP65 / IP67
Operating Temp. Range	-10°C to +55°C (ambient)
Stability	≤ ±0.1% of URL/year

4. Integration & Compatibility

Feature	Specification
PLC/SCADA Integration	Direct 4–20 mA to PLC/RTU/SCADA AI channels
Mounting Arrangement	Optional manifold or bracket for panel/pump housing
Cable Length	Standard 3–5 m (extendable)
EMI/RFI Protection	Built-in surge and transient protection
Local/Remote Configuration	Optional zero/span adjust or HART via handheld communicator

5. Environmental Conditions

Parameter	Specification
Ambient Temperature	-10°C to +55°C
Humidity	5–95% RH, non-condensing
Vibration Resistance	5 g (20–2000 Hz)
Ingress Protection	IP65 / IP67

6. Certifications & Standards

Compliance	Standard
Electrical Safety	IEC 61010
EMC	EN 61326
Ingress Protection	IEC 60529 (IP65/IP67)

7. Deliverables

- Pressure gauge with calibration certificate
- Pressure transmitter with factory calibration
- Mounting accessories (nuts, adapters, brackets)
- Test and inspection report
- Wiring diagram and operation manual
- Manufacturer's warranty (minimum 1 year)

8. Optional Features

- Digital display pressure transmitter (LED/LCD)
- Combined gauge and transmitter in a single housing
- 2-wire HART or Modbus RTU digital communication
- Intrinsically safe models for hazardous areas
- Flush diaphragm for slurry/sewage applications

14.21 TECHNICAL SPECIFICATION: ELECTROMAGNETIC FLOW METER

1. General Description

The electromagnetic flow meter shall be a full bore, inline type flow meter designed for accurate, non-intrusive measurement of conductive fluids in a 200 mm / 300 mm / 500 mm diameter pipe (As per Main Header Pipe Dia Size). It shall be suitable for measuring sewage, raw water, treated water, or slurry and capable of operating in harsh environments.

2. Measuring Principle

Parameter	Specification
Type	Electromagnetic
Application	Sewage

3. Flow Specifications

Parameter	Specification
Pipe Size	As per Pumping Station Design Inputs
Flow Velocity Range	As per Pumping Station Design Inputs
Flow Rate Range	As per Pumping Station Design Inputs
Accuracy	±0.5% of reading or better
Repeatability	±0.1%
Liner Material	Hard rubber, PTFE, or polyurethane (suitable for sewage)
Electrode Material	As per fluid compatibility

4. Output and Communication

Parameter	Specification
Analog Output	4–20 mA, isolated
Digital Output	Pulse / Frequency / Status
Communication Protocols	Modbus RTU (RS485), HART, or Profibus (as required)

5. Power Supply

Parameter	Specification
Power Input	85–265 VAC or 24 VDC

6. Construction and Mechanical

Parameter	Specification
Sensor Body	Carbon Steel with corrosion-resistant coating or SS304
Flange Type	ANSI 150 / PN 10/PN 16 (as per requirement)
Enclosure Rating	IP65/IP67 (sensor), IP65/IP68 (optional submerged sensor)
Installation	In-line, horizontal/vertical orientation
Electronics Housing	Wall/pipe/panel/field-mounted type (IP65 minimum)

7. Environmental Conditions

Parameter	Specification
Ambient Temperature	-10°C to +55°C
Fluid Temperature	0°C to +80°C (rubber), up to +150°C (PTFE liner)
Humidity	0–95% RH, non-condensing
Ingress Protection	IP65/IP67/IP68 (optional)

8. Calibration and Testing

Parameter	Specification
Factory Calibration	Calibrated on certified hydraulic test rig
Test Certificate	Included with 3-point or 5-point calibration report
Repeatability	≤ ±0.1% of measured value

9. Certifications and Standards

Category	Standard
Accuracy & Calibration	ISO 6817 / OIML R49
Ingress Protection	IEC 60529

Category	Standard
Electrical Safety	IEC 61010-1
EMC Compliance	EN 61326

10. Deliverables

- Flow sensor with flanged ends (As per Requirement)
- Transmitter/display unit (field or remote-mounted)
- Calibration certificate
- Grounding rings and cables
- Installation and operation manual
- Test and inspection certificate
- Manufacturer's warranty (minimum 1 year)

11. Optional Features

- Remote display up to 10–20 m distance
- Solar power operation (with DC version)
- GSM/GPRS/4G data transmission modem
- Internal battery for short-term backup
- Batching function for dosing applications
- Tamper-proof totalizer with password access

14.22 TECHNICAL SPECIFICATION: CHEMICAL EARTHING SYSTEM FOR C&I SYSTEM

1. General Description

The chemical earthing system shall provide a low-impedance, long-lasting, and maintenance-free earthing solution. The system includes a primary and secondary electrode assembly enclosed in a highly conductive backfill compound, ensuring consistent earthing performance in all soil conditions. It is especially suitable for electrical systems, PLC panels, SCADA, VFDs, and sensitive electronic devices in harsh environments like sewage stations.

2. Earthing Electrode Assembly

A. Primary Electrode

Feature	Specification
Type	Flat hot-dip galvanized (GI) strip
Size	25 mm × 6 mm
Coating	Hot dip galvanized (min. 85 microns)
Purpose	Main conducting electrode embedded in chemical compound

B. Secondary Electrode (Outer Casing)

Feature	Specification
Type	ISI-marked GI Pipe
Diameter	50 mm
Wall Thickness	2.6 mm
Length	Typically, 3 meters
Coating	Hot dip galvanized
Base Plate	GI base plate, 300 mm × 300 mm, sealed at the bottom of pipe

3. Backfill Compound (BFC)

Material	Carbon-based compound or bentonite with metal oxide mixture
Life Span	Minimum 10 years maintenance-free under normal conditions

4. Compliance & Standards

Standard	Description
IS:3043	Code of practice for earthing
IEEE Std 80	Guide for safety in AC substation grounding
IEC 62561	Lightning protection grounding system components

14.23 TECHNICAL SPECIFICATION: 12-CORE UNARMOURED OPTICAL FIBRE CABLE

1. General Description

The cable shall be a 12-core unarmoured optical fibre cable, designed for reliable high-speed data transmission in indoor/outdoor industrial applications. The cable shall consist of single-mode fibres with excellent mechanical strength, low attenuation, and protection against environmental factors without additional metallic armouring.

2. Optical Fibre Characteristics

Parameter	Specification
Fibre Type	Single-mode
Number of Fibres	12 cores

3. Cable Construction

Parameter	Specification
Core Arrangement	12 fibres organized in loose tubes or central tube
Water Blocking	Water-swellable tape/yarn layers
Strength Member	FRP (Fiber Reinforced Plastic) rods or glass yarns for tensile strength
Outer Sheath	LSZH (Low Smoke Zero Halogen) or PVC, UV stabilized
Sheath Thickness	Approx. 1.0–1.2 mm
Cable Diameter	Typically 6–8 mm
Operating Temperature	-10°C to +55°C
Storage Temperature	-10°C to +55°C

4. Mechanical & Environmental Properties

Parameter	Specification
Tensile Strength	≥ 1500 N (installation)
Impact Resistance	IEC 60794-1-2 compliant
Water Penetration	Passed water-blocking test per IEC 60794
Flame Retardant	IEC 60332-1 compliant

5. Standards & Compliance

Parameter	Specification
Optical Fibre Standard	ITU-T G.652D (single mode)
Cable Standard	IEC 60794, IEC 60793
Flame Retardancy	IEC 60332-1, IEC 60332-3

6. Testing & Quality

- Optical attenuation
- Tensile strength test
- Crush and impact resistance test
- Water penetration test
- Bending test
- Proof test of fibres
- Manufacturer's test certificate and quality assurance report

7. Marking

- Cable shall be marked at regular intervals with the manufacturer’s name, fibre count, type, and length marking
- Outer sheath colour: Typically black (or as specified)

8. Packing

- Supplied in wooden drums or reels suitable for handling and installation
- Length per drum: 2 km (typical) or as per project requirement

14.24 TECHNICAL SPECIFICATION: GRP JOINT BOX FOR OFC LOOP & TERMINATION WITH OFC CONNECTION SWITCH AND MODEM

1. General Description

The GRP (Glass Reinforced Plastic) Joint Box shall be a robust, weatherproof enclosure designed for looping, splicing, and terminating optical fiber cables. It shall accommodate fiber management trays, splitter modules, OFC switches, and modems required for optical network distribution and communication. The enclosure shall provide mechanical protection, environmental sealing, and easy access for maintenance.

2. Material & Construction

Parameter	Specification
Body Material	High-quality UV stabilized Glass Reinforced Plastic (GRP)
Color	Light grey or as specified
Wall Thickness	Minimum 3 mm
Protection Class	IP65 / IP67 rated for dust and water ingress
UV Resistance	UV stabilized for outdoor use without degradation
Corrosion Resistance	Excellent resistance to chemicals, salt spray, and corrosion
Lid/Closure	Hinged or bolted with stainless steel fasteners and rubber gasket for sealing
Mounting	Wall mount / pole mount / pedestal options

3. OFC Connection Switch & Modem Integration

Parameter	Specification
OFC Connection Switch	Compact modular optical switch (1xN or NxN), suitable for network routing and protection
Switch Type	Mechanical or solid-state optical switch compatible with single-mode fibers
Modem	Industrial-grade optical modem for communication (e.g., Ethernet over fiber, media converter)
Power Supply for Modem	12V/24V DC or 230V AC as per installation
Mounting Provision	DIN rail or bracket mounting inside joint box
Cooling	Passive ventilation or integrated fan (if modem generates heat)
Connectors	SC/APC or LC type connectors for fiber termination and patching

5. Environmental & Mechanical Specifications

Parameter	Specification
Operating Temperature	-10°C to +55°C
Humidity	5 to 95%
Impact Resistance	IK08 or better
Ingress Protection	IP65 minimum, suitable for outdoor installation
Vibration Resistance	Compliant with relevant industrial standards

6. Standards & Compliance

Standard	Description
Material Standards	ASTM D256 for impact resistance, UL 94-V0 for flammability
IP Rating	IEC 60529
Fiber Optic Standards	IEC 60794 for cable handling
Electrical Safety	IEC 61010 (for modem and active devices)

7. Accessories

- Mounting brackets and hardware
- Cable glands and sealing kits
- Labels and identification tags
- Earthing wire and connectors

- Instruction manual for installation and maintenance

8. Testing & Documentation

- Factory inspection and acceptance test reports
- Water ingress and dust ingress test certificates
- Mechanical strength test report
- Warranty: Minimum 1 year for enclosure and active components

14.25 TECHNICAL SPECIFICATION: SINGLE PHASE UPS WITH NI-CD BATTERY

1. General Description

The UPS system shall provide uninterrupted power supply to critical control and monitoring equipment during power failures and voltage fluctuations. It shall be compact, reliable, and suitable for industrial environments with a 1 kVA power rating and integrated Ni-Cd (Nickel-Cadmium) battery backup.

2. UPS Electrical Specifications

Parameter	Specification
UPS Type	Online / Line-interactive (preferably Online for zero transfer time)
Capacity	1 kVA (approx. 700–800 W output power)
Input Voltage	230 V AC ±20%
Input Frequency	50 Hz ±5%
Output Voltage	230 V AC ±2% (regulated sine wave)
Output Frequency	50 Hz ±0.5 Hz
Waveform	Pure sine wave
Transfer Time	Zero or ≤ 10 ms (for online UPS)
Efficiency	≥ 85% at full load
Overload Capacity	125% for 1 minute, 150% for 10 seconds
Output Protection	Short circuit, overload, overvoltage protection

3. Battery Specifications (Ni-Cd)

Parameter	Specification
Battery Type	Nickel-Cadmium (Ni-Cd) sealed, maintenance-free
Voltage	Typically, 12 V per cell, configured for required output (e.g., 24 V or 48 V system)
Capacity	Sized to provide minimum 30 minutes backup at full load
Battery Life	Minimum 12 years (Ni-Cd typical lifecycle)
Operating Temperature	-20°C to +50°C
Recharge Time	≤ 8 hours to 90% capacity
Battery Management	Built-in temperature compensation and battery monitoring circuitry
Safety Features	Overcharge protection, thermal cutoff

4. Physical & Environmental

Parameter	Specification
Dimensions (L × W × H)	Approx. 300 × 150 × 400 mm (varies by manufacturer)
Weight	Approx. 15–20 kg

Parameter	Specification
Operating Temperature	-10°C to 55°C
Storage Temperature	-10°C to 55°C
Relative Humidity	5% to 95%
Noise Level	≤ 45 dB
Protection Rating	IP20 / IP21 (indoor use)

5. Control & Indications

Parameter	Specification
Display Panel	LCD or LED indicators showing load level, battery status, input/output voltage, alarms
Alarms & Protections	Battery low, overload, fault, mains failure, battery charging status
Bypass Switch	Automatic/manual bypass
Communication Interface	RS232/USB or dry contacts for remote monitoring (optional)

6. Standards & Compliance

Standard	Description
Safety	IEC 62040-1, IS 13252
EMC	IEC 62040-2
Battery Safety	IEC 61951-2 (Ni-Cd batteries)
Quality	ISO 9001 Certified Manufacturer

7. Accessories
   - Input/output cables and connectors
   - Battery enclosure (if separate)
   - User manual and installation guide
   - Warranty: Minimum 1 year UPS & 5 years battery warranty recommended

15. TECHNICAL SPECIFICATION FOR ELECTRICAL INSTALLATIONS

15.1. Introduction

This document outlines the Electrical Specifications for the IPS and MPS of Sewage treatment plant. This specification covers the complete installation, testing, and commissioning of all electrical equipment in the plant area, including but not limited to:

- Power and Motor Control Centers (PMCCs)
- Control Panels
- Switchgears

- Motors
- Soft Starters
- Transformers
- DG Set
- Illumination Systems
- Earthing System
- 11kV Substation/Switchyard
- 11kV Underground Cabling system
- Make List

15.2. Scope of Work

This specification is intended to cover complete installation, testing and commissioning of electrical equipments i.e. motor control centers, power control centers, control panels, switchgears, motors, push button starters, transformers, etc.

a) Liaison for getting new HT/LT power supply agreement for getting connection and necessary arrangements for getting the Electrical Inspector's clearance and approval for the same will be in the scope of contractor.

b) Supply, installation, testing and commissioning of the complete electrical distribution system inside the plant and underground cabling system with Main HT/LV switchboards, lugging, earthing, fixed terminal connected Capacitor banks etc. as per single line diagram layout drawing and technical specifications.

c) Supply, installation, testing and commissioning of the complete cabling system including terminations (scope includes supply of gland, lug, etc.) as per technical specification, single line

d) Supply, installation, testing and commissioning of the illumination system including new lighting panels, lighting fixtures, cables, cable terminations, wires, GI conduits, switches, receptacles etc including all the necessary accessories as per approved lighting layout drawings and technical specification.

e) Supply, installation, testing and commissioning of earthling and lightning protection system with earthling pits and connecting the pits to the earth grid and forming earth-grid and equipment connection to the grid including necessary clamps, nuts, bolts, etc. all including welding, bolting and associated civil works for two pole structure, for all specification.

f) Civil works associated with the electrical works is also included in the Contractors scope of works. Preparation of supports and structures for erection of transformers, switchgear, poles, cable trays and other accessories are included in the scope of works of the contractor.

15.3. Power Supply

Operating Voltages and Frequencies

HV System		
Voltage		11kV nominal,12kV highest
Frequency		50 Hz
Connection		3phase,3wire
11 kV System		Fault level in coordination with State electrical utility
LV System		
Voltage		415V nominal
Frequency		50 Hz
Connection		4wire
0.4 Kv System		Fault level in coordination with State electrical utility
System Earthing		Solidly earthed
Control Voltage		**Instrumentation Power Supply, AC Control Lighting & Space heating**
Voltage		110 V - 240 V
Phases		1
Frequency		50Hz
DC Control Voltage		
Voltage		110 V DC
Wires / Earthing		2 wire / unearthed

15.3.1 General Power Distribution Scheme

The following assumptions have been be made to arrive at the estimated load of the different sites.

a) Load Factor

i) Motor	0.9
ii) Auxiliary load, valve motors, etc.	0.9
iii) Lighting load	1.0

b) Diversity Factor

i) Motor	1.0
ii) Auxiliary load, valve motors, etc.	1.5
iii) Lighting load	1.2

c) Power factor of Motors: As per manufacturers' catalogue

d) Efficiency of Motors: As per manufacturers' catalogue (Energy efficient EFF 3)

e) Protections

The following protections are proposed for various switch boards, transformers, motors and other plant feeders.

1) 11kV Switch board

i) IDMT over current and earth fault protection for incomers

ii) IDMT and instantaneous over current and earth fault protection for outgoing transformer feeders

2) LV switch board

i) Over current, short circuit and earth fault protection on ACBs/MCCBs

3) Motors

i) Overload protection by thermal (bimetal) relays in all the three phases to trip with single phase preventer (SPP) and short circuit protection in all the three phases through motor protection circuit breakers / MCCBs Alternatively, microprocessor based motor protection relay can also be used.

ii) Thermal, locked rotor, short circuit, negative sequence, under voltage, over voltage and earth fault for each motor feeder of rating 90kW and above.

f) Metering

The following metering will be provided

1) **11 kV Switch board**

Multifunction meter (for incomer) containing

i) Ammeter

ii) Voltmeter

iii) kW meter

iv) Frequency meter

v) Power factor meter

vi) Kilo watt hour meter

vii) kVA r meter

viii) k V A Meter for outgoing feeder

ix) Ammeter with selector Switch

2) **LV Incomers**

i) Ammeters with selector switch

ii) Voltmeter with selector switch

iii) kW meter

iv) Power factor meter

vi) Kilowatt-hour meter

vii) Frequency meter

3) **LV Outgoing Feeders**

i) Ammeter with ammeter selector switch
Multifunction meter will be equipped with inter facing capability for RS-485 port.

g) Indicating Lamp
The following indication will be provided:
1) 11kV Incomer, Bus Coupler and Outgoing feeders
i) Circuit breaker ON, OFF and TRIP, spring charged, control supply healthy and trip circuit healthy (Mains ON (R,Y,B) indication for incomer only)
2) LV Incomers
i) Mains ON (red, yellow and blue)
3) Motor Feeders
i) Motor ON, OFF and Trip indication (Red, green and Amber)
ii) Motor ON, OFF and Trip indication (Red, green and Amber), control supply healthy and trip circuit healthy for breaker feeder.

All electrical equipment will be rated for 50^0 C design ambient temperatures. All power cables will be sized based on continuous current capacity, permissible voltage drop and short circuit current rating. The voltage drop will be limited to 2.5 % at rated equipment current rating. The other rating factors for variation in ground temperature, variation in ambient air temperature, grouping of cables, depth of laying, etc. will also be considered for cable sizing.

Illumination Levels
The illumination levels proposed for various areas are as follows:

Area	**Illumination level (Lux)**
Pump House	250 - 300
Office/ Conference Room	400
Switch board Room	250
All other indoor areas	150
Outdoor plant area and Road	10-20

Component of luminaries will be 'energy efficient low loss type'. Fluorescent/CFL type of luminaries will be used for office/ all indoor areas except pump house area. HPSV or HPMV luminaries will be used for pump house area and other outdoor areas. Decorative fixtures/receptacles will be used for office areas and industrial type fixtures/ receptacles will be used for remaining areas. Street/ area lighting will be controlled by time switch for automatic switching of luminaries.

Emergency light will be provided for safe evacuation of the people in case of fire or panic (blackout, total power failure, etc.) Emergency lighting will be automatically switched ON when mains power supply fails.

Electrical system
The values of fault level for designing the electrical system will be based on transformer capacity, its impedance and system fault level. Fault clearing time for sizing of earth conduct or will be taken as one second.

The materials of earthing conduct or will be hot dip Galvanized Steel. All connections between the earth conductors buried in earth/concrete and between earth conductor and earth leads will be of welded type. While sizing the buried earth conductor, a corrosion allowance of at least 20% will be taken. Plant earthing system will be designed such that the overall earthing grid resistance is maximum one ohm.

Main earthing conductors outside and inside the building will be planned in such a manner that various equipment is connected to earthing system by two connections in a reliable manner.
The scope also includes cabling, lighting, earthing and lightning protection installation for the all the three phases of the plant. A complete electrical Load List comprising process loads and other loads will be furnished by the Bidder along with his Bid. The contractor will work out the details based on `requirement and other local authorities and site condition.
It will be the contractual responsibility of the contractor to obtain approval of drawings, design electrical installation and test certificates from Chief Electrical inspector to Government (CEIG) and any other statutory bodies.
Necessary official procedural support as well as technical required in obtaining the approval will be provided by the purchaser/ engineer.

15.4. Reference Standards

All equipment / systems supplied under this Contract shall conform to the latest editions of the International Electro-technical Commission (IEC) Standards or equivalent Indian Standards or other International Standards, provided they promise to confirm equal or superior performance.
If standards other than IEC are referred, then the same will be highlighted accordingly.

Standard No.	**Electrical Item**
IS :12729	General requirements of Switch gear and control gears for voltages exceeding 1000v.
IS : 3427	Metal enclosed switch gear and control gears for voltages above1000v.
IS :13118	General requirements of circuit breakers for voltages above1000v.
IS :13947	Specification for low voltages witch gears and control gears
:375	Specification for bus bar marking
IS : 2705	Specification current transformers
IS : 3516	Specification for voltage transformers
IS : 1248	Specification for electrical indicating instruments
IS : 2419	Specification for Panel mounted electrical indicating instruments
IS : 3213	Specification for electrical relays for power system protection
IS : 6875	Specification for control switches and push button
IS : 9920	Specification for switches and switch isolators for voltages above 1000v.
IS : 1554	Specification for PVC insulated cables for voltages upto 1100 v grade (Heavy duty)
IS : 7098	Specification for XLPE insulated cables for voltages upto 11KV

IS : 1255	Specification for installation and maintenance of underground cables.
IS : 3961	Specification for current ratings of cables
IS :325	Specification for A.C. Inductor motors
IS : 4691	Specification of protective enclosures for electrical items
IEC :62271	International Standard for High voltage alternating current Circuit Breakers
IEC:60298	International standard for AC metal enclosed switch gear and control rear for rated voltages above 1000 vand upto 52KV
IEC :60694	International standard for common specification for high voltage switch gears and control gears.
IEC :60947	International Standard for low voltage switch gears and control gears (voltage not exceeding1000v)
IEC :60898	International Standard for air break circuit breaker s (voltage not exceeding1000v)
IEC :60298	International Standard for metal enclosed switch gear and control gear for voltages above1000 v but not exceeding 11,000v.
IEC :34	International Standard for A.C. Inductor motors

15.5. Power transformers

Transformers and its accessories shall comply with the following International Standards, including those referred to therein: IEC 60076, 60214, 60296 / IS2026, IS335.
The technical parameters of transformers shall be as below:

Table 1: Technical Parameters of Transformers

Description	Particulars
General	
Quantity required	As per requirement
Installation (Indoor/Outdoor)	Outdoor
Ratings	
Rated power	
(*)Contractor shall submit their design calculation for rating of each equipment for or the Employer for approval.	KVA
No load voltage Primary	11 KV
Secondary	0.433 KV
Number of phases	3
Rated frequency	50 Hz
Impedance voltage	% (As per IEC / BIS)
Vector group	Dyn11
Winding material	Electric Grade Copper
Type of cooling	ONAN
System Voltage	

Nominal system voltage Primary	11 KV
Secondary	0.415 KV
Highest system voltage-Primary	12 KV
Highest system voltage--Secondary	KV
Transformer Secondary Neutral Earthing	Effectively earthed
Insulation Withstand	
Rated lightning impulse withstand voltage	kV (Peak)
-Secondary	kV (rms)
Temperature Rise	
Reference design ambient	50 deg C
Temperature rise over design ambient temperature of 50 deg C	
Average winding temperature rise(by resistance measurement)	55 deg C
Description	Particulars
Top oil temperature rise (by thermometer)	50o C
Tap Changing Gear	
Type of tap changer	Off Circuit tap Changer
Tapping range	
Tapping steps	2.5%
Bushings	
Rated voltage–Primary	12 KV
Rated voltage-Secondary	1.1 K
One minute power frequency withstand voltage (dry and wet) –Primary	KV (rms)
-Secondary (Line and Neutral)	KV (rms)
Rated lightning impulse withstand voltage	KV (peak)
Nominal creep age distance	mm/KV
Terminal Connections	
Primary line end	Cable box
Secondary line end	Cable box /Bus Duct
Secondary neutral end	One bushing each inside and outside cable box
Type of wheels	Plain–Bi-directional

Transformers will be located outdoor; plinth mounted and shall also be rated for satisfactory operation at 50^{o}C design ambient temperature. All accessories and fittings, core. Shall be as per manufacturer confirming to relevant IS standards.

15.6. Silent type DG set with AMF panel

The DG sets will be for capacity for the emergency load in order to maintain regular growth of bacteria in case of failure of regular power supply.

The DG set will be equipped with automatic starter and automatic change over switch in case of power failure.
A separate feeder line will be provided from automatic change over switch of DG set to respective units where consistent power supply is required.

Engine - The engine shall be complete with the following accessories:
a) Heat Exchanger
b) Corrosion inhibitor coolant
c) Paper element filters for fuel, lube oil and by-pass
d) Flywheel to single bearing alternator with housing.
e) Dry type air cleaners and vacuum indicators
f) PT Self Adjusting direct fuel injection system
g) Silencer
h) Stainless steel exhausts flexible bellows
i) Electronic Control panel with digital governor suitable for synchronization.
j) Electric Starter
k) Battery charging alternator
l) Electronic Instrument panel (Displaying the following):
i) Battery Voltage
ii) Coolant Water Temperature
iii) Lubricating Oil Pressure
iv) Engine Speed
v) Engine Hours

m) Safety Control: High water temperature (HWT) (Trip & Indication for)
: Low lube oil pressure (LLOP)
: Over speed stop
n) Air inlet system, Charging system, Control system, Exhaust system.

AMF Control Panel –
Cubicle type, floor mounting Control Panel, with dust and vermin proof for accommodating the following:
a) Suitable Moulded Case Circuit Breaker, Ammeter with Selector switch
b) Voltmeter with Selector Switch, 500 Volts
c) Frequency Meter
d) KWH Meter
e) KW Meter
f) Current Transformers
g) Indicating Lamps for Supply “ON” & Load “ON”
h) Instrument fuses
.

15.7. APFC Panel
Capacitors shall comply with IEC 60871 and IS 5553, 13925 including those standards referred to therein. The technical parameters of capacitors shall be as given below

Table: Technical parameters of capacitors

Description	Unit	Particulars
Capacitor Bank		
Application		Power factor improvement
Arrangement		Automatic Power Factor Correction (APFC)
Type of insulation		Polypropylene (APP) / Mixed Dielectric (MD)
Rated output	kVAR	(*)
Rated voltage	V	415
Rated frequency and no.of phases	Hz/-	50,3 Phase
Capacitor bank connection		Delta
Type of mounting and location		Floor mounted and Indoor
Design ambient temperature		50
Type of switching		Automatic
Control supply		110VDC
No. of steps for control	Nos.	Minimum 8
Degree of protection of enclosure		IP4X
Color finish shade		Light Grey Semi Glossy
Type of APFC relay		Microprocessor based automatic power-factor correction relay (maximum setting 0.99lag)

Capacitor (APFC) Control Panel For LV Application

APFC microprocessor based relay shall automatically switch ON / OFF the capacitor banks to attain the value of 'pf' close to the set value. Switching shall follow first in first out (FIFO) method to ensure uniform use of all capacitor banks. At least eight steps shall be provided for switching. Harmonic filter (inbuilt with APFC panel) shall be provided to restrict Total Harmonic Distortion (THD) to 3% or less. Capacitor and capacitor control shall be housed in a metal enclosed cubicle. Capacitor shall be housed in the lower compartment and capacitor control unit at the top compartment, the two compartments being segregated.

The cubicle shall be fabricated out of 2 mm thick cold rolled sheet steel and shall of a degree of protection of IP 4X (for Capacitor Panel IP 4X is applicable as cut out for fan for heat dissipation).

15.8. HV and LV CABLES

MV / LV Cables shall comply with the following International Standards, including those referred to therein: IEC60183, 60227, 60502, 60885 and IS 7098, 5831, 8130, 1554, 10810.

The technical parameters of cables shall be as given below:

TABLE: TECHNICAL PARAMETERS OF CABLES

Description	Unit	Particulars
MVXLPE Power Cables		

Rated Voltage U/Uo/(Um)	kV	11
Material of conductor		Aluminum (stranded)
Cross-sectional area		(*)
Type of insulation		XLPE
Inner sheath		Extruded
Outer sheath		Extruded
Conductor and insulation screening		Required
Material of armour		Galvanized Steel (Aluminum for single core cable)
LV Power, Control and Lighting Cables		
Rated voltage	kV	0.4
Material of conductor		Aluminum for Power and Tinned Copper for Control cable (stranded)
Cross-sectional area		(*)
Type of insulation		XLPE for power and PVC for control cables
Inner sheath		Extruded
Outer sheath		Extruded
Material of armour		Galvanized cable
Cable Protection		Compound of outer sheath of all HV / MV/ LV cables shall contain suitable chemicals for preventing attack by rodents

Installation

a) In air or buried in ground

b) Depth of laying in ground 1000 mm for directly buried HV / MV cables and 750 mm for LV cables

c) In conduit: space factor not more than 40 % (ratio of total cable area to internal conduit area)

d) In trays: single layeru with spacing of one diameter for HV / MV and main LV cables and touching for small LV cables

Control cables shall be 2C, 4C, 7C, 12C and 19C type. Minimum size of conductor for control cables shall be 2.5 sq.mm. Copper.

All power cables shall be sized based on continuous current capacity, maximum permissible voltage drop of 2.5% and rated short circuit current withstand. In addition, rating factors for variation in ground / air temperature, grouping of cables, depth of laying, number of racks, etc. shall be considered for cable sizing.

15.9. LV Indoor Switchboard and Motor Control

LV indoor switchboard and its components shall comply with the following International Standards, including those referred to therein:

IEC60269, 60947, 61459, 60529 and IS4237, 8623, 1248, 722, 2705, 3156, 10118, 11353, 13947

The technical parameters of LV switchboard shall be as given below:

TABLE: TECHNICAL PARAMETERS OF LV SWITCHBOARD

Description	**Unit**	**Particulars**
General		
Rated voltage, no. of phases and rated frequency	V / -/Hz	415V, 3ph,50Hz
System neutral earthing		Effectively Earthed
Rated short duration power frequency withstand voltage		
-Power circuit	kV(rms)	
-Controlcircuit	kV(rms)	
Rated normal current of bus bars under design ambient temperature of C and material of bus bar	A / -	(*),Aluminum
Rated short –time withstand current and time	kA(rms)/sec	

Constructional Requirements		
Thickness of sheet steel in mm Cold rolled (Frame / Enclosure / Covers)	mm	Frame– 2.5 mm Doors / Covers–2.0 mm
Degree of protection of enclosure		IP-4X, Form-4 enclosure
Color finish shade		
-Interior		
-Exterior		Light Grey
Cable connection		Bottom entry and exit

Description	**Unit**	**Particulars**
Circuit Breakers		
Type		Air
Rated current inside the cubicle under design ambient temperature at 50 deg C	A	(*)
Rated operating sequence		O–3Min– CO-3Min-CO
Rated short- time withstand current and time	kA (rms)/sec	
Min.no. of auxiliary contacts		6NO+6NC after internal use by manufacturer
Type of operating mechanism		
-Normal		Spring charging for closing and tripping
-Emergency		Manual and Spring charged for closing and tripping
Auxiliary control voltage		

-Closing coil / Tripping coil	V	110V DC
- Spring charging motor	V	110VDC
- Space heater and lighting	V	230VAC
Earthing switch		Required
Current and Voltage Transformers		
Details of ratio, taps, burden, accuracy		As per Single Line Diagram (*)
Protective Relays		
Type		Numerical (Microprocessor based)
Auxiliary supply	V	110VDC
Detailsof protective relays		As per Single Line Diagram
Moulded Case Circuit Breakers		

Description	**Unit**	**Particulars**
Type		Moulded Case
Rated current when installed within cubicle under design ambient temperature of 500C	A	As required(*)
Rated short-time withstand current	kA(rms)	
Miniature Circuit Breakers		
Type		Miniature
Rated current when installed within cubicle under design ambient temperature of 500C	A	(*)
Rated short-time withstand current	kA(rms)	
Motor Starters and Contactors		
Type		Soft Starter / Star-Delta / Direct-online
Rated current	A	(*)
Rated voltage of coil	V	230VAC /110VDC
Utilization category		AC-3

These cover the main switchboard and distribution boards. The distribution board shall be of floor / wall mounting type. Entry for incoming and outgoing cables shall be from bottom. Bus bars shall be of aluminum. Degree of protection of the panel shall be IP 4X.

15.10. 11 KV SWITCH BOARD

MV indoor VCB switch board shall comply with the following Standards, including those referred to therein: IEC 60044, 60186, 60255, 60265, 60282, 60298, 60466, 60529, 60694, 60787, 62271, IEC / TR261211 and IS 9046, 9920, 9921, 13118, 3427, 4237, 2156, 2705, 3156, 10118, 722, 13118.
The technical parameters of HV switch board shall be as below:

Table : Technical Parameters of HV Switch boards

Description	Unit	Particulars
General		
Type	Metal enclosed, compartmentalized, draw- out type	
Rated voltage, no. of phases and rated frequency	kV/-/ Hz	11kV,3 Phase,50Hz
System neutral earthing	Effectively Earthed	
Rated Insulation Levels		
- Rated short duration power frequency with stand voltage	kV(rms)	
- Rated lightning impulse with stand voltage	kV(peak)	
Rated normal current of bus bars under design ambient temperature of 50oCand material of busbar	A / -	(*),Aluminium-suitable for 100% load including future loads
Rated short-time withstand current and time	kA (rms) /sec	
Dynamic rating	kA(peak)	
Constructional Requirements		
Minimum thickness of sheet steel in mm Cold rolled (Frame / Enclosure / Covers)	mm	Frame–2 Doors/Covers–2.0
Degree of protection of enclosure	IP-5X	
Colour finish shade		
-Interior	Glossy White	
-Exterior	Light Grey Semi Glossy	
Cable connection	Bottom entry and exit	
Circuit Breakers		
Type		
Rated current inside the cubicle under design ambient temp of 50 deg C	A	(*)–(Breakers shall be rated for final ratings of motors in WTP)
Rated operating sequence	O–3Min–CO-3Min-CO	
Rated short time breaking current	kA(rms)	
Rated short time making current	kA(peak)	
Rated short-time with stand current and time	kA (rms) /sec	
Rated peak with stand current	kA(peak)	

Min. no. of auxiliary contacts	6NO+6NCafterinternalusebymanufacturer
Type of operating mechanism	
-Normal	Spring charging for closing and tripping

-Emergency	Manual and Spring charged for closing and tripping	
Auxiliary control voltage		
-Closing coil Tripping coil	V	110VDC
- Spring charging motor	V	110VDC
- Space heater and lighting	V	230VAC
Earthing switch	Required	
Current and Voltage Transformers		
Details of ratio, taps, burden ,accuracy	As per Single Line Diagram(*)	
Protective Relays		
Type		
Auxiliary supply	V	110VDC
Details of protective relays	As per Single Line Diagram	
Switch- Disconnector		
Rated current under design ambient tempera	A	(*)
Rated making current	kA(peak)	
Rated peak withstand capacity	kA(peak)	
Rated short-time with stand current and time	kA(rms)/sec	
Insulation levels		
Rated lightning impulse with stand voltage		
- Across the isolating distance	kV(peak)	
-Phase to phase, between phases and across open switching devices	kV(peak)	
Rated short duration power frequency with stand voltage		
- Across the isolating distance	kV(rms)	
-Phase to phase, between phases and across open switching devices	kV(rms)	
Operating mechanism		
- Closing and opening	Spring charged	
- Control voltage	V	110VDC
Earthing switch	Required	
HV Fuses		
Application	Indoor	
Type	HRC	
Rated current	A	(*)
Rated voltage	kV	11
Rated breaking capacity	kA(rms)	

15.11. MOTORS

All motors shall be of premium efficiency as per IS 12615:2011 motors and also comply with IEC60034, 60072/IS325, 4691, 6362, 4029, 12065, 12075, including standards referred to therein. The technical parameters of motors shall be as below:

TABLE E- 1: TECHNICAL PARAMETERS OF MOTOR		
Description	**Unit**	**Particulars**
Type		Squirrel cage Induction motor(TEFC)
Rating	kW	(*)
Rated voltage	kV	0.415
Type of mounting		Vertical / Horizontal (As required)
Duty type		Continuous (S1)
Method of starting		By variable speed drive (For Blower / compressor motors) Direct on line- for motors upto 5kW Star-Delta (Close transition type)–For motors 7.5kW and upto 45kW Soft Starter–For motors above 55kW
Type of system earthing		Effectively earthed
Class of insulation		F
Design ambient temperature	oC	50
Limits of temperature rise of winding		
-Determination by resistance method	oC	70
- Determination by ETD method	oC	80
Location		Indoor/Outdoor
Degree of Protection		IP55
Cooling designation		IC411
External cable details		0.4/1kV,3C(#)x(*) Aluminum, XLPE, armoured
Space heater for motor		Required for rating 30 kW and above

15.12. LV Soft Starter

The soft starters shall comply with the requirements of IEC 60034, 60947 and IS 325 including those standards referred to therein.

Constructional and Performance Features

Motor soft starters shall be switched or electronic type.

Soft starter panel shall be indoor, metal clad with separate metal enclosed compartments for:

a) control, metering and current transformers for differential protection, if specified

b) shorting (bypass) arrangement

c) busbars

d) power cable terminations

e) push buttons with indicating lamps.
Soft starter shall achieve smooth starting by torque control for gradual acceleration of the drive thus preventing jerks and extending the life of equipment.
Starting current shall be limited to 2.5 to 3 times the rated current of the motor. The soft starter manufacturer shall co-ordinate with motor manufacturer for this purpose.
Separate removable gland plates shall be provided for power and control cables.
Each cubicle shall be fitted with a label in the front and rear of the cubicle, indicating the panel designation, rating and duty. Each relay, instrument, switch, fuse and other devices shall be provided with separate labels

15.13. DC EQUIPMENT

DC equipment shall comply with IEC 60896 including those standards referred to therein.
Following items shall be covered in the under DC Equipment:
a) One no.110V Nickel Cadmium type Battery (Minimum capacityof Battery–200AH)
b) Two nos.Float-cum-boost chargers for 110V battery
c) DC distribution board.
All connections between battery, battery chargers and DC distribution board shall be designed for effective segregation between positive and negative leads.
110 V Battery
Battery offered shall be Nickel Cadmium (Ni-Cd) type.Nickel hydroxide and Cadmium hydroxide shall be used for positive and negative electrode respectively.

Battery Charger (110 V)
The float-cum-boost type battery charger shall comprise silicon controlled rectifiers (SCRs) connected in a full wave bridge circuit.
Each battery charger shall be suitable for float charging the battery under normal conditions and boost charging the battery when it has discharged during service conditions. The changeover from float to boost mode and vice versa shall be automatic.

15.14. LIGHTING SYSTEM EQUIPMENT

Lighting system shall comply with the following International Standards, including those referred to therein IEC 60083, 60598, 60669, 60884, 60906 and 60947. However at least 33% of street lighting shall be solar based as per specifications given below:

General Requirements
Lighting system equipment shall cover lighting panels, lighting fixtures, switches, receptacles with switches, for out door lighting-lighting masts, street lighting poles, etc.
Galvanized conduits shall be used for all exposed wiring and black enameled MS conduit shall be used for all concealed wiring. Minimum size of conduit shall be 20 mm / 25mm for exposed / concealed conduits respectively. Wiring inside the pump house, switchboard room and others shall be concealed type.

Lighting Fixtures and Its Accessories

Lighting fixtures for illumination of outdoor and indoor areas shall be supplied. Fixtures for outdoor installation shall be of weatherproof design with degree of protection of IP 65. The fixtures shall be suitable for operation on a nominal supply of 240 V, single phase, 50 Hz, AC with a voltage variation of +10%.
Fixtures shall be complete with internal wiring, lamp, capacitor, starter, holder, ballast, reflector, louvers / Perspex, etc. as required for their satisfactory operation. Fixtures shall be energy efficient and ballast shall be electronic low loss type. All indoor lighting fixtures for office and control room shall be decorative type and for remaining areas it shall be industrial type.

15.15. EARTHING AND LIGHTNING PROTECTION SYSTEM

Earthing and lightning protection system shall comply with the following International Standards, including those referred to therein. ANSI/IEEE Std. 80 and142, IEC 61024 andIS 2309, 3043. The total number of Earth Pits, Strip sizes etc shall be as per earth resitivity report.
The scope includes measurement of electrical soil resistivity (during dry season) at site, supply of earthing conductors, earth electrode pits, lightning protection system and their installation including associated civil work as per the specifications and approved drawings, to the satisfaction of the Employer. The scope of works shall also comprise designing the earthing and lightning protection systems as per the applicable standards.

15.16. 11kV Switchyard/Substation

The following equipment shall be supplied, installed, and commissioned as part of the 11kV substation setup, suitable for power distribution to utilities such as WATCO. All items must conform to the latest applicable IS/IEC standards and approved makes by the local utility.

1. GI Pole – 13 Meter Height
   - Hot-dip galvanized steel pole, minimum 13 meters in height with approximate weight of 31.1 kg/meter. The pole shall be suitable for outdoor installation and capable of withstanding wind pressure and conductor load. Galvanizing thickness shall be as per the state utility norms

2. Cross Arms – Channel Type,
   - Material: MS Channel, hot-dip galvanized. Size: 100 mm x 50 mm x 6 mm thick. Length: 3 meters complete with nut, bolts, and washers. To be installed on poles for stringing conductors and supporting insulators.

3. Lightning Arrester (LA) –
   - Metal oxide gapless type Lightning Arresters with Rated discharge current suitable for 11kV system.
   - Rated voltage: Suitable for 11kV systems. To be mounted on structures/poles near transformer. Shall conform to IS 3070 Part-3 / IEC 60099-4.

4. Metering CT & PT with Enclosure
   - Combined CT & PT unit housed in a weatherproof enclosure as per state utility norms.

5. Disc Insulators

- Porcelain/Polymer disc insulators rated for 11kV, suitable for suspension and tension application having minimum mechanical strength: 45 kN.
- Should conform to IS 731 / IEC 60120.

6. DOG Conductor

- Aluminium conductor, Dog (100 sq.mm) size.
- Stranded Aluminium Conductor Steel Reinforced (ACSR), Conforming to IS 398 (Part 2). This will be used for 11kV line stringing and transformer connections.

7. Load Break Switch (LBS) – Suitable for Transformer

- Outdoor type, gang-operated LBS rated for 11kV, 630A, Capable of interrupting transformer-rated load current.
- With operating handle, suitable arc quenching medium, and provision for earthing in compliance to relevant standard and local utility norms

8. Drop Out (DO) Fuse – Ampere rating as suitable

- Outdoor type Drop Out fuses for 11kV line protection with suitable rating, complete with fuse carrier and insulator base. Expulsion type, with easy fuse element replacement.

9. Stay Set with Earthing

- Complete GI stay set including, GI Stay rod, Anchor plate, Stay insulator, stay wire and other necessary items as required. This Includes earthing at the stay rod end using 3 mtr GI earth rod.

10. Earthing Pits – GI with Rod

- Earthing pits comprising of GI earth electrode of minimum 3 meters length. Pipe diameter: 40 mm (nominal bore). Filled with charcoal and salt layers. Inspection chamber with cover for maintenance.

11. Earthing Strip – Cross section as required

- Hot-dip galvanized GI flat strip for earthing interconnection.

12. Miscellaneous Items

Includes supply and installation of:

- Fencing for substation yard (MS angle with barbed wire). Danger plates as per IS 2551. Barbed wire, clamps, nuts and bolts, nameplates, signboards, and other minor accessories as required for complete installation.

15.17. 11kV Underground Cabling

The work involves complete Supply, Installation, Testing, and Commissioning of 11kV, 3-core, 120 sq.mm XLPE insulated, aluminium conductor, armoured cable, including associated trenching, protection, and accessories. All works shall comply with the latest IS/IEC standards and utility guidelines.

1. Supply of Cable

Supply of 11kV, 3C x 120 sq.mm, XLPE insulated, Aluminium conductor, armoured cable conforming to IS 7098 (Part II). Cable shall be suitable for direct burial, outdoor conditions, and high mechanical stress.

2. Excavation of Trench

Excavation of trench in normal soil to the required depth and width:

- Depth: 1.2 meters
- Width: 0.3 meters

Alignment shall follow site layout approved by the Engineer-in-Charge.

3. Sand Cushioning

Supply and laying of fine sand for cable cushioning: 100 mm below and 100 mm above the cable. Sand to be clean, non-cohesive, and free from debris or stones.

4. Brick Protection

Supply and laying of first-class bricks above the sand layer: 16 bricks per meter (flat arrangement) to prevent mechanical damage to the cable.

5. HDPE Pipe at Crossings

Supply and laying of HDPE pipe of 150 mm dia for cable protection at road crossings, drains, or locations requiring mechanical protection. Pipe shall conform to IS 4984 or equivalent and be of pressure-rated PE 80 or higher.

6. Cable Laying in Trench

Laying of cable in excavated trench with proper dressing, straight alignment, and no kinks or twists. Cable shall be gently uncoiled and laid without sharp bends. Cable rollers and suitable jacks to be used where required.

7. Cable Jointing

Supply and installation of heat-shrinkable straight-through joint kits for 11kV XLPE cables (if joints are required). Kits to be of reputed make (Raychem, M-Seal, 3M, or equivalent). Jointing shall be performed by trained personnel under supervision.

8. Backfilling and Compaction

Backfilling of trench using excavated soil in layers. Each layer to be properly compacted to original ground level and restored to site condition.

9. Warning Tape

Supply and laying of red, electrical-grade warning tape above cable layer (approx. 300 mm below surface). Tape shall be continuous and of high visibility to indicate presence of electrical cable.

Testing & Commissioning:

- Insulation resistance test and high-voltage withstand test to be conducted as per IS 1255 and IS 7098.
- Earth continuity and phase identification to be verified.
- Test results to be documented and submitted to the Engineer-in-Charge.

16 TECHNICAL SPECIFICATION FOR EXTERNAL ELECTRICAL INSTALLATIONS WORK:

i) General Requirement

The installations shall generally be carried out in conformity with the requirements of Indian Electricity Act 1910 as emended up to date and Indian Electricity Rules, 1956 framed there under, the relevant regulations of the Electric Supply Authority concerned and also with the specifications laid down in the Indian Standard IS:732/1963 "Code of Practice (Revised) for Electrical Wiring Installations (System Voltage nor exceeding 650-V)". The work shall be executed as per the National Electrical Code and if any item is not covered there under or there is any doubt, the specification approved by the Authority Engineer will be final and binding.

Ambient Conditions:

All Electrical installations and equipment shall be suitable to work in following ambient conditions.

Maximum temperature	:	50-degree
CelsiusRelative humidity	:	100%
In the vicinity of	:	Bhubaneswar

System Conditions:

The Electrical installation and equipment shall be suitable for operation in the following system conditions.

Supply voltage	:	415 volts $\pm$10%
Supply frequency	:	50Hz $\pm$5%
Number of phases	:	Three

ii) Scope:

a) Materials

All the materials, fittings, appliances used in electrical installations shall conform to Indian Standard Specifications wherever these exist. A list of approved materials is attached in Annexure-I. Materials not included in the list as well as any particular make not included in the list should be approved by the Authority/ Authority's Engineer before use. All required materials covered under this specification shall be supplied and installed by the contractor complete in all respect except in cases where it is clearly mentioned otherwise. The materials and accessories required for completing the work will form part of the work although they have not been specified separately.

Selection of Materials and installation work shall be such as to simplify operation, inspection, maintenance and testing. The work shall include all

reasonable pre-cautions and provision for safety of operation and maintenance personnel.

b) Standard:

Unless otherwise specified, all materials covered under this specification shall be designed, manufactured, tested and installed in conformity with the latest Indian Standard specifications. In case such Indian Standard Specifications are not published equivalent British Standard Specifications shall be followed. All equipment shall confirm to latest Indian Electricity Rules, PWD and Local / State laws or bye-laws as regards to safety, earthing and other essential provisions specified therein.

All equipment and materials selected shall also be supplied and installed taking into consideration the Factories Act, Fire Regulations and Local laws or bye-laws. All light fittings and equipment selected shall be of well tied out design. All materials used in the assembly of fittings and their accessories shall be of high quality and manufactured in accordance with the best modern practice.

All the materials supplied by the contractor according to the contract conditions will be subject to inspection and approval by the consultant or / and Authority Engineer or their authorized representative from time to time. The contractor shall extend all required facilities for such inspection free of cost. At the time of inspection, the inspecting officer shall have full libertyto reject any such material, which does not confirm to specifications or the requirements. The owner shall not entertain any claim for the rejected materials. The contractor shall remove all rejected materials from the site at his own cost.

The owner shall not accept any surplus materials procured by the contractor.

The contractor will be responsible to get electrical installations inspected by the Electrical Inspector of the State Govt. and to obtain the statutory clearance for energization. The owner will reimburse the necessary inspection fees on production of documentary evidences.

The contractor should possess valid electrical contract license and labour license issued by the appropriate statutory authority of the State Govt. during the execution of the Contract. The contractor shall be registered with provident fund Department for engagement of Labourers / Employees.

c) Inspection & Approval

The contractor shall put up samples of all major items for inspection and testing the consultant and or Authority Engineer for which the contractor shall furnish minimum 10 days clear notice in advance to enable them to depute their Inspecting Officer. Similar procedure shall be adopted for the approval of samples of minor materials / accessories to be used for the work.

iii. Power Supply:

Standard voltage shall be as follows :

i) 415V (± 6%, 3-Ph, 4-wire, 50 (± 5%) Hz AC available line for A.C. motors

and illumination/Ventilation.

ii) 230V, 1-ph, 50Hz. AC for control power and lighting.

LIST OF ACCEPTABLE MAKES OF EQUIPMENT

S. No.	Equipment	Makes	Short Form
1.	Submersible Pumps (Sewerage)	KSB Pumps, Grundfos, WPIL / Mather & Platt/XYLOM	(KSB,(GRUNDFOS), WPIL / M &P/XYLOM
2.	Horizontal/Vertical Split Casing EndSuction Pumps (Sewerage)	KSB Pumps, Grundfos, WPIL / Mather & Platt/XYLOM	(KSB,(GRUNDFOS), WPIL / M &P/XYLOM
3.	Dewatering/Sump Pump Set (Sewage)	Kirloskar Brothers Ltd,Modi Industries (FC)Pvt. Ltd. Flyght, Grundfos	(KBL), (MODI), (FLYGHT), (GRUNDFOS)
4.	Progress CavityivePump	NETZSCH,ROTO Pump,TUSHACO,ALPHA HELICAL	NETZSCH,ROTO Pump,TUSHACO,ALPHA HELICAL
5.	Rotary Lobe Pumps	NETZSCH,ROTO Pump,TUSHACO,ALPHA HELICAL	NETZSCH,ROTO Pump,TUSHACO,ALPHA HELICAL
6.	Dosing Pump	Milton Roy, Positive Metering Pumps, SWELLORE	Milton Roy, Positive Metering Pumps, SWELLORE
7.	Clear Water Pump	Kirloskar Brothers Limited, Matherplatt,ABS	KBL,Matherplatt,ABS
8.	Submersible Mixers	ABS,ITT,Grudfos	ABS,ITT,Grudfos
9.	Centrifug Aral Blower	AERZEN,HOWDEN,SIEMENS,ABS,ATLAS COPCO	AERZEN,HOWDEN,SIEMENS,ABS,ATLAS COPCO
10.	FLASH MIXER/AGITATORS	REMI,FIBRE& FIBRE,CEECON	REMI,FIBRE& FIBRE,CEECON
11.	CLARIFIER, THICKNER, DEGRITTER	EIMCO,DORR-OLIVER,WESTECH,TRIVENI	EIMCO, DORR-OLIVER,WESTECH,TRIVENI
12.	DIFFUSER	EDI,OTT,ABS,REHAU	EDI,OTT,ABS,REHAU
13.	Manual& MechanicalBar Screen (Coarse & Fine)	HUBER,JASH,JOHNSON,HEADWORKS	HUBER,JASH,JOHNSON,HEADWORKS
14.	Gate Valves	VAG, Audco, TALIS, AVK	(VAG, Audco, TALIS, AVK
15.	Non return valves	Kirloskar Brothers Ltd., Indian Valve Pvt Ltd., VAG, TALIS, AVK	(KBL), VAG, TALIS, AVK

S. No.	Equipment	Makes	Short Form
16.	Sluice Gates	Jash Engineering (P) Ltd., The Indian Valve Pvt. Ltd., VAG, TALIS, AVK	(JASH), (IVC) VAG, TALIS, AVK
17.	Cast Iron Pipes & Fittings and Dismantling Joints	The Indian Iron & Steel Company Ltd.,Oriental Castings, Upadhayay Castings, Electro-Steel Castings Ltd, Tata Iron & Steel Co.	(IISCO), (BIC), (OC), (UCL), (ECL),(TISCO)
18.	Ductile Iron pipes & Fittings and Dismantling Joints	Electrosteel Castings Ltd, Jindal Saw Ltd, Tata Mettalics, Jay Balaji, ESL steels	(ECL),(JSL),(TATA),,(BALAJI),, ESL
19.	Crane	W.H. Brady & Co. Ltd., Hercules Hoists Ltd.,Delta Engineering Works, Sharps Engineering Pvt. Ltd., Reva Engineering, Avon Cranes	(BRADY),(INDEF),(DELTA),(SHARPS),(REVA), (AVON)
20.	Chain Pulley Block	Reva Engg., Hercules Hoists Ltd., W.H. Brady & Co. Ltd.	(REVA),(INDEF), (BRADY)
21.	CHLORINATOR	Industrial METITO, Device, PENNWALT, BANNACO	Industrial METITO, Device, PENNWALT, BANNACO
22.	CENTRIFUGE	Humbolt, Penavolt, Alfa Level, Flottweg, Guinard, Broadbent	(HUMBOLT), (PENAVOLT), (ALFA LEVEL), LOTTWEG), (GUINARD), (BROADBENT)
23.	Exhaust Fan 415 V	Bajaj Electricals Ltd., Crompton Greaves Ltd., ALSTOM	(BAJAJ),(CGL), (ALSTOM)
24.	Switch-gear Control gear Components/Bus Duct	Crompton Greaves Ltd., ALSTOM, General Electric Company Ltd., Larsen & Toubro Ltd., Siemens India Limited, ASPL	(CGL), (ALSTOM), (L&T), (GEC),(SIEMENS), (ASPL)
25.	Power Transformer	Bharat Bijlee Ltd., New Government Electric Factory Ltd., Kirloskar Electric Co. Ltd.	(BBL),(NGEF),(KEC)
26.	Motors	Kirloskar Electric Co. Ltd., Siemens India Limited, Bharat Heavy Electricals Ltd., Crompton Greaves Ltd.	(KEC),(SIEMENS), (BHEL), (CGL)
27.	11KV/3.3KV Switchgear	Siemens India Limited, ALSTOM, ABB, Kirloskar Electric Ltd., Heavy Electricals Ltd., Crompton Greaves,	(SIEMENS), (ABB), (ALSTOM), (KIRLOSKAR), (BHEL), (CGL)
28.	Lighting Fixtures	Bajaj Electrical Ltd.,Crompton Greaves Ltd., Philips, Wipro Ltd.,Havells	(BAJAJ),(CGL),(PHILIPS),(WIPRO),(HAVELLS)
29.	415 V Air Circuit Breaker	English Electric Ltd., Larsen & Toubro Ltd., Siemens India Ltd.	(EEL), (L&T), (SIEMENS)
30.	Cables	Indian Cables Ltd., Cable Corpn. Of India,Universal Cables Indian Cable Co.,Asian Cables Corporation Ltd., Finolex Cables Ltd,	(ICL), (CCI), (UNISTAR), (ICC), (ASIAN),(FCL)

S. No.	Equipment	Makes	Short Form
31.	Power Capacitors	Crompton Greaves Ltd., Universal Cables Ltd.,Bharat Heavy Electricals Limited., L&T	(CGL), (UNIVERSAL),(BHEL),(L&T)
32.	Instrument & Meters	Universal Electrics Ltd., Automatic Electric Ltd., Meco Instruments (P) Ltd., Industrial Motors (P) Ltd., Havells Pvt. Ltd., Gollica Electricals Pvt. Ltd.	(UEL), (AEL), (MEL), (IML), (HAVELLS),(GOLLICA)
33.	Motor Starters	Bharat Heavy Elecrtricals Ltd., Perimal Engineering Ind., Enterprising Engineering, Pan Asia	(BHEL), (PEI), (EE), (PAN)
34.	Push Buttons and Indication lights	Larsen & Turbro, Siemens, Bhartiya Cutler Hammer, Vaishnov	(L & T), (Siemens), (BCH), (VAISHNOV)
35.	Relays (for 3.3 KV 11 KV switchgear)	English Electric Ltd., ALSTOM, Universal Electrics Ltd., Easun Reyrolles Relays, Larsen & Turbro, Asian Brown Boveri, JYOTI	(EEL) (ALSTOM) (UEL) (ERR) (L & T)(ABB) JYOTI
36.	Battery	Standard Batteries Ltd., Chloride India Ltd., Amco Batteries Ltd., Exide	(SBL), (CIL), (ABL), (EXIDE)
37.	Voltage & Frequency Stabilizer	Applied Electronics Ltd., Electric, Jindal Surya Electro, Servocon, Logicstat	(APLAB), (JINDAL), (SURYA), (SERVOCON), (LOGICSTAT)
38.	Lightening Protection Unit	National Radio & Electronics Co. Ltd.	(NELCO)
39.	Instrument Transformers (CT's & PT's)	Mysore Electrical Industries, Automatic Electric Pvt. Ltd., Kappa Electricals	(MEI), (AEP), (KAPPA)
40.	Vaccum Pump	Kirloskar Brothers Ltd., SLM Manek Lal Industries Ltd.	(KBL), (SKM)
41.	Battery Charger	Uptron Powertronics, Shreetron Statcom, Automatic Electric Ltd., Chabi, Kerla State Electricity Crop., APCO	(UPTRON) (STATCOM) (AEL) (CHABI)(KSEC) (APCO)
42.	Fire Extinguishers	Steelage Industries Kooverji Devshi & Co. Ltd., Vijay Fire Protection System Pvt. Ltd.	(MINIMAX), (FIREX), (VIJAY)
43.	Nuts & Bolts	GKW, TATA	(GKW), (TATA)
44.	Ceiling Fans	Bajaj, Orient, Usha, Crompton	(BAJAJ), (ORIENT (USHA), (CROMPT), ON)
45.	Multimeter	Excrop, Motwane	(EXCROP), (MOTWANE)
46.	Push Button For non-flameproof Flameproof Weather Proof	Siemens, FCG, BALIGA	(SIEMENS) (FCG) (BALIGA)
47.	Switch / Fuses	GE Power, Larsen & Tubro Ltd, Siemens, HPL	(GE), (L&T), (SIEMENS), (HPL)

S. No.	Equipment	Makes	Short Form
48.	Motors contactors	Bhartia Curtler Hammer,Larsen & Tubro Ltd, Siemens, GE Power	(BCH), (L&T), (SIEMENS), (GE)
49.	Gear Reducers	Essen Pro, Radicon, Elecon, Greaves	(ESSEN), (RADICON), (ELECON), (GREAVES)
50.	Bus Duct	Best & Crompton Eng. Ltd, Power Gears Pvt. Ltd, Control & Switchgear, Zeta Switchgear	(B&C) (PGPL) (C&S) (ZETA)
51.	Control System / Instrumentation, PLC & SCADA System	AIMIL Limited, Johnson Controls (I) Pvt. Ltd, Landis & Staefa (I) Pvt. Ltd, TATA, Honeywell, Rockwell Automation, GE, FANUC, Alstom, Alan Bradely	(AIMIL), (JCPL), (SIEMENS), (TATA),RAIL, GE, FANUC, ALSTOM
52.	Ultra Violet radiation System	Trozan, Wedico, Suntech, INFILCO	(TROZAN), (WEDICO), (SUNTECH), (INFILCO)
53.	PCC / MCC	Advance Electro Control. Vidyut Control .Tricolite. Larsen & Toubro. Siemens. Jakson. Associated Electrical. Bhartiya Cutler Hammer. Control & Switch Gear. G.E Power Chavare Engineering. Spark Electro	(AEC), (VC), (TRICOLITE), (L & T),SIEMENS, JAKSON, ASPL, BCH, C & SG, G.E POWER
54.	Optic Fibre Cables	Delink Cords, RR Cable Icon, Aksh	DELINK CORDS, RR ICON, AKSH
55.	Flow Meters	Forbe Marshall,ABB, Schlumburger,Endress Hauser, YBL Yokogawa Magnetrol	KM, ABB, SB, EH, YBL
56.	Actuator	Marsh, L&T, Rotork	MARSH, L&T, ROTORK
57.	Pressure Guage	GIC, H Guru, AN Instrument	GIC, H Guru, AN Instrument
58.	Pressure Switches / Pressure transmitters	E + H,ABB, Fisher Rose Mont	E + H,ABB, Fisher Rose Mont
59.	Temperature Transmitter	Pyrotech,Masibus,Nishko	Pyrotech,Masibus,Nishko
60.	Level Switch	Endress Hauser, EIP, Nivo Control, ABB Level Cone Magnetrol	EH, EIP, NIVO, ABB, LEVEL CONE
61.	Electronic Ballast	Philips, Opal, Washlow	PHILIPS, OPAL, WASH
62.	Micro Processor Based Relays for Motor Protection	GE Power, Rockwell, L&T, Simens	GEP, RAIL, L&T, SIMENS
63.	Scrubber	Excellent engine, Pilani Envirotec	Excel, Pilenv
64.	UPS	Tata Emerson, Merlin Gerin Mitsubishi	Emer, M & G, Mits

S. No.	Equipment	Makes	Short Form
65.	Laboratory instruments	Polymetron/ Zellweger Analytic/ Hach	Polymetron/ Zellweger Analytic/ Hach
66.	Laboratory Glass Wares	Borosil	Borosil

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

(a) **GI pipes and fittings**: TATA/Jindal
(b) CPVC/ uPVC pipes and fittings: Astral/ Supreme/ Oriplast
(c) **Sanitary wares:** Parryware/Nycer/Hindware
(d) **Sanitary fitting:** Jaguar/ESS
(e) **All furniture:** Godrej
(f) **Paints, distemper**: Johnsons Nicholsons/ Asian Paint/ Berger paints
(g) **All locks and locking arrangements, hydraulic door closures**: Godrej.
(h) **Other Accessories**: The firm shall clearly state the make which shall be approved by Department.

17. **Inspection, Testing, Trial-Run, Guarantee Test, Operation & Maintenance Manual, Completion Drawings, Guarantee & Acceptance:**

(i) General:

- All equipment, 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 Department 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 Authority's Engineer of the Department.

- 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.
- 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.

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

(ii) Tests at works:

- All equipment, sub-assembly and components, auxiliaries and accessories shall be tested at manufacturer's works 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 Department 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.
- Testing for performance of equipment shall be carried out and be checked with the approved parameters and performance characteristic curves for the purpose of acceptance.

(iii) Tests at Site:

- On completion of erection, all equipment, accessories, auxiliaries, pipings, 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 for calibration and for proper functioning during the test. All testing requirements specified elsewhere in these 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.
- All the water retaining structures shall be tested for **water tightness** as per relevant IS code of practice before starting of Trial run.
- The contractor shall also carry out at site, any tests, which may be required by the State/ Central Government, State Pollution Control & prevention Board and/or any other Statutory Body.

(iv) Trial Run & Hydraulic testing:

- 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- s i x (96) hours continuous operation. All defective items or any defect is observed during trial run shall be replaced and/or rectified by the Tenderer.
- The detailed schedule of trial-run and procedure shall be furnished by the Contractor to be approved by Department. Proper record shall be maintained by the contractor for all such testings and trial run.

(v) Performance Guarantee Test:

- 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 days (480 hours).**

  The performance guarantee test by the Contractor shall demonstrate satisfactory operation of all individual items, equipment, controls, instruments, electrics, auxiliaries & accessories, and piping etc.

(vi) Operating Log Sheets:

Record Books of operating log sheets shall be handed over by the contractor to the Authority Engineer in an approved form before the completion of the trial run period.

(vii) Completion Drawings:

A set of approved process, hydraulic, structural, mechanical, electrical, equipment drawings basing on the actual execution of the plant shall be handed over by the contractor to the Authority/ Authority's Engineer before

completion of trial run and performance guarantee test. The record drawings shall be prepared on best quality polyester tracing papers. One set of soft copies of the drawings shall also be provided along with the hard copy.

(viii) Penalty for non-submission of completion drawings (As built Drawings): A penalty @ **0.3 % of 10 %** meant for **"inspection, testing, trial-run, guarantee test, training, operation & maintenance manual, completion drawings, guarantee & acceptance"** shall be imposed per day of non-submission of the manual & completion drawings beyond 7 days of date of completion of successful performance guarantee test up to a maximum ceiling of 2% of the 10% meant for the aforesaid item, after which 1% of ISD shall also be forfeited.

ix) On completion of construction:

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, equipment, 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, equipment, pipelines, valves etc.** The code nos. scheme shall be worked out in consultation with the Department.

x) Acceptance of Project:

On completion of successful testing, trial running, satisfactory performance guarantee test, successful training, submission of Manual, operating log sheets and completion drawings, the 'Installation' shall be accepted by the Department.

SCHEDULE - E

(See Clauses 2.1 and 14.2)

OPERATION & MAINTENANCE REQUIREMENTS

1. Operation & Maintenance Requirements

1.1 The Contractor shall, at all times operate & maintain the Sewerage Project in accordance with the provisions of this Agreement, Applicable Laws and Applicable Permits.

1.2 The Contractor shall repair or rectify any Defect or deficiency set forth in Paragraph 2 of this Schedule-E within the time limit specified therein and any failure in this behalf shall constitute non-fulfillment of the Operation & Maintenance obligations by the Contractor. Upon occurrence of any breach hereunder, the Authority shall be entitled to effect reduction in monthly lump sum payment as set forth in Clause 14.6 of this Agreement, without prejudice to the rights of the Authority under this Agreement, including Termination thereof.

1.3 All Materials, works and construction Operation & Maintenance shall conform to the relevant IS specification and CPHEEO Manual of MoUD publications. Where the specifications for a work are not given, Good Industry Practice shall be adopted. [Specify all the relevant documents]

2. Repair/rectification of Defects and deficiencies

The obligations of the Contractor in respect of Operation & Maintenance Requirements shall include repair and rectification of the Defects and deficiencies specified in Annex - I of this Schedule-E within the time limit set forth therein.

3. Other Defects and deficiencies

In respect of any Defect or deficiency not specified in Annex - I of this Schedule-E, the Authority/ Authority's Engineer may, in conformity with Good Industry Practice, specify the permissible limit of deviation or deterioration with reference to the Specifications and Standards, and any deviation or deterioration beyond the permissible limit shall be repaired or rectified by the Contractor within the time limit specified by the Authority/ Authority's Engineer.

4. Extension of time limit

Notwithstanding anything to the contrary specified in this Schedule-E, if the nature and extent of any Defect or deficiency justifies more time for its repair or rectification than the time specified herein, the Contractor shall be entitled to additional time in conformity with Good Industry Practice. Such additional time shall be determined by the Authority/ Authority's Engineer and conveyed to the Contractor and the Authority with reasons thereof.

5. Emergency repairs/restoration

Notwithstanding anything to the contrary contained in this Schedule-E, if any Defect, deficiency or deterioration in the Sewerage Project poses a hazard to safety or risk of damage to property, the Contractor shall promptly take all reasonable measures for eliminating or minimizing such danger.

6. Daily inspection by the Contractor

The Contractor shall, through its engineer, undertake a daily visual inspection of the Sewerage Project and maintain a record thereof in a register to be kept in such form and manner as the Authority may specify. Such record shall be kept in safe custody of the Contractor and shall be open to inspection by the Authority/ Authority's Engineer at any time during office hours.

7. Pre-monsoon inspection / post-monsoon inspection
Deleted

8. Repairs on account of natural calamities
All damages occurring to the Sewerage Project on account of a Force Majeure Event or default or neglect of the Authority shall be undertaken by the Authority at its own cost. The Authority may instruct the Contractor to undertake the repairs at the rates agreed between the Parties.

Annex - I

(Schedule-E)

Rectification of Defects and Deficiencies

Sl. No.	Name of defect or deficiencies	Time limit for repair/rectification
1.	**Pumps, Motors & Control Panels**	Up to 50 HP – 7 days Above 50 HP-15 days
2.	**Transformers/Sub-stations**	Minor repair -24 Hrs. Major repair – 3 days
3.	**Rising/ Pumping Mains**	24 Hrs.
4.	**Gravity Sewer**	24 Hrs.
5.	**STP – Mechanical/ Electrical Equipments, Instrumentations & Control System (excluding items covered in Sl. No. 1 to 4 above)**	24 Hrs.
6.	**Determination of Chemical dosing rate**	Thrice daily (Shift wise)
7.	**Waste-water sample testing**	Daily test as per Operation and Maintenance Manual of CPHEEO
8.	**Preventive Maintenance as detailed in Clause No.19.3.8. of EPC Agreement.**	**Monthly, Quarterly, semi-annually (Half Yearly), Annually and Bi-Annually**

Annex - II

(Schedule-E)

Check List for Operation & Maintenance

Name of Water supply Project		:	"Construction of Waste Water Treatment Plant at the Confluence point of River Daya & Ganguanala (Phase-II)" on Engineering, Procurement & Construction (EPC) Contract Including Operation & Maintenance for a Period of Five (5) Years	
Name of the contractor		:		
District/ Division		:		
Name of ULB		:		
Date of commission of the scheme		:		
Agreement No.		:		
Operation & Maintenance period		:	from …… to ……	
Date of inspection/ reporting		:		
Name of person inspected/ reported		:		
Designation (not below the rank of JE/ AE)		:		
1.	**Pumps, Motors, Control Panels, Circuit Breakers, etc.**	:		
	a) If Daily checks are done	:	Yes	No
	b) On detection of defects, if steps taken to rectify	:	Yes	No
2.	**Transformer & Sub-stations**	:		
	a) If Daily checks are done	:	Yes	No
	b) On detection of defects, if steps taken to rectify	:	Yes	No
3.	**Sewage Pumping Mains**	:		
	a) If Daily checks are done	:	Yes	No
	b) No. of leakages detected during site inspection and/or through complaint received	:	Nos. (Received)	Nos. (Attended within 24 Hrs.)
4.	**Gravity Sewer Network**	:		
	a) If Daily checks are undertaken to detect leakages/ blockages	:	Yes	No

	b) No. of leakages/ blockages detected during site inspection and/or through complaint received	:	Nos. (Received)	Nos. (Attended within 24 Hrs.)
5.	**STP – Mechanical/ Electrical Equipment, Instrumentations & Control System (excluding items covered in Sl.No.1 to 4 above)**	:		
	a) If Daily checks are done	:	Yes	No
	b) On detection of defects, if steps taken to rectify	:	Yes	No
6.	**Sewage Treatment & Treated Sewage Quality Monitoring**	:		
	a) If Daily checks on quality are done in each shift	:	Yes	No
	b) Whether required sewage sample testings are conducted during the day as per recommendations in the CPHEEO manual	:	Yes	No

Signature of JE/ AE

Verified & found correct & recommended for payment:

Signature of AEE/ DEE

Accepted for payment:

Signature of EE

NB: *In case JE/ AE/ AEE/ DEE do not agree to the report, then he shall return the report to the reporting officer with reason*.

Annex - III
(Schedule-E)

ESTIMATE FOR OPERATION & MAINTENANCE OF

Construction of Waste Water Treatment Plant at the Confluence point of River Daya & Ganguanala (Phase-II))" on Engineering, Procurement & Construction (EPC) Contract Including Operation & Maintenance for a Period of Five (5) Years

Estimated Cost of the Project: Rs.6468.31 Lakhs

O & M Cost for Five Years: Rs. 543.36 Lakhs

Energy charges for Five Years: Rs. 232.85 Lakhs

ANNUAL OPERATION & MAINTENANCE COST:

Sl	Items of Work		Cost in Lakhs
I	Annual Cost of Manpower for the 1st Year Annual O & M of SPSs, Rising main, including Cost of POL, Chemicals & Consumables, Inspection Vehicles	:	108.672
	Total Annual Operation & Maintenance Cost	:	**108.672**
II	**Total Annual Energy Cost** (Annual energy consumption about 6,65,300 KWH)	:	**46.57**
	Grand Total:	:	**155.242**

Note:

- The above mention Scope/Quantity are indicative only. Bidder has to assess the cost towards Man-power and cost towards Chemical Consumption for Annual Operation & Maintenance of the Project as per their requirement.

- Bidder also has to assess & assured the Annual energy consumption of the project basing on the latest energy-efficient technology.

- **The cost of O & M includes cost of energy charges. The actual energy charges shall be paid by department which will be deducted from the running bill of the agency.**

Note: The detailed calculation towards Operation & Maintenance cost is providedat Annex-III of Schedule-E for reference and guidance only.

SCHEDULE – E

(See Clauses 2.1 and 14.2)

OPERATION & MAINTENANCE REQUIREMENTS

1. Operation & Maintenance Requirements

1.1 The Contractor shall, at all times operate & maintain the Sewerage Project in accordance with the provisions of this Agreement, Applicable Laws and Applicable Permits.

1.2 The Contractor shall repair or rectify any Defect or deficiency set forth in Paragraph 2 of this Schedule-E within the time limit specified therein and any failure in this behalf shall constitute non-fulfillment of the Operation & Maintenance obligations by the Contractor. Upon occurrence of any breach hereunder, the Authority shall be entitled to effect reduction in monthly lump sum payment as set forth in Clause 14.6 of this Agreement, without prejudice to the rights of the Authority under this Agreement, including Termination thereof.

1.3 All Materials, works and construction operation &Maintenance shall conform to the relevant IS specification and CPHEEO Manual of MoUD publications. Where the specifications for a work are not given, Good Industry Practice shall be adopted. [Specify all the relevant documents]

2. Repair/rectification of Defects and deficiencies

The obligations of the Contractor in respect of Operation & Maintenance Requirements shall include repair and rectification of the Defects and deficiencies specified in Annex - I of this Schedule-E within the time limit set forth therein.

3. Other Defects and deficiencies

In respect of any Defect or deficiency not specified in Annex - I of this Schedule-E, the Authority's Engineer may, in conformity with Good Industry Practice, specify the permissible limit of deviation or deterioration with reference to the Specifications and Standards, and any deviation or deterioration beyond the permissible limit shall be repaired or rectified by the Contractor within the time limit specified by the Authority's Engineer.

4 Extension of time limit

Notwithstanding anything to the contrary specified in this Schedule-E, if the nature and extent of any Defect or deficiency justifies more time for its repair or rectification than the time specified herein, the Contractor shall be entitled to additional time in conformity with Good Industry Practice. Such additional time shall be determined by the Authority's Engineer and conveyed to the Contractor and the Authority with reasons thereof.

5 Emergency repairs/restoration

Notwithstanding anything to the contrary contained in this Schedule-E, if any Defect, deficiency or deterioration in the Sewerage Project poses a hazard to safety or risk of damage to property, the Contractor shall promptly take all reasonable measures for eliminating or minimizing such danger.

6 Daily inspection by the Contractor

The Contractor shall, through its engineer, undertake a daily visual inspection of the Sewerage Project and maintain a record thereof in a register to be kept in such form and manner as the Authority may specify. Such record shall be kept in safe custody of the Contractor and shall be open to inspection by the Authority at any time during office hours.

7. Pre-monsoon inspection / Post-monsoon inspection

Deleted

8. Repairs on account of natural calamities

All damages occurring to the Sewerage Project on account of a Force Majeure Event or default or neglect of the Authority shall be undertaken by the Authority at its own cost. The Authority may instruct the Contractor to undertake the repairs at the rates agreed between the Parties.

SCHEDULE - F

(See Clause 3.1.7(a))

APPLICABLE PERMITS

1 Applicable Permits

1.1 The Contractor shall obtain permits and clearances as required under the Applicable Laws for smooth execution of works:

1.2 Applicable Permits, as required, relating to environmental protection and conservation shall have been procured by the Authority in accordance with the provisions of this Agreement.

1.3 The Contractor shall be solely responsible for obtaining the required permits and the Authority will not be liable for payment of compensation on any account for failure in the part of the Contractor to obtain any such permits. However, the authority will facilitate to obtain permits/clearances from the concerned Department.

SCHEDULE - G

(See Clauses 7.1.1, 7.5.3 and 19.2)

FORM OF BANK GUARANTEE

Annex-I

(See Clause 7.1.1)

Performance Security

To,
General Manager,
WATCO Division, Puri.

WHEREAS:

(A) _____[name and address of contractor] (hereinafter called the "**Contractor**") has executed an agreement (hereinafter called the "Agreement") with the [General Manager, WATCO Division, Puri representing MD, WATCO, Bhubaneswar], (hereinafter called the "**Authority**") for "**Construction of Waste Water Treatment Plant at the Confluence point of River Daya & Ganguanala (Phase-II)**" on Engineering, Procurement & Construction (EPC) Contract Including Operation & Maintenance for a Period of Five (5) Years" on Engineering, Procurement and Construction (the "**EPC**") basis, subject to and in accordance with the provisions of the Agreement.

(B) The Agreement requires the Contractor to furnish a Performance Security for due and faithful performance of its obligations, under and in accordance with the Agreement, during the {Construction Period/ Defects Liability Period and operation maintenance period} (as defined in the Agreement) in a sum of Rs…… cr. (Rupees ……..….. crore) (the "**Guarantee Amount**").

(C) We, …….. through our branch at .....(the "**Bank**") have agreed to furnish this bank guarantee (*hereinafter called the* **"Guarantee**") by way of Performance Security.

NOW, THEREFORE, the Bank hereby, unconditionally and irrevocably, guarantees and affirmsas follows:

1. The Bank hereby unconditionally and irrevocably guarantees the due and faithful performance of the Contractor's obligations during the {Construction Period/ Defects Liability Period and Operation & Maintenance period} under and in accordance with the Agreement, and agrees and undertakes to pay to the Authority, upon its mere first written demand, and without any demur, reservation, recourse, contest or protest, and without any reference to the Contractor, such sum or sums up to an aggregate sum of the Guarantee Amount as the Authority shall claim, without the Authority being required to prove or to show grounds or reasons for its demand and/or for the sum specified therein.

2. A letter from the Authority, under the hand of an officer not below the rank of [**General Manager, WATCO Division-II, Bhubaneswar],** that the Contractor has committed default in the due and faithful performance of all or any of its obligations under and in accordance with the Agreement shall be conclusive, final and binding on the Bank. The Bank further

agrees that the Authority shall be the sole judge as to whether the Contractor is in default in due and faithful performance of its obligations during and under the Agreement and its decision that the Contractor is in default shall be final and binding on the Bank, notwithstanding any differences between the Authority and the Contractor, or any dispute between them pending before any court, tribunal, arbitrators or any other authority or body, or by the discharge of the Contractor for any reason whatsoever.

3. In order to give effect to this Guarantee, the Authority shall be entitled to act as if the Bank were the principal debtor and any change in the constitution of the Contractor and/or the Bank, whether by their absorption with any other body or corporation or otherwise, shall not in any way or manner affect the liability or obligation of the Bank under this Guarantee.

4. It shall not be necessary, and the Bank hereby waives any necessity, for the Authority to proceed against the Contractor before presenting to the Bank its demand under this Guarantee.

5. The Authority shall have the liberty, without affecting in any manner the liability of the Bank under this Guarantee, to vary at any time, the terms and conditions of the Agreementor to extend the time or period for the compliance with, fulfillment and/ or performance of all or any of the obligations of the Contractor contained in the Agreement or to postponefor any time, and from time to time, any of the rights and powers exercisable by the Authority against the Contractor, and either to enforce or forbear from enforcing any ofthe terms and conditions contained in the Agreement and/or the securities available to the Authority, and the Bank shall not be released from its liability and obligation under these presents by any exercise by the Authority of the liberty with reference to the matters aforesaid or by reason of time being given to the Contractor or any other forbearance, indulgence, act or omission on the part of the Authority or of any other matter or thing whatsoever which under any law relating to sureties and guarantors would but for this provision have the effect of releasing the Bank from its liability and obligation under this Guarantee and the Bank hereby waives all of its rights under any such law.

6. This Guarantee is in addition to and not in substitution of any other guarantee or security now or which may hereafter be held by the Authority in respect of or relating to the Agreement or for the fulfillment, compliance and/or performance of all or any of the obligations of the Contractor under the Agreement.

7. Notwithstanding anything contained hereinbefore, the liability of the Bank under this Guarantee is restricted to the Guarantee Amount and this Guarantee will remain in forcefor the period specified in paragraph 8 below and unless a demand or claim in writing is made by the Authority on the Bank under this Guarantee all rights of the Authority under this Guarantee shall be forfeited and the Bank shall be relieved from its liabilities hereunder.

8. The Guarantee shall cease to be in force and effect on ****[5]. Unless a demand or claim under this Guarantee is made in writing before expiry of the Guarantee, the Bank shall be discharged from its liabilities hereunder.

9. The Bank undertakes not to revoke this Guarantee during its currency, except with the previous express consent of the Authority in writing, and declares and warrants that it has the power to issue this Guarantee and the undersigned has full powers to do so on behalfof the Bank.

10. Any notice by way of request, demand or otherwise hereunder may be sent by post addressed to the Bank at its above referred branch, which shall be deemed to have been duly authorized to receive such notice and to effect payment thereof forthwith, and if sent by post it shall be deemed to have been given at the time when it ought to have been delivered in due course of post and in proving such notice, when given by post, it shall be sufficient to prove that the envelope containing the notice was posted and a certificate signed by an officer of the

[5] Insert date being 2 (two) years from the date of issuance of this Guarantee (in accordance with Clause 7.2 of theAgreement).

Authority that the envelope was so posted shall be conclusive.

11. This Guarantee shall come into force with immediate effect and shall remain in force and effect for up to the date specified in paragraph 8 above or until it is released earlier by the Authority pursuant to the provisions of the Agreement.

Signed and sealed this ……. day of ……., 20…… at ……..

SIGNED, SEALED AND DELIVERED

For and on behalf of the Bank by:

(Signature)

(Name)

(Designation)

(Code Number)

(Address)

NOTES:

(i) The bank guarantee should contain the name, designation and code number of the officer(s) signing the guarantee.

(ii) The address, telephone number and other details of the head office of the Bank as well as of issuing branch should be mentioned on the covering letter of issuing branch.

(iii) The stamp papers of appropriate value shall be purchased in the name of bank who issues the "Bank Guarantee".

(iv) The bank guarantee shall be from a Nationalised/Scheduled Indian Bank with counter guaranteed by its branch at **Bhubaneswar**.

Annex – II

(Schedule - G)
(See Clause 7.5.3)

Form for Guarantee for Withdrawal of Retention Money

The General Manager,
WATCO Division, Puri.

WHEREAS:

(A) [name and address of contractor] (hereinafter called the "**Contractor**") has executed an agreement (hereinafter called the "Agreement") with the [General Manager, WATCO Sewerage Division, Bhubaneswar representing MD, WATCO, Bhubaneswar, (hereinafter called the "**Authority**") for **"Construction of Waste Water Treatment Plant at the Confluence point of River Daya & Ganguanala (Phase-II)" on Engineering, Procurement & Construction (EPC) Contract Including Operation & Maintenance for a Period of Five (5) Years**" on Engineering, Procurement and Construction (the "**EPC**") basis, subject to and in accordance with the provisions of the Agreement.

(B) In accordance with Clause 7.5.3 of the Agreement, the Contractor may withdraw the retention money (hereinafter called the "**Retention Money**") after furnishing to the Authority a bank guarantee for an amount equal to the proposed withdrawal.

(C) We, …….. through our branch at .....(the "**Bank**") have agreed to furnish this bank guarantee (hereinafter called the "**Guarantee**") for the amount of Rs. -------- cr. (Rs ---------- crore) (the "**Guarantee Amount**").

NOW, THEREFORE, the Bank hereby unconditionally and irrevocably guarantees and affirms as follows:

1. The Bank hereby unconditionally and irrevocably undertakes to pay to the Authority, upon its mere first written demand, and without any demur, reservation, recourse, contest or protest, and without any reference to the Contractor, such sum or sums up to an aggregate sum of the Guarantee Amount as the Authority shall claim, without the Authority being required to prove or to show grounds or reasons for its demand and/or for the sum specified therein.

2. A letter from the Authority, under the hand of an officer not below the rank of [**General Manager, WATCO Division-II, Bhubaneswar],** that the Contractor has committed default in the due and faithful performance of all or any of its obligations for under and in accordance with the Agreement shall be conclusive, final and binding on the Bank. The Bank further agrees that the Authority shall be the sole judge as to whether the Contractor is in default in due and faithful performance of its obligations during and under the Agreement and its decision that the Contractor is in default shall be final, and binding onthe Bank, notwithstanding any differences between the Authority and the Contractor, or any dispute between them pending before any court, tribunal, arbitrators or any other authority or body, or by the discharge of the Contractor for any reason whatsoever.

3. In order to give effect to this Guarantee, the Authority shall be entitled to act as if the Bank were the principal debtor and any change in the constitution of the Contractor and/or the Bank, whether by their absorption with any other body or corporation or otherwise, shall not in any way or manner affect the liability or obligation of the Bank under this Guarantee.

4. It shall not be necessary, and the Bank hereby waives any necessity, for the Authority to proceed against the Contractor before presenting to the Bank its demand under this Guarantee.

5. The Authority shall have the liberty, without affecting in any manner the liability of the Bank under this Guarantee, to vary at any time, the terms and conditions of the Retention Money and any of the rights and powers exercisable by the Authority against the Contractor, and either to enforce or forbear from enforcing any of the terms and conditions contained in the Agreement and/or the securities available to the Authority, and the Bank shall not be released

from its liability and obligation under these presents by any exercise by the Authority of the liberty with reference to the matters aforesaid or by reason of time being given to the Contractor or any other forbearance, indulgence, act or omission on the part of the Authority or of any other matter or thing whatsoever which under any law relating to sureties and guarantors would but for this provision have the effect of releasing the Bank from its liability and obligation under this Guarantee and the Bank hereby waives all of its rights under any such law.

6. This Guarantee is in addition to and not in substitution of any other guarantee or security now or which may hereafter be held by the Authority in respect of or relating to the Retention Money.

7. Notwithstanding anything contained hereinbefore, the liability of the Bank under this Guarantee is restricted to the Guarantee Amount and this Guarantee will remain in forcefor the period specified in paragraph 8 below and unless a demand or claim in writing is made by the Authority on the Bank under this Guarantee all rights of the Authority under this Guarantee shall be forfeited and the Bank shall be relieved from its liabilities hereunder.

8. The Guarantee shall cease to be in force and effect 90 (ninety) days after the date of the Completion Certificate specified in Clause 12.4 of the Agreement.

9. The Bank undertakes not to revoke this Guarantee during its currency, except with the previous express consent of the Authority in writing, and declares and warrants that it has the power to issue this Guarantee and the undersigned has full powers to do so on behalfof the Bank.

10. Any notice by way of request, demand or otherwise hereunder may be sent by post addressed to the Bank at its above referred branch, which shall be deemed to have been duly authorized to receive such notice and to effect payment thereof forthwith, and if sent by post it shall be deemed to have been given at the time when it ought to have been delivered in due course of post and in proving such notice, when given by post, it shall be sufficient to prove that the envelope containing the notice was posted and a certificate signed by an officer of the Authority that the envelope was so posted shall be conclusive.

11. This Guarantee shall come into force with immediate effect and shall remain in force and effect up to the date specified in paragraph 8 above or until it is released earlier by the Authority pursuant to the provisions of the Agreement.

Signed and sealed this ……. day of ……., 20…… at ……..

SIGNED, SEALED AND DELIVERED

For and on behalf of the Bank by:
(Signature)
(Name)
(Designation)
(Code Number)
(Address)

NOTES:

(i) The bank guarantee should contain the name, designation and code number of the officer(s) signing the guarantee.

(ii) The address, telephone number and other details of the head office of the Bank as well as of issuing branch should be mentioned on the covering letter of issuing branch.

(iii) The stamp papers of appropriate value shall be purchased in the name of bank who issues the "Bank Guarantee".

(iv) The bank guarantee shall be from a Nationalised/Scheduled Indian Bank with counter guaranteed by its branch at Bhubaneswar.

Annex – III *(Schedule - G)*

(See Clause 19.2)

Form for Guarantee for Advance Payment

The General Manager
WATCO Division-II, Bhubaneswar.

WHEREAS:

(A) [name and address of contractor] (hereinafter called the "**Contractor**") has executed an agreement (hereinafter called the "Agreement") with the [General Manager, WATCO Division-II, Bhubaneswar representing MD, WATCO, Bhubaneswar, (hereinafter called the "**Authority**") for "Construction of Waste Water Treatment Plant at the Confluence point of River Daya & Ganguanala (Phase-II)" on Engineering, Procurement & Construction (EPC) Contract Including Operation & Maintenance for a Period of Five (5) Years on Engineering, Procurement and Construction (the "**EPC**") basis, subject to and in accordance with the provisions of the Agreement.

(B) In accordance with Clause 19.2 of the Agreement, the Authority shall make to the Contractor an interest bearing advance payment @10% per Annum (herein after called "**Advance Payment**") equal to 10% (ten per cent) of the Contract Price; and that the Advance Payment shall be made in four installments subject to the Contractor furnishingan irrevocable and unconditional guarantee by a Nationalised Bank, counter guaranteed by its branch at Bhubaneswar for an amount equivalent to 110% (one hundred and ten percent) of such installment to remain effective till the complete and full repayment of the installment of the Advance Payment as security for compliance with its obligations in accordance with the Agreement. The amount of {first/second/third/fourth} installment of the Advance Payment is Rs. ------ cr. (Rupees ------ crore) and the amount of this Guarantee is Rs. ------- cr. (Rupees crore)(the **"Guarantee Amount")**[6]**.**

(C) We, …….. through our branch at .....(the "**Bank"**) have agreed to furnish this bank guarantee (*hereinafter called the* **"Guarantee"**) for the Guarantee Amount.

NOW, THEREFORE, the Bank hereby, unconditionally and irrevocably, guarantees and affirmsas follows:

1. The Bank hereby unconditionally and irrevocably guarantees the due and faithful repayment on time of the aforesaid installment of the Advance Payment under and in accordance with the Agreement, and agrees and undertakes to pay to the Authority, uponits mere first written demand, and without any demur, reservation, recourse, contest or protest, and without any reference to the Contractor, such sum or sums up to an aggregate sum of the Guarantee Amount as the Authority shall claim, without the Authority being required to prove or to show grounds or reasons for its demand and/or for the sum specified therein.

2. A letter from the Authority, under the hand of an officer not below the rank of [**General Manager, WATCO Division-II, Bhubaneswar],** that the Contractor has committed default in the due and faithful performance of all or any of its obligations for the repayment of the installment of the Advance Payment under and in accordance with the Agreement shall be conclusive, final and binding on the Bank. The Bank further agrees that the Authority shall be the sole judge as to whether the Contractor is in default in due and faithful performanceof its obligations during and under the Agreement and its decision that the Contractor is in default

[6] The Guarantee Amount should be equivalent to 110% of the value of the applicable installment.

shall be final and binding on the Bank, notwithstanding any differences between the Authority and the Contractor, or any dispute between them pending before any court, tribunal, arbitrators or any other authority or body, or by the discharge of the Contractorfor any reason whatsoever.

3. In order to give effect to this Guarantee, the Authority shall be entitled to act as if the Bank were the principal debtor and any change in the constitution of the Contractor and/or the Bank, whether by their absorption with any other body or corporation or otherwise, shall not in any way or manner affect the liability or obligation of the Bank under this Guarantee.
4. It shall not be necessary, and the Bank hereby waives any necessity, for the Authority to proceed against the Contractor before presenting to the Bank its demand under this Guarantee.
5. The Authority shall have the liberty, without affecting in any manner the liability of the Bank under this Guarantee, to vary at any time, the terms and conditions of the Advance Payment or to extend the time or period of its repayment or to postpone for any time, and from time to time, any of the rights and powers exercisable by the Authority against the Contractor, and either to enforce or forbear from enforcing any of the terms and conditions contained in the Agreement and/or the securities available to the Authority, and the Bank shall not be released from its liability and obligation under these presents by any exercise by the Authority of the liberty with reference to the matters aforesaid or by reason of time being given to the Contractor or any other forbearance, indulgence, act or omission on the part of the Authority or of any other matter or thing whatsoever which under any law relating to sureties and guarantors would but for this provision have the effect of releasing the Bank from its liability and obligation under this Guarantee and the Bank hereby waives all of its rights under any such law.
6. This Guarantee is in addition to and not in substitution of any other guarantee or security now or which may hereafter be held by the Authority in respect of or relating to the Advance Payment.
7. Notwithstanding anything contained hereinbefore, the liability of the Bank under this Guarantee is restricted to the Guarantee Amount and this Guarantee will remain in force for the period specified in paragraph 8 below and unless a demand or claim in writing is made by the Authority on the Bank under this Guarantee all rights of the Authority under this Guarantee shall be forfeited and the Bank shall be relieved from its liabilities hereunder.
8. The Guarantee shall cease to be in force and effect on ****.[7] Unless a demand or claim under this Guarantee is made in writing on or before the aforesaid date, the Bank shall be discharged from its liabilities hereunder.
9. The Bank undertakes not to revoke this Guarantee during its currency, except with the previous express consent of the Authority in writing, and declares and warrants that it has the power to issue this Guarantee and the undersigned has full powers to do so on behalfof the Bank.
10. Any notice by way of request, demand or otherwise hereunder may be sent by post addressed to the Bank at its above referred branch, which shall be deemed to have been duly authorised to receive such notice and to effect payment thereof forthwith, and if sent by post it shall be deemed to have been given at the time when it ought to have been delivered in due course of post and in proving such notice, when given by post, it shall be sufficient to prove that the envelope containing the notice was posted and a certificate

    signed by an officer of the Authority that the envelope was so posted shall be conclusive.
11. This Guarantee shall come into force with immediate effect and shall remain in force and effect up to the date specified in paragraph 8 above or until it is released earlier by the Authority pursuant to the provisions of the Agreement.

[7] Insert a date being 90 (ninety) days after the end of one year from the date of payment of the Advance payment to theContractor (in accordance with Clause 19.2 of the Agreement).

Signed and sealed this ……. day of ……., 20…… at ……..

SIGNED, SEALED AND DELIVERED

For and on behalf of the Bank by:

(Signature)

(Name)

(Designation)

(Code Number)

(Address)

NOTES:

(i) The bank guarantee should contain the name, designation and code number of the officer(s) signing the guarantee.

(ii) The address, telephone number and other details of the head office of the Bank as well as of issuing branch should be mentioned on the covering letter of issuing branch.

(iii) The stamp papers of appropriate value shall be purchased in the name of bank who issues the "Bank Guarantee".

(iv) The bank guarantee shall be from a Nationalised/Scheduled Indian Bank with counter guaranteed by its branch at Bhubaneswar.

_____

SCHEDULE - H

(See Clauses10.1.4 and 19.3)

Contract Price Weightage

1.1 The Contract Price for this Agreement is Rs. ******

1.2 Proportions of the Contract Price for different stages of Construction of the Project shall be as specified below:

(In order to closely monitor the execution of the project and to ensure quality, cost and time of the project are not compromised in any manner, the contractor shall provide Bar Chart & PERT Chart in such a realistic manner so that there will be balance between financial & physical progress with reference to cost & completion time.)

A. PAYMENT BREAK-UP SCHEDULE

Sl No.	Description of Item	Indicative Estimated Project Cost in Rs.	% to Agreement Price
1	Construction Cost (Indicative)	646831000.00	89.29
2	Operation & Maintenance Cost for five year excluding Energy Charges	54336000.00	7.50
3	Energy Charges for Five Years	23285000.00	3.21
		724452000.00	100.00%

B. SEWERAGE PROJECT COMPONENT-WISE PAYMENT BREAK-UP SCHEDULE IN PERCENTAGE FOR MAJOR COMPONENTS OF WORK FOR CONSTRUCTION

Sl No.	Description of Item	% to Total Project Cost
1	**Cluster-I:** **Construction of :** i. **2 Nos** Interception & Diversion works in Drain -1, 2&3 ii. Sewerage Pumping Station (**SPS 1A & 1B**) (Wet Well cum Overhead Pump House). The Pump house is equipped with all the necessary pumping units and required electrical and mechanical units are to be provided. As for inlet to the SPS an Inlet channel 1 No. of width **2.4 m** each and length **10m** to be provided for allow water entrance to the SPS. iii. Laying of Rising Main Network iv. Laying of Sewerage Network v. Power supply by providing dedicated feeder to each SPS. vi. Provision of DG sets to each SPS and automation of the entire system.	16.48
2	**Cluster-II:** **Construction of :** i. **4 Nos** Interception & Diversion works in Branch Drain - 4, 4A, 5 and 10 ii. Sewerage Pumping Station (**SPS-2**) (Wet Well cum Overhead Pump House). The Pump house is equipped with all the necessary pumping units and required electrical and mechanical units are to be provided. As for inlet to the SPS an Inlet channel 2 nos. of width **2.4 m** each and length **10m** are to be provided for allow water entrance to the SPS. iii. Laying of Rising Main Network iv. Laying of Sewerage Network v. Power supply by providing dedicated feeder to each SPS. vi. Provision of DG sets to the SPS and automation of the entire system	29.84
3	**Cluster-III:** **Construction of :** i. **2 Nos** Interception & Diversion works in Branch Drain - 6 and 7 ii. Sewerage Pumping Station (**SPS-3**) (Wet Well cum Overhead Pump House). The Pump house is equipped with all the necessary pumping units and required electrical and mechanical units are to be provided. As for inlet to the SPS an Inlet channel 2 nos. of width **2.4 m** each and length **10m** are to be provided for allow water entrance to the SPS. iii. Laying of Rising Main Network iv. Laying of Sewerage Network v. Power supply by providing dedicated feeder to each SPS. vi. Provision of DG sets to the SPS and automation of the entire system	15.58
4	**Cluster-IV:** **Construction of :** i. **3 Nos** Interception & Diversion works in Branch Drain - 8, 8A & 9, 9A & 11 ii. Sewerage Pumping Station (**SPS-4**) (Wet Well cum Overhead Pump House). The Pump house is equipped with all the necessary pumping units and required electrical and mechanical units are to be provided. As for inlet to the SPS an Inlet channel 2 nos. of width **2.4 m** each and length **10m** are to be provided for allow water entrance to the SPS. iii. Laying of Rising Main Network iv. Laying of Sewerage Network v. Power supply by providing dedicated feeder to each SPS. vi. Provision of DG sets to the SPS and automation of the entire system	38.10
	Total :	**100.00**

(A) SCHEDULE OF BREAK-DOWN PAYMENT AGINST MAJOR COMPONENTS OF WORKS UNDER ITEM A & B ABOVE.

[To be furnished by the Successful Bidder after due approval of the construction schedule for the period of 24 months as per Schedule-J by the authority. The decision of the authority i.e., PHEO is final & binding on the proposal of the successful bidder regarding break-down payment schedule]

If payment is on a periodic basis according to pre-estimated construction progress.

Month	Description	Type of Payment	Amount for INR Portion			
			Civil works	Design & Documentation	Plant &Equipment	Total
1st 2nd 3rd 24th						
Total						

Note:

*(i) The Employer and the Contractor may make necessary **Approval and adjustments** to the payment schedule if the progress of work is substantially ahead of or behind the program.*

*(ii) The Contractor shall make necessary break down of Civil works for Payment Schedule with reference to the Table **A0.***

Table A0 Break Down of Civil Works Payment Schedule for Interim Valuations		
Major Work Category	**Type of Payment**	**Payment (in % of Total Price)**
1.Water Retaining Structure Units		
(i) Up to Base slab	LS	15%
(ii) Walls	LS	
(a) Half Stage of Design Height		25%
(b) Full Stage Design Height		25%
(iii) Platform, Handrail and other Miscellaneous Works	LS	25%
(iv) Hydraulic Testing	LS	5%
(v) On successful Testing, Commissioning & Stabilization	LS	5%
2. Other Units		
(i) Up to Base Slab / Foundation	LS	25%
(ii) Walls	LS	50%
(iii) Platform, Handrail and other Miscellaneous Works	LS	15%
(iv) On successful Testing, Commissioning & Stabilization	LS	10%
3. Buildings (Single Storeyed)		
(i) Up to Plinth Level	LS	15%
(ii) Up to Roof Slab(including Roof Slab)	LS	25%
(iii) Brick work, Internal & External Plastering	LS	20%
(iv) Flooring, Plastering, Doors, Windows, Painting, Waterproofing & other Miscellaneous Works	LS	30%
(v) On successful Testing, Commissioning	LS	10%
4. Buildings (Double Storied)		
(i) Up to Plinth Level	LS	10%
(ii) Up to Ground floor Roof Slab(including Roof Slab)	LS	15%
(iii) Up to First floor Roof Slab(including Roof Slab)	LS	15%
(iv) Brick work, Internal & External Plastering	LS	20%
(v) Flooring, Plastering, Doors, Windows, Painting, Waterproofing & other Miscellaneous Works	LS	30%
(vi) On successful Testing, Commissioning	LS	10%
5. Boundary Wall Complete		
(i) On completion per meter	P	90%
(ii) On successful Commissioning	LS	10%
6. Landscaping Complete		
(i) Hard Landscaping On completion per Square meter	P	30%
(ii) Soft Landscaping On completion per Square meter	P	30%
(iii) Planting of Trees, Shrubs	P	20%
(iv) Completion	LS	20%
7. Roads, Pavements Complete		
(i) On completion per square meter	P	90%
(ii) On successful Commissioning	LS	10%

Table A0 Break Down of Civil Works Payment Schedule for Interim Valuations		
Major Work Category	**Type of Payment**	**Payment (in % of Total Price)**
8. **Supplying & Laying of DWC pipes, RCC NP-3 pipes & DI pipes**		
(i) On Delivery of pipes duly inspected by Third Party Inspection as per the work schedule approved by Engineer-in-Charge with responsibility of contractor for safely stacking, storing, handling, watch & ward etc till completion in all respect (%age to be paid on the item brought to the site)	P	75%
(ii) On completion of laying of pipeline	P	15%
(iii) Testing & Commissioning	LS	10%
9. **Supplying & installation of pump sets**		
(i) On Delivery of pump sets duly inspected by Third Party Inspection as per the work schedule approved by Engineer-in-Charge with responsibility of contractor for safely storing, handling, watch & ward etc till completion in all respect (%age to be paid on the item brought to the site)	P	70%
(ii) On completion of installation	P	20%
(iii) Testing & Commissioning	LS	10%

SCHEDULE OF PRICES

Name of Work	**"Construction of Waste Water Treatment Plant at the Confluence point of River Daya & Ganguanala (Phase-II)" on Engineering, Procurement & Construction (EPC) Contract Including Operation & Maintenance for a Period of Five (5) Years**

Note: Described full name of work listed in PREAMBLE of Schedules of Rates and Prices

A1 Design, Drawings and Documentation

Item	Description	Unit	Quantity	Unit Rate		Total Price	
					Local Currency Portion (INR)		Local (INR)
Total (to Schedule A-5-a Summary of Work)							

A2 Plant & Equipment including mandatory spare parts, to be supplied from within India

Item	Description	Unit	Quantity	Ex-Factory Price (INR)	GST (INR)	Freight & Insurance (INR)	Total Price (INR)
						Total (to Schedule A-5-a Summary of Work)	

A3 Civil Works, Installation and Other Services

Item	Description	Unit	Quantity	Unit Rate		Total Price	
					Local Currency Portion (INR)		Local (INR)
Total (to Schedule A-5-a Summary of Work)							

A4-(a)Summary of Work

Name of Work	**"Construction of Waste Water Treatment Plant at the Confluence point of River Daya & Ganguanala (Phase-II)" on Engineering, Procurement & Construction (EPC) Contract Including Operation & Maintenance for a Period of Five (5) Years**

Note: Described full name of work listed in PREAMBLE of Schedules of Rates and Prices

Item	Description	Total Price	
			Local
A-1	Total Schedule A-1: Design, Drawings and Documentation		
	Total Schedule A-2:		
A-2	Plant and Equipment, including Mandatory spare parts, supplied from within the Employer's Country		
A-3	Total Schedule A-3: Civil Works, Installation and Other Services		
	Total (to Schedule A-5-b Grand Summary)		

A4-(b) Grand Summary

"Construction of Waste Water Treatment Plant at the Confluence point of River Daya & Ganguanala (Phase-II)" on Engineering, Procurement & Construction (EPC) Contract Including Operation & Maintenance for a Period of Five (5) Years			
Item	Description	Total Price	
			Local
(i)	Total Schedule A-5 Gravity Sewer network for TP-1,2,3&4		
(ii)	Total Schedule A-5 Construction of Manholes		
(iii)	Total Schedule A-5 Construction of Sewer property Connection		
(iv)	Total Schedule A-5 Construction of bituminous Road		
(v)	Total Schedule A-5 Construction & Restoration of Roads		
(vi)	Total Schedule A-5 Construction of Sewage Treatment Plant		
(vii)	Total Schedule A-5 Construction of Sewage Pumping Stations		
(viii)	Total Schedule A-5 Electro-Mechanical Works for Pumping Stations		
(ix)	Total Schedule A-5 Providing & Commissioning Pumping Main		
(x)	Total Schedule A-5 Providing sewer cleaning equipments		
(xi)	Total Schedule A-5 Sewer Laying by Micro-Tunnelling		
(xii)	Other ancillary items as defined and/or required for completion of project		
	Total (to Letter of Price Bid)		

A-5 Schedule of Operation and Maintenance Requirements

Requirements for operation and maintenance of the Sewage Treatment Plant & Pumping Stations, Pipelines etc. for an initial Five year period following completion of the Works.

Name of Work	

Note: Described full name of work listed in PREAMBLE of Schedules of Rates and Prices

Description of Operation	**Recommended Frequency of Operation (Daily, Weekly, Monthly, Yearly, etc.)**	**Annual Consumption/ Requirement**	**Unit Rate(2018 – 2019 rates)**	**Yearly Fixed Charges (2018 – 2019 rates)**	**Yearly Variable Cost (2018 – 2019 rates)**
Year 1 (a) a-.Routine operating costs Electricity Energy (with details of HP, KVA,KWH) Fuel Oil b- Chemicals Other inputs Labour (i) (ii) (iii) c-Periodic maintenance costs(as per manufacturer's maintenance schedule) Servicing (Labour) Cost of oil, chemicals, lubricants, etc. d-Others (a) Repair and Replacement Replacements: (i) (ii) (iii) Repairs (b) Miscellaneous (Others) Sludge Disposal (i) (ii)					
Total (a)+(b)+(c)+(d)(goes to "Summary of Operation and Maintenance")					

Note: (The Bidder shall provide complete details on all aspects of the operating and maintenance requirements relating to his proposed facilities in the above form or in any other form and detail as may be required for the Employer to properly evaluate the annual costs of operating the facilities with due regard to the particular items of Plant and equipment which the Bidder proposes to supply under the Contract. In preparing this schedule the Bidder shall consider that the Plant and facilities will operate for 22 hours per day, 365 days per year, and shall be operating at the specified design capacity throughout the entire period. Quantities and costs shall be estimated based on the current rates for such activity (i.e. 2016-2017 costs), but the Year in which such expenditure is to be incurred shall be clearly identified.).

A 6 (a) Summary of Operation and Maintenance by Work

Name of Work	**"Construction of Waste Water Treatment Plant at the Confluence point of River Daya & Ganguanala (Phase-II)" on Engineering, Procurement & Construction (EPC) Contract Including Operation & Maintenance for a Period of Five (5) Years**

Note: Described full name of work listed in PREAMBLE of Schedules of Rates and Prices

O&M Year	Yearly Expenditure (as Base Year _____)		
	Fixed Charge	Variable Cost	Total Cost
Year 1			
Year 2			
Year3			
Year 4			
Year 5			
Total for Operation and Maintenance(carried forward to Grand Summary)	In Figure	In Figure	In Figure
	In Words	In Words	In Words

O&M cost: 5 yr. Operation & Maintenance (O&M)

A 6 (b) Grand Summary of Operation and Maintenance

O&M Year	Yearly Expenditure (as Base Year _____)						Reserve Fund For Major Maintenance, Repair and replacement	Total Cost
Year-1								
Year 2								
Year 3								
Year 4								
Year 5								
Total for Operation and Maintenance (carried forward to letter of Price Bid)								In Figure
	Total Cost In Words							

O&M cost: 5 yr. Operation & Maintenance (O&M)

Reserve Fund for Major Maintenance, Repair and replacement: minimum 5% of the Fixed component of annual O&M cost for each year.

SCHEDULE - I

(See Clause 10.2.4)

DRAWINGS

1 Drawings

In compliance of the obligations set forth in Clause 10.2 of this Agreement, the Contractor shall furnish to the Authority/ Authority's Engineer, free of cost, all Drawings listed in Annex-I of this Schedule-I.

2 Additional Drawings

If the Authority/ Authority's Engineer determines that for discharging its duties and functions under this Agreement, it requires any drawings other than those listed in Annex- I, it may by notice require the Contractor to prepare and furnish such drawings forthwith. Upon receiving a requisition to this effect, the Contractor shall promptly prepare and furnish such drawings to the Authority/ Authority's Engineer, as if such drawings formed part of Annex-I of this Schedule-I.

Annex - I

(Schedule - I)

List of Drawings

The contractor is required to furnish the following drawing to the Authority Engineer free of cost under clause 10.2 including the details as attached in the Annexure herewith describing the scope of work during survey, investigation and design stage.

1. Index Plan for Proposed Sewerage Scheme
2. Schematic Layout of Proposed Sewerage Scheme
3. Plan showing Rising Main Alignment drawing for all RM
4. Layout of Proposed STP
5. Layout of Proposed Pumping Stations
6. Hydraulic Flow Diagram of Proposed STPs
7. Details of Inspection Chambers
8. Details for Manholes of various depth
9. Details of Bedding to sewer network
10. General Arrangement Drawing for Security Room with toilet block
11. General Arrangement Drawing for Compound walls
12. SLD for Pumping Station
13. SLD for STP
14. GAD of individual units of STP
15. Structural drawings of units of STP
16. Piping Layout for PS & STP
17. Electrical Layouts
18. Cable trey layout
19. Sub Station Layouts
20. System Architecture
21. All necessary drawings which are required to complete the works

SCHEDULE – J

See Clause 10.3.2)

PROJECT COMPLETION SCHEDULE

[In order to closely monitor the execution of the project and to ensure quality, cost and time of the project are not compromised in any manner, the contractor shall provide bar chart & PERT Chart in such a realistic manner so that there will be balance between financial & physical progress with reference to cost & completion time]

1 Project Completion Schedule

During Construction period, the Contractor shall comply with the requirements set forth in this Schedule-J for each of the Project Milestones and the **Scheduled Completion Date**. Within 15 (fifteen) days of the date of each Project Milestone, the Contractor shall notify the Authority of such compliance along with necessary particulars thereof.

2 Project Milestone-I

2.1 Project Milestone-I shall occur on the date falling on the 4th* month from the Appointed Date (the "**Project Milestone-I**").

2.2 Prior to the occurrence of Project Milestone-I, the Contractor shall have commenced construction of the Sewerage Project and submitted to the Authority duly and validly prepared Stage Payment Statements for an amount not less than 10% (Ten per cent) of the Contract Price.

3 Project Milestone-II

3.1 Project Milestone-II shall occur on the date falling on the 8th* month from the Appointed Date (the "**Project Milestone-II**").

3.2 Prior to the occurrence of Project Milestone-II, the Contractor shall have continued with construction of the Sewerage Project and submitted to the Authority duly and validly prepared Stage Payment Statements for an amount not less than 30% (thirty per cent) of the Contract Price.

4 Project Milestone-III

4.1 Project Milestone-III shall occur on the date falling on the 12th* month from the Appointed Date (the "**Project Milestone-III**").

4.2 Prior to the occurrence of Project Milestone-III, the Contractor shall have continued with construction of the Sewerage Project and submitted to the Authority duly and validly prepared Stage Payment Statements for an amount not less than 50% (fifty per cent) of the Contract Price.

5 Project Milestone-IV

5.1 Project Milestone-III shall occur on the date falling on the 16th* month from the Appointed Date (the "**Project Milestone-IV**").

5.2 Prior to the occurrence of Project Milestone-III, the Contractor shall have continued with construction of the Sewerage Project and submitted to the Authority duly and validly prepared Stage Payment Statements for an amount not less than 70% (seventy per cent) of the Contract Price.

6 Project Milestone-V

6.1 Project Milestone-V shall occur on the date falling on the 20th* month from the Appointed

Date (the "**Project Milestone-V**").

6.2 Prior to the occurrence of Project Milestone-III, the Contractor shall have continued with construction of the Sewerage Project and submitted to the Authority duly and validly prepared Stage Payment Statements for an amount not less than 90% (Ninety per cent) of the Contract Price.

7 Scheduled Completion Date

7.1 The Scheduled Completion Date shall occur on the last day of 24th** month from the Appointed Date.

7.2 On or before the Scheduled Completion Date, the Contractor shall have completed construction in accordance with this Agreement.

8 Extension of time

Upon extension of any or all of the aforesaid Project Milestones or the Scheduled Completion Date, as the case may be, under and in accordance with the provisions of this Agreement, the Project Completion Schedule shall be deemed to have been amended accordingly.

* The milestone has to be proportionately fixed considering the period of completion.

** Period of completion.

SCHEDULE - K

(See Clause 12.1.2)

Tests on Completion

1 Schedule for Tests

1.1 The Contractor shall, no later than 30 (thirty) days prior to the likely completion of construction, notify the Authority/ Authority's Engineer and the Authority of its intent to subject the Sewerage Project to Tests, and no later than 10 (ten) days prior to the actualdate of Tests, furnish to the Authority/ Authority's Engineer and the Authority detailed inventory and particulars of all works and equipment forming part of Works.

1.2 The Contractor shall notify the Authority/ Authority's Engineer of its readiness to subject the Sewerage Project to Tests at any time after 10 (ten) days from the date of such notice, and upon receipt of such notice, the Authority/ Authority's Engineer shall, in consultation with the Contractor, determine the date and time for each Test and notify the same to the Authority who may designate its representative to witness the Tests. The Authority/ Authority's Engineer shall thereupon conduct the Tests itself or cause any of the Tests tobe conducted in accordance with Article 12 and this Schedule-K.

2 Tests

2.1 Visual and physical test: The Authority/ Authority's Engineer shall conduct a visual and physical check of construction to determine that all works and equipment forming part thereof conform to the provisions of this Agreement. The physical tests shall include hydraulic test of pipelines, water tightness of water retaining structures, duty of pump sets, flow measurement and head loss test, operation of valves and any other physical tests required as per scope of work.

2.2 Effluent standard test: Quality of raw sewage and effluent from STP shall be checked according to CPCB norms.

2.3 Tests for Pipe lines: Rising main and sewer networks shall be subjected to the tests to be conducted as per relevant IS specification.

2.4 Other tests: The Authority/ Authority's Engineer may require the Contractor to carry out or cause to be carried additional tests, in accordance with Good Industry Practice, for determining the compliance of the Sewerage Project with Specifications and Standards.

2.5 Environmental audit: The Authority/ Authority's Engineer shall carry out a check to determine conformity of the Sewerage Project with the environmental requirements set forth in Applicable Laws and Applicable Permits.

2.6 Safety Audit: The Authority/ Authority's Engineer shall carry out, or cause to be carried out, a safety audit to determine conformity of the Sewerage Project with the safety requirements and Good Industry Practice.

3 Agency for conducting Tests

All Tests set forth in this Schedule-K shall be conducted by the Authority/ Authority's Engineer or such other agency or person as it may specify in consultation with the Authority.

4 Completion Certificate

Upon successful completion of Tests, the Authority/ Authority's Engineer shall issue the Completion Certificate in accordance with the provisions of Article 12.

SCHEDULE - L

(See Clause 12.2 and 12.4)

PROVISIONAL CERTIFICATE

1 I, ……. (Name of the Authority/ Authority's Engineer), acting as the Authority/ Authority's Engineer, under and in accordance with the Agreement dated ……. (the **"Agreement"**), for construction of the work (Name of the Project) on Engineering, Procurement and Construction (EPC) basis through …… (Name of Contractor), hereby certify that the Tests in accordance with Article 12 of the Agreement have been undertaken to determine compliance of the Sewerage Project withthe provisions of the Agreement.

2 Works that are incomplete on account of Time Extension have been specified in the Punch List appended hereto, and the Contractor has agreed and accepted that it shall complete all such works in the time and manner set forth in the Agreement. In addition, certain minor works are incomplete and these are not likely to cause material inconvenience to the Users of the Sewerage Projector affect their safety. The Contractor has agreed and accepted thatas a condition of this Provisional Certificate, it shall complete such minor works within 30 (thirty) days hereof. These minor works have also been specified in the aforesaid Punch List.

3 In view of the foregoing, I am satisfied that the Sewerage Project can be safely and reliably placed in service of the Users thereof, and in terms of the Agreement, the Sewerage Project is hereby provisionally declared fit for entry into operation on this the …… day of …….. 20…...

ACCEPTED, SIGNED, SEALED AND DELIVERED For and on behalf of CONTRACTOR by:	SIGNED, SEALED AND DELIVERED For and on behalf of AUTHORITY'S ENGINEER by:
(Signature) (Name and Designation) (Address)	(Signature) (Name and Designation) (Address)

COMPLETION CERTIFICATE

1 I, ……. (Name of the Authority/ Authority's Engineer), acting as the Authority/ Authority's Engineer, under and in accordance with the Agreement dated …… (the "**Agreement**"), for construction of the work (Name of the Project) on Engineering, Procurement and Construction (EPC) basis through..... (Name of Contractor), hereby certify that the Tests in accordance with Article 12 of the Agreement have been successfully undertaken to determine compliance of the Sewerage Project with the provisions of the Agreement, and I am satisfied that the Sewerage Project can be safely and reliably placed in service of the Users thereof.

2 It is certified that, in terms of the aforesaid Agreement, all works forming part of Sewerage Project have been completed, and the Sewerage Project is hereby declared fit for entry into operation on this the …… day of …… 20…..

SIGNED, SEALED AND DELIVERED by

For and on behalf of the Authority/ Authority's Engineer b

(Signature)

(Name)

(Designation)

(Address)

SCHEDULE - M

(See Clauses 14.6, 15.2 and 19.7)

PAYMENT REDUCTION FOR NON-COMPLIANCE

1. Payment reduction for non-compliance with the Operation & Maintenance Requirements

1.1 Monthly lump sum payments for Operation & maintenance shall be reduced in the case of non-compliance with the Operation & Maintenance Requirements set forth in Schedule-E.

1.2 Any deduction made on account of non-compliance with the Operation & Maintenance requirements shall not be paid even after compliance subsequently. The deductions shall continue to be made every month until compliance is done.

1.3 The Authority shall calculate the amount of payment reduction on the basis of weightage assigned to non-conforming items as given in Paragraph 2.

2. Reductions in lump sum payments

2.1 The following shall govern the payment reduction:

[A] REDUCTION TO BE MADE FROM LUMP-SUM PAYMENT FOR NON-PERFORMANCE OF DAILY MAINTENANCE

Sl. No.	Items	Penalties
1.	**Pumps, Motors , Control Panels, PLC/SCADA, Screens, Classifiers, Centrifuge and Blowers etc.**	
a)	If daily checks are not undertaken	Rs.50.00/each /day
b)	If steps are not taken to rectify defects	Rs.100.00/each day beyond the day on which the defects were noticed.
c)	If defects are not rectified within the time as prescribed in Schedule – E or within a justified time frame in the opinion of the Authority Engineer, whichever is later.	The defects may be rectified by the Department by engaging any other suitable agency and the cost thereof & damages shall be recovered from the contractor as per clause 14.7.
2.	**Transformers/Sub-stations**	
a)	If daily checks are not undertaken	Rs.50.00/each Transformer or Sub-station/day
b)	If steps are not taken to rectify defects	Rs.100.00/each day beyond the day on which the defects were noticed.
c)	If defects are not rectified within the time as prescribed in Schedule – E or within a justified time frame in the opinion of the Authority Engineer, whichever is later.	The defects may be rectified by the Department by engaging any other suitable agency and the cost thereof & damages shall be recovered from the contractor as per clause 14.7.
3.	**Rising main**	
a)	If daily checks are not undertaken	Rs.100.00/each Km./day
b)	If leakages are not rectified within 24 hours.	• Rs.200.00/each leakage/ day for pipe lines upto 300 mm dia. • Rs.400.00/each leakage/ day for pipe lines beyond 300 mm dia & upto 600 mm dia. • Rs.800.00/each leakage/ day for pipe lines beyond 600 mm dia.

c)	If leakages are not rectified within the time as prescribed in Schedule – E or within a justified time frame in the opinion of the Authority Engineer, whichever is later.	The defects may be rectified by the Department by engaging any other suitable agency and the cost thereof & damages shall be recovered from the contractor as per clause 14.7.
4.	**Sewer network/ Gravity sewers**	
a)	If daily checks against complaints received are not undertaken	Rs.50.00/each complaint/day
b)	If corrective measures against complaints/leakages are not rectified within 24 hours.	Rs.100.00/each complaint or leakage/ day
c)	If leakages are not rectified within the time as prescribed in Schedule – E or within a justified time frame in the opinion of the Authority Engineer, whichever is later.	The defects may be rectified by the Department by engaging any other suitable agency and the cost thereof & damages shall be recovered from the contractor as per clause 14.7.
5.	**STP –Instrumentations & Control System (excluding items covered in Sl.No.1 to 4 above)**	
a)	If daily checks are not undertaken	Rs.400.00/each/day
b)	If corrective measures/steps against defects are not undertaken within 24 hours.	Rs.800.00/each defect/ day
c)	If defects are not rectified within the time as prescribed in Schedule – E or within a justified time frame in theopinion of the Authority Engineer, whichever is later.	The defects may be rectified by the Department by engaging any other suitable agency and the cost thereof & damages shall be recovered from the contractor as per clause 14.7.

[B] REDUCTION TO BE MADE FROM LUMP-SUM PAYMENT FOR NON-PERFORMANCE OF PREVENTIVE MAINTENANCE AS DETAILED IN CLAUSE NO.19.3.8 OF ANNEXURE-I, SCHEDULE-B OF EPC AGREEMENT.

Sl. No.	Items	Penalties
1.	**Monthly**	
a)	Pumps, Panels, Circuit Breakers, Starters, PLC/SCADA, Screens, Classifiers, Centrifuge, Decanters& Blowers etc.	Rs.800.00/month
b)	Transformers/Sub-stations	Rs.400.00/month
2.	**Quarterly**	
a)	Pumps, Panels, Circuit Breakers,Starters, PLC/SCADA, Screens, Classifiers, Centrifuge, Decanters & Blowers etc.	Rs.1200.00/month
b)	Transformers/Sub-stations	Rs.800.00/month
3.	**Semi-Annually (Half Yearly)**	
a)	Pumps, Panels, Circuit Breakers, Starters, PLC/SCADA, Screens, Classifiers, Centrifuge, Decanters & Blowers etc.	Rs.1600.00/month
b)	Transformers/Sub-stations	Rs.1600.00/month
4.	**Annually**	

a)	Pumps, Panels, Circuit Breakers, Starters, PLC/SCADA, Screens, Classifiers, Centrifuge, Decanters & Blowers etc..	Rs.2000.00/month
b)	Transformers/Sub-stations	Rs.2000.00/month
c)	Cleaning of tanks and de-silting	These items of works will be taken up by the Department by engaging any other suitable agency and the cost thereof & damages shall be recovered from the contractor as per clause 14.7.
5.	**Bi-Annually**	
a)	Transformers/Sub-stations	The complete examination including internal connections, core & windings etc., as may be required & rectifications will be taken up by the Department by engaging any other suitable agency and the cost thereof & damages shall be recoveredfrom the contractor as per clause 14.7.

SCHEDULE - N

(See Clause 18.1.1)

SELECTION OF AUTHORITY'S ENGINEER

1 Selection of Authority's Engineer

1.1 The provisions of the Model Request for Proposal for Selection of Technical Consultants, issued by the Ministry of Finance in May 2009, or any substitute thereof shall apply for selection of an experienced firm to discharge the functions and duties of an Authority's Engineer.

1.2 In the event of termination of the Technical Consultants appointed in accordance with the provisions of Paragraph 1.1, the Authority shall appoint another firm of Technical Consultants forthwith and may engage a government-owned entity in accordance with the provisions of Paragraph 3 of this Schedule-N.

2 Terms of Reference

The Terms of Reference for the Authority's Engineer (the "**TOR**") shall substantially conform with Annex 1 to this Schedule N.

3 Appointment of Government entity as Authority's Engineer

Notwithstanding anything to the contrary contained in this Schedule, the Authority may in its discretion appoint a government-owned entity as the Authority's Engineer; provided that such entity shall be a body corporate having as one of its primary functions the provision of consulting, advisory and supervisory services for engineering projects; provided further that a government-owned entity which is owned or controlled by the Authority shall not be eligible for appointment as Authority's Engineer.

Annex – I

(Schedule - N)

TERMS OF REFERENCE FOR AUTHORITY'S ENGINEER

1 Scope

1.1 These Terms of Reference (the "**TOR**") for the Authority's Engineer are being specified pursuant to the EPC Agreement dated.....(the "**Agreement**), which has been entered into between the [name and address of the Authority] (the "**Authority**") and.....(the "**Contractor**") for the work (Name of the Project) in the State of Odisha on Engineering, Procurement, Construction (EPC) basis, and a copy of which is annexed hereto and marked as Annex-A to form part of this TOR.

1.2 The TOR shall apply to construction and Operation & Maintenance of the Sewerage Project.

2 Definitions and interpretation

2.1 The words and expressions beginning with or in capital letters and not defined herein but defined in the Agreement shall have, unless repugnant to the context, the meaning respectively assigned to them in the Agreement.

2.2 References to Articles, Clauses and Schedules in this TOR shall, except where the context otherwise requires, be deemed to be references to the Articles, Clauses and Schedules of the Agreement, and references to Paragraphs shall be deemed to be references to Paragraphs of this TOR.

2.3 The rules of interpretation stated in Clauses 1.2, 1.3 and 1.4 of the Agreement shall apply, *mutatis mutandis*, to this TOR.

3. General

3.1 The Authority's Engineer shall discharge its duties in a fair, impartial and efficient manner, consistent with the highest standards of professional integrity and Good Industry Practice.

3.2 The Authority's Engineer shall perform the duties and exercise the authority in accordance with the provisions of this Agreement, but subject to obtaining prior written approval of the Authority before determining:

(a) any Time Extension;

(b) any additional cost to be paid by the Authority to the Contractor;

(c) the Termination Payment; or

(d) any other matter which is not specified in (a), (b) or (c) above and which creates an obligation or liability on either Party for a sum exceeding Rs. 5,000,000 (Rs. fifty lakh).

3.3 The Authority's Engineer shall submit regular periodic reports, at least once every month, to the Authority in respect of its duties and functions under this Agreement. Such reports shall be submitted by the Authority's Engineer within 10 (ten) days of the beginning of every month.

3.4 The Authority's Engineer shall inform the Contractor of any delegation of its duties and responsibilities to its suitably qualified and experienced personnel; provided, however, thatit shall not delegate the authority to refer any matter for the Authority's prior approval in accordance with the provisions of Clause 18.2.

3.5 The Authority's Engineer shall aid and advise the Authority on any proposal for Change of Scope under Article 13.

3.6 In the event of any disagreement between the Parties regarding the meaning, scope and nature of Good Industry Practice, as set forth in any provision of the Agreement, the Authority's Engineer shall specify such meaning, scope and nature by issuing a reasoned written statement relying on good industry practice and authentic literature.

4 Construction Period

4.1 During the Construction Period, the Authority's Engineer shall review the Drawings furnished by the Contractor along with supporting data, including the geo-technical and hydrological investigations, characteristics of materials from quarry sites, topographical surveys, and the recommendations of the Safety Consultant in accordance with the provisions of Clause 10.1.6. The Authority's Engineer shall complete such review and send its observations to the Authority and the Contractor within 15 (fifteen) days of receipt of such Drawings; provided, however that in case of a Major Structures, the aforesaid period of 15 (fifteen) days may be extended upto 30 (thirty) days. In particular, such comments shall specify the conformity or otherwise of such Drawings with the Scope ofthe Project and Specifications and Standards.

4.2 The Authority's Engineer shall review any revised Drawings sent to it by the Contractor and furnish its comments within 10 (ten) days of receiving such Drawings.

4.3 The Authority's Engineer shall review the Quality Assurance Plan submitted by the Contractor and shall convey its comments to the Contractor within a period of 21 (twenty- one) days stating the modifications, if any, required thereto.

4.4 The Authority's Engineer shall complete the review of the methodology proposed to be adopted by the Contractor for executing the Works, and convey its comments to the Contractor within a period of 10 (ten) days from the date of receipt of the proposed methodology from the Contractor.

4.5 Deleted.

4.6 The Authority's Engineer shall review the monthly progress report furnished by the Contractor and send its comments thereon to the Authority and the Contractor within 7 (seven) days of receipt of such report.

4.7 The Authority's Engineer shall inspect the Construction Works of the Sewerage Project and shall submit a monthly Inspection Report bringing out the results of inspections and the remedial action taken by the Contractor in respect of Defects or deficiencies. In particular, the Authority's Engineer shall include in its Inspection Report, the compliance of the recommendations made by the Safety Consultant.

4.8 The Authority's Engineer shall conduct the pre-construction review of manufacturer's test reports and standard samples of manufactured Materials, and such other Materials as the Authority's Engineer may require.

4.9 For determining that the Works conform to Specifications and Standards, the Authority's Engineer shall require the Contractor to carry out, or cause to be carried out, tests at such time and frequency and in such manner as specified in the Agreement and in accordance with Good Industry Practice for quality assurance. For purposes of this Paragraph 4.9, the tests specified in the relevant IS specification and CPHEEO manual on Sewerage & Sewage Treatment issued by MoUD or any modification/substitution thereof shall be deemed to be tests conforming to Good Industry Practice for quality assurance.

4.10 The Authority's Engineer shall test check at least 20 (twenty) percent of the quantity or number of tests prescribed for each category or type of test for quality control by the Contractor.

4.11 The timing of tests referred to in Paragraph 4.9, and the criteria for acceptance/ rejection of their results shall be determined by the Authority's Engineer in accordance with the Quality Control Manuals. The tests shall be undertaken on a random sample basis and shall be in addition to, and independent of, the tests that may be carried out by the Contractor for its own quality assurance in accordance with Good Industry Practice.

4.12 In the event that results of any tests conducted under Clause 11.10 establish any Defects or deficiencies in the Works, the Authority's Engineer shall require the Contractor to carry out remedial measures.

4.13 The Authority's Engineer may instruct the Contractor to execute any work which is urgently required for the safety of the Sewerage Project, whether because of an accident, unforeseeable event or otherwise; provided that in case of any work required on account ofa Force Majeure Event, the provisions of Clause 21.6 shall apply.

4.14 In the event that the Contractor fails to achieve any of the Project Milestones, the Authority's Engineer shall undertake a review of the progress of construction and identify potential delays, if any. If the Authority's Engineer shall determine that completion of the Sewerage Project is not feasible within the time specified in the Agreement, it shall require the Contractor to indicate within 15 (fifteen) days the steps proposed to be taken to expedite progress, and the period within which the Project Completion Date shall be achieved. Upon receipt of a report from the Contractor, the Authority's Engineer shall review the same and send its comments to the Authority and the Contractor forthwith.

4.15 The Authority's Engineer shall obtain from the Contractor a copy of all the Contractor's quality control records and documents before the Completion Certificate is issued pursuant to Clause 12.4.

4.16 Authority's Engineer may recommend to the Authority suspension of the whole or part of the Works if the work threatens the safety of the Users. After the Contractor has carried out remedial measure, the Authority's Engineer shall inspect such remedial measures forthwith and make a report to the Authority recommending whether or not the suspension hereunder may be revoked.

4.17 In the event that the Contractor carries out any remedial measures to secure the safety of suspended works and Users, and requires the Authority's Engineer to inspect such works, the Authority's Engineer shall inspect the suspended works within 3 (three) days of receiving such notice, and make a report to the Authority forthwith, recommending whether or not such suspension may be revoked by the Authority.

4.18 The Authority's Engineer shall carry out, or cause to be carried out, all the Tests specified in Schedule-K and issue a Completion Certificate or Provisional Certificate, as the case may be. For carrying out its functions under this Paragraph 4.18 and all matters incidental thereto, the Authority's Engineer shall act under and in accordance with the provisions of Article 12 and Schedule-K.

5. Operation & Maintenance Period

5.1 Deleted
5.2 Deleted
5.3 Deleted
5.4 Deleted
5.5 Deleted

6 Determination of costs and time

6.1 The Authority's Engineer shall determine the costs, and/or their reasonableness, that are required to be determined by it under the Agreement.

6.2 The Authority's Engineer shall determine the period of Time Extension that is required to be determined by it under the Agreement.

6.3 The Authority's Engineer shall consult each Party in every case of determination in accordance with the provisions of Clause 18.5.

7. Payments

7.1 The Authority's Engineer shall withhold payments for the affected works for which the Contractor fails to revise and resubmit the Drawings to the Authority's Engineer in accordance with the provisions of Clause 10.2.4 (d).

7.2 Authority's Engineer shall -

(a) within 10 (ten) days of receipt of the Stage Payment Statement from the Contractor pursuant to Clause 19.4, determine the amount due to the Contractor and recommend the release of 90 (ninety) percent of the amount so determined as part payment, pending issueof the Interim Payment Certificate; and

(b) within 15 (fifteen) days of the receipt of the Stage Payment Statement referred to in Clause 19.4, deliver to the Authority and the Contractor an Interim Payment Certificate certifying the amount due and payable to the Contractor, after adjustments in accordance with the provisions of Clause 19.10.

7.3 Deleted

7.4 Deleted

8. Other duties and functions

The Authority's Engineer shall perform all other duties and functions as specified in the Agreement.

9. Miscellaneous

9.1 A copy of all communications, comments, instructions, Drawings or Documents sent by the Authority's Engineer to the Contractor pursuant to this TOR, and a copy of all the test results with comments of the Authority's Engineer thereon, shall be furnished by the Authority's Engineer to the Authority forthwith.

9.2 The Authority's Engineer shall retain at least one copy each of all Drawings and Documents received by it, including 'as-built' Drawings, and keep them in its safe custody.

9.3 Within 90 (ninety) days of the Project Completion Date, the Authority's Engineer shall obtain a complete set of as-built Drawings, in 2 (two) hard copies and in micro film formor in such other medium as may be acceptable to the Authority, reflecting the Sewerage Project as actually designed, engineered and constructed, including an as-built survey illustrating the layout of the Sewerage Project and setback lines, if any, of the buildings and structures forming part of Project Facilities; and shall hand them over to the Authority against receipt thereof.

9.4 The Authority's Engineer, if called upon by the Authority or the Contractor or both, shall mediate and assist the Parties in arriving at an amicable settlement of any Dispute between the Parties.

9.5 The Authority's Engineer shall inform the Authority and the Contractor of any event of Contractor's Default within one week of its occurrence.

SCHEDULE - O

(See Clauses 19.4.1, 19.6.1, and 19.8.1)

Forms of Payment Statements

1. Stage Payment Statement for Works

The Stage Payment Statement for Works shall state:

(a) the estimated amount for the Works executed in accordance with Clause 19.3.1 subsequent to the last claim;

(b) amounts reflecting adjustments in price for the aforesaid claim;

(c) the estimated amount of each Change of Scope Order executed subsequent to the last claim;

(d) amounts reflecting adjustment in price, if any, for (c) above in accordance with the provisions of Clause 13.2.3 (a);

(e) total of (a), (b), (c) and (d) above;

(f) Deductions:

  (i) Any amount to be deducted in accordance with the provisions of the Agreement except taxes;

  (ii) Any amount towards deduction of taxes; and

  (iii) Total of (i) and (ii) above.

(g) Net claim: (e) – (f) (iii);

(h) The amounts received by the Contractor upto the last claim:

  (i) For the Works executed (excluding Change of Scope orders);

  (ii) For Change of Scope Orders, and

  (iii) Taxes deducted

2. Monthly Operation & Maintenance Payment Statement

The monthly Statement for Operation & Maintenance Payment shall state:

(a) the monthly payment admissible in accordance with the provisions of the Agreement;

(b) the deductions for Operation & maintenance work not done;

(c) net payment for Operation & maintenance due, (a) minus (b);

(d) Deleted

(e) amount towards deduction of taxes

3. Contractor's claim for Damages

Note: The Contractor shall submit its claims in a form acceptable to the Authority.

SCHEDULE - P

(See Clause 20.1)

INSURANCE

1. Insurance during Construction Period

1.1 The Contractor shall effect and maintain at its own cost, from the Appointed Date till the date of completion of Operation and Maintenance period, the following insurances for any loss or damage occurring on account of Non Political Event of Force Majeure, malicious act, accidental damage, explosion, fire and terrorism:

(a) insurance of Works, Plant and Materials and an additional sum of [15 (fifteen)] per cent of such replacement cost to cover any additional costs of and incidental to the rectification of loss or damage including professional fees and the cost of demolishing and removing any part of the Works and of removing debris of whatsoever nature; and

(b) insurance for the Contractor's equipment and Documents brought onto the Site by the Contractor, for a sum sufficient to provide for their replacement at the Site.

1.2 The insurance under paragraph 1.1 (a) and (b) above shall cover the Authority and the Contractor against all loss or damage from any cause arising under paragraph 1.1 other than risks which are not insurable at commercial terms.

2. Insurance for Contractor's Defects Liability

The Contractor shall effect and maintain insurance cover for the Works from the date of issue of the Completion Certificate until the end of the Defects Liability Period for any loss or damage for which the Contractor is liable and which arises from a cause occurring prior to the issue of the Completion Certificate. The Contractor shall also maintain other insurances for maximum sums as may be required under the Applicable Laws and in accordance with Good Industry Practice.

3. Insurance against injury to persons and damage to property

3.1 The Contractor shall insure against its liability for any loss, damage, death or bodily injury, or damage to any property (except things insured under Paragraphs 1 and 2 of this Schedule or to any person (except persons insured under Clause 7.20.9), which may arise out of the Contractor's performance of this Agreement. This insurance shall be for a limit per occurrence of not less than the amount stated below with no limit on the number of occurrences.

The insurance cover shall be not less than: Rs. [*****]

3.2 The insurance shall be extended to cover liability for all loss and damage to the Authority's property arising out of the Contractor's performance of this Agreement excluding:

(a) the Authority's right to have the construction works executed on, over, under, in or through any land, and to occupy this land for the Works; and

(b) damage which is an unavoidable result of the Contractor's obligations to execute the Works.

4. Insurance to be in joint names

The insurance under paragraphs 1 to 3 above shall be in the joint names of the Contractor and the Authority.

SCHEDULE - Q

(See Clause 1.2.3. of RFP)

FEASIBILITY REPORT

- The present scheme **Construction of Waste Water Treatment Plant at the Confluence point of River Daya & Ganguanala (Phase-II)**" on Engineering, Procurement & Construction (EPC) Contract Including Operation & Maintenance for a Period of Five (5) Years The work include , construction/ laying of 17.13 Km of RCC Gravity Sewer Network, 7.67 Km of Rising Main, 623 nos of Manholes, 5 numbers of sewage pumping stations, 5 nos Sub-stations along with transformer 100KVA to 350 KVA, DG sets, construction of 11 Nos Interception & Diversion works, including preparation of detail design and drawings, supply of labour, materials, equipment, fabrication, erection, construction, testing, commissioning, guaranteeing the performance of the proposed sewerage system..

1. **Status of Existing System: The** Sewer Network **will feeding waste water to the 60MLD capacity Waste Water Treatment Plant being executed under Ganguanala (Phase-I) Tender at Project Area.**
2. **Availability of Land for Construction of major structures:** Land for most of the locations are available for execution of the project.
3. **Feasibility of Construction of I&D Structure and Sewage pumping stations:** The lands identified for the structures are suitable for construction purpose. Required construction materials like cement, steel reinforcements, aggregates (fine and coarse), etc. and labour required for the work are adequately available locally. However, the contractor is to decide the construction methodology to be adopted depending on the site conditions and soil strata.
4. Necessary permission, if any, from State Pollution Control Board, Electrical Department, Water Resource Department, PWD, Bhubaneswar Municipal Corporation (BMC) etc., will be initiated and will be obtained in due course.

Hence the Project is feasible.